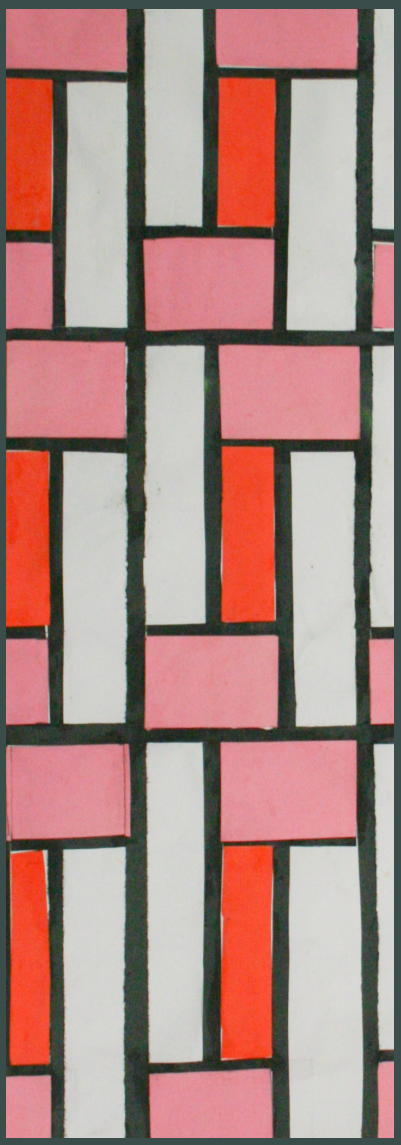
U.S. DEPARTMENT OF ENERGY PORTSMOUTH ANNUAL SITE ENVIRONMENTAL REPORT (ASER) FOR 2011

Student Summary



The ASER Summary Project is funded by a grant from the U.S. Department of Energy Office of Environmental Management Portsmouth/Paducah Project Office

Message from the U.S. Department of Energy

The U.S. Department of Energy (DOE) conducts environmental monitoring at the former Portsmouth Gaseous Diffusion Plant Site (PORTS) on an ongoing basis. Each year, the information collected is presented in a data volume, and a comprehensive publication entitled the Annual Site Environmental Report. This year, a class at Eastern Local High School, located in Pike County, Ohio, developed this summary report. Each of these reports is important as it allows DOE to clearly and concisely explain our environmental monitoring programs to our many stakeholders. The information presented in this summary shows that the PORTS site near Piketon, Ohio is safe due in part to the Department's focus on safety. The work at DOE's facility is highly detailed and technically complex, but it is our commitment to perform each of these activities safely. No matter what we do, our first priority is to protect the well-being of our workers, the surrounding communities, and the environment. We would like to offer our sincerest appreciation to the students and faculty leader at Eastern Local High School who worked on this summary document. On behalf of the entire Department of Energy, we congratulate each of you for your effort, enthusiasm, and willingness to support DOE with this project. We hope that you enjoy reading the P*ORTS 2011 Annual Site Environmental Report Summary*.

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Message from the Students

Dear Reader,

The ASER report has been a privilege to work on. It has been very interesting for us high school juniors to work together on it. This summary will help you to understand what the U.S. Department of Energy (DOE) does at the Portsmouth Gaseous Diffusion Plant Site (PORTS) and the area surrounding it. There were many people from Ohio University, Fluor B&W Portsmouth, DOE and Rio Grande University that gave us presentations. We greatly appreciate all of the presenters and the information they shared with us. There are many ASER report sections and several student groups that worked on this project. These include the "rads," the "nonrads," the "enviros," the "comps," and the "groundwaters." Working on this project has helped all of us to understand what happens at the PORTS site and how it impacts the counties around it, including Pike, Ross, Scioto, and Jackson.

We have learned a lot about how DOE wants to protect the environment and strives to protect and preserve the ecosystems. DOE works to monitor the area for our safety and health. This summary provides information to inform you, the general public, about everything that occurs inside and outside the PORTS site and the effectiveness up to 2011.

Sincerely, Mr. Fitch's 10:30 Chemistry Class,

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Alexandria Hatfield
Casey Elizabeth Howard
Shania Lavonne Jenkins
Virginia Rose Keppler
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1. Introduction

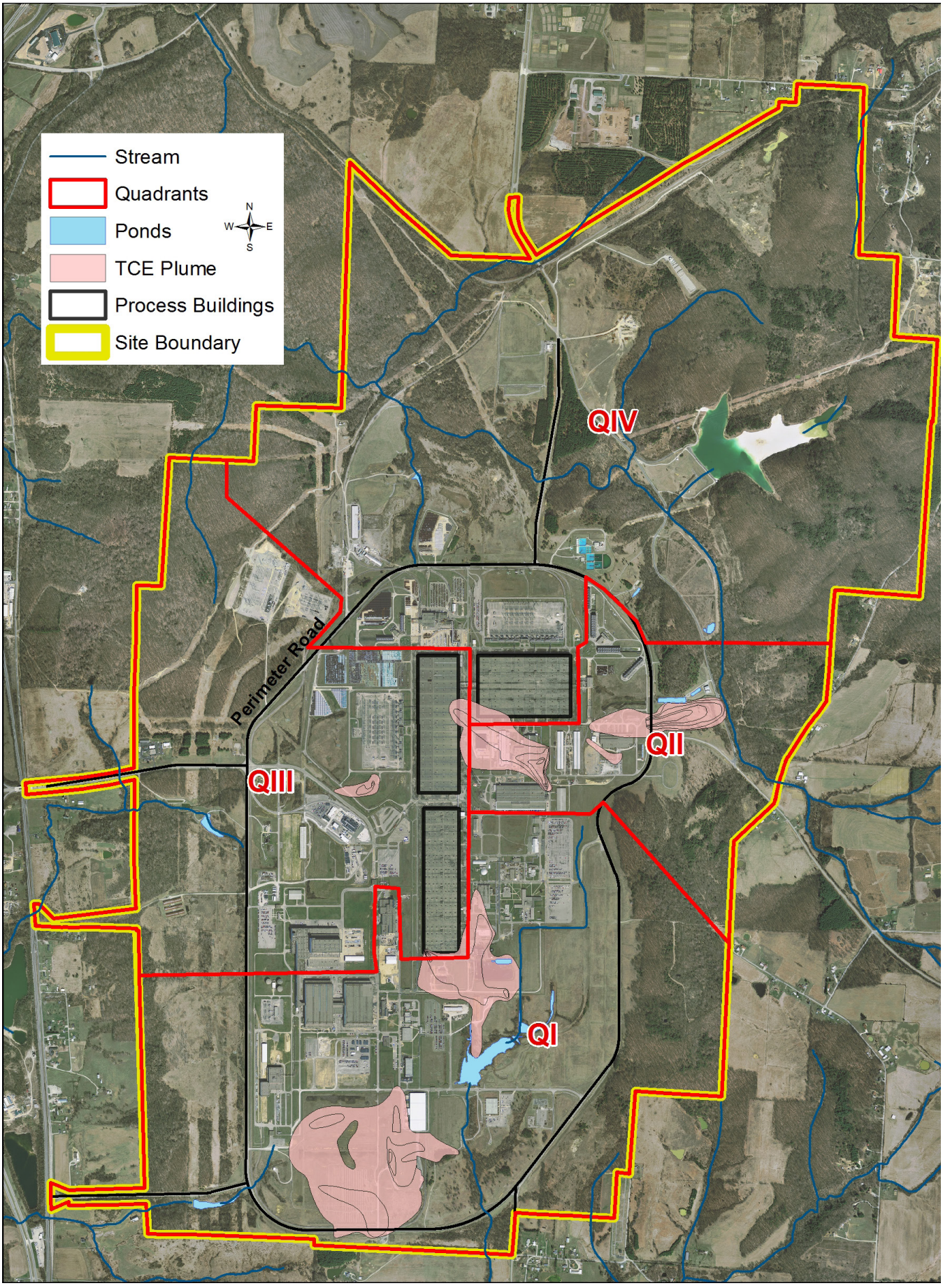
The Portsmouth Gaseous Diffusion Plant (PORTS) is located in Pike County, Ohio. Department of Energy (DOE) activities at PORTS include environmental restoration, waste management, uranium operations, and decontamination and decommissioning (D&D). Fluor-B&W Portsmouth, (FBP) Limited Liability Company (LLC) is the DOE contactor responsible for D&D of PORTS, which includes three process buildings and other associated facilities. The United States Enrichment Corporation (USEC) enriched uranium here until 2001. They maintained the facilities in a safe and secure condition from 2001 to 2011. USEC, Inc. leases facilities at PORTS from DOE. USEC Government Services began the process of returning the facilities to DOE in 2009. This process was completed for most facilities on September 30, 2011. USEC Government Services is no longer responsible for any activities at PORTS. The activities conducted by USEC, Inc. generally are not covered by this document because their operations are not subject to DOE orders, but USEC, Inc. data is sometimes included to provide a better, more complete picture of the activities at PORTS.

Background Information

PORTS produced enriched uranium from 1954 to 2001. PORTS is owned by DOE. As of March 29, 2011, FBP is responsible for restoring contaminated areas, monitoring and reporting on compliance, disposition of radioactive waste, D&D of inactive facilities, disposition of enriched uranium, and operations of waste storage facilities. Wastren-EnergX Mission Support, LLC (WEMS) provides maintenance for infrastructure, janitorial services, secure access to DOE facilities, trainings, records and fleet management, and information technology/network support for DOE operations. B&W Conversion Services, LLC (BWCS) is responsible for the actions of the Depleted Uranium Hexafluoride (DUF_6) Conversion Facility at PORTS. DUF_6 is a product of the uranium enrichment process and is stored in cylinders on site. The DUF_6 Conversion Facility converts DUF_6 into uranium oxide and hydrogen fluoride, which is then recycled or reused. LATA/Parallax Portsmouth, LLC (LPP) and Uranium Disposition Services, LLC (UDS) were on-site as DOE's contractor prior to March 29, 2011 and held the same responsibilities as FBP and BWCS, respectively.

USEC enriched uranium at PORTS through the gaseous diffusion process for use in commercial nuclear power reactors until 2001 when they stopped production. USEC Government Services initiated the return of PORTS to DOE in 2009, and the process was completed on September 30, 2011. USEC, Inc. now operates a gaseous centrifuge uranium enrichment plant at PORTS. The USEC, Inc. Lead Cascade, a small-scale demonstration centrifuge for uranium enrichment, has been in operation since 2006 in PORTS facilities that were intended for DOE's Gaseous Centrifuge Enrichment Plant, which was cancelled in 1985.

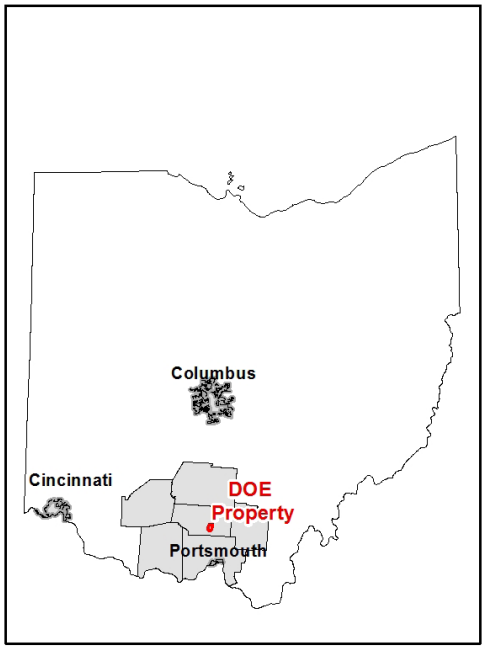
This is an annual report on regulatory compliance, environmental programs, radiological and non-radiological programs, groundwater programs, and quality assurance. Also, it shows the means of satisfying radiation protection requirements of DOE Order 458.1, Radiation Protection of the Public and the Environment. The report is not made to show all data of PORTS; this information is found in separate documents such as *2011 Groundwater Monitoring Reports* and *2011 Annual Hazardous Waste Report*. For more detail, please refer to the *U.S. Department of Energy Portsmouth Gaseous Diffusion Plant Annual Site Environmental Report (ASER) – 2011*. It should also be


Stream
Quadrants
Ponds
TCE Plume
Process Buildings
Site Boundary
N
W
E
S
QIV
QII
QIII
QI
Perimeter Road

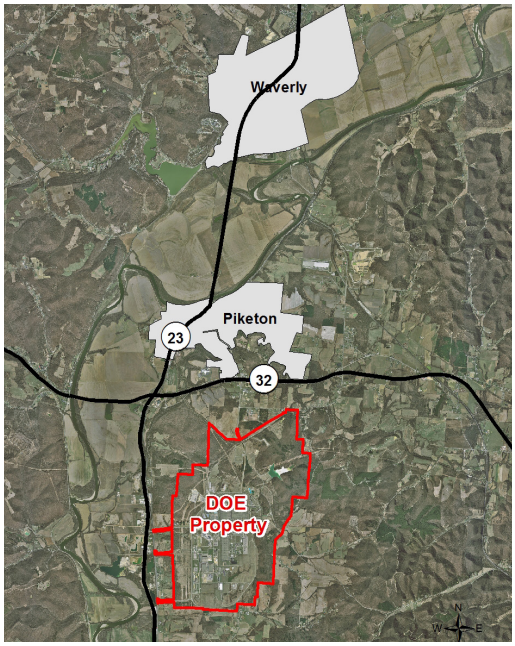
noted that, because this is a summary of the 2011 ASER, the report may refer to some facilities that have since been demolished as still being in use.

PORTS is located in rural Pike County, Ohio, on a 5.9-square-mile site. The site is 2 miles east of the Scioto River. The county contains a number of small villages such as Piketon and Beaver that lie within a few miles of the plant. Waverly is the largest community in the county. The nearest residential center is Piketon, which is about 5 miles north of the plant. Additional nearby cities are Portsmouth, Chillicothe, and Jackson.

DOE is responsible for D&D of the gaseous diffusion uranium enrichment buildings and associated facilities, environmental restoration, and waste management associated with DOE activities. DOE is also responsible for uranium management, which includes the DUF_6 Conversion Facility.



Map: Matt Trainer, Voinovich School of Leadership and Public Affairs



Map: Matt Trainer, Voinovich School of Leadership and Public Affairs

2. Compliance Summary

In 2011, DOE and/or the responsible DOE contractors (LPP, FBP, BWCS, or UDS) held permits for water discharge to surface streams, air emissions, and a permit to store hazardous wastes. The National Pollutant Discharge Elimination System (NPDES) outfalls and air emission permits transferred from USEC to FBP in 2011. DOE contractors are responsible for numerous reports on compliance with environmental regulations. Information from many reports is covered in this chapter.

DOE activities at PORTS are regularly inspected by various agencies responsible for enforcing environmental regulations. DOE or DOE contractors received three Notices of Violations in 2011:

- In April, Ohio Environmental Protection Agency (EPA) saw a release of used oil at the X-630 site violating used oil storage regulation. In response, FBP removed and disposed of oil-saturated material and gravel, and absorbent material was placed around the site to catch any remaining oil. By the end of April, the Ohio EPA stated that FBP abated the violation. Documentation of the cleanup was provided to Ohio EPA.
- In June, a DOE violation was reported by the U.S. and Ohio EPA: failure to label containers of used oil and used florescent lamps. The violation was immediately abated by labeling the containers.
- In August, LATA/Parallax Portsmouth, LLC (LPP) received a Notice of Violation from the Utah Radiation Control Board for a shipment of three 85 gallon drums of radioactive waste, which exceeded the facility's waste acceptance criteria. A civil penalty of $10,000 was assessed by the Board and paid by LPP. The waste was shipped to another facility.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

PORTS is not on the CERCLA National Priorities List of sites requiring priority cleanup. However, D&D at PORTS is proceeding in accordance with CERCLA and the D&D DFF&O *(Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action)*, which describes the regulatory process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use. CERCLA requires notification to the National Response Center if hazardous substances are released to the environment in amounts greater than or equal to the reportable quantity. No releases from DOE contractors were subject to this requirement in 2011.

Artwork by Paige Sanders

Compliance Status

The Emergency Planning and Community Right-To-Know Act is also known as the Superfund Amendments and Reauthorization Act Title III. The Act requires reporting of emergency planning information, hazardous chemical inventories, and releases to the environment.

In accordance with the *Toxic Chemical Release Inventory*, which requires reporting of releases to the environment of

specified chemicals when they are used by the entire site in amounts exceeding threshold amounts specified by the EPA, DOE contractors reported the release, off-site transfer, and/or on-site treatment of 9 chemicals in 2011:

- Chlorine for water treatment
- Dichlorotetrafluoroethane (CFC-114), 6,000 lbs released to the air from the gaseous diffusion cascade system
- Hydrogen fluoride, 3 lbs released to the air from the DUF_6 Conversion Facility and 35 lbs treated off-site
- Lead compounds, about 8 lbs released from burning coal and 547 lbs in materials disposed or recycled off site
- Methanol, about 175 lbs released from air emissions and 52 lbs released to the Scioto River through NPDES outfalls from water treatment
- Nitrate compounds, about 31,000 lbs released to the Scioto River through NPDES outfalls from water treatment
- Nitric acid, about 200 lbs released to the air from burning coal
- Sulfuric acid, about 34,000 lbs released to the air from burning coal

The Resource Conservation and Recovery Act (RCRA) regulates the generation, accumulation, storage, transportation, and disposal of solid and hazardous wastes. Hazardous wastes are a subset of solid wastes that are identified by the Ohio EPA. This is done because of the hazardous materials' chemical properties including toxicity, reactivity, corrosivity, and ignitability.

During 2011 LPP and DOE were allowed to store hazardous waste in designated areas. The Ohio EPA permit was then transferred to DOE and FBP in March 2011. The permit is called Part B Permit. It was issued to DOE and DOE contractors in 1995, renewed in 2001 and again in 2011, expiring in 2021. This permit includes regulations for the storage of hazardous wastes, waste identification, inspections of storage areas and emergency equipment, emergency procedures, training requirements, and other regulations.

Facilities like PORTS that generate or store hazardous wastes are required to submit an annual report to Ohio EPA. These reports contain the name and address of each facility that waste was shipped to during the last year, the name of the transporter, and the description of waste minimization efforts. DOE submitted their report for 2011 in the beginning of 2012. RCRA requires groundwater monitoring at certain hazardous waste management units. All of the requirements for groundwater monitoring have been made into one document called the *Integrated Groundwater Monitoring Plan*. These reports are submitted to Ohio EPA.

Waste that is a mixture of RCRA hazardous waste and low-level radioactive waste is stored at PORTS. The Federal Facility Compliance Act allows for storage of hazardous waste for longer than one year because treatment for this type of waste is not readily available. An annual update to the required Site Treatment Plan for fiscal year 2011 was submitted to Ohio EPA in December, 2011.

The Toxic Substances Control Act (TSCA) regulates the use, storage, and disposal of polychlorinated biphenyls (PCB), which are most commonly found in older electrical components like transformers and capacitors. Many PCB transformers and capacitors have been removed and there were only eight in service at the end of 2011. An annual document log is prepared in order to meet TSCA requirements and provides an inventory of PCB items that

are still in use. Over 800 tons of PCB waste was generated and shipped off site in 2011.

Annual reports of progress toward milestones specified in the Federal Facilities Compliance Agreement are submitted to U.S. EPA. DOE was in compliance with the requirements in 2011.

DOE Order 458.1 provides guidance and establishes radiation protection standards and control practices designed to protect the public and the environment from undue radiological risk from operations of DOE and DOE contractors. Chapter 4 provides the dose calculations and monitoring results that demonstrate compliance with these DOE Orders. The objective of DOE Order 435.1 is to ensure that radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment. Low-level radioactive waste is generated and stored in accordance with the *Authorization Agreement and Radioactive Waste Basis for Portsmouth Gaseous Diffusion Plant Facilities and Material Storage Areas* and its implementing procedures.

Clean Air Act, Title VI, Stratospheric Ozone Protection

DOE made a record keeping system with labels and forms to comply with Title VI record-keeping and labeling requirements. These requirements affect all areas that use ozone-depleting substances in units or devices. Technicians who service air conditioning/refrigeration units under DOE are trained in accordance with U.S. EPA requirements. Dichlorotetrafluoroethane, an ozone-depleting substance, was used as coolant and is present in the gaseous diffusion cascade system formerly used to produce enriched uranium. In 2011, approximately 6,000 pounds of the substance were released to the air.

Artwork by Tifany Frazier

The National Emissions Standards for Hazardous Air Pollutants requires DOE to submit an annual report that shows the radiological emissions from air emission sources. In 2011, air emission sources were returned to DOE from USEC. FBP is now responsible for those sources. The sources monitored room ventilation exhausts and pressure relief vents associated with various buildings. Additionally, DOE and LPP/FBP are responsible for five sources of radionuclide emissions transferred from LPP to FBP in March of 2011. Radiological air emissions from FBP sources in 2011 were 0.145 curie (Ci).

DOE and BWCS/ Uranium Disposition Services, LLC (UDS) were responsible for emissions from the DUF_6 Conversion Facility. Emissions from the Facility are based on the annual emissions allowed in the permit for the facility. Radiological air emissions from the DUF_6 Conversion Facility in 2011 were 0.0000042 Ci.

Clean Water Act

Responsibility for the permits that allow discharge of water to streams was transferred to FBP and BWCS on March 29, 2011. FBP became responsible for the majority of the NPDES outfalls, which were formerly the responsibility

of USEC, on September 1, 2011. At the end of 2011, FBP was responsible for 18 monitoring locations. The BWCS NPDES permit allows the discharge of process wastewaters from the DUF_6 Conversion Facility. Data required to demonstrate compliance with the NPDES permits are submitted to Ohio EPA in monthly operating reports. The overall BWCS NPDES compliance rate for 2011 was 96%. The BWCS outfall is not monitored for radionuclides. Storm water runoff is regulated under the Clean Water Act. *A Stormwater Pollution Prevention Plan* is prepared for construction activities covered by the NPDES Construction Stormwater General Permit.

In 2011, FBP became responsible for operation of the PORTS drinking water system, formerly operated by USEC. The Safe Drinking Water Act sets requirements for water testing, treatment, and disinfection, as well as distribution system maintenance and operator training. PORTS obtains its drinking water from two water supply well fields west of PORTS in the Scioto River Valley buried aquifer near the Scioto River. Sampling results are submitted to Ohio EPA in a monthly report.

The Underground Storage Tank Program is managed in accordance with the *Ohio State Fire Marshal's Bureau of Underground Storage Tank Regulation*. Tanks include six diesel fuel tanks ranging in size from 500 to 20,000 gallons and a 20,000 gallon gasoline tank.

The National Environmental Policy Act requires evaluation of the environmental impacts of activities at federal facilities and of activities funded with federal dollars. Restoration actions, waste management, enrichment facilities maintenance, and other activities are evaluated to determine the appropriate level of evaluation and documentation. Routine operation and maintenance activities are also evaluated to assess potential environmental impacts. Most of these activities at PORTS qualify for a categorical exclusion as defined in the regulations. The activities are considered routine and have no significant individual or cumulative environmental impacts. Categorical exclusions are posted on the DOE Portsmouth/Paducah Project Office website for 2011 (www.pppo.energy.gov).

The Endangered Species Act provides the protection and designations of endangered animals and plants, as well as the species' habitat. When appropriate, formal consultations are made with the U.S. Fish and Wildlife Service and the Ohio Department of Natural Resources. An endangered species survey was done on Indiana bats; none were found at PORTS. No additional activities were completed in 2011.

The National Historic Preservation Act governs the protection of cultural resources. DOE is working with the Ohio Historic Preservation office to decide how to document the history of the buildings and areas that are part of D&D. In 2011, site surveys were completed in 51 farmsteads throughout the undeveloped PORTS property. These farmsteads were evaluated to see if they have information on settlements in the late 1800s and early 1900s in Appalachian Ohio. None of the sites were eligible for inclusion on the National Register of Historic Places. Also underway in 2011 are site surveys for prehistoric Native American activity.

DOE Order 450.1A, *Departmental Sustainability*, was replaced by DOE Order 436.1, *Environmental Protection Program*, during 2011. Both DOE orders require development and implementation of an Environmental Management System (EMS). An annual EMS report is prepared in order to document DOE's progress, performance, and success in implementing the EMS at PORTS. The report identifies top priorities like evaluating opportunities for energy efficiency, cleaning up environmental contamination, removing inactive facilities, and reducing inventory of waste. The latest report stated that 80% or more of the objectives, targets, and programs were on schedule to be met.

3. Environmental Program Information

Decontamination & Decommissioning Program

The DFF&O, an agreement between DOE and Ohio EPA, governs the D&D process of gaseous diffusion process buildings and associated facilities under one of two processes. The DFF&O uses the CERCLA outline for determining suitable removal and remedial actions. The DFF&O requires that DOE provide a Community Relations Plan, which shows opportunities to give information to the public and get public input.
The DFF&O requires that buildings be evaluated by: engineering evaluations/cost analysis (and action memoranda for less complex facilities); a remedial investigation/feasibility study (RI/FS) and a record of decision for process buildings and complex facilities; and an RI/FS and record of decision for evaluation and selection of alternatives for site-wide waste disposition.

Smaller, less complex PORTS buildings undergo D&D under the process for non-time critical removal actions. This includes a site evaluation determining anticipated wastes, volumes, and any release of hazardous substances. The Ohio EPA reviews and concurs with these documents, followed by an engineering evaluation/cost analysis, and finally a public comment period commences. Then, an action memorandum is issued with a responsiveness summary to address public comments. The removal of two groups of buildings continued in 2011.

Artwork by Cheyanne Pickett

The most complex of the buildings to be removed under the DFF&O are buildings that must be addressed by the RI/FS process and include the three gaseous diffusion process buildings and four additional buildings.

The RI/FS work plan details the tasks to be completed to standards, determines waste generated, assesses the risk to human health and environment, and evaluates potential alternatives. The RI/FS report provides results of the work plan. Ohio EPA reviews and provides concurrence for the pre-investigation evaluation report, RI/FS work plan, and RI/FS report. A proposed plan is made available for public comment and a record of decision is issued with a responsiveness summary to address public comments; then remedial action is selected by DOE and Ohio EPA.

Site-wide waste disposition

This portion of D&D evaluates off-site/on-site waste disposition alternatives for waste generated. The on-site disposal alternative involves construction of an on-site waste disposal facility. The waste disposition project follows a similar process as D&D. Development of waste acceptance criteria for an on-site waste disposal facility is included as part of the RI/FS work plan.

Pre-D&D activities

In 2011, due to small size and simplicity, four buildings were removed as pre-D&D actions under the DFF&O. An investigation to identify soil contamination associated with the buildings was also completed.

Environmental Restoration Program

The Environmental Restoration Program was established by DOE in 1989. It is used to identify, control, and remediate the contamination at PORTS. Assessment and investigation of PORTS under the RCRA corrective action process was completed in the 1990s. Since PORTS is so large, it is divided into quadrants. Remedial actions have been implemented in each quadrant.

Quadrant I

The *First Five-Year Review for the X-749/X-120 Groundwater Plume*, submitted to Ohio EPA in January 2011, found that remedial actions were achieving objectives by preventing migration of contaminants from the X-749 Landfill and controlling the migration of contaminants from the Landfill and the groundwater plume. However, Ohio EPA and DOE agreed that the phyotoremediation system was not as successful as expected. Phytoremediation is a process that uses plants to remove, degrade, or contain contaminants in soil and/or groundwater. Extraction wells in the groundwater collection trench and barrier walls on the south and east sides of the X-749 Landfill are mostly responsible for reductions in trichloroethylene (TCE) in the X-749/X-120 groundwater plume.

Photograph courtesy of Fluor-B&W Portsmouth

In the *Second Five-Year Review for the X-749B Peter Kiewit (PK) Landfill*, completed in 2008, it was found that remedial actions at the PK Landfill, including groundwater collection systems and a landfill cap, had decreased concentrations of contaminants in PK Landfill wells, sumps, and manholes significantly from 1999 to 2007. The next review of PK Landfill remedial actions will be submitted to Ohio EPA in 2013.

The report, the *First Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegrading Plots*, completed in 2008, shows that remediation activities eliminated potential exposure pathways to contaminants and reduced groundwater concentrations of TCE, although more slowly than expected. The next review of remedial actions at the Quadrant I Groundwater Investigative Area and X-231 A/B Oil Biodegradation Plots was submitted to Ohio EPA in 2013.

The X-760 Chemical Engineering Building and the X-770 Mechanical Testing Facility were removed in 2010 and 2007, respectively, and contaminated soil was removed from the south and east sides of the X-770 building. Contaminated soil was identified on the north and west sides of the X-760 building, but will be left in place until cleanup plans are made for the whole Quadrant.

Quadrant II

TCE was detected in soil and groundwater at the Quadrant II Investigative Area. In 2010, Ohio EPA approved an interim remedial measure (IRM) for the area: Enhanced anaerobic bioremediation, which uses injections of fermentable carbon compounds to provide additional food for naturally occurring microorganisms in soil that degrade TCE so that it is no longer harmful. The project continues into 2012.

Photograph courtesy of Fluor-B&W Portsmouth

An IRM approved for the X-701B Holding Pond, where contaminated soil was excavated to inject oxidant directly, was completed in 2011. TCE concentrations decreased in soil samples, but groundwater for wells that monitor the IRM area show a rebound in groundwater TCE concentrations.

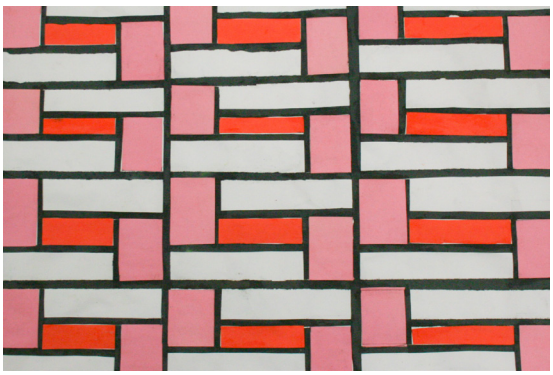
The X-633 Recirculating Cooling Water Complex was demolished in 2010 using funding provided by the American Recovery and Reinvestment Act. A soil and groundwater investigation was implemented in 2011. Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals. DOE agreed to sample eight wells around the area through 2012 to continue evaluation of chromium and TCE groundwater in this area.

Quadrant III

The *Supplemental Evaluation to the Five-Year Evaluation Report for the X-740 Phytoremediation System*, submitted to Ohio EPA in 2007, showed that over 700 hybrid poplar trees on a 2.6 acre area had not performed as expected to remove TCE from groundwater. Enhanced anaerobic bioremediation took place in December 2010 and January 2011. Groundwater samples were collected throughout 2011.

Quadrant IV

No new remedial actions were required in Quadrant IV as of 2000 (remedial actions had already taken place at the X-344D Hydrogen Fluoride Neutralization Pit, X-735 Landfills, X-611A Former Lime Sludge Lagoons, and X-734 Landfills). Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals. DOE sampled four wells around that area through 2012 to continue evaluation of chromium and TCE in groundwater in this area.



Artwork by Owen Strong

Waste Management Program

The DOE Waste Management Program directs safe storage, treatment, and disposal of waste created by past and present operations and from current D&D and Environmental

Restoration projects at PORTS. In 2011, about 16,000 tons of waste from DOE activities at PORTS were recycled, treated, or disposed of at off-site locations.

Waste management requirements are complex because of the variety of waste streams made by DOE activities at PORTS. Waste management must be able to demonstrate compliance with DOE orders, Ohio EPA regulations, and U.S. EPA regulations.

Photograph courtesy of Fluor-B&W Portsmouth

Policies for management of radioactive, hazardous, and mixed wastes include:

- minimizing waste generation;
- characterizing and certifying wastes before they are stored, processed, treated, or disposed;
- pursuing volume reduction (like blending, bulking) as well as on-site storage in preparation for safe and compliant final treatment and/or disposal; and
- recycling.

Environmental Sustainability Program

DOE commits to reducing environmental risks, costs, wastes, and future liability by utilizing environmental sustainability principles in DOE activities at PORTS in a cost effective and environmentally conscious manner. The DOE Environmental Sustainability Program is a balanced, holistic approach that links planning, budgeting, measuring, and improving PORTS overall environmental performance to specific goals and outcomes. The Program includes elements of pollution prevention, wastes minimization, affirmative procurement, sustainable design, and energy/water efficiency.

DOE works hard to minimize/eliminate the amount and type of waste made and to achieve reduced life cycle costs for managing and disposing property and waste during DOE's projects and activities at PORTS. These objectives of the Environmental Sustainability Program reduce the life cycle cost and liability of DOE programs and PORTS operations:

- eliminating, minimizing, or recycling wastes that would otherwise require storage, treatment, disposal, and long term monitoring and surveillance;
- eliminating/minimizing use of toxic chemicals and associated environmental releases that would otherwise require control, treatment, monitoring, and reporting;
- maximizing the use of recycled content materials and environmentally preferable products/services, thereby minimizing the economic/environmental impacts of managing by-products and wastes generated in the conduct of mission-related activities; and
- reducing the life-cycle cost of managing personal property at PORTS.

The following are accomplishments from fiscal year 2011:

- a 4.6% decrease in greenhouse gas emissions versus fiscal year 2008;
- 8.4% of electricity consumption from renewable energy sources;
- an increase in the number of alternative fuel vehicles to 69.6%;
- set duplex printing as default when possible to decrease paper usage; and
- implemented power management features on all eligible computers, printers, copiers and monitors to decrease energy use.

Environmental Training Program & Public Awareness Program

DOE contractors at PORTS provide environmental training to increase employee awareness of environmental activities and to enhance the knowledge/qualifications of personnel performing tasks associated with environmental assessment, planning, and restoration. A comprehensive community relations and public participation program is also in place at PORTS. The purpose of the program is to foster a spirit of openness and credibility between PORTS officials and local citizens, elected officials, business, media, and various segments of the public. The PORTS Site Specific Advisory Board is made up of 20 local citizens and provides public input and recommendations to DOE. In 2011, the PORTS Envoy Program was established to match employee volunteers with community stakeholders, like those living close to the PORTS facility. The envoys are able to communicate information about PORTS D&D. The following are information sources for the public:

- Environmental Information Center: portseic@wems-llc.com 740.289.8898
- DOE Portsmouth/Paducah Project Office: www.pppo.energy.gov
- DOE Site Office (Environmental Management Program): 740.897.5010
- Office of Public Affairs (Environmental Management Program): 740.897.3486

4. Environmental Radiological Program Information

Environmental monitoring at PORTS is designed to detect the effects of PORTS operations on human health and the environment. Specific radionuclides monitored are selected based on the materials handled at PORTS, and also on historic monitoring data. This section will show the potential radionuclide doses released from PORTS. The National Emission Standards for Hazardous Air Pollutants (NESHAP) sets an annual dose limit of 10 mrem/year to any member of the public as a result of airborne radiological releases. DOE Orders set an annual dose limit for all radionuclides from any facility to a member of the public as 100mrem/year. The table below summarizes the findings of this section.

Table 1: Summary of potential doses to the public from PORTS in 2011

Source of dose	Dose (mrem/year)
Airborne radionuclides	0.032
Radionuclides released to the Scioto River	0.012
Direct radiation from cylinder storage yards	0.81
Radionuclides detected by environmental monitoring programs (sediment, soil, vegetation, crops, deer, drinking water)	0.42
Total	**1.3**

Radiological Emissions and Doses

Exposure to radioactive materials can occur from releases to the atmosphere, surface water, or groundwater and from exposure to direct radiation from buildings or other objects. A dose is a measure of the potential biological damage that could be caused by absorption of radiation to the body. Doses are estimated for exposure to atmospheric releases, direct radiation and releases to surface water from PORTS in 2011. Doses are also estimated for sediment, soil, vegetation, crops, deer and drinking water. Groundwater is not included because contaminated groundwater at PORTS is not a source of drinking water.

Most consequences of radionuclides in the environment are caused by interactions with human tissue and different types of radiation emitted from radionuclides. Three natural uranium isotopes and technetium-99 are the most commonly detected radionuclides around PORTS. There are different specialized measurement units for characterizing exposure to radiation. The units are defined by the amount of ionizing radiation absorbed by human/animal tissue and in terms of biological consequences of the absorbed energy. These units include:

- Absorbed dose- quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Measured in units of rad or gray (1rad = 0.01 gray).
- Dose- the product of the absorbed dose in tissue and a quality factor. Measured in rem or sievert (1 rem = 0.01 sievert).

- Effective dose- sum of the doses received by all organs/tissues in the body after being multiplied by a weighting factor.
- Collective dose/Collective effective dose- the sum of all doses of all individuals in an exposed population. Expressed in units of person-rem or person-sievert. Also called "population dose."

Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the Clean Air Act of NESHAP. Emissions from the DOE/FBP sources in 2011 were calculated at 0.041Ci. Emissions from the DOE/BWCS sources in 2011 were calculated at 0.0000042Ci. USEC reported emissions of 0.0000122Ci from the Lead Cascade.

Artwork by Katie Shreck

Dose Calculations Based on Airborne Emissions

Dose calculations are required for radionuclides by the U.S. EPA under NESHAP. The effects of radionuclides in 2011 were characterized by calculating the effective dose to the maximally exposed person and to the entire population within 50 miles of the plant. The maximum potential dose to an off-site individual from radiological releases in 2011 was 0.032 mrem/year. The combined dose from USEC and DOE sources is also 0.032 mrem/year. This dose is well below the 10-mrem/year limit applicable to PORTS and the approximate 311-mrem/year dose that the average individual in the United States receives from natural sources of radiation (National Council Radiation Protection, 2009). The population dose from PORTS emissions was .35 person-rem per year (the average population dose to all people within 50 miles of PORTS from the ingestion of naturally-occurring radionuclides in water and food is about 19,630 person-rem per year).

Dose Calculations Based on Ambient Air Monitoring

DOE collects samples from 15 ambient air monitoring stations and uses them to analyze the radionuclides that could be in ambient air from PORTS activities. These radionuclides are isotopic uranium, technetium-99 and selected transuranic radionuclides. The net dose for each station ranged from 0 (at stations with a lower dose than the background station) to 0.0012 mrem/year. The highest net dose is significantly less than the 10 mrem/year NESHAP limit for airborne radiological releases and 100 mrem/year DOE limit for all radiological releases from a facility.

Discharge of Radionuclides from FBP Outfalls

At the end of 2011, FBP was responsible for 18 monitoring locations. Discharges of radionuclides in liquid through FBP NPDES outfalls have no significant impact on public health or the environment. Uranium discharges from

FBP external outfalls were estimated at 8.7 kilograms. Techentium-99 was estimated at 0.06 Ci. No transuranics were detected in the FBP outfalls.

USEC Inc. Outfalls

USEC was responsible for three NPDES outfalls. Uranium discharges were estimated at 0.55 kilograms. Technetium-99 was estimated at 0.001Ci. Transuranic radionuclides were not detected in any of the outfalls.

Dose Calculation for Releases to Surface Water

Radionuclides are measured at the FBP and USEC NPDES external outfalls. These outfalls eventually discharge into the Scioto River through Little Beaver Creek or other tributaries. The radionuclides released from PORTS in the Scioto River were measured at 0.012 mrem/year, significantly less than the 100 mrem/year limit.

Radiological Dose Calculation for Direct Radiation

Radiation is emitted from uranium hexafluoride cylinders stored on site at PORTS in the cylinder storage yards near Perimeter Road. Data from direct radiation monitoring at the cylinder yards is used to assess potential exposure to members of the public who drive on Perimeter Road. Environmental radiation is monitored at five locations along Perimeter Road. In 2011 the average dose recorded at the cylinder yards was 818 mrem/year, based on exposure to ionizing radiation for an entire year. The radiological exposure to members of the public is estimated by the time that a person drives on Perimeter Road past the cylinder yards, which is conservatively estimated at 8.7 hours per year. Based on the assumptions, exposure to a member of the public from radiation at the cylinder yards is approximately 0.81 mrem/year. The average annual dose to a person from the United States from all radiation sources is 620 mrem. The potential dose is 0.1 percent of the average yearly dose and is significantly lower than the 100 mrem/year DOE limit.

Radiological Dose Results for DOE Workers and Visitors

The 2,402 total DOE workers monitored in 2011 received and average dose of 0.9 mrem. Only 38 DOE contractors received a measureable dose (10 mrem total effective dose or more). These workers received a measurable dose that averaged 52 mrem.

Radiological Dose Calculations for Off-Site Environmental Monitoring Data

Environmental monitoring at PORTS includes collecting samples from off-site locations and analyzing them for radionuclides that could be present due to PORTS operations, including uranium, uranium isotopes, technetium-99, and/or selected transuranics. Detections of radionuclides in sediment and soil at the PORTS facility are not used to assess risk because the public does not have access to the sampled areas of the facility. In 2011, dose calculations were completed for public exposure to radionuclides detected in sediment, soil, vegetation, crops, deer, and residential water. Table 2 summarizes the results of each dose calculation. Potential doses to the public from radionuclides detected by the PORTS environmental monitoring program in 2011 are significantly less than the DOE limit of 100mrem/year.

Table 2: Summary of potential doses to the public from radionuclides detected by DOE environmental monitoring program in 2011

Source of dose	Dose (mrem/year)
Sediment	0.012
Soil	0.036
Vegetation	0.002
Crops	0.009
Deer	0.19
Drinking Water	0.169
Total	**0.42**

Artwork by Rachelle Chenoweth

Protection of Biota

DOE Order 458.1 sets absorbed dose rate limits for aquatic animals, riparian animals (animals that live on the banks of a river or in wetlands adjacent to a body of water), terrestrial plants, and terrestrial animals. Assessments indicate that the levels of radionuclides detected do not result in a dose of more than 1 rad/day to aquatic animals and terrestrial plants, and 0.1 rad/day to riparian and terrestrial animals.

Ambient Air Monitoring

In 2011, samples were collected from 15 ambient monitoring stations located within and around PORTS, including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant. Radionuclides were detected at each air monitoring station, but at levels well below the DOE derived concentration standards.

Environmental Radiation

DOE measures radiation continuously at 19 locations. Radiation is measured in millirems as a whole body dose, which is a dose that a person would receive if they were continuously present at the monitoring locations. Three locations detected elevated levels of radiation in 2011: location #874, location #862, and location #933. The cumulative whole body doses at these locations were 765 mrem, 140 mrem, and 169 mrem, respectively. The cumulative whole body dose calculated for each of the other 16 locations ranged from 72 to 99 mrem and averaged 91 mrem. DOE has a 100 mrem/year dose limit to the public for radionuclides from all potential pathways. Radiation is measured at 5 locations around the northwest corner of PORTS just inside Perimeter Road. These locations are not accessible to the general public. The cumulative whole body doses at locations #41 and #890 were 280 mrem and 269 mrem, respectively. Locations #874 and #882 cumulatively recorded whole body doses of 753 mrem and 1087 mrem, respectively, and location #868 recorded whole body doses of 1,702 mrem. No administrative guidelines or regulatory dose limits were exceeded in 2011.

Surface Water from Cylinder Storage Yards

Ohio EPA requires monthly collection of surface water samples from four locations. DOE voluntarily collects samples at three additional locations. Samples collected during 2011 were analyzed for alpha activity, beta activity, and uranium. In January 2011, uranium was detected at a maximum (highest) concentration of 17.2 ug/L at sampling location X-745C4. Maximum levels of alpha and beta activity were detected in samples collected in July from the same location at 35.4 and 34.5 pCi/L, respectively. Other detections of alpha and beta activity in 2011 were less than 15 pCi/L. The dose from radionuclides released from the cylinder yards to the Scioto River is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

Local Surface Water

In 2011, local surface water samples were collected from 14 locations upstream and downstream from PORTS. As background measurements, samples were also collected from local streams approximately 10 miles north, south, east, and west of PORTS. Americium-241 and/or plutonium-239/240 were detected at activities ranging from 0.0529 to 0.0756 pCi/L in samples collected from five locations. These detections are below the DOE derived concentration standards for americium-241 and plutonium-239/240 in drinking water. Technetium-99 was detected at 9.05 pCi/L in the second quarter sample collected from Little Beaver Creek, below the DOE derived concentration standard for technetium-99 in drinking water.

Sediment

Sediment samples are collected from the same locations as local surface water samples. Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities. Maximum detections of uranium and uranium isotopes in sediment samples were detected at the background sampling location west of PORTS (RM-10W) and Little Beaver Creek (RM-8). Plutonium-239/340 and neptunium-237 were detected at very low activities ranging from 0.000548 to 0.021 pCi/L in sediment samples collected from three locations on Little Beaver Creek (RM-11, RM-7, RM-8) and one location on Big Beaver Creek (RM-13). Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS. In 2011, technetium-99 was detected in six samples collected. The highest detection (9.58 pCi/g) was at location RM-8, a downstream location on Little Beaver Creek. These detections are consistent with data from previous sampling from 2002-2010 and below DOE standards.

Soil

Soil samples are collected annually from ambient air monitoring locations and analyzed for transuranic radionuclides, technetium-99, uranium, and uranium isotopes in accordance with the DOE *Environmental Monitoring Plan for PORTS.* The highest potential dose to a member of the public resulting from PORTS operations is well below the DOE standard of 100 mrem/year.

Vegetation

Vegetation samples were collected in the same areas where soil samples are collected at the ambient air monitoring

stations. With the exception of uranium-233/234, no radionuclides were detected in vegetation samples collected in 2011. Uranium-233/234 was detected at 0.00785 pCi/g in sample collected from station A41, well below DOE standards.

Biological Monitoring

The DOE Environmental Monitoring Plan for PORTS requires biological monitoring to assess the uptake of radionuclides into local biota.

Deer

Samples of liver, kidney, and muscle from deer killed on site in motor vehicle collisions were collected in January and December of 2011. No transuranics or technetium-99 were detected in the deer samples collected during 2011. Uranium-233/234 was detected at levels ranging from 0.01521 to 0.0251 pCi/g in each of the samples collected from the deer killed in January 2011. The total potential dose to a member of the public from PORTS operations, which includes this dose calculation, is well below the standard of 100 mrem/year.

Fish

Samples from fish caught at downstream locations in the Scioto River, Big Beaver Creek, and Little Beaver Creek were analyzed for radionuclides, along with upstream locations. No radionuclides were detected in the fish samples collected during 2011.

Crops

Crop samples were collected from five off-site locations near PORTS. Americium-241 was detected at 0.0125 pCi/g in the samples collected from one of the off-site locations. Uranium, uranium-233/234, uranium-238 were detected in the crop sample from a different off-site location. The total potential dose to the public is below the DOE standard.

Milk and Eggs

Samples were collected of milk produced by a diary near Waverly and eggs from a farm near Lucasville. No radionuclides were detected in the milk and egg samples collected during 2011.

Release of Property Containing Residual Radioactive Material

In 2011, no DOE property was released to the public that contained radioactive material that exceeded DOE release limits. BWCS began shipment of hydrogen fluoride produced by the DUF_6 Conversion Facility. Just over 39,000 gallons of hydrogen fluoride were shipped off site in 2011, with the average total uranium activity of all shipments at 0.01 pCi/mL, meeting the release limit of less than 3 pCi/mL of total uranium activity.

5. Environmental Non-Radiological Program Information

Environmental programs at PORTS monitor radiological and non- radiological constituents that can be exposed to the environment due to PORTS activities. The DOE specifies non-radiological monitoring requirements for ambient air, surface water, sediment and fish. Environmental permits by Ohio EPA to DOE specify discharge limits, monitoring requirements and requirements for air emissions and water discharges. USEC data covering air, surface water sediment and biota is in this section.

Air emissions that are permitted at PORTS emit non-radiological air pollutants. DOE's ambient air monitoring program measures the fluoride at PORTS monitoring stations within the property boundaries and surrounding areas.

Artwork by Tyler Hale

In 2011, FBP became responsible for air emission associated with old product and support facilities (the sources that were formerly the responsibility of USEC Government Services). The facilities and sources, which include the X-600 Steam Plant boilers, emit non-radiological pollutants but they are what caused DOE to become a major source of air pollutants as defined in *Title 40 of the Code of Federal Regulations, Part 70*.

Due to the high pollution output, FBP was required to conduct the EPA Fee Emission Report instead of their biennial report that was completed when pollution levels were not as high. In 2011, FBP reported 0.155, tons of lead, 54.6 tons of particulate matter, 5.58 tons of organic compounds, 149 tons of sulfur dioxide and 176 tons of nitrogen oxides. This is mostly due to the X-600 Steam Plant.

The DUF_6 Conversion Facility converts DUF_6 into uranium oxide and hydrogen fluoride. Because the DUF_6 Conservation Facility only emits small amounts of pollution, Ohio EPA only required a report every 2 years. BWCS reported less than 10 tons of non-radiological air pollutants and 3 lbs. hydrogen fluoride emitted in the air. Another potential air pollutant present at PORTS is asbestos released by D&D of plant facilities. Asbestos emissions are controlled by a system of work practices. The amount of asbestos removed and disposed is reported to Ohio EPA. In 2011, 251.6 tons (503,164 lbs.) of material contaminated with asbestos were shipped from PORTS.

Ambient Air

Ambient air monitoring stations measure fluoride which occurs naturally in the environment. It could be present due to background concentrations, activities with the former gaseous diffusion process, and operation of the DUF_6 conversion facility. In 2011, 14 or 15 samples of fluoride were collected weekly from air monitoring stations in, around, and including a background monitoring station which is located about 13 miles southwest of the plant.

A monitoring station was removed in Zahn's Corner due to road construction in May 2011 and was not replaced until the end of 2011.

In 2011, fluoride was not detected in more than half of the samples for the ambient air monitoring program. On average, fluoride samples collected at background station A37 were 0.026 micrograms per cubic meter ($\mu g/m^3$). Average fluoride collected around PORTS ranged from 0.021 $\mu g/m^3$ at station A6 in Piketon to 0.042 $\mu g/m^3$ at station A40 that is near the X-100 Administration Building. The concentrations of fluoride in background locations are not different from concentrations near PORTS. There is no set standard for fluoride in ambient air.

Water

Surface and ground water is monitored at PORTS. Non-radiological surface water monitoring primarily consists of sampling water discharges associated with the FBP, BWCS, and USEC, Inc. NPDES-permitted outfalls. PCBs are monitored in surface water downstream from the cylinder storage yard.

At the end of 2011, FBP was responsible for 18 discharge points, or outfalls. This is where water is discharged off site. Ohio EPA selects the chemical parameter that must be monitored at each outfall based on chemical results of water that flows through the outfall, and sets discharge limitations for some of the parameters.

In January 2011, the maximum daily concentration limit for 5-day carbonaceous biochemical oxygen demand (15 mg/L) was exceeded at Outfall 003 (the X-6619 Sewage Treatment Plant) with a sample result of 22 mg/L. This exceedance was the responsibility of USEC because it occurred prior to the outfall's transfer to FBP.

The FBP NPDES background outfall is located at Scioto River. Samples were collected from monitoring points for toxicity for minnows and aquatic life. In November 2011, the maximum limit for acute toxicity for fathead minnows was exceeded at outfall 004 (Cooling Tower Blowdown). The containment came from treating the cooling water to reduce corrosion, scale and algae.

BWCS NPDES Outfall

On March 29, BWCS gained responsibility for the discharge process waste waters from the DUF_6 conversion facility to the West Ditch. Water discharged is monitored for temperature, biochemical oxygen demand, pH, suspended solids, oil and grease, ammonia nitrogen, phosphorus, chlorine, and dissolved solids. This data is given to Ohio EPA monthly. Since 2008, all process waste water is taken to the X-6619 sewage treatment for treatment before exiting through outfall 003.

Discharge limits for total suspended solids were exceeded 14 times due to rain and gatherings in storm sewers. Discharge limits for dissolved solids were also exceeded 4 times in 2011, twice due to an ice melt spill and twice due to rainfall. In 2011, the minimum pH discharge limit was not met seven times, ranging from 6.11 to 6.44 due to malfunctioning pH meter probes. Only precipitation run-off was discharged through the BWCS outfall during 2011. The overall BWCS NPDES compliance rate in 2011 was 96%.

In 2011 and 2012, Ohio EPA and BWCS discussed eliminating the BWCS NPDES permit because process effluents are not discharged through the outfall.

USEC, Inc. NPDES Outfalls

At the end of 2011 USEC Inc. was responsible for two outfalls that discharged directly to surface water and one that discharged to FBP NPDES Outfall 003 before leaving the site. The data was sent in monthly to Ohio EPA and showed no exceedances so the overall USEC Inc. compliance rate with the NPDES permit was 100%.

Cylinder Storage Yards

Filtered and unfiltered surface water samples are collected from X-745C, X-745E, and X- 745G cylinder storage yards, quarterly. PCBs were not detected from the area.

Sediments

In 2011, sediment monitoring at PORTS included local streams, the Scioto River, and drainage basins from the DUF_6 cylinder storage yards.

Samples are collected annually from locations upstream and downstream of PORTS. Two of the detections of PCBs in sediment around PORTS were more than the risk-based concentrations of PCBs for protection of human health developed by U.S. EPA. These detections were in sediment samples collected on site in Little Beaver Creek at monitoring locations RM-11 (258 µg/kg) and RM-8 (303 µg/kg). Investigation and remediation of PCBs in soil and sediment at PORTS will be addressed as part of the environmental remediation of PORTS.

Sediment samples are collected quarterly for PCB analysis from four drainage basins downstream from the X-745C. X745E, and X-745G Cylinder Storage Yards. In 2011, PCBs were found in at least one sample collected from each station up to a concentration of 690 µg/kg. These concentrations are below the 1 ppm reference value set forth in the U.S. EPA Region 5 TSCA Approval for Storage for Disposal of PCB Bulk Product (Mixed) Waste. Only one sample contained total PCBs above the risk-based amount for the protection of human health developed by U.S. EPA Region 9: 220 µg/kg. These locations are on site at PORTS and not accessible to the public.

Biological Monitoring-Fish

In 2011, fish were collected from upstream locations on Big Beaver Creek, the Scioto River, and downstream. Fish samples were analyzed for PCBs. Fish samples included sheephead, bass, small mouth bass, and catfish. PCBs were detected only in the duplicate sample of small mouth bass collected from on-site sampling location RW-8 at an estimated concentration of 347 µg/kg. This detection was compared to the Ohio Fish Consumption Advisory Chemical Limits provided in the State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program (Ohio EPA 2008). The limits of fish consumption are: “unrestricted,” “1 per week,” “1 per month,” “6 per year,” and “do not eat at all.” The detection was above the limit of 1 per week (220 µg/kg), but less than 1 per month (1000µg/kg).

6. Groundwater

In the 1980s, PORTS initiated groundwater monitoring programs. Groundwater monitoring has been conducted in response to state and/or federal regulations, regulatory documents prepared by DOE and Ohio EPA or U.S. EPA, and DOE orders. The Integrated Groundwater Monitoring Plan was developed to address all groundwater monitoring requirements for PORTS. The initial plan was approved by Ohio EPA and implemented at PORTS starting in April 1999. Groundwater monitoring in 2011 was completed in accordance with the Integrated Groundwater Monitoring Plan dated September 2010. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants.

Two water-bearing zones are present beneath PORTS: the Gallia and Berea formations. Gallia is the uppermost water-bearing zone and contains most of the groundwater contamination at PORTS. The Sunbury shale usually separates the deeper Berea formation from the Gallia.

Monitoring Activities

Groundwater monitoring at PORTS includes several activities. Water is collected from groundwater monitoring wells and analyzed to obtain information about contaminants as well as compounds that occur naturally. Level of water, or groundwater elevation, is measured in a number of wells over a short period of time. The groundwater elevations, combined with information about the subsurface soil, can be used to estimate the rate and direction of groundwater flow. The rate and direction of groundwater flow can be used to predict the movement of contaminates in the groundwater and to develop ways to control or remediate groundwater contamination.

Artwork by Ethan Leist

Groundwater Monitoring Areas

The Integrated Groundwater Monitoring Plan requires groundwater monitoring of 12 areas within the quadrants of the site designated by the RCRA Corrective Action Program. Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of volatile organic compounds (primarily TCE) and radionuclides such as technetium-99. The areas containing groundwater plumes are X-749/X-120/PK Landfill, Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility, Quadrant II Groundwater Investigative Area, X-701B Holding Pond, X-740 Waste Oil Handling Facility, and the X-616 Chromium Sludge Surface Impoundment. The monitoring areas that contain groundwater plumes are discussed below.

X-749 Contaminated Materials Disposal Facility/PK Landfill

In the southernmost section of PORTS in Quadrant I, groundwater concerns focus on three containment sources: X-749 Contaminated Material Disposal Facility, X-120 Old Training Facility, and PK Landfill. Ninety-five wells and one sump/extraction were sampled during 2011 to monitor the X-749-/X-120 area. Also in 2011, nine wells, two sumps, and two manholes were sampled to monitor the PK Landfill area.

No TCE or other volatile organic compounds were detected in any of the seven off-site monitoring wells sampled in the second, third, or fourth quarters of 2011. The area within the central portion of the groundwater plume where TCE concentrations are less than 5 µg/L expanded from two wells in 2010 to four wells in 2011. The area of the plume with higher TCE concentrations to the south and west of the Landfill remained detached from the higher TCE concentrations around the landfill and was continuing to decrease.

Artwork by Tetiana Arturivna

In the third quarter, TCE was detected in the samples collected on July 7, 2011, from two wells that are typically outside of the X-749/X-120 groundwater plume. These wells are on the east side of the X-749/X-120 monitoring area, south of the landfill and 200 to 250 feet west of Big Run Creek. To confirm these results, the wells were sampled again on September 7, 2011. TCE was again detected in the two wells. These two wells and eight additional wells on the east side of the monitoring area were sampled in October 2011. Samples were collected monthly in the fourth quarter of 2011 from surface water sampling location BRC-SW02 in Big Run Creek. TCE was present in the samples collected in the fourth quarter of 2011 at an estimated concentration less than 1 µg/l. The 2011 Groundwater Monitoring Report for PORTS includes complete data collected in 2011 for this special sampling. More frequent monitoring of this area was continued in 2012.

Quadrant I Groundwater Investigative Area X-749A Classified Materials Disposal Facility

The Quadrant I Groundwater Investigative Area, also called the Five-Unit Groundwater Investigative Area, consists of a groundwater plume resulting from a number of potential sources of groundwater contamination: the X-231A and X-231B Oil Biodegradation Plots, X-600 Coal-Fired Steam Plant, X-600A Coal Pile Yard, X-621 Coal Pile Runoff Treatment Facility, X-710 Technical Services Building, X-749A Classified Materials Disposal Facility, the X-760 Pilot Investigation Building, and the X-770 Mechanical Testing Facility. The 6-acre X-749A Classified Materials Disposal Facility (also called the X-749A Landfill) is a landfill that operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act. Potential contaminants include PCBs, asbestos, radionuclides, and industrial waste.

Thirty-one wells were sampled in 2011 as part of the monitoring program for the Quadrant I Groundwater Investigative Area. There were no significant changes in TCE concentrations identified for Quadrant I in 2011. Samples from selected wells that monitor the Quadrant I Groundwater Investigative Area were analyzed for

radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235, uranium-236, and/or uranium-238). If detected, radionuclides were present at levels below the preliminary remediation goals.

Under the detection monitoring program for the X-749A Landfill, concentrations of alkalinity, chloride, sodium, sulfate, and total dissolved solids in down gradient Gallia wells are evaluated to monitor potential impacts to groundwater and trends in concentrations of these parameters (alkalinity, chloride, sodium, sulfate, and total dissolved solids). None of the set limits or background concentrations for alkalinity, chloride, sodium, sulfate, and total dissolved solids were exceeded in samples collected in 2011.

Quadrant II Groundwater Investigative Area

This is an area of groundwater contamination with several potential sources. One is the X-701C Neutralization Pit, an open-topped neutralization pit that received process effluents and basement sump wastewater contaminated with TCE and other volatile organic compounds from metal cleaning operations. The pit was removed in 2001, and in 2010, Ohio EPA approved an IRM to remediate containment source areas within the southeastern portion of the groundwater plume. The natural groundwater flow direction in the area is to the east of Little Beaver Creek. The groundwater flow pattern has been changed by use of sump pumps in the basement of the buildings. Thus, the groundwater plume in this area does not spread, but instead flows toward the sumps where it is collected and then treated at the Groundwater Treatment Facility. Eighteen wells are sampled biennially as part of the monitoring program for this area.

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant II Groundwater Investigative Area. The perimeter of the plume did not change in 2011, although concentrations of TCE and other volatile organic compounds within the southeastern portions of the plume changed due to the IRM. Also because of the IRM, some wells that provide routine monitoring of the area were monitored monthly. In the third quarter of 2011, TCE was detected at concentrations above 5 µg/L in two wells on the east side of the Quadrant II Groundwater Investigative Area plume. TCE is not usually detected above this level in the two wells. The concentrations decreased in fourth quarter samples. The increases in TCE may be due to high rainfall in 2011. In other wells, radionuclides were at levels below the preliminary remediation goals if detected.

In 1996, based on historical data for groundwater wells, the X-633 Pumphouse/Cooling Towers Area was identified as an area of concern for potential metal contamination. Based on detections of chromium above the preliminary remediation goal from 1998 to 1999, the area was added to the PORTS groundwater monitoring program. Chromium was detected in both of the X-633 monitoring wells in 2011. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 µg/L: 560 µg/L (second quarter) and 980 µg/L (fourth quarter). Samples collected from well X633-PZ04G also contained chromium but at concentrations well below the preliminary remediation goal. These results are typical for these wells.

X-701B Holding Pond

The X-701B Holding Pond was in use from 1954, the beginning of plant operations, until 1988. The pond was designed for neutralization and settlement of acid waste from several sources. TCE and other volatile organic

compounds were also discharged to the pond. Two sludge retention basins were located west of the holding pond. The X-230J7 Holding Pond received wastewater from the X-701B Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Holding Pond. The yard is approximately 15 acres. RCRA hazardous waste was managed in this area.

Groundwater remediation in the X-701B Holding Pond began in 2006 with oxidant injected into the subsurface through 2008 to remediate volatile organic compounds in soil and groundwater. The X-701B IRM was started in 2009 and completed in 2011 to further address remaining contaminants in soil and groundwater following the oxidant injections. Contaminated soil in the area was removed and mixed with oxidant, along with additional oxidant mixed into remaining soil at the bottom of the excavation.

Generally, concentrations of TCE detected in the eastern portion of the X-701B groundwater plume (the area that was not part of the IRM) and the X-744G area were similar to previous years. In the northeast corner of the monitoring area, however, TCE was detected at 84 µg/L in the third quarter sample collected from one well (LBC-PZ06G) that is located just west of Little Beaver Creek. TCE is not typically detected in this well. TCE was not detected in third quarter samples collected from the two wells closest to LBC-PZ06G. Well LBC-PZ06G, as well as four other wells in the vicinity were sampled in the fourth quarter and analyzed for volatile organic compounds to provide more information about this detection. TCE was not detected in the fourth quarter sample collected from well LBC-PZ06G. TCE was detected in the sample collected at 19 µg/L from well X701-IRMPZ08G which is located on the north side of the East Drainage Ditch in an area where the groundwater plume was not believed to be present.

In the western portion of the monitoring area, TCE was detected in the new monitoring wells installed in the IRM area at concentration similar to those detected in groundwater prior to the IRM. Samples from five wells in or near the X-744G Bulk Storage Building and the X-744Y storage yard were analyzed for cadmium and nickel, which were detected in three of the five wells at levels above the preliminary remediation goals.

X-740 Waste Oil Handling Facility

The former X-740 Waste Oil Handling Facility, which was demolished in 2006, was located on the western half of PORTS south of the X-530A Switchyard in Quadrant III. It was used to store waste oil and solvents that came from a variety of plant operations and maintenance work. From 1986 and 1990 a sump pump was used to collect the oil and solvents. In 1991, the facility and the sump were identified as hazardous waste units. A contaminated groundwater plume consisting of primarily TCE is located near the X-740 Waste Oil Handling Facility in Quadrant III.

Twelve monitoring wells were sampled in the second, third, and fourth quarters of 2011, including six new monitoring wells installed for a pilot study on enhanced anaerobic bioremediation which was started in 2010 and continued throughout 2011.

The perimeter of the X-740 groundwater plume did not change significantly in 2011, although concentrations of TCE and other volatile organic compounds within the plume changed due to the remedial activities. TCE decreased in well X740-18G, which is within the treatment area, but TCE did not decrease in well X740-22G,

which is down gradient from the treatment area. TCE also decreased in well X740-03G, within the treatment area. Well X740-03G typically has the highest concentrations of TCE detected in the X-740 monitoring area.

X-616 Chromium Sludge Surface Impoundment

The X-616 Chromium Sludge Surface Impoundments are two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by treatment of water from the PORTS process cooling system. Sludge containing chromium was produced by the water treatment system and was pumped into and stored in the X-616 impoundments. Seven wells are sampled annually and nine wells are sampled biennially as part of the monitoring program for this area. Monitoring results for the X-616 Chromium Sludge Surface Impoundments in 2011 show chromium was detected above the preliminary remediation goal of 100 µg/L in one well that monitors the X-616 area: well X616-05G (on the northeastern boundary of the area). Nickel was detected above the preliminary remediation goal in two wells. Volatile organic compounds were detected at low levels in nine wells, with only three wells showing levels above the preliminary remediation goals.

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Additional Monitoring

The X-611A Former Lime Sludge Lagoons took up 18 acres and were constructed in a low-lying area that included Little Beaver Creek. As a result, 1,500 feet of Little Beaver Creek was relocated around it. The RCRA Corrective Action Program required prairie habitats to be made over the area. Six wells are sampled semiannually as part of the monitoring program for the presence of beryllium and chromium in the area. In 2011 chromium was detected in 4 out of 6 wells. The detection of chromium at 110 µg/L in the first quarter sample collected from well X611-01B was the first detection of chromium that exceeded the preliminary remediation goal (100 µg/L) since the current monitoring program began in 1999. Previous concentrations of chromium in well X611-01B did not exceed 15 µg/L. The concentration of chromium detected in well X611-01B in the third quarter decreased to 7.6 µg/L. Monitoring results for the X-735 Landfill show concentrations of three metals (cobalt, mercury, and nickel) and five indicator parameters (alkalinity, chloride, sodium, sulfate, and total dissolved solids) detected in down gradient Gallia wells. The results are compared to concentration limits based on drinking water standards or site background concentrations. None of these concentration limits were exceeded in 2011.

X-734 Landfills are also monitored. In 2011, only vinyl chloride was detected above the preliminary remediation goal (2 µg/L). Vinyl chloride was detected at 2.4 µg/L in the second quarter sample collected from well X734-23G. Vinyl chloride is routinely detected in this well at concentrations just above or below 2 µg/L. Samples from the X-734 monitoring wells were also analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235, uranium-236, and uranium-238). If detected, radionuclides were present at levels below the preliminary remediation goals.

Three wells are sampled semiannually for cadmium and nickel in the X-533 Switchyard Area. Each of the well samples contained these nickel and cadmium at concentrations above the preliminary remediation goals (6.5 µg/L

for cadmium and 100 µg/L for nickel). Concentrations of cadmium detected in the wells ranged from 10 to 54 µg/L, and concentrations of nickel detected in the wells ranged from 150 to 590 µg/L.

The Former X-344C Hydrogen Fluoride Storage Building is also monitored. One volatile organic compound, cis-1,2-dichloroethene, was detected at 2 µg/L in the sample collected in the first quarter of 2011, which is less than the preliminary remediation goal of 70 µg/L. This detection is consistent with the data collected at this well in 2009 and 2010.

Surface Water Monitoring

Surface water monitoring is conducted in conjunction with the groundwater assessment monitorings to find out if there are contaminants from groundwater in the surface water. Samples were taken from Little Beaver Creek, Big Run Creak, the Southwestern Drainage Ditch, North Holding Pond, and both the West and East Drainage Ditches. In 2011, concentrations of various volatile organic compounds, such as bromodichloromethane, bromoform, chloroform, and dibromochloromethane, were found in the samples but in very low concentrations below Ohio EPA standards. TCE was detected but at levels below the applicable Ohio EPA water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin. Some transuranics such as Americium-241 and Plutonium-239/240 were detected above the minimum detectable activity but less than the laboratory reporting limit. No other transuranics were detected in the surface water samples collected during 2011. Technetium-99 detected was well below the Ohio EPA drinking water standard. Uranium was routinely detected in 2011 surface water at low concentrations, which were also well below the DOE derived concentration guide.

Water Supply Monitoring

There were six residential water supply sources that participated in the monitoring program in 2011. They are sampled semiannually. TCE was found in a sample from RES-17 (one of the residential sites) in 2011. This residential water supply was added into the program in 2009 and TCE was routinely found since then. Amounts found were less than the drinking water standard for TCE. Samples were also tested for transuranics. The total potential dose of transuranics to a member of the public resulting from PORTS operations (1.3 mrem/year), which includes this dose calculation (0.169 mrem/year), is well below the DOE standard of 100 mrem/year. No other organic chemicals were found in the other residential water supply locations during 2011.

DOE Order Monitoring Programs

One of the DOE surveillance monitoring programs at PORTS is Exit Pathway Monitoring. Exit Pathway Monitoring shows the effect of the facility on off-site surface water and groundwater quality. TCE was detected at the Southwestern Drainage Ditch and Big Run Creek below the levels accepted.

Around 34 gallons of TCE was removed from 34 million gallons of water by the Groundwater Treatment Facilities in 2011. Processed water is discharged through outfalls before exiting PORTS.

7. Conclusion

The DOE PORTS facility has many Federal regulations that must be followed. There are also regular inspections of the facility including 15 inspections in 2011 by federal, state or local agencies. Environmental monitoring includes collecting samples at off-site locations and analyzing the samples for radionuclides that could be present due to PORTS operations. Routine monitoring of six private residential drinking water sources is completed at PORTS to determine whether these water sources have been adversely affected by plant operations. Fish samples were analyzed and PCBs were detected only in the sample from on-site sampling location RW-8 at a concentration above the 1 per week maximum limit and below the 1 per month maximum limit as defined by *the State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program* (Ohio EPA, 2008). The DOE waste management program directs safe storage, treatment, and disposal of waste. DOE is focused on decommissioning and decontaminating the PORTS property. Monitoring includes the following important results:

Artwork by Morgan Conley

- The maximum potential dose to a person from off-site of the property from radiological releases to the air in 2011 was .032/mrm, which is well below the 10-mrem/year limit applicable to PORTS and the approximate 311-mrem/year dose that the average individual in the United States receives from natural sources of radiation (National Council Radiation Protection, 2009).

- TCE has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the Ohio EPA drinking water standard of 5 µg/L for the 2011 monitoring year.

Definitions

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

Biota – animal and plant life characterizing a given region.

Centrifuge – piece of equipment that rotates around a fixed axis to separate isotopes in nuclear power and nuclear weapon programs (U.S. Centrifuge Systems, 2012).

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.

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."

Effluent – a liquid or gaseous waste discharge to the environment.

Gaseous diffusion – technology used to produce enriched uranium by forcing gases through a porous barrier (United States Nuclear Regulatory Commission, 2011).

Ionizing radiation – radiation that has enough energy to remove electrons from substances that it passes through, forming ions (U.S. DOE, 2004).

Isotope – form of an element having the same number of protons but differing numbers of neutrons in their nuclei.

Radionuclide – 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.

Rem – unit of radiation dose that reflects the ability of different types of radiation to damage human tissues and the susceptibility of different tissues to the damage (U.S. DOE, 2004).

Remediate – correction or cleanup of a contaminated site.

Stratospheric Ozone – the "good" ozone layer that extends upward from about 6 to 30 miles and protects life on Earth from the sun's harmful ultraviolet (UV) rays. This natural shield has been gradually depleted by manmade chemicals, allowing more UV radiation to reach the ground and leading to more health and environmental problems (U.S. EPA, 2010).

Switchyard complex – enclosed area used as the distribution center where power is supplied to the plant from the outside, and power is sent from the plant (Peak Power Engineering, 2012).

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.

Uranium cylinders – containment vessel with a flat bottom and a domed top that is used to store uranium (U.S. Department of Energy, 2004).

Acronyms and Abbreviations

ACP	American Centrifuge Plant
BWCS	B&W Conversion Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
D&D	decontamination and decommissioning
DFF&O	Director's Final Findings and Orders for Removal Action and a Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
EMS	Environmental Management System
FBP	Fluor-B&W Portsmouth LLC
IRM	interim remedial measure
LLC	limited liability company
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)
mrem	millirem
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
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
TCE	trichloroethylene
TSCA	Toxic Substances Control Act
UDS	Uranium Disposition Services, LLC
USEC	United States Enrichment Corporation
U.S. EPA	U.S. Environmental Protection Agency
WEMS	Wastren-EnergX Mission Support, LLC

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