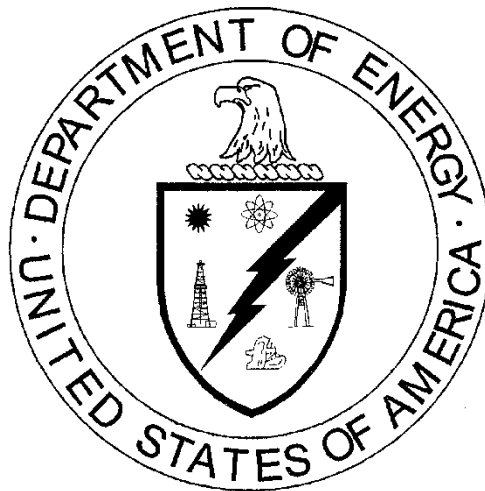


**U.S. Department of Energy  
Portsmouth Gaseous Diffusion Plant  
Annual Site Environmental Report – 2011  
Piketon, Ohio**

**U.S. Department of Energy  
DOE/PPPO/03-0381&D1**

**January 2013**

**By  
Fluor-B&W Portsmouth LLC, under Contract DE-AC30-10CC40017**



**FBP-ER-PRO-WD-RPT-0017, Revision 2**

This document is approved for public release  
per review by:

<u>Henry H. Thomas</u>	<u>09/10/2012</u>
PORTS Classification/Information Office	Date

This page intentionally left blank.

## CONTENTS

FIGURES .....	ix
TABLES .....	xi
ACRONYMS AND ABBREVIATIONS .....	xiii
DEFINITIONS .....	xv
EXECUTIVE SUMMARY .....	ES-1
1. INTRODUCTION .....	1-1
1.1 SUMMARY .....	1-1
1.2 BACKGROUND INFORMATION .....	1-2
1.3 DESCRIPTION OF SITE LOCALE .....	1-3
1.4 DESCRIPTION OF SITE OPERATIONS .....	1-3
2. COMPLIANCE SUMMARY .....	2-1
2.1 SUMMARY .....	2-1
2.2 INTRODUCTION .....	2-1
2.3 COMPLIANCE STATUS .....	2-2
2.3.1 Environmental Restoration and Waste Management .....	2-2
2.3.1.1 Comprehensive Environmental Response, Compensation, and Liability Act.....	2-2
2.3.1.2 Emergency Planning and Community Right-to-Know Act.....	2-2
2.3.1.3 Resource Conservation and Recovery Act .....	2-4
2.3.1.4 Federal Facility Compliance Act.....	2-5
2.3.1.5 Toxic Substances Control Act.....	2-5
2.3.1.6 Federal Insecticide, Fungicide, and Rodenticide Act.....	2-6
2.3.2 Radiation Protection .....	2-6
2.3.2.1 DOE Orders 5400.5 and 458.1, <i>Radiation Protection of the Public and</i>	2-6
<i>the Environment</i> .....	2-6
2.3.2.2 DOE Order 435.1, <i>Radioactive Waste Management</i> .....	2-6
2.3.3 Air Quality and Protection.....	2-6
2.3.3.1 Clean Air Act.....	2-6
2.3.3.2 Clean Air Act, Title VI, Stratospheric Ozone Protection .....	2-7
2.3.3.3 National Emission Standards for Hazardous Air Pollutants.....	2-7
2.3.4 Water Quality and Protection .....	2-8
2.3.4.1 Clean Water Act .....	2-8
2.3.4.2 Safe Drinking Water Act .....	2-8
2.3.5 Other Environmental Statutes.....	2-9
2.3.5.1 Underground storage tank regulations.....	2-9
2.3.5.2 National Environmental Policy Act.....	2-9
2.3.5.3 Endangered Species Act .....	2-10
2.3.5.4 National Historic Preservation Act.....	2-10
2.3.5.5 Archaeological and Historic Preservation Act and Archaeological Resources	
Protection Act.....	2-10
2.3.6 DOE Order 436.1, <i>Departmental Sustainability</i> .....	2-10

2.3.7	Executive Orders .....	2-11
2.3.7.1	Executive Order 13514, <i>Federal Leadership in Environmental, Energy, and Economic Performance</i> .....	2-11
2.3.7.2	Executive Order 11988, <i>Floodplain Management</i> , and Executive Order 11990, <i>Protection of Wetlands</i> .....	2-11
2.4	OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS .....	2-11
2.4.1	Environmental Program Inspections .....	2-11
2.5	UNPLANNED RELEASES .....	2-13
2.6	SUMMARY OF PERMITS .....	2-13
3.	ENVIRONMENTAL PROGRAM INFORMATION .....	3-1
3.1	SUMMARY .....	3-1
3.2	D&D PROGRAM .....	3-1
3.2.1	Non-time critical removal actions .....	3-2
3.2.1.1	Non-time critical removal action activities in 2011 .....	3-2
3.2.2	Process buildings and complex facilities .....	3-3
3.2.2.1	Process buildings and complex facilities RI/FS activities in 2011 .....	3-4
3.2.3	Site-wide waste disposition .....	3-4
3.2.3.1	Site-wide waste disposition activities in 2011 .....	3-4
3.2.4	Pre-D&D activities .....	3-5
3.3	ENVIRONMENTAL RESTORATION PROGRAM .....	3-5
3.3.1	Quadrant I .....	3-6
3.3.1.1	X-749/X-120 groundwater plume .....	3-6
3.3.1.2	PK Landfill .....	3-8
3.3.1.3	Quadrant I Groundwater Investigative Area .....	3-8
3.3.1.4	X-103 Auxiliary Office Building investigation .....	3-9
3.3.2	Quadrant II .....	3-9
3.3.2.1	Quadrant II Groundwater Investigative Area .....	3-9
3.3.2.2	X-701B Holding Pond .....	3-10
3.3.2.3	X-633 Pumphouse/Cooling Towers Area investigation .....	3-10
3.3.3	Quadrant III .....	3-11
3.3.4	Quadrant IV .....	3-11
3.3.4.1	X-611A Former Lime Sludge Lagoons .....	3-11
3.3.4.2	X-734 Landfills .....	3-12
3.3.4.3	X-334 Transformer Cleaning and Storage Building investigation .....	3-12
3.3.4.4	X-344B Maintenance Storage Building investigation .....	3-12
3.3.4.5	X-605H, I, and J; X-230J9 Building investigation .....	3-12
3.3.4.6	X-630 Recirculating Cooling Water Complex investigation .....	3-12
3.4	WASTE MANAGEMENT PROGRAM .....	3-13
3.5	ENVIRONMENTAL SUSTAINABILITY PROGRAM .....	3-15
3.6	ENVIRONMENTAL TRAINING PROGRAM .....	3-16
3.7	PUBLIC AWARENESS PROGRAM .....	3-16
4.	ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION .....	4-1
4.1	SUMMARY .....	4-1
4.2	INTRODUCTION .....	4-1
4.3	RADIOLOGICAL EMISSIONS AND DOSES .....	4-3
4.3.1	Dose Terminology .....	4-3
4.3.2	Airborne Emissions .....	4-4
4.3.3	Dose Calculation Based on Airborne Emissions .....	4-5
4.3.4	Dose Calculation Based on Ambient Air Monitoring .....	4-6

4.3.5	Discharges of Radionuclides from NPDES Outfalls .....	4-6
4.3.5.1	FBP outfalls.....	4-8
4.3.5.2	USEC, Inc. outfalls.....	4-11
4.3.6	Dose Calculation for Releases to Surface Water.....	4-12
4.3.7	Radiological Dose Calculation for Direct Radiation.....	4-12
4.3.8	Radiological Dose Results for DOE Workers and Visitors.....	4-13
4.3.9	Radiological Dose Calculations for Off-site Environmental Monitoring Data .....	4-13
4.3.9.1	Dose calculation for sediment .....	4-14
4.3.9.2	Dose calculation for soil.....	4-15
4.3.9.3	Dose calculation for vegetation.....	4-15
4.3.9.4	Dose calculation for crops.....	4-15
4.3.9.5	Dose calculation for deer.....	4-15
4.3.9.6	Dose calculation for residential drinking water.....	4-16
4.4	PROTECTION OF BIOTA .....	4-16
4.5	UNPLANNED RADIOLOGICAL RELEASES .....	4-16
4.6	ENVIRONMENTAL RADIOLOGICAL MONITORING .....	4-16
4.6.1	Ambient Air Monitoring.....	4-17
4.6.2	Environmental Radiation.....	4-17
4.6.3	Surface Water from Cylinder Storage Yards.....	4-19
4.6.4	Local Surface Water.....	4-19
4.6.5	Sediment.....	4-21
4.6.6	Settleable Solids .....	4-22
4.6.7	Soil.....	4-22
4.6.8	Vegetation .....	4-24
4.6.9	Biological Monitoring .....	4-24
4.6.9.1	Deer .....	4-24
4.6.9.2	Fish.....	4-25
4.6.9.3	Crops .....	4-25
4.6.9.4	Milk and eggs .....	4-25
4.7	RELEASE OF PROPERTY CONTAINING RESIDUAL RADIOACTIVE MATERIAL.....	4-25
5.	ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION.....	5-1
5.1	SUMMARY.....	5-1
5.2	INTRODUCTION .....	5-1
5.3	AIR.....	5-1
5.3.1	Airborne Discharges.....	5-1
5.3.2	Ambient Air Monitoring.....	5-2
5.4	WATER .....	5-2
5.4.1	Water Discharges (NPDES Outfalls) .....	5-2
5.4.1.1	FBP NPDES outfalls .....	5-3
5.4.1.2	BWCS NPDES outfall.....	5-4
5.4.1.3	USEC, Inc. NPDES outfalls .....	5-5
5.4.2	Surface Water Monitoring Associated with Cylinder Storage Yards.....	5-5
5.5	SEDIMENT .....	5-6
5.5.1	Local Sediment Monitoring.....	5-6
5.5.2	Sediment Monitoring Associated with Cylinder Storage Yards.....	5-6
5.6	BIOLOGICAL MONITORING - FISH .....	5-7

6. GROUNDWATER PROGRAMS.....	6-1
6.1 SUMMARY .....	6-1
6.2 INTRODUCTION .....	6-1
6.3 OVERVIEW OF GROUNDWATER MONITORING AT PORTS .....	6-2
6.3.1 Regulatory Programs .....	6-2
6.3.2 Groundwater Use and Geology .....	6-2
6.3.3 Monitoring Activities .....	6-2
6.4 GROUNDWATER MONITORING AREAS .....	6-2
6.4.1 X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/ PK Landfill .....	6-4
6.4.1.1 X-749 Contaminated Materials Disposal Facility .....	6-4
6.4.1.2 X-120 Old Training Facility .....	6-7
6.4.1.3 PK Landfill .....	6-8
6.4.1.4 Monitoring results for the X-749/X-120/PK Landfill in 2011 .....	6-8
6.4.2 Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility .....	6-10
6.4.2.1 Quadrant I Groundwater Investigative Area .....	6-10
6.4.2.2 X-749A Classified Materials Disposal Facility .....	6-10
6.4.2.3 Monitoring results for the Quadrant I Groundwater Investigative Area/X-749A in 2011 .....	6-11
6.4.3 Quadrant II Groundwater Investigative Area .....	6-11
6.4.3.1 Monitoring results for the Quadrant II Groundwater Investigative Area in 2011 .....	6-11
6.4.4 X-701B Holding Pond.....	6-14
6.4.4.1 Monitoring results for the X-701B Holding Pond in 2011 .....	6-15
6.4.5 X-633 Pumphouse/Cooling Towers Area.....	6-15
6.4.5.1 Monitoring results for the X-633 Pumphouse/Cooling Towers Area in 2011 ..	6-17
6.4.6 X-616 Chromium Sludge Surface Impoundments .....	6-17
6.4.6.1 Monitoring results for the X-616 Chromium Sludge Surface Impoundments in 2011 .....	6-17
6.4.7 X-740 Waste Oil Handling Facility.....	6-17
6.4.7.1 Monitoring results for the X-740 Waste Oil Handling Facility in 2011 .....	6-20
6.4.8 X-611A Former Lime Sludge Lagoons .....	6-20
6.4.8.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2011 .....	6-20
6.4.9 X-735 Landfills .....	6-23
6.4.9.1 Monitoring results for the X-735 Landfills in 2011.....	6-23
6.4.10 X-734 Landfills .....	6-25
6.4.10.1 Monitoring results for the X-734 Landfills in 2011.....	6-25
6.4.11 X-533 Switchyard Area.....	6-25
6.4.11.1 Monitoring results for the X-533 Switchyard Area in 2011 .....	6-27
6.4.12 Former X-344C Hydrogen Fluoride Storage Building.....	6-27
6.4.12.1 Monitoring results for the Former X-344C Hydrogen Fluoride Storage Building in 2011 .....	6-27
6.4.13 Surface Water Monitoring .....	6-27
6.4.13.1 Monitoring results for surface water in 2011.....	6-30
6.4.14 Water Supply Monitoring.....	6-31
6.5 DOE ORDER MONITORING PROGRAMS .....	6-33
6.5.1 Exit Pathway Monitoring .....	6-33
6.6 GROUNDWATER TREATMENT FACILITIES.....	6-35
6.6.1 X-622 Groundwater Treatment Facility .....	6-36
6.6.2 X-623 Groundwater Treatment Facility .....	6-36

6.6.3	X-624 Groundwater Treatment Facility .....	6-36
6.6.4	X-627 Groundwater Treatment Facility .....	6-37
7.	QUALITY ASSURANCE.....	7-1
7.1	SUMMARY .....	7-1
7.2	INTRODUCTION .....	7-1
7.3	FIELD SAMPLING AND MONITORING .....	7-2
7.4	ANALYTICAL QUALITY ASSURANCE .....	7-2
8.	REFERENCES .....	8-1
APPENDIX A: RADIATION.....		A-1
APPENDIX B: ENVIRONMENTAL PERMITS.....		B-1
APPENDIX C: RADIONUCLIDE AND CHEMICAL NOMENCLATURE .....		C-1

This page intentionally left blank.



## FIGURES

1	Comparison of dose from various common radiation sources.....	ES-6
1.1	The Portsmouth Gaseous Diffusion Plant – 2011 .....	1-1
1.2	Location of PORTS.....	1-3
4.1	DOE ambient air and radiation monitoring locations .....	4-7
4.2	PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations .....	4-9
4.3	On-site radiation and cylinder yard dose monitoring locations .....	4-18
4.4	Local surface water and sediment monitoring locations.....	4-20
4.5	DOE settleable solids monitoring locations.....	4-23
6.1	Groundwater monitoring areas at PORTS .....	6-3
6.2	TCE-contaminated Gallia groundwater plume at the X-749/X-120/ PK Landfill – 2011.....	6-9
6.3	TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative Area – 2011 .....	6-12
6.4	TCE-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative Area – 2011 .....	6-13
6.5	TCE-contaminated Gallia groundwater plume at the X-701B Holding Pond – 2011 .....	6-16
6.6	Metal concentrations in groundwater at the X-633 Pumphouse/Cooling Towers Area and X-533 Switchyard Area – 2011 .....	6-18
6.7	TCE and metal concentrations in groundwater at the X-616 Chromium Sludge Surface Impoundments – 2011 .....	6-19
6.8	TCE-contaminated Gallia groundwater plume near the X-740 Waste Oil Handling Facility – 2011 .....	6-21
6.9	Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons – 2011 .....	6-22
6.10	Monitoring wells at the X-735 Landfills.....	6-24
6.11	Monitoring wells at the X-734 Landfills.....	6-26

6.12	Monitoring well at the Former X-344C Hydrogen Fluoride Storage Building .....	6-28
6.13	Surface water monitoring locations .....	6-29
6.14	Water supply monitoring locations.....	6-32
6.15	Exit pathway monitoring locations .....	6-34

## TABLES

2.1	Environmental inspections of DOE activities at PORTS for 2011 .....	2-12
3.1	Remedial actions at PORTS in groundwater monitoring areas .....	3-7
3.2	Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2011 .....	3-14
4.1	Summary of potential doses to the public from PORTS in 2011 .....	4-1
4.2	Summary of potential doses to the public from radionuclides detected by DOE environmental monitoring programs in 2011 .....	4-14
6.1	Analytical parameters for monitoring areas and programs at PORTS in 2011 .....	6-5
6.2	Summary of TCE removed by PORTS groundwater treatment facilities in 2011 .....	6-35

This page intentionally left blank.

## ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
ARARs	applicable or relevant and appropriate requirements
ARRA	American Recovery and Reinvestment Act
BWCS	B&W Conversion Services, LLC
CBOD	carbonaceous biochemical oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	curie
D&D	decontamination and decommissioning
DFF&O	<i>The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto</i>
DOE	U.S. Department of Energy
DUF <sub>6</sub>	depleted uranium hexafluoride
EMS	Environmental Management System
FBP	Fluor-B&W Portsmouth LLC
IRM	interim remedial measure
LLW	low-level radioactive waste
LPP	LATA/Parallax Portsmouth, LLC
µg/kg	microgram per kilogram (equivalent to part per billion)
µg/L	microgram per liter (equivalent to part per billion)
µg/m <sup>3</sup>	microgram per cubic meter
mL	milliliter
mrem	millirem
NCRP	National Council on Radiation Protection
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/mL	picocurie per milliliter
pCi/m <sup>3</sup>	picocurie per cubic meter
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
SODI	Southern Ohio Diversification Initiative
SU	standard unit
TCE	trichloroethene
TSCA	Toxic Substances Control Act
TUa	acute toxicity unit
UDS	Uranium Disposition Services, LLC
U.S. EPA	U.S. Environmental Protection Agency
USEC	United States Enrichment Corporation
WEMS	Wastren-EnergX Mission Support, LLC

This page intentionally left blank.

## DEFINITIONS

**absorption** – Taking up of energy from radiation by the medium through which the radiation is passing.

**activity** – See “radioactivity.”

**air stripper** – Equipment that bubbles air through water to remove volatile organic compounds from the water.

**alpha activity** – The rate of emission of alpha particles from a given material.

**alpha particle** – A positively charged particle consisting of two protons and two neutrons, identical with the nucleus of a helium atom; emitted by several radioactive substances.

**ambient air** – The atmosphere around people, plants, and structures. Ambient air usually means outdoor air (as opposed to indoor air).

**analyte** – The specific component that is being measured in a chemical analysis.

**aquifer** – A permeable body of rock below the ground surface that is capable of yielding quantities of groundwater to wells and springs. A subsurface zone that yields economically important amounts of water to wells.

**atom** – Smallest particle of an element capable of entering into a chemical reaction.

**background radiation** – The radiation in humans’ natural environment, including cosmic rays and radiation from the naturally radioactive elements.

**beta activity** – The rate of emission of beta particles from a given material.

**beta particle** – A negatively charged particle emitted from the nucleus of an atom during radioactive decay. It has a mass and charge equal to those of an electron.

**biota** – Animal and plant life characterizing a given region.

**categorical exclusion** – A class of actions that either individually or cumulatively do not have a significant effect on the human environment and therefore do not require preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act.

**chain-of-custody** – A process that documents custody and control of a sample through sample collection, transportation and analysis.

**closure** – Formal shutdown of a hazardous waste management facility under Resource Conservation and Recovery Act requirements.

**compliance** – Fulfillment of applicable regulations or requirements of a plan or schedule ordered or approved by a government authority.

**concentration** – The amount of a substance contained in a unit volume or mass of a sample.

**contaminant** – Any substance that enters a system (the environment, food, the human body, etc.) where it is not normally found. Contaminants include substances that spoil food, pollute the environment, or cause other adverse effects.

**cosmic radiation** – Ionizing radiation with very high energies that originates outside the earth's atmosphere. Cosmic radiation is one contributor to natural background radiation.

**critical habitat** – Specific geographic areas, whether occupied by a species listed under the Endangered Species Act or not, that are essential for conservation of the species and that have been formally designated by a rule published in the Federal Register.

**curie (Ci)** – A unit of radioactivity, defined as that quantity of any radioactive nuclide which has  $3.7 \times 10^{10}$  (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

**kilocurie (kCi)** –  $10^3$  Ci, one thousand curies;  $3.7 \times 10^{13}$  disintegrations per second.

**millicurie (mCi)** –  $10^{-3}$  Ci, one-thousandth of a curie;  $3.7 \times 10^7$  disintegrations per second.

**microcurie (μCi)** –  $10^{-6}$  Ci, one-millionth of a curie,  $3.7 \times 10^4$  disintegrations per second.

**picocurie (pCi)** –  $10^{-12}$  Ci, one-trillionth of a curie; 0.037 disintegration per second.

**decontamination and decommissioning** – Removing equipment, demolishing buildings, disposing of wastes, and investigating potential contamination in areas of PORTS that are no longer part of current operations.

**deferred unit** – An area at PORTS that is in or adjacent to current production and operational areas such that remedial activities would interrupt operations, or an area that could become recontaminated from ongoing operations.

**derived concentration guide** – The concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) would result in either a dose of 0.1 rem or a dose of 5 rem to any tissue, including skin and the lens of the eye. The guidelines for radionuclides in air and water are provided in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

**dose** – The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium.

- **absorbed dose** – The quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).
- **dose** – The product of the absorbed dose (rad) in tissue and a quality factor. Dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).
- **effective dose** – The sum of the doses received by all organs or tissues of the body after each one has been multiplied by the appropriate weighting factor. In this report, the term "effective dose" is often shortened to "dose."
- **collective dose/collective effective dose** – The sums of the doses of all individuals in an exposed population expressed in units of person-rem (or person-sievert). The collective effective dose is also frequently called the "population dose."



**downgradient** – The direction that groundwater flows; similar to downstream for surface water.

**downgradient well** – A well installed downgradient of a site that may be capable of detecting migration of contaminants from a site.

**effluent** – A liquid or gaseous waste discharge to the environment.

**effluent monitoring** – The collection and analysis of samples or measurement of liquid and gaseous effluents to characterize and quantify the release of contaminants, assess radiation exposures to the public, and demonstrate compliance with applicable standards.

**Environmental Restoration** – A DOE program that directs the assessment and cleanup of its sites (remediation) and facilities (decontamination and decommissioning) contaminated with waste as a result of nuclear-related activities.

**exposure (radiation)** – The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is exposure to ionizing radiation that takes place at a person's workplace. Population exposure is the exposure to the total number of persons who inhabit an area.

**external radiation** – The exposure to ionizing radiation when the radiation source is located outside the body.

**gamma ray** – High-energy short-wavelength electromagnetic radiation emitted from the nucleus of an excited atom. Gamma rays are identical to X-rays except for the source of the emission.

**glove box** – An enclosure with built-in sleeves and gloves used by a person to manipulate hazardous materials such as highly enriched uranium without directly exposing the person to the material.

**groundwater** – Any water found below the land surface.

**half-life, radiological** – The time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life; half-lives can range in duration from less than a second to many millions of years.

**industrial solid waste landfill** – A type of landfill that exclusively disposes of solid waste generated by manufacturing or industrial operations.

**in situ** – In its original place; field measurements taken without removing the sample from its original location; remediation performed while the contaminated media (e.g., groundwater or soil) remains below the surface or in place.

**interim remedial measure (IRM)** – Cleanup activities initiated after it has been determined that contamination or waste disposal practices pose an immediate threat to human health and/or the environment. These measures are implemented until a more permanent solution can be made.

**internal radiation** – Occurs when natural radionuclides enter the body by ingestion of food or liquids or by inhalation. Radon is the major contributor to the annual dose for internal radionuclides.

**irradiation** – Exposure to radiation.

**isotopes** – Forms of an element having the same number of protons but differing numbers of neutrons in their nuclei.

**maximally exposed individual** – A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose.

**maximum contaminant level (MCL)** – The maximum permissible level of a contaminant in drinking water provided by a public water system.

**migration** – The transfer or movement of a material through air, soil, or groundwater.

**millirem (mrem)** – The dose that is one-thousandth of a rem.

**monitoring** – Process whereby the quantity and quality of factors that can affect the environment or human health are measured periodically to regulate and control potential impacts.

**natural radiation** – Radiation from cosmic and other naturally occurring radionuclide sources (such as radon) in the environment.

**nuclide** – An atom specified by atomic weight, atomic number, and energy state.

**outfall** – The point of conveyance (e.g., drain or pipe) of wastewater or other effluents into a ditch, pond, or river.

**part per billion** – A unit measure of concentration equivalent to the weight to volume ratio expressed as microgram per liter ( $\mu\text{g/L}$ ) or the weight to weight ratio of microgram per kilogram ( $\mu\text{g/kg}$ ).

**part per million** – A unit measure of concentration equivalent to the weight to volume ratio expressed as milligram per liter ( $\text{mg/L}$ ), the weight to weight ratio expressed as milligram per kilogram ( $\text{mg/kg}$ ), or the weight to weight ratio of microgram per gram ( $\mu\text{g/g}$ ).

**person-rem** – A unit of measure for the collective dose to a population group. For example, a dose of 1 rem to 10 individuals results in a collective dose of 10 person-rem.

**pH** – A measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 to 7, neutral solutions have a pH equal to 7, and basic solutions have a pH from 7 to 14.

**polychlorinated biphenyls (PCBs)** – Man-made chemicals that range from oily liquids to waxy solids. PCBs were used in hundreds of industrial and commercial applications due to their chemical properties until production in the United States ceased in 1977. PCBs have been demonstrated to cause a variety of adverse health effects in animals and possibly cause cancer and other adverse health effects in humans.

**preliminary remediation goal** – The maximum concentration of a constituent in environmental media (soil, groundwater, etc.) that is considered protective of human health and the environment.

**quality assurance** – Any action in environmental monitoring to demonstrate the reliability of monitoring and measurement data.

**quality control** – The routine application of procedures within environmental monitoring to obtain the required standards of performance in monitoring and measurement processes.

**quality factor** – The factor by which an absorbed dose (rad) is multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage to an exposed person. The quality factor is used because some types of radiation, such as alpha particles, are more biologically damaging than others.

**rad** – The unit of absorbed dose deposited in a volume of material.

**radioactivity** – The spontaneous emission of radiation, generally alpha or beta particles or gamma rays, from the nucleus of an unstable isotope.

**radionuclide** – A radioactive nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accomplished by the emission of photons or particles.

**release** – Any discharge to the environment. “Environment” is broadly defined as any water, land, or ambient air.

**rem** – The unit of dose (absorbed dose in rads multiplied by the radiation quality factor). Dose is frequently reported in units of millirem (mrem), which is one-thousandth of a rem.

**remediation** – The correction or cleanup of a site contaminated with waste. See “Environmental Restoration.”

**reportable quantity** – A release to the environment that exceeds reportable quantities as defined by the Comprehensive Environmental Response, Compensation, and Liability Act.

**Resource Conservation and Recovery Act (RCRA)** – Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes.

**riparian** – related to the banks of a river or wetlands adjacent to rivers and streams.

**settleable solids** – Material settling out of suspension in a liquid within a defined period of time.

**source** – A point or object from which radiation or contamination emanates.

**Superfund** – The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act that funds and conducts U.S. EPA emergency and long-term removal and remedial actions.

**surface water** – All water on the surface of the earth, as distinguished from groundwater.

**suspended solids** – Mixture of fine, nonsettling particles of any solid within a liquid or gas.

**terrestrial radiation** – Ionizing radiation emitted from radioactive materials in the earth’s soils such as potassium-40, thorium, and uranium. Terrestrial radiation contributes to natural background radiation.

**transuranics** – Elements such as americium, plutonium, and neptunium that have atomic numbers (the number of protons in the nucleus) greater than 92. All transuranics are radioactive.

**trichloroethene (TCE)** – A colorless liquid used in many industrial applications as a cleaner and/or solvent. One of many chemicals that is classified as a volatile organic compound. High levels of TCE

may cause health effects such as liver and lung damage and abnormal heartbeat; moderate levels may cause dizziness or headache. The International Agency for Research on Cancer considers TCE a probable human carcinogen.

**trip blank** – A quality control sample of water that accompanies sample containers from the analytical laboratory, to the field sampling location where environmental samples are collected, back to the analytical laboratory to determine whether environmental samples have been contaminated during transport, shipment, and/or site conditions.

**turbidity** – A measure of the concentration of sediment or suspended particles in a liquid.

**upgradient** – In the opposite direction of groundwater flow; similar to upstream for surface water.

**upgradient well** – A well installed hydraulically upgradient of a site to provide data to compare to a downgradient well to determine whether the site is affecting groundwater quality.

**volatile organic compounds** – Organic (carbon-containing) compounds that evaporate readily at room temperature. These compounds are present in solvents, degreasers, paints, thinners, and fuels. Due to a number of factors including widespread industrial use, they are commonly found as contaminants in soil and groundwater. Volatile organic compounds found at PORTS include TCE, vinyl chloride, benzene, and dichloroethenes.

**weighting factor** – A tissue specific number that represents the fraction of the total health risk resulting from uniform, whole body irradiation to the specific organ or tissue (bone marrow, lungs, thyroid, etc.).

**wetland** – An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, floodplains, fens, and similar areas. A jurisdictional wetland is one that falls under state or federal regulatory authority; a non-jurisdictional wetland does not.