RTL# A9.690E

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION

2016 RADIOACTIVE EFFLUENT RELEASE REPORT

AND

2016 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

RTL A9.690E
Enclosure 1

BEAVER VALLEY POWER STATION

ENVIRONMENTAL & CHEMISTRY SECTION

Technical Report Approval:

2016 RADIOACTIVE EFFLUENT RELEASE REPORT

AND

2016 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

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Subject: **Beaver Valley Power Station, Unit Nos. 1 and 2**
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Radioactive Effluent Release Report for 2016, and
Annual Radiological Environmental Operating Report for 2016

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Form 1/2-ENV-01.05.F01 (page 1 of 39), Rev 4
Beaver Valley Power Station - Units 1 & 2

2016 Radioactive Effluent Release Report

FirstEnergy Nuclear Operating Company
FENOC

Beaver Valley Power Station - Units 1 & 2
Unit 1 License No. DPR-66
Unit 2 License No. NPF-73

Radioactive Effluent Release Report

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Note: The Total Error values (%) listed in this report are documented in Calculation Package No. ERS-ATL-04-002

Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Report Submittal Requirements

Report Submittal and Requirements: The report was prepared and submitted in accordance with the requirements contained in the following documents:

BVPS Integrated Technical Specifications, Administrative Control 5.6.2

Offsite Dose Calculation Manual (ODCM) procedure 1/2-ODC-3.03, "*Controls for RETS and REMP Programs*", Attachment U, Control 6.9.3

BVPS procedure 1/2-ENV-01.05, *"Compliance with Regulatory Guide 1.21 and Technical Specifications"*

NUREG-1301, "*Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No.1, April 1991"*

Regulatory Guide 1.21, "*Measuring Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Material in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants, Revision 1, June 1974"*

BVPS Condition Report No. CR-2016-10326: RM-1VS-109 Stack Flow Decrepencies Found During Ventilation Testing

BVPS Condition Report No. CR-2016-13127: Discrepancy in Carbon-14 data

BVPS Condition Report No. CR-2016-14667: Inability to obtain a sample from Groundwater Piezometer Wells

BVPS SAP Notification No. 601018638: 2016 REMP/RETS Tracking for ARERR/AREOR

Radioactive Effluent Release Report

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Executive Summary - Liquid and Gaseous Effluent Control (Part 1 of 2)

Onsite Groundwater Monitoring: In 2016, twenty three (23) on-site monitoring wells were sampled in the spring and twenty two (22) fall sampling periods. One (1) well, P-3 was not sampled due to access issues and weather conditions. No new wells were installed, nor were any wells retired. MW-16 was sampled eight (8) times throughout 2016, two (2) of which were included in the yearly biannual sampling.
No adverse effect to the offsite environment has been detected at this time, because all offsite groundwater, drinking water and surface water samples were <440 pCi/L. See Enclosure 2, Page xvii for additional details.

Onsite Spills: There were no onsite spills >100 gallons.

Decommissioning File Update: There were no items added to the site decommissioning files in accordance with 10CFR50.75(g).

Abnormal Liquid Releases: There were no abnormal liquid releases.

Abnormal Gaseous Releases: There were no abnormal gaseous releases.

Liquid Radwaste Treatment System: The site operated via a shared Liquid Radwaste Treatment System, even though each Unit has its own ion-exchange vessels. Shared operation allowed either Unit to process liquid waste at the Unit of origin, or at the other Unit. Typically, when Unit 1 or 2 high level liquid waste was processed (e.g., coolant recovery waste) it was performed at Unit 1, because it has a carbon pre-conditioning filter.

Gaseous Radwaste Treatment System: The site operated via a shared Gaseous Radwaste Treatment System, even though each Unit has its own charcoal delay beds and storage/decay tanks. Shared operation allowed either Unit to process gaseous waste at the Unit of origin, or at the other Unit. Typically, when Unit 1 or 2 went to a shutdown condition, the gaseous waste was transferred for storage and decay at Unit 2, because Unit 2 has four (4) additional storage tanks.

Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Liquid and Gaseous Effluent Control (Part 1 of 2)

Lower Limits of Detectability (LLD): All a-priori calculated LLD met the minimum requirements specified in the ODCM.

Effluent Monitoring Channels Inoperable >30 Days: There was one (1) Effluent Monitoring Instrumentation Channels not returned to Operable status within 30 days.

ODCM Surveillance Deficiencies: There were no ODCM Surveillance Deficiencies.

ODCM Changes: There were two (2) changes made to the ODCM during the report period. See ODCM procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History ODCM Changes" for a complete description of the change and the change justification. All changes maintain the level of radioactive effluent control required by 10 CFR 20.1302, 40 CFR Part 190, 10 CFR 50.36a, and Appendix I to 10 CFR 50. Detailed descriptions of the ODCM changes are provided in Enclosure 2, Page 21 Table 9 and Attachment 2.

Meteorological Data Recovery: The Meteorological Data Recovery met the minimum requirement of at-least 90%, as specified in Section 5 of Revision 1 to Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants.

Population Dose vs. Natural Background: The 0-50 mile total and average population doses were calculated using liquid and gaseous release quantities and real time meteorology. The average population dose is based on four (4) million people within 0-50 miles of the BVPS site. The following comparison to natural background radiation demonstrates that BVPS operations did not adversely affect the surrounding environment.

102.44 man-mrem =BVPS Total Population Dose for the year

0.0000250 mrem = BVPS Average Individual Dose for the year

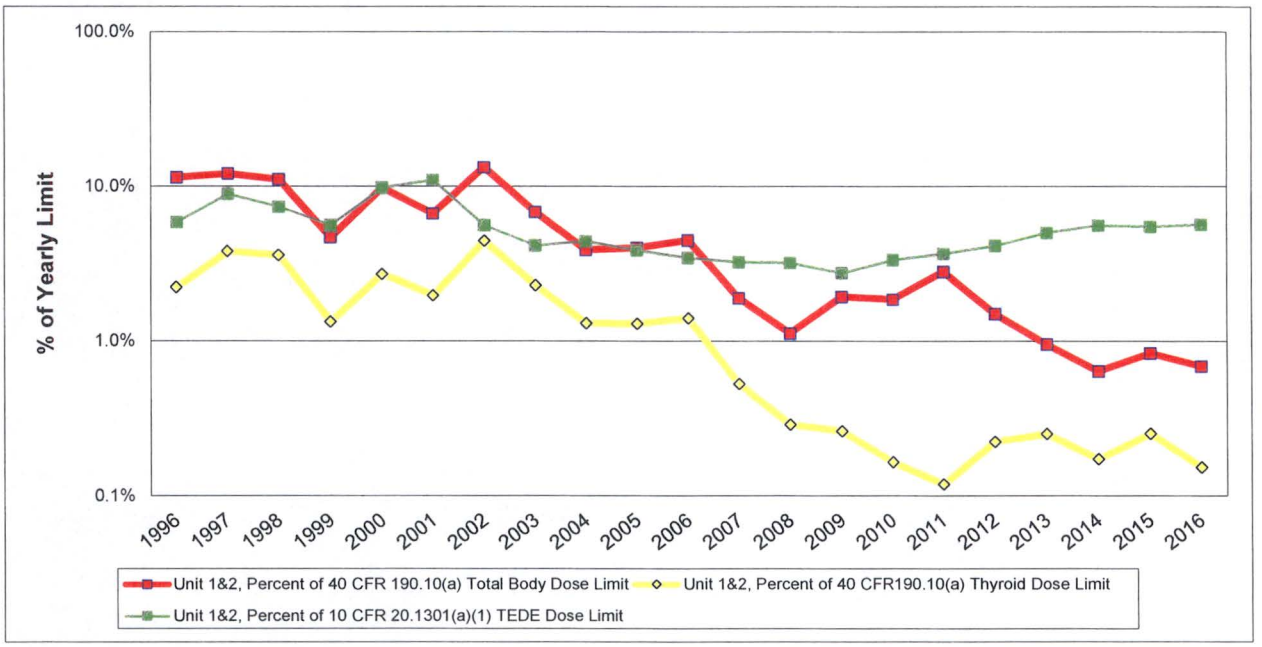
620 mrem = Natural Background Individual Dose for the year. This dose value is documented as natural background radiation exposure for an individual in a year from the NCRP Report No. 160 (2009).

Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Total Dose

Trends of Total Dose (Both Units): The following graph provides a comparison of the ODCM dose projections from all facility releases and direct radiation exposures to show compliance with Member of the Public dose limits from 10 CFR 20.1301 and 40 CFR Part 190. The graph reflects the results of the efforts to stabilize and reduce offsite dose.

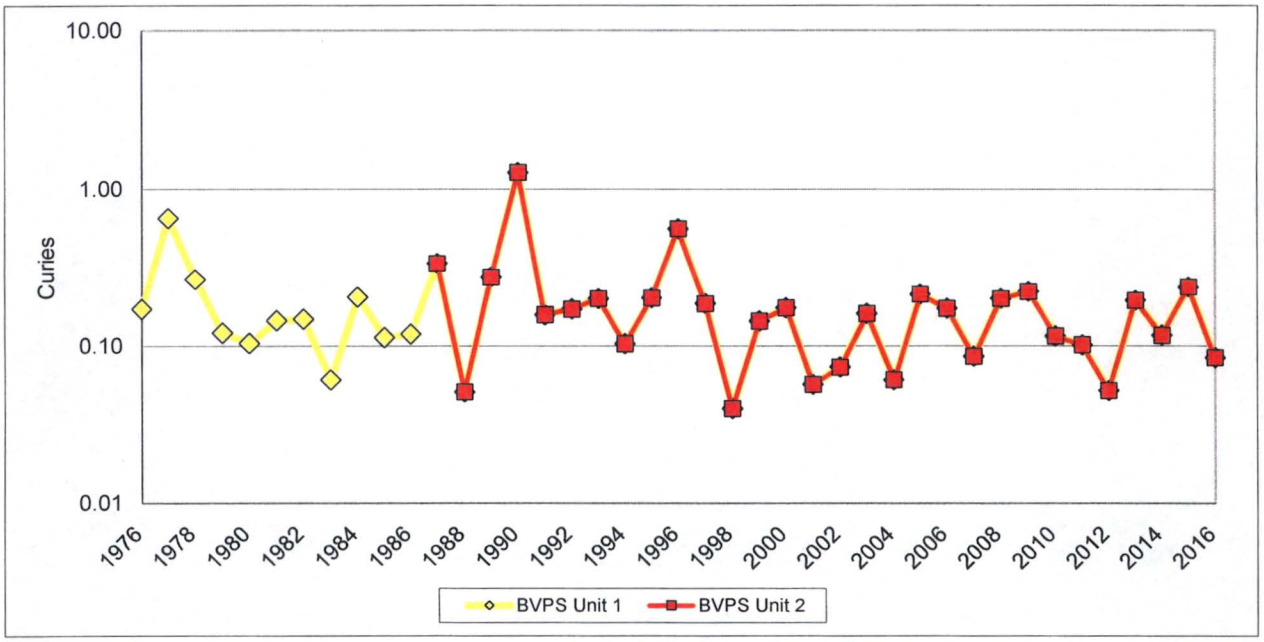


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Liquid Release Activity (Fission and Activation Products)

Liquid Release Activity (Fission and Activation Products): The following graph provides a comparison of total liquid mixed fission and activation product (particulate) radioactivity discharged from the site from 1976 to present.

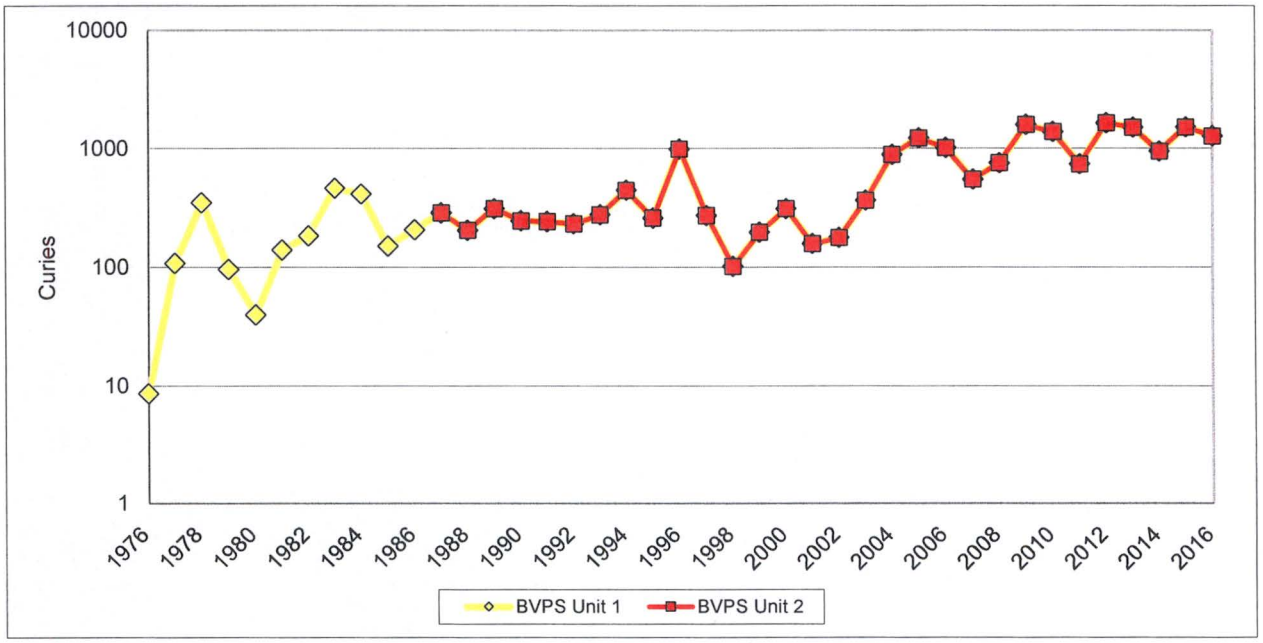


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Liquid Release Activity (Tritium)

Liquid Release Activity (Tritium): The following graph provides a comparison of total liquid tritium radioactivity discharged from the site from 1976 to present. The latest increases were due to the increase power of the reactor, or power uprate, which lead to increased tritium.

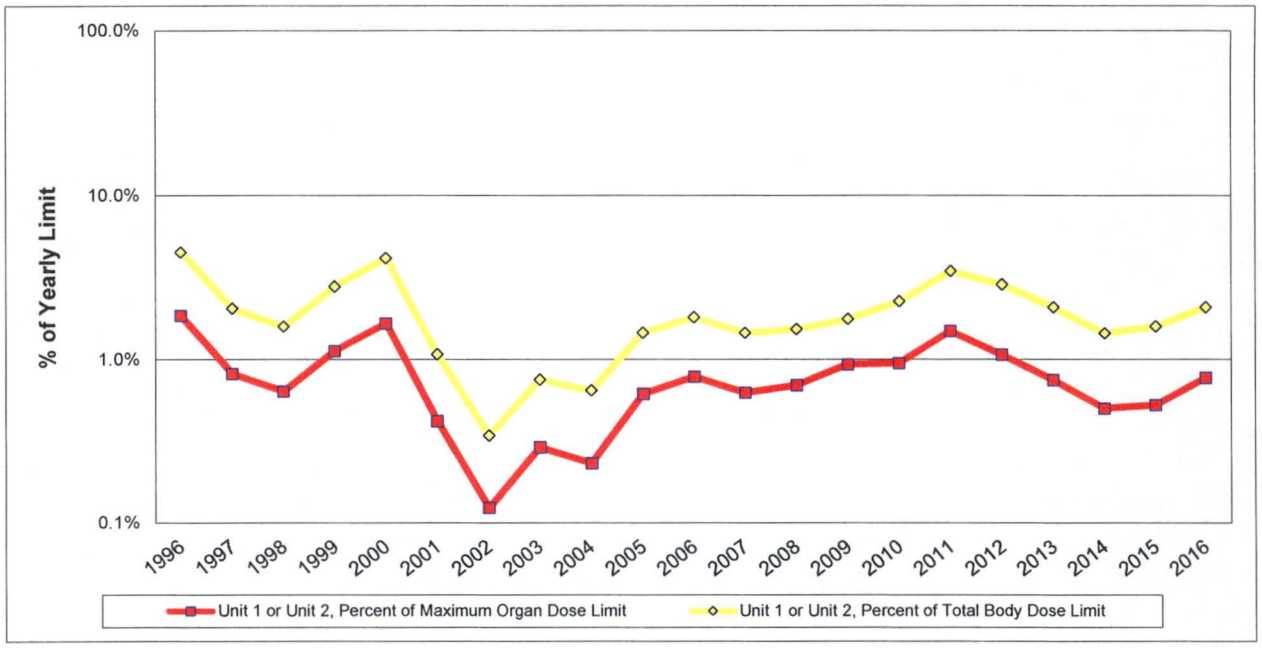


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Liquid Release Offsite Dose Projections

Liquid Release Offsite Dose Projections (Both Units): The following graph provides a comparison of liquid offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default flow rates for the receiving water (Ohio River), and were performed prior to release authorization.

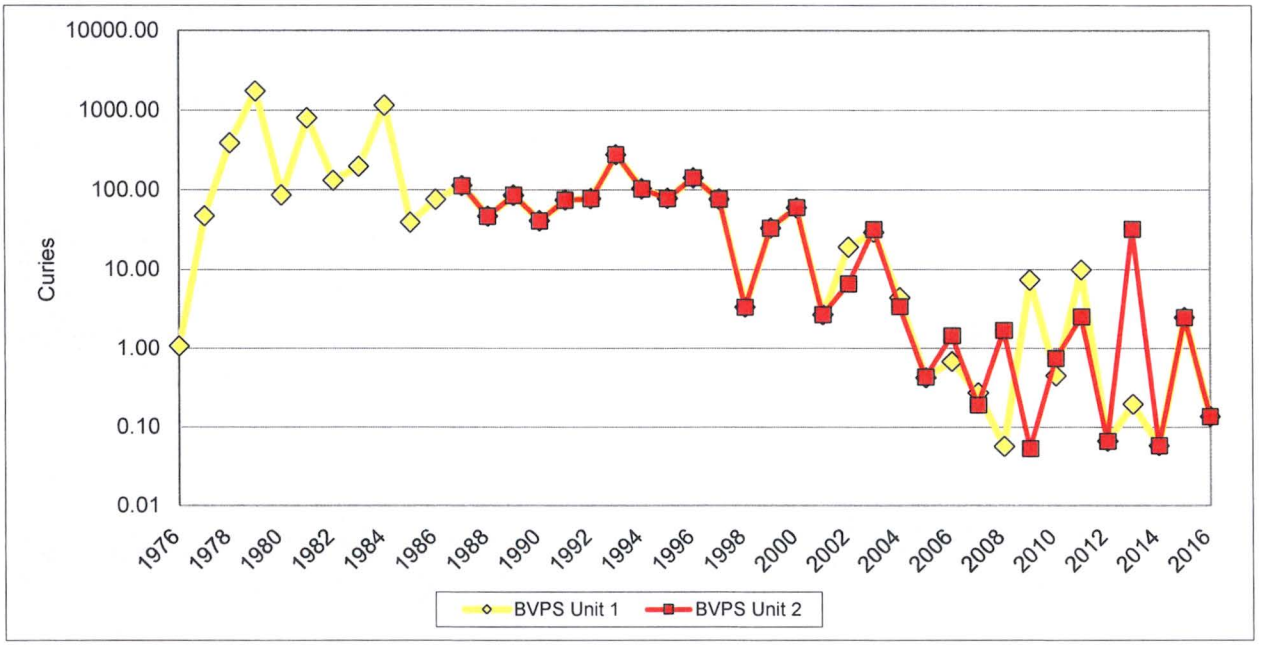


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Gaseous Release Activity (Fission and Activation Gas)

Gaseous Release Activity (Fission and Activation Gas): The following graph provides a comparison of total gaseous fission and activation gas discharged from the site from 1976 to present. The steady decreases are due to extended hold-up periods of gas space prior to release. The differences between the units are relative to the outages that occured that year.

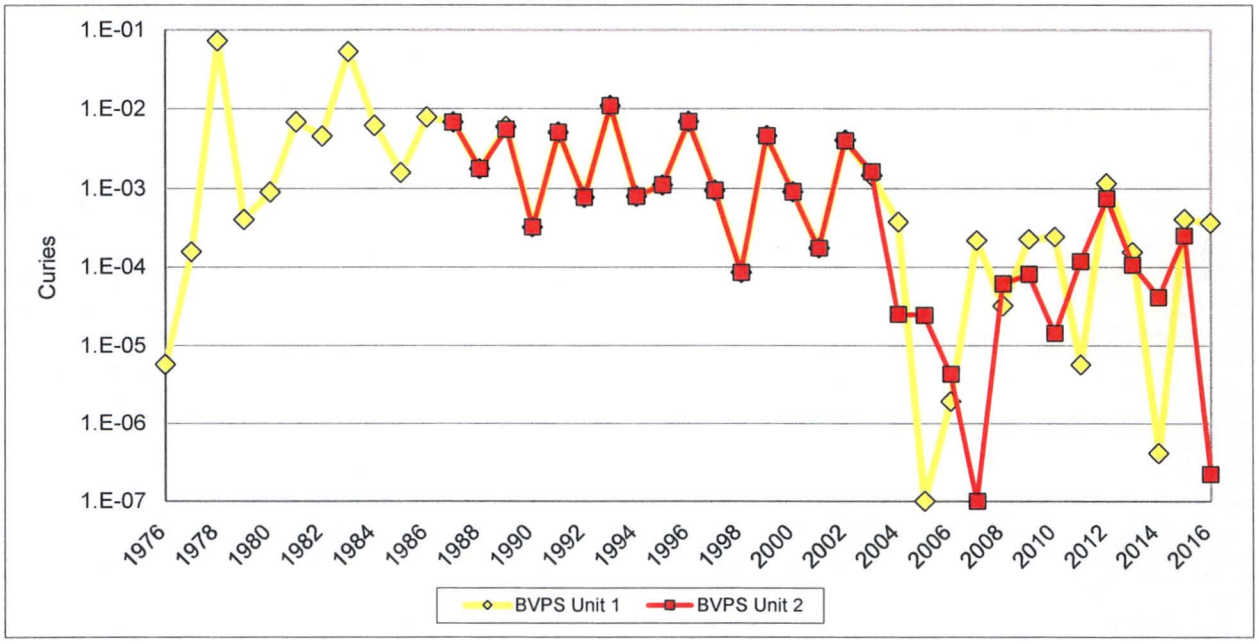


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Gaseous Release Activity (Particulates and Radioiodines)

Gaseous Release Activity (Particulates and Radioiodines): The following graph provides a comparison of total gaseous particulates and radioiodines discharged from the site from 1976 to present. The long-term decreases are due to extended hold-up periods of gas space prior to release. The differences between the units are relative to the outages that occured that year.

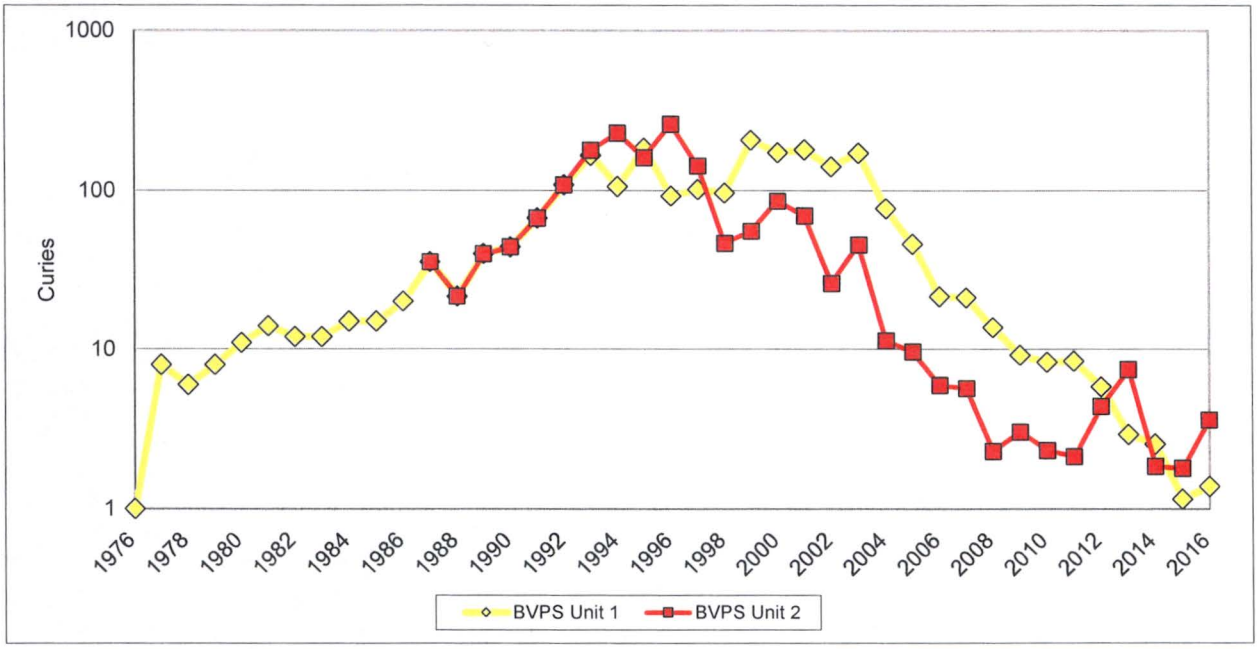


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Gaseous Release Activity (Tritium)

Gaseous Release Activity (Tritium): The following graph provides a comparison of total gaseous tritium discharged from the site from 1976 to present. The long-term decreases were due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.

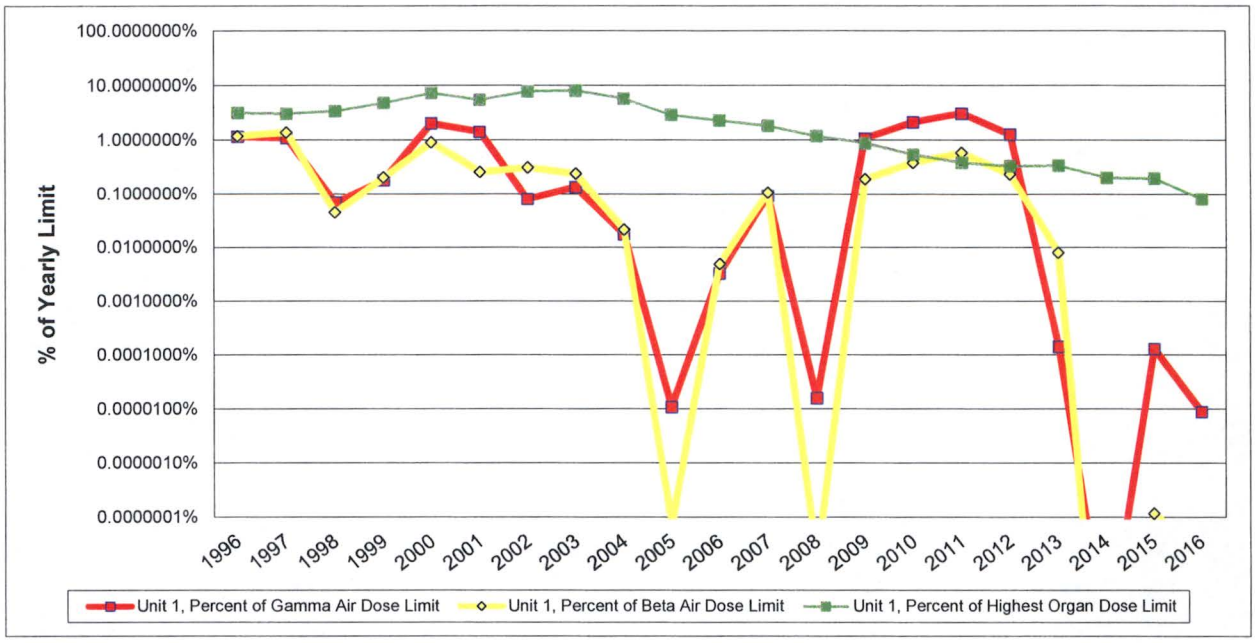


Radioactive Effluent Release Report

Calendar Year - 2016

Executive Summary - Trends of Unit 1 Gaseous Release Offsite Dose Projections

Unit 1 Gaseous Release Offsite Dose Projections: The following graph provides a comparison of Unit 1 gaseous offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default meteorological parameters for the atmospheric conditions surrounding the plant site, and were performed prior to release authorization. The long-term decrease in highest organ dose were due to efforts to reduce overall offsite dose.



Radioactive Effluent Release Report

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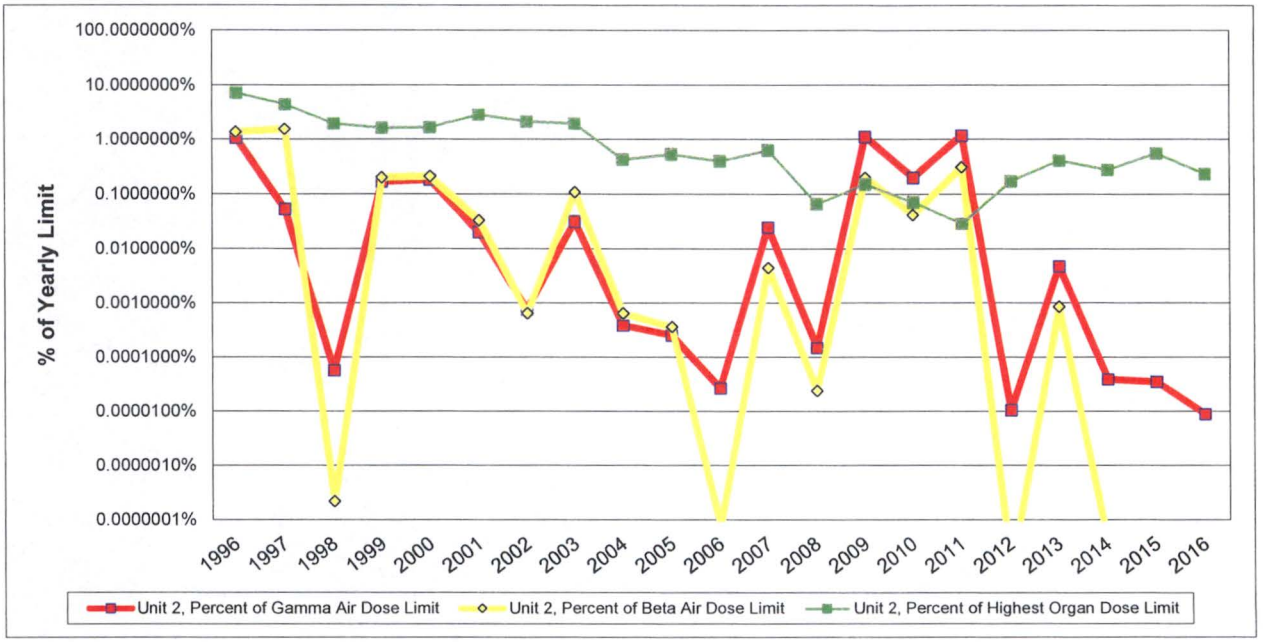
Executive Summary - Trends of Unit 1 Gaseous Release Offsite Dose Projections

Unit 2 Gaseous Release Offsite Dose Projections: The following graph provides a comparison of Unit 2 gaseous offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default meteorological parameters for the atmospheric conditions surrounding the plant site, and were performed prior to release authorization. The long-term decrease in highest organ dose were due to efforts to reduce overall offsite dose.



Radioactive Effluent Release Report

Calendar Year - 2016

Results of Abnormal Releases

Description of Abnormal Release(s)
Abnormal Liquid Releases: NONE Abnormal Gaseous Releases: NONE

Radioactive Effluent Release Report

Calendar Year - 2016

Results of Onsite Spills and Items Added to Decommissioning Files per 10CFR50.75(g)

Description of Spills or Items added to 10CFR50.75(g)
Summary of Onsite Spills (>100 gallons): NONE Summary of Items added to Decommissioning Files per 10CFR50.75(g) Files: NONE

Radioactive Effluent Release Report

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Results of Onsite Groundwater Monitoring Program

Summary of Onsite Groundwater Samples

	2015 H-3 Maximum (pCi/L)	2015 H-3 Minimum (pCi/L)	2015 H-3 Average (pCi/L)	Typical H-3 LLD (pCi/L)	Required H-3 LLD (pCi/L)	Pre Operational Mean For H-3 (pCi/L)	Are Any H-3 Analyses Greater Than The Pre Operational Mean For H-3 ?	NEI and FENOC Communication Level For H-3 (pCi/L)	EPA Reporting Level For H-3 (pCi/L)
Spring (Q2)	7621	147	832	<200	<2000	440	Yes	2000	20000
Fall (Q4)	13224	146	1010	<200	<2000	440	Yes	2000	20000
MW-16	13477	7621	11285	<200	<2000	440	Yes	2000	20000

Tritium (H-3) Summary

In 2016, twenty three (23) on-site monitoring wells were sampled in the spring and twenty two (22) fall sampling periods. One (1) well, P-3 was not sampled due to access issues and weather conditions. No new wells were installed, nor were any wells retired. MW-16 was sampled eight (8) times throughout 2016, two (2) of which were included in the yearly biannual sampling. These samples that were taken account for the highest concentrations.

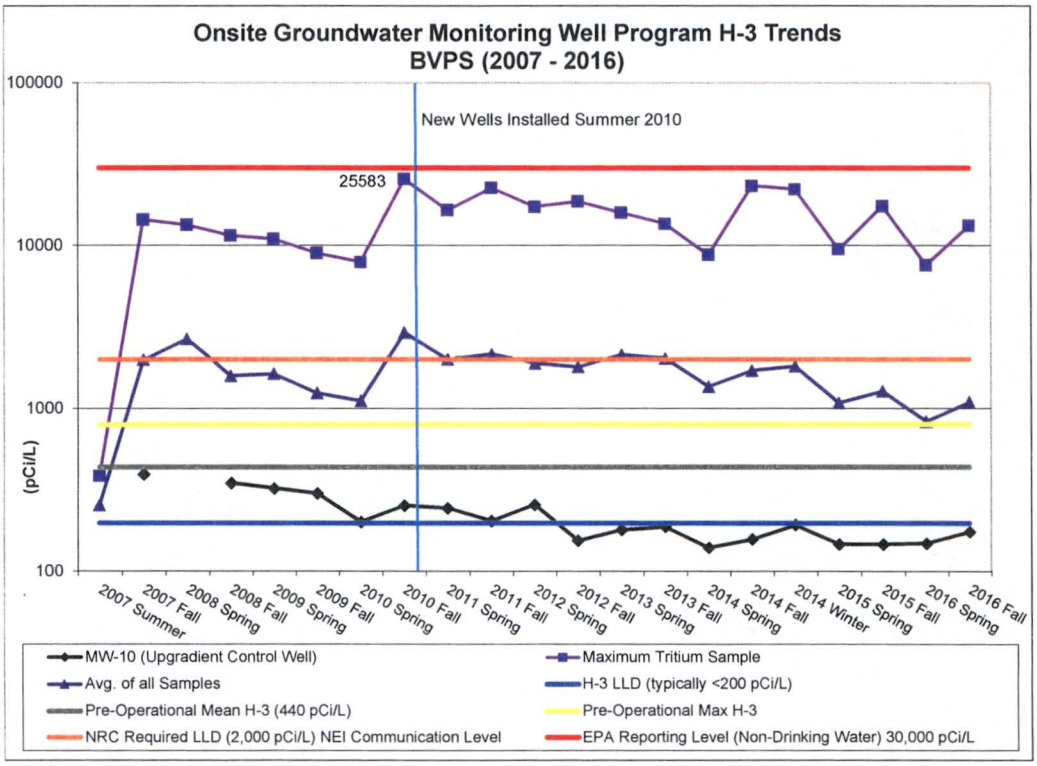
Sixteen (16) wells returned results of less than the pre-operational mean (440 pCi/L) during all sample periods in 2016. Five (5) wells returned results >440 pCi/L, but <2000 pCi/L. Three (3) wells returned results >2000 pCi/L. No wells exceeded 20,000 pCi/L with the highest concentration recorded as 13,477 pCi/L.

The NEI/FENOC communication level was reached for MW-12S & MW-12D during 2007. Notification to local, state & federal agencies was performed on 10/08/07. Additional communication for new well results was performed on 09/08/10 for those new wells that exceeded 2000 pCi/L. The newly installed well MW-20D exceeded 2,000 pCi/L on its first sample, but this was expected since the well was installed to monitor the previously identified plume intercepting MW-16. No adverse effect to the offsite environment has been detected at this time, because all offsite groundwater, drinking water and surface water samples were <440 pCi/L. Mitigation activities (catch basin sleeving) to prevent tritiated condensate water from reaching the groundwater were completed 12/17/11.

Remediation well, EW-1, was installed and began operation in October 2013. This equipment captures the tritium plume and it becomes a permitted discharge. Samples are taken monthly to provide the concentration of the discharge. Remediation will continue until the suspected plume is depleted and tritium levels stabilize.

Principal Gamma Emmitter Summary

Twenty three (23) onsite monitoring wells were sampled on at least two occasions during the year and analyzed for Principle Gamma Emitters. The results showed no positive indication of Licensed Radioactive Material (LRM) in any of the analyses.



Radioactive Effluent Release Report

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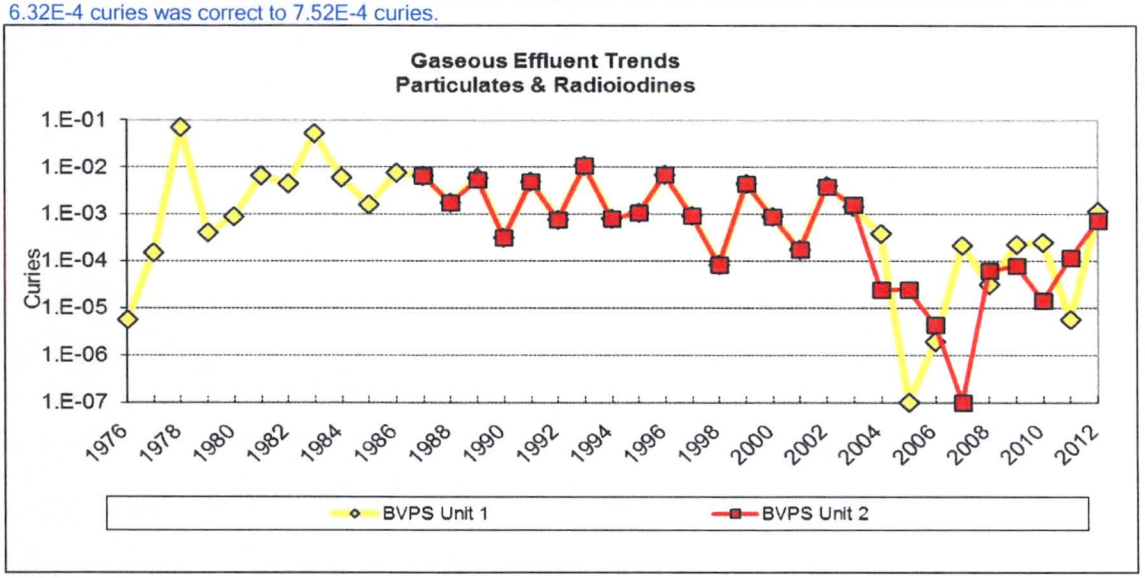
Corrections to previous Radioactive Effluent Release Reports

Description of Corrections Made to RERR(s)

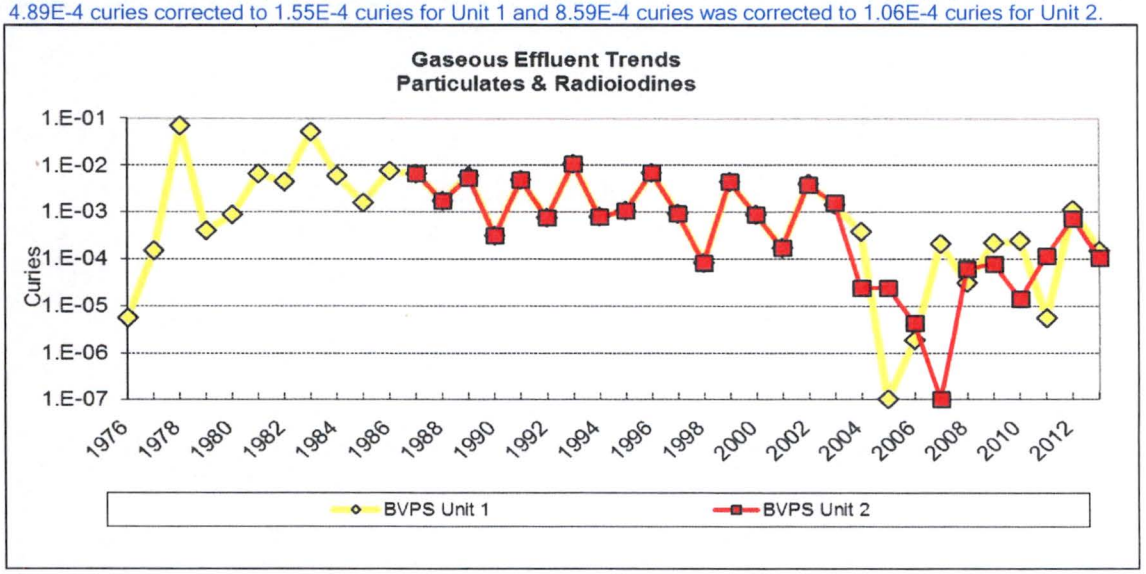
Correction(s) to Previous Radioactive Effluent Release Reports:

There were six (6) corrections made to previous reports.

There was one (1) correction to the 2012 Annual Radiolocial Effluent Release Report. The graph that corresponds to Gaseous Release Activity (Particulates and Radioiodines) had an incorrect amount of curies displayed for Unit 2; 6.32E-4 curies was correct to 7.52E-4 curies.



There was one (1) correction to the 2013 Annual Radiolocial Effluent Release Report. The graph that corresponds to Gaseous Release Activity (Particulates and Radioiodines) had an incorrect amount of curies displayed for both units; 4.89E-4 curies corrected to 1.55E-4 curies for Unit 1 and 8.59E-4 curies was corrected to 1.06E-4 curies for Unit 2.



Radioactive Effluent Release Report

Calendar Year - 2016

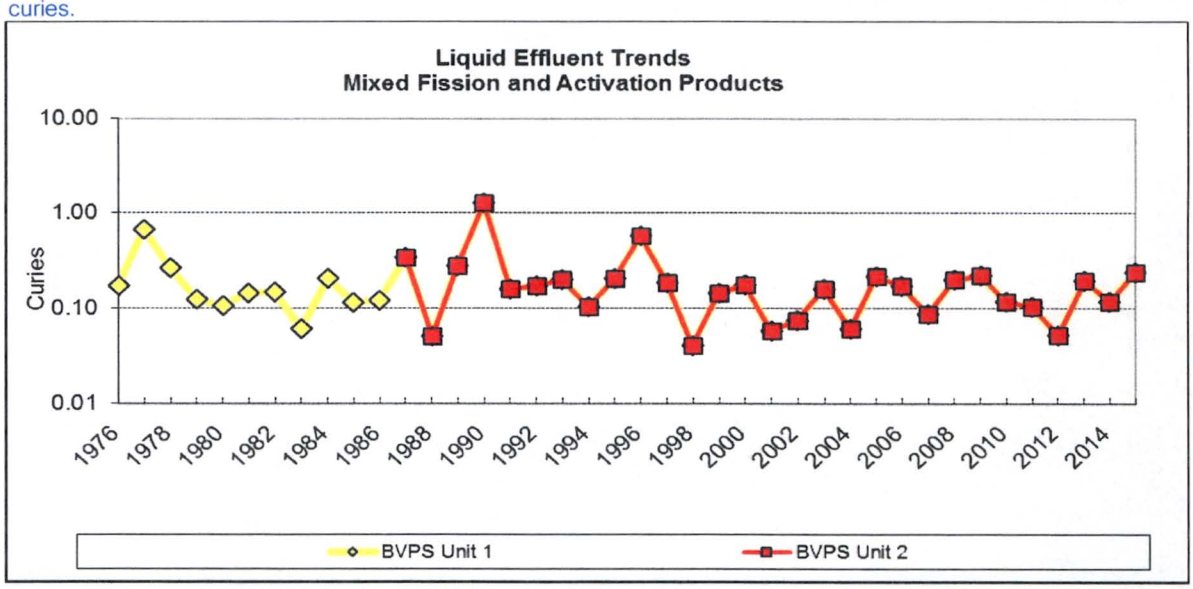
Corrections to previous Radioactive Effluent Release Reports

Description of Corrections Made to RERR(s)

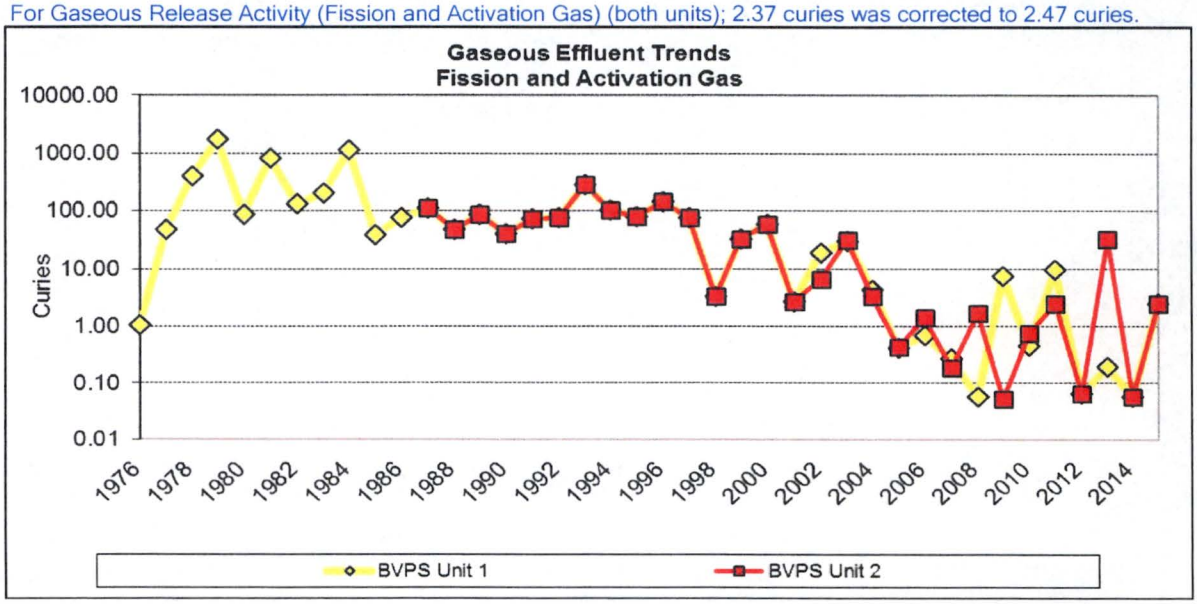
Correction(s) to Previous Radioactive Effluent Release Reports:

There were four (4) correction to the 2015 Annual Radiolocial Effluent Release Report. The graph that corresponds to Liquid Release Activity (Fission and Activation Products), Gaseous Release Activity (Fission and Activation Gas, Particulates and Radioiodines, and Tritium) had an incorrect amount of curies displayed.

For Liquid Release Activity (Fission and Activation Products) (both units); 0.2148 curies was corrected to 0.2354 curies.



For Gaseous Release Activity (Fission and Activation Gas) (both units); 2.37 curies was corrected to 2.47 curies.



Radioactive Effluent Release Report

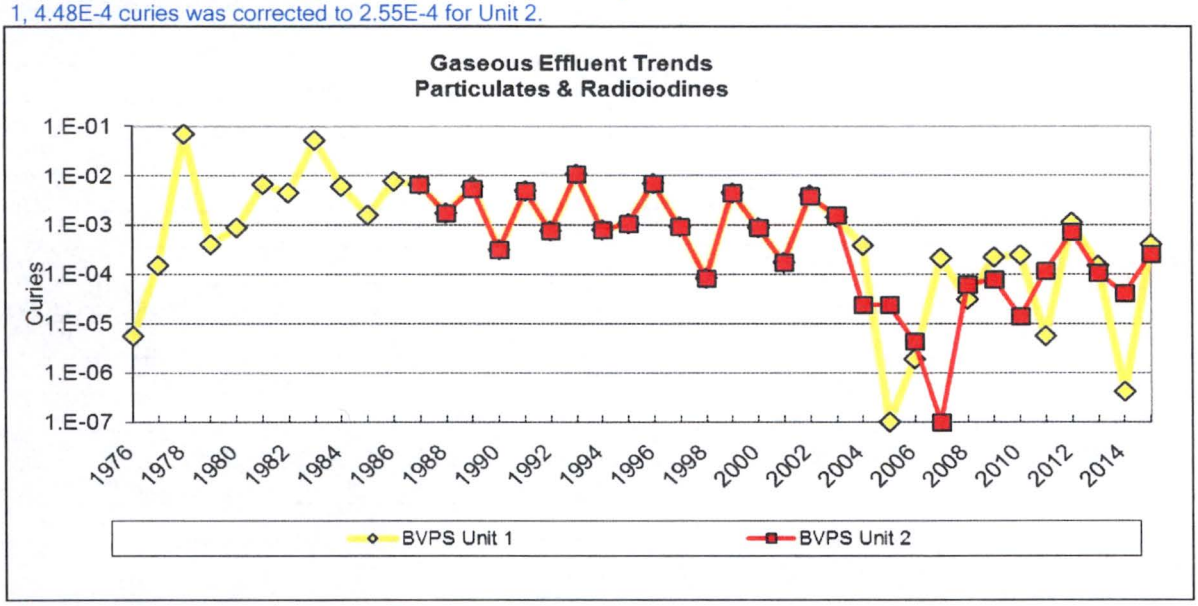
Calendar Year - 2016

Corrections to previous Radioactive Effluent Release Reports

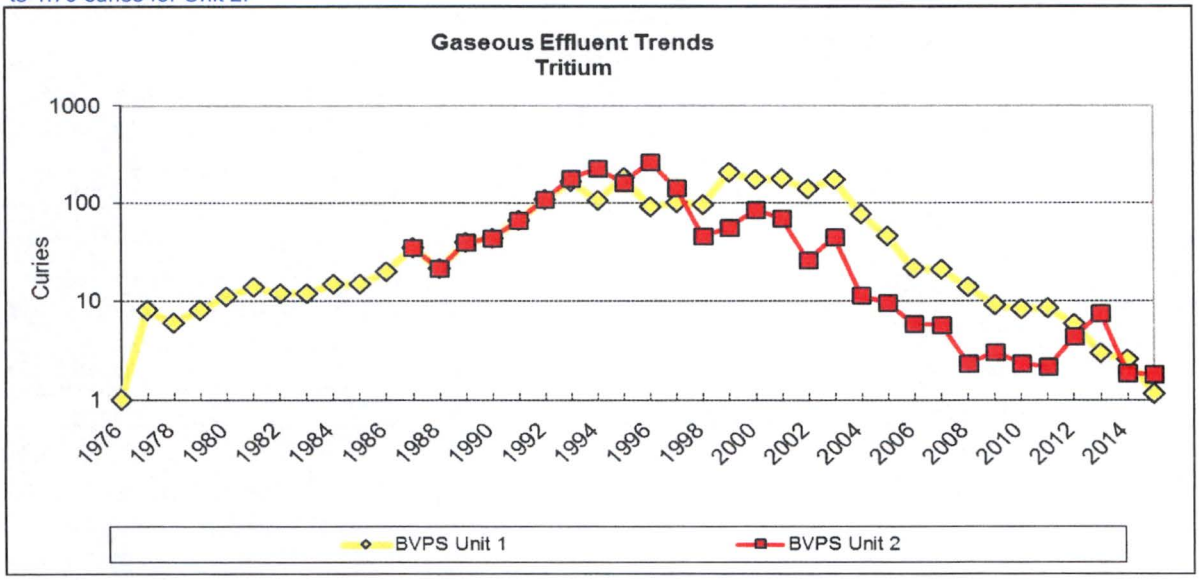
Description of Corrections Made to RERR(s)

Correction(s) to Previous Radioactive Effluent Release Reports:

For Gaseous Release Activity (Particulates and Radioiodines); 2.15E-4 curies was correct to 4.14E-4 curies for Unit 1, 4.48E-4 curies was corrected to 2.55E-4 for Unit 2.



For Gaseous Release Activity (Tritium); 0.61 curies was corrected to 1.15 curies for Unit 1, 1.25 curies was corrected to 1.79 curies for Unit 2.



Radioactive Effluent Release Report

Calendar Year - 2016
Supplemental Information Page

FACILITY: BVPS Units 1 and 2 **LICENSEE: FENOC**

1. Regulatory Limits	
a. Fission and activation gases:	Annual Unit 1 or 2 Dose: 10 mrad from Gamma, & 20 mrad from Beta
b. Iodines & particulates, half-lives > 8 days:	Annual Unit 1 or 2 Dose: 15 mrem to Any Organ
c. Liquid effluents:	Annual Unit 1 or 2 Dose: 3 mrem to Total Body, & 10 mrem to Any Organ

2. Maximum Permissable Concentrations Used In Determining Allowable Release Rates Or Concentrations	
a. Fission and activation gases:	Site Release Rate: 500 mrem/yr to Total Body, & 3000 mrem/yr to the Skin
b. Iodines & particulates, half-lives > 8 days:	Site Release Rate: 1500 mrem/yr to Any Organ
c. Liquid effluents:	Site Release Concentration: 10 times 10 CFR 20 Appendix B, Table 2, EC's

3. Average Energy (Not Applicable To The BVPS ODCM)

4. Measurements and Approximations of Total Radioactivity	
The methods used to measure or approximate the total radioactivity in effluents, and the methods used to determine radionuclide composition are as follows:	
a. Fission and activation gases:	Ge Gamma Spectrometry, Liquid Scintillation Counter
b. Iodines:	Ge Gamma Spectrometry
c. Particulates, half-lives > 8 days:	Ge Gamma Spectrometry, Proportional Counter
d. Liquid effluents:	Ge Gamma Spectrometry, Proportional Counter, Liquid Scintillation

5. Batch & Abnormal Release Information	Unit	Q1	Q2	Q3	Q4	Calendar Year
a. Liquid Batch Releases						
1. Number of batch releases		12	17	23	26	78
2. Total time period for batch releases	min	2532	7058	12591	14223	36404
3. Maximum time period for a batch release	min	226	3615	4305	4617	4617
4. Average time period for batch releases	min	211	415	547	547	467
5. Minimum time period for a batch release	min	197	196	187	191	187
6. Average river flow during release periods	cuft/sec	52778	34637	12118	37213	34187
b. Gaseous Batch Releases						
1. Number of batch releases		6	3	8	7	24
2. Total time period for batch releases	min	1529	777	13294	13241	28841
3. Maximum time period for a batch release	min	420	400	5887	10550	10550
4. Average time period for batch releases	min	255	259	1662	1892	1202
5. Minimum time period for a batch release	min	152	182	138	150	138
c. Abnormal Liquid Releases						
1. Number of releases		NONE	NONE	NONE	NONE	NONE
2. Total activity released	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
d. Abnormal Gaseous Releases						
1. Number of releases		NONE	NONE	NONE	NONE	NONE
2. Total activity released	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1A
Gaseous Effluents - Summation Of All Releases

	Unit	Q1	Q2	Q3	Q4	Calendar Year	Total Error %
A. Fission & Activation Gases							
1. Site Total release	Ci	0.00E+00	0.00E+00	2.71E-01	5.63E-06	2.71E-01	26.5%
1a. Unit 1 Gases	Ci	0.00E+00	0.00E+00	1.35E-01	2.82E-06	1.35E-01	
1b. Unit 2 Gases	Ci	0.00E+00	0.00E+00	1.35E-01	2.82E-06	1.35E-01	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	3.44E-02	7.14E-07	8.59E-03	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
B. Iodines							
1. Site Total iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	28.3%
1a. Unit 1 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
C. Particulates							
1. Particulates with half-lives > 8 days	Ci	3.40E-07	0.00E+00	4.05E-05	3.30E-04	3.71E-04	30.0%
1a. Unit 1 Particulates	Ci	1.70E-07	0.00E+00	4.05E-05	3.30E-04	3.71E-04	
1b. Unit 2 Particulates	Ci	1.70E-07	0.00E+00	0.00E+00	5.21E-08	2.22E-07	
2. Average release rate for period	uCi/sec	4.31E-08	0.00E+00	5.14E-06	4.19E-05	1.18E-05	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
D. Gross Alpha							
1. Site Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	30.0%
1a. Unit 1 Gross alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 Gross alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
E. Tritium							
1. Site Total release	Ci	1.42E+00	1.76E+00	9.64E-01	8.58E-01	5.00E+00	32.9%
1a. Unit 1 Tritium	Ci	4.30E-01	5.45E-01	8.47E-02	3.28E-01	1.39E+00	
1b. Unit 2 Tritium	Ci	9.91E-01	1.21E+00	8.79E-01	5.30E-01	3.61E+00	
2. Average release rate for period	uCi/sec	1.80E-01	2.23E-01	1.22E-01	1.09E-01	1.59E-01	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
F. Carbon-14							
1. Site Total release	Ci	4.41E+00	4.63E+00	4.42E+00	4.07E+00	1.75E+01	41.1%
1a. Unit 1 Carbon-14	Ci	2.33E+00	2.33E+00	2.08E+00	1.72E+00	8.45E+00	
1b. Unit 2 Carbon-14	Ci	2.09E+00	2.31E+00	2.34E+00	2.35E+00	9.09E+00	
2. Average release rate for period	uCi/sec	5.60E-01	5.88E-01	5.60E-01	5.17E-01	5.56E-01	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	

N/A = Not Applicable

The amount of time (in seconds) used to calculate the release rates specified in A.2, B.2, C.2, D.2 and E.2 is the average amount of seconds per calendar quarter (7.88E+06 seconds).

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1B-EB
Gaseous Effluents - Elevated Batch Releases

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	1.79E-04	LLD	1.79E-04
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	8.96E-06	LLD	8.96E-06
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	3.51E-03	5.63E-06	3.52E-03
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	9.27E-04	LLD	9.27E-04
xenon-135m	Ci	LLD	LLD	1.49E-04	LLD	1.49E-04
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	4.77E-03	5.63E-06	4.78E-03
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1B-EC
Gaseous Effluents - Elevated Continuous Releases

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	2.66E-01	LLD	2.66E-01
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	2.66E-01	ND	2.66E-01
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	3.40E-07	LLD	LLD	1.04E-07	4.44E-07
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	3.40E-07	ND	ND	1.04E-07	4.44E-07

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1C-GB1
Gaseous Effluents - Ground Level Batch Releases (Unit 1)

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1C-GC1
Gaseous Effluents - Ground Level Continuous Releases (Unit 1)

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	4.05E-05	1.17E-04	1.58E-04
cobalt-60	Ci	LLD	LLD	LLD	2.42E-05	2.42E-05
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	LLD	LLD	LLD	1.89E-04	1.89E-04
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	4.05E-05	3.30E-04	3.71E-04

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1C-GB2
Gaseous Effluents - Ground Level Batch Releases (Unit 2)

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-97	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016
Table 1C-GC2
Gaseous Effluents - Ground Level Continuous Releases (Unit 2)

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

Radioactive Effluent Release Report

Calendar Year - 2016

Table 2A

Liquid Effluents - Summation Of All Releases

	Unit	Q1	Q2	Q3	Q4	Calendar Year	Total Error %
A. Fission & activation products							
1. Total release (excl. H-3, gas & alpha)	Ci	1.74E-02	1.98E-02	3.62E-02	1.08E-02	8.42E-02	26.1%
2. Average diluted concentration	uCi/ml	4.49E-09	4.60E-09	6.80E-09	2.19E-09	4.57E-09	
3. Percent of applicable limit	%	6.97E-01	7.91E-01	1.45E+00	4.30E-01	8.42E-01	
B. Tritium							
1. Total release	Ci	2.91E+01	2.89E+02	8.23E+02	1.33E+02	1.27E+03	25.0%
2. Average diluted concentration	uCi/ml	7.50E-06	6.72E-05	1.54E-04	2.71E-05	6.91E-05	
3. Percent of applicable limit	%	7.50E-02	6.72E-01	1.54E+00	2.71E-01	6.91E-01	
C. Dissolved and entrained gases							
1. Total release	Ci	ND	ND	4.46E-04	1.75E-04	6.20E-04	27.0%
2. Average diluted concentration	uCi/ml			8.36E-11	3.55E-11	3.37E-11	
3. Percent of applicable limit	%			4.18E-05	1.77E-05	1.68E-05	
D. Gross alpha radioactivity (total release)	Ci	LLD	LLD	LLD	LLD	LLD	28.9%
E. Volume of waste released (prior to dilution)	L	1.20E+07	1.27E+07	1.42E+07	1.38E+07	5.26E+07	11.2%
F. Volume of dilution water used	L	3.87E+09	4.29E+09	5.31E+09	4.91E+09	1.84E+10	22.9%

LLD = Below the Lower Limit of Detectability, in uCi/ml (Table 4)

A.3 is based on a historical PA-DEP guide of 10 Ci/yr

B.3 is based on a ODCM limit of 1.00E-2 uCi/ml

C.3 is based on a ODCM limit of 2.00E-04 uCi/ml

The values listed at F. are the volumes during actual liquid waste discharge periods. The total dilution volume for a continuous calendar quarter is approximately 1E+10 liters for BVPS-1 & 2 (ie.; ~ 22,800 gpm is the total dilution flowrate from the site)

Radioactive Effluent Release Report

Calendar Year - 2016
Table 2B-B
Liquid Effluents - Batch Releases

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission and activation products						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
sodium-24	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	4.71E-05	4.68E-04	8.39E-04	3.63E-04	1.72E-03
manganese-54	Ci	1.02E-05	LLD	1.50E-04	3.84E-05	1.99E-04
iron-55	Ci	2.90E-03	1.37E-03	LLD	3.30E-03	7.57E-03
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	6.87E-05	1.79E-05	LLD	LLD	8.66E-05
cobalt-58	Ci	4.89E-03	2.59E-03	8.46E-04	2.45E-03	1.08E-02
cobalt-60	Ci	7.40E-04	1.34E-03	5.94E-03	1.61E-03	9.63E-03
nickel-63	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	9.07E-05	LLD	9.07E-05
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	6.35E-06	LLD	LLD	3.02E-04	3.08E-04
zirconium/niobium-97	Ci	LLD	5.79E-06	8.65E-05	2.39E-05	1.16E-04
molybdenum-99/technetium-99m	Ci	LLD	LLD	LLD	LLD	LLD
rhodium-105	Ci	LLD	LLD	LLD	LLD	LLD
ruthenium-103	Ci	LLD	LLD	LLD	LLD	LLD
ruthenium-106	Ci	LLD	LLD	LLD	LLD	LLD
silver-110m	Ci	LLD	LLD	LLD	LLD	LLD
tin-113	Ci	LLD	LLD	LLD	LLD	LLD
tin-117m	Ci	1.51E-04	3.62E-04	3.67E-04	5.16E-04	1.40E-03
antimony-122	Ci	LLD	LLD	LLD	LLD	LLD
antimony-124	Ci	4.45E-03	LLD	LLD	LLD	4.45E-03
antimony-125	Ci	4.13E-03	1.28E-02	2.59E-02	2.00E-03	4.48E-02
antimony-126	Ci	LLD	LLD	LLD	LLD	LLD
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	4.51E-05	7.95E-04	2.02E-03	1.51E-04	3.01E-03
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	1.74E-02	1.98E-02	3.62E-02	1.08E-02	8.42E-02
2. Dissolved and entrained gases						
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	4.46E-04	1.75E-04	6.20E-04
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	4.46E-04	1.75E-04	6.20E-04

LLD = Below the Lower Limit of Detectability, in uCi/ml (Table 4)

Radioactive Effluent Release Report

Calendar Year - 2016

Table 2B-C

Liquid Effluents - Continuous Releases

Nuclides released	Unit	Q1	Q2	Q3	Q4	Calendar Year
1. Fission and activation products						
beryllium-7	Ci	N/A	N/A	N/A	N/A	N/A
sodium-24	Ci	N/A	N/A	N/A	N/A	N/A
chromium-51	Ci	N/A	N/A	N/A	N/A	N/A
manganese-54	Ci	N/A	N/A	N/A	N/A	N/A
iron-55	Ci	N/A	N/A	N/A	N/A	N/A
iron-59	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-57	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-58	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-60	Ci	N/A	N/A	N/A	N/A	N/A
nickel-63	Ci	N/A	N/A	N/A	N/A	N/A
zinc-65	Ci	N/A	N/A	N/A	N/A	N/A
strontium-89	Ci	N/A	N/A	N/A	N/A	N/A
strontium-90	Ci	N/A	N/A	N/A	N/A	N/A
zirconium/niobium-95	Ci	N/A	N/A	N/A	N/A	N/A
zirconium/niobium-97	Ci	N/A	N/A	N/A	N/A	N/A
molybdenum-99/technetium-99m	Ci	N/A	N/A	N/A	N/A	N/A
ruthenium-103	Ci	N/A	N/A	N/A	N/A	N/A
ruthenium-106	Ci	N/A	N/A	N/A	N/A	N/A
silver-110m	Ci	N/A	N/A	N/A	N/A	N/A
tin-113	Ci	N/A	N/A	N/A	N/A	N/A
tin-117m	Ci	N/A	N/A	N/A	N/A	N/A
antimony-122	Ci	N/A	N/A	N/A	N/A	N/A
antimony-124	Ci	N/A	N/A	N/A	N/A	N/A
antimony-125	Ci	N/A	N/A	N/A	N/A	N/A
iodine-131	Ci	N/A	N/A	N/A	N/A	N/A
iodine-133	Ci	N/A	N/A	N/A	N/A	N/A
cesium-134	Ci	N/A	N/A	N/A	N/A	N/A
cesium-137	Ci	N/A	N/A	N/A	N/A	N/A
barium/lanthanum-140	Ci	N/A	N/A	N/A	N/A	N/A
cerium-141	Ci	N/A	N/A	N/A	N/A	N/A
cerium-144	Ci	N/A	N/A	N/A	N/A	N/A
unidentified	Ci	N/A	N/A	N/A	N/A	N/A
Total for period	Ci	N/A	N/A	N/A	N/A	N/A
2. Dissolved and entrained gases						
krypton-85	Ci	N/A	N/A	N/A	N/A	N/A
xenon-131m	Ci	N/A	N/A	N/A	N/A	N/A
xenon-133	Ci	N/A	N/A	N/A	N/A	N/A
xenon-133m	Ci	N/A	N/A	N/A	N/A	N/A
unidentified	Ci	N/A	N/A	N/A	N/A	N/A
Total for period	Ci	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable (liquids not discharged in a continuous mode during this period)

Radioactive Effluent Release Report

Calendar Year - 2016

Table 3A

Solid Waste And Irradiated Fuel Shipments (Part 1 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Spent resins, Filter Sludges, Evaporator Bottoms, Oil)		Jan - Jun	Jul - Dec	Estimated Total Error
a. Volume Shipped		25.53 m^3	0.00 m^3	0.0% (1)
b. Volume Buried		15.67 m^3	1.10 m^3	0.0% (1)
c. Total Activity		607.40 Ci	0.00 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		0.057 %	0.00 %	
C-14		0.19 %	0.00 %	
Mn-54		2.24 %	0.00 %	
Fe-55		8.45 %	0.00 %	
Co-58		10.50 %	0.00 %	
Co-60		19.60 %	0.00 %	
Ni-59		0.45 %	0.00 %	
Ni-63		55.70 %	0.00 %	
Zn-65		0.37 %	0.00 %	
Nb-95		0.33 %	0.00 %	
Cs-137		0.21 %	0.00 %	
Sb-125		0.81 %	0.00 %	
Zr-96		0.27 %	0.00 %	
3. Number of Shipments		12	0	
a. Type of Container Used	LSA	10	0	
	Type A	1	0	
	Type B	1	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	12	0	
c. Mode of Transport	Truck	12	0	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Erwin, TN	7	0	
	Oak Ridge, TN	5	0	
e. Waste Class per 10 CFR Part 61	Class A	4	0	
	Class B	8	0	
	Class C	0	0	
	> Class C	0	0	

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.
(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2016

Table 3B

Solid Waste And Irradiated Fuel Shipments (Part 2 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Dry Compressible Waste, Contaminated Equipment, etc.)		Jan - Jun	Jul - Dec	Estimated Total Error
a. Volume Shipped		123.30 m^3	285.40 m^3	0.0% (1)
b. Volume Buried		25.56 m^3	30.66 m^3	0.0% (1)
c. Total Activity		0.685 Ci	0.306 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		3.94 %	6.04 %	
C-14		0.06 %	3.21 %	
Cr-51		0.041 %	1.23 %	
Mn-54		0.22 %	0.516 %	
Fe-55		12.50 %	29.70 %	
Co-58		1.16 %	11.60 %	
Co-60		11.70 %	11.90 %	
Ni-63		59.80 %	21.50 %	
Sn-113		0.002 %	0.01 %	
Nb-95		0.07 %	2.31 %	
Zn-65		0.07 %	0.002 %	
Zr-95		0.0315 %	1.15 %	
Ag-110m		0.002 %	2.24 %	
Sb-125		1.62 %	0.00 %	
Cs-134		0.17 %	0.004 %	
Cs-137		8.55 %	7.56 %	
3. Number of Shipments		3	5	
a. Type of Container Used	LSA	2	5	
	Type A	1	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	3	5	
c. Mode of Transport	Truck	3	5	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	3	5	
	Wampum, PA	0	0	
e. Waste Class per 10 CFR Part 61	Class A	3	5	
	Class B	0	0	
	Class C	0	0	
	> Class C	0	0	

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.
(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2016

Table 3C

Solid Waste And Irradiated Fuel Shipments (Part 3 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Irradiated components, Control Rods, etc)		Jan - Jun	Jul - Dec	Estimated Total Error
a. Volume Shipped		0.0637 m^3	0.00E+00 m^3	0.0% (1)
b. Volume Buried		0.010 m^3	0.00E+00 m^3	0.0% (1)
c. Total Activity		0.035 Ci	0.00E+00 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		0.02 %	0.00 %	
Mn-54		0.89 %	0.00 %	
Fe-55		89.10 %	0.00 %	
Co-60		9.50 %	0.00 %	
Ni-59		0.04 %	0.00 %	
Ni-63		0.40 %	0.00 %	
Nb-95		0.05 %	0.00 %	
Sb-125		1.62 %	0.00 %	
Cs-134		0.17 %	0.00 %	
Cs-137		8.55 %	0.00 %	
3. Number of Shipments		1	0	
a. Type of Container Used	LSA	0	0	
	Type A	1	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	1	0	
c. Mode of Transport	Truck	1	0	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	1	0	
	Barnwell, SC	0	0	
e. Waste Class per 10 CFR Part 61	Class A	1	0	
	Class B	0	0	
	Class C	0	0	
	> Class C	0	0	

B. No Irradiated Fuel Shipments

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.

(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2016
Table 4
Lower Limits Of Detectability (LLD)

	RWDA-G 1000 cc Gas Grab Sample		RWDA-L 1000 ml Liquid Grab Sample		Filter Paper / Charcoal Continuous Effluent Sample	
Nuclide	(3) Calculated LLD (uCi/cc)	ODCM Required LLD (uCi/cc)	(3) Calculated LLD (uCi/ml)	ODCM Required LLD (uCi/ml)	(3) Calculated (2) LLD (uCi/cc)	ODCM Required LLD (uCi/cc)
H-3	(4) 1.00E-06	1E-06	1.00E-06	1E-06		
Na-24	1.04E-07	1E-04	2.32E-08	5E-07	1.97E-13	1E-11
Ar-41	7.26E-08	1E-04	1.63E-08	5E-07	--------	-----
Cr-51	3.86E-07	1E-04	9.30E-08	5E-07	1.24E-12	1E-11
Mn-54	5.08E-08	1E-04	1.16E-08	5E-07	1.33E-13	1E-11
Fe-55			(1) 1.00E-06	1E-06		
Fe-59	1.09E-07	1E-04	2.47E-08	5E-07	5.03E-13	1E-11
Co-57	4.69E-08	1E-04	1.24E-08	5E-07	8.68E-14	1E-11
Co-58	4.71E-08	1E-04	1.08E-08	5E-07	1.60E-13	1E-11
Co-60	9.17E-08	1E-04	2.07E-08	5E-07	2.11E-13	1E-11
Zn-65	1.25E-07	1E-04	2.82E-08	5E-07	5.74E-13	1E-11
Se-75					9.79E-14	1E-11
Kr-85	1.54E-05	1E-04	3.60E-06	1E-05		
Kr-85m	5.51E-08	1E-04	1.42E-08	1E-05		
Kr-87	8.34E-08	1E-04	1.98E-08	1E-05		
Kr-88	1.68E-07	1E-04	4.20E-08	1E-05		
Sr-89			(1) 5.00E-08	5E-08	(1) 1.00E-13	1E-11
Sr-90			(1) 5.00E-08	5E-08	(1) 1.00E-14	1E-11
Sr-92	1.22E-07	1E-04	2.73E-08	5E-07	2.77E-13	1E-11
Nb-95	5.03E-08	1E-04	1.15E-08	5E-07	1.52E-13	1E-11
Nb-97	5.26E-08	1E-04	1.22E-08	5E-07	1.20E-13	1E-11
Zr-95	8.19E-08	1E-04	1.88E-08	5E-07	2.91E-13	1E-11
Mo-99	3.10E-07	1E-04	7.13E-08	5E-07	1.20E-12	1E-11
Tc-99m	4.58E-08	1E-04	1.19E-08	5E-07	7.72E-14	1E-11
Ag-110m	4.69E-08	1E-04	1.09E-08	5E-07	1.15E-13	1E-11
Sb-124	3.84E-08	1E-04	8.93E-09	5E-07	1.80E-13	1E-11
Sb-125	1.95E-07	1E-04	4.62E-08	5E-07	3.64E-13	1E-11
I-131	6.07E-08	1E-04	1.45E-08	1E-06	9.25E-14	1E-12
I-133	3.95E-08	1E-04	9.24E-09	5E-07	1.46E-13	1E-10
I-135	2.44E-07	1E-04	5.48E-08	5E-07	8.82E-13	1E-11
Xe-131m	1.85E-06	1E-04	4.70E-07	1E-05		
Xe-133	1.14E-07	1E-04	3.43E-08	1E-05		
Xe-133m	4.20E-07	1E-04	1.03E-07	1E-05		
Xe-135	3.63E-08	1E-04	8.90E-09	1E-05		
Xe-135m	1.09E-07	1E-04	2.55E-08	1E-05		
Xe-137	7.07E-07	1E-04	1.67E-07	1E-05		
Xe-138	2.24E-07	1E-04	5.49E-08	1E-05		
Cs-134	3.86E-08	1E-04	8.97E-09	5E-07	1.28E-13	1E-11
Cs-137	6.70E-08	1E-04	1.55E-08	5E-07	2.11E-13	1E-11
Ba-139	1.87E-07	1E-04	4.74E-08	5E-07	2.98E-13	1E-11
Ba-140	2.34E-07	1E-04	5.48E-08	5E-07	4.65E-13	1E-11
La-140	8.50E-08	1E-04	1.89E-08	5E-07	3.99E-13	1E-11
Ce-141	1.00E-07	1E-04	2.58E-08	5E-07	1.76E-13	1E-11
Ce-144	4.16E-07	1E-04	1.09E-07	5E-07	4.33E-13	1E-11
Gross Alpha			(1) 1.00E-07	1E-07	(1) 3.51E-15	1E-11

(1) Sample analyses performed by a contractor laboratory.

(2) These LLD calculations contain a default weekly continuous sample volume of 2.85E+8 cc. Therefore, grab sample LLD values reflect a different volume (ie; 10 cuft or 2.83E+5 cc).

(3) The calculated LLD's, except those denoted by (1), are from a counter/detector calibration on 09/23/15. These values are typical for other counter/detectors used for effluent counting at BVPS.

(4) Based on counting 50 ml of the water that was bubbled through a 20 liter air sample.

Radioactive Effluent Release Report

Calendar Year - 2016
Table 5A
Assessment Of Radiation Doses

		Unit 1 Liquid Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
	Bone	5.84E-04	0.0117	9.28E-03	0.1856	2.01E-02	0.4029	1.90E-03	0.0380	3.19E-02	0.3191
O	Liver	6.30E-03	0.1261	1.88E-02	0.3757	4.03E-02	0.8060	1.22E-02	0.2446	7.76E-02	0.7762
R	Total Body	6.05E-03	0.4035	1.44E-02	0.9612	3.08E-02	2.0537	1.14E-02	0.7571	6.26E-02	2.0877
G	Thyroid	5.48E-03	0.1096	6.07E-03	0.1213	1.27E-02	0.2542	9.65E-03	0.1930	3.39E-02	0.3391
A	Kidney	5.75E-03	0.1150	1.04E-02	0.2072	2.20E-02	0.4408	1.05E-02	0.2102	4.87E-02	0.4866
N	Lung	5.57E-03	0.1114	7.50E-03	0.1500	1.58E-02	0.3163	9.95E-03	0.1991	3.88E-02	0.3884
(1)	GI-LLI	5.95E-03	0.1190	6.70E-03	0.1339	1.42E-02	0.2841	1.03E-02	0.2052	3.71E-02	0.3711

		Unit 1 Gaseous Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch & Continuous Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
(2)	Gamma Air	0.00E+00	0.0000	0.00E+00	0.0000	1.70E-08	0.0000	8.77E-07	0.0000	8.94E-07	0.0000
(2)	Beta Air	0.00E+00	0.0000	0.00E+00	0.0000	7.42E-11	0.0000	4.13E-09	0.0000	4.21E-09	0.0000
	Bone	9.05E-09	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	4.87E-04	0.0065	4.87E-04	0.0032
O	Liver	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.23E-03	0.0431	1.18E-02	0.0783
R	Total Body	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.26E-03	0.0434	1.18E-02	0.0785
G	Thyroid	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.21E-03	0.0428	1.17E-02	0.0782
A	Kidney	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.21E-03	0.0428	1.17E-02	0.0782
N	Lung	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.84E-03	0.0512	1.24E-02	0.0824
(3)	GI-LLI	3.66E-03	0.0488	4.23E-03	0.0563	6.40E-04	0.0085	3.36E-03	0.0448	1.19E-02	0.0792

(1) These doses are listed in mrem; they are calculated for the maximum individual for all batch liquid effluents

(2) These doses are listed in mrad; they are calculated at the site boundary for batch & continuous gaseous effluents (0.4 miles NW)

(3) These doses are listed in mrem; they are calculated for the most likely exposed real individual (child) via all real pathways at 0.89 miles NW.

Limits used for calculation of percent (%) are from ODCM procedure 1/2-ODC-3.03, Attachment H Control 3.11.1.2, Attachment L Control 3.11.2.2, and Attachment M Control 3.11.2.3 (considered to be the design objectives).

Radioactive Effluent Release Report

Calendar Year - 2016
Table 5B
Assessment Of Radiation Doses

		Unit 2 Liquid Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
	Bone	5.84E-04	0.0117	9.28E-03	0.1856	2.01E-02	0.4029	1.90E-03	0.0380	3.19E-02	0.3191
O	Liver	6.30E-03	0.1261	1.88E-02	0.3757	4.03E-02	0.8060	1.22E-02	0.2446	7.76E-02	0.7762
R	Total Body	6.05E-03	0.4035	1.44E-02	0.9612	3.08E-02	2.0537	1.14E-02	0.7571	6.26E-02	2.0877
G	Thyroid	5.48E-03	0.1096	6.07E-03	0.1213	1.27E-02	0.2542	9.65E-03	0.1930	3.39E-02	0.3391
A	Kidney	5.75E-03	0.1150	1.04E-02	0.2072	2.20E-02	0.4408	1.05E-02	0.2102	4.87E-02	0.4866
N	Lung	5.57E-03	0.1114	7.50E-03	0.1500	1.58E-02	0.3163	9.95E-03	0.1991	3.88E-02	0.3884
(1)	GI-LLI	5.95E-03	0.1190	6.70E-03	0.1339	1.42E-02	0.2841	1.03E-02	0.2052	3.71E-02	0.3711

		Unit 2 Gaseous Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch & Continuous Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
(2)	Gamma Air	0.00E+00	0.0000	0.00E+00	0.0000	1.70E-08	0.0000	8.77E-07	0.0000	8.94E-07	0.0000
(2)	Beta Air	0.00E+00	0.0000	0.00E+00	0.0000	7.42E-11	0.0000	4.13E-09	0.0000	4.21E-09	0.0000
	Bone	9.05E-09	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	9.73E-10	0.0000	1.00E-08	0.0000
O	Liver	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362
R	Total Body	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362
G	Thyroid	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362
A	Kidney	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362
N	Lung	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362
(3)	GI-LLI	3.01E-02	0.4019	2.21E-03	0.0294	2.07E-03	0.0275	1.01E-03	0.0135	3.54E-02	0.2362

(1) These doses are listed in mrem; they are calculated for the maximum individual for all batch liquid effluents

(2) These doses are listed in mrad; they are calculated at the site boundary for batch & continuous gaseous effluents (0.4 miles NW)

(3) These doses are listed in mrem; they are calculated for the most likely exposed real individual (child) via all real pathways at 0.89 miles NW.

Limits used for calculation of percent (%) are from ODCM procedure 1/2-ODC-3.03, Attachment H Control 3.11.1.2, Attachment L Control 3.11.2.2, and Attachment M Control 3.11.2.3 (considered to be the design objectives).

Radioactive Effluent Release Report

Calendar Year - 2016
Table 6

Effluent Monitoring Instrumentation Channels Not Returned To Operable Status Within 30 Days

There were several Effluent Monitoring Instrumentation Channels that were not returned to operable status within 30 days.

1) Unit 1 Auxiliary Building Vent Monitor, RM-VS-109 - On 08/29/16 the flow transmitter associated for RM-VS-109 was taken out of service during ventilation system testing. During this test, it was discovered that the stack flow was responding incorrectly by displaying a value, declaring it non-functional. The last calibration was done 11/28/15 and it is believed to be non-functional since this date. The monitor was returned to service on 09/14/2016 (reference CR-2016-10326).

Radioactive Effluent Release Report

Calendar Year - 2016

Table 7

Total Dose Commitments, Total Effective Dose Equivalents and Population Doses

Total Dose Commitment From All Facility Releases To Members of the Public 40 CFR 190.10(a) Environmental Doses				
Organ	(1) Effluent Dose (mrem)	(2) Direct Radiation Dose (mrem)	Total Dose (mrem)	% of ODCM or 40 CFR 190 Limit
Bone	6.43E-02	0.00E+00	6.43E-02	0.26%
Liver	2.02E-01	0.00E+00	2.02E-01	0.81%
Total Body	1.72E-01	0.00E+00	1.72E-01	0.69%
Thyroid	1.15E-01	0.00E+00	1.15E-01	0.15%
Kidney	1.44E-01	0.00E+00	1.44E-01	0.58%
Lung	1.25E-01	0.00E+00	1.25E-01	0.50%
GI-LLI	1.22E-01	0.00E+00	1.22E-01	0.49%

(1) The cumulative dose contributions from liquid and gaseous effluents were determined in accordance with the applicable CONTROLS & SURVEILLANCE REQUIREMENTS listed in ODCM procedure 1/2-ODC-3.03. The dose commitment limits for 40 CFR 190 MEMBERS OF THE PUBLIC (ODCM 1/2-ODC-3.03 Control 3.11.4.1) are as follows:
a) < or = 25 mrem / calendar year (for the total body, or any organ except the thyroid)
b) < or = 75 mrem / calendar year (for the thyroid)

(2) The dose contribution listed for the total body is for Direct Radiation. This was calculated by comparing offsite TLD exposure at the ODCM controlling location (0.8 miles NW; Midland, PA) to TLD exposure at the REMP control location (16.5 miles SSW; Weirton, WV).

Compliance to 100 mrem Limit of 10 CFR 20.1301 For Total Effective Dose Equivalent

Pursuant to 10 CFR 20.1301(a)(1), the Total Effective Dose Equivalent from licensed operation to the maximum individual during the report period, is 5.66 mrem. This is a summation of Direct Radiation Exposure (calculated by comparing the maximum of all perimeter TLD exposures to TLD exposure at the REMP control location) plus Effluent Doses (calculated per the ODCM).

Members of the Public Doses Due To Their Activities Inside The Site Boundary

The radiation doses for MEMBER(S) OF THE PUBLIC due to their activities inside the site boundary are not greater than the doses listed in this table to show compliance with 40 CFR Part 190 or 10 CFR 20.1301. Evaluations have shown that exposure time for individuals not occupationally associated with the plant site is minimal in comparison to the exposure time considered for the dose calculation at or beyond the site boundary. Therefore, a separate assessment of radiation doses from radioactive effluents to MEMBER(S) OF THE PUBLIC, due to their activities inside the site boundary, is not necessary for this report period.

0-50 Mile Population Doses From Liquid and Gaseous Effluents

0-50 mile Total Population Dose from liquid and gaseous effluents =	102.44	man-mrem (Total Body)
0-50 mile Average Population Dose from liquid and gaseous effluents =	0.0000250	man-mrem (Total Body)

Radioactive Effluent Release Report

Calendar Year - 2016
Table 8

Offsite Dose Calculation Manual Surveillance Deficiencies
There were no ODCM related Surveillances Deficiencies (as required by procedure 1/2-ODC-3.03 of the Offsite Dose Calculation Manual) during this report period. This is regarding all required ODCM Surveillances associated with monitoring, sampling & analysis and offsite dose projection.

Radioactive Effluent Release Report

Calendar Year - 2016
Table 9

Offsite Dose Calculation Manual Changes (Description)

There was two changes made to the ODCM during the report period. See ODCM procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History ODCM Changes" for a complete description of the change and the change justification. A brief description of the change is as follows:

Change (39) to the ODCM (Effective March 2016)

1) **Procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History of ODCM Changes" (Rev 22)**
   Updated the History of ODCM changes to include this change

2) **Procedure 1/2-ODC-2.01, "ODCM: Liquid Effluents" (Rev 16)**
   Added dose factors for beryllium-7 (Be-7), selenium-75 (Se-75), tin-113 (Sn-113), tin 117m (Sn-117m) and antimony-122 (Sb-122)

3) **Procedure 1/2-ODC-2.02, "ODCM: Gaseous Effluents" (Rev 7)**
   Revised dose factors for selenium-75 (Se-75)

Change (40) to the ODCM (Effective November 2016)

1) **Procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History of ODCM Changes" (Rev 23)**
   Updated the History of ODCM changes to include this change

3) **Procedure 1/2-ODC-2.02, "ODCM: Gaseous Effluents" (Rev 8)**
   Alarm setpoints updated and PING monitors changed to primary monitors

4) **Procedure 1/2-ODC-2.03, "ODCM: Radiological Environmental Monitoring Program" (Rev 7)**
   Sample location maps updated

5) **Procedure 1/2-ODC-3.03, "ODCM: Controls for RETS and REMP programs" (Rev 14)**

   Coincides with ODC-2.02 change and form update for preplanned method of monitoring

ENCLOSURE 2, ATTACHMENT 1

Radioactive Effluent Release Report

Calendar Year - 2016
Attachment 1
Joint Frequency Distribution Tables

Attachment 1

As specified in the ODCM, an annual summary of hourly meteorological data (in the form of joint frequency distribution) is provided for the calendar year. In summary, the joint frequency distribution data is similar to previous years and close to long-term normals.

Meteorological Data Recovery

The Meteorological Data Recovery for the calendar year met the minimum requirement of at-least 90% (as specified in Section 5 of Revision 1 to Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants). The actual Meteorological Data Recovery is shown in the following table:

PERCENT RECOVERY OF INDIVIDUAL METEOROLOGICAL PARAMETERS
100% = Wind Speed 35'
99.4% = Wind Speed 150'
100% = Wind Speed 500'
100% = Wind Direction 35'
99.9% = Wind Direction 150'
100% = Wind Direction 500'
100% = Delta Temperature (150' - 35') 1P
99.7% = Delta Temperature (500' - 35') 2P
100% = Temperature 35'
100% = Precipitation
99.9% = Average Recovery of Individual Meteorological Parameters
PERCENT RECOVERY OF COMPOSITE VARIABLES
100% = Wind Speed 35', Wind Direction 35', Delta Temperature 1P
99.4% = Wind Speed 150', Wind Direction 150', Delta Temperature 1P
99.7% = Wind Speed 500', Wind Direction 500', Delta Temperature 2P
99.8% = Average Recovery of Composite Variables

Attachment 1 Clarification

Hourly meteorological data is not provided for specific periods of Abnormal Gaseous Release during the calendar quarters (as indicated in Regulatory Guide 1.21), for the following reasons:

1) All routine Gaseous Releases for the calendar year were determined to be within design objectives, where as, the ODCM Dose Limits and the ODCM Dose Rate Limits are considered to be the design objectives.

2) There were no Abnormal Gaseous Releases during the calendar year.

For a copy of the hourly meteorological data during the calendar quarters, contact Patrick Seidel at 724-682-4255.

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	38	64	2	0	0	0	104
NNE	36	31	2	0	0	0	69
NE	39	17	0	0	0	0	56
ENE	44	18	0	0	0	0	62
E	29	12	0	0	0	0	41
ESE	44	8	0	0	0	0	52
SE	40	4	0	0	0	0	44
SSE	22	8	1	0	0	0	31
S	3	20	3	0	0	0	26
SSW	10	45	7	0	0	0	62
SW	17	86	31	0	0	0	134
WSW	19	120	30	2	0	0	171
W	35	135	21	0	0	0	191
WNW	26	73	8	0	0	0	107
NW	40	42	2	0	0	0	84
NNW	44	52	2	0	0	0	98
Total	486	735	109	2	0	0	1332

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1332
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	14	6	0	0	0	0	20
NNE	5	3	0	0	0	0	8
NE	9	0	0	0	0	0	9
ENE	5	2	0	0	0	0	7
E	9	2	0	0	0	0	11
ESE	1	0	0	0	0	0	1
SE	2	0	0	0	0	0	2
SSE	5	0	0	0	0	0	5
S	1	5	0	0	0	0	6
SSW	0	3	4	0	0	0	7
SW	6	19	9	0	0	0	34
WSW	6	16	6	0	0	0	28
W	12	15	9	0	0	0	36
WNW	6	6	1	0	0	0	13
NW	9	12	1	0	0	0	22
NNW	11	11	0	0	0	0	22
Total	101	100	30	0	0	0	231

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	231
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	6	7	0	0	0	0	13
NNE	7	3	0	0	0	0	10
NE	8	0	0	0	0	0	8
ENE	5	2	0	0	0	0	7
E	5	1	0	0	0	0	6
ESE	3	1	0	0	0	0	4
SE	3	0	0	0	0	0	3
SSE	3	1	0	0	0	0	4
S	3	1	0	0	0	0	4
SSW	4	8	2	0	0	0	14
SW	8	17	15	1	0	0	41
WSW	14	20	4	0	0	0	38
W	8	24	5	0	0	0	37
WNW	11	11	2	0	0	0	24
NW	8	9	0	0	0	0	17
NNW	6	7	0	0	0	0	13
Total	102	112	28	1	0	0	243

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	243
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	94	48	0	0	0	0	142
NNE	95	15	0	0	0	0	110
NE	82	5	0	0	0	0	87
ENE	88	19	0	0	0	0	107
E	55	10	0	0	0	0	65
ESE	30	0	0	0	0	0	30
SE	43	0	0	0	0	0	43
SSE	32	4	0	0	0	0	36
S	42	21	5	0	0	0	68
SSW	63	54	19	1	0	0	137
SW	104	150	98	4	0	0	356
WSW	101	195	92	7	0	0	395
W	75	270	108	1	0	0	454
WNW	87	99	16	0	0	0	202
NW	94	75	3	0	0	0	172
NNW	86	37	0	0	0	0	123
Total	1171	1002	341	13	0	0	2527

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2527
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	73	12	0	0	0	0	85
NNE	108	5	0	0	0	0	113
NE	159	5	0	0	0	0	164
ENE	157	36	0	0	0	0	193
E	165	9	0	0	0	0	174
ESE	125	1	0	0	0	0	126
SE	124	1	0	0	0	0	125
SSE	139	7	0	0	0	0	146
S	170	29	0	0	0	0	199
SSW	170	74	13	0	0	0	257
SW	99	121	49	3	0	0	272
WSW	61	92	24	4	0	0	181
W	67	63	10	0	0	0	140
WNW	61	44	0	0	0	0	105
NW	81	24	3	0	0	0	108
NNW	69	8	0	0	0	0	77
Total	1828	531	99	7	0	0	2465

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2465
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2016 00:00 - 12/31/2016 23:00 **All Hours**

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	15	0	0	0	0	0	15
NNE	29	1	0	0	0	0	30
NE	31	0	0	0	0	0	31
ENE	56	0	0	0	0	0	56
E	159	0	0	0	0	0	159
ESE	241	0	0	0	0	0	241
SE	244	0	0	0	0	0	244
SSE	128	0	0	0	0	0	128
S	126	2	0	0	0	0	128
SSW	80	9	0	0	0	0	89
SW	29	1	1	0	0	0	31
WSW	11	3	0	0	0	0	14
W	4	1	0	0	0	0	5
WNW	6	0	0	0	0	0	6
NW	7	0	0	0	0	0	7
NNW	10	0	0	0	0	0	10
Total	1176	17	1	0	0	0	1194

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1194
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	7	1	0	0	0	0	8
NNE	19	0	0	0	0	0	19
NE	20	0	0	0	0	0	20
ENE	25	0	0	0	0	0	25
E	68	0	0	0	0	0	68
ESE	138	0	0	0	0	0	138
SE	179	0	0	0	0	0	179
SSE	81	0	0	0	0	0	81
S	64	0	0	0	0	0	64
SSW	34	2	0	0	0	0	36
SW	13	1	0	0	0	0	14
WSW	7	0	0	0	0	0	7
W	7	0	0	0	0	0	7
WNW	10	0	0	0	0	0	10
NW	6	0	0	0	0	0	6
NNW	7	0	0	0	0	0	7
Total	685	4	0	0	0	0	689

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	689
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2016 00:00 - 12/31/2016 23:00 **All Hours**

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Stability Class: ALL Delta Temperature

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	247	138	2	0	0	0	387
NNE	299	58	2	0	0	0	359
NE	348	27	0	0	0	0	375
ENE	380	77	0	0	0	0	457
E	490	34	0	0	0	0	524
ESE	582	10	0	0	0	0	592
SE	635	5	0	0	0	0	640
SSE	410	20	1	0	0	0	431
S	409	78	8	0	0	0	495
SSW	361	195	45	1	0	0	602
SW	276	395	203	8	0	0	882
WSW	219	446	156	13	0	0	834
W	208	508	153	1	0	0	870
WNW	207	233	27	0	0	0	467
NW	245	162	9	0	0	0	416
NNW	233	115	2	0	0	0	350
Total	5549	2501	608	23	0	0	8681

Calm Hours not Included above for:	**Total Period**	**All Hours**	101
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	2
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8681
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	5	46	44	2	0	0	97
NNE	3	61	25	4	0	0	93
NE	3	31	16	1	0	0	51
ENE	2	32	21	0	0	0	55
E	2	42	19	0	0	0	63
ESE	3	41	19	1	0	0	64
SE	3	37	10	1	0	0	51
SSE	1	29	12	0	0	0	42
S	0	15	30	4	0	0	49
SSW	2	16	20	6	0	0	44
SW	3	20	39	7	0	0	69
WSW	1	34	67	13	0	0	115
W	6	46	86	29	8	0	175
WNW	7	78	65	33	3	0	186
NW	9	39	39	11	1	0	99
NNW	13	37	25	2	0	0	77
Total	63	604	537	114	12	0	1330

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1330
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	5	13	2	0	0	0	20
NNE	4	10	2	0	0	0	16
NE	0	1	2	0	0	0	3
ENE	2	6	4	0	0	0	12
E	0	3	3	0	0	0	6
ESE	2	2	0	0	0	0	4
SE	1	3	3	0	0	0	7
SSE	0	2	3	0	0	0	5
S	0	2	5	0	0	0	7
SSW	0	2	4	2	0	0	8
SW	1	2	12	4	0	0	19
WSW	3	4	11	5	0	0	23
W	3	15	8	6	3	0	35
WNW	0	7	7	9	0	0	23
NW	3	6	8	3	0	0	20
NNW	4	7	9	0	0	0	20
Total	28	85	83	29	3	0	228

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	228
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	1	8	2	0	0	0	11
NNE	2	5	3	1	0	0	11
NE	4	6	0	0	0	0	10
ENE	0	6	4	0	0	0	10
E	0	4	2	0	0	0	6
ESE	1	2	1	0	0	0	4
SE	1	4	0	0	0	0	5
SSE	0	5	1	0	0	0	6
S	1	3	3	0	0	0	7
SSW	1	6	7	1	0	0	15
SW	1	1	6	10	0	0	18
WSW	1	7	15	6	0	0	29
W	6	15	11	10	0	0	42
WNW	2	15	12	8	0	0	37
NW	1	9	10	0	0	0	20
NNW	2	4	5	0	0	0	11
Total	24	100	82	36	0	0	242

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	242
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2016 00:00 - 12/31/2016 23:00 **All Hours**

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	25	70	27	0	0	0	122
NNE	34	78	28	5	0	0	145
NE	40	38	3	1	0	0	82
ENE	31	60	26	2	0	0	119
E	12	40	14	0	0	0	66
ESE	12	20	4	0	0	0	36
SE	9	21	3	0	0	0	33
SSE	14	21	8	0	0	0	43
S	12	29	20	3	0	0	64
SSW	23	33	39	17	2	0	114
SW	23	53	84	35	1	0	196
WSW	38	73	131	33	5	0	280
W	36	105	244	211	36	2	634
WNW	31	93	114	72	5	0	315
NW	29	79	36	4	0	0	148
NNW	29	57	24	0	0	0	110
Total	398	870	805	383	49	2	2507

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2507
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

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Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	35	36	16	0	0	0	87
NNE	78	30	14	0	0	0	122
NE	105	102	8	1	0	0	216
ENE	88	137	38	8	0	0	271
E	42	69	22	0	0	0	133
ESE	32	18	7	0	0	0	57
SE	20	16	12	1	0	0	49
SSE	22	27	7	0	0	0	56
S	32	49	37	1	0	0	119
SSW	56	62	47	9	0	0	174
SW	75	85	113	19	0	0	292
WSW	64	85	72	21	3	0	245
W	44	69	82	49	4	0	248
WNW	26	114	68	11	0	0	219
NW	29	66	17	5	0	0	117
NNW	20	38	4	0	0	0	62
Total	768	1003	564	125	7	0	2467

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2467
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

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Part 2: Joint Frequency Distribution Tables (150ft)
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Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	60	7	1	0	0	0	68
NNE	133	21	0	0	0	0	154
NE	138	85	1	0	0	0	224
ENE	65	58	3	0	0	0	126
E	37	15	0	0	0	0	52
ESE	21	8	0	0	0	0	29
SE	19	13	0	0	0	0	32
SSE	20	8	2	0	0	0	30
S	30	21	2	0	0	0	53
SSW	66	46	5	0	0	0	117
SW	69	55	10	0	0	0	134
WSW	52	36	6	0	0	0	94
W	26	16	1	0	0	0	43
WNW	10	6	0	0	0	0	16
NW	18	7	0	0	0	0	25
NNW	26	8	0	0	0	0	34
Total	790	410	31	0	0	0	1231

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1231
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	27	8	0	0	0	0	35
NNE	67	16	0	0	0	0	83
NE	81	39	0	0	0	0	120
ENE	34	27	0	0	0	0	61
E	19	4	0	0	0	0	23
ESE	17	3	0	0	0	0	20
SE	11	6	0	0	0	0	17
SSE	10	7	1	0	0	0	18
S	10	31	2	0	0	0	43
SSW	44	43	2	0	0	0	89
SW	56	29	5	0	0	0	90
WSW	27	26	2	0	0	0	55
W	9	8	0	0	0	0	17
WNW	12	6	0	0	0	0	18
NW	7	5	0	0	0	0	12
NNW	11	3	0	0	0	0	14
Total	442	261	12	0	0	0	715

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	715
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

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Part 2: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2016 00:00 - 12/31/2016 23:00 **All Hours**

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Stability Class: ALL Delta Temperature

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	158	188	92	2	0	0	440
NNE	321	221	72	10	0	0	624
NE	371	302	30	3	0	0	706
ENE	222	326	96	10	0	0	654
E	112	177	60	0	0	0	349
ESE	88	94	31	1	0	0	214
SE	64	100	28	2	0	0	194
SSE	67	99	34	0	0	0	200
S	85	150	99	8	0	0	342
SSW	192	208	124	35	2	0	561
SW	228	245	269	75	1	0	818
WSW	186	265	304	78	8	0	841
W	130	274	432	305	51	2	1194
WNW	88	319	266	133	8	0	814
NW	96	211	110	23	1	0	441
NNW	105	154	67	2	0	0	328
Total	2513	3333	2114	687	71	2	8720

Calm Hours not Included above for:	**Total Period**	**All Hours**	7
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	57
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8720
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	5	4	1	0	0	10
NNE	0	3	7	1	0	0	11
NE	0	3	3	0	0	0	6
ENE	0	1	6	0	0	0	7
E	0	3	8	0	0	0	11
ESE	0	8	1	1	1	0	11
SE	1	3	2	0	0	0	6
SSE	0	2	0	0	0	0	2
S	0	0	4	0	0	0	4
SSW	0	0	3	1	0	0	4
SW	0	0	5	1	0	0	6
WSW	0	0	0	0	0	0	0
W	0	2	3	0	0	0	5
WNW	0	0	6	1	0	0	7
NW	1	2	1	2	0	0	6
NNW	0	2	2	3	0	0	7
Total	2	34	55	11	1	0	103

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	103
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	10	6	3	0	0	19
NNE	0	10	4	0	1	0	15
NE	0	3	2	0	0	0	5
ENE	0	2	10	0	0	0	12
E	0	9	5	1	0	0	15
ESE	0	7	8	0	0	0	15
SE	0	11	11	0	0	0	22
SSE	0	1	6	0	0	0	7
S	0	5	6	0	0	0	11
SSW	0	1	5	2	0	0	8
SW	0	1	7	2	0	0	10
WSW	0	6	4	4	0	0	14
W	0	2	5	3	1	0	11
WNW	0	1	9	11	2	0	23
NW	0	1	3	6	0	0	10
NNW	1	3	4	1	0	0	9
Total	1	73	95	33	4	0	206

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	206
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2016 00:00 - 12/31/2016 23:00 **All Hours**

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	8	13	3	3	0	27
NNE	0	3	2	1	0	0	6
NE	0	6	7	0	0	0	13
ENE	2	7	10	0	0	0	19
E	0	13	6	1	0	0	20
ESE	0	12	6	1	0	0	19
SE	0	7	4	0	0	0	11
SSE	1	3	5	0	0	0	9
S	0	2	10	3	2	0	17
SSW	0	5	10	2	0	0	17
SW	1	3	12	5	0	0	21
WSW	0	3	13	12	0	0	28
W	0	3	8	14	5	0	30
WNW	0	10	14	17	8	3	52
NW	1	4	6	2	1	0	14
NNW	1	10	13	3	0	0	27
Total	6	99	139	64	19	3	330

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	330
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	21	68	122	53	0	0	264
NNE	14	47	38	19	1	0	119
NE	17	56	16	6	1	0	96
ENE	24	43	41	15	4	0	127
E	24	73	72	24	2	0	195
ESE	22	70	72	30	2	0	196
SE	14	48	51	19	4	0	136
SSE	16	39	37	15	2	0	109
S	15	45	47	47	5	1	160
SSW	12	27	75	96	31	6	247
SW	15	42	111	187	88	8	451
WSW	19	59	138	197	38	18	469
W	24	78	181	361	190	44	878
WNW	21	92	218	185	115	24	655
NW	18	45	138	50	10	0	261
NNW	11	54	120	43	3	0	231
Total	287	886	1477	1347	496	101	4594

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	4594
Total Hours for the Period:			8784

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	16	32	42	8	0	0	98
NNE	23	26	19	8	0	0	76
NE	38	41	17	0	0	0	96
ENE	49	62	38	12	1	0	162
E	48	76	30	8	1	0	163
ESE	27	72	34	8	0	0	141
SE	38	58	44	14	3	0	157
SSE	41	42	25	14	4	0	126
S	30	23	45	43	2	0	143
SSW	23	31	34	46	16	2	152
SW	36	39	62	109	64	3	313
WSW	38	76	47	30	7	2	200
W	44	79	90	32	5	2	252
WNW	37	46	50	4	0	0	137
NW	20	19	17	7	1	0	64
NNW	23	15	28	9	0	0	75
Total	531	737	622	352	104	9	2355

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2355
Total Hours for the Period:			8784

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Part 3: Joint Frequency Distribution Tables (500ft)
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Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	18	11	7	0	0	0	36
NNE	13	13	4	2	0	0	32
NE	26	20	5	2	0	0	53
ENE	30	37	9	1	0	0	77
E	38	59	5	0	0	0	102
ESE	25	56	17	2	0	0	100
SE	18	25	13	3	0	0	59
SSE	16	26	23	3	0	0	68
S	9	23	37	22	0	0	91
SSW	7	14	20	20	0	0	61
SW	16	16	29	25	10	0	96
WSW	19	40	10	2	0	0	71
W	21	31	26	10	0	0	88
WNW	25	29	7	0	0	0	61
NW	15	7	2	0	0	0	24
NNW	15	11	4	0	0	0	30
Total	311	418	218	92	10	0	1049

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1049
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

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Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	1	0	0	0	0	1
NNE	1	1	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	1	0	0	0	0	0	1
E	1	6	0	0	0	0	7
ESE	1	3	0	0	0	0	4
SE	1	6	2	0	0	0	9
SSE	1	2	1	1	0	0	5
S	0	2	6	11	0	0	19
SSW	1	4	8	17	1	0	31
SW	0	1	5	7	4	0	17
WSW	0	4	0	1	0	0	5
W	0	3	0	0	0	0	3
WNW	2	0	0	0	0	0	2
NW	3	2	0	0	0	0	5
NNW	0	2	0	0	0	0	2
Total	13	37	22	37	5	0	114

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	114
Total Hours for the Period:			8784

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2016
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2016 00:00 - 12/31/2016 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Stability Class: ALL Delta Temperature

Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	55	135	194	68	3	0	455
NNE	51	103	74	31	2	0	261
NE	82	129	50	8	1	0	270
ENE	106	152	114	28	5	0	405
E	111	239	126	34	3	0	513
ESE	75	228	138	42	3	0	486
SE	72	158	127	36	7	0	400
SSE	75	115	97	33	6	0	326
S	54	100	155	126	9	1	445
SSW	43	82	155	184	48	8	520
SW	68	102	231	336	166	11	914
WSW	76	188	212	246	45	20	787
W	89	198	313	420	201	46	1267
WNW	85	178	304	218	125	27	937
NW	58	80	167	67	12	0	384
NNW	51	97	171	59	3	0	381
Total	1151	2284	2628	1936	639	113	8751

Calm Hours not Included above for:	**Total Period**	**All Hours**	2
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	31
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8751
Total Hours for the Period:			8784

ENCLOSURE 2, ATTACHMENT 2

Beaver Valley Power Station - Units 1 & 2

Radioactive Effluent Release Report

Calendar Year - 2016
Attachment 2
Unit 1 and 2 Offsite Dose Calculation Manual Changes

Attachment 2
Enclosed is a complete copy of the ODCM that includes: Change (40) of the ODCM (Effective: November 2016)

Attachment 2 Clarification
A complete copy of the ODCM has been provided to the following offices: United States Nuclear Regulatory Commission Attention: Document Control Desk Washington, DC 20555-0001 United States Nuclear Regulatory Commission Regional Administrator 2100 Renaissance Blvd., Suite 100 King of Prussia, PA 19406-2713 For a complete copy of the ODCM, contact Patrick Seidel at 724-682-4255.

ENCLOSURE 2, ATTACHMENT 3

Radioactive Effluent Release Report

Calendar Year - 2016
Attachment 3
Unit 1 and 2 Carbon-14 (C-14) Dose Estimates

Carbon-14 Methodology

Gaseous doses from carbon-14 were calculated in accordance with EPRI and Regulatory Guide 1.109 methodology. Other considerations were made in the calculations; daylight hours and growing season.

Liquid effluent release doses are considered to be insignificant and are not included in this report. This report does not address the amount of carbon-14 disposed of in shipments of solid waste and irradiated fuel. The term "other" discussed below refers to liver, total body, thyroid, kidney, lung and GI. Doses for these organs are assumed to be equal.

The receptor chosen was selected based upon the default ODCM receptor - NW 1432 meters (0.89 miles). It is assumed that only vegetation and inhalation exposure pathways are available.

The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 1 was determined to be less than **2.53** mrem to the bone and less than **0.51** mrem to all other organs.

The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 2 was determined to be less than **2.29** mrem to the bone and less than **0.46** mrem to all other organs.

Dose Calculations for Unit 1

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
Inhalation	0.059	0.012	0.080	0.015	0.058	0.011	0.040	0.008
Vegetation Ingestion	-	-	2.451	0.490	1.016	0.203	0.625	0.125
TOTAL	0.06	0.01	2.53	0.51	1.07	0.21	0.67	0.13

Dose Calculations for Unit 2

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
Inhalation	0.061	0.012	0.083	0.016	0.060	0.011	0.042	0.008
Vegetation Ingestion	-	-	2.211	0.442	0.919	0.184	0.571	0.114
TOTAL	0.06	0.01	2.29	0.46	0.98	0.20	0.61	0.12

Dose Calculations for BVPS

	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
TOTAL	**0.12**	**0.02**	**4.83**	**0.96**	**2.05**	**0.41**	**1.28**	**0.25**

RTL A9.690E
Enclosure 3

Beaver Valley Power Station - Units 1 & 2

2016 Annual Radiological Environmental Operating Report

FirstEnergy Nuclear Operating Company
FENOC

Beaver Valley Power Station - Units 1 & 2
Unit 1 License No. DPR-66
Unit 2 License No. NPF-73

EXECUTIVE SUMMARY and INDEX

Report Preparation and Submittal Requirements: The Beaver Valley Power Station (BVPS) Annual Radiological Environmental Operating Report (AREOR) was prepared and submitted in accordance with the requirements contained in the following documents:

- BVPS Integrated Technical Specifications, Administrative Control 5.6.1
- Offsite Dose Calculation Manual (ODCM) procedure 1/2-ODC-3.03, Attachment T, Control 6.9.2, "*Controls for RETS and REMP Programs*"
- BVPS procedure 1/2-ENV-01.05, "*Compliance with Regulatory Guide 1.21 and Technical Specifications*"
- BVPS procedure 1/2-ENV-02.01, "*Radiological Environmental Monitoring Program*"
- NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No.1, April 1991"
- SAP Notification 601018638: 2016 RETS and REMP Report
- BVPS Condition Report No. 2016-08789: REMP NRC Observations Identified During 2016 Inspection

EXECUTIVE SUMMARY and INDEX

Report Overview:

The AREOR provides a detailed summary of the BVPS Radiological Environmental Monitoring Program (REMP). During the report period, samples of air, water, shoreline sediment, milk, fish, food crops, feed crops, vegetation, and direct radiation (in the vicinity of the BVPS site) have been measured, analyzed, evaluated, and summarized. During the report period, the BVPS radioactive effluent releases (as performed in accordance with the Radiological Effluent Technical Specification (RETS) program), did not exceed the limits identified in the BVPS Operating License, Technical Specifications and/or the Offsite Dose Calculation Manual (ODCM). The results of REMP verify that the effluent releases did not impact the environment with a measurable concentration of radioactive materials and/or levels of radiation that are higher than expected.

Description of Pre-operational REMP (1974 – 1975):

A pre-operational REMP was performed during the period 1974 through 1975. At that time, samples were collected and analyzed to determine the amount of radioactivity present in the environment prior to BVPS operation. The resulting values are considered a "baseline" to which current sample analyses can be compared. A summary of the pre-operational data is summarized in Table 2-3 of this report.

Description of Operational REMP (1976 – Present):

The operational REMP was initiated during calendar year 1976 and continued through the report period. During the past forty (40) years, radiation and radioactivity in the environment was monitored within a 10-mile radius of the site. A description of the operational REMP is outlined in Table 2-1 of this report. In general, two (2) types of samples were collected and compared during the report period, and are described as follows:

- **Control Samples:** These samples are collected from areas that are beyond measurable influence of BVPS operation, and are used as reference data. Normal background radiation levels, or radiation present due to causes other than BVPS operation, can thus be compared to the environment surrounding the BVPS site. During the report period, four hundred one (401) analyses were performed on samples from the control locations. In addition, eight (8) analyses were completed for thermoluminescent dosimeters (TLDs) at the control locations. Results of the analyses from the control locations are summarized in Table 2-2 of this report.

- **Indicator Samples:** Indicator samples are collected to determine the radiological impact of BVPS operation in the environment. These samples are collected from various locations near the BVPS site. At a minimum, the samples are collected from areas where the BVPS contribution would indicate the most significant radiological impact. During the report period, one thousand eight hundred eighty two (1,882) analyses were performed on samples collected from eighty four (84) indicator locations. In addition, five hundred seventeen (517) analyses were completed for TLDs at the indicator locations. Results of the analyses from the indicator locations are also summarized in Table 2-2 of this report.

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- **Comparisons:** Current analysis results from the indicator samples were compared to both current control sample values and the pre-operational baseline to determine if changes in radioactivity levels were attributable to BVPS operation.

Determination of Environmental Impact

- **2016 Sample Media and Analyses:** Results for drinking water, surface water, precipitation, groundwater, shoreline stream sediment, fish, cow milk, goat milk, feedstuff, foodcrops, air particulate and air radioiodine media remained consistent with previous data. Minor increases and decreases were noted in most sample media, and any positive results attributable to the BVPS operation were consistent with station data of authorized radioactive discharges, and were within limits permitted by the operating license and the ODCM. Other radioactivity detected was attributable to naturally occurring radionuclides, previous nuclear weapons tests, other man-made sources, and to the normal statistical fluctuation for activities near the Lower Limit of Detection (LLD).

- **Airborne Exposure Pathway:** This ODCM required pathway was evaluated via sampling of airborne radioiodine and airborne particulates. The results during this report period were similar to previous years. There was no notable increase in natural products and no detectable fission products or other radionuclides in the airborne particulate media during the year attributed to effluent releases from BVPS.

- **Direct Exposure Pathway:** This ODCM required pathway was evaluated via measurement of environmental radiation doses by use of Thermo Luminescent Dosimeters (TLDs). The results of TLD processing have indicated a stable trend and compare well with previous years.

- **Ingestion Exposure Pathway:** This ODCM required pathway was evaluated via sampling of milk, fish, and foodcrops (leafy vegetables).

  For milk samples, strontium-90 (attributable to past atmospheric weapons testing), was detected at levels similar to those of previous years. The gamma spectrometry analyses indicated positive results for naturally occurring potassium-40 at average environmental levels.

  The fish samples indicated below LLD levels in each of the sample analyses.

  Foodcrop (leafy vegetation) samples indicated naturally occurring potassium-40 at average environmental levels.

- **Waterborne Exposure Pathway:** This ODCM pathway was evaluated via samples of drinking water, ground (well) water, surface (river) water and river sediment.

  Water samples were analyzed for tritium and gamma-emitting radionuclides. Tritium was not identified in any of these water samples. Iodine-131 analysis of drinking water indicated

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positive analyses, but the values were consistent with iodine-131 at the upstream surface (river) water control location, and was not due to liquid effluent releases from BVPS.

Sediment samples were collected from upstream of the site, at the discharge point of BVPS liquid effluent releases, and downstream of the site. Analysis of samples indicated naturally occurring radionuclides potassium-40, thallium-208, bismuth-214, lead-212, lead-214, radium-226, and actinium-228 in all results. The analyses also indicated cesium-137, but the values were consistent with cesium-137 at the control location, and most likely caused by previous nuclear weapons tests. Cobalt-58 and cobalt-60 were identified in some of the samples that were obtained at the shorelines of the BVPS Main Outfall Facility. This is not unusual because the BVPS site discharges cobalt-58 and cobalt-60 in liquid waste effluents. The activity detected at these sample locations is consistent with discharge data of authorized liquid effluent releases, and all liquid effluent releases during the report period did not exceed the release concentration limits set forth in the ODCM.

- **Other Exposure Pathways:** In addition to the samples collected from the exposure pathways described above, other media (i.e., precipitation and feedstuff) were also collected. Results were consistent with previous years, with no degrading trends.

- **Offsite Groundwater Monitoring:** A total of four (4) offsite groundwater samples were collected and analyzed for tritium and by gamma spectrometry during the report period. The samples were collected on a semi-annual basis from two (2) locations within four (4) miles of the site. The locations included one (1) well in Hookstown, PA; and one (1) well in Georgetown, PA. No gamma-emitting radionuclides were detected in the analyses. All tritium results were less than the pre-operational value.

- **Supplemental Sample Sites:** REMP includes supplemental sampling sites in addition to the required sites set forth in the ODCM. The supplemental sites include five (5) air sampling sites, one (1) surface water site, two (2) groundwater sites, three (3) precipitation sites, two (2) sediment sites, and one (1) milk animal feedstuff site.

- **Population Dose vs. Natural Background:** During the report period, the total calculated 0-50 mile population dose was 58 man-mrem (liquid releases), and 44 man-mrem (gaseous releases). The average individual population dose from BVPS operation was less than <1 mrem. Accordingly, the typical dose to an individual from background (natural radiation exposure including radon) was estimated as an average of 296 mrem per year according to the National Academy of Sciences 1990 BEIR Report. In 2009, the NCRP Report No. 160: "Ionizing Radiation Exposure of the Population of the United States," *Journal of Radiological Protection J. Radiol. Prot.* 29.3 (2009) defined the radiation exposure population dose to be 620 mrem per year. The following graph in Figure i-1 illustrates that the average individual population dose was not affected from BVPS operation.

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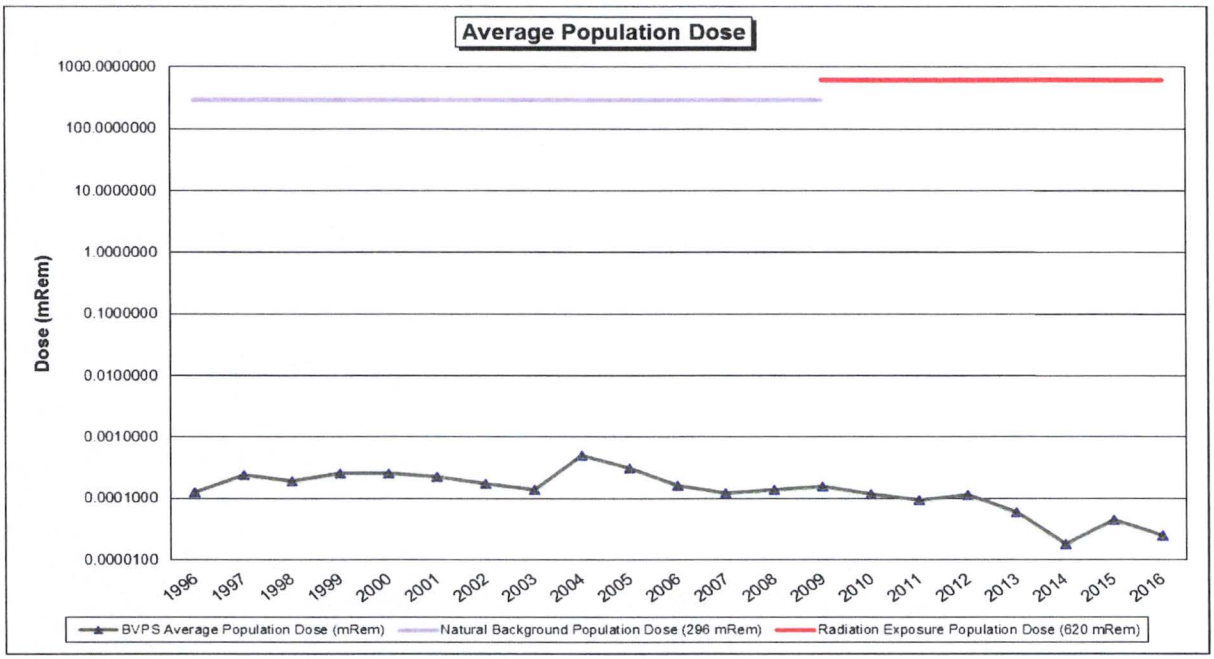
Figure i-1
Graph of Annual Average Population Dose: BVPS Dose and Natural Background Dose



- **Summary:** During the report period, radioactive effluent releases from the BVPS site did not exceed the limits identified in the BVPS Operating License, Technical Specifications and/or the ODCM. The BVPS operational REMP program was followed throughout the report period. The results demonstrate the adequacy of radioactive effluent control at BVPS, and that BVPS operation did not adversely affect the surrounding environment. Positive results were attributable to BVPS operation and were consistent with station data of authorized radioactive discharges within limits permitted by the NRC license and the ODCM. Other radioactivity detected was attributable to naturally occurring radionuclides, previous nuclear weapons tests, other man-made sources, and to the normal statistical fluctuation for activities near the LLD.

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Inter-laboratory Comparison Programs:

- **Split Sample Program:** BVPS shared split samples with the Pennsylvania Department of Environmental Protection (PADEP) in support of their nuclear power plant monitoring program. The shared media and number of locations were typically comprised of milk (2), surface water (3), river sediment (1), fish (1), foodcrops (2), co-located air particulate/air iodine (4), and TLD (24). The split sample program was coordinated by the state, and the results are not provided with this report.

- **Spike Sample Program:** Spiked samples were provided by an independent laboratory and then analyzed by the REMP contractor laboratory. The samples were provided throughout the report period and included water samples, milk samples, filter paper samples and charcoal cartridge samples. All one hundred eight (108) analyses performed by the contactor laboratory on the spiked samples met the NRC comparison criteria.

Special Reports:

- **SINCE** no reporting levels were exceeded during 2016, **THEN** no Special Reports were required. A Special Report shall be submitted to the NRC when (1) levels of radioactivity in an environmental sampling medium exceeds the limits specified in ODCM procedure 1/2-ODC-3.03, Attachment Q Table 3.12-2, and when (2) the results of the following calculation are ≥ 1.0 (for calculations performed when more than one radionuclide is detected in the sampling medium):

$$\frac{\text{Concentration (1)}}{\text{Limit Level (1)}} + \frac{\text{Concentration (2)}}{\text{Limit Level (2)}} + \ldots \geq 1.0$$

Land Use Census Results:

Highlights from the most recent Land Use Census are documented in letter NPD3NRE:1198, dated March 24, 2017 and are summarized as follows:

- **Nearest Residence (0 to 5 mile radius):** The location has not changed since the previous census. The nearest inhabited residence is at 209 Ferry Hill Road, Shippingport, PA (0.4 miles, east).

- **Nearest Garden >500 sqft:** The location has not changed since the previous census. The closest garden location is at the Pringle Residence, 1221 Virginia Avenue, Midland, PA (1.0 miles, in the northwest). The previous sampling location at the Cox Residence, 238 State Route 168, Hookstown, PA (0.760 miles, south-southwest) was available for sampling cabbage this year but does not meet all the requirements of NUREG-1301.

- **Nearest Dairy Cow:** The location has not changed since the previous census. The location remains at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.158 miles, southeast).

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- **Nearest Doe Goat:** The location has not changed since the previous census. The closest location is the Covert Residence, 930 Pine Street, Hookstown, PA (1.900 miles, southwest).

- **Prevailing Winds:** The prevailing wind direction for Ground Releases was identified by showing the highest D/Q in the east sector. The prevailing wind direction for Elevated Releases was identified by showing the highest D/Q in the east-southeast sector. The REMP properly monitors the environment with air particulate sampling stations in some Sectors and direct radiation TLDs in all Sectors.

- **2016 Dairy Cow & Doe Goat Sampling Locations:** The dairy cow sampling locations have not changed in 2016. The locations remain at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.158 miles, southeast), and Windsheimer Dairy, 20 Windsheimer Lane, Burgettstown, PA (10.476 miles, south-southwest). The doe goat sampling location has not changed since the previous census and remains at the Covert Residence, 930 Pine Street, Hookstown, PA (1.900 miles, southwest).

- **Deposition (D/Q) for Milch Animal Locations:** None of the 2016 milch animal sampling locations experienced a >20% increase in D/Q. Therefore, a Special Report per ODCM Control 3.12.2 Action "a" and/or Action "b" is not required.

- **D/Q for Offsite Dose Determination:** There is no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, the analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% of the offsite dose previously calculated using current ODCM methodology. Therefore, a Special Report per ODCM Control 3.12.2 Action "a" and/or Action "b" is not required.

- **D/Q Historical Trend Comparison:** There is no adverse trend in D/Q when comparing 2000 to 2016 data to the ODCM default D/Q values. This validates that there is no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, the analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% of the offsite dose previously calculated using current ODCM methodology. Therefore, a change in ODCM Receptor location and/or a change to meteorology at the current ODCM Receptor location is not required.

The 2016 Land Use Census results indicate that no significant changes are required in the current Radiological Environmental Monitoring Program or to its methodology.

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Deviations, Changes and Adjustments to the Normal Sampling Program

- **Deviation from Required Milk Sampling & Analysis Schedule:** One deviation from the required milk sampling and analysis schedule occurred for the reporting period. Sufficient milk samples were not available from locations within the 5 mile radius in 2016. The unavailability of milk caused the REMP to not meet the ODCM sample requirements in 1/2-ODC-2.03 and in 1/2-ODC-3.03, Attachment Q Table 3.12-1 stating that a minimum of four (4) milk locations shall be sampled. This initiated the ODCM requirement for sampling two (2) additional garden locations based upon the highest predicted annual average D/Q when milk locations are not available.

- **Deviation from Required Surface and Drinking Water Sampling and Analysis Schedule:** There were two deviations from the ODCM required water sampling and analysis schedule during the report.

  ½-ODC-2.03: Radiological Environmental Monitoring Program requires a waterborne surface (river) sample for two locations, one upstream and one downstream. Site No. 2.1, Sector 14, Midland - ATI Allegheny Ludlum, the downstream sample, is no longer a viable sample location. ATI permanently closed the Midland facility in 2016. As of December 2016, surface water samples were no longer available. Site No. 5, Sector 14, East Liverpool Water Department was an additional downstream sample location in which grab samples were taken. Accordingly, the East Liverpool site was transitioned to a composite sample location thus replacing ATI Allegheny Ludlum. The equipment was installed in early December resulting in no missed samples. This issue is documented in Notification 601018638, Task 12.

  In addition, the REMP drinking water monitor (Site No. 04) was out of service in April of 2016. Small leaks started to develop in the copper water supply line that is connected to the REMP water station. The water station was shut down, the copper water line was replaced and the water station was returned to service on April 12, 2016 at 1620. Therefore, a sample was not missed since the sample requirement is bi-weekly. "Time off" was extrapolated by using the volume collected to have been approximately 0204 on April 6, 2016. ½-ODC-2.03: Radiological Environmental Monitoring Program, states that deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. This issue is documented in Notification 601018638, Task 9.

- **Deviation from Required Air Particulate & Iodine Sampling and Analysis Schedule:** There was one deviation from the required airborne particulate sampling and analysis schedule during the report period.

  During the sampling period of 03/28/2016 - 04/03/2016, REMP air particulate and iodine control sampling station at East Liverpool Water Department in East Liverpool, OH (Site No. 47) was found to be out of service. This location is not an ODCM required location. The REMP technician observed that the pump was running but was not drawing vacuum most likely indicating that the carbon vanes had shattered and prevented the pump from pulling air. The shattered vanes were replaced, the air monitor equipment was calibrated and the

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station was returned to service. The sample station was in service for 4 days, 12 hours, 8 minutes, indicating that the station was out of service for approximately 61 hours, as reported by the REMP technician. This issue was documented in SAP Notification 601018638, Task 8.

- **Deviation from Required Direct Radiation Monitoring:** On January 7, 2016, the REMP Technician was performing the scheduled quarterly TLD changeout. During the work, it was noticed that Station #81 (Millcreek United Presbyterian Church) was missing one of the two TLDs for the First Quarter of 2016. On September 29, 2016, the REMP Technician was performing the scheduled fourth quarter changeout and noticed that Station 94 (McCleary & Pole Cat Hollow Road) was missing both of the TLDs. ½-ODC-2.03 states that deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. 1/2-ODC-3.03, ODCM: Controls for RETS and REMP Programs, only requires that 40 offsite locations be obtained with quarterly collection of at least 2 TLDs at each site. Therefore, BVPS still meets the minimum ODCM requirements by having complete data for 41 of 44 sample stations available. This issue is documented in Notification 601018638, Task 10.

- **Deviations from Soil Sampling and Analysis Schedule:** Soil sampling is not an ODCM requirement. In 2017, the sample frequency was revised from once per three years to once every five years. Soil was last sampled in 2015 and will be performed in 2020.

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EXECUTIVE SUMMARY

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SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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AREOR TABLES

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AREOR FIGURES

SECTION 1 - INTRODUCTION

A. Radiation Fundamentals

Radiation is the conveyance of energy through space. For example, heat emanating from a stove is a form of radiation, as are light rays, microwaves, and radio waves. All matter consists of atoms, which are comprised of positively charged particles (protons), negatively charged particles (electrons), and non-charged/neutral particles (neutrons). The relatively large particles (protons and neutrons) are packed tightly together in a cluster at the center of the atom called the nucleus, while the smaller particles (electrons) orbit around the nucleus. In an electrically neutral atom, the negative charges of the electrons are balanced by the positive charges of the protons. Due to their dissimilar charges, the protons and electrons have a strong attraction for each other. This holds the atom together. Other attractive forces between the protons and neutrons keep the densely packed protons from repelling each other, and prevent the nucleus from breaking apart.

B. Radiation and Radioactivity

The following provides an alphabetical glossary of terms associated with radiation, radioactivity, and the radioactive decay process. The terms discussed include alpha particles, beta particles, gamma rays, genetic effects, half-life, ionization, isotopes, neutrons, radiation, radioactive decay, radionuclides and somatic effects.

Alpha Particles: Particulate and electromagnetic radiation each travel through matter differently because of their different properties. Alpha particles contain 2 protons and 2 neutrons, are relatively large, and carry an electrical charge of +2. Alpha particles are ejected from the nucleus of a radioactive atom at speeds ranging from 2,000 to 20,000 miles per second. However, due to its comparatively large size, an alpha particle usually does not travel very far before it loses most of its energy through collisions and interactions with other atoms. As a result, a sheet of paper or a few centimeters of air can easily stop alpha particles.

Beta Particles: Beta particles are very small, and comparatively fast particles, traveling at speeds near the speed of light (186,000 miles per second). Beta particles have an electrical charge of either +1 or -1. Because they are so small and have a low charge, they do not collide and interact as often as alpha particles, so they can travel farther. Beta particles can usually travel through several meters in air, but may be stopped by a thin piece of metal or wood.

Gamma Rays: Gamma rays are pure energy and travel at the speed of light. They have no measurable charge or mass and generally travel much farther than alpha or beta particles before being absorbed. After repeated interactions, the gamma ray loses its energy and vanishes. The range of a gamma ray in air varies, depending on the ray's energy and interactions. Very high-energy gamma radiation can travel a considerable distance, where as low energy gamma radiation may travel only a few feet in air. Lead is used as shielding material for gamma radiation because of its density. Several inches of lead or concrete may be needed to effectively shield gamma rays.

Genetic Effects: The effects of ionizing radiation which are observed in the offspring of the exposed individual that could occur as a result of ionizing radiation interacting with the genes in the human cells.

Half-life: The length of time an atom remains radioactive is defined in terms of half-life, which is the amount of time required for a radioactive substance to lose half of its activity through the process of radioactive decay. Radionuclides that have infrequent emissions have a long half-life, where as, radionuclides that have more frequent emissions have a short half-life.

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Ionization: Through interactions with atoms, alpha, beta, and gamma radiation lose their energy. When these forms of radiation interact with any form of material, the energy they impart may cause atoms in that material to become ions, or charged particles. Normally, an atom has the same number of protons as electrons, thus, the number of positive and negative charges cancel, in which the atom is electrically neutral. When one or more electrons are removed, an ion is formed. Ionization is one of the processes that may result in damage to biological systems.

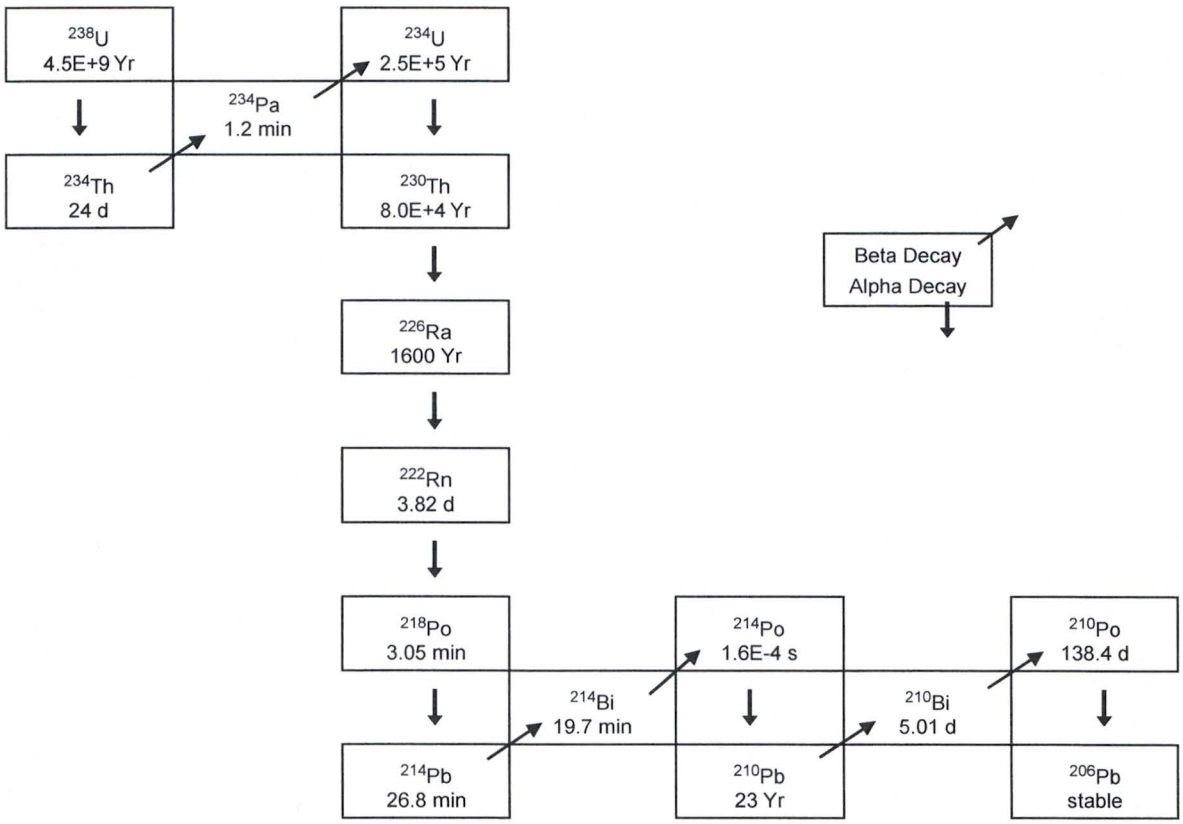
Isotopes: A group of identical atoms containing the same number of protons make up an element. In fact, the number of protons an atom contains determines its chemical identity. For instance, all atoms with one proton are hydrogen atoms, and all atoms with eight protons are oxygen atoms. However, the number of neutrons in the nucleus of an element may vary. Atoms with the same number of protons but different numbers of neutrons are called isotopes. Different isotopes of the same element have the same chemical properties, and many are stable or non-radioactive. An unstable or radioactive isotope of an element is called a radioisotope, a radioactive atom, or a radionuclide. Radionuclides usually contain an excess amount of energy in the nucleus. The excess energy is usually due to a surplus or deficit in the number of neutrons in the nucleus. Radionuclides such as uranium-238, beryllium-7 and potassium-40 occur naturally. Others are man-made, such as iodine-131, cesium-137, and cobalt-60.

Neutrons: Neutrons come from several sources, including the interactions of cosmic radiation with the earth's atmosphere and nuclear reactions within operating nuclear power reactors. However, neutrons are not of environmental concern since the neutron source at nuclear power stations is sealed within the containment building. Because neutrons have no charge, they are able to pass very close to the nuclei of the material through which they are traveling. As a result, neutrons may be captured by one of these nuclei or they may be deflected. When deflected, the neutron loses some of its energy. After a series of these deflections, the neutron has lost most of its energy. At this point, the neutron moves about as slow as the atoms of the material through which it is traveling, and is called a thermal neutron. In comparison, fast neutrons are much more energetic than thermal neutrons and have greater potential for causing damage to the material through which they travel. Fast neutrons can have from 200 thousand to 200 million times the energy of thermal neutrons. Neutron shielding is designed to slow fast neutrons and absorb thermal neutrons. Neutron shielding materials commonly used to slow neutrons down are water or polyethylene. The shield is then completed with a material such as cadmium, to absorb the now thermal neutrons. Concrete is also used to form an effective neutron shield because it contains water molecules and can be easily molded around odd shapes.

Radiation: This is the conveyance of energy through space. For instance, heat emanating from a stove is a form of radiation, as are light rays, microwaves, and radio waves. Ionizing radiation is another type of radiation and has similar properties to those of the examples listed above. Ionizing radiation consists of both electromagnetic radiation and particulate radiation. Electromagnetic radiation is energy with no measurable mass that travels with a wave-like motion through space. Included in this category are gamma rays and x-rays. Particulate radiation consists of tiny, fast moving particles which, if unhindered, travel in a straight line through space. The three types of particulate radiation of concern to us are alpha particles, which are made up of 2 protons and 2 neutrons; beta particles, which are essentially free electrons; and neutrons. The properties of these types of radiation will be described more fully in the Range and Shielding section.

SECTION 1 - INTRODUCTION

Radioactive Decay: Radioactive atoms, over time, will reach a stable, non-radioactive state through a process known as radioactive decay, which is the release of energy from an atom through the emission of ionizing radiation. Radioactive atoms may decay directly to a stable state or may go through a series of decay stages, called a radioactive decay series, and produce several daughter products that eventually result in a stable atom. The loss of energy through radioactive decay may transform the atom into a chemically different element. For example, when uranium-238 decays, it emits an alpha particle and, as a result, the atom loses 2 protons and 2 neutrons. Since the number of protons in the nucleus of an atom determines its chemical identity, then when the uranium-238 atom loses the 2 protons and 2 neutrons, it is transformed into an atom of thorium-234. Thorium-234 is one of the 14 successive daughter products of uranium-238. Radon is another daughter product, and the decay series ends with stable lead-206. The following example is part of a known radioactive decay series, called the uranium series, which begins with uranium-238 and ends with lead-206. The information provided in the upper portion of each block is the isotope name, while the information provided in the lower portion of each block is the half-life.



Radionuclides: See description for "isotopes".

Somatic Effects: The effects of ionizing radiation develop in the directly exposed individual, including an unborn child. Somatic effects can be divided further into acute and chronic effects. Acute effects develop shortly after exposure to large amount of radiation. Chronic effects are a result of exposure to radiation over an extended period of time.

SECTION 1 - INTRODUCTION

C. Units of Measurement

Activity (Curie): This relates the number of atoms in a sample that disintegrate (decay) per unit of time. Each time an atom disintegrates, radiation is emitted. The curie (Ci) is the unit used to describe the activity of a material and indicates the rate at which the atoms of a radioactive substance are decaying. One curie indicates the disintegration of 37 billion atoms per second. A curie is a unit of activity, not a quantity of material. Thus, the amount of material required to produce one curie varies. A smaller unit of the curie is used when discussing the low concentrations of radioactivity detected in environmental samples. For instance, the picocurie (pCi) represents one trillionth of a curie.

Absorbed Dose (rad): This is a term used to describe the radiation energy absorbed by any material exposed to ionizing radiation, and can be used for both particulate and electromagnetic radiation. The rad is the unit used to measure the absorbed dose. It is defined as the energy of ionizing radiation deposited per gram of absorbing material (1 rad = 100 erg/g). The rate of absorbed dose is usually given in rad/hr. The rad is not used to quantify biological damage caused by ionizing radiation.

Dose Equivalent (rem): Biological damage due to alpha, beta, gamma and neutron radiation may result from ionizing radiation. Some types of radiation, especially alpha particles, cause dense local ionization and can result in up to 20 times the amount of biological damage for the same energy imparted as do gamma or x-rays. Therefore, a quality factor must be applied to account for the different ionizing capabilities of various types of ionizing radiation. When the quality factor is multiplied by the absorbed dose (rad) the result is the dose equivalent. Dose equivalent is an estimate of the possible biological damage resulting from exposure to a particular type of ionizing radiation and is measured in rem. An example of this conversion from absorbed dose (rad) to dose equivalent (rem) uses the quality factor for alpha radiation, which is equal to 20. Thus, 1 rad of alpha radiation is equal to 20 rem. Since beta and gamma radiation each have a quality factor of 1, then 1 rad of either beta or gamma radiation is equal to 1 rem. Neutrons have a quality factor ranging from 2 to 10. In terms of radiation, the rem is a relatively large unit. Therefore, a smaller unit known as the millirem, is often used and one millirem (mrem) is equal to 1/1000 of a rem.

D. Lower Limit of Detection

The Lower Limit of Detection (LLD) for environmental samples is a calculated value that represents an a-priori (before-the-fact) limit for the smallest concentration (i.e.; pCi per unit mass or volume) of radioactive material in a sample that will be detected with 95% probability, and with 5% probability of falsely concluding that a blank observation represents a real signal. A calculated LLD must consider analytical variables such as standard deviation of the background counting rate, counting efficiency, sample size, fractional radiochemical yield, radioactive decay constant, and elapsed time between sample collection and time of counting.

E. Scope and Objectives of REMP

The environmental program consists of environmental monitoring for radioactivity in the vicinity of BVPS. Environmental sampling and analyses include air, water, milk, vegetation, river sediments, fish, and ambient radiation levels in areas surrounding the site. The results of these media are assessed to determine impacts of the plant operation on the environment. The AREOR for BVPS summarizes REMP conducted by the FirstEnergy Nuclear Operating Company during the report period.

SECTION 1 - INTRODUCTION

F. Description of the Beaver Valley Site

BVPS is located on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania, on a 453 acre tract of land. The site is approximately one mile from Midland, Pennsylvania, five miles from East Liverpool, Ohio, and twenty-five miles from Pittsburgh, Pennsylvania. Figure 1-1 shows the site location in relation to the principal population centers. Population density in the immediate vicinity of the site is relatively low. The population within a five mile radius of the plant is approximately 18,000. The only area within the radius of concentrated population is the Borough of Midland, Pennsylvania, with a population of approximately 2,635 as determined from the 2010 U.S. Census.

The site lies in a valley along the Ohio River. It extends from the river (elevation 665 feet above sea level) to a ridge along the border south of the Beaver Valley Power Station at a maximum elevation of 1160 feet. Plant grade level is approximately 735 feet above sea level.

BVPS is on the Ohio River at river mile 34.8, a location on the New Cumberland Pool that is 3.1 river miles downstream from Montgomery Lock and Dam, and 19.6 miles upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is located 5.2 river miles downstream from the site. The river flow is regulated by a series of dams and reservoirs on the Beaver, Allegheny, Monongahela and Ohio Rivers and their tributaries. During the report period, the Ohio River flow (as obtained from the Corps of Engineers – Water Resources Engineering) at the New Cumberland Dam ranged from 5,324 cubic feet per second (minimum monthly average) to 153,916 cubic feet per second (maximum monthly average). The mean flow during the report period was approximately 34,112 cubic feet per second.

Water temperature of the Ohio River typically varies from 32° Fahrenheit to 86° Fahrenheit. The minimum temperatures occur in January and/or February and maximum temperatures in July and/or August. Water quality in the Ohio River at the site location is affected primarily by the water quality of the Allegheny, Monongahela and Beaver rivers.

The climate of the area may be classified as humid continental. The predominant wind direction is typically from the southwest in summer and from the west in winter. The National Climatic Data Center indicates the following data for the Beaver Falls, PA area:

- The total annual precipitation during the report period was 42.77 inches.
- The average mean temperature during the report period was 51.9° Fahrenheit.

SECTION 1 - INTRODUCTION

The basic features of the Beaver Valley Power Station Units 1 and 2 are tabulated below:

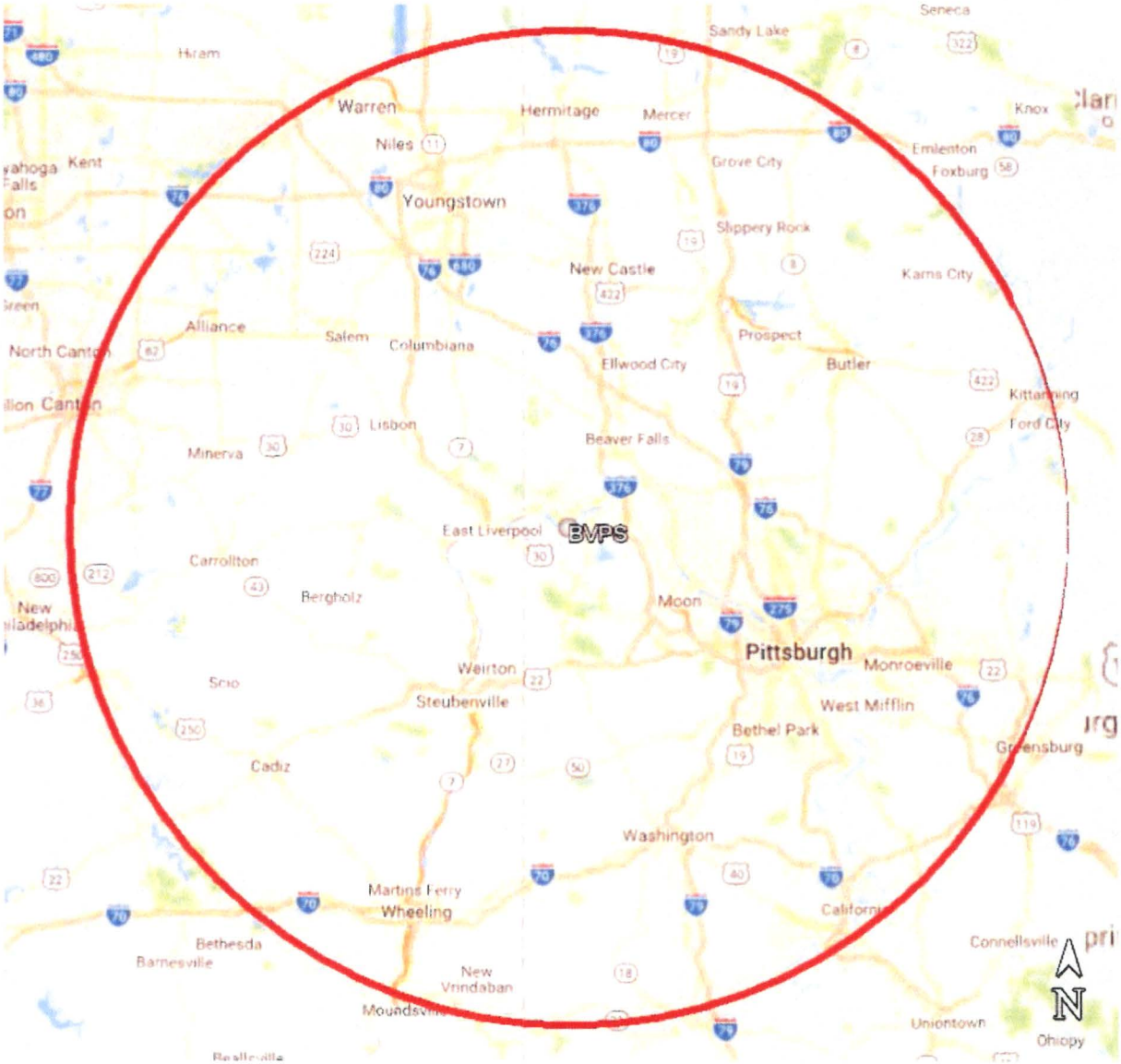
	Beaver Valley Unit 1	Beaver Valley Unit 2
Licensed Power Level	2900 – megawatts thermal	2900 – megawatts thermal
Type of Power	PWR	PWR
No. of Reactor Coolant Loops	3	3
No. of Steam Generators & Type	3 - Vertical	3 - Vertical
Steam Used by Main Turbine	Saturated	Saturated

The BVPS units utilize two separate systems (primary and secondary) for transferring heat from the source (the reactor) to the receiving component (turbine-generator). Because the two systems are isolated from each other, primary and secondary waters do not mix, and radioactivity in the primary system water is normally isolated from the secondary system. Reactor coolant in the primary system is pumped through the reactor core and steam generators by means of reactor coolant pumps. Heat is transferred from the primary system to the secondary system in the steam generators. The steam is then formed and delivered to the main unit turbine, which drives the electrical generator. The steam is condensed after passing through the turbine, and returned to the steam generators to begin another steam/water cycle.

SECTION 1 - INTRODUCTION

Figure 1-1

Geographical Map and Principal Communities in 50-mile Radius of the Beaver Valley Power Station



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

A. Radiological Environmental Monitoring Program

1. Program Description

The program consists of monitoring water, air, soil, river bottoms (sediment), feedstuff, vegetation, foodcrops, cow's milk, ambient radiation levels in areas surrounding the site, and aquatic life as summarized in Table 2-1. Further description of each portion of the program (Sampling Methods, Sample Analysis, Discussion and Results) are included in Sections 2-B through 2-I of this report.

2-B - **Air Monitoring**

2-C - **Monitoring of Shoreline Stream Sediment and Soil**

2-D - **Monitoring of Feedstuff and Foodcrops**

2-E - **Monitoring of Local Cow and Goat Milk**

2-F - **Environmental Radiation Monitoring**

2-G - **Monitoring of Fish**

2-H - **Monitoring of Surface Water, Drinking Water, Groundwater and Precipitation**

2-I - **Estimates of Radiation Dose to Man**

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-1

Operational Radiological Environmental Monitoring Program

Section	Sample Type	Sample Site No.	Sample Location	Sample Frequency	Sample Preparation / Analysis Frequency	Analysis
1	Air Particulate & Radionuclide	13	Hookstown, PA (Old Meyer Farm)	Continuous Sampling with Sample Collection at least weekly	Weekly - Air Particulate Weekly – Charcoal Quarterly Composite [c]	Gross Beta [b] Iodine-131 Gamma Scan
		27	Aliquippa, PA (Brunton Farm)			
		28	Sherman Farm			
		29B	Beaver, Pa (Friendship Ridge)			
		30	Shippingport, PA (Cook's Ferry Substation)			
		32	Midland, PA (North Substation)			
		46.1	Industry, PA (McKeel's Service - Rt. 68)			
		47	East Liverpool, OH (Water Department)			
		48 [a]	Weirton, WV (Water Tower - Collier Way)			
		51	Aliquippa, PA (Sheffield Substation)			
2	Direct Radiation	7-8	BVPS Site Perimeter Locations	Continuous (TLD)	Quarterly [i]	Gamma Dose
		10	Shippingport, PA (Post Office)			
		13	Hookstown, PA (Old Meyer Farm)			
		14	Hookstown, PA			
		15	Georgetown, PA (Post Office)			
		27	Aliquippa, PA (Brunton Farm)			
		28	Sherman Farm			
		29B	Beaver, PA (Friendship Ridge)			
		30	Shippingport, PA (Cook's Ferry Substation)			
		32	Midland, PA (North Substation)			
		33-44	BVPS Site Perimeter Locations			
		45	Raccoon Township, PA (Christian House Baptist Chapel - Rt. 18)			
		45.1	Raccoon Township, PA (Kennedy's Corner)			
		46	Industry, PA (Midway Drive)			
		46.1	Industry, PA (McKeel's Service - Rt. 68)			
		47	East Liverpool, OH (Water Department)			
		48 [a]	Weirton, WV (Water Tower - Collier Way)			
		51	Aliquippa, PA (Sheffield Substation)			
		52-56	BVPS Site Perimeter Locations			
		59	236 Green Hill Road, Aliquippa, PA			
		60	444 Hill Road, Georgetown, PA			
		70	236 Engle Road, Industry, PA			
		71	Brighton Township, PA (First Western Bank)			
		72	Ohioview, PA (Lutheran Church – Rear)			
		73	618 Squirrel Run Road, Industry, PA			
		74	37 Poplar Avenue, Monaca, PA (CCBC)			
		75	117 Holt Road , Aliquippa, PA			
		76	Raccoon Township, PA (Elementary School)			
		77	3614 Green Garden Road, Aliquippa, PA			
		78	Raccoon Township, PA (Municipal Building)			
		79	106 Rt. 151, Aliquippa, PA			
		80	Raccoon Township, PA (Park Office -Rt. 18)			
		81	Millcreek United Presbyterian, Church Hookstown, PA			
		82	2697 Rt. 18, Raccoon Twp, PA			
		83	735 Mill Creek Road, Hookstown, PA			
		84	Hancock County, WV (Senior Center)			
		85	2048 Rt. 30, West Chester, WV			
		86	1090 Ohio Avenue, East Liverpool, OH			
		87	50103 Calcutta Smith Ferry Road, Calcutta, OH			
		88A	Route 168, Midland Heights, PA			
		89	488 Smith Ferry Road, Ohioville, PA			
		90	6286 Tuscarawras Road, Midland, PA			
		91	Pine Grove Road & Doyle Road, Industry, PA			
		92	Georgetown, PA (Georgetown Road Substation)			
		93	104 Linden, Midland, PA (Sunrise Hills)			
		94	Hookstown, PA (McCleary & Pole Cat Hollow Roads)			
		95	832 McCLeary Road, Hookstown, PA)			
		111-112	BVPS Site Perimeter Locations			

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-1 (Continued)

Operational Radiological Environmental Monitoring Program

Section	Sample Type	Sample Site No.	Sample Location	Sample Frequency	Sample Preparation / Analysis Frequency	Analysis
3	Surface Water	49A [a]	Industry, PA (Upstream of Montgomery Dam)	Weekly Grab Sample [h]	Weekly Sample from Site49A only	Iodine-131
		2.1	Midland, PA (ATI Allegheny Ludlum)	Weekly Intermittent Composite Sample [h]	Monthly Composite of Weekly Sample [c]	Gamma Scan
		5	East Liverpool, OH (Water Department)	Daily Grab Sample Collected Weekly [h]	Quarterly Composite [c]	Tritium (H-3)
4	Groundwater	14A	Hookstown, PA (Downstream)	Semi-Annual	Semi-Annual	Gamma Scan Tritium (H-3)
		15B	Georgetown, PA (Downstream)			
5	Drinking Water	4	Midland, PA (Water Department)	Intermittent [d] Sample Collected Weekly	Weekly Composite of Daily sample [d]	Iodine-131
					Monthly Composite [d]	Gamma Scan
		5	East Liverpool, OH (Water Department)		Quarterly Composite [d]	Tritium (H-3)
6	Shoreline Sediment	2A	BVPS Outfall Vicinity	Semi-Annual	Semi-Annual	Gamma Scan
		49A[a]	Industry, PA (Upstream of Montgomery Dam)			
		50	New Cumberland, WV (Upstream of Dam)			
7	Milk	27	Aliquippa, PA (Brunton Farm)	Biweekly [f] When animals are on pasture; monthly at other times	All other samples & analyses are Biweekly during grazing but Monthly during other times	Gamma Scan Iodine-131 Strontium-89 Strontium-90
		96[a]	Burgettstown, PA (Windsheimer Farm)			
		114 [k]	Hookstown, PA (Covert Residence)			
8	Fish	2A	BVPS Outfall Vicinity	Semi-Annual	Composite of edible parts by species [g]	Gamma Scan on edible parts
		49A[a]	Industry, PA (Upstream of Montgomery Dam)			
9	Food Crops	10*[l] [m]	Shippingport, PA	Annual at Harvest if available	Composite of each sample species	Gamma Scan Iodine-131 on green leafy vegetables
		15*[l] [m]	Georgetown, PA			
		12 [l] [m]	Racoon Township, PA			
		46*[l] [m]	Industry, PA			
		48*[a][l][m]	Weirton, WV			
		* [l] [m]				

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-1 (Continued)

Operational Radiological Environmental Monitoring Program

Section	Sample Type	Sample Site No.	Sample Location	Sample Frequency	Sample Preparation / Analysis Frequency	Analysis
10	Feedstuff & Summer Forage	27	Aliquippa, PA (Brunton Farm)	Monthly	Monthly	Gamma Scan
11	Soil	13A	Hookstown, PA (Old Meyer Farm)	Every Five (5) Years (2015, 2020, 2025)	12 Core Samples 3" Deep (2" diameter at each location approx. 10' radius)	Gamma Scan
		27B	Aliquippa, PA (Brunton Farm)			
		29A	Beaver, PA (Nicol Farm)			
		30A	Shippingport, PA (Cook's Ferry Substation)			
		32A	Midland, PA (North Substation)			
		46B	Industry, PA (Willows Inn - Rt. 68)			
		47A	East Liverpool, OH (Water Department)			
		48 [a]	Weirton WV (Water Tower - Collier Way)			
		51A	Aliquippa, PA (Sheffield Substation)			
12	Precipitation	30	Shippingport, PA (Cook's Ferry Substation)	Weekly grab samples when available	Quarterly Composite [c]	Gamma Scan
		47	East Liverpool, OH (Water Department)			Tritium (H-3)
		48 [a]	Weirton WV (Water Tower–Collier Way)			

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-1 (Continued)

Operational Radiological Environmental Monitoring Program

Notes for Table 2-1

(a) Control sample station: These Locations which are presumed to be outside the influence of plant effluents.

(b) Particulate Samples are not counted within 24 hours after filter change. Perform gamma isotopic analysis on each sample when gross beta is greater than 10 times the yearly mean of control samples.

(c) Long-term composite samples are obtained from short-term composite samples at the specified locations.

(d) Composite samples are collected at intervals not exceeding 2 hours.

(e) Searight Dairy is no longer operational.

(f) Milk samples are collected bi-weekly when animals are grazing. The milk samples are collected monthly at other times.

(g) The fish samples contain whatever species are available.
IF adequate sample size is available, THEN the sample is separated according to species, and compositing will provide one sample of each species.
IF adequate sample size is not available, THEN separation by species is not practical. Therefore edible parts of all fish in the sample are mixed to provide one sample.

(h) Composite samples are obtained by collecting an aliquot at intervals not exceeding 2 hours at location 2.1. In December of 2016, location 2.1 was closed. The water treatment plant operator at location 5 obtains the weekly grab sample from the daily composite grab samples. In December of 2016, location 5 was transitioned to a composite sample to replace location 2.1. For location 49A, the weekly grab sample is obtained by a field technician.

(i) Two (2) TLDs are collected quarterly from each monitoring location.

(k) ODCM procedure 1/2-ODC-3.03, Attachment Q, Table 3.12-1 requires three (3) dairies to be selected on basis of highest potential thyroid dose using milch census data. See Section 2-E of this report (Monitoring of Local Cows Milk) for specific locations sampled.

(l) Three (3) garden locations required by 1/2-ODC-2.03, Attachment A Table 3.0-1; Sites designated by 1/2-ODC-2.03 Attachment B Figure 3.0-5. Sampling locations may be altered by the REMP Administrator at any time based on availability.

(m) When there are not enough milk sample locations available to meet the ODCM requirements, three (3) different types of broad leaf vegetation are to be sampled at each of two (2) indicator locations based on the highest predicted annual average ground D/Q (as determined from the previous year's Land Use Census results), in addition to those samples described in Note (l). Three (3) different types of broad leaf vegetation shall also be sampled at one (1) control location when in this condition.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

2. Summary of Results

All results of this monitoring program are summarized in Table 2-2. This table is prepared in the format specified by the NRC via the Branch Technical Position in NUREG-1301, and in accordance with Beaver Valley Power Station ODCM. Summaries of results of analysis of each media are discussed in Sections 2-B through 2-H and an assessment of radiation doses are given in Section 2-I. Table 2-3 summarizes BVPS pre-operational ranges for the various sampling media during the years 1974 and 1975. Comparisons of pre-operational data with operational data indicate the ranges of values are generally in good agreement for both periods of time.

Activity detected was attributed to naturally occurring radionuclides, BVPS effluents, previous nuclear weapons tests and/or to the normal statistical fluctuation for activities near the LLD.

The conclusion from all program data is that the operation of BVPS has resulted in no significant changes to the environment.

3. Quality Control Program

The Quality Control Program implemented by BVPS to assure reliable performance by the contractor and the supporting QC data are presented and discussed in Section 4 of this report.

4. Program Changes

½-ODC-2.03: Radiological Environmental Monitoring Program requires a waterborne surface (river) sample is required for two locations, one upstream and one downstream. Site No. 2.1, Sector 14, Midland - ATI Allegheny Ludlum, the downstream sample, is no longer a viable sample location. ATI permanently closed the Midland facility in 2016. As of December 2016, surface water samples were no longer available. Site No. 5, Sector 14, East Liverpool Water Department was an additional downstream sample location in which grab samples were taken. Accordingly, the East Liverpool site was transitioned to a composite sample location thus replacing ATI Allegheny Ludlum. The equipment was installed in early December resulting in no missed samples.

Accordingly, a change occurred in the frequency of soil sampling. Soil sampling is not an ODCM requirement. In 2017, the sample frequency was revised from once per three years to once every five years. Soil was last sampled in 2015 and will be performed in 2020.

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Air Particulate and Radioiodine
Unit of Measurement: (picoCuries / cubic meter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
Gross Beta 520	< 0.002	0.026 (468 / 468) 0.010 - 0.058	No. 32 Midland (North Sub Station) 0.8 miles NW	0.028 (52 / 52) 0.012 - 0.058	No. 48 Weirton, WV Water Tower Collier Way 16.3 miles SSW	0.026 (52 / 52) 0.014 - 0.060	0
I-131 520	< 0.04	LLD (0 / 468)		LLD (0 / 468)	No. 48 Weirton, WV Water Tower Collier Way 16.3 miles SSW	LLD (0 / 52)	0
Gamma 40							
Be-7	NA	0.076 (36 / 36) 0.050 - 0.110	No. 32 Midland (North Sub Station) 0.8 miles NW	0.087 (4 / 4) 0.065 - 0.110	No. 48 Weirton, WV Water Tower Collier Way 16.3 miles SSW	0.080 (4 / 4) 0.062 - 0.100	NA
Co-60	NA	LLD (0 / 36)		LLD (0 / 36)		LLD (0 / 4)	NA
Cs-134	< 0.0005	LLD (0 / 36)		LLD (0 / 36)		LLD (0 / 4)	0
Cs-137	< 0.0005	LLD (0 / 36)		LLD (0 / 36)		LLD (0 / 4)	0
Ba-La-140	NA	LLD (0 / 36)		LLD (0 / 36)		LLD (0 / 4)	NA

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Drinking Water
Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
I-131 156	< 0.5	0.5 (13 / 104) 0.3 - 1.0	No. 4 Midland Water 1.3 miles NW	0.5 (7 / 52) 0.3 - 1.0	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.6 (19 / 52) 0.3 - 1.6	0
H-3 12	< 200	294 (1 / 8) 294 - 294	No. 4 Midland Water 1.3 miles NW	294 (1 / 4) 294 - 294	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	LLD (0 / 4)	0
Gamma 36							
Mn-54	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Fe-59	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Co-58	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Co-60	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Zn-65	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Zr-Nb-95	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Cs-134	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Cs-137	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Ba-La-140	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Surface Water
Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
I-131 52	< 0.5				No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.6 (19 / 52) 0.3 - 1.6	0
H-3 12	< 200	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Gamma 36							
Mn-54	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Fe-59	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Co-58	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Co-60	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Zn-65	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Zr-Nb-95	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Cs-134	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Cs-137	< 5	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0
Ba-La-140	< 10	LLD (0 / 24)		LLD (0 / 24)		LLD (0 / 12)	0

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Ground Water
Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
H-3 4	< 200	LLD (0 / 4)		LLD (0 / 4)			
Gamma 4					Note: There is no longer a well available for sampling in Shippingport		
Mn-54	< 5	LLD (0 / 4)		LLD (0 / 4)			
Fe-59	< 10	LLD (0 / 4)		LLD (0 / 4)			
Co-58	< 5	LLD (0 / 4)		LLD (0 / 4)			
Co-60	< 5	LLD (0 / 4)		LLD (0 / 4)			
Zn-65	< 10	LLD (0 / 4)		LLD (0 / 4)			
Zr-Nb-95	< 5	LLD (0 / 4)		LLD (0 / 4)			
Cs-134	< 5	LLD (0 / 4)		LLD (0 / 4)			
Cs-137	< 5	LLD (0 / 4)		LLD (0 / 4)			
Ba-La-140	< 10	LLD (0 / 4)		LLD (0 / 4)			

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Precipitation Water
Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
H-3 12	< 200	LLD (0 / 8)		LLD (0 / 8)	No. 48 Weirton, WV Water Tower Collier Way 16.3 miles SSW	LLD (0 / 4)	0
Gamma 12							
Mn-54	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Fe-59	< 10	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Co-58	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Co-60	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Zn-65	< 10	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Zr-Nb-95	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Cs-134	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Cs-137	< 5	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0
Ba-La-140	< 10	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 4)	0

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Milk
Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
I-131 57	< 0.5	LLD (0 / 37)		LLD (0 / 37)	No. 96 Burgettstown, PA Windsheimer Farm 10.4 miles SSW	LLD (0 / 20)	0
Sr-89 57	< 2.0	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Sr-90 57	< 0.7	1.0 (25 / 37) 0.5 - 2.6	No. 114 Hookstown, PA Covert Residence 1.9 miles SW	1.3 (17 / 17) 0.7 - 2.6	No. 96 Burgettstown, PA Windsheimer Farm 10.4 miles SSW	1.0 (19 / 20) 0.5 - 2.0	NA
Gamma 57							
K-40	< 150	1477 (37 / 37) 1251 - 1929	No. 114 Hookstown, PA Covert Residence 1.9 miles SW	1606 (17 / 17) 1324 - 1929	No. 96 Burgettstown, PA Windsheimer Farm 10.4 miles SSW	1344 (20 / 20) 1219 - 1485	NA
Mn-54	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Fe-59	< 10	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Co-58	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Co-60	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Zn-65	< 10	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Zr-Nb-95	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	NA
Cs-134	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	0
Cs-137	< 5	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	0
Ba-La-140	< 10	LLD (0 / 37)		LLD (0 / 37)		LLD (0 / 20)	0

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Fish
Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
Gamma 11					No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE		
Mn-54	< 0.05	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Fe-59	< 0.10	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Co-58	< 0.05	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Co-60	< 0.05	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Zn-65	< 0.10	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Zr-Nb-95	< 0.01	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	NA
Cs-134	< 0.05	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Cs-137	< 0.05	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	0
Ba-La-140	< 0.01	LLD (0 / 6)		LLD (0 / 6)		LLD (0 / 5)	NA

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Foodcrops
Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean Name Distance and Direction	Mean (fraction) [b] Range [b]	Control Location Name Distance and Direction	Mean (fraction) [b] Range [b]	Number of Nonroutine Reported Measurements [c]
I-131 9	< 0.06	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	0
Gamma 9							
K-40	NA	2.81 (8 / 8) 2.20 - 6.71	No. 12 Racoon, PA 2.7 miles E	3.95 (4 / 4) 2.50 - 6.71	No. 48B Weirton, WV 16.5 miles SSW	1.63 (1 / 1) 1.63 - 1.63	NA
Mn-54	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Fe-59	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Co-58	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Co-60	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Zn-65	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Zr-Nb-95	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
Cs-134	0.04	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	0
Cs-137	0.06	LLD (0 / 8)		LLD (0 / 8)	No. 48B Weirton, WV 16.5 miles SSW	LLD (0 / 1)	0
Ba-La-140	NA	LLD (0 / 8)		LLD (0 / 8)		LLD (0 / 1)	NA
C-14 4	NA	228.9 (2 / 2) 225.8 - 232.1	No. 10B Shippingport, PA 1.0 miles ENE	228.9 (2 / 2) 225.8 - 232.1	No. 48 Weirton, WV 16.5 miles SSW	227.6 (2 / 2) 227.3 - 227.8	NA

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Feedstuff
Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Gamma 12							
Be-7	< 0.2	0.39 (2 / 12) 0.32 - 0.46	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.2 miles SE	0.39 (2 / 12) 0.32 - 0.46	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.2 miles SE	0.39 (1 / 12) 0.32 - 0.46	NA
K-40	< 0.15	9.37 (12 / 12) 7.30 - 11.76	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.2 miles SE	9.37 (12 / 12) 7.30 - 11.76	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.2 miles SE	9.37 (12 / 12) 7.30 - 11.76	NA
Mn-54	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Fe-59	< 0.04	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Co-58	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Co-60	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Zn-65	< 0.04	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Zr-Nb-95	< 0.03	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
Ru-103	< 0.03	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA
I-131	< 0.06	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Cs-134	< 0.04	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Cs-137	< 0.06	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Ba-La-140	< 0.01	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	NA

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Sediment (page 1 of 2)
Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Gamma 6							
K-40	NA	8.55 (4 / 4) 6.20 - 11.11	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	9.48 (2 / 2) 7.85 - 11.11	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	12.24 (2 / 2) 10.90 - 13.58	NA
Mn-54	< 0.02	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Fe-59	< 0.03	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Co-58	< 0.02	0.08 (1 / 4) LLD - 0.08	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.08 (1 / 2) 0.08 - 0.08		LLD (0 / 2)	NA
Co-60	< 0.02	0.41 (2 / 4) LLD - 0.67	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.41 (2 / 2) 0.15 - 0.67		LLD (0 / 2)	NA
Zn-65	< 0.04	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Zr-95	< 0.03	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Nb-95	< 0.03	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Cs-134	< 0.06	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	0
Cs-137	< 0.08	0.08 (3 / 4) 0.03 - 0.13	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.13 (2 / 2) 0.12 - 0.13	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.07 (2 / 2) 0.06 - 0.07	0
Ba-La-140	< 0.03	LLD (0 / 4)		LLD (0 / 4)		LLD (0 / 2)	NA
Tl-208	NA	0.28 (4 / 4) 0.20 - 0.38	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.33 (2 / 2) 0.27 - 0.38	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.35 (2 / 2) 0.31 - 0.38	NA

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Sediment (page 2 of 2)
Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Bi-214	NA	0.65 (4 / 4) 0.51 - 0.76	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.73 (2 / 2) 0.69 - 0.76	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.85 (2 / 2) 0.80 - 0.90	NA
Pb-212	NA	0.78 (4 / 4) 0.49 - 1.05	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.88 (2 / 2) 0.71 - 1.05	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.94 (2 / 2) 0.83 - 1.05	NA
Pb-214	NA	0.73 (4 / 4) 0.60 - 0.91	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.79 (2 / 2) 0.67 - 0.91	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	0.96 (2 / 2) 0.88 - 1.03	NA
Ra-226	NA	1.66 (4 / 4) 1.02 - 2.08	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	1.86 (2 / 2) 1.63 - 2.08	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	2.31 (2 / 2) 1.99 - 2.63	NA
Ac-228	NA	0.82 (4 / 4) 0.57 - 1.07	No. 2A BVPS Outfall Vicinity 0.2 miles WSW	0.93 (2 / 2) 0.78 - 1.07	No. 49A Industry, PA Upstream of Montgomery Dam 5.0 miles NE	1.10 (2 / 2) 0.93 - 1.26	NA

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Soil (page 1 of 2)
Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Gamma							
Note: Soil Sampling is performed every five (5) years. Sampling was performed in 2015, and is next due in 2020.							
K-40	NA						
Mn-54	NA						
Fe-59	NA						
Co-58	NA						
Co-60	NA						
Zn-65	NA						
Zr-95	NA						
Nb-95	NA						
Cs-134	NA						
Cs-137	NA						

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: Soil (page 2 of 2)
Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Note: Soil Sampling is performed every five (5) years. Sampling was performed in 2015, and is next due in 2020.							
Ba-La-140	NA						
Tl-208	NA						
Bi-214	NA						
Pb-212	NA						
Pb-214	NA						
Ra-226	NA						
Ac-228	NA						

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 - ENVIRONMENTAL MONITORING PROGRAM

Table 2-2 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility: Beaver Valley Power Station Unit 1 and Unit 2
Docket No.: 50-334 / 50-412
Location of Facility: Beaver County, Pennsylvania
Reporting Period: Calendar Year - 2016

Medium: External Radiation
Unit of Measurement: (mR / Quarter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD [a]	All Indicator Locations Mean (fraction) [b] Range [b]	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements [c]
			Name Distance and Direction	Mean (fraction) [b] Range [b]	Name Distance and Direction	Mean (fraction) [b] Range [b]	
Gamma 525	4.6	18.9 (517 / 517) 10.3 - 28.8	No. 112 BVPS Site Perimeter Location 0.3 miles SSE	25.6 (8 / 8) 21.8 - 28.8	No. 48 Weirton, WV Water Tower Collier Way 16.4 miles SSW	19.8 (8 / 8) 18.8 - 21.5	0

[a] Nominal Lower Limit of Detection

[b] Mean and range based upon detectable measurements only.
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

[c] Nonroutine Reported Measurements (Reference: ODCM procedure 1/2-ODC-3.03, Attachment Q, Control 3.12.1)

NA = Not Applicable (Naturally Occurring Radionuclides Not required by ODCM)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-3
Pre-Operational Environmental Radiological Monitoring Program Summary

Name of Facility: Beaver Valley Power Station **Docket No.:** 50-334
Location of Facility: Beaver County, Pennsylvania **Reporting Period:** Calendar years 1974 - 1975

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean, Fraction (c), Range		
Sediments (dry) [picoCurie /gram]	Gross Alpha	(0)	--		--	
	Gross Beta	(33)	1	18	(33/33)	5 - 30
	Sr-90	(0)	--		--	
	U-234, 235, 238	(0)	--		--	
	Gamma	(33)	--	13	(33/33)	2 - 30
	K-40		1.5	13	(33/33)	2 - 30
	Cs-137		0.1	0.4	(21/33)	0.1 - 0.6
	Zr/Nb-95		0.05	0.8	(12/33)	0.2 - 3.2
	Ce-144		0.3	0.5	(3/33)	0.4 - 0.7
	Ru-106(a)		0.3	1.5	(3/33)	1.3 - 1.8
	Others		--		< LLD	
Foodcrops (dry) [picoCurie /gram]	Gamma	(8)	--		--	
	K-40		1	33	(8/8)	10 - 53
	Cs-137		0.1	0.2	(1/8)	--
	Zr/Nb-95		0.05	0.2	(1/8)	--
	Ru-106(a)		0.3	0.8	(1/8)	--
	Others		--		< LLD	
Feedstuff (dry) [picoCurie /gram]	Gross Beta	(80)	0.05	19	(80/80)	8 - 50
	Sr-89	(81)	0.025	0.2	(33/81)	0.04 - 0.93
	Sr-90	(81)	0.005	0.4	(78/81)	0.02 - 0.81
	Gamma	(81)	--		--	
	K-40		1	19	(75/81)	5 - 46
	Cs-137		0.1	0.5	(6/81)	0.2 - 1.6
	Ce-144		0.3	1.5	(5/81)	0.9 - 2.6
	Zr/Nb-95		0.05	0.8	(13/81)	0.2 - 1.8
	Ru-106(a)		0.3	1.4	(12/81)	0.6 - 2.3
	Others		--		< LLD	
Soil (dry) - Template Samples - [picoCurie /gram]	Gross Alpha	(0)	--		--	
	Gross Beta	(64)	1	22	(64/64)	14 - 32
	Sr-89	(64)	0.25	0.4	(1/64)	--
	Sr-90	(64)	0.05	0.3	(48/64)	0.1 - 1.3
	U-234, 235, 238	(0)	--		--	
	Gamma	(64)	--		--	
	K-40		1.5	13	(63/64)	5 - 24
	Cs-137		0.1	1.5	(56/64)	0.1 - 6.8
	Ce-144		0.3	1.1	(7/64)	0.2 - 3
	Zr/Nb-95		0.05	0.3	(13/64)	0.1 - 2
	Ru-106(a)		0.3	1.1	(3/64)	0.5 - 2
	Others		--		< LLD	

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-3 (Continued)

Pre-Operational Environmental Radiological Monitoring Program Summary

Name of Facility: Beaver Valley Power Station **Docket No.:** 50-334
Location of Facility: Beaver County, Pennsylvania **Reporting Period:** Calendar years 1974 - 1975

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean, Fraction (c), Range		
Soil (dry)	Gross Alpha	(0)	--		--	
	Gross Beta	(8)	1	21	(8/8)	16 - 28
- Core Samples -	Sr-89	(8)	0.25		< LLD	
	Sr-90	(8)	0.05	0.2	(5/8)	0.08 - 0.5
[picoCurie /gram]	Gamma	(8)	--		--	
	K-40		1.5	13	(8/8)	7 - 20
	Cs-137		0.1	1.2	(7/8)	0.2 - 2.4
	Co-60		0.1	0.2	(1/8)	--
	Others		--		< LLD	
Surface Water	Gross Alpha	(40)	0.3	0.75	(5/40)	0.6 - 1.1
[picoCurie / liter]	Gross Beta	(120)	0.6	4.4	(120/120)	2.5 - 11.4
	Gamma	(1)	10 - 60		< LLD	
	Tritium	(121)	100	300	(120/121)	180 - 800
	Sr-89	(0)	--		--	
	Sr-90	(0)	--		--	
	C-14	(0)	--		--	
Drinking Water	I-131	(0)	--		--	
[picoCurie / liter]	Gross Alpha	(50)	0.3	0.6	(4/50)	0.4 - 0.8
	Gross Beta	(208)	0.6	3.8	(208/208)	2.3 - 6.4
	Gamma	(0)	--		--	
	Tritium	(211)	100	310	(211/211)	130 - 1000
	C-14	(0)	--		--	
	Sr-89	(0)	--		--	
	Sr-90	(0)	--		--	
Ground Water	Gross Alpha	(19)	0.3		< LLD	
[picoCurie / liter]	Gross Beta	(76)	0.6	2.9	(73/75)(b)	1.3 - 8.0
	Tritium	(81)	100	440	(77/81)	80 - 800
	Gamma	(1)	10 - 60		< LLD	
Air Particulates	Gross Alpha	(188)	0.001	0.003	(35/188)	0.002 - 0.004
and Gaseous	Gross Beta	(927)	0.006	0.07	(927/927)	0.02 - 0.32
[picoCurie /cubic meter]	Sr-89	(0)	--		--	
	Sr-90	(0)	--		--	
	I-131	(816)	0.04	0.08	(2/816)	0.07 - 0.08
	Gamma	(197)	--		--	
	Zr/Nb-95		0.005	0.04	(122/197)	0.01 - 0.16
	Ru-106		0.010	0.04	(50/197)	0.02 - 0.09
	Ce-141		0.010	0.02	(3/197)	0.01 - 0.04
	Ce-144		0.010	0.02	(44/197)	0.01 - 0.04
	Others				< LLD	

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-3 (Continued)

Pre-Operational Environmental Radiological Monitoring Program Summary

Name of Facility: Beaver Valley Power Station **Docket No.:** 50-334
Location of Facility: Beaver County, Pennsylvania **Reporting Period:** Calendar years 1974 - 1975

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean, Fraction (c), Range		
Milk	I-131	(91)	0.25	0.6	(4/91)	0.3 - 0.8
[picoCurie / liter]	Sr-89	(134)	5	7	(4/134)	6 - 11
	Sr-90	(134)	1	5.3	(132/134)	1.5 - 12.8
	Gamma	(134)	--		--	
	Cs-137		10	13	(19/134)	11 - 16
	Others				< LLD	
External Radiation	γ - Monthly	(599)	0.5 mR*	0.20	(599/599)	0.08 - 0.51
[milliRoentgen / day]	γ - Quarterly	(195)	0.5 mR*	0.20	(195/195)	0.11 - 0.38
	γ - Annual	(48)	0.5 mR*	0.19	(48/48)	0.11 - 0.30
Fish (wet)	Gross Beta	(17)	0.01	1.9	(15/17)	1.0 - 3.2
[picoCurie / gram]	Sr-90	(17)	0.005	0.14	(17/17)	0.02 - 0.50
	Gamma	(17)	0.5			
	K-40		--	2.4	(17/17)	1.0 - 3.7
	Others		--		< LLD	

* LLD in units of mR - Lower end of useful integrated exposure detectability range for a passive radiation detector (TLD).

(a) May include Ru-106, Ru-103, Be-7.

(b) One outlier not included in mean. (Water taken from dried-up spring with high sediment and potassium content. Not considered typical groundwater sample).

(c) Fraction of detectable measurements at specified location, indicated in parenthese.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

B. Air Monitoring

1. Characterization of Air and Meteorology

The air in the vicinity of the site contains pollutants typical for an industrial area. Air flow is generally from the southwest in summer and from the west in the winter.

2. Air Sampling Program and Analytical Techniques

a. Program

The air is sampled for gaseous radioiodine and radioactive particulates at each of ten (10) offsite air sampling stations. The locations of these stations are listed in Table 2-1 and shown on a map in Figure 2-1.

Samples are collected at each of these stations by continuously drawing two cubic feet per minute of atmosphere air through a glass fiber filter paper and a charcoal cartridge. The glass fiber filter paper is used for collection of airborne particulates, while the charcoal cartridge is used for collection of radioiodine. Samples are collected on a weekly basis.

The charcoal cartridge is used in the weekly analysis of airborne iodine-131. The glass fiber filter papers are analyzed each week for gross beta, then composited by station each quarter for gamma spectrometry analysis. In order to reduce interference from short-lived naturally occurring radioactivity (e.g. radon and thorium), the glass fiber filter papers are allowed to decay prior to performing beta analysis in a low background counting system.

b. Procedures

Gross Beta Analysis of Filter Paper: Analysis is performed by placing the glass fiber filter paper from the weekly air sample in a 2 inch planchet followed by analysis in a low background, gas flow proportional counter.

Gamma Emitter Analysis of Filter Paper: Analysis is performed by stacking all of the glass fiber filter papers collected from each monitoring station during the quarter and scanning the composite on a high resolution germanium gamma spectrometer.

Iodine-131 Analysis of Charcoal Cartridge: Analysis is performed by a gamma scan of each charcoal cartridge.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

3. Results and Conclusions

A summary of data is presented in Table 2-2.

a. Airborne Radioactive Particulates

Gross Beta: A total of five hundred twenty (520) weekly samples from ten (10) locations were analyzed for gross beta. The results were comparable to that of previous years. Figure 2-2 indicates the weekly average concentration of gross beta in air particulates.

Gamma Spectrometry: A total of forty (40) quarterly samples were composited from ten (10) locations and analyzed for gamma spectrometry. Naturally occurring beryllium-7 was identified in thirty six of thirty six (36 of 36) indicator samples, and four of four (4 of 4) control samples. No other gammas were identified. A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-2.

Deviations from Required Sampling and Analysis Schedule: There was one deviation from the required airborne particulate sampling and analysis schedule during the report period.

During the sampling period of 03/28/2016 - 04/03/2016, REMP air particulate and iodine control sampling station at East Liverpool Water Department in East Liverpool, OH (Site No. 47) was found to be out of service. This location is not an ODCM required location. The REMP technician observed that the pump was running but was not drawing vacuum most likely indicating that the carbon vanes had shattered and prevented the pump from pulling air. The shattered vanes were replaced, the air monitor equipment was calibrated and the station was returned to service. The sample station was in service for 4 days, 12 hours, 8 minutes, indicating that the station was out of service for approximately 61 hours, as reported by the REMP technician. This issue was documented in SAP Notification 601018638, Task 8.

Summary: Based on the analytical results, the operation of BVPS did not contribute any measurable increase in air particulate radioactivity during the report period.

b. Airborne Radioiodine

Iodine-131: A total of five hundred twenty (520) weekly charcoal filter samples were analyzed for iodine-131. Iodine-131 was not identified in any of the four hundred sixty eight (468) indicator samples, nor was it identified in any of the fifty two (52) control samples.

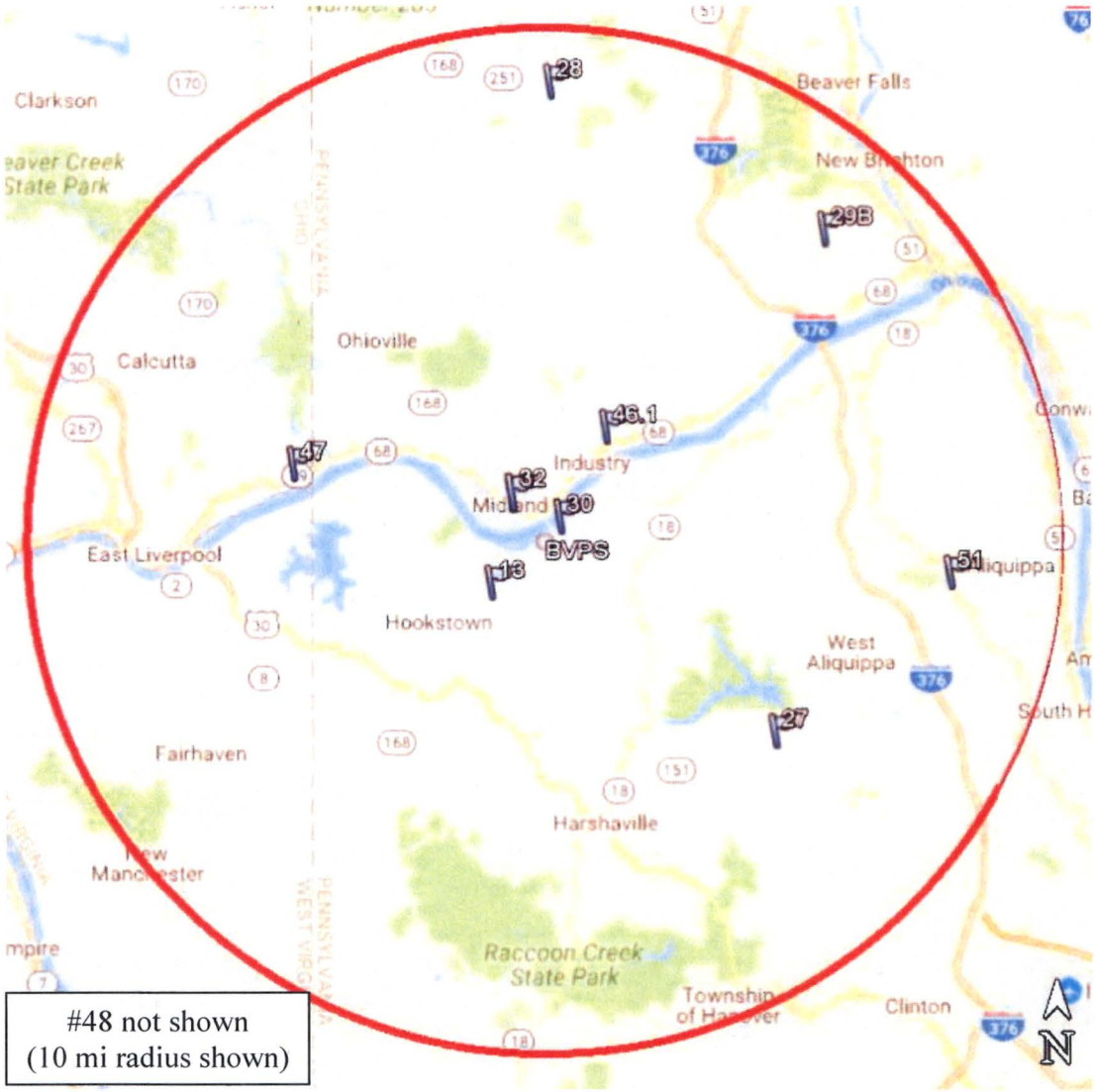
Deviations from Required Sampling and Analysis Schedule: The deviations are the same as described above for airborne particulates.

Summary: Based on analytical results, the operation of BVPS did not contribute any measurable increase in airborne radioiodine during the report period.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-1

Environmental Monitoring Locations - Air Sampling Stations

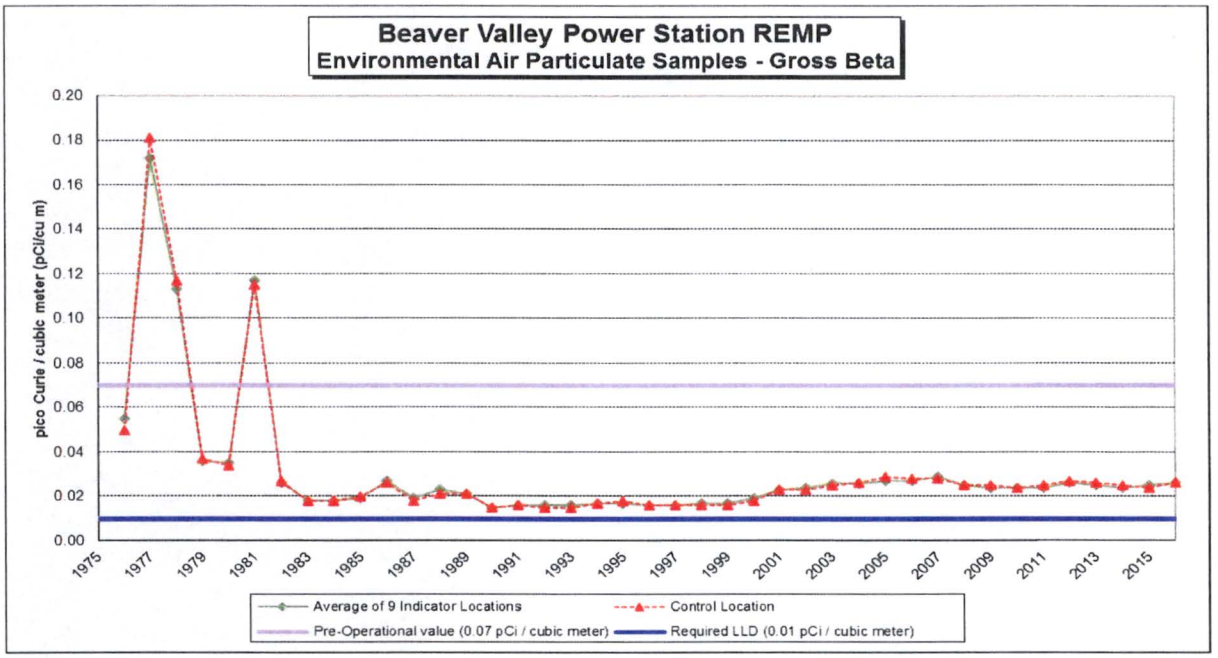


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Air Particulate & Radioiodine	13	11-SW	1.49	Hookstown, PA (Old Meyer Farm)
	27	7-SE	6.14	Aliquippa, Pa (Brunton Farm)
	28	1-N	8.60	Beaver Falls, PA (Sherman Farm)
	29B	3-NE	7.97	Beaver, PA (Friendship Ridge)
	30	4-ENE	0.43	Shippingport, PA (Cook's Ferry Substation)
	32	15-NW	0.75	Midland, PA (North Substation - Rt. 68)
	46.1	2-NNE/ 3-NE	2.28	Industry, PA (McKeels Service - Rt. 68)
	47	14-WNW	4.88	East Liverpool, OH (Water Department)
	48	10-SSW	16.40	Weirton, WV (Water Tower, Collier Way)
	51	5-E	8.00	Aliquippa, PA (Sheffield Substation)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-2

Graph of Annual Average Concentration: Gross Beta in Air Particulates



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C. Monitoring of Shoreline Stream Sediment and Soil

1. Characterization of Shoreline Stream Sediment and Soil

The stream sediment (river bottoms) consists largely of sand and silt. Soil samples may vary from sand and silt to a heavy clay with variable amounts of organic material.

2. Sampling Program and Analytical Techniques

a. Program

Shoreline stream sediment was collected semi-annually above the Montgomery Dam, in the vicinity of the BVPS outfall structure, and above the New Cumberland Dam. A Ponar or Eckman dredge is used to collect the sample. The sampling locations are also listed in Table 2-1 and are shown in Figure 2-3.

Although not required by the ODCM, soil samples were collected at each of the nine (9) locations in 2015. In 2017, the sample frequency was revised from once per three years to once every five years. Soil was last sampled in 2015 and will be performed in 2020. At each location, twelve (12) core samples (3" diameter by 2" deep) are gathered at prescribed points on a 10 foot radius circle. Each location is permanently marked with reference pins. Each set of samples is systematically selected by moving along the radius in such a manner as to assure representative undisturbed samples. Sampling locations are listed in Table 2-1 and are shown in Figure 2-3.

Shoreline stream sediment and soil are analyzed for gamma-emitting radionuclides.

b. Analytical Procedures

Gamma Emitter Analysis of Stream Sediment: Analysis is performed in a 300 mL plastic bottle and analyzed by gamma spectrometry.

Gamma Emitter Analysis of Soil: Although not required by the ODCM, analysis is performed in a 300 mL plastic bottle and analyzed by gamma spectrometry.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

3. Results and Conclusions

A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-4 and Figure 2-5.

a. Shoreline Stream Sediment

Gamma Spectrometry: A total of six (6) sediment samples were analyzed by gamma spectrometry during the report period. Naturally occurring potassium-40, thallium-208, lead-212, lead-214, bismuth-214, radium-226 and actinum-228, were detected in four of four (4 of 4) indicator samples and two of two (2 of 2) control samples.

Cesium-137: Radionuclide cesium-137 was identified in three of four (3 of 4) indicator samples and two of two (2 of 2) control samples. The results were similar to that of previous years (current annual range = 0.03 to 0.13 picoCurie / gram) and less than the pre-operational level of 0.4 picoCurie / gram. Also, because cesium-137 was identified at the control location (upstream), then it was not due to plant effluent releases and is most likely residual contamination due from previous nuclear weapons tests.

Cobalt-58: Radionuclide cobalt-58 was identified in one of four (1 of 4) indicator samples and zero of two (0 of 2) control samples. The sample, which indicated cobalt-58, was obtained at the shore line of the BVPS Main Outfall Facility. The result was similar to the previous years (current annual range = LLD to 0.080 picoCurie / gram) and the data is slightly lower than the BVPS Main Outfall Facility pre-operational level of 0.098 picoCurie / gram.

Cobalt-60: Radionuclide cobalt-60 was identified in two of four (2 of 4) indicator samples and zero of two (0 of 2) control samples. The sample, which indicated cobalt-60, was obtained at the shore line of the BVPS Main Outfall Facility. The result was similar to previous years (current annual range = LLD to 0.67 picoCurie / gram), and the data is currently slightly higher than the BVPS Main Outfall Facility pre-operational level of 0.4 picoCurie / gram.

Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required sediment sampling and analysis schedule during the report period.

Summary: The identification of cobalt-58 and cobalt-60 in the shoreline stream sediment near the main outfall facility is not unusual because the plant discharges these radionuclides in liquid effluent releases. The analyses are consistent with discharge data of authorized liquid effluent releases, and all liquid effluent releases during the report period did not exceed the release limits set forth in the ODCM.

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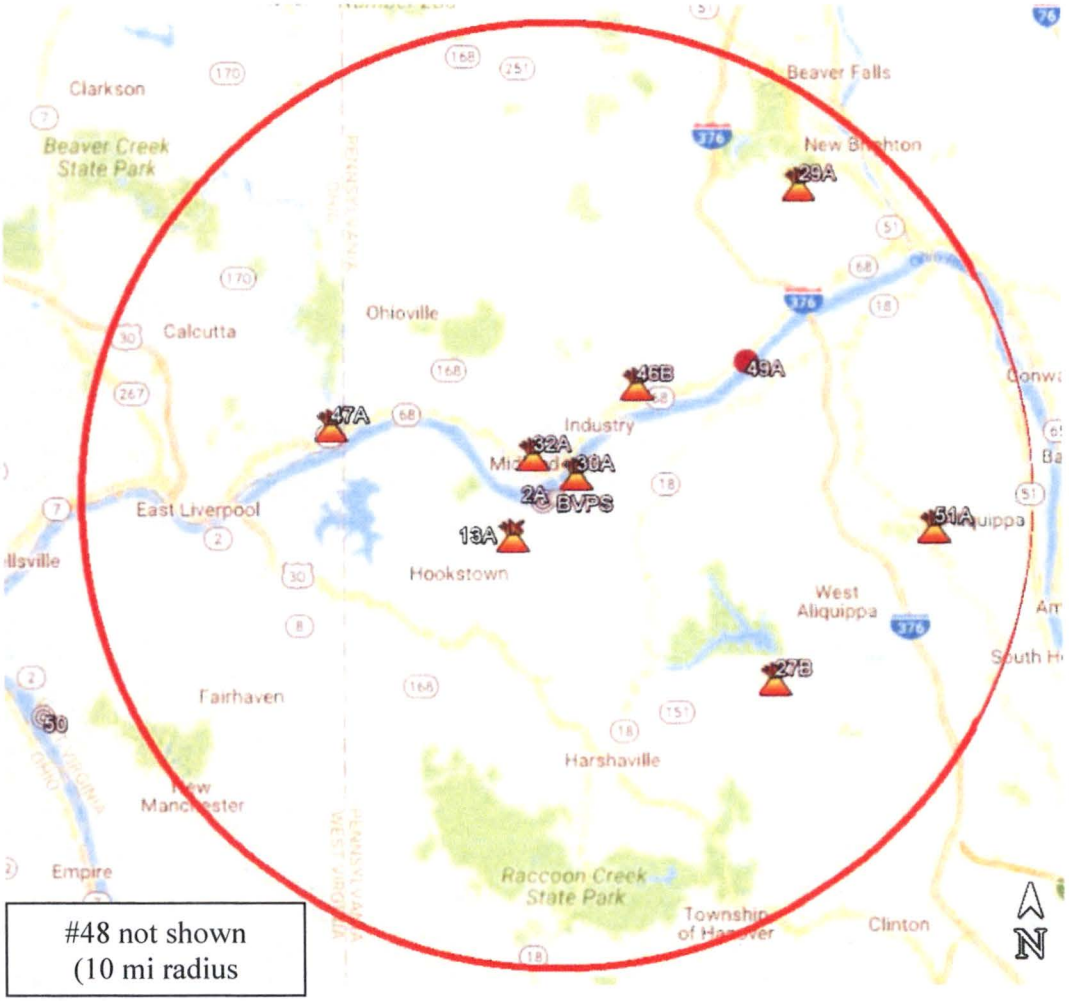
b. Soil

Soil sampling is not an ODCM requirement. In 2017, the sample frequency was revised from once per three years to once every five years. Soil was last sampled in 2015 and will be performed in 2020.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-3

Environmental Monitoring Locations - Shoreline Sediments and Soil



Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Soil	13A	11-SW	1.49	Hookstown, PA (Old Meyer Farm)
	27B	7-SE	6.19	Aliquippa, PA (Brunton Farm)
	29A	3-NE	8.09	Beaver, PA (Nicol Farm)
	30A	4-ENE	0.43	Shippingport, PA (Cooks Ferry Substation)
	32A	15-NW	0.74	Midland, PA (North Substation)
	46B	3-NE	2.66	Industry, PA (Willows Inn – Rt. 68)
	47A	14-WNW	4.89	East Liverpool, OH (Water Department)
	48	10-SSW	16.40	Weirton, WV (Collier Way Water Tower)
	51A	5-E	7.99	Aliquippa, PA (Sheffield Substation)
Sediment	2A	12-WSW	0.31	Shippingport, PA (BVPS Outfall Vicinity)
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)
	50	12-WSW	11.77	New Cumberland, WV (Upstream of Dam)

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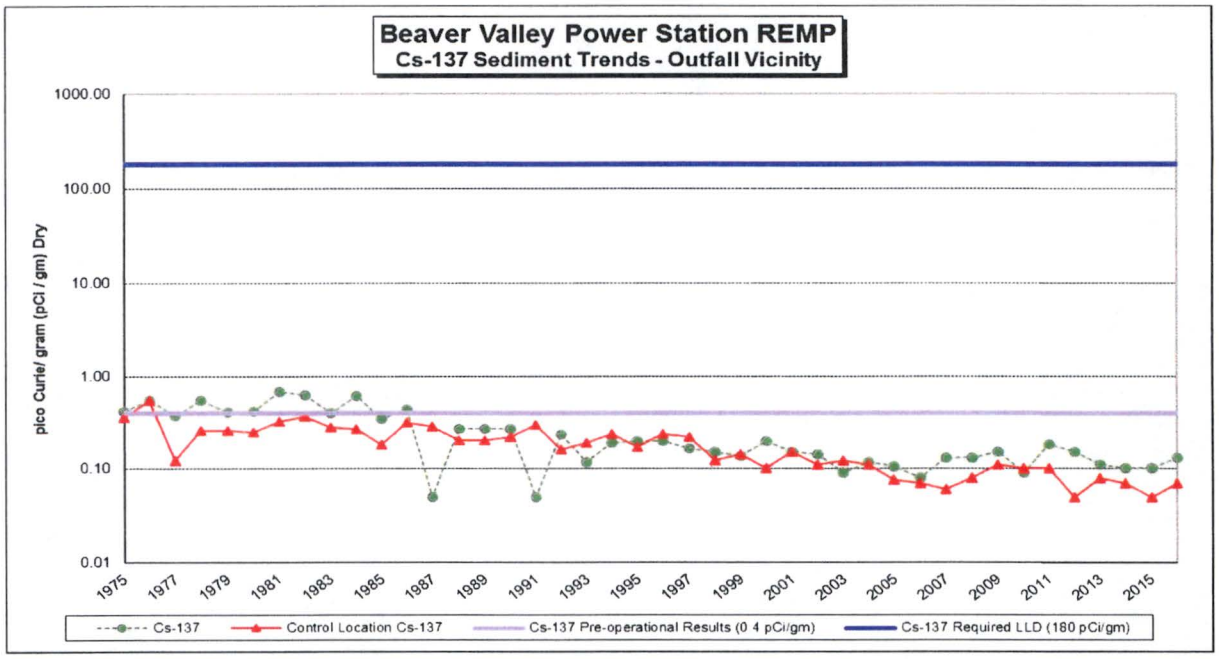
Figure 2-4

Graph of Annual Average Concentration: Cesium-137, Cobalt-58 & Cobalt-60 in Sediment



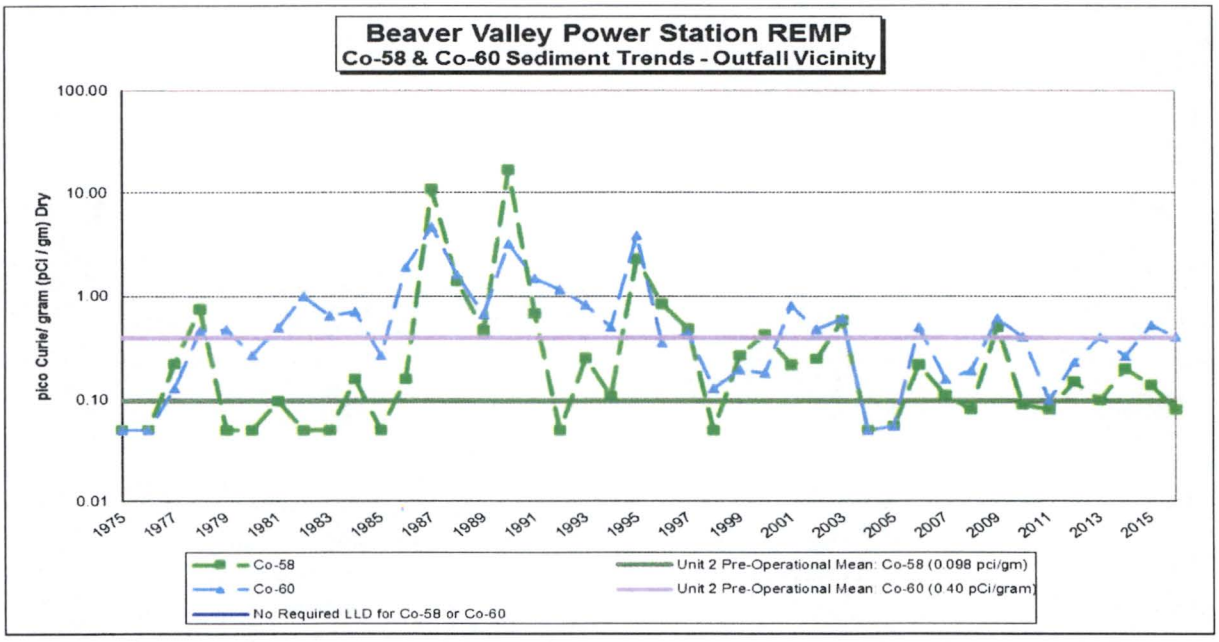


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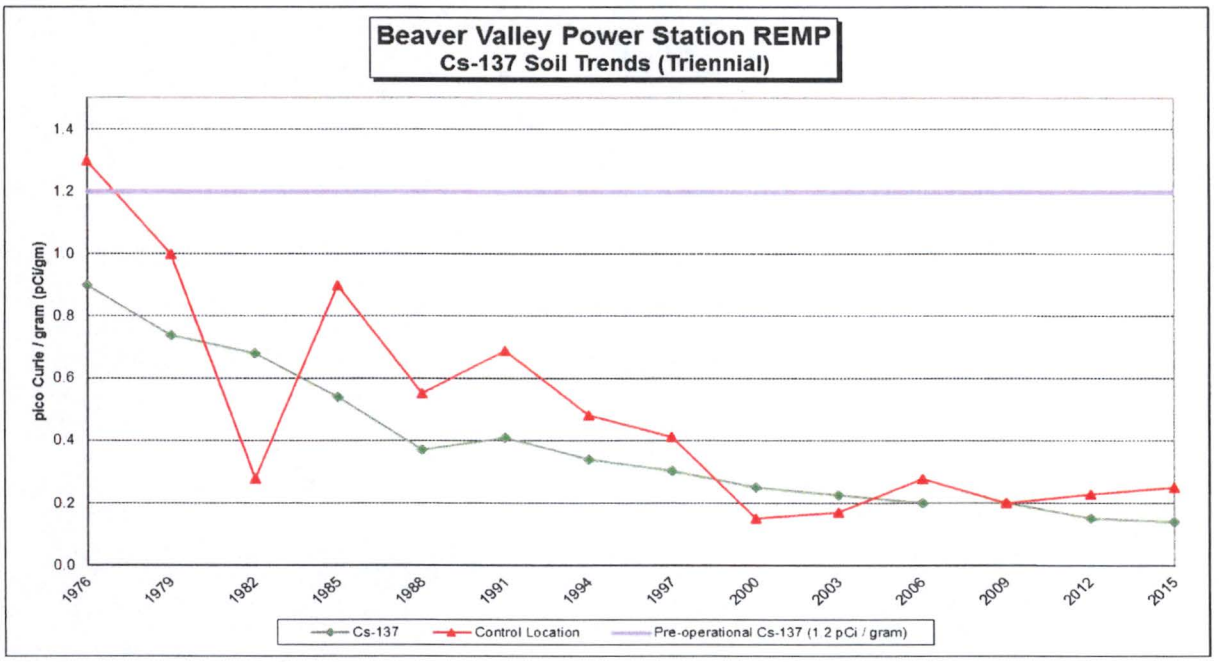
Figure 2-5

Graph of Annual Average Concentration: Cesium-137 in Soil



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

D. Monitoring of Feedstuff and Foodcrops

1. Characterization of Farm Products

According to the 2012 Census of Agriculture [1], there were six hundred and forty six (646) farms in Beaver County. Total market value of production was $20,913,000.00 and of the total market value, $10,879,000.00 from crops and $10,035,000.00 from livestock. Some of the principal sources of revenue (>$25,000.00) are as follows:

Milk and Other Dairy Products from Cows	$5,271,000.00
Grains, Oil Seeds, Dry Beans and Dry Peas	$4,419,000.00
Cattle and Calves	$3,331,000.00
Other Crops and Hay	$2,673,000.00
Nursery, Greenhouse, Floriculture and Sod	$1,989,000.00
Vegetables, Melons, Potatoes and Sweet Potatoes	$826,000.00
Other Animals and Other Animal Products	$89,000.00
Sheep, Goats and their Products	$59,000.00
Poultry and Eggs	$38,000.00
Fruits, Tree Nuts and Berries	Undisclosed Amount
Cut Christmas Trees, and Short Rotation Woody Crops	Undisclosed Amount
Horses, Ponies, Mules, Burros, and Donkeys	Undisclosed Amount
Hogs & Pigs	Undisclosed Amount
Tobacco	Undisclosed Amount

(1) http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Pennsylvania/cp42007.pdf

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

2. Sampling Program and Analytical Techniques

a. Program

Feedstuff: Although not required by the ODCM, representative samples of feedstuff (cattle feed) are collected monthly from the nearest dairy farm (Brunton Dairy) and analyzed by gamma spectrometry. See Figure 2-6.

Foodcrops (leafy vegetables): Foodcrops are collected at garden locations during the growing season. Leafy vegetables (e.g. cabbage) are obtained from Shippingport, Raccoon, Georgetown, and Industry, Pennsylvania. Samples are obtained from two (2) additional locations based upon the highest predicted annual average ground D/Q when milk locations are unavailable. Samples are also obtained from the control location in Weirton, West Virginia. All samples are analyzed for gamma emitters by gamma spectrometry. Samples are also analyzed by radiochemical analysis for iodine-131.

b. Procedures

Gamma Emitter Analysis of Foodcrops: Analysis is performed by scanning a dried, homogenized sample with a gamma spectrometry system. A high resolution germanium detector is utilized with this system. Samples of feedstuff and foodcrops are loaded into tare weight 150 or 300 mL plastic bottles or 1-liter Marinelli containers, weighed and the net weight of the sample is determined prior to scanning for gamma emitters.

Gamma Emitter Analysis of Feedstuff: Although not required by the ODCM, analysis is performed by scanning a dried, homogenized sample with a gamma spectrometry system. A high resolution germanium detector is utilized with this system. Samples of feedstuff and foodcrops are loaded into tare weight 150 or 300 mL plastic bottles or 1-liter Marinelli containers, weighed and the net weight of the sample is determined prior to scanning for gamma emitters.

Iodine-131 Analysis of Foodcrops: Analysis is performed by radiochemistry. A stable iodide carrier is added to a chopped sample, which is then leached with a sodium hydroxide solution, evaporated to dryness and fused in a muffle furnace. The melt is dissolved in water, filtered and then treated with sodium hypochlorite. The iodate is then reduced to iodine with hydroxylamine hydrochloride and is extracted with toluene. It is then back-extracted as iodide into sodium bisulfite solution and precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchet for low level beta counting.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Carbon-14 Analysis of Foodcrops: Analysis is performed by accelerator mass spectrometry radiocarbon dating. Samples are converted into solid graphite via combustion and various chemical reactions. Samples (and reference materials) are pressed into metal discs and loaded onto a target wheel. Ions from a cesium gun are fired at the discs to create negatively charged carbon atoms. Ions are then passed along a stripper causing them to lose their electrons and gain a triple positive charge. At this point, only carbon atoms remain because other molecules in the sample cannot exist in this triple positive state. For mass analysis, a magnetic field is applied to the moving particles which causes them to deflect along the path they are traveling in relation to their masses, allowing the number of particles to be measured.

3. Results and Conclusions

A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-7.

a. Feedstuff

Gamma Spectrometry: Although not required by the ODCM, a total of twelve (12) samples were analyzed by gamma spectrometry. Naturally occurring potassium-40 was identified in twelve of twelve (12 of 12) samples. Naturally occurring beryllium-7 was found in two of twelve (2 of 12) samples.

Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required feedstuff sampling and analysis schedule during the report period.

Summary: The data from the feedstuff analyses was consistent with previous data. Based on the analytical results, the operation of BVPS did not contribute any measurable increase in radioactivity in the feedstuff during the report period.

b. Foodcrops

Iodine-131: A total of nine (9) samples were analyzed for iodine-131. No detectable concentrations were present in the eight (8) indicator samples or the one (1) control sample.

Gamma Spectrometry: A total of nine (9) samples were analyzed by gamma spectrometry. Naturally occurring potassium-40 was identified in eight of eight (8 of 8) indicator samples and one of one (1 of 1) control sample.

Carbon-14: Although not required by the ODCM, a total of four (4) samples were analyzed. Radionuclide carbon-14 was identified in two of two (2 of 2) indicator samples and two of two (2 of 2) control samples.

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Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required foodstuff sampling and analysis schedule during the report period.

Summary: The data from the foodcrops analyses was consistent with previous data. Based on the analytical results, the operation of BVPS did not contribute any measurable increase in radioactivity in the foodcrops during the report period.

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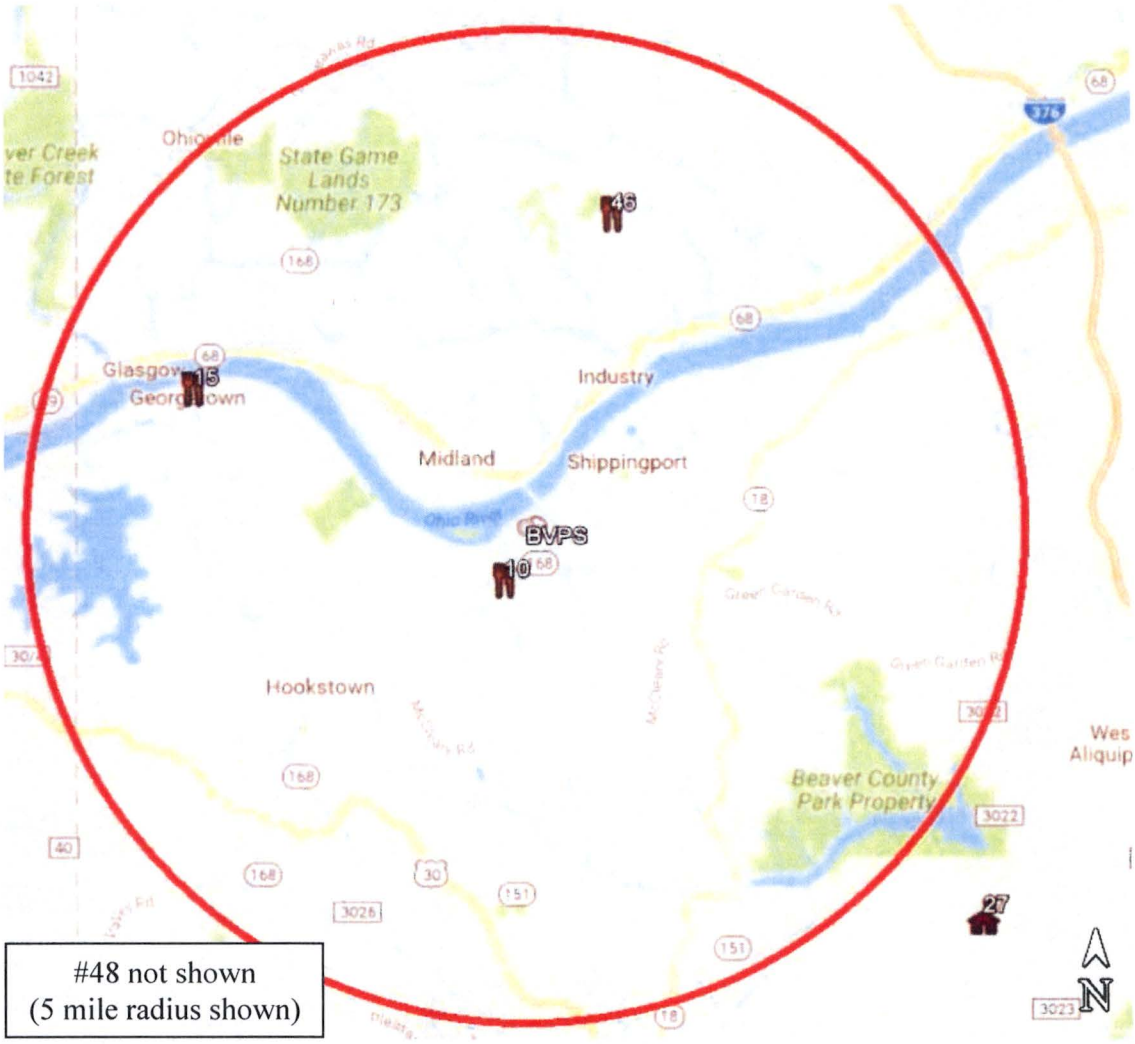
Figure 2-6

Environmental Monitoring Locations – Feedstuff and Foodcrops



Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Feed	27	7-SE	6.16	Aliquippa, PA (Brunton Farm)
Food	10*	*	*	Shippingport, PA
	15*	*	*	Georgetown, PA
	46*	*	*	Industry, PA
	48*	*	*	Weirton, WV
	*	*	*	2 locations based on highest predicted D/Q
Individual garden locations may change based upon availability. The requirements are met as long as one garden is sampled from each of these communities.				

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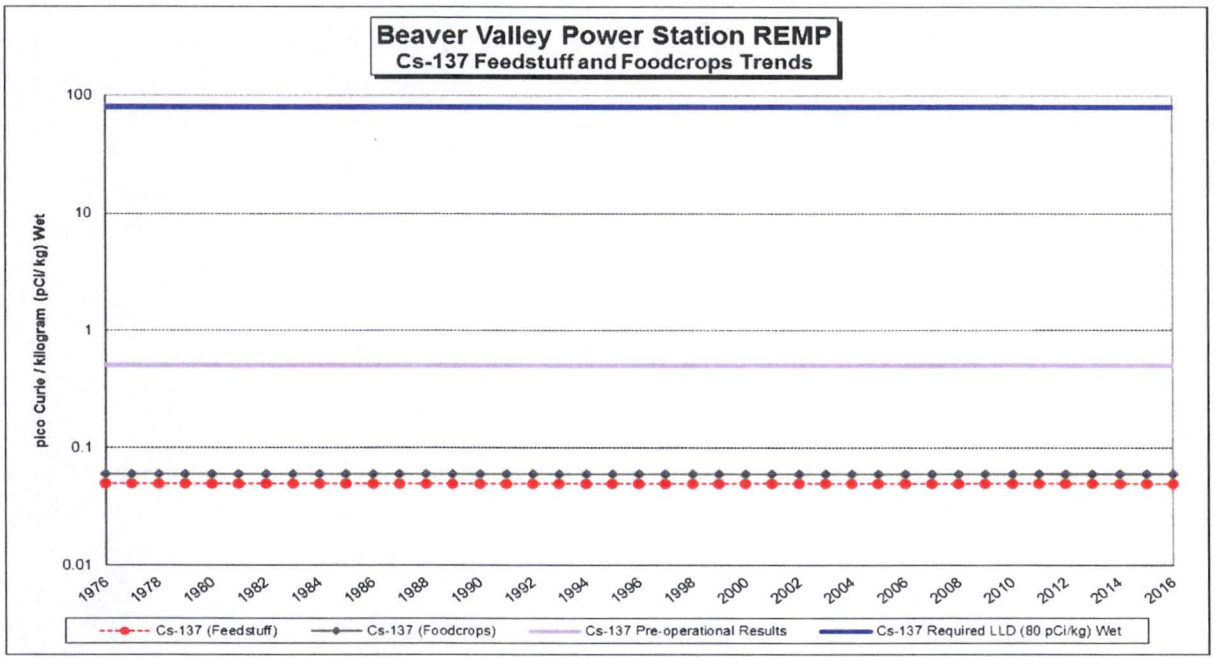
Figure 2-7

Graph of Annual Average Concentration: Cesium-137 in Feedstuff and Foodcrops



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E. Monitoring of Local Cow and Goat Milk

1. Description - Milch Animal Locations

Samples of fresh milk are obtained from milch animals at locations and frequencies noted in Table 2-1. The milk is analyzed for its radioiodine content, gamma emitters, strontium-89 and strontium-90.

Detailed field surveys are performed during the grazing season to locate and enumerate milch animals within a five (5) mile radius of the site. Survey data for the most recent survey conducted is shown in Section 3, Land Use Census.

2. Sampling Program and Analytical Techniques

a. Program

Cow milk was collected from the one (1) reference dairy farm within a 10-mile radius of the BVPS, Brunton Dairy Farm (6.1 miles southeast) and one (1) control location dairy farm outside of the 10-mile radius, Windsheimer Dairy Farm (10.4 miles south-southwest).

Dairy cow sampling was performed at Brunton Dairy in 2016 due to the fact that Halstead Dairy and Searight Dairy closed in 2014.

Additionally, one goat location was available for sampling and samples were obtained at the Covert Residence (1.9 miles southwest).

The dairies are subject to change based upon availability of milk or when more recent data (milch animal census, and/or change in meteorological conditions) indicate other locations are more appropriate.

The milk samples are collected and analyzed biweekly when the animals are on pasture and monthly at other times. The monthly and/or bi-weekly sample is analyzed for principle gamma emitters (including cesium-137 by high resolution germanium gamma spectrometry), and iodine-131 high sensitivity analysis. Although not required by the ODCM, the monthly and/or bi-weekly sample is also analyzed for strontium-89, strontium-90.

The location of each is shown in Figure 2-8 and described below.

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Figure 2-8

Table of Local Cow and Goat Locations

Site	Dairy	Approximate Number of Animals being Milked	Distance and Direction from Midpoint between Unit 1 and Unit 2 Reactor	Collection Period
25*	Searight Dairy 948 McCleary Road Hookstown, PA	Dairy Closed end of 2013	2.1 miles SSW	January thru December
27	Brunton Dairy 3681 Ridge Road Aliquippa, PA	100 Cows	6.1 miles SE	January thru December
96	Windsheimer Dairy 20 Windsheimer Lane Burgettstown, PA	76 Cows	10.4 miles SSW	January thru December
113*	Halstead Dairy 104 Tellish Drive Hookstown, PA	Dairy Closed beginning of 2014	5.1 miles SSW	January thru December
114	Covert Residence 930 Pine Street (Route 168) Hookstown, PA	12 Goats	1.9 miles SW	January thru December
* Highest potential pathway dairies based on evaluation of deposition parameters				

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b. Procedure

Iodine-131 Analysis of Milk: The milk samples are chemically prepared, and then analyzed with a low-level beta counting system.

Gamma Emitter Analysis of Milk: This is determined by gamma spectrometry analysis of a 1 liter Marinelli container of milk.

Strontium-90 Analysis of Milk: Although not required by the ODCM, the milk samples are prepared by adding a stable strontium carrier and evaporating to dryness, then ashing in a muffle furnace, followed by precipitating phosphates. Strontium is purified in all samples by the Argonne method using 3 grams of extraction material in a chromatographic column. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for the in-growth of yttrium-90 (Y-90). Yttrium is then precipitated as hydroxide dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low-level beta counter to infer strontium-90 activity.

Strontium-89 Analysis of Milk: Although not required by the ODCM, the strontium-89 activity is determined by precipitating strontium carbonate ($SrCO_3$) from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting. Chemical yields of strontium and yttrium are determined by gravimetric means.

3. Results and Conclusions

A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of iodine-131 and strontium-90 analyses (including the pre-operational period through the report period) is shown on Figure 2-9.

a. Strontium-89: Although not required by the ODCM, a total of fifty seven (57) milk samples were analyzed for strontium-89 during the report period. Strontium-89 was not detected in any of the thirty seven (37) indicator samples, nor was it detected in any of the twenty (20) control samples.

b. Strontium-90: Although not required by the ODCM, a total of fifty seven (57) milk samples were analyzed for strontium-90 during the report period. Strontium-90 was detected in twenty five of thirty seven (25 of 37) indicator samples and nineteen of twenty (19 of 20) control samples. The levels detected were attributed to previous nuclear weapons tests and are within the expected range.

c. Gamma Spectrometry: A total of fifty seven (57) milk samples were analyzed by gamma spectrometry during the report period. Naturally occurring potassium-40 was present in

thirty seven of thirty seven (37 of 37) indicator samples and twenty of twenty (20 of 20) control samples. No other gamma-emitting radionuclides were identified during analysis.

d. Iodine-131: A total of fifty seven (57) milk samples were analyzed for iodine-131 during the report period. Iodine-131 was not detected in any of the thirty seven (37) indicator samples, nor was it detected in any of the twenty (20) control samples.

e. Deviations from Required Sampling and Analysis: One deviation from the required milk sampling and analysis schedule occurred for the reporting period.

Sufficient milk samples were not available from locations within the 5 mile radius in 2016. The unavailability of milk caused the REMP to not meet the ODCM sample requirements in 1/2-ODC-2.03 and in 1/2-ODC-3.03, Attachment Q Table 3.12-1 stating that a minimum of four (4) milk locations shall be sampled. This initiated the ODCM requirement for sampling two (2) additional garden locations based upon the highest predicted annual average D/Q when milk locations are not available.

f. Summary: Based on all the analytical results and the comparison to pre-operational levels, the operation of BVPS did not contribute any measurable increase in radioactivity in the milk during the report period compared to previous years.

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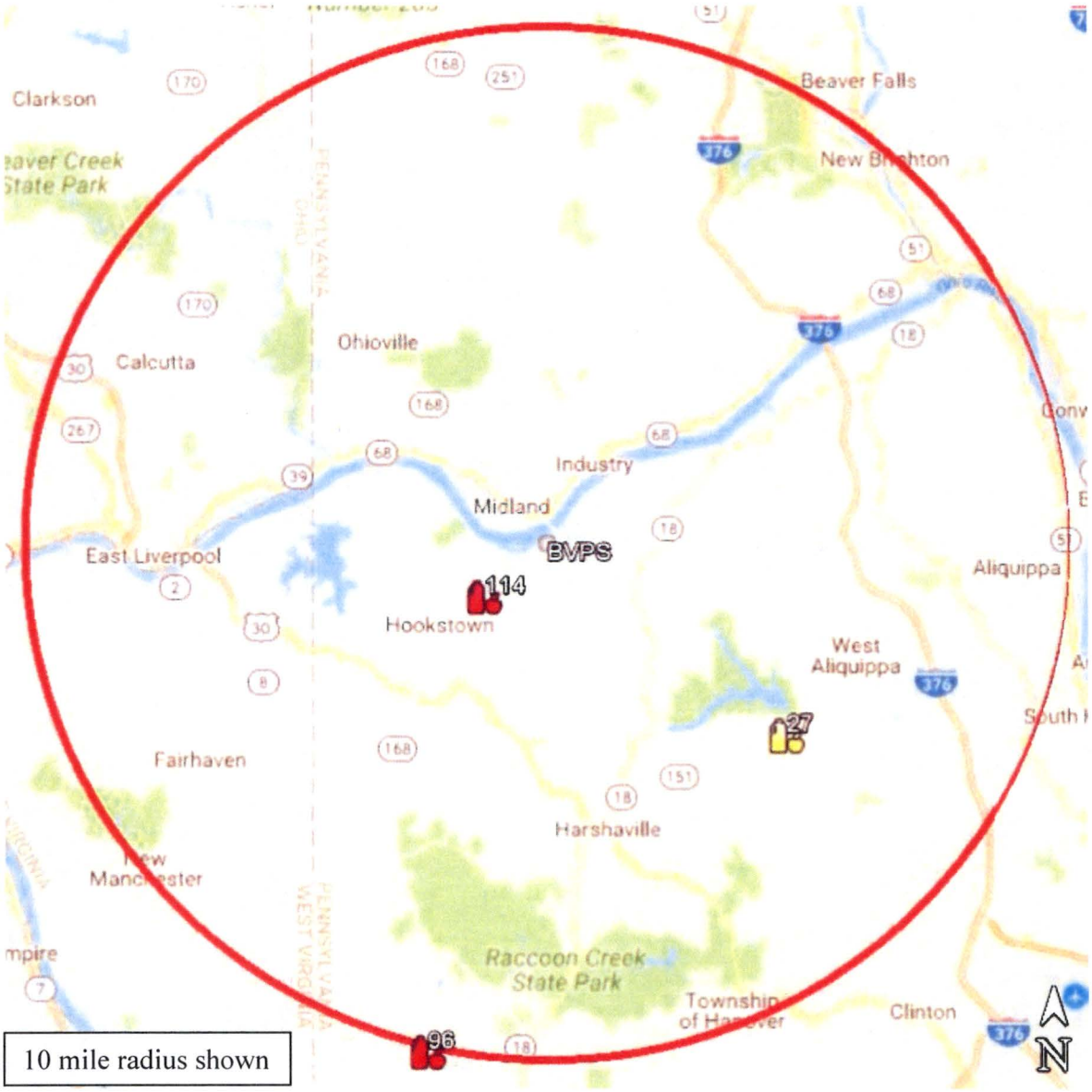
Figure 2-8

Environmental Monitoring Locations – Milk



Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Milk	27	7-SE	6.1	Aliquippa, PA (Brunton Farm)
	96	10-SSW	10.4	Burgettstown, PA (Windsheimer Farm)
	114	11-SW	1.9	Hookstown, PA (Covert Residence)

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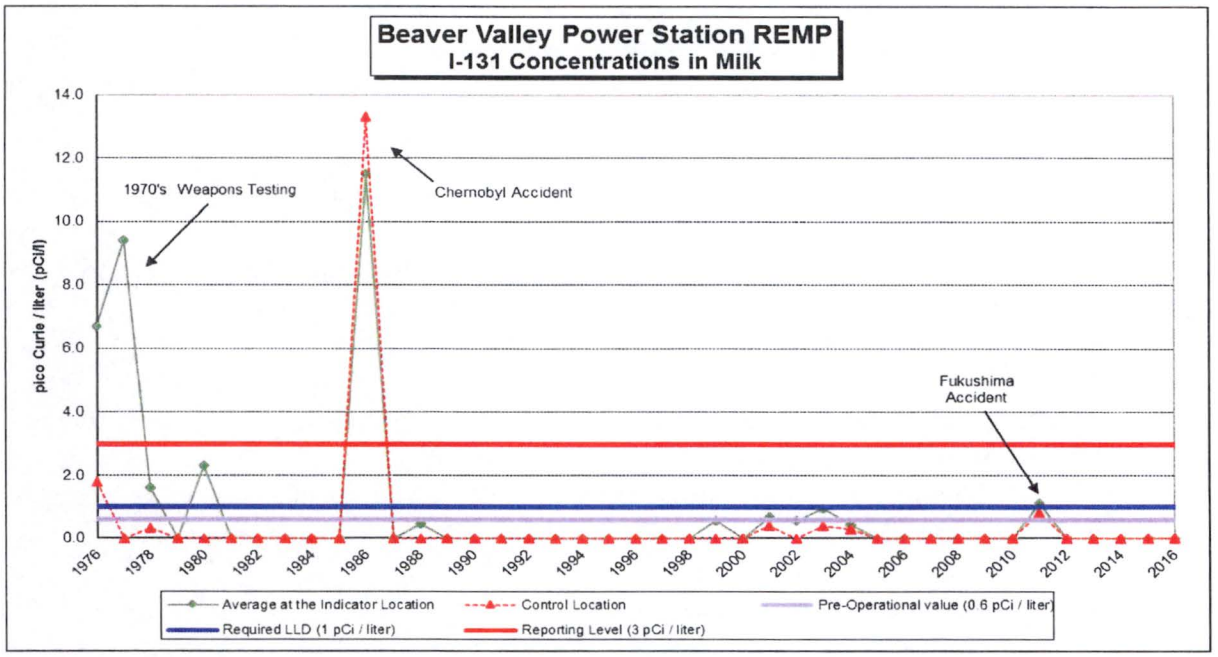
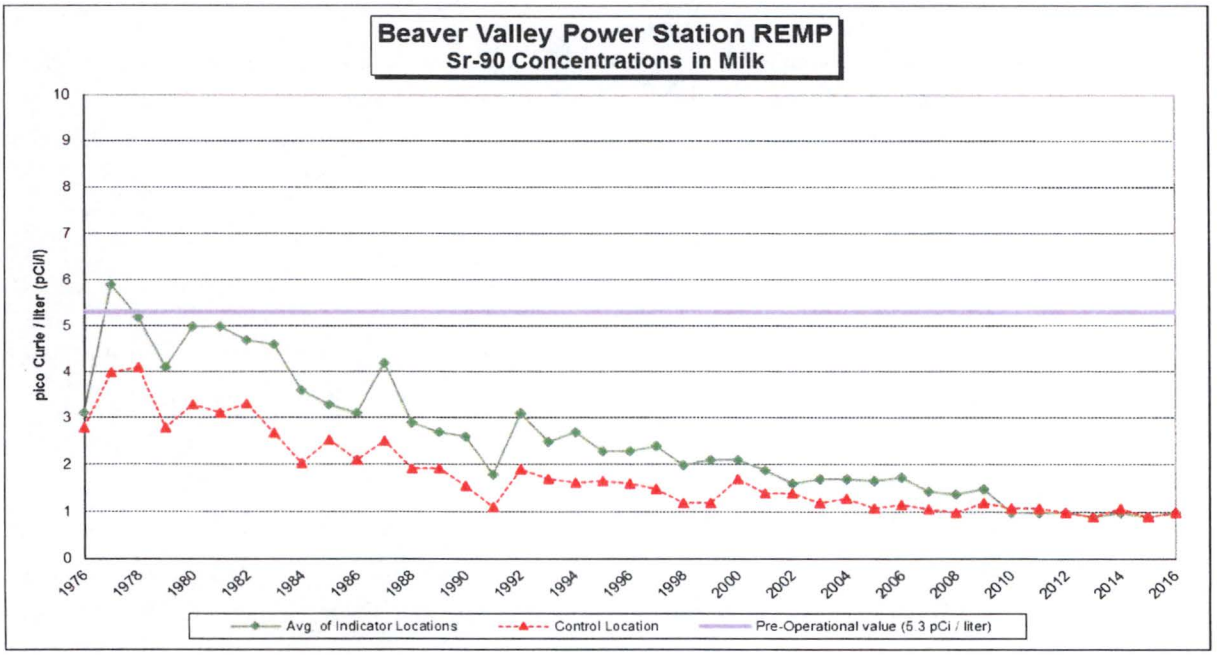
Figure 2-9

Graph of Annual Average Concentration: Iodine-131 & Sr-90 in Milk





SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Environmental Radiation Monitoring

1. Description of Regional Background Radiation and Sources

Historical information for regional background was obtained from Reuter-Stokes instruments that were previously located within a five (5) mile radius of the BVPS site. Data is no longer available from these instruments, but historical data indicated that the background exposure rates ranged from 6 μR/hr to 12 μR/hr.

The sources of background radiation are affected by the terrain in the vicinity of BVPS, whereas, the local hills (i.e. altitude variations of 300-400 feet) and densely wooded areas contribute to variations in background radiation. Other sources (e.g. radon) are affected by the geological features of the region, which are characterized by nearly flat-laying sedimentary beds of the Pennsylvania age. For information, the local sedimentary beds of limestone alternate with sandstone and shale with abundant interbedded coal layers. Pleistocene glacial deposits partially cover the older sedimentary deposits in the northwest. Most of the region is underlain by shale, sandstone, and some coal beds of the Conemaugh Formation. Outcrops of sandstone, shale, and limestone of the Allegheny Formation exist within the Ohio River Valley and along major tributary streams.

2. Locations and Analytical Procedures

Ambient external radiation levels around the site were measured using TLDs.

During the report period, there were a total of sixty six (66) environmental TLD locations. This is comprised of forty four (44) offsite locations, along with twenty two (22) fence perimeter locations. The offsite TLD locations are plotted on Figure 2-10, but the fence perimeter locations are not plotted due to the large scale of the figure.

The TLDs were annealed at the Contractor Central Laboratory shortly before placing the TLDs in their field locations. The radiation dose accumulated in-transit between the Central Laboratory, the field location, and the Central Laboratory was corrected by transit controls maintained in lead shields at both the Central Laboratory and the field office. All dosimeters were exposed in the field for a calendar quarter, in a specific holder that contains two (2) TLDs at each location.

3. Results and Conclusions

A summary of the TLD results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-11.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

TLD Analysis: During the report period, the average quarterly external exposure rate (as measured from TLD) was 18.9 mR at the sixty six (66) indicator locations, and 19.8 mR at the control location. This external exposure rate is comparable to previous years. As expected, there was some variation in external exposure rate among locations and seasons.

Deviations from Required Sampling and Analysis Schedule: There were two deviations from the required TLD sampling and analysis schedule during the report period.

On January 7, 2016, the REMP Technician was performing the scheduled quarterly TLD changeout. During the work, it was noticed that Station #81 (Millcreek United Presbyterian Church) was missing one of the two TLDs for the first quarter of 2016. On September 29, 2016, the REMP Technician was performing the scheduled fourth quarter changeout and noticed that Station 94 (McCleary & Pole Cat Hollow Road) was missing both of the TLDs. ½-ODC-2.03 states that deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. 1/2-ODC-3.03, ODCM: Controls for RETS and REMP Programs, only requires that 40 offsite locations be obtained with quarterly collection of at least 2 TLDs at each site. Therefore, BVPS still meets the minimum ODCM requirements by having complete data for 41 of 44 sample stations available. Further actions are not required. This issue is documented in Notification 601018638, Task 10.

Summary: The quarterly TLD external exposure rates are comparable to that of the previous decade. There was no evidence of anomalies that could be attributed to the operation of BVPS. It should also be noted that the average external exposure rate at the indicator locations was less than average external exposure rate at the control location. Based on all the analytical results and the comparison to pre-operational levels, the operation of BVPS did not contribute any measurable increase in external exposure in the vicinity of the site during the report period. The TLD exposure rates also confirm that changes from natural radiation levels, if any, are negligible.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-10

Environmental Monitoring Locations - TLDs

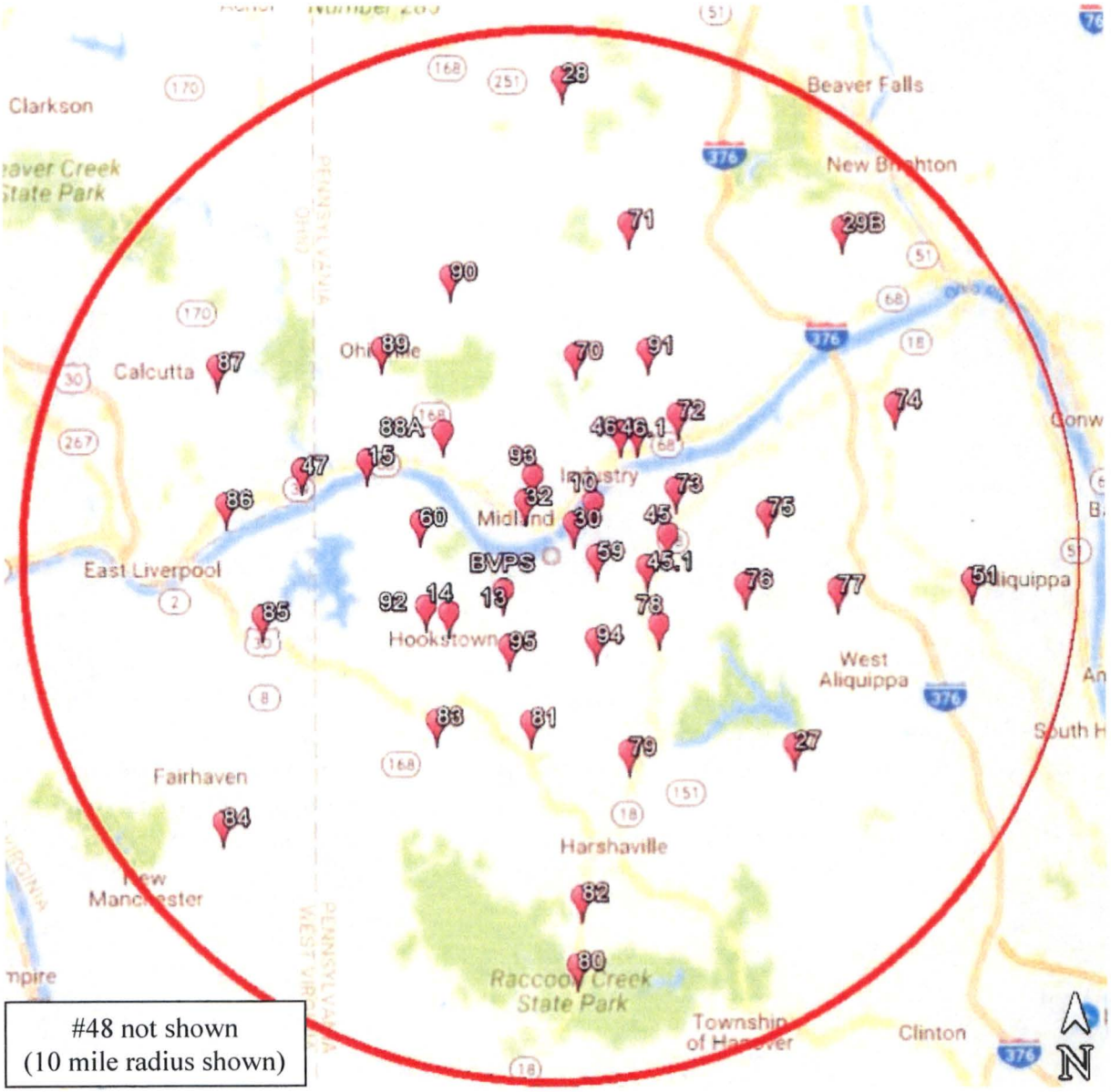


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Figure 2-10 (Continued)

TLD Locations

SOUTHEAST QUADRANT

Site No.	Sector	Distance (miles)	Location
27	7-SE	6.14	Brunton Dairy Farm Aliquippa, PA
45.1	6-ESE	1.92	Kennedy's Corners Raccoon Township, PA
51	5-E	8.00	Sheffield Substation Aliquippa, PA
59	6-ESE	0.99	236 Green Hill Road Aliquippa, PA
76	6-ESE	3.80	Raccoon Elementary School Raccoon Township, PA
77	6-ESE	5.52	3614 Green Garden Road Aliquippa, PA
78	7-SE	2.72	Racoon Twp Municipal Building Raccoon Township, PA
79	8-SSE	4.46	106 State Route 151 Green Twp. Aliquippa, PA
80	9-S	8.27	Park Office, State Route 18 Raccoon Township, PA
82	9-S	6.99	2697 State Route 18 Raccoon Twp, PA
94	8-SSE	2.25	McCleary & Pole Cat Hollow Road Hookstown, PA

NORTHWEST QUADRANT

Site No.	Sector	Distance (miles)	Location
15	14-WNW	3.75	Post Office Georgetown, PA
32	15-NW	0.75	North Substation Midland, PA
47	14-WNW	4.88	Water Department East Liverpool, OH
60	13-W	2.51	444 Hill Road Georgetown, PA
86	13-W	6.18	1090 Ohio Avenue East Liverpool, OH
87	14-WNW	7.04	50103 Calcutta Smith Ferry Road Calcutta, OH
88A	15-NW	2.8	Route 168 Midland Heights PA
89	15-NW	4.72	488 Smith's Ferry Road Ohioville, PA
90	16-NNW	5.20	6286 Tuscarawras Road Midland, PA
93	16-NNW	1.10	104 Linden - Sunrise Hills Midland, PA

NORTHEAST QUADRANT

Site No.	Sector	Distance (miles)	Location
10	3-NE 4-ENE	0.94	Post Office Shippingport, PA
28	1-N	8.60	Sherman Farm Brighton Twp, PA
29B	3-NE	7.97	Friendship Ridge Beaver, PA
30	4-ENE	0.43	Cook's Ferry Substation Shippingport, PA
45	5-E	2.19	Christian House Baptist Chapel, State Rte 18 Raccoon Township, PA
46	3-NE	2.49	Midway Drive Industry, PA
46.1	2-NNE 3-NE	2.28	McKeel's Service, State Route 68 Industry, PA
70	1-N	3.36	236 Engle Road Industry, PA
71	2-NNE	6.01	First Western Bank Brighton Township, PA
72	3-NE	3.25	Ohioview Lutheran Church – Rear Raccoon Twp, PA
73	4-ENE	2.48	618 Squirrel Run Road Industry, PA
74	4-ENE	6.92	137 Poplar Avenue (CCBC) Monaca, PA
75	5-E	4.08	117 Holt Road Aliquippa, PA
91	2-NNE	3.89	Pine Grove Road & Doyle Road Industry, PA

SOUTHWEST QUADRANT

Site No.	Sector	Distance (miles)	Location
13	11-SW	1.49	Old Meyer Farm Hookstown, PA
14	11-SW	2.53	Hookstown, PA
48	10-SSW	16.40	Collier Way Water Tower Weirton , WV
81	9-S	3.69	Millcreek United Presbyterian Church Hookstown, PA
83	10-SSW	4.26	735 Mill Creek Road, Hookstown, PA
84	11-SW	8.35	Senior Center Hancock County, WV
85	12-WSW	5.73	2048 State Route 30 West Chester, WV
92	12-WSW	2.81	Georgetown Road Substation Georgetown, PA
95	10-SSW	2.37	832 McCleary Road Hookstown, PA

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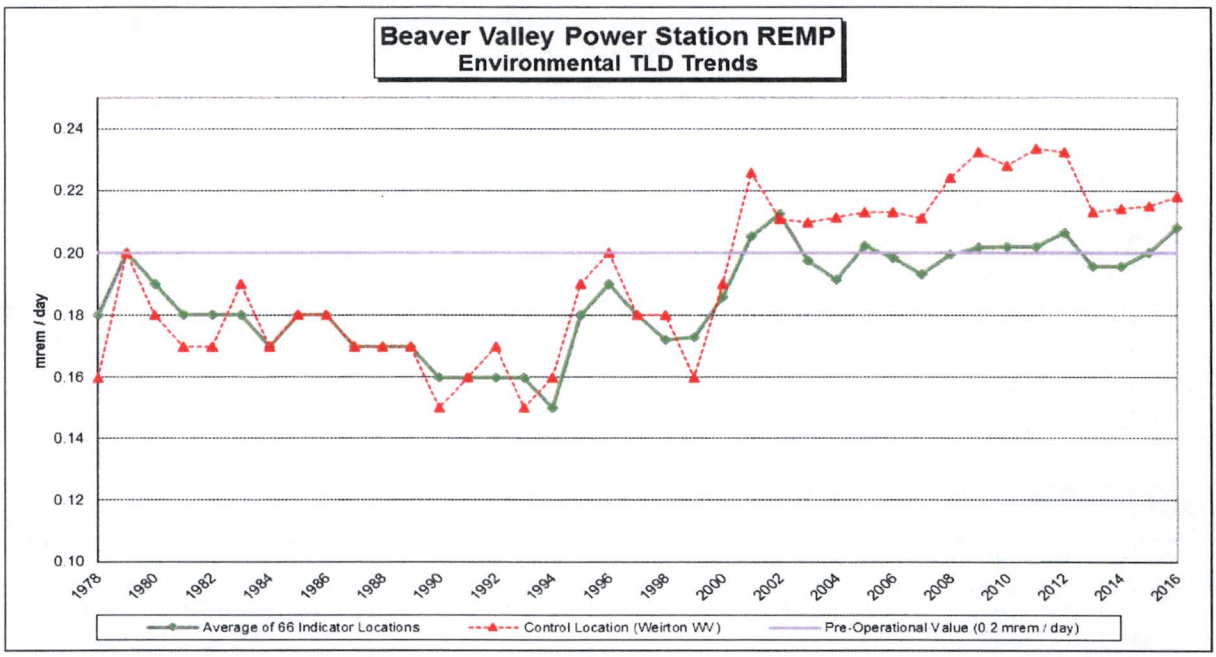
Figure 2-11

Graph of Annual Average Exposure: Direct Radiation in Environment



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

G. Monitoring of Fish

1. Description

During the report period, fish species collected for the radiological monitoring program included carp, black buffalo, white sucker, shorthead redhorse, tiger muskie, channel catfish, smallmouth bass, freshwater drum and brown catfish.

2. Sampling Program and Analytical Techniques

a. Program

Fish samples are collected semi-annually in the New Cumberland pool of the Ohio River at the Beaver Valley effluent discharge point and upstream of the Montgomery Dam. The edible portion of each species caught is analyzed by gamma spectroscopy. Fish sampling locations are shown in Figure 2-12.

b. Procedure

A sample is prepared in a standard tare weight 300 mL plastic bottle and scanned for gamma emitting nuclides with gamma spectrometry system which utilizes a high resolution germanium detector.

3. Results and Conclusions

A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-13.

Gamma Spectrometry: A total of eleven (11) fish samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in any of the six (6) indicator samples, nor were they detected in any of the five (5) control samples.

Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required fish sampling and analysis schedule during the report period.

Summary: Based on the analytical results, the operation of BVPS did not contribute any measurable increase in radioactivity in the Ohio River fish population during the report period.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-12

Environmental Monitoring Locations - Fish

Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Fish	2A	12-WSW	0.31	BVPS Outfall Vicinity
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)

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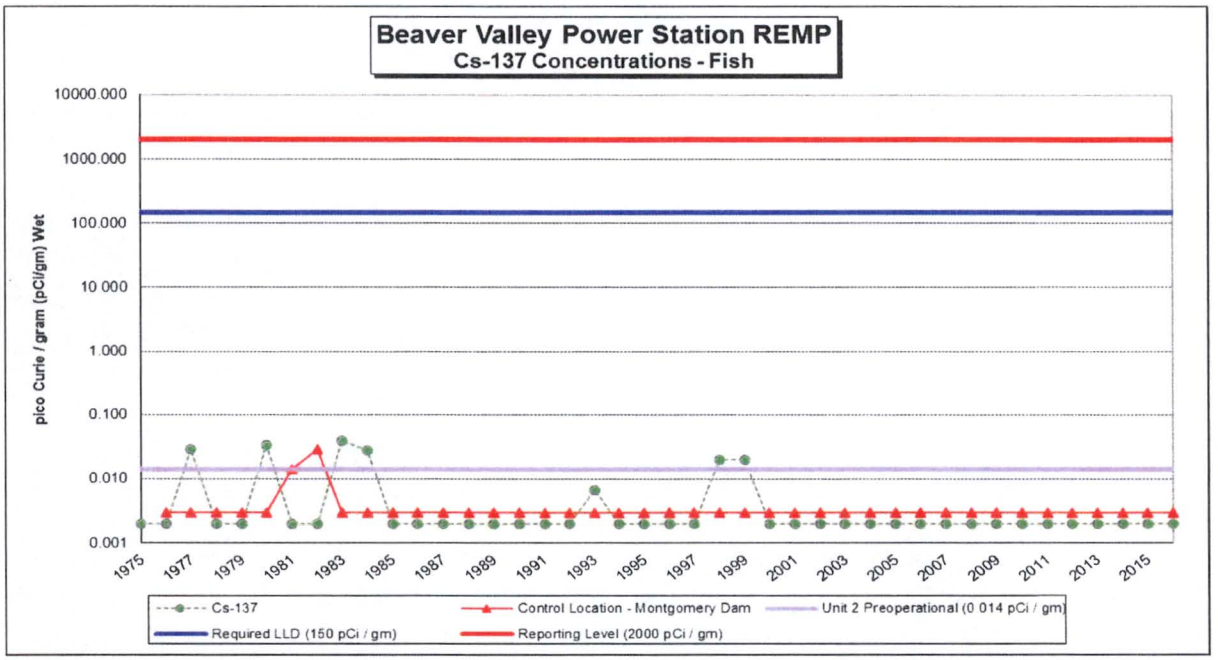
Figure 2-13

Graph of Annual Average Concentration: Cesium-137 in Fish



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

H. Monitoring of Surface Water, Drinking Water, Groundwater, and Precipitation

1. Description of Water Sources

The Ohio River is the main body of water in the area and is the main surface water supply for drinking water in the area. The Beaver Valley Power Station obtains water from the Ohio River for plant make-up water and discharges water to the Ohio River via National Pollutant Discharge Elimination System (NPDES) discharge points (e.g. cooling tower blowdown, liquid effluent releases, etc.).

The Ohio River is the main surface water supply source for towns, municipalities, and industries both upstream and downstream of the BVPS site. The nearest user of the Ohio River as a potable water source is Midland Borough Municipal Water Authority. The intake of the treatment plant is approximately 1.5 miles downstream of the Midland Borough Municipal Water Authority and is located on the opposite side of the river. The next downstream user is East Liverpool, Ohio and is approximately 6 miles downstream. The heavy industries in Midland, as well as other users downstream, also use river water for cooling purposes.

Groundwater occurs in large volumes in the gravel terraces which lie along the river, and diminishes considerably in the bedrock underlying the site. Normal well yields in the bedrock are less than ten (10) gallons per minute (gpm) with occasional wells yielding up to 60 gpm.

In general, the BVPS site experiences cool winters and moderately warm summers with ample annual precipitation evenly distributed throughout the year. The National Climate Data Center indicated the total annual precipitation during the report period for the Beaver Falls, PA area was 42.77 inches.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

2. Sampling and Analytical Techniques

a. Surface (Raw River) Water

The sampling program of river water included three (3) sampling points along the Ohio River for most of 2016. In December 2016, one of the locations closed in which the program now includes two (2) sampling points.

Furthermore, Site No. 2.1, Sector 14, Midland - ATI Allegheny Ludlum, the downstream sample, is no longer a viable sample location. ATI permanently closed the Midland facility in 2016. As of December 2016, surface water samples were no longer available. Site No. 5, Sector 14, East Liverpool Water Department was an additional downstream sample location in which grab samples were taken. Accordingly, the East Liverpool site was transitioned to a composite sample location thus replacing ATI Allegheny Ludlum. The equipment was installed in early December of 2016 resulting in no missed samples.

Raw water samples were collected daily at the Water Treatment Plant in East Liverpool, OH, sample location 5, [River Mile 41.2], and then made into a weekly composite sample. Now the water sample is collected with a composite water sampler. The automatic sampler takes a 20-40 mL sample every 15 minutes and samples are collected on a weekly basis. The weekly samples are then combined for a monthly composite sample for each location. The monthly composite samples are analyzed for gamma emitters. In addition, a quarterly composite sample is prepared from the monthly composites for each sample point. Quarterly composites are analyzed for hydrogen-3 (tritium). One automatic river water sampler was located at the ATI-Allegheny Ludlum (formerly J&L Steel) river water intake, sample location 2.1, [River Mile 36.2] and was transitioned to East Liverpool due to the closing of the facility.

A weekly grab sample is taken upstream of the Montgomery Dam, sample location 49 [River Mile 29.6]. This upstream sample at the Montgomery Dam is the control sample. The weekly grab samples upstream of the Montgomery Dam are analyzed for iodine-131. Weekly grab samples are then made into monthly composites and are analyzed for gamma emitters. Quarterly composites are prepared from each of the monthly composites. The quarterly composites are analyzed for tritium.

Locations of each sample point are shown in Figure 2-14.

b. Drinking Water (Public Supplies)

Drinking water (i.e. treated water) is collected at both the Water Treatment Plant in Midland, PA, sample location 4, and the Water Treatment Plant in East Liverpool, OH, sample location 5. An automatic sampler at each location collects 20-40 mL every 20

minutes, which is then combined for a weekly composite sample. The weekly composite sample from each location is analyzed for iodine-131. Monthly composites are prepared from the weekly samples and are analyzed by gamma spectrometry. In addition, a quarterly composite sample is prepared for each sample point from the monthly composites. Quarterly composites are analyzed for tritium.

A weekly grab sample is taken upstream of the Montgomery Dam, sample location 49A [River Mile 29.6]. This upstream sample at the Montgomery Dam is the control sample. The weekly grab samples upstream of the Montgomery Dam are analyzed for iodine-131. Weekly grab samples are then made into monthly composites and are analyzed by gamma spectrometry. Quarterly composite are prepared from each of the monthly composites. The quarterly composites are analyzed for tritium.

Locations of each sample point are shown in Figure 2-14.

c. Groundwater

Although not required by the ODCM, semi-annual grab samples were collected from two (2) locations within four (4) miles of the site (see Figure 2-14). These locations are:

One (1) well in Hookstown, PA

One (1) well in Georgetown, PA

Each ground water sample is analyzed for tritium and is analyzed by gamma spectrometry.

d. Precipitation

Although not required by the ODCM, precipitation is collected in Shippingport, PA, East Liverpool, OH, and Weirton, WV. Precipitation, when available, is collected each week and combined for quarterly composite samples from the weekly samples. The quarterly composites are analyzed for tritium and gamma emitters. Locations of each of the sample points are shown in Figure 2-14.

e. Procedures

Gamma Analysis of Drinking Water and Surface Water: The analysis is performed by placing one liter of the sample into a Marinelli container and analyzing on a high resolution germanium gamma spectrometry system. Although not required by the ODCM, this analysis is also performed on groundwater and precipitation samples.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Tritium Analysis of Drinking Water and Surface Water: The tritium is determined in water samples by liquid scintillation analysis. Although not required by the ODCM, this analysis is also performed on surface water, groundwater and precipitation samples.

Iodine-131 Analysis of Drinking Water: The sample is chemically prepared and analyzed with a low-level beta counting system. Although not required by the ODCM, this analysis is also performed on surface water samples.

3. Results and Conclusions

A summary of the analysis results of water samples (surface water, drinking water, ground water, and precipitation) during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown in Figures 2-15 through 2-18.

a. Surface Water

Tritium: A total of twelve (12) surface water samples were analyzed for tritium during the report period. Tritium was not detected in the eight (8) indicator samples, nor was it detected in the four (4) control samples.

Gamma Spectrometry: A total of thirty six (36) surface water samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in the twenty four (24) indicator samples, nor were they detected in the twelve (12) control samples.

Iodine-131: Although not required by the ODCM, a total of fifty two (52) surface water control samples were analyzed for iodine-131 using radiochemical methods during the report period. Iodine-131 was detected in nineteen of fifty two (19 of 52) weekly control samples, of which zero (0) analysis exceeded the reporting level of 2 picoCurie / liter. The results were similar to previous years, (current annual range = 0.3 to 1.6 picoCurie / liter). The positive results were detected at the control location, which is five (5) miles upstream (not influenced by BVPS operation). Identification of iodine-131 during the report period was most likely due to medical diagnostic and treatment procedures performed at upstream facilities.

b. Drinking Water

Tritium: A total of twelve (12) drinking water samples were analyzed for tritium during the report period. Tritium was detected in one (1) of eight (8) indicator samples and was not detected in any of the four (4) control samples. Location 04, Midland Water Department, contained the highest positive value (294 picoCurie / liter) and was well below the required LLD (2,000 picoCurie / liter).

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Gamma Spectrometry: A total of thirty six (36) drinking water samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in any of the twenty four (24) indicator samples, nor were they detected in any of the twelve (12) control samples.

Iodine-131: A total of one hundred fifty six (156) drinking water samples were analyzed for iodine-131 (using radiochemical methods) during the report period. Iodine-131 was detected in thirteen of one hundred four (13 of 104) indicator samples and nineteen of fifty two (19 of 52) control samples. Some of the positive results at the downstream location exceeded the positive results from the upstream surface water control location, but none of these analyses exceeded the reporting level of 2 picoCurie / liter. Because positive results were detected in the upstream control sample, some positive results are most likely due to medical diagnostic and treatment procedures performed at upstream facilities, and not caused by BVPS operations. However, the analyses are also consistent with discharge data of authorized liquid effluent releases, and all liquid effluent releases during the report period did not exceed the release limits set forth in the ODCM.

c. Groundwater

Tritium: Although not required by ODCM, a total of four (4) groundwater samples were analyzed for tritium during the report period. Tritium was not detected in any of the four (4) indicator samples and samples were not taken at the control location because the well is no longer available.

Gamma Spectrometry: Although not required by ODCM, a total of four (4) groundwater samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in any of the four (4) indicator samples and samples were not taken at the control location because the well is no longer available.

d. Precipitation

Tritium: Although not required by ODCM, a total of twelve (12) precipitation samples were analyzed for tritium during the report period. Tritium was not detected in the eight (8) indicator samples, and it was not detected in the four (4) control samples.

Gamma Spectrometry: Although not required by ODCM, a total of twelve (12) precipitation samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in the eight (8) indicator samples, nor were they detected in the four (4) control samples.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Deviations from Required Sampling and Analysis Schedule: There were two deviations from the ODCM required water sampling and analysis schedule during the report.

½-ODC-2.03: Radiological Environmental Monitoring Program requires a waterborne surface (river) sample for two locations, one upstream and one downstream. Site No. 2.1, Sector 14, Midland - ATI Allegheny Ludlum, the downstream sample, is no longer a viable sample location. ATI permanently closed the Midland facility in 2016. As of December 2016, surface water samples were no longer available. Site No. 5, Sector 14, East Liverpool Water Department was an additional downstream sample location in which grab samples were taken. Accordingly, the East Liverpool site was transitioned to a composite sample location thus replacing ATI Allegheny Ludlum. The equipment was installed in early December resulting in no missed samples. This issue is documented in Notification 601018638, Task 12.

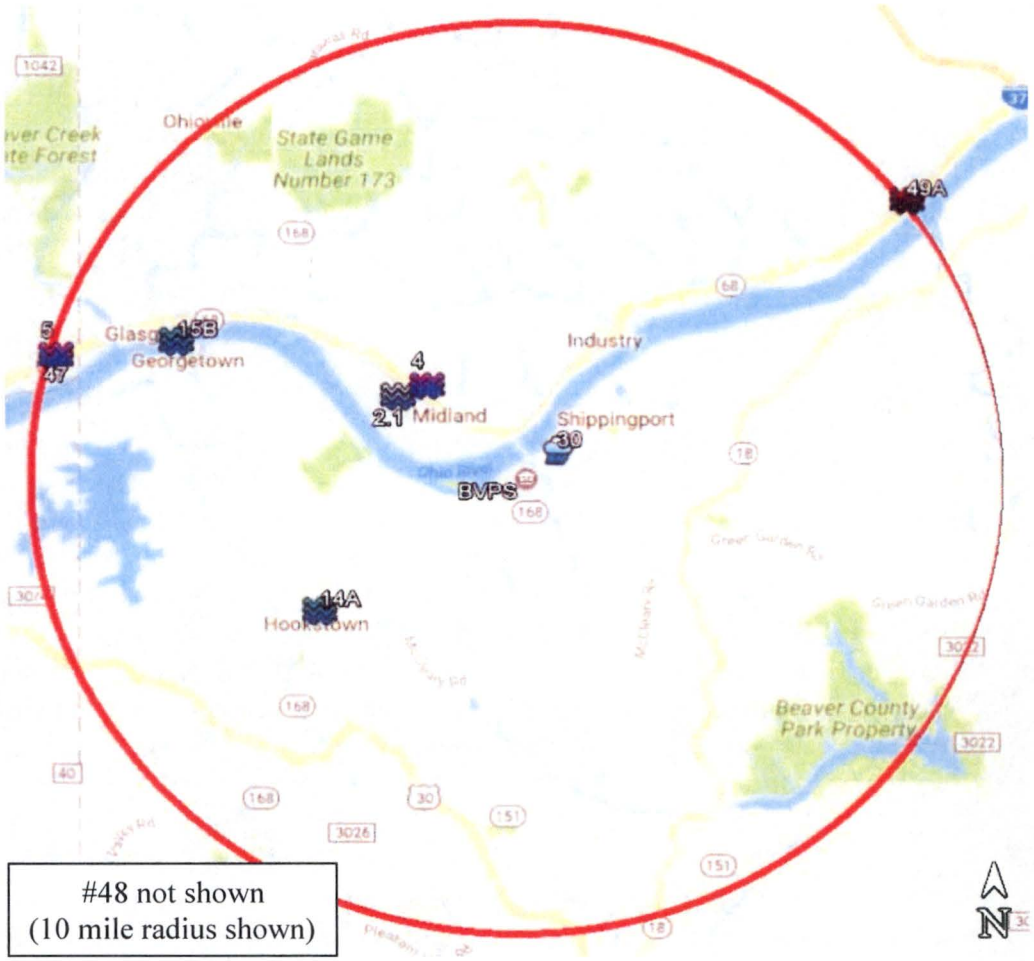
In addition, the REMP drinking water monitor (Site No. 04) was out of service in April of 2016. Small leaks started to develop in the copper water supply line that is connected to the REMP water station. The water station was shut down, the copper water line was replaced and the water station was returned to service on April 12, 2016 at 1620. Therefore, a sample was not missed since the sample requirement is bi-weekly. "Time off" was extrapolated by using the volume collected to have been approximately 0204 on April 6, 2016. ½-ODC-2.03: Radiological Environmental Monitoring Program, states that deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. This issue is documented in Notification 601018638, Task 9.

e. Summary: Data from the water sample analyses demonstrate that BVPS did not contribute a significant increase of radioactivity in the local river, in the drinking water, in the well water, or in the precipitation. The analytical results confirm that the station assessments, prior to authorizing radioactive discharges, are adequate and that the environmental monitoring program is sufficiently sensitive.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-14

Environmental Monitoring Locations -
Ground Water, Surface Water, Drinking Water and Precipitation



Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Drinking Water	4	15-NW	1.26	Midland, PA (Water Department)
	5	14-WNW	4.90	East Liverpool, OH (Water Department)
Surface Water	2.1	14-WNW	1.43	Midland, PA (ATI Allegheny Ludlum)
	5	14-WNW	4.90	East Liverpool, OH (Water Department)
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)
Ground Water	14A	11-SW	2.61	Hookstown, PA
	15B	14-WNW	3.75	Georgetown, PA
Precipitation	30	4-ENE	0.43	Shippingport, PA (Cook's Ferry Substation)
	47	14-WNW	4.88	East Liverpool, OH (Water Department)
	48	10-SSW	16.40	Weirton WV (Water Tower, Collier Way)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-15

Graph of Annual Average Concentration: Iodine-131 in Surface Water & Drinking Water

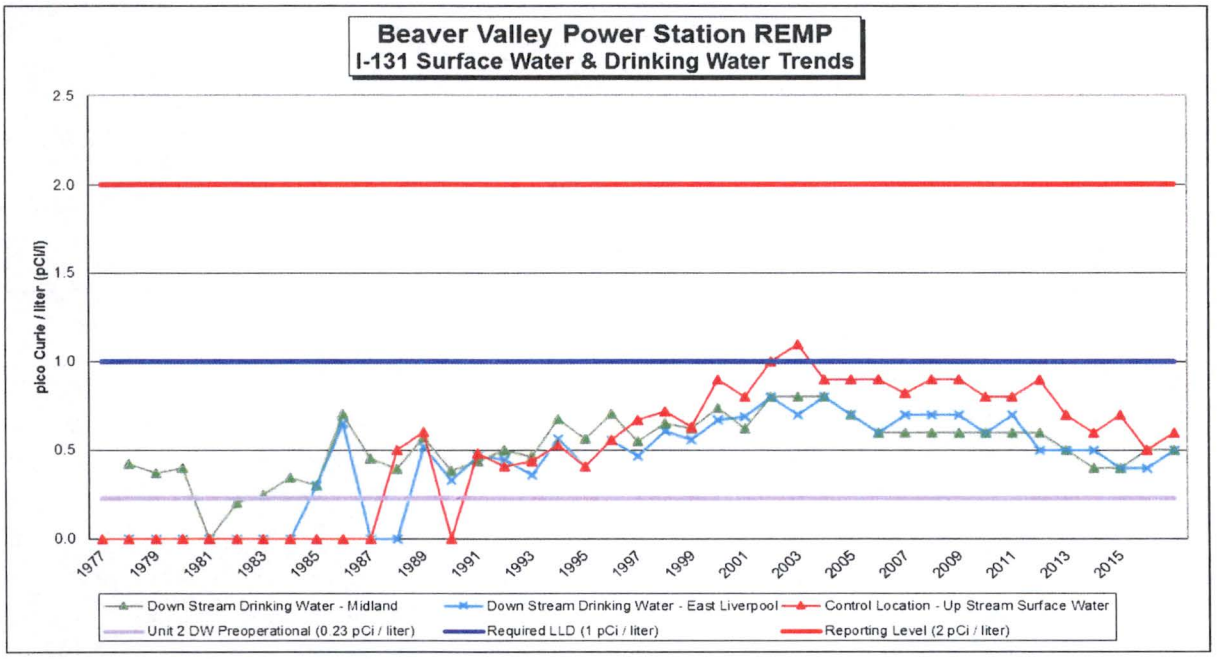
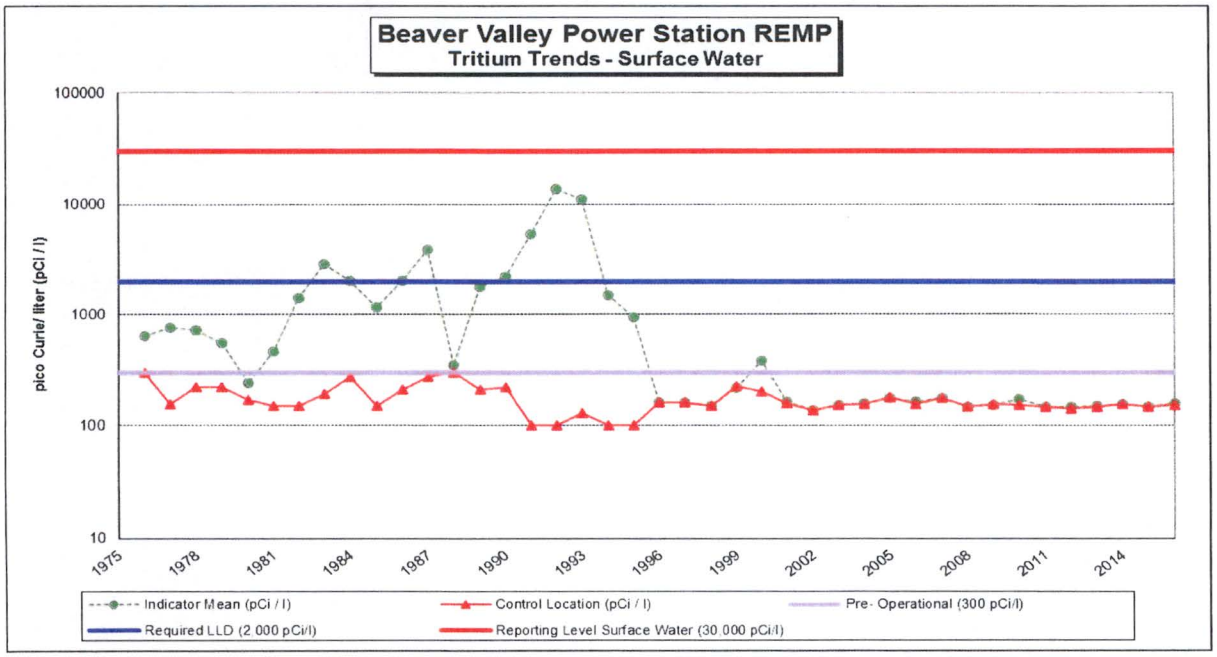


Figure 2-16

Graph of Annual Average Concentration: Tritium in Surface Water



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-17

Graph of Annual Average Concentration: Tritium in Ground Water

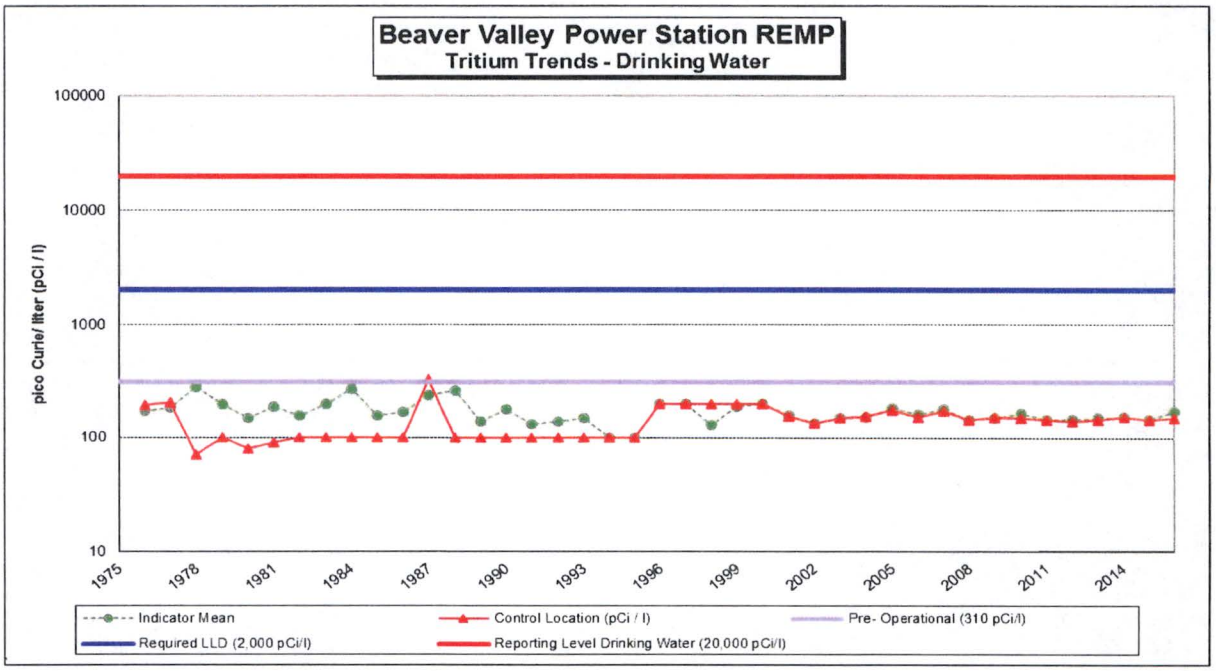
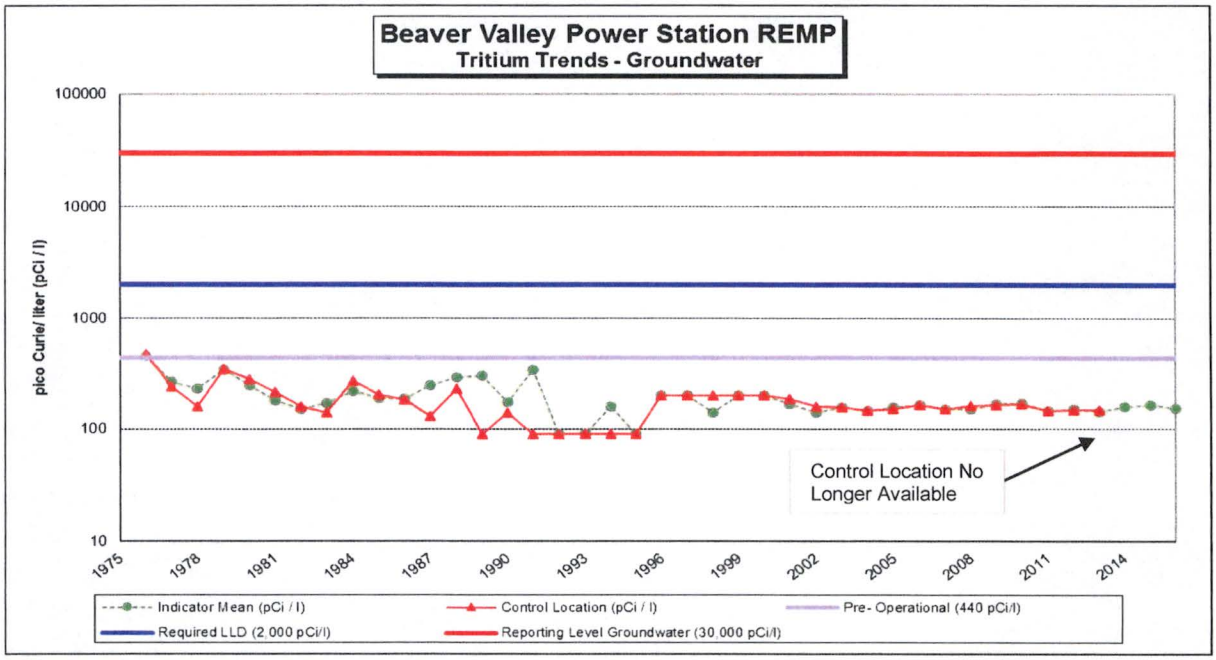


Figure 2-18

Graph of Annual Average Concentration: Tritium in Drinking Water



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

I. Estimates of Radiation Dose to Man

1. Pathways to Man - Calculation Models

The radiation doses to man as a result of BVPS operations were calculated for both gaseous and liquid effluent pathways using computer codes for the ARERAS/MIDAS computer system. These computer codes are equivalent to NRC computer codes XOQDOQ2, GASPAR, and LADTAP. Dose factors listed in the ODCM are used to calculate doses from radioactive noble gases in discharge plumes. BVPS effluent data, based on sample analysis were used as the radionuclide activity input.

All liquid and gaseous effluent radionuclides listed in the Annual Radioactive Effluent Release Report were used as input source terms to the computer codes.

All batch and continuous gaseous effluent releases were included in the dose assessment calculations. The release activities are based on laboratory analysis. Meteorological data collected by the BVPS Meteorology System was also used as input to the computer codes. The usage factors were obtained from the BVPS Final Environmental Statements or Regulatory Guide 1.109, except when more recent or specific data was available.

All radioactive liquid effluents are released by batch mode after analysis by gamma spectrometry. Each batch is diluted by cooling tower blowdown water prior to discharge into the Ohio River via the main outfall [River Mile 35.0]. The actual data from these analyses are tabulated and used as the radionuclide source term input to the computer code. The usage factors were obtained from the BVPS Final Environmental Statements or Regulatory Guide 1.109, except when more recent or specific data was available.

The total population doses were evaluated for all liquid and gaseous effluent pathways up to 50 miles. For these evaluations, a total population of approximately 4 million people was used. An estimate of the populations are listed in the BVPS-2 UFSAR Section 2.1.3.1 for 0-10 miles and Section 2.1.3.2 for 10-50 miles.

2. Results of Calculated Population Dose to Man - Liquid Effluent Releases

During the report period, the calculated dose to the entire population within 50 miles of the plant is presented in Table 2-4 for BVPS liquid effluent releases. Also shown in the Table 2-6 is a comparison to natural radiation exposure.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

3. Results of Calculated Population Dose to Man – Gaseous Effluent Releases

During the report period, the calculated dose to the entire population within 50 miles of the plant is presented in Table 2-5 for BVPS airborne effluent releases. Also shown in the Table 2-6 is a comparison to natural radiation exposure. The doses include the contribution of all pathways.

Conclusions

Based upon the estimated dose to individuals from the natural background radiation exposure in Tables 2-4 and 2-5, the incremental increase in total body dose to the 50-mile population from the operation of BVPS - Unit 1 and 2, is less than **0.0000025%** of the annual background dose.

The calculated doses to the public from the operation of BVPS - Unit 1 and 2, are below ODCM annual limits and resulted in only a small incremental dose to that which area residents already received as a result of natural background. The doses constituted no meaningful risk to the public.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-4: Calculated Population Dose to Man
Liquid Effluent Releases

0-50 mile Population Dose from BVPS Liquid Effluent Releases		
	Man-millirem	Largest Isotope Contributor
Total Dose	58	Tritium
Average Dose (per Individual)	0.0000142	Tritium

Comparison of Individual Dose BVPS Liquid Effluent Releases Versus Natural and Medical Radiation Exposure	
	millirem
BVPS Liquid Effluent Release Dose	0.0000142
Radiation Exposure	620

Table 2-5: Calculated Population Dose to Man
Gaseous Effluent Releases

0-50 mile Population Dose from BVPS Gaseous Effluent Releases		
	Man-millirem	Largest Isotope Contributor
Total Dose	44	Tritium
Average Dose (per Individual)	0.0000108	Tritium

Comparison of Individual Dose BVPS Gaseous Effluent Releases Versus Natural and Medical Radiation Exposure	
	millirem
BVPS Gaseous Effluent Release Dose	0.0000108
Radiation Exposure	620

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-6: Natural and Medical Radiation Exposures

TYPICAL DOSE TO INDIVIDUALS FROM RADIATION EXPOSURE [a]		
Ubiquitous background	=	311 millirem / year
Internal, inhalation		228 millirem / year
Internal, ingestion		29 millirem / year
External, space		33 millirem / year
External, terrestrial		21 millirem / year
Medical	=	300 millirem / year
CT		147 millirem / year
Nuclear medicine		77 millirem / year
Interventional fluoroscopy		43 millirem / year
Conventional radiography		33 millirem / year
Consumer	=	13 millirem / year
Industrial, security, educational, research	=	0.3 millirem / year
Occupational	=	0.5 millirem / year
Average Individual	=	**620 millirem / year**
(Total from all sources shown above)		

(a) NCRP Report No. 160: Ionizing Radiation Exposure of the Population of the United States." *Journal of Radiological Protection J. Radiol. Prot.* 29.3 (2009)

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

A. **Split Sample Program (Inter-Laboratory Comparison, Part 1 of 2):** BVPS participates in a split sample program with the Pennsylvania Department of Environmental Protection (PADEP) in support of their nuclear power plant monitoring program.

- BVPS provided split samples to PADEP throughout the report period. The shared media and number of locations were typically comprised of milk (1), surface water (3), sediment (1), fish (1), and food crops (2).
- PADEP has co-located continuous air particulate & air iodine sample stations with four (4) of the BVPS locations.
- PADEP has co-located TLDs with twenty-four (24) of the BVPS TLDs.

B. **Spike Sample Program (Inter-Laboratory Comparison, Part 2 of 2):** BVPS participates in a spike sample program with an Independent Laboratory. This program is used to independently verify sample analyses performed by the BVPS Contractor Laboratory.

- **Acceptance Criteria:** The NRC criteria listed in NRC Inspection Procedure 84750, 03/15/94, Inspection Guidance 84750-03 is used as acceptance criteria for comparisons of results of spiked samples between the Contractor Lab and the Independent Lab. These comparisons are performed by dividing the comparison standard (Independent Lab result) by its associated uncertainty to obtain the resolution. The comparison standard value is multiplied by the ratio values obtained from the following table to find the acceptance band for the result to be compared. However, in such cases in which the counting precision of the standard yields a resolution of less than 4, a valid comparison is not practical, and therefore, not performed.

NRC Criteria	
Resolution	**Ratio**
< 4	--
4 - 7	0.50 - 2.00
8 - 15	0.60 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
> 200	0.85 - 1.18

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Participation in an Inter-Laboratory Comparison Program is required by BVPS Unit 1 and 2 ODCM procedure 1/2-ODC-3.03 Attachment S Control 3.12.3. For the report period, the requirement was met by the Contractor Lab analyzing NIST traceable spiked samples supplied by an Independent Lab.

During the report period, BVPS used (Environmental, Inc., Midwest Laboratory – Northbrook, IL) as the Contractor Laboratory, and (Eckert & Ziegler Analytics – Atlanta, GA) as the Independent Laboratory.

The spiked samples included air particulate filter papers, charcoal cartridges, water samples, and milk samples. The samples were submitted by the Independent Laboratory to the Contractor Laboratory for analysis. The "spiked to" values were used for calculating comparison Acceptance Criteria.

- **Spiked Milk & Water Samples:** The spiked sample results (i.e. the BVPS criteria) for each calendar quarter are reported in Table 4-1 through Table 4-4, respectively. The following summary is provided:

  - A total of forty-eight (48) gamma spectrometry radionuclide analyses were performed by the Contractor Laboratory on four (4) milk samples.

  - A total of forty-eight (48) gamma spectrometry radionuclide analyses were performed by the Contractor Laboratory on four (4) water samples.

  - A total of four (4) chemical analyses for I-131 were performed by the Contractor Laboratory on four (4) milk samples.

  - A total of four (4) I-131 analyses were performed by the Contractor Laboratory on four (4) water samples.

  - A total of four (4) tritium analyses were performed by the Contractor Laboratory on four (4) water samples.

  - Comparison of results of the spiked milk and water samples showed acceptable agreement with the NRC acceptance criteria. All one hundred eight (108) analyses met the NRC acceptance criteria.

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

- **Spiked Filter Paper and Charcoal Cartridge Samples:** The spiked sample results for each calendar quarter are reported in Table 4-1 through Table 4-4, respectively. The following summary is provided:

  - Gross Beta (cesium-137) analyses were performed by the Contractor Laboratory on two (2) filter paper samples.

  - Iodine-131 analyses were performed by the Contractor Laboratory on two (2) charcoal cartridge samples.

  - Comparison of results of the spiked filter paper and charcoal cartridge samples showed acceptable agreement with the NRC acceptance criteria. All four (4) analyses performed by the Contractor Laboratory met the NRC acceptance criteria.

C. Conclusions

- **Results of Split Sample Program:**

  The split sample program is coordinated by the state, and the results are not included in this report.

- **Results of Spike Sample Program:**

  Based on the Inter-Laboratory comparison data, BVPS considers all analyses provided throughout the report period by the Contractor Laboratory to be acceptable with respect to both accuracy and measurement. A comparison of the data is provided in the following tables. All analyses for the 2016 report period were within the NRC Acceptance Criteria.

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-1

Inter-Laboratory Comparison Program Spiked Samples – 1st Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
04/25/16 Water Ind Lab: E11508 Con. Lab: SPW-1886	Sr-89	60	0.80 - 1.25	0.89	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	0.87	AGREEMENT
	I-131	60	0.80 - 1.25	1.01	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.02	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.07	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.90	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.00	AGREEMENT
	Co-58	60	0.80 - 1.25	0.96	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.07	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.05	AGREEMENT
	Zn-65	60	0.80 - 1.25	0.95	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT
03/17/16 Water Ind. Lab: E11507 Con. Lab: SPW-1885	H-3	60	0.80 - 1.25	0.99	AGREEMENT
04/25/16 Milk Ind. Lab: E11509 Con. Lab: SPMI-1887	Sr-89	60	0.80 - 1.25	0.90	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	0.87	AGREEMENT
	I-131	60	0.80 - 1.25	1.05	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.03	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.18	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	0.96	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.05	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.05	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	1.01	AGREEMENT
03/17/16 Filter Paper Ind. Lab: E11510 Con. Lab: SPAP-1888	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.20	AGREEMENT
04/25/16 Charcoal Cartridge Ind. Lab: E111511A Con. Lab: SPCH-4882	I-131	60	0.80 - 1.25	0.90	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-2

Inter-Laboratory Comparison Program Spiked Samples – 2nd Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
06/09/16 Water Ind Lab: E11578 Con. Lab: SPW-2915	Sr-89	60	0.80 - 1.25	0.96	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.81	AGREEMENT
	I-131	60	0.80 - 1.25	0.89	AGREEMENT
	I-131	60	0.80 - 1.25	1.01	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.00	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.00	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.96	AGREEMENT
	Cs-137	60	0.80 - 1.25	0.99	AGREEMENT
	Co-58	60	0.80 - 1.25	0.98	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.03	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.05	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.12	AGREEMENT
	Co-60	60	0.80 - 1.25	1.05	AGREEMENT
06/09/16 Water Ind. Lab: E11557 Con. Lab: SPW-2914	H-3	60	0.80 - 1.25	0.96	AGREEMENT
06/09/16 Milk Ind. Lab: E11579 Con. Lab: SPMI-2916	Sr-89	60	0.80 - 1.25	0.80	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.84	AGREEMENT
	I-131	60	0.80 - 1.25	0.87	AGREEMENT
	I-131	60	0.80 - 1.25	0.97	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.01	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.92	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.92	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	1.06	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.08	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.09	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	1.04	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-3

Inter-Laboratory Comparison Program Spiked Samples – 3rd Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
09/15/16 Water Ind Lab: E11594 Con. Lab: SPW-4880	Sr-89	60	0.80 - 1.25	0.92	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	1.00	AGREEMENT
	I-131	60	0.80 - 1.25	0.99	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.97	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.90	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.91	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.00	AGREEMENT
	Co-58	60	0.80 - 1.25	0.97	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.02	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.07	AGREEMENT
	Co-60	60	0.80 - 1.25	0.98	AGREEMENT
09/15/16 Water Ind. Lab: E11593 Con. Lab: SPW-4878	H-3	60	0.80 - 1.25	0.98	AGREEMENT
09/15/16 Milk Ind. Lab: E11595 Con. Lab: SPMI-4879	Sr-89	60	0.80 - 1.25	0.80	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.93	AGREEMENT
	I-131	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	0.98	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.94	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.86	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.00	AGREEMENT
	Co-58	60	0.80 - 1.25	1.03	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.00	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.02	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.06	AGREEMENT
	Co-60	60	0.80 - 1.25	1.02	AGREEMENT
09/15/16 Filter Paper Ind. Lab: E11596 Con. Lab: SPAP-4881	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.21	AGREEMENT
09/15/16 Charcoal Cartridge Ind. Lab: E11597 Con. Lab: SPCH-4882	I-131	60	0.80 - 1.25	0.84	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-4

Inter-Laboratory Comparison Program Spiked Samples – 4th Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
12/01/16 Water Ind Lab: E11704 Con. Lab: SPW-6620	Sr-89	60	0.80 - 1.25	0.98	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.06	AGREEMENT
	I-131	60	0.80 - 1.25	0.97	AGREEMENT
	I-131	60	0.80 - 1.25	1.06	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.04	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.04	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.97	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.06	AGREEMENT
	Co-58	60	0.80 - 1.25	1.03	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.07	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.12	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	1.03	AGREEMENT
12/01/16 Water Ind. Lab: E11704 Con. Lab: SPW-6619	H-3	60	0.80 - 1.25	1.00	AGREEMENT
12/01/16 Milk Ind. Lab: E11706 Con. Lab: SPMI-6624	Sr-89	60	0.80 - 1.25	0.92	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.01	AGREEMENT
	I-131	60	0.80 - 1.25	0.97	AGREEMENT
	I-131	60	0.80 - 1.25	0.99	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.95	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.00	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.00	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.02	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.01	AGREEMENT
	Co-60	60	0.80 - 1.25	1.01	AGREEMENT

SECTION 3 – LAND USE CENSUS

A. **Land Use Census Overview:** A Land Use Census was conducted June 1 through September 1, 2016 to comply with:

- Offsite Dose Calculation Manual procedure 1/2-ODC-3.03, "*Controls for RETS and REMP Programs*", Attachment R, Control 3.12.2, and Surveillance Requirement 4.12.2.1

- BVPS REMP procedure 1/2-ENV-04.02, "*Milch Animal Sampling Location Determination & ODCM Procedure 1/2-ODC-3.03, Control 3.12.2 Action Statements a and b Compliance Determination*"

The Land Use Census indicated that no changes were required in the current sampling locations, and no changes were required to the methodology used for determination of offsite dose from plant releases. A numerical summary of the Land Use Census results are provided in Table 3-1. The following information is also provided to clarify the Land Use Census as documented in letter NPD3NRE:1198, dated March 24, 2017:

B. **Nearest Residence:** The location has not changed since the previous census. The nearest inhabited residence is 209 Ferry Hill Road, Shippingport, PA (0.4 miles, east).

C. **Nearest Garden >500 sq ft**: The location has not changed since the previous census. The closest garden location is the Pringle Residence, 1221 Virginia Avenue, Midland, PA (1.0 miles, northwest). The previous sampling location at the Cox Residence, 238 State Route 168, Hookstown, PA (0.760 miles, south-southwest) was available for sampling cabbage this year but does not meet all the requirements of NUREG-1301 Ref (h).

D. **Nearest Dairy Cow:** The location has not changed since the previous census. The location remains at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.158 miles, southeast).

E. **Nearest Doe Goat:** The location has not changed since the previous census. The closest location is the Covert Residence, 930 Pine Street, Hookstown, PA (1.900 miles, southwest).

F. **Projection for 2016 Dairy Cow Sampling Locations:** Using a linear regression analysis of deposition parameters (D/Q), Dairy Cow sampling locations were determined to remain at the same locations used in 2016:
- Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.158 miles southeast)
- Windsheimer Dairy, 20 Windsheimer Lane, Burgettstown, PA (10.476 miles south-southwest)

SECTION 3 – LAND USE CENSUS

G. **Projection for 2016 Doe Goat Sampling Locations:** The linear regression analysis also indicated that there will be a Doe Goat sampling location in 2016. The Doe Goat sampling location for 2016 may be as follows if Goat Milk continues to be available from this site: Covert Residence, 930 Pine Street, Hookstown PA (1.900 miles, southwest)

H. **D/Q for Milch Animal Locations:** None of the 2016 milch animal sampling locations experienced a >20% increase in D/Q. Therefore, a Special Report per ODCM procedure 1/2-ODC-3.03, Attachment R, Control 3.12.2 Action "a" and/or Action "b" was not required.

I. **D/Q for Offsite Dose Determination:** There was no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, the analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% of the offsite dose previously calculated using current ODCM methodology. Therefore, a Special Report per ODCM Control 3.12.2 Action "a" and/or Action "b" is not required.

J. **D/Q Historical Comparison:** There is no adverse trend in D/Q when comparing 2000 to 2016 data to the ODCM default D/Q values. This validates that there is no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, the analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% of the offsite dose previously calculated using current ODCM methodology. Therefore, a change in ODCM receptor location and/or a change to meteorology at the current ODCM receptor location are not required.

SECTION 3 – LAND USE CENSUS

Table 3-1

Location of Nearest Residences, Gardens, Dairy Cows and Doe Goats

SECTOR	RESIDENCES	GARDENS	DAIRY COWS	DOE GOATS
	0 to 5 miles (miles)	**0 to 5 miles (miles)**	**0 to 5 miles (miles)**	**0 to 5 miles (miles)**
N	1.584	1.584	None	None
NNE	1.661	1.8	None	None
NE	0.4	3.3	None	None
ENE	0.603	1.047	None	None
E	**0.4** [b]	2.1	None	3.402
ESE	0.850	1.713	None	None
SE	1.583	1.3	None [a]	None
SSE	1.102	None	None	None
S	1.399	1.5	None	None
SSW	0.760	**2.215** [b]	None	None
SW	1.453	1.453	None	1.900
WSW	1.394	2.5	None	None
W	2.204	None	None	None
WNW	2.742	2.8	None	None
NW	0.885	1.0	None	None
NNW	0.902	2.4	2.442	None

[a] Although there are no Dairy Cows within 5 miles in this sector, a large local dairy located at 6.158 miles is included in the milk sampling program.

[b] **Distances shown in Bold print are the nearest location for that receptor.**

SECTION 5 – CORRECTIONS TO PREVIOUS RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT(S)

Corrections to Previous Radiological Environmental Operating Report(s): There are no corrections to previous reports at this time.