Department of Energy

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DEC 14 2009

PPPO-02-219-10

Ms. Jennifer Tufts
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

Mr. Edward Winner, FFA Manager
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Tufts and Mr. Winner:

TRANSMITTAL OF THE ERRATA PAGES AND REPLACEMENT PAGES FOR THE REMOVAL ACTION WORK PLAN FOR CONTAMINATED SEDIMENT ASSOCIATED WITH THE SURFACE WATER OPERABLE UNIT (ON-SITE) AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-0221&D2/R1)

Reference: Letter from J. Tufts to R. Knerr, "Approval of the D2 Removal Action Work Plan for Contaminated Sediment Associated with Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-0221&D2/R1)," dated November 12, 2009

Please find enclosed the errata pages and replacement pages for the D2/R1 *Removal Action Work Plan for Contaminated Sediment Associated with Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/LX/07-0221&D2/R1). The enclosed replacement pages and errata pages satisfy the condition for approval from the Environmental Protection Agency (EPA) (reference) and include the additional agreed upon changes that are detailed in the letter from EPA dated November 12, 2009 (reference).

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

Reinhard Knerr
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Certification Page
2. List of Changes Made to the D2/R1 SWOU RAWP
3. Clean Replacement Pages and Errata Pages
4. Red-lined Replacement Pages

cc w/enclosures:
AR File/Kevil
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EIC/PAD

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CERTIFICATION

Document Identification: ***Errata for the D2/R1 Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* (DOE/LX/07-0221&D2/R1)**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Paducah Remediation Services, LLC
Operator

Dennis Ferrigno, PM, Site Manager

12-11-09
Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy (DOE)
Owner

Reinhard Knerr, Paducah Site Lead
Portsmouth/Paducah Project Office

12/14/09
Date Signed

CHANGES MADE:

Removal Action Work Plan
for Contaminated Sediment Associated with the
Surface Water Operable Unit (On-Site)
at the Paducah Gaseous Diffusion Plant,
Paducah, Kentucky
DOE/LX/07-0221&D2/R1, issued October 2009

The enclosed replacement pages and errata pages document the following 19 changes.

1. Title Page – added revised date, corrected document number
2. Table of Contents, page vi – added Appendix H
3. Section 3.4 Removal Action Approach, page 12, 1st paragraph, 3rd line, inserted text "or riprap"
4. Appendix A, page A-10, 3rd bullet, insert text "riprap"
5. Appendix A, page A-11, 4th paragraph, 8th row – deleted text "and/or" and capitalized the "s" in the word "sealand"
6. Appendix A, page A-11, 4th paragraph, 9th row - inserted text "and/or other appropriate DOT performance orientated packaging"
7. Appendix A, page A-11, 4th paragraph, last row – deleted the extra period at end of sentence
8. Appendix A, page A-13, Section A.3.3 Outfall 001 EU 15, letter "O" – added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
9. Appendix A, page A-14, Section A.3.4 Outfall 008 EU 11, letter "N" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
10. Appendix A, page A-15, Section A.3.5 Outfall 010 EU 10, letter " M - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
11. Appendix A, page A-16, Section A.3.6 Outfall 010 EU 01, letter "M" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
12. Appendix A, page A-17, Section A.3.7 Outfall 015 EU 02, letter "O" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
13. Appendix A, page A-17, Section A.3.8 Outfall 015 EU 03, letter "N" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
14. Appendix A, page A-18, Section A.3.9 Outfall 015 EU 04, letter "O" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"

15. Appendix A, page A-19, Section A.3.10 Outfall 015 EU 07, letter " M - added text "fill (Appendix H) and" and deleted the “ed” off the word "compacted" and deleted the word "soil"
16. Appendix A, page A-20, Section A.3.11 Outfall 015 EU 08, letter “N” - added text "fill (Appendix H) and" and deleted the “ed” off the word "compacted" and deleted the word "soil"
17. Appendix A, page A-21, Section A.3.12 NSDD Section 3 EUs 01 and 02, letter "O" - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
18. Appendix A, page A-22, Section A.3.13 NSDD Section 3 EU 03, letter “O” - added text "fill (Appendix H) and" and deleted the "ed" off the word "compacted" and deleted the word "soil"
19. Inserted Appendix H (errata pages)

DOE/LX/07-0221&D2/R1
Primary Document

Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—October 2009

Revised Date—December 2009

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

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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CONTENTS

control structure to contain discharges of oil released to Outfall 008. In 1983, Outfall ditch 011 was included in an extensive PCB "hot spot" removal action conducted by DOE. There have been no CERCLA actions for the internal plant ditches to Outfall 011; however, DOE has implemented several remedial measures and treatability studies in areas of Outfall 011 located outside of the plant security fence. In the early 1980s, DOE excavated the upper 0.46 m (1.5 ft) of sediment in the Outfall 011 ditch from the PGDP security fence to Dyke Road to remove PCB contamination, and the ditch was restored with clean material.

Due to concerns about the presence of PCBs and radiological contamination in outfalls at the plant, ICMs were instituted in 1992 to restrict public access to creeks, outfalls, and lagoons surrounding PGDP. Access restriction was accomplished through the installation of fencing and the posting of warning signs at various off-site locations. Subsequently, in 2000, additional warning signs were posted that identified the creeks, outfalls, and lagoons as contaminated areas. In 2008, warning signs were posted along the creeks that identified some areas as potentially contaminated.

In 1994, discharge water from the C-617 Treatment Lagoon was diverted from Outfall 011 to Outfall 010 to mitigate resuspension of PCB-contaminated sediment. In 1995, DOE coated the Outfall 011 ditch with a bentonite concentrate to prevent erosion and potential contaminant migration. In 1996, DOE performed a Nature's Way bioremediation technology field demonstration in an effort to minimize/eliminate further PCB releases at PGDP (LMES 1997).

3.2 REMOVAL ACTION OBJECTIVES

NSDD Sections 3 and 5 and Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas have been identified as SWMUs under the FFA due to the potential for actual or threatened releases of hazardous constituents. These identified areas contain contamination within the upper one ft of surface soil/sediment. The identified contamination was derived from various plant activities conducted at PGDP facilities and was determined to pose human health risks from direct contact with contaminated sediments greater than the EPA risk range under some scenarios.

The RAOs for this removal action are consistent with the overall Remedial Action Objectives for the SWOU and include the following:

- Ensure direct contact risk at the on-site ditches for the current industrial worker falls within the EPA risk range (EPA 1999).

- Ensure direct contact risk at the NSDD for both the current industrial worker and recreational user falls within the EPA risk range (EPA 1999).

Completion of this removal action will reduce the risk to the current and future industrial workers and the current and future recreational user from direct contact by removing known sources of contamination.

Under this action, identified hot spots will be removed and verification of cleanup to a cumulative excess lifetime cancer risk (ELCR) of 1E-05 and a cumulative hazard index (HI) of 1.0 will be conducted following excavation. Verification of cleanup will be based upon comparisons between sampling results and chemical-specific ELCR-based cleanup levels. The ELCR and HI target used in deriving the cleanup levels will be 5E-06 and 1.0, respectively. The cancer risk-based and hazardous-based cleanup levels that will be used in the comparison for the SWOU On-Site Project are shown in Table 1.

Table 1. Cleanup Levels Based on Carcinogenic Risk and Hazard

COC	Risk-Based Concentration	
Arsenic	27	mg/kg
Beryllium	50,000	mg/kg
Total PCB	16	mg/kg
Americium-241	115	pCi/g
Cesium-137	8	pCi/g
Neptunium-237	22	pCi/g
Plutonium-239/240	108	pCi/g
Technetium-99	3,825	pCi/g
Thorium-230	147	pCi/g
Thorium-232	129	pCi/g
Uranium-234	188	pCi/g
Uranium-235	30	pCi/g
Uranium-238	94	pCi/g
COC	**Hazard-Based Concentration**	
Uranium	227	mg/kg

COC = contaminant of concern
ELCR = excess lifetime cancer risk
HI = hazard index
PCB = polychlorinated biphenyl compound

3.3 NATIONAL ENVIRONMENTAL POLICY ACT INTEGRATION

Consistent with DOE's *Secretarial Policy Statement on the National Environmental Policy Act* (NEPA), June 13, 1994, DOE has relied on the CERCLA process for evaluating the proposed activities associated with the removal action and incorporated the analysis for NEPA values (DOE 1994). No significant adverse environmental impacts are expected from implementation of this action. The impact to vulnerable or sensitive populations, habitats, or natural resources (i.e., critical or aquatic habitat, migratory birds, wetlands, streams, and floodplains) has been identified. These impacts have been evaluated and any necessary mitigation measures required to meet ARARs have been incorporated into the design phase and will be implemented during the construction and operation phases of the removal action (see Tables 2 through 4).

3.4 REMOVAL ACTION APPROACH

The portion of the SWOU Remedial Action addressed in this RAWP will include excavating the SWOU "hot spots" per the Action Memorandum (DOE 2009a), post-excavation sampling, restoring the excavated area with clean clay and soil or riprap, and managing and properly disposing of remediation waste. Work will include mobilization; postings; excavation; post-excavation sampling; restoration; soil handling, transportation and disposal; and demobilization. Additional details are included in appendices to this RAWP:

- Appendix A provides a Scope of Work with information on the sequencing and types of construction activities that will be performed;

drawing C7DC90000A026. There are two soil removal areas. One soil removal area is approximately 4,140 ft^2 and exceeds 1E-5 total ELCR. The other soil removal area is broken into three areas with a total of approximately 10,270 ft^2 and is contaminated with uranium.

A.1.12 NSDD 5 EU 08

NSDD 5 EU 08 is located north of PGDP and Kentucky State Highway 358 as shown on drawing C7DC90000A027. The soil removal area is approximately 2,510 ft^2 and exceeds 1E-5 total ELCR.

A.2 SCOPE

The SWOU (On-Site) RA will include implementation of one or more engineered controls to prevent transport of contaminated soil and sediment; temporary access controls, such as exclusion fencing and hazard postings will be used as required; complete removal of identified "hot spots" within NSDD Sections 3 and 5 and KPDES Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas; post-excavation sampling; and managing and properly disposing of remediation waste. Work will include mobilization; fence installation with hazard postings; installation of Best Management Practice (BMP) controls; excavation; post-excavation sampling; restoration; soil handling, transportation and disposal; and demobilization. The following outlines the specific details of the activities included in the RA; however, it should be noted that specifics of certain construction and disposition activities are not supplied so as to provide flexibility when performing the work:

- Establish construction site access control (as needed) such as exclusion zones, fencing, and hazard postings to exclude unauthorized personnel from entering the contamination areas (i.e., "hot spot") and provide directions should access to the area be required by authorized personnel. Decisions regarding where postings will be placed will be made by the Certified Industrial Hygienist.

- Excavate the hot spots depicted in maps in Appendix B to a depth of 2 ft to eliminate the risk of human receptors contacting contaminated sediment. Hot spots under this action were identified using a cumulative ELCR of 1E-05 and a cumulative hazard index (HI) of 1.0 based upon the information presented in Appendix F, "Risk-Based Cost-Benefit Analysis" of the Engineering Evaluation/Cost Analysis. Any residual contamination located outside or underneath the indentified hot spots after excavation is complete that is at concentrations greater than those acceptable for unrestricted use/unlimited exposure will be addressed as part of future remedial investigation activities [e.g., SWOU (Off-Site), Soils Operable Unit (OU), Comprehensive Site OU, etc.)].

- Collect samples from the bottom of the hot spot to confirm that the risk-based targets of a cumulative ELCR of 1E-05 and a cumulative HI of 1.0 have been achieved, subsequently meeting the project Removal Action Objectives (RAOs). If RAOs are not initially met, additional excavation may be required as described in Appendix F.

- Consistent with the results of the risk-based cost-benefit analysis, verification of cleanup to the cumulative ELCR of 1E-05 and a cumulative HI of 1.0 following excavation will be based upon comparisons between sampling results and chemical-specific ELCR-based and HI-based cleanup levels. The ELCR target used in deriving the cleanup levels will be 5E-06. The HI target used in deriving the cleanup levels will be 1.0. The cleanup goals under this action are presented in Table A.1.

- Methods to validate the achievement of the chemical-specific cleanup levels (See Appendix F) will be implemented similar to the NSDD Sections 1 and 2 remediation.

Table A.1. Cleanup Levels Based on Carcinogenic Risk and Hazard

COC	**Risk-Based Concentration**	
Arsenic	27	mg/kg
Beryllium	50,000	mg/kg
Total PCB	16	mg/kg
Americium-241	115	pCi/g
Cesium-137	8	pCi/g
Neptunium-237	22	pCi/g
Plutonium-239/240	108	pCi/g
Technetium-99	3825	pCi/g
Thorium-230	147	pCi/g
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Uranium-234	188	pCi/g
Uranium-235	30	pCi/g
Uranium-238	94	pCi/g
COC	**Hazard-Based Concentration**	
Uranium	227	mg/kg

COC = contaminant of concern
PCB = polychlorinated biphenyl compound

- Install temporary localized sediment control measures such as small stormwater retention areas, silt fencing, or rock check dams during excavation activities, as needed. Installation will control sediment and contaminant migration from the action and will be dependent upon the site conditions at the time of excavation.

- Survey the excavation limits, all sample points and elevations, then restore (i.e., backfill with clean soil, reseeding, riprap, etc.) disturbed acreage to prevent erosion, migration and recontamination.

- Characterize (to the extent necessary per waste acceptance criteria of disposition facility), containerize, transport, and dispose of all equipment and contaminated soil/sediment at an appropriate on- or off-site disposal/storage facility.

- Assess temporary localized sediment control measures and interim institutional controls (if applied) and discontinue as appropriate.

- Continue inspection and site maintenance during and after excavation and restoration to control erosion and until the excavated/restored area is stable.

The impact to vulnerable or sensitive populations, habitats, or natural resources (i.e., critical or aquatic habitat, migratory birds, wetlands, streams, and floodplains) has been identified. These impacts have been evaluated and the necessary mitigation measures required to meet applicable or relevant and appropriate requirements (ARARs) will be implemented during the construction

and operation phases of this RA [see tables 2 through 4 of the main text of the Removal Action Work Plan (RAWP)].

Mobilization will include, but is not limited to, participation in the Readiness Assessment process, delivery of all necessary construction and environmental, safety, and health (ES&H) equipment, setup of any temporary facilities, establishment of a trained and qualified workforce on the job site, and delivery of construction materials required for starting work. All work shall be performed in strict compliance with U.S. Occupational Safety and Health Administration (OSHA) 29 *CFR* 1910 and 1926. An experienced worker with excavation competent person training in accordance with OSHA 29 *CFR* 1926 subpart P shall supervise excavation and backfill activities.

Storm water and erosion control will be implemented as described in the BMP Plan, PRS/PROG/0017. The BMP plan will be implemented to minimize and/or eliminate the potential that contaminants associated with the NSDD Sections 3 and 5 and KPDES Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas might migrate beyond their current boundaries. These BMPs may include use of dust mitigation/suppression, diversion of run-on/run-off around the project area, and/or installation of small storm water retention areas, silt fencing, or rock check dams as localized sediment control measures, as required. Any containers of oil or oil products will be inventoried in accordance with PRS/ENM/0037, April 2008, *Spill Prevention, Control, and Countermeasure Plan*, for the U.S. Department of Energy (DOE) Paducah Site. If volumes equal or exceed 55 gal, plans for controls will be set in place.

Excavation and removal activities will be conducted in a manner that will limit fugitive dust emissions and will provide sedimentation controls, thereby limiting potential impacts due to airborne particulates and suspended solid loading. Fuel and oils also will be properly stored at secure locations away from storm water access.

The RA will generate approximately 7,000 yd^3 of soil/sediment and waste materials requiring off-site disposal and 6,300 yd^3 requiring on-site disposal. Sediment and other waste will be characterized, managed, transported, and disposed of in accordance with the ARARs/to be considered (TBCs) for low-level radioactive, Resource Conversation Recovery Act (RCRA), Toxic Substances and Control Act, or industrial waste in the approved EE/CA. DOE will manage/store PCB remediation wastes in risk-based storage instead of storage meeting 40 *CFR* 761.61(b)(1) requirements pursuant to 40 *CFR* 761.65(b)(2)(vi) and 761.65(c)(9)(iv). Such wastes may be stored up to 180 days in drums, B-12 boxes, B-25 boxes, intermodal containers, Sealand containers and/or other appropriate DOT performance orientated packaging, provided that the containers are sealed when not adding/removing materials. Storing PCB remediation wastes in this manner provides a level of protectiveness that is similar to storing PCB remediation wastes in piles under 40 *CFR* 761.65(c)(9). DOE will perform disposal [in accordance with 40 *CFR* § 761.61(a)(5)(v)] of soil containing equal to or less than 49 ppm PCBs at the C-746-U solid waste landfill. The Environmental Performance Standard in 401 *Kentucky Administrative Regulation* (*KAR*) 47:030, Section 8, and Condition Number ACTV0006, "Standard Requirement 1" of Solid Waste Permit No. 073-00014/073-00015/073-00045 currently allow such disposal. PCB remediation waste requiring off-site disposal (i.e., greater than 49 ppm) will be disposed of in accordance with 40 *CFR* § 761.61(a), (b), or (c) in a RCRA permitted landfill, in a landfill with a coordinated approval, in a chemical waste landfill, or in a facility with approval from U. S. Environmental Protection Agency (EPA). The contractor will follow applicable state and federal requirements including DOE Orders in addition to the facility WAC.

Water may be treated and disposed of on- or off-site and will meet facility WAC.

Off-site transfer of any hazardous substance, pollutant, or contaminant generated during this action will be sent to a facility that complies with applicable federal and state laws and has been approved by U.S. Environmental Protection Agency (EPA) for acceptance of CERCLA waste. Accordingly, DOE will verify with the appropriate EPA regional contact that any needed off-site facility is acceptable for receipt of CERCLA wastes prior to transfer in accordance with the requirements of the Off-Site Rule in 40 *CFR* § 300.440(a)(4).

Post-excavation soil sampling activities will be conducted following excavations. All post-excavation sampling will be conducted in accordance with the Sampling and Analysis Plan (SAP) found in Appendix F. Sampling locations will be surveyed upon completion of sampling activities.

Upon completion of fieldwork, demobilization will occur. Demobilization includes decontamination and removal of all construction and health and safety equipment, dismantlement and removal of temporary structures and storm water controls, removal of excess construction materials, removal of all personnel, and preparation of a post construction completion report.

All work shall be performed in accordance with the RAWP, this SOW (Appendix A); the design drawings (Appendix B); ES&H Plan (Appendix C); WMP (Appendix D); Quality Assurance Project Plan (Appendix E); SAP (Appendix F); and the Data Management Implementation Plan (Appendix G).

A.3 WORK INCLUDED

A.3.1 MOBILIZATION

A. Mobilization shall include, but is not limited to, participation in the Readiness Review process; delivery of all necessary construction and health & safety equipment; setup of any temporary facilities; maintenance of temporary facilities; establishment of the total required workforce on the job site; completion of site specific training; delivery of all construction materials required to start work and establishment of construction site access controls. It also includes the submittal of all documentation required prior to the start of fieldwork.

A.3.2 SEDIMENT CONTROL MEASURES

A. Construct and maintain, at a minimum, storm water and erosion management controls, including, but not limited to, diversion ditches, diversion dams, silt fence, silt socks, erosion control blankets or mats, and rock check dams. Storm water and erosion control will be implemented as described in the BMP Plan, PRS/PROG/0017.

B. Install erosion and sediment control measures. All erosion and sediment control measures shall be maintained throughout the construction period. Weekly checks will be made to ensure erosion controls are in place during project downtime. Erosion and sediment controls will be put in place at the end of each day’s activities.

C. If feasible, disturbed areas shall be securely covered with an impermeable liner during extended periods of time where no excavation/sampling work is required or when inclement weather is forecast. Transfer water collected in the work area into liquid storage containers. A pump (i.e., trash pump) would be used to transfer rainwater. A low

point would be created when placing the liner over the excavation to allow for the water to collect. The water would be pumped into a mobile poly tank and disposed of in an appropriate manner.

D. BMPs shall be implemented as outlined in the *Best Management Practices Plan*, PRS/PROG/0017.

A.3.3 OUTFALL 001 EU 15

A. Refer to drawing C7DC375W9A001 located in Appendix B related to the RA at Outfall 001 EU 15.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W9A001).

G. Install earth berms and/or silt fence (sock), if required, as shown on the referenced drawing (Appendix B, C7DC375W9A001).

H. Ensure that the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W9A001).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W9A001).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.4 OUTFALL 008 EU 11

A. Refer to drawing C7DC375W7A001 located in Appendix B related to the RA at Outfall 008 EU 11.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W7A001).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W7A001).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W7A001).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.5 OUTFALL 010 EU 10

A. Refer to drawing C7DC375E3A001 located in Appendix B related to the RA at Outfall 010 EU 10.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install sediment control measures as shown on the referenced drawing (Appendix B, C7DC375E3A001)

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375E3A001).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.6 OUTFALL 011 EU 01

A. Refer to drawing C7DC375E4A001 located in Appendix B related to the RA at Outfall 011 EU 01.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375E4A001).

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375E4A001).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.7 OUTFALL 015 EU 02

A. Refer to drawing C7DC375W8A001 located in Appendix B related to the RA at Outfall 015 EU 02.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W8A001).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A001).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A001).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A001).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.8 OUTFALL 015 EU 03

A. Refer to drawing C7DC375W8A002 located in Appendix B related to the RA at Outfall 015 EU 03.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A002).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A002).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A002).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.9 OUTFALL 015 EU 04

A. Refer to drawing C7DC375W8A003 located in Appendix B related to the RA at Outfall 015 EU 04.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W8A003).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A003).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A003).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A003).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.10 OUTFALL 015 EU 07

A. Refer to drawing C7DC375W8004 located in Appendix B related to the RA at Outfall 015 EU 07.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8004).

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8004).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.11 OUTFALL 015 EU 08

A. Refer to drawing C7DC375W8A005 located in Appendix B related to the RA at Outfall 015 EU 08.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A005).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A005).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A005).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.12 NSDD SECTION 3 EUs 01 AND 02

A. Refer to drawing C7DC90000A025 located in Appendix B related to the RA at NSDD Section EUs 01 and 02.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A025).

G. Install silt fence (sock) as shown on the referenced drawing (Appendix B, C7DC90000A025).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC90000A025).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A025).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.13 NSDD SECTION 3 EU 03

A. Refer to drawing C7DC90000A026 located in Appendix B related to the RA at NSDD Section 3 EU 03.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC90000A026).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A026).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC90000A026).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A026).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

A.3.14 NSDD SECTION 5 EU 08

A. Refer to drawing C7DC90000A027 located in Appendix B related to the RA at NSDD Section 5 EU 08.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Place pumps necessary to reroute water, or if conditions warrant, temporarily relocate NSDD as shown on the referenced drawing (Appendix B, C7DC90000A027).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A027).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A027).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean, compacted soil.

APPENDIX H
FILL AND COVER MATERIAL VERIFICATION PROTOCOL

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Paducah Gaseous Diffusion Plant
Fill and Cover Material Verification Protocol

Objective

The protocol will serve as a standard method for determining if fill and cover material is acceptable for response actions at the Paducah Gaseous Diffusion Plant (PGDP). While this protocol presents a standard method for sampling fill and cover material and evaluating the sampling results, deviations from this protocol are likely, and these deviations will be discussed on a case-by-case basis. Examples of likely deviations are the use of historical sampling results instead of results from new sampling in the evaluation and, in the case of historical data, some deviations from the analyte list and analyte sample quantitation limits (SQLs) presented below.

Basis

This protocol is based upon a similar protocol used at the U.S. Department of Energy's (DOE) Savannah River Site (SRS) (Westinghouse Savannah River Company 2003). This protocol was modeled after the SRS protocol in order to respond to preference expressed by U. S. Environmental Protection Agency (EPA) personnel. This protocol was discussed at Federal Facility Manager Meetings held in September 2009, as well as during teleconferences held in September and October 2009.

Verification Protocol

This protocol applies to fill taken from areas owned by DOE at the PGDP. Commercial suppliers of soil for fill or cover will be asked for assurances that soil is uncontaminated as part of contracting.

Protocol requirements are:

- Samples will be collected from soil designated for use in response actions either prior to excavation or from loads at a rate of approximately one five-part composite for every 1,000 yds^3 of soil. If *in situ* historical data from an area is available, then results from that sampling may be evaluated instead of results from new sampling; however, DOE will provide information showing that the historical sampling was performed in a manner consistent with this protocol. Once an area is approved through this protocol for a project, then the area sampled will remain as an approved source of fill or cover for that project or similar projects, and additional sampling from that area will not be required.

- Newly collected soil samples will be analyzed for the sitewide list of chemicals of potential concern in Table 2.1 of *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1,. Human Health,* DOE/LX/07-0107&D1/V1, (Risk Methods Document) (RMD), with some deviations. This list of analytes and deviations are in Table H.1. Historical results will be evaluated, and the absence of any analytes in the historical results will be discussed.

- Sampling and laboratory analytical methods will be consistent with EPA methods, DOE requirements, and contractor-approved procedures.

- SQLs and their radionuclide equivalents for analytes are shown in Table H.1. Historical data with SQLs or their radionuclide equivalents that exceed the values shown in Table H.1 will be evaluated to determine the impact of SQLs on the acceptability of soil proposed as fill or cover. Results with SQLs exceeding the values shown in Table H.1 may be acceptable, once the impacts on the evaluation are understood.

- Results of laboratory analysis will be screened as follows:

  — For those analytes with site-specific background concentrations (i.e., most metals and radionuclides), results will be compared to the full range of background expected or likely at PGDP. This evaluation will begin with a simple comparison against background concentrations presented in Table H.2, but additional analyses will be used to determine if exceedances of these background concentrations represent potential contamination or natural variation.

  — For analytes without site-specific background concentrations (i.e., some metals, some radionuclides, and organic compounds), results will be compared to the appropriate risk-based value derived from no action levels (NAL) presented in Appendix A of the Risk Methods Document (DOE 2009). Justification for the risk-based values used in the comparison will be provided. The risk-based values used will be the lesser of values based upon a cancer risk target of 1E-05 and a hazard index target of 1.

  — If exceedances of either the full range of background or appropriate risk-based value are identified, then an uncertainty analysis will be performed to determine the possible reasons and importance of exceedances. The identification of analyte concentrations exceeding the background and risk-based value benchmarks will not be the sole basis for discounting use of soil from a particular area as fill or cover.

References

DOE 2001. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1, Human Health*, DOE/OR/07-1506&D2, December.

DOE 2009. Draft *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1, Human Health*, DOE/LX/07-0107&D1/V1, August.

Westinghouse Savannah River Company 2003. *SRS Fill and Cover Material Verification Protocol*, ERTEC-2003-00012, December.

Table H.1. Sitewide Chemicals of Potential Concern at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky[1]

Analyte	CAS Number	Sample Quantitation Limit or Radionuclide Equivalent[2]	
Inorganic Chemicals			
Aluminum	7429905	8,022.5	mg/kg
Antimony	7440360	0.105	mg/kg
Arsenic	7440382	5.5	mg/kg
Barium	7440393	91	mg/kg
Beryllium	7440417	0.45	mg/kg
Boron	7440428	9,180	mg/kg
Cadmium	7440439	0.105	mg/kg
Chromium[3]	7440473	12.5	mg/kg
Cobalt	7440484	6.5	mg/kg
Copper	7440508	12	mg/kg
Iron	7439896	14,328.5	mg/kg
Lead	7439921	17.5	mg/kg
Manganese	7439965	350.5	mg/kg
Mercury	7439976	0.1	mg/kg
Molybdenum	7439987	230	mg/kg
Nickel	7440020	14	mg/kg
Selenium	7782492	0.3	mg/kg
Silver	7440224	1.5	mg/kg
Thallium	7440280	0.105	mg/kg
Uranium	7440611	3.8	mg/kg
Vanadium	7440622	22	mg/kg
Zinc	7440666	41	mg/kg
Organic Compounds			
Acenaphthene	83329	1,230	mg/kg
Acenaphthylene	208968	NA	mg/kg
Acrylonitrile	107131	0.729	mg/kg
Anthracene	120127	7,610	mg/kg
Benzene	71432	3.46	mg/kg
Carbazole	86748	87.2	mg/kg
Carbon tetrachloride	56235	0.574	mg/kg
Chloroform	67663	0.123	mg/kg
1,1-Dichloroethene	75354	0.235	mg/kg
1,2-Dichloroethene (mixed)	540590	156	mg/kg
trans-1,2-Dichloroethene	156605	20	mg/kg
cis-1,2-Dichloroethene	156592	15.4	mg/kg
Dieldrin	60571	0.105	mg/kg
Ethylbenzene	100414	46.4	mg/kg
Fluoranthene	206440	1,090	mg/kg
Fluorene	86737	945	mg/kg
Hexachlorobenzene	118741	0.414	mg/kg
Naphthalene	91203	19.4	mg/kg
2-Nitroaniline	88744	4.56	mg/kg
N-Nitroso-di-n-propylamine	621647	0.2	mg/kg
Phenanthrene	85018	NA	mg/kg
Pyrene	129000	814	mg/kg
Tetrachloroethene	127184	1.08	mg/kg
Trichloroethene	79016	0.22	mg/kg
Total Dioxins/Furans[4]	1746016	1.14E-05	mg/kg

Table H.1. Site-wide Chemicals of Potential Concern at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky[1] (Continued)

Analyte	CAS Number	Sample Quantitation Limit or Radionuclide Equivalent[2]	
Total PAHs	50328	0.197	mg/kg
Benz(a)anthracene	56553	1.96	mg/kg
Benzo(a)pyrene	50328	0.197	mg/kg
Benzo(b)fluoranthene	205992	1.97	mg/kg
Benzo(k)fluoranthene	207089	19.7	mg/kg
Chrysene	218019	197	mg/kg
Dibenz(a,h)anthracene	53703	0.197	mg/kg
Indeno(1,2,3-cd)pyrene	193395	1.97	mg/kg
Total PCBs[5]	1336363	0.624	mg/kg
Aroclor 1016	12674112	0.618	mg/kg
Aroclor 1221	11104282	0.682	mg/kg
Aroclor 1232	11141165	0.682	mg/kg
Aroclor 1242	53469219	0.619	mg/kg
Aroclor 1248	12672296	0.682	mg/kg
Aroclor 1254	11097691	0.493	mg/kg
Aroclor 1260	11096825	0.657	mg/kg
Vinyl chloride	75014	0.402	mg/kg
Xylenes (Mixture)	1330207	82.1	mg/kg
p-Xylene	106423	NA	mg/kg
m-Xylene	108383	3,940	mg/kg
o-Xylene	95476	4,140	mg/kg
Radionuclides			
Americium-241	14596102	15	pCi/g
Cesium-137+D	10045973	0.25	pCi/g
Cobalt-60	10198400	0.0547	pCi/g
Neptunium-237+D	13994202	0.014	pCi/g
Plutonium-238	13981163	0.002	pCi/g
Plutonium-239	15117483	0.009	pCi/g
Plutonium-240	14119336	31.6	pCi/g
Technetium-99	14133767	0.15	pCi/g
Thorium-230	14269637	1.1	pCi/g
Uranium-234	13966295	0.95	pCi/g
Uranium-235+D	15117961	0.055	pCi/g
Uranium-238+D	7440611	0.95	pCi/g

[1] Taken from Table 2.1 in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume, 1, Human Health*, DOE/LX/07-0107&D1/V1.

[2] Sample Quantitation Limit refers to the lowest reliably detected value for an inorganic or an organic analyte. For purposes of this table, the radionuclide equivalent or the minimum detectable activity (MDA) is presented. Values presented for most metals and radionuclides are the "average" site-specific background concentrations at the PGDP. Values presented for boron, molybdenum, americium-241, cobalt-60, and organic compounds are derived from no action levels for the child resident taken from the RMD by revising the target cancer risk and hazard index to 1×10^{-5} and 1, respectively.

[3] Table 2.1 in the RMD includes Cr III, Cr Total, and Cr VI. Only Cr Total is included here because it is type of chromium expected in soil samples at the PGDP. The cancer-based screening value presented in the RMD for Cr Total was derived using the cancer slope factor for Cr VI. Background values for Cr III are used here.

[4] Table 2.1 in the RMD presents several dioxins and furans. Analyses for these organic compounds will not be required for samples from fill and cover material because they are unlikely to be present in soil from DOE-owned areas at the PGDP the absence of polychlorinated biphenyls (PCBs) based upon PGDP process information.

[5] The list of PCBs may be smaller than that shown here. The list will include Aroclor 1248, 1254, and 1260, which are the most commonly detected PCBs at the PGDP.

NA = not applicable

Table H.2. Site Specific Background Values Used for Soil Evaluation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Analysis	CAS Number	Site-Specific Background Values 2001[1]	2009[2]
Metals (mg/kg)			
Aluminum	7429905	13,000	16,045
Antimony	7440360	0.21	0.21
Arsenic	7440382	12	11
Barium	7440393	200	182
Beryllium	7440417	0.67	0.9
Cadmium	7440439	0.21	0.21
Calcium	7440702	200,000	8,376
Chromium[3]	7440473	16	25
Cobalt	7440484	14	13
Copper	7440508	19	24
Iron	7439896	28,000	28,657
Lead	7439921	36	35
Magnesium	7439954	7,700	2,652
Manganese	7439965	1,500	701
Mercury	7439976	0.2	0.2
Nickel	7440020	21	28
Potassium	7440097	1,300	1,005
Selenium	7782492	0.8	0.6
Silver	7440224	2.3	3
Sodium	7440235	320	142
Thallium	7440280	0.21	0.21
Uranium	7440611	4.9	7.6
Vanadium	7440622	38	44
Zinc	7440666	65	82
Radionuclides (pCi/g)			
Cesium-137	10045973	0.49	0.5
Neptunium-237	13994202	0.1	0.028
Plutonium-238	13981163	0.073	0.004
Plutonium-239	15117483	0.025	0.018
Potassium-40	13966002	16	27
Radium-226	13982633	1.5	2.2
Strontium-90	10098972	4.7	0
Technetium-99	14133767	2.5	0.3
Thorium-228	14274829	1.6	2.3
Thorium-230	14269637	1.5	2.2
Thorium-232	NA	1.5	2.2
Uranium-234	13966295	2.5	1.9
Uranium-235	15117961	0.14	0.11
Uranium-238	7440611	1.2	1.9

[1] Background taken from surface soil values found in Table A.12 of DOE 2001.
[2] Background taken from surface soil values found in Table A.12 of DOE 2009.
[3] Background values for Chromium III are presented.
NA = not available

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Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—October 2009

Revised Date—December 2009

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

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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CONTENTS

control structure to contain discharges of oil released to Outfall 008. In 1983, Outfall ditch 011 was included in an extensive PCB "hot spot" removal action conducted by DOE. There have been no CERCLA actions for the internal plant ditches to Outfall 011; however, DOE has implemented several remedial measures and treatability studies in areas of Outfall 011 located outside of the plant security fence. In the early 1980s, DOE excavated the upper 0.46 m (1.5 ft) of sediment in the Outfall 011 ditch from the PGDP security fence to Dyke Road to remove PCB contamination, and the ditch was restored with clean material.

Due to concerns about the presence of PCBs and radiological contamination in outfalls at the plant, ICMs were instituted in 1992 to restrict public access to creeks, outfalls, and lagoons surrounding PGDP. Access restriction was accomplished through the installation of fencing and the posting of warning signs at various off-site locations. Subsequently, in 2000, additional warning signs were posted that identified the creeks, outfalls, and lagoons as contaminated areas. In 2008, warning signs were posted along the creeks that identified some areas as potentially contaminated.

In 1994, discharge water from the C-617 Treatment Lagoon was diverted from Outfall 011 to Outfall 010 to mitigate resuspension of PCB-contaminated sediment. In 1995, DOE coated the Outfall 011 ditch with a bentonite concentrate to prevent erosion and potential contaminant migration. In 1996, DOE performed a Nature's Way bioremediation technology field demonstration in an effort to minimize/eliminate further PCB releases at PGDP (LMES 1997).

3.2 REMOVAL ACTION OBJECTIVES

NSDD Sections 3 and 5 and Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas have been identified as SWMUs under the FFA due to the potential for actual or threatened releases of hazardous constituents. These identified areas contain contamination within the upper one ft of surface soil/sediment. The identified contamination was derived from various plant activities conducted at PGDP facilities and was determined to pose human health risks from direct contact with contaminated sediments greater than the EPA risk range under some scenarios.

The RAOs for this removal action are consistent with the overall Remedial Action Objectives for the SWOU and include the following:

- Ensure direct contact risk at the on-site ditches for the current industrial worker falls within the EPA risk range (EPA 1999).

- Ensure direct contact risk at the NSDD for both the current industrial worker and recreational user falls within the EPA risk range (EPA 1999).

Completion of this removal action will reduce the risk to the current and future industrial workers and the current and future recreational user from direct contact by removing known sources of contamination.

Under this action, identified hot spots will be removed and verification of cleanup to a cumulative excess lifetime cancer risk (ELCR) of 1E-05 and a cumulative hazard index (HI) of 1.0 will be conducted following excavation. Verification of cleanup will be based upon comparisons between sampling results and chemical-specific ELCR-based cleanup levels. The ELCR and HI target used in deriving the cleanup levels will be 5E-06 and 1.0, respectively. The cancer risk-based and hazardous-based cleanup levels that will be used in the comparison for the SWOU On-Site Project are shown in Table 1.

Table 1. Cleanup Levels Based on Carcinogenic Risk and Hazard

COC	Risk-Based Concentration	
Arsenic	27	mg/kg
Beryllium	50,000	mg/kg
Total PCB	16	mg/kg
Americium-241	115	pCi/g
Cesium-137	8	pCi/g
Neptunium-237	22	pCi/g
Plutonium-239/240	108	pCi/g
Technetium-99	3,825	pCi/g
Thorium-230	147	pCi/g
Thorium-232	129	pCi/g
Uranium-234	188	pCi/g
Uranium-235	30	pCi/g
Uranium-238	94	pCi/g
COC	**Hazard-Based Concentration**	
Uranium	227	mg/kg

COC = contaminant of concern
ELCR = excess lifetime cancer risk
HI = hazard index
PCB = polychlorinated biphenyl compound

3.3 NATIONAL ENVIRONMENTAL POLICY ACT INTEGRATION

Consistent with DOE's *Secretarial Policy Statement on the National Environmental Policy Act* (NEPA), June 13, 1994, DOE has relied on the CERCLA process for evaluating the proposed activities associated with the removal action and incorporated the analysis for NEPA values (DOE 1994). No significant adverse environmental impacts are expected from implementation of this action. The impact to vulnerable or sensitive populations, habitats, or natural resources (i.e., critical or aquatic habitat, migratory birds, wetlands, streams, and floodplains) has been identified. These impacts have been evaluated and any necessary mitigation measures required to meet ARARs have been incorporated into the design phase and will be implemented during the construction and operation phases of the removal action (see Tables 2 through 4).

3.4 REMOVAL ACTION APPROACH

The portion of the SWOU Remedial Action addressed in this RAWP will include excavating the SWOU "hot spots" per the Action Memorandum (DOE 2009a), post-excavation sampling, restoring the excavated area with clean clay and soil or riprap, and managing and properly disposing of remediation waste. Work will include mobilization; postings; excavation; post-excavation sampling; restoration; soil handling, transportation and disposal; and demobilization. Additional details are included in appendices to this RAWP:

- Appendix A provides a Scope of Work with information on the sequencing and types of construction activities that will be performed;

drawing C7DC90000A026. There are two soil removal areas. One soil removal area is approximately 4,140 ft^2 and exceeds 1E-5 total ELCR. The other soil removal area is broken into three areas with a total of approximately 10,270 ft^2 and is contaminated with uranium.

A.1.12 NSDD 5 EU 08

NSDD 5 EU 08 is located north of PGDP and Kentucky State Highway 358 as shown on drawing C7DC90000A027. The soil removal area is approximately 2,510 ft^2 and exceeds 1E-5 total ELCR.

A.2 SCOPE

The SWOU (On-Site) RA will include implementation of one or more engineered controls to prevent transport of contaminated soil and sediment; temporary access controls, such as exclusion fencing and hazard postings will be used as required; complete removal of identified "hot spots" within NSDD Sections 3 and 5 and KPDES Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas; post-excavation sampling; and managing and properly disposing of remediation waste. Work will include mobilization; fence installation with hazard postings; installation of Best Management Practice (BMP) controls; excavation; post-excavation sampling; restoration; soil handling, transportation and disposal; and demobilization. The following outlines the specific details of the activities included in the RA; however, it should be noted that specifics of certain construction and disposition activities are not supplied so as to provide flexibility when performing the work:

- Establish construction site access control (as needed) such as exclusion zones, fencing, and hazard postings to exclude unauthorized personnel from entering the contamination areas (i.e., "hot spot") and provide directions should access to the area be required by authorized personnel. Decisions regarding where postings will be placed will be made by the Certified Industrial Hygienist.

- Excavate the hot spots depicted in maps in Appendix B to a depth of 2 ft to eliminate the risk of human receptors contacting contaminated sediment. Hot spots under this action were identified using a cumulative ELCR of 1E-05 and a cumulative hazard index (HI) of 1.0 based upon the information presented in Appendix F, "Risk-Based Cost-Benefit Analysis" of the Engineering Evaluation/Cost Analysis. Any residual contamination located outside or underneath the indentified hot spots after excavation is complete that is at concentrations greater than those acceptable for unrestricted use/unlimited exposure will be addressed as part of future remedial investigation activities [e.g., SWOU (Off-Site), Soils Operable Unit (OU), Comprehensive Site OU, etc.)].

- Collect samples from the bottom of the hot spot to confirm that the risk-based targets of a cumulative ELCR of 1E-05 and a cumulative HI of 1.0 have been achieved, subsequently meeting the project Removal Action Objectives (RAOs). If RAOs are not initially met, additional excavation may be required as described in Appendix F.

- Consistent with the results of the risk-based cost-benefit analysis, verification of cleanup to the cumulative ELCR of 1E-05 and a cumulative HI of 1.0 following excavation will be based upon comparisons between sampling results and chemical-specific ELCR-based and HI-based cleanup levels. The ELCR target used in deriving the cleanup levels will be 5E-06. The HI target used in deriving the cleanup levels will be 1.0. The cleanup goals under this action are presented in Table A.1.

- Methods to validate the achievement of the chemical-specific cleanup levels (See Appendix F) will be implemented similar to the NSDD Sections 1 and 2 remediation.

Table A.1. Cleanup Levels Based on Carcinogenic Risk and Hazard

COC	**Risk-Based Concentration**	
Arsenic	27	mg/kg
Beryllium	50,000	mg/kg
Total PCB	16	mg/kg
Americium-241	115	pCi/g
Cesium-137	8	pCi/g
Neptunium-237	22	pCi/g
Plutonium-239/240	108	pCi/g
Technetium-99	3825	pCi/g
Thorium-230	147	pCi/g
Thorium-232	129	pCi/g
Uranium-234	188	pCi/g
Uranium-235	30	pCi/g
Uranium-238	94	pCi/g
COC	**Hazard-Based Concentration**	
Uranium	227	mg/kg

COC = contaminant of concern
PCB = polychlorinated biphenyl compound

- Install temporary localized sediment control measures such as small stormwater retention areas, silt fencing, or rock check dams during excavation activities, as needed. Installation will control sediment and contaminant migration from the action and will be dependent upon the site conditions at the time of excavation.

- Survey the excavation limits, all sample points and elevations, then restore (i.e., backfill with clean soil, reseeding, riprap, etc.) disturbed acreage to prevent erosion, migration and recontamination.

- Characterize (to the extent necessary per waste acceptance criteria of disposition facility), containerize, transport, and dispose of all equipment and contaminated soil/sediment at an appropriate on- or off-site disposal/storage facility.

- Assess temporary localized sediment control measures and interim institutional controls (if applied) and discontinue as appropriate.

- Continue inspection and site maintenance during and after excavation and restoration to control erosion and until the excavated/restored area is stable.

The impact to vulnerable or sensitive populations, habitats, or natural resources (i.e., critical or aquatic habitat, migratory birds, wetlands, streams, and floodplains) has been identified. These impacts have been evaluated and the necessary mitigation measures required to meet applicable or relevant and appropriate requirements (ARARs) will be implemented during the construction

and operation phases of this RA [see tables 2 through 4 of the main text of the Removal Action Work Plan (RAWP)].

Mobilization will include, but is not limited to, participation in the Readiness Assessment process, delivery of all necessary construction and environmental, safety, and health (ES&H) equipment, setup of any temporary facilities, establishment of a trained and qualified workforce on the job site, and delivery of construction materials required for starting work. All work shall be performed in strict compliance with U.S. Occupational Safety and Health Administration (OSHA) 29 *CFR* 1910 and 1926. An experienced worker with excavation competent person training in accordance with OSHA 29 *CFR* 1926 subpart P shall supervise excavation and backfill activities.

Storm water and erosion control will be implemented as described in the BMP Plan, PRS/PROG/0017. The BMP plan will be implemented to minimize and/or eliminate the potential that contaminants associated with the NSDD Sections 3 and 5 and KPDES Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and areas might migrate beyond their current boundaries. These BMPs may include use of dust mitigation/suppression, diversion of run-on/run-off around the project area, and/or installation of small storm water retention areas, silt fencing, or rock check dams as localized sediment control measures, as required. Any containers of oil or oil products will be inventoried in accordance with PRS/ENM/0037, April 2008, *Spill Prevention, Control, and Countermeasure Plan*, for the U.S. Department of Energy (DOE) Paducah Site. If volumes equal or exceed 55 gal, plans for controls will be set in place.

Excavation and removal activities will be conducted in a manner that will limit fugitive dust emissions and will provide sedimentation controls, thereby limiting potential impacts due to airborne particulates and suspended solid loading. Fuel and oils also will be properly stored at secure locations away from storm water access.

The RA will generate approximately 7,000 yd^3 of soil/sediment and waste materials requiring off-site disposal and 6,300 yd^3 requiring on-site disposal. Sediment and other waste will be characterized, managed, transported, and disposed of in accordance with the ARARs/to be considered (TBCs) for low-level radioactive, Resource Conversation Recovery Act (RCRA), Toxic Substances and Control Act, or industrial waste in the approved EE/CA. DOE will manage/store PCB remediation wastes in risk-based storage instead of storage meeting 40 *CFR* 761.61(b)(1) requirements pursuant to 40 *CFR* 761.65(b)(2)(vi) and 761.65(c)(9)(iv). Such wastes may be stored up to 180 days in drums, B-12 boxes, B-25 boxes, intermodal containers, Sealand containers and/or other appropriate DOT performance orientated packaging, provided that the containers are sealed when not adding/removing materials. Storing PCB remediation wastes in this manner provides a level of protectiveness that is similar to storing PCB remediation wastes in piles under 40 *CFR* 761.65(c)(9). DOE will perform disposal [in accordance with 40 *CFR* § 761.61(a)(5)(v)] of soil containing equal to or less than 49 ppm PCBs at the C-746-U solid waste landfill. The Environmental Performance Standard in 401 *Kentucky Administrative Regulation* (*KAR*) 47:030, Section 8, and Condition Number ACTV0006, "Standard Requirement 1" of Solid Waste Permit No. 073-00014/073-00015/073-00045 currently allow such disposal. PCB remediation waste requiring off-site disposal (i.e., greater than 49 ppm) will be disposed of in accordance with 40 *CFR* § 761.61(a), (b), or (c) in a RCRA permitted landfill, in a landfill with a coordinated approval, in a chemical waste landfill, or in a facility with approval from U. S. Environmental Protection Agency (EPA). The contractor will follow applicable state and federal requirements including DOE Orders in addition to the facility WAC.

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Water may be treated and disposed of on- or off-site and will meet facility WAC.

Off-site transfer of any hazardous substance, pollutant, or contaminant generated during this action will be sent to a facility that complies with applicable federal and state laws and has been approved by U.S. Environmental Protection Agency (EPA) for acceptance of CERCLA waste. Accordingly, DOE will verify with the appropriate EPA regional contact that any needed off-site facility is acceptable for receipt of CERCLA wastes prior to transfer in accordance with the requirements of the Off-Site Rule in 40 *CFR* § 300.440(a)(4).

Post-excavation soil sampling activities will be conducted following excavations. All post-excavation sampling will be conducted in accordance with the Sampling and Analysis Plan (SAP) found in Appendix F. Sampling locations will be surveyed upon completion of sampling activities.

Upon completion of fieldwork, demobilization will occur. Demobilization includes decontamination and removal of all construction and health and safety equipment, dismantlement and removal of temporary structures and storm water controls, removal of excess construction materials, removal of all personnel, and preparation of a post construction completion report.

All work shall be performed in accordance with the RAWP, this SOW (Appendix A); the design drawings (Appendix B); ES&H Plan (Appendix C); WMP (Appendix D); Quality Assurance Project Plan (Appendix E); SAP (Appendix F); and the Data Management Implementation Plan (Appendix G).

A.3 WORK INCLUDED

A.3.1 MOBILIZATION

A. Mobilization shall include, but is not limited to, participation in the Readiness Review process; delivery of all necessary construction and health & safety equipment; setup of any temporary facilities; maintenance of temporary facilities; establishment of the total required workforce on the job site; completion of site specific training; delivery of all construction materials required to start work and establishment of construction site access controls. It also includes the submittal of all documentation required prior to the start of fieldwork.

A.3.2 SEDIMENT CONTROL MEASURES

A. Construct and maintain, at a minimum, storm water and erosion management controls, including, but not limited to, diversion ditches, diversion dams, silt fence, silt socks, erosion control blankets or mats, and rock check dams. Storm water and erosion control will be implemented as described in the BMP Plan, PRS/PROG/0017.

B. Install erosion and sediment control measures. All erosion and sediment control measures shall be maintained throughout the construction period. Weekly checks will be made to ensure erosion controls are in place during project downtime. Erosion and sediment controls will be put in place at the end of each day's activities.

C. If feasible, disturbed areas shall be securely covered with an impermeable liner during extended periods of time where no excavation/sampling work is required or when inclement weather is forecast. Transfer water collected in the work area into liquid storage containers. A pump (i.e., trash pump) would be used to transfer rainwater. A low

point would be created when placing the liner over the excavation to allow for the water to collect. The water would be pumped into a mobile poly tank and disposed of in an appropriate manner.

D. BMPs shall be implemented as outlined in the *Best Management Practices Plan*, PRS/PROG/0017.

A.3.3 OUTFALL 001 EU 15

A. Refer to drawing C7DC375W9A001 located in Appendix B related to the RA at Outfall 001 EU 15.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W9A001).

G. Install earth berms and/or silt fence (sock), if required, as shown on the referenced drawing (Appendix B, C7DC375W9A001).

H. Ensure that the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W9A001).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W9A001).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.4 OUTFALL 008 EU 11

A. Refer to drawing C7DC375W7A001 located in Appendix B related to the RA at Outfall 008 EU 11.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W7A001).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W7A001).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W7A001).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.5 OUTFALL 010 EU 10

A. Refer to drawing C7DC375E3A001 located in Appendix B related to the RA at Outfall 010 EU 10.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install sediment control measures as shown on the referenced drawing (Appendix B, C7DC375E3A001)

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375E3A001).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.6 OUTFALL 011 EU 01

A. Refer to drawing C7DC375E4A001 located in Appendix B related to the RA at Outfall 011 EU 01.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375E4A001).

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375E4A001).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.7 OUTFALL 015 EU 02

A. Refer to drawing C7DC375W8A001 located in Appendix B related to the RA at Outfall 015 EU 02.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W8A001).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A001).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A001).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A001).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.8 OUTFALL 015 EU 03

A. Refer to drawing C7DC375W8A002 located in Appendix B related to the RA at Outfall 015 EU 03.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A002).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A002).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A002).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.9 OUTFALL 015 EU 04

A. Refer to drawing C7DC375W8A003 located in Appendix B related to the RA at Outfall 015 EU 04.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC375W8A003).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A003).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A003).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A003).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.10 OUTFALL 015 EU 07

A. Refer to drawing C7DC375W8004 located in Appendix B related to the RA at Outfall 015 EU 07.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8004).

G. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8004).

H. Take special care during excavation near utilities, roads, culverts, or any structure.

I. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

J. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

K. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

L. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

M. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.11 OUTFALL 015 EU 08

A. Refer to drawing C7DC375W8A005 located in Appendix B related to the RA at Outfall 015 EU 08.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC375W8A005).

G. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC375W8A005).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC375W8A005).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.12 NSDD SECTION 3 EUs 01 AND 02

A. Refer to drawing C7DC90000A025 located in Appendix B related to the RA at NSDD Section EUs 01 and 02.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A025).

G. Install silt fence (sock) as shown on the referenced drawing (Appendix B, C7DC90000A025).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC90000A025).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A025).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.13 NSDD SECTION 3 EU 03

A. Refer to drawing C7DC90000A026 located in Appendix B related to the RA at NSDD Section 3 EU 03.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. The culverts to be plugged are shown on the referenced drawing (Appendix B, C7DC90000A026).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A026).

H. Ensure the pumps necessary to reroute the water are available as shown on the referenced drawing (Appendix B, C7DC90000A026).

I. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A026).

J. Take special care during excavation near utilities, roads, culverts, or any structure.

K. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

L. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

M. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

N. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

O. Backfill the excavated area with clean fill (Appendix H) and compact.

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A.3.14 NSDD SECTION 5 EU 08

A. Refer to drawing C7DC90000A027 located in Appendix B related to the RA at NSDD Section 5 EU 08.

B. Obtain excavation/penetration permit prior to excavation work.

C. Setup working zones near the excavation area in accordance with the ES&H Plan (Appendix C).

D. Locate utilities by hand excavation methods.

E. Field verify the location of all utilities by vacuum or hand excavation and determine the proper action (capping, relocating, or plugging) of all utilities prior to continuation of work. Utilities and locations shown in Appendix B are from the PGDP utility maps.

F. Place pumps necessary to reroute water, or if conditions warrant, temporarily relocate NSDD as shown on the referenced drawing (Appendix B, C7DC90000A027).

G. Install earth berms and/or sediment control measures as shown on the referenced drawing (Appendix B, C7DC90000A027).

H. Excavate the hot spot as shown on the referenced drawing (Appendix B, C7DC90000A027).

I. Take special care during excavation near utilities, roads, culverts, or any structure.

J. The excavated soil and sediments shall be managed in accordance with the WMP (Appendix D).

K. Characterize the waste, as necessary, and dispose of according to the WMP (Appendix D).

L. Collect soil samples from the bottom of the hot spot location to confirm the risk-based targets have been achieved as described in the SAP (Appendix F).

M. If confirmation samples do not meet the risk-based target levels, proceed with further excavation as described in the SAP (Appendix F).

N. Backfill the excavated area with clean, compacted soil.

APPENDIX H
FILL AND COVER MATERIAL VERIFICATION PROTOCOL

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Paducah Gaseous Diffusion Plant
Fill and Cover Material Verification Protocol

Objective

The protocol will serve as a standard method for determining if fill and cover material is acceptable for response actions at the Paducah Gaseous Diffusion Plant (PGDP). While this protocol presents a standard method for sampling fill and cover material and evaluating the sampling results, deviations from this protocol are likely, and these deviations will be discussed on a case-by-case basis. Examples of likely deviations are the use of historical sampling results instead of results from new sampling in the evaluation and, in the case of historical data, some deviations from the analyte list and analyte sample quantitation limits (SQLs) presented below.

Basis

This protocol is based upon a similar protocol used at the U.S. Department of Energy's (DOE) Savannah River Site (SRS) (Westinghouse Savannah River Company 2003). This protocol was modeled after the SRS protocol in order to respond to preference expressed by U. S. Environmental Protection Agency (EPA) personnel. This protocol was discussed at Federal Facility Manager Meetings held in September 2009, as well as during teleconferences held in September and October 2009.

Verification Protocol

This protocol applies to fill taken from areas owned by DOE at the PGDP. Commercial suppliers of soil for fill or cover will be asked for assurances that soil is uncontaminated as part of contracting.

Protocol requirements are:

- Samples will be collected from soil designated for use in response actions either prior to excavation or from loads at a rate of approximately one five-part composite for every 1,000 yds^3 of soil. If *in situ* historical data from an area is available, then results from that sampling may be evaluated instead of results from new sampling; however, DOE will provide information showing that the historical sampling was performed in a manner consistent with this protocol. Once an area is approved through this protocol for a project, then the area sampled will remain as an approved source of fill or cover for that project or similar projects, and additional sampling from that area will not be required.

- Newly collected soil samples will be analyzed for the sitewide list of chemicals of potential concern in Table 2.1 of *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1,. Human Health,* DOE/LX/07-0107&D1/V1, (Risk Methods Document) (RMD), with some deviations. This list of analytes and deviations are in Table H.1. Historical results will be evaluated, and the absence of any analytes in the historical results will be discussed.

- Sampling and laboratory analytical methods will be consistent with EPA methods, DOE requirements, and contractor-approved procedures.

- SQLs and their radionuclide equivalents for analytes are shown in Table H.1. Historical data with SQLs or their radionuclide equivalents that exceed the values shown in Table H.1 will be evaluated to determine the impact of SQLs on the acceptability of soil proposed as fill or cover. Results with SQLs exceeding the values shown in Table H.1 may be acceptable, once the impacts on the evaluation are understood.

- Results of laboratory analysis will be screened as follows:

  — For those analytes with site-specific background concentrations (i.e., most metals and radionuclides), results will be compared to the full range of background expected or likely at PGDP. This evaluation will begin with a simple comparison against background concentrations presented in Table H.2, but additional analyses will be used to determine if exceedances of these background concentrations represent potential contamination or natural variation.

  — For analytes without site-specific background concentrations (i.e., some metals, some radionuclides, and organic compounds), results will be compared to the appropriate risk-based value derived from no action levels (NAL) presented in Appendix A of the Risk Methods Document (DOE 2009). Justification for the risk-based values used in the comparison will be provided. The risk-based values used will be the lesser of values based upon a cancer risk target of 1E-05 and a hazard index target of 1.

  — If exceedances of either the full range of background or appropriate risk-based value are identified, then an uncertainty analysis will be performed to determine the possible reasons and importance of exceedances. The identification of analyte concentrations exceeding the background and risk-based value benchmarks will not be the sole basis for discounting use of soil from a particular area as fill or cover.

References

DOE 2001. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1, Human Health*, DOE/OR/07-1506&D2, December.

DOE 2009. Draft *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1, Human Health*, DOE/LX/07-0107&D1/V1, August.

Westinghouse Savannah River Company 2003. *SRS Fill and Cover Material Verification Protocol*, ERTEC-2003-00012, December.

Table H.1. Sitewide Chemicals of Potential Concern at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky[1]

Analyte	CAS Number	Sample Quantitation Limit or Radionuclide Equivalent[2]	
Inorganic Chemicals			
Aluminum	7429905	8,022.5	mg/kg
Antimony	7440360	0.105	mg/kg
Arsenic	7440382	5.5	mg/kg
Barium	7440393	91	mg/kg
Beryllium	7440417	0.45	mg/kg
Boron	7440428	9,180	mg/kg
Cadmium	7440439	0.105	mg/kg
Chromium[3]	7440473	12.5	mg/kg
Cobalt	7440484	6.5	mg/kg
Copper	7440508	12	mg/kg
Iron	7439896	14,328.5	mg/kg
Lead	7439921	17.5	mg/kg
Manganese	7439965	350.5	mg/kg
Mercury	7439976	0.1	mg/kg
Molybdenum	7439987	230	mg/kg
Nickel	7440020	14	mg/kg
Selenium	7782492	0.3	mg/kg
Silver	7440224	1.5	mg/kg
Thallium	7440280	0.105	mg/kg
Uranium	7440611	3.8	mg/kg
Vanadium	7440622	22	mg/kg
Zinc	7440666	41	mg/kg
Organic Compounds			
Acenaphthene	83329	1,230	mg/kg
Acenaphthylene	208968	NA	mg/kg
Acrylonitrile	107131	0.729	mg/kg
Anthracene	120127	7,610	mg/kg
Benzene	71432	3.46	mg/kg
Carbazole	86748	87.2	mg/kg
Carbon tetrachloride	56235	0.574	mg/kg
Chloroform	67663	0.123	mg/kg
1,1-Dichloroethene	75354	0.235	mg/kg
1,2-Dichloroethene (mixed)	540590	156	mg/kg
trans-1,2-Dichloroethene	156605	20	mg/kg
cis-1,2-Dichloroethene	156592	15.4	mg/kg
Dieldrin	60571	0.105	mg/kg
Ethylbenzene	100414	46.4	mg/kg
Fluoranthene	206440	1,090	mg/kg
Fluorene	86737	945	mg/kg
Hexachlorobenzene	118741	0.414	mg/kg
Naphthalene	91203	19.4	mg/kg
2-Nitroaniline	88744	4.56	mg/kg
N-Nitroso-di-n-propylamine	621647	0.2	mg/kg
Phenanthrene	85018	NA	mg/kg
Pyrene	129000	814	mg/kg
Tetrachloroethene	127184	1.08	mg/kg
Trichloroethene	79016	0.22	mg/kg
Total Dioxins/Furans[4]	1746016	1.14E-05	mg/kg

Table H.1. Site-wide Chemicals of Potential Concern at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky[1] (Continued)

Analyte	CAS Number	Sample Quantitation Limit or Radionuclide Equivalent[2]	
Total PAHs	50328	0.197	mg/kg
Benz(a)anthracene	56553	1.96	mg/kg
Benzo(a)pyrene	50328	0.197	mg/kg
Benzo(b)fluoranthene	205992	1.97	mg/kg
Benzo(k)fluoranthene	207089	19.7	mg/kg
Chrysene	218019	197	mg/kg
Dibenz(a,h)anthracene	53703	0.197	mg/kg
Indeno(1,2,3-cd)pyrene	193395	1.97	mg/kg
Total PCBs[5]	1336363	0.624	mg/kg
Aroclor 1016	12674112	0.618	mg/kg
Aroclor 1221	11104282	0.682	mg/kg
Aroclor 1232	11141165	0.682	mg/kg
Aroclor 1242	53469219	0.619	mg/kg
Aroclor 1248	12672296	0.682	mg/kg
Aroclor 1254	11097691	0.493	mg/kg
Aroclor 1260	11096825	0.657	mg/kg
Vinyl chloride	75014	0.402	mg/kg
Xylenes (Mixture)	1330207	82.1	mg/kg
p-Xylene	106423	NA	mg/kg
m-Xylene	108383	3,940	mg/kg
o-Xylene	95476	4,140	mg/kg
Radionuclides			
Americium-241	14596102	15	pCi/g
Cesium-137+D	10045973	0.25	pCi/g
Cobalt-60	10198400	0.0547	pCi/g
Neptunium-237+D	13994202	0.014	pCi/g
Plutonium-238	13981163	0.002	pCi/g
Plutonium-239	15117483	0.009	pCi/g
Plutonium-240	14119336	31.6	pCi/g
Technetium-99	14133767	0.15	pCi/g
Thorium-230	14269637	1.1	pCi/g
Uranium-234	13966295	0.95	pCi/g
Uranium-235+D	15117961	0.055	pCi/g
Uranium-238+D	7440611	0.95	pCi/g

[1] Taken from Table 2.1 in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume, 1, Human Health*, DOE/LX/07-0107&D1/V1.

[2] Sample Quantitation Limit refers to the lowest reliably detected value for an inorganic or an organic analyte. For purposes of this table, the radionuclide equivalent or the minimum detectable activity (MDA) is presented. Values presented for most metals and radionuclides are the "average" site-specific background concentrations at the PGDP. Values presented for boron, molybdenum, americium-241, cobalt-60, and organic compounds are derived from no action levels for the child resident taken from the RMD by revising the target cancer risk and hazard index to 1×10^{-5} and 1, respectively.

[3] Table 2.1 in the RMD includes Cr III, Cr Total, and Cr VI. Only Cr Total is included here because it is type of chromium expected in soil samples at the PGDP. The cancer-based screening value presented in the RMD for Cr Total was derived using the cancer slope factor for Cr VI. Background values for Cr III are used here.

[4] Table 2.1 in the RMD presents several dioxins and furans. Analyses for these organic compounds will not be required for samples from fill and cover material because they are unlikely to be present in soil from DOE-owned areas at the PGDP the absence of polychlorinated biphenyls (PCBs) based upon PGDP process information.

[5] The list of PCBs may be smaller than that shown here. The list will include Aroclor 1248, 1254, and 1260, which are the most commonly detected PCBs at the PGDP.

NA = not applicable

Table H.2. Site Specific Background Values Used for Soil Evaluation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Analysis	CAS Number	Site-Specific Background Values 2001[1]	2009[2]
Metals (mg/kg)			
Aluminum	7429905	13,000	16,045
Antimony	7440360	0.21	0.21
Arsenic	7440382	12	11
Barium	7440393	200	182
Beryllium	7440417	0.67	0.9
Cadmium	7440439	0.21	0.21
Calcium	7440702	200,000	8,376
Chromium[3]	7440473	16	25
Cobalt	7440484	14	13
Copper	7440508	19	24
Iron	7439896	28,000	28,657
Lead	7439921	36	35
Magnesium	7439954	7,700	2,652
Manganese	7439965	1,500	701
Mercury	7439976	0.2	0.2
Nickel	7440020	21	28
Potassium	7440097	1,300	1,005
Selenium	7782492	0.8	0.6
Silver	7440224	2.3	3
Sodium	7440235	320	142
Thallium	7440280	0.21	0.21
Uranium	7440611	4.9	7.6
Vanadium	7440622	38	44
Zinc	7440666	65	82
Radionuclides (pCi/g)			
Cesium-137	10045973	0.49	0.5
Neptunium-237	13994202	0.1	0.028
Plutonium-238	13981163	0.073	0.004
Plutonium-239	15117483	0.025	0.018
Potassium-40	13966002	16	27
Radium-226	13982633	1.5	2.2
Strontium-90	10098972	4.7	0
Technetium-99	14133767	2.5	0.3
Thorium-228	14274829	1.6	2.3
Thorium-230	14269637	1.5	2.2
Thorium-232	NA	1.5	2.2
Uranium-234	13966295	2.5	1.9
Uranium-235	15117961	0.14	0.11
Uranium-238	7440611	1.2	1.9

[1] Background taken from surface soil values found in Table A.12 of DOE 2001.
[2] Background taken from surface soil values found in Table A.12 of DOE 2009.
[3] Background values for Chromium III are presented.
NA = not available

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