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FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION

2017

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)

AND

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

BEAVER VALLEY POWER STATION

ENVIRONMENTAL & CHEMISTRY SECTION

Technical Report Approval:

2017

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)

AND

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)

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 2017, and
Annual Radiological Environmental Operating Report for 2017

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2017 Annual 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

Annual 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

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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-2017-04211, Lack of isokinetic sampling for ODCM requirements

BVPS Condition Report No. CR-2017-04541, RM-1MS-100C not returned to service within 30 days

BVPS Condition Report No. CR-2017-07282, U2 MSCV sump sample cannot be located, ODCM surveillance missed

BVPS Condition Report No. CR-2017-12446, RM-1LW-104 Not Returned to Service Within 30 days as Required by the ODCM

BVPS Condition Report No. CR-2018-00126, Annual Catch Basin samples were unable to be obtained

BVPS Condition Report No. CR-2018-02122, REMP Control Location TLD #48 exposure abnormally low

BVPS SAP Order No. 601078879, 2017 RETS/REMP Tracking for ARERR/AREOR

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

Onsite Groundwater Monitoring: H-3 Summary: In 2017, twenty three (23) on-site monitoring wells were sampled in the spring and fall sampling periods. No new wells were installed, nor were any wells retired. MW-16 was sampled twelve (12) times throughout 2017, two (2) of which were included in the yearly biannual sampling. These samples that were taken account for the highest concentrations. 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 two 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.

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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 were two (2) Effluent Monitoring Instrumentation Channels not returned to Operable status within 30 days.

ODCM Surveillance Deficiencies: There were two (2) ODCM Surveillance Deficiencies.

ODCM Changes: There was one (1) changes made to the ODCM.

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.

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

0.0000250 mrem = BVPS Average Individual Dose for the year

296 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 1990 BEIR V Report.

Carbon-14 Dose Assessment: Carbon-14 dose was calculated using EPRI & RG-1.109 calculation methods and the default ODCM receptor. The highest organ doses were to the bone (child). Details of the dose assessment due to releases of Carbon-14 in gaseous effluents are provided in Attachment 3 of this report.

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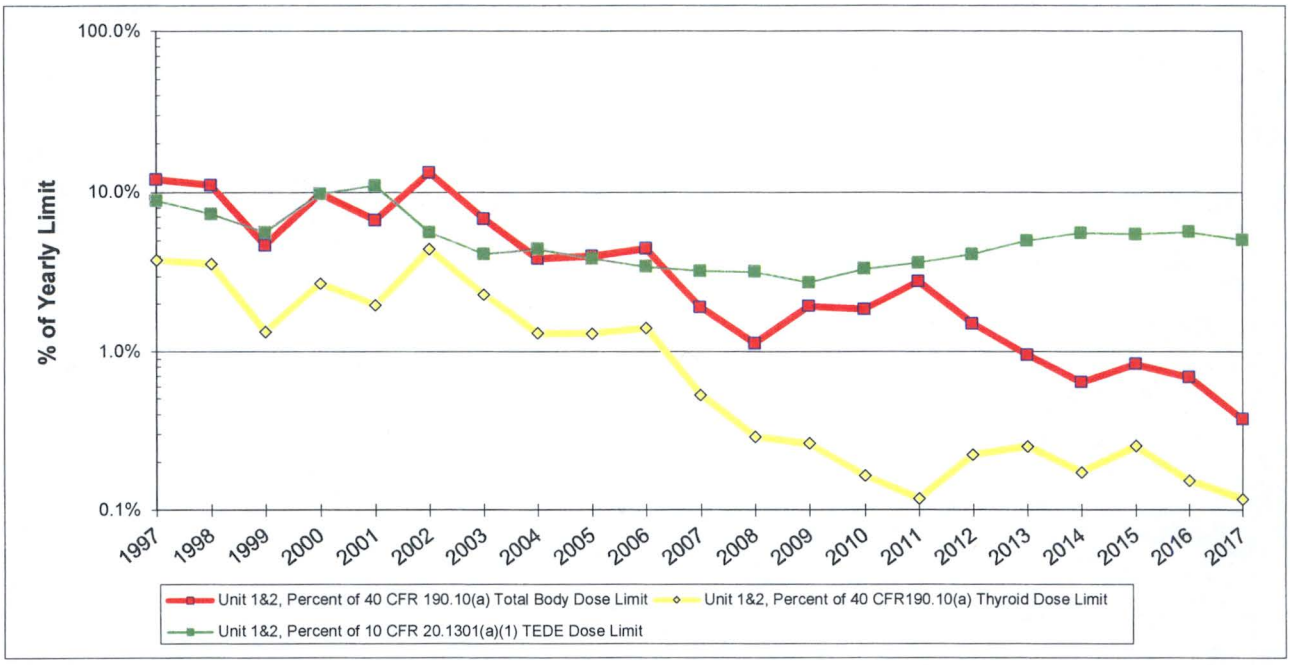
Executive Summary - Trends of Total Dose

Trends of Total Dose: 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.



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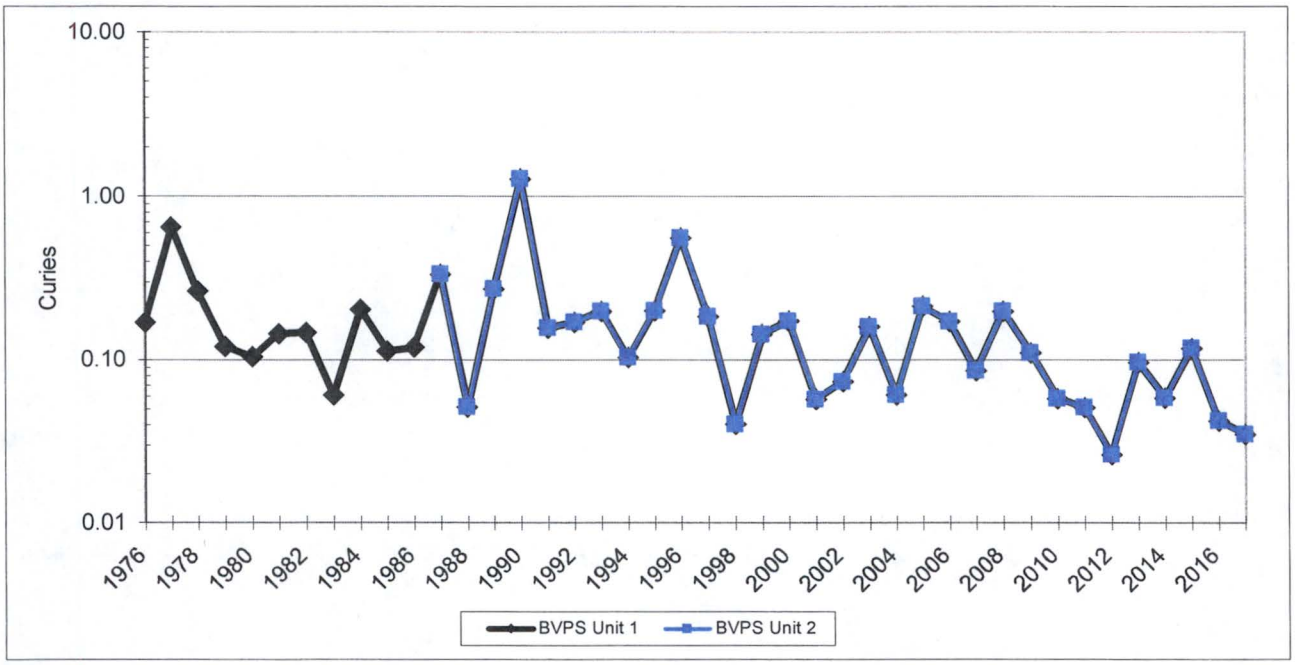
Executive Summary - Trends of Liquid Release Activity (Fission and Activation Products)

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.



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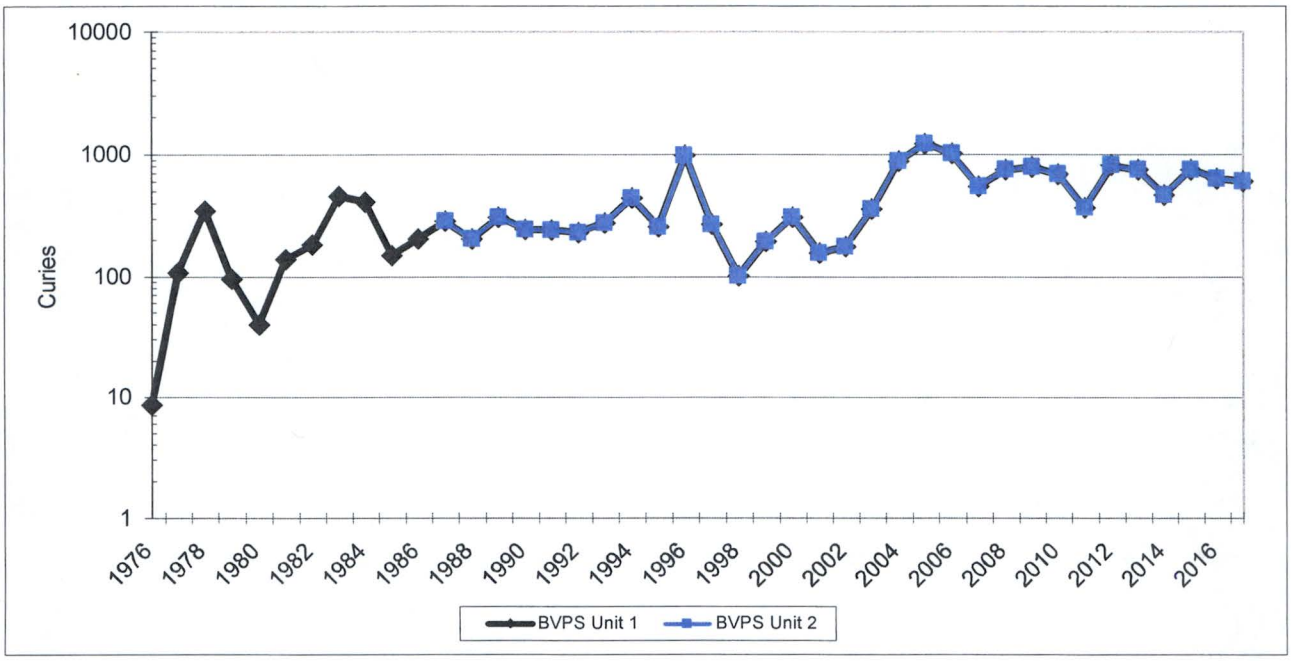
Executive Summary - Trends of Liquid Release Activity (Tritium)

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.



Annual Radioactive Effluent Release Report

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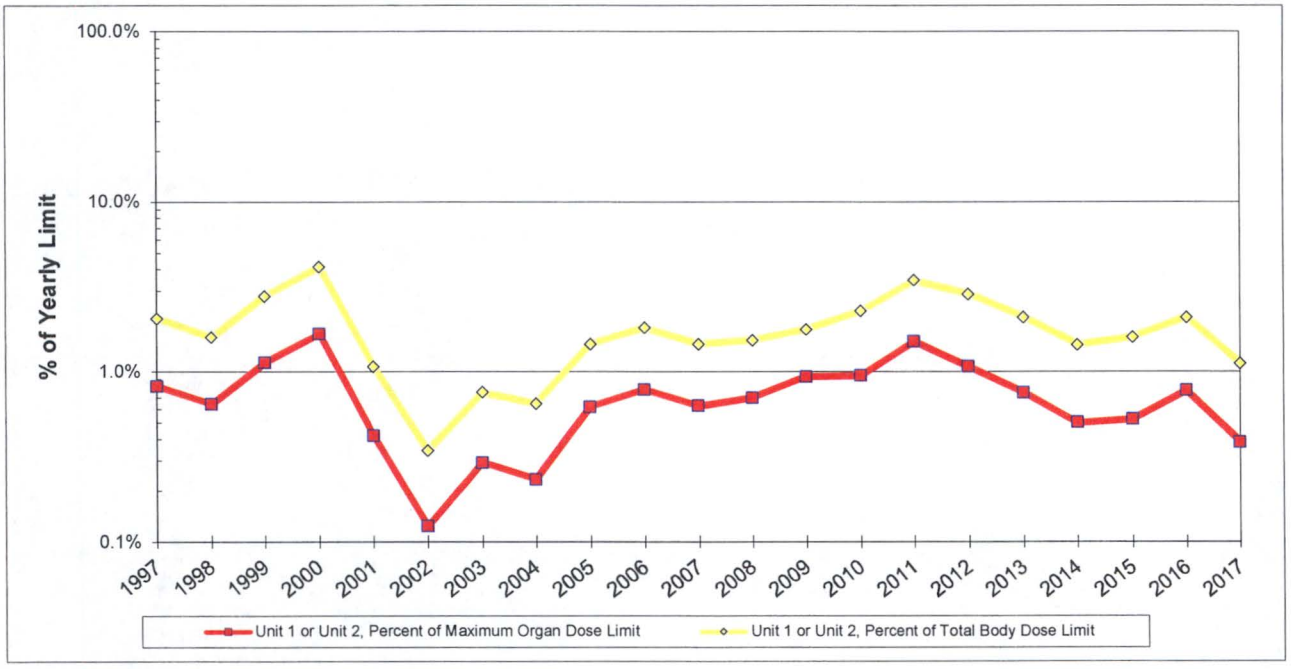
Executive Summary - Trends of Liquid Release Offsite Dose Projections

Liquid Release Offsite Dose Projections: 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.



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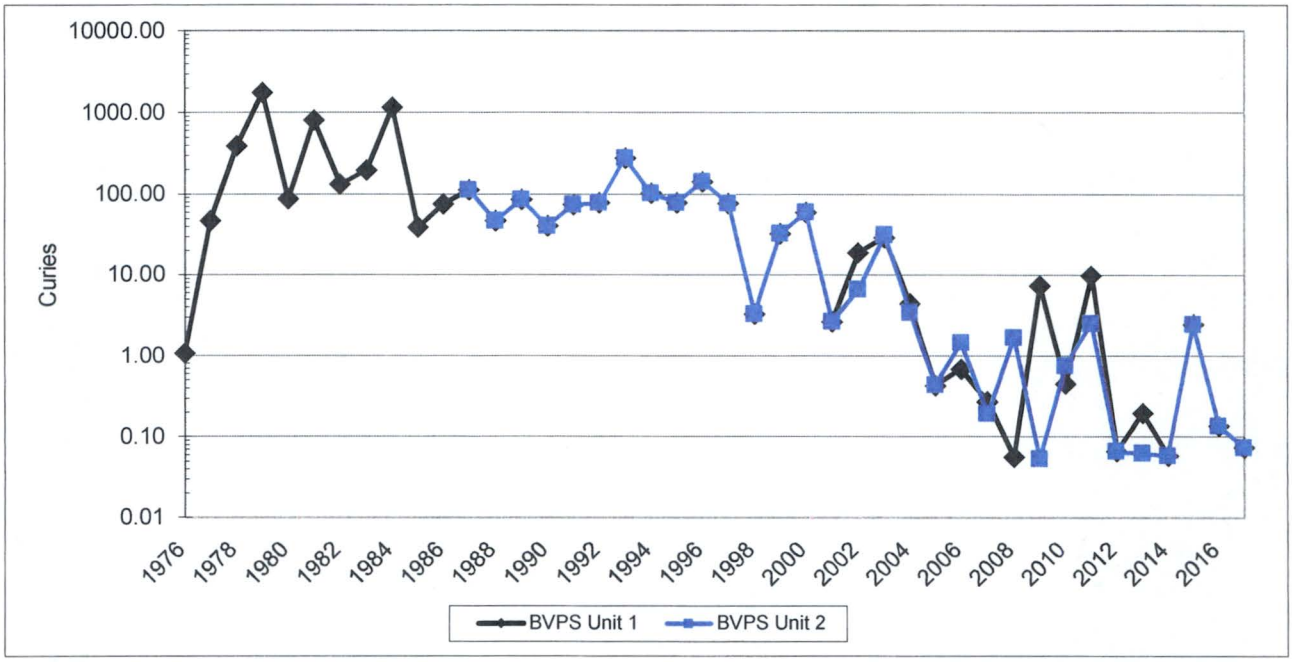
Executive Summary - Trends of Gaseous Release Activity (Fission and Activation Gas)

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.



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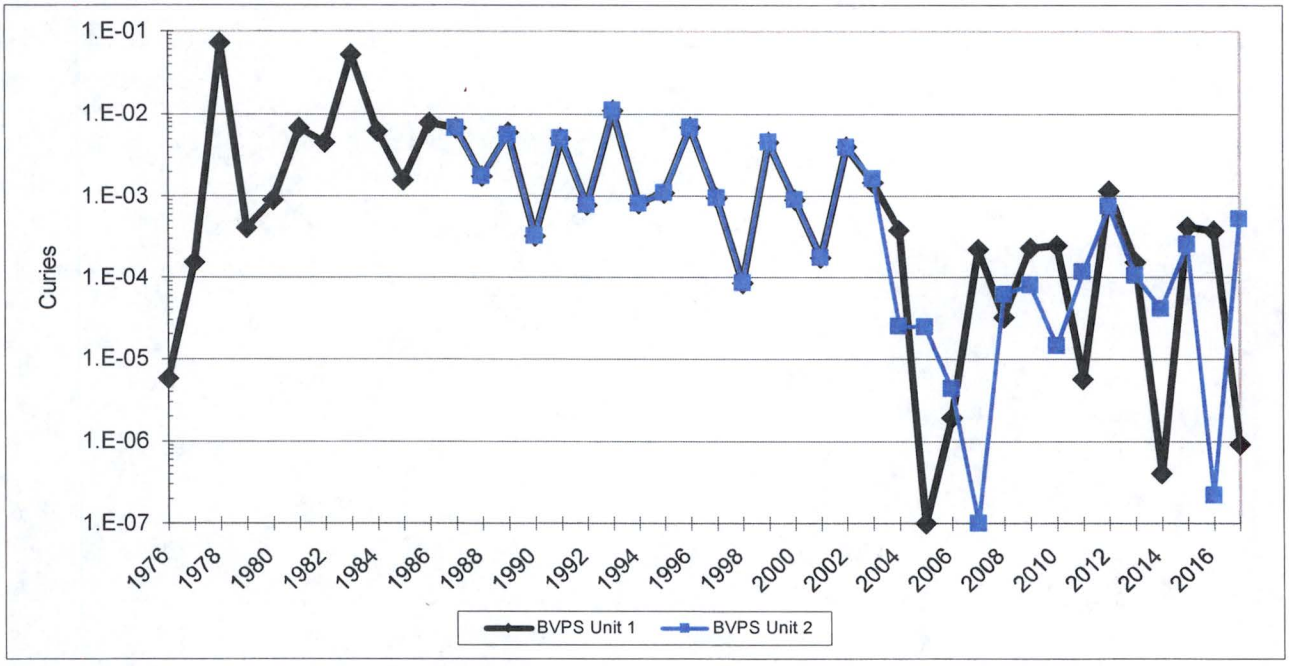
Executive Summary - Trends of Gaseous Release Activity (Particulates and Radioiodines)

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 differences between the units are relative to the outages that occured that year.



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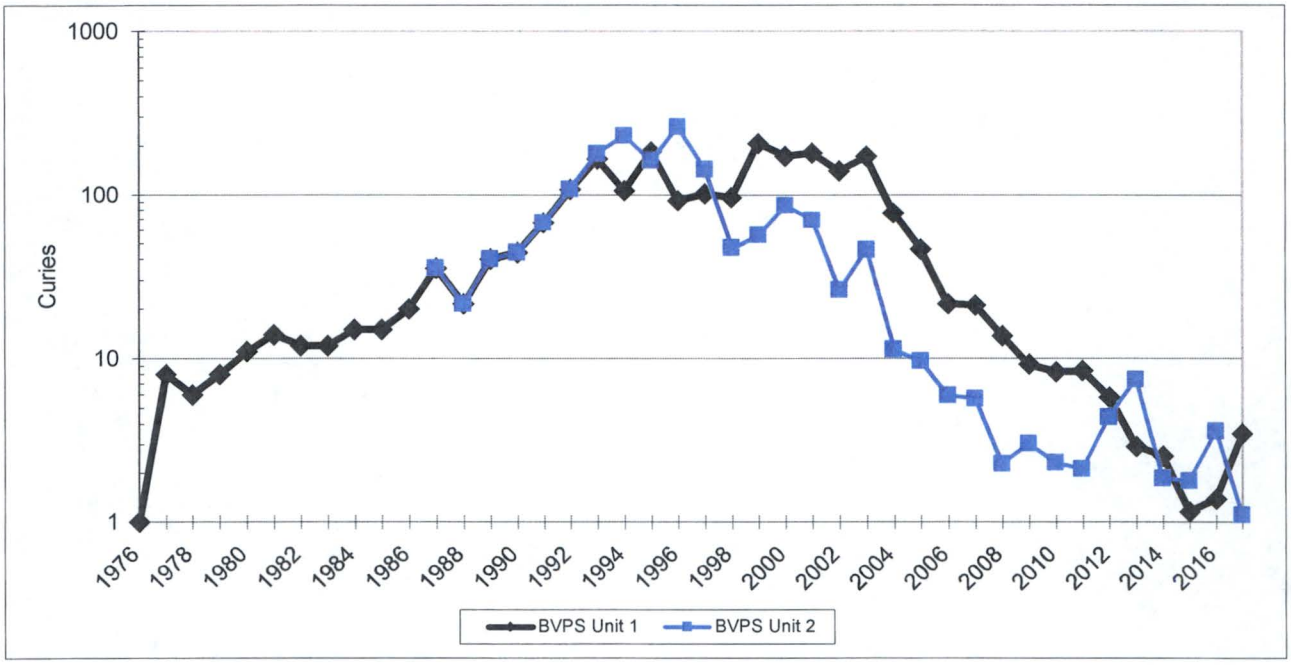
Executive Summary - Trends of Gaseous Release Activity (Tritium)

Gaseous Release Activity (Tritium): The following graph provides a comparison of total gaseous tritium discharged from the site from 1976 to present. The recent 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. The increase in Unit 1 tritium was due to the steam releases from the Forced Outage in November.



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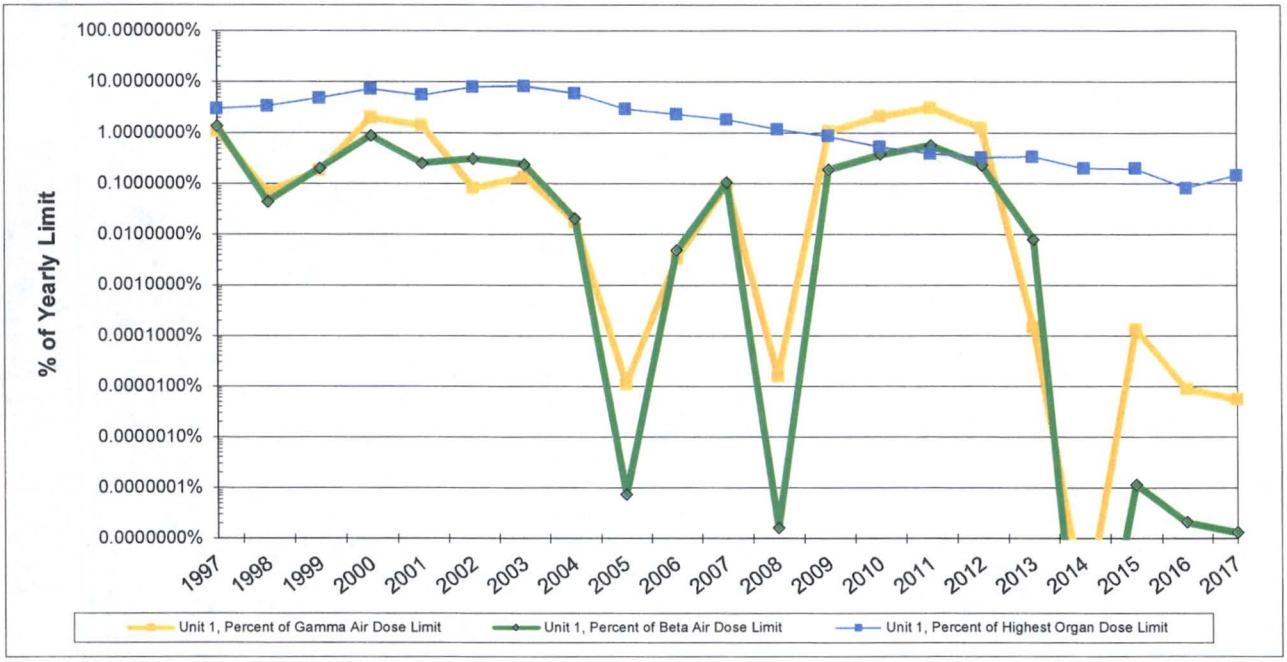
Executive Summary - Trends of Unit 1 Gaseous Release Offsite Dose Projections

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.



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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.

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Results of Abnormal Releases

Description of Abnormal Release(s)
Abnormal Liquid Releases: NONE **Abnormal Gaseous Releases:** There were two abnormal discharges are from the Unit 1 Force Outage that was due to a reactor trip caused by generator overcurrent. One discharge is from the Auxiliary Feedwater Terry Turbine trip valve and the other is for the Residual Heat Removal valves. These discharges were steam releases and are an expected response to a reactor trip. Tritium was the only radioactive isotope associated with them and no ODCM limits were exceeded (reference CR-2017-11134).

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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

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Results of Onsite Groundwater Monitoring Program

Summary of Onsite Groundwater Samples

	2017 H-3 Maximum (pCi/L)	2017 H-3 Minimum (pCi/L)	2017 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)	6517	148	611	<200	<2000	440	Yes	2000	20000
Fall (Q4)	14219	148	926	<200	<2000	440	Yes	2000	20000
MW-16	15516	5916	8894	<200	<2000	440	Yes	2000	20000

Tritium (H-3) Summary

In 2017, twenty three (23) on-site monitoring wells were sampled in the spring and fall sampling periods. No new wells were installed, nor were any wells retired. MW-16 was sampled twelve (12) times throughout 2017, 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 2017. Seven (7) wells returned results >440 pCi/L, but <2000 pCi/L. One (1) well returned results >2000 pCi/L. No wells exceeded 20,000 pCi/L with the highest concentration recorded as 15,516 pCi/L.

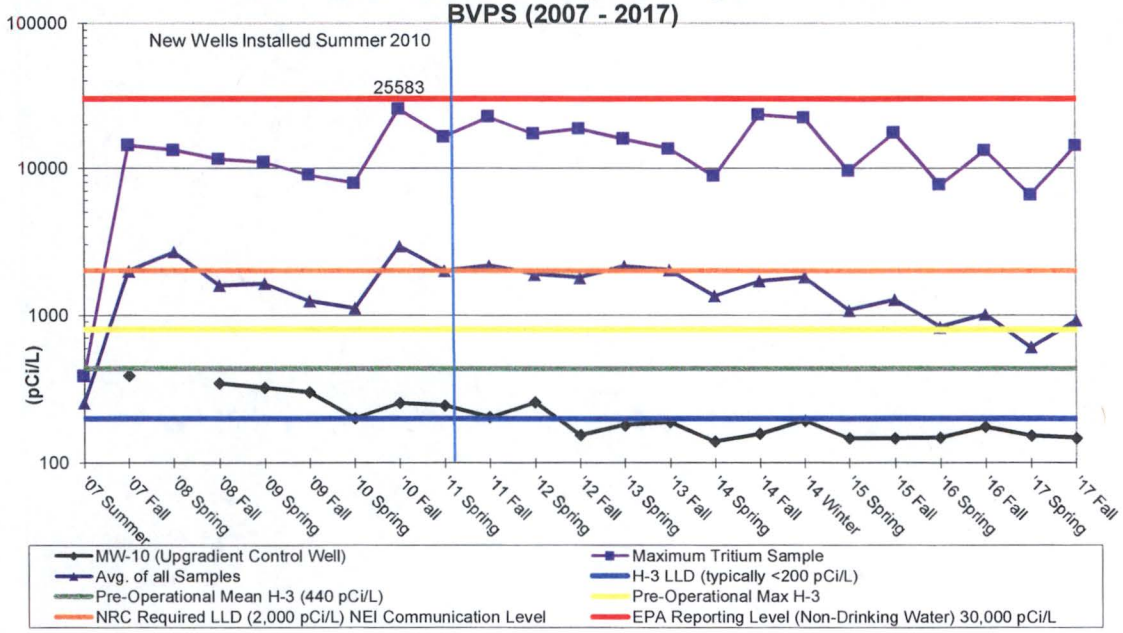
The NEI/FENOC communication level was reached for MW-12S & MW-12D during 2007. Notification to local, state & federal agencies was performed on 10/08/07. Additional communication for new well results was performed on 09/08/10 for those new wells that exceeded 2000 pCi/L. The newly installed well MW-20D 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

All onsite monitoring wells were sampled during the year, and analyzed for Principal Gamma Emitters. The results showed no positive indication of Licensed Radioactive Material (LRM) in any of the analyses.

Onsite Groundwater Monitoring Well Program H-3 Trends
BVPS (2007 - 2017)



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Corrections to previous Annual Radioactive Effluent Release Reports

Description of Corrections Made to RERR(s)
Correction(s) to Previous Annual Radioactive Effluent Release Reports: NONE

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Supplemental Information Page

FACILITY: B.V.P.S. Units 1 and 2

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		18	21	37	17	93
2. Total time period for batch releases	min	7466	13930	8741	7276	37413
3. Maximum time period for a batch release	min	3939	4135	4390	4445	4445
4. Average time period for batch releases	min	415	663	236	428	402
5. Minimum time period for a batch release	min	190	13	13	13	13
6. Average river flow during release periods	cuft/sec	74911	64447	25186	34803	49837
b. Gaseous Batch Releases						
1. Number of batch releases		6	12	2	5	25
2. Total time period for batch releases	min	4385	11405	282	7861	23933
3. Maximum time period for a batch release	min	3595	4972	176	7210	7210
4. Average time period for batch releases	min	731	950	141	1572	957
5. Minimum time period for a batch release	min	1	1	106	94	1
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	2	2
2. Total activity released	Ci	0.00E+00	0.00E+00	0.00E+00	1.78E+06	1.78E+06

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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	1.48E-01	0.00E+00	0.00E+00	1.48E-01	26.5%
1a. Unit 1 Gases	Ci	0.00E+00	7.41E-02	0.00E+00	0.00E+00	7.41E-02	
1b. Unit 2 Gases	Ci	0.00E+00	7.41E-02	0.00E+00	0.00E+00	7.41E-02	
2. Average release rate for period	uCi/sec	0.00E+00	1.88E-02	0.00E+00	0.00E+00	4.70E-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	0.00E+00	5.29E-04	5.17E-07	0.00E+00	5.30E-04	30.0%
1a. Unit 1 Particulates	Ci	0.00E+00	6.59E-07	2.59E-07	0.00E+00	9.18E-07	
1b. Unit 2 Particulates	Ci	0.00E+00	5.29E-04	2.59E-07	0.00E+00	5.29E-04	
2. Average release rate for period	uCi/sec	0.00E+00	6.72E-05	6.57E-08	0.00E+00	1.68E-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	5.82E-01	4.26E-01	8.10E-01	2.76E+00	4.58E+00	32.9%
1a. Unit 1 Tritium	Ci	2.45E-01	3.52E-01	5.84E-01	2.29E+00	3.47E+00	
1b. Unit 2 Tritium	Ci	3.38E-01	7.41E-02	2.26E-01	4.69E-01	1.11E+00	
2. Average release rate for period	uCi/sec	7.39E-02	5.41E-02	1.03E-01	3.50E-01	1.45E-01	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
F. Carbon-14							
1. Site Total release	Ci	4.59E+00	3.81E+00	4.69E+00	4.54E+00	1.76E+01	41.1%
1a. Unit 1 Carbon-14	Ci	2.30E+00	2.33E+00	2.35E+00	2.20E+00	9.18E+00	
1b. Unit 2 Carbon-14	Ci	2.29E+00	1.48E+00	2.34E+00	2.34E+00	8.45E+00	
2. Average release rate for period	uCi/sec	5.83E-01	4.83E-01	5.95E-01	5.76E-01	5.59E-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).

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1B-EB

Gaseous Effluents - Elevated Batch Releases (Unit 1 & 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. Fission gases						
argon-41	Ci	LLD	8.53E-06	LLD	LLD	8.53E-06
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	1.93E-03	LLD	LLD	1.93E-03
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	7.45E-04	LLD	LLD	7.45E-04
xenon-135m	Ci	LLD	8.16E-05	LLD	LLD	8.16E-05
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	2.77E-03	ND	ND	2.77E-03
B. 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
C. Particulates						
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
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND

NOTE: Unit 1/2 Process Vent

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1B-EC

Gaseous Effluents - Elevated Continuous Releases (Unit 1 & 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. 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	1.45E-01	LLD	LLD	1.45E-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
Total for period	Ci	ND	1.45E-01	ND	ND	1.45E-01
B. 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
C. Particulates						
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
selenium-75	Ci	LLD	1.32E-06	5.17E-07	LLD	1.84E-06
zirconium/niobium-95	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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	1.32E-06	5.17E-07	ND	1.84E-06

NOTE: Unit 1/2 Process Vent

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1C-GB1

Gaseous Effluents - Ground Level Batch Releases (Unit 1)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. 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
Total for period	Ci	ND	ND	ND	ND	ND
B. 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
C. Particulates						
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
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND

NOTE: Unit 1 Ventilation & Containment Vent

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1C-GC1

Gaseous Effluents - Ground Level Continuous Releases (Unit 1)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. 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
Total for period	Ci	ND	ND	ND	ND	ND
B. 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
C. Particulates						
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
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND

NOTE: Unit 1 Ventilation & Containment Vent

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1C-GB2

Gaseous Effluents - Ground Level Batch Releases (Unit 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. 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
Total for period	Ci	ND	ND	ND	ND	ND
B. 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
C. Particulates						
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
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND

NOTE: Unit 2 Ventilation, Containment, Decontamination Bldg, Waste Gas Vault, & Condensate Polishing Bldg. Vent

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 1C-GC2

Gaseous Effluents - Ground Level Continuous Releases (Unit 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. 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
Total for period	Ci	ND	ND	ND	ND	ND
B. 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
C. Particulates						
chromium-51	Ci	LLD	1.24E-04	LLD	LLD	1.24E-04
manganese-54	Ci	LLD	2.58E-06	LLD	LLD	2.58E-06
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	2.83E-04	LLD	LLD	2.83E-04
cobalt-60	Ci	LLD	3.29E-05	LLD	LLD	3.29E-05
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	LLD	8.56E-05	LLD	LLD	8.56E-05
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
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	5.28E-04	ND	ND	5.28E-04

NOTE: Unit 2 Ventilation, Containment, Decontamination Bldg, Waste Gas Vault, & Condensate Polishing Bldg. Vent
LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).
ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017
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	1.10E-02	3.62E-02	1.93E-02	4.39E-03	7.09E-02	26.1%
2. Average diluted concentration	uCi/mL	2.65E-09	7.94E-09	4.37E-09	1.02E-09	4.06E-09	
3. Percent of applicable limit	%	4.42E-01	1.45E+00	7.72E-01	1.76E-01	7.09E-01	
B. Tritium							
1. Total release	Ci	2.20E+02	3.18E+02	2.03E+02	4.79E+02	1.22E+03	25.0%
2. Average diluted concentration	uCi/mL	5.28E-05	6.97E-05	4.59E-05	1.11E-04	6.99E-05	
3. Percent of applicable limit	%	5.28E-01	6.97E-01	4.59E-01	1.11E+00	6.99E-01	
C. Dissolved and entrained gases							
1. Total release	Ci	ND	1.27E-04	ND	ND	1.27E-04	27.0%
2. Average diluted concentration	uCi/mL		2.78E-11			7.26E-12	
3. Percent of applicable limit	%		1.39E-05			3.63E-06	
D. Gross alpha radioactivity (total release)	Ci	LLD	LLD	LLD	LLD	LLD	28.9%
E. Volume of waste released (prior to dilution)	L	1.26E+07	1.34E+07	1.32E+07	1.27E+07	5.19E+07	11.2%
F. Volume of dilution water used	L	4.16E+09	4.54E+09	4.41E+09	4.30E+09	1.74E+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)

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 2B-B

Liquid Effluents - Batch Releases

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. Fission & Activation Products						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
sodium-24	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	LLD	2.58E-03	5.50E-05	LLD	2.63E-03
manganese-54	Ci	2.20E-04	3.23E-04	3.47E-03	1.07E-05	4.02E-03
iron-59	Ci	LLD	LLD	9.71E-06	LLD	9.71E-06
cobalt-57	Ci	3.73E-05	5.05E-05	4.30E-05	1.14E-05	1.42E-04
cobalt-58	Ci	5.64E-04	1.47E-02	5.91E-03	1.11E-03	2.23E-02
cobalt-60	Ci	4.82E-03	5.76E-03	2.29E-03	5.57E-04	1.34E-02
zinc-65	Ci	2.19E-05	LLD	LLD	LLD	2.19E-05
zirconium/niobium-95	Ci	LLD	9.21E-04	2.04E-04	3.70E-05	1.16E-03
zirconium/niobium-97	Ci	6.07E-06	LLD	2.66E-05	3.07E-05	6.33E-05
molybdenum-99/technetium-99m	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	2.45E-03	1.66E-03	3.50E-04	7.55E-05	4.53E-03
tin-113	Ci	LLD	1.85E-04	LLD	LLD	1.85E-04
tin-117m	Ci	LLD	LLD	LLD	LLD	LLD
antimony-122	Ci	LLD	5.08E-05	LLD	LLD	5.08E-05
antimony-124	Ci	LLD	3.60E-04	1.79E-04	LLD	5.38E-04
antimony-125	Ci	1.61E-03	5.76E-03	2.98E-03	1.16E-03	1.15E-02
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	3.48E-05	8.00E-05	8.71E-07	2.77E-06	1.18E-04
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
iron-55	Ci	1.28E-03	3.77E-03	3.78E-03	1.40E-03	1.02E-02
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	1.10E-02	3.62E-02	1.93E-02	4.39E-03	7.09E-02
B. Tritum						
hydrogen-3	Ci	2.20E+02	3.17E+02	2.02E+02	4.79E+02	1.22E+03
Total for period	Ci	2.20E+02	3.17E+02	2.02E+02	4.79E+02	1.22E+03
C. Dissolved & Entrained Gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	1.27E-04	LLD	LLD	1.27E-04
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	1.27E-04	ND	ND	1.27E-04

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

ND = None Detected

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Table 2B-C

Liquid Effluents - Continuous Releases

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
A. Fission & Activation Products						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
sodium-24	Ci	LLD	LLD	LLD	LLD	LLD
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
zirconium/niobium-95	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-97	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99/technetium-99m	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	LLD	LLD	LLD	LLD	LLD
antimony-122	Ci	LLD	LLD	LLD	LLD	LLD
antimony-124	Ci	LLD	LLD	LLD	LLD	LLD
antimony-125	Ci	LLD	LLD	LLD	LLD	LLD
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	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
iron-55	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
B. Tritum						
hydrogen-3	Ci	1.43E-01	1.82E-01	2.69E-01	2.33E-01	8.28E-01
Total for period	Ci	1.43E-01	1.82E-01	2.69E-01	2.33E-01	8.28E-01
C. Dissolved & Entrained Gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	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
Total for period	Ci	ND	ND	ND	ND	ND

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

ND = None Detected

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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		12.40 m^3	11.52 m^3	0.0% (1)
b. Volume Buried		2.80 m^3	8.80 m^3	0.0% (1)
c. Total Activity		43.10 Ci	36.36 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		1.08 %	1.64 %	
C-14		4.41 %	2.48 %	
Mn-54		0.416 %	0.88 %	
Fe-55		9.68 %	7.72 %	
Co-58		6.98 %	2.01 %	
Co-60		13.22 %	19.04 %	
Ni-59		0.694 %	0.34 %	
Ni-63		58.80 %	60.84 %	
Zn-65		0.327 %	0.48 %	
Zr-95		0.38 %	0.11 %	
Nb-95		0.786 %	0.24 %	
Sb-125		1.61 %	3.03 %	
Cs-137		0.38 %	0.64 %	
3. Number of Shipments		7	4	
a. Type of Container Used	LSA	7	4	
	Type A	0	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	UreaFormaldehyde	0	0	
	None	7	4	
c. Mode of Transport	Truck	7	4	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	6	3	
	Erwin, TN	1	1	
e. Waste Class per 10 CFR Part 61	Class A	2	4	
	Class B	1	0	
	Class C	4	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.

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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		275.00 m^3	366.13 m^3	0.0% (1)
b. Volume Buried		28.82 m^3	27.20 m^3	0.0% (1)
c. Total Activity		0.63 Ci	1.73 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		4.34 %	0.10 %	
C-14		1.19 %	1.48 %	
Cr-51		0.41 %	0.085 %	
Mn-54		0.57 %	0.36 %	
Fe-55		28.1 %	21.30 %	
Co-58		15.54 %	4.57 %	
Co-60		18.6 %	14.62 %	
Ni-59		0.07 %	0.0 %	
Ni-63		26.9 %	0.2 %	
Zn-65		0.03 %	0.0 %	
Zr-95		0.61 %	0.2 %	
Nb-95		1.0 %	0.39 %	
Ag-110m		0.08 %	0.13 %	
Sn-113		0.0 %	0.002 %	
Sb-125		1.37 %	2.17 %	
Cs-134		0.0 %	0.5 %	
Cs-137		8.0 %	7.0 %	
3. Number of Shipments		6	5	
a. Type of Container Used	LSA	6	5	
	Type A	0	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	UreaFormaldehyde	0	0	
	None	6	5	
c. Mode of Transport	Truck	6	5	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	6	5	
	Wampum, PA	0	0	
e. Waste Class per 10 CFR Part 61	Class A	6	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.

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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		m^3	m^3	
b. Volume Buried		m^3	m^3	
c. Total Activity		Ci	Ci	0.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table[2]		Percent (%)	Percent (%)	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
		%	%	
3. Number of Shipments				
a. Type of Container Used	LSA			
	Type A			
	Type B			
	Large Quantity			
b. Solidification Agent Used	Cement			
	UreaFormaldehyde			
	None			
c. Mode of Transport	Truck			
	Rail			
	Other			
d. Final Destination	Oak Ridge, TN			
	Barnwell, SC			
e. Waste Class per 10 CFR Part 61	Class A			
	Class B			
	Class C			
	> Class C			

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.

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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	7.33E-08	1E-04	1.63E-08	5E-07	3.41E-13	1E-11
Ar-41	1.09E-07	1E-04	2.42E-08	5E-07		
Cr-51	3.29E-07	1E-04	7.98E-08	5E-07	9.11E-13	1E-11
Mn-54	5.35E-08	1E-04	1.22E-08	5E-07	1.63E-13	1E-11
Fe-55			(1) 1.00E-06	1E-06		
Fe-59	1.15E-07	1E-04	2.59E-08	5E-07	2.91E-13	1E-11
Co-57	4.61E-08	1E-04	1.25E-08	5E-07	7.44E-14	1E-11
Co-58	4.71E-08	1E-04	1.07E-08	5E-07	1.99E-13	1E-11
Co-60	5.29E-08	1E-04	1.18E-08	5E-07	2.99E-13	1E-11
Zn-65	1.77E-07	1E-04	3.96E-08	5E-07	5.74E-13	1E-11
Se-75					9.33E-14	1E-11
Kr-85	1.21E-05	1E-04	2.86E-06	1E-05		
Kr-85m	6.17E-08	1E-04	1.60E-08	1E-05		
Kr-87	1.22E-07	1E-04	2.93E-08	1E-05		
Kr-88	1.78E-07	1E-04	4.48E-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	2.71E-08	5E-07	2.26E-13	1E-11
Nb-95	6.75E-08	1E-04	1.55E-08	5E-07	1.43E-13	1E-11
Nb-97	7.44E-08	1E-04	1.72E-08	5E-07	1.47E-13	1E-11
Zr-95	1.00E-07	1E-04	2.30E-08	5E-07	2.76E-13	1E-11
Mo-99	5.37E-07	1E-04	1.23E-07	5E-07	1.70E-12	1E-11
Tc-99m	4.80E-08	1E-04	1.27E-08	5E-07	8.92E-14	1E-11
Ag-110m	6.64E-08	1E-04	1.54E-08	5E-07	1.40E-13	1E-11
Sb-124	5.43E-08	1E-04	1.27E-08	5E-07	1.80E-13	1E-11
Sb-125	1.62E-07	1E-04	3.87E-08	5E-07	2.97E-13	1E-11
I-131	6.27E-08	1E-04	1.51E-08	1E-06	1.25E-13	1E-12
I-133	4.42E-08	1E-04	1.04E-08	5E-07	1.98E-13	1E-10
I-135	3.45E-07	1E-04	7.68E-08	5E-07	6.95E-13	1E-11
Xe-131m	1.89E-06	1E-04	4.85E-07	1E-05		
Xe-133	1.29E-07	1E-04	4.32E-08	1E-05		
Xe-133m	3.99E-07	1E-04	9.87E-08	1E-05		
Xe-135	4.24E-08	1E-04	1.04E-08	1E-05		
Xe-135m	7.71E-08	1E-04	1.81E-08	1E-05		
Xe-137	7.07E-07	1E-04	1.68E-07	1E-05		
Xe-138	2.16E-07	1E-04	5.30E-08	1E-05		
Cs-134	4.73E-08	1E-04	1.10E-08	5E-07	1.28E-13	1E-11
Cs-137	7.11E-08	1E-04	1.64E-08	5E-07	1.49E-13	1E-11
Ba-139	1.90E-07	1E-04	4.87E-08	5E-07	2.67E-13	1E-11
Ba-140	1.58E-07	1E-04	3.71E-08	5E-07	3.79E-13	1E-11
La-140	6.94E-08	1E-04	1.55E-08	5E-07	2.82E-13	1E-11
Ce-141	8.32E-08	1E-04	2.18E-08	5E-07	1.66E-13	1E-11
Ce-144	3.19E-07	1E-04	8.52E-08	5E-07	8.47E-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 are for Unit 2 Detector 2, except those denoted by (1), are from a counter/detector calibration on 11/16/17. 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.

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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	5.94E-04	0.0119	2.13E-03	0.0426	4.27E-05	0.0009	7.78E-05	0.0016	2.85E-03	0.0285
O	Liver	6.96E-03	0.1392	1.55E-02	0.3110	6.17E-03	0.1235	6.05E-03	0.1209	3.47E-02	0.3473
R	Total Body	6.70E-03	0.4469	1.48E-02	0.9880	6.18E-03	0.4123	6.01E-03	0.4007	3.37E-02	1.1239
G	Thyroid	6.10E-03	0.1220	1.31E-02	0.2619	6.08E-03	0.1217	5.96E-03	0.1192	3.12E-02	0.3124
A	Kidney	6.39E-03	0.1278	1.38E-02	0.2758	6.09E-03	0.1219	5.98E-03	0.1195	3.23E-02	0.3225
N	Lung	6.18E-03	0.1237	1.34E-02	0.2680	6.10E-03	0.1219	5.98E-03	0.1197	3.17E-02	0.3166
(1)	GI-LLI	7.15E-03	0.1430	1.84E-02	0.3681	6.93E-03	0.1386	6.14E-03	0.1228	3.86E-02	0.3863

		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	5.59E-07	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	5.59E-07	0.0000
(2)	Beta Air	0.00E+00	0.0000	2.65E-09	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	2.65E-09	0.0000
	Bone	0.00E+00	0.0000	3.65E-09	0.0000	1.38E-08	0.0000	0.00E+00	0.0000	1.74E-08	0.0000
O	Liver	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477
R	Total Body	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477
G	Thyroid	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477
A	Kidney	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477
N	Lung	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477
(3)	GI-LLI	2.82E-03	0.0376	3.72E-03	0.0496	5.31E-03	0.0708	1.03E-02	0.1374	2.22E-02	0.1477

(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).

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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	5.94E-04	0.0119	2.13E-03	0.0426	4.27E-05	0.0009	7.78E-05	0.0016	2.85E-03	0.0285
O	Liver	6.96E-03	0.1392	1.55E-02	0.3110	6.17E-03	0.1235	6.05E-03	0.1209	3.47E-02	0.3473
R	Total Body	6.70E-03	0.4469	1.48E-02	0.9880	6.18E-03	0.4123	6.01E-03	0.4007	3.37E-02	1.1239
G	Thyroid	6.10E-03	0.1220	1.31E-02	0.2619	6.08E-03	0.1217	5.96E-03	0.1192	3.12E-02	0.3124
A	Kidney	6.39E-03	0.1278	1.38E-02	0.2758	6.09E-03	0.1219	5.98E-03	0.1195	3.23E-02	0.3225
N	Lung	6.18E-03	0.1237	1.34E-02	0.2680	6.10E-03	0.1219	5.98E-03	0.1197	3.17E-02	0.3166
(1)	GI-LLI	7.15E-03	0.1430	1.84E-02	0.3681	6.93E-03	0.1386	6.14E-03	0.1228	3.86E-02	0.3863

		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	5.59E-07	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	5.59E-07	0.0000
(2)	Beta Air	0.00E+00	0.0000	2.65E-09	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	2.65E-09	0.0000
	Bone	0.00E+00	0.0000	3.67E-04	0.0049	1.38E-08	0.0000	0.00E+00	0.0000	3.67E-04	0.0024
O	Liver	8.84E-04	0.0118	9.35E-04	0.0125	7.60E-04	0.0101	8.60E-04	0.0115	3.44E-03	0.0229
R	Total Body	8.84E-04	0.0118	9.62E-04	0.0128	7.60E-04	0.0101	8.60E-04	0.0115	3.47E-03	0.0231
G	Thyroid	8.84E-04	0.0118	9.20E-04	0.0123	7.60E-04	0.0101	8.60E-04	0.0115	3.42E-03	0.0228
A	Kidney	8.84E-04	0.0118	9.22E-04	0.0123	7.60E-04	0.0101	8.60E-04	0.0115	3.43E-03	0.0228
N	Lung	8.84E-04	0.0118	1.42E-03	0.0190	7.60E-04	0.0101	8.60E-04	0.0115	3.93E-03	0.0262
(3)	GI-LLI	8.84E-04	0.0118	1.03E-03	0.0137	7.60E-04	0.0101	8.60E-04	0.0115	3.53E-03	0.0236

(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).

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Table 6

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

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

1) Unit 1 Main Steam Effluent Monitor, RM-1MS-100C

On 03/25/17 the monitor was taken out of service to inspect and repair with regards to spiking. It was determined that the detector and preamp were to be replaced. Due to the location of the detector, it must be replaced during an outage. The monitor is currently out of service and is scheduled to be replaced during 1R25. (reference CR-2017-04541).

2) Unit 1 Liquid Waste Effluent Monitor, RM-1LW-104

On 11/26/17 the monitor was taken out of service in support of ECP 16-0113-001 that would replace and install new digital rate meters. Due to Engineering and vendor issues with parts, the replacement was delayed. The monitor was returned to service on 02/01/2018 (reference CR-2017-12446).

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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	Effluent Dose [1] (mrem)	Direct Radiation Dose [2] (mrem)	Total Dose (mrem)	% of ODCM or 40 CFR 190 Limit
Bone	6.06E-03	0.00E+00	6.06E-03	0.02%
Liver	9.50E-02	0.00E+00	9.50E-02	0.38%
Total Body	9.30E-02	0.00E+00	9.30E-02	0.37%
Thyroid	8.80E-02	0.00E+00	8.80E-02	0.12%
Kidney	9.01E-02	0.00E+00	9.01E-02	0.36%
Lung	8.94E-02	0.00E+00	8.94E-02	0.36%
GI-LLI	1.03E-01	0.00E+00	1.03E-01	0.41%

(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 5.06 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 =	99.96	man-mrem (Total Body)
0-50 mile Average Population Dose from liquid and gaseous effluents =	0.0000250	man-mrem (Total Body)

Annual Radioactive Effluent Release Report

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Table 8

Offsite Dose Calculation Manual Surveillance Deficiencies

There were three Offsite Dose Calculation Manual Surveillance Deficiencies during this report period.

1) Main Steam Cable Vault (Fire Sump) sample
On 5/22/17 the main steam cable vault was discharged. Two independent samples were obtained by Radiation Protection and no isotopes were identified. However, the samples were discarded before Chemistry could analyze them for tritium. The discharge was documented and based on the tritium from the most recent sump discharge (reference CR-2017-07282).

2) Catch Basin (Yard Drain) Sample
Catch Basin 17A, 1CB-17A, is sampled annually. During Q4 2017, there was no flow observed at this location and no sample could be obtained. This location is the first sample point of the yard drains around Unit 1 and samples were obtained downstream of 1CB-17A and had no LRM detected. (reference CR-2018-00126)

3) Beaver Valley Representative Sampling
It was determined that, due to incorrectly sized nozzles and variations the ventilation stack flows, the effluent monitor sampling skid does not provide representative sampling of particulate isotopes (especially of larger particle sizes) under all normally occurring ventilation conditions at all of Unit 1 pathways and Unit 2 Ventilation Vent and Condensate Polishing Building Vent pathways. This condition was identified and questioned during a Unit 1 sample pump replacement in April 2017. Due to the limited amount of particulate that is released from the site, it does not significantly affect dose or dose rates to the public, nor challenge any regulatory limits (reference CR-2017-04211).

Annual Radioactive Effluent Release Report

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Table 9

Offsite Dose Calculation Manual Changes (Description)

There was one (1) change 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:

1) Change (41) to the ODCM (Effective January 2017)

<> Procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History of ODCM Changes" (Rev 24)
Updated the History of ODCM changes to include this change

<> Procedure 1/2-ODC-2.03, "ODCM: Radiological Environmental Monitoring Program " (Rev 8)
Updated for the relocation of waterbourne surface sample location from #2.1 to #5 and added milk sample location #114. Maps for all sample locations were updated.

ENCLOSURE 2, ATTACHMENT 1

Annual Radioactive Effluent Release Report

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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
99.5% = Wind Speed 35'
98.1% = Wind Speed 150'
99.9% = Wind Speed 500'
99.9% = Wind Direction 35'
99.9% = Wind Direction 150'
99.8% = Wind Direction 500'
99.8% = Delta Temperature (150' - 35') 1P
99.8% = Delta Temperature (500' - 35') 2P
99.8% = Temperature 35'
99.9% = Precipitation
99.6% = Average Recovery of Individual Meteorological Parameters
PERCENT RECOVERY OF COMPOSITE VARIABLES
99.7% = Wind Speed 35', Wind Direction 35', Delta Temperature 1P
98.1% = Wind Speed 150', Wind Direction 150', Delta Temperature 1P
99.7% = Wind Speed 500', Wind Direction 500', Delta Temperature 2P
99.5% = 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 two Abnormal Gaseous Releases during the calendar year, neither exceeded design objectives.
For a copy of the hourly meteorological data during the calendar quarters, contact Radiological Effluents Administrator at 724-682-4255.

Annual Radioactive Effluent Release Report

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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 = 01/01/2017 01:00 - 12/31/2017 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	43	42	0	0	0	0	85
NNE	34	28	0	0	0	0	62
NE	41	7	0	0	0	0	48
ENE	59	18	0	0	0	0	77
E	25	24	0	0	0	0	49
ESE	30	7	0	0	0	0	37
SE	31	9	0	0	0	0	40
SSE	11	6	0	0	0	0	17
S	21	24	1	0	0	0	46
SSW	19	49	9	0	0	0	77
SW	26	66	24	0	0	0	116
WSW	32	104	17	0	0	0	153
W	39	143	17	0	0	0	199
WNW	47	98	6	0	0	0	151
NW	52	50	2	0	0	0	104
NNW	35	44	0	0	0	0	79
Total	545	719	76	0	0	0	1340

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1340
Total Hours for the Period:			8759

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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 = 01/01/2017 01:00 - 12/31/2017 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	9	4	0	0	0	0	13
NNE	2	5	0	0	0	0	7
NE	7	0	0	0	0	0	7
ENE	10	4	0	0	0	0	14
E	4	1	0	0	0	0	5
ESE	2	0	0	0	0	0	2
SE	4	1	0	0	0	0	5
SSE	5	2	0	0	0	0	7
S	2	3	0	0	0	0	5
SSW	2	9	7	0	0	0	18
SW	2	9	13	3	0	0	27
WSW	7	24	8	1	0	0	40
W	8	20	6	0	0	0	34
WNW	5	8	1	0	0	0	14
NW	9	6	1	0	0	0	16
NNW	2	4	0	0	0	0	6
Total	80	100	36	4	0	0	220

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	220
Total Hours for the Period:			8759

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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 = 01/01/2017 01:00 - 12/31/2017 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	8	9	0	0	0	0	17
NNE	5	2	0	0	0	0	7
NE	4	1	0	0	0	0	5
ENE	10	0	0	0	0	0	10
E	6	4	0	0	0	0	10
ESE	8	0	0	0	0	0	8
SE	4	0	0	0	0	0	4
SSE	3	0	0	0	0	0	3
S	4	1	0	0	0	0	5
SSW	1	9	0	0	0	0	10
SW	3	11	14	0	0	0	28
WSW	6	22	10	0	0	0	38
W	9	24	4	0	0	0	37
WNW	6	16	2	0	0	0	24
NW	8	11	1	0	0	0	20
NNW	7	7	0	0	0	0	14
Total	92	117	31	0	0	0	240

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	240
Total Hours for the Period:			8759

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Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	58	36	0	0	0	0	94
NNE	60	14	0	0	0	0	74
NE	66	4	0	0	0	0	70
ENE	82	14	0	0	0	0	96
E	55	3	0	0	0	0	58
ESE	34	2	0	0	0	0	36
SE	47	1	0	0	0	0	48
SSE	38	8	0	0	0	0	46
S	45	45	1	0	0	0	91
SSW	48	64	16	0	0	0	128
SW	84	199	119	8	0	0	410
WSW	75	185	84	9	0	0	353
W	73	237	64	4	0	0	378
WNW	85	144	13	0	0	0	242
NW	90	94	6	0	0	0	190
NNW	74	61	5	0	0	0	140
Total	1014	1111	308	21	0	0	2454

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2454
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2017 01:00 - 12/31/2017 23:00 **All Hours**

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	68	10	0	0	0	0	78
NNE	84	3	0	0	0	0	87
NE	160	4	0	0	0	0	164
ENE	197	25	0	0	0	0	222
E	170	2	0	0	0	0	172
ESE	133	1	0	0	0	0	134
SE	113	0	0	0	0	0	113
SSE	122	3	0	0	0	0	125
S	141	28	3	0	0	0	172
SSW	170	63	9	0	0	0	242
SW	123	110	45	2	0	0	280
WSW	82	92	37	5	0	0	216
W	48	82	18	0	0	0	148
WNW	61	40	7	0	0	0	108
NW	61	26	0	0	0	0	87
NNW	102	19	0	0	0	0	121
Total	1835	508	119	7	0	0	2469

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2469
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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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 = 01/01/2017 01:00 - 12/31/2017 23:00

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	1	0	0	0	0	16
NNE	18	1	0	0	0	0	19
NE	41	1	0	0	0	0	42
ENE	57	0	0	0	0	0	57
E	112	0	0	0	0	0	112
ESE	187	0	0	0	0	0	187
SE	221	0	0	0	0	0	221
SSE	148	0	0	0	0	0	148
S	125	4	0	0	0	0	129
SSW	66	13	0	0	0	0	79
SW	34	9	0	0	0	0	43
WSW	23	1	0	0	0	0	24
W	13	1	0	0	0	0	14
WNW	10	2	0	0	0	0	12
NW	8	0	0	0	0	0	8
NNW	17	0	0	0	0	0	17
Total	1095	33	0	0	0	0	1128

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1128
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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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 = 01/01/2017 01:00 - 12/31/2017 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	0	0	0	0	0	7
NNE	12	0	0	0	0	0	12
NE	23	0	0	0	0	0	23
ENE	37	0	0	0	0	0	37
E	55	0	0	0	0	0	55
ESE	99	0	0	0	0	0	99
SE	201	0	0	0	0	0	201
SSE	62	0	0	0	0	0	62
S	45	7	0	0	0	0	52
SSW	41	1	0	0	0	0	42
SW	20	0	0	0	0	0	20
WSW	11	0	0	0	0	0	11
W	2	0	0	0	0	0	2
WNW	2	0	0	0	0	0	2
NW	12	0	0	0	0	0	12
NNW	5	0	0	0	0	0	5
Total	634	8	0	0	0	0	642

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	642
Total Hours for the Period:			8759

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Part 1: Joint Frequency Distribution Tables (35ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 23:00

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	208	102	0	0	0	0	310
NNE	215	53	0	0	0	0	268
NE	342	17	0	0	0	0	359
ENE	452	61	0	0	0	0	513
E	427	34	0	0	0	0	461
ESE	493	10	0	0	0	0	503
SE	621	11	0	0	0	0	632
SSE	389	19	0	0	0	0	408
S	383	112	5	0	0	0	500
SSW	347	208	41	0	0	0	596
SW	292	404	215	13	0	0	924
WSW	236	428	156	15	0	0	835
W	192	507	109	4	0	0	812
WNW	216	308	29	0	0	0	553
NW	240	187	10	0	0	0	437
NNW	242	135	5	0	0	0	382
Total	5295	2596	570	32	0	0	8493

Calm Hours not Included above for:	**Total Period**	**All Hours**	240
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	26
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8493
Total Hours for the Period:			8759

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Attachment 1

Part 1: 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 = 01/01/2017 01:00 - 12/31/2017 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	8	48	32	1	0	0	89
NNE	8	27	22	2	0	0	59
NE	6	25	11	0	0	0	42
ENE	3	39	24	0	0	0	66
E	2	39	27	1	0	0	69
ESE	3	27	17	0	0	0	47
SE	1	25	15	2	0	0	43
SSE	0	19	13	0	0	0	32
S	3	34	37	4	0	0	78
SSW	3	21	28	2	0	0	54
SW	6	21	30	11	0	0	68
WSW	15	28	70	15	0	0	128
W	12	77	112	25	1	0	227
WNW	19	55	80	35	5	0	194
NW	12	28	24	5	0	0	69
NNW	16	39	20	0	0	0	75
Total	117	552	562	103	6	0	1340

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1340
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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Attachment 1

Part 1: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	0	6	3	0	0	0	9
NNE	2	9	1	0	0	0	12
NE	3	5	1	0	0	0	9
ENE	0	5	6	0	0	0	11
E	1	5	1	0	0	0	7
ESE	0	1	1	0	0	0	2
SE	0	0	2	0	0	0	2
SSE	0	6	2	0	0	0	8
S	0	1	5	0	0	0	6
SSW	0	4	7	8	0	0	19
SW	0	0	10	8	0	0	18
WSW	2	10	10	9	1	1	33
W	3	11	14	8	1	0	37
WNW	4	5	9	7	1	0	26
NW	4	3	4	1	0	0	12
NNW	2	5	2	0	0	0	9
Total	21	76	78	41	3	1	220

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	220
Total Hours for the Period:			8759

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Part 1: 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 = 01/01/2017 01:00 - 12/31/2017 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	3	6	2	0	0	0	11
NNE	4	7	1	0	0	0	12
NE	2	1	1	0	0	0	4
ENE	2	5	5	0	0	0	12
E	1	4	5	0	0	0	10
ESE	2	2	2	0	0	0	6
SE	0	5	2	0	0	0	7
SSE	2	1	0	0	0	0	3
S	1	6	4	0	0	0	11
SSW	0	1	5	1	0	0	7
SW	1	2	8	6	0	0	17
WSW	4	8	10	11	0	0	33
W	6	9	21	10	0	0	46
WNW	2	11	12	10	1	0	36
NW	1	7	8	2	0	0	18
NNW	0	3	4	0	0	0	7
Total	31	78	90	40	1	0	240

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	240
Total Hours for the Period:			8759

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Attachment 1

Part 1: 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 = 01/01/2017 01:00 - 12/31/2017 23:00

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	15	32	32	1	0	0	80
NNE	21	47	16	1	0	0	85
NE	29	27	7	0	0	0	63
ENE	14	62	20	2	0	0	98
E	12	30	12	0	0	0	54
ESE	12	13	6	2	0	0	33
SE	15	21	10	0	0	0	46
SSE	14	24	12	1	0	0	51
S	16	51	50	4	0	0	121
SSW	21	43	55	18	0	0	137
SW	23	48	136	63	5	0	275
WSW	38	76	114	48	4	2	282
W	41	101	222	151	18	7	540
WNW	28	106	146	72	5	0	357
NW	15	69	52	2	1	0	139
NNW	15	31	33	4	0	0	83
Total	329	781	923	369	33	9	2444

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2444
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	45	25	17	0	0	0	87
NNE	81	41	2	1	0	0	125
NE	126	151	8	0	0	0	285
ENE	79	153	51	3	0	0	286
E	41	50	11	1	0	0	103
ESE	21	25	2	0	0	0	48
SE	34	29	7	0	0	0	70
SSE	24	33	11	0	0	0	68
S	53	61	47	6	0	0	167
SSW	76	67	45	8	0	0	196
SW	76	72	91	26	0	0	265
WSW	47	59	62	16	1	0	185
W	39	64	81	61	20	1	266
WNW	20	102	67	10	4	0	203
NW	27	51	10	0	0	0	88
NNW	19	35	9	0	0	0	63
Total	808	1018	521	132	25	1	2505

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2505
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	50	5	0	0	0	0	55
NNE	127	25	1	0	0	0	153
NE	165	98	5	0	0	0	268
ENE	75	39	4	0	0	0	118
E	31	10	0	0	0	0	41
ESE	9	8	0	0	0	0	17
SE	12	6	1	0	0	0	19
SSE	14	13	2	0	0	0	29
S	48	25	5	0	0	0	78
SSW	90	59	7	0	0	0	156
SW	80	36	14	0	0	0	130
WSW	43	23	6	0	0	0	72
W	25	10	4	1	0	0	40
WNW	8	6	1	0	0	0	15
NW	16	3	0	0	0	0	19
NNW	27	12	0	0	0	0	39
Total	820	378	50	1	0	0	1249

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1249
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (150ft)
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Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2017 01:00 - 12/31/2017 23:00 **All Hours**

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	41	4	0	0	0	0	45
NNE	88	28	0	0	0	0	116
NE	70	60	1	0	0	0	131
ENE	43	12	0	0	0	0	55
E	10	6	0	0	0	0	16
ESE	13	5	0	0	0	0	18
SE	9	6	1	0	0	0	16
SSE	12	11	1	0	0	0	24
S	30	39	5	0	0	0	74
SSW	43	32	2	0	0	0	77
SW	37	30	5	0	0	0	72
WSW	15	9	2	0	0	0	26
W	12	1	0	0	0	0	13
WNW	7	9	1	0	0	0	17
NW	9	1	0	0	0	0	10
NNW	12	2	0	0	0	0	14
Total	451	255	18	0	0	0	724

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	724
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (150ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2017 01:00 - 12/31/2017 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	162	126	86	2	0	0	376
NNE	331	184	43	4	0	0	562
NE	401	367	34	0	0	0	802
ENE	216	315	110	5	0	0	646
E	98	144	56	2	0	0	300
ESE	60	81	28	2	0	0	171
SE	71	92	38	2	0	0	203
SSE	66	107	41	1	0	0	215
S	151	217	153	14	0	0	535
SSW	233	227	149	37	0	0	646
SW	223	209	294	114	5	0	845
WSW	164	213	274	99	6	3	759
W	138	273	454	256	40	8	1169
WNW	88	294	316	134	16	0	848
NW	84	162	98	10	1	0	355
NNW	91	127	68	4	0	0	290
Total	2577	3138	2242	686	68	11	8722

Calm Hours not Included above for:	**Total Period**	**All Hours**	9
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	28
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8722
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)
Page 1 of 8

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	0	2	3	0	0	5
NNE	0	0	0	0	0	0	0
NE	0	0	0	2	0	0	2
ENE	0	0	4	1	0	0	5
E	0	3	5	0	0	0	8
ESE	0	4	6	0	0	0	10
SE	0	1	10	2	0	0	13
SSE	0	1	3	0	0	0	4
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	1	0	0	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Total	0	10	30	8	0	0	48

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	48
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

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Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)
Page 2 of 8

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	1	2	4	0	0	0	7
NNE	0	3	6	1	0	0	10
NE	0	0	2	0	0	0	2
ENE	0	2	1	0	0	0	3
E	1	4	6	0	0	0	11
ESE	1	10	6	2	0	0	19
SE	0	8	1	2	0	0	11
SSE	0	3	1	1	0	0	5
S	0	5	5	1	0	0	11
SSW	0	2	2	0	0	0	4
SW	0	0	2	0	0	0	2
WSW	0	1	0	1	0	0	2
W	0	0	0	0	0	0	0
WNW	0	0	2	5	2	0	9
NW	0	0	0	0	0	0	0
NNW	0	1	2	1	0	0	4
Total	3	41	40	14	2	0	100

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	100
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 23:00

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	7	10	5	0	0	22
NNE	1	4	6	1	0	0	12
NE	0	9	3	1	0	0	13
ENE	0	2	4	2	0	0	8
E	0	5	13	1	1	0	20
ESE	0	8	6	1	0	0	15
SE	1	6	2	3	0	0	12
SSE	0	2	7	1	0	0	10
S	0	5	13	1	0	0	19
SSW	0	3	13	1	0	0	17
SW	0	1	5	1	0	0	7
WSW	1	0	8	3	0	0	12
W	1	3	14	6	0	0	24
WNW	0	5	15	19	10	3	52
NW	1	1	15	1	2	1	21
NNW	1	4	4	2	0	0	11
Total	6	65	138	49	13	4	275

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	275
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)
Page 4 of 8

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	19	48	94	23	3	0	187
NNE	5	16	45	22	1	0	89
NE	13	33	18	1	0	0	65
ENE	24	36	57	19	1	0	137
E	23	70	83	21	3	0	200
ESE	23	64	78	12	2	0	179
SE	13	35	36	19	3	0	106
SSE	6	24	51	12	2	0	95
S	12	23	65	46	4	0	150
SSW	17	26	76	124	30	1	274
SW	16	21	111	233	95	5	481
WSW	18	60	120	194	51	9	452
W	39	73	170	315	158	47	802
WNW	18	76	227	298	110	33	762
NW	16	45	176	86	21	4	348
NNW	16	54	126	34	4	0	234
Total	278	704	1533	1459	488	99	4561

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	4561
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	28	14	25	13	0	0	80
NNE	22	24	21	8	0	0	75
NE	37	45	10	4	0	0	96
ENE	44	59	38	10	0	0	151
E	52	80	50	11	0	0	193
ESE	38	97	66	12	0	0	213
SE	33	64	46	15	4	0	162
SSE	20	36	30	21	4	0	111
S	21	40	45	47	4	0	157
SSW	25	28	54	65	36	6	214
SW	39	35	70	114	59	3	320
WSW	47	75	45	33	6	3	209
W	53	101	82	36	4	1	277
WNW	32	75	58	12	2	1	180
NW	27	29	17	14	3	0	90
NNW	22	18	32	5	0	0	77
Total	540	820	689	420	122	14	2605

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	2605
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	13	7	5	1	0	0	26
NNE	13	12	8	0	0	0	33
NE	19	17	1	0	0	0	37
ENE	33	29	11	2	0	0	75
E	31	47	7	0	0	0	85
ESE	29	58	27	2	0	0	116
SE	31	27	10	2	0	0	70
SSE	18	33	10	8	0	1	70
S	10	28	37	17	0	0	92
SSW	16	20	24	31	3	0	94
SW	19	18	36	36	11	1	121
WSW	23	34	9	3	1	0	70
W	17	22	13	1	0	0	53
WNW	16	17	6	0	0	0	39
NW	15	8	2	1	0	0	26
NNW	10	3	3	0	0	0	16
Total	313	380	209	104	15	2	1023

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	1023
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period** 01/01/2017 01:00 - 12/31/2017 23:00 **All Hours**

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	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	1	0	0	0	0	1
E	4	2	0	0	0	0	6
ESE	3	6	0	0	0	0	9
SE	2	4	0	0	0	0	6
SSE	4	7	1	0	0	0	12
S	6	5	16	9	1	0	37
SSW	1	4	4	5	0	0	14
SW	0	3	8	16	3	0	30
WSW	0	0	3	0	1	0	4
W	1	0	0	0	0	0	1
WNW	2	0	0	0	0	0	2
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Total	23	32	32	30	5	0	122

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	122
Total Hours for the Period:			8759

Annual Radioactive Effluent Release Report

Calendar Year – 2017
Attachment 1

Part 1: Joint Frequency Distribution Tables (500ft)

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period **All Hours**

Period of Record = 01/01/2017 01:00 - 12/31/2017 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	61	78	140	45	3	0	327
NNE	41	59	86	32	1	0	219
NE	69	104	34	8	0	0	215
ENE	101	129	115	34	1	0	380
E	111	211	164	33	4	0	523
ESE	94	247	189	29	2	0	561
SE	80	145	105	43	7	0	380
SSE	48	106	103	43	6	1	307
S	49	106	181	121	9	0	466
SSW	59	83	173	226	69	7	617
SW	74	78	232	400	168	9	961
WSW	89	170	185	234	59	12	749
W	111	200	279	358	162	48	1158
WNW	68	173	308	334	124	37	1044
NW	59	83	210	102	26	5	485
NNW	49	80	167	42	4	0	342
Total	1163	2052	2671	2084	645	119	8734

Calm Hours not Included above for:	**Total Period**	**All Hours**	6
Variable Direction Hours for:	**Total Period**	**All Hours**	0
Invalid Hours for:	**Total Period**	**All Hours**	19
Number of Valid Hours for this Table:	**Total Period**	**All Hours**	8734
Total Hours for the Period:			8759

ENCLOSURE 2, ATTACHMENT 2

Annual Radioactive Effluent Release Report

Calendar Year - 2017

Attachment 2

Unit 1 and 2 Offsite Dose Calculation Manual Changes

Attachment 2
Enclosed is a complete copy of the ODCM that includes: Change (42) of the ODCM (Effective: January, 2018)

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 Radiological Effluents Administrator at 724-682-4255.

ENCLOSURE 2, ATTACHMENT 3

Annual Annual Radioactive Effluent Release Report

Calendar Year - 2017
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 **2.50** mrem to the bone and less than **1.07** 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 **2.46** mrem to the bone and less than **1.04** 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	0.06	0.01	0.08	0.02	0.06	0.01	0.04	0.01
Vegetation Ingestion	-	-	2.42	0.48	1.00	0.20	0.62	0.12
TOTAL	0.06	0.01	2.50	0.50	1.07	0.21	0.66	0.13

Dose Calculations for Unit 2

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
Inhalation	0.05	0.01	0.07	0.01	0.05	0.01	0.03	0.01
Vegetation Ingestion	-	-	2.40	0.48	0.99	0.20	0.60	0.12
TOTAL	0.05	0.01	2.46	0.49	1.04	0.21	0.64	0.13

Dose Calculations for Site

	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
TOTAL	**0.11**	**0.02**	**4.97**	**0.99**	**2.11**	**0.42**	**1.30**	**0.26**

2017 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

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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"
- BVPS Condition Report No. CR-2017-04551: REMP Air Station #27 found OOS
- BVPS Condition Report No. CR-2017-04706: REMP TLD #94 Missing
- BVPS Condition Report No. CR-2017-08225: REMP Air Station #30 found OOS
- BVPS Condition Report No. CR-2017-09446: REMP Drinking Water Station #4 found OOS
- BVPS Condition Report No. CR-2017-10809: REMP Milk Station #96 August Analysis
- BVPS Condition Report No. CR-2017-12347: REMP Air Station #13 found OOS
- SAP Notification 601078879: 2017 RETS/REMP Tracking for ARERR/AREOR

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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, three hundred four (304) analyses were performed on samples from the control locations. This includes 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

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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 five hundred forty-nine (1,549) analyses were performed on samples collected from eighty-seven (87) indicator locations. In addition, five hundred twenty (520) 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.

- **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

- **2017 Sample Media and Analyses:** Results for drinking water, surface water, 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

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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 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., feedstuff) were also collected. Results were consistent with previous years, with no degrading trends.

- **Offsite Groundwater Monitoring (Historical):** There were a total of four (4) offsite groundwater samples collected and analyzed for tritium and by gamma spectrometry. 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.

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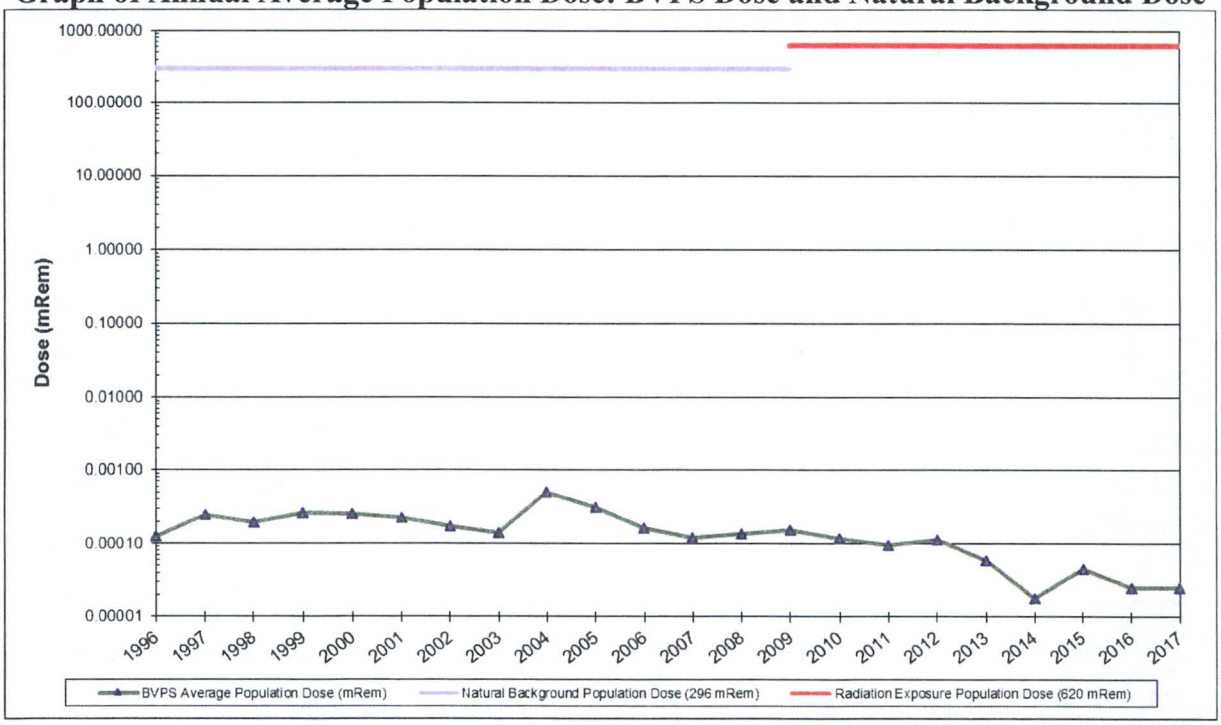
- **Supplemental Sample Sites:** REMP includes supplemental sampling sites in addition to the required sites set forth in the ODCM. The supplemental sites include three (3) air sampling sites, one (1) sediment site, one (1) milk animal feedstuff site, and five (5) soil sampling sites.

- **Population Dose vs. Natural Background:** During the report period, the total calculated 0-50 mile population dose was 61 man-mrem (liquid releases), and 39 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.

Figure i-1

Graph of Annual Average Population Dose: BVPS Dose and Natural Background Dose



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- **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.

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 2017, 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):

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

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Land Use Census Results:

Highlights from the most recent Land Use Census are documented in letter NPD3NRE:1250, dated October 23, 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 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 the Colaber Residence, 1201 Virginia Avenue, Midland, PA (1.033 miles, northwest). 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 (0 to 5 mile radius):** The location has not changed since the previous census. The location remains at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.067 miles, southeast).

- **Nearest Doe Goat (0 to 5 mile radius):** The location has not changed since the previous census. The closest location is the Covert Residence, 930 Pine Street (Route 168), Hookstown, PA (2.131 miles, southwest).

- **Prevailing Winds:** The prevailing wind direction for ground releases was identified by showing the highest deposition parameters (D/Q) in the east (E) sector. The prevailing wind direction for elevated releases was identified by showing the highest D/Q in the east-southeast (ESE) sector. The REMP properly monitors the environment with air particulate sampling stations in some sectors and direct radiation TLDs in all sectors.

- **2017 Dairy Cow & Doe Goat Sampling Locations:** The dairy cow sampling locations have not changed in 2017. The locations remain at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.067 miles, southeast), and Windsheimer Dairy, 20 Windsheimer Lane, Burgettstown, PA (10.475 miles, south-southwest). The doe goat sampling location has not changed since the previous census and remains at the Covert Residence, 930 Pine Street (Route 168), Hookstown, PA (2.131 miles, southwest).

- **D/Q for Milch Animal Locations:** The 2017 milch animal sampling locations have not 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.

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- **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 2003 to 2017 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 2017 Land Use Census results indicate that no significant changes are required in the current Radiological Environmental Monitoring Program or to its methodology.

Deviations, Changes and Adjustments to the Normal Sampling Program

- **Deviation from Normal Milk Sampling & Analysis Schedule:** There were two deviations 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 2017. 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. The other issue was documented through internal notification because it regarded a supplemental sample.

- **Deviation from Normal Surface and Drinking Water Sampling and Analysis Schedule:** There was one deviation from the ODCM required water sampling and analysis schedule during the report. The one issue was documented in Condition Report 2017-09446.

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- **Deviation from Normal Air Particulate & Iodine Sampling and Analysis Schedule:** There were three deviations from the required airborne particulate sampling and analysis schedule during the report period. These issues were documented in Condition Report 2017-04551 and 2017-08225.

- **Deviation from Normal Direct Radiation Monitoring:** There was one deviation from the required direct radiation monitoring schedule during the report period. This issue was documented in Condition Report 2017-04706

- **Deviations from Previous Sampling and Analysis Schedule:** Beginning in 2017, the REMP was modified to exclude non-required samples and analyses. These changes are documented in the REMP procedure.

  Two (2) Air Particulate and Radioiodine sampling points; Sherman Farm in Brighton Township (Site No. 28, 8.6 miles N) and Friendship Ridge in Beaver (Site No. 29B 7.97 miles NE).

  Two (2) Groundwater sampling points; Hookstown Borough (Site No. 14A, 2.61 miles SW) and Georgetown Borough (Site No. 15B, 3.75 miles WNW).

  One (1) Sediment sample point; Upstream of New Cumberland Dam (Site No. 50, 11.77 miles WSW).

  Three (3) Precipitation sample points; Cook's Ferry Substation in Shippingport (Site No. 30, 0.5 miles ENE), East Liverpool Water Department (Site No. 47, 4.88 miles WNW), and Weirton Water Tower (Site No. 48, 16.4 miles SSW).

  Five (5) Soil sample points; Old Meyer Farm in Hookstown (Site No. 13A, 1.49 miles SW), South of BVPS perimeter (Site No. 22, 0.28 miles SSE), Brunton Farm (Site No. 27, 6.16 miles SE), Nicol Farm in Beaver (Site No. 29A, 8.09 miles NE) and East Liverpool Water Department (Site No. 47, 4.88 miles WNW).

  The analysis schedule of I-131 for both drinking and surface was changed from weekly to biweekly.

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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.

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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.

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.

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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.

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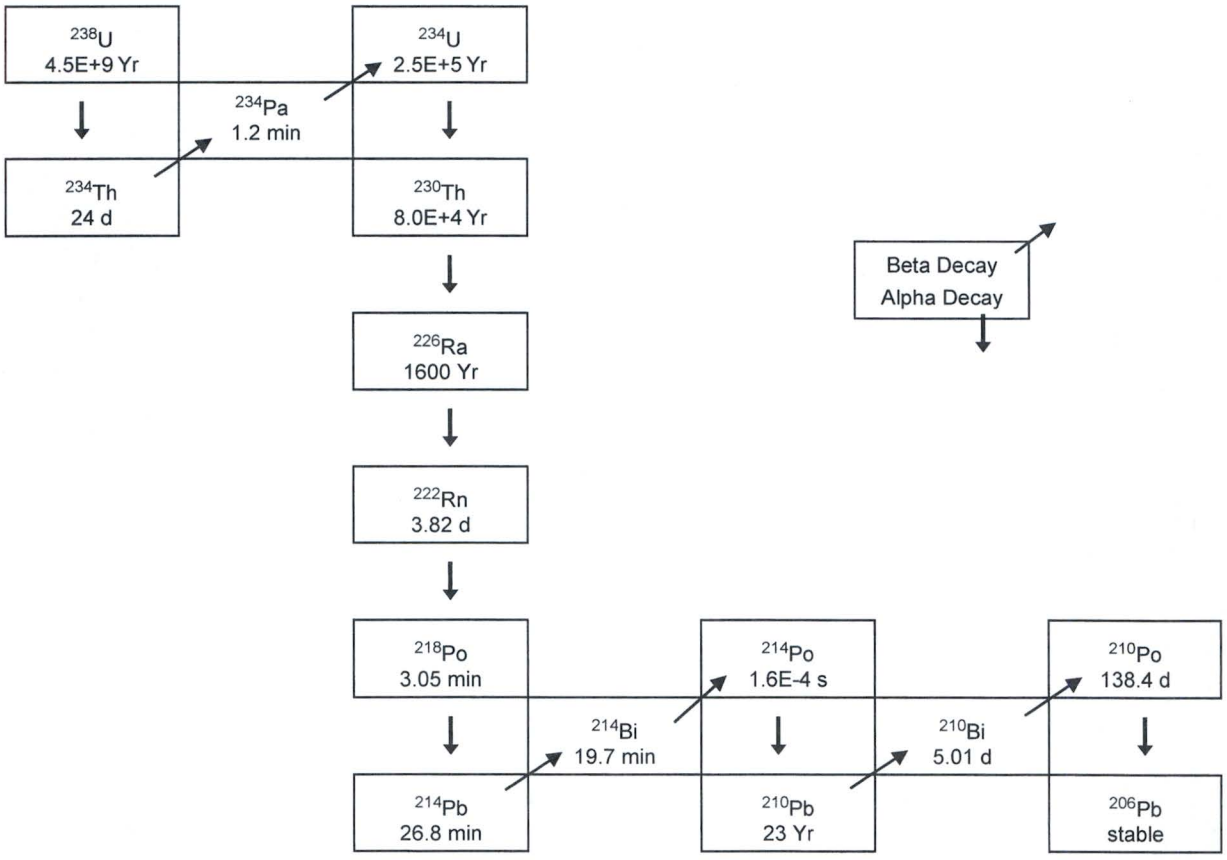
Radioactive Decay: Radioactive atoms, over time, will reach a stable, non-radioactive state through a process known as radioactive decay, which is the release of energy from an atom through the emission of ionizing radiation. Radioactive atoms may decay directly to a stable state or may go through a 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".

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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.

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.

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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.

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 15,000. The only area within the radius of concentrated population is the Borough of Midland, Pennsylvania, with a population of approximately 2,539 as determined from the 2016 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

SECTION 1 - INTRODUCTION

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 6,904 cubic feet per second (minimum monthly average) to 204,852 cubic feet per second (maximum monthly average). The mean flow during the report period was approximately 49,837 cubic feet per second. Water temperature of the Ohio River typically varies from 33° Fahrenheit to 80° 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 37.20 inches.

The average mean temperature during the report period was 60.8° Fahrenheit.

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

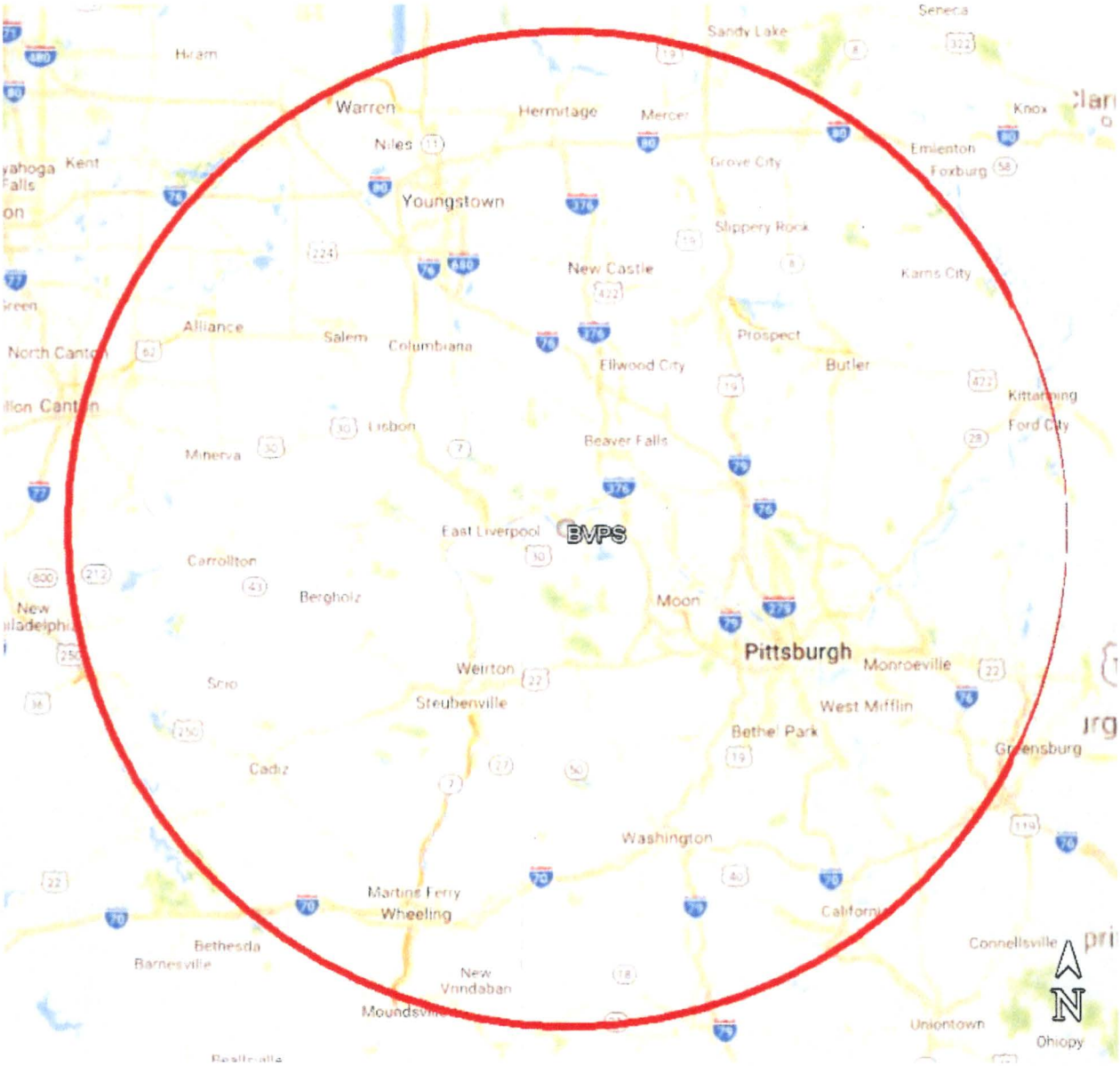
	Beaver Valley Unit 1	Beaver Valley Unit 2
Licensed Power Level	2900 – megawatts thermal	2900 – megawatts thermal
Type of Power	PWR	PWR
No. of Reactor Coolant Loops	3	3
No. of Steam Generators & Type	3 - Vertical	3 - Vertical
Steam Used by Main Turbine	Saturated	Saturated

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)			
		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]	Biweekly Sample	Iodine-131
					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	**No sampling performed**				
5	Drinking Water	4	Midland, PA (Water Department)	Intermittent [d] Sample Collected Weekly	Biweekly Composite of Daily sample [d]	Iodine-131
		5	East Liverpool, OH (Water Department)		Monthly Composite [d]	Gamma Scan
					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)			
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]				
10	Feedstuff & Summer Forage	27	Aliquippa, PA (Brunton Farm)	Monthly	Monthly	Gamma Scan
11	Soil	30A	Shippingport, PA (Cook's Ferry Substation)	Every Five (5) Years (2015, 2020, 2025)	12 Core Samples 3" Deep (2" diameter at each location approx. 10' radius)	Gamma Scan
		32A	Midland, PA (North Substation)			
		46B	Industry, PA (Willows Inn - Rt. 68)			
		48 [a]	Weirton WV (Water Tower - Collier Way)			
		51A	Aliquippa, PA (Sheffield Substation)			
12	Precipitation	**No sampling performed**				

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 biweekly 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 Cow's 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

In January 2017, REMP sampling changes were made to remove non-ODCM samples, and they are as follows; two air particulate and radioiodine locations, two groundwater locations, one sediment location, three precipitation locations, and five soil locations. Additionally, the frequency of drinking water analysis was changed to biweekly, surface water analysis #49A was changed to biweekly, and soil sample collection was changed to quinquennial.

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 - 2017

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 416	< 0.002	0.026 (364 / 364) 0.009 - 0.065	No. 46.1 Industry, PA 2.28 miles NE	0.027 (52 / 52) 0.012 - 0.056	No. 48 Weirton, WV Water Tower Collier Way 16.4 miles SSW	0.025 (52 / 52) 0.009 - 0.051	0
I-131 416	< 0.04	LLD (0 / 364)		LLD (0 / 364)		LLD (0 / 52)	0
Gamma 32							
Be-7	NA	0.080 (28 / 28) 0.061 - 0.097	No. 46.1 Industry, PA 2.28 miles NE	0.086 (4 / 4) 0.075 - 0.097	No. 48 Weirton, WV Water Tower Collier Way 16.4 miles SSW	0.085 (4 / 4) 0.067 - 0.100	0
Co-60	NA	LLD (0 / 28)		LLD (0 / 28)		LLD (0 / 4)	0
Cs-134	< 0.0005	LLD (0 / 28)		LLD (0 / 28)		LLD (0 / 4)	0
Cs-137	< 0.0005	LLD (0 / 28)		LLD (0 / 28)		LLD (0 / 4)	0
Ba-La-140	NA	LLD (0 / 28)		LLD (0 / 28)		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 - 2017

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 76	< 0.5	0.3 (1 / 50) LLD - 0.3	No. 5 East Liverpool Water 4.9 miles WNW	0.3 (1 / 25) LLD - 0.3	No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE	0.7 (3 / 26) 0.3 - 1.3	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 - 2017

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 26	< 0.5				No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE	0.7 (3 / 26) 0.3 - 1.3	0
H-3 8	< 200	LLD (0 / 4)		LLD (0 / 4)		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 - 2017

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

Sample locations are no longer in use

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	< 200						
Gamma							
Mn-54	< 5						
Fe-59	< 10						
Co-58	< 5						
Co-60	< 5						
Zn-65	< 10						
Zr-Nb-95	< 5						
Cs-134	< 5						
Cs-137	< 5						
Ba-La-140	< 10						

[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 - 2017

Medium: Precipitation Water — **Sample locations are no longer in use**
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]	
H-3	< 200						
Gamma							
Mn-54	< 5						
Fe-59	< 10						
Co-58	< 5						
Co-60	< 5						
Zn-65	< 10						
Zr-Nb-95	< 5						
Cs-134	< 5						
Cs-137	< 5						
Ba-La-140	< 10						

[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 - 2017

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 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 63	< 0.5	LLD (0 / 42)		LLD (0 / 42)	No. 96 Burgettstown, PA Windsheimer Farm 10.46 miles SSW	1.4 (1 / 21) LLD - 1.4	0
Sr-89 63	< 2.0	LLD (0 / 42)		LLD (0 / 37)		LLD (0 / 21)	0
Sr-90 63	< 0.7	0.6 (14 / 42) 0.5 - 1.7	No. 114 Hookstown, PA Covert Residence 2.13 miles SW	1.0 (9 / 21) 0.6 - 1.7	No. 96 Burgettstown, PA Windsheimer Farm 10.46 miles SSW	1.0 (16 / 21) 0.5 - 1.2	0
Gamma 63							
K-40	< 150	1354 (32 / 42) 1252 - 1899	No. 114 Hookstown, PA Covert Residence 2.13 miles SW	1620 (11 / 21) 1339 - 1899	No. 96 Burgettstown, PA Windsheimer Farm 10.46 miles SSW	1382 (21 / 21) 1228 - 1509	0
Mn-54	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Fe-59	< 10	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Co-58	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Co-60	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Zn-65	< 10	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Zr-Nb-95	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Cs-134	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Cs-137	< 5	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	0
Ba-La-140	< 10	LLD (0 / 42)		LLD (0 / 42)		LLD (0 / 21)	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 - 2017

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 9					No. 49A Industry, PA Upstream of Montgomery Dam		
Mn-54	< 0.05	LLD (0 / 5)		LLD (0 / 5)	4.93 miles NE	LLD (0 / 4)	0
Fe-59	< 0.10	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Co-58	< 0.05	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Co-60	< 0.05	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Zn-65	< 0.10	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Zr-Nb-95	< 0.01	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Cs-134	< 0.05	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Cs-137	< 0.05	LLD (0 / 5)		LLD (0 / 5)		LLD (0 / 4)	0
Ba-La-140	< 0.01	LLD (0 / 5)		LLD (0 / 5)		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 - 2017

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 11	< 0.06	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Gamma 11							
K-40	NA	2.85 (10 / 10) 1.80 - 9.40	No. 12 Racoon Township, PA 2.74 miles E	5.00 (10 / 10) 2.60 - 9.40	No. 48B Weirton, WV 16.52 miles SSW	3.30 (1 / 1) LLD - 3.30	0
Mn-54	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Fe-59	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Co-58	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Co-60	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Zn-65	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Zr-Nb-95	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Cs-134	0.04	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Cs-137	0.06	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	0
Ba-La-140	NA	LLD (0 / 10)		LLD (0 / 10)		LLD (0 / 1)	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 - 2017

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	0.34 (4 / 12) 0.25 - 0.42	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.08 miles SE	0.34 (4 / 12) 0.25 - 0.42	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.08 miles SE	0.34 (4 / 12) 0.25 - 0.42	0
K-40	< 0.15	8.87 (12 / 12) 6.78 - 11.48	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.08 miles SE	8.87 (12 / 12) 6.78 - 11.48	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.08 miles SE	8.87 (12 / 12) 6.78 - 11.48	0
Mn-54	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Fe-59	< 0.04	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Co-58	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Co-60	< 0.02	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Zn-65	< 0.04	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Zr-Nb-95	< 0.03	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
Ru-103	< 0.03	LLD (0 / 12)		LLD (0 / 12)		LLD (0 / 12)	0
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)	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 - 2017

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 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 4							
K-40	NA	10.50 (2 / 2) 9.58 - 11.42	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	10.50 (2 / 2) 9.58 - 11.42	No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE	12.45 (2 / 2) 11.86 - 13.04	0
Mn-54	< 0.02	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Fe-59	< 0.03	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Co-58	< 0.02	0.14 (1 / 2) LLD - 0.14	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	0.14 (1 / 2) LLD - 0.14		LLD (0 / 2)	0
Co-60	< 0.02	0.14 (2 / 2) 0.12 - 0.15	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	0.14 (2 / 2) 0.12 - 0.15		LLD (0 / 2)	0
Zn-65	< 0.04	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Zr-95	< 0.03	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Nb-95	< 0.03	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Cs-134	< 0.06	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0
Cs-137	< 0.08	0.07 (2 / 2) 0.07 - 0.07	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	0.07 (2 / 2) 0.07 - 0.07	No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE	0.07 (2 / 2) 0.05 - 0.08	0
Ba-La-140	< 0.03	LLD (0 / 2)		LLD (0 / 2)		LLD (0 / 2)	0

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 - 2017

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 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]
Tl-208	NA	0.35 (2 / 2) 0.35 - 0.35	No. 2A BVPS Outfall Vicinity 0.31 miles WSW *Same location for the following nuclides*	0.35 (2 / 2) 0.35 - 0.35	No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE *Same location for the following nuclides*	0.34 (2 / 2) 0.32 - 0.36	0
Bi-214	NA	0.81 (2 / 2) 0.73 - 0.88		0.73 (2 / 2) 0.69 - 0.76		0.82 (2 / 2) 0.77 - 0.86	0
Pb-212	NA	1.18 (2 / 2) 0.97 - 1.39		1.18 (2 / 2) 0.97 - 1.39		0.99 (2 / 2) 0.87 - 1.11	0
Pb-214	NA	0.90 (2 / 2) 0.84 - 0.95		0.90 (2 / 2) 0.84 - 0.95		0.96 (2 / 2) 0.95 - 0.96	0
Ra-226	NA	2.35 (2 / 2) 2.12 - 2.58		2.35 (2 / 2) 2.12 - 2.58		1.98 (2 / 2) 1.80 - 2.15	0
Ac-228	NA	1.15 (2 / 2) 1.05 - 1.25		1.15 (2 / 2) 1.05 - 1.25		1.20 (2 / 2) 1.11 - 1.29	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 - 2017

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

Soil Sampling is performed every five (5) years. Next sampling is 2020.

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							
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						
Ba-La-140	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 - 2017

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

Soil Sampling is performed every five (5) years. Next sampling is 2020.

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]	
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 - 2017

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 528	4.6	18.3 (520 / 520) 12.6 - 26.8	No. 7 BVPS Site Perimeter Location 0.25 miles SSE	25.2 (8 / 8) 23.8 - 26.8	No. 48 Weirton, WV Water Tower Collier Way 16.4 miles SSW	19.5 (8 / 8) 14.8 - 23.9	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)	--		--	
- Core Samples -	Gross Beta	(8)	1	21	(8/8)	16 - 28
	Sr-89	(8)	0.25		< LLD	
[picocurie /gram]	Sr-90	(8)	0.05	0.2	(5/8)	0.08 - 0.5
	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 near 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 eight (8) 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 four hundred sixteen (416) weekly samples from eight (8) 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 thirty-two (32) quarterly samples were composited from eight (8) locations and analyzed for gamma spectrometry. Naturally occurring beryllium-7 was identified in twenty-eight of twenty-eight (28 of 28) 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 were two deviations from the required airborne particulate sampling and analysis schedule during the report period.

During the sampling period of 04/10/17-04/17/17, REMP Air Particulate and Iodine sampling station at Brunton's Dairy in Aliquippa (Site No. 27, 6.16 miles SE) was found to be out of service. The cause was a tripped breaker on the totalizer due to thunderstorms over the weekend. The breaker was reset during the change out for the next week. The sample station was out of service for approximately 22 hours as reported by the REMP technician. (CR-2017-04551)

During the sampling period of 12/1/17-12/18/17, REMP Air Particulate and Iodine sampling station at Cook's Ferry Substation in Shippingport (Site No. 30, 0.5 miles ENE) was found to be out of service. The cause was a malfunctioning totalizer. The components of the air station were replaced and returned to service. The sample station was out of service for approximately 70 hours as reported by the REMP technician. (CR-2017-08225)

During the sampling period of 07/31/17-08/07/17, REMP Air Particulate and Iodine sampling station at Old Meyer Farm in Hookstown (Site No. 13, 1.49 miles SW) was found to be out of service. The cause was shattered carbon vanes. They were

replaced, and components of the air station were restored and returned to service. The sample station was out of service for approximately 83 hours as reported by the REMP technician. (CR-2017-12347)

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 four hundred sixteen (416) weekly charcoal filter samples were analyzed for iodine-131. Iodine-131 was not identified in any of the three hundred sixty-four (364) indicator samples, nor was it identified in any of the fifty-two (52) control samples.

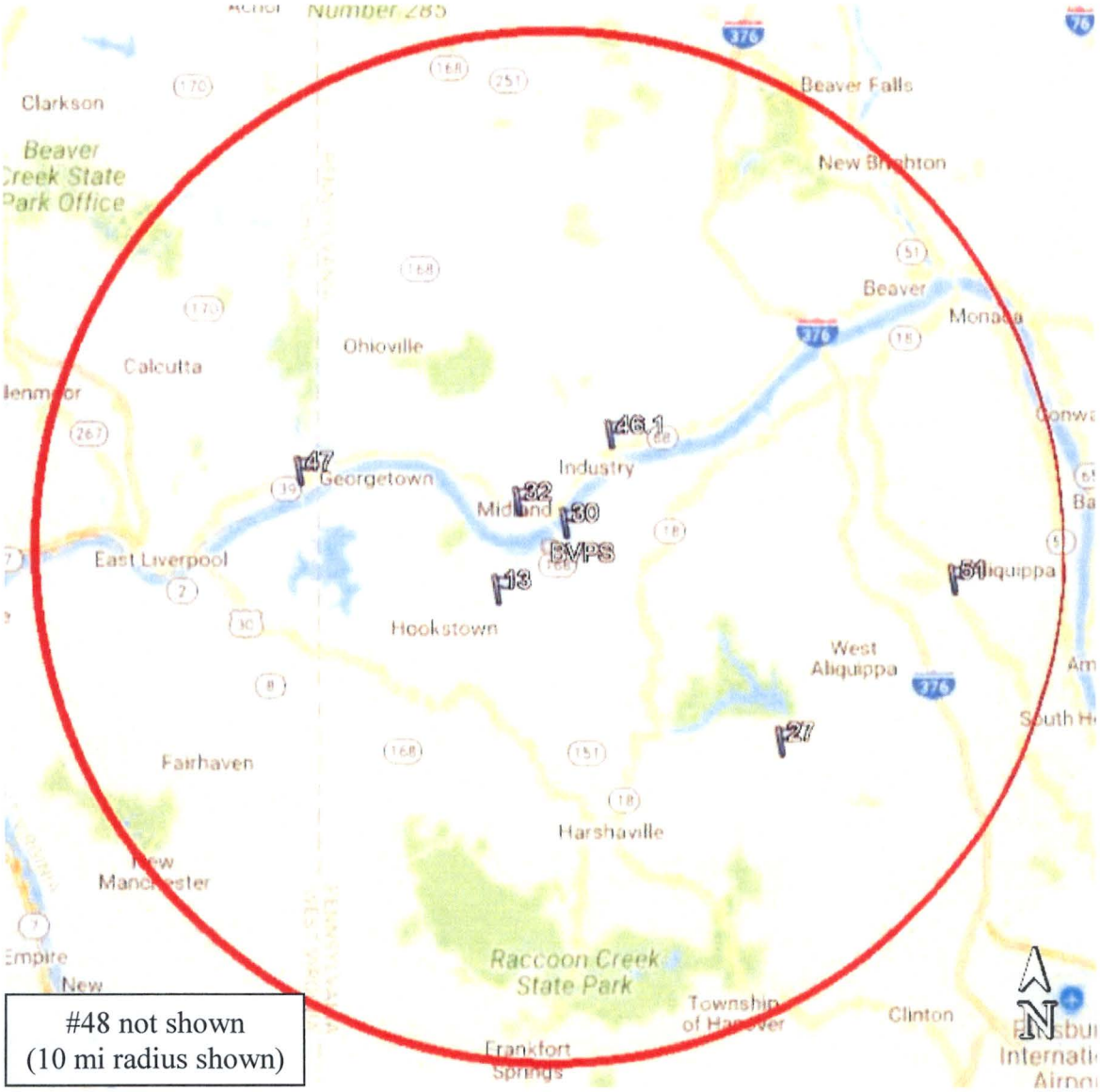
Deviations from Required Sampling and Analysis Schedule: The deviations are the same as described above for airborne particulates.

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

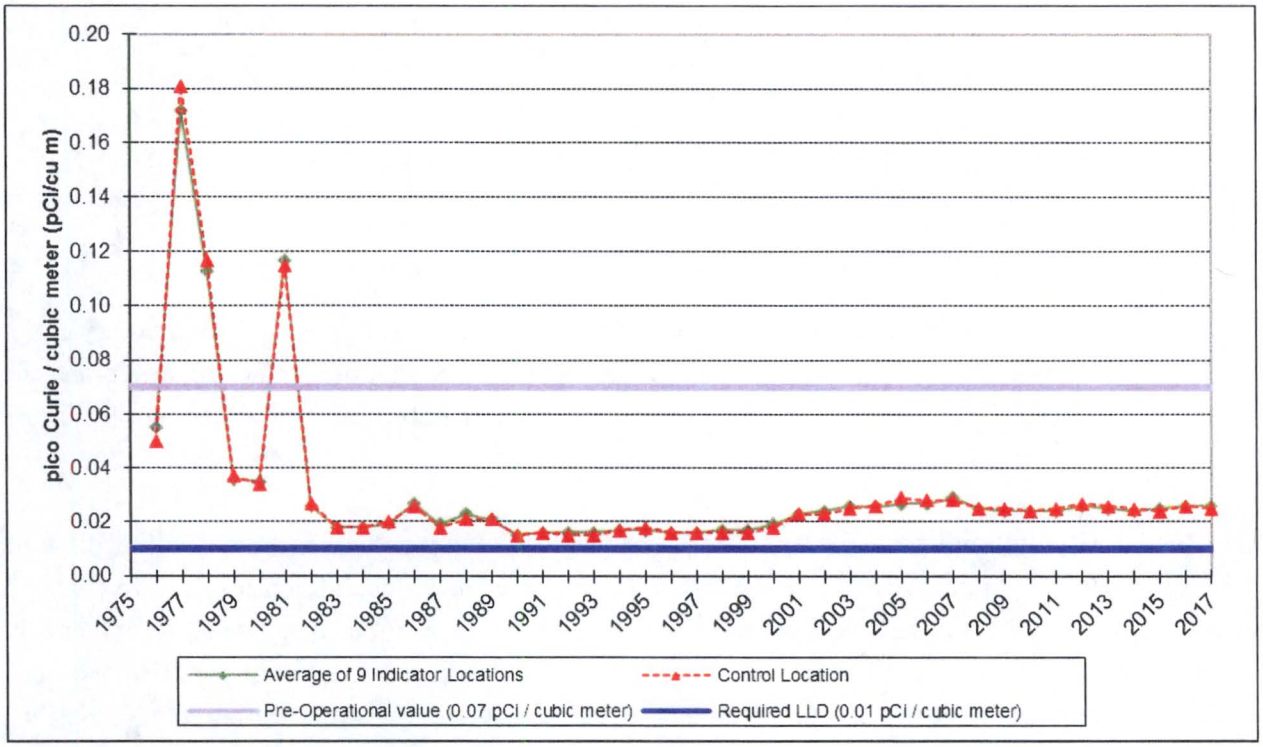


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Air Particulate & Radioiodine	13	11-SW	1.49	Hookstown, PA (Old Meyer Farm)
	27	7-SE	6.14	Aliquippa, Pa (Brunton Farm)
	30	4-ENE	0.43	Shippingport, PA (Cook's Ferry Substation)
	32	15-NW	0.75	Midland, PA (North Substation - Rt. 68)
	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



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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, and near the BVPS outfall structure. 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 locations were reduced from ten (10) to five (5), as well as 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.

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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 four (4) 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 two of two (2 of 2) indicator samples and two of two (2 of 2) control samples.

Cesium-137: Radionuclide cesium-137 was identified in two of two (2 of 2) indicator samples and two of two (2 of 2) control samples. The results were comparable to that of previous years (current annual range = 0.05 to 0.08 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 two (1 of 2) 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 comparable to the previous years (current annual range = LLD to 0.14 picocurie / gram) and the data is slightly higher than the BVPS Main Outfall Facility pre-operational level of 0.098 picocurie / gram.

Cobalt-60: Radionuclide cobalt-60 was identified in two of two (2 of 2) indicator samples and zero of two (0 of 2) control samples. The samples, which indicated cobalt-60, were obtained at the shore line of the BVPS Main Outfall Facility. The results were comparable to previous years (current annual range = 0.12 to 0.15 picocurie / gram), and the data is currently lower 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.

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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.

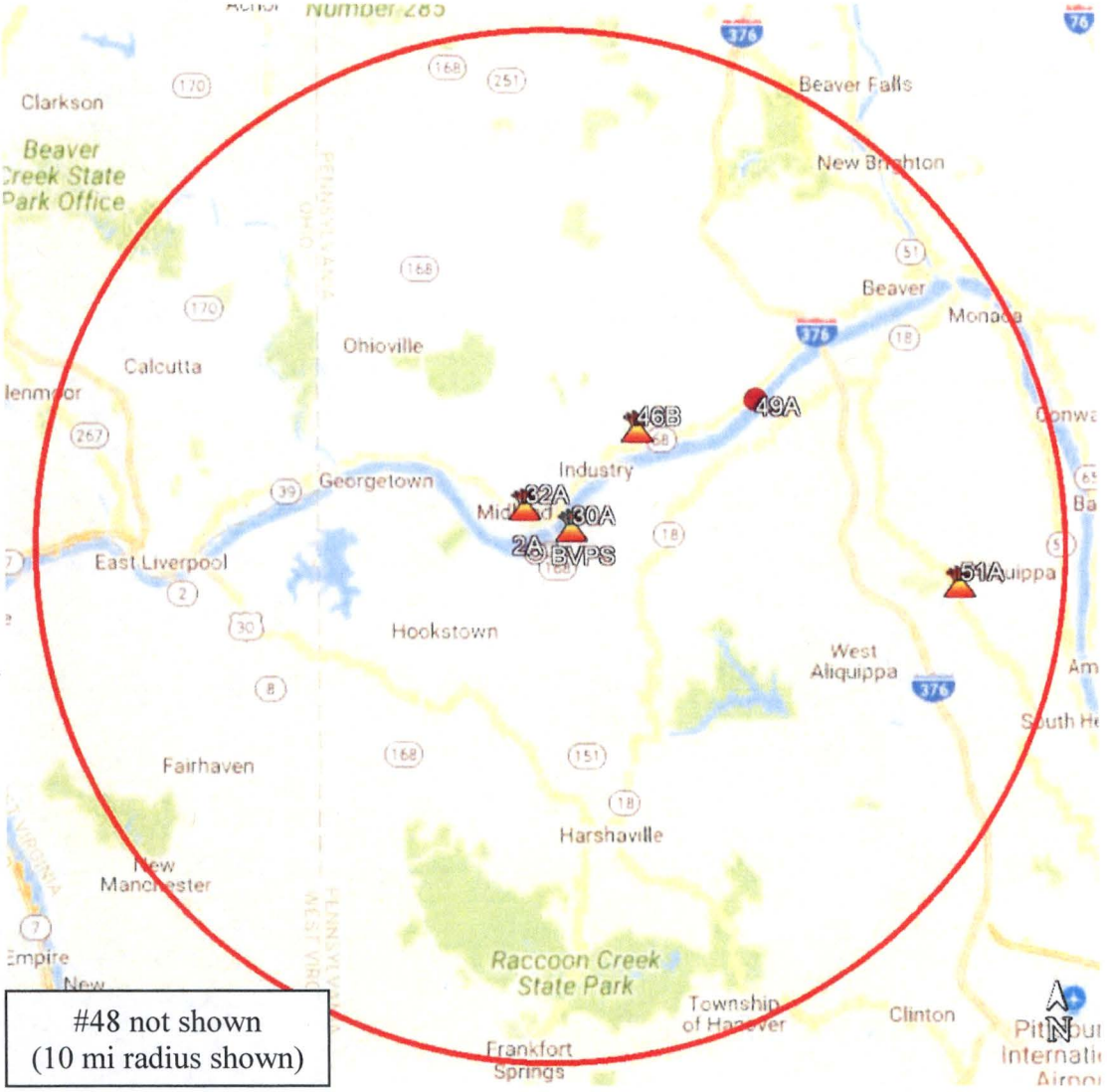
b. Soil

Soil sampling is not an ODCM requirement. 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

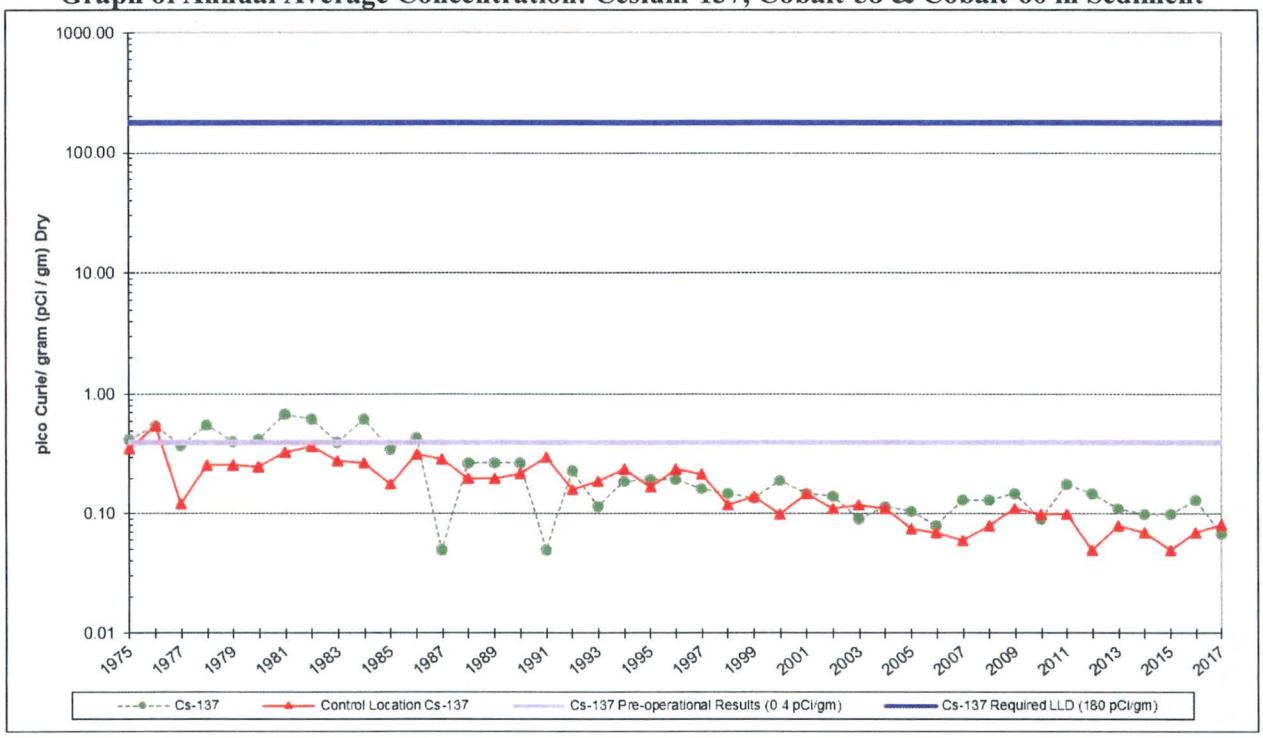


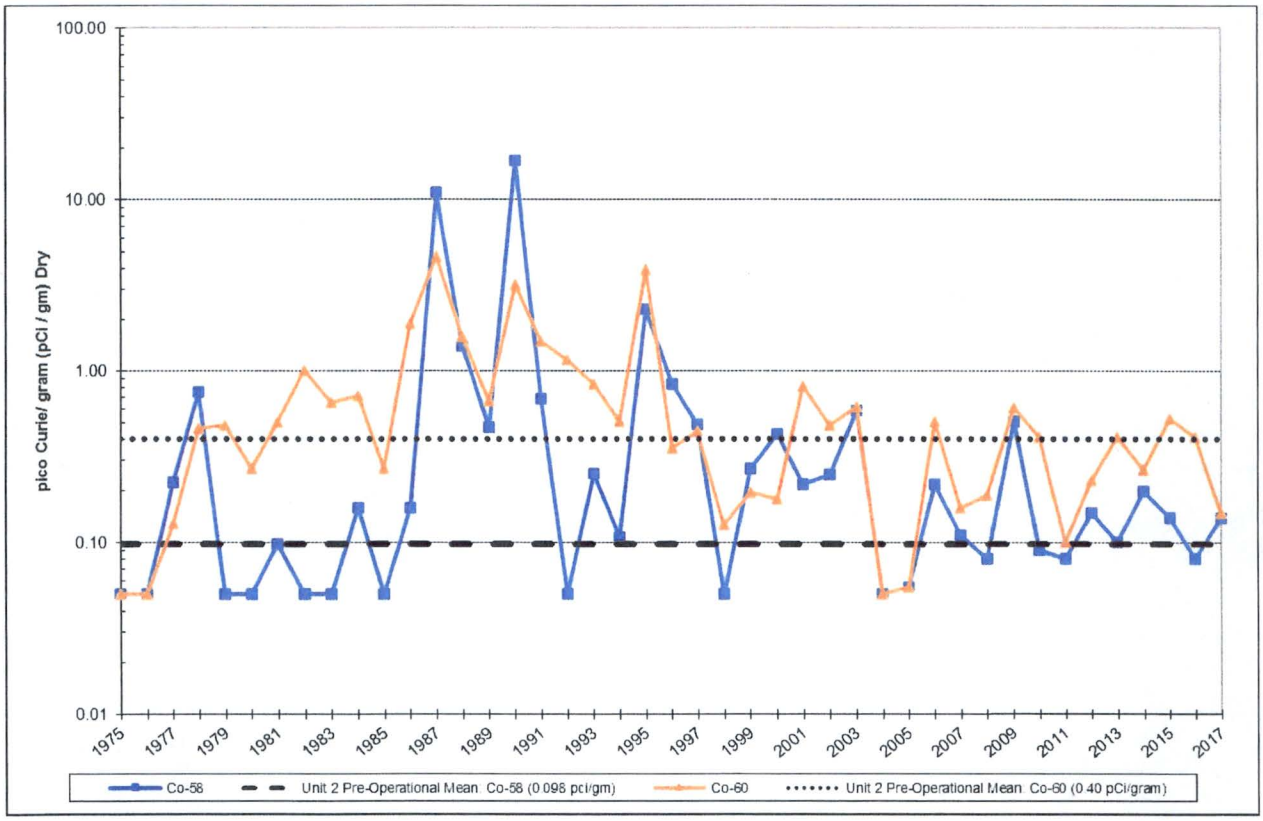
Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Soil	30A	4-ENE	0.43	Shippingport, PA (Cooks Ferry Substation)
	32A	15-NW	0.74	Midland, PA (North Substation)
	46B	3-NE	2.66	Industry, PA (Willows Inn – Rt. 68)
	48	10-SSW	16.40	Weirton, WV (Collier Way Water Tower)
	51A	5-E	7.99	Aliquippa, PA (Sheffield Substation)
Sediment	2A	12-WSW	0.31	Shippingport, PA (BVPS Outfall Vicinity)
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-4

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

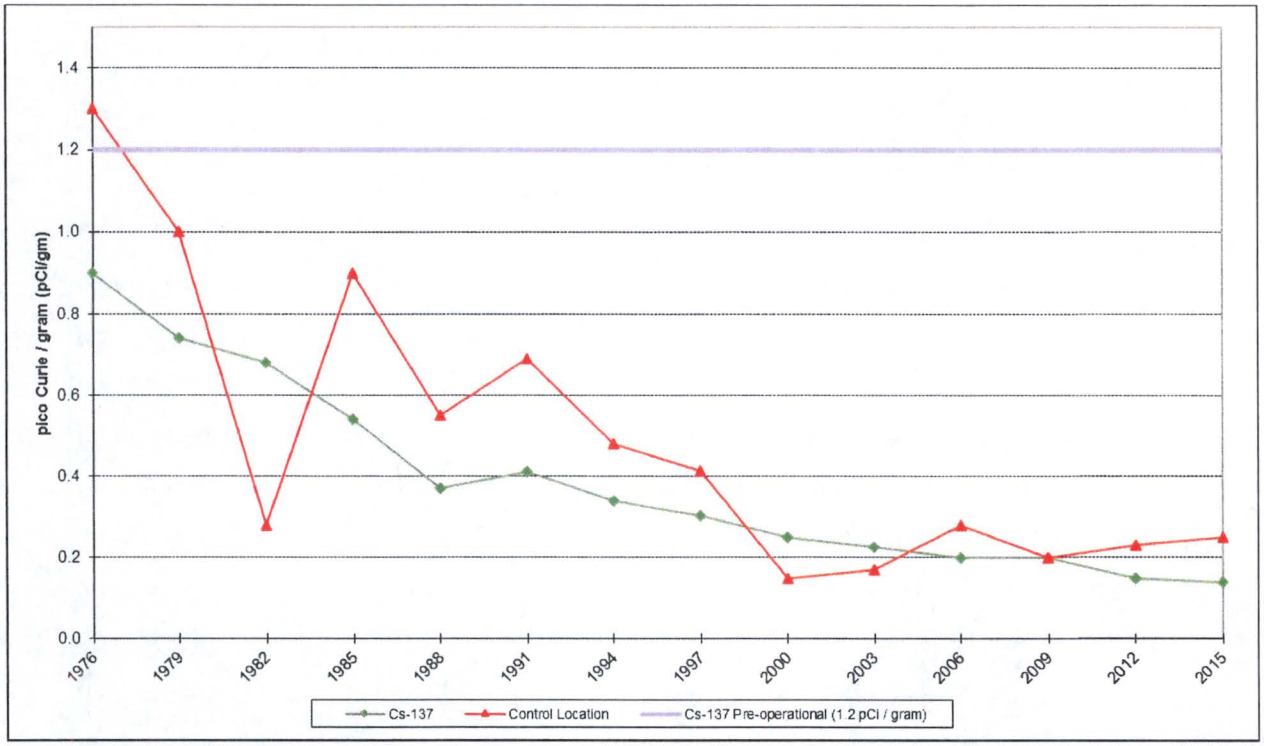




SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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.

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 four of twelve (4 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 ten (10) samples were analyzed for iodine-131. No detectable concentrations were present in the ten (10) indicator samples or the one (1) control sample.

Gamma Spectrometry: A total of ten (10) samples were analyzed by gamma spectrometry. Naturally occurring potassium-40 was identified in ten or ten (10 of 10) samples indicator samples and the one (1) control sample.

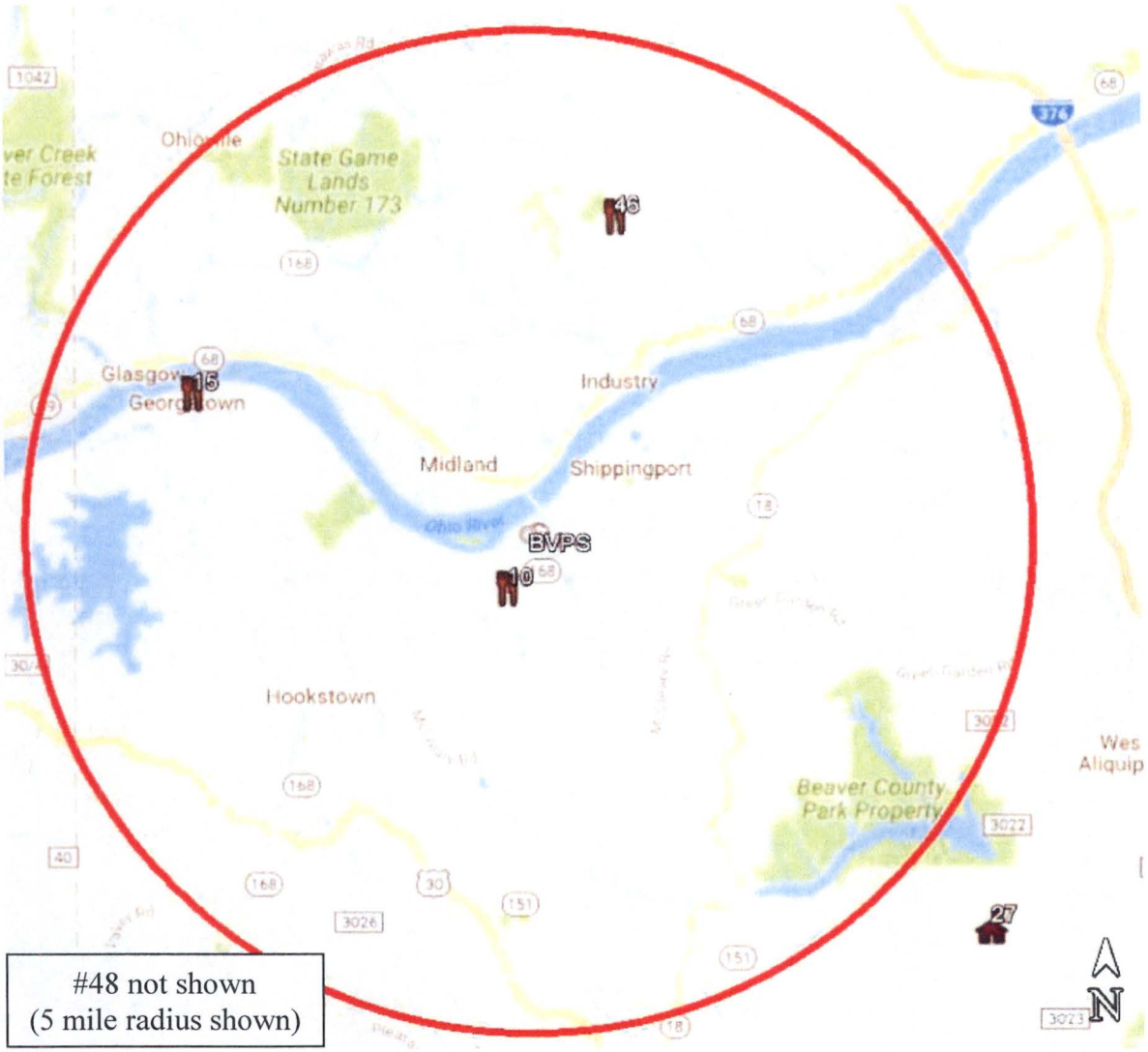
Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required foodstuff sampling and analysis schedule during the report period.

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.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-6

Environmental Monitoring Locations – Feedstuff and Foodcrops

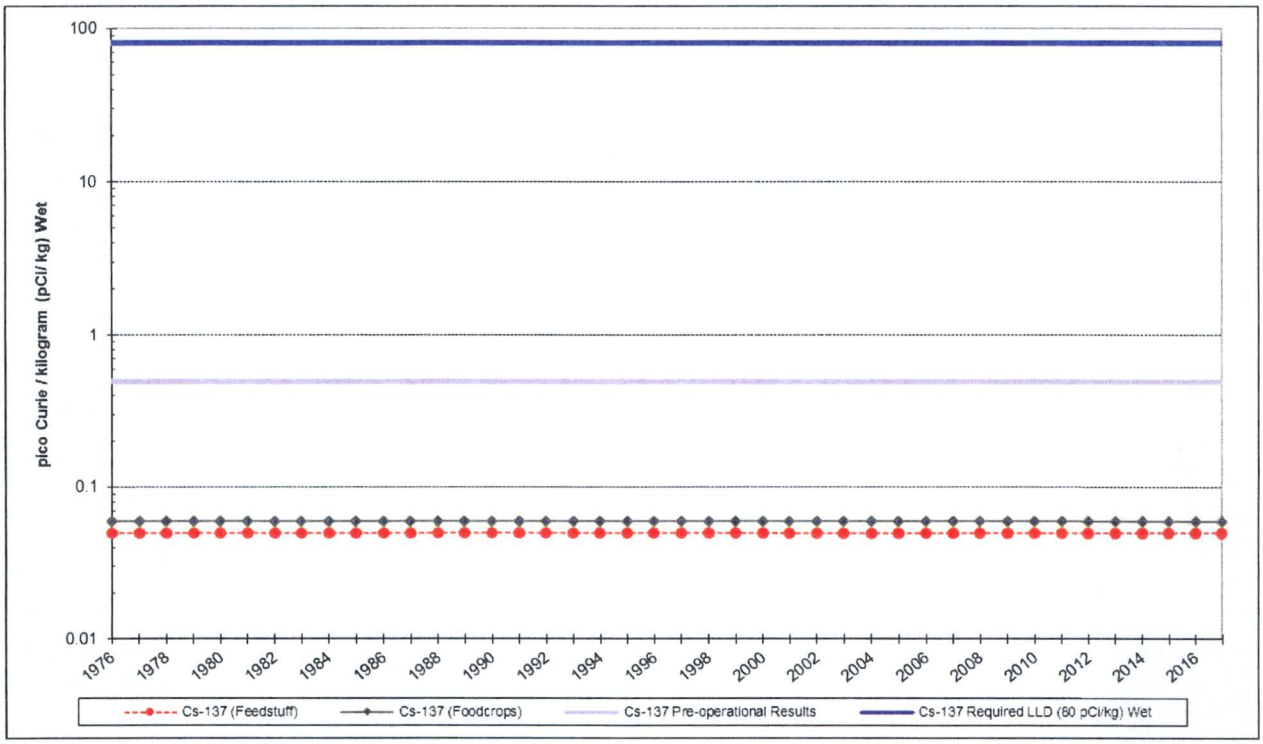


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Feed	27	7-SE	6.16	Aliquippa, PA (Brunton Farm)
Food	10*	*	*	Shippingport, PA
	15*	*	*	Georgetown, PA
	46*	*	*	Industry, PA
	48*	*	*	Weirton, WV
	*	*	*	2 locations based on highest predicted D/Q
Individual garden locations may change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

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-7

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



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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 (6.076 miles southeast) and one (1) control location dairy farm outside of the 10-mile radius, Windsheimer Dairy Farm (10.475 miles south-southwest).

Dairy cow sampling is performed at Brunton Dairy since 2016, due to the closure of Halstead Dairy and Searight Dairy in 2014. Additionally, one goat location was available for sampling and samples were obtained at the Covert Residence (2.131 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 biweekly 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 biweekly 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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Table 2-4

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	2.107 miles SSW	January thru December
27	Brunton Dairy 3681 Ridge Road Aliquippa, PA	104 Cows	6.076 miles SE	January thru December
96	Windsheimer Dairy 20 Windsheimer Lane Burgettstown, PA	76 Cows	10.475 miles SSW	January thru December
113*	Halstead Dairy 104 Tellish Drive Hookstown, PA	Dairy Closed beginning of 2014	5.184 miles SSW	January thru December
114	Covert Residence 930 Pine Street (Route 168) Hookstown, PA	9 Goats	2.131 miles SW	January thru December
* Highest potential pathway dairies based on evaluation of deposition parameters				

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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 sixty-three (63) milk samples were analyzed for strontium-89 during the report period. Strontium-89 was not detected in any of the forty-two (42) indicator samples, nor was it detected in any of the twenty-one (21) control samples.

b. Strontium-90: Although not required by the ODCM, a total of sixty-three (63) milk samples were analyzed for strontium-90 during the report period. Strontium-90 was detected in fourteen of forty-two (14 of 42) indicator samples and sixteen of twenty-

one (16 of 21) control samples. The levels detected were attributed to previous nuclear weapons tests and are within the expected range.

c. Gamma Spectrometry: A total of sixty-three (63) milk samples were analyzed by gamma spectrometry during the report period. Naturally occurring potassium-40 was present in thirty-two of forty-two (32 of 42) indicator samples and twenty-one of twenty-one (21 of 21) control samples. No other gamma-emitting radionuclides were identified during analysis.

d. Iodine-131: A total of sixty-three (63) milk samples were analyzed for iodine-131 during the report period. Iodine-131 was not detected in any of the forty-two (42) indicator samples, but was it detected in one of twenty-one (21) control samples. This anomaly was under the reportable limit and was documented for trending.

e. Deviations from Required Sampling and Analysis: There were two deviations 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 2017. 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.

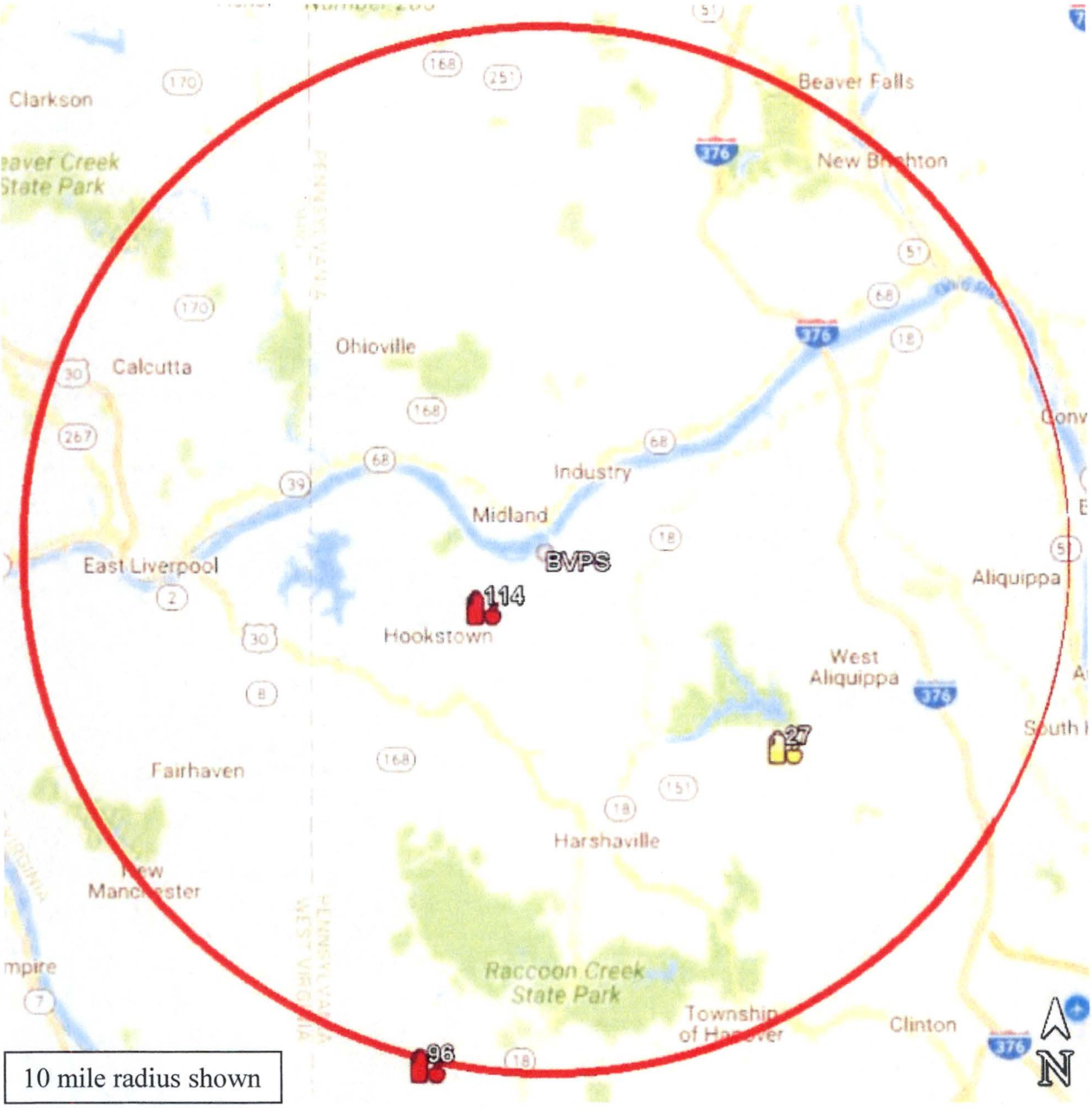
During the sampling period, 07/09/2017 – 07/15/2017, REMP milk (goat) sampling location at the Covert's Residence in Hookstown, PA (Site No. 114, 2.131 miles SW) was unavailable. The owner and goats were out of town during the sampling period. (Notification 601078879, Line 6)

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.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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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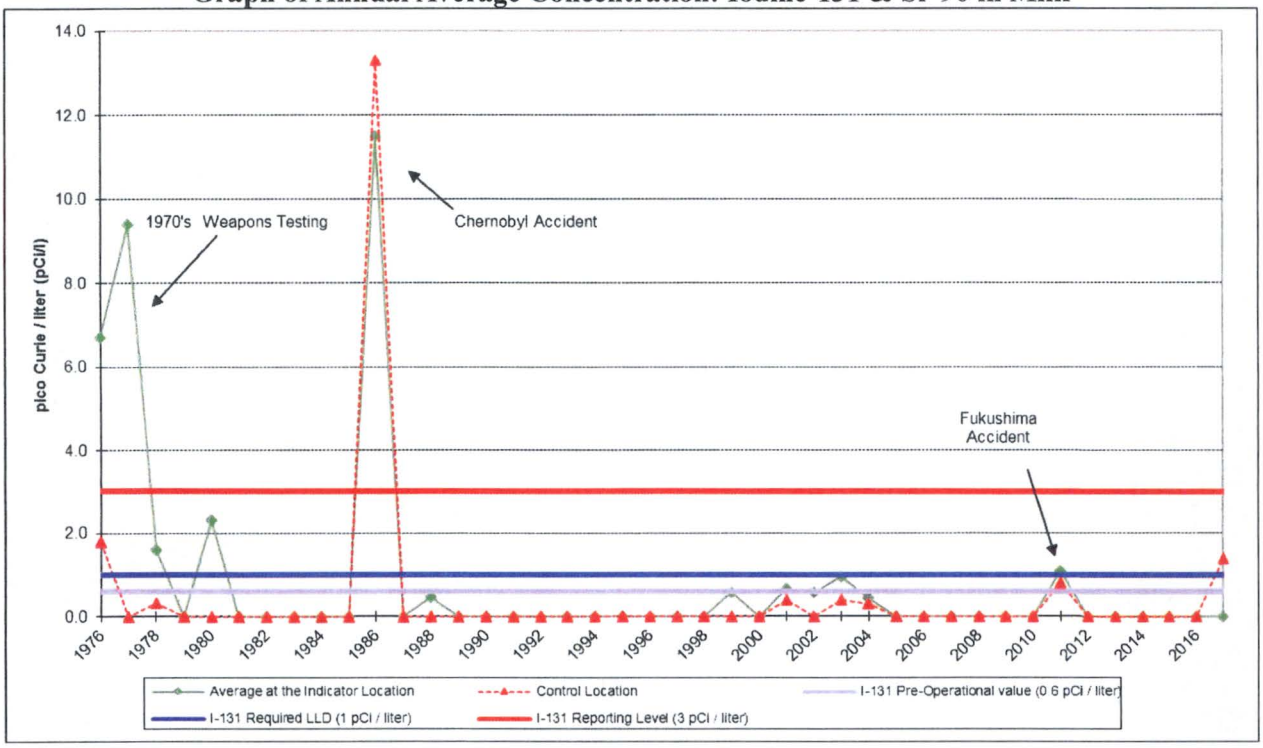
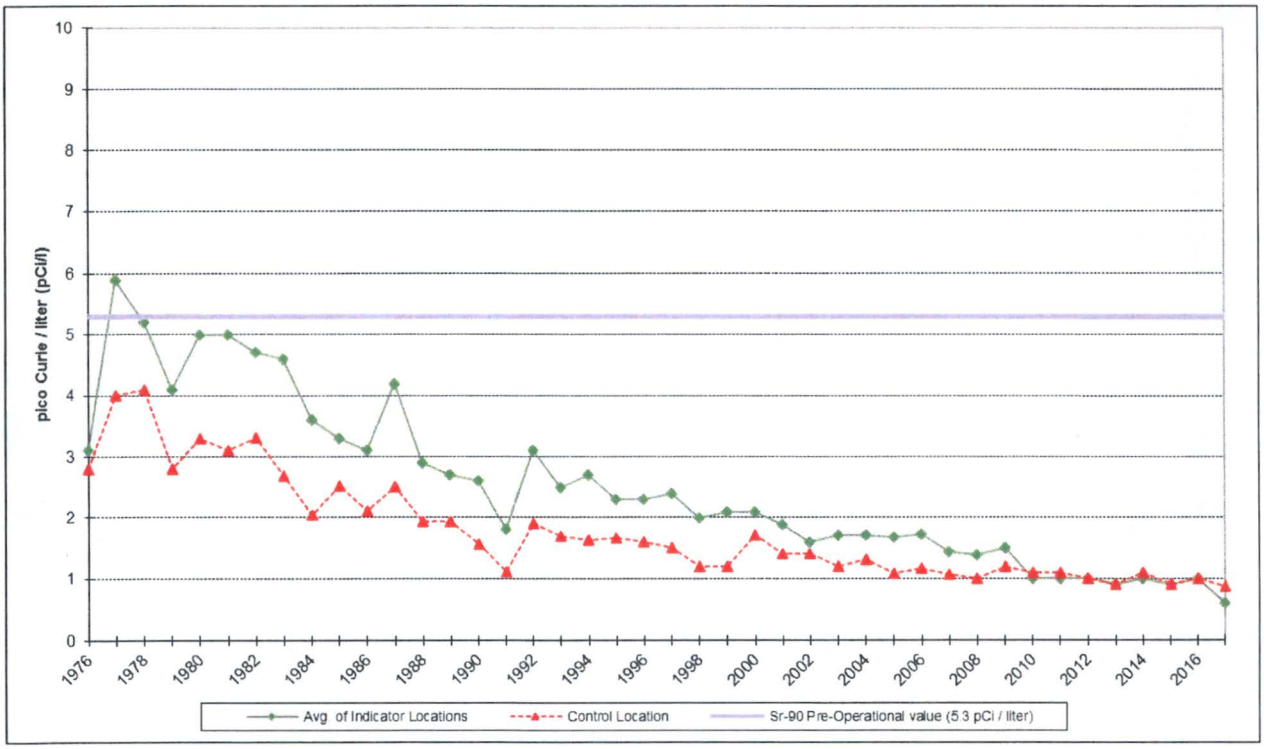
Figure 2-9

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





SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

F. 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.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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.

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 19.5 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 was one deviation from the required direct radiation monitoring schedule during the report period.

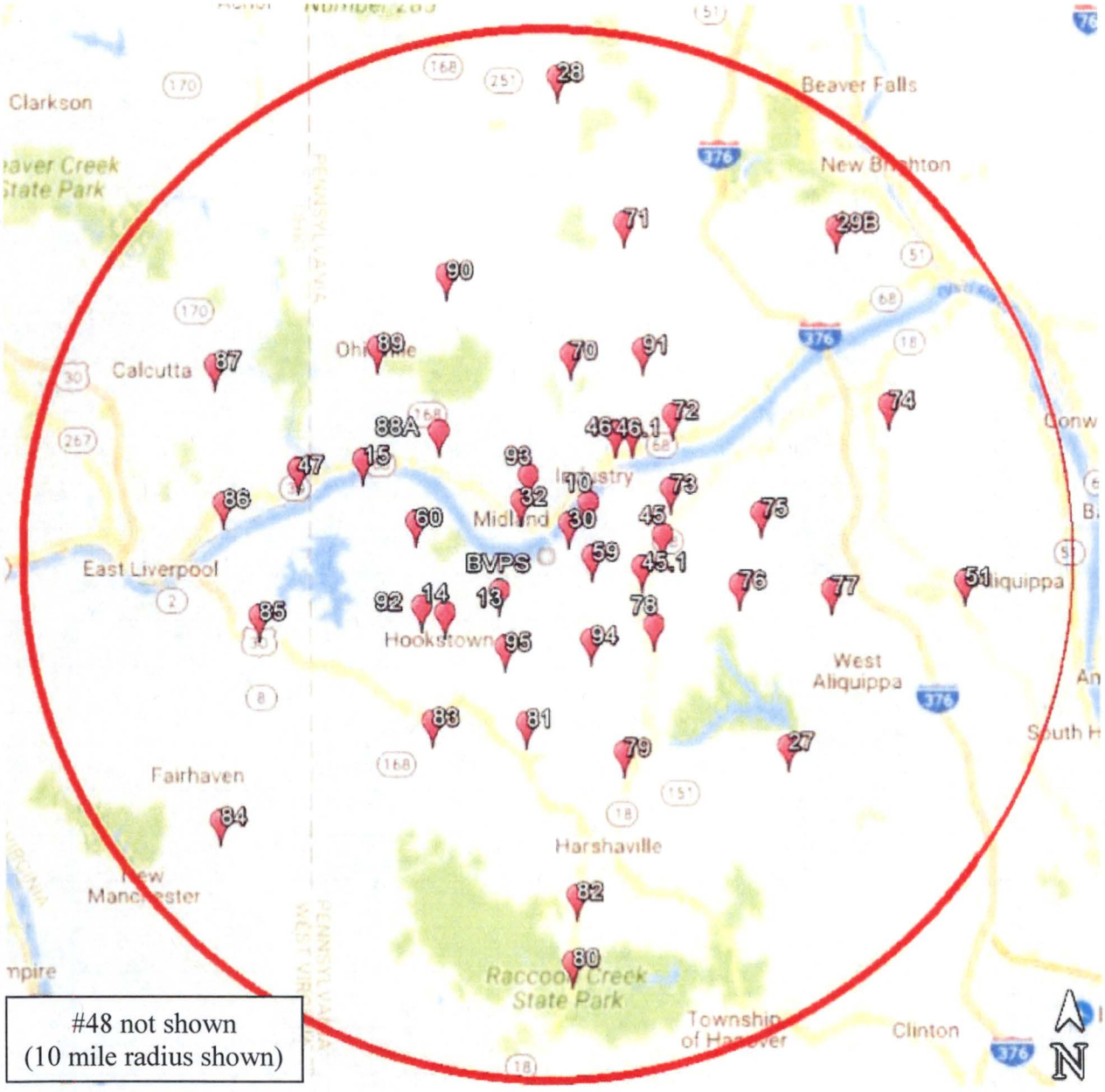
On Thursday January 5, 2017, the REMP technician was performing the scheduled quarterly TLD changeout. During the work, it was noticed that Station #94 (McCleary Road & Pole Cat Hollow Rd, 2.37 miles SSW) was missing both of its two TLDs for the 4th quarter for 2016. The TLDs have been replaced at this location for 1st quarter collection (CR-2017-04706).

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



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-10 (Continued)

TLD Locations

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 Monaca, 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

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

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

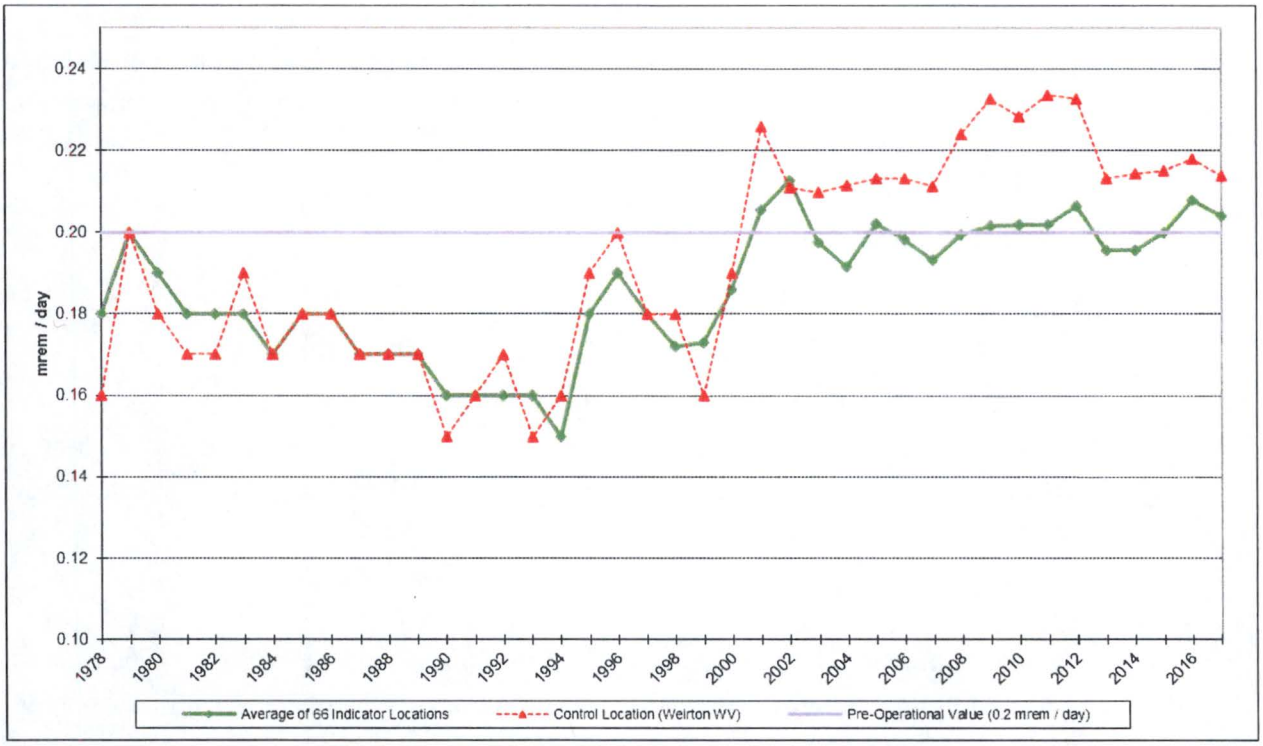
NORTHWEST QUADRANT

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

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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 rock bass, striped bass, channel catfish, bullhead catfish, brown catfish, and freshwater drum.

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 nine (9) fish samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in any of the five (5) indicator samples, nor were they detected in any of the four (4) control samples.

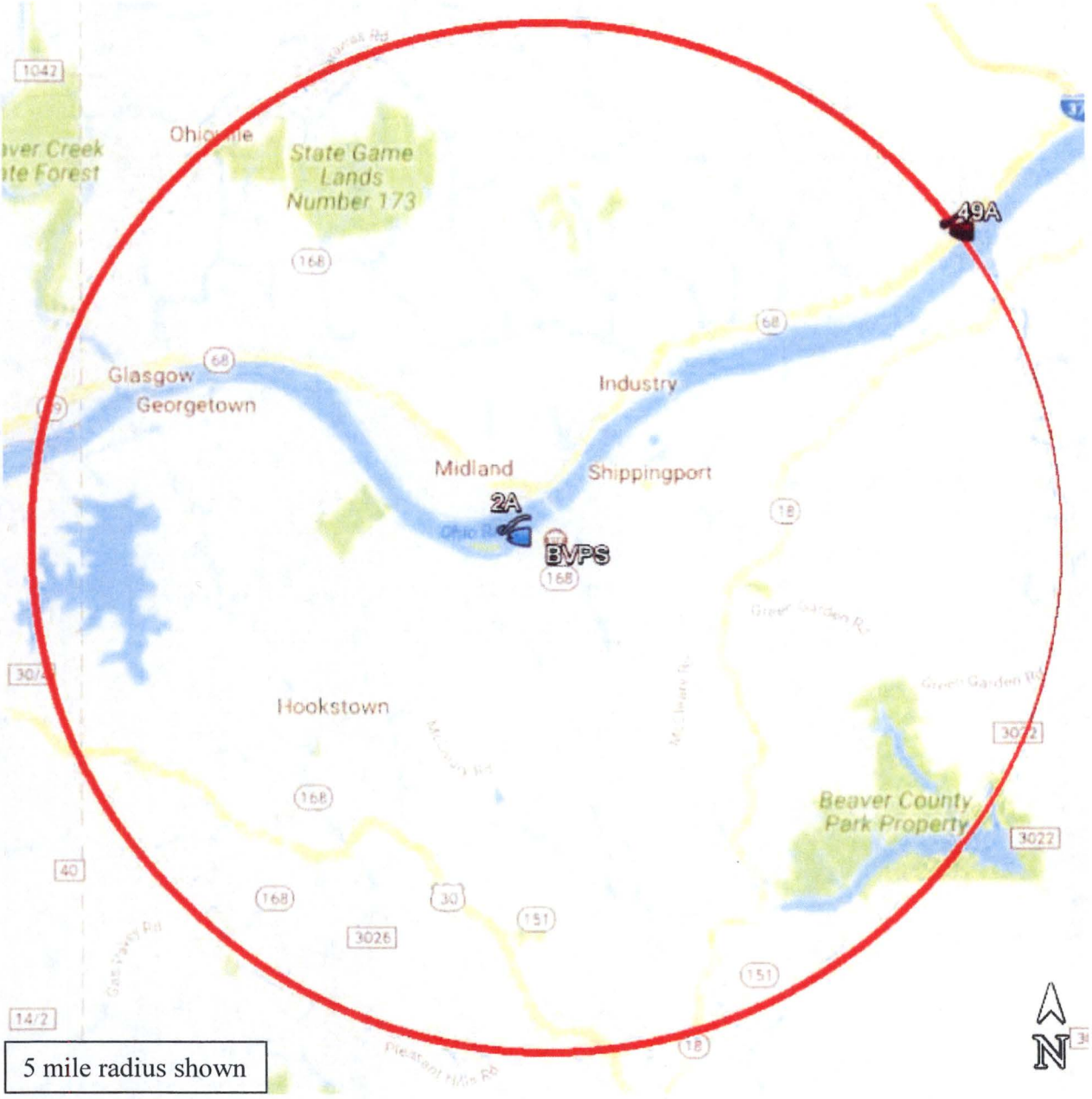
Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required fish sampling and analysis schedule during the report period.

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

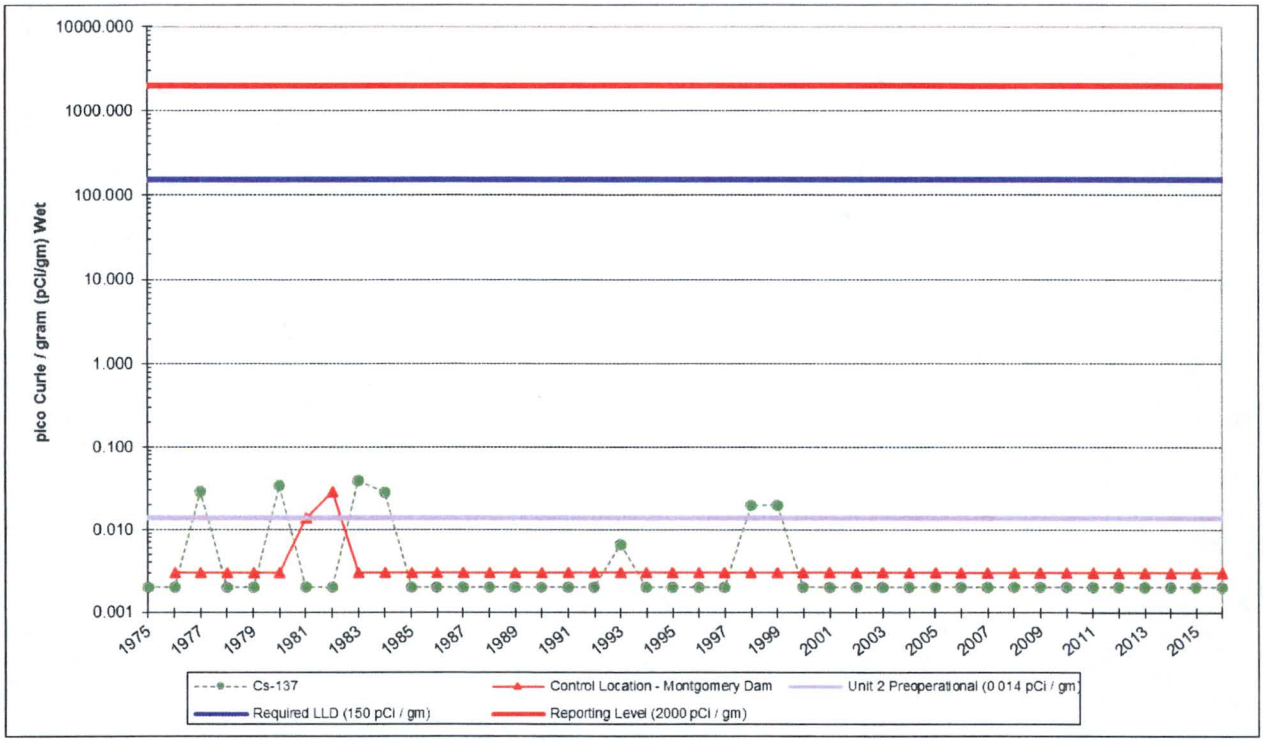


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Fish	2A	12-WSW	0.31	BVPS Outfall Vicinity
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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 37.2 inches.

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. The East Liverpool site was transitioned to a composite sample location thus replacing ATI Allegheny Ludlum.

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 that 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 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.

c. Groundwater

For historical information, groundwater was collected semiannually by grab samples at locations within four (4) miles of the site (see Figure 2-14), one (1) well in Hookstown, PA and one (1) well in Georgetown, PA. Each ground water sample was analyzed for tritium and is analyzed by gamma spectrometry.

d. Precipitation

For historical information, precipitation was collected in Shippingport, PA, East Liverpool, OH, and Weirton, WV. Precipitation, when available, was collected each week and combined for quarterly composite samples from the weekly samples. The quarterly composites were analyzed for tritium and gamma emitters.

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.

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.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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

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

Iodine-131: Although not required by the ODCM, a total of twenty-six (26) surface water control samples were analyzed for iodine-131 using radiochemical methods during the report period. Iodine-131 was detected in three of twenty-six (3 of 26) 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 1.3 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 not detected in the eight (8) indicator samples and was not detected in any of the four (4) control samples.

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.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Iodine-131: A total of fifty (50) drinking water samples were analyzed for iodine-131 (using radiochemical methods) during the report period. Iodine-131 was detected in one of fifty (1 of 50) indicator samples and three of twenty-six (3 of 26) surface water control samples. There was one positive result at the downstream location that was similar to the positive results from the upstream surface water control location, and 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.

c. Groundwater
Since these samples are not required, they will no longer be collected as of 2017.

d. Precipitation
Since these samples are not required, they will no longer be collected as of 2017.

e. Deviations from Required Sampling and Analysis Schedule: There was one deviation from the ODCM required water sampling and analysis schedule during the report.

During the sampling period of 09/05/17-09/12/17, REMP Drinking water sampling station at Midland Water Department in Midland (Site No. 4, 1.26 miles NW) was found to be out of service. The cause was the timing component that triggers the sample collection. No sample was lost because the trigger failed open causing the collection container to overflow. The component was replaced, and the water sampler was returned to service. The sample station was out of service for approximately 4 hours while performing maintenance as reported by the REMP technician (CR-2017-09446).

f. 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 -
Surface Water and Drinking Water

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	5	14-WNW	4.90	East Liverpool, OH (Water Department)
	49A	3-NE	4.93	Industry, PA (Upstream Montgomery Dam)

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-15

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

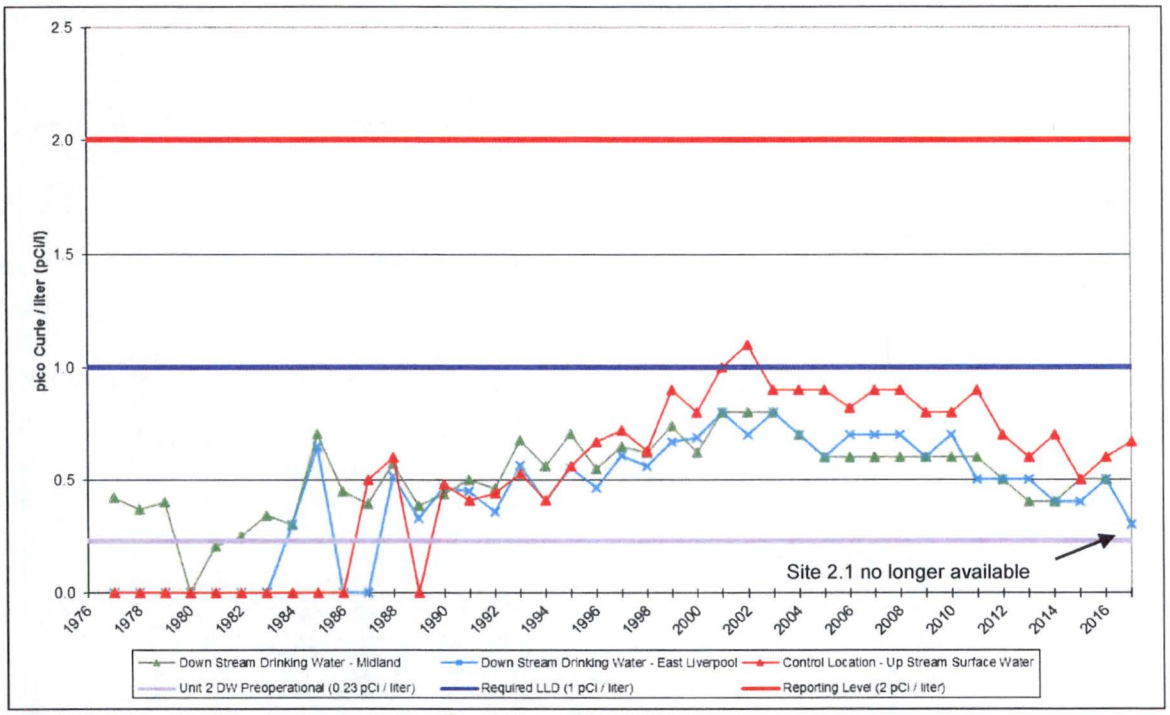
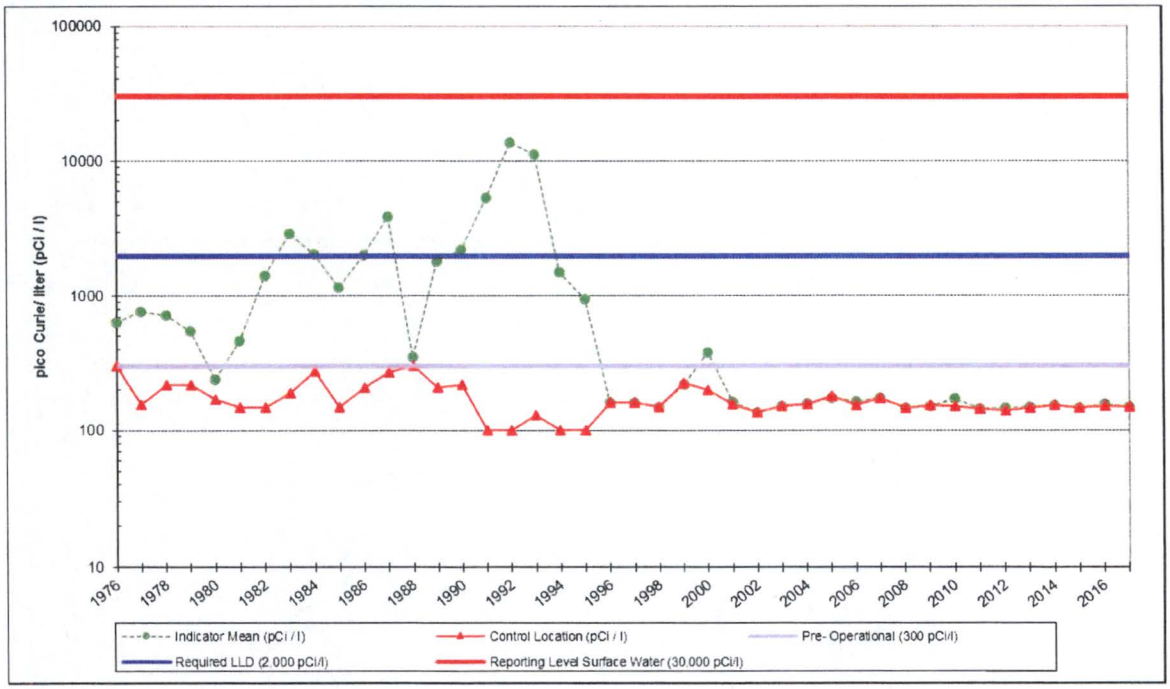


Figure 2-16

Graph of Annual Average Concentration: Tritium in Surface Water



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-17

Graph of Annual Average Concentration: Tritium in Drinking Water

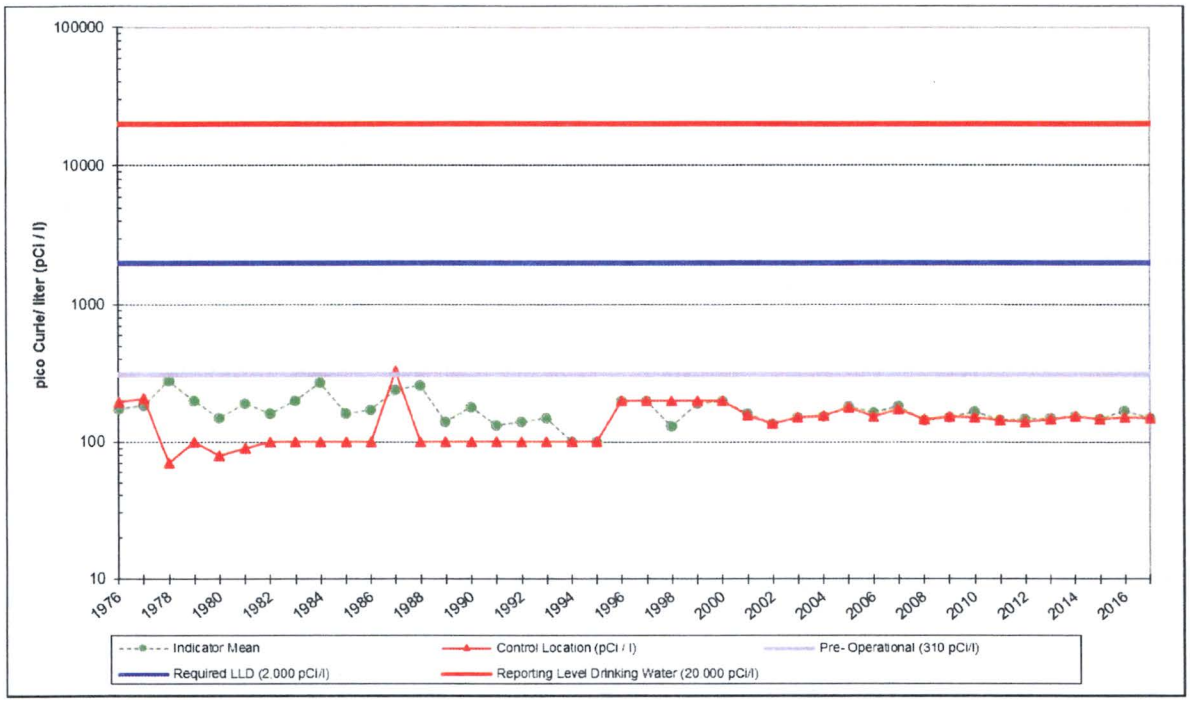


Figure 2-18

Graph of Annual Average Concentration: Tritium in Groundwater

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.

4. 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 0.00000403% of the annual radiation exposure.

   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 2-5: 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	61	Tritium
Average Dose (per Individual)	0.0000153	Tritium

Comparison of Individual Dose BVPS Liquid Effluent Releases Versus Natural and Medical Radiation Exposure	
	millirem
BVPS Liquid Effluent Release Dose	0.0000153
Radiation Exposure	620

**Table 2-6: 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	39	Tritium
Average Dose (per Individual)	0.0000097	Tritium

Comparison of Individual Dose BVPS Gaseous Effluent Releases Versus Natural and Medical Radiation Exposure	
	millirem
BVPS Gaseous Effluent Release Dose	0.0000097
Radiation Exposure	620

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-7: 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 3 – LAND USE CENSUS

A. **Land Use Census Overview**: A Land Use Census was conducted June 1 through September 1, 2017 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:1250, dated October 27, 2017:

B. **Nearest Residence:** The location has not changed since the previous census. The nearest inhabited residence is 209 Ferry Hill Road, Shippingport, PA (0.438 miles, east-northeast).

C. **Nearest Garden >500 sq ft**: The location has changed since the previous census. The closest garden location is now the Colaber Residence, 1201 Virginia Avenue, Midland, PA (1.03 miles, northwest). The previous sampling location at the Cox Residence, 238 State Route 168, Hookstown, PA (0.76 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 (6.076 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 (2.131 miles, southwest).

SECTION 3 – LAND USE CENSUS

F. **Projection for 2017 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 2017:
- Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.076 miles southeast)
- Windsheimer Dairy, 20 Windsheimer Lane, Burgettstown, PA (10.475 miles south-southwest)

G. **Projection for 2017 Doe Goat Sampling Locations:** The linear regression analysis also indicated that there will be a Doe Goat sampling location in 2017. The Doe Goat sampling location for 2017 may be as follows if Goat Milk continues to be available from this site: Covert Residence, 930 Pine Street, Hookstown PA (2.131 miles, southwest)

H. **D/Q for Milch Animal Locations:** None of the 2017 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 2003 to 2017 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	1.604	2.92	None	None
NNE	1.643	1.79	None	None
NE	0.474	4.86	None	None
ENE	0.438 [b]	1.05	None	None
E	1.20	1.92	None	3.413
ESE	0.852	1.24	None	None
SE	1.534	1.56	None [a]	None
SSE	2.106	4.36	None	None
S	1.367	1.48	None	None
SSW	0.765	2.22 [c]	None	None
SW	1.463	1.34	None	2.131
WSW	1.417	239	None	None
W	2.222	None	None	None
WNW	2.30	3.62	None	None
NW	0.892	1.03	None	None
NNW	0.910	2.41	2.442	None

[a] Although there are no Dairy Cows within 5 miles in this sector, a large local dairy located at 6.076 miles is included in the milk sampling program.
[b] Distance is the nearest location for that receptor.
[c] No garden at receptor location, distances is the nearest location in the sector.

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 2017 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
03/16/17 Water Ind Lab: E11780 Con. Lab: SPW-1054	Sr-89	60	0.80 - 1.25	0.92	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.94	AGREEMENT
	I-131	60	0.80 - 1.25	0.97	AGREEMENT
	I-131	60	0.80 - 1.25	1.04	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.22	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.05	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.02	AGREEMENT
	Co-58	60	0.80 - 1.25	1.01	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.04	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	1.02	AGREEMENT
03/16/17 Water Ind. Lab: E11779 Con. Lab: SPW-1052	H-3	60	0.80 - 1.25	0.98	AGREEMENT
03/16/17 Milk Ind. Lab: E11781 Con. Lab: SPMI-1053	Sr-89	60	0.80 - 1.25	0.82	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.91	AGREEMENT
	I-131	60	0.80 - 1.25	1.04	AGREEMENT
	I-131	60	0.80 - 1.25	1.03	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.93	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.05	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.91	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.06	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.04	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.04	AGREEMENT
	Co-60	60	0.80 - 1.25	1.01	AGREEMENT
03/16/17 Filter Paper Ind. Lab: E11782 Con. Lab: SPAP-1055	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.02	AGREEMENT
03/16/17 Charcoal Cartridge Ind. Lab: E11783 Con. Lab: SPCH-1056	I-131	60	0.80 - 1.25	0.93	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
06/08/17 **Water** Ind Lab: E11882 Con. Lab: SPW-2787	Sr-89	60	0.80 - 1.25	1.02	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.98	AGREEMENT
	I-131	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	1.02	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.02	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.05	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.83	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.00	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.00	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT
06/08/17 **Water** Ind. Lab: E11881 Con. Lab: SPW-2784	H-3	60	0.80 - 1.25	0.97	AGREEMENT
06/08/17 **Milk** Ind. Lab: E11883 Con. Lab: SPMI-2785	Sr-89	60	0.80 - 1.25	0.95	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.94	AGREEMENT
	I-131	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	1.01	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.99	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.00	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.91	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	0.98	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.00	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	0.99	AGREEMENT
	Co-60	60	0.80 - 1.25	1.00	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
09/14/17 **Water** Ind Lab: E11936 Con. Lab: SPW-4710	Sr-89	60	0.80 - 1.25	1.01	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	0.94	AGREEMENT
	I-131	60	0.80 - 1.25	1.02	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.10	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.08	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	0.98	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.04	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.05	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.06	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT
09/14/17 **Water** Ind. Lab: E11935 Con. Lab: SPW-4709	H-3	60	0.80 - 1.25	0.95	AGREEMENT
09/14/17 **Milk** Ind. Lab: E11937 Con. Lab: SPMI-4712	Sr-89	60	0.80 - 1.25	0.96	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.95	AGREEMENT
	I-131	60	0.80 - 1.25	0.83	AGREEMENT
	I-131	60	0.80 - 1.25	1.00	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.02	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.14	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.86	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	1.07	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	0.97	AGREEMENT
09/14/17 **Filter Paper** Ind. Lab: E11938 Con. Lab: SPAP-4715	Cs-137 (Gross Beta)	60	0.80 - 1.25	0.95	AGREEMENT
09/14/17 **Charcoal Cartridge** Ind. Lab: E11939A Con. Lab: SPCH-4717	I-131	60	0.80 - 1.25	0.99	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
12/07/167 **Water** Ind Lab: E12045 Con. Lab: SPW-6378	Sr-89	60	0.80 - 1.25	0.98	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.11	AGREEMENT
	I-131	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	1.05	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.01	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.95	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.02	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.06	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.01	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.02	AGREEMENT
	Co-60	60	0.80 - 1.25	1.03	AGREEMENT
12/07/1 **Water** Ind. Lab: E12044 Con. Lab: SPW-6405	H-3	60	0.80 - 1.25	1.00	AGREEMENT
12/07/17 **Milk** Ind. Lab: E12043 Con. Lab: SPMI-6404	Sr-89	60	0.80 - 1.25	1.02	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.12	AGREEMENT
	I-131	60	0.80 - 1.25	1.04	AGREEMENT
	I-131	60	0.80 - 1.25	1.10	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.13	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.08	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.95	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.12	AGREEMENT
	Co-58	60	0.80 - 1.25	1.08	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.14	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.13	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.11	AGREEMENT
	Co-60	60	0.80 - 1.25	1.07	AGREEMENT

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

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