

US Department of Energy
Portsmouth Gaseous
Diffusion Plant

2021

Portsmouth Site
Annual Site
Environmental Report

DOE/PPPO/03-1111&D1

Portsmouth Site

**Annual Site
Environmental
Report 2021**

**DOE/PPPO/03-1111&D1
FBP-ER-RCRA-WD-RPT-0403**

**Portsmouth Site
Annual Site Environmental Report 2021**

December 2022

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FLUOR-BWXT PORTSMOUTH LLC,
managing the
Decontamination and Decommissioning Project at the
Portsmouth Gaseous Diffusion Plant
under Contract DE-AC30-10CC40017

Contents

Figures.....	v
Tables	vi
Acronyms and Abbreviations	vii
Executive Summary	ES-1
1. Introduction.....	1-1
1.1 Site Location.....	1-2
1.2 Environmental Setting	1-2
1.3 Site Operations	1-3
2. Compliance Summary	2-1
2.1 Environmental Protection and Waste Management.....	2-1
2.1.1 Comprehensive Environmental Response, Compensation, and Liability Act.....	2-1
2.1.2 Emergency Planning and Community Right-To-Know Act.....	2-2
2.1.3 Resource Conservation and Recovery Act	2-3
2.1.4 Federal Facility Compliance Act.....	2-4
2.1.5 National Environmental Policy Act.....	2-4
2.1.6 Toxic Substances Control Act	2-5
2.1.7 Federal Insecticide, Fungicide, and Rodenticide Act	2-6
2.2 Radiation Protection	2-6
2.2.1 Atomic Energy Act of 1954.....	2-6
2.2.2 DOE Order 458.1, Radiation Protection of the Public and the Environment.....	2-6
2.2.3 DOE Order 435.1, Radioactive Waste Management.....	2-8
2.3 Air Quality and Protection.....	2-8
2.3.1 Clean Air Act.....	2-9
2.3.2 National Emission Standards for Hazardous Air Pollutants.....	2-9
2.3.3 Hydrofluorocarbon Phasedown	2-10
2.4 Water Quality and Protection	2-10
2.4.1 Clean Water Act	2-10
2.4.2 Safe Drinking Water Act	2-12
2.5 Other Environmental Statutes.....	2-12
2.5.1 Endangered Species Act	2-12
2.5.2 Impacts of Invasive Species.....	2-13
2.5.3 Migratory Bird Treaty Act.....	2-13
2.5.4 Floodplain Management and Protection of Wetlands.....	2-13
2.5.5 National Historic Preservation Act.....	2-13
2.5.6 Archaeological and Historic Preservation Act and Archaeological Resources Protection Act.....	2-14
2.6 Sustainability	2-14
2.6.1 Departmental Sustainability.....	2-14
2.6.2 Federal Leadership in Environmental, Energy, and Economic Performance.....	2-15

2.7	Other Major Environmental Issues and Actions.....	2-15
2.7.1	Enforcement and Compliance History Online.....	2-15
2.7.2	Environmental Program Inspections.....	2-15
2.7.3	Unplanned Releases.....	2-16
2.7.4	Summary of Permits	2-16
3.	Environmental Programs and Activities.....	3-1
3.1	Environmental Management System.....	3-1
3.2	Site Sustainability Program	3-1
3.3	Environmental Management and Waste Management Activities.....	3-3
3.3.1	Decontamination and Decommissioning Program: Process Buildings and Other Facilities	3-3
3.3.2	Site-Wide Waste Disposition.....	3-5
3.4	Environmental Restoration and Remediation	3-6
3.4.1	Quadrant I.....	3-8
3.4.2	Quadrant II.....	3-10
3.4.3	Quadrant III	3-11
3.4.4	Quadrant IV	3-12
3.5	Public Awareness Program.....	3-13
3.5.1	Community and Educational Outreach.....	3-13
3.5.2	Site Specific Advisory Board	3-14
3.5.3	Environmental Information Center.....	3-14
4.	Environmental Radiological Protection and Monitoring.....	4-1
4.1	Environmental Radiological Program	4-2
4.2	Radiological Dose.....	4-3
4.2.1	Dose Assessment Methodology.....	4-3
4.2.2	Dose Summary	4-3
4.3	Air Monitoring and Estimated Dose.....	4-4
4.3.1	Air Monitoring.....	4-4
4.3.2	Air Estimated Dose.....	4-5
4.3.3	Ambient Air Monitoring.....	4-5
4.3.4	Ambient Air Estimated Dose.....	4-8
4.4	Liquid Discharge Monitoring and Estimated Dose	4-8
4.4.1	Surface Water Monitoring.....	4-8
4.4.2	Surface Water Estimated Dose	4-13
4.5	Sediment and Soil Monitoring and Estimated Dose.....	4-13
4.5.1	Sediment Monitoring.....	4-15
4.5.2	Sediment Estimated Dose.....	4-15
4.5.3	Soil Monitoring.....	4-16
4.5.4	Soil Estimated Dose.....	4-16
4.6	External Radiation Monitoring and Estimated Dose	4-18
4.6.1	External Radiation Monitoring.....	4-18
4.6.2	External Radiation Estimated Dose	4-18
4.7	Monitoring of Plants and Animals and Estimated Dose.....	4-20

4.7.1	Wildlife, Animal Products, and Crops Monitoring.....	4-20
4.7.2	Wildlife, Animal Products, and Crops Estimated Dose.....	4-21
4.7.3	Biota Monitoring and Estimated Dose	4-21
4.8	Unplanned Radiological Releases	4-23
4.9	Release of Property Containing Residual Radioactive Material.....	4-23
4.9.1	Fluor-BWXT Portsmouth Property Releases	4-24
4.9.2	Mid-America Conversion Services Property Releases.....	4-24
5.	Environmental Non-Radiological Programs	5-1
5.1	Air.....	5-1
5.1.1	Airborne Discharges	5-1
5.1.2	Ambient Air Monitoring.....	5-2
5.1.3	On-Site Waste Disposal Facility.....	5-5
5.1.4	Fluoride.....	5-5
5.2	Water	5-6
5.2.1	Water Discharges via NPDES Outfalls	5-6
5.2.2	On-Site Waste Disposal Facility Surface Water Monitoring.....	5-8
5.2.3	Surface Water Monitoring Associated with Cylinder Storage Yards.....	5-9
5.3	Sediment	5-9
5.3.1	Local Sediment Monitoring.....	5-9
5.3.2	Sediment Monitoring Associated with Cylinder Storage Yards.....	5-10
5.4	Biota.....	5-10
6.	Groundwater Protection Programs.....	6-1
6.1	Geology and Uses of Groundwater.....	6-1
6.2	Groundwater Monitoring Programs.....	6-1
6.2.1	On-Site Waste Disposal Facility.....	6-2
6.2.2	Integrated Groundwater Monitoring.....	6-2
6.2.3	Exit Pathway Monitoring.....	6-4
6.3	Groundwater Monitoring Results	6-4
6.3.1	On-Site Waste Disposal Facility.....	6-4
6.3.2	Integrated Groundwater Monitoring.....	6-5
6.3.3	Surface Water	6-14
6.3.4	Water Supply	6-16
6.3.5	Exit Pathway Monitoring.....	6-17
6.4	Emerging Contaminants	6-19
6.5	Groundwater Treatment Facilities	6-19
6.5.1	X-622 Groundwater Treatment Facility	6-19
6.5.2	X-623 Groundwater Treatment Facility	6-20
6.5.3	X-624 Groundwater Treatment Facility	6-20
6.5.4	X-627 Groundwater Treatment Facility	6-21
7.	Quality Assurance	7-1
7.1	Field Sampling.....	7-1
7.1.1	Data Quality Objectives and Sample Planning.....	7-2
7.1.2	Training for Sampling Personnel.....	7-2

7.1.3	Sampling Procedures	7-2
7.1.4	Field Quality Control Samples	7-2
7.2	Analytical Quality Assurance	7-3
7.2.1	Analytical Procedures.....	7-3
7.2.2	Laboratory Quality Control	7-3
7.2.3	Independent Quality Control	7-4
7.2.4	Laboratory Audits and Accreditation	7-4
7.3	Data Management.....	7-4
7.3.1	Project Environmental Measurements System	7-4
7.3.2	PORTS OREIS	7-5
7.3.3	PEGASIS.....	7-5
7.3.4	Data Verification, Validation, and Assessment.....	7-5
8.	References.....	8-1
Appendix A	Glossary	A-2
Appendix B	Introduction to Radiation	B-2
B.1	What Is Radiation?	B-2
B.2	What Is a Radionuclide?.....	B-4
B.3	What Are Some Radionuclides of Concern?.....	B-4
B.4	What Is Radioactivity and How Is It Measured?.....	B-4
B.5	What Is Dose and How Is It Measured?	B-5
B.6	How Are Radioactivity and Dose Reported?	B-5
B.7	What Is an Exposure Pathway?	B-6
B.8	What Radiation Sources and Doses Are We Exposed To?	B-7
B.9	What Are the Potential Health Effects of Radiation Exposure?.....	B-10
Appendix C	Radionuclide and Chemical Names.....	C-2
Appendix D	Units of Measure	D-2

Figures

<i>Figure</i>	<i>Page</i>
Figure ES.1. A deer in the brush at PORTS.....	ES-1
Figure ES.2. Relative doses from radiation sources	ES-2
Figure 1.1. Location of PORTS	1-2
Figure 3.1. Extent of demolition of the X-326 Process Building in December 2021 (looking northwest).....	3-4
Figure 3.2. Location of the On-Site Waste Disposal Facility (OSWDF) at PORTS	3-5
Figure 4.1. Ambient air and radiation monitoring locations.....	4-7
Figure 4.2. PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations.....	4-9
Figure 4.3. Settleable solids monitoring locations.....	4-12
Figure 4.4. Local surface water and sediment monitoring locations	4-14
Figure 4.5. Soil and vegetation monitoring locations	4-17
Figure 4.6. External radiation monitoring locations	4-19
Figure 5.1. DOE/Ohio EPA air monitoring stations	5-2
Figure 6.1. Groundwater monitoring areas	6-3
Figure 6.2. Gallia groundwater plume contaminated with trichloroethene at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility in 2021.....	6-6
Figure 6.3. Gallia groundwater plume contaminated with trichloroethene at the Quadrant I Groundwater Investigative (5-Unit) Area in 2021.....	6-8
Figure 6.4. Gallia groundwater plume contaminated with trichloroethene at the Quadrant II Groundwater Investigative (7-Unit) Area in 2021.....	6-10
Figure 6.5. Gallia groundwater plume contaminated with trichloroethene at the X-701B Former Holding Pond in 2021	6-11
Figure 6.6. Trichloroethene and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments in 2021.....	6-13
Figure 6.7. Surface water monitoring locations.....	6-15
Figure 6.8. Exit pathway monitoring locations.....	6-18
Figure B.1. Radioactive atom showing ionizing radiation.....	B-2
Figure B.2. Comparison of penetrating ability of alpha, beta, and gamma radiation	B-4
Figure B.3. Potential exposure pathways.....	B-7
Figure B.4. Sources of radiation exposure.....	B-8

Tables

<i>Table</i>	<i>Page</i>
Table 2.1. Chemicals reported in the Hazardous Chemical Inventory Report for 2021	2-2
Table 2.2. Approved authorized limits for real property transfer at PORTS	2-8
Table 2.3. Fluor-BWXT Portsmouth NPDES exceedances in 2021	2-11
Table 2.4. Environmental inspections of DOE activities at PORTS for 2021	2-15
Table 2.5. DOE environmental permits and registrations at PORTS.....	2-17
Table 3.1. Remedial actions at PORTS in groundwater monitoring areas	3-7
Table 4.1. Summary of potential annual doses to the public from PORTS in 2021	4-4
Table 4.2. Maximum levels of radionuclides detected in ambient air in 2021	4-6
Table 4.3. Maximum detections of radionuclides at Fluor-BWXT Portsmouth cylinder storage yards in 2021.....	4-10
Table 4.4. Maximum detections of radionuclides at Mid-America Conversion Services cylinder storage yards in 2021	4-10
Table 4.5. Maximum levels of radionuclides detected in local surface water in 2021	4-13
Table 4.6. Average activity of radionuclides detected in the Scioto River in 2021	4-13
Table 4.7. Radionuclides detected in sediment in 2021	4-15
Table 4.8. Radionuclides detected in soil in 2021	4-16
Table 4.9. Detections of radionuclides used in dose assessment for aquatic and riparian animals	4-22
Table 4.10. Detections of radionuclides used in dose assessment for terrestrial plant and animals	4-23
Table 5.1. Metals monitored by DOE in PORTS ambient air	5-3
Table 5.2. Volatile organic compounds monitored by DOE in PORTS ambient air	5-4
Table 5.3. PCB results in fish and Ohio advisory consumption limits	5-11
Table 6.1. Technetium-99 and uranium in Big Run Creek and the discharge from the X-230K South Holding Pond.....	6-16
Table 6.2. Summary of groundwater treatment facility information for 2021.....	6-19
Table 7.1. Definitions and purpose of field quality control samples	7-3
Table B.1. Commonly used numerical prefixes.....	B-6
Table B.2. Names and symbols for units of radioactivity and radiological dose.....	B-6
Table C.1. Names and abbreviations for elements and chemical constituents	C-2
Table C.2. Selected names, abbreviations, and half-life for radionuclides	C-3
Table D.1. Units of measure and their abbreviations.....	D-2
Table D.2. Quantitative prefixes	D-2
Table D.3. Unit conversions	D-3

Acronyms and Abbreviations

A	ALARA	as low as reasonably achievable
	ASER	Annual Site Environmental Report
C	CAP-88	Clean Air Act Assessment Package—Version 4.1
	CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
	<i>CFR</i>	<i>Code of Federal Regulations</i>
D	DOE	US Department of Energy
	DUF ₆	depleted uranium hexafluoride
E	EPCRA	Emergency Planning and Community Right-to-Know Act
M	MEI	maximally exposed individual
N	NEPA	National Environmental Policy Act
	NESHAP	National Emission Standards for Hazardous Air Pollutants
	NPDES	National Pollutant Discharge Elimination System
O	Ohio EPA	Ohio Environmental Protection Agency
	OREIS	Oak Ridge Environmental Information System
P	PEGASIS	PPPO Environmental Geographic Analytical Spatial Information System
	PFAS	per- and polyfluoroalkyl substances
	PK Landfill	X-749B Peter Kiewit Landfill
	PM	particulate matter
	PORTS	Portsmouth Gaseous Diffusion Plant
	PPPO	Portsmouth/Paducah Project Office
R	RCRA	Resource Conservation and Recovery Act
S	SODI	Southern Ohio Diversification Initiative
	STEM	science, technology, engineering, and math
U	US EPA	US Environmental Protection Agency
	USEC	United States Enrichment Corporation