



Beaver Valley Power Station  
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**Barry N. Blair**  
Site Vice President

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April 27, 2023  
L-23-115

10 CFR 50.36a

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

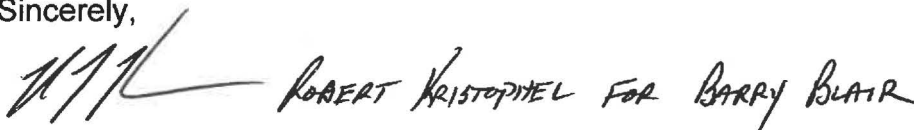
SUBJECT:  
Beaver Valley Power Station, Unit Nos. 1 and 2  
Docket No. 50-334, License No. DPR-66  
Docket No. 50-412, License No. NPF-73  
Submittal of 2022 Annual Radioactive Effluent Release Report, 2022 Annual Radiological Environmental Operating Report, and 2022 Annual Environmental Operating Report (Non-Radiological)

Energy Harbor Nuclear Corp. hereby submits the Beaver Valley Power Station (BVPS) *2022 Annual Radioactive Effluent Release Report* and the *2022 Annual Radiological Environmental Operating Report*. These reports are provided in Enclosure A, in accordance with 10 CFR 50.36a and BVPS, Unit Nos. 1 and 2 Technical Specifications 5.5.1, 5.6.1, and 5.6.2.

Energy Harbor Nuclear Corp. also submits the *2022 Annual Environmental Operating Report (Non-Radiological)* in accordance with the BVPS, Unit No. 2 Operating License, Appendix B – Environmental Protection Plan. This report is provided in Enclosure B.

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Scott York, Manager - Radiation Protection/Chemistry, at (724) 682-7669.

Sincerely,



ROBERT KRISTOFEL FOR BARRY BLAIR

Barry N. Blair

Beaver Valley Power Station Unit Nos. 1 and 2  
L-23-115  
Page 2

Enclosures:

- A. *2022 Annual Radioactive Effluent Release Report and 2022 Annual Radiological Environmental Operating Report*
- B. *2022 Annual Environmental Operating Report (Non-Radiological)*

cc: NRC Region I Administrator  
NRC Resident Inspector  
NRR Project Manager  
Director BRP/DEP  
Site BRP/DEP Representative  
NRC Region I Health Physics Inspector

Enclosure A  
L-23-115

*2022 Annual Radioactive Effluent Release Report*  
and  
*2022 Annual Radiological Environmental Operating Report*  
(Reports follow)

**ENERGY HARBOR NUCLEAR CORP.  
BEAVER VALLEY POWER STATION**



**2022**

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)**

**AND**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)**

**UNIT NOS. 1 AND 2**

**LICENSES DPR-66 AND NPF-73**

**BEAVER VALLEY POWER STATION  
ENVIRONMENTAL & CHEMISTRY SECTION**

**Technical Report Approval:**

**2022**

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)**

**AND**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)**

**UNIT NOS. 1 AND 2**

**LICENSES DPR-66 AND NPF-73**

Prepared by: Jiovanni Nunez *Jiovanni Nunez* Date: 04/14/23

Reviewed by: Donald J. Salera *Donald J. Salera* Date: 4-15-23

Approved by: Scott W. York *Scott W. York* Date: 4/20/23

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 2022, and**  
**Annual Radiological Environmental Operating Report for 2022**

**Distribution for Enclosures 1 - 3:**

**Original Report to:**

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

**Copies of Report to Other USNRC:**

U. S. Nuclear Regulatory Commission  
NRR Project Manager

U. S. Nuclear Regulatory Commission  
NRC Senior Resident Inspector

U. S. Nuclear Regulatory Commission  
NRC Region I Administrator

U. S. Nuclear Regulatory Commission  
NRC Region I Health Physics Inspector

**Copies of Report to Other Agencies:**

American Nuclear Insurers  
95 Glastonbury Boulevard  
Glastonbury, CT 06033

Department of Environmental Protection (5 copies)  
Bureau of Radiation Protection  
Rachel Carson State Office Building  
400 Market Street  
Harrisburg, PA 17101

Department of Environmental Protection (2 copies)  
Southwest Regional Office  
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Pittsburgh, PA 15222

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Columbus, OH 43235

East Liverpool Water Authority  
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ORSANCO  
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Cincinnati, OH 45228

Bureau of Radiation Protection HP3  
Ohio Department of Health  
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Akron, OH 44308-1612

Distribution for Enclosures 1 - 3:

Page 3

**Copies of Report for EH Addressees:**

SW York, BVPS; Manager, Radiation Protection & Chemistry

ES Krage, BVPS; Certified Health Physicist

J Nunez, BVPS; Chemistry Services, RETS/REMP (5 copies)

EH Crosby, Perry; Manager, Fleet RP & Chemistry

J Derringer, Field Specialist, Environmental, Inc

BVPS Document Control, RTL A9.690E



# **2022 Annual Radioactive Effluent Release Report**

**Energy Harbor Nuclear Corp.**

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

**Annual Radioactive Effluent Release Report**  
**Calendar Year - 2022**  
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Attachment 3	Unit 1 and 2 Carbon-14 (C-14) Dose Estimates	

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

# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### 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-2022-04511, Effluent Monitor will not be restored within 30 days

BVPS Condition Report No. CR-2022-04530, BV-2SGC-RQ100 Liquid Waste Effluent Radiation Monitor Check Source Test Fail

BVPS Condition Report No. CR-2022-05203, Liquid Waste Effluent Radiation Monitor 2SGC-RQ100 will not be returned to service within 30 days

BVPS Condition Report No. CR-2022-07001, REMP Air Station found OOS

BVPS Condition Report No. CR-2022-08060, 2SGC-RQ100 Liquid Waste Effluent Radiation Monitor loss of sample flow

BVPS Condition Report No. CR-2022-08921, BV-2SGC-RQ100 LIQUID WASTE EFFLUENT RADIATION MONITOR Approaching OOS >30 Days

**Condition Reporting Process:** The condition reports referenced above are documents generated electronically by plant personnel to record noncompliance issues with federal, state, local, and plant regulations and operating procedures, and to ensure that such issues are promptly addressed. If any nonconformities are identified, the Condition Reporting Process allows for corrective actions to be assigned to the proper individuals, in order to rectify adverse plant conditions and to prevent the future occurrence of similar issues.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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

**Onsite Groundwater Monitoring:** H-3 Summary: In 2022, 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 2022, two (2) of which were included in the yearly biannual sampling. No adverse effect to the offsite environment has been detected at this time, because all offsite groundwater, drinking water and surface water samples were <440 pCi/L

See Annual Environmental Operating Report, Enclosure 3, Table 2-2 for additional details on the results of the groundwater monitoring program.

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

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

**Abnormal Liquid Releases:** There were no abnormal liquid releases.

**Abnormal Gaseous Releases:** There were no abnormal gaseous releases.

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

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

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Executive Summary - Liquid and Gaseous Effluent Control (Part 2 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 three (3) Effluent Monitoring Instrumentation Channels not returned to Operable status within 30 days.

**ODCM Surveillance Deficiencies:** There were no ODCM Surveillance Deficiencies during the report period.

**ODCM Changes:** There were no 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.

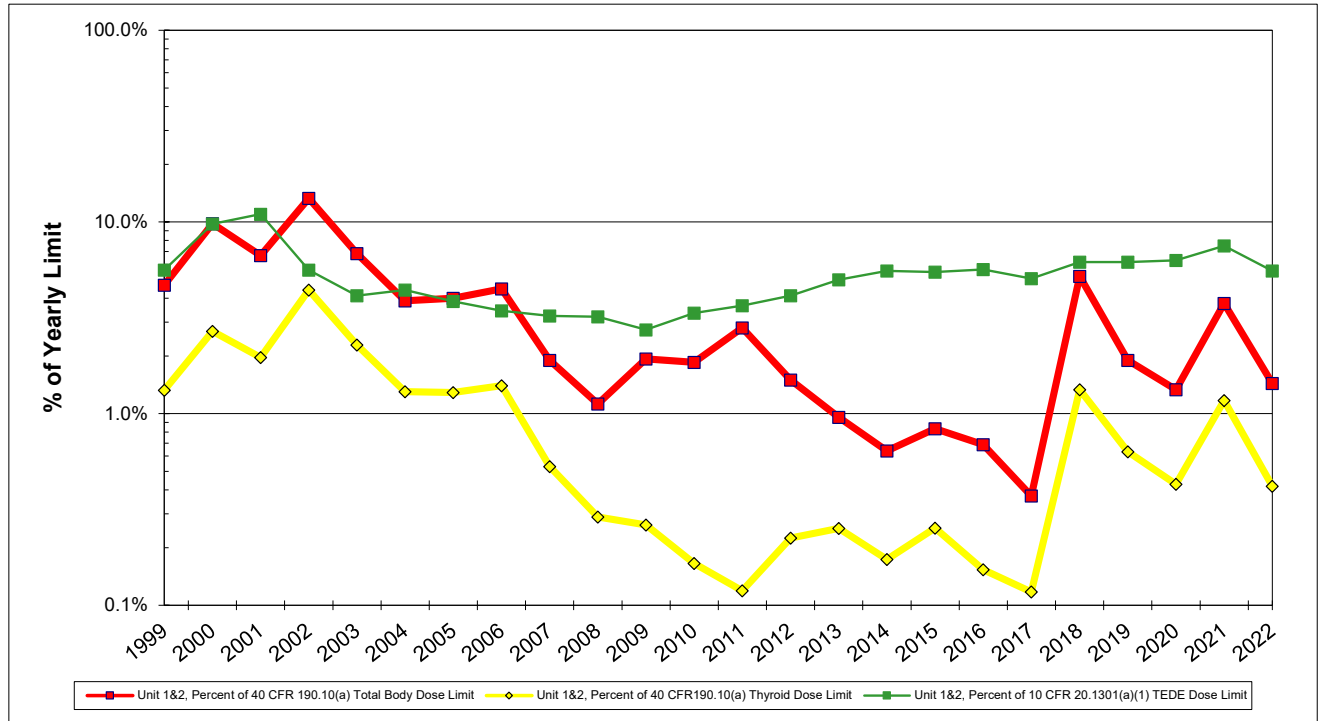
**Carbon-14 Dose Assessment:** Carbon-14 dose was calculated using EPRI & RG-1.109 calculation methods and the default ODCM receptor. The highest organ doses were to the bone (child). Details of the dose assessment due to releases of Carbon-14 in gaseous effluents are provided in Attachment 3 of this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

# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### 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.

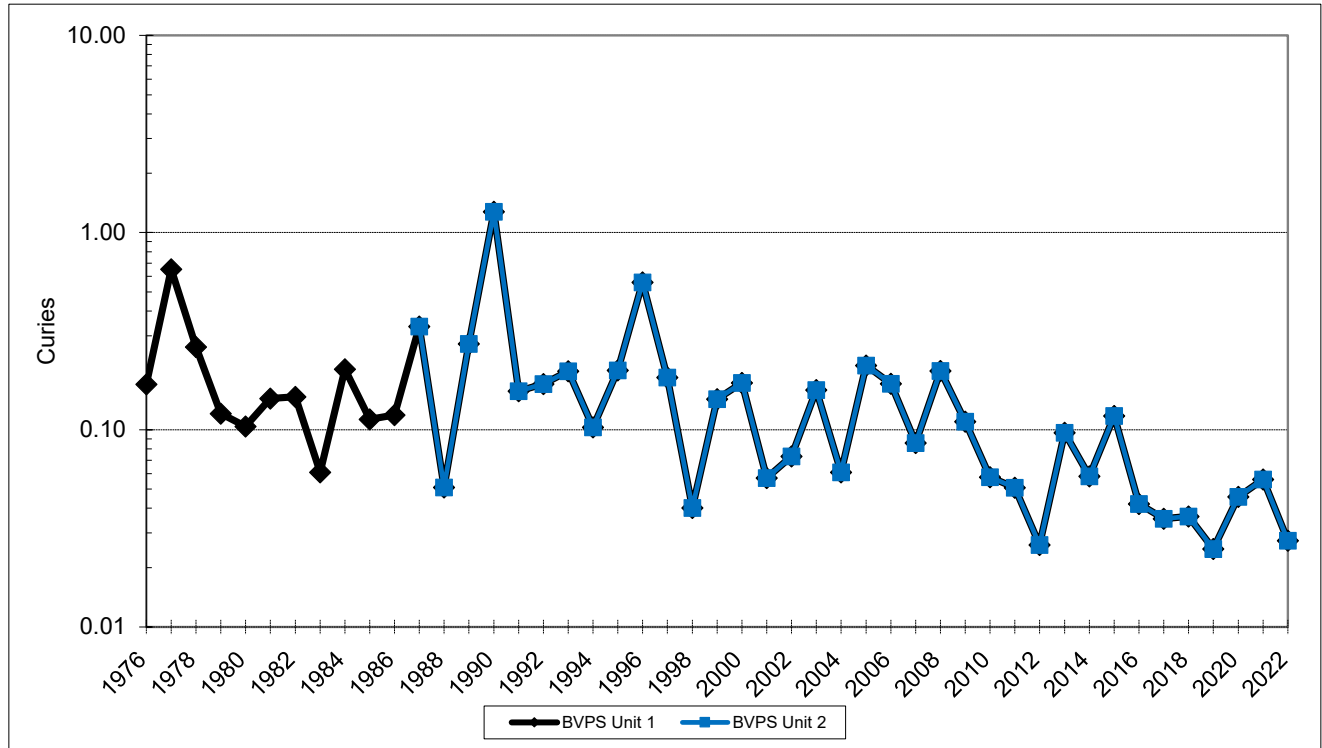


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## 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 each unit from 1976 to present.

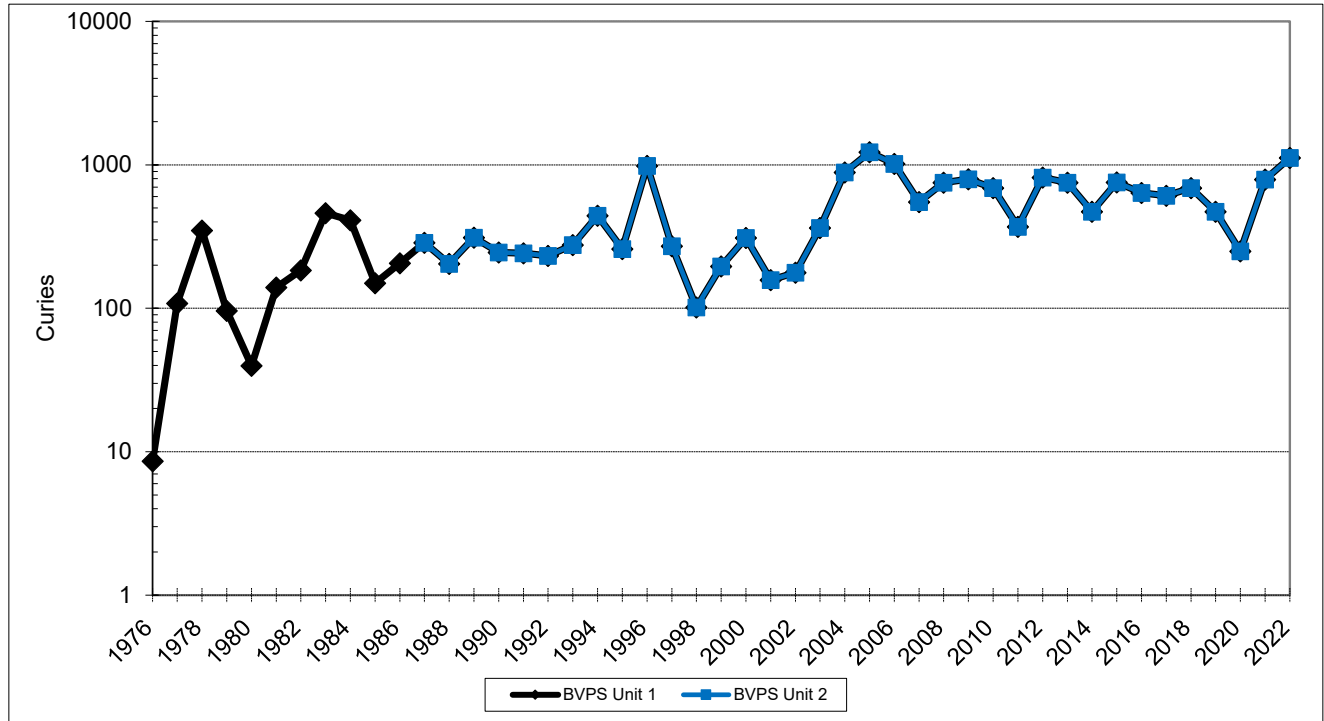


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## 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 each unit from 1976 to present. The latest increases were due to the increase power of the reactor, or power uprate, which lead to increased tritium.



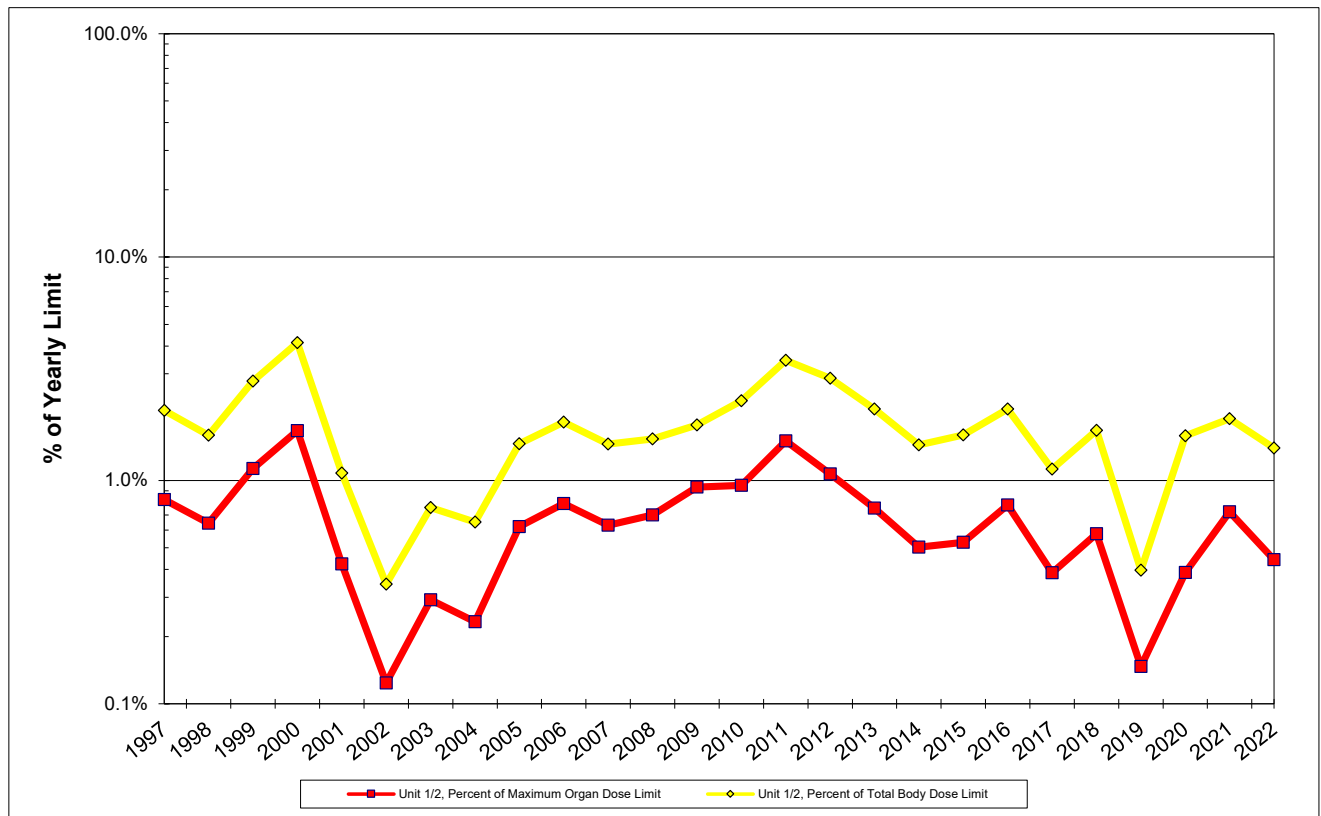


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## 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.



# Annual Radioactive Effluent Release Report

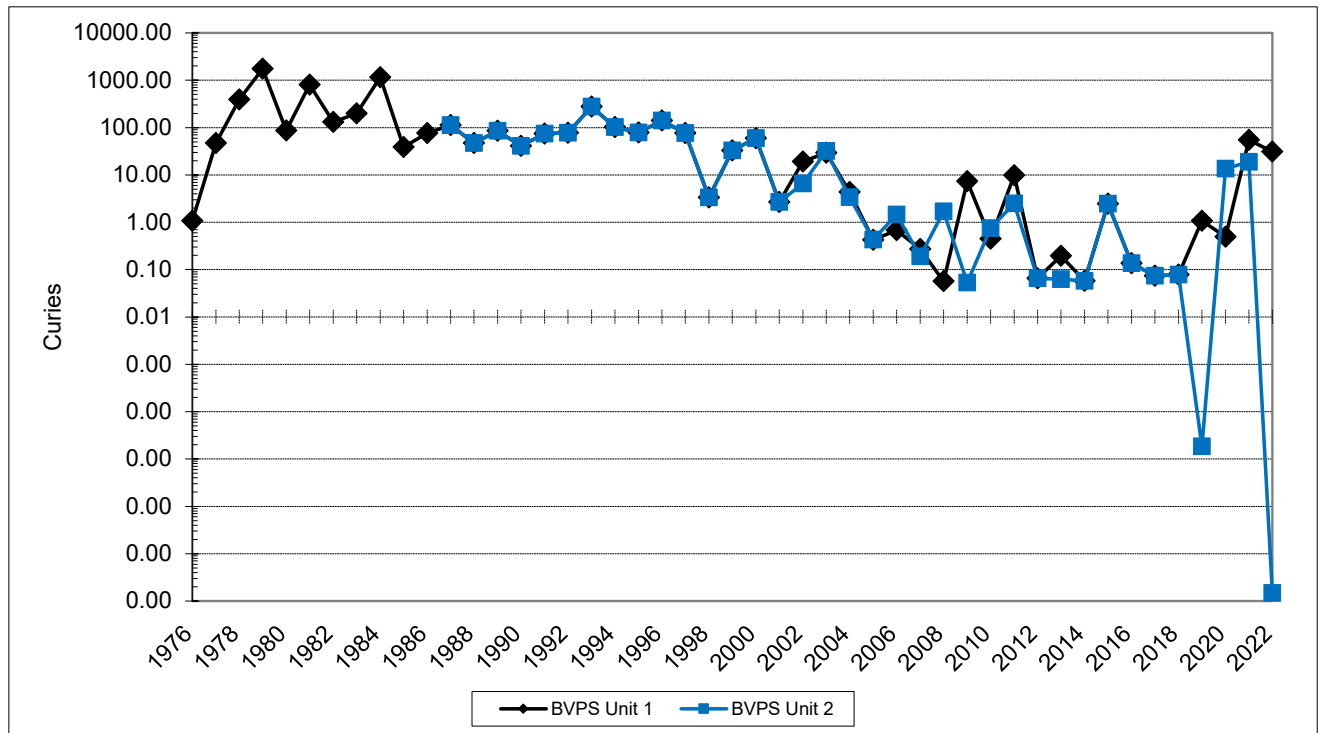
Calendar Year - 2022

## 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 each unit 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 occurred that year.

Note that in 2019, due to new effluent software, all continuous releases out of the elevated release Process Vent are now assigned to Unit 1, even though it is a shared pathway. This accounts for the drastic change in trend values.

The sharp increases in gaseous release activity that occurred from Unit 2 in 2020 and from Unit 1 in 2021 were determined to have been the result of the routine degassification of the reactor coolant systems that occurred as part of the refueling outages during those years. RCS degas activity is conservatively approximated by using the results of samples taken during startup from the previous outage from the same unit, and the sample used during these years contained high concentrations of Argon-41, which accounts for the increase in activity. These releases did not pose any radiation health risk to the public or plant personnel, nor did they exceed any NRC regulations or reporting criteria.

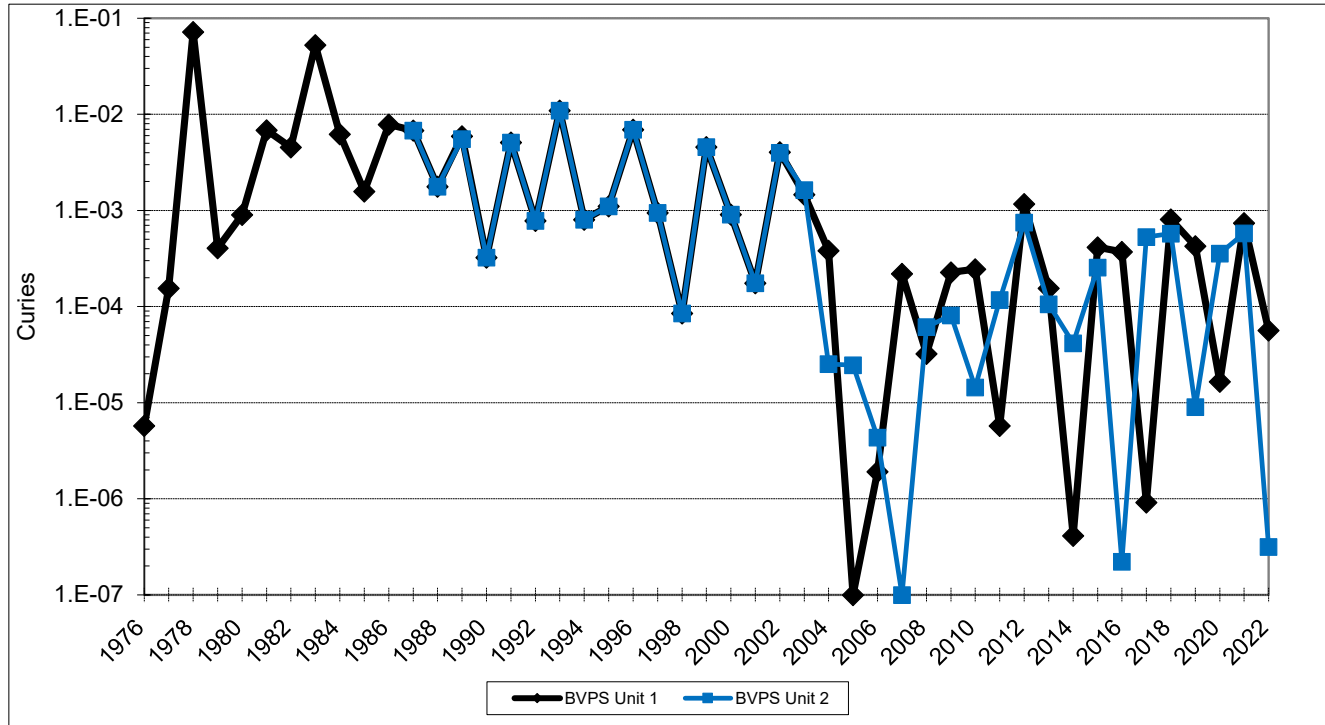


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## 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 each unit from 1976 to present. The differences between the units are relative to the outages that occurred that year.



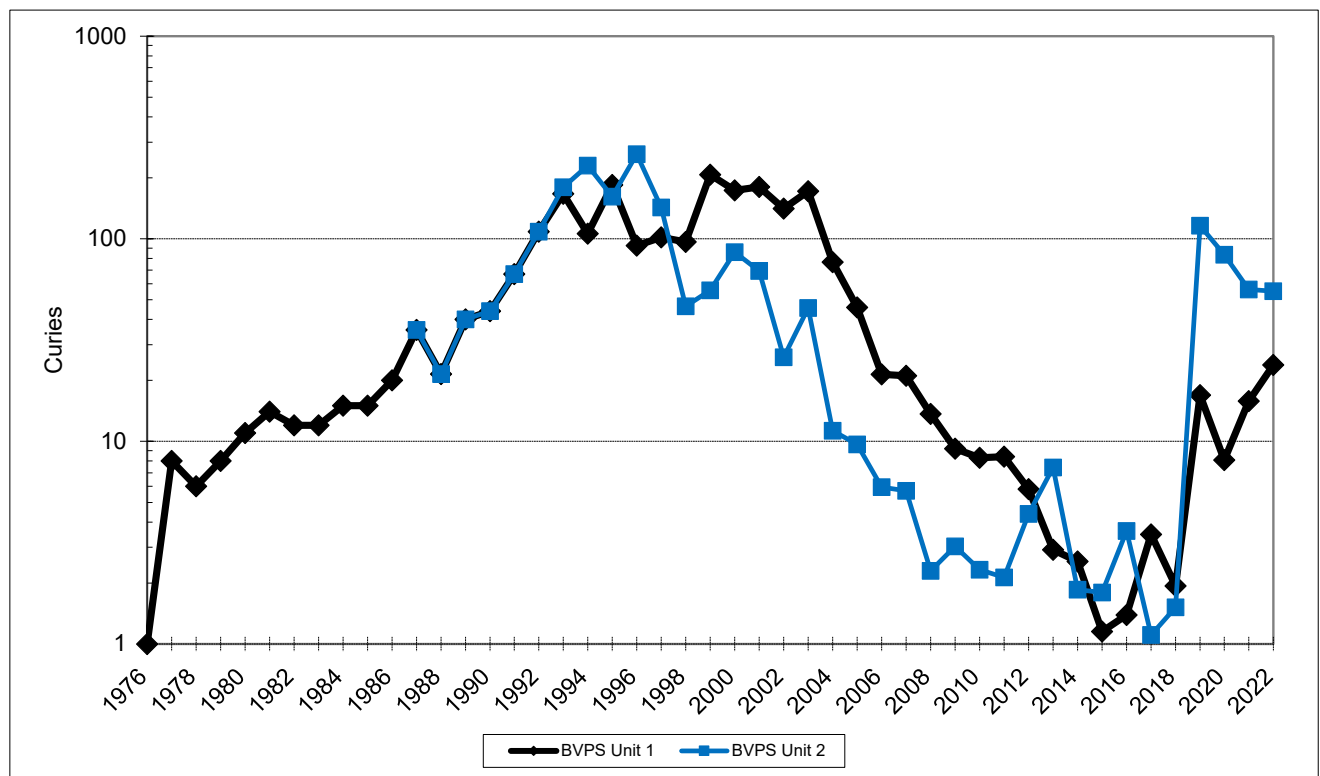
# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## Executive Summary - Trends of Gaseous Release Activity (Tritium)

**Gaseous Release Activity (Tritium):** The following graph provides a comparison of total gaseous tritium discharged from each unit 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.

Note that beginning in 2019, Beaver Valley no longer adjusts gaseous tritium effluents for background tritium and for evaporation of tritium from Fuel Pool. Excluding these adjustments provides a more conservative total for gaseous tritium released.

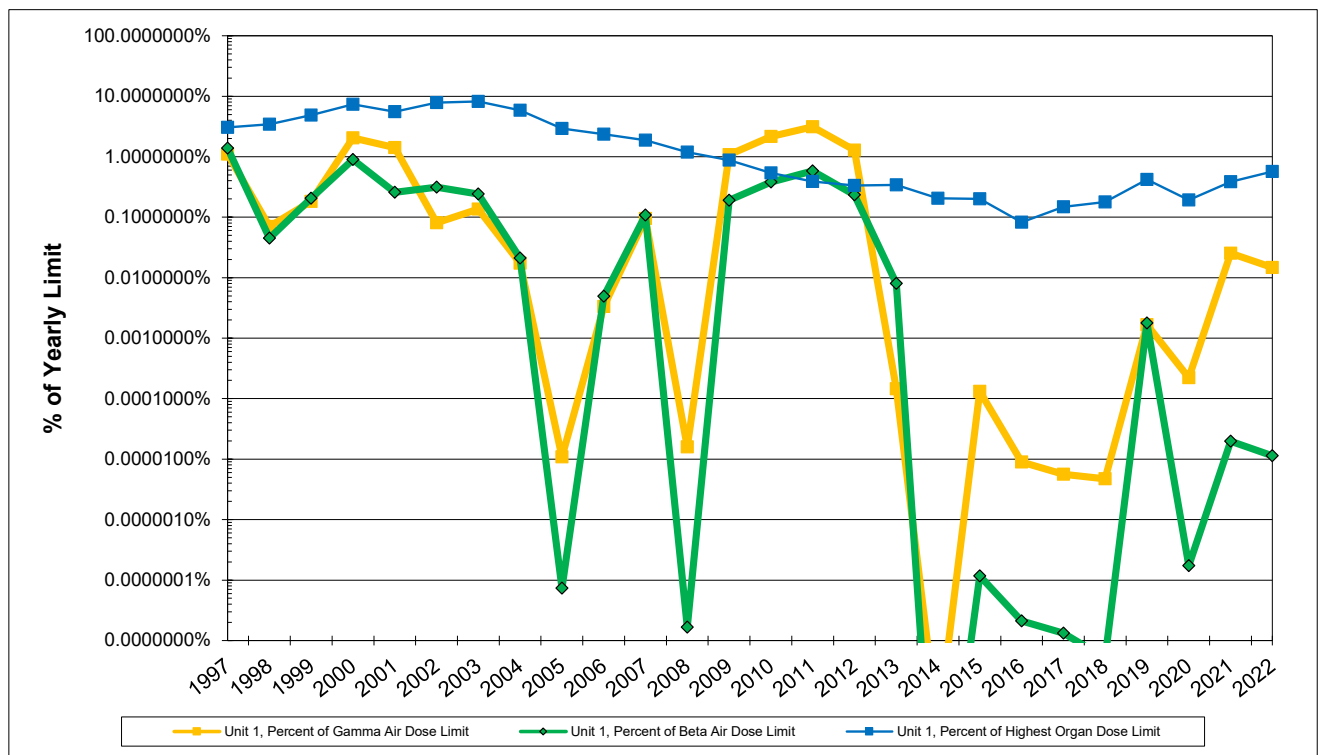


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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

**Unit 1 Gaseous Release Offsite Dose:** 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.

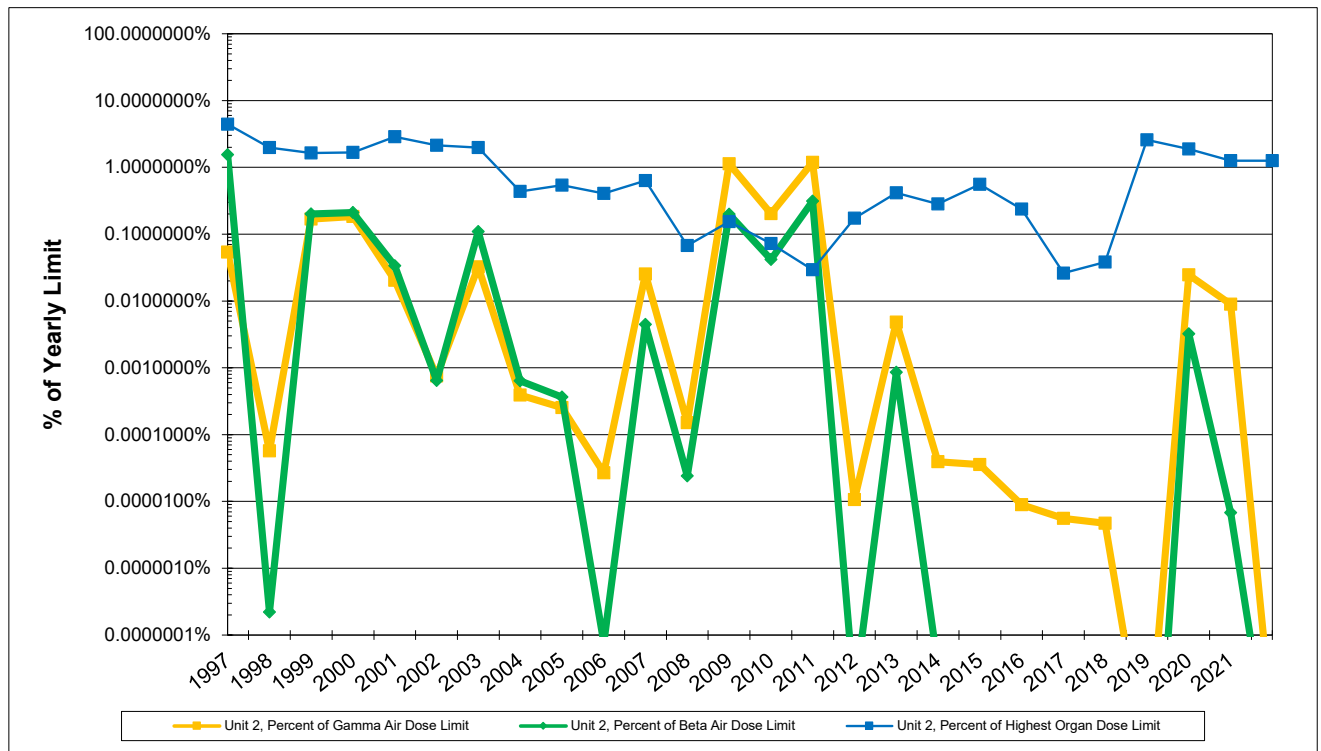


# Annual Radioactive Effluent Release Report

Calendar Year - 2022

## Executive Summary - Trends of Unit 2 Gaseous Release Offsite Dose

**Unit 2 Gaseous Release Offsite Dose:** 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.



# Annual Radioactive Effluent Release Report

Calendar Year - 2022  
Results of Abnormal Releases

Description of Abnormal Release(s)
<p><u>Abnormal Liquid Releases:</u> NONE</p> <p><u>Abnormal Gaseous Releases:</u> NONE</p>

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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

Description of Spills or Items added to 10CFR50.75(g)
<p><u>Summary of Onsite Spills (&gt;100 gallons):</u> NONE</p> <p><u>Summary of Items added to Decommissioning Files per 10CFR50.75(g) Files:</u> NONE</p>

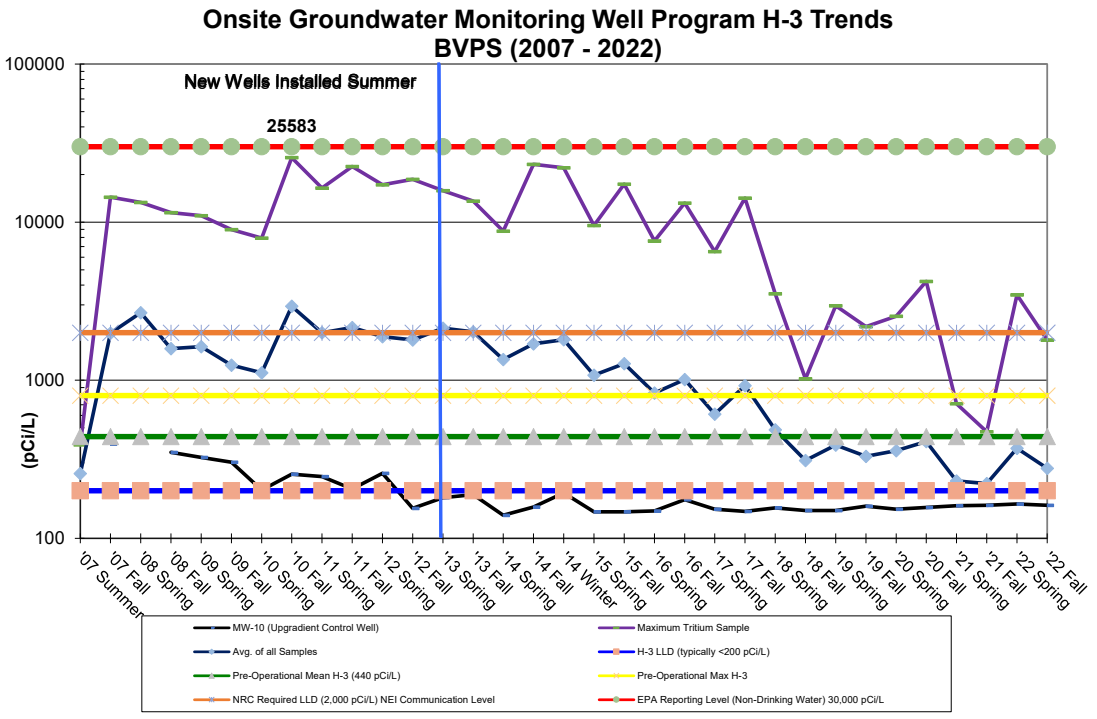


**Annual Radioactive Effluent Release Report**  
**Calendar Year - 2022**  
**Results of Onsite Groundwater Monitoring Program**

Summary of Onsite Groundwater Samples									
	2022 H-3 Maximum (pCi/L)	2022 H-3 Minimum (pCi/L)	2022 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)	3470	165	372	<200	<2000	440	Yes	2000	20000
Fall (Q4)	1800	157	277	<200	<2000	440	Yes	2000	20000
MW-16	5320	702	2640	<200	<2000	440	Yes	2000	20000

Tritium (H-3) Summary									
<p>In 2022, 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, two (2) of which were included in the yearly biannual sampling.</p> <p>Twenty (20) wells returned maximum results of less than the pre-operational mean (440 pCi/L) during all sample periods in 2022. Two (2) wells (MW-14D, &amp; MW-15) returned maximum results &gt;440 pCi/L, but &lt;2000 pCi/L. One (1) well (MW-16) returned maximum results &gt;2000 pCi/L, due to previously identified and communicated leakage into groundwater. No wells exceeded 20,000 pCi/L with the highest concentration recorded as 5320 pCi/L.</p> <p>The licensee communication level was reached for MW-12S &amp; MW-12D during 2007. Notification to local, state &amp; 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 &lt;440 pCi/L. Mitigation activities (catch basin sleeving) to prevent tritiated condensate water from reaching the groundwater were completed 12/17/11.</p> <p>Extraction 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.</p>									
Principal Gamma Emitter Summary									
<p>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.</p>									



# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### Corrections to previous Annual Radioactive Effluent Release Reports

Description of Corrections Made to RERR(s)		
<p><b><u>Correction(s) to Previous Annual Radioactive Effluent Release Reports:</u></b> The Joint Frequency Distribution tables provided with the 2021 ARERR were discovered to be incorrect, and correct JFD tables will be provided in this report. ABS, the vendor responsible for developing Beaver Valley's JFDs, found that there were some issues with the software program that we use for the JFD tables and have developed a new software program and interface that corrects those issues. The issue had to deal with the way the old program handled calm winds and the wind speed database table it used.</p>		
<table border="1"><thead><tr><th><b>Compliance with 10 CFR 72.44(d)(3) for Dry Fuel Storage</b></th></tr></thead><tbody><tr><td>While there are minimal gaseous and liquid effluents specifically from the Independent Spent Fuel Storage Installation (ISFSI), there is a contribution from Direct Radiation. The doses listed in this section include the contributions from the ISFSI.</td></tr></tbody></table>	<b>Compliance with 10 CFR 72.44(d)(3) for Dry Fuel Storage</b>	While there are minimal gaseous and liquid effluents specifically from the Independent Spent Fuel Storage Installation (ISFSI), there is a contribution from Direct Radiation. The doses listed in this section include the contributions from the ISFSI.
<b>Compliance with 10 CFR 72.44(d)(3) for Dry Fuel Storage</b>		
While there are minimal gaseous and liquid effluents specifically from the Independent Spent Fuel Storage Installation (ISFSI), there is a contribution from Direct Radiation. The doses listed in this section include the contributions from the ISFSI.		

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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 Permissible 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
d. Liquid effluents:	Ge Gamma Spectrometry, Liquid Scintillation Counter

5. Batch & Abnormal Release Information	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>a. Liquid Batch Releases</b>						
1. Number of batch releases		13	24	31	19	87
2. Total time period for batch releases	min	2547	7047	13015	14668	37277
3. Maximum time period for a batch release	min	206	3810	4710	4550	4710
4. Average time period for batch releases	min	196	294	420	772	429
5. Minimum time period for a batch release	min	186	13	13	13	13
6. Average river flow during release periods	cuft/sec	76733	52033	16100	33233	44525
<b>b. Gaseous Batch Releases</b>						
1. Number of batch releases		2	3	5	19	29
2. Total time period for batch releases	min	232	789	2227	31006	34254
3. Maximum time period for a batch release	min	167	340	752	9837	9837
4. Average time period for batch releases	min	116	263	445	1631	1181
5. Minimum time period for a batch release	min	65	130	70	17	17
<b>c. Abnormal Liquid Releases</b>						
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
<b>d. Abnormal Gaseous Releases</b>						
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

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 1A

## Gaseous Effluents - Summation Of All Releases

	unit	Q1	Q2	Q3	Q4	Calendar Year	Total Error %
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### A. Fission & Activation Gases

1. Site Total release	Ci	1.48E-08	0.00E+00	8.80E-06	3.11E+01	3.11E+01	26.5%
1a. Unit 1 Gases	Ci	0.00E+00	0.00E+00	8.80E-06	3.11E+01	3.11E+01	
1b. Unit 2 Gases	Ci	1.48E-08	0.00E+00	0.00E+00	0.00E+00	1.48E-08	
2. Average release rate for period	uCi/sec	1.91E-09	0.00E+00	1.11E-06	3.91E+00	9.78E-01	
3. Percent of applicable limit	%	8.80E-09	N/A	8.10E-10	2.95E-02	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	N/A
1a. Unit 1 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	

### C. Particulates

1. Particulates with half-lives > 8 days	Ci	3.42E-07	0.00E+00	0.00E+00	7.10E-06	7.44E-06	30.0%
1a. Unit 1 Particulates	Ci	2.53E-08	0.00E+00	0.00E+00	7.10E-06	7.13E-06	
1b. Unit 2 Particulates	Ci	3.17E-07	0.00E+00	0.00E+00	0.00E+00	3.17E-07	
2. Average release rate for period	uCi/sec	4.41E-08	0.00E+00	0.00E+00	7.10E-06	7.14E-06	
3. Percent of applicable limit	%	4.82E-06	N/A	N/A	1.86E-03	1.86E-03	

### D. Gross Alpha

1. Site Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
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	2.35E+01	1.77E+01	2.40E+01	1.38E+01	7.90E+01	32.9%
1a. Unit 1 Tritium	Ci	9.98E+00	7.23E+00	3.21E+00	3.41E+00	2.38E+01	
1b. Unit 2 Tritium	Ci	1.35E+01	1.05E+01	2.08E+01	1.04E+01	5.52E+01	
2. Average release rate for period	uCi/sec	2.39E+00	1.71E+00	1.96E+00	3.08E+00	9.14E+00	
3. Percent of applicable limit	%	1.09E+00	8.33E-01	1.07E+00	6.67E-01	3.66E+00	

### F. Carbon-14

1. Site Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	41.1%
1a. Unit 1 Carbon-14	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 Carbon-14	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	

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 - 2022

Table 1B-EB

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

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission gases</b>						
argon-41	Ci	LLD	LLD	LLD	2.98E+01	2.98E+01
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	4.86E-02	4.86E-02
krypton-87	Ci	LLD	LLD	LLD	1.43E-01	1.43E-01
krypton-88	Ci	LLD	LLD	LLD	1.34E-01	1.34E-01
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	8.80E-06	1.89E-01	1.89E-01
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	3.84E-01	3.84E-01
xenon-135m	Ci	LLD	LLD	LLD	8.96E-02	8.96E-02
xenon-138	Ci	LLD	LLD	LLD	3.00E-01	3.00E-01
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>8.80E-06</b>	<b>3.11E+01</b>	<b>3.11E+01</b>
<b>B. Iodines</b>						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>C. Particulates</b>						
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
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>D. Tritium</b>						
hydrogen-3	Ci	LLD	LLD	1.24E-06	8.57E-04	8.58E-04

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 - 2022

Table 1B-EC

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

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission gases</b>						
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>B. Iodines</b>						
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
<b>C. Particulates</b>						
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	2.53E-08	LLD	LLD	LLD	2.53E-08
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	2.53E-08	ND	ND	ND	2.53E-08
<b>D. Tritium</b>						
hydrogen-3	Ci	2.33E-01	2.17E-01	6.86E-01	1.89E-01	1.33E+00

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 1C-GB1

Gaseous Effluents - Ground Level Batch Releases (Unit 1)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission gases</b>						
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>B. Iodines</b>						
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
<b>C. Particulates</b>						
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
<b>D. Tritium</b>						
hydrogen-3	Ci	1.57E-03	8.99E-02	4.83E-03	1.02E+00	1.12E+00

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 1C-GC1

Gaseous Effluents - Ground Level Continuous Releases (Unit 1)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission gases</b>						
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>B. Iodines</b>						
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
<b>C. Particulates</b>						
chromium-51	Ci	LLD	LLD	LLD	9.02E-06	9.02E-06
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	2.56E-05	2.56E-05
cobalt-60	Ci	LLD	LLD	LLD	7.22E-06	7.22E-06
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
niobium-95	Ci	LLD	LLD	LLD	1.46E-05	1.46E-05
zirconium-95	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	5.64E-05	5.64E-05
<b>D. Tritium</b>						
hydrogen-3	Ci	9.75E+00	6.93E+00	2.52E+00	2.20E+00	2.14E+01



# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 1C-GB2

Gaseous Effluents - Ground Level Batch Releases (Unit 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission gases</b>						
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>B. Iodines</b>						
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
<b>C. Particulates</b>						
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
<b>D. Tritium</b>						
hydrogen-3	Ci	1.50E-02	2.07E-02	1.44E-02	2.92E-02	7.93E-02

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 1C-GC2

Gaseous Effluents - Ground Level Continuous Releases (Unit 2)

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
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A. Fission gases						
argon-41	Ci	1.44E-08	LLD	LLD	LLD	1.44E-08
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	4.40E-10	LLD	LLD	LLD	4.40E-10
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
<b>Total for period</b>	<b>Ci</b>	<b>1.48E-08</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>1.48E-08</b>

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
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>

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	3.17E-07	LLD	LLD	LLD	3.17E-07
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
niobium-95	Ci	LLD	LLD	LLD	LLD	LLD
zirconium-95	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
<b>Total for period</b>	<b>Ci</b>	<b>3.17E-07</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>3.17E-07</b>

D. Tritium						
hydrogen-3	Ci	1.35E+01	1.05E+01	2.08E+01	1.04E+01	5.52E+01

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 2A

Liquid Effluents - Summation Of All Releases

	unit	Q1	Q2	Q3	Q4	Calendar Year	Total Error %
<b>A. Fission &amp; activation products</b>							
1. Total release (excl. H-3, gas & alpha)	Ci	3.05E-03	7.05E-03	1.12E-02	3.34E-02	5.48E-02	26.1%
2. Average diluted concentration	uCi/mL	7.92E-10	1.66E-09	2.28E-09	6.81E-09	5.56E-09	
3. Percent of applicable limit	%	6.10E-02	1.41E-01	2.24E-01	6.68E-01	5.48E-01	
<b>B. Tritium</b>							
1. Total release	Ci	1.15E+01	4.81E+02	1.04E+03	7.04E+02	2.24E+03	25.0%
2. Average diluted concentration	uCi/mL	2.98E-06	1.13E-04	2.20E-04	1.43E-04	2.27E-04	
3. Percent of applicable limit	%	2.98E-01	1.13E+01	2.20E+01	1.43E+01	2.27E+00	
<b>C. Dissolved and entrained gases</b>							
1. Total release	Ci	0.00E+00	0.00E+00	2.41E-04	5.58E-04	7.99E-04	27.0%
2. Average diluted concentration	uCi/mL	0.00E+00	0.00E+00	4.90E-11	1.14E-10	8.11E-11	
3. Percent of applicable limit	%	0.00E+00	0.00E+00	2.45E-05	5.69E-05	4.06E-05	
<b>D. Gross alpha radioactivity (total release)</b>							
	Ci	4.22E-04	4.08E-04	1.89E-04	0.00E+00	1.02E-03	28.9%
<b>E. Volume of waste released (prior to dilution)</b>							
	L	1.02E+07	1.09E+07	7.77E+06	8.85E+06	3.77E+07	11.2%
<b>F. Volume of dilution water used</b>							
	L	3.84E-09	4.24E-09	4.91E+09	4.90E+09	9.81E+09	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 - 2022

### Table 2B-B

#### Liquid Effluents - Batch Releases

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission &amp; Activation Products</b>						
beryllium-7	Ci	LLD	6.46E-06	LLD	LLD	6.46E-06
sodium-24	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	1.25E-05	LLD	LLD	5.14E-04	5.27E-04
manganese-54	Ci	3.91E-05	1.07E-04	2.23E-05	5.83E-05	2.26E-04
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	2.00E-06	LLD	3.14E-05	1.44E-06	3.48E-05
cobalt-58	Ci	2.26E-04	8.40E-04	3.62E-03	2.68E-03	7.37E-03
cobalt-60	Ci	1.16E-03	3.11E-03	2.21E-03	2.64E-03	9.12E-03
nickel-65	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
strontium-92	Ci	4.42E-06	1.48E-06	1.25E-06	LLD	7.15E-06
niobium-95	Ci	LLD	LLD	LLD	5.13E-05	5.13E-05
zirconium-95	Ci	LLD	LLD	LLD	3.05E-05	3.05E-05
niobium-97	Ci	1.11E-05	5.56E-05	4.66E-04	2.50E-05	5.58E-04
zirconium-97	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99/technetium-99m	Ci	LLD	1.44E-06	LLD	LLD	1.44E-06
ruthenium-103	Ci	LLD	LLD	LLD	LLD	LLD
ruthenium-105	Ci	LLD	LLD	LLD	LLD	LLD
ruthenium-106	Ci	LLD	LLD	LLD	LLD	LLD
silver-108m	Ci	LLD	LLD	LLD	LLD	LLD
silver-110m	Ci	1.51E-04	9.74E-05	1.86E-05	9.33E-06	2.76E-04
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	6.98E-04	1.97E-03	2.45E-03	2.36E-02	2.87E-02
tin-125	Ci	LLD	LLD	LLD	LLD	LLD
iodine-131	Ci	LLD	LLD	LLD	2.69E-06	2.69E-06
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	1.62E-05	5.90E-05	7.52E-05
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	7.48E-04	8.61E-04	2.39E-03	3.67E-03	7.67E-03
nickel-63	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
<b>Total for period</b>	<b>Ci</b>	<b>3.05E-03</b>	<b>7.04E-03</b>	<b>1.12E-02</b>	<b>3.33E-02</b>	<b>5.47E-02</b>
<b>B. Tritium</b>						
hydrogen-3	Ci	1.14E+01	4.81E+02	1.08E+03	7.04E+02	2.28E+03
<b>Total for period</b>	<b>Ci</b>	<b>1.14E+01</b>	<b>4.81E+02</b>	<b>1.08E+03</b>	<b>7.04E+02</b>	<b>2.28E+03</b>
<b>C. Dissolved &amp; Entrained Gases</b>						
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	2.41E-04	5.58E-04	7.99E-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
xenon-137	Ci	LLD	LLD	LLD	LLD	LLD
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>2.41E-04</b>	<b>5.58E-04</b>	<b>7.99E-04</b>

LLD = Below the Lower Limit of Detectability, in uCi/mL (Table 4)  
 ND = None Detected

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 2B-C

Liquid Effluents - Continuous Releases

Nuclides released	unit	Q1	Q2	Q3	Q4	Calendar Year
<b>A. Fission &amp; Activation Products</b>						
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
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>B. Tritium</b>						
hydrogen-3	Ci	2.44E-02	3.61E-02	2.38E-02	1.38E-02	9.81E-02
<b>Total for period</b>	<b>Ci</b>	<b>2.44E-02</b>	<b>3.61E-02</b>	<b>2.38E-02</b>	<b>1.38E-02</b>	<b>9.81E-02</b>
<b>C. Dissolved &amp; Entrained Gases</b>						
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
<b>Total for period</b>	<b>Ci</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>

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

ND = None Detected

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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		0.00 m <sup>3</sup>	10.34 m <sup>3</sup>	0.0% (1)
b. Volume Buried		0.00 m <sup>3</sup>	10.34 m <sup>3</sup>	0.0% (1)
c. Total Activity		0.00 Ci	75.45 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table <sup>(2)</sup>		Percent (%)	Percent (%)	
H-3		0.00 %	1.27 %	
C-14		0.00 %	0.74 %	
Mn-54		0.00 %	1.46 %	
Fe-55		0.00 %	12.46 %	
Co-57		0.00 %	0.36 %	
Co-58		0.00 %	4.09 %	
Co-60		0.00 %	31.90 %	
Ni-63		0.00 %	0.37 %	
Zn-65		0.00 %	37.43 %	
Nb-95		0.00 %	0.06 %	
Cs-137		0.00 %	0.08 %	
Sb-125		0.00 %	11.45 %	
Zr-95		0.00 %	0.01 %	
3. Number of Shipments		0	5	
a. Type of Container Used	LSA	0	4	
	Type A	0	0	
	Type B	0	1	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	UreaFormaldehyde	0	0	
	None	0	0	
c. Mode of Transport	Truck	0	5	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	0	0	
	Erwin, TN	0	5	
e. Waste Class per 10 CFR Part 61	Class A	0	4	
	Class B	0	1	
	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.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022  
 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	140.00 m <sup>3</sup>	0.00 m <sup>3</sup>	0.0% (1)
b. Volume Buried	3.53 m <sup>3</sup>	0.00 m <sup>3</sup>	0.0% (1)
c. Total Activity	0.09 Ci	0.00 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table <sup>(2)</sup>	Percent (%)	Percent (%)	
H-3	1.40 %	0.00 %	
C-14	0.42 %	0.00 %	
Cr-51	0.00 %	0.00 %	
Mn-54	0.91 %	0.00 %	
Fe-55	29.90 %	0.00 %	
Co-58	10.10 %	0.00 %	
Co-60	25.55 %	0.00 %	
Ni-59	0.00 %	0.00 %	
Ni-63	17.33 %	0.00 %	
Sn-113	0.09 %	0.00 %	
Nb-95	1.89 %	0.00 %	
Zn-65	1.12 %	0.00 %	
Zr-95	6.70 %	0.00 %	
Ag-110m	0.67 %	0.00 %	
Tc-99	0.00 %	0.00 %	
Sb-125	3.01 %	0.00 %	
I-129	0.00 %	0.00 %	
Cs-134	0.00 %	0.00 %	
Cs-137	0.36 %	0.00 %	
Ce-144/Pr-144	0.00 %	0.00 %	
Pu-241	0.00 %	0.00 %	
3. Number of Shipments	5	0	
a. Type of Container Used	LSA	5	0
	Type A	0	0
	Type B	0	0
	Large Quantity	0	0
b. Solidification Agent Used	Cement	0	0
	UreaFormaldehyde	0	0
	None	5	0
c. Mode of Transport	Truck	5	0
	Rail	0	0
	Other	0	0
d. Final Destination	Oak Ridge, TN	5	0
	Wampum, PA	0	0
e. Waste Class per 10 CFR Part 61	Class A	5	0
	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.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 3C

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

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)			
1. Type of Waste (Irradiated components, Control Rods, etc)	Jan - Jun	Jul - Dec	Estimated Total Error
a. Volume Shipped	0.00E+00 m <sup>3</sup>	0.00E+00 m <sup>3</sup>	0.0% (1)
b. Volume Buried	0.00E+00 m <sup>3</sup>	0.00E+00 m <sup>3</sup>	0.0% (1)
c. Total Activity	0.00E+00 Ci	0.00E+00 Ci	0.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table <sup>(2)</sup>	Percent (%)	Percent (%)	
H-3	0 %	0 %	
Mn-54	0 %	0 %	
Fe-55	0 %	0 %	
Co-60	0 %	0 %	
Ni-59	0 %	0 %	
Ni-63	0 %	0 %	
Nb-95	0 %	0 %	
Zn-65	0 %	0 %	
Sb-125	0 %	0 %	
Cs-134	0 %	0 %	
Cs-137	0 %	0 %	
3. Number of Shipments	0	0	
a. Type of Container Used	LSA	0	0
	Type A	0	0
	Type B	0	0
	Large Quantity	0	0
b. Solidification Agent Used	Cement	0	0
	UreaFormaldehyde	0	0
	None	0	0
c. Mode of Transport	Truck	0	0
	Rail	0	0
	Other	0	0
d. Final Destination	Oak Ridge, TN	0	0
	Barnwell, SC	0	0
e. Waste Class per 10 CFR Part 61	Class A	0	0
	Class B	0	0
	Class C	0	0
	> Class C	0	0
B. No Irradiated Fuel Shipments			

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

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



# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 4

## Lower Limits Of Detectability (LLD)

Nuclide	RWDA-G 1000 cc Gas Grab Sample		RWDA-L 1000 mL Liquid Grab Sample		Filter Paper / Charcoal Continuous Effluent Sample	
	(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	9.62E-08	1E-04	2.08E-08	5E-07	1.81E-13	1E-11
Ar-41	5.85E-08	1E-04	1.27E-08	5E-07		
Cr-51	4.51E-07	1E-04	1.04E-07	5E-07	6.31E-13	1E-11
Mn-54	6.31E-08	1E-04	1.39E-08	5E-07	2.08E-13	1E-11
Fe-55			(1) 1.00E-06	1E-06		
Fe-59	8.36E-08	1E-04	1.81E-08	5E-07	4.57E-13	1E-11
Co-57	4.55E-08	1E-04	1.13E-08	5E-07	6.76E-14	1E-11
Co-58	4.39E-08	1E-04	9.71E-09	5E-07	2.05E-13	1E-11
Co-60	8.59E-08	1E-04	1.86E-08	5E-07	2.72E-13	1E-11
Zn-65	1.65E-07	1E-04	3.58E-08	5E-07	3.69E-13	1E-11
Se-75					1.78E-13	1E-11
Kr-85	1.48E-05	1E-04	3.36E-06	1E-05		
Kr-85m	3.70E-08	1E-04	8.96E-09	1E-05		
Kr-87	1.11E-07	1E-04	2.55E-08	1E-05		
Kr-88	1.43E-07	1E-04	3.38E-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	7.59E-08	1E-04	1.64E-08	5E-07	2.36E-13	1E-11
Nb-95	4.20E-08	1E-04	9.31E-09	5E-07	1.95E-13	1E-11
Nb-97	4.92E-08	1E-04	1.10E-08	5E-07	1.52E-13	1E-11
Zr-95	9.35E-08	1E-04	2.08E-08	5E-07	2.04E-13	1E-11
Mo-99	3.54E-07	1E-04	7.87E-08	5E-07	1.16E-12	1E-11
Tc-99m	4.50E-08	1E-04	1.10E-08	5E-07	7.15E-14	1E-11
Ag-110m	4.38E-08	1E-04	9.82E-09	5E-07	1.04E-13	1E-11
Sb-124	3.11E-08	1E-04	7.00E-09	5E-07	1.16E-13	1E-11
Sb-125	1.45E-07	1E-04	3.32E-08	5E-07	3.33E-13	1E-11
I-131	5.72E-08	1E-04	1.31E-08	1E-06	1.24E-13	1E-12
I-133	6.68E-08	1E-04	1.51E-08	5E-07	1.30E-13	1E-10
I-135	3.21E-07	1E-04	6.95E-08	5E-07	6.67E-13	1E-11
Xe-131m	1.89E-06	1E-04	4.53E-07	1E-05		
Xe-133	7.16E-08	1E-04	1.98E-08	1E-05		
Xe-133m	3.93E-07	1E-04	9.20E-08	1E-05		
Xe-135	4.70E-08	1E-04	1.10E-08	1E-05		
Xe-135m	1.04E-07	1E-04	2.35E-08	1E-05		
Xe-137	8.92E-07	1E-04	2.03E-07	1E-05		
Xe-138	2.43E-07	1E-04	5.66E-08	1E-05		
Cs-134	4.42E-08	1E-04	9.94E-09	5E-07	1.16E-13	1E-11
Cs-137	5.85E-08	1E-04	1.31E-08	5E-07	2.03E-13	1E-11
Ba-139	1.70E-07	1E-04	4.07E-08	5E-07	4.53E-13	1E-11
Ba-140	1.32E-07	1E-04	3.00E-08	5E-07	4.00E-13	1E-11
La-140	1.13E-07	1E-04	2.42E-08	5E-07	2.59E-13	1E-11
Ce-141	8.10E-08	1E-04	1.97E-08	5E-07	1.38E-13	1E-11
Ce-144	2.89E-07	1E-04	7.10E-08	5E-07	4.66E-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 1.43E+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 7, except those denoted by (1), are from a counter/detector calibration on 3/31/20. 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.

# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### Table 5A

### Assessment Of Radiation Doses (Unit 1)

		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
	O R G A N (1)	Bone	0.00E+00	0.0000	4.00E-07	0.0000	2.69E-04	0.0054	3.38E-04	0.0068	6.08E-04
Liver		2.67E-06	0.0001	7.82E-03	0.1564	1.75E-02	0.3496	1.16E-02	0.2320	3.69E-02	0.3690
Total Body		2.67E-06	0.0002	7.84E-03	0.5227	1.74E-02	1.1587	1.15E-02	0.7640	3.67E-02	1.2228
Thyroid		2.67E-06	0.0001	7.80E-03	0.1560	1.72E-02	0.3436	1.12E-02	0.2238	3.62E-02	0.3617
Kidney		2.67E-06	0.0001	7.80E-03	0.1560	1.73E-02	0.3456	1.13E-02	0.2258	3.64E-02	0.3637
Lung		2.67E-06	0.0001	7.80E-03	0.1560	1.73E-02	0.3456	1.13E-02	0.2256	3.64E-02	0.3636
GI-LLI		2.67E-06	0.0001	8.14E-03	0.1628	1.78E-02	0.3556	1.19E-02	0.2382	3.78E-02	0.3783

		Unit 1 Gaseous Effluents (4)									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
Batch & Continuous Releases		Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
	(2)	Gamma Air	0.00E+00	0.0000	0.00E+00	0.0000	4.35E-11	0.0000	1.47E-03	0.0294	1.47E-03
(2)	Beta Air	0.00E+00	0.0000	0.00E+00	0.0000	2.05E-13	0.0000	2.27E-06	0.0000	2.27E-06	0.0000
O R G A N (3)	Bone	1.28E-10	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	8.29E-05	0.0011	8.29E-05	0.0006
	Liver	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.30E-02	0.1733	8.52E-02	0.5680
	Total Body	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.31E-02	0.1747	8.52E-02	0.5680
	Thyroid	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.30E-02	0.1733	8.51E-02	0.5673
	Kidney	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.30E-02	0.1733	8.51E-02	0.5673
	Lung	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.31E-02	0.1747	8.52E-02	0.5680
(3)	GI-LLI	3.67E-02	0.4893	2.60E-02	0.3467	9.40E-03	0.1253	1.31E-02	0.1747	8.52E-02	0.5680

- (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.
- (4) Unit 1 gaseous dose includes ALL continuous releases from the shared Process Vent.

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).

# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### Table 5B

#### Assessment Of Radiation Doses (Unit 2)

		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
	O R G A N (1)	Bone	3.84E-05	0.0008	4.53E-05	0.0009	1.65E-04	0.0033	1.27E-03	0.0254	1.52E-03
Liver		2.84E-04	0.0057	9.25E-04	0.0185	9.29E-04	0.0186	3.72E-03	0.0744	5.86E-03	0.0586
Total Body		2.80E-04	0.0187	9.35E-04	0.0623	8.76E-04	0.0584	3.15E-03	0.2100	5.24E-03	0.1747
Thyroid		2.29E-04	0.0046	8.34E-04	0.0167	6.81E-04	0.0136	1.98E-03	0.0396	3.72E-03	0.0372
Kidney		2.32E-04	0.0046	2.06E-04	0.0041	7.54E-04	0.0151	2.54E-03	0.0508	3.73E-03	0.0373
Lung		2.43E-04	0.0049	8.52E-04	0.0170	7.09E-04	0.0142	2.18E-03	0.0436	3.98E-03	0.0398
GI-LLI		6.53E-04	0.0131	1.69E-03	0.0338	1.18E-03	0.0237	2.05E-03	0.0410	5.57E-03	0.0557

		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	4.40E-10	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	4.40E-10
(2)	Beta Air	1.58E-10	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	1.58E-10	0.0000
O R G A N (3)	Bone	5.95E-08	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	5.95E-08	0.0000
	Liver	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600
	Total Body	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600
	Thyroid	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600
	Kidney	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600
	Lung	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600
(3)	GI-LLI	4.52E-02	0.6027	3.64E-02	0.4853	7.06E-02	0.9413	3.70E-02	0.4933	1.89E-01	1.2600

- (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).

# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### Table 6

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

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

**1) Unit 2 gaseous effluent radiation monitors 2HVS-RQ109B/C/D (CR-2022-04511)**

Containment ventilation gaseous effluent radiation monitors 2HVS-RQ109B/C/D remained out of service from May 1, 2022 and were not returned to service by June 1, 2022. The monitors were declared Non-Functional due to issues related to the velocity probe encountered during performance of Order 200791289. 2HVS-RQ109 was previously declared Non-functional for maintenance and compensatory measures put in place. Completion of the monitor repairs was moved to a 2023 completion date.

**2) Unit 2 liquid effluent radiation monitor 2SGC-RQ100 (CR-2022-05203)**

Liquid waste effluent radiation monitor 2SGC-RQ100 Channel Check Source failed on May 30, 2022 (captured in CR-2022-04530). Multiple attempts were unsuccessful at getting the check source test to pass, and the monitor was declared Non-Functional. Due to issues encountered by FIN in acquiring the required parts to fix the check source mechanism, 2SGC-RQ100 was not returned to service within the 30 day window.

**3) Unit 2 liquid effluent radiation monitor 2SGC-RQ100 (CR-2022-08921)**

Liquid waste effluent radiation monitor 2SGC-RQ100 was declared Non-Functional on October 23, 2022 due to a "Monitor Loss of Sample Flow" error encountered during a liquid waste discharge (captured in CR-2022-08060). Orders to restore monitor functionality were entered, and Work Order 200895725 was completed on November 28, 2022, however this was beyond the 30 day window which had ended on November 22, 2022.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Table 7

## Total Dose Commitments and Total Effective Dose Equivalents

Total Dose Commitment From All Facility Releases To Members of the Public 40 CFR 190.10(a) Environmental Doses				
Organ	Effluent Dose <sup>(1)</sup> (mrem)	Direct Radiation Dose <sup>(2)</sup> (mrem)	Total Dose (mrem)	% of ODCM or 40 CFR 190 Limit
Bone	1.30E-03	0.00E+00	1.30E-03	0.01%
Liver	3.48E-01	0.00E+00	3.48E-01	1.39%
Total Body	3.49E-01	0.00E+00	3.49E-01	1.40%
Thyroid	3.47E-01	0.00E+00	3.47E-01	0.46%
Kidney	3.47E-01	0.00E+00	3.47E-01	1.39%
Lung	3.47E-01	0.00E+00	3.47E-01	1.39%
GI-LLI	3.50E-01	0.00E+00	3.50E-01	1.40%

(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 **5.56** 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.

**Compliance with 10 CFR 72.44(d)(3) for Dry Fuel Storage**

While there are minimal gaseous and liquid effluents specifically from the Independent Spent Fuel Storage Installation (ISFSI), there is a contribution from Direct Radiation. The doses listed in this section include the contributions from the ISFSI.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022  
Table 8

Offsite Dose Calculation Manual Surveillance Deficiencies
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There were no Offsite Dose Calculation Manual Surveillance Deficiencies during this report period:
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# Annual Radioactive Effluent Release Report

## Calendar Year - 2022

### Table 9

#### Offsite Dose Calculation Manual Changes (Description)

There were no changes made to the ODCM during the report period. See ODCM procedure 1/2-ODC-1.01, "ODCM: Index, Matrix and History ODCM Changes" for a complete description of previous changes to the ODCM.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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

93.5% = Wind Speed 35'

98.7% = Wind Speed 150'

98.7% = Wind Speed 500'

93.5% = Wind Direction 35'

98.7% = Wind Direction 150'

98.7% = Wind Direction 500'

99.8% = Delta Temperature (150' - 35' ) 1P

100.0% = Delta Temperature (500' - 35' ) 2P

100.0% = Temperature 35'

99.2% = Precipitation

**98.1% = Average Recovery of Individual Meteorological Parameters**

#### PERCENT RECOVERY OF COMPOSITE VARIABLES

93.4% = Wind Speed 35', Wind Direction 35', Delta Temperature 1P

98.5% = Wind Speed 150', Wind Direction 150', Delta Temperature 1P

98.7% = Wind Speed 500', Wind Direction 500', Delta Temperature 2P

**96.9% = Average Recovery of Composite Variables**

### Attachment 1 Clarification

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

- 1) All routine Gaseous Releases for the calendar year were determined to be within design objectives, where as, the ODCM Dose Limits and the ODCM Dose Rate Limits are considered to be the design objectives.
- 2) There were no Abnormal Gaseous Release during the calendar year, no design objectives were exceeded.

For a copy of the hourly meteorological data during the calendar quarters, contact Radiological Effluents Administrator at 724-682-5839.



### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	62	62	0	0	0	0	124
NNE	56	27	0	0	0	0	83
NE	52	24	0	0	0	0	76
ENE	57	20	0	0	0	0	77
E	52	15	0	0	0	0	67
ESE	22	11	0	0	0	0	33
SE	28	7	0	0	0	0	35
SSE	17	18	0	0	0	0	35
S	29	26	0	0	0	0	55
SSW	34	77	14	0	0	0	125
SW	31	117	44	6	0	0	198
WSW	43	164	31	1	0	0	239
W	67	129	17	0	0	0	213
WNW	40	56	6	0	0	0	102
NW	44	38	3	0	0	0	85
NNW	49	43	0	0	0	0	92
<b>Total</b>	<b>683</b>	<b>834</b>	<b>115</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>1639</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1639
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	6	2	0	0	0	0	8
NNE	5	1	0	0	0	0	6
NE	1	0	0	0	0	0	1
ENE	6	1	0	0	0	0	7
E	3	0	0	0	0	0	3
ESE	0	0	0	0	0	0	0
SE	2	0	0	0	0	0	2
SSE	3	1	0	0	0	0	4
S	2	1	0	0	0	0	3
SSW	2	10	0	0	0	0	12
SW	1	7	4	2	0	0	14
WSW	6	15	7	0	0	0	28
W	5	9	0	0	0	0	14
WNW	6	5	1	0	0	0	12
NW	4	3	2	0	0	0	9
NNW	6	3	0	0	0	0	9
<b>Total</b>	<b>58</b>	<b>58</b>	<b>14</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>132</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	132
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	11	2	0	0	0	0	13
NNE	4	2	0	0	0	0	6
NE	3	1	0	0	0	0	4
ENE	3	1	0	0	0	0	4
E	5	0	0	0	0	0	5
ESE	1	0	0	0	0	0	1
SE	1	1	0	0	0	0	2
SSE	2	2	0	0	0	0	4
S	3	1	0	0	0	0	4
SSW	6	8	1	0	0	0	15
SW	7	16	7	0	0	0	30
WSW	7	14	7	2	0	0	30
W	6	6	2	0	0	0	14
WNW	8	5	2	0	0	0	15
NW	4	2	2	0	0	0	8
NNW	9	2	1	0	0	0	12
<b>Total</b>	<b>80</b>	<b>63</b>	<b>22</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>167</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	167
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	91	11	0	0	0	0	102
NNE	66	6	0	0	0	0	72
NE	63	3	0	0	0	0	66
ENE	38	7	0	0	0	0	45
E	37	4	0	0	0	0	41
ESE	9	1	0	0	0	0	10
SE	17	1	0	0	0	0	18
SSE	19	4	0	0	0	0	23
S	22	7	2	0	0	0	31
SSW	38	33	2	0	0	0	73
SW	51	101	76	7	0	0	235
WSW	52	132	77	13	0	0	274
W	60	99	27	1	0	0	187
WNW	52	37	0	0	0	0	89
NW	45	24	1	0	0	0	70
NNW	75	20	2	1	0	0	98
<b>Total</b>	<b>735</b>	<b>490</b>	<b>187</b>	<b>22</b>	<b>0</b>	<b>0</b>	<b>1434</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1434
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	107	7	0	0	0	0	114
NNE	82	4	0	0	0	0	86
NE	127	6	0	0	0	0	133
ENE	139	39	0	0	0	0	178
E	114	6	0	0	0	0	120
ESE	110	2	0	0	0	0	112
SE	81	0	0	0	0	0	81
SSE	88	2	1	0	0	0	91
S	102	16	1	0	0	0	119
SSW	105	46	7	0	0	0	158
SW	85	142	45	0	0	0	272
WSW	71	148	31	3	0	0	253
W	59	78	10	0	0	0	147
WNW	58	31	1	0	0	0	90
NW	79	25	0	0	0	0	104
NNW	71	23	0	0	0	0	94
<b>Total</b>	1478	575	96	3	0	0	2152

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	2152
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** F **Delta Temperature** Moderately Stable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	27	0	0	0	0	0	27
NNE	27	1	0	0	0	0	28
NE	36	0	0	0	0	0	36
ENE	60	6	0	0	0	0	66
E	142	1	0	0	0	0	143
ESE	215	1	0	0	0	0	216
SE	179	2	0	0	0	0	181
SSE	84	1	0	0	0	0	85
S	105	5	0	0	0	0	110
SSW	70	18	2	0	0	0	90
SW	38	21	4	0	0	0	63
WSW	13	16	4	0	0	0	33
W	10	15	1	0	0	0	26
WNW	10	2	1	0	0	0	13
NW	11	1	1	0	0	0	13
NNW	17	1	0	0	0	0	18
<b>Total</b>	1044	91	13	0	0	0	1148

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1148
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	10	0	0	0	0	0	10
NNE	14	0	0	0	0	0	14
NE	20	0	0	0	0	0	20
ENE	67	1	0	0	0	0	68
E	190	1	0	0	0	0	191
ESE	243	0	0	0	0	0	243
SE	215	0	1	1	0	0	217
SSE	106	0	1	0	0	0	107
S	51	2	0	0	0	0	53
SSW	32	4	0	0	0	0	36
SW	17	0	1	0	0	0	18
WSW	5	0	0	0	0	0	5
W	6	1	0	0	0	0	7
WNW	6	0	0	0	0	0	6
NW	2	0	0	0	0	0	2
NNW	7	0	0	0	0	0	7
<b>Total</b>	991	9	3	1	0	0	1004

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1004
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** ALL **Delta Temperature**

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	314	84	0	0	0	0	398
NNE	254	41	0	0	0	0	295
NE	302	34	0	0	0	0	336
ENE	370	75	0	0	0	0	445
E	543	27	0	0	0	0	570
ESE	600	15	0	0	0	0	615
SE	523	11	1	1	0	0	536
SSE	319	28	2	0	0	0	349
S	314	58	3	0	0	0	375
SSW	287	196	26	0	0	0	509
SW	230	404	181	15	0	0	830
WSW	197	489	157	19	0	0	862
W	213	337	57	1	0	0	608
WNW	180	136	11	0	0	0	327
NW	189	93	9	0	0	0	291
NNW	234	92	3	1	0	0	330
<b>Total</b>	5069	2120	450	37	0	0	7676

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	7676
<b>Total Hours for the Period:</b>			8759



### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.81	0.81	0.00	0.00	0.00	0.00	1.62
NNE	0.73	0.35	0.00	0.00	0.00	0.00	1.08
NE	0.68	0.31	0.00	0.00	0.00	0.00	0.99
ENE	0.74	0.26	0.00	0.00	0.00	0.00	1.00
E	0.68	0.20	0.00	0.00	0.00	0.00	0.87
ESE	0.29	0.14	0.00	0.00	0.00	0.00	0.43
SE	0.36	0.09	0.00	0.00	0.00	0.00	0.46
SSE	0.22	0.23	0.00	0.00	0.00	0.00	0.46
S	0.38	0.34	0.00	0.00	0.00	0.00	0.72
SSW	0.44	1.00	0.18	0.00	0.00	0.00	1.63
SW	0.40	1.52	0.57	0.08	0.00	0.00	2.58
WSW	0.56	2.14	0.40	0.01	0.00	0.00	3.11
W	0.87	1.68	0.22	0.00	0.00	0.00	2.77
WNW	0.52	0.73	0.08	0.00	0.00	0.00	1.33
NW	0.57	0.50	0.04	0.00	0.00	0.00	1.11
NNW	0.64	0.56	0.00	0.00	0.00	0.00	1.20
<b>Total</b>	<b>8.90</b>	<b>10.87</b>	<b>1.50</b>	<b>0.09</b>	<b>0.00</b>	<b>0.00</b>	<b>21.35</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1639
<b>Total Hours for the Period:</b>			8759

**Joint Frequency Distribution**

**Percent**

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.08	0.03	0.00	0.00	0.00	0.00	0.10
NNE	0.07	0.01	0.00	0.00	0.00	0.00	0.08
NE	0.01	0.00	0.00	0.00	0.00	0.00	0.01
ENE	0.08	0.01	0.00	0.00	0.00	0.00	0.09
E	0.04	0.00	0.00	0.00	0.00	0.00	0.04
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.03	0.00	0.00	0.00	0.00	0.00	0.03
SSE	0.04	0.01	0.00	0.00	0.00	0.00	0.05
S	0.03	0.01	0.00	0.00	0.00	0.00	0.04
SSW	0.03	0.13	0.00	0.00	0.00	0.00	0.16
SW	0.01	0.09	0.05	0.03	0.00	0.00	0.18
WSW	0.08	0.20	0.09	0.00	0.00	0.00	0.36
W	0.07	0.12	0.00	0.00	0.00	0.00	0.18
WNW	0.08	0.07	0.01	0.00	0.00	0.00	0.16
NW	0.05	0.04	0.03	0.00	0.00	0.00	0.12
NNW	0.08	0.04	0.00	0.00	0.00	0.00	0.12
<b>Total</b>	0.76	0.76	0.18	0.03	0.00	0.00	1.72

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	132
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.14	0.03	0.00	0.00	0.00	0.00	0.17
NNE	0.05	0.03	0.00	0.00	0.00	0.00	0.08
NE	0.04	0.01	0.00	0.00	0.00	0.00	0.05
ENE	0.04	0.01	0.00	0.00	0.00	0.00	0.05
E	0.07	0.00	0.00	0.00	0.00	0.00	0.07
ESE	0.01	0.00	0.00	0.00	0.00	0.00	0.01
SE	0.01	0.01	0.00	0.00	0.00	0.00	0.03
SSE	0.03	0.03	0.00	0.00	0.00	0.00	0.05
S	0.04	0.01	0.00	0.00	0.00	0.00	0.05
SSW	0.08	0.10	0.01	0.00	0.00	0.00	0.20
SW	0.09	0.21	0.09	0.00	0.00	0.00	0.39
WSW	0.09	0.18	0.09	0.03	0.00	0.00	0.39
W	0.08	0.08	0.03	0.00	0.00	0.00	0.18
WNW	0.10	0.07	0.03	0.00	0.00	0.00	0.20
NW	0.05	0.03	0.03	0.00	0.00	0.00	0.10
NNW	0.12	0.03	0.01	0.00	0.00	0.00	0.16
<b>Total</b>	1.04	0.82	0.29	0.03	0.00	0.00	2.18

Calm Hours not Included above for:	Total Period	All Hours	503
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	580
Number of Valid Hours for this Table:	Total Period	All Hours	167
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	1.19	0.14	0.00	0.00	0.00	0.00	1.33
NNE	0.86	0.08	0.00	0.00	0.00	0.00	0.94
NE	0.82	0.04	0.00	0.00	0.00	0.00	0.86
ENE	0.50	0.09	0.00	0.00	0.00	0.00	0.59
E	0.48	0.05	0.00	0.00	0.00	0.00	0.53
ESE	0.12	0.01	0.00	0.00	0.00	0.00	0.13
SE	0.22	0.01	0.00	0.00	0.00	0.00	0.23
SSE	0.25	0.05	0.00	0.00	0.00	0.00	0.30
S	0.29	0.09	0.03	0.00	0.00	0.00	0.40
SSW	0.50	0.43	0.03	0.00	0.00	0.00	0.95
SW	0.66	1.32	0.99	0.09	0.00	0.00	3.06
WSW	0.68	1.72	1.00	0.17	0.00	0.00	3.57
W	0.78	1.29	0.35	0.01	0.00	0.00	2.44
WNW	0.68	0.48	0.00	0.00	0.00	0.00	1.16
NW	0.59	0.31	0.01	0.00	0.00	0.00	0.91
NNW	0.98	0.26	0.03	0.01	0.00	0.00	1.28
<b>Total</b>	9.58	6.38	2.44	0.29	0.00	0.00	18.68

Calm Hours not Included above for:	Total Period	All Hours	503
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	580
Number of Valid Hours for this Table:	Total Period	All Hours	1434
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 23:00

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

Stability Class: E Delta Temperature Slightly Stable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	1.39	0.09	0.00	0.00	0.00	0.00	1.49
NNE	1.07	0.05	0.00	0.00	0.00	0.00	1.12
NE	1.65	0.08	0.00	0.00	0.00	0.00	1.73
ENE	1.81	0.51	0.00	0.00	0.00	0.00	2.32
E	1.49	0.08	0.00	0.00	0.00	0.00	1.56
ESE	1.43	0.03	0.00	0.00	0.00	0.00	1.46
SE	1.06	0.00	0.00	0.00	0.00	0.00	1.06
SSE	1.15	0.03	0.01	0.00	0.00	0.00	1.19
S	1.33	0.21	0.01	0.00	0.00	0.00	1.55
SSW	1.37	0.60	0.09	0.00	0.00	0.00	2.06
SW	1.11	1.85	0.59	0.00	0.00	0.00	3.54
WSW	0.92	1.93	0.40	0.04	0.00	0.00	3.30
W	0.77	1.02	0.13	0.00	0.00	0.00	1.92
WNW	0.76	0.40	0.01	0.00	0.00	0.00	1.17
NW	1.03	0.33	0.00	0.00	0.00	0.00	1.35
NNW	0.92	0.30	0.00	0.00	0.00	0.00	1.22
<b>Total</b>	19.25	7.49	1.25	0.04	0.00	0.00	28.04

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	2152
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** F **Delta Temperature** Moderately Stable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0.35	0.00	0.00	0.00	0.00	0.00	0.35
NNE	0.35	0.01	0.00	0.00	0.00	0.00	0.36
NE	0.47	0.00	0.00	0.00	0.00	0.00	0.47
ENE	0.78	0.08	0.00	0.00	0.00	0.00	0.86
E	1.85	0.01	0.00	0.00	0.00	0.00	1.86
ESE	2.80	0.01	0.00	0.00	0.00	0.00	2.81
SE	2.33	0.03	0.00	0.00	0.00	0.00	2.36
SSE	1.09	0.01	0.00	0.00	0.00	0.00	1.11
S	1.37	0.07	0.00	0.00	0.00	0.00	1.43
SSW	0.91	0.23	0.03	0.00	0.00	0.00	1.17
SW	0.50	0.27	0.05	0.00	0.00	0.00	0.82
WSW	0.17	0.21	0.05	0.00	0.00	0.00	0.43
W	0.13	0.20	0.01	0.00	0.00	0.00	0.34
WNW	0.13	0.03	0.01	0.00	0.00	0.00	0.17
NW	0.14	0.01	0.01	0.00	0.00	0.00	0.17
NNW	0.22	0.01	0.00	0.00	0.00	0.00	0.23
<b>Total</b>	13.60	1.19	0.17	0.00	0.00	0.00	14.96

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1148
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.13	0.00	0.00	0.00	0.00	0.00	0.13
NNE	0.18	0.00	0.00	0.00	0.00	0.00	0.18
NE	0.26	0.00	0.00	0.00	0.00	0.00	0.26
ENE	0.87	0.01	0.00	0.00	0.00	0.00	0.89
E	2.48	0.01	0.00	0.00	0.00	0.00	2.49
ESE	3.17	0.00	0.00	0.00	0.00	0.00	3.17
SE	2.80	0.00	0.01	0.01	0.00	0.00	2.83
SSE	1.38	0.00	0.01	0.00	0.00	0.00	1.39
S	0.66	0.03	0.00	0.00	0.00	0.00	0.69
SSW	0.42	0.05	0.00	0.00	0.00	0.00	0.47
SW	0.22	0.00	0.01	0.00	0.00	0.00	0.23
WSW	0.07	0.00	0.00	0.00	0.00	0.00	0.07
W	0.08	0.01	0.00	0.00	0.00	0.00	0.09
WNW	0.08	0.00	0.00	0.00	0.00	0.00	0.08
NW	0.03	0.00	0.00	0.00	0.00	0.00	0.03
NNW	0.09	0.00	0.00	0.00	0.00	0.00	0.09
<b>Total</b>	12.91	0.12	0.04	0.01	0.00	0.00	13.08

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1004
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** ALL **Delta Temperature**

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	4.09	1.09	0.00	0.00	0.00	0.00	5.18
NNE	3.31	0.53	0.00	0.00	0.00	0.00	3.84
NE	3.93	0.44	0.00	0.00	0.00	0.00	4.38
ENE	4.82	0.98	0.00	0.00	0.00	0.00	5.80
E	7.07	0.35	0.00	0.00	0.00	0.00	7.43
ESE	7.82	0.20	0.00	0.00	0.00	0.00	8.01
SE	6.81	0.14	0.01	0.01	0.00	0.00	6.98
SSE	4.16	0.36	0.03	0.00	0.00	0.00	4.55
S	4.09	0.76	0.04	0.00	0.00	0.00	4.89
SSW	3.74	2.55	0.34	0.00	0.00	0.00	6.63
SW	3.00	5.26	2.36	0.20	0.00	0.00	10.81
WSW	2.57	6.37	2.05	0.25	0.00	0.00	11.23
W	2.77	4.39	0.74	0.01	0.00	0.00	7.92
WNW	2.34	1.77	0.14	0.00	0.00	0.00	4.26
NW	2.46	1.21	0.12	0.00	0.00	0.00	3.79
NNW	3.05	1.20	0.04	0.01	0.00	0.00	4.30
<b>Total</b>	<b>66.04</b>	<b>27.62</b>	<b>5.86</b>	<b>0.48</b>	<b>0.00</b>	<b>0.00</b>	<b>100.00</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	503
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	580
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	7676
<b>Total Hours for the Period:</b>			8759



### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	7	74	19	0	0	0	100
NNE	17	66	25	0	0	0	108
NE	16	49	24	2	0	0	91
ENE	19	48	21	0	0	0	88
E	11	40	21	1	0	0	73
ESE	1	26	19	0	0	0	46
SE	1	36	18	0	0	0	55
SSE	2	38	28	0	0	0	68
S	5	53	39	4	0	0	101
SSW	5	28	65	12	1	0	111
SW	7	35	66	29	3	0	140
WSW	22	80	76	21	2	0	201
W	19	73	82	48	2	0	224
WNW	13	42	44	26	3	0	128
NW	9	32	41	5	6	1	94
NNW	3	42	26	1	0	0	72
<b>Total</b>	157	762	614	149	17	1	1700

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1700
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	1	6	0	0	0	0	7
NNE	2	5	0	0	0	0	7
NE	2	4	0	0	0	0	6
ENE	1	2	1	0	0	0	4
E	2	5	0	0	0	0	7
ESE	0	1	1	0	0	0	2
SE	0	1	2	0	0	0	3
SSE	1	4	3	0	0	0	8
S	0	3	2	1	0	0	6
SSW	3	1	8	0	0	0	12
SW	1	2	7	3	0	0	13
WSW	0	6	7	5	1	0	19
W	2	7	5	7	0	0	21
WNW	0	1	7	3	0	0	11
NW	0	0	3	3	0	0	6
NNW	1	2	6	0	0	0	9
<b>Total</b>	16	50	52	22	1	0	141

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	141
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	7	1	0	0	0	11
NNE	2	7	2	0	0	0	11
NE	2	3	4	0	0	0	9
ENE	0	3	2	0	0	0	5
E	2	0	0	0	0	0	2
ESE	2	3	0	0	0	0	5
SE	0	2	1	0	0	0	3
SSE	0	3	2	1	0	0	6
S	0	4	4	1	0	0	9
SSW	1	6	7	1	0	0	15
SW	2	4	11	3	0	0	20
WSW	0	8	13	5	0	0	26
W	1	7	6	6	1	2	23
WNW	1	3	4	4	0	0	12
NW	0	1	4	6	0	0	11
NNW	1	4	1	0	0	0	6
<b>Total</b>	17	65	62	27	1	2	174

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	174
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** D Delta Temperature Neutral

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	24	53	9	1	0	0	87
NNE	30	65	18	0	0	0	113
NE	28	51	36	1	0	0	116
ENE	18	37	7	0	0	0	62
E	17	20	5	0	0	0	42
ESE	7	4	6	0	0	0	17
SE	2	14	5	0	0	0	21
SSE	7	15	8	0	0	0	30
S	10	27	17	2	0	0	56
SSW	12	30	23	2	0	0	67
SW	9	44	62	16	0	0	131
WSW	18	44	90	68	8	1	229
W	13	44	102	79	21	5	264
WNW	11	36	52	39	2	0	140
NW	13	27	68	31	1	0	140
NNW	13	41	23	2	0	0	79
<b>Total</b>	<b>232</b>	<b>552</b>	<b>531</b>	<b>241</b>	<b>32</b>	<b>6</b>	<b>1594</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1594
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	30	50	11	0	0	0	91
NNE	60	70	5	0	0	0	135
NE	110	138	46	0	0	0	294
ENE	73	85	36	0	0	0	194
E	88	51	12	0	0	0	151
ESE	21	25	11	0	0	0	57
SE	18	24	2	0	0	0	44
SSE	28	33	12	1	0	0	74
S	35	53	32	2	0	0	122
SSW	30	50	47	9	0	0	136
SW	34	71	101	11	0	0	217
WSW	33	63	117	43	2	1	259
W	25	64	87	26	2	0	204
WNW	20	77	55	21	2	1	176
NW	22	55	28	26	2	0	133
NNW	23	64	22	0	0	0	109
<b>Total</b>	650	973	624	139	8	2	2396

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	2396
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	43	6	2	0	0	0	51
NNE	117	42	2	0	0	0	161
NE	163	119	3	0	0	0	285
ENE	76	52	7	0	0	0	135
E	77	32	2	0	0	0	111
ESE	18	5	2	1	0	0	26
SE	22	10	5	0	0	0	37
SSE	27	17	3	1	0	0	48
S	40	34	5	3	0	0	82
SSW	50	48	19	3	0	0	120
SW	38	38	19	1	0	0	96
WSW	25	28	15	8	0	0	76
W	25	22	7	3	1	0	58
WNW	14	11	10	5	2	0	42
NW	15	6	2	0	0	0	23
NNW	22	12	1	0	0	0	35
<b>Total</b>	772	482	104	25	3	0	1386

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1386
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	49	6	0	0	0	0	55
NNE	112	97	1	0	0	0	210
NE	143	158	1	0	0	0	302
ENE	56	64	1	0	0	0	121
E	65	19	0	1	0	0	85
ESE	25	21	0	0	0	0	46
SE	20	10	0	0	0	0	30
SSE	13	20	1	0	0	0	34
S	28	39	3	0	0	0	70
SSW	56	37	4	0	0	0	97
SW	39	21	1	0	0	0	61
WSW	22	16	2	1	0	0	41
W	11	7	0	0	0	0	18
WNW	7	4	1	0	0	0	12
NW	16	3	0	0	0	0	19
NNW	22	5	0	0	0	0	27
<b>Total</b>	<b>684</b>	<b>527</b>	<b>15</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1228</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1228
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	157	202	42	1	0	0	402
NNE	340	352	53	0	0	0	745
NE	464	522	114	3	0	0	1103
ENE	243	291	75	0	0	0	609
E	262	167	40	2	0	0	471
ESE	74	85	39	1	0	0	199
SE	63	97	33	0	0	0	193
SSE	78	130	57	3	0	0	268
S	118	213	102	13	0	0	446
SSW	157	200	173	27	1	0	558
SW	130	215	267	63	3	0	678
WSW	120	245	320	151	13	2	851
W	96	224	289	169	27	7	812
WNW	66	174	173	98	9	1	521
NW	75	124	146	71	9	1	426
NNW	85	170	79	3	0	0	337
<b>Total</b>	2528	3411	2002	605	62	11	8619

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	8619
<b>Total Hours for the Period:</b>			8759



### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.08	0.86	0.22	0.00	0.00	0.00	1.16
NNE	0.20	0.77	0.29	0.00	0.00	0.00	1.25
NE	0.19	0.57	0.28	0.02	0.00	0.00	1.06
ENE	0.22	0.56	0.24	0.00	0.00	0.00	1.02
E	0.13	0.46	0.24	0.01	0.00	0.00	0.85
ESE	0.01	0.30	0.22	0.00	0.00	0.00	0.53
SE	0.01	0.42	0.21	0.00	0.00	0.00	0.64
SSE	0.02	0.44	0.32	0.00	0.00	0.00	0.79
S	0.06	0.61	0.45	0.05	0.00	0.00	1.17
SSW	0.06	0.32	0.75	0.14	0.01	0.00	1.29
SW	0.08	0.41	0.77	0.34	0.03	0.00	1.62
WSW	0.26	0.93	0.88	0.24	0.02	0.00	2.33
W	0.22	0.85	0.95	0.56	0.02	0.00	2.60
WNW	0.15	0.49	0.51	0.30	0.03	0.00	1.49
NW	0.10	0.37	0.48	0.06	0.07	0.01	1.09
NNW	0.03	0.49	0.30	0.01	0.00	0.00	0.84
<b>Total</b>	1.82	8.84	7.12	1.73	0.20	0.01	19.72

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1700
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.01	0.07	0.00	0.00	0.00	0.00	0.08
NNE	0.02	0.06	0.00	0.00	0.00	0.00	0.08
NE	0.02	0.05	0.00	0.00	0.00	0.00	0.07
ENE	0.01	0.02	0.01	0.00	0.00	0.00	0.05
E	0.02	0.06	0.00	0.00	0.00	0.00	0.08
ESE	0.00	0.01	0.01	0.00	0.00	0.00	0.02
SE	0.00	0.01	0.02	0.00	0.00	0.00	0.03
SSE	0.01	0.05	0.03	0.00	0.00	0.00	0.09
S	0.00	0.03	0.02	0.01	0.00	0.00	0.07
SSW	0.03	0.01	0.09	0.00	0.00	0.00	0.14
SW	0.01	0.02	0.08	0.03	0.00	0.00	0.15
WSW	0.00	0.07	0.08	0.06	0.01	0.00	0.22
W	0.02	0.08	0.06	0.08	0.00	0.00	0.24
WNW	0.00	0.01	0.08	0.03	0.00	0.00	0.13
NW	0.00	0.00	0.03	0.03	0.00	0.00	0.07
NNW	0.01	0.02	0.07	0.00	0.00	0.00	0.10
<b>Total</b>	0.19	0.58	0.60	0.26	0.01	0.00	1.64

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	141
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.03	0.08	0.01	0.00	0.00	0.00	0.13
NNE	0.02	0.08	0.02	0.00	0.00	0.00	0.13
NE	0.02	0.03	0.05	0.00	0.00	0.00	0.10
ENE	0.00	0.03	0.02	0.00	0.00	0.00	0.06
E	0.02	0.00	0.00	0.00	0.00	0.00	0.02
ESE	0.02	0.03	0.00	0.00	0.00	0.00	0.06
SE	0.00	0.02	0.01	0.00	0.00	0.00	0.03
SSE	0.00	0.03	0.02	0.01	0.00	0.00	0.07
S	0.00	0.05	0.05	0.01	0.00	0.00	0.10
SSW	0.01	0.07	0.08	0.01	0.00	0.00	0.17
SW	0.02	0.05	0.13	0.03	0.00	0.00	0.23
WSW	0.00	0.09	0.15	0.06	0.00	0.00	0.30
W	0.01	0.08	0.07	0.07	0.01	0.02	0.27
WNW	0.01	0.03	0.05	0.05	0.00	0.00	0.14
NW	0.00	0.01	0.05	0.07	0.00	0.00	0.13
NNW	0.01	0.05	0.01	0.00	0.00	0.00	0.07
<b>Total</b>	0.20	0.75	0.72	0.31	0.01	0.02	2.02

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	174
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.28	0.61	0.10	0.01	0.00	0.00	1.01
NNE	0.35	0.75	0.21	0.00	0.00	0.00	1.31
NE	0.32	0.59	0.42	0.01	0.00	0.00	1.35
ENE	0.21	0.43	0.08	0.00	0.00	0.00	0.72
E	0.20	0.23	0.06	0.00	0.00	0.00	0.49
ESE	0.08	0.05	0.07	0.00	0.00	0.00	0.20
SE	0.02	0.16	0.06	0.00	0.00	0.00	0.24
SSE	0.08	0.17	0.09	0.00	0.00	0.00	0.35
S	0.12	0.31	0.20	0.02	0.00	0.00	0.65
SSW	0.14	0.35	0.27	0.02	0.00	0.00	0.78
SW	0.10	0.51	0.72	0.19	0.00	0.00	1.52
WSW	0.21	0.51	1.04	0.79	0.09	0.01	2.66
W	0.15	0.51	1.18	0.92	0.24	0.06	3.06
WNW	0.13	0.42	0.60	0.45	0.02	0.00	1.62
NW	0.15	0.31	0.79	0.36	0.01	0.00	1.62
NNW	0.15	0.48	0.27	0.02	0.00	0.00	0.92
<b>Total</b>	<b>2.69</b>	<b>6.40</b>	<b>6.16</b>	<b>2.80</b>	<b>0.37</b>	<b>0.07</b>	<b>18.49</b>

Calm Hours not Included above for:	Total Period	All Hours	7
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	133
Number of Valid Hours for this Table:	Total Period	All Hours	1594
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.35	0.58	0.13	0.00	0.00	0.00	1.06
NNE	0.70	0.81	0.06	0.00	0.00	0.00	1.57
NE	1.28	1.60	0.53	0.00	0.00	0.00	3.41
ENE	0.85	0.99	0.42	0.00	0.00	0.00	2.25
E	1.02	0.59	0.14	0.00	0.00	0.00	1.75
ESE	0.24	0.29	0.13	0.00	0.00	0.00	0.66
SE	0.21	0.28	0.02	0.00	0.00	0.00	0.51
SSE	0.32	0.38	0.14	0.01	0.00	0.00	0.86
S	0.41	0.61	0.37	0.02	0.00	0.00	1.42
SSW	0.35	0.58	0.55	0.10	0.00	0.00	1.58
SW	0.39	0.82	1.17	0.13	0.00	0.00	2.52
WSW	0.38	0.73	1.36	0.50	0.02	0.01	3.00
W	0.29	0.74	1.01	0.30	0.02	0.00	2.37
WNW	0.23	0.89	0.64	0.24	0.02	0.01	2.04
NW	0.26	0.64	0.32	0.30	0.02	0.00	1.54
NNW	0.27	0.74	0.26	0.00	0.00	0.00	1.26
<b>Total</b>	7.54	11.29	7.24	1.61	0.09	0.02	27.80

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	2396
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.50	0.07	0.02	0.00	0.00	0.00	0.59
NNE	1.36	0.49	0.02	0.00	0.00	0.00	1.87
NE	1.89	1.38	0.03	0.00	0.00	0.00	3.31
ENE	0.88	0.60	0.08	0.00	0.00	0.00	1.57
E	0.89	0.37	0.02	0.00	0.00	0.00	1.29
ESE	0.21	0.06	0.02	0.01	0.00	0.00	0.30
SE	0.26	0.12	0.06	0.00	0.00	0.00	0.43
SSE	0.31	0.20	0.03	0.01	0.00	0.00	0.56
S	0.46	0.39	0.06	0.03	0.00	0.00	0.95
SSW	0.58	0.56	0.22	0.03	0.00	0.00	1.39
SW	0.44	0.44	0.22	0.01	0.00	0.00	1.11
WSW	0.29	0.32	0.17	0.09	0.00	0.00	0.88
W	0.29	0.26	0.08	0.03	0.01	0.00	0.67
WNW	0.16	0.13	0.12	0.06	0.02	0.00	0.49
NW	0.17	0.07	0.02	0.00	0.00	0.00	0.27
NNW	0.26	0.14	0.01	0.00	0.00	0.00	0.41
<b>Total</b>	<b>8.96</b>	<b>5.59</b>	<b>1.21</b>	<b>0.29</b>	<b>0.03</b>	<b>0.00</b>	<b>16.08</b>

Calm Hours not Included above for:	Total Period	All Hours	7
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	133
Number of Valid Hours for this Table:	Total Period	All Hours	1386
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	0.57	0.07	0.00	0.00	0.00	0.00	0.64
NNE	1.30	1.13	0.01	0.00	0.00	0.00	2.44
NE	1.66	1.83	0.01	0.00	0.00	0.00	3.50
ENE	0.65	0.74	0.01	0.00	0.00	0.00	1.40
E	0.75	0.22	0.00	0.01	0.00	0.00	0.99
ESE	0.29	0.24	0.00	0.00	0.00	0.00	0.53
SE	0.23	0.12	0.00	0.00	0.00	0.00	0.35
SSE	0.15	0.23	0.01	0.00	0.00	0.00	0.39
S	0.32	0.45	0.03	0.00	0.00	0.00	0.81
SSW	0.65	0.43	0.05	0.00	0.00	0.00	1.13
SW	0.45	0.24	0.01	0.00	0.00	0.00	0.71
WSW	0.26	0.19	0.02	0.01	0.00	0.00	0.48
W	0.13	0.08	0.00	0.00	0.00	0.00	0.21
WNW	0.08	0.05	0.01	0.00	0.00	0.00	0.14
NW	0.19	0.03	0.00	0.00	0.00	0.00	0.22
NNW	0.26	0.06	0.00	0.00	0.00	0.00	0.31
<b>Total</b>	7.94	6.11	0.17	0.02	0.00	0.00	14.25

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1228
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	1.82	2.34	0.49	0.01	0.00	0.00	4.66
NNE	3.94	4.08	0.61	0.00	0.00	0.00	8.64
NE	5.38	6.06	1.32	0.03	0.00	0.00	12.80
ENE	2.82	3.38	0.87	0.00	0.00	0.00	7.07
E	3.04	1.94	0.46	0.02	0.00	0.00	5.46
ESE	0.86	0.99	0.45	0.01	0.00	0.00	2.31
SE	0.73	1.13	0.38	0.00	0.00	0.00	2.24
SSE	0.90	1.51	0.66	0.03	0.00	0.00	3.11
S	1.37	2.47	1.18	0.15	0.00	0.00	5.17
SSW	1.82	2.32	2.01	0.31	0.01	0.00	6.47
SW	1.51	2.49	3.10	0.73	0.03	0.00	7.87
WSW	1.39	2.84	3.71	1.75	0.15	0.02	9.87
W	1.11	2.60	3.35	1.96	0.31	0.08	9.42
WNW	0.77	2.02	2.01	1.14	0.10	0.01	6.04
NW	0.87	1.44	1.69	0.82	0.10	0.01	4.94
NNW	0.99	1.97	0.92	0.03	0.00	0.00	3.91
<b>Total</b>	29.33	39.58	23.23	7.02	0.72	0.13	100.00

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	7
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	133
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	8619
<b>Total Hours for the Period:</b>			8759



### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	1	5	2	0	0	0	8
NNE	0	8	5	0	0	0	13
NE	1	4	10	1	0	0	16
ENE	0	5	4	0	0	0	9
E	0	0	3	0	0	0	3
ESE	0	2	6	1	0	0	9
SE	0	3	8	1	0	0	12
SSE	2	4	9	0	0	0	15
S	0	6	3	0	0	0	9
SSW	0	1	4	3	0	0	8
SW	0	1	2	0	0	0	3
WSW	1	0	4	0	0	0	5
W	1	1	8	1	0	0	11
WNW	1	3	4	3	3	0	14
NW	4	1	5	3	0	0	13
NNW	0	4	1	6	0	0	11
<b>Total</b>	11	48	78	19	3	0	159

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	159
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** B Delta Temperature Moderately Unstable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	2	4	0	0	0	6
NNE	1	1	4	0	0	0	6
NE	1	2	9	3	0	0	15
ENE	0	5	8	0	0	0	13
E	0	1	6	0	0	0	7
ESE	0	5	8	0	0	0	13
SE	1	8	7	0	1	0	17
SSE	0	3	3	1	0	0	7
S	0	5	10	1	0	0	16
SSW	0	4	10	0	0	0	14
SW	0	1	9	2	0	0	12
WSW	1	7	5	6	0	0	19
W	0	6	9	7	0	0	22
WNW	1	5	17	4	2	0	29
NW	0	7	4	3	1	0	15
NNW	0	4	3	2	0	0	9
<b>Total</b>	5	66	116	29	4	0	220

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	220
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** C Delta Temperature Slightly Unstable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0	8	5	0	0	0	13
NNE	0	10	5	1	0	0	16
NE	0	14	10	2	0	0	26
ENE	0	6	2	2	0	0	10
E	0	2	7	0	0	0	9
ESE	0	4	5	2	0	0	11
SE	1	4	4	2	0	0	11
SSE	1	4	3	1	0	0	9
S	0	5	8	5	1	0	19
SSW	0	5	14	10	1	0	30
SW	0	9	11	9	1	0	30
WSW	1	2	15	15	1	0	34
W	0	9	10	20	3	1	43
WNW	1	12	17	14	10	1	55
NW	2	3	6	5	1	0	17
NNW	0	2	3	1	0	0	6
<b>Total</b>	<b>6</b>	<b>99</b>	<b>125</b>	<b>89</b>	<b>18</b>	<b>2</b>	<b>339</b>

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	339
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	16	55	78	22	0	0	171
NNE	15	52	39	12	0	0	118
NE	18	56	35	6	0	0	115
ENE	17	57	44	24	4	0	146
E	14	64	47	7	1	0	133
ESE	11	44	26	21	1	0	103
SE	12	23	36	14	2	1	88
SSE	8	30	22	9	0	0	69
S	6	33	61	51	11	0	162
SSW	3	20	90	90	23	0	226
SW	12	39	108	184	65	7	415
WSW	25	42	108	218	54	15	462
W	13	67	141	291	139	41	692
WNW	19	65	165	147	67	12	475
NW	14	64	103	57	12	0	250
NNW	10	48	107	17	1	0	183
<b>Total</b>	213	759	1210	1170	380	76	3808

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	3808
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	22	26	31	4	0	0	83
NNE	19	48	34	7	1	0	109
NE	33	64	33	6	0	0	136
ENE	33	52	39	14	0	0	138
E	48	64	32	13	0	0	157
ESE	44	66	42	5	2	0	159
SE	38	51	54	23	5	1	172
SSE	31	45	42	14	7	2	141
S	26	44	51	56	20	0	197
SSW	29	35	53	66	24	1	208
SW	23	40	56	112	46	4	281
WSW	32	43	66	47	12	1	201
W	41	71	86	54	12	2	266
WNW	23	60	46	15	1	2	147
NW	22	39	27	8	1	0	97
NNW	15	27	26	1	0	0	69
<b>Total</b>	479	775	718	445	131	13	2561

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	2561
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	12	7	4	0	0	0	23
NNE	13	20	4	0	0	0	37
NE	13	41	10	0	0	0	64
ENE	19	29	30	1	0	0	79
E	27	58	24	0	0	0	109
ESE	42	53	25	3	0	0	123
SE	16	38	38	9	0	0	101
SSE	26	32	34	15	1	0	108
S	18	44	43	23	1	0	129
SSW	14	30	20	13	0	0	77
SW	17	34	27	28	4	0	110
WSW	17	54	44	5	0	0	120
W	20	33	27	9	0	0	89
WNW	13	24	12	0	0	0	49
NW	13	15	4	0	0	0	32
NNW	7	11	2	0	0	0	20
<b>Total</b>	287	523	348	106	6	0	1270

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	1270
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	3	0	0	0	0	0	3
ENE	2	2	1	0	0	0	5
E	3	12	1	0	0	0	16
ESE	3	23	2	1	0	0	29
SE	4	13	17	2	0	0	36
SSE	1	12	20	6	0	0	39
S	9	16	25	13	0	0	63
SSW	2	8	14	19	0	0	43
SW	1	10	7	12	4	0	34
WSW	0	11	2	0	0	0	13
W	2	1	1	0	0	0	4
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
<b>Total</b>	30	108	90	53	4	0	285

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	285
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	51	103	124	26	0	0	304
NNE	48	139	91	20	1	0	299
NE	69	181	107	18	0	0	375
ENE	71	156	128	41	4	0	400
E	92	201	120	20	1	0	434
ESE	100	197	114	33	3	0	447
SE	72	140	164	51	8	2	437
SSE	69	130	133	46	8	2	388
S	59	153	201	149	33	0	595
SSW	48	103	205	201	48	1	606
SW	53	134	220	347	120	11	885
WSW	77	159	244	291	67	16	854
W	77	188	282	382	154	44	1127
WNW	58	169	261	183	83	15	769
NW	55	129	149	76	15	0	424
NNW	32	96	142	27	1	0	298
<b>Total</b>	1031	2378	2685	1911	546	91	8642

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	8642
<b>Total Hours for the Period:</b>			8759



### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.01	0.06	0.02	0.00	0.00	0.00	0.09
NNE	0.00	0.09	0.06	0.00	0.00	0.00	0.15
NE	0.01	0.05	0.12	0.01	0.00	0.00	0.19
ENE	0.00	0.06	0.05	0.00	0.00	0.00	0.10
E	0.00	0.00	0.03	0.00	0.00	0.00	0.03
ESE	0.00	0.02	0.07	0.01	0.00	0.00	0.10
SE	0.00	0.03	0.09	0.01	0.00	0.00	0.14
SSE	0.02	0.05	0.10	0.00	0.00	0.00	0.17
S	0.00	0.07	0.03	0.00	0.00	0.00	0.10
SSW	0.00	0.01	0.05	0.03	0.00	0.00	0.09
SW	0.00	0.01	0.02	0.00	0.00	0.00	0.03
WSW	0.01	0.00	0.05	0.00	0.00	0.00	0.06
W	0.01	0.01	0.09	0.01	0.00	0.00	0.13
WNW	0.01	0.03	0.05	0.03	0.03	0.00	0.16
NW	0.05	0.01	0.06	0.03	0.00	0.00	0.15
NNW	0.00	0.05	0.01	0.07	0.00	0.00	0.13
<b>Total</b>	0.13	0.56	0.90	0.22	0.03	0.00	1.84

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	159
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 23:00

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

Stability Class: B Delta Temperature Moderately Unstable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0.00	0.02	0.05	0.00	0.00	0.00	0.07
NNE	0.01	0.01	0.05	0.00	0.00	0.00	0.07
NE	0.01	0.02	0.10	0.03	0.00	0.00	0.17
ENE	0.00	0.06	0.09	0.00	0.00	0.00	0.15
E	0.00	0.01	0.07	0.00	0.00	0.00	0.08
ESE	0.00	0.06	0.09	0.00	0.00	0.00	0.15
SE	0.01	0.09	0.08	0.00	0.01	0.00	0.20
SSE	0.00	0.03	0.03	0.01	0.00	0.00	0.08
S	0.00	0.06	0.12	0.01	0.00	0.00	0.19
SSW	0.00	0.05	0.12	0.00	0.00	0.00	0.16
SW	0.00	0.01	0.10	0.02	0.00	0.00	0.14
WSW	0.01	0.08	0.06	0.07	0.00	0.00	0.22
W	0.00	0.07	0.10	0.08	0.00	0.00	0.25
WNW	0.01	0.06	0.20	0.05	0.02	0.00	0.34
NW	0.00	0.08	0.05	0.03	0.01	0.00	0.17
NNW	0.00	0.05	0.03	0.02	0.00	0.00	0.10
<b>Total</b>	0.06	0.76	1.34	0.34	0.05	0.00	2.55

Calm Hours not Included above for:	Total Period	All Hours	0
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	117
Number of Valid Hours for this Table:	Total Period	All Hours	220
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

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

**Stability Class:** C **Delta Temperature** Slightly Unstable

#### Wind Speed (mph)

Wind Direction	0.6-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	0.00	0.09	0.06	0.00	0.00	0.00	0.15
NNE	0.00	0.12	0.06	0.01	0.00	0.00	0.19
NE	0.00	0.16	0.12	0.02	0.00	0.00	0.30
ENE	0.00	0.07	0.02	0.02	0.00	0.00	0.12
E	0.00	0.02	0.08	0.00	0.00	0.00	0.10
ESE	0.00	0.05	0.06	0.02	0.00	0.00	0.13
SE	0.01	0.05	0.05	0.02	0.00	0.00	0.13
SSE	0.01	0.05	0.03	0.01	0.00	0.00	0.10
S	0.00	0.06	0.09	0.06	0.01	0.00	0.22
SSW	0.00	0.06	0.16	0.12	0.01	0.00	0.35
SW	0.00	0.10	0.13	0.10	0.01	0.00	0.35
WSW	0.01	0.02	0.17	0.17	0.01	0.00	0.39
W	0.00	0.10	0.12	0.23	0.03	0.01	0.50
WNW	0.01	0.14	0.20	0.16	0.12	0.01	0.64
NW	0.02	0.03	0.07	0.06	0.01	0.00	0.20
NNW	0.00	0.02	0.03	0.01	0.00	0.00	0.07
<b>Total</b>	0.07	1.15	1.45	1.03	0.21	0.02	3.92

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	339
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.19	0.64	0.90	0.25	0.00	0.00	1.98
NNE	0.17	0.60	0.45	0.14	0.00	0.00	1.37
NE	0.21	0.65	0.40	0.07	0.00	0.00	1.33
ENE	0.20	0.66	0.51	0.28	0.05	0.00	1.69
E	0.16	0.74	0.54	0.08	0.01	0.00	1.54
ESE	0.13	0.51	0.30	0.24	0.01	0.00	1.19
SE	0.14	0.27	0.42	0.16	0.02	0.01	1.02
SSE	0.09	0.35	0.25	0.10	0.00	0.00	0.80
S	0.07	0.38	0.71	0.59	0.13	0.00	1.87
SSW	0.03	0.23	1.04	1.04	0.27	0.00	2.62
SW	0.14	0.45	1.25	2.13	0.75	0.08	4.80
WSW	0.29	0.49	1.25	2.52	0.62	0.17	5.35
W	0.15	0.78	1.63	3.37	1.61	0.47	8.01
WNW	0.22	0.75	1.91	1.70	0.78	0.14	5.50
NW	0.16	0.74	1.19	0.66	0.14	0.00	2.89
NNW	0.12	0.56	1.24	0.20	0.01	0.00	2.12
<b>Total</b>	2.46	8.78	14.00	13.54	4.40	0.88	44.06

Calm Hours not Included above for:	Total Period	All Hours	0
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	117
Number of Valid Hours for this Table:	Total Period	All Hours	3808
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.25	0.30	0.36	0.05	0.00	0.00	0.96
NNE	0.22	0.56	0.39	0.08	0.01	0.00	1.26
NE	0.38	0.74	0.38	0.07	0.00	0.00	1.57
ENE	0.38	0.60	0.45	0.16	0.00	0.00	1.60
E	0.56	0.74	0.37	0.15	0.00	0.00	1.82
ESE	0.51	0.76	0.49	0.06	0.02	0.00	1.84
SE	0.44	0.59	0.62	0.27	0.06	0.01	1.99
SSE	0.36	0.52	0.49	0.16	0.08	0.02	1.63
S	0.30	0.51	0.59	0.65	0.23	0.00	2.28
SSW	0.34	0.40	0.61	0.76	0.28	0.01	2.41
SW	0.27	0.46	0.65	1.30	0.53	0.05	3.25
WSW	0.37	0.50	0.76	0.54	0.14	0.01	2.33
W	0.47	0.82	1.00	0.62	0.14	0.02	3.08
WNW	0.27	0.69	0.53	0.17	0.01	0.02	1.70
NW	0.25	0.45	0.31	0.09	0.01	0.00	1.12
NNW	0.17	0.31	0.30	0.01	0.00	0.00	0.80
<b>Total</b>	5.54	8.97	8.31	5.15	1.52	0.15	29.63

Calm Hours not Included above for:	Total Period	All Hours	0
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	117
Number of Valid Hours for this Table:	Total Period	All Hours	2561
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

#### Total Period

#### All Hours

Period of Record = 01/01/2022 01:00 - 12/31/2022 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	0.14	0.08	0.05	0.00	0.00	0.00	0.27
NNE	0.15	0.23	0.05	0.00	0.00	0.00	0.43
NE	0.15	0.47	0.12	0.00	0.00	0.00	0.74
ENE	0.22	0.34	0.35	0.01	0.00	0.00	0.91
E	0.31	0.67	0.28	0.00	0.00	0.00	1.26
ESE	0.49	0.61	0.29	0.03	0.00	0.00	1.42
SE	0.19	0.44	0.44	0.10	0.00	0.00	1.17
SSE	0.30	0.37	0.39	0.17	0.01	0.00	1.25
S	0.21	0.51	0.50	0.27	0.01	0.00	1.49
SSW	0.16	0.35	0.23	0.15	0.00	0.00	0.89
SW	0.20	0.39	0.31	0.32	0.05	0.00	1.27
WSW	0.20	0.62	0.51	0.06	0.00	0.00	1.39
W	0.23	0.38	0.31	0.10	0.00	0.00	1.03
WNW	0.15	0.28	0.14	0.00	0.00	0.00	0.57
NW	0.15	0.17	0.05	0.00	0.00	0.00	0.37
NNW	0.08	0.13	0.02	0.00	0.00	0.00	0.23
<b>Total</b>	<b>3.32</b>	<b>6.05</b>	<b>4.03</b>	<b>1.23</b>	<b>0.07</b>	<b>0.00</b>	<b>14.70</b>

Calm Hours not Included above for:	Total Period	All Hours	0
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	117
Number of Valid Hours for this Table:	Total Period	All Hours	1270
Total Hours for the Period:			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 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	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.03	0.00	0.00	0.00	0.00	0.00	0.03
ENE	0.02	0.02	0.01	0.00	0.00	0.00	0.06
E	0.03	0.14	0.01	0.00	0.00	0.00	0.19
ESE	0.03	0.27	0.02	0.01	0.00	0.00	0.34
SE	0.05	0.15	0.20	0.02	0.00	0.00	0.42
SSE	0.01	0.14	0.23	0.07	0.00	0.00	0.45
S	0.10	0.19	0.29	0.15	0.00	0.00	0.73
SSW	0.02	0.09	0.16	0.22	0.00	0.00	0.50
SW	0.01	0.12	0.08	0.14	0.05	0.00	0.39
WSW	0.00	0.13	0.02	0.00	0.00	0.00	0.15
W	0.02	0.01	0.01	0.00	0.00	0.00	0.05
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	0.35	1.25	1.04	0.61	0.05	0.00	3.30

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	285
<b>Total Hours for the Period:</b>			8759

### Joint Frequency Distribution

#### Percent

Hours at Each Wind Speed and Direction

**Period of Record =** **Total Period** 01/01/2022 01:00 - 12/31/2022 23:00 **All Hours**

**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	0.59	1.19	1.43	0.30	0.00	0.00	3.52
NNE	0.56	1.61	1.05	0.23	0.01	0.00	3.46
NE	0.80	2.09	1.24	0.21	0.00	0.00	4.34
ENE	0.82	1.81	1.48	0.47	0.05	0.00	4.63
E	1.06	2.33	1.39	0.23	0.01	0.00	5.02
ESE	1.16	2.28	1.32	0.38	0.03	0.00	5.17
SE	0.83	1.62	1.90	0.59	0.09	0.02	5.06
SSE	0.80	1.50	1.54	0.53	0.09	0.02	4.49
S	0.68	1.77	2.33	1.72	0.38	0.00	6.88
SSW	0.56	1.19	2.37	2.33	0.56	0.01	7.01
SW	0.61	1.55	2.55	4.02	1.39	0.13	10.24
WSW	0.89	1.84	2.82	3.37	0.78	0.19	9.88
W	0.89	2.18	3.26	4.42	1.78	0.51	13.04
WNW	0.67	1.96	3.02	2.12	0.96	0.17	8.90
NW	0.64	1.49	1.72	0.88	0.17	0.00	4.91
NNW	0.37	1.11	1.64	0.31	0.01	0.00	3.45
<b>Total</b>	11.93	27.52	31.07	22.11	6.32	1.05	100.00

<b>Calm Hours not Included above for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Variable Direction Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	0
<b>Invalid Hours for:</b>	<b>Total Period</b>	<b>All Hours</b>	117
<b>Number of Valid Hours for this Table:</b>	<b>Total Period</b>	<b>All Hours</b>	8642
<b>Total Hours for the Period:</b>			8759



# Annual Radioactive Effluent Release Report

Calendar Year - 2022

Attachment 2

Unit 1 and 2 Offsite Dose Calculation Manual Changes

## Attachment 2

As no changes were made to the ODCM during the report period, submittal of a complete copy to the NRC is not required.

For a complete copy of the ODCM, contact Radiological Effluents Administrator at 724-682-5839.

# Annual Radioactive Effluent Release Report

Calendar Year - 2022

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 **2.55** mrem to the bone and less than **0.51** mrem to all other organs.

The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 2 was determined to be less than **2.55** mrem to the bone and less than **0.51** 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	-	-	2.48	0.50	1.03	0.21	0.63	0.13
<b>TOTAL</b>	0.06	0.01	2.55	0.51	1.08	0.22	0.67	0.13

## Dose Calculations for Unit 2

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
Inhalation	0.06	0.01	0.08	0.02	0.06	0.01	0.04	0.01
Vegetation Ingestion	-	-	2.48	0.50	1.03	0.21	0.63	0.13
<b>TOTAL</b>	0.06	0.01	2.55	0.51	1.08	0.22	0.67	0.13

## Dose Calculations for Site

	Infant		Child		Teen		Adult	
	Bone	Other	Bone	Other	Bone	Other	Bone	Other
<b>TOTAL</b>	0.12	0.02	5.11	1.02	2.16	0.43	1.34	0.27

**Beaver Valley Power Station - Units 1 & 2**

# **2022 Annual Radiological Environmental Operating Report**

Energy Harbor Nuclear Corp.

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

## **EXECUTIVE SUMMARY and INDEX**

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

- BVPS Integrated Technical Specifications, Administrative Control 5.6.1
- Offsite Dose Calculation Manual (ODCM) procedure 1/2-ODC-3.03, Attachment T, Control 6.9.2, “*Controls for RETS and REMP Programs*”
- BVPS procedure 1/2-ENV-01.05, “*Compliance with Regulatory Guide 1.21 and Technical Specifications*”
- BVPS procedure 1/2-ENV-02.01, “*Radiological Environmental Monitoring Program*”
- NUREG-1301, “Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No.1, April 1991”
- BVPS form 1/2-ENV-03.01.F02, “*Environmental Field Log*”. REMP sampling deviations for 2022 were tracked using the Environmental Field Log, Maintenance Tab.

## **EXECUTIVE SUMMARY and INDEX**

### **Report Overview:**

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

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

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

### **Description of Operational REMP (1976 – Present):**

The operational REMP was initiated during calendar year 1976 and continued through the report period. During the past forty-four (44) 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, two hundred sixty-(260) analyses were performed on samples from the control locations. This includes eight (8) analyses that 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

## **EXECUTIVE SUMMARY and INDEX**

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 thirty (1,530) analyses were performed on samples collected from eighty-one (81) indicator locations. In addition, five hundred twenty-six (526) 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**

- **2022 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 the indicator 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, most likely caused by previous nuclear weapons tests. Cobalt-60 was identified in some of the samples 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):** Since these samples are not required, they will no longer be collected as of 2017. For historical information, groundwater was collected semiannually by grab samples at locations within four (4) miles of the site, 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.
- **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

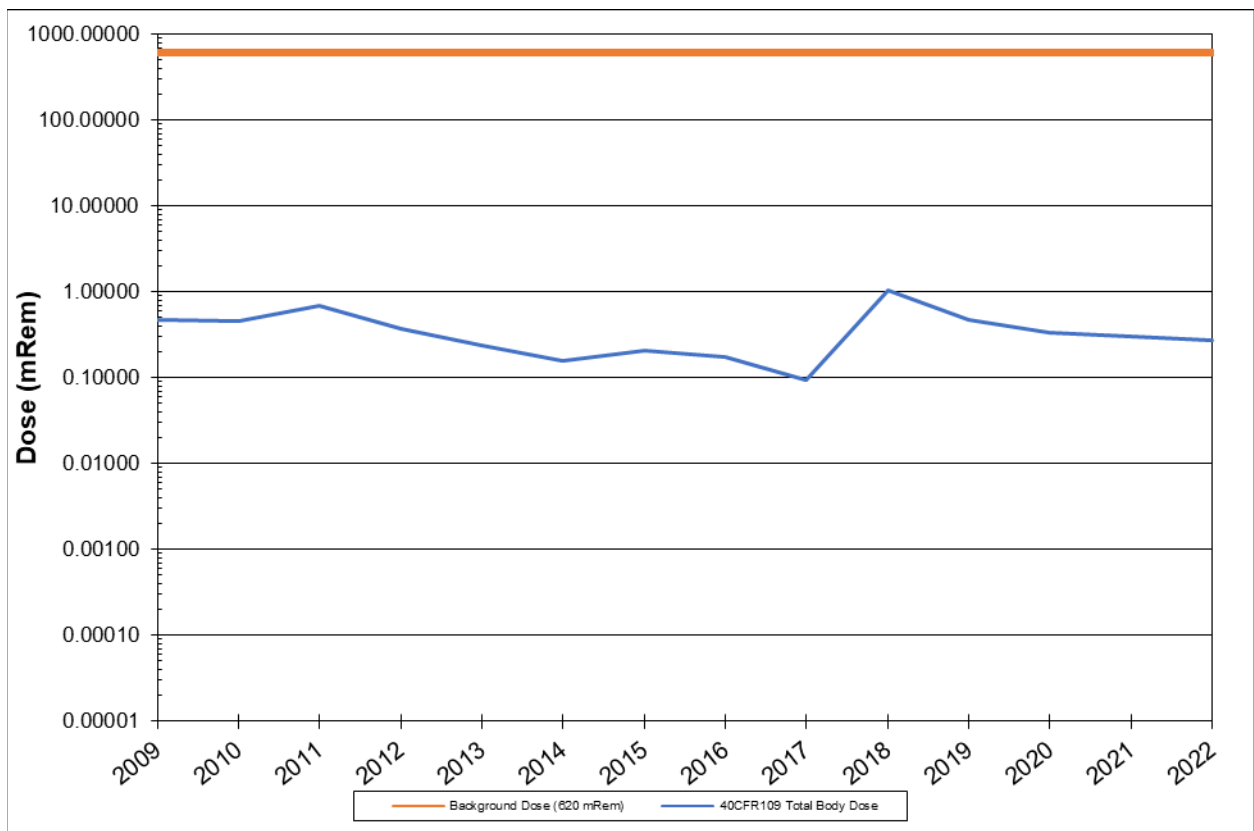
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sites, one (1) sediment site, one (1) milk animal feedstuff site, and five (5) soil sampling sites.

- Individual Dose vs. Natural Background:** The radiation doses to man as a result of BVPS operations were calculated for both gaseous and liquid effluent pathways using computer software RADEAS which was implemented in 2019. The computer software follows Regulatory Guide 1.109 and site ODCM methodology. 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. The total doses to an individual were evaluated for all liquid and gaseous effluent pathways. The calculated dose to an individual member of the public from liquid effluent release was 0.0419 mrem whereas the gaseous effluent release was 0.274 mrem. The incremental increase in total body dose from the operation of BVPS - Unit 1 and 2, is 0.051% of the annual radiation exposure. Figure i-1 illustrates the individual dose from BVPS effluents and natural background dose.

**Figure i-1**

**Graph of Individual Dose from BVPS Effluents 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 (2), 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. A total of one hundred eight (108) analyses were performed in 2022. All analyses met NRC acceptance criteria.

### **Special Reports:**

- Since no reporting levels were exceeded during 2022, 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  $\geq 1.0$  (for calculations performed when more than one radionuclide is detected in the sampling medium):

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

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### **Land Use Census Results:**

Highlights from the most recent Land Use Census 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 (0.44 miles, east-northeast).
- **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).
- **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 (6.076 miles, southeast).
- **Nearest Doe Goat (0 to 5 mile radius):** The location has not changed since the previous census. The closest location is the Henderson (née 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 west (W) 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.
- **2022 Dairy Cow & Doe Goat Sampling Locations:** The dairy cow sampling locations have not changed in 2022. The locations remain at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.076 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 Henderson (née Covert) Residence, 930 Pine Street (Route 168), Hookstown, PA (2.131 miles, southwest).
- **D/Q for Milch Animal Locations:** The 2022 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.
- **X/Q and D/Q for Offsite Dose Determination:** A change in methodology from MIDAS to XOQDOQ for calculating meteorological dispersion (X/Q) and deposition (D/Q) values resulted in some significant differences (>20% change in a non-conservative direction) that will be addressed in the next ODCM revision. This is due to the fact that

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the X/Q and D/Q values reported in the ODCM were originally calculated using MIDAS and will need to be recalculated using XOQDOQ. This change in meteorology has no bearing on meeting the requirements of Control 3.12.2 Action “a” and/or Action “b”. Therefore, a Special Report per ODCM is not required.

- **X/Q and D/Q Historical Trend Comparison:** There is no adverse trend in D/Q when comparing 2009 to 2022 data to the ODCM default D/Q values. However, due to the change in calculation methodology explained above, several locations incorrectly had higher calculated X/Q values that were >20% of the ODCM default values.

The Land Use Census results indicate that there were no changes in the nearest resident, milch cow, garden or doe goat. Therefore, no changes are required to be made in the current Radiological Environmental Monitoring Program (REMP).

### **Deviations, Changes and Adjustments to the Normal Sampling Program**

- **Deviation from Normal Air Particulate & Iodine Sampling and Analysis Schedule:** There were eight (8) deviations from the required airborne particulate sampling and analysis schedule during the report period:

During the sampling period of 02/20/2022 - 02/26/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Brunton Farm, Site No. 27, Sector 07, 6.16 miles SE) was discovered to have been out of service for approximately seven hours during the sampling period due to power loss at Brunton Dairy.

During the sampling period of 04/24/2022 - 04/30/2022, REMP Air Particulate and Iodine sampling station located in Shippingport (Cook’s Ferry Substation, Site No. 30, Sector 04, 0.43 miles ENE) was found to be out of service. The initial cause was determined to be a temporary power disconnect as a result of a Duquesne Light substation service upgrade. After further investigation, Duquesne Light condemned the meter box and disconnected the feed without notification. The station was returned to service on 06/20/2022, and this deficiency is recorded in CR-2022-04096.

During the sampling period of 06/26/2022 - 07/02/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was found to be out of service. The cause was determined to be an improperly functioning turbine, resulting in a reading of 0.0 cfm. The turbine was removed and cleaned and returned to service immediately.

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During the sampling period of 07/10/2022 - 07/16/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Brunton Farm, Site No. 27, Sector 07, 6.16 miles SE) was found to be out of service. The cause was determined to be an improperly functioning exhaust filter, resulting in a reading of 0.0 cfm. The exhaust filter was removed and cleaned and returned to service immediately.

During the sampling period of 07/10/2022 - 07/16/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was found to be out of service. The cause was determined to be a non-functional cabinet fan. The fan was removed for maintenance, and the station was returned to service on 08/01/2022 after the fan motor was replaced.

During the sampling period of 08/07/2022 - 08/13/2022, REMP Air Particulate and Iodine sampling station located in Midland (North Substation, Site No. 32, Sector 15, 0.75 miles NW) was found to be out of service. The cause was determined to be a broken outlet plug, requiring the removal of the totalizer for repairs. The station was returned to service on 08/10/2022 with a new plug installed and a replacement fuse.

During the sampling period of 09/11/2022 - 09/17/2022, REMP Air Particulate and Iodine sampling station located in Midland (North Substation, Site No. 32, Sector 15, 0.75 miles NW) was found to be out of service. The cause was determined to be serious damage to the outlet and surrounding electrical wiring. Chemistry supervision was notified, and an electrician was hired and sent out to fix the outlet on 09/13/2022, after which the station was returned to service.

During the sampling period of 10/09/2022 - 10/15/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was damaged while undergoing routine calibration. An electrical switch was damaged, requiring replacement, and the station was returned to service on 10/11/2022.

- **Deviation from Normal Direct Radiation Monitoring:** There was one (1) deviation from the required direct radiation monitoring schedule during the report period. During the 3<sup>rd</sup> Quarter TLD changeout, Station #76 was found to only contain 1 TLD. Attempts to find the second TLD in the immediate area were unsuccessful, resulting in only 1 TLD collected for the 3<sup>rd</sup> Quarter. Both of the 4<sup>th</sup> Quarter TLD were placed in the holder during the collection.
- **Deviation from Normal Surface and Drinking Water Sampling and Analysis Schedule:** There was one (1) deviations from the ODCM required water sampling and analysis schedule during the report. During the sampling period of 01/30/2022 - 02/05/2022, a sample could not be collected at REMP Water sampling station located in Industry (Montgomery Dam,

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Site No. 49A, Sector 03, 4.93 miles NE), due to frozen conditions along the Ohio River, resulting in an unsafe environment for sample collection.

- **Deviation from Normal Milk Sampling & Analysis Schedule:** There was one (1) deviation from the required milk sampling and analysis schedule occurred for the reporting period. Sufficient milk samples were not available from locations within the 5-mile radius in 2022. 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.
- **Deviations from Previous Sampling and Analysis Schedule:** There were no deviations from the required sampling and analysis schedules during the report period.

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## 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.

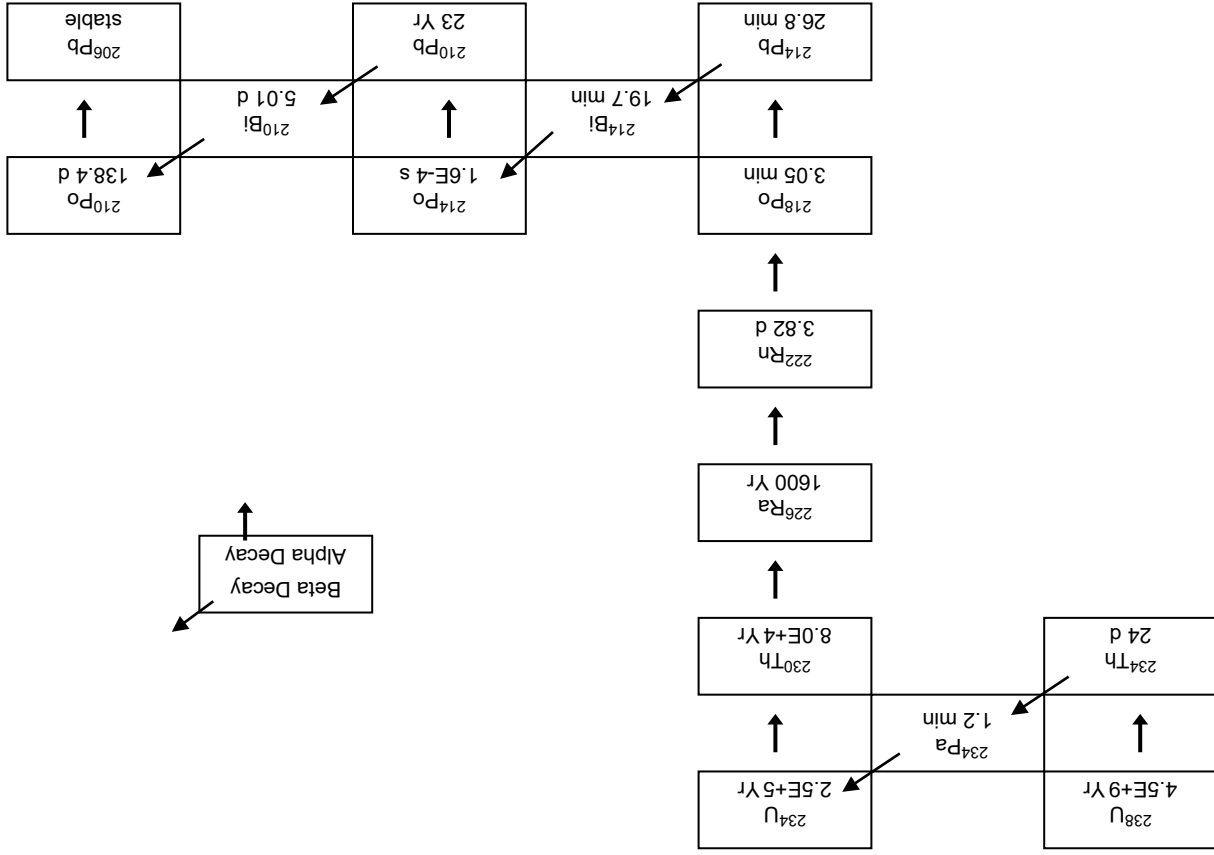
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**Neutrons:** Neutrons come from several sources, including the interactions of cosmic radiation with the earth's atmosphere and nuclear reactions within operating nuclear power reactors. However, neutrons are not of environmental concern since the 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.

SECTION 1 - INTRODUCTION

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



**Radionuclides:** See description for “isotopes”.

## SECTION 1 - INTRODUCTION

**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.

## **SECTION 1 - INTRODUCTION**

### **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 licensee 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 2,433 as determined from the 2020 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 13,300 cubic feet per second (minimum monthly average) to 98,900 cubic feet per second (maximum monthly average). The mean flow during the report period was approximately 44,525 cubic feet per second. Water temperature of the Ohio River typically varies from 31.8° Fahrenheit to 81.9° 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 46.3 inches.

The average mean temperature during the report period was 50.0° Fahrenheit.

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

	<u>Beaver Valley Unit 1</u>	<u>Beaver Valley Unit 2</u>
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



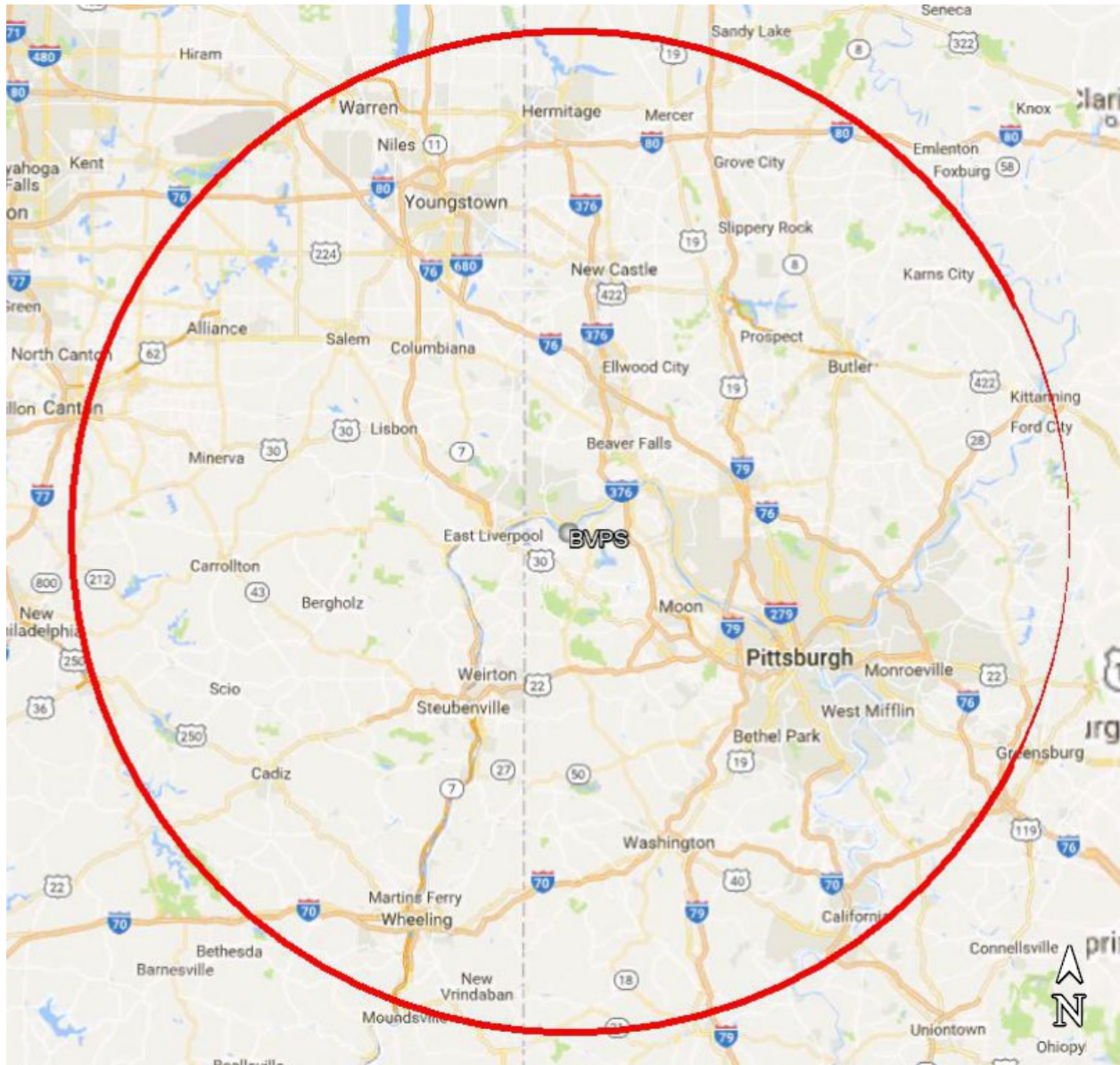
## **SECTION 1 - INTRODUCTION**

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 - Environmental Radiation Monitoring**

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

#### **2-E - Monitoring of Shoreline Stream Sediment and Soil**

#### **2-F - Monitoring of Local Cow and Goat Milk**

#### **2-G - Monitoring of Fish**

#### **2-H - Monitoring of Feedstuff and Foodcrops**

#### **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	Gross Beta <sup>(b)</sup>
		27	Aliquippa, PA (Brunton Farm)			
		30	Shippingport, PA (Cook's Ferry Substation)		Weekly – Charcoal	Iodine-131
		32B	Midland, PA (South Substation)			
		46.1	Industry, PA (McKeel's Service - Rt. 68)			
		47	East Liverpool, OH (Water Department)			
		48 <sup>(a)</sup>	Weirton, WV (Water Tower - Collier Way)			
		51	Aliquippa, PA (Sheffield Substation)			
2	Direct Radiation	7-8	BVPS Site Perimeter Locations	Continuous (TLD)	Quarterly <sup>(d)</sup>	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)			
		32B	Midland, PA (South 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 <sup>(a)</sup>	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 Tuscarawas 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 <sup>(a)</sup>	Industry, PA (Upstream of Montgomery Dam)	Weekly Grab Sample <sup>(b)</sup>	Biweekly Sample	Iodine-131
		5	East Liverpool, OH (Water Department)	Daily Grab Sample Collected Weekly <sup>(b)</sup>	Monthly Composite of Weekly Sample <sup>(c)</sup> Quarterly Composite <sup>(c)</sup>	Gamma Scan Tritium (H-3)
4	Groundwater	No sampling performed				
5	Drinking Water	4	Midland, PA (Water Department)	Intermittent <sup>(d)</sup> Sample Collected Weekly	Biweekly Composite of Daily sample <sup>(d)</sup>	Iodine-131
		5	East Liverpool, OH (Water Department)		Monthly Composite <sup>(d)</sup>	Gamma Scan
					Quarterly Composite <sup>(d)</sup>	Tritium (H-3)
6	Shoreline Sediment	2A 49A <sup>(a)</sup>	BVPS Outfall Vicinity Industry, PA (Upstream of Montgomery Dam)	Semi-Annual	Semi-Annual	Gamma Scan
7	Milk	27 96 <sup>(a)</sup> 114 <sup>(k)</sup>	Aliquippa, PA (Brunton Farm) Burgettstown, PA (Windsheimer Farm) Hookstown, PA (Covert Residence)	Biweekly <sup>(f)</sup> 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
8	Fish	2A 49A <sup>(a)</sup>	BVPS Outfall Vicinity Industry, PA (Upstream of Montgomery Dam)	Semi-Annual	Composite of edible parts by species <sup>(g)</sup>	Gamma Scan on edible parts
9	Food Crops	10 <sup>* (l) (m)</sup> 15 <sup>* (l) (m)</sup> 12 <sup>(l) (m)</sup> 46 <sup>* (l) (m)</sup> 48 <sup>* (a) (l) (m)</sup> * (l) (m)	Shippingport, PA Georgetown, PA Racoon Township, PA Industry, PA Weirton, WV	Annual at Harvest if available	Composite of each sample species	Gamma Scan Iodine-131 on green leafy vegetables
10	Feedstuff & Summer Forage	27	Aliquippa, PA (Brunton Farm)	Monthly	Monthly	Gamma Scan
11	Soil	30B 32A 46.1 48 <sup>(a)</sup> 51A	Shippingport, PA (Cook's Ferry Substation) Midland, PA (North Substation) Industry, PA Weirton WV (Water Tower - Collier Way) Aliquippa, PA (Sheffield Substation)	Every Five (5) Years (2020, 2025, 2030)	12 Core Samples 3" Deep (2" diameter at each location approx. 10' radius)	Gamma Scan
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

The REMP Air Particulate and Iodine sampling station located in Midland (Midland North Sub Station, Site No. 32, Sector 15, 0.75 miles NW) was re-located along with the Pennsylvania Department of Environmental Protection's monitor per the request of the property owner, Duquesne Light Company. The relocation of the air monitor station was the result of the demolition of a Duquesne Light control house. The station was moved from the inside of the Midland Sub Station North to outside of the Midland Sub Station South, which is approximately  $\frac{1}{4}$  of a mile from the original location.

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 - 2022

Medium: Air Particulate and Radioiodine

Unit of Measurement: (picoCuries / cubic meter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gross Beta 404	< 0.002	0.021 ( 352 / 352 ) 0.006 - 0.043	No. 32 Midland (North S.S.) Midland, PA 0.75 miles NW	0.024 ( 52 / 52 ) 0.013 - 0.042	No. 48 Weirton Water Tower Collier Way Weirton, WV 16.4 miles SSW	0.022 ( 52 / 52 ) 0.012 - 0.036	0
I-131 404	< 0.04	LLD ( 0 / 352 )		LLD ( 0 / 352 )	No. 48 Weirton Water Tower Collier Way Weirton, WV 16.4 miles SSW	LLD ( 0 / 52 )	0
Gamma 32							
Be-7	NA	0.077 ( 28 / 28 ) 0.044 - 0.148	No. 30 Shippingport (Cook's Ferry) Aliquippa, PA 0.43 miles ENE	0.093 ( 4 / 4 ) 0.047 - 0.148	No. 48 Weirton Water Tower Collier Way Weirton, WV 16.4 miles SSW	0.085 ( 4 / 4 ) 0.057 - 0.111	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

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: External Radiation

Unit of Measurement: (mR / Quarter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gamma 526	4.6	18.2 ( 518 / 518 ) 5.9 - 30.4	No. 8 BVPS Site Perimeter Location 0.25 miles SSE	24.0 ( 8 / 8 ) 21.3 - 26.8	No. 48 Weirton, WV Water Tower Collier Way 16.4 miles SSW	20.7 ( 8 / 8 ) 18.1 - 24.2	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Surface Water

Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
I-131 27	< 0.5				No. 49A Upstream of Montgomery Dam Industry, PA 4.93 miles NE	0.5 ( 3 / 27 ) 0.4 - 0.5	0
H-3 8	< 200	307 ( 1 / 4 ) 307 - 307	No. 5 East Liverpool Water Dpt. East Liverpool, OH 4.9 miles WNW	307 ( 1 / 4 ) 307 - 307	No. 49A Upstream of Montgomery Dam Industry, PA 4.93 miles NE	LLD ( 0 / 4 )	0
Gamma 24							
Mn-54	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Fe-59	< 10	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Co-58	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Co-60	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Zn-65	< 10	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Zr-Nb-95	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Cs-134	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Cs-137	< 5	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0
Ba-La-140	< 10	LLD ( 0 / 12 )		LLD ( 0 / 12 )		LLD ( 0 / 12 )	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Drinking Water

Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
I-131 52	< 0.5	LLD ( 0 / 52 )		LLD ( 0 / 52 )			0
H-3 8	< 200	308 ( 2 / 8 ) 184 - 431	No. 5 East Liverpool Water Dpt. East Liverpool, OH 4.9 miles WNW	308 ( 2 / 4 ) 184 - 431			0
Gamma 24							
Mn-54	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Fe-59	< 10	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Co-58	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Co-60	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Zn-65	< 10	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Zr-Nb-95	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Cs-134	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Cs-137	< 5	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0
Ba-La-140	< 10	LLD ( 0 / 24 )		LLD ( 0 / 24 )			0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Ground 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 <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
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						

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

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 <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
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						

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.  
 Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Sediment (page 1 of 2)

Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gamma 4							
K-40	NA	8.70 ( 2 / 2 ) 7.82 - 9.57	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	8.70 ( 2 / 2 ) 7.82 - 9.57	No. 49A Upstream of Montgomery Dam Industry, PA 4.93 miles NE	8.27 ( 2 / 2 ) 7.50 - 9.04	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	LLD ( 0 / 2 )		LLD ( 0 / 2 )		LLD ( 0 / 2 )	0
Co-60	< 0.02	0.58 ( 2 / 2 ) 0.27 - 0.89	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	0.58 ( 2 / 2 ) 0.27 - 0.89		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	0.06 ( 2 / 2 ) 0.06 - 0.07	No. 2A BVPS Outfall Vicinity 0.31 miles WSW	0.06 ( 2 / 2 ) 0.06 - 0.07		LLD ( 0 / 2 )	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 - 2022

Medium: Sediment (page 2 of 2)

Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Tl-208	NA	0.27 ( 2 / 2 ) 0.24 - 0.30	No. 2A BVPS Outfall Vicinity 0.31 miles WSW <i>Same location for the following nuclides</i>	0.27 ( 2 / 2 ) 0.24 - 0.30	No. 49A Upstream of Montgomery Dam Industry, PA 4.93 miles NE <i>Same location for the following nuclides</i>	0.25 ( 2 / 2 ) 0.23 - 0.27	0
Bi-214	NA	0.80 ( 2 / 2 ) 0.79 - 0.81		0.80 ( 2 / 2 ) 0.79 - 0.81		0.68 ( 2 / 2 ) 0.63 - 0.73	0
Pb-212	NA	0.80 ( 2 / 2 ) 0.71 - 0.88		0.80 ( 2 / 2 ) 0.71 - 0.88		0.72 ( 2 / 2 ) 0.65 - 0.8	0
Pb-214	NA	0.88 ( 2 / 2 ) 0.86 - 0.9		0.88 ( 2 / 2 ) 0.86 - 0.9		0.78 ( 2 / 2 ) 0.67 - 0.90	0
Ra-226	NA	1.86 ( 2 / 2 ) 1.61 - 2.11		1.86 ( 2 / 2 ) 1.61 - 2.11		1.38 ( 2 / 2 ) 1.30 - 1.46	0
Ac-228	NA	0.83 ( 2 / 2 ) 0.78 - 0.87		0.83 ( 2 / 2 ) 0.78 - 0.87		0.81 ( 2 / 2 ) 0.71 - 0.90	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.  
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Soil (page 1 of 2)

Soil Sampling is performed every five (5) years. Next sampling is 2025.

Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gamma 0	NA						
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 - 2022

Medium: Soil (page 2 of 2)

Soil Sampling is performed every five (5) years. Next sampling is 2025.

Unit of Measurement: (picoCuries / gram) Dry

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
TI-208	NA						
Bi-214	NA						
Pb-212	NA						
Pb-214	NA						
Ra-226	NA						
Ac-228	NA						

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.  
Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Milk

Unit of Measurement: (picoCuries / liter)

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
I-131 55	< 0.5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Sr-89 55	< 2.0	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Sr-90 55	< 0.7	0.5 ( 2 / 20 ) 0.5 - 0.5	No. 114 Covert Residence Hookstown, PA 1.9 miles SW	0.5 ( 2 / 20 ) 0.5 - 0.5	No. 96 Windsheimer Farm Burgettstown, PA 10.48 miles SSW	0.7 ( 8 / 20 ) 0.5 - 0.8	0
Gamma 55							
K-40	< 150	1482 ( 35 / 35 ) 1210 - 2543	No. 114 Covert Residence Hookstown, PA 1.9 miles SW	1446 ( 35 / 35 ) 1210 - 2040	No. 96 Windsheimer Farm Burgettstown, PA 10.48 miles SSW	1354 ( 20 / 20 ) 1183 - 1987	0
Mn-54	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Fe-59	< 10	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Co-58	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Co-60	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Zn-65	< 10	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Zr-Nb-95	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Cs-134	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Cs-137	< 5	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0
Ba-La-140	< 10	LLD ( 0 / 35 )		LLD ( 0 / 35 )		LLD ( 0 / 20 )	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Fish

Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gamma 8			No. 2A BVPS Outfall Vicinity 0.31 miles WSW		No. 49A Industry, PA Upstream of Montgomery Dam 4.93 miles NE		
Mn-54	< 0.05	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Fe-59	< 0.10	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Co-58	< 0.05	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Co-60	< 0.05	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Zn-65	< 0.10	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Zr-Nb-95	< 0.01	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Cs-134	< 0.05	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Cs-137	< 0.05	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0
Ba-La-140	< 0.01	LLD ( 0 / 4 )		LLD ( 0 / 4 )		LLD ( 0 / 4 )	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Feedstuff

Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
Gamma 12							
Be-7	< 0.2	0.26 ( 7 / 12 ) 0.24 - 0.27	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.16 miles SE	0.26 ( 7 / 12 ) 0.24 - 0.27			0
K-40	< 0.15	8.35 ( 12 / 12 ) 6.23 - 13.53	No. 27 Brunton Farm 3681 Ridge Road Aliquippa, PA 6.16 miles SE	8.35 ( 12 / 12 ) 6.23 - 13.53			0
Mn-54	< 0.02	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Fe-59	< 0.04	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Co-58	< 0.02	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Co-60	< 0.02	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Zn-65	< 0.04	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Zr-Nb-95	< 0.03	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Ru-103	< 0.03	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
I-131	< 0.06	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Cs-134	< 0.04	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Cs-137	< 0.06	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0
Ba-La-140	< 0.01	LLD ( 0 / 12 )		LLD ( 0 / 12 )			0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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 - 2022

Medium: Foodcrops

Unit of Measurement: (picoCuries / gram) Wet

Type and Total Number of Analysis Performed	Lower Limit of Detection LLD <sup>(a)</sup>	All Indicator Locations Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Locations with Highest Annual Mean		Control Location		Number of Nonroutine Reported Measurements <sup>(c)</sup>
			Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	Name Distance and Direction	Mean (fraction) <sup>(b)</sup> Range <sup>(b)</sup>	
I-131 10	< 0.06	LLD ( 0 / 9 )		LLD ( 0 / 9 )	No. 48B Weirton, WV 16.52 miles SSW	LLD ( 0 / 1 )	0
Gamma 10							
K-40	NA	3.61 ( 9 / 9 ) 1.93 - 5.26	No. 15 Georgetown, PA 3.76 miles WNW	5.26 ( 1 / 1 ) 5.26 - 5.26	No. 48B Weirton, WV 16.52 miles SSW	2.61 ( 1 / 1 ) 2.61 - 2.61	0
Mn-54	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Fe-59	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Co-58	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Co-60	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Zn-65	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Zr-Nb-95	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Cs-134	0.04	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Cs-137	0.06	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0
Ba-La-140	NA	LLD ( 0 / 9 )		LLD ( 0 / 9 )		LLD ( 0 / 1 )	0

<sup>a</sup> Nominal Lower Limit of Detection

<sup>b</sup> Mean and range based upon detectable measurements only.

Fraction of detectable measurements at specified locations is indicated in parentheses (fraction)

<sup>c</sup> 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

<b>Medium or Pathway Sampled (Unit of Measurement)</b>	<b>Analysis and Total Number of Analysis Performed</b>	<b>Lower Limit of Detection (LLD)</b>	<b>All Indicator Locations Mean, Fraction (c), Range</b>
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

<b>Medium or Pathway Sampled (Unit of Measurement)</b>	<b>Analysis and Total Number of Analysis Performed</b>	<b>Lower Limit of Detection (LLD)</b>	<b>All Indicator Locations Mean, Fraction (c), Range</b>		
Soil (dry) - Core Samples - [picocurie /gram]	Gross Alpha (0)	--	--	--	--
	Gross Beta (8)	1	21	(8/8)	16 - 28
	Sr-89 (8)	0.25		< LLD	
	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 [picocurie / liter]	Gross Alpha (40)	0.3	0.75	(5/40)	0.6 - 1.1
	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 [picocurie / liter]	I-131 (0)	--	--	--	--
	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 [picocurie / liter]	Gross Alpha (19)	0.3		< LLD	
	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 and Gaseous [picocurie /cubic meter]	Gross Alpha (188)	0.001	0.003	(35/188)	0.002 - 0.004
	Gross Beta (927)	0.006	0.07	(927/927)	0.02 - 0.32
	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

<b>Medium or Pathway Sampled (Unit of Measurement)</b>	<b>Analysis and Total Number of Analysis Performed</b>	<b>Lower Limit of Detection (LLD)</b>	<b>All Indicator Locations Mean, Fraction (c), Range</b>
Milk [picocurie / liter]	I-131 (91)	0.25	0.6 (4/91) 0.3 - 0.8
	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 (134)	10	13 (19/134) 11 - 16
	Others		< LLD
External Radiation [milliRoentgen / day]	γ - Monthly (599)	0.5 mR*	0.20 (599/599) 0.08 - 0.51
	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) [picocurie / gram]	Gross Beta (17)	0.01	1.9 (15/17) 1.0 - 3.2
	Sr-90 (17)	0.005	0.14 (17/17) 0.02 - 0.50
	Gamma (17)	0.5	
	K-40 (17)	--	2.4 (17/17) 1.0 - 3.7
	Others		< LLD
<p>* LLD in units of mR - Lower end of useful integrated exposure detectability range for a passive radiation detector (TLD).</p> <p>(a) May include Ru-106, Ru-103, Be-7.</p> <p>(b) One outlier not included in mean. (Water taken from dried-up spring with high sediment and potassium content. Not considered typical groundwater sample).</p> <p>(c) Fraction of detectable measurements at specified location, indicated in parentheses.</p>			



## 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 northwest 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 the 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 four (404) 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 eight (8) deviations from the required airborne particulate sampling and analysis schedule during the report period.

During the sampling period of 02/20/2022 - 02/26/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Brunton Farm, Site No. 27, Sector 07, 6.16 miles SE) was discovered to have been out of service for approximately seven hours during the sampling period due to power loss at Brunton Dairy.

During the sampling period of 04/24/2022 - 04/30/2022, REMP Air Particulate and Iodine sampling station located in Shippingport (Cook's Ferry Substation, Site No. 30, Sector 04, 0.43 miles ENE) was found to be out of service. The initial cause was determined to be a temporary power disconnect as a result of a Duquesne Light substation service upgrade. After further investigation, Duquesne Light condemned the meter box and disconnected the feed without notification. The station was returned to service on 06/20/2022, and this deficiency is recorded in CR-2022-04096.

During the sampling period of 06/26/2022 - 07/02/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was found to be out of service. The cause was determined to

## **SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM**

be an improperly functioning turbine, resulting in a reading of 0.0 cfm. The turbine was removed and cleaned and returned to service immediately.

During the sampling period of 07/10/2022 - 07/16/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Brunton Farm, Site No. 27, Sector 07, 6.16 miles SE) was found to be out of service. The cause was determined to be an improperly functioning exhaust filter, resulting in a reading of 0.0 cfm. The exhaust filter was removed and cleaned and returned to service immediately.

During the sampling period of 07/10/2022 - 07/16/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was found to be out of service. The cause was determined to be a non-functional cabinet fan. The fan was removed for maintenance, and the station was returned to service on 08/01/2022 after the fan motor was replaced.

During the sampling period of 08/07/2022 - 08/13/2022, REMP Air Particulate and Iodine sampling station located in Midland (North Substation, Site No. 32, Sector 15, 0.75 miles NW) was found to be out of service. The cause was determined to be a broken outlet plug, requiring the removal of the totalizer for repairs. The station was returned to service on 08/10/2022 with a new plug installed and a replacement fuse.

During the sampling period of 09/11/2022 - 09/17/2022, REMP Air Particulate and Iodine sampling station located in Midland (North Substation, Site No. 32, Sector 15, 0.75 miles NW) was found to be out of service. The cause was determined to be serious damage to the outlet and surrounding electrical wiring. Chemistry supervision was notified, and an electrician was hired and sent out to fix the outlet on 09/13/2022, after which the station was returned to service.

During the sampling period of 10/09/2022 - 10/15/2022, REMP Air Particulate and Iodine sampling station located in Aliquippa (Sheffield Substation, Site No. 51, Sector 05, 8.00 miles E) was damaged while undergoing routine calibration. An electrical switch was damaged, requiring replacement, and the station was returned to service on 10/11/2022.

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

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b. Airborne Radioiodine

Iodine-131: A total of four hundred four (404) weekly charcoal filter samples were analyzed for iodine-131. Iodine-131 was not identified in any of the three hundred seventy-one (371) indicator samples, nor was it identified in any of the fifty-three (53) control samples.

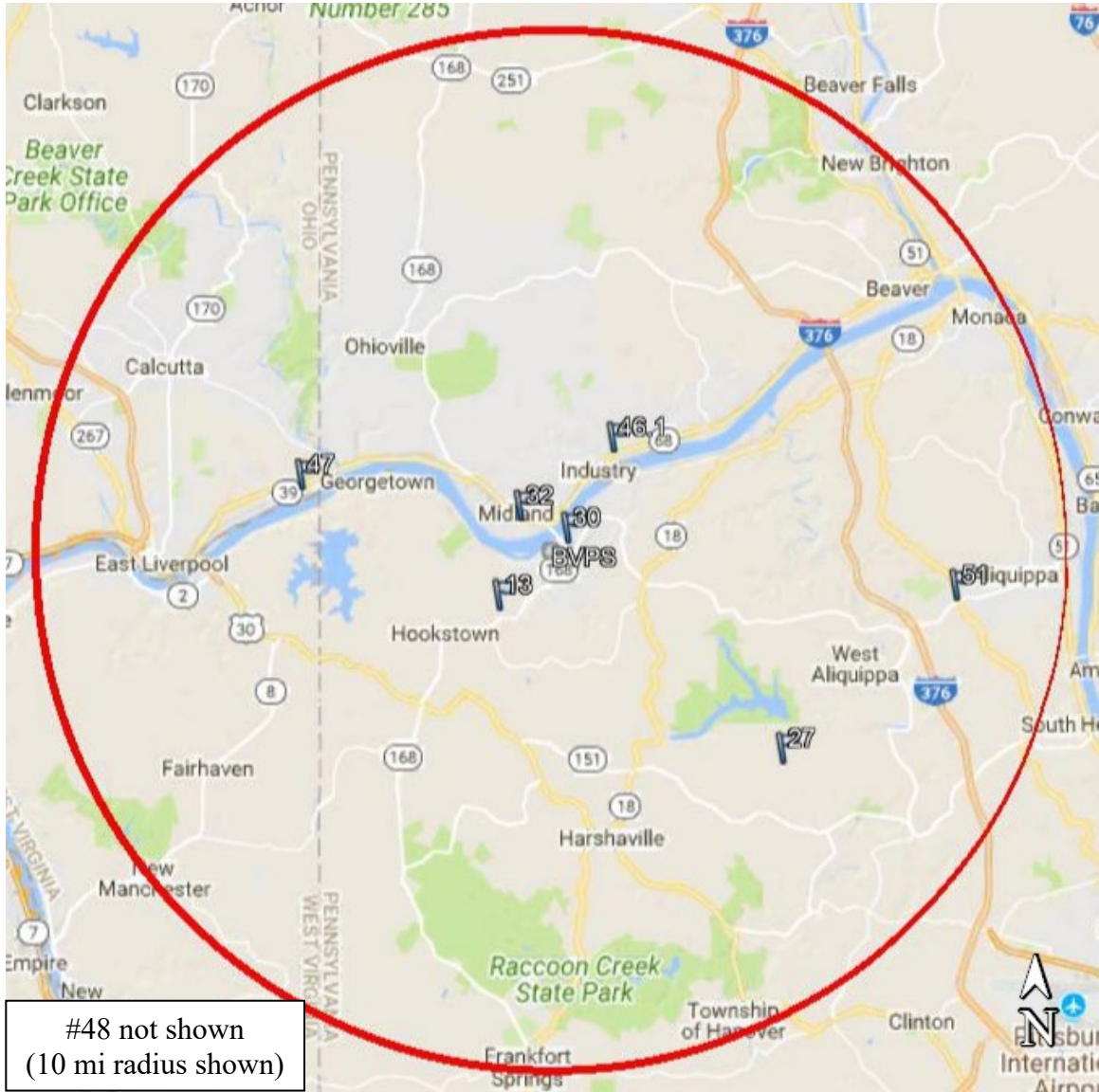
Deviations from Required Sampling and Analysis Schedule: The deviations are the same as described above for airborne particulates.

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

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Figure 2-1

Environmental Monitoring Locations - Air Sampling Stations

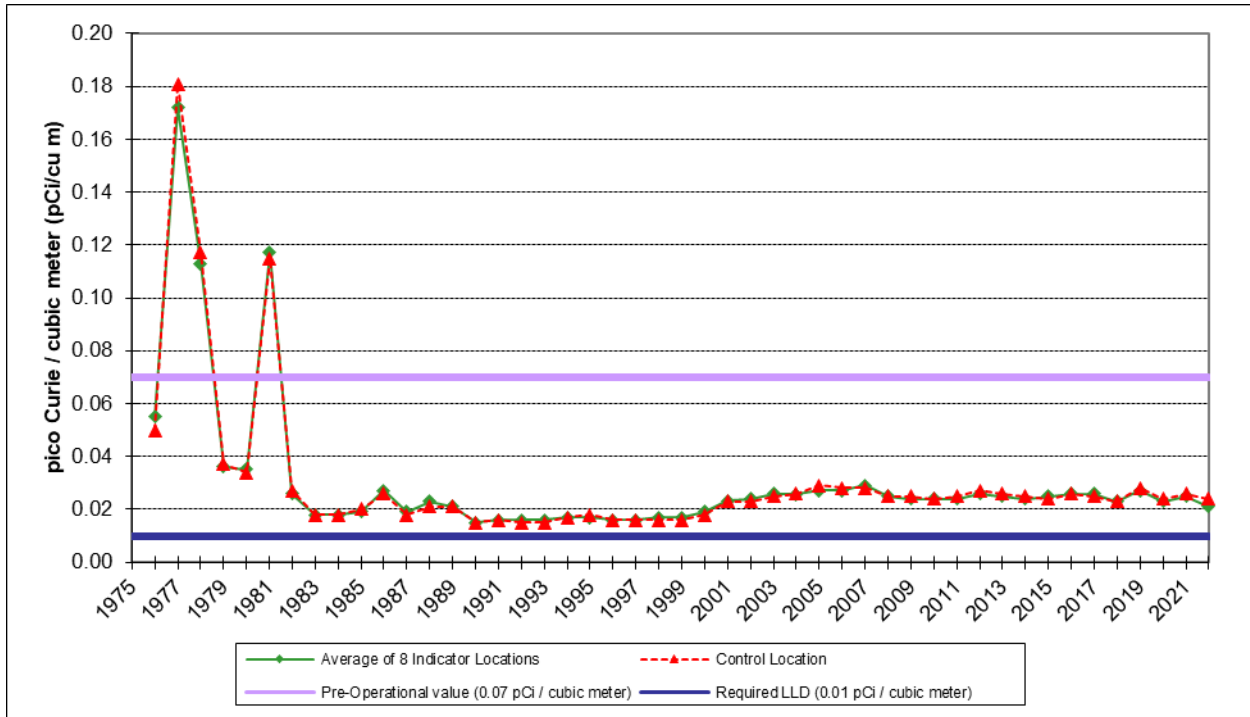


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Air Particulate & Radioiodine	13	11-SW	1.49	Hookstown, PA (Old Meyer Farm)
	27	7-SE	6.14	Aliquippa, Pa (Brunton Farm)
	30	4-ENE	0.43	Shippingport, PA (Cook's Ferry Substation)
	32B	15-NW	0.50	Midland, PA (South Substation - Rt. 68)
	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)

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Figure 2-2

Graph of Annual Average Concentration: Gross Beta in Air Particulates



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### C. 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  $\mu\text{R/hr}$  to 12  $\mu\text{R/hr}$ .

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-five (65) environmental TLD locations. This is comprised of forty-four (44) offsite locations, along with twenty-one (21) fence perimeter locations. The offsite TLD locations are plotted on Figure 2-3, 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.

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### 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 2-4.

TLD Analysis: During the report period, the average quarterly external exposure rate (as measured from TLD) was 18.2 mR at the sixty-five (65) indicator locations, and 20.7 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 (1) deviation from the required direct radiation monitoring schedule during the report period.

During the 3<sup>rd</sup> Quarter TLD changeout, Station #76 was found to only contain 1 TLD. Attempts to find the second TLD in the immediate area were unsuccessful, resulting in only 1 TLD collected for the 3<sup>rd</sup> Quarter. Both of the 4<sup>th</sup> Quarter TLD were placed in the holder during the collection.

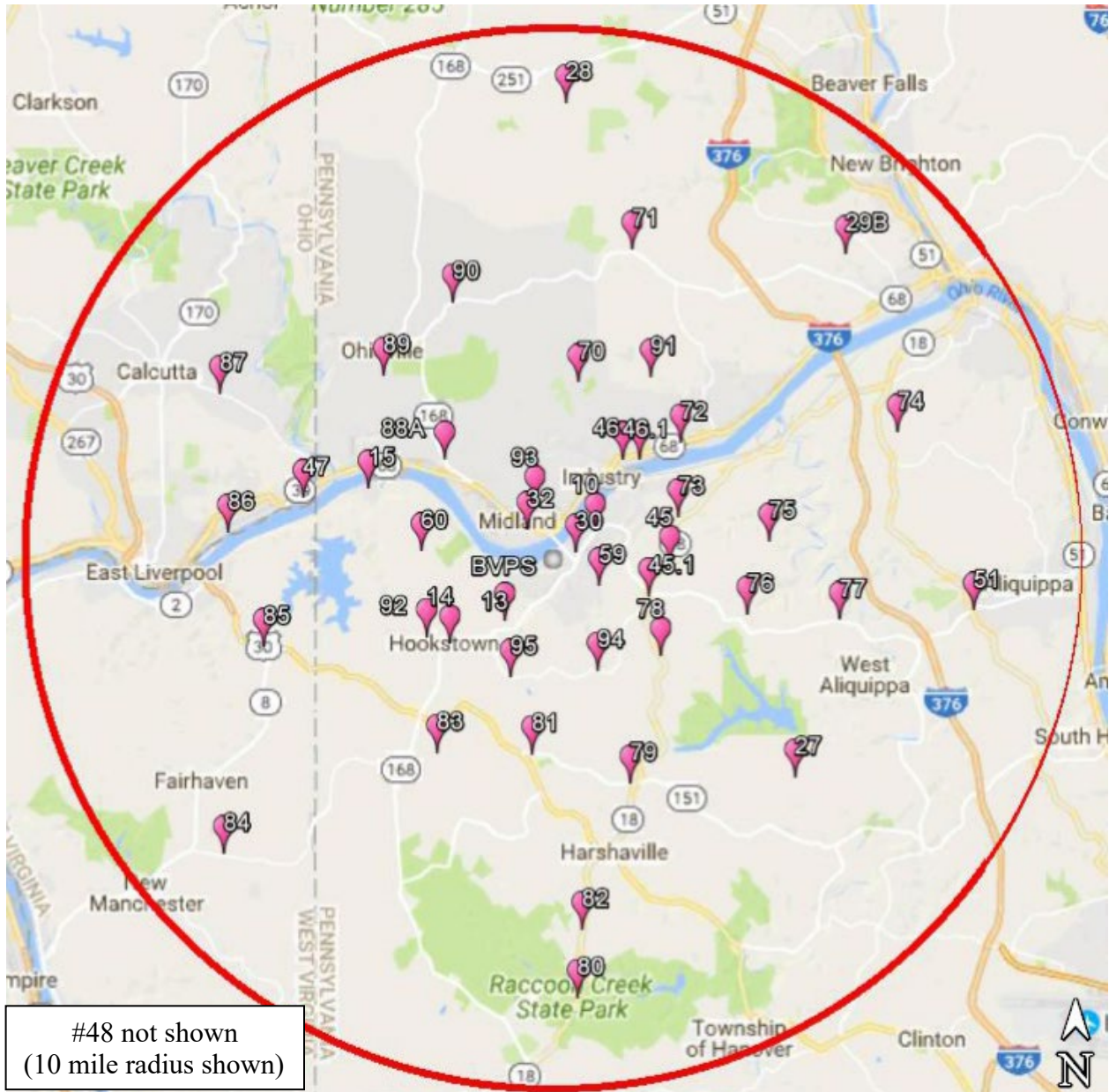
Summary: The quarterly TLD external exposure rates are comparable to that of the previous decade. There was no evidence of anomalies that could be attributed to the operation of BVPS. It should also be noted that the average external exposure rate at the indicator locations was less than average external 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.



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Figure 2-3

Environmental Monitoring Locations - TLDs



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**Figure 2-3 (Continued)**

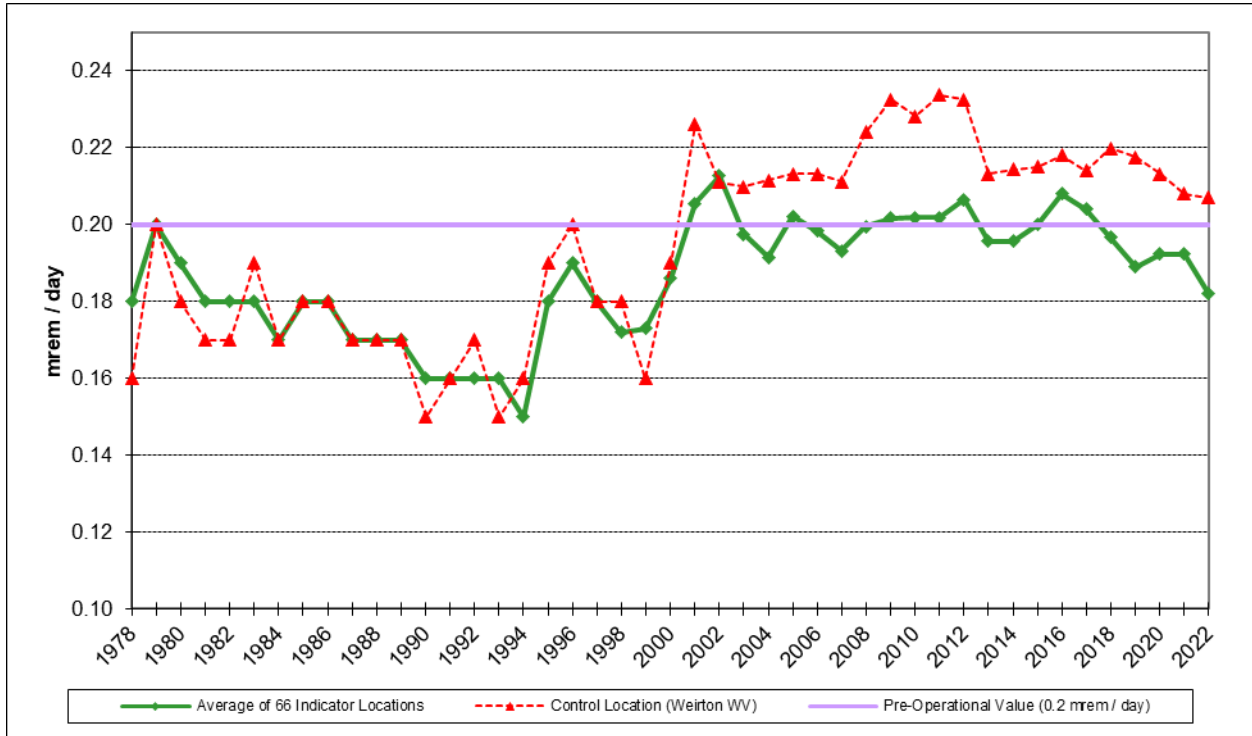
**TLD Locations**

<b>NORTHEAST QUADRANT</b>							
Site No.	Sector	Distance (miles)	Location	Site No.	Sector	Distance (miles)	Location
10	3-NE 4-ENE	0.94	Post Office Shippingport, PA	70	1-N	3.36	236 Engle Road Industry, PA
28	1-N	8.60	Sherman Farm Brighton Twp, PA	71	2-NNE	6.01	First Western Bank Brighton Township, PA
29B	3-NE	7.97	Friendship Ridge Beaver, PA	72	3-NE	3.25	Ohioview Lutheran Church – Rear Raccoon Twp, PA
30	4-ENE	0.43	Cook’s Ferry Substation Shippingport, PA	73	4-ENE	2.48	618 Squirrel Run Road Monaca, PA
45	5-E	2.19	Christian House Baptist Chapel, State Rte 18 Raccoon Township, PA	74	4-ENE	6.92	137 Poplar Avenue (CCBC) Monaca, PA
46	3-NE	2.49	Midway Drive Industry, PA	75	5-E	4.08	117 Holt Road Aliquippa, PA
46.1	2-NNE 3-NE	2.28	McKeel’s Service, State Route 68 Industry, PA	91	2-NNE	3.89	Pine Grove Road & Doyle Road Industry, PA
<b>SOUTHEAST QUADRANT</b>							
Site No.	Sector	Distance (miles)	Location	Site No.	Sector	Distance (miles)	Location
27	7-SE	6.14	Brunton Dairy Farm Aliquippa, PA	78	7-SE	2.72	Raccoon Twp Municipal Building Raccoon Township, PA
45.1	6-ESE	1.92	Kennedy’s Corners Raccoon Township, PA	79	8-SSE	4.46	106 State Route 151 Green Twp. Aliquippa, PA
51	5-E	8.00	Sheffield Substation Aliquippa, PA	80	9-S	8.27	Park Office, State Route 18 Raccoon Township, PA
59	6-ESE	0.99	236 Green Hill Road Aliquippa, PA	82	9-S	6.99	2697 State Route 18 Raccoon Twp, PA
76	6-ESE	3.80	Raccoon Elementary School Raccoon Township, PA	94	8-SSE	2.25	McCleary & Pole Cat Hollow Road Hookstown, PA
77	6-ESE	5.52	3614 Green Garden Road Aliquippa, PA				
<b>SOUTHWEST QUADRANT</b>							
Site No.	Sector	Distance (miles)	Location	Site No.	Sector	Distance (miles)	Location
13	11-SW	1.49	Old Meyer Farm Hookstown, PA	84	11-SW	8.35	Senior Center Hancock County, WV
14	11-SW	2.53	Hookstown, PA	85	12- WSW	5.73	2048 State Route 30 West Chester, WV
48	10-SSW	16.40	Collier Way Water Tower Weirton, WV	92	12- WSW	2.81	Georgetown Road Substation Georgetown, PA
81	9-S	3.69	Millcreek United Presbyterian Church Hookstown, PA	95	10-SSW	2.37	832 McCleary Road Hookstown, PA
83	10-SSW	4.26	735 Mill Creek Road, Hookstown, PA				
<b>NORTHWEST QUADRANT</b>							
Site No.	Sector	Distance (miles)	Location	Site No.	Sector	Distance (miles)	Location
15	14-WNW	3.75	Post Office Georgetown, PA	87	14- WNW	7.04	50103 Calcutta Smith Ferry Road Calcutta, OH
32	15-NW	0.75	North Substation Midland, PA	88A	15-NW	2.8	Route 168 Midland Heights PA
47	14-WNW	4.88	Water Department East Liverpool, OH	89	15-NW	4.72	488 Smith’s Ferry Road Ohioville, PA
60	13-W	2.51	444 Hill Road Georgetown, PA	90	16- NNW	5.20	6286 Tuscarawas Road Midland, PA
86	13-W	6.18	1090 Ohio Avenue East Liverpool, OH	93	16- NNW	1.10	104 Linden - Sunrise Hills Midland, PA

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Figure 2-4

Graph of Annual Average Exposure: Direct Radiation in Environment



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### D. 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 45.3 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

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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, located at the ATI-Allegheny Ludlum (formerly J&L Steel) river water intake, sample location 2.1, [River Mile 36.2], 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 2-5.

### 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

## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

the monthly composites. The quarterly composites are analyzed for tritium. Locations of each sample point are shown in Figure 2-5.

c. Groundwater

Since these samples are not required, they will no longer be collected as of 2017. For historical information, groundwater was collected semiannually by grab samples at locations within four (4) miles of the site, 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

Since these samples are not required, they will no longer be collected as of 2017. 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 2-6 through 2-9.

#### a. Surface Water

Tritium: A total of eight (8) surface water samples were analyzed for tritium during the report period. Tritium was detected in one (1) of the four (4) indicator samples, but none the four (4) control samples. Tritium was detected at the East Liverpool Water Department at a concentration of 307 pCi/l.

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-seven (27) surface water control samples were analyzed for iodine-131 using radiochemical methods during the report period. Iodine-131 was detected in three of twenty-seven (3 of 27) 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 = LLD to 0.50 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 eight (8) surface water samples were analyzed for tritium during the report period. Tritium was detected in two (2) of the four (4) indicator samples, but none the four (4) control samples. Tritium was detected at the East Liverpool Water Department at an average concentration of 308 pCi/l.

Gamma Spectrometry: A total of twenty-four (24) 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.

## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Iodine-131: A total of fifty-two (52) drinking water samples were analyzed for iodine-131 (using radiochemical methods) during the report period. Iodine-131 was not detected in any of the fifty-two (52) weekly indicator samples. The results were similar to previous years, (current annual range = LLD to 0.30 picocurie / liter).

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 (1) deviations from the ODCM required water sampling and analysis schedule during the report.

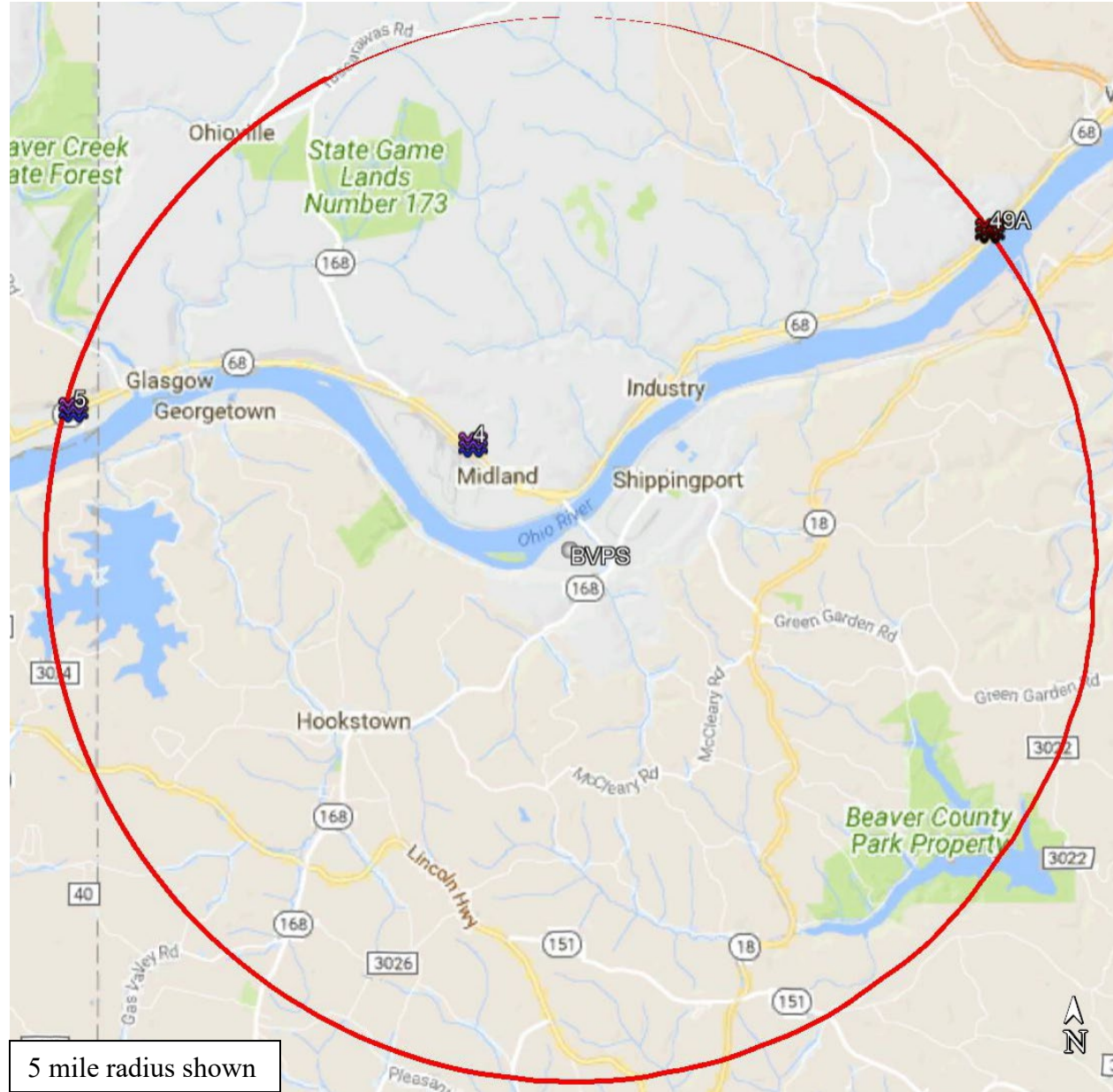
During the sampling period of 01/30/2022 - 02/05/2022, a sample could not be collected at REMP Water sampling station located in Industry (Montgomery Dam, Site No. 49A, Sector 03, 4.93 miles NE), due to frozen conditions along the Ohio River, resulting in an unsafe environment for sample collection.

f. Summary: Data from the water sample analyses demonstrate that BVPS did not contribute a significant increase of radioactivity in the local river and drinking water. 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 2-5  
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 2-6

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

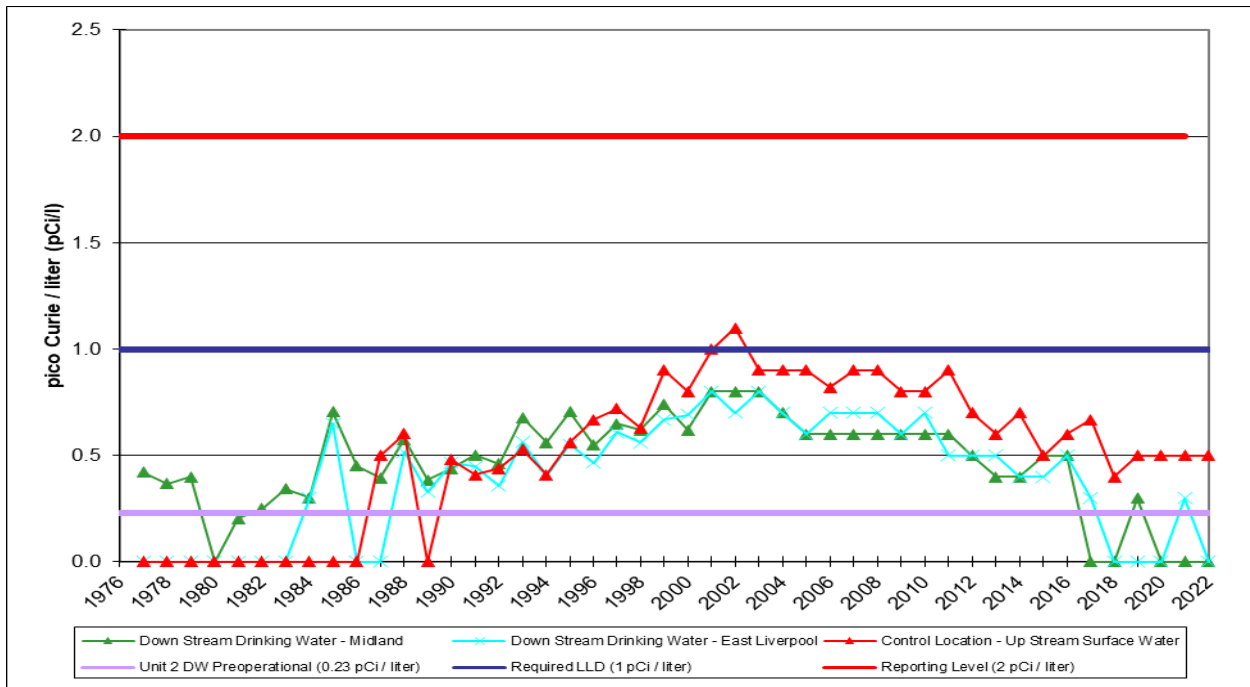
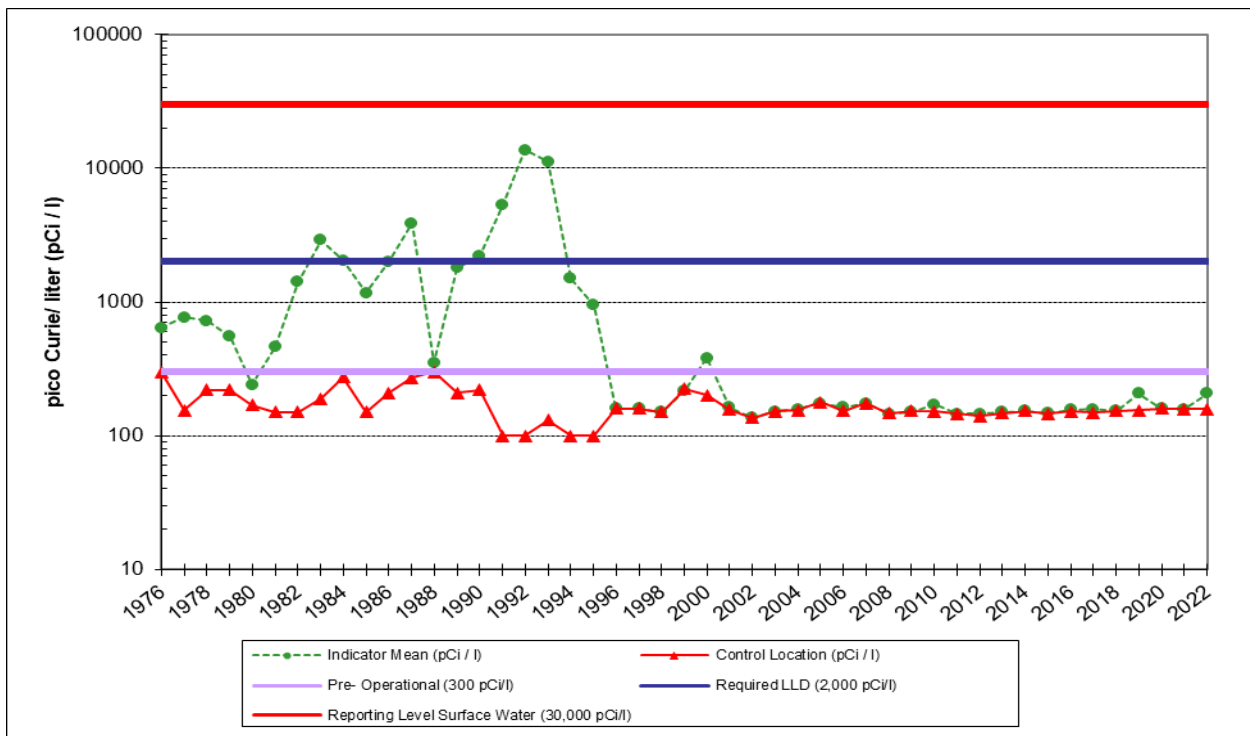


Figure 2-7

Graph of Annual Average Concentration: Tritium in Surface Water



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-8

Graph of Annual Average Concentration: Tritium in Drinking Water

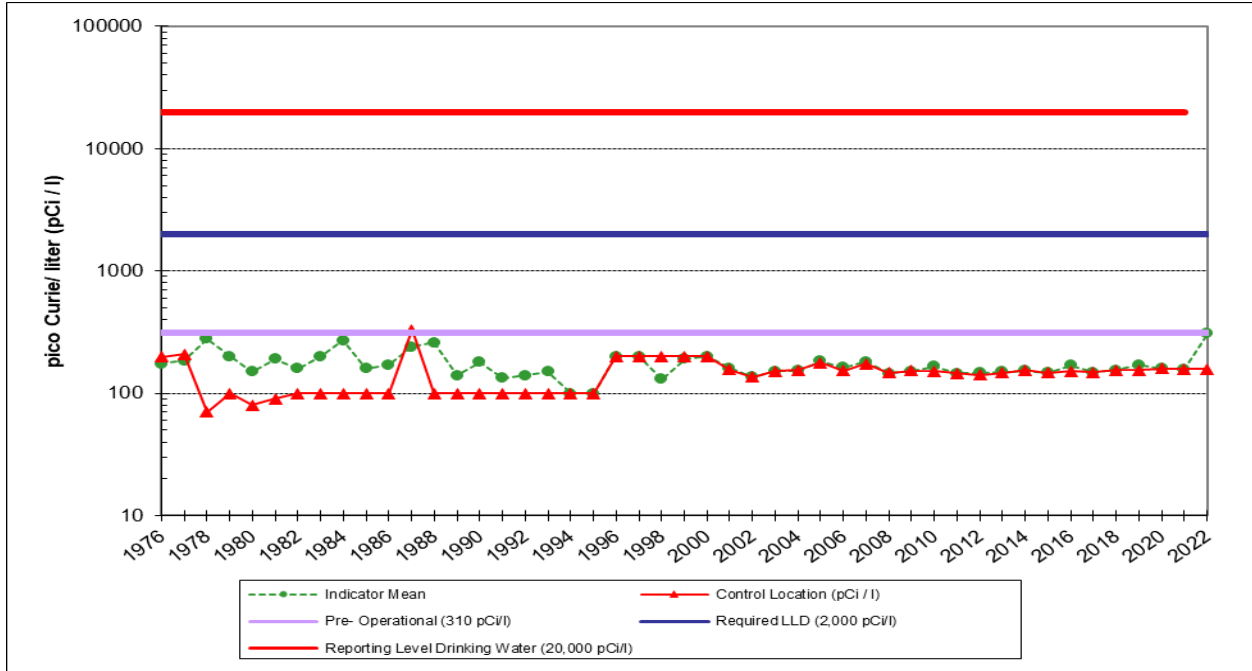
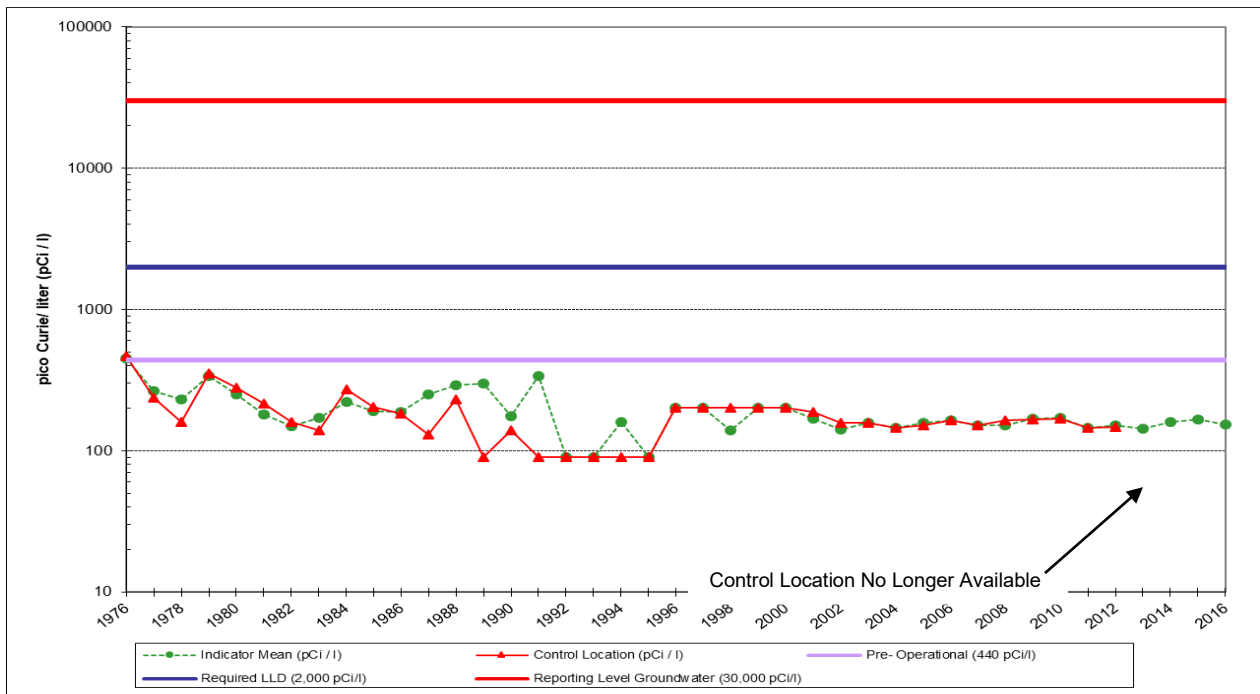


Figure 2-9

Graph of Annual Average Concentration: Tritium in Groundwater



## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

### E. 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 2-10.

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 was recently 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 2-10.

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

##### b. Analytical Procedures

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

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

## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

### 3. Results and Conclusions

A summary of the analysis results during the report period are listed in Table 2-2. A trend graph of analyses (including the pre-operational period through the report period) is shown on Figure 2-11 and Figure 2-12.

#### 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, bismuth-214, lead-212, lead-214, radium-226, and actinium-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 zero of two (0 of 2) control samples. The results were comparable to that of previous years (current annual range = 0.06 to 0.07 picocurie / gram).

Cobalt-58: Radionuclide cobalt-58 was not identified in any of the indicator or control samples. The results were comparable to previous years.

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 = 0.27 to 0.89 picocurie / gram).

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

Summary: The identification of cobalt-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.

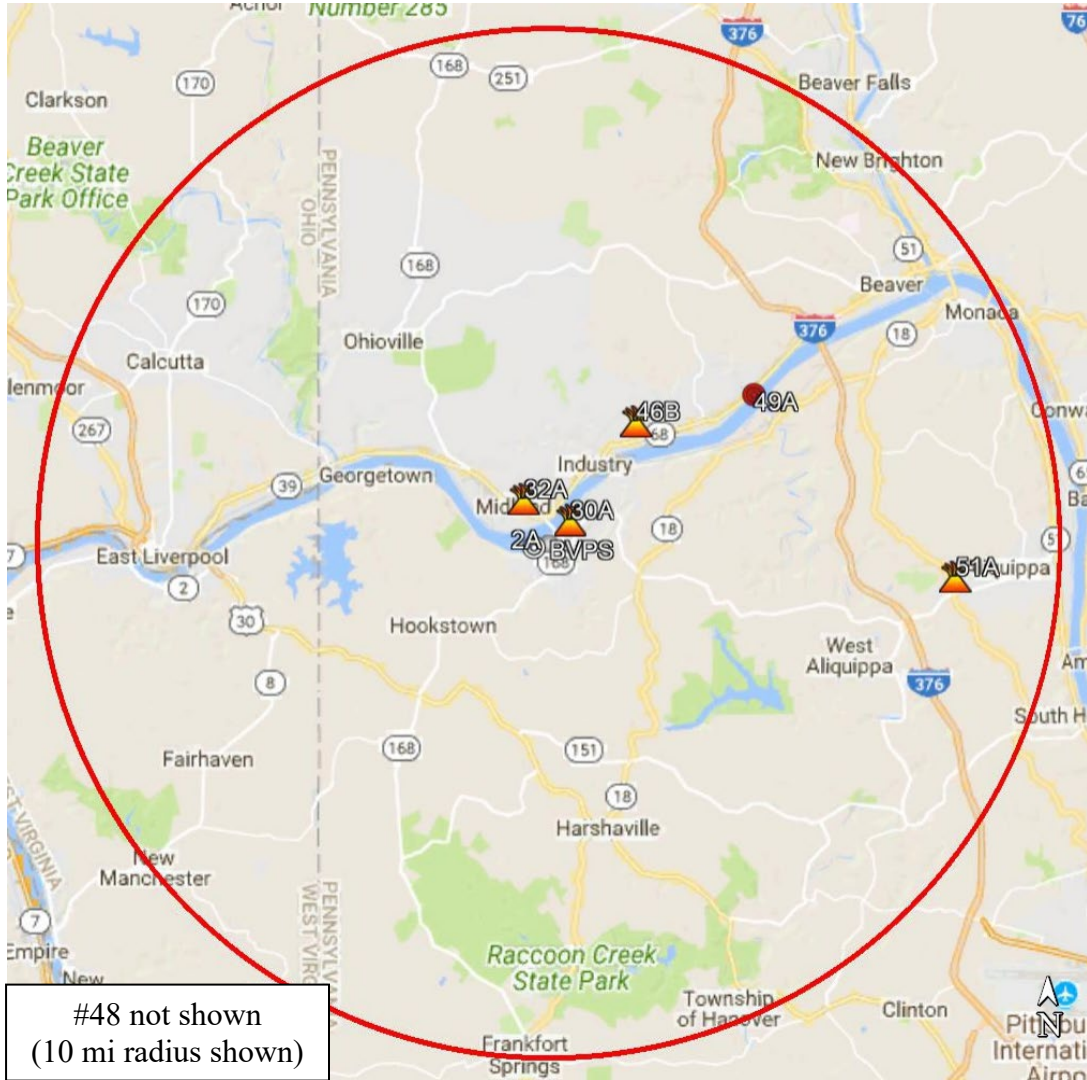
#### b. Soil

Soil sampling is not an ODCM requirement. Soil was last sampled in 2020 and will be performed in 2025.

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-10

Environmental Monitoring Locations - Shoreline Sediments and Soil



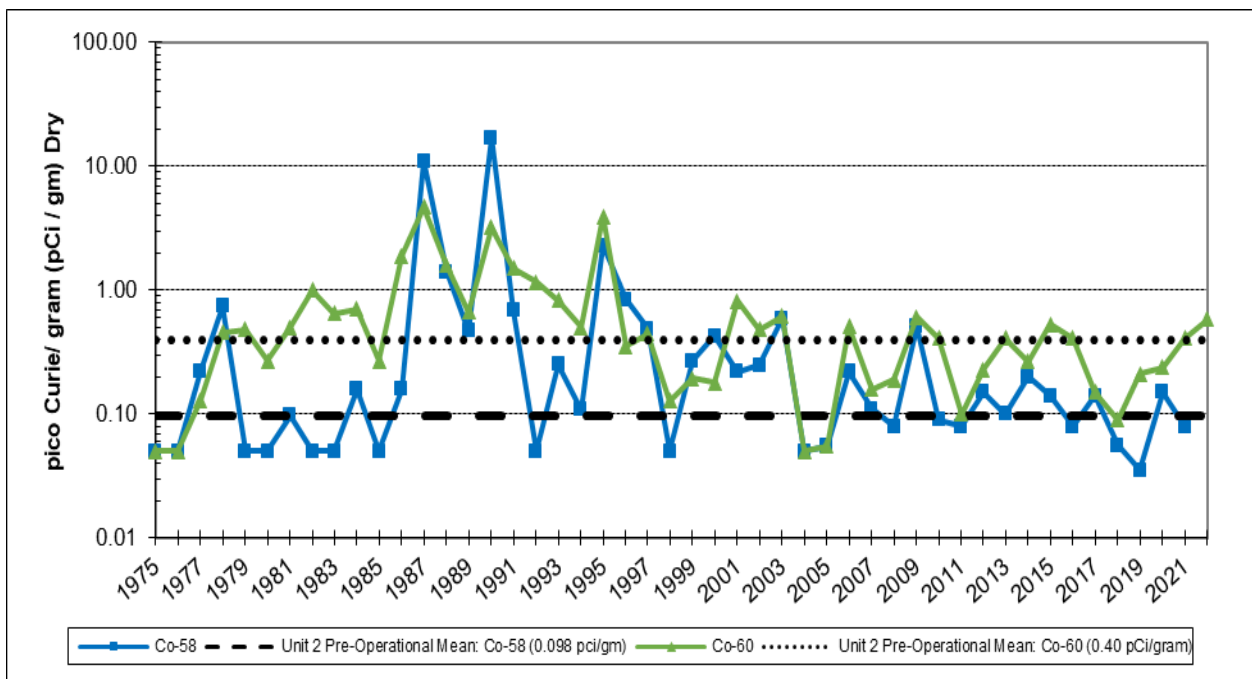
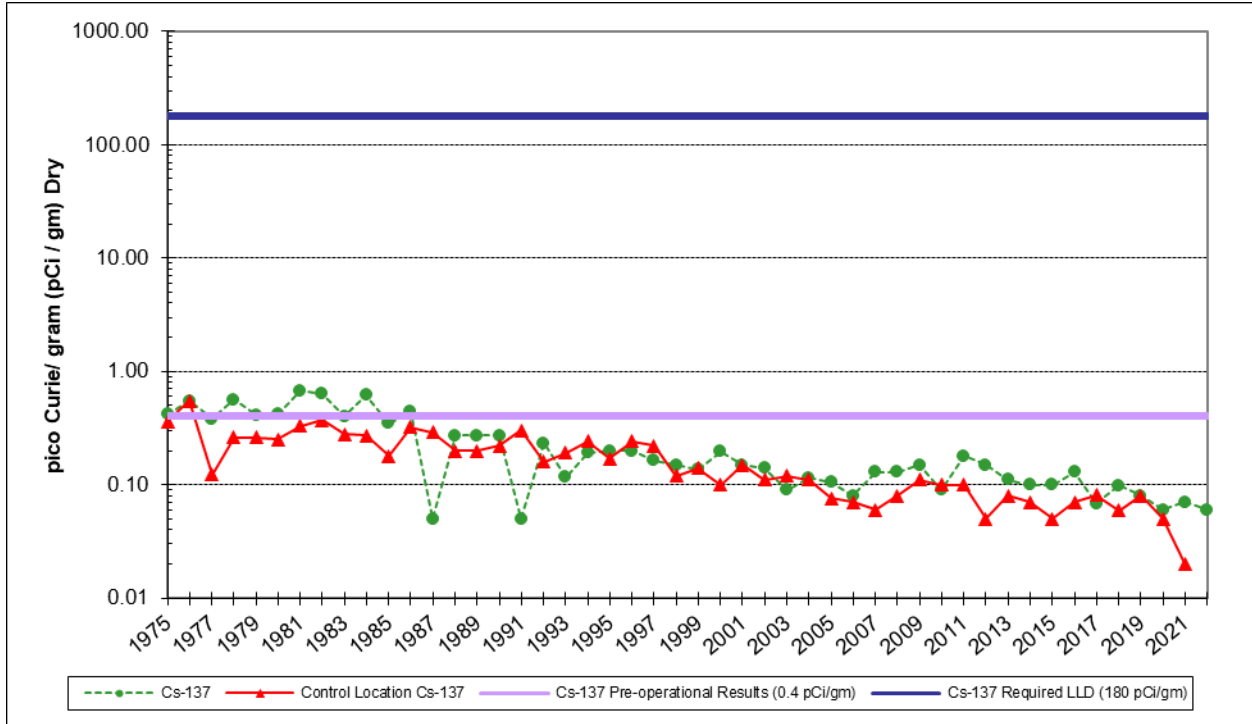
#48 not shown  
 (10 mi radius shown)

Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Soil	30B	4-ENE	0.43	Shippingport, PA (Cooks Ferry Substation)
	32A	15-NW	0.74	Midland, PA (North Substation)
	46.1	3-NE	2.66	Industry, PA
	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 2-11

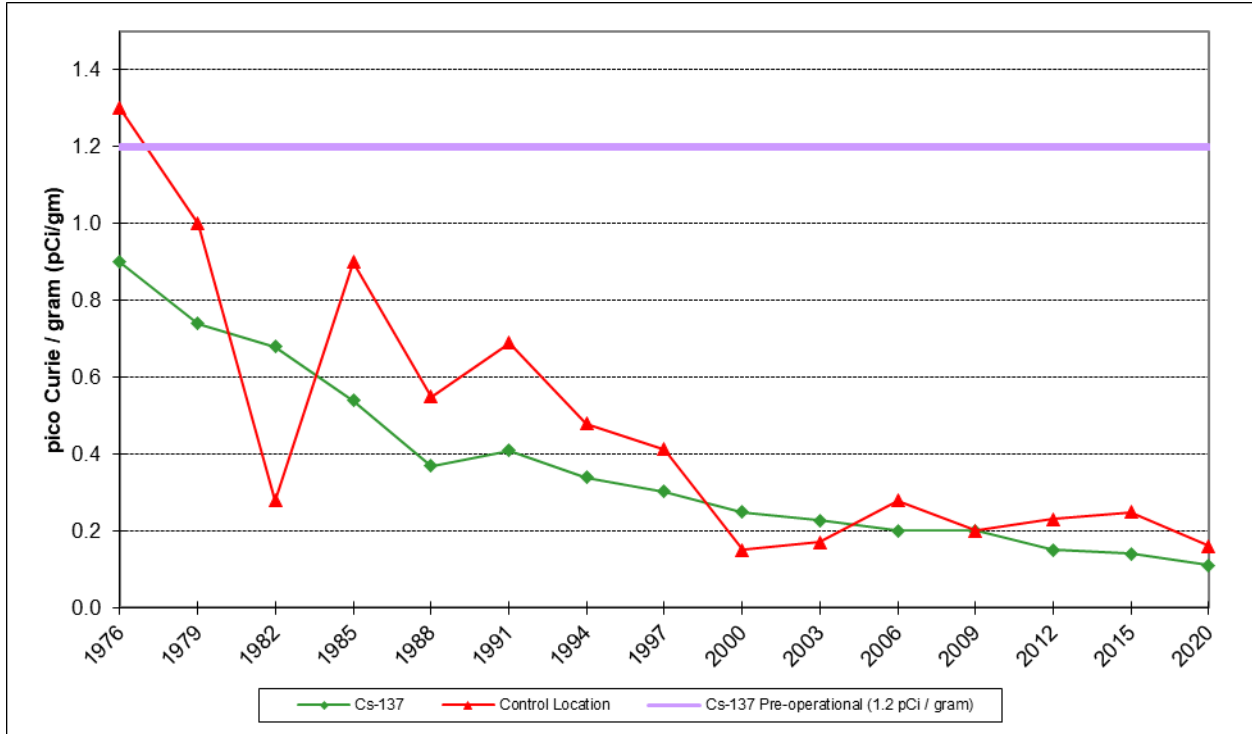
Graph of Annual Average Concentration: Cesium-137, Cobalt-58 & Cobalt-60 in Sediment



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Figure 2-12

Graph of Annual Average Concentration: Cesium-137 in Soil





## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

### F. 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 has been 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 2-13 and described below.

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**Table 2-4**

**Local Cow and Goat Locations**

<b>Site</b>	<b>Dairy</b>	<b>Approximate Number of Animals being Milked</b>	<b>Distance and Direction from Midpoint between Unit 1 and Unit 2 Reactor</b>	<b>Collection Period</b>
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	105 Cows	6.076 miles SE	January thru December
96	Windsheimer Dairy 20 Windsheimer Lane Burgettstown, PA	70 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	11 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 ( $\text{SrCO}_3$ ) from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an  $80 \text{ mg/cm}^2$  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 2-14.

- a. Strontium-89: Although not required by the ODCM, a total of fifty-five (55) milk samples were analyzed for strontium-89 during the report period. Strontium-89 was detected in none of the thirty-five (35) indicator samples.
- b. Strontium-90: Although not required by the ODCM, a total of fifty-five (55) milk samples were analyzed for strontium-90 during the report period. Strontium-90 was detected in two of thirty-five (2 of 35) indicator samples and fourteen of twenty (14 of 20) control samples. The levels detected were attributed to previous nuclear weapons tests and are within the expected range.

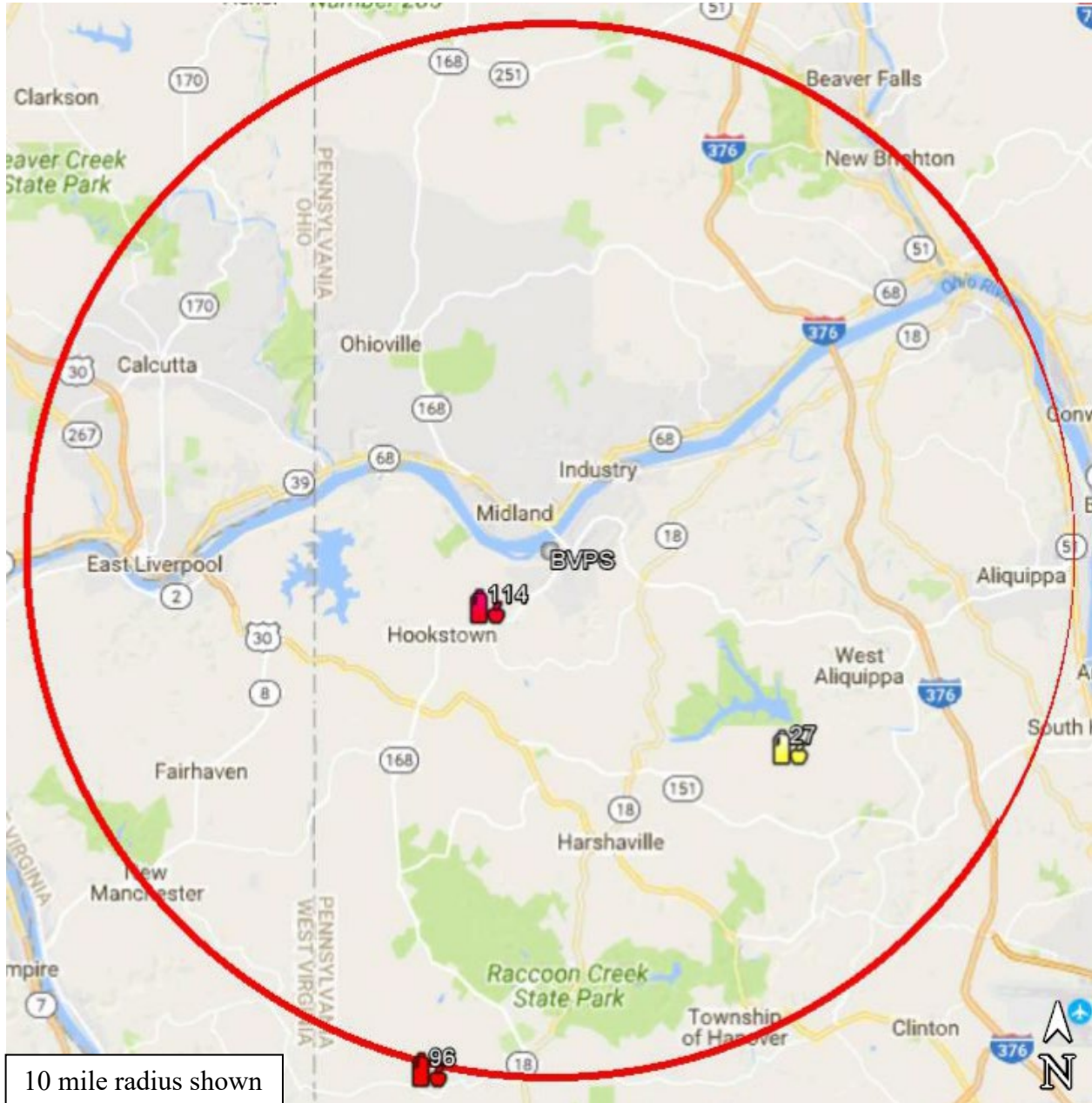
## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

- c. Gamma Spectrometry: A total of fifty-five (55) milk samples were analyzed by gamma spectrometry during the report period. Naturally occurring potassium-40 was present in thirty-five of thirty-five (35 of 35) indicator samples and twenty of twenty (20 of 20) control samples. No other gamma-emitting radionuclides were identified during analysis.
- d. Iodine-131: A total of fifty-five (55) milk samples were analyzed for iodine-131 during the report period. Iodine-131 was not detected in any of the thirty-five (35) indicator samples, nor was it detected in of the twenty (20) control samples.
- e. Deviations from Required Sampling and Analysis: There were no deviations from the required milk sampling and analysis schedule occurred for the reporting period.
- 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 2-13

Environmental Monitoring Locations – Milk

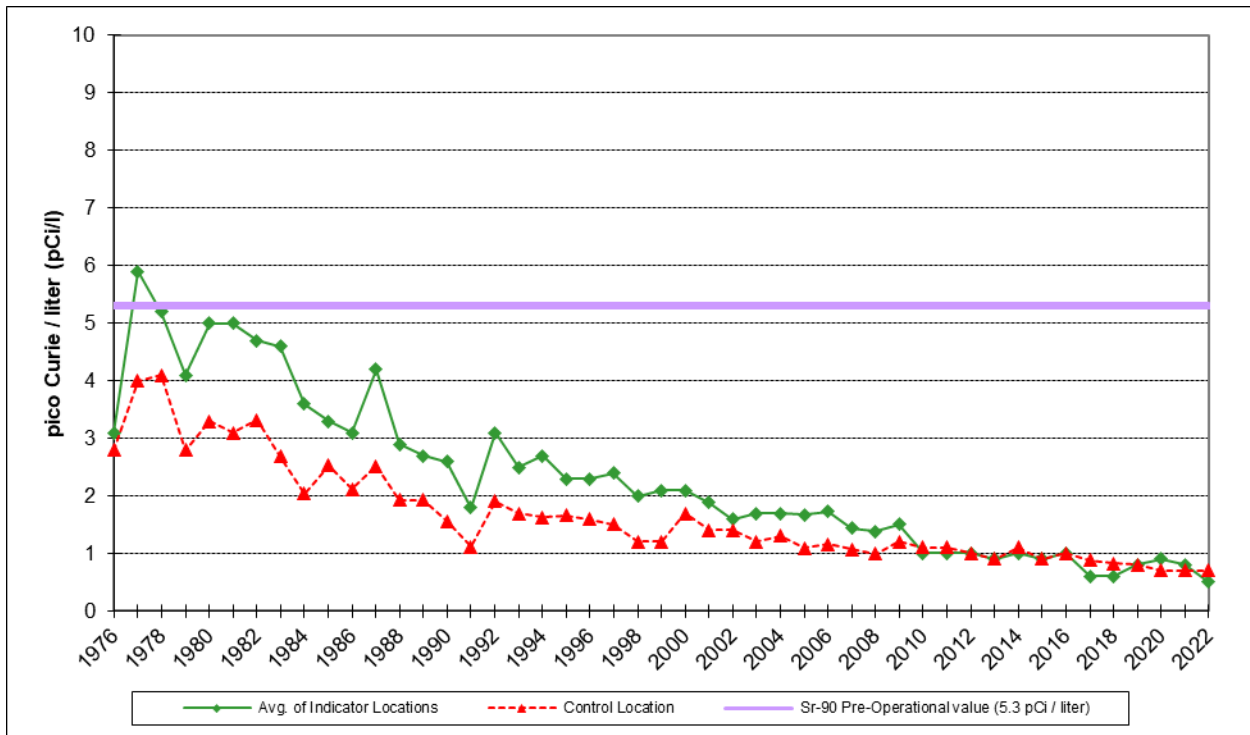
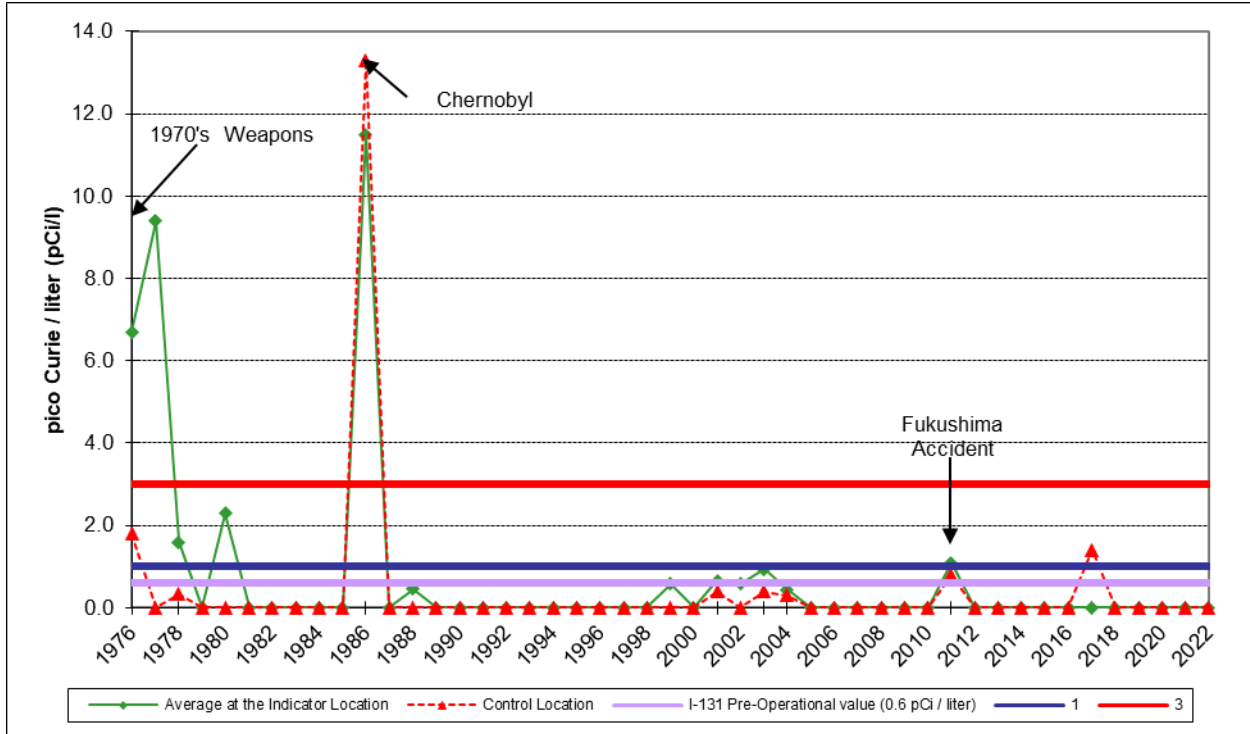


Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Milk	27	7-SE	6.1	Aliquippa, PA (Brunton Farm)
	96	10-SSW	10.4	Burgettstown, PA (Windsheimer Farm)
	114	11-SW	1.9	Hookstown, PA (Covert Residence)

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Figure 2-14

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



## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

### G. Monitoring of Fish

#### 1. Description

During the report period, fish species collected for the radiological monitoring program included channel catfish, brown catfish, and carp.

#### 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 2-15.

##### 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 2-16.

Gamma Spectrometry: A total of eight (8) fish samples were analyzed by gamma spectrometry during the report period. Gamma emitting radionuclides were not detected in any of the four (4) indicator samples, nor were they detected in any of the four (4) control samples.

Deviations from Required Sampling and Analysis Schedule: There were one (1) deviations from the required fish sampling and analysis schedule during the report period.

During the Fall fish sample collection, numerous attempts were made to acquire a proper sample from the Industry (Montgomery Dam, Site No. 49A, Sector 03, 4.93 miles NE) sample location. All attempts were unsuccessful, requiring the submission of an additional downstream fish sample.

**SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM**

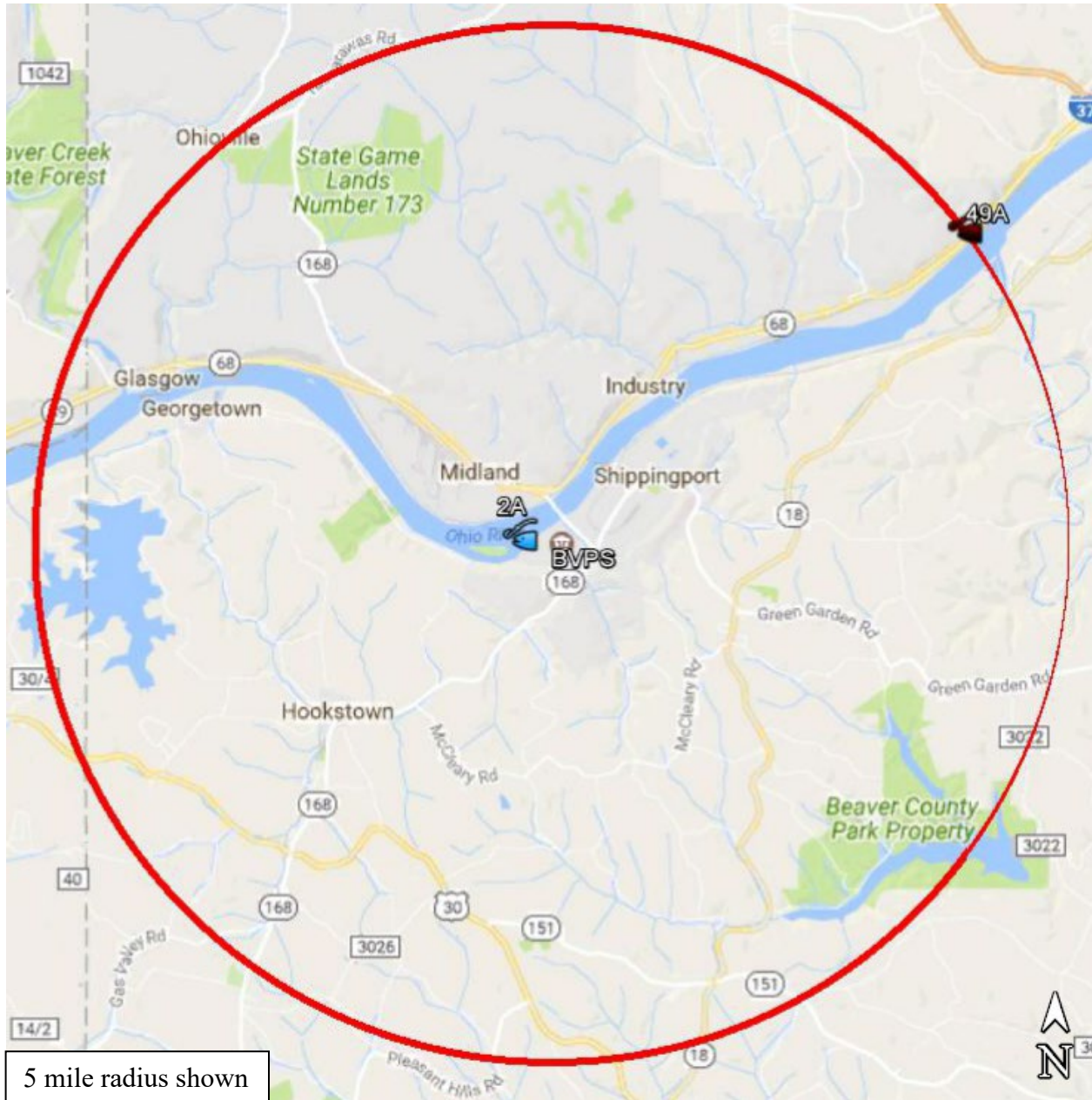
Summary: Based on the analytical results, the operation of BVPS did not contribute any measurable increase in radioactivity in the Ohio River fish population during the report period.



SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Figure 2-15

Environmental Monitoring Locations - Fish



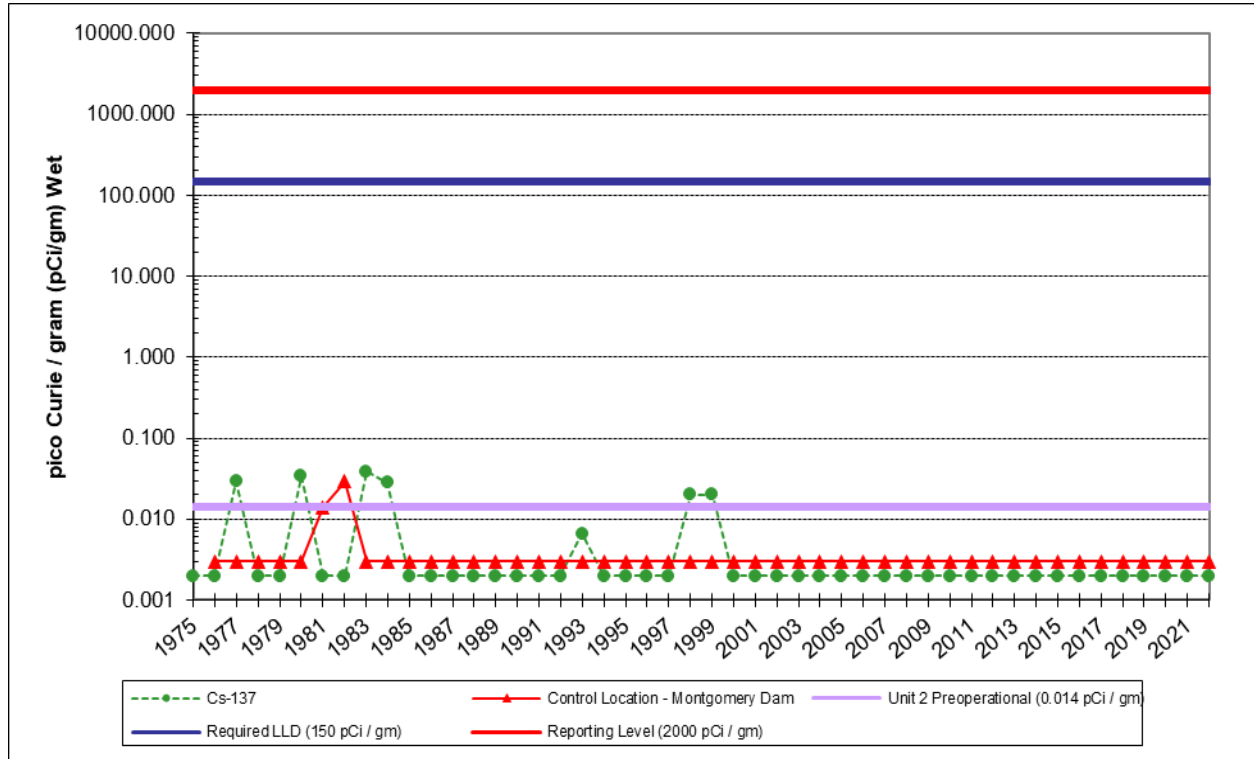
5 mile radius shown

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 2-16

Graph of Annual Average Concentration: Cesium-137 in Fish



## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

### H. Monitoring of Feedstuff and Foodcrops

#### 1. Characterization of Farm Products

According to the 2017 Census of Agriculture <sup>(1)</sup>, there were six hundred and thirteen (613) farms in Beaver County. Total market value of production was \$23,653,000.00 and of the total market value, \$14,486,000.00 from crops and \$9,167,000.00 from livestock. Some of the principal sources of revenue (>\$25,000.00) are as follows:

Milk and Other Dairy Products from Cows	\$5,597,000.00
Other Crops and Hay	\$4,849,000.00
Nursery, Greenhouse, Floriculture and Sod	\$4,127,000.00
Grains, Oil Seeds, Dry Beans and Dry Peas	\$2,799,000.00
Cattle and Calves	\$1,859,000.00
Vegetables, Melons, Potatoes and Sweet Potatoes	\$1,507,000.00
Cut Christmas Trees, and Short Rotation Woody Crops	\$739,000.00
Fruits, Tree Nuts and Berries	\$466,000.00
Sheep, Goats and their Products	\$95,000.00
Other Animals and Other Animal Products	\$86,000.00
Horses, Ponies, Mules, Burros, and Donkeys	\$61,000.00
Poultry and Eggs	Undisclosed Amount
Hogs & Pigs	Undisclosed Amount

(1) [https://www.nass.usda.gov/Publications/AgCensus/2017/Online\\_Resources/County\\_Profiles/Pennsylvania/index.php](https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Pennsylvania/index.php)

## 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 2-17.

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

## SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

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 2-18.

#### 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 seven of twelve (7 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 nine (9) 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 nine of nine (9 of 9) samples indicator samples and the one (1) control sample.

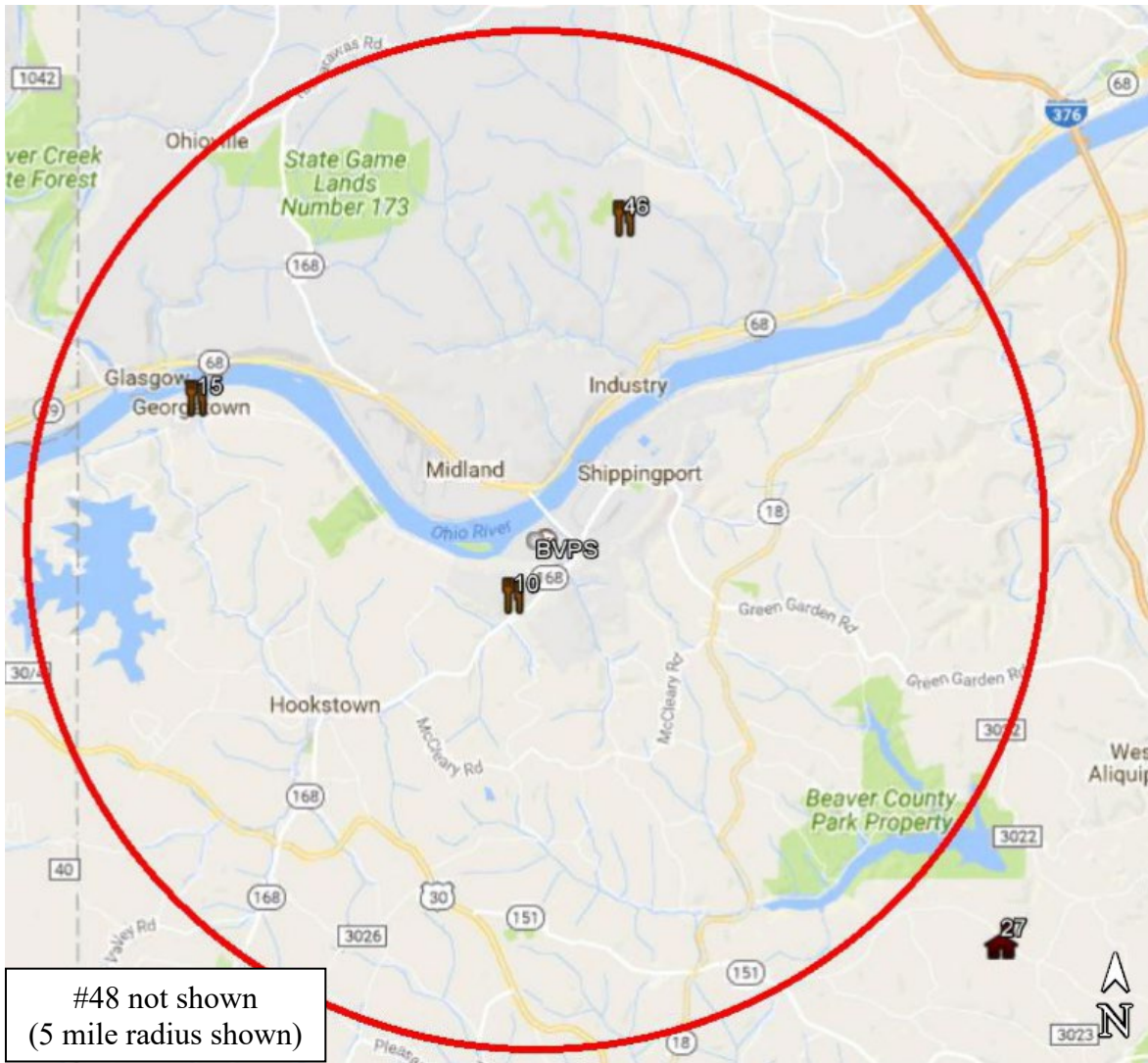
Deviations from Required Sampling and Analysis Schedule: There were no deviations from the required foodstuff sampling and analysis schedule during the report period.

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 2-17

Environmental Monitoring Locations – Feedstuff and Foodcrops



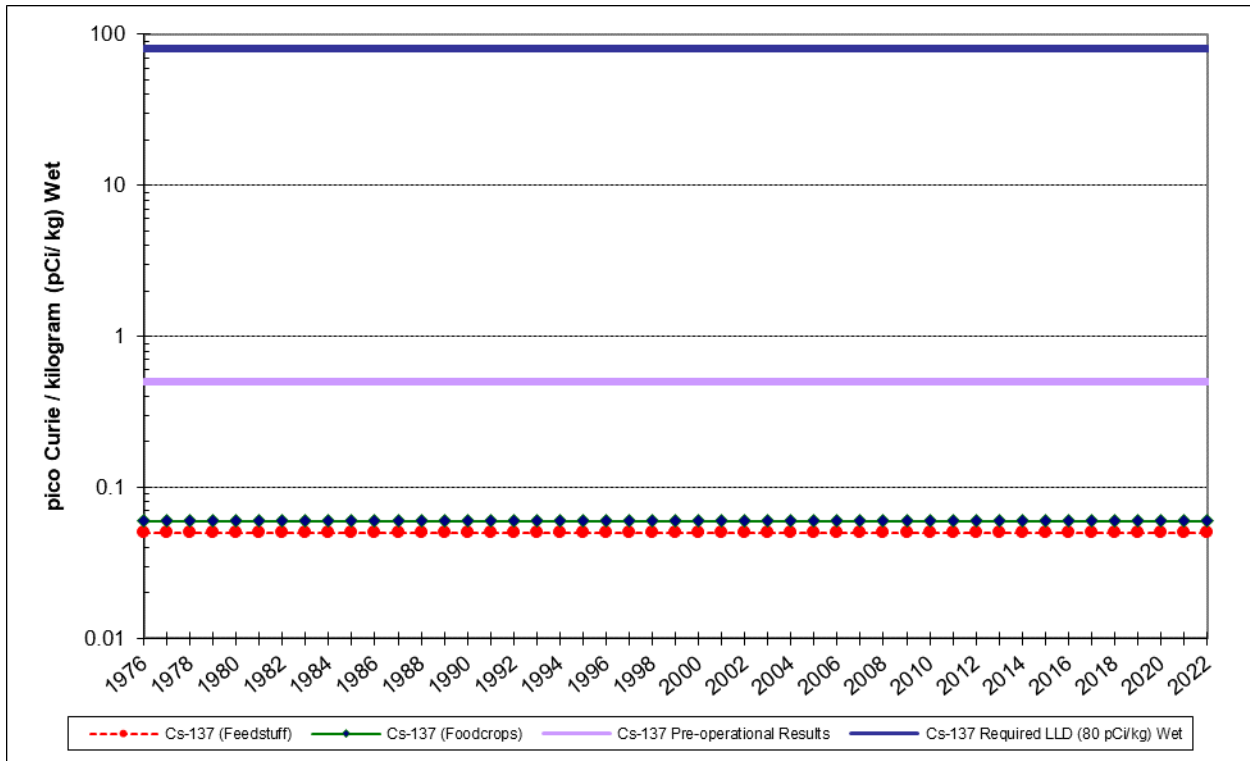
Sample Type	Site No.	Sector	Distance (miles)	Sample Point Description
Feed	27	7-SE	6.16	Aliquippa, PA (Brunton Farm)
Food	10*	*	*	Shippingport, PA
	15*	*	*	Georgetown, PA
	46*	*	*	Industry, PA
	48*	*	*	Weirton, WV
	*	*	*	2 locations based on highest predicted D/Q

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 2-18

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



## 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 software RADEAS which was implemented in 2019. The computer software follows Regulatory Guide 1.109 and site ODCM methodology. 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 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 dose assessment. 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 software. 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 doses to an individual were evaluated for all liquid and gaseous effluent pathways.

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

During the report period, the calculated dose to an individual member of the public from liquid effluent releases is presented in Table 2-5. Also shown in the Table 2-7 is a comparison to natural radiation exposure.



## **SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM**

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

During the report period, the calculated dose to an individual member of the public from airborne effluent releases. Also shown in the Table 2-7 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 2-5 and 2-6, the incremental increase in total body dose from the operation of BVPS - Unit 1 and 2, is 0.051% 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 Dose to Man  
Liquid Effluent Releases**

<b>Comparison of Individual Dose BVPS Liquid Effluent Releases Versus Natural and Medical Radiation Exposure</b>	
	<b>millirem</b>
<b>BVPS Liquid Effluent Release Dose to the Total Body</b>	<b>0.0419</b>
<b>United States Annual Average Radiation Exposure</b>	<b>620</b>

**Table 2-6: Calculated Dose to Man  
Gaseous Effluent Releases**

<b>Comparison of Individual Dose BVPS Gaseous Effluent Releases Versus Natural and Medical Radiation Exposure</b>	
	<b>millirem</b>
<b>BVPS Gaseous Effluent Release Dose</b>	<b>0.274</b>
<b>United States Annual Average Radiation Exposure</b>	<b>620</b>

SECTION 2 – ENVIRONMENTAL MONITORING PROGRAM

Table 2-7: Natural and Medical Radiation Exposures

<u>TYPICAL DOSE TO INDIVIDUALS</u>	
<u>FROM RADIATION EXPOSURE</u> <sup>(a)</sup>	
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
<b>Average Individual</b>	= <b>620 millirem / year</b>
<b>(Total from all sources shown above)</b>	
<sup>(a)</sup>	NCRP Report No. 160: Ionizing Radiation Exposure of the Population of the United States." <i>Journal of Radiological Protection J. Radiol. Prot.</i> 29.3 (2009)

## SECTION 3 – LAND USE CENSUS

A. **Land Use Census Overview:** A Land Use Census was conducted June 1 through August 31, 2022 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 results indicate that there were no changes in the nearest resident, milch cow, garden or doe goat. Therefore, no changes are required to be made in the current Radiological Environmental Monitoring Program (REMP). Table 3-1 summarizes the location of nearest residences, gardens, milch cows and doe goats. Changes in the methodology for determining meteorological dispersion (X/Q) and deposition (D/Q) resulted in recommended changes to the Offsite Dose Calculation Manual (ODCM) and to the X/Q and D/Q values used in the effluent tracking software. A comparison of the annual D/Q to ODCM default D/Q is provided in Table 3-2. The Land Use Census is summarized as follows:

B. **Nearest Residence:** The location has not changed since the previous census. The nearest inhabited residence is 209 Ferry Hill Road, Shippingport, PA (0.44 miles, east-northeast). The ODCM default D/Q values for the four release points remained conservative when compared to the new XOQDOQ output. However, several release points (CV 1/2, VV 1/2 and TV 1/2) had higher calculated X/Q values that were > 20% of the default ODCM.

C. **Nearest Garden >500 sq. ft:** The location has not changed since the previous census. The closest garden location remains the Colaber Residence, 1201 Virginia Avenue, Midland, PA (1.03 miles, northwest). ODCM default X/Q and D/Q values were compared to the XOQDOQ output X/Q and D/Q values in which the ODCM values remain conservative.

D. **Nearest Dairy Cow:** The location has not changed since the previous census. The location is not within a five-mile radius; however, the closest milking cow location is Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.076 miles, southeast). There are no changes in the default ODCM D/Q for the nearest dairy cow milked for ground and elevated releases; however, two of the ground level release points (VV-1/2 and TV-2) had increased X/Q values that were >20% of the default ODCM values.

E. **Nearest Doe Goat:** The location has not changed since the previous census. The location is at the Henderson (née Covert) Residence, 930 Pine Street (Route 168), Hookstown, PA (2.131 miles, southwest). The default ODCM X/Q values remained conservative. However,

### SECTION 3 – LAND USE CENSUS

two of the ground release points (VV-1/2 and TV-2) D/Q values were >20% of the default ODCM values.

- F. **Prevailing Winds:** The prevailing wind direction for ground releases was identified by showing the highest D/Q in the west sector. The prevailing wind direction for elevated releases was identified by showing the highest D/Q in the east-southeast sector. The REMP properly monitors the environment with air particulate sampling stations in some sectors and direct radiation TLDs in all sectors.
- G. **2022 Dairy Cow & Doe Goat Sampling Locations:** The dairy cow sampling locations will remain at Brunton Dairy, 3681 Ridge Road, Aliquippa, PA (6.076 miles, southeast), and Windsheimer Dairy, 20 Windsheimer Lane, Burgettstown, PA (10.475 miles, south-southwest). The doe goat sampling location will remain at the Henderson (née Covert) Residence, 930 Pine Street (Route 168), Hookstown, PA (2.131 miles, southwest).
- H. **D/Q for Milch Animal Locations:** None of the 2022 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” is not required.
- I. **X/Q and D/Q for Offsite Dose Determination:** A change in methodology from MIDAS to XOQDOQ for calculating meteorological dispersion (X/Q) and deposition (D/Q) values resulted in some significant differences (>20% change in a non-conservative direction) that will be addressed in the next ODCM revision. This is due to the fact that the X/Q and D/Q values reported in the ODCM were originally calculated using MIDAS and will need to be recalculated using XOQDOQ. This change in meteorology has no bearing on meeting the requirements of Control 3.12.2 Action “a” and/or Action “b”. Therefore, a Special Report per ODCM is not required.
- J. **X/Q and D/Q Comparison:** There is no adverse trend in D/Q when comparing 2009 to 2022 data to the ODCM default D/Q values. However, due to the change in calculation methodology explained above, several locations incorrectly had higher calculated X/Q values that were >20% of the ODCM default values.

**SECTION 3 – LAND USE CENSUS**

**Table 3-1**

**Location of Nearest Residences, Gardens, Milch 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	1.60	1.31	None	None
NNE	1.64	3.08	None	None
NE	0.47	2.39	None	None
ENE	0.44 <sup>b</sup>	1.05	None	None
E	1.20	2.26	None	3.41
ESE	0.85	1.24	None	None
SE	1.50	1.71	None <sup>a</sup>	None
SSE	2.11	3.08	None	None
S	1.37	1.48	None	None
SSW	0.76	2.11	None	None
SW	1.46	1.46	None	2.13
WSW	1.42	2.39	None	None
W	2.22	None	None	None
WNW	2.30	3.77	None	None
NW	0.892	1.03	None	None
NNW	0.910	2.39	2.44	None

<sup>a</sup> 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.

<sup>b</sup> Distance is the nearest location for that receptor.

**SECTION 3 – LAND USE CENSUS**

**Table 3-2**

**Comparison of Annual D/Q to ODCM Default D/Q**

Receptor	Sector	Mode	Release Point	ODCM		XOQDOQ		Percent Difference	
				X/Q	D/Q	X/Q	D/Q	X/Q	D/Q
Residence	ENE	Elevated	PV 1/2	5.25E-08	1.76E-09	1.5E-09	8.9E-10	-97%	-49%
		Ground	CV 1/2	4.20E-06	3.22E-08	6.1E-06	2.8E-08	45%	-13%
		Ground	VV 1/2	5.04E-06	3.22E-08	1.1E-05	2.0E-08	118%	-35%
		Ground	TV-2	4.63E-06	3.22E-08	9.8E-06	2.0E-08	112%	-38%
Garden	NW	Elevated	PV 1/2	7.40E-09	4.25E-10	4.0E-09	5.4E-10	-46%	27%
		Ground	CV 1/2	1.94E-05	1.50E-08	1.1E-06	4.2E-09	-94%	-72%
		Ground	VV 1/2	2.62E-05	1.50E-08	2.6E-06	7.5E-09	-90%	-50%
		Ground	TV-2	2.16E-05	1.49E-08	2.5E-06	7.5E-09	-88%	-50%
Dairy Cow	SE	Elevated	PV 1/2	1.23E-07	4.66E-10	8.1E-09	7.6E-11	-93%	-84%
		Ground	CV 1/2	9.94E-08	3.50E-10	5.2E-08	1.4E-10	-48%	-60%
		Ground	VV 1/2	1.03E-07	3.50E-10	3.6E-07	1.9E-10	250%	-46%
		Ground	TV-2	1.02E-07	3.51E-10	3.4E-07	1.9E-10	233%	-46%
Doe Goat	SW	Elevated	PV 1/2	2.56E-07	6.93E-10	6.6E-09	1.2E-10	-97%	-83%
		Ground	CV 1/2	9.05E-07	1.32E-09	8.7E-07	1.3E-09	-4%	-2%
		Ground	VV 1/2	9.98E-07	1.32E-09	7.5E-07	2.0E-09	-25%	52%
		Ground	TV-2	9.55E-07	1.32E-09	7.2E-07	2.0E-09	-25%	52%

**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 (2), 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, 11/14/19, 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.

<b>NRC Criteria</b>	
<b>Resolution</b>	<b>Ratio</b>
< 4	--
4 - 7	0.50 - 2.00
8 - 15	0.60 - 1.66
16 - 50	0.75 - 1.33
<b>51 - 200</b>	<b>0.80 - 1.25</b>
> 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(chemical) 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. A total of one hundred eight (108) analyses were performed in 2022. 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. A total of one hundred twelve (112) analyses were performed in which one hundred twelve (112) analyses met 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 – 1<sup>st</sup> Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
<b>03/10/22</b> <b>Water</b> Ind. Lab: E13681 Con. Lab: SPW-511	Sr-89	60	0.80 - 1.25	1.04	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.98	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	1.09	AGREEMENT
	I-131	60	0.80 - 1.25	1.09	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.95	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.02	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.00	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.04	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.03	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.04	AGREEMENT
	Co-60	60	0.80 - 1.25	1.00	AGREEMENT
<b>03/10/22</b> <b>Water</b> Ind. Lab: E13680 Con. Lab: SPW-509	H-3	60	0.80 - 1.25	1.03	AGREEMENT
<b>03/10/22</b> <b>Milk</b> Ind. Lab: E13682 Con. Lab: SPMI-513	Sr-89	60	0.80 - 1.25	0.96	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.90	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	1.07	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.93	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.99	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.91	AGREEMENT
	Cs-137	60	0.80 - 1.25	0.98	AGREEMENT
	Co-58	60	0.80 - 1.25	0.96	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.01	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.02	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.00	AGREEMENT
	Co-60	60	0.80 - 1.25	0.98	AGREEMENT
<b>03/10/22</b> <b>Filter Paper</b> Ind. Lab: E13683 Con. Lab: SPAP-516	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.08	AGREEMENT
<b>03/10/22</b> <b>Charcoal Cartridge</b> Ind. Lab: E13684 Con. Lab: SPCH-516	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 – 2<sup>nd</sup> Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
<b>06/16/22</b> <b>Water</b> Ind Lab: E13686 Con. Lab: SPW-1825	Sr-89	60	0.80 - 1.25	1.02	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.92	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	1.09	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	1.03	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.92	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	1.01	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	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT
<b>06/16/22</b> <b>Water</b> Ind. Lab: E13685 Con. Lab: SPW-1813	H-3	60	0.80 - 1.25	0.99	AGREEMENT
<b>06/16/22</b> <b>Milk</b> Ind. Lab: E13687 Con. Lab: SPMI-1815	Sr-89	60	0.80 - 1.25	0.91	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.98	AGREEMENT
	I-131 (CHM)	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	1.00	AGREEMENT
	Cr-51	60	0.80 - 1.25	0.99	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	0.99	AGREEMENT
	Co-58	60	0.80 - 1.25	0.99	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.03	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.04	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT

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

Table 4-3

Inter-Laboratory Comparison Program Spiked Samples – 3<sup>rd</sup> Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
<b>09/15/22</b> <b>Water</b> Ind. Lab: E13689 Con. Lab: SPW-3001	Sr-89	60	0.80 - 1.25	1.03	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.96	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	1.01	AGREEMENT
	I-131	60	0.80 - 1.25	1.08	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.95	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.04	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.92	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.03	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.06	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	1.01	AGREEMENT
<b>09/15/22</b> <b>Water</b> Ind. Lab: E13688 Con. Lab: SPW-2995	H-3	60	0.80 - 1.25	0.98	AGREEMENT
<b>09/15/22</b> <b>Milk</b> Ind. Lab: E13690 Con. Lab: SPMI-2997	Sr-89	60	0.80 - 1.25	0.94	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.05	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	1.03	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.99	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.04	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.92	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	0.99	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.02	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.04	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.02	AGREEMENT
	Co-60	60	0.80 - 1.25	0.98	AGREEMENT
<b>09/15/22</b> <b>Filter Paper</b> Ind. Lab: E13691B Con. Lab: SPAP-3732	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.02	AGREEMENT
<b>09/15/22</b> <b>Charcoal Cartridge</b> Ind. Lab: E13692 Con. Lab: SPCH-3733	I-131	60	0.80 - 1.25	0.92	AGREEMENT

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

Table 4-4

Inter-Laboratory Comparison Program Spiked Samples – 4<sup>th</sup> Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
<b>12/01/22</b> <b>Water</b> Ind Lab: E13694 Con. Lab: SPW-3951	Sr-89	60	0.80 - 1.25	0.96	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.94	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	0.93	AGREEMENT
	I-131	60	0.80 - 1.25	1.05	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	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.06	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.10	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	1.02	AGREEMENT
<b>12/01/22</b> <b>Water</b> Ind. Lab: E13693 Con. Lab: SPW-3955	H-3	60	0.80 - 1.25	1.01	AGREEMENT
<b>12/01/22</b> <b>Milk</b> Ind. Lab: E13695 Con. Lab: SPMI-3953	Sr-89	60	0.80 - 1.25	0.92	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.89	AGREEMENT
	I-131 (CHM)	60	0.80 - 1.25	0.91	AGREEMENT
	I-131	60	0.80 - 1.25	1.07	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.01	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.05	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.90	AGREEMENT
	Cs-137	60	0.80 - 1.25	0.99	AGREEMENT
	Co-58	60	0.80 - 1.25	1.03	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.05	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.07	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.07	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	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 be addressed for the previous report.

Enclosure B  
L-23-115

*2022 Annual Environmental Operating Report (Non-Radiological)*  
(Report follows)



**ENERGY HARBOR NUCLEAR CORPORATION  
BEAVER VALLEY POWER STATION**



**2022**

**ANNUAL ENVIRONMENTAL OPERATING REPORT**

**NON-RADIOLOGICAL**

**UNIT NOs. 1 AND 2**

**LICENSES DPR-66 AND NPF-73**

T5.1.1 BEAVER VALLEY POWER STATION

## ENVIRONMENTAL & CHEMISTRY SECTION

### Technical Report Approval

2022 ANNUAL ENVIRONMENTAL OPERATING REPORT

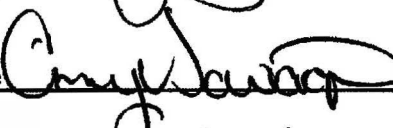
(Non-Radiological)

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

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## 1.0 EXECUTIVE SUMMARY

### 1.1 INTRODUCTION

This report is submitted in accordance with Section 5.4.1 of **Appendix B: To Facility Operating License No. NPF-73, Beaver Valley Power Station Unit 2, Environmental Protection Plan (Non-Radiological)**. Beaver Valley Power Station (BVPS) is operated by Energy Harbor, formerly FirstEnergy Nuclear Operating Company (FENOC). The Objectives of the Environmental Protection Plan (EPP) are to:

- Verify that the facility is operated in an environmentally acceptable manner, as established by the Final Environmental Statement-Operating License Stage (FES-OL) and other Nuclear Regulatory Commission (NRC) environmental impact assessments,
- Keep plant operations personnel appraised of changes in environmental conditions that may affect the facility,
- Coordinate NRC requirements and maintain consistency with other Federal, State, and local requirements for environmental protection, and
- Keep the NRC informed of the environmental effects of facility construction and operation and of actions taken to control those effects.

To achieve the objectives of the Environmental Protection Plan (EPP), both Energy Harbor and BVPS have written programs and procedures to comply with the EPP, protect the environment, and comply with governmental requirements primarily including the US Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP) requirements. Water quality matters identified in the Final Environmental Statements-Operating License Stage (FES-OL) are regulated under the National Pollutants Discharge Elimination System (NPDES) Permit No. PA0025615. Waste is regulated under EPA Identification No. PAR000040485. Attachment 10.1 contains a listing of permits and certificates for environmental compliance.

The BVPS programs and procedures include pre-work and pre-project environmental evaluations, operating procedures, pollution prevention and response programs procedures and plans, process improvement and corrective action programs, and human performance programs. Technical and managerial monitoring of tasks, operations, and other activities are performed. Any identified challenges, concerns, or questions are captured in the Energy Harbor Corrective Action Program with a Condition Report. Condition Reports are reviewed and closed through investigations, cause determinations, and corrective actions.

During 2022 BVPS continued an Aquatic Monitoring Program to provide information on potential impacts to BVPS operation from macrofoulers such as Asian clams (*Corbicula*) and zebra mussels (*Dreissena* spp.).

## 1.2 SUMMARY & CONCLUSIONS

There was a significant environmental event at Unit 1 cooling tower basin as described in Section 2.0. Due to this event, a different treatment strategy was employed to the circulating water system. The treatment to the circulating water in the cooling tower changed to treating with only sodium hypochlorite, instead of a sodium bromide/sodium hypochlorite mixture. The acceptance criteria for treatments also increased the limits of Free Available Halogen. Due to this change, there were no significant changes to operations that affect the environment at Beaver Valley Power Station in 2022.

## 1.3 ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

During 2022 no significant changes were made at Beaver Valley Power Station to cause any significant negative impacts on the environment.

## 1.4 AQUATIC MONITORING PROGRAM EXECUTIVE SUMMARY

The 2022 Beaver Valley Power Station (BVPS) Units 1 and 2 Non-Radiological Monitoring Program consisted of an Aquatic Program that included surveillance and field sampling of the Ohio River's aquatic life in the vicinity of the station. Historically, the Aquatic Program was an annual program conducted to provide baseline aquatic resources data, to assess the impact of the operation of BVPS on the aquatic ecosystem of the Ohio River, and to monitor for potential impacts of biofouling organisms (*Corbicula* and zebra mussels) on BVPS operations. This is the 47<sup>th</sup> year of operational environmental monitoring for Unit 1 and the 36<sup>th</sup> year for Unit 2. In 2022, similar to the previous five years, no fish or benthic macroinvertebrate sampling occurred, however, the zebra mussel and *Corbicula* monitoring programs were continued.

The monthly reservoir ponar samples collected at the Unit 1 and 2 cooling towers and the three samples collected in the Ohio River at the intake during 2022 indicated that *Corbicula* were present in the Ohio River and entering the station. In 2022, 24 settled live and 15 dead *Corbicula* were collected from the Unit 1 cooling tower reservoir during monthly ponar sampling. Also in 2022, six (6) live and seven (7) dead settled *Corbicula* were collected from the Unit 2 cooling tower reservoir. Further, nine (9) live *Corbicula* were collected from the Ohio River at the intake during three sampling events in 2022. Juvenile *Corbicula* were also collected in pump samples collected in 2022. ***The overall low numbers of live Corbicula collected in the samples taken outside the intake and cooling towers in 2022 compared to levels in the 1980's, likely reflects a natural decrease in the density of Corbicula in the Ohio River near BVPS. However, the continued presence of Corbicula adults and juveniles in and near BVPS indicates that they could still impact the facility if the current control program is not continued. Continued monitoring of Corbicula densities is also recommended to determine whether changes in the Corbicula populations that could impact facility operations are occurring.***

In 1995, live macrofouling zebra mussels were collected for the first time by divers in the BVPS main intake and auxiliary intake structures during scheduled cleanings. Zebra Mussels have been found at BVPS every year since. Overall, both the number of observations and densities of settled mussels in 2022 were consistent to those recorded in 2008-2021, and much higher than the prior five years. Although densities of settled mussels are lower than other populations such as the Lower Great Lakes, densities present in the Ohio River are more than sufficient to cause problems in the operation of untreated cooling water intake systems. ***Whether the population of zebra mussels in this reach of***

*the Ohio River will remain the same or increase cannot be determined. In any case, the densities of mussels that presently exist are more than sufficient to impact the BVPS if continued prudent monitoring and control activities are not conducted.*

## **2.0 ENVIRONMENTAL PROTECTION PLAN NON-COMPLIANCES**

During a Sodium Hypochlorite chemical addition to the Unit 1 cooling tower basin on June 21, 2022, Sodium Hypochlorite inadvertently back-fed into the Unit 1 Sodium Bromine tank. The back feed was caused by a valve misalignment and through the force of gravity, the Sodium Hypochlorite was introduced into the Sodium Bromide Tank. This led to an overflow of the Sodium Bromide tank and an exothermic reaction between these two chemicals resulting in a release of gas and liquid through the upper tank vent which reached the Ohio River via a storm drain resulting in a reportable event. This event was reported to the state of Pennsylvania DEP, Beaver County EMA, the National Response Center and the Nuclear Regulatory Commission.

## **3.0 CHANGES INVOLVING UN-REVIEWED ENVIRONMENTAL QUESTIONS**

No Un-reviewed Environmental Questions were identified in 2022. Therefore, there were no changes involving an Un-reviewed Environmental Questions.

## **4.0 NON-ROUTINE ENVIRONMENTAL REPORTS**

On July 1, 2022, Energy Harbor Nuclear Corp. was issued a renewal of their Hazardous Materials Certificate of Registration For Registration Years 2022-2025 Registration No: 051922550116EG

## **5.0 AQUATIC MONITORING PROGRAM**

This section of the report summarizes the Non-Radiological Environmental Program conducted for the BVPS Units 1 and 2; Operating License Numbers DPR-66 and NPF-73. This is a non-mandatory program, because on February 26, 1980, the NRC granted BVPS's request to delete all of the Aquatic Monitoring Program, with the exception of the fish impingement program (Amendment No. 25), from the Environmental Technical Specifications (ETS). In 1983, BVPS was permitted to also delete the fish impingement studies from the ETS program of required sampling along with non-radiological water quality requirements. In 2017, BVPS elected to not conduct the fish and benthic macroinvertebrate tasks related to this program. The zebra mussel and *Corbicula* monitoring tasks were maintained and conducted as in previous years.

The objectives of the 2022 environmental program were:

- To evaluate the presence, growth, and reproduction of macrofouling *Corbicula* (Asiatic clam) and zebra mussels (*Dreissena* spp.) at BVPS.
- To keep plant operations apprised of any of changes in environmental conditions that may affect the facility.

These objectives have assisted facility personnel in the past. For instance, in the facility's Significant Operating Experience Report (SOER 07-2, October 2008) relative to "Intake Cooling Water Blockage" this Aquatic Monitoring Program was credited as a means of addressing "Changing Environmental Conditions" by looking "for changes in quantity of clam and mussel activity by



monitoring the veliger (commonly known as larvae) density in the river and mussel settlement density.”

## 5.1 SITE DESCRIPTION

BVPS is located on an approximately 453-acre tract of land on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania. The Shippingport Atomic Power Station once shared the site with BVPS, before being decommissioned. Figure 5.1 is a plan view of BVPS. The site is approximately 1 mile (1.6 km) from Midland, Pennsylvania; 5 miles (8 km) from East Liverpool, Ohio; and 25 miles (40 km) from Pittsburgh, Pennsylvania. The population within a 5-mile (8 km) radius of the plant is approximately 15,000. The Borough of Midland, Pennsylvania has a population of approximately 2,433 as determined from the 2020 Census.

The station is situated at Ohio River Mile 34.8 (Latitude: 40° 36' 18"; Longitude: 80° 26' 02") at a location on the New Cumberland Pool that is 3.1 river miles (5.3 km) downstream from Montgomery Lock and Dam and 19.6 miles (31.2 km) upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is 5.2 river miles (8.4 km) 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.

The study site lies along the Ohio River in a valley that has a gradual slope that extends from the river at an elevation of 665 ft. (203 m) above mean sea level; to an elevation of 1,160 ft. (354 m) along a ridge south of BVPS. The plant entrance elevation at the station is approximately 735 ft. (224 m) above mean sea level.

BVPS Units 1 and 2 have a thermal rating of 2,900 megawatts (MW). Units 1 and 2 have a design electrical rating of 994 MW and 1,009 MW, respectively. The circulating water systems for each unit are considered a closed cycle system with continuous overflow, using a cooling tower to minimize heat released to the Ohio River. Commercial operation of BVPS Unit 1 began in 1976 and Unit 2 began operation in 1987.

## 5.2 METHODS

Civil & Environmental Consultants, Incorporated (CEC Inc.) was contracted to perform the 2022 Aquatic Monitoring Program as specified in BVBP-ENV-001-Aquatic Monitoring (procedural guide). This procedural guide references and describes in detail the field and laboratory procedures used in the various monitoring programs, as well as the data analysis and reporting requirements. These procedures are summarized according to task in the following subsections. Sampling was conducted according to the schedule presented in Table 5.1.

### 5.2.1 *Corbicula* Density Determinations for Cooling Tower Reservoirs

The *Corbicula* Monitoring Program at BVPS includes sampling the circulating river water and the service water systems of the BVPS (intake structure and cooling towers). The objectives of the ongoing Monitoring Program were to evaluate the presence of *Corbicula* at BVPS and to evaluate the potential for and timing of infestation of the BVPS. This program was conducted in conjunction with a program to monitor for the presence of macrofouling zebra mussels (see Section 5.2.3).

*Corbicula* enter the BVPS from the Ohio River by passing through the water intakes, and eventually settling in low flow areas including the lower reservoirs of the Units 1 and 2 cooling towers. *Corbicula* residing in the cooling water system can also produce young that will settle in the system. The density and growth of these *Corbicula* were monitored by collecting monthly samples from the lower reservoir sidewalls and sediments. The sampler used on the sidewalls consisted of a D-frame net attached behind a 24-inch long metal scraping edge. This device was connected to a pole long enough to allow the sampler to extend down into the reservoir area from the outside wall of the cooling tower. Sediments were sampled with a petite Ponar dredge. All equipment was tied off prior to sampling to prevent equipment from accidentally falling into the reservoirs.

Cooling tower reservoir sampling was historically conducted once per month. Beginning in December 1997, it was decided to forego sampling in cold water months, since buildup and growth of *Corbicula* does not occur then. Monthly sampling has been maintained throughout the warmer water months of the year. In 2022, sampling was completed as scheduled, beginning in April and ending in October.

In 2022, once each month (April through October), a single petite Ponar grab sample was scheduled to be taken in the reservoir of each cooling tower to obtain density and growth information on *Corbicula* present in the bottom sediment. In June, equipment issues precluded petite Ponar sampling. All other scheduled sampling was successfully completed.

The samples collected from each cooling tower were returned to the laboratory and processed. Samples were individually washed, and any *Corbicula* removed and rinsed through a series of stacked U.S. Standard sieves that ranged in mesh size from 1.00 mm to 9.49 mm. Live and dead clams retained in each sieve were counted and the numbers were recorded. The size distribution data obtained using the sieves reflected clam width, rather than length. Samples containing a small number of *Corbicula* were not sieved; individuals were measured and placed in their respective size categories. A scraping sample of about 12 square feet was also collected at each cooling tower during each monthly sampling effort. This sample was processed in a manner consistent with the petite ponar samples.

### **5.2.2 *Corbicula* Juvenile Monitoring**

The *Corbicula* juvenile study was designed to collect data on *Corbicula* spawning activities and growth of individuals entering the intake from the Ohio River. From 1988 through 1998, clam cages were deployed in the intake forebay to monitor for *Corbicula* that entered the BVPS.

During the 1998 sampling season, at the request of BVPS personnel, all clam cages were removed after the May collection. Monthly petite ponar grabs from the forebay in the intake building continued thereafter. Samples were processed in the same manner as Cooling Tower samples (Section 5.2.1).

From 2002 to present, because of site access restrictions, sampling with the petite ponar has been moved to the Ohio River directly in front of the Intake Structure Building. Collections are presently scheduled to be made in May, July, and September. During each sampling month, two ponar grabs were taken just offshore of the intake building. These grab samples were processed in the same manner as when they were collected during monthly sampling.

### 5.2.3 Zebra Mussel Monitoring

The Zebra Mussel Monitoring Program includes sampling the Ohio River and the circulating river water system of the BVPS.

The objectives of the Monitoring Program are:

- (1) To identify if zebra mussels were in the Ohio River adjacent to BVPS and provide early warning to operations personnel as to their possible infestation;
- (2) To provide data as to when the larvae were mobile in the Ohio River and insights as to their vulnerability to potential treatments; and
- (3) To provide data on their overall density and growth rates under different water temperatures and provide estimates on the time it requires these mussels to reach the size and density that could impact the plant.

The zebra mussel sampling for settled adults was historically conducted once per month throughout the year. Beginning in December 1997, it was decided to forego sampling in the colder water months of each year, since buildup of zebra mussels and growth of the individuals that were present, does not occur. Monthly sampling has been maintained throughout the balance of the year. In 2022 sampling occurred from April through October.

A pump sample for zebra mussel veligers was collected at the barge slip location monthly from April through October in 1996 and 1997. The scope of the sampling was expanded in 1998 to also include the Ohio River near the intake structure. In June 1998, the Emergency Outfall and the Emergency Outfall Impact Basin (impact basin) locations were also added. Additional pump samples were collected from the cooling towers of Unit 1 and Unit 2 in October 1998. In 2022, veliger sampling began in April and was conducted monthly through October.

At the Intake Structure and Barge Slip the following surveillance techniques were used:

- Wall scraper sample collections on a monthly basis from the barge slip and the riprap near the intake structure to detect attached adults; and
- Pump sample collections from the barge slip and outside the intake structure, to detect the planktonic early life forms.

At each of the cooling towers the following techniques were used:

- Monthly reservoir scraper sample collections in each cooling tower; and
- Monthly pump samples to detect planktonic life forms.

At the Emergency Outfall and the impact basin the following techniques were used:

- Monthly scraper sample collections in each; and
- Monthly pump samples in each to detect planktonic life forms.

## 5.2.4 Reports

Each month when sampling was performed, activity reports summarizing the activities that took place the previous month were prepared and submitted. These reports included the results of the monthly *Corbicula* and zebra mussel monitoring including any trends observed and any preliminary results available. The reports addressed progress made on each task and reported any observed biological activity of interest.

## 5.3 AQUATIC MONITORING PROGRAM RESULTS

The following sections summarize the findings for each of the program elements. Sampling dates for each of the program elements are presented in Table 5.1.

### 5.3.1 *Corbicula* Monitoring Program

In 2022, no petite Ponar sampling was conducted at the cooling tower reservoirs in June due to an equipment issue. All other sampling was successfully conducted as scheduled.

In 2022, 24 settled live *Corbicula* were collected from the Unit 1 cooling tower reservoir during monthly ponar sampling (Table 5.2 and Figure 5.2). One (1) individual was collected in April, and one (1) in July. Both were greater than 4.75 mm. Twelve (12) settled live *Corbicula* were collected in August and ranged from 4.75 mm to greater than 9.5 mm, which indicated that they were a mix of individuals that settled earlier in 2022 as well as during prior years. Five (5) live *Corbicula* were collected in September and five (5) additional live *Corbicula* were collected in October and also were a mix of individuals that likely settled earlier in 2022 and in prior years. Ten (15) dead *Corbicula* were also collected in 2022 in the Unit 1 cooling tower reservoir and were likely killed during scheduled molluscicide treatments. The seasonal average density of settled live *Corbicula* was 172/m<sup>2</sup>, which was higher than 2021 (43/m<sup>2</sup>), 2020 (37/m<sup>2</sup>), and 2019 (60/m<sup>2</sup>). *Corbicula* juveniles were also collected in monthly pump samples collected in the Unit 1 cooling tower reservoir in June and July, which indicates that *Corbicula* are continuing to be available for settlement in the cooling tower reservoir. No *Corbicula* were collected in the scraping samples, which the scraping sampling device generally does not collect *Corbicula*, and focusses on monitoring for zebra mussels.

In 2022, six (6) live settled *Corbicula* were collected from the Unit 2 cooling tower reservoir (Table 5.3 and Figure 5.3). Live mussels were collected in April, May, August and September. They ranged in size from 3.35 mm to greater than 9.5 mm, which indicated that some likely settled in 2022 while others settled in prior years. Seven (7) dead *Corbicula* were also collected during 2022. The dead *Corbicula* were probably killed by scheduled molluscicide treatments. The seasonal average density of settled live *Corbicula* was 43/m<sup>2</sup>, which was much lower than in 2021 (208/m<sup>2</sup>) and 2020 (104/m<sup>2</sup>). *Corbicula* juveniles were collected in monthly pump samples collected in the Unit 2 cooling tower reservoir in June and July. The density of *Corbicula* juveniles collected in June was relatively high (98/m<sup>3</sup>). No *Corbicula* were collected in the scraping samples.

*Corbicula* juveniles were collected at non-cooling tower locations during monthly pump sampling from May through October 2022. In June, *Corbicula* juveniles were collected at all locations except the intake. Densities of *Corbicula* juveniles reached 138 individuals/m<sup>3</sup> in the June emergency outfall

sample. This indicates that there is a significant reproducing population of *Corbicula* in the vicinity of the BVPS that could impact plant operations if steps are not taken to control them.

In 2022, BVPS continued its *Corbicula* control program that included the use of a molluscicide to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the PADEP to use a molluscicide to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 and 1995, the applications targeted the internal water systems; therefore, the molluscicide concentrations in the cooling towers were reduced during applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the applications. Reservoir sediment samples taken after molluscicide applications represent mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

The monthly reservoir sediment samples and pump samples collected in Units 1 and 2 Cooling Towers in 2022 and in recent years demonstrated that *Corbicula* were entering and colonizing the reservoirs. An average density of 143 live settled *Corbicula*/m<sup>2</sup> was collected in the Unit 1 cooling tower and 43/m<sup>2</sup> in the Unit 2 cooling tower in 2022. A density of 516 live *Corbicula*/m<sup>2</sup> collected in the Unit 1 cooling tower reservoir in August is likely a high enough density to cause operational impacts if the clams were not controlled and instead were allowed to mature, grow and reproduce. *Corbicula* juveniles were also in the cooling tower pump samples as well as at all other pump sampling locations, which indicates that they still are available for establishment in the cooling towers. The decrease of *Corbicula* at the BVPS returns densities to levels more consistent with densities in the Ohio River in the mid-1990's, but well below those present during the 1980's. Whether the relatively low density of *Corbicula* in 2022 is indicative of permanent lower levels in the environment or due to natural variability is uncertain, however, and continued monitoring of *Corbicula* densities is recommended.

### 5.3.2 *Corbicula* Juvenile Monitoring

Figure 5.4 presents the abundance and size distribution data for samples collected in the Ohio River near the intake structure by petite ponar dredge in 2022. Nine (9) live *Corbicula* were collected in 2022; one more live individual than in 2021 and two more than in 2020. In 2022, they ranged in size from the 4.75 mm to greater than 9.5 mm and were likely spawned in 2022 or 2021. Live individuals were collected during each of the three sampling events. A spring/early-summer spawning period typically occurs in the Ohio River near BVPS each year when preferred spawning temperatures are reached (60-65° F) (Figure 5.5). The offspring from this spawning event generally begin appearing in the sample collections in July. The settled clams then generally increase in size throughout the late summer and fall. The number of individuals collected per sampling event in 2022 were comparable 2021 and 2020 but was less than in 2019 and 2018. This is most likely due to normal variability in the population in the Ohio River. In any case, the densities of *Corbicula* continue to be low relative what was present in the 1980's.

The overall low numbers of live *Corbicula* collected in the samples taken outside the intake in 2022, compared to levels in the 1980's, likely reflects a natural decrease in the density of *Corbicula* in the Ohio River near BVPS, although the continued presence of *Corbicula* adults and juveniles near BVPS indicates that they could impact the facility if the current control program is not continued. Continued

monitoring of *Corbicula* densities is also recommended to determine whether changes in the *Corbicula* populations that could impact facility operations are occurring.

### 5.3.3 Zebra Mussel Monitoring Program

Zebra mussels (*Dreissena polymorpha* and the closely related species *Dreissena bugensis*) are exotic freshwater mollusks that have ventrally flattened shells, which are generally marked with alternating dark and lighter bands. They are believed to have been introduced into North America through the ballast water of ocean-going cargo vessels probably from Eastern Europe. They were first identified in Lake St. Clair in 1988 and rapidly spread to other Great Lakes and the Mississippi River drainage system, and have become abundant in the lower, middle, and upper Ohio River. They use strong adhesive byssal threads, collectively referred to as their byssus, to attach themselves to any hard surfaces (e.g. intake pipes, cooling water intake systems, and other mussels). Responding to NRC Notice No. 89-76 (Biofouling Agent-Zebra Mussel, November 21, 1989), BVPS instituted a Zebra Mussel Monitoring Program in January 1990. Studies have been conducted each year since then.

Spawning begins as water temperature reach approximately 57° F and peaks at water temperatures of 74° F. The veliger form is a small, planktonic early life stage form of the zebra mussel that remains in the water column for approximately two weeks prior to settling and transforming into the adult. Veliger densities usually peak about two weeks after the optimum water temperature for spawning is reached. Veliger densities then fall off as veligers mature and settle, although female mussels continue to broadcast mature eggs throughout the season. River water temperature in April was below 55° F, which is below the low end of the spawning range (Figure 5.5). River water temperature in July reached nearly 80° F, which is in the preferred spawning temperature and was still above 60° F in October.

Zebra mussels were detected in both the pump samples (Figures 5.6 and 5.7) and the substrate samples (Figure 5.8 and 5.9) in 2022. Veligers were collected at all of the six sites that were sampled in 2022. Zebra mussel veligers were collected in pump samples from May through October. No veligers were collected in the April samples.

Veligers were present at all sampled locations from June through September. In May they were collected at all locations except in the samples collected at Unit 1 and Unit 2 cooling tower reservoirs. In October they were collected (in low densities) only at the Unit 1 cooling tower reservoir and the barge slip. By sampling location, the highest annual densities in zebra mussel veligers occurred in June at all locations except at the intake where the highest densities were collected in July. Throughout the year, the majority of the veligers were D-form, which were very recently spawned and not able to settle. The percentage of mussels capable of settling generally increased throughout the sampling season.

The greatest density of veligers in any sample collected in 2022 was present in the sample collected at the intake in July (35,800/m<sup>3</sup>). This was much greater than the highest veliger density found in 2021 (8,367/m<sup>3</sup>), and more consistent with the highest densities in 2020 (20,520/m<sup>3</sup>), 2019 (48,500/m<sup>3</sup>), and 2018 (28,750/m<sup>3</sup>). Overall, the density of mussels were sufficient to contribute to significant settlement and potential fouling of BVPS systems.

As in past years, in 2022 settled zebra mussels were frequently collected in scrape samples taken at the barge slip (Figures 5.8 and 5.9), however, unlike previous years, no mussels were collected at the

intake. In 2022 they were not collected at any other location. The highest density of settled mussels in any sample collected was at the barge slip (16.59 mussels/m<sup>2</sup>) in the August sample. The mussels collected at the barge slip included individuals that were capable of reproducing as well as mussels settled during 2022. Overall, both the number of observations and densities of settled mussels in 2022 were consistent to those recorded in 2008-2021, and much higher than the prior five years.

Although densities of settled mussels are low compared to other populations such as the Lower Great Lakes, densities comparable to those in the Ohio River are sufficient to cause problems in the operation of untreated cooling water intake systems.

Whether the population of zebra mussels in this reach of the Ohio River will remain the same or increase cannot be determined. In any case, the densities of mussels that presently exist are more than sufficient to impact BVPS if continued prudent monitoring and control activities are not conducted.

## **6.0 ZEBRA MUSSEL AND *CORBICULA* CONTROL ACTIVITIES**

In 2022, BVPS continued its *Corbicula* and zebra mussel control program (34<sup>th</sup> year), which includes the use of a molluscicide to prevent the proliferation of *Corbicula* and zebra mussels within BVPS. BVPS was granted permission by the PADEP to use a molluscicide to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications (CT-1) focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 through 2006, the CT-1 or CT-2 (reformulated CT-1) applications targeted zebra mussels and *Corbicula* in the internal water systems; therefore, the molluscicide concentrations in the cooling towers were reduced during CT-1 or CT-2 applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the applications. Reservoir sediment samples taken after CT-1 or CT-2 applications represented mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems. In 2007 BVPS began using Nalco H150M as the molluscicide. This product, which has the same active ingredients as the CT-1 and CT-2, was applied in the same manner.

In addition to clamicide treatments, preventive measures were taken that included spring and fall cleanings of the Intake Bays. The bay cleanings are intended to minimize the accumulation and growth of mussels within the bays. This practice prevents creating an uncontrolled internal colonization habitat.

## 7.0 REFERENCES

- Counts, C. C. III, 1985. Distribution of *Corbicula fluminea* at Nuclear Facilities. Division of Engineering, U.S. Nuclear Regulatory Commission. NUREGLCR. 4233. 79 pp.
- FENOC, 2003. 2002 Annual Environmental Operating Report, Non-radiological. First Energy Nuclear Operating Company, Beaver Valley Power Station, Unit No. 1 & 2. 113 pp.
- FENOC, 2004. 2003 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2005. 2004 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2006. 2005 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2007. 2006 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2008. 2007 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2009. 2008 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2010. 2009 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2011. 2010 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2012. 2011 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2013. 2012 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2014. 2013 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.
- FENOC, 2015. 2014 Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 83 pp.
- FENOC, 2016. 2015 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 83 pp.
- FENOC, 2017. 2016 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 83 pp.



FENOC, 2018. 2017 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 26 pp.

FENOC, 2019. 2018 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 26 pp.

Energy Harbor, 2020. 2019 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 26 pp.

Energy Harbor, 2021. 2020 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 26 pp.

Energy Harbor, 2022. 2021 Annual Environmental Operating Report Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 26 pp.

NRC, IE Bulletin 81-03: Flow Blockage of Cooling Tower to Safety System Components by *Corbicula* sp. (Asiatic Clam) and *Mytilus* sp. (Mussel).

## 8.0 TABLES

TABLE 5.1

BEAVER VALLEY POWER STATION (BVPS)  
SAMPLING DATES FOR 2022

Study	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Macroinvertebrate*												
Fish*												
<i>Corbicula</i> and Zebra Mussel				28	26	23	21	25	15	5		
Zebra Mussel Veliger				28	26	23	21	25	15	5		

\* Not scheduled in 2022

TABLE 5.2

UNIT 1 COOLING RESERVOIR MONTHLY SAMPLING  
CORBICULA DENSITY DATA FOR  
2022 FROM BVPS

Collection Date	Area Sampled (sq ft)	Live or Dead	Count	Maximum Length Range (mm)	Minimum Length Range(mm)	Estimated Number (per sq m)
4/28/2022	0.25	Dead	1	4.75-6.29	4.75-6.29	43
		Live	1	6.30-9.49	6.30-9.49	43
5/26/2022	0.25	Dead	0	---	---	0
		Live	0	---	---	0
6/23/2022*	0.25	Dead	---	---	---	---
		Live	---	---	---	---
7/21/2022	0.25	Dead	0	---	---	0
		Live	1	>9.5	>9.5	43
8/25/2022	0.25	Dead	5	>9.5	4.75-6.29	215
		Live	12	>9.5	4.75-6.29	516
9/15/2022	0.25	Dead	6	6.30-9.49	4.75-6.29	258
		Live	5	>9.5	4.75-6.29	215
10/5/2022	0.25	Dead	3	4.75-6.29	6.30-9.49	129
		Live	5	>9.5	3.35-4.74	215
<b>Unit summary</b>		<b>Dead</b>	<b>15</b>	<b>&gt;9.5</b>	<b>4.75-6.29</b>	<b>108</b>
		<b>Live</b>	<b>24</b>	<b>&gt;9.5</b>	<b>3.35-4.74</b>	<b>172</b>

\*Not Sampled due to Equipment Issues

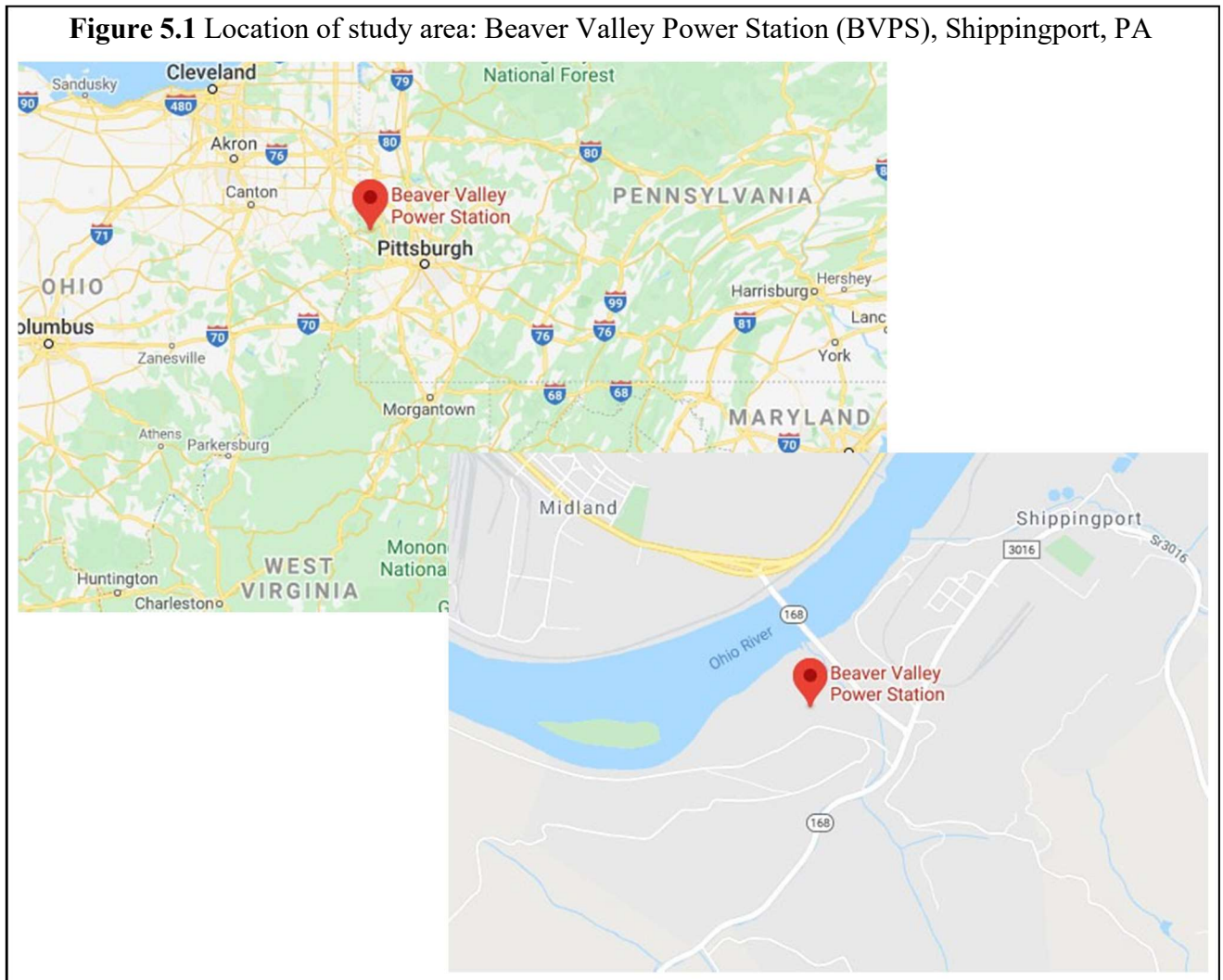
**TABLE 5.3**

**UNIT 2 COOLING RESERVOIR MONTHLY SAMPLING  
CORBICULA DENSITY DATA FOR  
2022 FROM BVPS**

<b>Collection Date</b>	<b>Area Sampled (sq ft)</b>	<b>Live or Dead</b>	<b>Count</b>	<b>Maximum Length Range (mm)</b>	<b>Minimum Length Range(mm)</b>	<b>Estimated Number (per sq m)</b>
4/28/2022	0.25	Dead	0	---	---	0
		Live	1	>9.5	>9.5	43
5/26/2022	0.25	Dead	3	4.75-6.29	3.35-4.74	129
		Live	1	3.35-4.74	3.35-4.74	43
6/23/2022*	0.25	Dead	---	---	---	---
		Live	---	---	---	---
7/21/2022	0.25	Dead	0	---	---	0
		Live	0	---	---	0
8/25/2022	0.25	Dead	0	---	---	0
		Live	2	>9.5	4.75-6.29	86
9/15/2022	0.25	Dead	3	4.75-6.29	3.35-4.74	129
		Live	2	6.30-9.49	4.75-6.29	86
10/5/2022	0.25	Dead	1	6.30-9.49	6.30-9.49	43
		Live	0	---	---	0
<b>Unit summary</b>		<b>Dead</b>	<b>7</b>	<b>6.30-9.49</b>	<b>3.35-4.74</b>	<b>50</b>
		<b>Live</b>	<b>6</b>	<b>&gt;9.50</b>	<b>3.35-4.74</b>	<b>43</b>

\*Not Sampled due to Equipment Issues

## 9.0 FIGURES



**Comparison of live *Corbicula* clam density estimates among 2022  
BVPS Unit 1 cooling tower reservoir events, for various clam shell groups.**

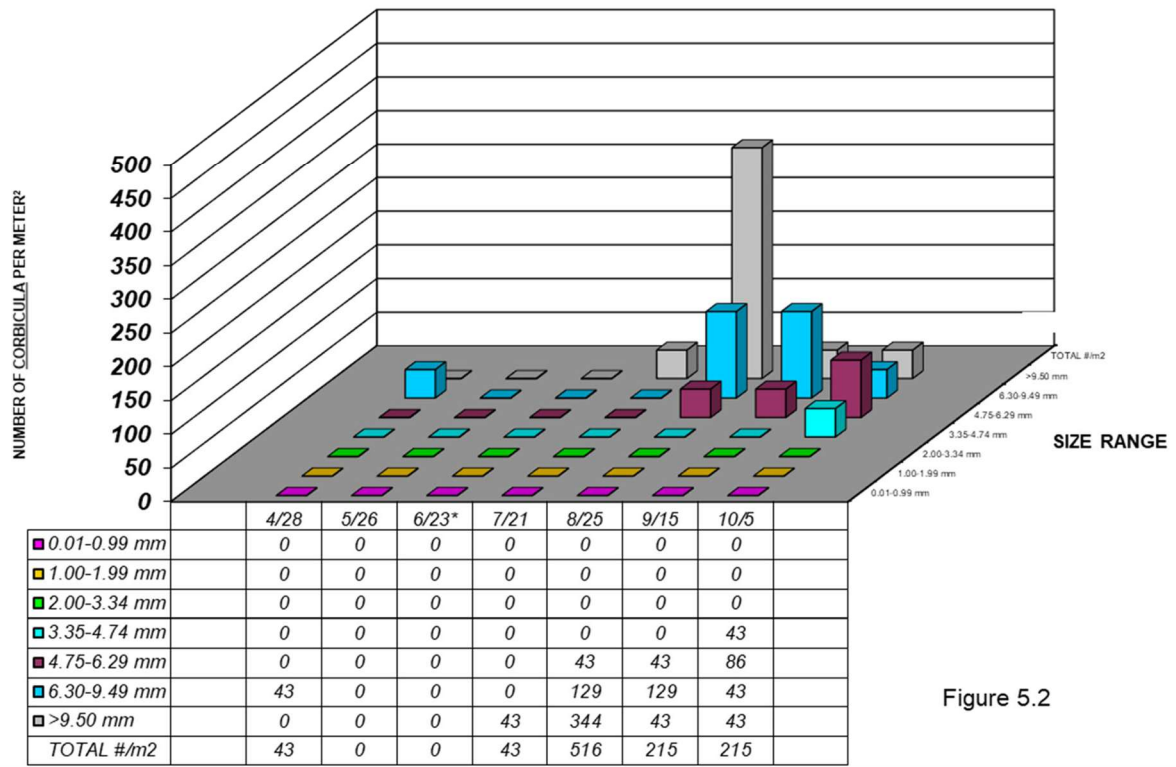


Figure 5.2

\*Not Sampled in June due to Equipment Issues

Comparison of live Corbicula clam density estimates among 2022 BVPS Unit 2 cooling tower reservoir events, for various clam shell groups.

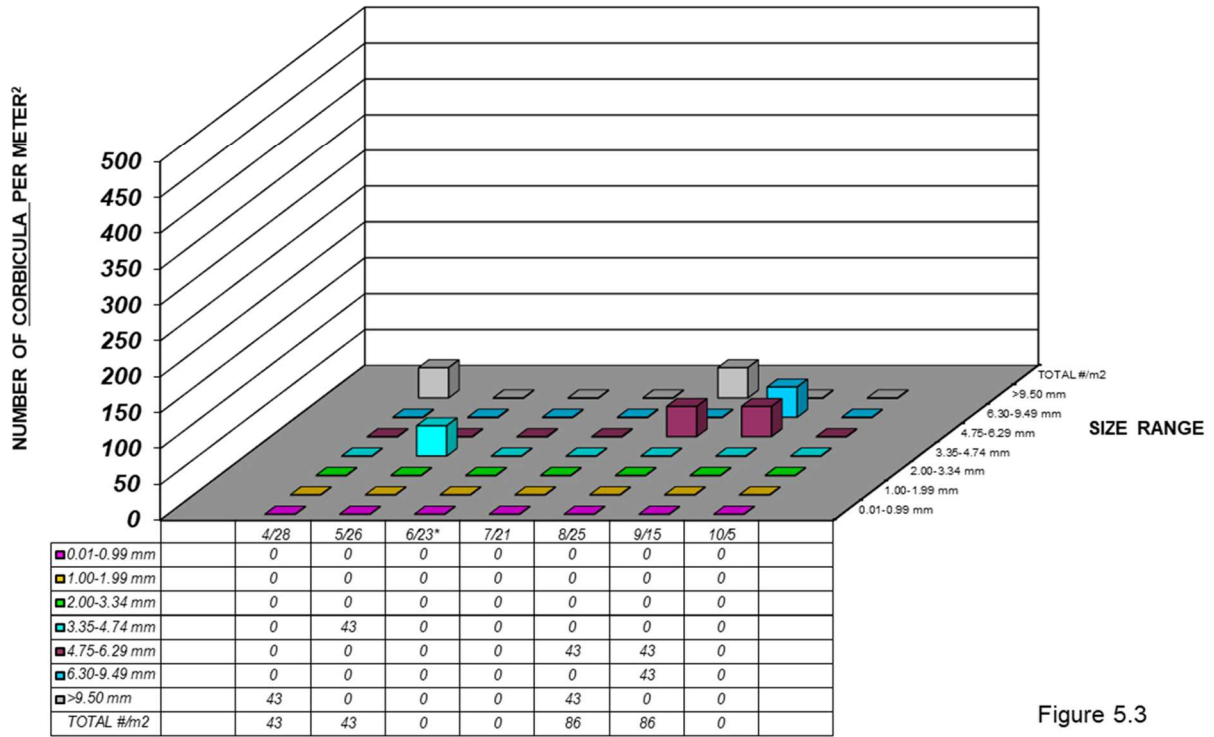


Figure 5.3

\*Not Sampled in June due to Equipment Issues

Comparison of live *Corbicula* clam density estimates among 2022 BVPS Intake Structure sample events, for various clam shell groups.

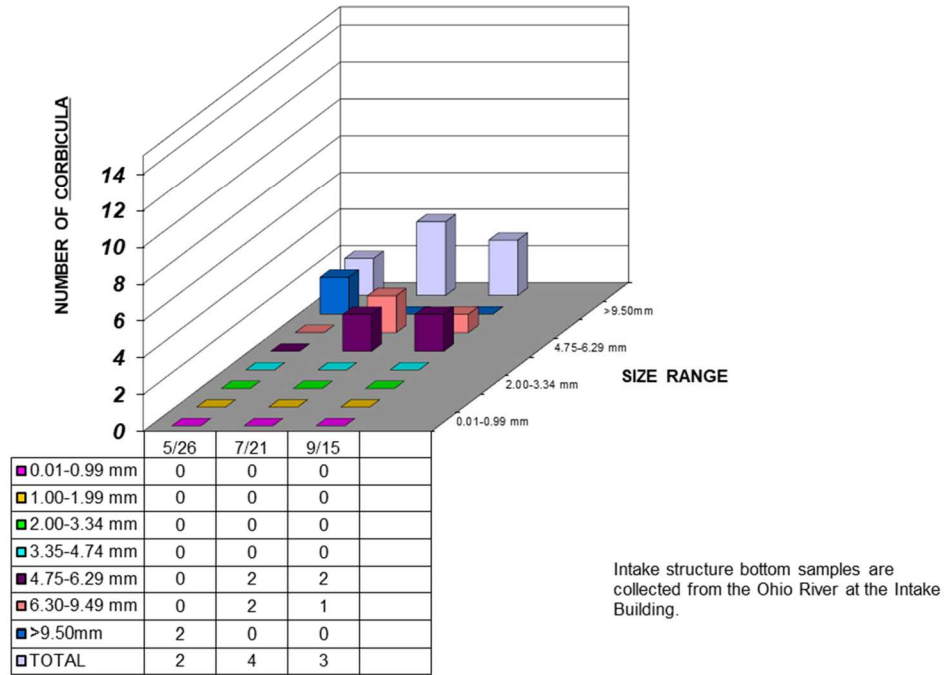


Figure 5.4

**Water Temperature and River Elevation Recorded at the Ohio River at BVPS Intake Structure During 2022 on Monthly Sample Dates.**

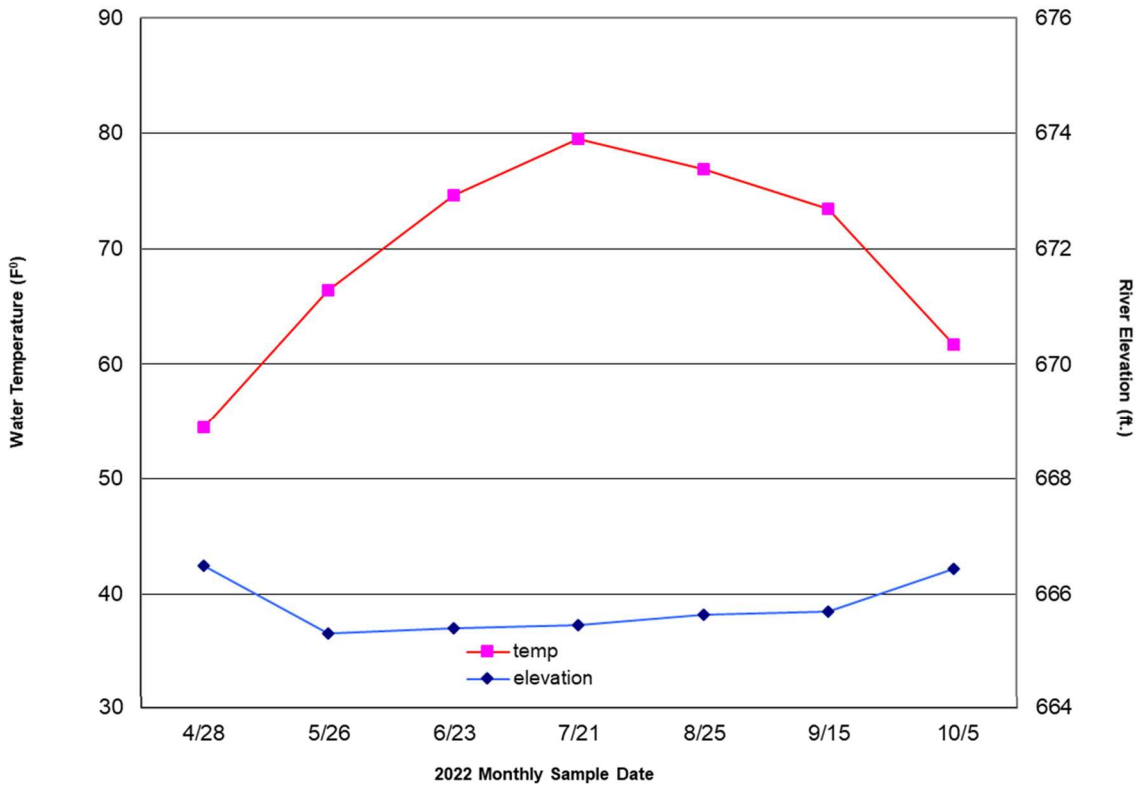
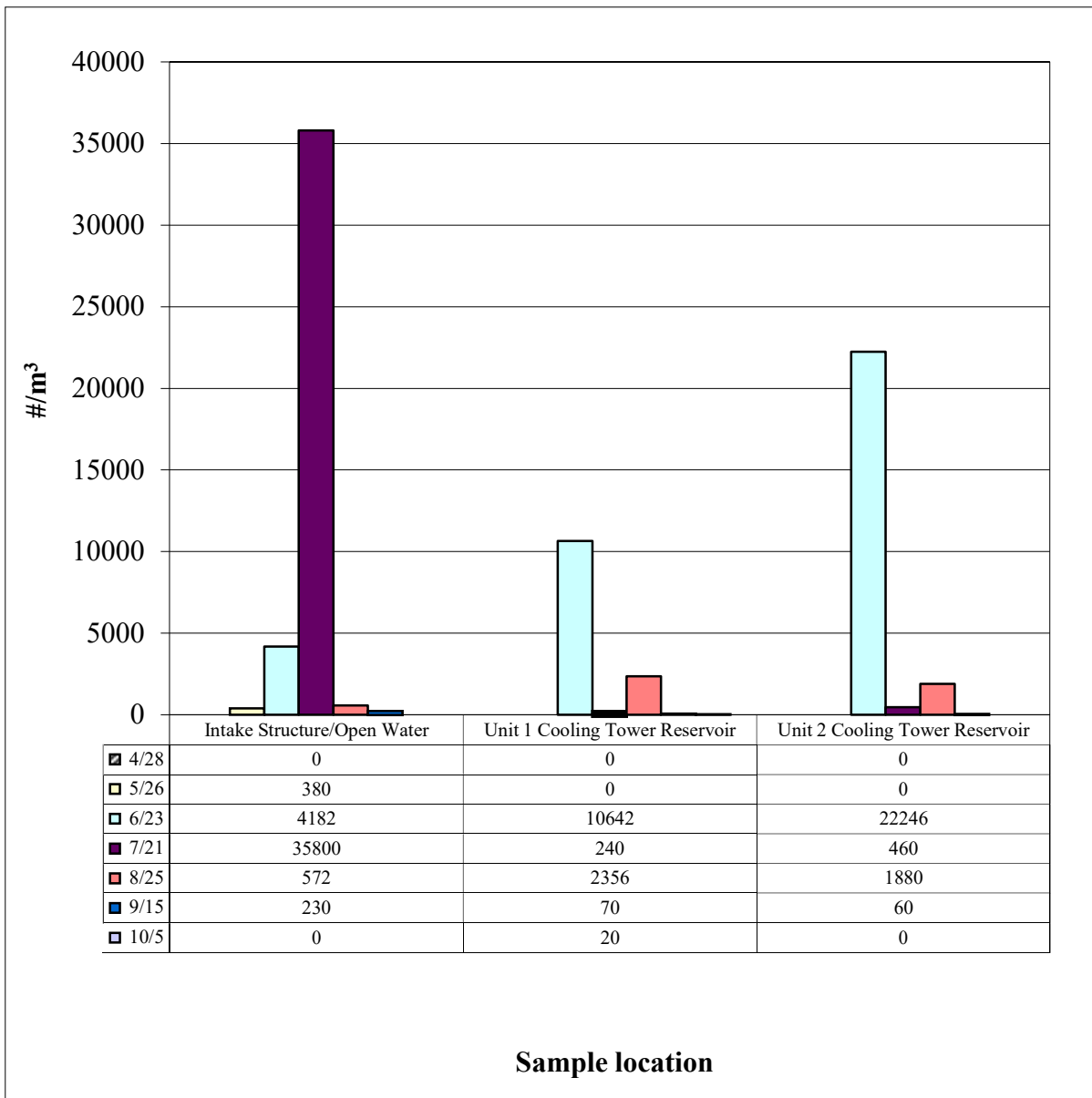
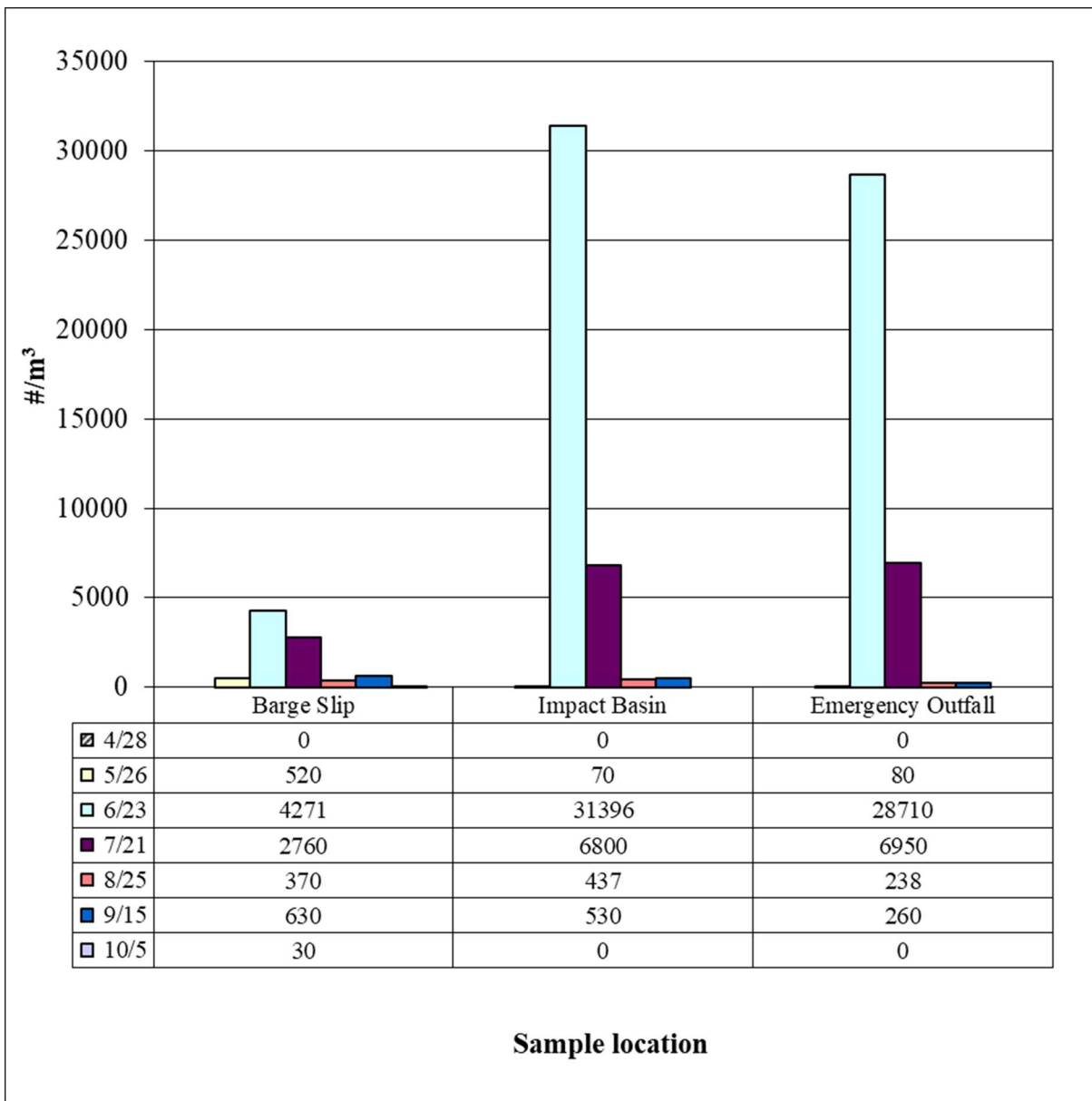


Figure 5.5

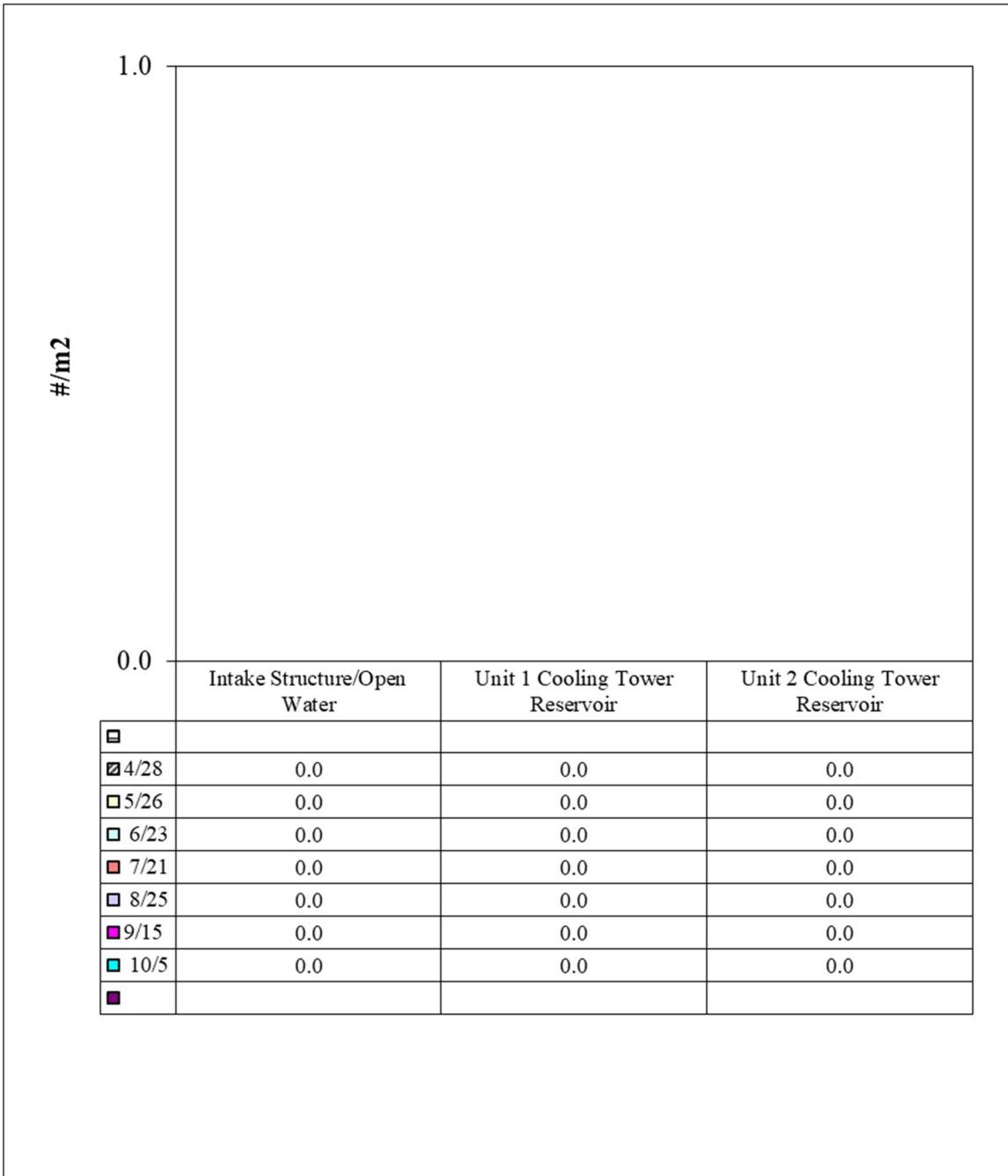




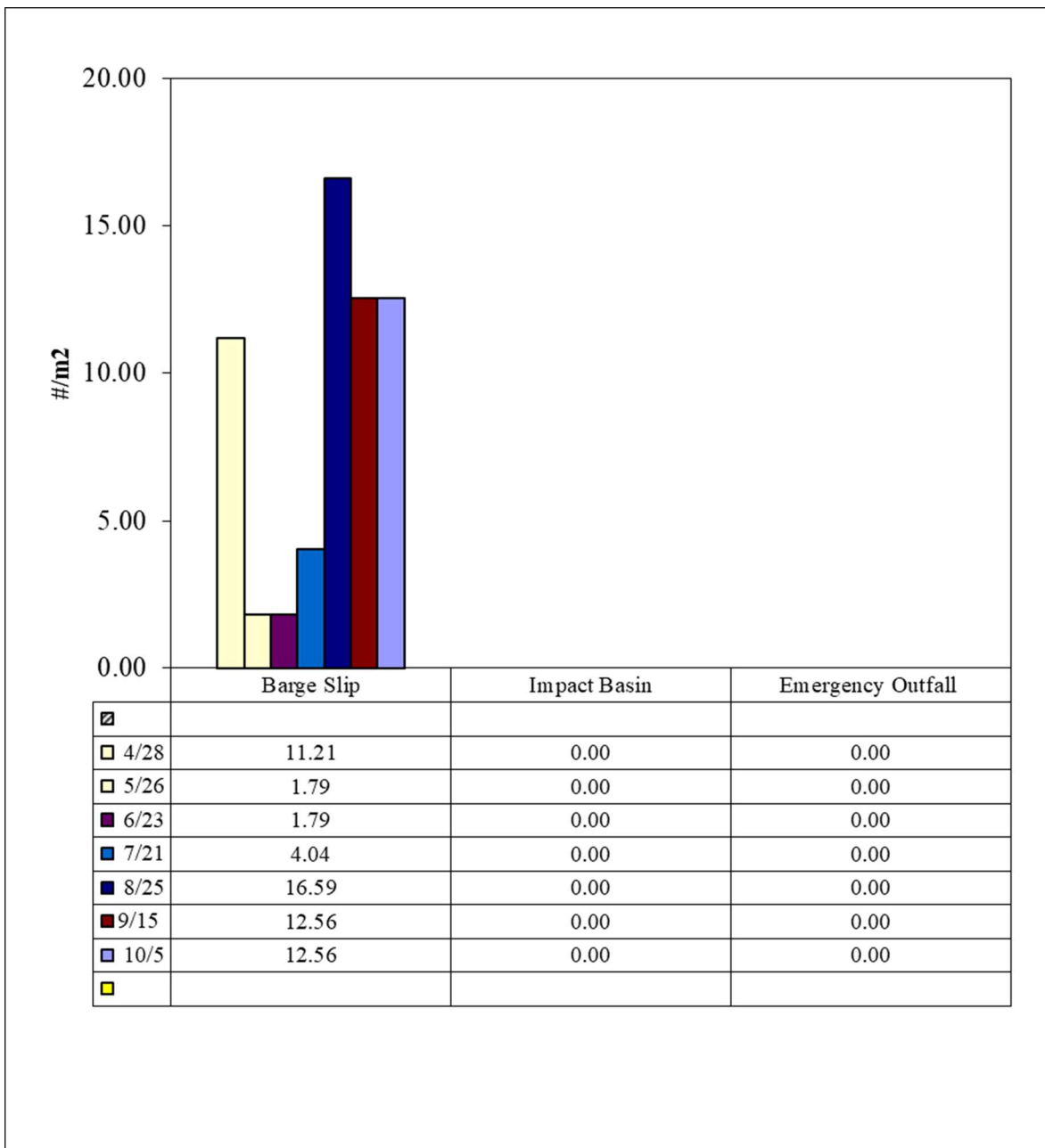
**Figure 5.6. Density of zebra mussel veligers collected at Beaver Valley Power Station, 2022.**



**Figure 5.7. Density of zebra mussel veligers collected at Beaver Valley Power Station, 2022.**



**Figure 5.8. Density of settled zebra mussels at Beaver Valley Power Station, 2022.**



**Figure 5.9. Density of settled zebra mussels at Beaver Valley Power Station, 2022.**

## 10.0 PERMITS

### Attachment 10.1 BEAVER VALLEY POWER STATION (BVPS) PERMITS AND CERTIFICATES FOR ENVIRONMENTAL COMPLIANCE

Registration Number	Regulator/Description	Expiration
PAR000040485	BVPS EPA generator identification Resource Conservation & Recovery Act (RCRA) Identification number for regulated waste activity. Also used by PA DEP to monitor regulated waste activity under the Pennsylvania Solid Waste Management Act (SWMA)	Indefinite
04-02474	BVPS EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for SARA Tier II reporting and emergency planning.	Indefinite
04-02475	FE Long Term Distribution Center/Warehouse (22) EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for Sara Tier II reporting and emergency planning.	Indefinite
PA0025615	BVPS NPDES Permit Number under US EPA and PA DEP.	10/31/2026
04-13281	BVPS Unit 1 PA DEP Facility Identification & certification number for regulated storage tanks.	Indefinite
04-13361	BVPS Unit 2 PA DEP Facility Identification & certification number for regulated storage tanks.	Indefinite
OP-04-00086	PA DEP State Only Synthetic Minor Permit for emergency auxiliary boilers, emergency diesel generators, paint shop and other miscellaneous sources.	6/12/2025
N/A	PA DEP Open Burning Permit for operation of the BVPS Fire School – annual application and renewal.	1/1/2021 Did not renew
05122550116EG	US Department of Transportation Hazardous Materials Registration.	6/30/2025
2001-242	US Army Permit for maintenance dredging (with Encroachment/Submerged Lands Agreement #0477705, this allows maintenance dredging).	12/31/2032
477705	Encroachment Permit/Submerged Lands Agreement for construction and maintenance of current barge slip (with US Army Permit #2000100242, this allows maintenance dredging).	Indefinite
06786A	Encroachment Permit/Submerged Lands Agreement for transmission line over Ohio River at Mile 34.5.	Indefinite
18737	Encroachment Permit/Submerged Lands Agreement for Unit 1 intake and discharge (main combined intake and outfall structures).	Indefinite
475711	Encroachment Permit/Submerged Lands Agreement for construction and maintenance of Unit 2 auxiliary line.	Indefinite