OhioEPA

John R. Kasich, Governor
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July 11, 2014

US DOE-PORTS
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RE: Ohio EPA Concurrence of the Revised Remedial Investigation and Feasibility Study Report for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Dear Ms. Wiehle and Mr. Bradburne:

Ohio EPA received the D3 version of the Revised *Remedial Investigation and Feasibility Study Report for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project* (PB RI/FS) and corresponding Responses to Ohio EPA Comments. The PB RI/FS Report was submitted in accordance with *The April 13th, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modifications for the Portsmouth Gaseous Diffusion Plant* (Decontamination and Decommissioning Project), (hereinafter DFF&O) on June 13, 2014 via e-mail and a hard copy was received on June 17, 2014.

DOE revised the PB RI/FS Report in accordance with the edits discussed in meetings with Ohio EPA on April 10, 2014 and May 9, 2014. DOE has adequately addressed all of Ohio EPA's concerns and modified the PB RI/FS as required. The PB RI/FS Report is concurred with in accordance with Section XV, Review of Submissions, and paragraph 45 a. of the DFF&O.

As a reminder, in accordance with the DFF&O, and as summarized in Section 7.1.2 of the PB RI/FS Report which states, "if the Waste Disposition ROD is not be finalized before the Process Building proposed plan, the Process Building proposed plan will include the requirement that all waste generated be disposed of off Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i through v. of the DFF&O until such time as the Waste Disposition ROD is finalized. The proposed plan will also indicate that upon finalization of the Waste Disposition ROD, the waste will be disposed of in accordance with the decision in that Waste Disposition ROD. If the decision in the Waste Disposition ROD selects an OSDC, this means that the waste generated pursuant to the Process Building ROD will be disposed of in the OSDC upon its becoming operational so long as the waste meets the Ohio EPA approved WAC and all Milestones for removal and disposal of staged wastes are also met."

If you have any questions regarding this correspondence please do not hesitate to contact me at 740-380-5289 or maria.galanti@epa.ohio.gov.

Sincerely,

for MG

Maria Galanti
Site Coordinator
Division of Environmental Response and Revitalization

MG/mr

cc: Dennis Carr, FBP, LLC
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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORT FOR THE PROCESS BUILDINGS AND COMPLEX FACILITIES DECONTAMINATION AND DECOMMISSIONING EVALUATION PROJECT AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT, PIKETON, OHIO

U.S. Department of Energy
DOE/PPPO/03-0245&D3

June 2014

This document has been approved for public release:

Henry Thomas (signature on file) 5/05/14
Classification & Information Officer Date

Richard Coriell (signature on file) 5/05/14
Export Controlled Information Officer Date

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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORT FOR THE PROCESS BUILDINGS AND COMPLEX FACILITIES DECONTAMINATION AND DECOMMISSIONING EVALUATION PROJECT AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT, PIKETON, OHIO

U.S. Department of Energy
DOE/PPPO/03-0245&D3

June 2014

Prepared for
U.S. Department of Energy

Prepared by
Fluor-B&W Portsmouth LLC, Under Contract DE-AC30-10CC40017
FBP-ER-RIFS-BG-RPT-0029, Revision 5

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ACRONYMS

ACM	asbestos-containing material
ACHP	Advisory Council on Historic Preservation
ACP	American Centrifuge Plant
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
AL	architectural location
ALARA	as low as reasonably achievable
AM	Action Memorandum
AMSL	above mean sea level
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
Battelle	Battelle Memorial Institute
BJC	Bechtel Jacobs Company LLC
BERA	baseline ecological risk assessment
BMP	best management practice
CEQ	President's Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CIP	Cascade Improvement Program
COC	contaminant of concern
COPC	chemical of potential concern
CRA	Cultural Resource Analysts, Inc.
CSM	conceptual site model
CUP	Cascade Uprating Program
D&D	decontamination and decommissioning
DFF&O	*April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DUF_6	depleted uranium hexafluoride
EE/CA	Engineering Evaluation/Cost Analysis
ELCR	excess lifetime cancer risk
EM	Environmental Management
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ERP	extended range product
ETTP	East Tennessee Technology Park
FEMA	Federal Emergency Management Agency
FBP	Fluor-B&W Portsmouth LLC
FS	feasibility study
FY	fiscal year
GCEP	Gas Centrifuge Enrichment Plant
GDP	gaseous diffusion plant
GIS	geographic information system
GRA	general response action
GVI	Giffells & Vallet, Inc.

HEU	highly enriched uranium
IP	industrial packaging
LAW	low assay withdrawal
LEU	low-enriched uranium
LiDAR	Light Detection and Ranging
LMES	Lockheed Martin Energy Systems, Inc.
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDA	nondestructive assay
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NNSS	Nevada National Security Site
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCE	National Register Criteria for Evaluation
NRHP	National Register of Historic Places
O&M	operation and maintenance
OAC	*Ohio Administrative Code*
ODNR	Ohio Department of Natural Resources
ODOD	Ohio Department of Development
OHI	Ohio Historic Inventory
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
OMB	Office of Management and Budget
OSDC	on-Site disposal cell
OSHA	U.S. Occupational Safety and Health Administration
OVEC	Ohio Valley Electric Corporation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGE	process gas equipment
PER	Pre-investigation Evaluation Report
PHWH	Primary Headwater Habitat
PORTS	Portsmouth Gaseous Diffusion Plant
PPE	personal protective equipment
PW	Product Withdrawal
RAO	remedial action objective
RAWP	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCW	recirculating cooling water
RD/RA	remedial design/remedial action
RFI	RCRA Facility Investigation
RHW	recirculating heating water
RI	remedial investigation
ROD	Record of Decision
ROI	region of influence
RSI	Restoration Services, Inc.
RU	recycled uranium
S&M	surveillance and maintenance
SAP	sampling and analysis plan

SODI	Southern Ohio Diversification Initiative
SOW	statement of work
SPCC	spill prevention, control, and countermeasure
SSAB	Site Specific Advisory Board
SVOC	semivolatile organic compound
TBC	to-be-considered
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TPMC	Theta Pro2Serve Management Company, LLC
TSCA	Toxic Substances Control Act of 1976
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USDA	U.S. Department of Agriculture
USEC	United States Enrichment Corporation
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WAC	waste acceptance criteria
WRCC	Western Regional Climate Center

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EXECUTIVE SUMMARY

Major environmental restoration decisions are facing the U.S. Department of Energy (DOE), the Ohio Environmental Protection Agency (Ohio EPA), and the public in the areas surrounding the Portsmouth Gaseous Diffusion Plant (PORTS) in Piketon, Ohio. Ohio EPA and DOE have entered into a formal agreement regarding performance of the decontamination and decommissioning (D&D) process at PORTS. The terms of the agreement between Ohio EPA and DOE are documented in *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (DFF&O). This remedial investigation/feasibility study (RI/FS), the *Remedial Investigation and Feasibility Study Report for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, presents the information necessary to select an option for D&D of the buildings/structures and infrastructure identified in the DFF&O, Attachment H. The evaluation of disposal options for waste generated from any PORTS D&D actions is being performed under a separate project governed by the DFF&O, and the results are presented in the *Remedial Investigation and Feasibility Study for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*. The information in this Process Buildings and Complex Facilities D&D Evaluation Project (Process Building) RI/FS supports three elements of decision making: (1) problem definition, (2) solution identification, and (3) solution evaluation.

Problem Definition. More than 250 buildings/structures and infrastructure systems at PORTS have been identified in the DFF&O, Attachment H. The buildings and structures are located primarily within the center of the PORTS Facility. Many of these buildings were built in the 1950s and 1960s, making them 50 to 60 years old with few, if any, upgrades over the years. The majority of the buildings/structures and area under this decision was used for managing nuclear materials, and is suspected of containing radiological and other contamination. The area and buildings/structures are currently maintained in a safe and secure condition.

An estimated 1.3 million cy of building/structure and infrastructure waste including 53,000 cy of residual soil [as described in the DFF&O Paragraph 5(e)(3) and 5(e)(4)(ii)] are anticipated to be generated under a demolition action. The majority of this waste (approximately 83 percent or 1.1 million cy) would be generated from D&D of the three gaseous diffusion process buildings (X-333, X-330, and X-326). This D&D volume includes the structure of each building, all process and industrial equipment and any reusable and/or recyclable materials within the buildings, residual soil, and associated slabs. The balance of the estimated D&D waste volume would come from the remaining smaller buildings/structures and infrastructure and is expected to be 225,000 cy of waste or approximately 17 percent of the total RI/FS waste.

Under a no-action alternative (Alternative 1), no D&D of PORTS buildings, their contents, or infrastructure would be performed, and no controls would be in place to prevent access to the contaminated facilities or their hazards. Without surveillance and maintenance (S&M), the buildings would eventually degrade. Contamination that currently is safely contained within the buildings/structures and equipment would slowly release to the environment during degradation. Contaminants such as radionuclides, polychlorinated biphenyls, and asbestos would be a future threat to users of the buildings, users of the media adjacent to the buildings/structures on the PORTS Facility, and to terrestrial species that are present at PORTS.

DOE is committed to recycling and/or reuse of materials from the PORTS D&D Project regardless of the selected disposal remedy. Specific recycle and/or reuse decisions will be made for discrete materials and waste streams across all phases of the D&D project as appropriate, including during performance of the RI/FS, remedial design, and remedial actions. Decisions to recycle and/or reuse materials will be made by DOE at its discretion so long as the decision to recycle and/or reuse materials fits the definition of D&D, does not require modification of any Ohio EPA approved or concurred with Submissions (e.g., proposed plan, decision document, remedial design, etc.), and is in compliance with all applicable or relevant and appropriate requirements (ARARs). If DOE's recycling proposal requires modification of any regulatory documents (e.g., proposed plan, decision document, remedial design, etc.), DOE will submit its proposed modification to Ohio EPA for approval or concurrence, as applicable.

Additionally, DOE is evaluating the potential for the recovery of material, including 6,400 tons of contaminated nickel barrier material within the converters within the X-333 and X-330 Buildings. The decision to recover this nickel or other materials is at the discretion of the DOE. The recovery and potential recycle of this material broadly consists of three components: segmentation of the converters and retrieval of the nickel barrier materials, storage of the recovered nickel, and processing/ decontamination of the nickel. The RI/FS for this Process Buildings Project addresses the scope and impacts of the segmentation and recovery component of material recovery while the Site-Wide Waste Disposition Evaluation Project (Waste Disposition) alternatives in that RI/FS include provisions for the potential storage and possible future processing/decontamination of the barrier materials.

Solution Identification. A single D&D alternative for the buildings/structures and infrastructure, Alternative 2, was developed to compare to the no-action baseline alternative. Alternative 2 includes the removal of stored waste, materials, equipment, and any component that requires unique handling or disposal. It also includes demolition of the above-grade buildings/structures (including slabs) and infrastructure; demolition of subsurface features and infrastructure, if required; excavation and movement of residual soil; preparation of the waste streams for packaging or disposal; separation of recyclable and/or reusable materials, treatment, if necessary, characterization, and packaging of the waste for final disposition. An assumption has been made solely for the purposes of developing and evaluating an alternative that the waste generated in this RI/FS is prepared for a combination of on- and off-Site disposal. The disposal decision from the Waste Disposition Project will be made before the Process Building decision. Should an off-Site only alternative be selected in the Waste Disposition Record of Decision (ROD), there would be impacts to the cost of Alternative 2. This impact is presented in the alternative evaluation. Should the disposal decision not be made before the Process Building decision, Alternative 2 of the Process Building decision would include off-Site disposal of the waste generated. The impacts of this event are also presented in the alternative evaluation. If a reuse potential for a building/structure or infrastructure is identified in the future, this alternative includes the opportunity to decontaminate the structure or infrastructure (if needed) for reuse. Key components of this alternative include the following:

- Before and during demolition, physical barriers, S&M, and monitoring activities associated with the buildings would continue. These activities would no longer be required in an area upon completion of the demolition activities in that area.

- Additional building or structure characterization would be performed, as needed, to support remedial design, develop worker safety protocols, facilitate segregation of waste streams, and develop plans for waste disposition.

- Each area would be prepared for demolition. Trailers and equipment would be brought to the area, laydown areas and runoff controls would be constructed, transportation support facilities would be upgraded, and vegetation would be removed. Temporary structures that are constructed would be evaluated for addition to the DFF&O, Attachment H if appropriate. They would then be demolished upon completion of the action if there is no future use.

- Asbestos-containing material would be removed, bagged or packaged appropriately, and disposed appropriately.

- Any remaining fluids (e.g., lubricating oils, fuels, and liquid chemicals from equipment and tanks) would be drained, drummed, and disposed at a permitted off-Site disposal facility.

- To the extent practicable and in compliance with ARARs, some materials within the buildings, including those listed above, may be removed, packaged, and appropriately dispositioned prior to building demolition. Other materials would be left in the building to be demolished with the rest of the structure. Predemolition removal of these materials would allow for waste segregation, as necessary, and appropriate disposal. In some cases, predemolition removal of some items would be done to improve the safety of demolition workers.

- Decontamination of building/structure components would be performed, as needed, to protect the workers, meet regulatory requirements, facilitate material recycle and/or reuse or building/structure demolition, or meet disposal facility waste acceptance criteria (WAC).

- Utilities and specialty systems (e.g., for alarms and security) would be deactivated or rerouted in concert with termination of need or removal of the hazards. Piping and electrical cables leaving the building/structure footprint would be cut or disconnected. New utilities may be installed.

- The gaseous diffusion process equipment (e.g., converters, compressors, coolers, and valves) would be removed from the three process buildings (X-333, X-330, and X-326). If required to meet transportation requirements, disposal facility WAC, or to facilitate material reuse and/or recycling, process equipment and piping would be segmented on Site, and/or uranium material deposits and/or material would be removed. The process equipment, process piping, and solidified uranium deposit materials would be packaged for transportation and disposal in accordance with the appropriate WAC while recovered material would be prepared for eventual recycling and/or reuse (addressed in the Waste Disposition RI/FS).

- Oversized auxiliary equipment would be removed and size-reduced separately, as appropriate.

- Above-grade structures, including slabs, would be demolished using heavy equipment with specialized attachments.

- Fugitive dust would be minimized during demolition. Any storm water runoff would be controlled and monitored.

- Soils as described in DFF&O Paragraph 5(e)(3) and 5(e)(4)(ii) would be removed and managed or recontoured. These soils are referred to as residual soils in this RI/FS.

- Subsurface structures and infrastructure would be removed using heavy equipment with specialized attachments. If uncontaminated, consideration can be given to leaving subsurface structures behind.

- Concrete may be rubblized and used for on-PORTS fill.

- Waste streams would be segregated by waste types and size reduced, treated, and packaged in accordance with applicable regulations and disposal facility WAC in preparation for disposition.

- Equipment or recyclable materials that would be considered for reuse and/or recycling at DOE's discretion.

- Demolition areas would be backfilled and/or graded, as needed, to promote drainage. They would then be seeded to promote revegetation.

- DOE plans to finalize the ROD for the Waste Disposition Project before the Process Buildings ROD. Should an off-Site only alternative be selected in the Waste Disposition ROD, there would be impacts to the cost of Alternative 2. This impact is presented in the alternative evaluation. Should the Waste Disposition ROD not be finalized before the Process Building proposed plan, Alternative 2 of the Process Building proposed plan will include a requirement that all waste generated be disposed of off-Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i. through v. of the DFF&O until such time as a Waste Disposition ROD is finalized. The impacts of this event are also presented in the alternative evaluation.

Solution Evaluation. The two alternatives were evaluated with respect to the DFF&O evaluation criteria. Alternative 1, no action, is not considered to be protective because it would allow the continued degradation of buildings and the accumulation of waste. This waste and the associated contaminants would pose a future unacceptable risk to on-PORTS receptors, both human and ecological. Risk is primarily from incidental ingestion of soils contaminated with radionuclides or from ingestion of underlying groundwater contaminated after a future release. Alternative 2, remove structures, treat as necessary, and package waste, is protective when combined with either of the waste disposition actions that may be selected in the Waste Disposition ROD. Human health and environmental risks during demolition and packaging would be controlled through compliance with ARARs and site-specific work plans. Long-term protection would be provided by removing contaminated buildings, infrastructure, and associated equipment; packaging waste; and appropriately disposing of demolition waste. There would be no need for long-term S&M or monitoring. The demolition areas would be stabilized to promote surface water runoff.

No ARARs are directly associated with the no-action alternative. Alternative 2, which removes buildings, treats as necessary, and packages waste for final disposition, would meet all ARARs without waivers.

The no-action alternative would present no specific short-term risks or benefits to the community or workers. With Alternative 2, potential short-term risk to the public could result from runoff, windborne dispersion of contaminants, or an increase in local traffic during demolition operations. These risks to the public would be low because of the robust protective systems that would be implemented during the project, and only slight increases in traffic are anticipated. Risk of radiological exposure or physical hazards to workers would be minimized by characterizing the buildings/structures and infrastructure prior to demolition; compliance with approved work procedures, health and safety plans, and regulatory requirements; and workplace monitoring.

Short-term environmental impacts would be least for the no-action alternative and minimal for the action alternative. Environmental impacts during implementation of Alternative 2 could result from a release to air, soil, or water during equipment or waste handling, or from runoff coming in contact with demolition waste. The risk of a release is low, and only minor adverse impacts would be anticipated to result from a release because controls would be in place and procedures to mitigate releases would be implemented. Runoff from the demolition area would be monitored to ensure no unacceptable contaminant migration is occurring.

Some buildings/structures and infrastructure may be considered historically significant, and, if that is the case, their removal would impact cultural resources. Impacts would be evaluated and mitigation strategies developed as appropriate. Specific mitigation methods include development of a record of PORTS history, detailed documentation of key buildings, and collection of items of potential historical significance for preservation.

No services or materials would be required to implement the no-action alternative, Alternative 1, and therefore it is very technically implementable. But it is not administratively implementable because it would not comply with DOE Orders.

Alternative 2 is technically and administratively feasible. The technology is currently available for demolishing the buildings and structures, and has been proven at several other radiologically contaminated DOE facilities. However, numerous challenges would be associated with demolishing the buildings/structures and infrastructure. Characterization, deposit removal, size or void reduction requirements, waste packaging, site restoration, deactivation in an operating plant, and coordination with corrective action soil response actions all require significant planning, and new processes or procedures might need to be developed. Removal of the process equipment, size reducing it, and removing any uranium deposits or material would be labor-intensive. However, these activities have previously been performed within the PORTS buildings and at the East Tennessee Technology Park in Oak Ridge, Tennessee.

There are no costs associated with the no-action alternative. Estimated total present worth costs for Alternative 2 are $1.6 billion under the assumption of preparing the waste for a combination of on- and off-Site disposal. If off-Site disposal is selected in the Waste Disposition ROD, the present worth costs of Alternative 2 are estimated to increase to $2.0 billion. Capital costs include those for remedial planning, characterization, deactivation, hazard abatement, treatment, equipment removal, and demolition and packaging of the waste, including the deactivation and demolition of any temporary facilities erected for D&D. No long-term operational or maintenance costs would be required after the D&D action is completed. The duration of Alternative 2 is assumed to take 10 to 12 years to complete based on the funding profile in early fiscal year 2012.

Should a disposal decision not be finalized in the Waste Disposition ROD prior to the Process Building proposed plan, Alternative 2 in the Process Building proposed plan will include a requirement that all waste generated be disposed of off-Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i. through v. of the DFF&O until such time as a Waste Disposition ROD is finalized. Off-Site disposal may increase the risk of off-Site transportation injuries and fatalities as thousands of truck trips and millions of rail miles would be needed to transport the waste off Site. The costs would also significantly increase due to the cost of transporting and disposing of the waste.

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1. INTRODUCTION

In April 2010, the U.S. Department of Energy (DOE) and the Ohio Environmental Protection Agency (Ohio EPA) entered into a regulatory agreement for the Portsmouth Gaseous Diffusion Plant (PORTS) federal facility. This agreement sets the stage for how the final decontamination and decommissioning (D&D) and waste disposition decisions for PORTS will proceed. The agreement, known as *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (DFF&O) (Ohio EPA 2012), adopts Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 *United States Code* (*USC*) 9601 et seq., decision-making protocols as its underlying regulatory framework and decision-making architecture.

Pursuant to Section I. of the DFF&O, the DFF&Os were issued to DOE pursuant to the authority vested in the Director of Ohio EPA under Ohio Revised Code Sections 3704.03, 3734. 13, 3734.20, 6111.03, and 3745.01 and DOE entered into the DFF&O pursuant to Section 104 of CERCLA, 42 *USC* §9604, Executive Order 12580, and the Atomic Energy Act of 1954, as amended, (AEA) 42 *USC* §2011, *et seq.* Using a CERCLA framework, the DFF&O defines the steps for identifying a range of technical alternatives for the D&D and waste disposition components of the project, and reaching formal decisions on how best to proceed. The steps include developing viable alternatives, evaluating and comparing them, gaining public feedback on the range of alternatives, selecting a final approach, and formalizing the decisions; and then defining the downstream regulatory requirements for successful implementation of the selected D&D and waste disposition remedial actions.

As a regulatory blueprint, the DFF&O envisions the following three principal decision elements as the means to carry out the remaining major gaseous diffusion plant (GDP) D&D and waste disposition decisions for PORTS:

- **The Process Buildings and Complex Facilities D&D Evaluation Project (Process Building).** This remedial action project consists of a Remedial Investigation/Feasibility Study (RI/FS), proposed plan, Record of Decision (ROD), and remedial design/remedial action (RD/RA) documents for most process-related PORTS structures, as identified in Attachment H of the DFF&O. The emphasis of this remedial action is to evaluate whether to D&D the buildings and structures, and comparatively examine the impacts if no D&D action is taken and the buildings are hypothetically allowed to degrade with no institutional or engineering controls in place.

- **Non-Time-Critical Removal Actions for Support Structures.** This decision-making option is recognized in the DFF&O to facilitate the early D&D of various combinations of support structures (outside of the Process Buildings Project) as fast-track, schedule-driven subprojects. As Non-Time-Critical Removal Actions, D&D of the support structures would be accomplished by identifying groups of structures and using Engineering Evaluation/Cost Analyses (EE/CAs), action memoranda (AMs), and Removal Action Work Plans (RAWPs) for the groups of structures identified. The support structures deemed as removal action candidates are identified in Attachment G of the DFF&O.

- **The Site-wide Waste Disposition Evaluation Project (Waste Disposition).** This remedial action project is recognized in the DFF&O as the regulatory means to reach a remedial action decision for the dispositioning of the D&D wastes to be generated under the work activities contemplated by the DFF&O. Potential waste streams from environmental media cleanup conducted under the Resource Conservation and Recovery Act of 1976, as amended (RCRA) Ohio Consent Decree and for which

DOE may seek exemptions under Ohio laws to allow placement of such waste streams in any potential on-Site disposal cell (OSDC) that might be constructed as a result of the Waste Disposition Project are acknowledged in the DFF&O as other potential waste streams. The Waste Disposition Project consists of the RI/FS, proposed plan, ROD, and RD/RA documents necessary to implement the selected remedial action.

1.1 PURPOSE OF THE REPORT

The purpose of this RI/FS report is to evaluate alternatives to determine the final status of process, process-related, and other support buildings and structures at PORTS. This report is intended to support a comprehensive decision for the disposition of these buildings and structures. Options include no action (i.e., allowing the buildings and structures to continue to deteriorate) or demolition, treatment, and packaging the generated waste for final disposition. Final waste disposition is addressed in the Waste Disposition Project.

As a combined RI/FS report, this document accomplishes three integrated objectives: (1) it defines the magnitude of the problem associated with degrading buildings, (2) it defines the range of potential solutions, and (3) it individually and comparatively evaluates the potential solutions so a preferred approach can be identified and shared with the public for review and comment through a subsequent proposed plan.

1.1.1 Scope of the Process Buildings and Complex Facilities Decision

Two hundred and fifty-four buildings and structures are currently identified for inclusion within the scope of this evaluation. The buildings and structures are listed in Table 1.1 and are described in Section 4 and Appendix A. To the extent the activities proposed for these buildings and structures meet the definition of D&D, they are included herein. The locations of these buildings and structures are shown in Figure 1.1. Inclusion of a building or structure on this list does not preclude a future reuse of that building or structure if a need should be identified.

A number of structures listed at the end of Table 1.1 include only residual concrete slabs and/or below-grade (subsurface) structures (e.g., footers, basements, valve pits, cooling tower basins, etc.) following the completion of early actions or removal actions conducted under the DFF&O.

1.1.2 Relationship to Other Documents

The RI/FS report is a document required by the DFF&O. It provides detailed technical documentation and foundational engineering and scientific information to support a remedial action decision. It is made available for review by the general public through the Process Buildings and Complex Facilities Administrative Record File. Three other documents will be issued subsequent to Ohio EPA concurrence with the RI/FS report:

- The proposed plan, which summarizes the results of the RI/FS at a level of detail that supports use by the general public and other entities, such as state agencies, that may elect to provide input to the decision. The proposed plan also identifies DOE’s preferred remedial action for official comment during the formal public comment period.

- The ROD, which memorializes the final remedial action decision for the DFF&O D&D work activities.

- The Responsiveness Summary, which provides DOE's formal responses to comments received on the proposed plan during the formal public comment period. The Responsiveness Summary is attached to the final ROD and placed in the official Administrative Record for the remedial action.

Together, the RI/FS report, proposed plan, ROD, and Responsiveness Summary comprise the decision-making documents leading to selection of the preferred remedial action. Other implementation documentation, such as the RD/RA work plan and other required remedial design document submittals, will follow formal issuance of the ROD. The implementation documents will also be subject to Ohio EPA review and concurrence or approval, as applicable, under the requirements of the DFF&O.

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS

Facility Identification	Facility Name
	Buildings and Structures
X-104A	Indoor Firing Range Building
X-104B[1]	Protective Forces Office Trailer
X-104C[1]	Protective Forces Shower/Locker Trailer
X-108A	South Portal and Shelter-Drive Gate
X-108B	North Portal and Shelter
X-108E	Construction Entrance Portal
X-108J	West Security Portal
X-108K	North Security Portal
X-108L	East Security Portal
X-111A	SNM Monitoring Portal
X-111B	SNM Monitoring Portal
X-114A	Outdoor Firing Range
X-120H	Weather Station
X-202	Roads
X-204-1	Railroad and Railroad Overpass (excluding DUF_6 utilized track)
X-206A	North Main Parking Lot
X-206B	South Main Parking Lot
X-206E	Construction Parking Lot
X-206H	Pike Avenue Parking Lot
X-206J	South Office Parking Lot
X-208[1]	Security Fence
X-208A[1]	Boundary Fence
X-208B[1]	SNM Security Fence
X-210[1]	Sidewalks
X-215A[1]	Electrical Distribution to Process Buildings
X-215B[1]	Electrical Distribution to Other Areas
X-215C[1]	Exterior Lighting
X-215D	Electrical Power Tunnels
X-220A	Instrumentation Tunnels
X-220B1[2]	Process Instrumentation Lines
X-220B2[2]	Carrier Communication Systems
X-220B3[2]	Water Supply Telemetering Lines
X-220C[2]	Superior American Alarm System
X-220D1[2]	General Telephone System
X-220D2[2]	Process Telephone System

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Identification	Facility Name
	Buildings and Structures
X-220D3[2]	Emergency Telephone System
X-220E1[2]	Evacuation PA System
X-220E2[2]	Process PA System
X-220E3[2]	Power Public Address System
X-220F[2]	Plant Radio System
X-220G[2]	Pneumatic Dispatch System
X-220H[2]	McCalloh Alarm System
X-220J[2]	Radiation Alarm System
X-220K[2]	Cascade Automatic Data Processing System
X-220L[2]	Classified Computer System
X-220N[2]	Security Alarm and Surveillance System
X-220P[2]	MSR System
X-220R[2]	Public Warning Siren System
X-220S[2]	Power Operations SCADA System
X-230[1]	Water Supply Line
X-230A[1]	Sanitary and Fire Water Distribution System
X-230A3[3]	Ambient Air Monitoring Station
X-230A6[3]	Ambient Air Monitoring Station
X-230A8[3]	Ambient Air Monitoring Station
X-230A9[3]	Ambient Air Monitoring Station
X-230A10	Ambient Air Monitoring Station
X-230A12[3]	Ambient Air Monitoring Station
X-230A15[3]	Ambient Air Monitoring Station
X-230A23[3]	Ambient Air Monitoring Station
X-230A24[3]	Ambient Air Monitoring Station
X-230A28[3]	Ambient Air Monitoring Station
X-230A29	Ambient Air Monitoring Station
X-230A36	Ambient Air Monitoring Station
X-230A37[3]	Ambient Air Monitoring Station
X-230A40	Ambient Air Monitoring Station
X-230A41[3]	Ambient Air Monitoring Station
X-230B[1]	Sanitary Sewers
X-230C[1]	Storm Sewers
X-230D[1]	Softened Water Distribution System
X-230E[1]	Plant Water System (make up)
X-230F[1]	Raw Water Supply Line
X-230G[1]	RCW System
X-230H[1]	Fire Water Distribution System
X-230J-1	Monitoring Station
X-230J2	South Environmental Sample Station
X-230J3	West Environmental Sampling Building for Intermittent Containment Basin
X-230J4	Environmental Air Sampling Station
X-230J5	West Holding Pond Oil Separation Station
X-230J6	Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
X-230J7	East Monitor Facility (East Holding Pond Oil Separation Building)
X-230M	Clean Test Site

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Identification	Facility Name
	Buildings and Structures
X-232A[1]	Nitrogen Distribution System
X-232B[1]	Dry Air Distribution System
X-232C1	Tie Line X-342 to X-330
X-232C2	Tie Line X-330 to X-326
X-232C3	Tie Line X-330 to X-333
X-232C4	Tie Line X-326 to X-770
X-232C5	Tie Line X-343 to X-333
X-232D[1]	Steam and Condensate System
X-232E[1]	Freon Distribution System
X-232F[1]	Fluorine Distribution System
X-232G[1]	Support for Distribution Lines
X-235	South Groundwater Collection System
X-237	Little Beaver Groundwater Collection System
X-240A[1]	RCW System (Cathodic Protection System)
X-300	Plant Control Facility
X-300A	Process Monitoring Building
X-300B	Plant Control Facility Carport
X-300C	Emergency Communications Antenna
X-326	Process Building and Instrumentation Tunnel
X-330	Process Building and Instrumentation Tunnel
X-333	Process Building and Instrumentation Tunnel
X-342A	Feed Vaporization Building
X-342B	Fluorine Storage Building
X-344A	UF_6 Sampling Facility
X-344H	Security Portal
X-345	SNM Storage Building
X-501	Substation
X-501A	Substation
X-502	Substation
X-515[1]	330 kV Tie Line Between X-530 and X-533
X-530G	GCEP Oil Pumping Station
X-530T1[1]	Office Trailer
X-533H	Personnel Monitoring Station
X-533 T1[1]	Trailer
X-533 T2[1]	Trailer
X-533 T3[1]	Trailer
X-533 T4[1]	Trailer
X-540	Telephone Building
X-600A	Coal Yard (structures)
X-600D[1]	Utilities Maintenance Field Office
X-605[3]	Sanitary Water Control House
X-605A[3]	Well Field
X-608[3]	Raw Water Pump House
X-608A[3]	Well Field
X-608B[3]	Well Field
X-611A	Old Lime Sludge Lagoon (structures)

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Identification	Facility Name
	Buildings and Structures
X-611B	Lagoon (structures)
X-611B1	Lagoon Supernatent Pumping Station
X-611B2	Lagoon Supernatent Pumping Station
X-611B3	Lagoon Supernatant Pumping Station
X-614D	South Sewage Lift Station
X-614P	North East Sewage Lift Station
X-614Q[1]	Sewage Booster Pump Station
X-617	South Holding Pond pH Control Facility
X-622	South Groundwater Treatment Facility
X-623	North Groundwater Treatment Building
X-624	Little Beaver Groundwater Treatment Facility
X-625	Groundwater Passive Treatment Facility
X-627	Groundwater Pump & Treatment Facility
X-633 T1[1]	Trailer
X-633 T2[1]	Trailer
X-633 T3[1]	Trailer
X-640-1A	Substation (required for Fire Services)
X-640-2A	Elevated Water Tank Auxiliary Building
X-670[1]	Dry Air Plant
X-670A[1]	Cooling Tower
X-675[1]	Plant Nitrogen Station
X-680[1]	Blowdown Sample and Treatment Building
X-690	Steam Plant
X-700	Converter Shop & Cleaning Building
X-700A	Air Conditioning Equipment Building
X-700B[1]	Sandblast Facility and Observation Booth
X-701E	Neutralization Building
X-701F	Effluent Monitoring Facility
X-705	Decontamination Building
X-705D	Heat Booster Pump Building
X-705E	Oxide Conversion Area
X-710	Technical Service Building
X-710A	Technical Service Gas Manifold Shed
X-710B	Explosion Test Facility
X-720	Maintenance & Stores Building
X-720B	Radio Base Station
X-720C	Paint & Storage Building
X-720 T01[1]	Office Trailer
X-721	Radiation Instrument Calibration
X-741	Oil Drum Storage Facility
X-742	Gas Cylinder Storage Facility
X-744K	Warehouse-K
X-744N	Warehouse N Non-UEA
X-744P	Warehouse P Non-UEA
X-744Q	Warehouse Q Non-UEA
X-744V	Surplus and Salvage Clean Storage Area

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Identification	Facility Name
	Buildings and Structures
X-744Y	Waste Storage Area
X-744Y T1[1]	Trailer
X-744Y T2[1]	Trailer
X-744Y T3[1]	Trailer
X-744Y T4[1]	Trailer
X-744Y T5[1]	Trailer
X-744Y T6[1]	Trailer
X-744Y T8[1]	Trailer
X-744Y T9[1]	Trailer
X-745B	Toll Enrichment Gas Yard
X-745D	Cylinder Storage Yard
X-745F	North Process Gas Stockpile Yard
X-745G-2	Cylinder Storage Yard
X-747	Clean Scrap Yard
X-747B	Material Storage Yard Pads and Equipment
X-747C	Material Storage Yard Pads and Equipment
X-747D	Material Storage Yard Pads and Equipment
X-747E	Material Storage Yard Pad
X-747H1	Loading Pad
X-747J	Decontamination Storage Yard
X-748	Truck Scale
X-751	GCEP Mobile Equipment Garage
X-760 T1[1]	Trailer
X-760 T2[1]	Trailer
X-1000	Administration Building
X-1000T1[1]	Training Trailer
X-1007	Fire Station
X-1107BV	Interplant Vehicle Portal
X-2230T1[1]	Recirculating Heating Water System (East of Valve Pit "A" and "B")
X-2232E[1]	Gas Pipeline
X-6619	Sewage Treatment Plant
XT-800	GCEP Construction Office Pad
XT-847	Warehouse
B	Pad in Field East of X-109A (near X-740)
C[1]	Old Switch Yard West of X-109A Pad (near X-740)
E[1]	X-700 "0000" Compressor Base Foundation
H	Old Firing Range Shed
I[1]	Peter Kiewit Powder Magazine
J	X-1000 Pavilion
	Slabs and Below-grade Structures Remaining from Previous Actions
X-100	Administration Building (slab and below-grade structures)
X-105	Electronic Maintenance Building (front apron/concrete pad and driveway)
X-106B	Old Fire Training Building (slab and below-grade water tank)
X-120	Old Weather Station (footers)
X-230J1	East Environmental Sampling Building (slab)
X-230J8	Environmental Storage Building (slab)

Table 1.1. Buildings and Structures Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Identification	Facility Name
	Slabs and Below-grade Structures Remaining from Previous Actions
X-342C	Waste HF Neutralization Pit (below-grade structures)
X-344C	Hydrogen Fluoride Storage Building (foundations and piers)
X-344D	HF Neutralization Pit (below grade)
X-344E	Gas Ventilation Stack (below grade)
X-344F	Safety Building (below-grade structures)
X-530A	High Voltage Switchyard (grounding system and underground cables)
X-530B	Switch House (slab and below-grade structures)
X-530C	Test and Repair Building (below-grade structures)
X-530D	Oil House (below-grade structures)
X-530E	Valve House (slab and below-grade structures)
X-530F	Valve House (slab and below-grade structures)
X-600	Steam Plant (slab and below-grade structures)
X-611	Water Treatment Plant (slab and below-grade structures)
X-611C	Filter Building (slab and below-grade structures)
X-611E	Clear Well & Chlorine Building (slab and below-grade structures)
X-612	Elevated Storage Tank (below-grade structures)
X-614A	Sewage Pumping Station (slab and below-grade structures)
X-614B	Sewage Pumping Station (slab and below-grade structures)
X-615	Old Sewage Treatment Plant (foundations and piers)
X-616	Liquid Effluent Control Facility (foundations and piers)
X-626-1	Recirculating Water Pump House (slab and below-grade structures)
X-626-2	Cooling Tower (below-grade structures)
X-630-1	Recirculating Water Pump House (slab and below-grade structures)
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-630-3	Acid Handling Station (saddles and basin)
X-640-1	Fire Water Pump House (slab and below-grade structures)
X-640-2	Elevated Storage Tank (below-grade structures)
X-701A	Lime House (below-grade structures)
X-701D	Water De-ionization Facility (below-grade structures)
X-720A	Maintenance and Stores Gas Manifold Shed (below-grade structures)
X-746	Material Receiving and Inspection (portions of above- and below-grade structures)
X-747A	Material Storage Yard (below-grade structures)
X-747G	Precious Metal Scrap Yard (below-grade structures)
X-747H	NW Contaminated Scrap Yard (below-grade structures)
X-750	Mobile Equipment Maintenance Shop (slab and below-grade structures)

Notes:
[1]Buildings/structures and infrastructure too extensive, small, or readily movable, e.g., trailers, to be shown in Figure 1.1
[2]Nonstructural support systems not shown in Figure 1.1
[3]Buildings/structures and infrastructure located off the map or near boundary and not shown in Figure 1.1

GCEP = Gas Centrifuge Enrichment Plant
MSR = maintenance service request
PA = public address
RCW = recirculating cooling water
SCADA = Supervisory Control and Data Acquisition
SNM = special nuclear material
UEA = uranium enrichment area

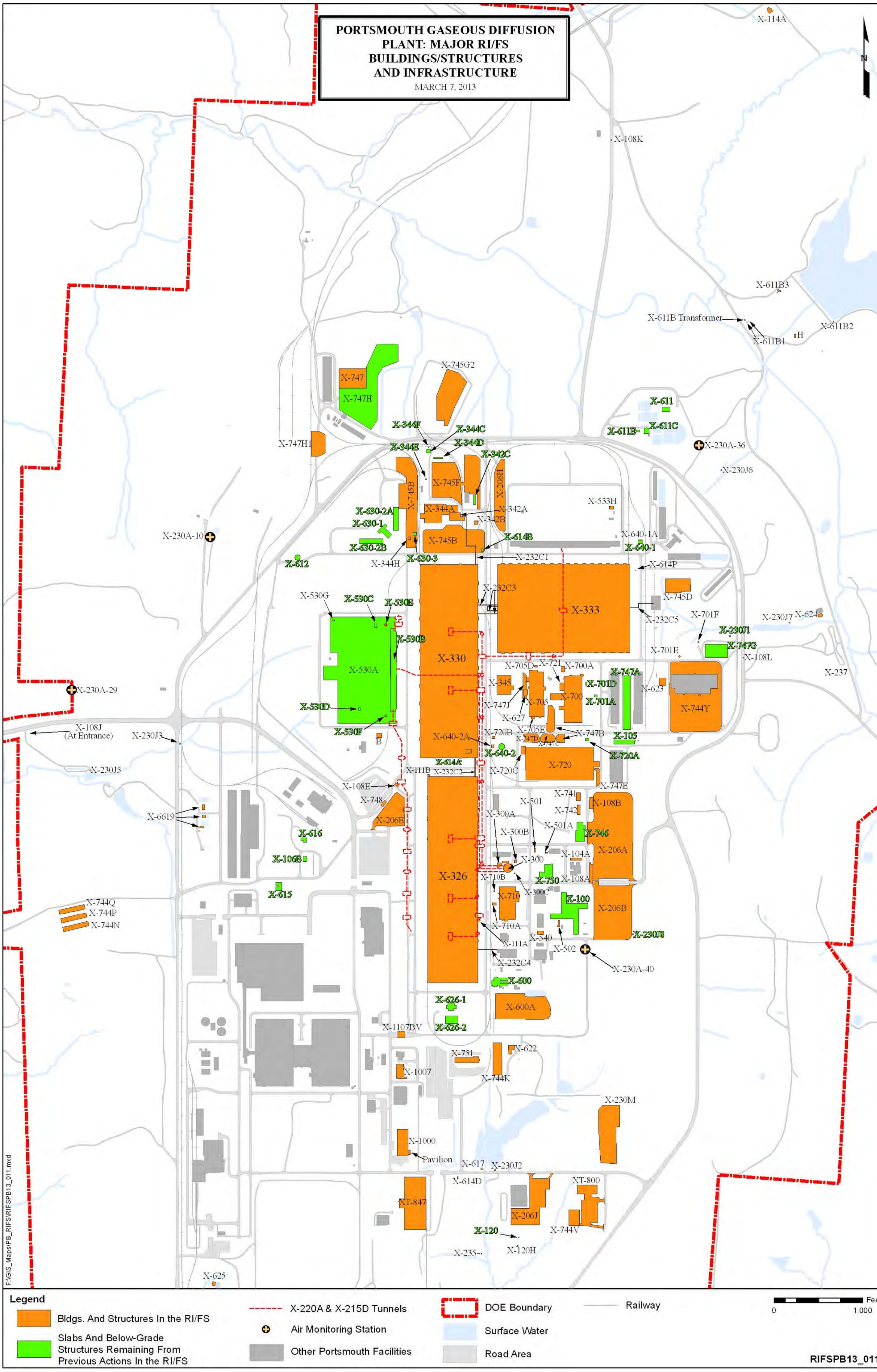

Figure 1.1. Locations of the Facilities Included in the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS

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The decision for the disposition of the wastes from the Process Building Project is being evaluated and selected in the Waste Disposition ROD. DOE plans to finalize the Waste Disposition ROD before the Process Building ROD is finalized. The data collected to evaluate the process buildings and building contents, and the evaluation of such data for the purpose of evaluating the disposition of waste alternatives in the Waste Disposition RI/FS and proposed plan, will be incorporated by reference in the Process Building proposed plan, RI/FS and ROD.

This RI/FS report was prepared in accordance with the DFF&O requirements. The general approach to evaluating potential remedial actions is based on U.S. Environmental Protection Agency (EPA) guidance (EPA 1988). The RI/FS approach also incorporates National Environmental Policy Act of 1969 (NEPA) values in accordance with the DOE Secretarial Policy on NEPA (DOE 1994). While NEPA values are incorporated throughout this RI/FS, they are the particular focus of certain sections in this report. The affected environment is described in Section 3, Physical Characteristics of the Study Area, and the environmental consequences (direct and indirect impacts and mitigation measures) are described in Section 8, Detailed Analysis of Alternatives.

1.1.3 Relationship to Other Environmental Restoration Activities at PORTS

The DFF&O decisions for process facility and support structure D&D and Site-wide waste disposition remedial actions are part of a larger environmental remediation effort that has been underway at the PORTS Facility since the late 1980s. Most notably, the Ohio Consent Decree earlier efforts focused on interim soil and groundwater restoration needs outside of the main processing facility boundaries. Earlier efforts also focused on regulatory closure of the existing 101 acres of historical landfills at PORTS.

The DFF&O adopts a CERCLA-based decision framework to complete decision making for the remaining D&D and D&D waste disposition decisions at PORTS. The earlier Ohio Consent Decree soil and groundwater and landfill closure efforts were conducted under the RCRA corrective action program obligations in accordance with the Facility’s Ohio Consent Decree.

Beyond the DFF&O decisions, several key environmental restoration decisions remain which will be accomplished under the Ohio Consent Decree: (1) establishment of final clean-up levels for soil and closeout of the remaining RCRA Solid Waste Management Units that were deferred for cleanup until the process facility D&D decision is made, and (2) selection of final remedial actions for affected groundwater within the reservation to complete the interim actions now in place. In addition, there may be the need for other actions, including but not limited to those under CERCLA, to be conducted.

Section 1.2.2.2 provides an overview of the regulatory and environmental restoration history at PORTS, dating back to 1989.

1.2 SITE BACKGROUND

This section provides a description of the PORTS Facility, as defined in the DFF&O, and a history of the PORTS operations, including the production mission history and the PORTS’ historical environmental restoration and regulatory compliance activities.

1.2.1 Site Description

PORTS, which began operations in 1954, is located on a 3,777-acre federal reservation in a rural area of Pike County, Ohio (Figure 1.2). From 1954 until 2001, the PORTS gaseous diffusion process enriched uranium for DOE and predecessor agencies, the Naval Nuclear Propulsion Program, and commercial customers. In 1993, DOE began leasing the uranium enrichment production and operations facilities

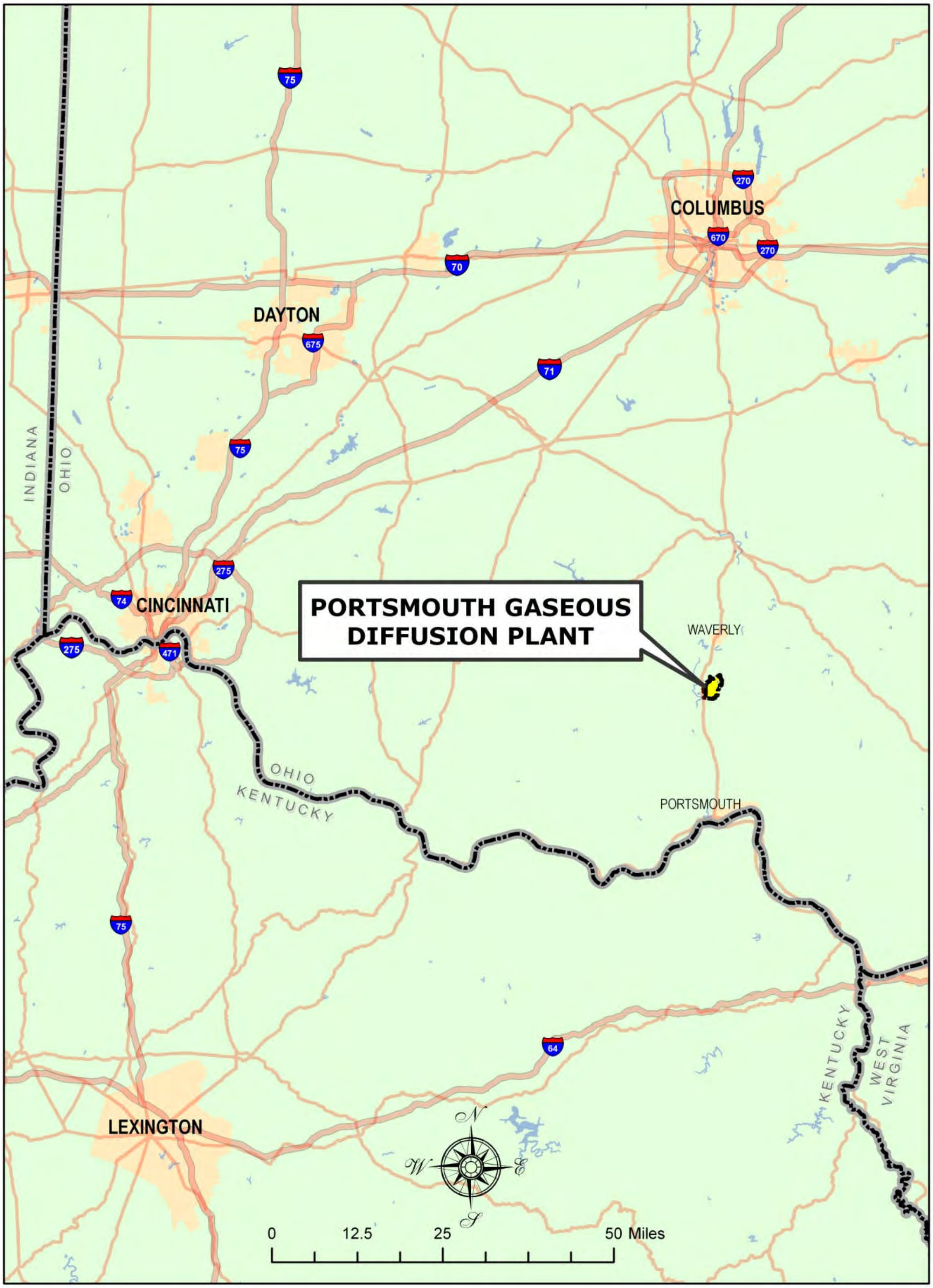

Figure 1.2. PORTS Location

at PORTS to the United States Enrichment Corporation (USEC). Uranium was enriched by USEC until May 2001, at which time the production facilities were placed into a cold-standby mode. During cold standby, the process buildings were maintained with a restart capability as a strategic hedge against a disruption in the nation's supply of enriched uranium. DOE terminated the cold-standby program in September 2005 and replaced it with a cold-shutdown program, which no longer maintains the gaseous diffusion restart capability. The process buildings, support facilities, and auxiliary facilities are more than 50 years old but have been maintained in a safe and secure condition.

The GDP and surrounding area are owned by DOE. PORTS consists of 415 facilities ("facility" can mean a building, utility system, or infrastructure unit) with three main process buildings known as X-333, X-330, and X-326, which house the gaseous diffusion equipment. The three main process buildings are located in the center of PORTS and cover a combined footprint of approximately 90 acres (Figure 1.3). Various support and auxiliary buildings/structures include many substantial buildings/structures for product feed and transfer operations, maintenance, steam generation, chemical cleaning, decontamination, process heat removal, water supply, water storage, water distribution, and electrical power distribution. Other buildings house the administrative offices, hospital, cafeteria, security headquarters, plant control facility, and laboratory support. These facilities consist mostly of concrete/steel construction on concrete slabs.

The three process buildings, as well as most of the remaining facilities, are situated within the approximately 1,000-acre industrialized area that lies within Perimeter Road. The industrialized area includes a 750-acre controlled access area. The central, industrialized area is largely devoid of trees, with managed lawns, parking lots, and paved roadways dominating the open space. The portion of the DOE property outside of Perimeter Road, consisting of more than 2,500 acres, is used for a variety of purposes, including a water treatment plant, sediment ponds, sanitary and inert landfills, cylinder storage yards, open fields, and forested buffer areas (U.S. Nuclear Regulatory Commission [NRC] 2006a). Closed existing landfills and burial grounds account for approximately 101 acres.

1.2.2 Site History

The sections below summarize the PORTS nearly 60-year history for two categorical areas. Section 1.2.2.1 focuses on the production mission history dating back to 1954 when PORTS began operations; and Section 1.2.2.2 focuses on the environmental restoration and regulatory compliance history dating back to 1989, when the Ohio Consent Decree was issued. This decree requires investigation and remediation of solid and hazardous waste units at PORTS in accordance with RCRA.

1.2.2.1 PORTS production and waste management history

PORTS began operations in 1954 and was one of three uranium enrichment facilities originally constructed in the United States; the other two were constructed in Oak Ridge, Tennessee, and Paducah, Kentucky. PORTS used the gaseous diffusion process to provide highly enriched uranium (HEU) to the U.S. Navy and low-enriched uranium (LEU) for electrical power generation. From 1991 until production ceased in 2001, PORTS produced only LEU for commercial power plants. In 1993, DOE leased the commercial uranium enrichment operations to USEC while retaining responsibility for certain environmental restoration and waste management activities, uranium programs, and long-term stewardship of nonleased facilities at PORTS.

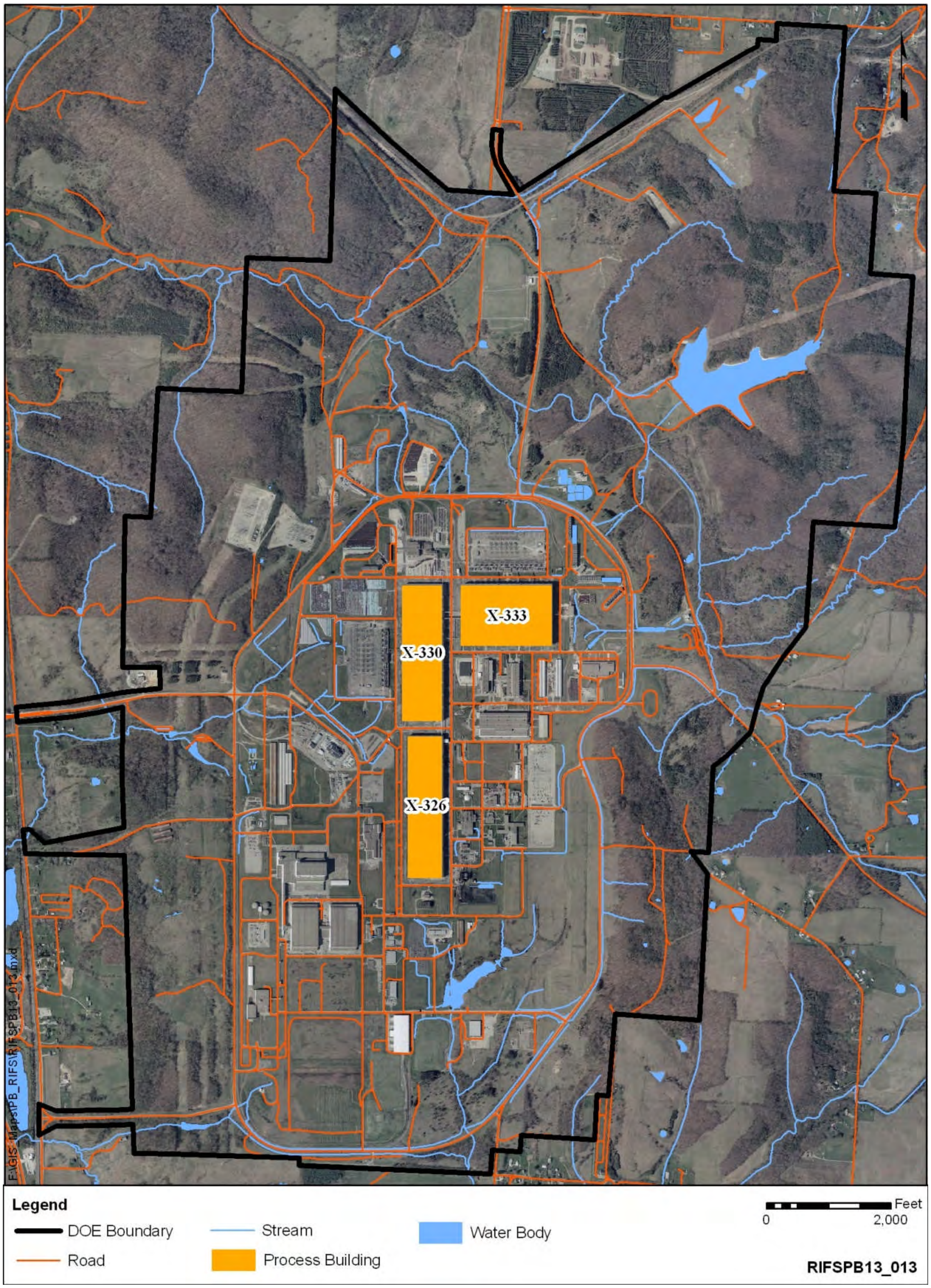

Figure 1.3. PORTS Facility

In August 2000, USEC made a business decision to terminate its enrichment operations at PORTS and ceased those activities in May 2001. At that time, DOE contracted with USEC to establish a cold-standby program to maintain enrichment restart capability at the facility as a strategic hedge against disruption in the nation's supply of enriched uranium. The cold-standby program was terminated by DOE at the end of fiscal year (FY) 2005, and the facilities have been maintained in cold-shutdown status while D&D was being planned.

Many operations and maintenance activities at PORTS involved hazardous conditions and the potential for exposure of personnel and the environment to radioactive and chemical hazards such as hazardous substances. Enrichment process facilities with the potential for such exposures included the gaseous diffusion cascade and other process buildings; a process feed manufacturing plant; an oxide conversion plant; decontamination, cleaning, and uranium recovery facilities; a smelter; and incinerators. Leaks and off-gassing from process equipment or components being repaired or replaced exposed workers and the environment to airborne uranium, transuranic constituents, fission products, fluorine, and hydrogen fluoride (HF) gas (DOE 2000a). Others worked with various hazardous substances such as asbestos, beryllium, lead, trichloroethene (TCE) and other solvents, polychlorinated biphenyls (PCBs), acids, chromium, nickel, lithium, and mercury. Radioactive materials and other hazardous substances were spilled or released to the environment from production-related facilities and attendant work activities.

Activities to manage wastes and liquid process effluents evolved over the operating lifetime of PORTS. Throughout PORTS' history, efforts were made to minimize the loss of valuable enriched uranium in PORTS waste streams. However, PORTS' sanitary landfills likely received some contaminated material because waste segregation practices were not fully implemented. As new requirements were enacted, additional waste streams, such as hazardous wastes, were restricted from disposal in these landfills. Oils contaminated with PCBs and uranium were disposed of in oil biodegradation plots, burned in open containers, or incinerated (DOE 2000a).

In the 1970s, several new wastewater treatment systems were constructed to meet new permit requirements and to significantly reduce the levels of radionuclide emissions to surface water. The PORTS National Pollutant Discharge Elimination System (NPDES) permit, issued by the State of Ohio in the 1970s, required testing and reporting of specific chemical and physical properties and set limits on chemical discharges. Despite the discharge restrictions, legacy environmental contamination exists in ponds, local ditches, and streams (DOE 2000a).

1.2.2.2 PORTS environmental restoration and regulatory compliance history

Dating back to 1989, nine major environmental regulatory documents have been established, and variously amended, for PORTS. These are summarized in Table 1.2. The table identifies the document, its year of enactment, and its major intended purpose.

The existing Ohio Consent Decree, signed in August 1989 by Ohio EPA and DOE, requires DOE to complete investigations to determine the nature and extent of any environmental contamination that exists at PORTS, complete clean-up alternative studies, and implement corrective actions as needed.

Coincident with the Ohio Consent Decree, DOE established the Environmental Restoration Program in 1989 to identify, control, and remediate environmental contamination at PORTS. The Environmental Restoration Program addresses inactive sites through remedial action, and it deals with contaminated soil and groundwater associated with active facilities by eventually implementing cleanup. Because PORTS is a large area, it was divided into four quadrants to facilitate the environmental contamination investigation and clean-up process. The Environmental Restoration Program was established to fulfill the clean-up requirements of the Ohio Consent Decree and the Amended EPA Consent Order (known as the "Three Party Order") signed in June 1997.

Table 1.2. PORTS Regulatory Documents

Regulatory Document	Date	Purpose
Ohio EPA Consent Decree	1989	Requires investigation and remediation of solid and hazardous waste units in accordance with RCRA, between Ohio EPA and DOE
Toxic Substances Control Act Compliance Agreement (EPA and DOE)	1992	Brings DOE into compliance with TSCA regulations; and establishes D&D milestones for TSCA waste, as modified in 1997
Ohio Hazardous Waste Facility Installation and Operation Permit (and Renewal)	1995-present	Allows RCRA permitted container storage for hazardous waste with DOE as the Owner and Co-Operator and current Co-Operator; references the RCRA Corrective Action Orders: Ohio Consent Decree, Administrative Consent Order, and Ohio Director's Final Findings and Orders for Integration; and amended in 2011 to add/remove Co-operator
Ohio Director's Final Findings and Orders for Site Treatment Plan	1995	Allows for the storage of mixed hazardous waste beyond the 1-year regulatory limit; requires an Annual Site Treatment Plan Report; and the 1993 amendment was superseded
Administrative Consent Order	1997	Requires investigation and remediation of solid and hazardous waste units in accordance with RCRA and CERCLA, between EPA and DOE
Ohio Director's Final Findings and Orders for Integration	1999	Integrates five RCRA closures into the RCRA Corrective Action Program. Provided for integration of groundwater monitoring and surveillance; maintenance of RCRA and solid waste units; amended in 2011 to update regulatory citations; and include the D&D contractor
Ohio Director's Final Findings and Orders [for Depleted Uranium Hexafluoride]	2008	Requires DOE and assigned parties to generate and comply with the Depleted Uranium Hexafluoride Management Plan; amended in 2011 to add/remove assigned parties; and the 2004 and 2005 amendments were superseded
Ohio Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action [for the Portsmouth Gaseous Diffusion Plant (Decontamination and Decommissioning Project)]	2010	Provides the framework for DOE to address the D&D of the GDP and support facilities using the framework of the CERCLA process; amended in 2011 with revisions to Attachments G, H, and I, corrected inadvertent omissions, reflected current strategy of documentation; and amended in 2012 with a revision to Attachment H

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (as amended)
D&D = decontamination and decommissioning
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
GDP = gaseous diffusion plant
Ohio EPA = Ohio Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act, as amended
TSCA = Toxic Substances Control Act of 1976

DOE has completed the description of current environmental conditions, RCRA Facility Investigations (RFIs), and a clean-up alternatives study/corrective measures study for each quadrant. These investigations and reports detail the characteristics of PORTS that are pertinent to the process buildings and complex facilities evaluation and characterized the nature and extent of contamination in soils, surface water, and groundwater at PORTS. The primary sources of information include the RFIs for the four quadrants (DOE 1996a, 1996b, 1996c, 1996d) and the corresponding corrective measures studies (DOE 1998a, 1998b, 2000b, 2001a).

As a result of these studies, the focus has been to control contaminant migration and address corrective action or closure of waste units that resided outside the main operating area.

Any remedial actions resulting from the process buildings and complex facilities decision process will be coordinated with the implementation of any associated RCRA corrective actions.

Three non-time-critical removal actions have been initiated under the DFF&O (Table 1.3). Since April 2010, three EE/CAs have been prepared for D&D of facilities listed in Attachment G to the DFF&O, and three AMs have been signed. The *Action Memorandum for Group 1 Buildings X-103, X-334, and X-344B at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0177&D3) and the *Action Memorandum for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0178&D3) were signed on January 20, 2011. The *Action Memorandum for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0230&D3) was signed on March 26, 2012. Other buildings and structures have been demolished under other programs throughout PORTS' history.

Table 1.3. Summary of DFF&O Removal Actions at PORTS

Removal Action	Building or Structure Dispositioned
Group 1 Buildings X-103, X-334, and X-344B	X-103 Auxiliary Office Building
	X-334 Transformer Cleaning and Storage Building
	X-344B Maintenance Storage Building
X-626 and X-630 Recirculating Cooling Water Complex	X-626-1 Recirculating Water Pump House
	X-626-2 Cooling Tower
	X-630-1 Recirculating Water Pump House
	X-630-2A Cooling Tower
	X-630-2B Cooling Tower
	X-630-3 Acid Handling Station
Plant Support Buildings and Structures	X-100 Administration Building
	X-100B Air Conditioner Equipment Building
	X-101 Dispensary
	X-102 Cafeteria
	X-104 Guard Headquarters
	X-106 Tactical Response Building
	X-106C New Fire Training Building
	X-108H Pike Ave Portal
	X-109A Personnel Monitoring Building
	X-109B Personnel Monitoring Building
	X-109C Personnel Monitoring Building
	X-343 Feed Vaporization & Sampling Building
	X-530A High Voltage Switchyard
	X-530B Switch House
	X-530C Test and Repair Building
	X-530D Oil House
	X-530E Valve House
	X-530F Valve House

Table 1.3. Summary of DFF&O Removal Actions at PORTS (Continued)

Removal Action	Building or Structure Dispositioned
Plant Support Buildings and Structures (Continued)	X-600 Steam Plant
	X-600B Steam Plant Shop Building
	X-600C Ash Wash Treatment Building
	X-611 Water Treatment Plant
	X-611C Filter Building
	X-611D Recarbonization Instrumentation Bldg
	X-611E Clear Well & Chlorine Building
	X-612 Elevated Storage Tank
	X-614A Sewage Pumping Station
	X-614B Sewage Pumping Station
	X-618 North Holding Pond Storage Building
	X-621 Coal Pile Treatment Facility
	X-624-1 Decontamination Pad
	X-640-1 Fire Water Pump House
	X-640-2 Elevated Storage Tank
	X-735A Landfill Utility Building
	X-743 Lumber Storage Facility
	X-744B Salt Storage Building
	X-744G Bulk Storage Building
	X-744H Bulk Storage Building
	X-744J Bulk Storage Building
	X-744L Stores & Maintenance Warehouse
	X-744S Warehouse S Non-UEA
	X-744W Surplus & Salvage Warehouse
	X-750 Mobile Equipment Maintenance Shop
	X-750A Garage Storage Building
	X-752 Warehouse
	X-752AT-1 Trailer
	X-752AT-2 Trailer
	X-752AT-3 Trailer
	X-752AT-4 Trailer

UEA = uranium enrichment area

Cultural resources include any prehistoric or historic district, site, building, structure, or object resulting from, or modified by, human activity. Under federal regulations (36 *Code of Federal Regulations [CFR] 800*), federal agencies must assess the impacts their actions have on historic properties and, if appropriate, mitigate adverse effects. Historic properties are cultural resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP) because of their significance and integrity. DOE's regulatory compliance history includes significant efforts to follow these regulations.

1.2.2.3 Process Buildings and Complex Facilities D&D Evaluation Project DFF&O history

A Pre-investigation Evaluation Report (PER) was prepared under the DFF&O and submitted to the Ohio EPA in April 2011 (DOE 2011a). The purpose of the PER was to identify the technical approach to be used in the Process Buildings and Complex Facilities RI/FS, document the RI/FS scoping tasks, record the results from performing these tasks, and establish a framework for development of the Process Buildings and Complex Facilities RI/FS Work Plan.

The Process Buildings and Complex Facilities RI/FS Work Plan, which incorporated comments from the PER (as appropriate), was submitted to Ohio EPA for review in April 2011 and was concurred with in December 2011 (DOE 2011b). As discussed in the PER and RI/FS Work Plan and concurred with by Ohio EPA, there was no need for additional data collection to make this remedial action decision.

1.3 REPORT ORGANIZATION

This RI/FS report consists of an executive summary, eight individual sections constituting the main report, and six supporting appendices (Appendices A through F). A brief overview of each of the eight sections contained in the main report is provided below. The overview includes a discussion of the content of the section, identifies the supporting appendices, and provides a summary of conclusions when appropriate. Readers should note that, while the DFF&O contains outlines of required elements for individual RI and FS reports, DOE, with Ohio EPA consent, has merged the two outlines into a combined RI/FS report. This report follows the combined outline and includes all of the required elements.

Section 1 – Introduction

Section 1 presents an overview of the PORTS Facility and its remediation history, discusses regulatory issues, defines the scope of the Process Buildings and Complex Facilities evaluation decision, and identifies the later decision documents that will be supported by the RI/FS.

Section 2 – Study Area Investigation

Section 2 provides a compilation of the information available and field investigations performed to support the process buildings and complex facilities evaluation. It summarizes relevant historical investigations as well as presents the results of more recent process gas equipment (PGE) sampling. This section begins to define the problem to be addressed by a remedial action.

Section 3 – Physical Characteristics of the Study Area

Section 3 describes the existing environmental setting of the PORTS Facility and surrounding areas to support the FS. This information includes surface features, meteorology, surface water hydrology, geology, soils, hydrogeology, demography and land use, cultural resources, transportation, and ecology. The section is intended to support the identification of environmental pathways and receptors, which are used in development of the RI/FS conceptual site model (CSM). The CSM is a tool used in the human health and ecological risk evaluation and in the identification and development of protective and compliant remedial action alternatives.

Section 4 – Condition and Content of Buildings and Structures

This section, along with information in Section 2 and Appendix A, describes the buildings and structures (by groupings) being addressed in this RI/FS. The uses of the buildings and structures, their approximate sizes, and the anticipated radiological and chemical hazards are presented. Estimates of D&D waste forms and volumes that are expected to be generated at PORTS are also included.

Section 4 concludes with a discussion of the potential uncertainties associated with building and structure conditions and contents, and the waste volumes and characteristics.

Section 5 – Potential Threat to Human Health, Safety, and the Environment

Section 5 is intended to summarize the potential excess lifetime cancer risks (ELCR) and hazards associated with the PORTS buildings and process equipment under a no-action alternative. A streamlined risk evaluation is presented including both evaluation of potential impacts on human health and on the environment.

For a no-action decision, the risk evaluation concludes that the contaminant concentration levels present in the D&D waste streams can result in hypothetical long-term human health threats of sufficient magnitude to justify the need for a remedial action. There is a potential risk to the environment also. This conclusion and the results from the risk assessment serve as one of the cornerstones for setting the remedial action objectives (RAOs) presented in Section 6.

Section 6 – Preliminary Identification and Screening of Remedial Alternatives
Section 6 sets the foundation for developing alternatives. It presents the chemical- and location-specific applicable or relevant and appropriate requirements (ARARs), RAOs, and general response actions (GRAs) for the development of alternatives. This section identifies and screens potential technology types so representative process options can be identified to develop alternatives. During the screening process, each relevant technology and process option is evaluated in terms of implementability, effectiveness, and cost.

Two appendices support the identification and screening of technologies in Section 6. Appendix B presents the ARARs and pertinent to-be-considered (TBC) guidance related to process buildings and complex facilities disposition. Appendix C is an engineering study of process options to mitigate void-related subsidence in the disposal of process building equipment and piping.

Section 7 – Final Development of Alternatives
Section 7 explains the assembly of representative process options into a final remedial action alternative that achieves the RAOs and complies with ARARs. The developed single action alternative is a demolition alternative. This section provides a sufficiently detailed description of the alternative to support the comparison of it to no action in Section 8.

Appendix D contains an evaluation of options for final site restoration to support the description of this element of the alternative.

Section 8 – Detailed Analysis of Alternatives
Section 8 presents an individual analysis of the final alternatives developed in Section 7, along with a comparative analysis of them to the no-action alternative using the nine CERCLA National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria recognized in the DFF&O. The individual analysis also includes a discussion of NEPA values regarding potential environmental impacts.

To support the detailed analysis, Appendix E presents the development of the cost estimates and associated cost estimate backup for the remedial action alternatives under an assumption of preparing and packaging to support primarily on-Site disposal. Should an off-Site only alternative be selected in the Waste Disposition ROD, there would be impacts to the cost of Alternative 2. Appendix F presents a sensitivity analysis of the cost estimate to evaluate the cost impacts to the alternative if only off-Site waste disposition is available.

DFF&O Compliance Matrices to Assist in Review of the RI/FS
The DFF&O contains requirements and attached outlines for developing RI and FS reports. It also contains a generic statement of work (SOW) for conducting and documenting RIs and FSs. To assist readers with mapping the contents of this RI/FS report to the RI and FS report outlines and SOW requirements, a set of compliance matrices is included. These can be found after Section 9 (the references) in the main report.

Each of the three compliance matrices serves as a crosswalk of requirements and how those requirements were addressed in the individual sections and appendices of the RI/FS report. The first compliance matrix focuses on RI report requirements (Attachment A, Appendix E, Outline E-2 of the DFF&O). The second matrix focuses on FS report requirements (Attachment A, Appendix G, Outline G-2 of the DFF&O), and the third matrix focuses on the RI and FS SOW itself (Attachment A of the DFF&O).

Readers can detach the provided matrices and use them to track compliance with all major DFF&O requirements and reporting obligations.

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2. STUDY AREA INVESTIGATION

Problem definition begins by assimilating the historical and current data that have been collected. These data are used in subsequent stages of problem definition to build a CSM that defines the sources of contamination, the fate and migration potential of the contamination, and the exposure to potential receptors. As described in the *Remedial Investigation and Feasibility Study Work Plan for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011b), DOE determined that existing information is sufficient to support development of this RI/FS report and that sufficient information is available to understand the challenges that would be associated with the different alternatives. The intent of Section 2 is to describe the type of information that is available about the building conditions that is used later in the report. Section 2.1 discusses the type of information that provides an overall understanding of the building conditions, some of which was used in developing detailed building descriptions. Section 2.2 provides the results of current investigations being conducted for other projects into the nature and extent of equipment contamination in the process buildings.

2.1 BUILDING CONDITION INFORMATION

Quantitative investigations and sampling pertaining to the exterior and interior spaces of buildings where ongoing processes occurred have been focused primarily on human health and safety related issues as required by the U.S. Occupational Safety and Health Administration (OSHA), DOE Orders, and the Toxic Substances Control Act of 1976 (TSCA). Some recent process equipment data have been collected to better understand the amount of technetium-99 in the barrier material of the process equipment. For the most part, information about the process buildings and support facilities is derived from process knowledge, as well as sampling related to environmental compliance and waste management activities associated with historical building demolition activities.

The investigations of PORTS buildings, structures, and contents that have been performed provide general information on the conditions of the buildings, known or anticipated contamination within the buildings, and the volume of waste anticipated from a potential D&D action. The existing building contamination information from historical building demolition activities is first described followed by a summary of supporting references that describe the condition or provide results from other studies that have been conducted at PORTS. All of these previous investigations were used to prepare the summary building/structure descriptions in Section 4, and the detailed descriptions provided in Appendix A for each group of buildings/structures included in this RI/FS report.

Historical PORTS D&D Contamination Data (from Numerous D&D Activities)

Several support buildings and structures have been demolished under previous removal actions. The buildings with waste characterization data available are X-100, X-100B, X-101, X-102, X-103, X-106, X-109C, X-334, X-342C, X-344, X-600, X-600B, X-600C, X-605, X-624-1, X-633, X-744S, X-760, and X-770. These buildings and structures ranged in complexity from simple warehouses and sheds having no contamination to complex facilities that were heavily contaminated with radionuclides, chemicals, and PCBs. Samples were collected from these buildings and structures to support waste characterization prior to disposition. Some individual buildings and structures had the potential for radiological, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), heavy metals, corrosives, and biological hazards contaminants to be present. Knowledge of materials or chemicals used in the buildings was the basis for identifying additional chemicals of potential concern (COPCs) and developing the characterization plans. Based on the proximity of the buildings to areas of contamination or to historic releases, it was assumed that PORTS-related contamination potentially existed at every building. As these buildings span the range of complexity, they are representative of the majority of the waste streams that are anticipated to be generated from the D&D of PORTS.

The results from the waste characterization sampling effort are summarized in Table 2.1. As noted in the table footnotes, various buildings were sampled and analyzed for metals, commonly used organics, radionuclides, and samples were also analyzed using the Toxicity Characteristic Leaching Procedure (TCLP). These results represent the minimum and maximum values for selected constituents. The building or structure in which the minimum or maximum occurred is also identified. Only detected values are presented. Note that not all sample results have been validated. For example, buildings and facilities sampled prior to the DFF&O were sampled for internal purposes and did not have the same validation as more recent sampling plans developed under the DFF&O.

Table 2.1. Characterization Results from Previous Buildings and Structures

Inorganics/Organics	**Minimum (mg/kg)**	**Building**	**Maximum (mg/kg)**	**Building**	
Arsenic	0.27	X-633	719	X-600	
Barium	1.63	X-633	1,700	X-100	
Cadmium	0.0402	X-633	89.8	X-106	
Chromium	0.21	X-760	1,470	X-600B	
Lead	0.386	X-633	2,590	X-600	
Mercury	0.0089	X-760	1.29	X-600	
Selenium	0.236	X-103	272	X-600	
Silver	0.16	X-103	13.9	X-600	
Benzene	0.032	X-100	0.032	X-100	
Chlorobenzene	0.003	X-342C	0.18	X-102	
Chloroform	0.003	X-342C	0.665	X-600	
1,1-Dichloroethylene	0.193	X-101	16.4	X-101	
Tetrachloroethylene	0.065	X-600B	0.318	X-600B	
Trichloroethylene	0.00047	X-103	0.087	X-600B	
2,4,6-Trichlorophenol	2.47	X-600	2.47	X-600	
PCB-1016	0.0084	X-103	1.95	X-103	
PCB-1242	0.00515	X-102	2.67	X-101	
PCB-1248	0.00152	X-101	0.74	X-100B	
PCB-1254	0.00201	X-600	221,000	X-100	
PCB-1260	0.00443	X-106	67,400	X-100	
PCB-1268	0.00553	X-106	18,900	X-106	
PCB total	0.005	X-103	279,000	X-100	
TCLP	**Minimum (mg/L)**	**Building**	**Maximum (mg/L)**	**Building**	**TCLP Limit (mg/L)**
Arsenic	0.005	X-770	4.19	X-100	5.0
Barium	0.0063	X-770	4.00	X-106	100
Cadmium	0.0011	X-770	0.711	X-103	1.0

Table 2.1. Characterization Results from Previous Buildings and Structures (continued)

TCLP	Minimum (mg/L)	Building	Maximum (mg/L)	Building	TCLP Limit (mg/L)
Chromium	0.0041	X-106	**25**	X-100	5.0
Lead	0.004	X-770	**4,890**	X-106	5.0
Mercury	0.00089	X-100	0.0056	X-770	0.2
Selenium	0.0076	X-770	**1.44**	X-600	1.0
Silver	0.0105	X-600	0.503	X-600	5.0
1,1-Dichloroethylene	0.442	X-101	**12.3**	X-101	0.7
Radionuclides	**Minimum (pCi/g)**	**Building**	**Maximum (pCi/g)**	**Building**	
Technetium-99	0.132	X-334	109	X-600	
Thorium-228	0.157	X-760	1.86	X-760	
Thorium-230	0.2660	X-600	4.30	X-600	
Uranium-232	0.0122	X-760	0.0197	X-760	
Uranium-233/234	0.132	X-100	324	X-344	
Uranium-234	2.68	X-106	98.5	X-600	
Uranium-235	0.00546	X-600	16	X-344	
Uranium-235/236	0.0198	X-334	1.06	X-106	
Uranium-236	0.00746	X-770	0.523	X-600	
Uranium-238	0.0173	X-600	325	X-344	
Plutonium-239/240	0.0141	X-760	0.0283	X-760	
Plutonium-242	0.0184	X-342C	0.0184	X-342C	
Americium-241	0.029	X-760	0.029	X-760	
Uranium-235 (weight %)	0.157	X-770	2.7	X-103	

Buildings with "mg/kg" results: X-100, X-100B, X-101, X-102, X-103, X-106, X-109C, X-334, X-342C, X-344, X-600, X-600B, X-600C, X-605, X-624-1, X-633, X-744S, X-760, X-770

Buildings with TCLP (mg/L) results: X-100, X-100B, X-101, X-102, X-103, X-106, X-109C, X-334, X-342C, X-344, X-600, X-600B, X-600C, X-605, X-624-1, X-633, X-744S, X-770

Buildings with "pCi/g" results: X-100, X-100B, X-101, X-102, X-103, X-106, X-109C, X-334, X-342C, X-344, X-600, X-600B, X-600C, X-624-1, X-633, X-744S, X-760, X-770

Bolded TCLP maximums represent exceedances of the TCLP limit

Most of the maximum radionuclide values are low with slightly elevated uranium activities in X-344. The X-100 Administration Building is associated with maximum values of arsenic and chromium in TCLP extracts (with chromium exceeding the TCLP limit) and PCBs. PCBs in X-100 are mostly associated with ventilation duct gaskets and light ballasts. Several of the maximum values of other constituents (such as arsenic, lead, mercury, selenium, silver, thorium-230, and uranium-234) were also associated with the X-600 Steam Plant. Selenium in a TCLP extract from X-600 exceeded the TCLP limit.

Recycled Uranium Mass Balance Project, Portsmouth, Ohio, Site Report, June 19, 2000, BJC/PORTS-139/R1 (Bechtel Jacobs Company LLC [BJC] 2000)

This report documents: (1) shipments and receipts of recycled uranium (RU); (2) levels of transuranic constituents and fission product contaminants (technetium-99) in the PORTS material flow and processes that have the potential to expose workers; and (3) information on mass balances for the RU, transuranic constituents, and fission product contaminants to identify potential environmental, safety, and health concerns. The significance of evaluating the RU was to determine the potential presence and quantities of transuranic constituents and technetium-99, which are constituents of the RU. These constituents are trace contaminants introduced from re-processing enriched fuels that had undergone fission. The buildings/facilities that are suspected of containing processes where RU constituents may be concentrated and present the potential for worker exposure to environmental contamination include the X-344A UF_6 Sampling Facility; the X-333, X-330, and X-326 cascade and associated feed, withdrawal, and sampling facilities; the X-705 Decontamination Building; and the X-705E Oxide Conversion Facility. Through this mass balance project, the processing of RU was found to have occurred in all of the evaluated facilities except X-344A.

There were quantities of transuranic constituents that did not enter the process equipment. Based on the mass balance, less than 0.3 g of plutonium were estimated to have been received at PORTS. Approximately 0.003 g of plutonium entered the process equipment. Approximately 140 g of neptunium were received, with about 46 g entering the process equipment. The balance of these transuranic constituents remained in the feed cylinders heels.

Approximately 60 to 90 kg of technetium-99 were estimated to have been fed to the cascade. It is estimated that up to 35 kg of technetium-99 remains in the process system. Much of the technetium-99 was released to the environment through venting or was captured in sludges generated by the uranium decontamination operations and subsequently discharged to the X-701B Holding Pond.

The enriched uranium hexafluoride (UF_6) product at PORTS was essentially free of transuranic constituents; however, low but detectable concentrations of technetium-99 were present in the product. At times, high levels of technetium-99 required additional processing to produce a product within specifications. UF_6 tails from the cascade were essentially free of transuranic constituents and fission products.

Technetium-99 was detected at low levels in plant process vents, effluents, and enriched product streams throughout much of the cascade. The majority of transuranic constituents and technetium-99 were removed from the cascade with the two equipment change-out programs (the first from FY 1957 to FY 1962 and the second from FY 1973 to FY 1983). Transuranic constituents would have also been in the LEU oxides produced from the solutions used to decontaminate and clean the change-out equipment. These oxides were containerized or shipped, and they no longer present a significant concern at PORTS. A small fraction of transuranic constituents remain in the process equipment that was not changed out.

Beryllium Surface Contamination, Initial Characterization, November 2004, POEF-USEC-61

Beryllium sampling and analysis were conducted in 12 facilities at PORTS during 2004 to investigate the presence of and potential for exposure to beryllium. This sampling and analysis were performed because some components (such as axial compressor blades) and tools (such as grinding wheels) in these buildings were known to be constructed with a beryllium composition. The 12 facilities investigated were the three process buildings, X-700, X-705, X-705E Area, X-710, X-720, X-744G, X-750, X-760, and

X-770. Samples were collected from equipment, articles, systems, elevated surfaces (greater than 8 ft), floors, and miscellaneous surfaces (including walls up to 8 ft above floor level). This study found removable beryllium surface contamination levels in excess of DOE surface limits in each of the characterized facilities.

Other very high concentrations of beryllium surface contamination were found in the cell housings in the X-326 and X-333 Process Buildings; the X-700 Converter Shop and Cleaning Building; and the X-720 Maintenance and Stores Building. These locations were designated as Beryllium Regulated Areas and posted to prevent unauthorized entry.

In addition to surface wipe sampling, surface bulk and destructive analysis samples were collected to analyze deposits, materials, and process components suspected to contain beryllium. Surface wiping involved collecting wipe samples for particulates and other removable materials to determine the amount of beryllium on a given surface area. Bulk surface sampling involved collecting samples of metal shavings, tailings, sludges, and other heavily accumulated particulates and analyzing for beryllium. A select number of suspect beryllium containing articles were targeted for destructive metallurgic analysis.

Eight percent of the surface bulk samples and 34 percent of the destructive analysis samples results had detectable beryllium levels at or above the laboratory's lowest reportable concentration level. Materials that had positive bulk sample results included aluminum shavings on blade tipping machines, as well as floor dust in a process cell housing and in the X-700B Sandblast Facility. Destructive analysis of aluminum components showed levels of beryllium at or above the laboratory's lowest reportable concentration level.

Higher levels of beryllium contamination in PORTS industrial shops, in the presence of aluminum machining operations using grinding wheels and/or areas using reactive chemicals, indicated that a significant amount of the beryllium contamination was a result of past industrial operations. In addition to the industrial sources, it was concluded that some wipe sample concentrations above DOE criteria were probably attributable in part to the presence of environmental sources of beryllium contamination, including windblown dust from soil, coal, and/or flyash.

Prudent health protection measures (based on DOE, OSHA, and EPA standards) were implemented at that time to address the positive beryllium sampling results. These protection measures included additional characterization, posting and marking of Beryllium Regulated Areas, decontamination of 20,000 sq ft of floor space, enhanced training and work procedures, and additional employee monitoring/testing.

Subsequent sampling was performed at PORTS to evaluate beryllium concentrations in background and non-industrial areas. Beryllium in excess of the exposure standard was only found to occur in industrial areas where work was performed in direct association with beryllium containing materials. Fly-ash from the on-PORTS coal-fire steam plant contained beryllium concentrations greater than the upper tolerance limit concentration of background and non-industrial areas (Pro2Serve 2007).

Technetium Characterization of the Diffusion Cascade at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, February 2006, TPMC/PORTS-47

This report documents information known at that time about the presence of technetium-99 within the PORTS cascade. The report notes that technetium-99 from RU was introduced into the cascade as an impurity in the UF_6 feed. According to the *Recycled Uranium Mass Balance Project, Portsmouth, Ohio,* *Site Report* (BJC 2000), 60 to 90 kg of technetium-99 were fed to the PORTS cascade. As of 1999, about 30 kg had been removed from PORTS, and an estimated 35 kg remained at PORTS. Based on historical data and the observed movement of technetium-99 in the PORTS cascade, three areas were suspected to have the largest technetium-99 concentrations: the shutdown top few isotopic cells in X-326; the top purge system in X-326; and the top cell(s) in X-330. The technetium-99 found in equipment removed during the Cascade Improvement Program/Cascade Uprating Program (CIP/CUP) was nearly all deposited in the barrier material.

The report states that PORTS preliminary investigations demonstrated that significant technetium-99 deposits can be located with portable radiation detection equipment and without opening the equipment.

Sections of barrier material from a converter were collected from 1996 to 1997 and analyzed in the PORTS radiochemistry laboratories. The overall average concentration of technetium-99 was approximately 10 µg of technetium-99/g sample.

Facility Condition Survey of the Portsmouth Gaseous Diffusion Plant Facilities, *Piketon*, *Ohio*, August 2006, TPMC/PORTS-59/R1 (Theta Pro2Serve Management Company, LLC [TPMC] 2006)

The facility condition survey was prepared to describe the current condition of many major PORTS structures with respect to the physical, radiological, and chemical hazards important to D&D planning. Ninety-two individual facilities were evaluated under this survey, and the facility conditions are tabulated in the appendix to the report. The survey used the *Report for the Environmental Audit Supporting Transition of the Gaseous Diffusion Plants to the United States Enrichment Corporation* (DOE 1993) as a starting point. The facility hazard status was updated by incorporating knowledge gained during walkdowns conducted in 2005 and 2006 to assess utilities infrastructure and estimate the quantities of excess equipment present.

The report concludes that the gaseous diffusion process buildings (X-333, X-330, and X-326) were in generally good condition structurally. The report also states the following generalities regarding the 92 evaluated facilities:

- The roofs were in marginal condition and no emergency repairs were currently needed. (The process building roofs were subsequently repaired by patching and overlaying in calendar years 2010 and 2011.)

- Facility cranes, lifting fixtures, etc. were generally not being maintained in a usable/certifiable condition.

- The existing criticality alarm system was being maintained in an operable condition.

- Utility production and distribution systems were greatly oversized for current needs; therefore, they were not being maintained to design specifications. Numerous steam, dry air, and water leaks had been identified, but they were not being stopped with repairs.

Conceptual Site Model and Nondestructive Assay Data Summary at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, February 2011, RSI/PORTS-016, Revision 0

This document presents historical nondestructive assay (NDA) data collected in the three process buildings. NDA measurement is a characterization technique commonly used in the nuclear industry and extensively used in the uranium processing industry to determine the quantity of uranium (and other measureable) isotopes in equipment, groups of equipment, or sections of process piping. This characterization technique is valuable when uranium contamination is present inside complex components, and the ability to obtain representative samples is technically infeasible.

The CSM describes the equipment designed to process UF_6 and most likely to contain uranium deposits, auxiliary process equipment that was not specifically designed to process UF_6 but may have been exposed to process gas during operations, nonprocess systems unlikely to have been exposed to UF_6, and building structures. These evaluations were performed for the three process buildings (X-333, X-330, and X-326) and the three primary auxiliary buildings used for feed, sampling, and transfer (X-342A, X-343 [not in the scope of this decision], and X-344A).

2.2 PROCESS EQUIPMENT SAMPLE RESULTS

The *Phase 1 Sampling and Analysis Plan for the Process Equipment Characterization in Support of the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011c) was written to support characterization activities in the three process buildings.

The objectives for the characterization activities in the process buildings were to collect process equipment samples and provide characterization data to verify process knowledge assumptions used to support D&D planning, and support the refinement of waste volume projections and definition of waste types for the Waste Disposition RI/FS. Samples were collected from primary process equipment (such as converters and compressors) and auxiliary equipment associated with other process gas systems (e.g., surge drums, instrument lines, etc.) in the three process buildings: X-333, X-330, and X-326. Following this data collection effort for the waste disposition RI/FS, data collection continues in support of the follow-on RD/RA to support the determination of waste acceptance criteria (WAC) compliance for components of the process gas system.

Prior to implementation of the Process Equipment Characterization Sampling and Analysis Plan (SAP), an initial characterization effort consisted of collecting both a shell and composite barrier sample from five converters located at the following locations in X-326: 27-2-2, 27-3-2, 27-3-4, 25-1-2, and 25-2-2. Therefore, 10 samples were collected (five shell samples and five barrier samples). Two duplicate samples were collected, one from the shell of the converter at the 27-3-2 location and one from the barrier of the same converter. Each sample was analyzed for TCLP metals (such as arsenic, barium, cadmium, chromium, lead, selenium, and silver), mercury, copper, zinc, total beryllium, PCBs, SVOCs, VOCs, and radionuclides.

No mercury, silver, total uranium-233 (as a separate isotopic concentration rather than undifferentiated uranium-233/234), total beryllium, PCBs, SVOCs, or VOCs were detected in any of the samples. The following items summarize the metals results from the initial characterization effort:

- Arsenic was detected in 5 of the 10 sample extracts at a range from 0.0179 to 0.313 mg/L; no concentration exceeded the 5.0 mg/L regulatory limit for arsenic. All of the detected concentrations were in the five barrier samples.

- Barium was detected in all 10 sample extracts at low concentrations (ranging from 0.0088 mg/L to 0.0340 mg/L) that do not exceed the regulatory limit of 100 mg/L for barium.

- Cadmium was detected in 3 of the sample extracts at concentrations (ranging from 0.0018 to 0.008 mg/L) that do not exceed the 1.0 mg/L regulatory limit for cadmium.

- Chromium was detected in 8 of the 10 sample extracts at concentrations (ranging from 0.00776 to 0.8290 mg/L) that do not exceed the 5.0 mg/L TCLP regulatory limit for chromium.

- Lead was detected in 5 of the 10 sample extracts at concentrations (ranging from 0.0122 to 0.0918 mg/L) that do not exceed the 5.0 mg/L TCLP regulatory limit for lead.

- Selenium was detected in 2 of the 10 samples ranging from 0.0339 to 0.0494 mg/L, which do not exceed the TCLP regulatory limit for selenium.

- Zinc was detected in 7 of the 10 sample extracts at concentrations ranging from 0.008 to 0.167 mg/L. There is no TCLP regulatory limit for comparison to these results.

Technetium-99 results from this initial characterization effort are provided in Table 2.2. These results confirm that the technetium-99 activity concentrations in the converter tubes are higher (generally two to three orders of magnitude higher) than those on the converter shells. These samples estimate the technetium-99 activities expected to be encountered in the converters.

Table 2.2. Technetium-99 Converter Initial Sample Results for PORTS

Converter Component ID	Shell Sample (pCi/g)	Tube Sample (pCi/g)	Average (pCi/g)
270302	186	2.72×10^{5}	1.36×10^{5}
270202	172	7.20×10^{4}	3.61×10^{4}
270304	77	1.59×10^{5}	7.95×10^{4}
250102	407	3.03×10^{5}	1.52×10^{5}
250202	198	3.05×10^{4}	1.53×10^{4}

ID = identification

The Process Equipment Characterization SAP included the collection of intrusive and nonintrusive samples and measurements. Intrusive characterization consisted of collecting physical samples by breaching the process gas system. Nonintrusive characterization consisted of collecting characterization data by using NDA techniques or surface swipes. NDA analysis measures either gamma or neutron emissions from radioisotopes. By measuring the amplitudes of various energy levels or counting neutrons, modeling of the equipment can be used to quantify the amounts of various radioisotopes. Then, either through refinement of the modeling or uranium enrichment process knowledge, more accurate quantities of the uranium radioisotopes can be determined (in grams or picocuries). NDA analysis, however, does not quantify beta emitters such as technetium-99 or the nonradioactive metals.

The sampling program design used both random and judgmental sampling techniques. In all cases, intrusive samples were collected at predetermined locations in the process equipment and analyzed for uranium isotopes and other constituents.

Intrusive samples of barrier material and shell coupons from converters, deposit material from the seal/seal cavity areas within the compressors, and coupons from process auxiliary equipment were taken. Sample locations associated with the random sampling program were preselected using a random number selection process, allowing for an equal likelihood of selection. In contrast, the judgmental sampling applied the detailed process knowledge to pinpoint how the concentration of uranium isotope ratios and technetium-99 would change in a measurable manner based on system design and material makeup.

Results from the Process Equipment Characterization SAP sampling effort are similar to those from the initial characterization discussed in Table 2.2. The following items summarize the TCLP metals results for samples collected from converters in the X-326 Building per the Process Equipment Characterization SAP (data pending verification):

- Arsenic was detected in two of the four sample extracts with a range from 0.0041 to 2.36 mg/L; no concentration exceeded the 5.0 mg/L regulatory limit for arsenic.

- Barium was detected in all four sample extracts at low concentrations (ranging from 0.0124 mg/L to 0.115 mg/L) that do not exceed the regulatory limit of 100 mg/L for barium.

- Cadmium was detected in two of four sample extracts at concentrations (ranging from 0.0055 to 0.0058 mg/L) that do not exceed the 1.0 mg/L regulatory limit for cadmium.

- Chromium was detected in all four sample extracts at concentrations (ranging from 0.128 to 2.25 mg/L) that do not exceed the 5.0 mg/L TCLP regulatory limit for chromium.

- Lead was detected in all four sample extracts at concentrations (ranging from 0.0113 to 0.111 mg/L) that do not exceed the 5.0 mg/L TCLP regulatory limit for lead.

- Mercury was not detected in any samples.

- Selenium was not detected in any TCLP sample extracts.

- Zinc was detected in all four TCLP sample extracts ranging from 0.00132 to 0.0066 mg/L.

The laboratory data for these TCLP samples are contained in the Waste Disposition RI/FS (DOE 2014).

The current radiological results from the Process Equipment Characterization SAP sampling effort are provided in Table 2.3. These results represent the minimum and maximum values for selected radionuclides, based on the type of sample (either swipe sample or solid sample from the component [converter or compressor]) from the process buildings. The information in Table 2.3 is based on the samples that have been collected to date and illustrates higher concentrations in X-326 process equipment.

Table 2.3. Process Equipment Sampling Results for the X-333, X-330, and X-326 Buildings at PORTS

	X-333				
	Converter Component Samples (2) (pCi/g)		Compressor Component Samples (2) (pCi/g)		Compressor Swipe Samples (2)
	Min	Max	Min	Max	(pCi/sample)
Americium-241	ND	ND	ND	ND	ND
Neptunium-237	0.207	0.207	ND	ND	ND
Plutonium-238	ND	ND	ND	ND	ND
Plutonium-239/240	ND	ND	ND	ND	ND
Technetium-99	$1.70{\times}10^{3}$	$1.70{\times}10^{3}$	ND	ND	43.1
Thorium-228	ND	ND	ND	ND	ND
Thorium-230	0.861	0.861	ND	ND	2.41
Uranium-233/234	22.7	22.7	2.06	4.74	$1.49{\times}10^{4}$
Uranium-235	ND	ND	0.128	0.128	63.1
Uranium-236	ND	ND	ND	ND	3.21
Uranium-238	30.7	30.7	1.70	4.75	$1.63{\times}10^{4}$
	X-330				
	Converter Component Samples (6) (pCi/g)		**Compressor Component Samples (3) (pCi/g)**		**Compressor Swipe Samples (3)**
	Min	**Max**	**Min**	**Max**	**(pCi/sample)**
Americium-241	ND	ND	ND	ND	ND
Neptunium-237	1.58	2.18	ND	ND	5.17
Plutonium-238	ND	ND	ND	ND	ND
Plutonium-239/240	0.424	0.509	ND	ND	ND
Technetium-99	26.9	$4.51{\times}10^{4}$	2.51	2.51	$1.07{\times}10^{4}$
Thorium-228	ND	ND	ND	ND	ND
Thorium-230	1.71	3.35	0.0105	0.0105	24.3
Uranium-233/234	0.360	162	2.25	5.87	$5.64{\times}10^{4}$
Uranium-235	NA	NA	0.138	0.138	$3.01{\times}10^{3}$
Uranium-236	0.220	0.220	ND	ND	82.4
Uranium-238	0.747	368	0.558	12.8	$1.17{\times}10^{5}$

Table 2.3. Process Equipment Sampling Results for the X-333, X-330, and X-326 Buildings at PORTS (continued)

	X-326				
	Converter Component Samples (53) (pCi/g)		Compressor Component Samples (12) (pCi/g)		Compressor Swipe Samples (10)
	Min	Max	Min	Max	(pCi/sample)
Americium-241	0.083	1.07	ND	ND	ND
Neptunium-237	0.306	4.56	ND	ND	8.02
Plutonium-238	0.0610	5.86	ND	ND	ND
Plutonium-239/240	0.045	6.04	ND	ND	ND
Technetium-99	22.9	3.03×10^{5}	15	1.33×10^{3}	7.26×10^{6}
Thorium-228	0.480	0.571	0.0188	0.140	165
Thorium-230	0.071	66.3	0.091	4.12	4.07×10^{3}
Uranium-233/234	0.27	3.32×10^{4}	18	1.18×10^{3}	1.11×10^{6}
Uranium-235	0.0529	1.01×10^{3}	0.745	36.5	3.89×10^{4}
Uranium-236	0.07	517	0.061	3.77	2.97×10^{3}
Uranium-238	0.052	623	0.105	12.6	3.21×10^{3}

Note: Number of samples in parentheses

Max = maximum detected value
Min = minimum detected value

NA = not applicable or not analyzed
ND = not detected above detection limit

For component samples, these data indicate activity concentrations in converters are higher than those in the compressors. The data also indicate that technetium-99, uranium-233/234, and uranium-235 activities are typically greater in the higher end of the enrichment process (in the X-326 Building process equipment). The above table does not include results from deposits which had technetium-99, uranium-235, and uranium-238 maximum values of 2,020,000 pCi/g, 13,300 pCi/g, and 1,953 pCi/g, respectively (both technetium-99 and uranium-235 maximums occurred in X-326 while the uranium-238 maximum occurred in X-330). The laboratory data for these process equipment samples are contained in the Waste Disposition RI/FS and incorporated by reference herein, as well as in the Process Building proposed plan and ROD.

Other analytes often detected in solid samples from the converters and compressors include chromium and lead. In all three process buildings, chromium ranged from 13.4 to 12,000 mg/kg in compressors and 9.1 to 707 mg/kg in converters. Lead results ranged from 1.9 to 444 mg/kg in compressors and 0.426 to 243 mg/kg in converters. These data indicated that chromium is higher in compressors than in converters, while lead is nearly the same for both pieces of equipment. The chromium and lead results were similar among the three process buildings.

HIGHLIGHTS OF SECTION 2

- The gaseous diffusion process buildings (X-333, X-330, and X-326) are generally in good condition structurally.
- Recently collected data from the process equipment confirms technetium-99 and uranium deposits in the process equipment—greatest contamination is in X-326.

NEXT STEP: SECTION 3 PRESENTS THE OVERALL ENVIRONMENTAL SETTING OF PORTS

3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section presents the current physical setting and conditions relative to location, surface features, meteorology, surface water hydrology, geology, hydrogeology, soils, demography, land use, and ecological resources. This information is used in developing a CSM if the buildings are left in place. A CSM discusses the potential sources of contamination (Section 2) as well as the release and transport mechanisms. The transport of contamination is dependent on the area conditions (Section 3). Development of a complete CSM and then defining the magnitude of the impact of contaminants on receptors completes the problem definition.

While specific information relative to the nature and extent of contamination within the process buildings is limited (Section 2), numerous investigations and reports have detailed the physical and environmental characteristics of PORTS media. In addition, these investigations have characterized the nature and extent of PORTS environmental media contamination that likely resulted from past operations within the process buildings. The primary reference sources that provided supporting information for this section include the following:

Plant-wide Baseline Human Health Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1995 [draft])

Quadrant I RFI Final Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1996a)

Quadrant II RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1996b)

Quadrant III RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1996c)

Quadrant IV RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1996d)

Baseline Ecological Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1996e)

Quadrant III Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1998a)

Quadrant IV Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1998b)

Quadrant I Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 2000b)

Quadrant II Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 2001a)

2010 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant (DOE 2011d).

3.1 SURFACE FEATURES

PORTS is located in Pike County in south central Ohio, east of the Scioto River, and within the Scioto River’s drainage basin (Figure 3.1). It occupies an upland area of southern Ohio and has an average land surface elevation of 670 ft above mean sea level (AMSL) (with a range from approximately 555 to 850 ft AMSL). PORTS sits in a 1-mile-wide abandoned river valley situated approximately 130 ft above the Scioto River floodplain, which lies to the west. In much of the industrialized area of PORTS, the original topography has been modified and graded for construction of buildings and other facility components. Much of the industrialized area is located on fill that was removed from higher elevations and placed in existing drainage valleys and depressions to make PORTS more level.

The local topography at PORTS is dominated by ancient and recent streams. The predominant landform in the area is an undulating, broad, sediment-filled, ancient river valley. This valley is oriented north-south and is bounded on the east and west by deeply dissected ridges and low-lying hills. The surface of the river valley is modified by recent streams (Figure 3.2). A small valley is formed by Little Beaver Creek, which flows in a northwesterly direction across the middle of PORTS, just north and east of the main industrialized area. Other small valleys formed by streams have cut into the flat-lying, unconsolidated deposits on which PORTS is located. One of these valleys is that of a westward-flowing stream, West Drainage Ditch, which is near the west-central area of PORTS. Two more streams are located in the southern portion of the industrialized area. In the southeast portion of PORTS, the southerly flowing stream, Big Run Creek, is situated in a relatively broad, gently-sloping valley. The Southwest Drainage Ditch has formed a narrow, steep-walled valley.

3.2 METEOROLOGY

This section describes the existing meteorological and air quality environment at the PORTS Facility and in its vicinity.

3.2.1 Existing Meteorological Environment at PORTS

The climate of the PORTS area is humid-continental and is characterized by warm, humid summers and cold, humid winters. For the period of record (June 1893 to December 2010) in Waverly, Ohio (approximately 10 miles north of PORTS), the daily temperature averages are 73°F in the summer (June through August) and 33°F in the winter (December through February). The average annual temperature is 54°F. Record high and low temperatures are 107°F and -31°F, respectively (Western Regional Climate Center [WRCC] 2011).

Precipitation is distributed relatively evenly throughout the year and averages approximately 40 in. per year. The month with the highest average precipitation for the period of record (June 1893 to December 2010) is May, and June is the second. Groundwater recharge and flood potential are greatest during the spring. February is the driest month. Snowfall averages approximately 19 in. per year (WRCC 2011).

Wind data have been collected at an on-PORTS meteorological tower. The data were collected at the 33-, 98-, and 197-ft levels. An evaluation of data collected from 1995 through 2001 indicated that winds at the 33-ft level appear to be influenced by local topographical and/or vegetative features, while the wind data from the 98-ft level are believed to be more representative (NRC 2004). A wind rose of the 98-ft level from 1995 through 2001 is presented in Figure 3.3. About one third of the time, the wind blew from the south-southwest at an average speed of almost 6.5 mph. Directional wind speed was highest from the south at approximately 8 mph, while the lowest value was recorded in winds blowing from the east at 4 mph.

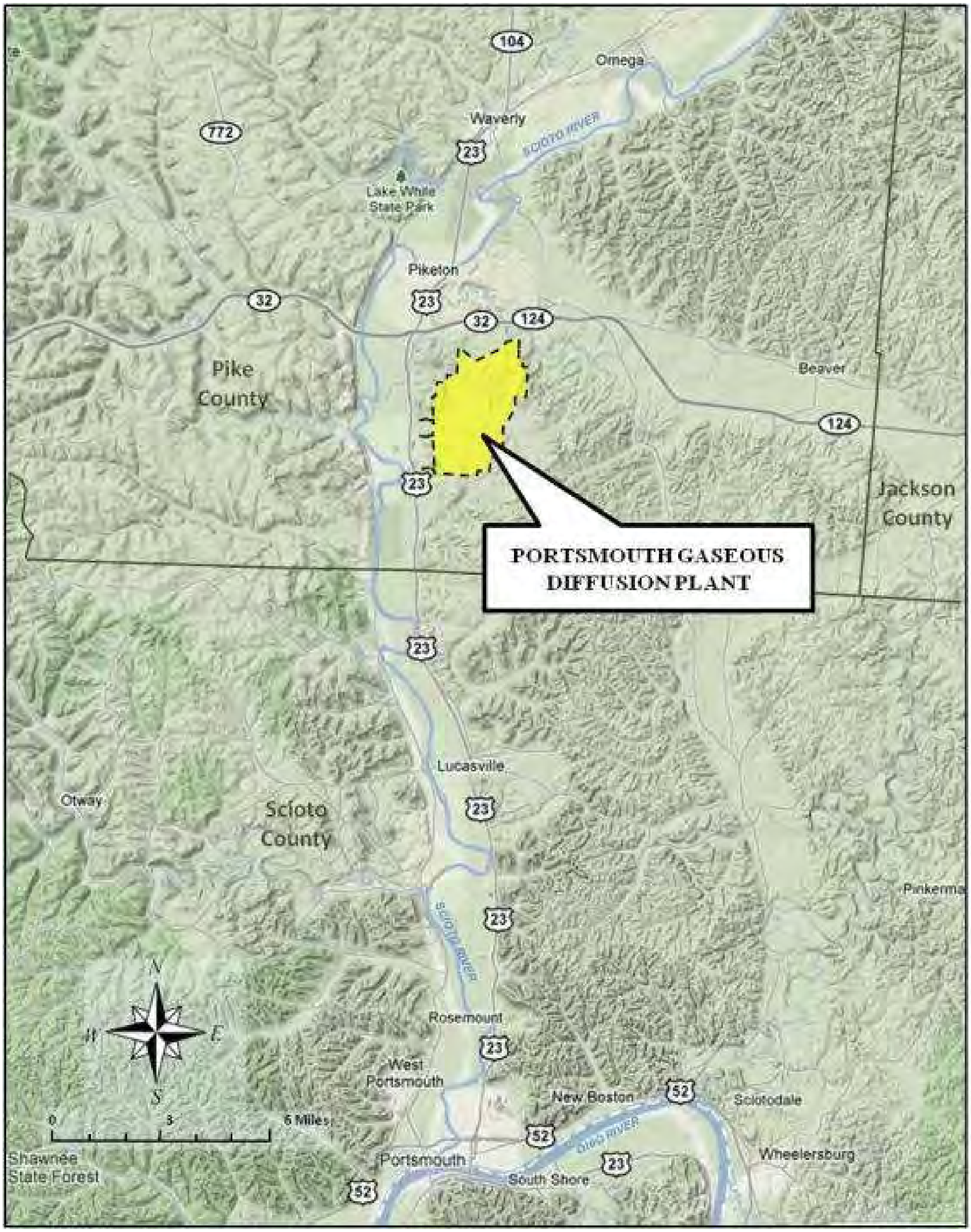


Figure 3.1. PORTS Location and Major Drainage

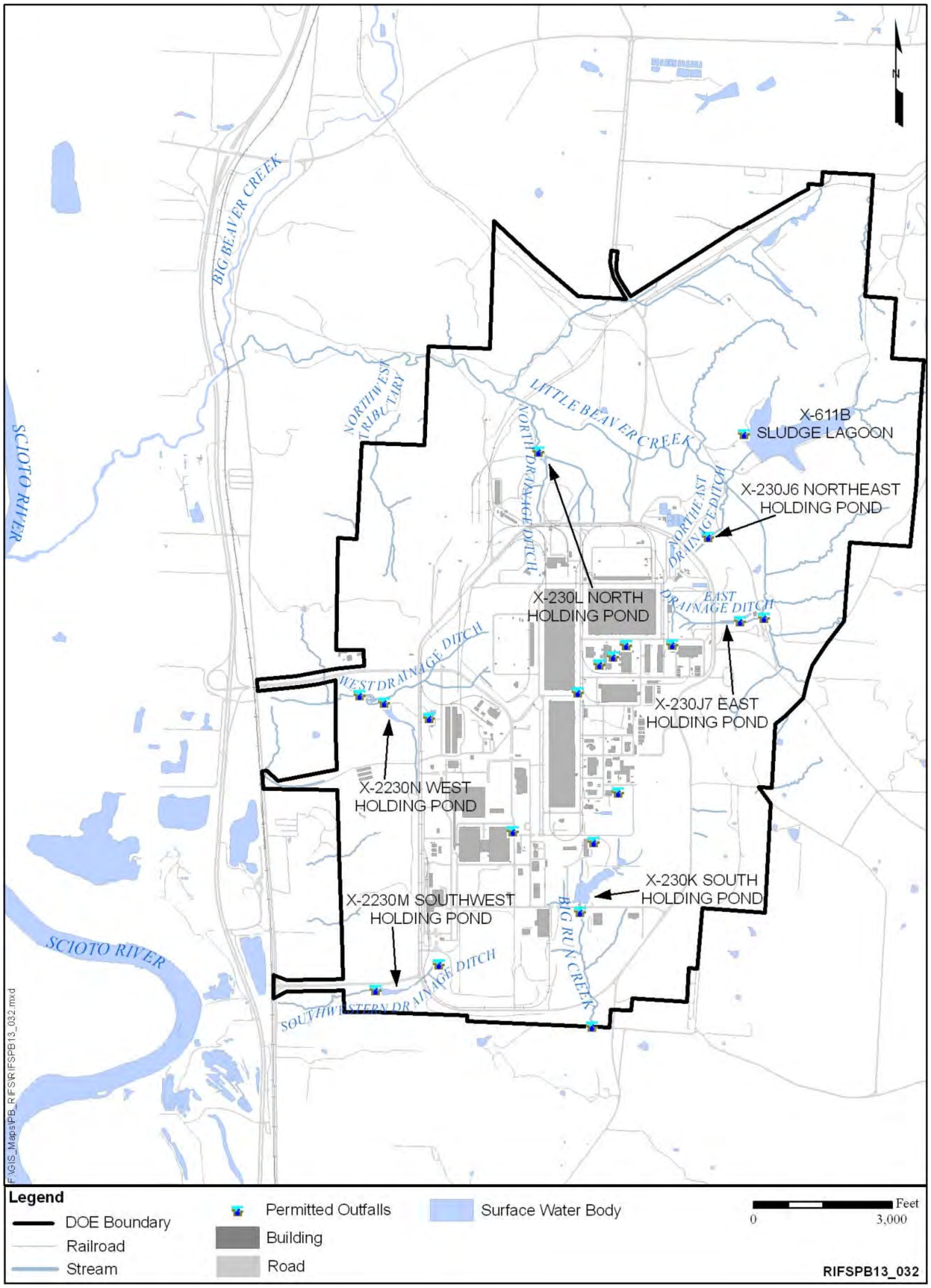
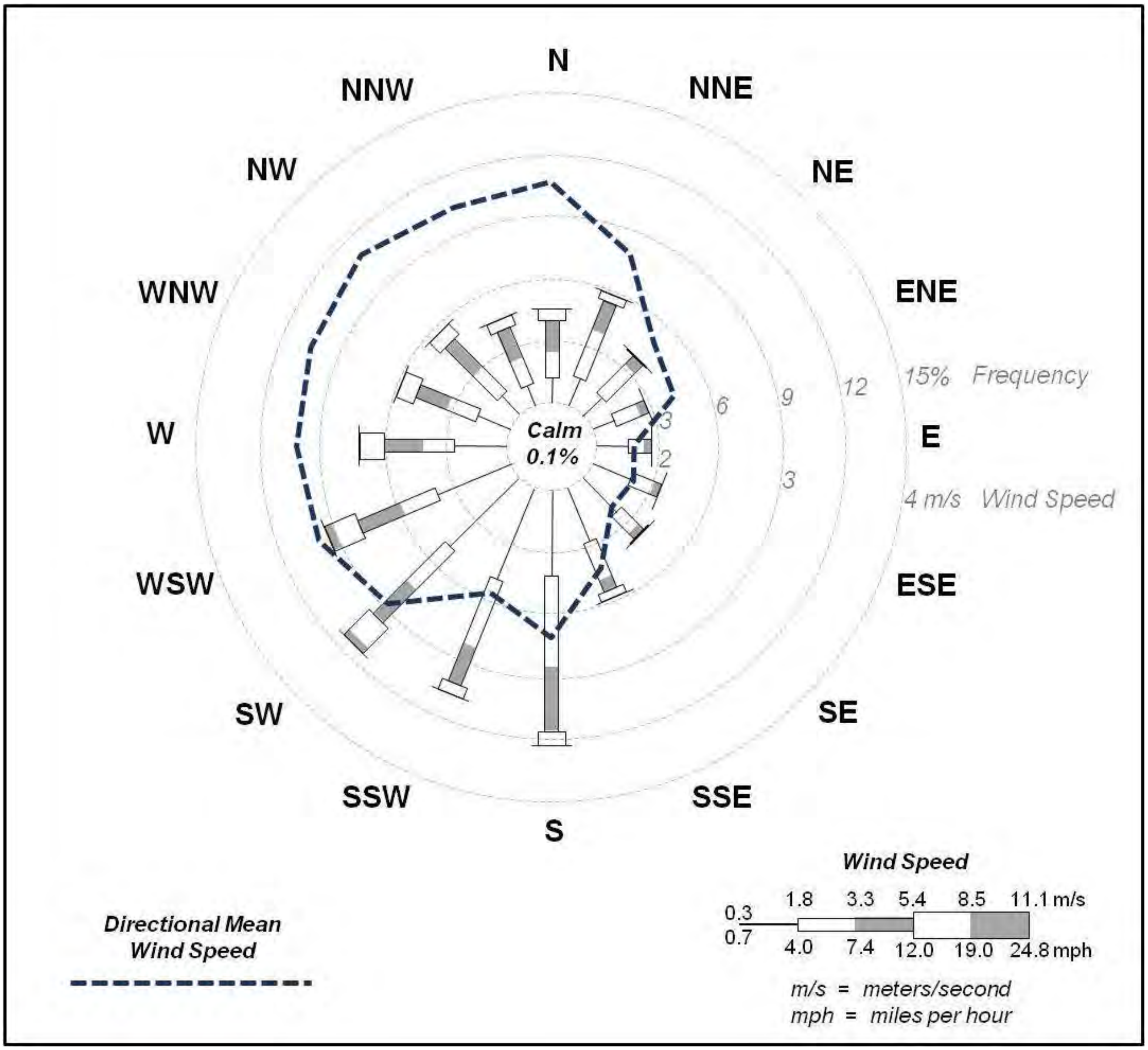


Figure 3.2. Surface Water Features at PORTS



Source: NRC 2004

Figure 3.3. Wind Rose for PORTS

3.2.2 Existing Air Quality Environment at PORTS

The EPA has established maximum concentrations for pollutants in ambient air, referred to as the National Ambient Air Quality Standards (NAAQS). The Ohio State Ambient Air Quality Standards are identical to the NAAQS. Six criteria pollutants are used as indicators of air quality: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide (SO_2), particulate matter with a mean diameter of 10 micrometers or less (PM_{10}), particulate matter with a mean diameter of 2.5 micrometers or less ($PM_{2.5}$), and lead. Areas in which ambient air concentrations meet the standards for each criteria pollutant are designated as attainment areas. Areas that do not meet the standards are designated as nonattainment areas. PORTS is located in the Wilmington-Chillicothe-Logan Intrastate Air Quality Control Region, which covers the south-central part of Ohio. Pike, Ross, and Jackson Counties are in attainment for all criteria air pollutants (40 *CFR* 81.336). Scioto County is a nonattainment area for $PM_{2.5}$ (EPA 2011a).

The DOE operations at PORTS generate conventional nonradiological air pollutants such as organic compounds and particulate matter. The air emission sources at PORTS include two landfill venting systems, one glove box, and four groundwater treatment facilities. Ohio EPA regulates these as minor sources. Other sources include the three boilers at the X-600 Steam Plant (which provide steam for PORTS); the X-6002 boilers, diesel engine compressors associated with the X-326 dry air systems, and gravel roads/parking lots associated with construction areas. Air emissions are estimated every 2 years for the Ohio EPA Biennial Emission Fee Statement. To calculate air emissions, PORTS assumes that each source emits the maximum allowable amount of each pollutant as provided in the permit or registration for each source. The following are 2009 emissions of nonradiological air pollutants from DOE operations at PORTS: 0.202 tons of lead, 48.9205 tons of particulate matter, 16.0003 tons of organic compounds, 2,051.16 tons of SO_2, and 225.666 tons of nitrogen oxides. More than 99 percent of these emissions were associated with the boilers, diesel engine compressors, and construction areas (DOE 2011e).

With regard to greenhouse gas emissions associated with PORTS, a significant source of carbon dioxide (CO_2) is employee transportation vehicles. The EPA estimates that each gallon of gasoline produces 19.4 lb of CO_2 emissions (EPA 2005). Assuming that each PORTS worker drives 30 miles roundtrip to and from work in a vehicle with a fuel economy rating of 20 miles per gallon of gasoline, each worker generates approximately 29 lb of CO_2 in their daily commute. Assuming a 5-day work week and 50 working weeks per year, the annual amount of CO_2 emissions by each worker is 7,300 lb (about 3.7 tons). Based on recent PORTS employment (2,709, including DOE and tenants), approximately 9,888 tons of CO_2 is emitted annually from employee vehicles. In addition, in the 1950s, two coal-fired power generation plants (Kyger Creek in Ohio and Clifty Creek in Indiana) were originally dedicated to supplying electrical power to PORTS. Kyger Creek and Clifty Creek emitted a total of approximately 16 million tons of CO_2 in 2006 (SourceWatch 2011a, 2011b). In the same year, both plants generated a total of approximately 16.2 million megawatt-hours (MWh) of electricity (Ohio Valley Electric Corporation [OVEC] 2007). This equates to approximately 0.99 tons of CO_2 emitted per MWh. To support current annual electrical requirements at PORTS (approximately 250,000 MWh), approximately 247,500 tons of CO_2 are emitted. This amount, combined with the employee vehicle emissions, means the total CO_2 footprint of PORTS is approximately 257,400 tons per year (SourceWatch 2011a, 2011b).

The DOE collects samples from 15 ambient air monitoring stations and analyzes them for radionuclides that could be present in ambient air as a result of PORTS activities. These radionuclides are isotopic uranium (uranium-233/234, uranium-235, uranium-236, and uranium-238), technetium-99, and selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). The ambient air monitoring stations measure radionuclides released from point sources, fugitive air emissions (emissions that are not associated with a specific release point such as a stack), and background levels of radiation (radiation that occurs naturally in the environment and is not associated with PORTS operations) (DOE 2011e).

Airborne discharges of radionuclides from PORTS are regulated in accordance with 40 *CFR* 61, Subpart H, and the National Emission Standards for Hazardous Air Pollutants. No transuranic radionuclides were detected in the samples collected from the ambient air stations in 2009. Technetium-99 was detected at Stations A23 (northeastern boundary) and A24 (north on Schuster Road). The maximum activity of technetium-99 in ambient air was 0.0031 pCi/m^3 at Station A24, which is well below the DOE-derived concentration guide of 2,000 pCi/m^3.

Uranium-233/234 and uranium-238 were detected in all of the 2009 samples, including those from background locations, which are established upward of PORTS operations. The highest average activity of uranium-233/234 (0.00083 pCi/m^3) was detected at Station A29 (at OVEC). The highest average activity of uranium-238 (0.00073 pCi/m^3) was detected at Station A28 (southwest of PORTS on Camp Creek Road). These average activities are well below the DOE-derived concentration guides for uranium-233/234 (0.09 pCi/m^3) and uranium-238 (0.1 pCi/m^3).

3.3 SURFACE WATER HYDROLOGY

The PORTS Facility has 19 permitted outfalls (Figure 3.2) that discharge process water from the property (DOE 2010a). Eleven of these outfalls discharge directly to surface water while the others initially discharge to internal outfalls, such as the X-6619 Sewage Treatment Plant, before leaving PORTS. PORTS is drained by several small tributaries of the Scioto River (Figure 3.2). Sources of surface water drainage include storm water runoff, groundwater discharge, and effluent from PORTS. The largest stream on PORTS is Little Beaver Creek, which drains the eastern and northern portions of PORTS before discharging into Big Beaver Creek. Little Beaver Creek is a small, high-gradient, unmodified stream that receives the majority of its flow from the X-230J7 East Holding Pond discharge through the East Drainage Ditch. The X-230J7 East Holding Pond, which primarily receives foundation drainage and storm runoff, currently contributes more than 1.5 million gal per day to the stream. Little Beaver Creek also receives effluent via the Northeast Drainage Ditch through the outfall from the X-230J6 Northeast Holding Pond (approximately 0.029 million gal per day), and via the North Drainage Ditch through the outfall from the X-230L North Holding Pond (0.29 million gal per day). The combined plant effluent discharges contribute approximately 1.9 million gal per day of flow to Little Beaver Creek, which comprises the majority of stream flow during low flow conditions. Substrates are predominantly slab boulders and bedrock at the upper reach to gravel and sand near the mouth of the stream. During parts of the year, intermittent flow conditions exist upstream from the X-230J7 discharge. During the summer/fall low-flow time of the year, the upstream section is composed of shallow, isolated pools with intermittent flow (Ohio EPA 2006). The Northwest Tributary stream corridor begins just southwest of the Don Marquis Substation and flows approximately 3,200 ft before leaving the PORTS property and prior to its confluence with Little Beaver Creek.

Big Run Creek is the smaller tributary of the Scioto River that drains the southern portion of PORTS. This stream receives outfall effluent from the X-230K South Holding Pond at its headwaters. The X-230K South Holding Pond discharge contributes a median flow of 0.393 million gal per day and comprises nearly the entire flow within the upper 1 mile of the stream. Big Run Creek flows south-southwest from PORTS for approximately 4 miles until it intersects the Scioto River. The substrates of Big Run Creek are predominantly gravel, cobbles, and sand, and the stream channel remains unmodified. Because of the small stream size and high gradient, deep pools are absent. The bottom of the creek tends to consist of poorly developed riffles and shallow pools (Ohio EPA 1993, 2006).

Because both Little Beaver Creek and Big Run Creek cut through unconsolidated material (sand, silt, and/or clay deposits) and intersect bedrock and the ancestral Portsmouth River Valley essentially forms a large “bowl” around the PORTS Facility, all groundwater leaving PORTS through unconsolidated deposits is eventually drained to the Scioto River by these two streams.

Two ditches drain the western and southwestern portions of PORTS. Flow in these ditches is low to intermittent. The West Drainage Ditch receives water from surface water runoff, storm sewers, and PORTS effluent. The Southwest Drainage Ditch receives water mainly from storm sewers and groundwater discharge. These two drainage ditches continue west and ultimately discharge into the Scioto River.

Primary Headwater Habitat (PHWH) stream systems exist in the upland areas of PORTS. In April 2012, a Level 1 assessment of the physical habitat and geomorphic characteristics of several streams in the northeastern portion of PORTS (related to OSDC Study Area D) was performed by DOE. Stream assessments were conducted using methods described in Ohio EPA's evaluation manual for PHWH streams. A total of eight PHWH stream systems were initially identified during the Level 1 assessment with a total of 22 individual streams being present within Study Area D. There were no obvious field indicators of a predominantly groundwater influence. In conclusion, there were no streams in that study area that were assigned a provisional Class IIIB PHWH classification. Also, these upland areas are outside the area of influence of this Process Building decision.

Floodplains consist of mostly level land that may be submerged by floodwaters along rivers and streams. The 1988 flood insurance rate map provided by the Federal Emergency Management Agency (FEMA) (FEMA 2009) indicates that the 100-year floodplain extends on both sides of Little Beaver Creek upstream from its confluence with Big Beaver Creek to the rail spur located near the X-230J9 North Environmental Sampling Station. The 100-year floodplain ranges on either side of Little Beaver Creek from 50 to 200 ft, roughly following the 575-ft topographic contour. Flooding is not a problem for the majority of PORTS. The highest recorded flood level of the Scioto River in the vicinity of PORTS was 570 ft AMSL in January 1913, which is approximately 100 ft below the level of most PORTS facilities. No portion of the 100-year floodplain for Big Run Creek is located within the PORTS boundary.

The 1988 flood insurance rate map provided by FEMA indicates that no portion of PORTS, including the area of Little Beaver Creek, falls within the 500-year floodplain. This is likely a result of the deeply incised drainage and steep gradients along Little Beaver Creek, which would limit the area covered by the 500-year floodplain.

3.4 GEOLOGY

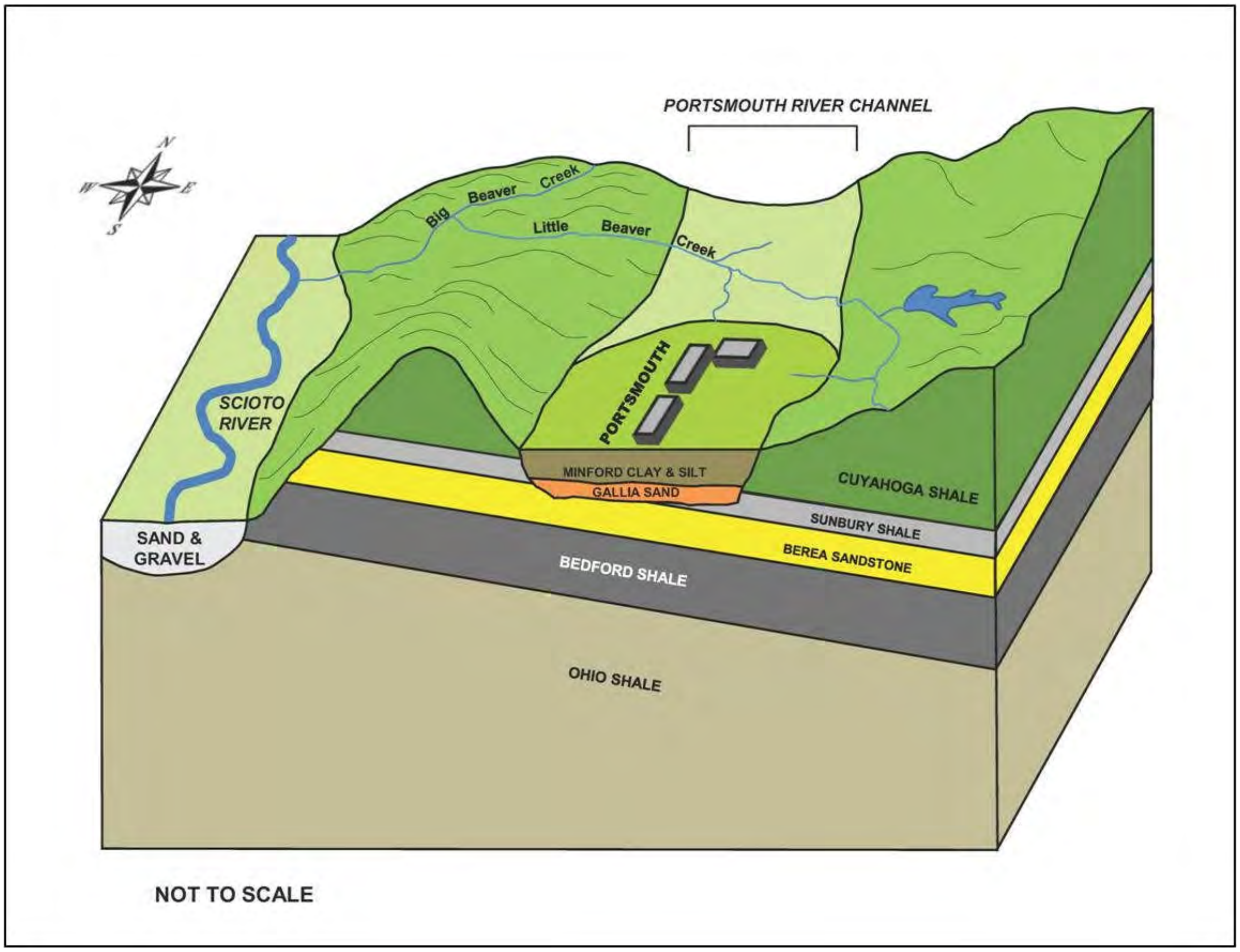
The geology of PORTS has been characterized over the years by the installation of more than 1,600 soil borings and wells. The information in this section was obtained primarily from the PORTS quadrant RFI final reports listed at the beginning of Section 3. The subsurface consists of approximately 30 to 40 ft of unconsolidated Quaternary clastic sediments (e.g., sand, silt, and clay) overlying Paleozoic bedrock that dips gently toward the east (Figure 3.4). In stratigraphic order, bedrock is overlain by fluvial Gallia sand and gravel (Gallia) and by the lacustrine Minford clay and silt (Minford) of the Teays Formation (Figure 3.5). The erosion and subsequent fill of the Portsmouth River Valley during the Pleistocene is a primary factor controlling the shallow geologic units beneath PORTS. A portion of the former Portsmouth River Valley underlies PORTS.

The bedrock beneath PORTS is comprised of sandstone and shale deposited in an inland sea during the late Devonian and Mississippian Periods (approximately 340 million years ago) (Coogan 1996).

The area was subsequently uplifted and gently folded. Erosion produced the deeply dissected, knobby terrain that characterizes southern Ohio. The near-surface bedrock formations (from oldest to youngest) are the Bedford shale, Berea sandstone, Sunbury shale, and Cuyahoga shale (Upper Devonian and Mississippian strata) that dip gently to the east-southeast at approximately 30 ft/mile. No known geologic faults are located in the immediate area. Two distinct joint sets (i.e., fractures) are present in outcrops of thin (2 to 8 in. thick) sandstone laminations in the Cuyahoga Formation and the lower Berea/upper Bedford Formations.

The Bedford shale is the lowest stratigraphic unit that has been encountered during environmental investigation activities at PORTS. The Bedford shale, continuous beneath PORTS, consists of thinly bedded shale with thin interbeds and laminations of hard, gray, fine-grained sandstone and siltstone. The typical depth to the top of this formation at PORTS is 70 to 100 ft below ground surface. It averages 100 ft in thickness and outcrops are present in deeply incised streams and valleys within the DOE reservation.

The Berea sandstone is composed of a light gray, hard, thickly bedded, fine-grained sandstone with thin shale laminations. The upper 10 to 15 ft of this formation consists of a massive sandstone bed with few joints or shale laminae. This formation is continuous beneath the industrial portion of PORTS, underlying the Sunbury shale on the eastern portion of PORTS and the unconsolidated Minford and Gallia members (Teays Formation) on the western portion of PORTS. The Berea sandstone averages 35 ft thick, and the lower 10 ft have numerous interlayered shale laminations similar to those in the underlying Bedford shale. This gradational contact does not allow for precise determination of the thickness of the Berea sandstone. Regionally, the formation contains naturally occurring hydrocarbons (petroleum) in quantities sufficient for commercial production.

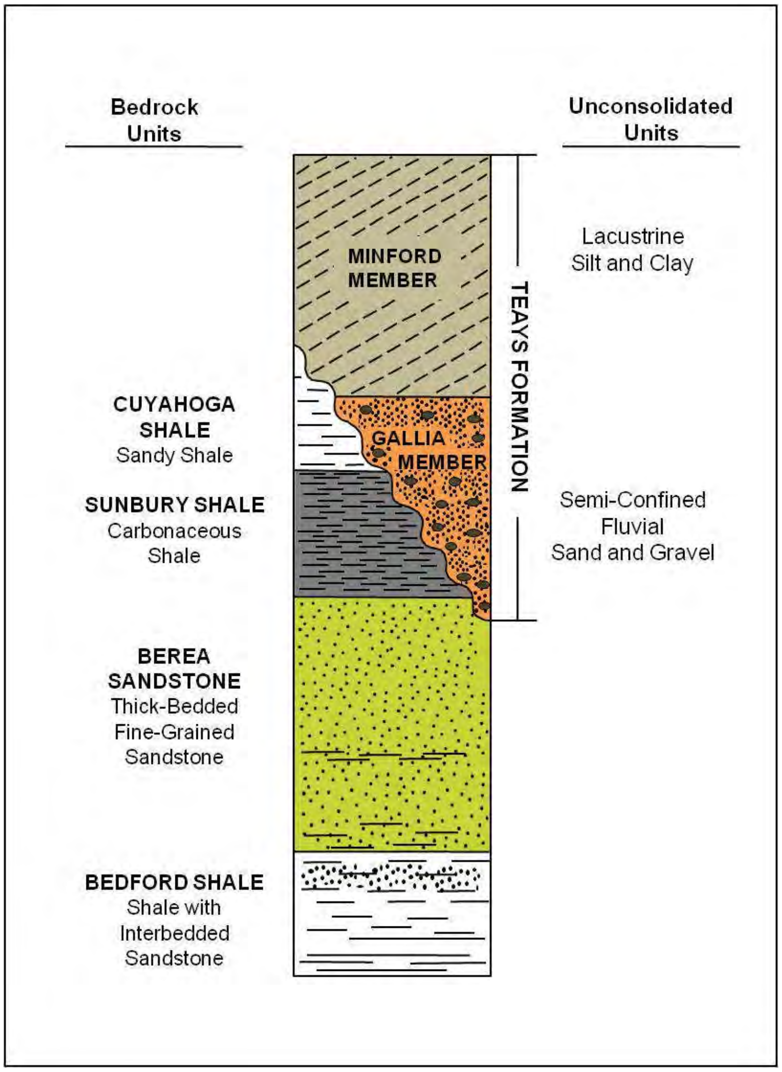


Source: DOE 1996a

Figure 3.4. Schematic Block Diagram Showing Geological Relationships at PORTS

The Sunbury shale is a competent, black, very carbonaceous shale that averages about 15 to 20 ft in thickness. It is typically the uppermost bedrock unit beneath PORTS, but thins westward as a result of erosion by the ancient Portsmouth River. The Sunbury shale is absent under the western half of the reservation. It is also absent in the drainage of Little Beaver Creek downstream from the X-611A Old Lime Sludge Lagoons and the southern portion of Big Run Creek, where it has been removed by erosion. The Sunbury shale underlies the unconsolidated Gallia of the Teays Formation beneath the industrialized eastern portion of PORTS and underlies the Cuyahoga shale outside of the Portsmouth River Valley.

The Cuyahoga shale, the youngest and uppermost bedrock formation in the geographic area, forms the hills surrounding PORTS. It is a moderately hard, thinly laminated shale (with numerous sandstone laminations) that regionally reaches a thickness of approximately 160 ft. The Cuyahoga shale is not found beneath the industrial portion of PORTS.



Source: DOE 2011d

Figure 3.5. Generalized Stratigraphy at PORTS

Prior to glaciation, the major drainage system in southern Ohio was the Teays River System. The river flowed northwest and passed about 3 miles north of PORTS. Glaciation occurring 25,000 to 2 million years ago changed the flow directions of streams, caused lakes to form, and filled in valleys with lake and river sediments.

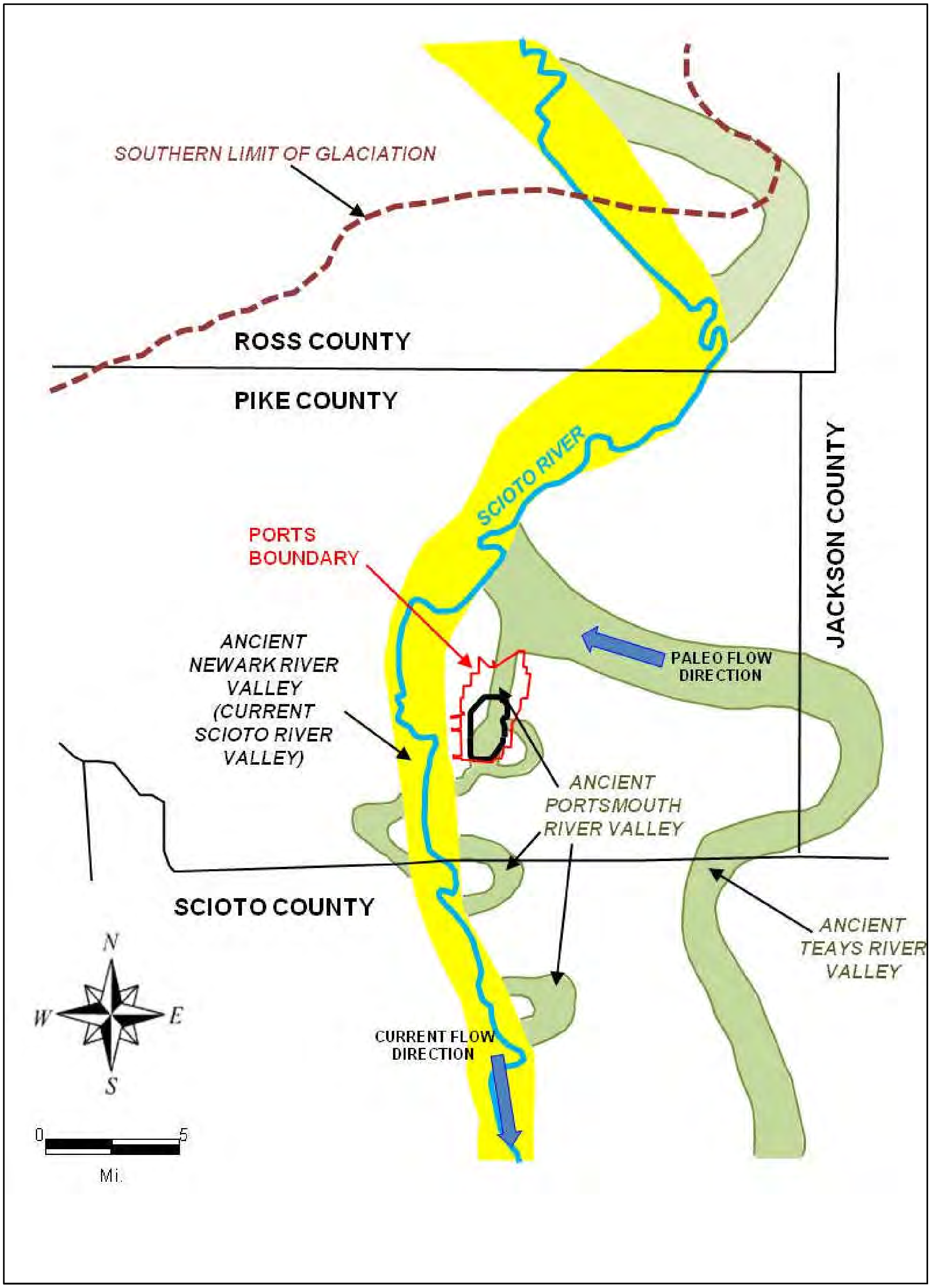
The Portsmouth River, a north-flowing tributary of the Teays, flowed across the area that is now occupied by PORTS (Figure 3.6). The Portsmouth River eroded a valley into bedrock. The Sunbury was eroded into a wedge that diminishes to the west and exposed the Berea bedrock on the western third of the facility. As the Portsmouth River meandered across the valley, silt, sand, and gravel were deposited. These unconsolidated fluvial deposits form the Gallia Member (Gallia) of the Teays Formation. The Gallia averages 3 to 4 ft in thickness at PORTS and is characterized as reddish-brown, clayey, medium-to-coarse sand and gravel (sand and gravel are typically poorly sorted). Channel migration and variation in depositional environments resulted in the variable thickness and hydraulic properties of the Gallia. The areas of thickest accumulation of Gallia sediments (exceeding 10 ft thick in some places) may represent the former channel location. They include areas under the southern end of the X-330 Process Building and near the X-701B Holding Pond. Gallia deposits beneath PORTS (found at a depth of approximately 25 ft below ground surface) are generally absent above an elevation of 650 ft AMSL. This happened because the valley walls of the ancient Portsmouth River formed a natural barrier for deposition of Gallia channel deposits.

Approximately 1 million years ago, an advancing glacier north of PORTS blocked the northwestward flow of the Teays River. A glacial lake, Lake Tight, filled the valleys of the Teays River and its tributary, the Portsmouth River. The Minford member (Minford) of the Teays Formation, consisting of lacustrine silts and clays, accumulated in the lake. The Minford, which represents the uppermost stratigraphic unit beneath PORTS, consists of two units with a gradational contact. The upper unit is predominantly silty clay with some very fine-grained sand, and the lower silt unit is composed of clayey silt and very fine to fine-grained sand. Both units are continuous beneath the industrialized part of PORTS. The lower unit is indicative of shallow lake levels or over-bank deposits that grade into the upper unit of laminated silty clays, which were deposited as Lake Tight increased in size and depth. The Minford averages 20 to 40 ft in thickness with the upper unit averaging 16 ft in thickness. Eventually, Lake Tight overflowed its banks and initiated the high-volume and high-energy lower elevation drainage paths that bypassed the area of PORTS as they flowed south in the vicinity of the present-day Scioto River.

The unconsolidated Gallia and Minford members of the Teays Formation beneath PORTS are not continuous with the unconsolidated deposits in the Scioto River Valley to the west. A bedrock ridge forms a western valley wall that separates the two groups of unconsolidated deposits.

The PORTS Facility is located in the Appalachian Plateau structural province. This structural province is bounded to the west by the Cincinnati Arch structural province and to the east by the fold-and-thrust belt of the Appalachian Mountains.

Geologic studies conducted to determine the potential seismic hazard for PORTS have determined that only one fault is located within 25 miles of PORTS. This fault lies approximately 18 miles to the west of the facility. No seismicity has been recorded on this fault, and no seismic events have occurred within 25 miles of PORTS during the historic period. Based on data from the Ohio Department of Natural Resources (ODNR) (ODNR 2011), 17 earthquakes have occurred within 50 miles of PORTS, and only a few of those were likely felt in the vicinity of PORTS. The largest event occurred on May 17, 1901, with an epicenter approximately 20 miles from PORTS and with an estimated magnitude of 4.3. Since 1978, two Ohio earthquakes within 50 miles of PORTS occurred with a magnitude greater than 3.0.



Source: DOE 1998a

Figure 3.6. Location of Ancestral River Systems in Relation to PORTS

Also since 1978, three Kentucky earthquakes within 50 miles of PORTS occurred with a magnitude greater than 3.0 (Hansen 2007). It should be noted that all of the earthquakes in the area since 1978 were less than magnitude 3.6. On August 23, 2011, an earthquake with a magnitude of 5.8 occurred in east-central Virginia (approximately 285 miles from PORTS) and was felt throughout Ohio.

The Kentucky River Fault Zone and the Lexington Fault System (formerly the Bryant Station-Hickman Creek Fault) are located farther away from PORTS, the latter fault being approximately 60 miles southwest. These faults bound the southern part of a north-northeast trending area of seismicity in central and eastern Ohio. Soil testing for the Gas Centrifuge Enrichment Plant (GCEP) indicated that the potential for earthquake-induced soil liquefaction at PORTS is relatively low (Law Engineering 1978). The potential for soil-structure interaction (ground motion magnification) is also slight.

3.5 SOIL

According to the soil survey of Pike County, 22 soil types occur within the PORTS property boundary. The predominant soil type at PORTS is Omulga Silt Loam (U.S. Department of Agriculture [USDA] 1990). Most of the area within the active portion of PORTS is classified as Urbanland-Omulga complex with a 0 to 6 percent slope, which consists of urban land and a deep, nearly level, gently sloping, moderately well-drained Omulga soil in preglacial valleys. The urban land is covered by roads, parking lots, buildings, and railroads, making identification of the soil series difficult. The soil in these areas is so obscured or disturbed that assignment of specific soil series is not feasible.

The surface layer of Omulga Silt Loam is dark grayish-brown, friable, and approximately 10 in. thick. The subsoil is approximately 54 in. thick and is composed of three portions: (1) a yellow-brown, friable silt loam; (2) a fragipan (brittle, compacted subsurface soil) of yellow-brown, mottled, firm, and brittle silty clay loam; and (3) a yellow-brown, mottled, friable silt loam approximately 20 in. thick. Generally, the root zone is restricted to the zone above the fragipan and contains none of the urban land soils. Well developed soil horizons may not be present in all areas inside Perimeter Road because of cut and fill operations related to construction.

3.6 HYDROGEOLOGY

The discussion of PORTS hydrogeology in this section is a summary developed from the quadrant RFI reports and annual groundwater monitoring reports mentioned at the beginning of Section 3.

The groundwater flow system at PORTS includes the aquifers of Berea sandstone and unconsolidated Gallia sand and gravel, along with the aquitards of Sunbury shale and unconsolidated Minford clay and silt. The basal portion of the Minford is generally grouped with the Gallia to form the uppermost and primary aquifer at the facility.

Groundwater recharge and discharge areas at PORTS include both natural and man-made recharge and discharge areas. Natural recharge to the groundwater flow system comes mainly from precipitation, although land use and the presence of thick upper Minford clay deposits and the Sunbury shale effectively reduce recharge to underlying units. Discharge of groundwater to the surface occurs primarily along streams that transect the facility. Groundwater recharge and discharge areas also are influenced by man-made features, including the storm sewer system, sanitary sewer system, recirculating cooling water (RCW) system, water lines, and building sumps. Precipitation falling on the larger buildings is intercepted and routed through the storm sewer system and through holding ponds rather than providing groundwater recharge. Groundwater flow at PORTS is significantly affected by the X-700 and X-705 building basement dewatering, extraction wells in the vicinity of X-231B and X-701B, and the groundwater interceptor trenches at X-749 and X-701B. The effects of man-made features on recharge and discharge would need to be accounted for during consideration of groundwater flow and transport following any process buildings and complex facilities D&D activities.

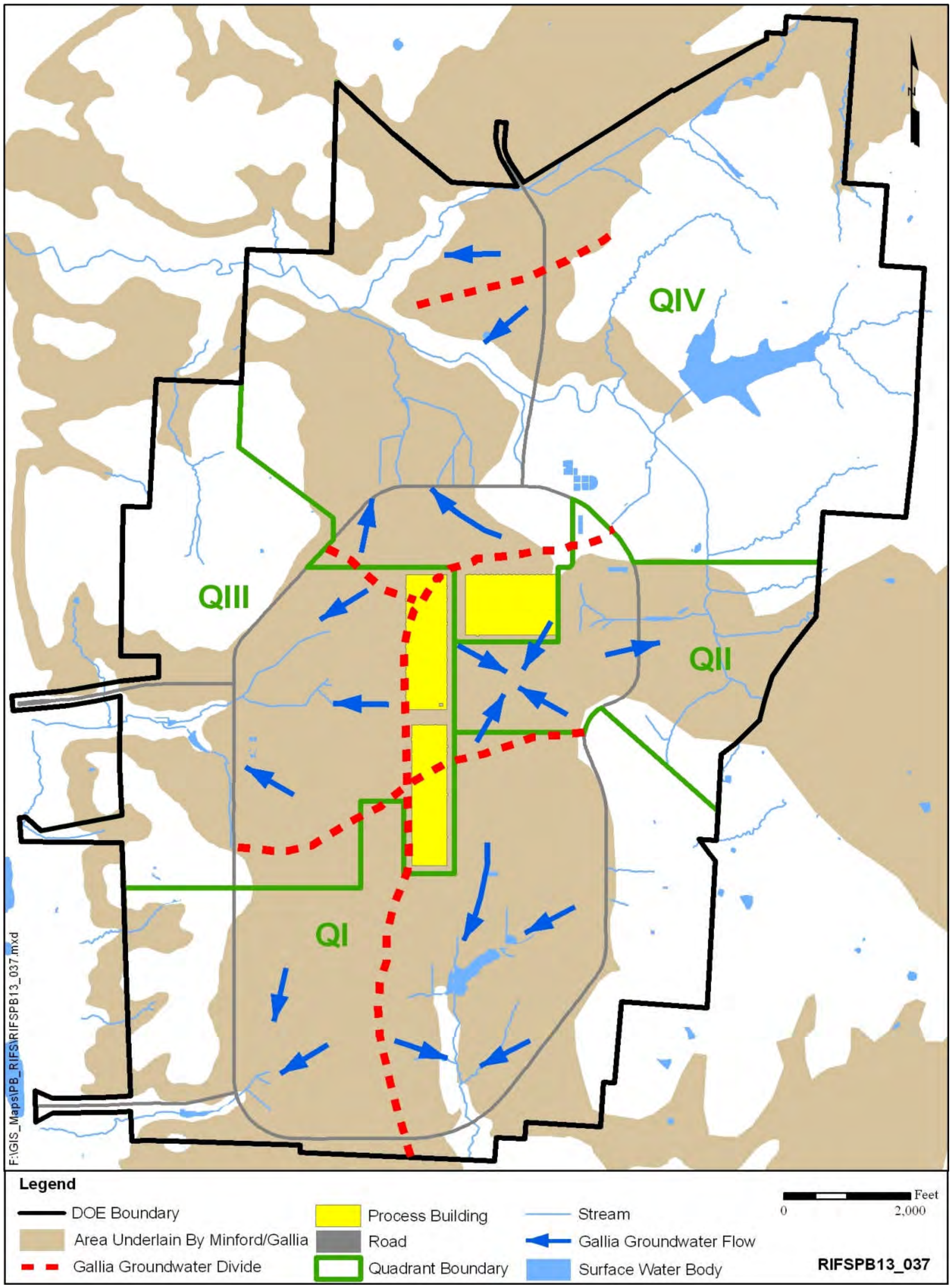
Groundwater flow at PORTS, at least within the Gallia, can generally be divided into four separate flow regions, or quadrants. Groundwater divides provide the basis for separation of PORTS into quadrants. The groundwater flow divides and general directions of groundwater flow for the Gallia and Berea aquifers are illustrated in Figures 3.7 and 3.8, respectively. The groundwater divides generally coincide with topographic highs along the center of the industrial complex (from south to north) and subtle topographic highs radiating outward and separating the predominant surface water features draining the facility. Locations of the flow divides may migrate because of small differences in response to seasonal changes in precipitation and groundwater recharge. In general, groundwater gradients are flatter in the upland areas in the center of the industrial complex and become steeper as groundwater approaches the streams or creeks. Vertical movement of groundwater between the Gallia and Berea is, in general, downward in upland areas of recharge and upward in areas of discharge near streams. Groundwater flow in specific quadrants and the primary controls on groundwater flow are discussed in the following paragraphs.

The direction of groundwater flow in Quadrant I, the southern portion of the facility, is controlled by the presence of surface drainages (Big Run Creek and the Southwest Drainage Ditch), the storm sewer system, and bedrock topography. In general, groundwater in the Gallia flows from north to south, discharging into either Big Run Creek or the Southwest Drainage Ditch. In the south-central portion of PORTS, groundwater in the Gallia flows primarily to the southeast toward the X-230 Holding Pond. The hydraulic gradient is very low because of the flat valley floor; the presence of thicker, more permeable Gallia deposits; and proximity to the east-west groundwater divide that runs through the facility. Storm drains have been observed to affect the local flow system at X-231B. The vertical hydraulic gradient from the Gallia to the Berea is steep, with an average difference of 8 to 10 ft near X-231B. The vertical hydraulic gradient between the Gallia and Berea decreases to the west as the Sunbury shale thins.

The flow system near X-749 exhibits a minor north-south-oriented divide in the Gallia. This divide runs near the western boundary of the landfill. Groundwater flows away from this divide to the east toward Big Run Creek and to the west toward the Southwest Drainage Ditch. Groundwater gradients are steep along Big Run Creek. This is attributed to the presence of sediment with low hydraulic conductivity and the rapid drop in elevation toward the creek. In this area, groundwater flow directions in the Berea are similar to the directions observed in the Gallia, but the north-south-oriented groundwater divide through Quadrant I is not present in the Berea.

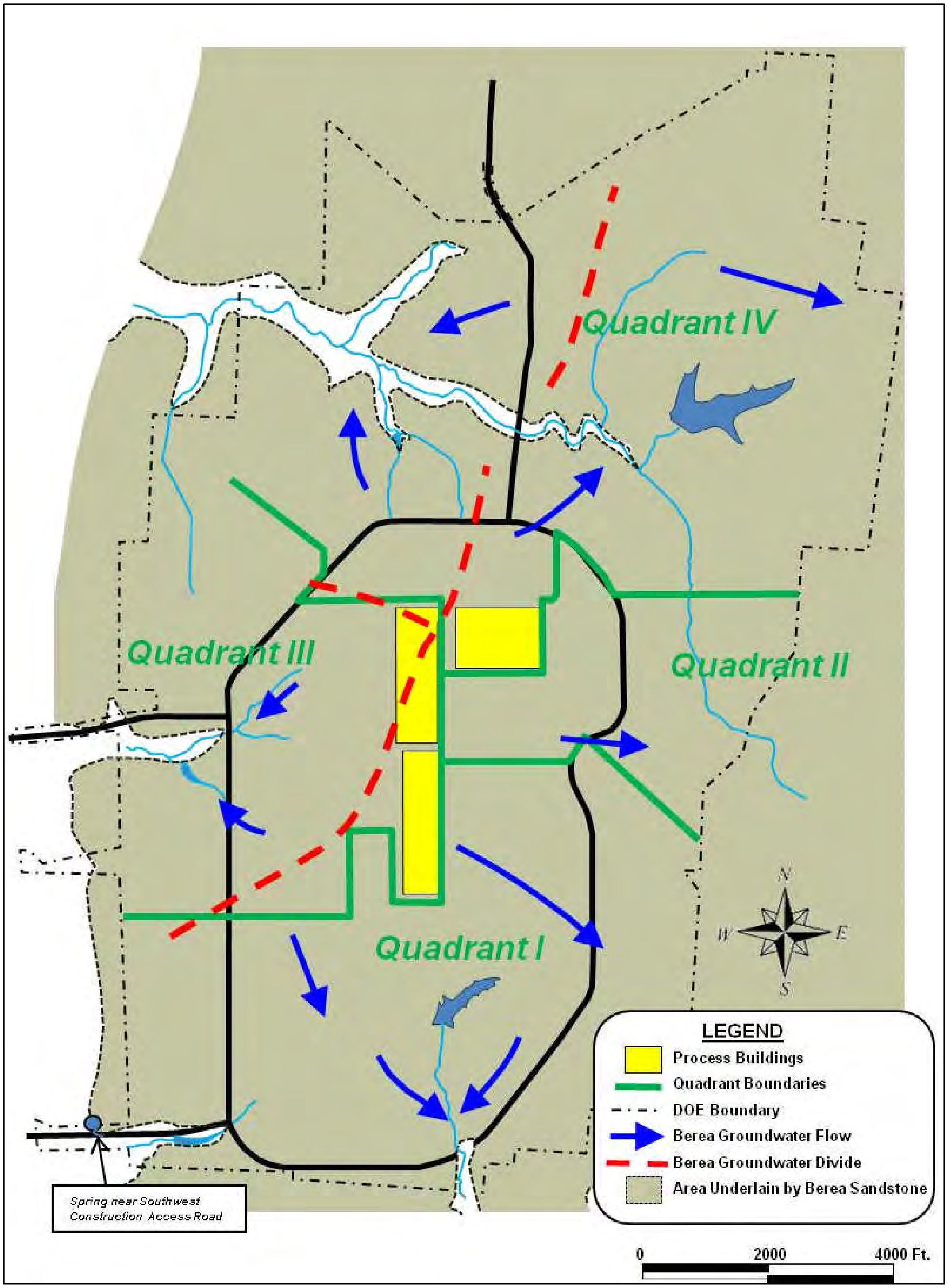
Groundwater flow in Quadrant II, in the eastern flow region, is influenced by factors such as Little Beaver Creek, holding ponds and drainage ditches, building sumps, Minford clay thickness, and the presence and absence of the Sunbury shale. Little Beaver Creek is the local surface water discharge point for shallow groundwater flow in Quadrant II. Much of the groundwater in the Minford and Gallia along the eastern portion of PORTS migrates toward the creek. The storm sewer system in the area is typically completed in the Minford. The impact of this system as well as the sanitary sewer system on local groundwater flow in Quadrant II appears to be limited.

Groundwater flow directions in both the Minford and Gallia are affected by the X-230J7 Holding Pond and the East Drainage Ditch. Both the holding pond and drainage ditch were excavated to bedrock, causing seepage faces to develop where the water table intersects the land surface along the side walls in both the Minford and Gallia. As a result, groundwater converges toward these local discharge areas.



Source: Modified from DOE 2011d

Figure 3.7. Generalized Groundwater Divides and Flow Directions for the Gallia Member at PORTS



Source: Modified from DOE 2011d

Figure 3.8. Generalized Groundwater Divides and Flow Directions for the Berea Sandstone at PORTS

In Quadrant II, groundwater flow in the Berea is primarily east to northeast. In most areas, the hydraulic gradient also is downward from the Gallia to the Berea. Vertical hydraulic gradients between the Gallia and Berea are greatest where the Sunbury is a thick, competent shale. Flow through the Sunbury is assumed to be essentially vertical. Near the X-705/X-700 buildings, where the Sunbury is thin or absent, vertical gradients indicate possible upward flow from the Berea to the Gallia. However, sumps located in the basement of the X-700 and X-705 buildings have a significant effect on groundwater flow because they create a cone of depression centered around the active sumps. These sumps remove approximately 0.02 million gal of water per day from the groundwater. If these sumps are removed, the groundwater flow will likely be toward the X-230J7 Holding Pond and the East Drainage Ditch.

Buildings, paved areas, and thick upper Minford clay and Sunbury shale deposits effectively reduce recharge to underlying units throughout the PORTS industrial facility. West of X-701B, recharge to the Minford and Gallia is reduced because a large portion of the land is paved or covered by buildings.

Groundwater flow in Quadrant III, the western flow region, is primarily influenced by the X-2230N Holding Pond and the West Drainage Ditch, which is the local surface water receptor for groundwater in the quadrant. As a result, much of the area groundwater in the Minford and Gallia migrates to the west and eventually discharges to the upper tributaries of the ditch. The West Drainage Ditch is deeply incised into bedrock, especially west of Perimeter Road. Seepage faces develop where the water table intersects the land surface along the side walls of the ditches in both the Minford and Gallia. Storm drains in the area are constructed in the Minford and provide only a limited effect on local groundwater flow.

Although groundwater flow in the Berea is northwest to southeast, along the west portion of Quadrant III, the direction of flow in the Berea has been altered by the West Drainage Ditch and erosion of the Berea in the Scioto River Valley to the west. In this area, groundwater flow is primarily to the west. The thinning and absence of Sunbury shale along the western portion of PORTS, including in much of Quadrant III, increase the communication between the Gallia and the Berea. In most areas, the flow is downward into the Berea.

Groundwater flow in Quadrant IV, in the northern portion of the facility, is strongly controlled by Little Beaver Creek, the North Drainage Ditch, and to a lesser extent, the Northeast Drainage Ditch. In the south and southeastern portions of Quadrant IV, groundwater flow in the Gallia is strongly controlled by an east-west groundwater divide that roughly coincides with the quadrant boundary. This divide is near a bedrock high in the Cuyahoga shale.

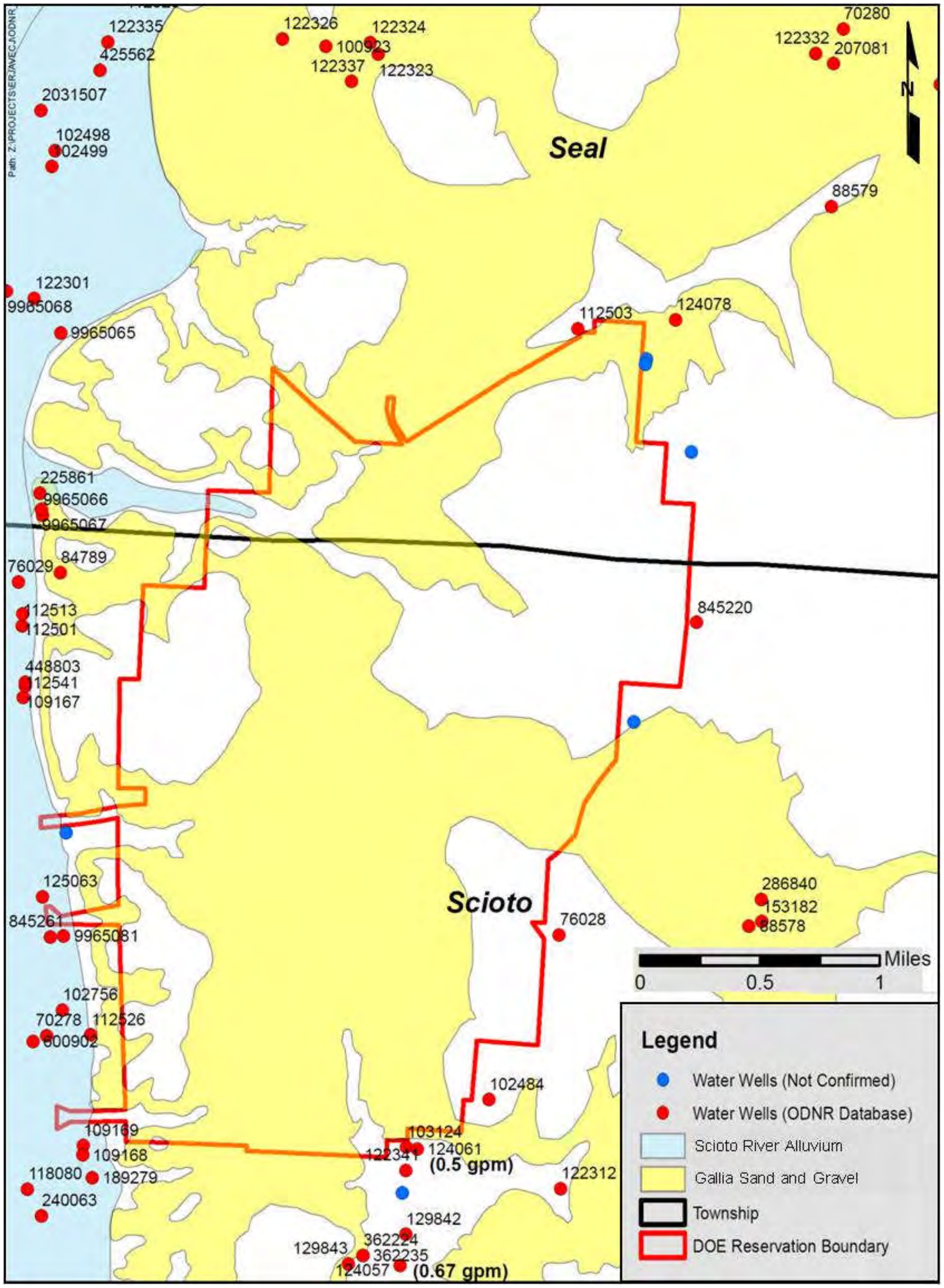
Groundwater flow directions for the Berea in Quadrant IV approximately parallel the flow directions in the Gallia, with flow primarily to the east and north toward Little Beaver Creek and to portions of the North Drainage Ditch. Because the Berea underlies the Sunbury shale, the groundwater flow in the Berea is unaffected by the bedrock high of the Cuyahoga shale near X-633. Vertical hydraulic gradients from the Gallia to the Berea are steepest near the bedrock high in the eastern portion of Quadrant IV (0.64 to 0.76 ft/ft) and in the northwestern portion of Quadrant IV near the X-734 landfill (0.41 to 0.90 ft/ft). Upward gradients are sometimes observed where the Sunbury shale is absent, along the southern portion of Quadrant IV near the Quadrant III/IV boundary.

PORTS median depth to the Gallia potentiometric surface was approximately 15 ft in 2010. (The Gallia, which behaves as a semi-confined aquifer, is found at a depth of 25 to 30 ft across the industrial portion of PORTS.) The water table within the Minford generally lies 10 to 15 ft below ground surface. Many factors can affect water table depth at a particular location, including seasonal variations from increased or decreased precipitation, surface coverings such as buildings and parking lots, topography at the location, land use, thickness of the upper clay portion of the Minford member, presence of storm drains, and operation of groundwater remediation processes (e.g., phytoremediation, extraction wells, sumps, and French drains). Based on water levels reported in the 2010 groundwater monitoring report (DOE 2011d), the water table in the Minford is usually slightly higher than the potentiometric level of the Gallia aquifer.

Groundwater is a supply source for domestic, municipal, and industrial water uses in the vicinity of PORTS. Most municipal and industrial water supplies in Pike County are developed from the Scioto River Valley buried aquifer. The village of Piketon's water supply wells are located in the Scioto River alluvium approximately 4 miles northwest of PORTS. The PORTS water supply comes from three well fields located near the Scioto River to the east of PORTS, where they draw groundwater from the Scioto River alluvium. Groundwater directly beneath PORTS is not used as a domestic, municipal, or industrial water supply. Beneath the facility, the groundwater yield is often too low, because of low aquifer transmissivity, to support municipal or industrial water supplies. Domestic water supplies are obtained from unconsolidated deposits in the preglacial buried valley aquifer, major tributaries of the Scioto River, or fractured bedrock encountered during drilling. Based on a previous study, domestic wells in the immediate vicinity of the PORTS property (Figure 3.9) obtain groundwater from the Berea sandstone (BJC 2003). However, an examination of drillers logs indicate several wells obtain groundwater from fractured shale or other, shallower geologic units (unconsolidated sand and gravel).

Four creeks, or drainage channels, drain the facility. Little Beaver Creek drains the eastern and northern portions, Big Run Creek and the Southwest Drainage Ditch drain the southeastern and southwestern portions, and the West Drainage Ditch drains the western portion. The four creeks and drainage ditches dissect the unconsolidated Minford and Gallia members, bedrock-forming Sunbury shale (where present), and Berea sandstone, resulting in the discharge of groundwater to them. Groundwater flow beneath PORTS is generally toward one of these discharge locations, and groundwater divides form between the discharge locations along areas of highest groundwater elevation.

The hydraulic properties of the hydrogeologic units have been defined during previous investigations at the facility. Groundwater flow at PORTS has been well defined by single-well aquifer tests of the Berea sandstone and Gallia sand and gravel. The average hydraulic conductivity for the Minford clay is 2.3×10^{-4} ft/day, and the average hydraulic conductivity for the Minford silt is 4.3×10^{-3} ft/day. These values are based on numerous laboratory tests. The vertical hydraulic conductivities of Minford clay and Minford silt are approximately an order of magnitude lower than their horizontal hydraulic conductivities. The hydraulic conductivity determined by single-well aquifer tests of the Gallia ranges from 0.11 to 150 ft/day with a mean value of 3.4 ft/day (DOE 1996a). In 2008, an aquifer performance test was conducted near the X-740 Waste Oil Handling Facility to estimate the hydraulic characteristics of the Gallia and Berea Formations and determine the interconnectedness between these two units (DOE 2009). That test determined the hydraulic conductivity for the Gallia to be 1.71 ft/day, which is comparable to the results from previous testing. The test also demonstrated the two aquifer units in that area are relatively interconnected.



Source: BJC 2003

Figure 3.9. Off-PORTS Private Domestic Water Wells

The estimated hydraulic conductivity of the Sunbury shale, based on numerical groundwater modeling, ranges from 1.6×10^{-4} to 9.6×10^{-4} ft/day. The vertical hydraulic conductivity of the Sunbury shale is assumed to be an order of magnitude lower than its horizontal hydraulic conductivity. The groundwater monitoring report for calendar year 2010 (DOE 2011d) determined groundwater flow velocities in the Gallia and Berea aquifers. The semiannual hydraulic gradients and linear velocities for these water-bearing units in various monitoring areas at PORTS are summarized in Table 3.1.

Table 3.1. Groundwater Linear Velocity Ranges Calculated for PORTS Monitoring Areas Using Calendar Year 2010 Data

Monitoring Area	Gallia Velocity Ranges[a] (ft/d)	Berea Velocity Ranges[a] (ft/d)
X-749/X-120/Peter Kiewit Landfill	0.08-0.6	0.1-0.3
Quad I/X-749A	0.2-1.2	0.1
Quad II	0.3-0.4	None[b]
X-701B	0.1	0.2[c]
X-633/X-533	0.03-0.06	None[b]
X-616	1.5-2.4	0.8-1.4
X-740	0.2	0.2-0.3
X-611A	None[b]	0.4
X-735	1.7-6.9	0.03
X-734	0.1	0.02

[a]Some of the monitoring areas are divided into more than one zone. The ranges reflect the calculated extremes for the zones over the two monitoring periods (first or third quarters 2010).
[b]Velocity is not provided for the Berea aquifer at Quadrant II and X-633/X-533 because insufficient data are available for the Berea in these areas. Velocity is not provided for the Gallia aquifer at X-611A because the Gallia is expected to be absent in this area, and Gallia wells are installed only on the western and southern edges of the area.
[c]Not determined in calendar year 2010; value reported is from calendar year 2008 data.

Defined groundwater contaminant plumes consisting primarily of TCE are found at five of the groundwater monitoring areas (Figure 3.10). These areas include the X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/Peter Kiewit Landfill, Quadrant I Groundwater Investigative Area, Quadrant II Groundwater Investigative Area, X-701B Holding Pond, and the X-740 Waste Oil Handling Facility.

3.7 DEMOGRAPHY AND LAND USE

The PORTS Facility is situated on a 3,777-acre parcel of DOE-owned land in Scioto Township, Pike County, Ohio. It is located 2 miles east of the Scioto River and within the Scioto River drainage basin. PORTS is in a small valley running parallel to and approximately 130 ft above the floodplain of the Scioto River.

This section of the report describes the existing demographic and land use environment of PORTS and the surrounding area. The text describes population and socioeconomics, land use, cultural resources, and transportation.

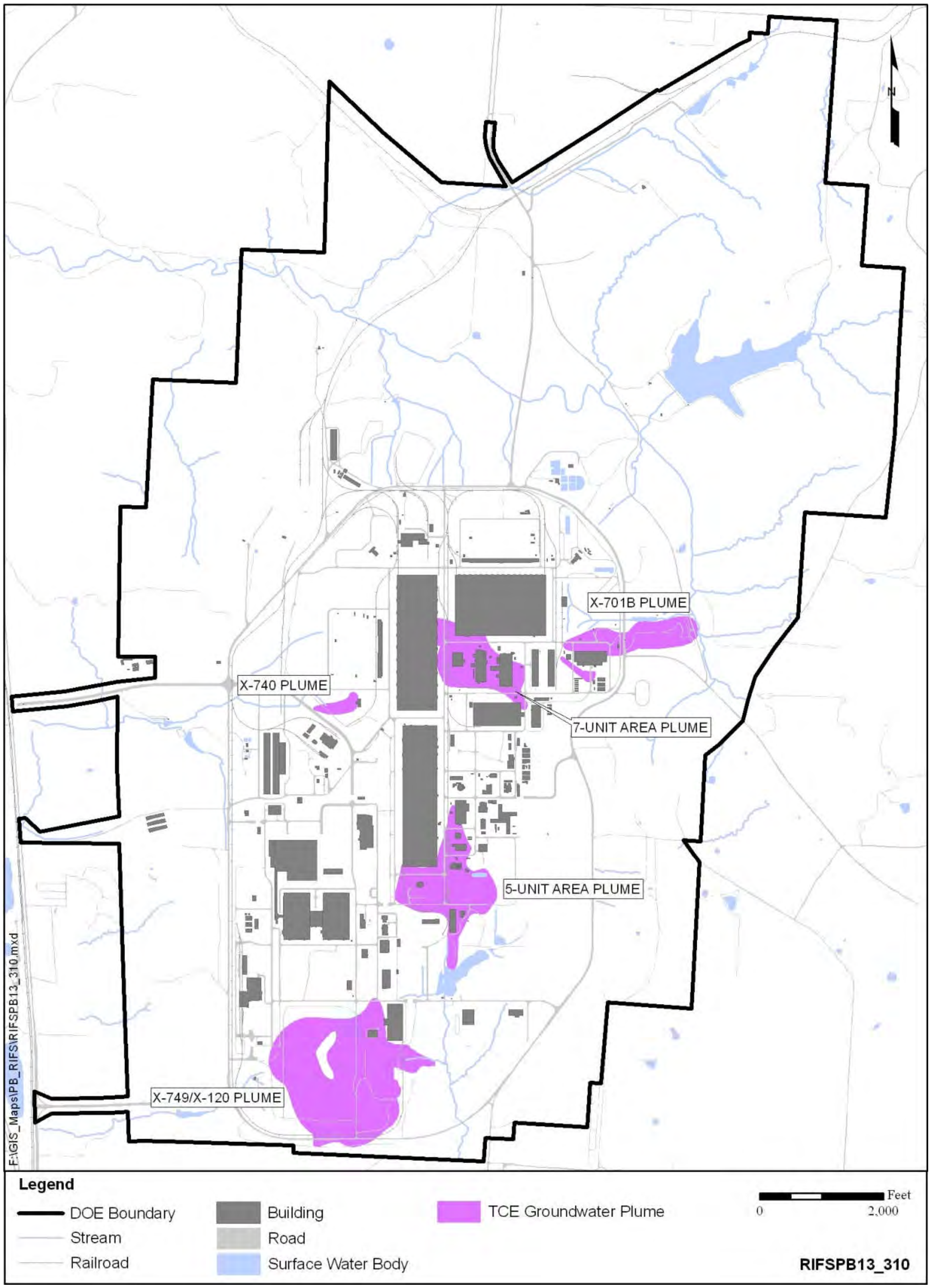


Figure 3.10. Groundwater Contamination (TCE) in the Gallia Member at PORTS

3.7.1 Population and Socioeconomics

The economic region of influence (ROI) for PORTS includes four counties in southern Ohio: Ross County, Scioto County, Jackson County, and Pike County (Figure 3.11). The largest city within 50 miles of PORTS is Chillicothe, Ohio, with a population of 21,901 persons, based on year 2010 census results (Ohio Department of Development [ODOD] 2011a). The city of Chillicothe is in Ross County, Ohio, and is approximately 27 miles north of PORTS.

Pike County, one of the least populated counties in Ohio, has 28,709 residents and a population density of 65 people per square mile. Scattered rural development is typical; however, the county contains a number of small villages such as Piketon and Beaver, which lie within a few miles of PORTS. The county's largest community, Waverly, is approximately 10 miles north of PORTS and has a population of 4,408 residents. The nearest residential center in this area is Piketon, which is about 5 miles north of PORTS on U.S. Highway 23. Piketon has a population of 2,181 (ODOD 2011a). Several residences are located adjacent to the southern half of the eastern PORTS boundary and along Wakefield Mound Road (old U.S. 23), directly west of PORTS.

The total labor force in Pike County was approximately 10,900 in 2008. Total average employment in the same year was 9,737. Based on these numbers, the major employment sectors were manufacturing (31.1 percent); government (18.3 percent); trade, transportation, and utilities (13.3 percent); education and health services (11.6 percent); professional and business services (7.1 percent); leisure and hospitality (6.8 percent); and construction (6.7 percent) (ODOD 2011b).

By 2009, the labor force in Pike County had increased to approximately 11,200. Of this total, approximately 9,500 people were employed and 1,700 were unemployed. In 2008, the unemployment rate had been 10.1 percent in Pike County, but it increased to 15.1 percent in 2009, which was a 33 percent increase in the unemployment rate in just 1 year (ODOD 2011b).

The average 2008 per capita personal income in Pike County was $26,163, compared to the state average of $35,889 and the national calendar year 2008 average of $40,166 (ODOD 2011c).

3.7.2 Land Use

Land use in the general vicinity of PORTS includes urban land, residential areas, private and commercial farms, light industries, and transportation corridors (highways and railroads) (NRC 2006a). In Pike County, the land use is approximately 66 percent forest, 23 percent cropland, and 8 percent pasture. The remaining 3 percent is classified as urban land, open water, and bare/mines areas (ODOD 2011b). The latter classification refers to largely unvegetated areas of nonurban land, some of which may be associated with mining. Two public recreational areas are located in the vicinity of PORTS. One is Brush Creek State Forest, located 5 miles to the southwest of PORTS. The other is Lake White State Park, located 6 miles north of PORTS (NRC 2006a).

In the immediate area surrounding PORTS, land is used primarily for farms, pastures, forests, and rural residences. The dominant land use is farming with approximately 25,430 acres of farmland. Farmland that qualifies for protection under the Farmland Protection and Policy Act of 1981 is located primarily along the Scioto River floodplain. Marginal quality farmland is located adjacent to PORTS and on PORTS. The soil survey of Pike County indicates that soils adjacent to PORTS and on PORTS are of low fertility and do not qualify as prime farmland. The land surrounding PORTS has 24,400 acres of forest cover (NRC 2006a).

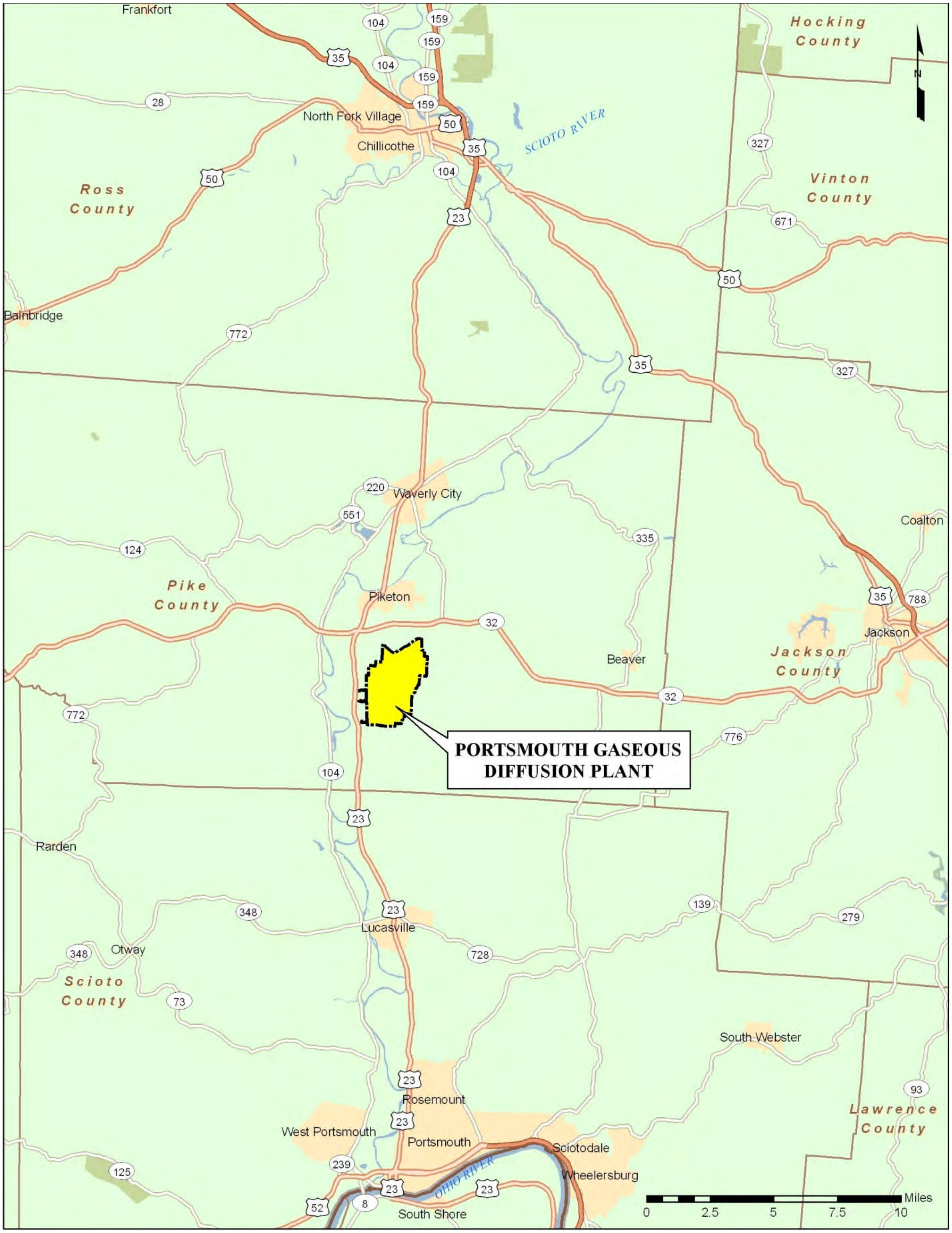


Figure 3.11. Locations of the Four Region of Influence Counties Relative to PORTS

Three DOE groundwater well fields are located outside the boundary of the PORTS Facility. The X-608A Well Field, X-608B Well Field, and X-608 Raw Water Pump House are located in Piketon. The pump house is on 1.92 acres of DOE land. However, the wells are within an easement, as are the portions of the supply pipelines that lie outside of the PORTS boundary. The X-605G Well Field and X-6609 Well Field are located near the Scioto River to the west of PORTS. These well fields and the portions of their supply pipelines outside the PORTS boundary are also within easements. A portion of the effluent pipeline from the X-6619 Sewage Treatment Plant runs from the PORTS boundary to the Scioto River and is located in the immediate vicinity of the X-6609 Well Field and its water supply pipeline.

The PORTS Facility contains 3,777 acres of DOE-owned land. Perimeter Road surrounds a 1,300-acre centrally developed area, which includes a 750-acre controlled access area. The portion of PORTS outside of Perimeter Road has approximately 2,500 acres of land that includes several areas of contiguous parcels ranging in size from 1 to over 1,000 acres. Land uses in this area include a water treatment plant, holding ponds, sanitary and inert landfills, cylinder storage yards, parking areas, open fields, and forested buffer areas (NRC 2006a).

More than 400 facilities are present on PORTS. They include the three large process buildings, support buildings and structures, utilities, plant systems, holding ponds, and infrastructure. Approximately 75 percent of these facilities are included in the Process Buildings Project (Restoration Services, Inc. [RSI] 2010). Two new facilities have been constructed over the last several years at PORTS: (1) the USEC American Centrifuge Plant (ACP) leased by USEC and operated pursuant to their NRC license, which will produce enriched uranium for commercial nuclear reactor fuel; and (2) the Depleted Uranium Hexafluoride (DUF_6) Conversion Facility, which was constructed by DOE to convert DUF_6 into constituents for disposal and commercial resale. In addition, a new dry air facility and a steam generation plant have recently been constructed.

Most operations at PORTS are supported by a steam plant, electrical switchyards, cooling towers, cleaning and decontamination facilities, water and wastewater treatment plants, maintenance and laboratory facilities, and office buildings. The buildings and other facilities are connected and served by an extensive network of utilities, plant systems, streets, roads, and sidewalks. Plant utilities include dry air, nitrogen, potable water, fire suppression water, cooling water, steam for heating, electric power, and a sewer system (RSI 2010). The DOE is continuing demolition of inactive, surplus facilities at PORTS. Between 2006 and 2008, DOE demolished approximately 16 minor inactive facilities (DOE 2010a). In 2009, DOE-Headquarters continued the planning process for D&D of the PORTS gaseous diffusion buildings and facilities, which was initiated in 2007 (DOE 2011e).

Currently, DOE has two real property leases with Southern Ohio Diversification Initiative (SODI). The first lease between DOE and SODI was signed in April 1998 for 7 acres of land on the north side of the DOE property. This tract is used as a right-of-way for a railroad spur that connects to the existing DOE north rail spur. The SODI subleases a portion of this property to the Glatfelter Corporation to allow access to the rail line for a wood-grading operation. In October 2000, a second lease between DOE and SODI was signed to allow concurrent SODI access to and use of the existing north rail spur.

3.7.3 Cultural Resources

Cultural resources include any prehistoric or historic district, site, building, structure, or object resulting from, or modified by, human activity. Under federal regulations (36 *CFR* 800), federal agencies must assess the impacts their actions have on historic properties and, if appropriate, avoid, minimize, or mitigate adverse effects. Historic properties are cultural resources listed in, or eligible for listing in, the

NRHP because of their significance and integrity. This section describes the existing cultural resources environment at PORTS as it pertains to the proposed decision.

3.7.3.1 Archaeological resources

Beginning in 1996 with a Phase I literature review and archaeological reconnaissance survey (Schweikart et al. 1997) and concluding in 2012 with Phase II surveys (Klinge 2009, Klinge and Mustain 2011, Pecora and Burks 2013, Pecora et al. 2013), DOE conducted several archaeological surveys at PORTS. The result of all the work was the identification of four sites eligible to be listed as historic properties. All of these sites are located outside of Perimeter Road. Any actions taken inside of Perimeter Road (a previously disturbed area) or on DOE facilities outside of Perimeter Road would have no impact on these sites.

The Ohio Archaeological Inventory at the Ohio Historic Preservation Office (OHPO) contains records on approximately 2,000 prehistoric Native American mounds in Ohio. Some of these mounds were once present on the floodplain of the Scioto River to the west of PORTS. Over the past 200 years, erosion, logging, plowing, and development have erased these mounds and many others in Ohio. However, some may remain as very low topographic rises on the landscape and are perceptible with the aid of geographic information systems (GIS) and remote sensing technology (Burks 2011).

As of 2011, no prehistoric mounds had been documented on the PORTS Facility. During May and June 2011, a study was conducted of the entire PORTS Facility using advanced technology to determine if there were prehistoric mound-like features on PORTS. This study included a detailed review of the PORTS preconstruction topographic maps and the use of high-density Light Detection and Ranging (LiDAR) data. As a result, 28 topographic features (1 ft to 10 ft tall and up to 82 ft in diameter) were identified on the PORTS Facility. However, archaeological ground-truthing visits to each location indicated that all of these features were either naturally occurring features or a result of historic-era or recent activity on the PORTS Facility (Burks 2011).

The survey concluded that PORTS contains no prehistoric mounds 1 ft tall or taller, which is the vertical size range of nearly all such documented mounds in Ohio. If smaller or more deflated mounds are present on the site, they are not detectable using LiDAR data or visual examination for topographic features.

3.7.3.2 Architectural resources

Numerous architectural resources have been identified on PORTS. This section summarizes the existing architectural resources environment within the DOE property boundary at PORTS.

Architectural Inventory of PORTS

A National Historic Preservation Act of 1966 (NHPA), Section 110, architectural inventory of buildings, facilities, and structures on the PORTS Facility has been conducted. This inventory was conducted to comply with Section 110 of the NHPA, as amended, which requires federal agencies to inventory the cultural resources present on their lands. The study area for this architectural inventory was the entire federal reservation at PORTS (3,777 acres) (DOE 2011f).

A literature review and a field survey of buildings, facilities, and structures on the PORTS Facility were conducted in 1996 and 1997 to collect the inventory information and data. The background literature review was focused on gathering already documented information about the buildings and structures that once stood and still stand on the PORTS Facility, including those present before the construction of PORTS. This literature review was completed between September 1996 and June 1997. The purpose of the field survey was to conduct a structured review of still-standing architectural properties on the PORTS

Facility and document them on Ohio Historic Inventory (OHI) forms. The survey was conducted in September 1996 and April 1997, and the completed OHI forms were archived at the OHPO in Columbus, Ohio. Demolition of several miscellaneous buildings and structures at PORTS began in 1997 and has continued to the present time in association with Environmental Management (EM) Program activities. On April 19, 2006, the Principal Investigator for the survey visited the PORTS Facility and confirmed that few physical alterations of PORTS facilities had occurred since the time of the original fieldwork (DOE 2011f).

The results of the 1996-1997 literature review and architectural inventory were reported in the *National Historic Preservation Act Section 110 Survey of the Architectural Properties at the Portsmouth Gaseous Diffusion Plant in Scioto and Seal Townships, Piketon, Ohio* (DOE 2011f). This report was submitted to the OHPO for review, and the OHPO accepted the final report in March 2011.

During the 1996-1997 architectural field survey, 196 buildings and structures were identified and documented at 160 architectural locations (ALs) on the PORTS Facility. Most of the reported ALs (131) were inside Perimeter Road, but 29 were located outside of the Perimeter Road. All of the major buildings, facilities, and structures throughout the PORTS Facility were included in the survey. These resources were assigned AL numbers in the order in which they were documented on the OHI forms. The number of buildings and structures exceeded the number of ALs because some architectural resources were grouped together under the same AL number. This grouping was done when the resources were of similar age, tightly grouped together, and/or closely interdependent, such as the numerous components of a sewage treatment plant or electrical switchyard. In the survey report, the recorded architectural resources were assigned to four developmental periods: Period of Development 1, Pre-Portsmouth Facility Structures (1900-1951); Period of Development 2, Original Portsmouth Facility (1952-1956); Period of Development 3, Portsmouth Facility Additions (1957-1978); and Period of Development 4, GCEP Facility and Later Buildings (1979-1997) (DOE 2011f).

Period of Development 1

Four architectural resources were assigned to this period. These are the X-204 Railroad Overpass (truss-type) and three small bridges that were later improved to support PORTS operations. All of these bridges were completed before construction of PORTS began in 1952 (DOE 2011f).

Period of Development 2

Most of the early architectural resources at PORTS were built during this period (1952-1956), when PORTS was first being constructed in accordance with the original architectural plans and before any additional buildings and structures were added in later years. These architectural resources were divided into six groups (DOE 2011f).

The first and most significant group consists of the three uranium enrichment process buildings (X-326, X-330, and X-333), giant structures lacking color and windows, framed in steel, sheathed with transite panels, and tied together by large overhead piping (DOE 2011f).

The second group consists of the original cooling facilities for the uranium enrichment process. The three cooling facilities had large pump houses and arrays of redwood cooling towers topped with conical flues. The X-633-2A and X-633-2B cooling towers were equipped with uncovered extension basins (DOE 2011f). After the 1996-1997 architectural survey, the cooling towers were demolished. However, the cooling tower extension basins are still present today.

A third group, headquarters buildings, is located at the main (east) entrance to PORTS. These buildings vary widely in design, but their diversity enhances the almost campus-like setting in this area. Most notable is the wood-framed, pinwheel-shaped X-100 Administration Building. Across from the Administration Building is the concrete X-104 Guard Headquarters, which has a minimal international styling in its cantilevered eaves and hoods. Anchoring one corner of this group is the bunker-like, domed, concrete X-300 Plant Control Facility, which was designed to withstand a direct nuclear weapons attack. The X-100 Administration Building (demolished), X-102 Cafeteria (demolished), and X-101 Health Service Center (demolished) were originally intended to be temporary buildings. This group also contains the X-106 Tactical Response Station (demolished) and the X-750 Mobile Equipment Maintenance Shop (DOE 2011f).

The fourth group includes the two large electric switchyards (X-530A, X-533A, and their associated facilities) that feed the process buildings (the above-ground infrastructure at the X-533A Switchyard was removed in 2011). These switchyards are barren, graveled, fenced areas that contain many steel towers and wires. The switchyards are fed by the two-tier Don Marquis Substation, which is owned by OVEC. This substation is located on a hill in the west portion of PORTS (DOE 2011f).

A fifth group consists of the original warehouses at PORTS (X-103 Auxiliary Office Building, X-744H Bulk Storage Building, X-744J Bulk Storage Building, and X-744K Warehouse K-non-uranium enrichment areas). After the 1996-1997 architectural field survey was completed, the X-103 Auxiliary Office Building was demolished. The other three warehouse buildings are still standing. These warehouses are linear, one-story steel structures with M-roofs (DOE 2011f).

The sixth group includes a wide variety of support buildings such as mechanical buildings, portals, garages, storage facilities, and facilities related to plant infrastructure such as underground piping and utility runs. These buildings are mostly steel framed and have transite siding (DOE 2011f).

Period of Development 3

The architectural resources of this period consist of a wide variety of support buildings and structures added between the end of the original PORTS construction in 1956 and the beginning of construction on the GCEP plant in the late 1970s. Most of these architectural resources are of relatively minor significance and include structures related to water and sewage, warehouses, and process support buildings (DOE 2011f).

Period of Development 4

Most of the buildings constructed during this period constitute the GCEP, a semi-self-sufficient uranium enrichment facility added to PORTS from 1979 to 1985. Additional miscellaneous buildings were added to PORTS in the years just prior to the 1996-1997 architectural survey. Many of these more recent support buildings are EM Program environmental monitoring stations and other buildings constructed in the 1980s and 1990s to meet environmental requirements. These properties are usually located on the fringes of the PORTS industrial area at a waterway (DOE 2011f).

The GCEP project was canceled in June 1985. This occurred before the project was completed, and the facility was never placed into operation. Many of the GCEP buildings have been reused and are clearly set apart by their newer architectural appearance, their concentration in the southwestern portion of PORTS, and the elements of contemporary styling in the administration buildings (DOE 2011f).

The GCEP facilities dominate the buildings and structures of this period with their large, irregular massing, steel sheathing, and physical ties of corridors and attached buildings. The styling of the administration buildings is best characterized as "Late International" with their dark brick veneer, bands of single-pane windows, flat roofs, and cantilevered eaves and hoods. Vehicular and pedestrian portals, each a clone of the same design, surround the GCEP facility. These portals have bands of bulletproof windows; low concrete block walls; and a wide, flat roof supported by steel posts. Other buildings and structures were constructed to serve as GCEP support facilities, including additional roads and railroad spurs (DOE 2011f).

Evaluation of Architectural Resources at PORTS

Not all of the aboveground architectural resources at PORTS were documented during the 1996-1997 survey, and some aspects of the already recorded resources were not able to be addressed during the recording process. Minor structures such as ground-mounted electric transformers, platforms, parking lots, storage yards, security fences, sidewalks, and most basins and pits were not documented. Because of security and classification issues, little information was recorded about the functions of the identified architectural resources, including the processes that took place inside them, how each was related to other architectural resources, or the role the resources played in the uranium enrichment process. The 1996-1997 architectural resources survey, documented in the 2011 inventory (DOE 2011f) was an important first step in the documentation of PORTS architectural resources.

Documentation Model for Architectural Resources

In 2010, DOE obtained the services of an architectural historian, who developed a documentation model (Cultural Resource Analysts, Inc. [CRA] 2011) for PORTS to follow. Implementation of the model provides DOE with a robust level of preservation (via recordation, documentation, and interpretation) of the PORTS Facility and its contribution to the nation’s Cold War history. The documentation model describes the additional information needed to finish recording of the architectural resources associated with the Cold War-era mission (1956-1991) at PORTS, which was the production of HEU by the gaseous diffusion process for defense/military purposes. From an historical perspective, this is considered to be the most important past mission era at PORTS. By priority for documentation, the most significant architectural resources associated with this era are: (1) the core uranium enrichment process facilities and (2) the uranium enrichment process support facilities. The documentation model also addresses the recording of additional information on the many non-Cold War-era architectural resources at PORTS and the area overall (CRA 2011).

Section 6.2.2.2 in this RI/FS report provides a detailed summary of the approach that has been developed to further document and comprehensively interpret the DOE-built environment at PORTS. A complete description of the approach and documentation model is presented in the *Portsmouth Gaseous Diffusion Plant, Pike County, Ohio: Recommended Cold War-era Mission Documentation Model* (CRA 2011).

3.7.4 Transportation

Activities at PORTS are supported by a system of transportation infrastructure that consists of roads, railroads, barges, and airports.

3.7.4.1 Roads

Two of southern Ohio’s major highway systems, U.S. Route 23 and State Route 32/124, provide access to PORTS (Figure 3.11). Both routes are four lanes with U.S. Route 23 traversing north-south and State Route 32 traversing east-west. PORTS is 3.5 miles from the U.S. Route 23 and State Route 32/124 interchange. State Route 32/124/50 runs 185 miles east-west from Cincinnati through Piketon to Parkersburg, West Virginia. To the west, State Route 32 provides access to Cincinnati's three interstate highways, I-71, I-74, and I-75. To the east, State Route 32/50 is linked with I-77. Approximately

70 miles north of PORTS, U.S. Route 23 intersects I-70, I-71, and I-270. Vehicles also may access I-64 approximately 35 miles southeast of Portsmouth.

The main access road for PORTS has a four-lane interchange with U.S. Route 23. The main access road is closed to general public access and connects to Perimeter Road, which encircles the fenced portion of PORTS. Smaller roads that intersect with Perimeter Road from four directions provide access to inner portions of PORTS. The buildings and facilities are serviced with a system of roads and streets, which generally follow a north-south grid. This system is in generally good condition because of road repaving projects (NRC 2006b).

As discussed above, there are two access roads to PORTS, U.S. Route 23 and State Route 32. Table 3.2 provides the annual average daily traffic for these roads. Load limits on these routes (85,000 lb) are controlled by the *Ohio Revised Code* gross vehicle weight. Special overload permitting is available (NRC 2006b).

Table 3.2. Traffic Conditions on Access Roads to PORTS

Access Road	Annual Average Daily Traffic
U.S. Route 23, entrance to PORTS	14,490
State Route 32 and U.S. Route 23	7,700

Source: ODOT 2011

ODOT = Ohio Department of Transportation
PORTS = Portsmouth Gaseous Diffusion Plant

Except during plant shift changes, traffic levels on the access roads and Perimeter Road are low. Peak traffic flows occur at shift changes, and the principal traffic problem areas during peak morning/afternoon traffic are locations where parking lot access roads meet Perimeter Road (NRC 2006b).

3.7.4.2 Railroads

Two railroad carriers, CSX and Norfolk Southern, serve Pike County. The CSX system provides access to other rail carriers. Railroad track in the vicinity of Piketon allows a maximum train speed of 60 mph (DOE 2004).

A railroad system is located on the PORTS Facility. The Norfolk Southern railroad connects to the CSX main rail system via a main rail spur entering the northwest portion of the PORTS Facility. Approximately 17 miles of track lie within the boundaries of PORTS. However, only approximately one-third of the tracks are currently in service. Several track configurations (switching capabilities) are possible within PORTS. The on-plant railroad system is used infrequently, approximately one train per week (DOE 2004).

3.7.4.3 Barges

PORTS Facility can be served indirectly by barge transportation on the Ohio River. However, use of the Ohio River barge terminals would require initial transportation of loads over public roads leading from PORTS to the barge terminal in the city of Portsmouth. The bulk materials-handling facility at the Portsmouth Barge Terminal is available for transporting bulk materials and heavy unit loads. All heavy-unit loading is done by mobile crane or barge-mounted crane at the open-air terminal. The Ohio River provides barge access to the Gulf of Mexico via the Mississippi River or the Tennessee-Tombigbee Waterway. Travel time to New Orleans is 14 to 16 days. A barge trip to St. Louis takes

7 to 9 days, and a trip to Pittsburgh takes 3 to 4 days. The U.S. Army Corps of Engineers (USACE) maintains the Ohio River at a minimum channel width of 800 ft and a depth of 9 ft (NRC 2006a).

3.7.4.4 Airports

Because of the relatively isolated location of the PORTS Facility, commercial air service is limited. The nearest airport is the Greater Portsmouth Regional Airport, located approximately 15 miles south of PORTS. This airport has dual runways and T-hangers and is operated by Chasteen Aviation, Inc. The airport mostly serves private aircraft owners and business travelers. There are no regularly scheduled commercial flights; however, charter service is available. Another nearby airport, the Pike County Airport, is located just north of Waverly. This facility is similar in size and makeup to the Greater Portsmouth Regional Airport. Three international airports are located within a 2-hour drive of PORTS: Cincinnati/Northern Kentucky International Airport, Dayton International Airport, and Port Columbus International Airport.

3.8 ECOLOGY

This section describes the existing ecological environment on the PORTS Facility and in its vicinity. It includes descriptions of terrestrial resources (flora and fauna); aquatic resources; rare, threatened, and endangered species; wetlands; and environmentally sensitive areas.

3.8.1 Terrestrial Resources

Terrestrial habitat types and the flora and fauna that depend upon them are described in this section of the report.

3.8.1.1 Flora

The PORTS Facility and the surrounding area contain diverse terrestrial habitat types representing many successional stages in ecosystem development. A terrestrial community is described by the dominant vegetation species that characterize the community. The following 10 terrestrial habitat types (DOE 2001b, NRC 2006a) have been identified at PORTS:

- Old field areas – Early successional stage of disturbed areas dominated by tall weeds, shade-intolerant trees, and shrubs.
- Scrub thicket – Later successional stage covering old field areas dominated by dense thickets of small trees.
- Managed grassland – Open areas actively maintained and dominated by grasses.
- Upland mixed hardwood forest – Mesic to dry upland areas dominated by black walnut (*Juglans nigra*), black locust (*Robinia pseudoacacia*), honey locust (*Gleditsia triacanthos*), black cherry (*Prunus serotina*), and persimmon (*Diospyros virginiana*).
- Pine forest – Advanced successional stage following scrub thicket; the over story is dominated by Virginia pine (*Pinus virginiana*).
- Pine plantation – Nearly pure stands of Virginia pines.
- Oak-hickory forest – Well-drained upland soils; white oak (*Quercus alba*) and shagbark hickory (*Carya ovata*) are the most dominant of the oaks and hickories.

- Riparian forest – Periodically flooded, low areas associated with streams dominated by cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), willows (*salix sp.*), silver maple (*Acer saccharinum*), and black walnut.

- Beech-maple forest – Undisturbed areas dominated by American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*).

- Maple forest – Dominated by sugar maple and other shade-tolerant species.

In 2011, Ohio University initiated a plant-wide habitat mapping project that was completed in late 2012. This project used LiDAR data along with extensive field surveys to provide more detailed habitat delineation than previously available at PORTS. The final report quantifies the overall ecological quality of the mapped habitat. An interim report provided habitat mapping information related to the study areas under consideration in this RI/FS report (Ohio University 2012).

The most common type of vegetation on PORTS is managed grassland, which makes up approximately 30 percent of the total area of PORTS. Oak-hickory forest covers approximately 17 percent, and upland mixed hardwood forest covers approximately 11 percent (NRC 2006a). The areas covered by each habitat type are presented in Table 3.3.

Table 3.3. Terrestrial Habitat Types at PORTS

Habitat Type	Approximate Total Area (acres)	Approximate Number of Communities	Percent of Total Area[a]
Managed grassland	1,102	Numerous[b]	30
Oak-hickory forest	632	14	17.2
Old field	420	10	11.4
Upland mixed hardwood forest	400	20	10.9
Riparian forest	153	10	4.2
Maple forest	128	7	3.5
Scrub thicket	79	10	2.2
Pine forest	69	10	1.9
Beech-maple forest	5	1	0.1
Old white pine plantation with mixed hardwoods	5	1	0.1

Source: NRC 2006a

[a]Total plant area is approximately 3,777 acres. Approximately 629 acres (16.9 percent) of the total area is covered by buildings, parking lots, and roads. The remainder of the total area contains aquatic habitat.
[b]This habitat is interspersed between buildings and paved areas across PORTS.

NRC = U.S. Nuclear Regulatory Commission

Within the central area surrounded by Perimeter Road, PORTS consists primarily of open grassland (including maintained grassy areas) and developed areas consisting of buildings, paved areas, and storage yards. The vegetative cover in the area surrounding the PORTS Facility consists mostly of hardwood forests and field crops (NRC 2006a).

In 2011, Ohio University initiated a PORTS-wide habitat mapping project that was completed in late 2012. This project used LiDAR data along with extensive field surveys to provide more detailed habitat delineation than previously available at PORTS. The final report quantifies the overall ecological quality of the mapped habitat.

3.8.1.2 Fauna

Several species of wildlife have been observed within the PORTS property boundary. Forty-nine mammals have ranges that include PORTS, but only 27 of those have been observed on the reservation. The most abundant mammals at PORTS include the white-footed mouse (*Peromyscus leucopus*) and the short-tailed shrew (*Blarina brevicauda*). An area of deciduous sugar maple forest along the Northwest Tributary stream corridor is the only identified area at PORTS that may be suitable habitat (summer months) for the Indiana bat (*Myotis sodalis*), a federally-listed endangered species. Larger mammals present include the white-tailed deer (*Odocoileus virginianus*), the eastern cottontail rabbit (*Sylvilagus floridanus*), and the opossum (*Didelphis virginiania*) (DOE 1996e). PORTS is also within the range of the northern long-eared bat (*Myotis septentrionalis*), which is a proposed federal-listed endangered species.

One hundred and fourteen bird species, including year-round residents, winter residents, and migratory species, have been observed at PORTS. These species include raptors (red-tailed hawk [*Buteo jamaicensis*]), aquatic foul (mallard [*Anas platyrynchos*] and wood duck [*Aix sponsa*]), game birds (wild turkey [*Meleagris gallopavo*]), and nongame bird species (nuthatches [*Sitta sp*.] and wrens [*Troglodytes sp*.]). Eleven species of reptiles and six species of amphibians have been observed at PORTS. The most common of these include the eastern box turtle (*Terrapene carolina*), black rat snake (*Elaphe obsolete*), northern black racer (*Coluber constrictor constrictor*), American toad (*Bufo americanus*), and northern dusky salamander *(Desmognathus fuscus*) (NRC 2006a). Common orders of insects found at PORTS include Homoptera (cicadas and aphids), Hymenoptera (bees, wasps, and ants), Diptera (flies), Coleoptera (beetles), and Orthoptera (grasshoppers) (Battelle Memorial Institute [Battelle] 1976).

Common species occurring in open grassland areas include the eastern cottontail rabbit (*Sylvilagus floridanus*), meadow vole (*Rodentia muridae*), and eastern meadowlark (*Sturnella magna*). Small wooded areas support numerous woodland and forest edge species such as raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), red-headed woodpecker (*Melanerpes erythrocephalus*), cardinal (*Cardinalis cardinalis*), white-breasted nuthatch (*Sitta carolinensis*), and yellow-rumped warbler (*Dendroica coronata*). Species that occur in the open grasslands and forest edges that are either actively managed (mowed) or adjacent to developed areas are tolerant of human activities and disturbances (NRC 2006a).

3.8.2 Aquatic Resources

The aquatic habitats on PORTS include the various man-made holding ponds, ephemeral ponds, streams, and intermittent streams that flow from or through PORTS. The three major aquatic habitats include Little Beaver Creek, the West Drainage Ditch, and the Southwest Drainage Ditch, which flows out of the Southwest Holding Pond. All three of these surface water bodies discharge into the Scioto River. Little Beaver Creek and the West Drainage Ditch are designated as warm water habitats. Warm water habitats are capable of supporting and maintaining a balanced, integrated, adaptive community of warm water aquatic organisms having a diverse species composition and functional organization. The aquatic habitat associated with Little Beaver Creek supports good to exceptional fish communities downstream of the X-230J7 discharge from PORTS, and fair fish communities upstream because of the intermittent stream flow (NRC 2006a). The contribution of over 1.5 million gal per day of flow into Little Beaver Creek from the X-230J7 East Holding Pond has improved biological diversity in the stream (Ohio EPA 2006).

Most of the aquatic resources at PORTS include populations of fish, amphibians, reptiles, invertebrates, and periphyton, all associated with streams and other surface waters on PORTS. The most common of the 34 total fish species and four hybrids found in Little Beaver Creek are the bluntnose minnow (*Pimephales notatus*), central stoneroller (*Campostoma anomalum*), creek chub (*Semotilus atromaculatus*), rainbow darter (*Etheostoma caeruleum*), spotfin shiner (*Cyprinella spiloptera*), and striped shiner (*Luxilus chrysocephalus*) (NRC 2006a, DOE 2007).

3.8.3 Wetlands

The USACE defines wetlands as "those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands usually include swamps, marshes, bogs, and similar areas. In identifying a wetland, three characteristics should be met. The first is the presence of hydrophytic vegetation that has morphological or physiological adaptations to grow, compete, or persist in anaerobic soil conditions. Second, hydric soils are present and possess characteristics that are associated with reducing soil conditions. Third, the area must be inundated or saturated to the surface at some time during the growing season of the prevalent vegetation (DOE 2004).

A wetlands survey of PORTS was conducted in 1995 (Lockheed Martin Energy Systems, Inc. [LMES] 1996). The results of that survey found that PORTS contains 45 wetlands (41 jurisdictional and four nonjurisdictional) totaling about 34 acres, excluding retention ponds and streams. Jurisdictional wetlands fall under the protection of Section 404 of the *Clean Water Act*; DOE and State of Ohio regulations, as well as Executive Order 11990, protect both jurisdictional and nonjurisdictional wetlands. These on-PORTS wetlands are described in Table 3.4. Most of the wetlands are associated with wet fields, areas of previous disturbance, drainage ditches, or wet areas along roads and railroad tracks. Palustrine forested wetlands occur along Little Beaver Creek (DOE 2004). A more detailed evaluation of wetlands in the area considered for siting a potential OSDC has been conducted; however, this area is outside the area of influence of this Process Building decision. Details can be found in the Waste Disposition RI/FS (DOE 2014).

Table 3.4. Wetlands at PORTS

Wetland Number	Quad	Status	Acreage	Location	Comments
Q1-01	I	Jurisdictional	0.328	West Perimeter Road ditch	Hillside seep
Q1-02	I	Jurisdictional	1.077	West Perimeter Road ditch	Hillside seep
Q1-03	I	Jurisdictional	1.922	West Perimeter Road ditch	Roadside ditch
Q1-05	I	Jurisdictional	0.259	X-2207 Parking	Drainage ditch
Q1-06	I	Jurisdictional	0.230	X-749A Landfill	Drainage ditch
Q1-32	I	Jurisdictional	3.189	Former GCEP location	Wet field; former GCEP location
Q1-33	I	Jurisdictional	0.029	West Perimeter Road ditch	Roadside ditch
Q1-34	I	Jurisdictional	0.269	Former GCEP location	Wet field; former GCEP location
Q1-35	I	Jurisdictional	0.374	Former GCEP location	Wet field; former GCEP location

Table 3.4. Wetlands at PORTS (Continued)

Wetland Number	Quad	Status	Acreage	Location	Comments
Q1-37	I	Jurisdictional	4.626	Former GCEP location	Wet field; former GCEP location
Q1-38	I	Jurisdictional	0.254	Former GCEP location	Wet field; former GCEP location
Q1-39	I	Jurisdictional	0.228	Former GCEP location	Wet field; former GCEP location
Q2-09	II	Jurisdictional	10.378	Little Beaver Creek, Fog Road	Natural wetland
Q2-11	II	Jurisdictional	0.450	X-611A	Previous disturbance
Q2-12	II	Jurisdictional	2.028	X-701B area	RAD area
Q3-27	III	Jurisdictional	0.117	West Perimeter Road ditch	Roadside ditch
Q3-29	III	Jurisdictional	0.036	West Perimeter Road ditch	Roadside ditch
Q3-30	III	Jurisdictional	0.480	X-744 N, P, & Q	Previous disturbance
Q3-31	III	Jurisdictional	0.103	X-615	RAD area
Q3-46	III	Jurisdictional	0.080	X-616	Drainage ditch
Q3-51	III	Jurisdictional	1.201	West Perimeter Road ditch	Associated with roadside ditch
Q4-13	IV	Jurisdictional	2.343	X-611A	Old borrow area
Q4-14	IV	Nonjurisdictional	0.012	X-611B	Sludge lagoon
Q4-15	IV	Nonjurisdictional	0.114	X-611B	Sludge lagoon
Q4-17	IV	Jurisdictional	0.229	Fog Road	Natural area; past disturbance
Q4-18	IV	Jurisdictional	0.322	North Access Road	Drainage ditch
Q4-19	IV	Jurisdictional	0.447	North Borrow Area	Part of drainage ditch
Q4-20	IV	Jurisdictional	0.389	North Borrow Area	Drainage ditch
Q4-21	IV	Jurisdictional	0.163	X-735 Landfill	Borders railroad track
Q4-22	IV	Jurisdictional	0.018	X-745G Cylinder Yard	Drainage ditch
Q4-23	IV	Jurisdictional	0.006	Ruby Hollow	Natural area; past disturbance
Q4-24	IV	Jurisdictional	0.044	Ruby Hollow	Natural area
Q4-25	IV	Jurisdictional	0.094	Ruby Hollow	Natural area; past disturbance
Q4-26	IV	Jurisdictional	0.160	X-752 Warehouse	Man-made ditch
Q4-40	IV	Jurisdictional	0.359	X-611B	Man-made ditch
Q4-42	IV	Jurisdictional	0.115	X-611B	Base of dam
Q4-43	IV	Jurisdictional	0.119	X-611B	Base of dam
Q4-44	IV	Jurisdictional	0.167	X-611B	Base of dam
Q4-45	IV	Jurisdictional	0.201	X747H Landfill	RAD area
Q4-46	IV	Jurisdictional	0.040	North Borrow Area	Borrow area
Q4-47	IV	Jurisdictional	0.499	North Borrow Area	Drainage ditch
Q4-48	IV	Jurisdictional	0.564	North Borrow Area	Drainage ditch; beaver activity
Q4-49	IV	Nonjurisdictional	0.142	X-611B	Sludge lagoon
Q4-50	IV	Nonjurisdictional	0.031	X-611B	Sludge lagoon

Source: LMES 1996

GCEP = Gas Centrifuge Enrichment Plant
LMES = Lockheed Martin Energy Systems, Inc.
RAD = radiological

3.8.4 Rare, Threatened, and Endangered Species

The Endangered Species Act of 1973 provides federal protection to species, and their habitats, that are listed as federally threatened or endangered. A federally-threatened species is defined as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. A federally endangered species is defined as any species in danger of extinction throughout all or a significant portion of its range (50 *CFR* 17). Ohio Statutes 1518 and 1531 provide protection for state-listed threatened and endangered species. ODNR defines a state endangered species as “a native species or subspecies threatened with extirpation from the state.” A state threatened species is defined as “a species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists.” A species of concern is defined as “a species or subspecies which might become threatened in Ohio under continued or increased stress.” A special interest species is defined as “a species that occurs periodically and is capable of breeding in Ohio.”

The potential existence of federal and state endangered, threatened, and rare species, as well as candidate species, in the vicinity of PORTS was determined through a review of previously prepared NEPA documents, by reviewing the results of previous site-specific studies, and through consultation with the U.S. Fish and Wildlife Service (USFWS) and the ODNR, Division of Wildlife and Division of Natural Areas and Preserves. No occurrence of federally-listed plant or animal species has been documented for the PORTS Facility (DOE 2004, 2007).

Previous consultation with the USFWS has indicated that the Indiana bat (*Myotis sodalis*) is the only federally-listed endangered species whose home range includes PORTS. Information from the ODNR identified several state-listed endangered, threatened, and special interest species within 1 mile of PORTS; however, database searches did not identify any such species within the PORTS boundary. Consultation with the USFWS was initiated again in 2012 regarding the potential for the Indiana bat at PORTS. The USFWS personnel indicated that they had no record of Indiana bats being sighted or caught in Pike County, Ohio, but they confirmed that the species is still federally listed and their home range does include PORTS. The northern long-eared bat (*Myotis septentrionalis*) is a proposed federal-listed endangered species that has been documented at PORTS. The northern long-eared bat roosts and forages in upland forests during late spring and summer.

An additional review of previously prepared NEPA documents and site-specific studies also indicated that the Indiana bat, northern long-eared bat, barn owl (*Tyto alba*), sharp-shinned hawk (*Accipiter striatus*), Carolina yellow-eyed grass (*Xyris difformis*), Virginia meadow-beauty (*Rhexia virginica*), and rough green snake (*Opheodrys aestivus*) may occur on PORTS. Other species that have been identified in the region, but not observed on PORTS, include the timber rattlesnake (*crotalus horridus*) and long-beaked arrowhead (*Sagittaria australis*) (NRC 2006a). Table 3.5 lists the federal- and state-listed endangered, threatened, potentially threatened, and special concern species in the vicinity of PORTS (no occurrence of federally-listed plant or animal species has been documented for the PORTS Facility [DOE 2004, 2007]).

Past and recent consultations with the USFWS indicate that some of the riparian areas at PORTS may be suitable summer habitat for the Indiana bat. Roosting and nursery locations may include forested areas with loose barked trees and standing dead trees. Potential summer habitat for the Indiana bat has been identified within the corridors along Little Beaver Creek in the northern portion of PORTS and along the Northwest Tributary stream. The Northwest Tributary begins just southwest of the Don Marquis substation and flows approximately 3,200 ft before leaving the PORTS property. It then proceeds on to its confluence with Little Beaver Creek. In 1994 and 1996, DOE conducted on-PORTS surveys to identify suitable bat habitat and then conducted mist netting in those areas to determine if Indiana bats were present. The surveys identified these two potential habitat areas for Indiana bats and the mist netting resulted in the documentation of four different species of bats in these two riparian areas, but no Indiana bats were found at PORTS (NRC 2006a, DOE 2007). Another bat mist-net survey was conducted in May 2011. During this survey, four nights of sampling resulted in the capture of eight bats, but no Indiana bats were observed. Based on USFWS approval of a mist net plan, a second mist net survey was conducted in the area of a potential OSDC in July 2013. No Indiana bats were collected, but northern long-eared bats were collected. Ohio University conducted a detailed habitat mapping study in 2012. Using updated guidelines, findings from this study found that Indiana bat and northern long-eared bat habitat may be more extensive than indicated in prior studies. The primary trees that produce exfoliating bark and nesting cavities (e.g., sycamore and shagbark hickory) are abundant in the older forest habitats (Ohio University 2012).

Table 3.5. Federal- and State-Listed Endangered, Threatened, Potentially Threatened, and Special Concern Terrestrial Species Near PORTS

		Status[a]	
Common Name	**Scientific Name**	**Federal**	**State**
Indiana bat	*Myotis sodalis*	E	E
Northern long-eared bat	*Myotis septentrionalis*	E[b]	S
Sharp-shinned hawk	*Accipiter striatus*	NL	E
Barn owl	*Tyto alba*	NL	T
Timber rattlesnake	*Crotalus horridus*	NL	E
Rough green snake	*Opheodrys aestivus*	NL	S
Virginia meadow-beauty	*Rhexia virginica*	NL	P
Carolina yellow-eyed grass	*Xyris difformis*	NL	E
Long-beaked arrowhead	*Sagittaria australis*	NL	T
Lopsided rush	*Juncus secundus*	NL	P
Balsam groudsel	*Packera paupercula*	NL	T
Blackseed speargrass	*Piptochaetium avenaceum*	NL	E

Source: NRC 2006a

[a]E – endangered; P – potentially threatened; S – species of concern; T – threatened; NL – not listed.
[b] Proposed as endangered

NRC = U.S. Nuclear Regulatory Commission
PORTS = Portsmouth Gaseous Diffusion Plant

Past isolated sightings of state-listed species on PORTS include the sharp-shinned hawk and the rough green snake, but no recent sightings have been reported. In addition, there has been evidence of barn owls (*Tyto alba*) nesting in one of the process buildings at PORTS. The barn owl is a state-listed threatened species. The Virginia meadow-beauty has been found near the X-611A Old Lime Sludge Lagoons, and Carolina yellow-eyed grass has been tentatively identified at the X-611B Sludge Lagoon. The Virginia meadow-beauty is associated with the wetlands of the former sludge lagoon, and its preferred habitat is on wet, sandy soils, particularly in sandy swamps. The Carolina yellow-eyed grass was observed in 1994; however, formal documentation of the species could not be performed because the grass was not in fruit or flower. Carolina yellow-eyed grass prefers wet peaty or sandy soils typically found in marshes or bogs (NRC 2006a).

The Ohio EPA previously determined that two state endangered fish species and four state threatened fish species exist near PORTS, but they are restricted to the Scioto River. Little Beaver Creek, the main body of water running through the PORTS Facility, does not provide sufficient habitat to support threatened or endangered species of fish (NRC 2006a). Therefore, no endangered or threatened fish species are present within the boundaries of PORTS.

3.8.5 Environmentally Sensitive Areas

In the immediate area surrounding PORTS (within 5 miles), no environmentally sensitive areas are present. This includes state and national parks, conservation areas, wild and scenic rivers, and other areas of recreational, ecological, scenic, or aesthetic importance (NRC 2006a).

Several potential environmentally sensitive areas are located within the PORTS boundary, including areas where Ohio endangered or threatened species have been observed, wetland areas, and the riparian areas along Little Beaver Creek and its Northwest Tributary. Additional studies being completed by Ohio University may provide locations that harbor listed, high-interest plant species. No federally-listed plant species have been observed during the current study but some state-listed species were tentatively identified and were revisited during the 2012 field season (Ohio University 2012). The specific sensitive areas are as follows:

- The Northwest Tributary stream corridor is considered a sensitive area because it represents the best potential habitat for bats at PORTS; however, recent studies indicate bat habitat may be more extensive than previously indicated.

- The area near the X-611B Sludge Lagoon should be considered a sensitive area because of the possible presence of Carolina yellow-eyed grass, which was observed at PORTS in 1994 (DOE 1996e).

- The area near the X-611A Old Lime Sludge Lagoon is a sensitive area because the Virginia meadow-beauty plant species was identified at the base of the dike. Wetlands are also present near this area.

- Several jurisdictional and nonjurisdictional wetlands have been identified within the PORTS boundary.

HIGHLIGHTS OF SECTION 3

- Immediate plant area is located on a thick layer of clay and silt. Shallow bedrock is present outside the main plant area.
- Off-PORTS groundwater transport pathways exist to the south in Quadrant I. Groundwater over most of PORTS discharges to surface water.
- All archeological sites are outside Perimeter Road, where little D&D would occur. There are architectural resources associated with the gaseous diffusion process.
- Rural residents exist at the PORTS boundary.
- A number of sensitive resources such as wetlands are present.

NEXT STEP: SECTION 4 DEFINES THE SOURCE TERM

(D&D WASTE STREAMS)

4. CONDITION AND CONTENT OF BUILDINGS

Providing information to support development of a CSM for the buildings continues in this section. Section 2 presented data that were obtained from investigations on the buildings, defining part of the source of potential future contamination. Section 3 provided an understanding of the physical features of PORTS that will have a bearing on the fate of contaminants, along with their transport mechanisms and the location of potential current receptors and sensitive resources. The intent of Section 4 is to present the process knowledge about the buildings that could impact consideration of demolition as well as the potential volumes of waste and material that could be generated from demolition of these buildings. This information defines the source term in the CSM that will be used in Section 5 to assess the threat to future users of these buildings.

To provide source term information, Section 4 is divided into three sections. The first (Section 4.1) provides an understanding of how the buildings were used and what their potential hazards may be. The materials of construction, potential equipment, and support facilities (all of which need to be considered when planning demolition or assessing a future threat) are described. Contaminants that are present in the buildings may potentially also be present in the soil immediately surrounding the structures that might adhere to any structure removed from the ground. This section is divided by groups of buildings. Section 4.2 provides an overview of the volume of waste that could be generated in the future and focuses attention on the major potential contributors to volume. The last section, Section 4.3, discusses the basis of the information in Section 4 along with a presentation of the potential uncertainties.

This section shows that most of the waste from a demolition alternative would be generated from the three large process buildings. The primary contaminants are radionuclides, but other contaminants are present. The information in this section is sufficient to define waste volumes and characteristics to support remedial alternative development and evaluation, as well as to assess potential future threats if no action is taken. Future sampling would be conducted as necessary to support implementation of the selected remedial action.

4.1 BUILDING DESCRIPTIONS

The 254 buildings, structures, and systems included in this RI/FS have been categorized into four general functional groupings:

- Process Buildings and Tie Lines
- Feed, Sampling, and Transfer Facilities
- Primary Laboratory, Maintenance, and Equipment Cleaning Facilities
- Support Facilities and Systems.

The groupings were established on the basis of functionality (what related operations they performed or their related purpose) to allow more concise descriptions. Subgroupings for the Primary Laboratory, Maintenance, and Equipment Cleaning Facilities include the X-700 Complex, the X-705 Complex, the X-710 Complex, and the X-720 Complex. Subgroupings for the Support Facilities and Systems include Administrative Facilities; Water Treatment, Storage, and Distribution Facilities; Sewage Collection and Treatment Facilities; Electrical Distribution Systems and Facilities; Miscellaneous Utilities; Infrastructure; Storage and Warehouse Facilities and Yards; Environmental Monitoring and Treatment Facilities; and Associated Nonstructural Support Systems.

The following sections provide an overview of the buildings, structures, and systems within these groupings and their subdivisions. A more detailed description of the buildings, structures, and systems included in each grouping (including known, or potential, radiological and chemical hazards and contaminants and known releases of contaminants) is presented in Appendix A to this document.

4.1.1 Process Buildings (X-333, X-330, and X-326) and Tie Lines

The process buildings and tie lines consist of the following:

- X-232C1 Tie Line (X-342 to X-330)
- X-232C2 Tie Line (X-330 to X-326)
- X-232C3 Tie Line (X-330 to X-333)
- X-232C4 Tie Line (X-326 to X-770)
- X-232C5 Tie Line (X-343 to X-333)
- X-326 Process Building & Instrumentation Tunnel
- X-330 Process Building & Instrumentation Tunnel
- X-333 Process Building & Instrumentation Tunnel.

The three process buildings (X-333, X-330, and X-326) were constructed to house the equipment and operations for uranium enrichment. These buildings are located in the center of PORTS and have a combined footprint of approximately 90 acres under roof (Table 4.1). Each process building has two stories. The process equipment is located on the second floor, known as the cell floor, and the auxiliary equipment, support equipment, and control rooms are located on the first floor, known as the operating floor. Tie lines were used to transfer process gas between buildings.

Table 4.1. Dimensions of the PORTS Gaseous Diffusion Process Buildings

Process Building Designation	Year Completed	Dimensions (ft)	Building Footprint (acres)
X-333	1956	1,456 × 970 × 82	32.5
X-330	1955[1]	2,176 × 640 × 66	32
X-326	1956	2,280 × 552 × 62	29

Source: GVI 1961

[1]Although construction of X-330 was not completed until 1955, several units were completed in 1954 and the first went on-line in September 1954.

GVI = Giffels & Vallet, Inc.

Natural uranium, as mined, contains approximately 99.3 percent of the nonfissionable uranium-238 isotope and approximately 0.7 percent of the fissionable uranium-235 isotope. Approximately 90 percent uranium-235 enrichment is required for defense applications. Because of the very small difference in molecular weight, these isotopes were separated using a physical process. The gaseous diffusion uranium enrichment process separated lighter uranium-235 from heavier uranium-238. UF_6 gas was forced through a series of porous membranes, or “barriers,” with microscopic openings (Figure 4.1). Uranium-235 moved through the barriers more easily, increasing the concentration of uranium-235 as it moved through the process.

Figure 4.1. Gaseous Diffusion Process at PORTS

Gaseous diffusion is similar to a distillation process because the lighter component moves "up" through the process equipment and is removed at the top, and the heavier component moves "down" and is removed near the bottom.

The basic separation equipment for gaseous diffusion is a "stage." At PORTS, a stage consists of the following:

- A converter that contains porous separation media (referred to as the barrier material or barrier tubes)
- A gas cooler
- A compressor driven by an electric motor (to move the UF_6 gas through the converter)
- Interconnecting piping and control valves to contain and control the gas flows.

A schematic of a stage, including compressor, converter, and interconnecting piping, is shown in Figure 4.2.

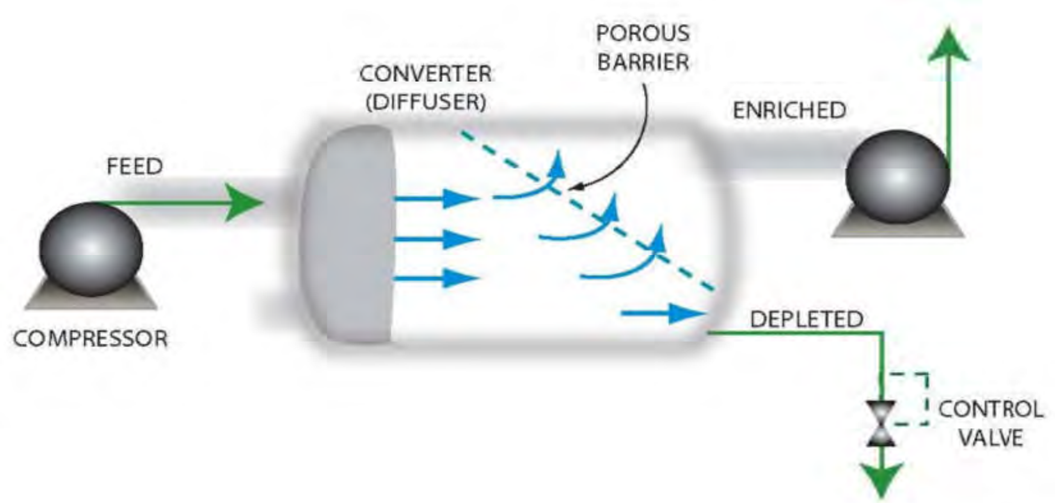


Figure 4.2. PORTS Gaseous Diffusion Stage Schematic

The UF_6 feed material was introduced as a gas and flowed along the inside of the barrier material. About half of the gas diffused through the barrier was fed to the next higher stage while the remaining undiffused portion was recycled to the next lower stage. The diffused stream was slightly enriched with respect to uranium-235, and the stream that was not diffused was slightly depleted.

One stage was capable of only very slight enrichment. Thousands of stages were connected in series to produce HEU. PORTS has 4,080 separation stages. The X-333 Building contains 640 stages, the X-330 Building contains 1,100 stages, and the X-326 Building contains 2,340 stages (Table 4.2).

Table 4.2. Process Building Units, Cells, and Stages at PORTS

Process Building	Size	No. of Units	Cells per Unit	No. of Cells	Stages per Cell	No. of Stages
X-326	Purge	0.5	20	10	6	60
X-326	X-25[a]	6.5	20	130	12	1,560
X-326	X-27	3	20	60	12	720
X-330	‘0’ (or X-29)	6	10	60	10	600
X-330	‘00’ (or X-31)	5	10	50	10	500
X-333	‘000’ (or X-33)[b]	8	10	80	8	640
Totals		29		390		4,080

[a]Smallest equipment
[b]Largest equipment

Stages were grouped into “cells,” which were the smallest groups of stages that could be removed from service, bypassed, and shut down for maintenance or other purposes. There are 12 stages per cell in most of the cells in X-326, 10 stages per cell in X-330, and 8 stages per cell in X-333. A schematic of a cell in X-333 is shown in Figure 4.3. There are 200 cells in X-326, 110 cells in X-330, and 80 cells in X-333 (Table 4.2).

Cells were further grouped into “units,” which were groups of cells that share common auxiliary systems. The 200 cells in X-326 are grouped into 10 units, the 110 cells in X-330 are grouped into 11 units, and the 80 cells in X-333 are grouped into 8 units (Table 4.2). Each unit consisted of cells containing the same equipment type and usually operating under the same conditions. The entire series-connected process was commonly referred to as the “cascade” (Figure 4.4). Ten of the cells in the south end of X-326 comprise the “purge cascades,” each containing six stages per cell. The process equipment in the top purge cascade is expected to contain the highest concentrations of technetium-99 contamination (LMES 1997).

There are five sizes of process equipment at PORTS, referred to as the X-25 size (or Size 8), X-27 size (or Size 7), ‘0’ (or X-29), ’00’ (or X-31), and ‘000’ (or X-33), with ‘000’ being the largest and the X-25 size the smallest. The normal cascade flow involved introducing the feed material into the largest size equipment in X-333. As the enrichment increased in the X-330 and X-326 Buildings, the equipment sizes and weights were reduced. The largest size equipment is at the point where the natural uranium or “feed” material was introduced into the process, and the equipment sizes were reduced as the flow of enriched uranium moved up toward the top of PORTS. The X-330 Process Building was split, process wise, into primary enriching stages and stripping stages. This is depicted in Figure 4.4 by having a portion of the X-330 Process Building above and below the X-333 Process Building. The largest electric motor, which drove a ‘000’ compressor in X-333, is rated at 3,300 horsepower (hp), and the smallest electric motor, which drove an X-25-size compressor in the top of X-326, is rated at 15 hp.

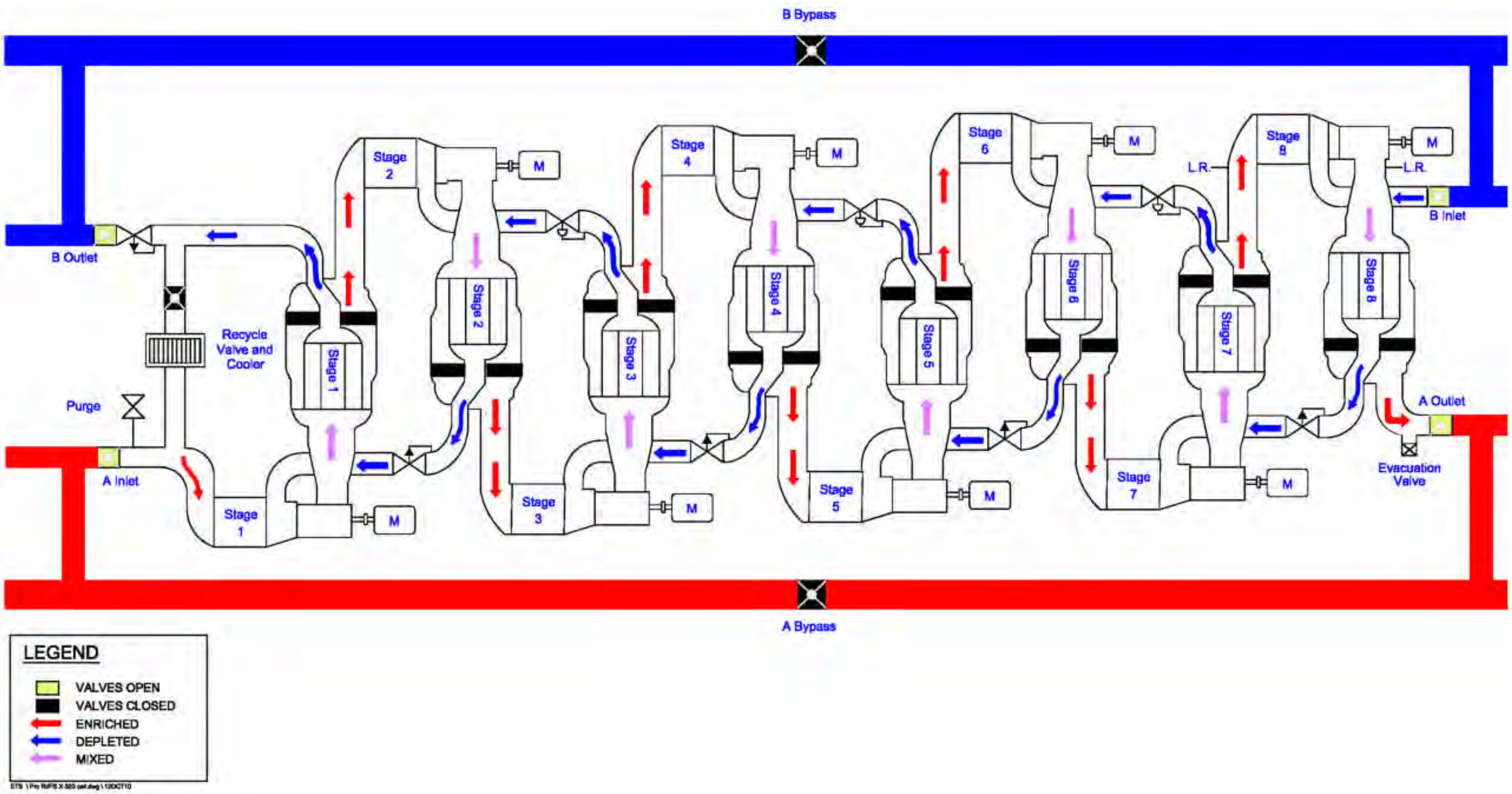


Figure 4.3. X-333 Building Cell at PORTS

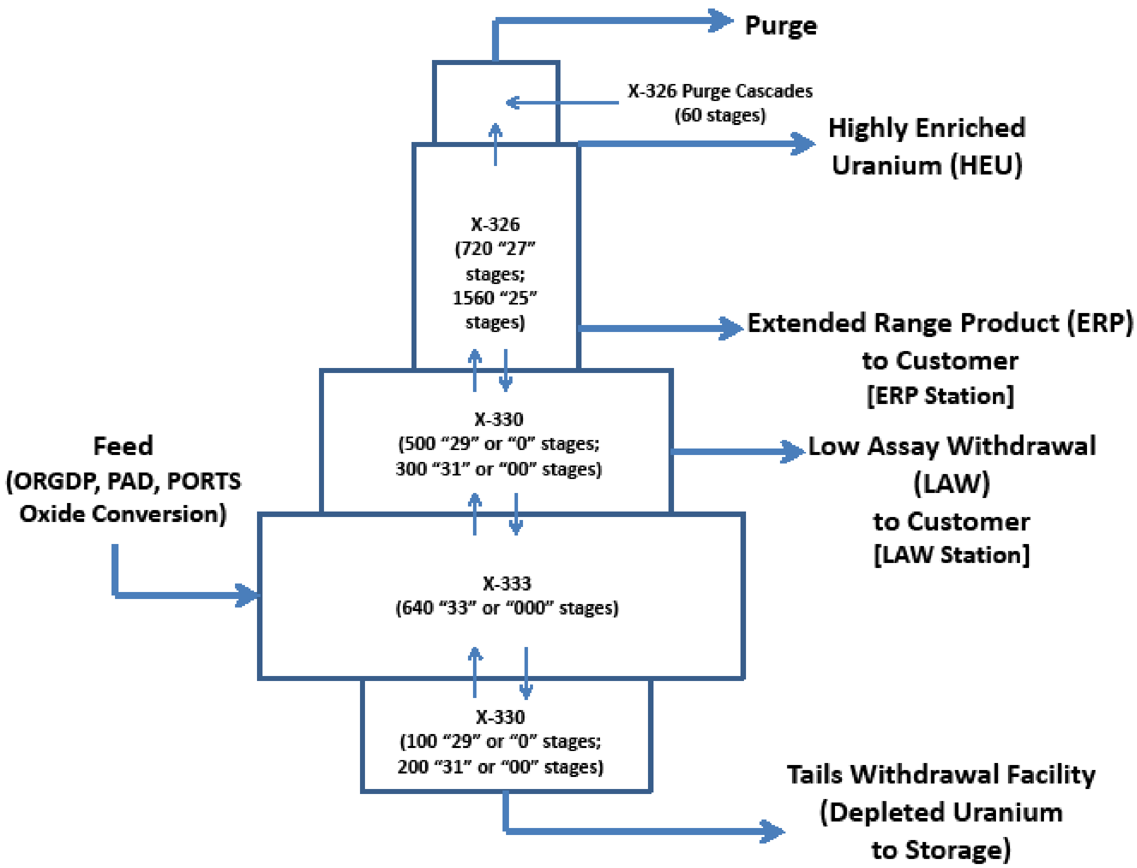


Figure 4.4. PORTS Gaseous Diffusion "Cascade"

The process equipment, piping, and instrument lines that contained process gas are enclosed by cell housings and bypass housings. The cell housings for X-326 process equipment are metal, and the cell housing for the X-330 and X-333 process equipment have a steel frame and transite siding. The tops of the housings have removable hatches that allow for equipment removal.

The major cascade feed streams were supplied through feed headers connected to the feed autoclaves in the main X-343 feed plant (called the Feed Vaporization Sampling Facility) and the auxiliary X-342A feed plant (called the Feed Vaporization Building). The uranium enrichment process was initiated in X-333 and continued in series to X-330 and X-326. Materials were withdrawn from the cascade at the following three locations (Figure 4.4):

- X-326 Product Withdrawal (PW) Station (90 to 97 percent uranium-235 during HEU production, 2.0 to 5.0 percent uranium-235 during LEU production)

- X-326 Extended Range Product (ERP) Station (0.7 to 5.0 percent uranium-235)

- X-333 Low Assay Withdrawal (LAW) Station (1.0 to 5.0 percent uranium-235)

- X-330 Tails Withdrawal Facility (0.2 to 0.3 percent uranium-235 and 1.0 to 5.0 percent uranium-235).

4.1.1.1 X-333 Building

The X-333 Building was used for the initial phase of uranium enrichment, LAW, production and distribution of plant dry air, waste storage, and cold recovery (the recovery of UF_6 from purge gases). The building is 1,456 ft long, 970 ft wide, and 82 ft high, and has a combined floor space of 65 acres (two stories) (Giffels & Vallet, Inc. [GVI] 1961). The two-story steel frame structure is constructed of asbestos-containing transite siding and steel-reinforced concrete floors and columns, and a flat, composite, built-up, tar-and-gravel-coated roof. Open truck alleys for rail and truck access are located on the east and west sides of the building.

In general, the control facilities, electrical switch gears, ventilation fans, unit auxiliary equipment, and cell-servicing facilities and maintenance are located on the first floor. Other major equipment on the first floor includes the air compressors and ventilation supply fans. The main control room, referred to as Area Control Room 1, is also located on the first floor. A basement that provides access to an underground instrument tunnel system is located below Area Control Room 1.

The process equipment and associated valves and piping are located on the second floor. The X-333 Building contains eight units (10 cells each and 640 stages total) of '000' equipment, which is the largest gaseous diffusion equipment at PORTS. The numbers of installed converters and compressors in the three process buildings are shown in Table 4.3. The converters in X-333 are approximately 13 ft in diameter and 24 ft long, and weigh approximately 66,000 lb. Between 1972 and 1983, DOE implemented a process modification campaign at PORTS and the other two GDPs. This campaign, called the CIP/CUP, was designed to improve the gaseous diffusion process efficiency and increase the throughput, respectively. During the CIP/CUP operations, essentially every compressor, converter, and motor in X-333 was removed, modified and improved, and reinstalled. Ancillary process equipment located in X-333 includes the freezer/sublimer systems, cold traps, LAW station, booster stations, and surge drums. Tie lines connect X-343 to X-333 and X-333 to X-330 in a heated housing located aboveground.

Table 4.3. Summary of PORTS-installed Compressors and Converters Used for the Gaseous Diffusion Process

Building	Equipment Type	Compressor Number	Motor (hp)	Compressor Unit Weight (lb)	Converter Number	Converter Unit Weight (lb)
X-333	000 (or X-33)	640	2,850 - 3,300	34,000	640	66,000
X-330	00 (or X-31)	500	700 - 1,700	16,000	500	29,000
X-330	0 (or X-29)	600	400 - 700	15,400	600	27,000 and 16,000
X-326	X-27 (or Size 7)	720	100 - 250	7,500	720	4,600
X-326	X-25 (or Sizes 8 and 9)	1,620	15 - 200	8,000	1,620	3,500

Sources: GVI 1961, LMES 1997

GVI = Giffells & Vallet, Inc.
LMES = Lockheed Martin Energy Systems, Inc.

Maintenance of the process equipment in X-333 required cranes for lifting major equipment components and transporting them within the building. All cranes are still present and potentially capable of operating in X-333 and the other two process buildings (X-330 and X-326). These bridge-type cranes are installed in crane bays and can travel the widths of the process buildings on rail tracks attached to the building support columns. The tracks are located near the ceilings of the buildings, and one crane is provided for each set of tracks in each crane bay. Handling different sizes and types of process equipment required several sizes of cranes with different lifting capacities. The cranes can be fitted with numerous slings and fixtures, each designed for lifting and moving a specific component of the equipment in the three process buildings (LMES 1997).

Twenty-one cranes are located in X-333. Its crane bays contain 20 alternating cranes with lifting capacities of 38 tons and 15 tons. The 10 large-capacity cranes can move over the converters, motors, and compressors. The 10 small-capacity cranes are confined to traveling above the lighter-weight coolant system equipment. One additional crane has a lifting capacity of 23 tons. The travel path of this crane is above the unit bypass piping, and it can move along the entire interior length of X-333.

4.1.1.2 X-330 Building

The X-330 Building was used for the intermediate phase of uranium enrichment and tails withdrawal. It is 2,176 ft long, 640 ft wide, and 66 ft high, and has a combined floor space of 55 acres (two stories) (GVI 1961). The construction is similar to that of X-333, with a two-story steel frame, asbestos-containing transite siding, steel-reinforced concrete floors and columns, and a flat, composite, built-up, tar-and-gravel-coated roof. The X-330 Building has one truck alley on the west side of the building.

Again, similar to X-333, the control facilities and most of the auxiliary support systems are on the first floor. Two Area Control Rooms (2 and 3) are located on the first floor. A basement is located below each Area Control Room and provides access to the underground instrument tunnel system.

The process equipment and associated valves and piping are located on the second floor. The X-330 Building is similar in design to X-333, but it contains two sizes of process equipment, ‘00’ (or X-31) and ‘0’ (or X-29), both sizes smaller than the equipment in X-333. It contains six units of ‘0’ size equipment (60 cells and 600 stages) and five units of ‘00’ size equipment (50 cells and 500 stages) (Table 4.2). Ancillary process equipment located in X-330 includes the cold traps, tails withdrawal facility, booster stations, and surge drums. Aboveground tie lines connect X-342 to X-330 and X-330 to X-326.

Twenty-two bridge-type cranes are located in X-330. Each crane has a lifting capacity of 15 tons. These cranes were designed to safely lift and transport the motors, compressors, converters, and condensers beneath their travel paths. The heaviest of these components are the converters, which weigh approximately 14.5 tons (LMES 1997).

4.1.1.3 X-326 Building

The X-326 Building was used for the high uranium enrichment phase and enriched product withdrawal. About two-thirds of the building was used to produce commercial grade nuclear material. This building is 2,280 ft long, 552 ft wide, and 62 ft high, and has a combined floor space of 58 acres (two stories) (GVI 1961). The two-story steel frame structure is constructed of asbestos-containing transite siding and steel-reinforced concrete floors and columns. In addition, it has a flat, composite, built-up, tar-and-gravel-coated roof.

Like the other two process buildings, the electrical switchgear, control facilities, and instrumentation are located on the first floor. A RCRA waste storage area permitted by the Ohio EPA in accordance with *Ohio Revised Code* Chapter 3734 is also located on the first floor of X-326 (Ohio EPA 2001). The storage area is authorized for container storage of hazardous and mixed waste and has a maximum permit capacity of slightly over 160,000 gal. Three Area Control Rooms (4, 5, and 6) are located on the first floor. A basement that provides access to the underground instrument tunnel system is located below each Area Control Room. The process equipment and associated valves and piping are located on the second floor.

The X-326 Building contains three sizes of equipment, which are the smallest pieces of gaseous diffusion equipment at PORTS. The two sizes of process equipment in X-326 are referred to as the X-27 size, which is the larger of the two sizes, and the X-25 size, which is the smaller of the two sizes. The converters weigh 3,500 lb and 4,600 lb. The gas cooler for the converters in X-326 is located outside the converter instead of being located inside the converter as it is in the converters contained in X-333 and X-330. There are three units of the X-27 size equipment (60 cells and 720 stages) and 6.5 units of the X-25 size equipment (130 cells and 1,560 stages). In addition, there are 10 six-stage cells, called the "purge cells," of X-25 size equipment specially designed to remove light gases from the UF_6 stream. Ancillary process equipment located in X-326 includes the cold traps, ERP station, and surge drums. Tie lines connected X-326 to X-770.

Twenty bridge-type cranes are located in X-326. Each crane has a lifting capacity of 5 tons. These cranes were designed to safely lift and transport the motors, converters, compressors, and condensers beneath their travel paths. The heaviest of these components are the condensers, which weigh less than 5 tons (LMES 1997).

4.1.1.4 Auxiliary systems

Numerous auxiliary systems are located in the three process buildings that supported the enrichment operations. The primary auxiliary systems and their purposes are described in Table 4.4.

Table 4.4. Summary of Process Buildings Auxiliary Systems at PORTS

Auxiliary Systems	Purpose
Seal exhaust	Removed N_2 and dry air from the seal cavities.
Steam	Distributed steam throughout the process buildings to provide supplemental heat.
Lubrication and hydraulic oil	Supplied oil for compressor bearings, motor bearings, and hydraulic control valves.
Nitrogen distribution	Supplied gaseous N_2 for seal feed, buffering areas, cell treatment, purging cells to the cascade, and servicing equipment.
Dry air distribution	Distributed dry air throughout PORTS for use in instruments, ventilation control, substituting for N_2 in emergencies, seal air, purging, buffering, and maintenance services.
Sanitary and fire water	Supplies potable water and cooling water for various plant equipment. In addition, the system supplies water for the fire protection sprinkler systems.
Coolant	Coolant drain, transport, and recovery systems transported and recovered coolant as a liquid or vapor within PORTS or from delivery tank cars to the storage facility. The system was also used to evacuate residual coolant from a cell coolant system prior to cutting into the system for repairs and to evacuate air in preparing for operations.

Table 4.4 Summary of Process Buildings Auxiliary Systems at PORTS (continued)

Auxiliary Systems	Purpose
Heating and ventilation	Heating system prevented freezout of UF_6 in the process piping or equipment and to prevent freezing of water-containing systems. Ventilation system controlled operating temperatures for motors and transformers. Exhaust fans used in maintenance areas, rest rooms, and shower rooms.
Electrical power	Provided power to stage motors, cascade support equipment, along with backup power.
Process monitoring and control instrumentation	Monitored process and auxiliary system operating conditions.

Source: LMES 1997
LMES = Lockheed Martin Energy Systems, Inc.

4.1.1.5 Radiological hazards

Many thousands of tons of uranium were processed through the gaseous diffusion process at PORTS during the time of normal operations. Most feed material consisted of naturally occurring uranium (preprocessed into UF_6), but some of the feed was obtained from spent reactor fuel. Most of the uranium was removed from the cascade during shutdown operations. However, residual deposits of enriched uranium (including trace quantities of fission products and transuranics that were introduced as the result of feeding reactor returns into the cascade) that accumulated along the inner surface areas of the process piping and equipment during the life of PORTS remain inside the piping and equipment.

Based on comprehensive NDA survey data, significant amounts of holdup were identified within the PGE and piping after process systems were shut down. Many significant deposits in the process buildings were removed. The remaining uranium is mostly present as a generally uniform and diffuse layer. In areas where moist air in-leakage occurred, the UF_6 would react with water vapor to produce nonvolatile uranyl fluoride (UO_2F_2). Therefore, thicker deposits of uranium are known to be in equipment near the locations of air in-leakage.

The primary radiological contaminants are uranium, including uranium-234, uranium-235, and uranium-238. Other identified radionuclides that were introduced to the cascade by processing reactor tails include technetium-99, neptunium-237, and plutonium-239.

Surface contamination can also be found throughout the process buildings. On occasions, when PGE was removed for maintenance, some materials were released or spilled in the working area and contaminated surfaces in the work environment. Some portions of the operating and cell floors, as well as internal rooms of the operating floors, are contamination control zones.

4.1.1.6 Chemical hazards

Known and potential chemical hazards include the following:

- Residual PCBs are contained in transformers and capacitors. Minor concentrations are in the process motor lubricating oil system. PCBs are also present in thousands of fluorescent light fixtures and in PCB-impregnated ventilation gaskets. PCB-contaminated oil has dripped from the gaskets onto the cell floor.

- Residual Freon is in cell cooling systems, cold recovery systems, room air conditioners, and refrigerators.

- Residual chromate is suspected to be present in the RCW and recirculating heating water (RHW) systems. Spills of RCW have resulted in chromium contamination of cell floors.

- Lead-based paint potentially containing PCBs is present on surfaces throughout the process buildings.

- Large quantities of asbestos-containing material (ACM) are present in exterior transite siding, cell housings, thermal insulation, and floor and ceiling tile.

- Large quantities of waste are stored in the process buildings, including hazardous, hazardous mixed, hazardous/PCB, PCB, PCB/radiological, radiological only, and nonregulated waste.

- Other chemical hazards include, but are not limited to, lead-acid batteries in battery rooms, alumina trapping material containing mercury, gasoline and diesel fuels, compressed gas cylinders, and janitorial supplies.

4.1.2 Feed, Sampling, and Transfer Facilities

The feed, sampling, and transfer facilities consist of the following:

- X-342A Feed Vaporization Building
- X-342B Fluorine Storage Building
- X-342C Waste HF Neutralization Pit (below-grade structures)
- X-344A UF_6 Sampling Facility
- X-344C Hydrogen Fluoride Storage Building (foundations and piers)
- X-344D HF Neutralization Pit (below grade)
- X-344E Gas Ventilation Stack (below grade)
- X-344F Safety Building (below-grade structures).

4.1.2.1 X-342A Feed Vaporization Building

The original X-342A feed plant is located north of the X-330 Process Building. The X-342A Feed Vaporization Building is a single-story, 13,800 sq ft structure that was the first PORTS feed and sampling facility (Figure 4.5). It contains two 84-in.-diameter containment autoclaves capable of handling cylinders up to 48 in. in diameter for feed vaporization or liquid sampling. The autoclaves are steam heated and designed to contain the contents of a 48-in.-diameter cylinder in the event of a cylinder rupture. The facility instrumentation allowed monitoring of temperature, pressure, conductivity of the steam condensate stream, and other parameters to reduce the potential for a release. This facility is equipped with two 20-ton-capacity bridge cranes for cylinder handling. A small control area is provided to control and monitor the process.

Figure 4.5. X-342A Feed Vaporization Building at PORTS (X-745B Cylinder Storage Yard shown in foreground)

Uranium contamination should be expected throughout the interior of the process piping and valves. The autoclave closing systems contain hydraulic oil, and the autoclaves should contain very little, if any, contamination.

A fluorine generating plant is also housed in the X-342A facility. This process used electrolysis of HF to produce fluorine and hydrogen. Hydrogen (the byproduct of the operation) was vented, and the fluorine was stored in tanks in the X-342B Fluorine Storage Building and piped to areas where needed throughout PORTS. Power rectifiers produced the direct current power that was applied to the fluorine "cells" that produced the fluorine.

The fluorine-generating plant is suspected of containing residual fluorine, HF, and potassium fluoride/HF electrolyte in the fluorine-generating cells. Building materials and equipment in the building could contain PCBs, ACM in pipe insulation, and lead-based paints.

4.1.2.2 X-342B Fluorine Storage Building

The X-342B Fluorine Storage Building, a single-story, 1,500 sq ft structure contains three 1,000-cf fluorine gas storage tanks connected to a covered outside manifold system. The building was used to store purified fluorine, which was piped in from the X-342A Feed Vaporization Building's fluorine-generating plant. From the storage tanks, fluorine was either transferred into gas cylinders at the facility's covered porch or fed directly into the fluorine distribution system servicing the various PORTS process and support facilities.

There are no known radiological hazards. Chemical hazards include fluorine and ACM from exterior transite sheeting. In addition, because the building is old, lead-based paint may be present. PCB equipment or PCB-contaminated equipment is not expected to be present.

4.1.2.3 X-342C Waste HF Neutralization Pit and X-344D HF Neutralization Pit

The X-342 Waste HF Neutralization Pit was a 26,000-gal concrete pit, originally filled with limestone designed to react with liquid HF in the event of a spill in the X-344C Hydrogen Fluoride Storage Building. Operations were discontinued in 1986 and the pit was completely removed in 2006.

The X-344D HF Neutralization Pit was a 75,000-gal concrete pit filled with limestone and designed as a filter and settling pit for pH adjustment of the waste HF effluent from the X-342A Feed Vaporization Building. Operations were discontinued in 1989, and the pit has been completely removed.

The feed lines into the pits have been disconnected.

4.1.2.4 X-344A UF_6 Sampling Facility

The X-344A UF_6 Sampling Facility was built in 1958 and was originally designed to convert UF_4 to UF_6 (X-344 Feed Manufacturing Plant) (Figure 4.6). In the early 1970s, it was converted to a sampling and transfer facility to accommodate the increased market for LEU for nuclear power reactors.

Figure 4.6. X-344A UF_6 Sampling Facility at PORTS (X-745B Cylinder Storage Yard shown in foreground)

This building contains four (96-in.diameter) steam-heated containment autoclaves that are elevated several feet above the floor. It had the unique capability of transferring liquid UF_6 product from 48-in.-diameter cylinders to 30-in. product cylinders suitable for shipment. The process involved a 48-in.-diameter cylinder being placed in an autoclave and connected to process instrumentation. Then the autoclave was closed and steam was introduced. Empty 30-in. cylinders were readied and placed on scales at floor level below the autoclaves. A flow was established between the "parent" cylinder in the autoclave and the empty "daughter" cylinder on the scales below. The desired amount of product was placed in the 30-in. cylinder and the process was repeated until the product order was filled. The 96-in.-diameter autoclaves have a tilt mechanism to allow the parent cylinder to be tilted to remove the maximum amount of product. The manifolds and lines were then purged of UF_6, and the purge gases were evacuated to the cascade.

X-344 is currently in use. Current operations include transfer of UF_6 from thin-walled 48-in. cylinders to thick-walled 48-in. cylinders for subsequent shipment off PORTS.

This building is equipped with three 20-ton bridge cranes to handle sampling and transferring, and it has two additional 20-ton cranes to handle shipping, receiving, and weighing. The X-344 facility has been used to remove technetium from UF_6 by chemical trapping.

In addition to the contamination issues discussed for X-342, this building is likely to contain low levels of technetium contamination.

4.1.2.5 X-344C Hydrogen Fluoride Storage Building, X-344E Gas Ventilation Stack, and X-344F Safety Building

The X-344C Hydrogen Fluoride Storage Building contained three 10,000-gal storages tanks that contained anhydrous HF received by rail tank car. The X-344E Gas Ventilation Stack was a 4-ft diameter steel pipe that was approximately 30 ft high. It was contained within a metal support structure and had vents from liquid and vapor lines that connected the X-344C storage tanks with the X-342A Feed Vaporization Building. The X-344F Safety Building was a small concrete structure that contained an emergency shower, a sink, a portable eye wash station, and a control panel.

The above-grade structures and equipment associated with these structures have been removed. This RI/FS addresses any remaining below-grade structures left after earlier above-grade structure demolition. No documented radiological or chemical hazards are associated with the remaining structures. However, there may be residual contamination (HF) in below-grade lines connecting X-344C, X-344E, and X-342A.

4.1.3 Primary Laboratory, Maintenance, and Equipment Cleaning Facilities

The primary laboratory, maintenance, and equipment cleaning facilities include 15 separately identified buildings and structures located in four complexes (X-700, X-705, X-710, and X-720 complexes). These complexes are described below.

4.1.3.1 X-700 Complex

The X-700 Complex consists of the following:

- X-700 Converter Shop & Cleaning Building
- X-700A Air Conditioning Equipment Building
- X-700B Sandblast Facility and Observation Booth
- X-721 Radiation Instrument Calibration.

The "E" X-700 "0000" Compressor Base Foundation is listed in Attachment H of the DFF&O but is not known to have been built.

4.1.3.1.1 X-700 Converter Shop & Cleaning Building

The X-700 Converter Shop & Cleaning Building is a 129,000 sq ft high bay building that was used for maintenance of contaminated and noncontaminated equipment from the diffusion cascade.

The building is divided into two main sections. The east section, Chemical Cleaning and Operations Area, is an equipment and parts cleaning area housing eight large tanks for dipping large equipment components, biodenitrification facilities, a vapor degreaser, and a solvent-contaminated wastewater treatment air stripper. The purpose of the biodenitrification facilities was to lower the nitrate-nitrite levels in the treated raffinate (filtrate) solution from the heavy metal precipitation and technetium ion-exchange facility located in the X-705 Decontamination Building. A partial basement exists under the tanks and biodenitrification equipment. A sandblasting area (X-700B Sandblast Facility and Observation Booth) is located just outside to the north of the eastern part of the building. Adjacent cleaning tanks are unused and emptied of residuals. The biodenitrification facility is operational. The vapor degreaser and air stripper are not in use.

The west section houses a shop area, two unused converter stabilization furnaces, and includes the X-721 Radiation Instrument Calibration facility, which is addressed in Section 4.3.1.3. The shop area is split into two halves. The south half was built to be a converter weld shop, and the north half was a humidity-controlled converter assembly area. The south half has been transformed into a set of shops (carpenter, electric, instrument, weld, paint, sign) and includes modular offices and a break room. The north half is the X-721 facility on the west side and converter storage on the east side. Currently, the west wing is essentially only used for storage. Radiological contamination control zones are established in several areas within the X-700 Converter Shop & Cleaning Building. One is for converters in the north portion of the west high bay. Two contamination control zones exist in the west wing at each of the furnace stand compressors. Another is in the center of the building where radiological waste is stored. Used sand from the sandblasting facility is considered to be radiological waste. Fixed contamination is present on the concrete floors (TPMC 2006).

Potential chemical contaminants include fluorine, acids, solvents, sodium carbonate, oils, degreasers, bases, alcohols, lead, benzene, heavy metals, and chromium. Acetylene, oxygen, nitrogen, and P10 (a mixture of argon and methane) gas were used, and ACM are believed to be present within transite siding and thermal insulation. PCBs are in ventilation duct gaskets and fluorescent light fixture ballasts. Mercury is in mercury vapor incandescent light bulbs and fluorescent light tubes. Surfaces potentially contain lead-based paint (TPMC 2006).

One hundred and ninety-one wipe samples were collected in X-700 during a beryllium surface contamination characterization conducted in 2003 and 2004 (USEC 2004). Of these samples, 58 (30 percent) exceeded the level of concern (0.2 µg/100 cm^2), five of which exceeded the level of immediate concern (3.0 µg/100 cm^2). Levels of immediate concern were exceeded in the converter weld shop (on a grinder), furnace stand facility (inside wall of Furnace No. 1), and sandblasting booth (grinding dust). Levels of concern were exceeded in the equipment/parts cleaning area floor; caged hand table and overhead area; converter barrier/assembly shop miscellaneous equipment and overhead area; furnace stand miscellaneous equipment and overhead area; women's west locker room; sandblasting booth; and the weld shop compressors, welding equipment, and overhead area.

4.1.3.1.2 X-700A Air Conditioning Equipment Building

The X-700A Air Conditioning Equipment Building is a 2,400 sq ft, steel-framed building with a concrete floor and metal roof. It is located north of the X-700 Converter Shop and Cleaning Building. Constructed in 1975, the building has been used to house air conditioning equipment (three chiller units, compressors, an air conditioning filter unit and blower unit) that services the X-700 Converter Shop and Cleaning Building and the X-721 Radiation Instrument Calibration facility located in the X-700 Building. Air is circulated to and from the X-700A facility via large insulated ductwork.

Nitrogen, Freon-502, and Freon-22 were used in X-700A. ACM, RHW (initially containing chromates and later containing phosphates), lubricating oils, PCBs, and mercury associated with fluorescent lighting were used in this building and may still be present.

4.1.3.1.3 X-721 Radiation Instrument Calibration

The X-721 Radiation Instrument Calibration facility, built in 1985, is used to test and evaluate radiation instruments and equipment and to certify plant radiation standards. The north and west walls are concrete and are shared with the X-700 Building. The remaining walls are stud walls, and the roof is made of steel decking. A portion of the facility is located outside X-700 and has a beam room. The laboratory and training room walls are made of steel-reinforced block, and all voids are filled with concrete grout. The control room and storage room share walls in common with other rooms. These walls are made of either concrete block or solid concrete.

The Cleaning Room, located inside X-700, is used to disassemble and clean incoming instruments. Utilities are supplied from X-700 and the X-700A Air Conditioning Equipment Building.

The Radiation Instrument Calibration facility houses several high-intensity radiation sources, which are intrinsically safe or are used remotely inside a shielded radiation room. A gamma irradiator and one filtered, 320 kV, constant potential X-ray unit are located in the "beam room" at fixed positions. The radiation protection development laboratory area, which is an integral part of the Radiation Instrument Calibration facility, is located in the southwest corner of this building outside of the X-700 high-bay area. This laboratory may contain additional alpha and beta particle emission reference standards and miscellaneous low-level standard reference materials provided by the National Institute of Standards and Technology.

The beam room north, east, and west walls are made of reinforced concrete. The south wall is made of reinforced concrete and contains two equivalent composite shield doors. Each shield door contains steel, boron-loaded polyethylene, and lead in equivalent proportions to equal the shielding of the concrete walls on the south side. The floor in the beam room has a special covering of concrete mixed with granular boron glass (frits). Part of the floor in the beam room is below the main floor level.

Radioactive sources were housed in the X-721 Building along with shielding. Surface contamination is unlikely.

4.1.3.2 X-705 Complex

The X-705 Complex consists of the following:

- X-705 Decontamination Building
- X-705D Heat Booster Pump Building
- X-705E Oxide Conversion Area.

4.1.3.2.1 X-705 Decontamination Building

The X-705 Decontamination Building, constructed in 1955 and occupying approximately 100,800 sq ft, is centrally located with respect to the X-700 Converter Shop & Cleaning Building and the X-720 Maintenance & Stores Building. It was used for process equipment disassembly and decontamination, small parts cleaning and decontamination, uranium recovery, routine chemical analyses, and laundering of company clothing worn by plant personnel (Figure 4.7). After decontamination, the equipment and parts were transferred for maintenance, returned to service, or containerized as scrap.

Figure 4.7. X-705 Decontamination Building at PORTS

Recoverable quantities of uranium in the decontamination solutions were reclaimed in a uranium recovery system located in the building. Uranium from other contaminated sources (e.g., some laboratory wastes and field decontamination solutions) was also recovered in the uranium recovery facility. Uranium-bearing solutions were processed to extract uranyl nitrate solutions, which were then calcined to produce uranium oxide (U_3O_8). The recovered U_3O_8 was stored on PORTS or shipped off PORTS for further processing and use. Waste streams containing toxic or radioactive contaminants were processed prior to discharge. Wastewater streams were treated to precipitate and filter residual heavy metals. This processed wastewater was discharged to the sanitary sewer system or transferred to the biodenitrification facility for further processing. The filtered solids were packaged for disposal. The waste gas stream from the calciners contained nitrous oxides (NO_x) and was passed through a scrubber to remove most of the NO_x prior to discharge.

X-705 processes remain capable of operating, and some processes are currently in operation. Equipment disassembly and decontamination operations are important to D&D. The facility may continue to be used during process building D&D.

Activities performed in the X-705 Decontamination Building and the X-700 Converter Shop & Cleaning Building required laboratory analyses to meet nuclear safety requirements and ensure process efficiencies. Some of these analyses were performed in the X-705 process laboratory.

The X-705 laundry was used to wash the company-issued clothing worn by plant personnel. The laundry equipment drained into the sanitary sewer system, which discharges to the X-6619 Sewage Treatment Plant.

The two main radioactive materials present in this building are uranium and technetium. Detectable concentrations of neptunium and plutonium are also present in the building. Radiological contamination is fixed in the floors and probably on the inside surfaces of the building and its fixed equipment, including laundry washing equipment (LMES 1997, TPMC 2006).

The following chemicals are either in use or present as residue from prior use: fluorine, caustic soda, nitrogen oxides, nitric acid, acetylene, tributyl phosphate, UO_2F_2, HF, propane, Stoddard solvent (mineral spirits), citric acid, aluminum nitrate, NH_3, boric acid, sodium carbonate, sodium bisulfate, uranyl nitrate, TCE, alumina, batteries, circuit boards, glass beads, laundry detergents, U_3O_8, and flammable liquids in lockers. PCBs are present in ventilation duct gaskets and fluorescent light fixture ballasts. Fluorescent light tubes contain mercury. Because the building is old, lead-based paint is potentially present, and ACM is present in thermal piping insulation and transite siding (TPMC 2006).

Cleaning activities have generated numerous sludges, gunks, and solutions (including floor sweepings) that contain radionuclides, hazardous chemicals, and heavy metals (TPMC 2006).

4.1.3.2.2 X-705D Heat Booster Pump Building

The X-705D Heat Booster Pump Building, built in 1983, is a 700-sq ft RHW pump house on the north side of X-705. It is no longer in use. Process support facilities were heated with waste heat from the gaseous diffusion process by pumping RHW from the process buildings to the process support facilities. The X-705D Heat Booster Pump Building boosted the heated water through the X-705 Decontamination Building to provide heat during cold weather. Operations were discontinued in 2001 when the gaseous diffusion cascade was shut down. The building has reinforced-concrete floors and concrete block walls. The outside dimensions are approximately 15 ft by 25 ft. The building has two levels: a ground level and a lower, below-grade level.

The X-705D Heat Booster Pump Building is posted as a radiological contamination area.

Residual amounts of chromate may be present in the RHW system in the X-705D Heat Booster Pump Building and could be a potential source of contamination, although the system was switched to a more environmentally acceptable phosphate-based corrosion inhibitor system in the 1990s.

4.1.3.2.3 X-705E Oxide Conversion Area

The X-705E Oxide Conversion Area is an area within the X-705 Decontamination Building. It was used to convert U_3O_8 containing technetium-99 and transuranic elements to UF_6 for feed to the enrichment cascade. The X-705E Oxide Conversion Area covers approximately 3,000 sq ft of the first floor and a mezzanine area. The eastern wall of X-705E is part of the eastern wall of the X-705 Decontamination Building.

The X-705E Oxide Conversion Area includes four rooms: the cold trap room, tower room, sampling room, and oxide unloading room. There are no vertical spaces, stairways, or elevator shafts in the building. Some of the equipment associated with the oxide conversion process is located on, or extends to, the second floor of X-705.

The exterior walls of the X-705 Decontamination Building are constructed of concrete block to a height of approximately 8 ft with windows and corrugated cement-asbestos (transite) siding on steel frame above the blocks. The interior portions, including the X-705E Oxide Conversion Area, consist of concrete block and steel frame and do not include any combustible finishes or coverings.

The oxide conversion area reacted uranium oxides with fluorine gas to generate UF_6 gas and byproducts. The X-705E area was operated as the oxide conversion facility from February 1957 through July 1977 (BJC 2000). The equipment was shut down because of high airborne radiation readings in the facility.

The X-705E Oxide Conversion Area is highly contaminated radiologically. The area is posted as a contamination control zone and is sealed because of potential or suspected contamination from transuranic isotopes (DOE 1993, TPMC 2006). In addition to uranium and technetium-99 contamination in this area, transuranics (including neptunium and plutonium) were concentrated in flame tower ash during the process, and transuranic contamination remains in the residual tower ash within the equipment. Samples from the H-Area (mezzanine area), collected following shutdown, indicated that the transuranic constituent percentage was 0.12 percent of the total activity measured (BJC 2000).

4.1.3.3 X-710 Complex

The X-710 Complex consists of the following:

- X-710 Technical Service Building
- X-710A Technical Service Gas Manifold Shed
- X-710B Explosion Test Facility.

4.1.3.3.1 X-710 Technical Service Building

The X-710 Technical Service Building is a two-story, 139,000-sq ft building constructed in two separate parts. The northern portion was built in 1953 and has an area of 109,000 sq ft. It is made of reinforced concrete and concrete block. Built in 1975, the southern portion has 30,000 sq ft and is a steel-framed addition with steel siding.

The X-710 Technical Service Building contains laboratories and facilities that provide technical, production, and development support for PORTS. Operations have included material sampling and testing, chemical analysis and laboratory services, information services and management (technical library and computer systems and procedures), instrumentation development and testing, cascade testing and evaluation, development testing/evaluation/fabrication, offices for technical services management, equipment repair and fabrication shops, a storeroom, and the mechanical equipment room. X-710 supported cell deposit removal and technetium-99 cleanup projects, currently conducts environmental sample analysis, and is home base for the NDA Applied Nuclear Technology Lab and Industrial Hygiene Health Physics support group. The Mass Spectrometer Lab still functions.

The X-710 Radiographic Facility is located in Room 202B on the west side of the second floor. The X-ray facility was used to radiograph small valves, sample containers, welds, and other components for determining internal soundness. The facility consists essentially of an X-ray vault that contains an industrial X-ray machine. The vault is 12 ft by 12 ft by 13 ft high. Three walls of the vault are common with adjacent rooms, and these rooms can be isolated during radiographic procedures. The fourth wall of the vault is an exterior wall located 14 ft above ground level. The three inside walls are 2 in. thick and contain 1/8 in. lead sandwiched between steel sheets. The exterior wall is constructed of concrete blocks. The floor is made of 3 in. of reinforced concrete with 12-in. steel beams and is covered with 3/8-in. lead sheeting. The roof has concrete and structural steel joists with nothing located above. Bi-parting access doors open into the control room and are constructed of 1/8 in. lead sandwiched between layers of wood (LMES 1997).

Radiological contamination signs are posted at the entrances to many rooms and 90-day storage areas in the X-710 Technical Service Building, indicating contamination exists in these areas. Laboratory equipment used for radionuclide analysis is also contaminated.

Chemical hazards associated with the X-710 Technical Service Building include the following:

- Heavy metals, mercury, chromium, lead, chlorine trifluoride, Freons, solvents, alcohols, arsenic, PCBs, fluorine, cyanides, oils and greases, asbestos, acids, bases, and other laboratory chemicals (DOE 1993).

- Wastes generated in the building include organic solvents and compounds, inorganic compounds, acid- and base-containing wastes, heavy metals, mixed wastes, and standard industrial wastes.

- The PORTS beryllium initial characterization identified X-710 as containing removable beryllium contamination levels in excess of published DOE release criterion surface limits of 0.2 µg/100 cm^2 (USEC 2004).

- Laboratory hoods may be contaminated with airborne residue from laboratory chemicals (e.g., perchloric acid, etc.).

- ACM is reported in the thermal system insulation around pipes, floor tiles, and steam condensate lines in the building (DOE 1993).

- Lead-based paint is suspected to be on the walls and piping in the building (DOE 1993).

- Equipment used to analyze for PCBs (Room 226) is contaminated. Rooms 331, 200, 201, 218, 226, and 263 were identified as testing, sample preparation, or handling areas for potential PCB-containing samples or reagents (DOE 1993).

- The machine shop (Room 160), weld shop (Rooms 146 and 149), and equipment rooms (166, 171, and 110) contain equipment that requires lube oil and various other greases. Stains in the rooms and on the equipment may be a source of PCB contamination from lubricating oils used in the past (DOE 1993).

- Fluorescent light ballasts are a potential source of PCBs (DOE 1993).

4.1.3.3.2 X-710A Technical Service Gas Manifold Shed

The X-710A Gas Manifold Shed, built in 1955, is a 37-ft-long, 26-ft-wide, open-air structure for the receiving, storing, and distribution of specialized high-pressure gases used in the laboratory areas of the X-710 Technical Service Building. It has a 6-ft-wide loading dock that extends the full length of the shed. The structure is located on the west side of the X-710 Technical Service Building and is served by a paved parking lot and driveway on 9th Street. The structure has a concrete platform and a shed-type, transite panel roof supported by steel framing. The structure is built approximately 4 ft off the ground. There are no walls, only a high chain-link fence to secure and enclose the gas manifolds and cylinder storage area. A concrete wall oriented north-south divides the shed into an east side and a west side. One area contains oxygen cylinders while the other contains hydrogen, liquid propane, and acetylene cylinders. Gas cylinders are connected to regulated piping manifolds serving the X-710 Technical Service Building. Aside from in-service cylinders, empty and full cylinders of these gases can be found at the facility. The function of the X-710A shed has always been to house high-pressure gas manifolds and cylinders for gas used in the laboratory areas of the adjacent X-710 Technical Service Building. Based on reference sources and recent field observations, the shed is lighted by four fixtures that appear to contain mercury vapor lamps (GVI 1961, LMES 1997, DOE 1993, TPMC 2006).

Compressed gas cylinders of oxygen, hydrogen, acetylene and liquid propane are possible sources of contamination. ACM is present in the corrugated transite roofing on the shed. Lead-based paint may be present on the piping (connected to cylinders) that transports gases to the laboratory and the cylinders themselves. Mercury may be present in mercury vapor lamps (DOE 1993).

4.1.3.3.3 X-710B Explosion Test Facility

The X-710B Explosion Test Facility, built in 1956, is a reinforced concrete structure located approximately 75 ft west of the X-710 Technical Service Building. The building was built to conduct experiments with unstable compounds that might result in an explosion. It consists of an approximately 12-ft by 14-ft laboratory/control room area with an adjacent circular explosion test chamber, approximately 8 ft in diameter and 10 ft in height, equipped with explosion vents to relieve explosive pressure. The work area is separated from the test chamber by a shock-absorbing expansion joint. The building has 245 sq ft of floor space. A 42-cf fluorine pig is located approximately 12 ft east of the test chamber. Both the fluorine pig and the X-710B Explosion Test Facility are enclosed by a high chain link fence (GVI 1961, LMES 1997, DOE 1993).

The test chamber cannot be entered. A small opening between the laboratory/control room and the test chamber, which can be sealed off, is provided for piping. The explosion vents were directed toward an unoccupied, controlled access area to mitigate any consequences of an explosion in the building. Blast-proof steel doors are provided for exterior access to the test chamber and work area. An 18-in. by 18-in., bullet-proof-glass vision panel and sleeves for remote control were provided for manipulation of test specimens. Other operational equipment included a fume hood with a powered exhauster and an acid-type sink that drained to the acid neutralization pit (GVI 1961, LMES 1997, DOE 1993).

Radiological contamination signs are posted on the door of the X-710B Explosion Test Facility, indicating the presence of radioactive contamination. A historical survey indicated that the radiological contamination is fixed (DOE 1993).

The building has not been used to conduct experiments for several years. Chemical hazards associated with the X-710B Explosion Test Facility include the following:

- ACM associated with wiring and thermal insulation (DOE 1993)
- Due to the age of the building, potential for lead-based paint.

Fluorine has been removed from the gas pig located outside the building. Small gas cylinders of unknown gases reported to be in the building (DOE 1993) have also been removed.

4.1.3.4 X-720 Complex

The major buildings and structures associated with the X-720 Complex are as follows:

- X-720 Maintenance & Stores Building
- X-720A Maintenance & Stores Gas Manifold Shed (below-grade structures)
- X-720B Base Station
- X-720C Paint & Storage Building.

4.1.3.4.1 X-720 Maintenance & Stores Building

The X-720 Maintenance & Stores Building contains 312,000 sq ft of space used for various shop activities, offices, and storage of parts (Figure 4.8). It is also used for testing and inspection of process and auxiliary equipment. The building houses carpenter, paint, sheet metal, utility and process maintenance, electrical, compressor, motor, seal, instrument, crane, sign, valve, gauge, spectrometer, refrigeration shops, and an unclassified vault. The south one-third of the floor space is a stores supply room. A second floor office area is located on the south side. Document records storage has been relocated to the south side. Several office areas are located throughout the building to support the various shops. At the southeast corner, there is a code inspection work area that includes an environmentally-controlled gage laboratory for inspecting parts to dimensional specifications.

Stored raw materials include paints; paint thinners; mineral spirits; glues; wood preservatives; various solvents; toluene reagent; silver plating; nitric acid; phosphoric acid; ammonia; acetone; methyl ethyl ketone; 1,1,1-trichloroethane; acetylene; mercury metal; Freon; motor oil; vinyl toluene; and cleaning/etching solutions. Stored waste included radioactive materials, used acetone, paint waste, rags, wipes, gloves, aerosol cans, fluorescent and other light bulbs, used solvents, PCB oil, and mineral oil. Any currently stored wastes are managed in radioactive material storage areas, satellite storage areas, or RCRA 90-day storage areas.

Figure 4.8. X-720 Maintenance & Stores Building at PORTS

Portions of machine, compressor, motor, instrument, and valve shops are radiological contamination control zones. Fixed contamination is present on the floors of these shops.

ACM is present in thermal piping insulation and floor tile. Because of the building’s age, lead-based paints may have been used in the paint shop and applied to various building surfaces. In addition to the outside PCB-contaminated transformer, the building contains PCB-impregnated ventilation duct gaskets in the ventilation system and fluorescent light fixtures that may contain ballasts with PCBs. Beryllium contamination is present in the compressor shop and some elevated portions of the high bay superstructure.

4.1.3.4.2 X-720B Radio Base Station

The X-720B Radio Base Station is an 800-sq ft metal auxiliary shop building located west of the X-720 Maintenance & Stores Building. The X-720B building, constructed in 1978, was used to store and maintain communications equipment. Currently, the building houses PORTS communications system repeater.

The building has ACM in piping insulation, potential lead-based paint on surfaces, and PCBs in fluorescent light fixture ballasts.

4.1.3.4.3 X-720C Paint & Storage Building

The X-720C Paint & Storage Building is a 4,200-sq ft building located at the northwest corner of the X-720 Maintenance & Stores Building. For approximately 13 years, the building was used for general storage. The building stores a wide variety of paints and solvents in the north half and a variety of lubricating fluids in the south half. No below-grade structures are associated with this building. A pole-mounted, PCB-contaminated transformer is located outside of the building.

4.1.4 Support Facilities and Systems

In addition to the process buildings and complex facilities described in the above sections, this RI/FS evaluation also includes 224 support facilities and systems located throughout PORTS. These facilities are described according to their functional subgroupings in the following paragraphs.

4.1.4.1 Administrative facilities

The administrative facilities include 10 portals, 23 trailers, and 16 other buildings or structures (Table 4.5). The majority of the known or potential contaminants associated with these buildings and structures includes ACM in transite siding, thermal insulation, and floor tile; surfaces covered with lead-based paint; PCBs in ventilation system gaskets, transformers, and fluorescent light fixture ballasts; and mercury in light bulbs and switches.

Table 4.5. Administrative Facilities at PORTS

Facility Number	Name
X-100	Office Building (slab and below-grade structures)
X-104A	Indoor Firing Range Building
X-104B	Protective Forces Office Trailer
X-104C	Protective Forces Shower/Locker Trailer
X-105	Electronic Maintenance Building (front apron/concrete pad and driveway)
X-106B	Old Fire Training Building (slab and below-grade water tank)
X-108A	South Portal and Shelter-Drive Gate
X-108B	North Portal and Shelter
X-108E	Construction Entrance Portal
X-108J	West Security Portal
X-108K	North Security Portal
X-108L	East Security Portal
X-111A	SNM Monitoring Portal
X-111B	SNM Monitoring Portal
X-300	Plant Control Facility
X-300A	Process Monitoring Building
X-300B	Plant Control Facility Carport
X-300C	Emergency Communications Antenna
X-344H	Security Portal
X-530 T1	Office Trailer
X-533H	Personnel Monitoring Station
X-533 T1	Trailer
X-533 T2	Trailer
X-533 T3	Trailer
X-533 T4	Trailer
X-540	Telephone Building
X-600D	Utilities Maintenance Field Office
X-633 T1	Trailer

Table 4.5. Administrative Facilities at PORTS (Continued)

Facility Number	Name
X-633 T2	Trailer
X-633 T3	Trailer
X-720 T01	Office Trailer
X-744Y T1	Trailer
X-744Y T2	Trailer
X-744Y T3	Trailer
X-744Y T4	Trailer
X-744Y T5	Trailer
X-744Y T6	Trailer
X-744Y T8	Trailer
X-744Y T9	Trailer
X-750	Mobile Equipment Maintenance Shop (slab and below-grade structures)
X-751	GCEP Mobile Equipment Garage
X-760 T1	Trailer
X-760 T2	Trailer
X-1000	Administration Building
X-1000 T1	Training Trailer
X-1007	Fire Station
X-1107BV	Interplant Vehicle Portal
XT-800	GCEP Construction Office Pad
J	X-1000 Pavilion

GCEP = Gas Centrifuge Plant
SNM = special nuclear material

4.1.4.2 Water treatment, storage, and distribution facilities

This subgrouping consists of 38 buildings, structures, and systems (Table 4.6). PORTS water system is made up of the raw and make-up water, sanitary water, sanitary fire water, RCW, RHW, and high-pressure fire water systems. PORTS water system is designed to procure, treat, and distribute water of the desired quality for sanitary use, cooling, heating, and fire protection.

Table 4.6. Water Treatment, Storage, and Distribution Facilities at PORTS

Facility Number	Name
X-230	Water Supply Line
X-230A	Sanitary and Fire Water Distribution System
X-230D	Softened Water Distribution System
X-230E	Plant Water System (make-up)
X-230F	Raw Water Supply Line
X-230G	RCW System
X-230H	Fire Water Distribution System
X-240A	RCW System (Cathodic Protection System)
X-605	Sanitary Water Control House
X-605A	Well Field
X-608	Raw Water Pump House
X-608A	Well Field
X-608B	Well Field
X-611	Water Treatment Plant (slab and below-grade structures)
X-611A	Old Lime Sludge Lagoon (structures)
X-611B	Lagoon (structures)

Table 4.6. Water Treatment, Storage, and Distribution Facilities at PORTS (Continued)

Facility Number	Name
X-611B1	Lagoon Supernatant Pumping Station
X-611B2	Lagoon Supernatant Pumping Station
X-611B3	Lagoon Supernatant Pumping Station
X-611C	Filter Building (slab and below-grade structures)
X-611E	Clear Well & Chlorine Building (slab and below-grade structures)
X-612	Elevated Storage Tank (below-grade structures)
X-616	Liquid Effluent Control Facility (foundations and piers)
X-626-1	Recirculating Water Pump House (slab and below-grade structures)
X-626-2	Cooling Tower (below-grade structures)
X-630-1	Recirculating Water Pump House (slab and below-grade structures)
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-630-3	Acid Handling Station (saddles and basin)
X-640-1	Fire Water Pump House (slab and below-grade structures)
X-640-2	Elevated Storage Tank (below-grade structures)
X-640-2A	Elevated Water Tank Auxiliary Building
X-680	Blowdown Sample and Treatment Building
X-701A	Lime House (below-grade structures)
X-701D	Water Deionization Facility (below-grade structures)
X-701E	Neutralization Building
X-701F	Effluent Monitoring Facility
X-2230T1	Recirculating Heating Water System (East of Valve Pits “A” and “B”)

RCW = recirculating cooling water

Raw water is obtained from three sources. It can be pumped from groundwater wells at four well fields (X-605A, X-608A, X-608B, and X-6609 [not addressed in this RI/FS]), from the Scioto River at the X-608 Raw Water Pump House, and/or from the X-611B3 Lagoon (via the X-611B1, B2, and B3 pumping stations). From the well fields and/or the X-608 Raw Water Pump House, the raw water is pumped to the X-611 Water Treatment Plant. At X-611, the raw water is chemically treated and fed into the RCW, RHW, and high-pressure fire water systems via the make-up water distribution system and, after further treatment, into the sanitary water and sanitary fire water systems. The function of the RCW system was to supply cooling water to the process buildings. The heat from compression of the process gas in the process equipment was transferred to the water and then transferred to the atmosphere via cooling towers. The RHW system consists of the necessary piping and equipment to circulate hot RCW return water from the X-330 Building to the X-700 Converter Shop & Cleaning Building, X-705 Decontamination Building, X-720 Maintenance & Stores Building, X-623 North Groundwater Treatment Building, and ACP facilities. The system provided a source of building heating.

In addition to the potential hazards found in the administrative buildings and structures, chromium from the chromium-based corrosion inhibitor (previously used in the RCW and RHW systems) and raw materials used in water treatment (e.g., lime, chlorine, etc.) are potential chemical hazards.

4.1.4.3 Sewage collection and treatment facilities

This subgrouping consists of 10 buildings, structures, and systems (Table 4.7). The storm sewer system receives precipitation runoff and discharges from plant operations. Generally, each storm sewer system discharges into a ditch that runs to a holding pond, drainage ditch, or larger stream. Sanitary sewage from plant operations is fed into a series of underground sanitary sewers that feed into one of the lift stations or pumping stations located around PORTS. The sewage is then routed to the X-6619 Sewage Treatment Plant.

The sanitary sewers and pumping stations have been radiologically contaminated as a result of contaminant releases from other buildings that are serviced by the sewage system. The X-6619 Sewage Treatment Plant has several areas that are radiologically contaminated. Sewage is assumed to contain hazardous materials such as heavy metals, VOCs, SVOCs, PCBs, and biological agents (e.g., *Escherichia coli*). Lead-based paint may have been used to paint pumping and lift stations and the X-6619 Sewage Treatment Plant. Float switches in the wet wells may contain mercury.

Table 4.7. Sewage Collection and Treatment Facilities at PORTS

Facility Number	Name
X-230B	Sanitary Sewers
X-230C	Storm Sewers
X-614A	Sewage Pumping Station (slab and below-grade structures)
X-614B	Sewage Pumping Station (slab and below-grade structures)
X-614D	South Sewage Lift Station
X-614P	North East Sewage Lift Station
X-614Q	Sewage Booster Pump Station
X-615	Old Sewage Treatment Plant (foundations and piers)
X-616	Liquid Effluent Control Facility (foundation and piers)
X-6619	Sewage Treatment Plant

4.1.4.4 Electrical distribution systems and facilities

There are 17 electrical distribution systems and facilities (Table 4.8). These include slabs and below-grade structures, grounding systems, and cables remaining from previous removal actions associated with the X-530A and X-533A High Voltage Switchyard Complexes; above- and below-ground plant electrical power distribution systems and substations; and a pumping station that maintains positive pressure (using nitrogen) on oil-filled underground pipes containing electrical power cables tying to the ACP Switch Yard.

Table 4.8. Electrical Distribution Systems and Facilities at PORTS

Facility Number	Name
X-215A	Electrical Distribution to Process Buildings
X-215B	Electrical Distribution to Other Areas
X-215C	Exterior Lighting
X-215D	Electrical Power Tunnels
X-501	Substation
X-501A	Substation
X-502	Substation
X-515	330 kV Tie Line Between X-530 and X-533
X-530A	High Voltage Switchyard (grounding systems and underground cables)
X-530B	Switch House (slab and below-grade structures)
X-530C	Test and Repair Building (below-grade structures)
X-530D	Oil House (below-grade structures)

Table 4.8 Electrical Distribution Systems and Facilities at PORTS (continued)

Facility Number	Name
X-530E	Valve House (slab and below-grade structures)
X-530F	Valve House (slab and below-grade structures)
X-530G	GCEP Oil Pumping Station
X-640-1A	Substation (required for Fire Services)
C	Old Switch Yard West of X-109A Pad (near X-740)

GCEP = Gas Centrifuge Enrichment Plant

The X-530B Switch House first floor slabs have areas of fixed radiological contamination. Some electrical power cables are lead-shielded and may contain PCB oil. The electrical power tunnels contain transite (ACM) cable trays. Water seeping into the electrical power tunnels may be contaminated with detectable amounts of uranium, technetium-99, chromium, VOCs, and PCBs. Lead-based paint may have been used on surfaces, and residual PCBs may be found in the substations and transformers included in the distribution systems and in fluorescent light fixture ballasts.

4.1.4.5 Miscellaneous utilities

Miscellaneous utilities consist of 10 utility piping systems for the distribution of nitrogen, dry air, steam and condensate, Freon, fluorine, and natural gas. A dry air plant, an associated cooling tower, and a plant nitrogen station are also included (Table 4.9). These structures, because of their presence on a GDP, are assumed to be radiologically or chemically contaminated pending further investigation.

Table 4.9. Miscellaneous Utilities at PORTS

Facility Number	Name
X-232A	Nitrogen Distribution System
X-232B	Dry Air Distribution System
X-232D	Steam and Condensate System
X-232E	Freon Distribution System
X-232F	Fluorine Distribution System
X-232G	Support for Distribution Lines
X-670	Dry Air Plant
X-670A	Cooling Tower
X-675	Plant Nitrogen System
X-2232E	Gas Pipeline

4.1.4.6 Infrastructure

Miscellaneous infrastructure consists of 20 buildings and structures that include sidewalks, roads, railroads, parking lots, fences, tunnels, firing range sheds, coal yard structures, below-grade structures associated with the steam plant, a test site, a powder magazine, and a truck scale (Table 4.10). These buildings and structures, because of their presence on a GDP, are assumed to be radiologically or chemically contaminated pending further investigation.

Table 4.10. Infrastructure at PORTS

Facility Number	Name
X-114A	Outdoor Firing Range
X-202	Roads
X-204-1	Railroad and Railroad Overpass (excluding DUF_6 utilized track)

Table 4.10. Infrastructure at PORTS (Continued)

Facility Number	Name
X-206A	North Main Parking Lot
X-206B	South Main Parking Lot
X-206E	Construction Parking Lot
X-206H	Pike Avenue Parking Lot
X-206J	South Office Parking Lot
X-208	Security Fence
X-208A	Boundary Fence
X-208B	SNM Security Fence
X-210	Sidewalks
X-220A	Instrumentation Tunnels
X-600	Steam Plant (slab and below-grade structures)
X-600A	Coal Yard (structures)
X-690	Steam Plant (new construction)
X-748	Truck Scale
B	Pad in Field East of X-109A (near X-740)
H	Old Firing Range Shed
I	Peter Kiewit Powder Magazine

SNM = special nuclear material

4.1.4.7 Storage and warehouse facilities and yards

This subgrouping consists of 25 buildings, structures, and yards that include warehouses, storage buildings, material storage yards, and cylinder storage yards (Table 4.11).

Table 4.11. Storage and Warehouse Facilities and Yards at PORTS

Facility Number	Name
X-345	SNM Storage Building
X-741	Oil Drum Storage Facility
X-742	Gas Cylinder Storage Facility
X-744K	Warehouse-K
X-744N	Warehouse N Non-UEA
X-744P	Warehouse P Non-UEA
X-744Q	Warehouse Q Non-UEA
X-744V	Surplus and Salvage Clean Storage Area
X-744Y	Waste Storage Area
X-745B	Toll Enrichment Gas Yard
X-745D	Cylinder Storage Yard
X-745F	North Process Gas Stockpile Yard
X-745G-2	Cylinder Storage Yard
X-746	Material Receiving and Inspection (portions of above- and below-grade structures)
X-747	Clean Scrap Yard
X-747A	Material Storage Yard (below-grade structures)
X-747B	Material Storage Yard Pads and Equipment
X-747C	Material Storage Yard Pads and Equipment
X-747D	Material Storage Yard Pads and Equipment
X-747E	Material Storage Yard Pad
X-747G	Precious Metal Scrap Yard (below-grade structures)
X-747H	NW Contaminated Scrap Yard (below-grade structures)
X-747H1	Loading Pad

Table 4.11. Storage and Warehouse Facilities and Yards at PORTS (Continued)

Facility Number	Name
X-747J	Decontamination Storage Yard
XT-847	Warehouse

NW = northwest
SNM = special nuclear material
UEA = uranium enrichment area

Cylinder storage yards store full and depleted 2.5 to 14-ton UF_6 cylinders. Material storage yards and areas store excess or unused equipment (e.g., old cylinder carts, trucks, forklifts); scrap materials and equipment (e.g., valves, converters, air conditioning equipment, wood); new material to be used at PORTS (e.g., waste containers, pallets, wood); and equipment that appears to be actively used (e.g., tanker trailers, vacuum trucks). Storage yards are also used for parking.

The X-744K, N, P, and Q warehouses (Figure 4.9) were used to store lithium hydroxide that may contain mercury.

Storage buildings and structures store special nuclear material, waste oils and chemicals, and gas cylinders.

Due to the nature of the materials and equipment stored in these buildings and structures, the potential exists for both radiological and chemical hazards.

Figure 4.9. X-744K Warehouse at PORTS

4.1.4.8 Environmental monitoring and treatment facilities

This subgrouping consists of 35 buildings, structures, and systems that include weather stations, air and other environmental media monitoring and sampling stations, oil separation stations, and groundwater collection and treatment systems (Table 4.12).

Table 4.12. Environmental Monitoring and Treatment Facilities at PORTS

Facility Number	Name
X-120	Old Weather Station (footers)
X-120H	Weather Station
X-230A3	Ambient Air Monitoring Station
X-230A6	Ambient Air Monitoring Station
X-230A8	Ambient Air Monitoring Station
X-230A9	Ambient Air Monitoring Station
X-230A10	Ambient Air Monitoring Station
X-230A12	Ambient Air Monitoring Station
X-230A15	Ambient Air Monitoring Station
X-230A23	Ambient Air Monitoring Station
X-230A24	Ambient Air Monitoring Station
X-230A28	Ambient Air Monitoring Station
X-230A29	Ambient Air Monitoring Station
X-230A36	Ambient Air Monitoring Station
X-230A37	Ambient Air Monitoring Station
X-230A40	Ambient Air Monitoring Station
X-230A41	Ambient Air Monitoring Station
X-230J-1	Monitoring Station
X-230J1	East Environmental Sampling Building (slab)
X-230J2	South Environmental Sample Station
X-230J3	West Environmental Sampling Building for Intermittent Containment Basin
X-230J4	Environmental Air Sampling Station
X-230J7	East Monitor Facility (East Holding Pond Oil Separation Building)
X-230J5	West Holding Pond Oil Separation Station
X-230J6	Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
X-230J8	Environmental Storage Building (slab)
X-230M	Clean Test Site
X-235	South Groundwater Collection System
X-237	Little Beaver Groundwater Collection System
X-617	South Holding Pond pH Control Facility
X-622	South Groundwater Treatment Facility
X-623	North Groundwater Treatment Building
X-624	Little Beaver Groundwater Treatment Facility
X-625	Groundwater Passive Treatment Facility
X-627	Groundwater Pump & Treatment Facility

The 15 air monitoring stations have continuous, low-volume air samplers that collect particulate radionuclides and gaseous fluorides from the ambient air.

The remaining sampling, monitoring, collection, and treatment buildings, structures, and systems would be expected to be potentially contaminated with radionuclides and hazardous chemicals (e.g., VOCs [mainly TCE], SVOCs, heavy metals, PCBs). Raw materials used in these facilities (e.g., acids, sodium hydroxide) are also a potential contaminant source.

4.1.4.9 Associated nonstructural support systems

Associated nonstructural support systems include 20 systems (e.g., telephone, public address, radio, alarm, etc.) that will be dispositioned as part of the buildings and structures with which they are associated (Table 4.13).

Table 4.13. Associated Nonstructural Support Systems at PORTS

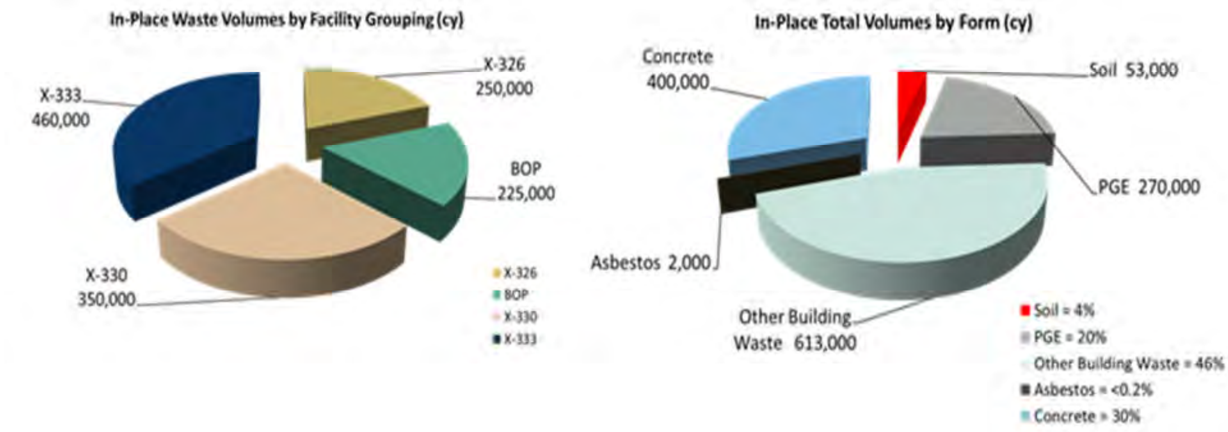
Facility Number	Name
X-220B1	Process Instrument Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines
X-220C	Superior American Alarm System
X-220D1	General Telephone System
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCulloh Alarm System
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System

MSR = maintenance service request
PA = public address
SCADA = Supervisory Control and Data Acquisition

4.2 PROJECT WASTE VOLUMES AND WASTE FORMS

The volume of waste anticipated to be generated from D&D of the buildings and structures included within the scope of this RI/FS is estimated to be approximately 1.34 million in-place cy including 53,000 cy of residual soil. The volume estimates evolved from field studies, process knowledge, building walkdowns (including measurements of building structures and components), and engineering studies, including review of as-built drawings. Figure 4.10 summarizes the estimated D&D waste by form. The primary waste forms are as follows:

- Concrete waste – 30 percent
- PGE waste – 20 percent
- Asbestos – less than 1 percent
- Other building waste – 46 percent
- Residual soil – 4 percent of the total waste volume.



BOP = balance of plant

PGE = Process Gas Equipment

Figure 4.10. PORTS In-Place Volumes by Waste Form and Facility Grouping

Figure 4.10 also shows the waste volume estimate divided among the four major buildings, structures, and systems groupings introduced in Section 4.1. (Residual soil is not included in the first element of Figure 4.10.) The balance of plant buildings include the feed, sampling, and transfer buildings; primary laboratory, maintenance, and equipment cleaning buildings; and the support facilities and systems.

The waste volumes represent in-place volumes, not transported volumes. The vast majority of waste volume (i.e., approximately 83 percent or 1.1 million cy) that would be generated during D&D of the PORTS GDP would originate from the three process buildings (X-326, X-330, and X-333). The waste volumes include the structure of each building, all process and industrial equipment within each building, building slabs, and other subsurface features. The balance of plant makes up approximately 17 percent (225,000 cy) of the total potentially generated waste under this project. Of the 256 buildings, the top 10 with respect to anticipated in-place waste volumes are shown in Figure 4.11.

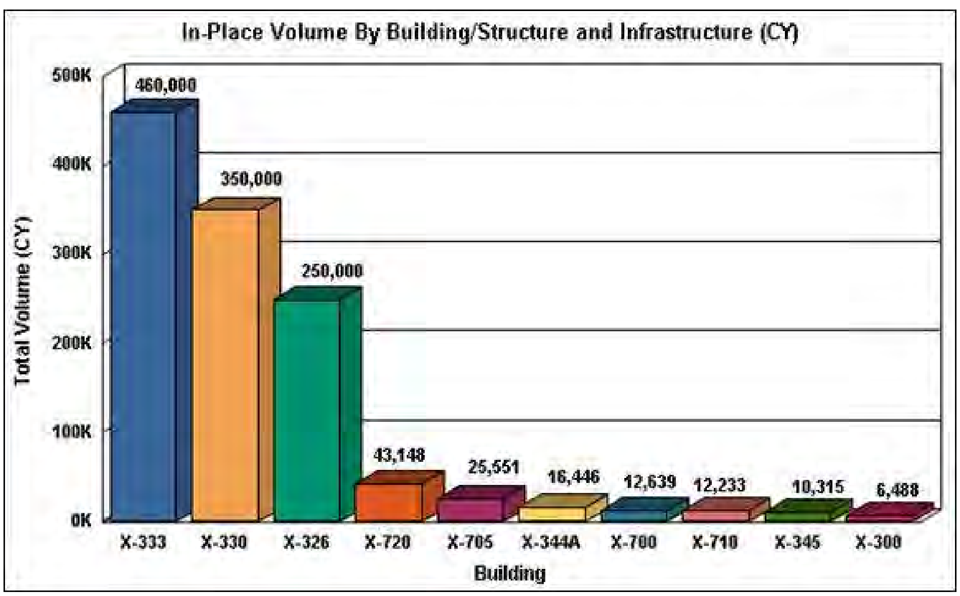


Figure 4.11. Top 10 PORTS Buildings/Structures by Volume

The estimated waste volumes presented in this section are based on a “snap shot” in time. These waste volumes are considered to be within the uncertainty/variability range of +50/-30 percent.

4.3 BASIS FOR ANTICIPATED BUILDING CONDITION AND CONTENT AND IDENTIFICATION OF POTENTIAL UNCERTAINTIES

The information presented in Sections 4.1, 4.2, and Appendix A on the buildings/structures included in this RI/FS has been prepared using construction reports, manufacturers’ manuals (for equipment), audits/assessments (which included building walkdowns), previous investigations, drawings, and process knowledge. Appendix A provides more detailed information that supports the general discussion on the building condition and contents. Fluor-B&W Portsmouth LLC (FBP) maintains a volume database that has estimates for each waste type and form for each building. The database is updated periodically as new information becomes available. Volumes available as of December 2011 are the basis for the estimates in this section.

As described in Section 4.1.1.5, existing NDA surveys show significant amounts of uranium materials within the process equipment, and these measurements are suspected to be high. Some characterization information does exist, and more definitive measurements are being collected to determine the actual uranium holdup. The most recent information is summarized in Section 2. The expected nature of contamination for the subsurface features is primarily based on process knowledge. Any post-ROD work plans would also specify any characterization activities required to identify the location, extent, quantities, and types of wastes associated with the subsurface features. None of these uncertainties are anticipated to affect development and evaluation of the remedial alternatives. Rather, they would only impact identification of data that may be needed to implement the selected remedial action.

Uncertainties are associated with the volume estimates presented in Section 4.2. The larger buildings have been the focus of significant effort in estimating their volumes by using building drawings, supplemented by walkdowns where measurements were taken. Smaller building volumes are often estimated on the basis of footprint size correlated to more detailed estimates of other buildings. However, even with the most attention to detail, actual volumes generated can be different than those estimated because of assumptions needed about interior walls, void spaces, and the presence or absence of miscellaneous materials.

History in demolishing the K-25 GDP has shown disparity between initial volume estimates and final resulting estimates. Table 4.14 illustrates this point with three large East Tennessee Technology Park (ETTP) buildings, one of which is a process building. These building volumes are just for the building shell; equipment is not included. The equivalent PORTS buildings are listed.

Table 4.14. History of ETTP In-Place Volume Estimates

Building (PORTS equivalent)	Original Estimate (cy)	Final Estimate (cy)
K-1401 (X-720)	47,000	16,500
K-1420 (X-705)	8,300	3,600
K-29 shell (top end of X-330)	32,000	25,000

Source: BJC 2010

BJC = Bechtel Jacobs Company LLC
PORTS = Portsmouth Gaseous Diffusion Plant

Similar processes for estimating the initial waste were used at both PORTS and ETTP. This brief history suggests that the waste volume estimates may be high, but these data are not sufficiently robust to make that judgment. Even if each building volume estimate is high, there may be generation of incidental wastes that have not been considered (such as some utilities or subsurface structures), and these wastes would bring the total waste stream volumes to higher levels. Despite these disparities, the overall conclusions as to which buildings are the major contributors to waste volumes, the order of magnitude of the waste volumes, and what types of waste that would be generated if the buildings are demolished are valid to support the development and evaluation of alternatives. The volume is not the driving consideration in the analysis.

HIGHLIGHTS OF SECTION 4

- There are 254 buildings, structures, or facilities in the scope of this decision.
- The majority of the waste volume is from the three process buildings.
- The primary contaminants in the buildings are radionuclides, but there are also asbestos, metals, and organics, including PCBs, present.

NEXT STEP: SECTION 5 PUTS TOGETHER THE COMPONENTS OF THE CONCEPTUAL SITE MODEL AND ASSESSES THE THREAT, THEREBY COMPLETING THE PROBLEM DEFINITION

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5. POTENTIAL THREAT TO HUMAN HEALTH, SAFETY AND THE ENVIRONMENT

Section 5 presents a streamlined evaluation of the potential threat to human health, safety, and the environment from the no-action conditions in which the buildings and structures would eventually degrade and no waste disposition would occur, resulting in releases of contaminants with migration to where exposures to human and ecological receptors may occur. This section uses the sources, migration pathways, and potential receptors described in previous sections to develop a CSM to understand the potential threats to human health and the environment. The potential threat analysis is streamlined because only a comprehensive qualitative analysis of risks to human health and ecological receptors is presented as agreed upon in the DFF&O. This qualitative evaluation of potential threats to human health and the environment is based on the no-action conditions under which the former GDP buildings and structures at PORTS are assumed to no longer undergo surveillance and maintenance (S&M), existing security and institutional controls are eliminated, and the resultant condition is that the buildings degrade and ultimately release currently contained contamination. For the process buildings and complex facilities, this streamlined evaluation has uses PORTS-specific risk guidance for conducting both human health and ecological risk assessments. The human health evaluation is based on the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2013a) [referred to as PORTS Risk Assessment Methods Document]. The ecological evaluation is based on the *Methods for Conducting Ecological Risk Assessments and Ecological Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2013b).

The potential threat to human health is assessed comprehensively, but qualitatively in Section 5.1. The potential effects to ecological species are addressed qualitatively in Section 5.2. On the basis of the evaluations presented in this section, the no action alternative is shown to present an unacceptable level of risk to human health and ecological receptors. On the basis of this unacceptable risk, remedial actions are warranted.

5.1 POTENTIAL THREAT TO HUMAN HEALTH

A streamlined evaluation of risk to human health for the no-action condition was conducted for purposes of determining whether remedial actions are warranted and to establish a risk analysis in support of developing and evaluating alternatives. To support the presentation of this risk evaluation, a previously established segmentation of PORTS, termed “quadrants,” was employed. Four quadrants were previously defined for purposes of conducting historical environmental clean-up activities at PORTS. These four quadrants encompass all areas on the DOE PORTS reservation. Evaluating the potential threat to human health using this quadrant approach permits the risk evaluation to consider unique building conditions and hazardous material inventories in the buildings within each quadrant and the likelihood of these buildings to contribute additional contaminant mass to the exposure locations within each quadrant. Relating the known conditions within the buildings to the relevant environmental data provides information on not only the release potential of the remaining hazardous materials in the buildings, but also on the relative movement of many of these same materials, in the form of contaminants, in the environment as a result of historical spill and release events.

Using the four-step process outlined in the PORTS Risk Assessment Methods Document (DOE 2013a), this qualitative human health risk evaluation identifies potential site-related contaminants using previous investigations and process knowledge and develops an exposure CSM to identify the sources of the COPCs, their likely migration pathways and potential exposure routes, and their ultimate fate in the environment. Finally, using the transport and fate results along with toxicity information, the contaminants of concern (COCs) are identified for applicable receptors. The PORTS-specific guidance focuses primarily on quantitative risk assessments. The qualitative risk assessment in this RI/FS uses the same steps, but each step is conducted on the basis of process and plant knowledge instead of contaminant-specific data. For instance, the potential COPC identifications are based on operations that occurred in the various buildings or on environmental data associated with past releases from the buildings. They are not based on a screening of building analytical data against risk-based levels. Likewise, the final identification of COCs and potential exposure pathways of concern are based on process knowledge about the prevalence of contamination sources and their likelihood to release, as well as their fate in the environment. In summary, risk is characterized in this analysis by qualitatively integrating process information and toxicity information about the contaminants likely to be present with exposure information for hypothetical receptors.

This streamlined evaluation includes the risk from not conducting D&D action, which is the no-action alternative. Under the no-action alternative, no D&D, S&M activities, or institutional controls would occur, and the equipment, buildings, and structures would continue to deteriorate. Structures would gradually degrade and ultimately fail. No waste management practices would be in place to remove the waste from PORTS. The resulting waste would be left where it falls, and uncontrolled dispersion of contaminants from within the structures and equipment eventually would occur. Natural structural degradation is a slow process characterized by incremental degradation of structural components eventually leading to episodic collapse. Therefore, persons in and around the deteriorating buildings would be at risk from physical hazards such as being struck by falling structural components or collapse of floors resulting in falls.

5.1.1 Contaminant Identification

COPCs are those contaminants that are associated with plant operations and could have a detrimental impact on human health if exposure occurs. For this qualitative assessment, the identification of COPCs for human health results in the same COPCs for ecological receptors. First, a list of contaminants identified in earlier investigations during the RFI in potentially contaminated areas at PORTS was obtained and evaluated. (These data differ from the data collected during this RI, which was collected in support of evaluating a potential OSDC.) While this RI/FS does not focus on environmental media, the earlier investigations illustrate what has been released to the environment historically. Even if these contaminants were identified in soil, they likely represent releases from activities that occurred originally in or around the buildings or as a result of waste generated in or around the buildings. Then COPCs for this evaluation are identified by considering the history and operations that occurred in the major buildings in each PORTS quadrant and by identifying chemicals or radionuclides that are still likely to be present in enough mass to potentially release and be a threat to human health in the future. Historical uses of chemicals that are no longer present may present a risk from exposure to environmental media, but they would not be a future risk from a release at a degrading building and, therefore, would not be identified as COPCs for purposes of this RI/FS. The COPCs associated with the PORTS buildings considered to have the highest potential for exposure to receptors are identified by quadrant in Table 5.1. Figure 5.1 identifies the locations of the four quadrants and their associated groundwater flow directions. The operational history and building contaminants that support the COPC selections are discussed in Section 4 and Appendix A.

Table 5.1. PORTS Buildings with the Highest Potential for Exposure of Receptors and Associated Chemicals of Potential Concern

Quadrant	Buildings	COPCs
Quadrant I	• X-710 Technical Service Building • X-710A Technical Service Gas Manifold Shed • X-710B Explosion Test Facility	• Uranium (uranium-234, uranium-235, uranium-238) • Total uranium • Technetium-99 • VOCs (e.g., TCE) • SVOCs • PCBs • Cyanides • Asbestos-containing materials • Lead • Mercury • Chromates
Quadrant II	• X-700 Converter Shop and Cleaning Building • X-721 Radiation Instrument Calibration • X-705 Decontamination Building • X-705D Heat Booster Pump Building • X-705E Oxide Conversion Area • X-720 Maintenance & Stores Building • X-720C Paint & Storage Building	• Uranium (uranium-234, uranium-235, uranium-238) • Total uranium • Technetium-99 • Neptunium-237 • Plutonium-239 • VOCs (e.g., TCE) • PAHs • PCBs • Freon-502, Freon-22 • Asbestos-containing materials • Arsenic • Beryllium • Cadmium • Chromates • Lead • Mercury • Nickel • Titanium • Zinc
Quadrant III	• X-330 Process Building • X-326 Process Building	• Uranium (uranium-234, uranium-235, uranium-238) • Total uranium • Technetium-99 • Neptunium-237 • Plutonium-239 • Freons • VOCs (e.g., TCE) • SVOCs • PCBs • Asbestos-containing materials • Arsenic • Barium • Beryllium • Cadmium • Chromates • Lead • Mercury • Silver

Table 5.1. PORTS Buildings with the Highest Potential for Exposure of Receptors and Associated Chemicals of Potential Concern (Continued)

Quadrant	Buildings	COPCs
Quadrant IV	• X-333 Process Building • X-342A Feed Vaporization Building • X-342B Fluorine Storage Building • X-344A UF_6 Sampling Facility	• Uranium (uranium-234, uranium-235, uranium-238) • Total uranium • Technetium-99 • Plutonium-239 • Neptunium-237 • Freons • VOCs (e.g., TCE) • SVOCs • PCBs • Asbestos-containing materials • Chromates • Mercury • Potassium fluoride • Lithium fluoride • Hydrogen fluoride • Arsenic • Barium • Beryllium • Cadmium • Lead • Silver

COPC = chemical of potential concern
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TCE = trichloroethene
VOC = volatile organic compound

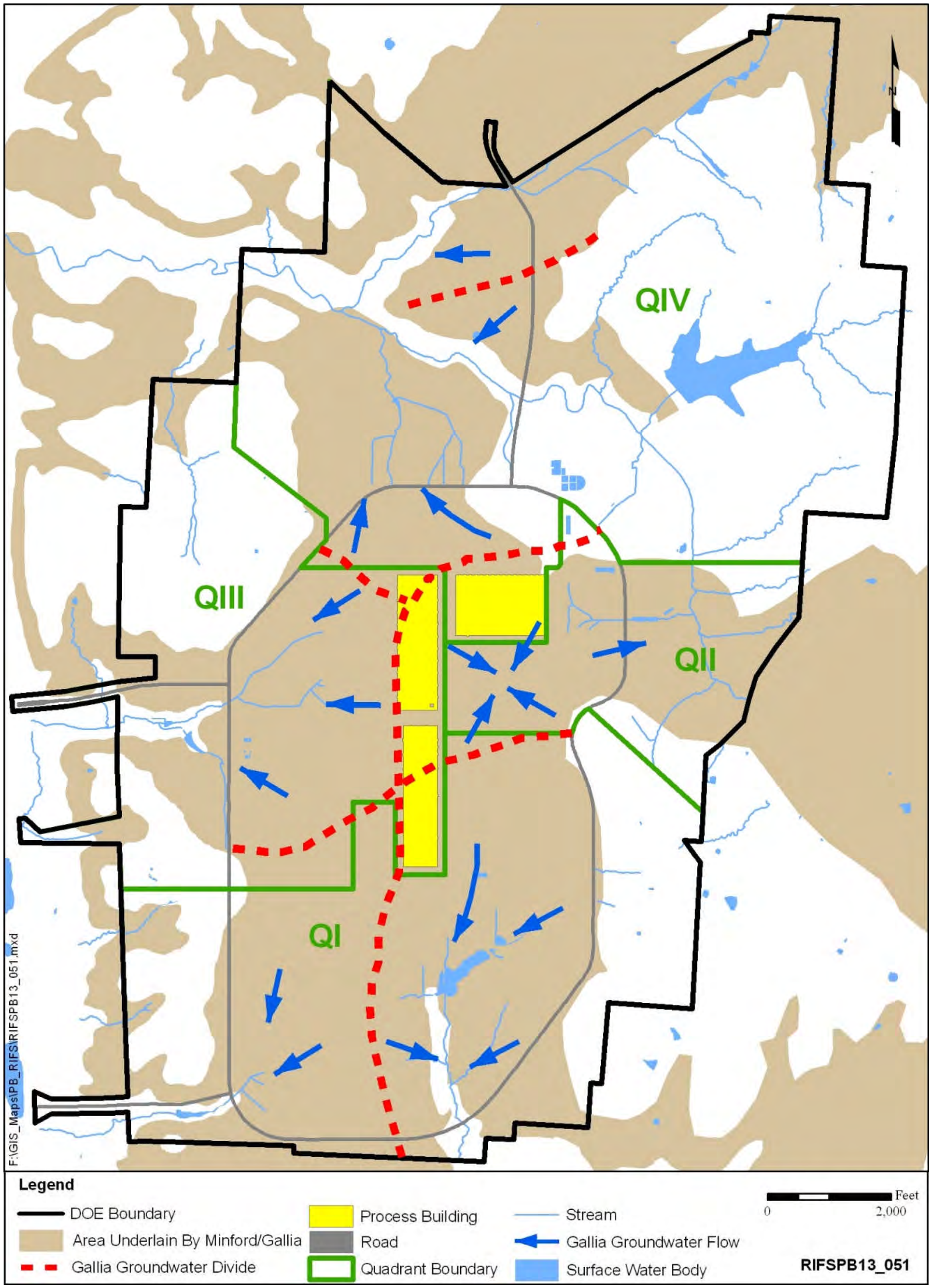

Figure 5.1. PORTS Quadrants and Groundwater Flow

5.1.2 Exposure Assessment

Exposure of potential receptors to COPCs in each quadrant depends on the physical setting of the area, how contaminants migrate from the sources, and the resultant contaminated media. The buildings listed on Table 5.1 are the main sources of the current and future contamination within each quadrant at PORTS. Exposures could be expected from other buildings, but these are the major contributors to potential future threats to human health and the environment. As noted above, documented releases from these buildings and others have contributed to the contaminated environmental media, resulting in the identification of COPCs in Table 5.1. Because these constituents remain in the buildings, future releases as the buildings degrade could increase contaminant mass in media outside the buildings.

To gain a better understanding of how contamination can move through PORTS, a brief description of the groundwater and basic soil characteristics is provided. Groundwater flow at PORTS can generally be divided into four separate flow quadrants, as indicated by the blue arrows in Figure 5.1. The direction of groundwater flow in Quadrant I, the southern portion of PORTS, is controlled by the presence of surface drainages (Big Run Creek and the Southwest Drainage Ditch), the storm sewer system, and bedrock topography. Based on the soils located in this quadrant, contaminants are expected to migrate slowly because of the clay characteristics. Groundwater flow in Quadrant II, in the eastern flow region, is bounded by Little Beaver Creek and serves as the local surface water discharge point for shallow groundwater. Because of the thick shale and abundance of clay minerals, the retardation of contaminants is great, and contaminant movement is expected to be very slow. Groundwater flow in Quadrant III, the western flow region, is primarily influenced by the X-2230N Holding Pond and the West Drainage Ditch. Contaminant migration through the soil in Quadrant III is expected to be similar to that in Quadrant I. Groundwater flow in Quadrant IV, in the northern portion of the PORTS Facility, is strongly controlled by Little Beaver Creek, the North Drainage Ditch, and to a lesser extent, the Northeast Drainage Ditch. Based on the thick shale and clay minerals, contaminant movement through the soil to groundwater in Quadrant IV is greatly retarded.

As the buildings degrade, contaminants will be released by surface rinse/runoff for any removable contamination. As the buildings and equipment further degrade over time and the PGE breaches, further releases of contamination will occur. The surrounding soil and sediments would be the first media to become contaminated. Surface water runoff, air dispersion, and deposition would increase the spread of contamination. Mobile contaminates would move via overland flow and through soil via infiltration, moving to surface water bodies and groundwater, respectively. Previous RCRA investigations (DOE 1996a, 1996b, 1996c, and 1996d) noted that exposures to COCs included chlorinated hydrocarbons and metals in groundwater to a hypothetical future on-PORTS resident. There is some evidence that low concentrations of PCBs are in soils (Quadrants I, II, III) and migrating to surface water bodies (Quadrant I).

The following paragraphs present general information on the mobility and chemical characteristics of several of the COPCs identified in the previous section and how they behave in various environments. This information supports a determination of which media are likely to be influenced by future releases of these contaminants.

Asbestos - Asbestos is the name given to a group of fibrous, naturally occurring silicate minerals. They are resistant to heat and most chemicals; therefore, they are used in insulation materials. The fibers do not evaporate into air or dissolve in water and are for all practical purposes inert. They do not tend to migrate through soil (Barbalace 2004). However, they can become airborne as particulate matter, referred to as friable asbestos. As a result, they can contaminate the surface soil around a building in which they have been used as construction materials.

PCBs - PCBs are a class of chemicals in which two to 10 chlorine atoms are attached to a biphenyl molecule. The PCB compounds are categorized by their degree of chlorination. PCB compounds in the United States were produced under the trade name Aroclor. The two prevalent congeners of the Aroclors at PORTS (and those sampled in the previous RCRA investigations) are Aroclor 1254 and Aroclor 1260. The water solubility and organic carbon partition coefficient of each are listed below. Aroclor 1254 has more than an order of magnitude greater solubility than Aroclor 1260, but both have fairly low solubilities. The organic carbon partition coefficient or K_{oc} indicates the tendency of a chemical to adhere to organic carbon. The higher the K_{oc} value, the more likely the chemical adheres to organic material in soil, sediment, or suspended particles in water. PCBs are very persistent as they do not readily break down in the environment. In water, a small amount of PCBs may remain dissolved and thus can migrate, although most are adsorbed onto organic particles and bottom sediments. Table 5.2 presents the solubility and organic carbon partition coefficient data for the two PCB congeners.

Table 5.2. Chemical Parameters for PCBs

PCB	Water Solubility (mg/L)	Organic Carbon Partition Coefficient (mL/g)
Aroclor 1254	0.0034	75,600
Aroclor 1260	0.000284	207,000

Source: ORNL 2011

ORNL = Oak Ridge National Laboratory
PCB = polychlorinated biphenyl

Chromium - Chromium occurs in nature, mostly as chrome iron ore or chromite. Although widely distributed in soils and plants, it is rare in natural waters. In most soils under reducing conditions, chromium will be present predominantly in the chromium III state, which has low solubility and very low mobility. Thus, chromium does not move significant distances in soil. A field trial on the application of wastewater treatment sludge to soils found movement of heavy metals, including chromium, from the soil surface to a depth of 10 cm, but most of the metal remained in the upper 5 cm of soil. Thus, chromium is not likely to migrate from soil to groundwater. However, the chromium VI species may be present, particularly under highly oxidizing conditions. Because of the higher solubility of chromium VI, its mobility in groundwater is higher. Chromium has been detected in groundwater at PORTS. Chromium compounds are very persistent in surface water. Most of the chromium in surface waters may be present in particulate form as sediment. The exact chemical forms of chromium in either medium are not well defined because species analysis is not typically conducted at PORTS. The solubilities of several chromium compounds are listed in Table 5.3. To account for the uncertainties in chromium oxidation states in the environment in the absence of specific sample data, the streamlined risk assessment assumes that the more toxic chromium VI, as well as the less toxic chromium III species, is represented by the total chromium sample results. This provides an assessment of risks associated with exposures to chromium and assures that, if warranted, remedial actions specific to chromium may be considered.

Table 5.3. Solubility of Chromium Compounds

Chemical Form	Chromium Oxidation State	Solubility	Units
Chromium chloride	+2	Soluble in cold water	NA
Chromate (lead salt)	+6	0.2	mg/L
Chromate (sodium salt)	+6	873	g/L at 30°C
Dichromate (sodium salt)	+6	2,380	g/L at 0°C
Chromium dioxide	+4	insoluble	NA
Chromium sulfate	+2/3	insoluble	NA
Chromium trioxide	+3	617	g/L at 0°C

Source: EPA 2011b

EPA = U.S. Environmental Protection Agency
NA = not applicable

Technetium - Technetium exists in valence states from +7 to -1. The most stable states in the environment are +7 and +4. In the +7 state (oxidizing conditions), dissolved technetium exists as the pertechnetate anion, which is highly soluble and mobile in most oxidizing systems. In the +4 state, technetium exists as the tetravalent cation and is relatively immobile (EPA 2004). Several studies have evaluated soil partition coefficient or K_d values. Site-specific K_d values have been measured for various geologic materials at PORTS. The technetium-99 K_d value measured in the Minford Formation ranged from 2.72 to 4.97 mL/g, indicating moderate potential for migration. Technetium-99 degradation occurs as a result of radiological decay. However, the radiological half-life (time required for half of the concentration to be lost due to degradation) is extremely long and thus appreciable degradation will not occur.

Uranium - Uranium can exist in the +3, +4, +5, and +6 oxidation states. The +4 and +6 states are the most common in the environment. These oxides are not very soluble, but will gradually form hydrated uranium oxides in moist conditions. They will slowly dissolve and be transported into the surrounding soil, pore water, and groundwater. The +6 form (uranyl ion) can be adsorbed to clays and organic compounds. The solid phases of the uranium +4 state have relatively low solubilities, and their concentrations in water are relatively low (3-30 mg/L). The +4 state typically adsorbs strongly to mineral surfaces and partitions into organic matter. These properties lead to its reduced mobility in water (EPA 2006). The form of uranium inside the PGE at removal is UO_2F_2 with minor residual UF_6, which upon contact with moisture will form HF and UO_2F_2. Although this form of uranium is soluble, it does not migrate. Placement of equipment with residual UO_2F_2 in scrap yards or landfills has not shown uranium migration to water sources, thus indicating an insoluble form of uranium being formed shortly after leaving the fluoride compound in the environment (perhaps due to the clay minerals in soil). The measured K_d in the Minford soil formation varies from 3.67 mL/g to 118 mL/g indicating little potential for mobility. Further evidence of the lack of mobility of uranium is shown via the historical soil data for PORTS, where detections of total uranium are found in the surface soils (0 to 2 ft), lesser in subsurface soils (0 to 10 ft) and very rarely in water samples. There are some detections of total uranium in sediment samples, which most likely are from washout and overland movement. Uranium degradation occurs as a result of radiological decay, generating a variety of radium isotopes. However, the radiological half-lives of the uranium isotopes are extremely long and thus appreciable degradation will not occur.

TCE - TCE is a nonflammable, colorless liquid at room temperature and has a somewhat sweet odor. It is mainly used as a solvent to remove grease from metal parts. Volatilization is the primary means of eliminating TCE from soil. Henry's Law constant (0.403) and vapor pressure (69 mm Hg) indicate a propensity to volatilize or partition to the air phase. TCE is readily mobile in soil and is primarily affected by the organic carbon content (Log K_{oc} values range from 2.03-2.66 mL/g) (Garbarini and Lion 1986). TCE that has not volatized tends to migrate to groundwater (solubility at 20°C is 1.070 g/L) (Agency for Toxic Substances and Disease Registry [ATSDR] 1997a). While TCE in surface water readily evaporates, it can remain in groundwater for long periods of time. Degradation of TCE in groundwater occurs with a half-life of approximately 10 years.

Under a no-action alternative, building S&M is assumed to cease, building waste would not be disposed of properly, and contaminants found in the buildings, including those in PGE, would be released to the environment. Therefore, there is the potential that receptors could come onto PORTS and be directly exposed to the contaminants in the buildings or waste after degradation begins. The CSM (Figure 5.2) shows the interrelationship between the sources of contamination and the potential receptors, including on-PORTS receptors (residents, trespassers, and industrial workers) and off-PORTS receptors (plant neighbors and other members of the public near PORTS).

The exposure assessment identifies and provides a discussion of the potential receptors that could be exposed to contaminants in the buildings or media as a result of transport from the contaminant sources, previously described, to the locations where receptors come into contact with these contaminants. The receptors considered in this streamlined evaluation of threats to human health include both on-PORTS (within the boundary of the PORTS Facility) and off-PORTS (outside the boundary of the PORTS Facility) receptors in the most likely down-gradient locations from the sources. Potential receptors are identified along with the exposure pathways associated with the various exposure media. The following sections present the exposure assessment by receptors, located both on PORTS and off PORTS.

On-PORTS receptors

Three types of receptors were considered for the on-PORTS scenario: a trespasser, an on-PORTS industrial worker, and an on-PORTS resident. Under the no-action alternative, receptors may trespass into the decaying or fallen buildings. There is also a potential for other on-PORTS receptors, including on-PORTS general industrial workers and future on-PORTS residents at the PORTS Facility, to be exposed to contaminants from the process buildings, complex facilities, and other support facilities. Such exposures could occur by inappropriate future use of the buildings and equipment/materials in them or if migration of contaminants from the buildings occurs. In the case of on-PORTS users of the buildings or waste piles, direct contact with contamination is likely. Although most of the contamination is contained in secondary structures (PGE), it could be released through metal oxidation (corrosion) and ultimately be washed out through breaches in the metal or through active physical disturbance. While corrosion rates vary widely based on metallic make-up and environmental conditions, corrosion of the equipment shells will occur and may accelerate once removed from the protection of the building structure. In addition to being directly exposed to contaminants in the building surfaces or associated waste, contaminants released from the buildings could migrate into immediately surrounding environmental media. The migration pathways include the migration of contaminants in air (as dust particulates and/or volatilization), surface water as runoff, and groundwater.

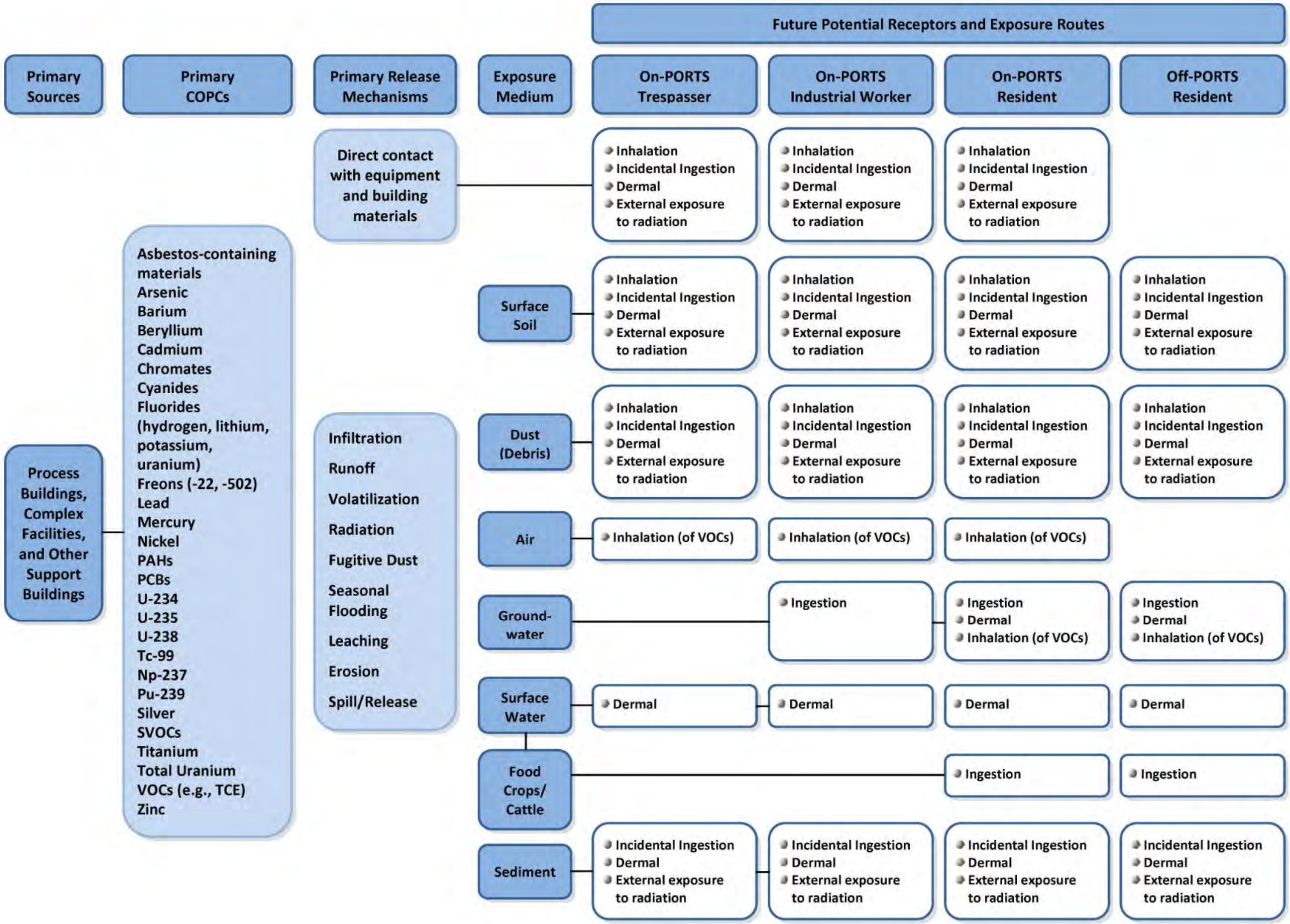

Figure 5.2. PORTS Conceptual Site Model for Human Receptors

- Trespassers – The trespasser is assumed to periodically traverse the industrialized area of PORTS, perhaps exploring or recreating in or immediately adjacent to the buildings. They would have intermittent exposure to building materials and to the contents within the buildings, including potentially stored solvents. They would also have exposure to soil adjacent to the buildings which may have become contaminated. The exposure routes of concern for the trespasser include:

    - Inhalation of particulates from contaminated equipment and building materials, dust from waste, surface soil, and VOCs in air (near dip vats)

    - Incidental ingestion of particulates from contaminated equipment and building materials, dust from waste, surface soil, and sediment

    - Dermal contact from contaminated equipment and building materials, dust from waste, surface soil, sediment, and surface water

    - External exposure from ionizing radiation from contaminated equipment and building materials, dust from waste, surface soil, and sediment.

- On-PORTS Industrial Worker – This receptor is a worker whose activities are in or near the deteriorating structures. The individual uses the building or building waste inappropriately in the future under a loss of institutional controls. The worker could be working inside or outside. The worker would consume groundwater from PORTS. It is also assumed that the workers would not consume surface water from PORTS but that they could have contact with nearby surface water bodies. The exposure routes of concern for the on-PORTS industrial worker include:

    - Inhalation of particulates from contaminated equipment and building materials, dust from waste, surface soil, and VOCs in air (near dip vats)

    - Incidental ingestion of particulates from contaminated equipment and building materials, dust from waste, surface soil, and sediment

    - Dermal contact from contaminated equipment and building materials, dust from waste, surface soil, surface water, and sediment

    - External exposure from ionizing radiation from contaminated equipment and building materials, dust from waste, surface soil, and sediment

    - Ingestion of groundwater.

- On-PORTS Resident – The on-PORTS resident is an upper bound receptor and assumes that humans set up residence adjacent to or among the deteriorating structures. It is an unlikely receptor but is included in this analysis as a reference point for decision makers. This receptor is assumed to engage in subsistence farming and uses groundwater from PORTS. Surface water is assumed to be used as an irrigation source for crops instead of groundwater as the groundwater yields on PORTS are typically low. The median yield for the Gallia is reported to be 0.6 gpm, which is equivalent to only 864 gpd. While this yield may be sufficient for small household use, numerous wells would be required to support irrigation. For example, the minimum yield to irrigate 1 acre is 5 to 10 gpm, operated approximately 20 hours per day (6,000 to 12,000 gpd for 1 acre) during the summer. The exposure routes of concern for the on-PORTS resident include:

- o Inhalation of particulates from contaminated equipment and building materials, dust from waste, surface soil, VOCs in air (near dip vats), and groundwater

- o Incidental ingestion of particulates from contaminated equipment and building materials, dust from waste, surface soil, and sediment

- o Dermal contact from contaminated equipment and building materials, dust from waste, surface soil, surface water, sediment, and groundwater

- o External exposure from ionizing radiation from contaminated equipment and building materials, dust from waste, surface soil, and sediment

- o Ingestion of groundwater and food crops and livestock (cattle) irrigated by surface water.

Off-PORTS receptors
The off-PORTS receptor considered is a resident, the receptor with the highest exposure parameters as compared to other receptors. Currently, contaminated air, soil/sediment, and surface water on PORTS have not reached any off-PORTS media with which an off-PORTS residential receptor may come in contact (DOE 2010a, 2010b). In 2004, TCE was detected in groundwater from an off-PORTS monitoring well south of the DOE property, however, TCE levels were less than the drinking water standard of 5µg/L. Mitigation measures have been put in place, and recent monitoring data indicates that the off-PORTS TCE contamination has been reduced to non-detectable levels (DOE 2012a).

- Off-PORTS Resident – This is a neighbor who lives along PORTS boundary and could be potentially exposed on a long-term basis to contaminants released from the buildings and migrating off PORTS.

  Under the no-action alternative, there is a potential for off-PORTS residents near the PORTS boundary to be exposed to contaminants migrating from the deteriorating process buildings, complex facilities, and other support facilities. Contamination off PORTS could result from the migration of contaminants in air (as wind-generated particulates), surface water as runoff, and groundwater. The potential exposure routes of concern from these migration pathways would include the following:

  - o Inhalation of particulates from wind-blown dust from waste and surface soil and VOCs in groundwater

  - o Incidental ingestion of particulates from wind-blown dust from waste and surface soil as well as sediment

  - o Dermal contact from wind-blown dust from waste and surface soil as well as surface water, sediment, and groundwater

  - o External exposure from ionizing radiation from wind-blown dust from waste and surface soil as well as sediment

  - o Ingestion of groundwater and food crops and livestock (cattle) irrigated with surface water.

Potential residential exposure to surface water, as shown in the CSM (Figure 5.2), would also be a secondary exposure pathway because surface water could be used for irrigation of crops and as a drinking source for cattle. However, this pathway is considered marginal in terms of exposure relative to the other primary exposure pathways.

5.1.3 Toxicity Assessment

Table 5.4 presents the carcinogenic class, primary human health exposure pathways, and primary target organs for potential systemic and/or cancerous effects from the expected COPCs. A brief summary of effects and toxicity is also provided.

Table 5.4. Health Data for Expected Chemicals of Potential Concern in Process Buildings and Complex Facilities at PORTS

Contaminant of Primary Concern	Carcinogen Class[a]	Human Health Exposure: Primary Pathway(s) of Concern	Primary Target Organ(s) (for Systemic and/or Cancer Effects)	Reference for Carcinogen Class and Target Organs
Arsenic	A	Ingestion, inhalation	Liver, skin, gastrointestinal tract, bladder, lungs, kidney, nasal passages, liver, respiratory tract, prostate	EPA 2012 (IRIS)
Asbestos (friable)	A	Inhalation	Lung, asbestosis, mesothelioma	EPA 2012 (IRIS)
Barium	D	Ingestion	Gastrointestinal	EPA 2012 (IRIS)
Beryllium (and compounds)	B1	Inhalation, ingestion	Lung, bone, liver, kidneys, nasal ulcers, small intestine, spleen, berylliosis	EPA 2012 (IRIS)
Cadmium	B1	Inhalation, ingestion	Lung, kidney, prostate, bladder, stomach, bones, (toxic)	EPA 2012 (IRIS)
Chromium VI	A	Ingestion, inhalation, dermal	Lung, developmental effects, skin, gastrointestinal, stomach ulcers, male reproductive system	EPA 2012 (IRIS)
Cyanide	D	Inhalation, oral, dermal	Lung, central nervous system, convulsions	ATSDR 2006
Fluorides (Hydrogen)	D	Inhalation, ingestion, dermal	Lung, gastrointestinal, heart, skeletal, liver, and kidney	ATSDR 2003
Freons	D	Inhalation, dermal	Lung, skin	Brown 1988
Lead	B2	Ingestion, inhalation	Central nervous system, bone, kidney, neuropsychological impairment	EPA 1989; EPA 2012 (IRIS)
Mercury (elemental)	D	Inhalation of vapors	Central nervous system, kidney, developmental effects, gastrointestinal, eyes, urinary system	EPA 2012 (IRIS)
Nickel (insoluble compounds)	A	Inhalation, ingestion	Lungs, nasal, respiratory tract, kidney, immune system effects	ATSDR 2005
PAHs	B1-B2	Inhalation, ingestion, dermal	Lung, stomach, skin	ATSDR 1995
PCBs	B2	Ingestion, inhalation, dermal	Liver, hepatocellular tumors	ATSDR 2000

Table 5.4. Health Data for Expected Chemicals of Potential Concern in Process Buildings and Complex Facilities at PORTS (Continued)

Contaminant of Primary Concern	Carcinogen Class	Human Health Exposure: Primary Pathway(s) of Concern	Primary Target Organ(s) (for Systemic and/or Cancer Effects)	Reference for Carcinogen Class and Target Organs
TCE	C-B2	Inhalation, ingestion, dermal	Liver, kidney, skin, reproductive system, blood, central nervous system, lungs	EPA 2012 (IRIS)
Uranium-total (soluble compounds)	D	Inhalation, ingestion	Lungs, kidney, DNA damage	EPA 2012 (IRIS)
Silver	D	Inhalation, dermal	Lungs and skin	EPA 2012 (IRIS)
Titanium (titanium tetrachloride)	D	Inhalation, dermal	Lung, skin	ATSDR 1997b
Zinc	D	Inhalation, ingestion	Lung	EPA 2012 (IRIS)
Uranium-234	A	Ingestion, inhalation, external exposure to radiation	Kidney, lung, tumors, brain, liver, reproductive effects	ATSDR 2011
Uranium-235	A	Ingestion, inhalation, external exposure to radiation	Kidney, lung, tumors, brain, liver, reproductive effects	ATSDR 2011
Uranium-238	A	Ingestion, inhalation, external exposure to radiation	Kidney, lung, tumors (kidney, brain, liver), reproductive	ATSDR 2011
Neptunium-237	A	Inhalation, ingestion, external exposure to ionizing radiation	Lungs, bones/skeleton surface, liver, developmental effects	IARC 2001
Plutonium-239	A	Inhalation, ingestion, external exposure to ionizing radiation	Lungs, respiratory tract, liver, bones/skeleton surface, developmental effects	IARC 2001; ATSDR 2010
Technetium-99	A	Ingestion, inhalation, external exposure to radiation	Thyroid, gastrointestinal	EPA 2002; EPA 2010

[a]Class A = human carcinogen, Class B1 = probable human carcinogen with limited human data, Class B2 = probable human carcinogen with sufficient evidence in animals, Class C = possible human carcinogen, and Class D = not classified (EPA 1989).

ATSDR = Agency for Toxic Substances and Disease Registry
DNA = deoxyribonucleic acid
EPA = U.S. Environmental Protection Agency
IARC = International Agency for Research on Cancer
IRIS = Integrated Risk Information System
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TCE = trichloroethene

Asbestos is a Class A carcinogen, which means it is known to cause cancer (asbestosis) in humans, based on epidemiological studies. If appropriate controls are not in place, asbestos has the potential to affect human health and the environment. Chrysolite, the most commonly found form of asbestos, is present in the transite siding at a volume of 12-50 percent. This asbestos would continue to become more brittle and friable if not removed. Other forms of asbestos exist in insulation on piping and may become friable as the buildings degrade. Uncontrolled releases of asbestos present a risk to human health and the environment. The exposure pathway for asbestos would most likely be through the air, and the primary pathway of concern would be inhalation, with the primary target organ being the lungs.

Arsenic is a Class A carcinogen. Arsenic is primarily found in process building instrument lines and sampling lines as a result of treatment gases, and may also be associated with the chemical trapping systems. Once degradation of these systems occurs, releases and exposures to receptors are likely to occur. There are no large quantities of arsenic in these systems, so the exposures would involve low concentrations. The most likely route of exposure is ingestion of contaminated soils.

Barium is a Class D compound, which means it is not currently classified as causing cancer in humans. Barium was used in the chemical trapping systems within the process buildings. Exposure to barium is likely to be low based on the quantities used. Ingestion is the primary pathway from contaminated soils and drinking water leading to gastrointestinal disturbances and muscle weakness at low doses and to kidney toxicity at higher doses.

Beryllium is a Class B1 carcinogen, meaning it is a probable human carcinogen. The primary exposure route is inhalation. Acute and chronic berylliosis of the lungs can occur upon inhalation of beryllium and its compounds. Beryllium can be found, for example, in the machine shop and compressor shop areas of the process buildings in low parts per million quantities. If released to the environment, the potential for human exposure via inhalation is increased.

Cadmium is a Class B1 carcinogen; it is a probable human carcinogen based on epidemiological studies. Small amounts of cadmium can be found in association with the chemical trapping materials in the process buildings. When degradation or disturbance of these traps occurs, releases of cadmium are likely. The main exposure routes to receptors are via ingestion and inhalation of contaminated soils. The quantities of cadmium are expected to be small, and exposures would be negligible.

Chromium VI is a Class A carcinogen by the inhalation route of exposure. Chromium compounds were used to prevent corrosion in the RCW treatment system until 1990, when treatment of cooling water was changed to a phosphate-based system. Residual chromates reside in the RCW systems in several structures. As this system degrades, releases of chromium VI are likely. Ingestion, inhalation, and dermal exposures are the main routes to receptors via releases to soils.

Cyanide is a Class D carcinogen, which means it is not currently classified as causing cancer in humans. The main route of exposure is through inhalation. However, ingestion via soil and groundwater may also occur. Low dose exposures may cause cardiovascular disturbances, while higher dose exposures cause central nervous system toxicity.

Fluorides (hydrogen) are Class D carcinogens, which means they are not currently classified as causing cancer in humans. Typically, they are in the form of gases and are irritating to the eyes, nose, and skin. Breathing large amounts of hydrogen fluoride can harm the lungs and heart. These compounds are most likely found in the process piping and the Feed, Transfer, and Sampling Facilities. Releases are expected to be periodic as breaches in systems occur. The routes of exposure include inhalation, ingestion, and dermal exposure.

Freons are Class D carcinogens, which means they are not currently classified as causing cancer in humans. Inhalation and dermal routes are the primary modes of exposure. Frostbite may occur due to liquid exposure to the skin, and inhalation of Freon vapors may cause central nervous system impacts, while prolonged exposure may lead to heart irregularities.

Lead is a Class B2 carcinogen, which means it is a probable human carcinogen. Lead-based paint is expected to be present in many of the painted structures because of the age of the buildings. Another form of lead expected to be present would be in the form of solder for tubing fittings. The lead paint would pose a threat to human health if it were to become airborne (such as through mobile dust) or if it were subjected to heat. The primary routes of exposure would be ingestion and inhalation, with the primary target organs and systems being the central nervous system, bones, and kidneys. Neuropsychological impairment would be a systemic effect from exposure; children are particularly susceptible to exposure to lead.

Mercury is a Class D carcinogen, which means it is not currently classified as causing cancer in humans. The primary exposure route of concern is inhalation of mercury vapors. The crucial target organ is the brain. Mercury primarily has adverse effects on the central nervous system and can cause developmental effects in children. Mercury is expected to be present in such places as temperature/pressure contact switches, chemical traps, fire pull stations, and mercury vapor lamps. If released to the environment, the potential for human exposure via inhalation is increased.

Nickel (insoluble compounds) is a Class A carcinogen, which means it is known to cause cancer in humans. The insoluble forms primarily impact the inhalation and ingestion pathways. The lungs, respiratory tract, kidneys, and immune system are the primary target organs/systems. Nickel, in the form of nickel plating, is located within the PGE and would be released from breaches of the equipment. The plating would need to go through oxidation before becoming available to receptors.

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals, many of which are Class B1 and B2 carcinogens, meaning there is evidence of them being probable carcinogens in humans (B1- limited human data; B2 - sufficient animal data). PAHs particularly affect the lungs via inhalation, stomach via ingestion, and skin via dermal exposure. These chemicals are primarily associated with discharges from industrial and wastewater treatment plants.

PCBs are Class B2 carcinogens, which means they are probable human carcinogens. PCBs are particularly harmful to the liver via the ingestion exposure route. PCBs may be found in fluorescent lights with PCB ballasts, ventilation systems, some types of wiring, and oils containing PCBs, although manufacture of PCBs was stopped in the United States in 1977. Also, PCBs can also be found in older paints.

Silver is a Class D carcinogen, which means it is not currently classified as causing cancer in humans. The primary exposure route is via inhalation and dermal exposure. Chronic inhalation of silver oxide and silver nitrate dusts may result in chronic respiratory irritation, while dermal exposures may cause argyria, a permanent gray discoloration of the skin. Uses of silver included small amounts in the form of silver solder for tubing fittings and other applications.

TCE is a Class C-B2 carcinogen, meaning it is a possible/probable human carcinogen. TCE can be harmful to, for example, the liver, kidneys, lungs, and central nervous system. The primary exposure routes are inhalation and ingestion.

Titanium is a Class D carcinogen, which means it is not currently classified as causing cancer in humans. As titanium tetrachloride, it is irritating to the skin, lungs, and mucus membranes. Inhalation of large doses can damage the lungs. It strongly reacts with water to form hydrochloric acid. Titanium dioxide may cause gastrointestinal irritation via ingestion.

Total uranium (including soluble compounds of uranium in which the predominant adverse effect is systemic toxicity) is classified by EPA to be a Class D carcinogen, which means it is not currently classified as causing cancer in humans. The primary modes of exposure to uranium are ingestion and inhalation (dermal exposure is typically only applicable to water soluble forms of uranium). According to EPA, the primary toxic effect is damage to the kidneys. Additionally, workers in industry who have inhaled UF_6, a component introduced into the process gas system at PORTS, experienced respiratory tract irritation. However, this response was thought to be associated with the hydrofluoric acid, a component present when UF_6 is heated to a gaseous form, rather than from the uranium.

Zinc is a Class D carcinogen, which means it is not currently classified as causing cancer in humans. Its toxicity is considered to be relatively low, and ingestion of excessive levels may lead to nausea, epigastric distress, and anemia. Inhalation of high concentrations can cause metal fume fever.

Radionuclides are Class A carcinogens, which means they are known to cause cancer in humans via a variety of exposure routes, depending on the specific radionuclide in question. Exposure to high levels of uranium isotopes (uranium-234, uranium-235, and uranium-238 in particular) can cause kidney, liver, and lung cancers/tumors from direct exposure, inhalation, and ingestion. Technetium-99 can cause thyroid and gastrointestinal cancers, primarily from the ingestion and inhalation exposure pathways. There are measureable amounts of neptunium-237 and plutonium-239 within the process buildings as a result of contaminants present in feed materials generated from reactor returns. Both neptunium-237 and plutonium-239 can cause lung, bone, and liver cancer, and developmental effects in children through direct exposure, inhalation, and ingestion. If released to the environment, the potential for human exposure to radionuclides via inhalation, ingestion, and direct exposure is increased.

5.1.4 Risk Characterization

The risk characterization estimates the potential for adverse health effects as a result of exposure to contaminants and the associated toxicity characteristics of the hazardous substances. In a quantitative assessment, this process ends with a list of COCs, as well as pathways of concern. This information guides alternative development to ensure that any action taken addresses the risk posed by exposure to plant contaminants. For a qualitative risk assessment, COCs are identified from the list of COPCs, using the understanding of the prevalence of the contaminant in remaining sources, their potential for release and/or migration, and their inherent toxicity.

The pathways of concern are identified as a result of the typical contribution of the pathways when risk is quantified. For instance, the use of surface water to irrigate crops generally is inconsequential compared to ingestion of groundwater.

If the PORTS buildings and structures are allowed to remain in place without maintenance over time, wind, rain, and freeze/thaw cycles would cause degradation of the building structures, eventually resulting in failure of the structures (e.g., roof leaks/failures, asbestos transite siding blowing off buildings and structures and concrete crumbling and collapsing). In turn, this may result in an increased threat for exposure of receptors. Additionally, oxidation of metal components may eventually lead to decay, resulting in breaches that allow infiltrating water to wash contaminants out and move them away from the components in an overland flow to surface water. Threats to human health from exposure to contaminants such as asbestos, PCBs, lead, mercury, beryllium, technetium-99, TCE or uranium isotopes are minimal under current conditions. However, future uncontrolled releases would cause increased threats to human health via the exposure pathways discussed above. As these buildings continue to age, the threat of radiological and chemical substance releases would increase, and actual releases to the environment would increase. For example, radiological and chemical substances could be released directly to the environment through a breach in a containment wall, roof, or other physical control as the buildings age and deteriorate. In addition to degradation causing a release, there is the potential that future users of PORTS may breach the PGE and buildings, becoming exposed to what are safely encased contaminants and causing a sudden release of these contaminants.

The following sections discuss COCs and most likely receptors that would be impacted by those COCs by quadrant and environmental media. The COC identifications are based on quantities anticipated to be present (as a result of process knowledge), associated toxicity, and the mobility of these contaminants in the environment.

Quadrant I

The most likely receptors exposed to the ACM are the on-PORTS trespasser, industrial worker, and resident. The inhalation pathway would be the primary mode of exposure. Because of its physical nature (does not migrate far) and the distance to PORTS boundary, the off-PORTS resident is not likely to be exposed to ACM.

PCBs are ubiquitous in the buildings and would migrate to soils. However, PCBs are not very mobile. As a result of previous releases, PCBs have been detected in surface water in this quadrant. There is a potential for accumulation in sediments, which may cause unacceptable risks for the on-PORTS resident through ingestion and dermal contact. Given no action, PCBs could migrate off PORTS in the future through surface water pathways.

In the buildings, TCE is expected to still be present in large enough quantities to be considered a source of exposure via inhalation for the trespasser, on-PORTS worker, and on-PORTS resident. Operations that took place within X-710 are considered to be a source of the existing plume. Based on the mobility of TCE and the presence of an existing plume, releases of TCE from this quadrant could continue to be a future impact to groundwater and a threat to on-PORTS residents and industrial workers through ingestion. The expected TCE concentrations would not be as great as those currently in the environment because operations have been shut down. It is unlikely that off-PORTS receptors would be impacted.

Other COPCs are not considered to be present in large enough quantities to result in unacceptable risks to receptors and thus are not COCs. Most of the metal COPCs are likely in small quantities in solder and switches. Also, much of the laboratory waste from past operations was already disposed, and only minor contamination is expected. Therefore, the following are COCs associated with Quadrant I:

- ACM
- PCBs
- TCE.

Quadrant II

Based on operations at the buildings in Quadrant II, radioactive contamination and associated risks are expected to be unacceptable for all of the on-PORTS receptors. The risks to the industrial worker and resident are expected to be greater than those to the trespasser (based on higher exposure frequency and duration). The main routes of exposure would be external exposure to ionizing radiation and incidental ingestion. The uranium isotopes are not very mobile, and soil is the most likely medium for external exposure to radiation. Technetium-99 is very mobile and may migrate to underlying groundwater. Ingestion of on-PORTS groundwater by a future industrial worker or on-PORTS resident could result in an unacceptable risk (Section 5.1.2). Technetium-99 is unlikely to stay in the soil long enough to cause a risk. The measured K_d for technetium-99 in the Minford soil varied from 2.72 to 4.97 mL/g, suggesting that technetium-99 is moderately mobile in soils.

Based on the operations, ACM is ubiquitous in the building materials, exposures may impact the on-PORTS receptors via inhalation.

Based on operations in Quadrant II buildings, it is likely that TCE would be a source, and exposures to on-PORTS receptors would be more likely via inhalation. TCE was used in the X-705 Decontamination Building and the X-720 Maintenance & Stores Building and neutralization pit. As a result, local TCE spill areas throughout this area of PORTS are likely to have been, and may still be, sources of TCE groundwater contamination (DOE 2001a). The most likely exposed receptors to future TCE releases to groundwater are the on-PORTS industrial worker and resident, and the pathway with the greatest risk potential is groundwater ingestion.

PCBs are prevalent in the buildings throughout this quadrant. If released, PCBs could be a concern in on-PORTS soils with regard to ingestion and dermal contact.

Chromium is expected to be a concern because X-705D served to circulate RCW, which contained chromium compounds, through X-705. Hexavalent chromium would be a risk to on-PORTS receptors via inhalation or ingestion of contaminated soils. Chromium has been associated with groundwater contamination and may be an issue for on-PORTS residents through inhalation or ingestion of groundwater and for the industrial worker through ingestion.

Other COPCs are not expected to be present in large enough quantities to pose a risk or hazard to human receptors. Similar to the situation in Quadrant I, metals are not expected to be released in great quantities, and any metals detected in groundwater were from past operations. Therefore, the following are COCs associated with Quadrant II:

- Uranium and uranium isotopes (uranium-234, uranium-235, uranium-238)
- Technetium-99
- ACM
- TCE
- PCBs
- Chromium.

Quadrant III

Quadrant III contains two of the process buildings and thus contains large quantities of uranium and technetium-99. Based on a limited early sampling of both the converter shells and tubes, technetium-99 concentrations averaged 84,000 pCi/g in X-326. This concentration is above a screening level (DOE 2013a) for human health and clearly demonstrates that the converters are a potential future source of this radionuclide. Likewise, uranium concentrations in the process buildings are in the 10,000 pCi/g range and indicate that uranium sources remain. Once degradation of the PGE occurs, releases of UF_6 (the form of uranium in equipment) will occur and upon contact with moisture, HF and UO_2F_2 will be formed. Although this form of uranium is soluble, historic releases to the atmosphere and subsequent deposition to soils have not shown migration to water sources, thus indicating an insoluble form of uranium in the environment. Technetium-99 is mobile and likely to migrate to water sources where it could be a threat through ingestion. The other radionuclides, neptunium-237 and plutonium-239, are in much smaller quantities and are not expected to cause unacceptable risks.

Because of the large sizes of the process buildings, it is expected that large quantities of ACM could become a source for on-PORTS receptors. Inhalation is the most likely exposure pathway.

Large quantities of PCBs from seals and gaskets in ductwork could be a future source of unacceptable exposure to receptors. Soil is the main medium of exposure, as discussed for the other quadrants. If migration to surface water does occur, dermal exposure to contaminated sediment is a potential for the on-PORTS resident. PCBs are not expected to migrate to off-PORTS receptors.

Chromium is expected to be present in association with the RCW lines and presents an unacceptable risk to on-PORTS receptors from soil and groundwater via inhalation or ingestion.

The other COPCs are not expected to be released in large enough quantities to impact either on-PORTS or off-PORTS receptors. Although there are many items that contain metals, it is assumed that the degradation of these items may occur slowly over time, and the concentrations released would be minimal. Other metals such as nickel are in the form of plating and would not cause impacts to receptors. Therefore, the following are COCs associated with Quadrant III:

- Uranium and uranium isotopes (uranium-234, uranium-235, uranium-238)
- Technetium-99
- ACM
- PCBs
- Chromium.

Quadrant IV

The X-333 Process Building is one of the main sources in Quadrant IV. This building contains contaminants similar to those in the other two process buildings in Quadrant III, and exposure to on-PORTS receptors would be similar. TCE is an additional contaminant that is considered a COC for Quadrant IV, based on operations conducted in the Feed, Transfer, and Sampling Facilities. No off-PORTS migration of contaminants is expected because of slow degradation of the process buildings coupled with the fact that groundwater flows in a northern direction with discharge into Little Beaver Creek (Figure 5.1), and surface water concentrations would be low because of dilution. Therefore, the following are COCs associated with Quadrant IV:

- Uranium and uranium isotopes (uranium-234, uranium-235, uranium-238)
- Technetium-99
- ACM
- TCE
- PCBs
- Chromium.

5.1.5 Summary of Streamlined Risk Characterization

The process buildings, complex facilities, and supporting facilities contain numerous radiological and chemical contaminants that are known carcinogens and/or toxicologically hazardous substances. Under the potential future scenarios, it is anticipated that the expected concentrations of COCs in all applicable exposure media for receptors presented in this streamlined evaluation of threats to human health are at levels exceeding typical risk-based standards (DOE 2013a). Table 5.5 shows the potential completed pathways for the COCs discussed above should the buildings be allowed to deteriorate and no action be taken to remediate the buildings and structures. Unacceptable exposures to human receptors from release of these contaminants are likely to occur if no action is taken to remediate these buildings and structures. As noted in Table 5.5, potential exposures to contaminants present within and on equipment and building materials likely results in unacceptable risks to all three on-PORTS receptors. Also, potential exposures to contaminants in soil, sediments, and groundwater likely result in unacceptable risks to an on-PORTS industrial worker and to an on-PORTS resident. Under the no-action alternative, the resulting threat to human health from these exposures establishes the need for remedial action.

Table 5.5. Summary of D&D Waste Contaminants of Concern and Potential Completed Pathways at PORTS

Media	COC	On-PORTS Trespasser	On-PORTS Industrial Worker	On-PORTS Resident
			Exposure Route	
Building Waste	ACM	Inhalation	Inhalation	Inhalation
	PCB	Ingestion/Dermal	Ingestion/Dermal	Ingestion/Dermal
	TCE	Inhalation	Inhalation	Inhalation
	Uranium	Ingestion/Inhalation	Ingestion/Inhalation	Ingestion/Inhalation
	Uranium Isotopes	Ionizing Radiation	Ionizing Radiation	Ionizing Radiation
	Tc-99	Ionizing Radiation	Ionizing Radiation	Ionizing Radiation
	Chromium	Ingestion/Inhalation	Ingestion/Inhalation	Ingestion/Inhalation
Soil/Sediment	PCB		Ingestion/Dermal	Ingestion/Dermal
	Uranium		Ingestion/Inhalation	Ingestion/Inhalation
	Uranium Isotopes		Ionizing Radiation	Ionizing Radiation
	Chromium		Ingestion/Inhalation	Ingestion/Inhalation
Groundwater	TCE		Ingestion	Ingestion
	Tc-99		Ingestion	Ingestion
	Uranium		Ingestion	Ingestion
	Chromium		Ingestion	Ingestion/Inhalation

ACM = asbestos-containing material
COC = contaminant of concern
PCB = polychlorinated biphenyl
PORTS = Portsmouth Gaseous Diffusion Plant
TCE = trichloroethene

5.1.6 Evaluation of Uncertainties

The estimation of uncertainty is fundamental to risk assessments. Types of uncertainty are divided into four broad categories: source term/data evaluation, exposure assessment, toxicity assessment, and risk characterization.

5.1.6.1 Uncertainties in source term/data evaluation

For the streamlined evaluation of the potential threats to human health, a list of contaminants identified in earlier environmental investigations at PORTS was obtained (DOE 2011d) and evaluated as well as process and building material of construction knowledge. The earlier investigations illustrate what has been released to the environment historically related to processes occurring in or around the buildings located within the quadrants. Identifying current and future COPCs using a process of considering the operations and historical releases, both documented and anecdotal, introduces uncertainties into the results. Historical releases may be greater than future releases because of recent efforts to bring the buildings into a safe shut down mode, lessening the types and levels of contamination in the buildings. Or, future releases may be greater under an assumption of the loss of institutional controls because there would be no effort used to control releases in the future. This uncertainty may overestimate or underestimate risk conclusions. For example, while PAHs have been detected in environmental media including soil and sediment in the vicinity of buildings within three of the four quadrants, there is no evidence that significant sources of PAHs remain in the building such that future releases could result in increases in contaminant load in the environmental media. Therefore, not carrying PAHs forward as COCs is unlikely to result in an underestimate of both carcinogenic and non-carcinogenic risk as a result of exposures associated with the receptors considered in the streamlined evaluation of the potential threat to human health.

5.1.6.2 Uncertainties in exposure assessment

For each receptor in the streamlined evaluation of the potential threat to human health, assumptions are made concerning the routes of exposure, the contaminated media a receptor can be exposed to, and the potential for intake by the different routes of exposure. The most significant uncertainty results from use assumptions of PORTS. Although the trespasser is a credible scenario under no action, the use of PORTS, as is, for industrial or residential use is unlikely. Then, there is considerable uncertainty in the assumptions of which media will result in exposure to contaminants. Groundwater is not likely to have sufficient yield for household use. These assumptions are likely to overestimate the risk.

5.1.6.3 Uncertainties in toxicity assessment

There are numerous uncertainties associated with the toxicity information derived for chemicals and radionuclides including carcinogen class, associated exposure routes, and primary target organs that apply to the evaluation of the potential threat to human health. Such uncertainties include those related to scientific study results that identify the potential for human toxicity, those introduced by the process of deriving carcinogenicity potential, those related to impacts of other factors such as the potential for synergistic or antagonistic interactions, and those related to the assumption of predicting lifetime cancer induction or non-cancer health impacts on the basis of less than lifetime exposure. Considering these uncertainties, the EPA has working groups that review all relevant human and animal studies, which themselves have undergone prior peer review, and select the studies most pertinent to the derivation of the specific non-carcinogenic and carcinogenic health impacts. These studies for chemicals often involve data from experimental animal studies using high exposure levels, and exposure under acute conditions (short-time periods). Extrapolation of these data to humans applicable to a lifetime exposure under low-dose chronic conditions introduces large uncertainty. The magnitude of this uncertainty is addressed by applying uncertainty factors to the dose response data associated with chemical exposure, which provides an adequate margin of safety for use in risk assessments.

Unlike the uncertainty that can exist with toxicity values for chemicals, the uncertainty associated with radionuclide toxicity values is better defined. The dose-response relationship between cancer and ionizing radiation has been evaluated over many years and is well documented from both animal and accidental human exposure. In addition, toxicity values for radionuclides are extrapolated from the cancer induction data established using the Japanese Atomic Bomb Survivors Database and a relative risk projection model basing these values on human data rather than extrapolated from an animal model. However, the effects seen in this population are a result of comparably high exposure doses.

The dose response assumptions, which are best estimates, are made using mathematical models and procedures for extrapolating adverse health impacts from high doses to low doses. Thus, applying the radionuclide dose response assumptions to high exposure doses may result in an overestimation of the risk of cancer associated with the individual radionuclides or a single exposure pathway, as well as the cumulative risk due to exposure to numerous radionuclides simultaneously or from exposure to a single radionuclide across multiple exposure pathways.

5.1.6.4 Uncertainties in risk characterization

The risk characterization estimates the potential for adverse health effects as a result of exposure to contaminants and the associated toxicity characteristics of the hazardous substances taking into account PORTS conditions, the exposure assessment, and toxicity assessment. For the streamlined evaluation of the potential threat to human health, COCs are identified from the list of COPCs, assuming a certain mass of these COPCs within the buildings, their potential for release and/or migration as the buildings deteriorate, and the inherent toxicity of the constituents. Likewise, the exposure pathways of concern are identified as a result of the typical contribution of the pathways when risk is quantified. However, the cumulative impact of these uncertainties is low since the list of COCs includes the high mass, high concentration constituents known to have been used at PORTS coupled with the fact that such constituents are present in the environmental media within the quadrants.

The results of the streamlined evaluation of the threats to human health provide information necessary to justify action at PORTS as related to the expected waste to be generated and allows the evaluation and selection of the best remedy for PORTS.

5.2 POTENTIAL THREAT TO ECOLOGICAL RECEPTORS

This streamlined ecological risk evaluation was conducted using the PORTS-specific guidance *Methods for Conducting Ecological Risk Assessments and Ecological Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2013b). This section uses the results of existing ecological assessments to determine the likelihood of impacts to ecological receptors as a result of contaminants that may be released from degrading buildings.

5.2.1 Process to Qualitatively Evaluate Potential Threat to Ecological Receptors

Seven steps are identified in the PORTS-specific guidance for conducting an ecological risk assessment. Using existing assessments of ecological impacts from plant activities, the screening elements (Steps 1 and 2) and problem formulation (Step 3) were completed when developing the PER (DOE 2011a) and RI/FS Work Plan for this project (DOE 2011b). The PER concluded that no new data were required to qualitatively assess ecological risk. Therefore, no new field sampling design (Steps 4 and 5) or data analysis (Step 6) was performed to evaluate impacts of the no-action alternative to ecological receptors. Only Step 7, risk characterization, remains. To complete this step qualitatively, the evaluation of COPC releases developed in Section 5.1.2 is examined against the assessment endpoints identified in previous ecological evaluations to determine if future impacts are expected. These endpoints from past evaluations are discussed in Section 5.2.3.

5.2.2 Receptor Identification and Conceptual Site Model Development

As part of the RFI at PORTS, DOE performed an assessment of the impacts that releases from PORTS had or may have had to the ecological receptors on PORTS. The results were reported in the *Baseline Ecological Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 1996e). The PORTS baseline ecological risk assessment (BERA) focused on the Little Beaver Creek and Big Run Creek watersheds, and the northwestern, western, and southwestern tributaries. The Little Beaver Creek watershed runs primarily through Quadrants II and IV. Big Run Creek is located mostly in Quadrant I. The northwestern and western tributaries are mostly impacted by contaminants from Quadrant III, whereas the southwestern tributary is impacted by those from Quadrant I.

The endpoint species for the BERA included aquatic species, including fish and benthic macroinvertebrate communities, terrestrial species including vascular plants, soil invertebrates, vole, short-tailed shrew and American woodcock, and piscivorous species including belted kingfisher and mink. Wetlands and threatened and endangered species were also addressed. However, no federal threatened and endangered species were identified on the PORTS reservation, and there was negligible risk to the wetland vegetation present. A CSM was developed for the PORTS BERA exposure pathways (Figure 5.3), and it shows how contaminants from PORTS move through environmental media to receptors. The existing CSM is sufficient for the needs of this streamlined evaluation of threats to ecological receptors.

5.2.3 Risk Characterization

The results of the BERA are presented in this section. These results illustrate which contaminants have historically had the potential to impact ecological receptors at PORTS based on concentrations in environmental media. Below is a summary of the BERA.

The risk results presented in the BERA from the Little Beaver Creek (Quadrants II and IV) watershed indicate potential impacts from chromium and mercury contamination to the invertebrate community in its alluvial soils due to exceedances of toxicity benchmarks. However, limited soil toxicity testing using an earthwork species did not indicate statistically significant impacts. Although there were no risks to plant communities from contaminated alluvial soils, contaminants may bioaccumulate and pose a risk to herbivorous wildlife. Potential impacts to the wildlife communities were also concluded. PCBs were found in sufficient amounts to have potential adverse impacts on the abundance and reproduction of the shrew population through ingestion of earthworms and incidental ingestion of soils due to exceedances of benchmarks only, as no media toxicity tests or biological surveys have been completed to verify such impacts. In addition, the BERA concluded that the American woodcock may potentially be impacted by the presence of chromium and the ingestion of earthworms within the Little Beaver Creek watershed due to exceedances of benchmarks. However, this species has a large home range and is highly mobile, thus it is unlikely that the entire PORTS Facility supports a distinct population of this endpoint species. Therefore, actual impacts to populations of this species are unlikely. The BERA also concluded that all other endpoint species within Quadrants II and IV were unlikely to have impacts from plant contaminants (DOE 1996e).

For Quadrants II and IV, the COCs identified in the BERA were chromium, mercury, and PCBs. Sufficient quantities of these contaminants may remain in buildings and therefore would be present in the associated waste in these quadrants, enough to cause increased impacts to receptors if they are released and migrate to associated exposure media. As discussed above, it is likely that PCB concentrations in the on-PORTS environment would increase from buildings in these quadrants in the future if no action is taken on the buildings and associated waste. Wildlife communities could be impacted from future releases. Chromium and mercury concentrations are also likely to increase as the buildings degrade and release contaminants. Therefore, based on PORTS operations and the likelihood of further releases of these contaminants into the environment in sufficient quantities, chromium, mercury, and PCBs are identified as COCs for this qualitative ecological risk assessment.

In the BERA, no unacceptable risks from past operations were identified for ecological endpoints in the Big Run Creek watershed (northwestern or western tributaries). There were indications of zinc toxicity impacts to the alluvial soil plant communities in the southwestern tributary (Quadrant I). Zinc was not identified as a COPC from buildings within this quadrant. Based on these results, it is unlikely that further releases from buildings or waste would impact ecological receptors. No ecological COCs from Quadrants I and III are identified.

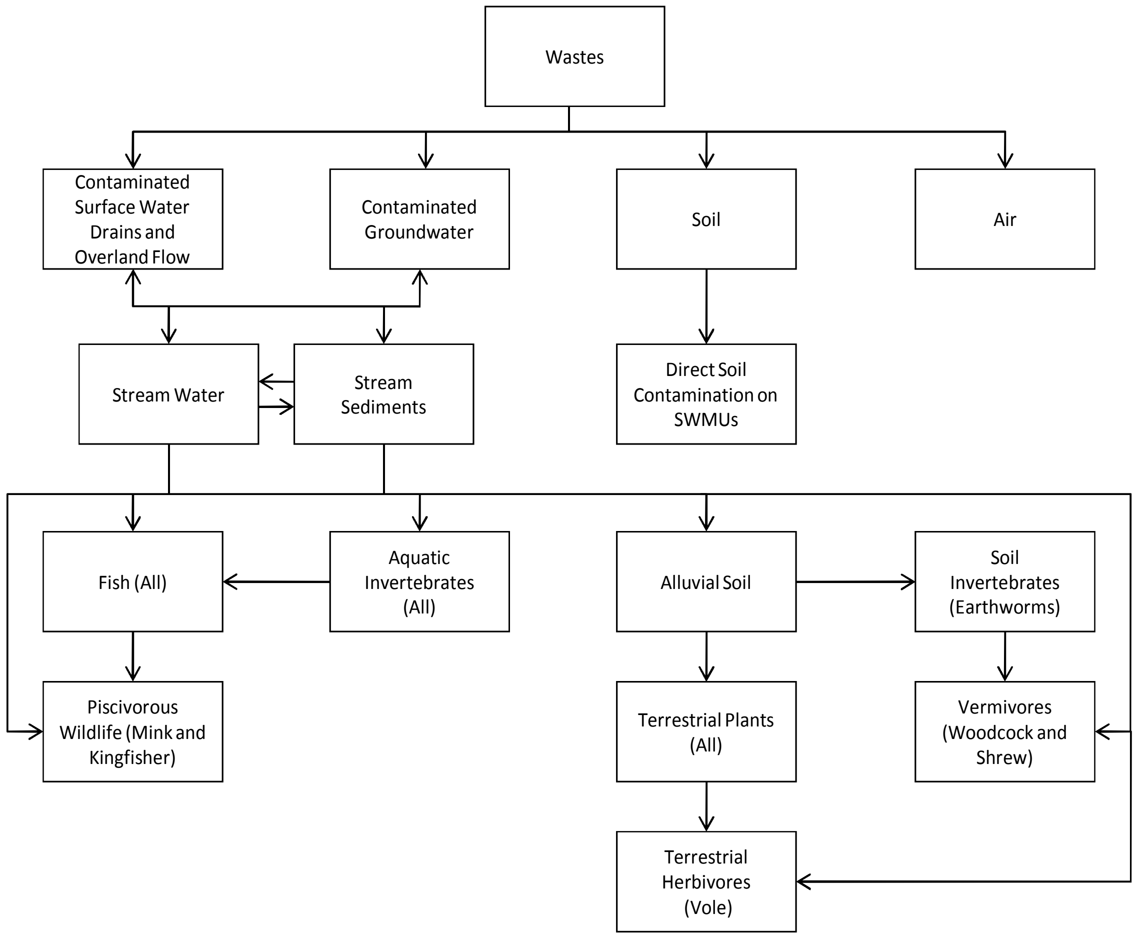

Figure 5.3. Conceptual Site Model for PORTS BERA Exposure Pathway

The results of this qualitative evaluation of threats to ecological receptors indicate that there are potential impacts to on-PORTS ecological receptors from the no-action alternative.

5.3 RISK ASSESSMENT DATA LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

Little quantitative sampling data are available to identify contamination levels in anticipated building waste. Therefore, a full quantification of the baseline risks to humans and ecological species as a result of building degradation and nondisposal of wastes is not possible. However, even if additional sampling data were available, there would be great uncertainty with estimating rate of degradation, rate of contaminant release, and rate of contaminant migration to receptors. The analysis presented in this section demonstrates that potential threats to humans and ecological species can be described qualitatively using the existing process knowledge and limited sample data from the PGE. No additional data are needed to assess future threats and no future work in that regard is recommended.

5.4 REVISED REMEDIAL ACTION OBJECTIVES

As a result of evaluating the no-action alternative scenario described within the streamlined risk assessment, DOE concludes that active measures are necessary to protect public health or welfare and the environment from actual or threatened releases of pollutants or contaminants from this plant. Such releases may present an imminent and substantial endangerment to the public health and the environment. The assessment shows radionuclides and other contaminants such as PCBs, asbestos, TCE, and chromium may be a future threat to on-PORTS users under no action. The RAOs developed during project scoping addressed the concern of unacceptable toxicity and carcinogenicity.

There is the limited potential, albeit slight, for future risk to terrestrial ecological populations if the buildings are left to degrade. To be protective of ecological species, the RAOs presented during project scoping have been revised to provide for future ecological protection. These RAOs are presented in Section 6.3.

HIGHLIGHTS OF SECTION 5

- With no D&D, degrading buildings could pose an unacceptable future risk to on-PORTS users and limited terrestrial ecological species.
- With no D&D, degrading buildings could pose some future off-PORTS unacceptable risk, however, because of limited contaminant migration these risks are expected to be less than on PORTS.
- There is a future potential physical hazard to human health from deteriorating buildings.
- The potential for future threats to human health to on-PORTS receptors and the environment from no waste disposition indicates the need to take an action to remedy the threat.

NEXT STEP: SECTION 6 SETS THE FOUNDATIONAL ELEMENTS TO ALLOW THE DEVELOPMENT OF ALTERNATIVES

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6. PRELIMINARY IDENTIFICATION AND SCREENING OF REMEDIAL ALTERNATIVES

6.1 INTRODUCTION

Once the problem has been identified, potential solutions are developed. The problem is that uncontrolled, degrading buildings could release contaminants at unacceptable levels into the environment. The purpose of Section 6 is to provide the foundation for developing solutions to this problem. This section does not develop the alternatives, but it identifies the considerations that will be factored into the alternative development in Section 7. First, regulations that need to be considered in developing alternative solutions are provided in Section 6.2. Section 6.3 then takes those requirements and assesses the level of protection the alternatives must meet, thereby developing the objectives of the remediation effort—RAOs. The last element of the foundation for alternative development is to identify potential technologies to be considered in the development of alternatives. This section, Section 6.4, is structured in accordance with CERCLA guidance to describe GRAs and technology types available, provide a preliminary screening of technology types and process options, and then evaluate and identify representative process options to use in the evaluation of alternatives. Development of the remedial alternatives then occurs in Section 7 by using the results in this section.

6.2 CHEMICAL- AND LOCATION-SPECIFIC ARARS

In accordance with the requirements of the DFF&O and pursuant to Ohio's laws and regulations, and using 40 *CFR* 300.430(f)(1)(ii)(B) of the NCP and CERCLA as a framework, on-Site remedial actions are required to attain ARARs, unless waived pursuant to the DFF&O, CERCLA Section §121(d)(4), and the NCP, Part §300.430(f)(1)(ii)(C). The ARARs include only federal, state, and local environmental and facility siting laws/regulations; they do not include occupational safety or worker radiation protection requirements. Additionally, per the DFF&O and 40 *CFR* 300.400(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance).

Section V, General Provisions, Paragraph 9.a of the DFF&O provides that portions of response actions conducted entirely on site pursuant to work plans or plans concurred with or approved by Ohio EPA under the order can be conducted pursuant to Section 121(e)(1) of CERCLA, 42 *USC* Section 9621. Section 121(e)(1) specifically provides that no federal, state, or local permit shall be required for the portion of any removal or remedial action conducted entirely as an on-site response action. In addition to permits, EPA has interpreted this section broadly to cover all administrative provisions from other laws, such as recordkeeping, consultation, and reporting requirements. In other words, administrative requirements do not apply to on-site response actions (EPA 1998). Those portions of the remedial action that are taken off site are subject to both the substantive and administrative requirements of applicable laws. Only the substantive requirements in the ARARs and TBCs on the tables in Appendix B apply to on-site actions.

ARARs are typically divided into three groups: (1) chemical-specific, (2) location-specific, and (3) action-specific. A detailed discussion of ARARs and TBCs specific to this response action is included in Appendix B to this RI/FS. No chemical-specific ARARs are identified for this response action. A brief description of key location-specific ARAR/TBC topics follows. Action-specific ARARs for the alternatives developed in this RI/FS are discussed in Section 7.2 and listed in detail in Appendix B.

6.2.1 Chemical-specific ARARs

Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, and air) for specific hazardous substances, pollutants, or contaminants. The scope of this action is D&D of buildings/structures and infrastructure and does not include remediation of environmental media; therefore, no chemical-specific ARARs are triggered.

6.2.2 Location-specific ARARs

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams, near cultural resources).

6.2.2.1 Floodplains, wetlands, surface water, and threatened and endangered species and mitigation of impacts

None of the activities associated with the remedial action alternative would be conducted within a floodplain. In addition, the proposed alternatives are not expected to adversely impact any federal- or state-listed threatened or endangered species because none have been identified on the PORTS Facility. Consequently, none of the requirements for protection of these sensitive resources are included as ARARs or TBCs.

Seven wetland areas could be impacted during the D&D efforts. These areas, shown on Figure 6.1, include Q1-06 (0.23 acres), Q2-12 (2.028 acres), Q3-46 (0.08 acres), Q3-30 (0.48 acres), Q4-18 (0.322 acres), Q4-22 (0.018 acres), and Q4-26 (0.16 acres). Total acreage of the potentially affected wetlands is 3.318 acres. These resources will be appropriately protected in accordance with the location-specific ARARs and TBCs identified in Table B.1, as appropriate. Activities will be designed to avoid or minimize impacts to wetlands. In the event wetlands would be impacted, mitigation activities would be incorporated into the remedial design for the locations where impacts would occur.

Potential impacts to nearby streams from surface water or storm water runoff are addressed as action-specific ARARs and TBCs in Section 7.2. Silt fences and other appropriate erosion control measures, as detailed on Table B.2 in Appendix B, would be implemented to control run-on/runoff and minimize concentrations of suspended particulates in storm water. As a result, minimal impacts on the surface water drainage system and surface water quality would be expected.

6.2.2.2 Cultural resources and mitigation of impacts

Cultural resources include any prehistoric or historic district, site, building, structure, or object resulting from, or modified by, human activity. Under federal regulations (36 *CFR* 800), federal agencies must assess the impacts their actions have on historic properties and, if appropriate, avoid, minimize, or mitigate adverse effects. Historic properties are cultural resources listed in, or eligible for listing in, the NRHP because of their significance and integrity.

Cultural resources can generally be divided into two broad types: archaeological (below ground) and architectural (aboveground buildings, structures, sites, etc.). Because both aboveground and below-ground activities would occur under the RI/FS and its follow-up implementation of measures to address risks and hazards, DOE will be implementing the following approach to take into account the impacts that potential actions may have on cultural resources.

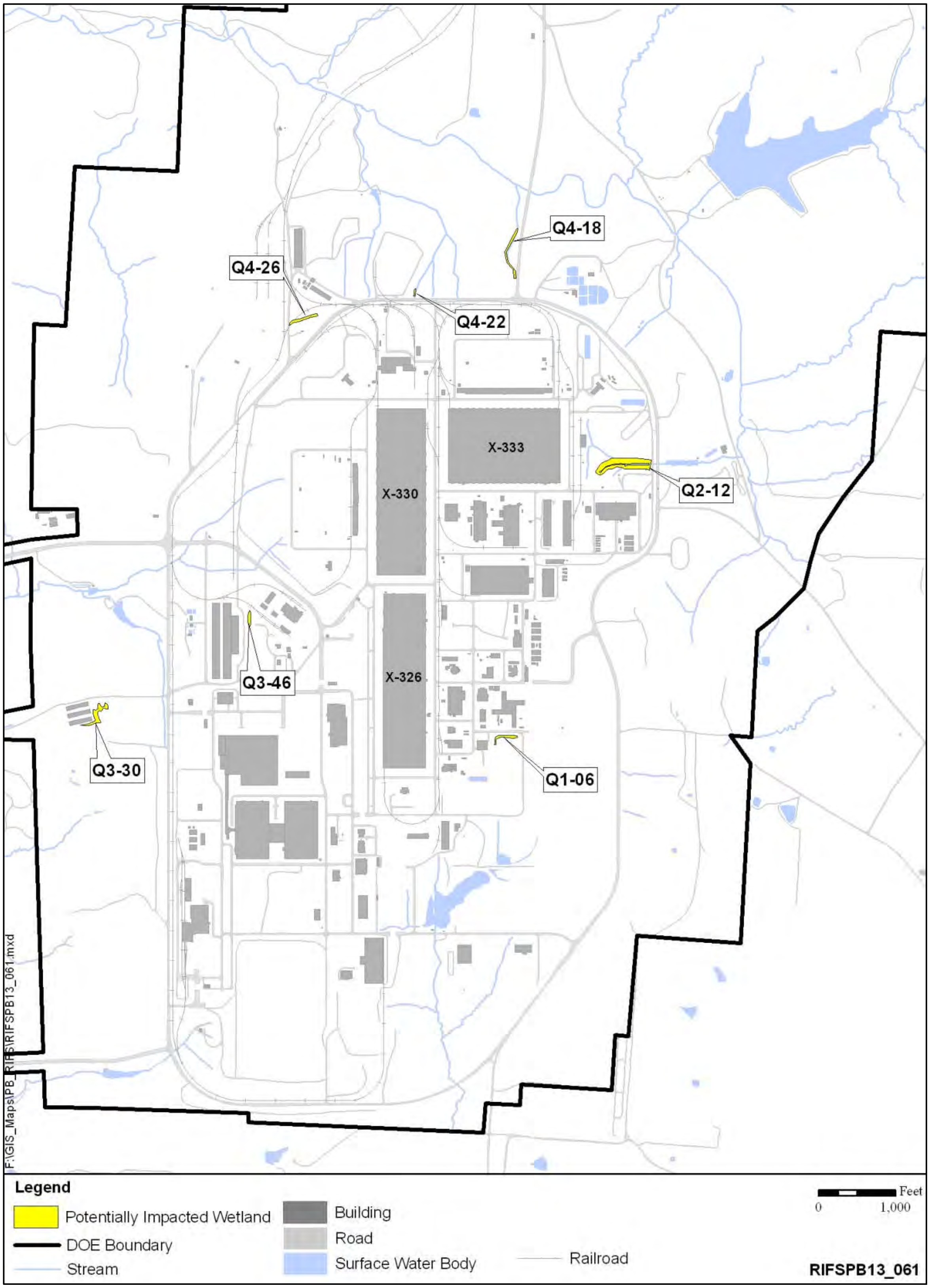

Figure 6.1. Potentially Impacted Wetlands at PORTS

6.2.2.2.1 Archaeological resources

To identify archaeological resources located within the PORTS boundary, a series of Phase I and Phase II archaeological surveys of PORTS have been conducted between 1996 and 2012. Based on the results of the archaeological surveys at PORTS, it has been determined that all of the area within Perimeter Road was significantly disturbed during plant construction. Therefore, potential remedial actions taking place inside Perimeter Road would have no impact on archaeological resources. Additionally, any actions within the scope of this decision taken outside of Perimeter Road would be on DOE-facilities where there are no identified archaeological resources.

Only limited response actions are anticipated for the area outside of Perimeter Road. However, for work in those areas, DOE would obtain the services of professional archaeologists with plant experience who would be available to assist DOE in the unlikely chance a previously unidentified archaeological resource is inadvertently discovered during a response action outside of Perimeter Road. The team archaeologists will identify, record, and salvage items in accordance with a PORTS unexpected discovery plan.

6.2.2.2.2 Architectural resources

To identify architectural resources, a comprehensive survey of PORTS was completed. As part of the architectural survey, an OHI form was completed for each of the 196 resources. These OHI forms were submitted to and recorded by the OHPO. The architectural inventory report documenting the results of the survey was accepted by the OHPO in March 2011 (DOE 2011f). Information about the buildings in the RI/FS Work Plan can be found in the inventory report.

NHPA Mitigation Measures. The following approach has been developed to document and comprehensively interpret the DOE-built environment at PORTS:

- Classification of PORTS architectural resources
- Evaluation of the significance of the architectural resources
- Development of a documentation model
- Development of an interpretation model.

A. Classification of PORTS Architectural Resources

PORTS architectural resources have been divided into three broad categories based on their original function: (1) Cold War-era core processing facilities, (2) Cold War-era processing support facilities, and (3) non-Cold War-era mission facilities. The descriptions of these categories are as follows:

1) **Cold War-era core processing facilities:** These NRHP-eligible properties are character-defining resources and are unique to the production of HEU by the gaseous diffusion process (PORTS historic mission). These facilities are central to telling the PORTS Cold War-era story and are discussed in Section 4.1 and Appendix A. They are usually monumental in size (the process facilities) and sometimes have unique forms and exterior architectural features and adaptations because of their association with the actual gaseous diffusion process buildings (e.g., control building and instrumentation tunnels). These facilities often involved complicated processes that took place inside their walls. These properties are eligible for the NRHP under Criterion A of the National Register Criteria for Evaluation (NRCE). (Mitigation measures are identified for this category of facilities below.)

2) **Cold War-era processing support facilities:** These National Register-eligible properties were essential to the HEU production process, but were not unique to uranium enrichment facilities and could be found on other large industrial plants. These properties are eligible for the National Register

under Criterion A of the NRCE. (Mitigation measures are identified for this category of facilities below. They are discussed further in Section 4.1 and Appendix A.)

3) **Non-Cold War-era mission facilities:** These are resources that were not specifically associated with the Cold War-era mission. This category can be further divided into two subcategories: a) resources that date to the Cold War-era, but were not specifically associated with the enrichment process, and b) resources that were (or are) associated with other missions. These resources may date after the Cold War-era or may date to the era, but are not associated with the Cold War-era mission. For example, EM facilities are in this category. More information can be found in Section 4.1 and Appendix A. These facilities are not considered to be eligible for the National Register.

B. Evaluation of the Significance of PORTS Architectural Resources

The GDP at Piketon was an integral part of the United States' Cold War nuclear weapons complex. PORTS' Cold War-era mission was the production of HEU by the gaseous diffusion process. The PORTS Facility was the last of three GDPs to be constructed. The first GDP was built in Oak Ridge, Tennessee, and the second GDP was built in Paducah, Kentucky. Paducah processed LEU to provide fuel for nuclear reactors. HEU was processed at only the Oak Ridge and PORTS facilities. PORTS was the largest producer of HEU by quantity enriched to the highest levels, and its production of HEU spanned the longest period. While there have been other missions at PORTS, and there are extant architectural resources associated with these other missions, it is the PORTS Cold War-era production of HEU by the gaseous diffusion process that is most significant. Thus, because they physically convey this story, the architectural resources that date to the Cold War-era are the most significant to the interpretation of PORTS. As outlined above, the architectural resources are divided into three broad categories based on their original function. The significance of each of the functional categories to telling the PORTS Cold War-era story has been ranked as follows and described above: (1) Cold War-era core processing facilities, (2) Cold War-era processing support facilities, and (3) non-Cold War-era mission facilities.

C. Development of a Documentation Model

Because of the unique environmental challenges at PORTS and the necessary procedures of environmental restoration, the physical preservation of buildings and structures will seldom be feasible. Because physical preservation is not realistic, for purposes of the NHPA, the following approach will be utilized as part of the mitigation measures proposed at PORTS to preserve PORTS architectural resources through documentation:

- Development of a written historic context
- Documentation of select individual resources based on their significance to telling the PORTS Cold War-era story.

The PORTS Cold War-era mission left an indelible impression on the landscape. The process required an extensive network of individual resources that were arranged in a manner designed to efficiently promote the movement of uranium within the built environment. While there are core resources, such as the X-326, X-330, and X-333 Process Buildings, which played the primary role in the enrichment process and are often, because of their size, the most dramatic components of the landscape, they could not operate in isolation. The chosen documentation approach enables the assignment of levels of documentation to categories of individual resources based on the characteristics that need to be preserved (via documentation) to interpret the contribution of the resource to the whole. As a result, while this Model recommends the highest level of documentation effort be reserved for the Cold War-era core processing facilities, it recommends some level of documentation for all of the individual architectural resources that comprise PORTS providing a comprehensive interpretation of the DOE-built environment. This Documentation Model is “cumulative” in that the PORTS Facility and its buildings are described in context with an increasing level of documentation proposed for the processing support facilities and the highest level of documentation for the core processing facilities.

It should be noted that information gathered for implementation of any proposed mitigation measures must be deemed suitable for public release before being publicly available. Should aspects of the proposed measures include items that have classification concerns, DOE will appropriately maintain and control the materials and will perform periodic reviews to ascertain whether they may be added to the collection of publicly available information.

The Documentation Model involves three levels of documentation for preservation purposes:

1) Establishment of the historic context
2) Documentation of select individual resources from the Cold War-era processing support facilities
3) Detailed documentation of all individual resources from the Cold War-era core processing facilities.

The historic context supports the understanding of PORTS overall. The documentation efforts use levels of documentation based on the unique characteristics of certain types of facilities engaged in the core mission. The written historic context report will include a summary discussion of all facilities located at PORTS and the role of PORTS in the DOE complex. The report will also include a more detailed discussion of select facilities defined in Table 6.1. All entries in Table 6.1 are eligible for listing on the NRHP. As noted in Table 6.1, some facilities are within the scope of this RI/FS evaluation and other facilities were identified in earlier EE/CAs. Cold War-era core processing facilities are indicated with “core.” Cold War-era processing support facilities are indicated with “support.”

Table 6.1. PORTS Facilities Identified for Individual Historic Documentation

Building	Category	Governing Document
X-100 Administration Building	Support	EE/CA – BOP
X-103 Auxiliary Office Building	Support	EE/CA – Group 1
X-104 Guard Headquarters	Support	EE/CA – BOP
X-109A Personnel Monitoring Station	Support	EE/CA – BOP
X-344B Maintenance Storage Building	Support	EE/CA – Group 1
X-530A High Voltage Switchyard	Support	EE/CA – BOP
X-530B Switch House	Support	EE/CA – BOP
X-530C Test and Repair Building	Support	EE/CA – BOP
X-530D Oil House	Support	EE/CA – BOP
X-530E Valve House	Support	EE/CA – BOP
X-600 Steam Plant	Support	EE/CA – BOP
X-611 Water Treatment Plant	Support	EE/CA – BOP
X-612 Elevated Storage Tank	Support	EE/CA – BOP
X-614-A Sewage Pumping Station	Support	EE/CA – BOP
X-626-2 Cooling Tower	Support	EE/CA – Cooling Tower
X-744H Bulk Storage Building	Support	EE/CA – BOP
X-750 Mobile Equipment Maintenance Shop	Support	EE/CA – BOP
X-220-A Instrumentation Tunnels	Core	RI/FS
X-300 Plant Control Facility	Core	RI/FS
X-326 Process Building	Core	RI/FS
X-330 Process Building	Core	RI/FS

Table 6.1. PORTS Facilities Identified for Individual Historic Documentation (Continued)

Building	Category	Governing Document
X-333 Process Building	Core	RI/FS
X-342A Feed Vaporization Building	Core	RI/FS
X-344A UF_6 Sampling Building	Core	RI/FS
X-108B North Portal and Shelter	Support	RI/FS
X-111A SNM Monitoring Portal	Support	RI/FS
X-111B SNM Monitoring Portal	Support	RI/FS
X-230J2 South Environmental Sample Station	Support	RI/FS
X-300A Process Monitoring Building	Support	RI/FS
X-342B Fluorine Storage Building	Support	RI/FS
X-700 Converter Shop	Support	RI/FS
X-705 Decontamination Building	Support	RI/FS
X-710 Technical Service Building	Support	RI/FS
X-720 Maintenance & Stores Building	Support	RI/FS

Notes:
Core = Cold War-era core processing facility (Class 1)
Support = Cold-War era processing support facility (Class 2)
The X-103 Auxiliary Office Building and X-344B Maintenance Storage Building were demolished in 2011.

BOP EE/CA = *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0207&D4).
Cooling Tower EE/CA = *Engineering Evaluation/Cost Analysis for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant* (DOE/PPPO/03-0146&D2/R1).
Group 1 EE/CA = *Engineering Evaluation Cost Analysis for Group 1 Buildings X-103, X-334, and X-344B at the Portsmouth Gaseous Diffusion Plant* (DOE/PPPO/03-0145&D2/R1).

BOP = balance of plant
EE/CA = Engineering Evaluation/Cost Analysis
RI/FS = remedial investigation/feasibility study
SNM = special nuclear material

1) <u>Development of a written historic context</u>
This level of documentation involves the completion of a detailed written history of PORTS, updating of OHI forms as needed, and supporting graphic documentation, directed by a professional architectural historian.

The historic context effort has two goals: to place the role of PORTS in the context of the larger United States nuclear weapons complex and to place individual architectural resources at PORTS in context as to how they were related to PORTS mission. This documentation level is designed to explain the enrichment process in general and how it occurred at PORTS. The written history will involve both primary and secondary archival research and oral interviews. The period of interest for the written historic context document is from 1952, beginning with the acquisition of land by the Atomic Energy Commission (AEC), until 1992, the end of the Cold War. OHI forms will be revised, as appropriate, to include additional information obtained during completion of the written history.

The written history and OHI forms will be supplemented by the following graphic documentation: (1) GIS atlas; (2) compendium of copies of archival site plans, maps, and panoramic photographs; and (3) current panoramic photographs. The GIS atlas will offer a visual analysis of information collected in the written history and OHI forms, and will consist of a series of GIS maps that illustrate the functional relationship between individual resources and the changes that have taken place on the PORTS landscape. Numerous site plans, maps, and panoramic photographs are part of existing PORTS records. These documents will be analyzed, and copies of those that best exemplify PORTS will be compiled into a portfolio designed to illustrate the written history of the Facility. Between

1953 and 1954, the AEC took a series of panoramic photographs that were designed to illustrate the construction of PORTS in a time-lapse manner. The original black and white photographs were taken monthly during construction. New black and white photographs will be taken from approximately the same location until D&D is completed to document the changes taking place as a result of the D&D program.

2) Documentation of Select Individual Resources
Cold War-era processing support facilities: Because of their individual importance to the Cold War mission at PORTS, processing support facilities will receive documentation in addition to the information found in the historic context document described above, which are proposed for contextual discussion and OHI forms (see Table 6.1). Often, two or more examples of many individual types of processing support facilities were located at PORTS (e.g., there were a number of portals and warehouses). While it is important to document one of the resources that best represents the "type," they do not all need to be documented at this level. However, any processing support resource that was represented by only one facility will be documented at this level.

This documentation level will consist of: (a) a detailed written history and description of the building; (b) a compendium of copies of original documentation, including photographs, floor plans, equipment layout, and training manuals; and (c) new photography and interpretive graphics as appropriate. In most cases, high-quality, detailed photographs and drawings of the interior and exterior of these resources, as well as the floor plans and arrangement of the equipment, already exist in PORTS records. After the available documentation is analyzed, DOE will determine if new photography and graphic documentation is needed to preserve the significance of these resources.

3) Detailed Documentation of Cold War-era core processing facilities
These resources (see Table 6.1) are the most significant for understanding the PORTS story and will all receive the highest level of documentation. This level of documentation is additional to what is afforded the Cold War-era processing support facilities as described above and includes: (a) a detailed written history and description; (b) a compendium of copies of historic documentation, including photographs, floor plans, equipment layout, and training manuals; (c) new photography and interpretive graphics as appropriate; and (d) informational interviews. Small-scale artifact salvage is also proposed on a limited basis for X-300 and X-326. This will be done when artifacts are available, contamination levels and DOE classification and security measures permit it, and storage facilities are available at the time of salvage. Such storage facilities will meet all necessary security and classification requirements, as well as any other applicable requirements.

Non-Cold War-era mission facilities: Buildings, structures, or features not listed in either the Cold War-era core processing support category or the Cold War-era core processing facilities category, but being evaluated in the scope of the RI/FS for potential removal, are either not associated with the PORTS historic mission and warrant only completion of an OHI form, have mitigation measures identified in other documents, or are not buildings and structures (e.g., parking lots, fences, sidewalks utility and infrastructure systems). It should be noted that the comprehensive written historic context will discuss PORTS overall and will include the aforementioned features and systems.

Additional NHPA Mitigation Measures: Additional mitigation measures are being evaluated related to the PORTS Facility. DOE is working closely with Native American Tribes, persons specifically interested in historic preservation, OHPO, the Advisory Council on Historic Preservation (ACHP), and the public to identify appropriate mitigation measures to address proposed D&D activities at PORTS. In the last few years, multiple meetings were held with the Site Specific

Advisory Board (SSAB) and the public and included updates on historic preservation activities and opportunities for interested parties to provide input to DOE. In these meetings, DOE met with persons specifically interested in historic preservation to explain specifically the implementation of substantive requirements of NHPA through the CERCLA process and to seek feedback on potential mitigation measures at PORTS. Interaction with Native American Tribes, persons specifically interested in historic preservation, OHPO, ACHP, SSAB and the public will continue to identify and refine mitigation measures for the PORTS Facility.

In January of 2012, the DOE released the PORTS Virtual Museum to the public. The Virtual Museum is a website designed to provide a detailed historical description of PORTS with information, anecdotal information from employees and retirees, photos, and video. Additional interviews are included with local citizens to provide insight into the local impact of PORTS during construction and operation. One of the unique features is a virtual tour of plant buildings. In its initial launch, only six buildings are included on the tour and information is limited to early construction and operations. However, more information, photos, interviews, and buildings are being added to the Virtual Museum on a regular basis. The Virtual Museum can be accessed at the following link: http://www.portsvirtualmuseum.org.

DOE and FBP are also in the process of identifying and removing items that may be of interest to the PORTS community and public in general. Items include equipment, signs, and other items that represent the history of the gaseous diffusion operation at PORTS. Items of potential interest are being stored in climate-controlled storage facilities at PORTS. DOE will work with interested parties to finalize the list of items that will be preserved and to outline the path forward for long-term preservation of the identified items. Any mitigation strategies would be implemented as part of this action.

6.3 REMEDIAL ACTION OBJECTIVES

RAOs are developed during the RI/FS process to set goals that ensure the protection of human health and the environment. The purpose of this action is to make a remediation decision to address all buildings/structures and infrastructure identified in the DFF&O, Attachment H. Before response action alternatives can be developed for consideration, a list of RAOs that must be achieved needs to be identified. According to EPA RI/FS guidance (EPA 1988), RAOs consist of medium-specific goals for protecting human health and the environment. There are no chemical-specific ARARs to guide selection of medium-specific goals as part of RAOs for this action because this decision is not an environmental remediation decision. Preliminary remediation goals are media-specific remediation levels based on ARARs or risk. Such goals are not appropriate for consideration of building demolition. However, the DFF&O recognizes that the goal of any alternative must be to meet ARARs, be protective, and be cost-effective.

Broad RAOs have been developed. Consideration was given to the fact that PORTS is best suited to be used as an industrial facility in the future and that natural ecological habitats would be prevalent outside of the industrialized area. To be protective of human health and the environment, any selected alternative must meet the following RAOs:

- Protect human health to an ELCR level of $1{\times}10^{-5}$ and a hazard index of 1 for an industrial user and protect ecological species by removing building or structure contamination that could pose a future threat to an industrial worker or ecological species.

- Protect surface water and groundwater from further degradation resulting from migration of contaminants to surface water and through the soil column to groundwater.

6.4 INITIAL IDENTIFICATION AND PRELIMINARY SCREENING OF ALTERNATIVES

This section presents the description and results of the screening of technologies and process options for remedial actions at the process buildings and complex facilities at PORTS. Much of this information was developed from similar efforts associated with decisions at the GDP on the Oak Ridge Reservation in Tennessee. Although the Oak Ridge technology screenings were conducted in the late 1990s, there have not been significant changes in the technologies associated with building demolition since that time. Point-of-generation void reduction or treatment technologies and process options used to meet applicable WAC or to support reuse and/or recycling are included. Technologies for waste disposal are not included because they are evaluated in the Waste Disposition RI/FS.

To screen technologies, potential process options are identified first and evaluated for technical implementability at PORTS. Those that are not technically implementable are screened out from further consideration.

As discussed in Section 4.2.5 of EPA's 1988 Guidance for Conducting RI/FSs (EPA 1988), during the development of alternatives phase of an RI/FS, "…technology processes (called process options) considered to be implementable are evaluated in greater detail before selecting one process to represent each technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase." For example, controlled demolition has been identified as a representative process option for demolition of buildings and structures. This use of a representative demolition process option allows detailed cost estimates to be generated while still allowing more detailed design evaluations to be used to conduct the final selection. The developed alternative that would be described in the proposed plan and ROD would be to demolish the buildings and structures. Other process options such as explosives could be evaluated for use in later phases of the project, should that alternative be selected. To identify representative process options, an evaluation against the following three broad criteria provided by the DFF&O is conducted.

- Effectiveness—This is the primary criterion for consideration of process options. The evaluation focuses on the potential effectiveness of the process option in meeting the RAOs, as well as the potential impacts to human health and the environment during implementation. The reliability of the process options with respect to the contaminants and location conditions should also be a factor in the evaluation.

- Implementability—Implementability is the measure of technical feasibility, including constructability and maintainability; administrative feasibility to construct, operate, and maintain the remedial action alternative; and the availability of services and materials to implement the alternative, including availability and capacity of treatment, storage, and disposal facilities, equipment, and design, as well as operating and support personnel.

- Cost—Cost plays a limited role in the screening of process options. Relative capital and operation and maintenance (O&M) costs are used rather than more detailed cost estimates. At this stage, the cost analysis is made on the basis of engineering judgment using a high, medium, or low comparative cost scale.

6.4.1 Identification of GRAs

The term GRA refers to a general category of measures that produces similar results when implemented. GRAs describe actions, alone or in combination, that will satisfy the RAOs. Consideration of the no-action alternative, even though it will not satisfy the RAOs, is required as a basis for comparison with other GRAs. The following GRAs apply to development of D&D alternatives for the remaining buildings/structures and infrastructure at PORTS:

- No Action (required for a baseline comparison)
- Institutional Controls
- Hazard Abatement
- Treatment
- Demolition.

6.4.2 Identification and Screening of Remedial Technology Types and Process Options

The next step in the alternatives development process is to identify and screen process options for each technology type. Remedial technology types are general categories of technologies. A process option refers to a specific process within each technology type. As specified in EPA RI/FS guidance (EPA 1988), two steps are taken to reduce the number of process options associated with each GRA that undergoes detailed analysis. In the initial screening step, each process option is evaluated to determine whether it is technically implementable. To determine technical implementability at PORTS, the capabilities of each process option are evaluated against the location conditions, expected contaminant types, and anticipated contaminant concentrations, as well as the level of development of the process option. Process options that are not technically implementable on the PORTS waste streams are eliminated from future consideration. Process options that are clearly administratively impractical or not sufficiently developed are also eliminated. In the second step (Section 6.4.3), the retained process options are evaluated more closely to identify one or more process options to represent each technology type. The process option that best satisfies the evaluation criteria is identified as the representative process option for assembly with other process options and used to provide a detailed description and evaluation of alternatives. Where process options within the same technology type differ significantly, the analysis of one option may not accurately represent the other. In such a case, two or more process options of a technology type may be identified as representative for alternative development. Identification of representative process options for the description of alternatives does not eliminate other process options from future consideration in the proposed plan, ROD, and project work plans.

The technology types and process options identified for each GRA and the results of the technical implementability screening are depicted in Figure 6.2. The “Screening Comment” column in Figure 6.2 identifies the retained process options, based on technical implementability, waste types, and/or waste contaminants. Process options that have been eliminated are also shown.

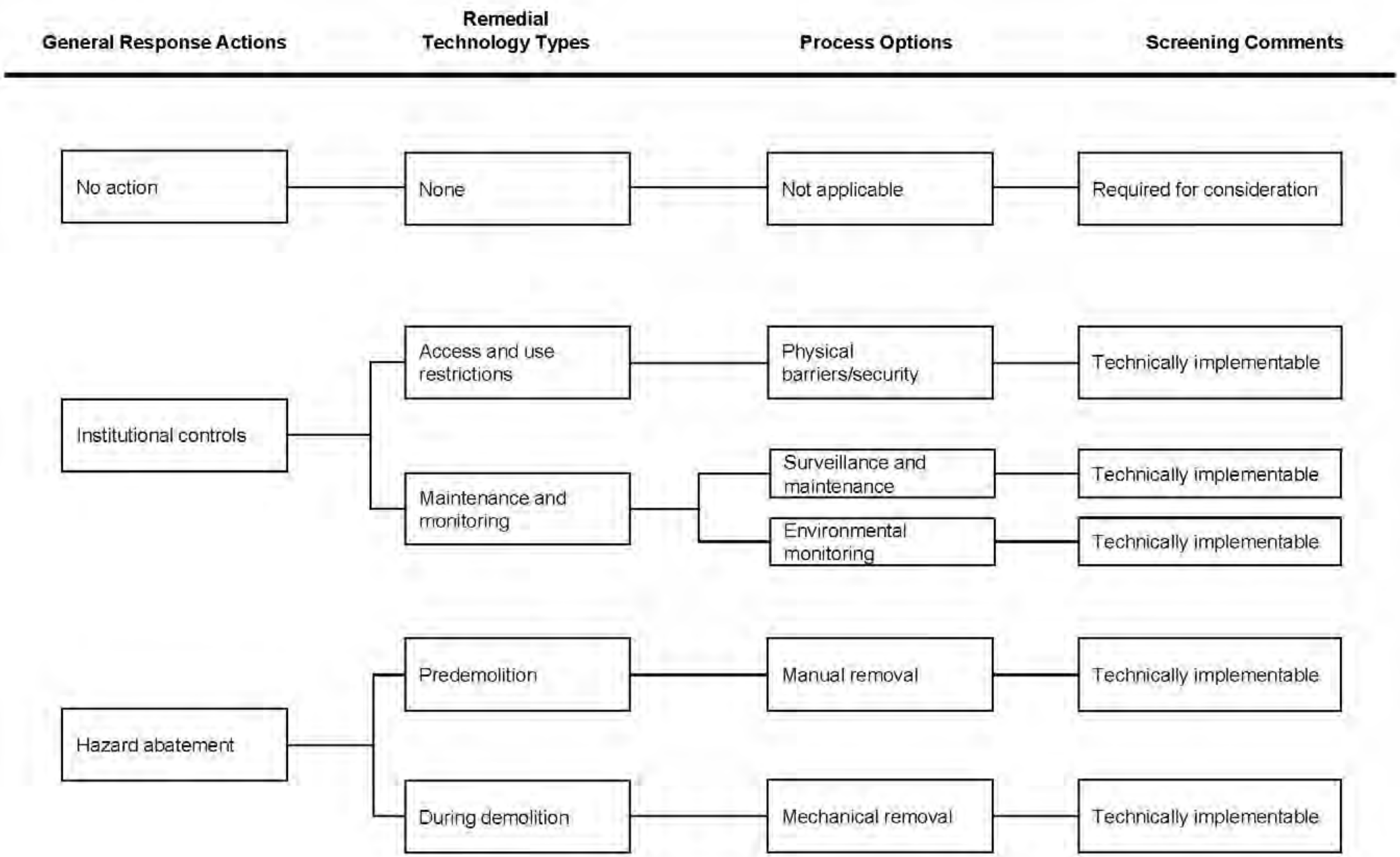

Figure 6.2. Screening of Remedial Technology Types and Process Options for PORTS

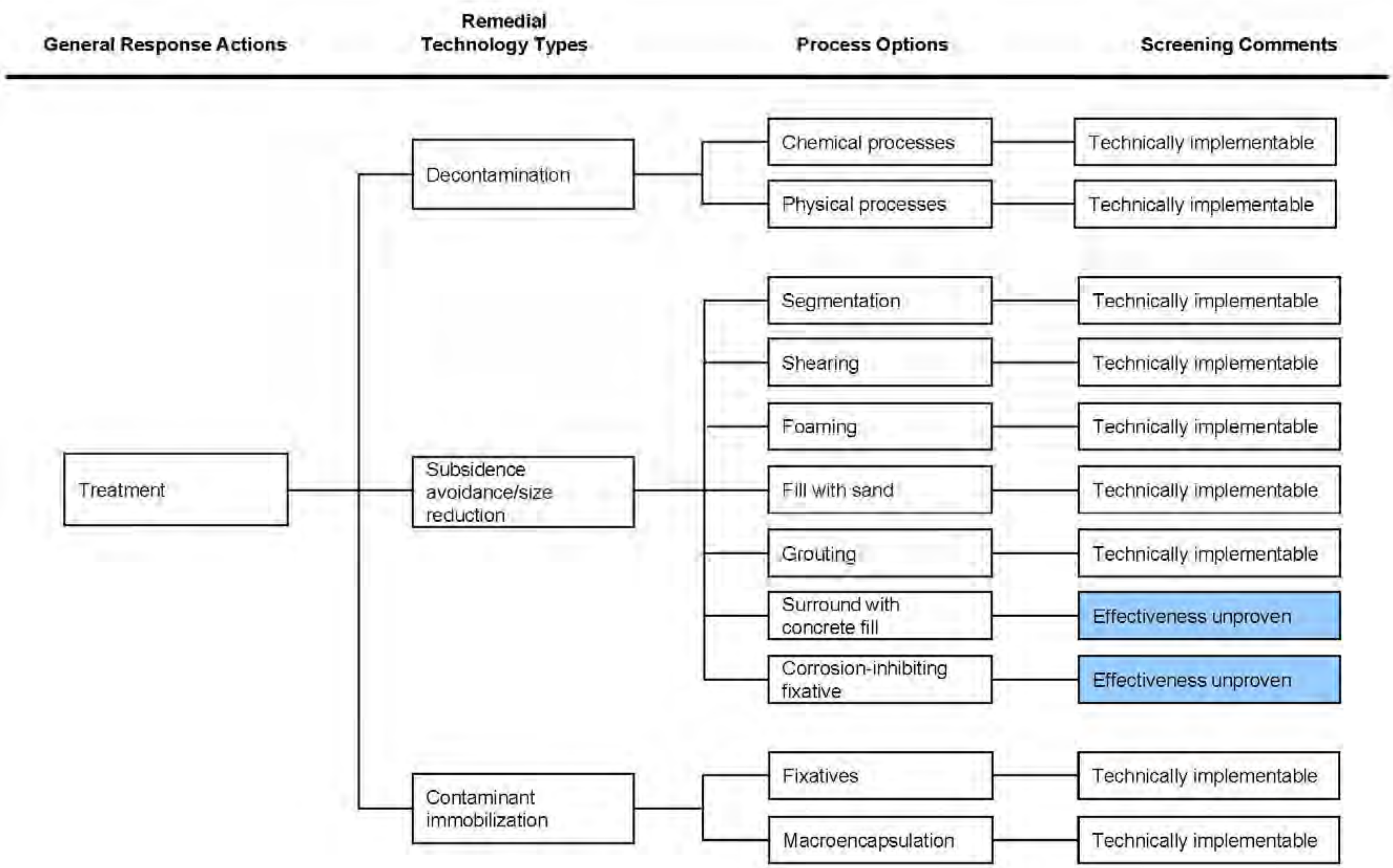

Figure 6.2. Screening of Remedial Technology Types and Process Options for PORTS (Continued)

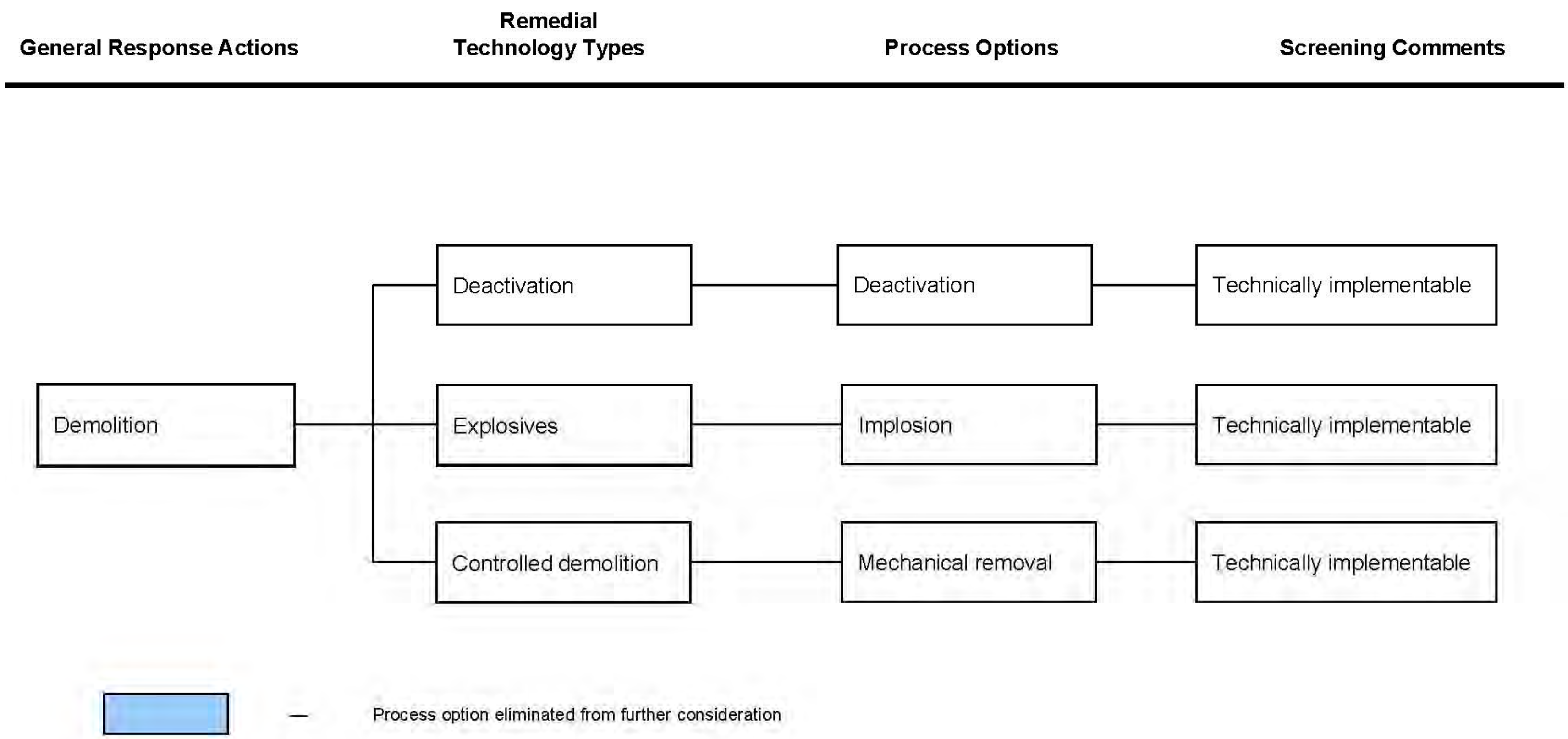

Figure 6.2. Screening of Remedial Technology Types and Process Options for PORTS (Continued)

6.4.2.1 No Action

Under the No-Action GRA, S&M activities would be discontinued, which would allow buildings/structures and equipment deterioration to continue. Institutional controls and environmental monitoring would be discontinued, resulting in the potential for direct contact with the on-PORTS contaminants and the potential for undetected off-PORTS migration of contaminants. Consideration of no action, which does not satisfy RAOs, is required as a basis for comparison with other GRAs.

6.4.2.2 Institutional controls

Access and use restrictions, as well as maintenance and monitoring, are institutional controls that reduce the potential for exposure to residual contamination remaining in or on the buildings or equipment surfaces. These technologies and the associated process options described below could be used in conjunction with other technology types to develop alternatives that would satisfy RAOs; their intended applicability is for short-term use prior to and during D&D activities.

Access and Use Restrictions

Physical Barriers/Security. Fences, signs, buffer zones, or other barriers could be installed around contaminated or hazardous areas of the buildings/structures to limit access prior to and during D&D activities. Security such as guards, surveillance, badges for access, could also be used to limit access to contaminated or hazardous areas and to control access to classified materials.

Maintenance and Monitoring

Surveillance and Maintenance. Scheduled and special inspections of buildings/structures and implementation of preventive or corrective measures could be used to ensure the proper operation of administrative and engineered controls. S&M activities would be short term, maintaining the building/structure in a stable condition prior to D&D activities.

Environmental Monitoring. Environmental monitoring could include monitoring of air, groundwater, and surface water. Sampling and analysis of environmental media before, during, and after any remedial action on the buildings/structures could be used to predict and verify the effectiveness of administrative and engineered controls. Environmental monitoring could also be used to ensure that human and ecological receptors are protected.

6.4.2.3 Hazard abatement

Hazard abatement is a technology used to minimize the volume of contaminated demolition waste by either removing hazardous materials from the buildings/structures and infrastructure prior to demolition (predemolition) or removing these materials from the demolition rubble during demolition. As a secondary benefit, hazard abatement also minimizes the potential exposure hazards for demolition and/or disposal facility workers.

Predemolition

Manual removal. Predemolition hazard abatement includes manual removal activities associated with removing materials, such as transite siding and chemicals drained from process lines. Some equipment may be used in high hazard situations or where there are large volumes and easy access, but the majority of the effort is manual. Removing these items prior to demolition reduces worker hazards during demolition and minimizes the volume of contaminated waste. However, it introduces workers to the waste streams as they manually remove the waste.

During demolition
Mechanical removal. Hazard abatement performed during demolition entails demolishing a building/ structure with heavy equipment and then segregating components from the demolition waste by picking through the waste with construction equipment. This technology and process option may contribute to the spread and dispersion of the hazardous materials through the waste during the demolition process, but it removes workers from working closely with the waste.

6.4.2.4 Treatment

Decontamination, subsidence avoidance/size reduction, and contaminant immobilization are treatment technologies that would be used waste stream-by-waste stream to reduce potential exposure hazards to demolition workers, reduce the volume of contaminated waste, meet disposal facility WAC, meet transportation requirements for off-Site shipment, or allow future recycle and/or reuse of equipment, materials, or buildings. Only treatment methods that are in compliance with ARARs and the DFF&O would be used.

Decontamination
Chemical processes. Chemical decontamination processes remove surface level contamination through a chemical reaction between the contaminated object, or surface, and the decontamination solution. More aggressive decontamination solutions can penetrate deeper into the contaminated surface. The spent decontamination solution can be recycled for additional use or treated for disposal. Examples of chemical decontamination techniques include acid etching and washing with surfactants. This process option is potentially applicable to metal and concrete materials to either allow recycling and/or reuse, protect workers, or meet a disposal facility WAC.

Physical processes. Physical decontamination processes use force, or suction, to remove contaminated material deposits and surface contamination. Application techniques vary in aggressiveness from surface cleaning to surface removal. The contaminated residues such as dust, wipes, and blast media from removal require treatment and/or disposal. Examples of physical decontamination techniques include using needle guns, dusting/vacuuming/wiping, and abrasive blasting. Primarily, this process option is potentially applicable to metal and concrete materials to either allow recycling and/or reuse, protect workers, or meet a disposal facility WAC.

Subsidence avoidance/size reduction
Segmentation. Segmentation uses cutting techniques (both manual and mechanical) to continue disassembly of the process equipment and piping, reducing the volume and void space of waste requiring disposal. This process option is considered primarily applicable to PGE. It is performed under controlled conditions for security reasons, for worker safety reasons, and for contamination control. Segmentation would be performed to allow removal of uranium deposit materials, to remove recyclable and/or reusable materials, or to size-reduce equipment and piping to meet disposal facility WAC or off-Site transportation requirements. Segmentation techniques include air carbon arc cutting, plasma arc cutting, oxy-acetylene cutting, and mechanical cutting by circular or reciprocating saws. Due to the large-size of the process equipment, associated contamination levels, and classified components within this equipment, the work would be performed on Site in a refurbished or new segmentation shop. Additional details regarding the segmentation process and other process options considered for the sole purpose of avoiding subsidence once placed in a disposal cell can be found in Appendix C.

Shearing. This process option is focused on in situ shearing that uses standard construction equipment with specialized attachments to cut/shear large pieces of equipment, piping and other waste at the demolition area. In-situ shearing would reduce waste disposal volumes, facilitate waste handling, and/or minimize void spaces. It was successfully used to shear up to 12-in. diameter process pipe, centrifugal compressors, and structural steel during demolition of the K-25 Building (west wing) on the DOE Oak Ridge Reservation. This option can also include sawing and other cutting methods conducted under field conditions at the point of generation. This process option is potentially applicable to equipment, piping, structural steel, rebar, and large pieces of demolition waste.

Foaming. The foaming process option is focused on in situ foaming, which involves using portable injection equipment to inject foam into equipment and pipe openings to fill void spaces. Some degree of contaminant immobility may be achieved through foam fixing with surface contamination. Foaming could be performed before or after cutting the process equipment and piping. The foam would be introduced into the equipment to withstand the weight of overlying waste in the disposal facility and final cover pressure after the process equipment external shell has degraded. Foaming in situ was successfully used at the K-25 Building for void reduction in some converters, which are nominally the size of the X-326 converters. This process option is potentially applicable to process equipment and piping.

Fill with sand. This process option involves introducing sand into the process equipment by gravity pour, drilling, or pumping to fill voids. No mobility reduction would occur with the use of sand. Prior to introducing the sand, all openings in the process equipment would be capped with plates capable of withstanding the static pressure from the sand, which can be several hundred pounds per square foot of opening. Because of the sand weight, this process option would need to be performed in or adjacent to the disposal facility. This process option is potentially applicable to process equipment and piping.

Grouting. Grout with a sufficient compressive strength to meet physical WAC requirements could be introduced into the top of the process equipment to fill voids. As with foaming, some degree of contaminant immobility may be achieved. Robust seal plates would be needed, as with sand.

Low-viscosity grout mixtures would maximize infiltration of voids. Again, because of the grout weight, this process option would need to be performed in or adjacent to the disposal facility. Grout filling has been successfully used for some equipment (e.g., centrifuge casings) at the Environmental Management Waste Management Facility (EMWMF) in Oak Ridge, Tennessee. This process option is potentially applicable to process equipment and piping.

Surround with concrete fill. This process option would involve placing equipment pieces into a disposal facility and then surrounding them with concrete fill materials. Placement in the disposal facility would begin with a lift of concrete fill. This would be followed by placement of the process equipment. In turn, this would be followed by a buildup around the equipment with concrete fill (eventually filling up, over, and between the equipment with concrete). Finally, a compacted lift of concrete fill would be added above the equipment so another layer of equipment could be placed. Appendix C illustrates that this process option is not sufficiently developed to be implemented in time to meet the project schedule. Its questionable effectiveness causes this process option not to be considered further.

Corrosion-inhibiting fixative. The corrosion-inhibiting fixative process option involves applying a coating or film to the exterior of the process equipment to form an impervious barrier to moisture and oxidation of the steel. The coating could be applied by brush or spray, depending on the required thickness. Fill material could then be placed around and between the equipment pieces in a manner similar to that in the methodology for the preceding option above. Appendix C illustrates that this process option is not sufficiently developed to be implemented in time to meet the project schedule. Its questionable effectiveness results in this process option not being considered further.

Contaminant immobilization

Fixatives. The fixative process option involves applying a coating of paints, films, or resins to a material surface (internal or external) to reduce the mobility of surface and loosely-bound subsurface contamination. The coating can be brushed or sprayed and can range in thickness from a light coating of latex paint to immobilize transferable contamination to a heavy polymer coating that provides more resiliency against impact or abrasion. This process option is potentially applicable to equipment, piping (interior and exterior), transite siding, and slabs, primarily to protect workers or the environment or to meet disposal facility WAC.

Macroencapsulation. Macroencapsulation is the encasement of waste within a low-solubility matrix to isolate contaminants from the environment by substantially reducing contact with leaching agents such as water. This technology can be used to treat radioactive and hazardous waste to meet disposal facility WAC and is specifically cited by EPA as the best demonstrated available technology for D008 waste (lead). Materials used in the macroencapsulation process include grout, ceramics, and polyethene. This process option is potentially applicable at the point of generation for small quantities of D008 hazardous or mixed waste (e.g., lead shielding blocks), uranium deposit materials, and/or classified components removed from the process equipment.

6.4.2.5 Demolition

Demolition technologies would be used to prepare and remove facilities, structures, and their related infrastructure. Technologies under consideration include deactivation, explosive demolition, and controlled demolition. These technologies have been used successfully by DOE for the demolition of structures.

Deactivation

Deactivation. The deactivation process option involves deactivating utilities and specialty systems (such as criticality alarms and security alarms) in concert with termination or removal of the hazards they were intended to protect against. Deactivation includes venting, draining, and isolation of lines, which removes hazardous materials that could contribute to the spread of contamination during the demolition process. This process option is potentially applicable to the utility and support systems associated with the buildings/structures included in this RI/FS.

Explosives

Implosion. Explosive demolition could be used for efficiently demolishing larger structures. When a building or structure (e.g., a water tank) is surrounded by other buildings, it may be necessary to "implode" it with explosives so it collapses into its own footprint. This process option is referred to as implosion. Implosion is accomplished by loading explosives on several different levels of the building so the building structure falls down on itself at multiple points. When executed correctly, the damage of the explosives and the weight of the falling building material are sufficient to collapse the structure entirely, leaving only a pile of rubble. Implosion is a specialized skill with a limited number of qualified vendors. This process option is not applicable to highly contaminated structures because of the potential for airborne dispersion of contaminants, but it is applicable to small-scale demolition jobs such as bringing down a water tower.

Controlled demolition

Mechanical removal. Controlled demolition using mechanical removal methods includes using heavy equipment (e.g., excavators) equipped with various attachments (e.g., breakers, shears, grapples, rams, jaws, etc.) to disassemble a structure. The strategy is to weaken a building's primary structural components while controlling the manner and direction in which the building falls. The heavy equipment is also used to size-reduce and segregate waste during the demolition process. Additional size reduction or segmentation can occur manually with cutting devices. Dust suppression techniques are used throughout the demolition process to control airborne contaminants. Storm water runoff from the demolition waste is captured or controlled by hay bales, silt fences, etc. This process option is potentially applicable to all structures (contaminated and noncontaminated).

6.4.3 Evaluation and Selection of Representative Process Options

EPA guidance (EPA 1988) and the DFF&O (Section 7.2 of the SOW for the RI/FS) discuss evaluating the effectiveness, implementability, and cost of each process option within the same technology type that passed the initial screening step to identify representative process options. Based on this evaluation, the process option that best satisfies the criteria of effectiveness, implementability, and cost for each technology group is identified as the representative process option. The representative process options identified from this evaluation are indicated by shading in Table 6.2. These process options “represent” other process options only in this FS evaluation. Future evaluation may result in the use of other, comparable process options, including options that are not shaded in this table. If a process option is not shaded in this table, it does not mean that it could not be used. This table does not eliminate process options from consideration; Figure 6.1 identifies the technologies/process options that are being screened (or eliminated) from further consideration.

6.4.3.1 No Action

Effectiveness. This process option would not address future risks to human health and the environment from deteriorating buildings/structures and unmitigated releases of contaminants. This GRA does not satisfy RAOs.

Implementability. No Action is easily implementable.

Cost. No costs are associated with No Action.

6.4.3.2 Institutional controls

Access and land use restrictions, as well as maintenance and monitoring, are institutional controls that could be used in conjunction with treatment and demolition GRAs to protect the public and industrial workers at the PORTS Facility. Such restrictions could be in use prior to and during demolition activities.

Access Restrictions – Physical Barriers/Security

Effectiveness. Physical barriers (such as fences) and security forces would be effective at preventing unauthorized personnel from coming in contact with contamination or physical hazards prior to and during demolition. There are already general access controls to the buildings at PORTS, and they have been implemented effectively for many decades.

Implementability. All access and use restrictions are readily implementable. These process options have been used at many DOE remediation facilities for short- and long-term protection; they represent a continuation of existing conditions at PORTS.

Cost. Physical barriers and security, over the short term, have relatively low costs.

Table 6.2. Process Options for PORTS

General Response Action	Technology Type	Process Option	Effectiveness	Implementability	Cost	Status
No Action	None	No Action	Response would not address future risks to human health or the environment and therefore does not meet RAOs.	No implementation required.	None.	Identified as representative process option to provide baseline.
Institutional Controls	Access and use restrictions	Physical barriers/security	Effective for preventing access to contaminated and deteriorating areas.	Implementable with available technology.	Low	Identified as representative process option.
	Maintenance and monitoring	Surveillance and maintenance	Effective for evaluating the integrity of engineered controls and maintaining the controls.	Implementable. Experienced personnel are available.	Moderate	Identified as representative process option.
		Environmental monitoring	Effective for detecting contaminant migration from buildings/structures.	Implementable. Experienced personnel are available.	Low	Identified as representative process option.
Hazard Abatement	Predemolition	Manual removal	Subject waste streams easier to access before demolition improving effectiveness.	Implementable. Experienced personnel and equipment are available.	Moderate	Identified as representative process option.
	During demolition	Mechanical removal	Not as effective for many of the smaller-sized waste streams. Also greater potential for releases and contamination of the entire waste pile. Effective for large items that are easily segregated.	Implementable. Requires more skilled equipment operators.	Moderate	Not identified as representative process option in favor of more effective abatement predemolition. However, there may be instances of anomalies being removed from a waste stream after demolition.
Treatment	Decontamination	Chemical processes	Effective for removing organic; inorganic; PCB; and radiological contamination, primarily from metals and concrete materials.	Implementable. May require the design and construction of reaction vessels. Could generate large quantities of secondary waste requiring treatment.	Moderate to high	Identified as representative process option depending on contamination and material.
		Physical processes	Effective at removing loosely bound contamination, primarily from metal and concrete surfaces. More aggressive techniques are also effective in removing uranium material deposits from process equipment and piping.	Implementable. Experienced personnel and equipment are available. Some techniques (uranium material deposit removal) would be labor intensive.	Moderate to high	Identified as representative process option depending on contamination and waste materials.

Table 6.2. Process Options for PORTS (Continued)

General Response Action	Technology Type	Process Option	Effectiveness	Implementability	Cost	Status
Treatment (continued)	Subsidence avoidance	Segmentation	Effective at reducing waste volume and void space associated with PGE. Also effective at providing access to uranium deposits or nickel within process equipment.	Implementable. Experienced personnel and equipment are available. Implementation is labor intensive. Security controls would be required when segmenting some process equipment. Could be performed in situ or at a suitable nearby, on-Site location.	High	Identified as representative process option.
		Shearing	Effective at reducing waste volume and void space associated with miscellaneous waste.	Implementable. Experienced personnel and equipment are available. Could be performed in situ to avoid double handling of waste. More protective of workers than other subsidence avoidance process options.	Moderate	Identified as representative process option.
		Foaming	Effective at reducing void space within equipment and piping, does not reduce waste volume.	Implementable. Experienced personnel and equipment are available. Has been implemented at Oak Ridge. Could be performed in situ or at the disposal facility. Special health and safety consideration are required due to the combustibility of the materials used.	Moderate	Not identified as representative process option (grouting represents this process option).
		Fill with sand	Effective at reducing void space within equipment and piping, does not reduce waste volume. Slightly lower effectiveness than foam or grout.	Implementable. Experienced personnel and equipment are available. More easily implemented during disposal activities than during demolition activities.	Moderate	Not identified as representative process option because of higher cost than grout (see Appendix C).

Table 6.2. Process Options for PORTS (Continued)

General Response Action	Technology Type	Process Option	Effectiveness	Implementability	Cost	Status
Treatment (continued)	Subsidence avoidance (continued)	Grouting	Effective at reducing void space within equipment and piping, does not reduce waste volume.	Implementable. Experienced personnel and equipment are available. More easily implemented during disposal activities.	Moderate	Identified as representative process option.
	Contaminant immobilization	Fixatives	Effective at binding contaminants to prevent the spread of contamination throughout waste during demolition. No removal of contaminants is achieved.	Implementable. Experienced personnel and equipment are available.	Low	Identified as representative process option.
		Macroencapsulation	Effective at isolating contaminants prior to disposal.	Implementable. Can be performed at the demolition Site if treating small volumes of waste. Labor-intensive but easy to implement. Increases the volume and mass of waste.	Moderate	Identified as representative process option.
Demolition	Deactivation	Deactivation	Effective at hazardous components associated with utilities and systems to prevent the spread of contamination throughout waste during demolition.	Implementable. Experienced personnel and equipment are available. Could be labor-intensive.	Moderate	Identified as representative process option.
	Explosives	Implosion	Effective at demolishing a building but the potential for contaminant release exists. Only applicable to lesser contaminated buildings/ structures.	Implementable. Requires specialty contractors.	Moderate	Not identified as representative process option in favor of controlled demolition.
	Controlled demolition	Mechanical removal	Effective at demolishing a variety of buildings/structures in a manner that minimizes contaminant migration.	Implementable. Experienced personnel and equipment are available. Would require substantial safety and environmental controls.	Moderate	Identified as representative process option.

Note:
Representative process options are shaded.

PCB = polychlorinated biphenyl
PGE = process gas equipment
RAO = remedial action objective

Maintenance and Monitoring – S&M and Environmental Monitoring
Effectiveness. Surveillance can effectively evaluate the integrity of engineered controls; maintenance can ensure the integrity of the controls for the duration of active institutional controls. Environmental monitoring is effective for detecting contaminant migration and assessing the reliability of containment and engineered control systems. Monitoring cannot control the spread of contamination and, therefore, does not provide any additional protection of the environment. However, frequent and early detection of problems does allow effective engineered solutions to be put in place to control unexpected releases, thereby providing protection to the environment.

Implementability. S&M and environmental monitoring are readily implemented with experienced personnel. Monitoring locations would be sited appropriately around the demolition areas. The technologies for monitoring air and water are already in use at PORTS. Minimal administrative complexities are envisioned for establishing monitoring locations.

Cost. S&M and environmental monitoring are anticipated to be implemented in the short term during the demolition activities. The short-term cost associated with S&M is moderate. S&M costs would decrease as the deactivation and demolition activities begin, but are significant until then. Monitoring costs are low.

Identification of Institutional Controls Representative Process Options. Physical barriers/security, S&M, and environmental monitoring, all performed in the short term, are identified as representative process options.

6.4.3.3 Hazard abatement

Predemolition hazard abatement and hazard abatement during demolition both remain from the initial screening.

Predemolition – Manual Removal
Effectiveness. Manual removal of hazardous materials prior to demolition is effective in maintaining separate waste streams and minimizing the amount of waste disposed as hazardous or mixed waste. It can minimize the potential for hazardous materials to contaminate other waste streams or even be released to the environment. Hazardous materials that would be removed prior to demolition include mercury switches and transite panels. Incidental quantities of hazardous materials would remain in the buildings for disposal with the post-demolition waste (e.g., PCB gaskets, wire insulation remaining in control panels). This work can be hazardous as workers enter tight spaces and manually drain or remove the appropriate waste streams. Some of this work would require respiratory protection, increasing risks from heat exhaustion in the summer.

Implementability. Predemolition manual removal of hazardous materials is implementable with the existing, trained workforce and available technologies, and it is a standard practice for D&D activities. Removal of large quantities of hazardous materials, such as the transite panels on the exteriors of the process buildings, can be labor intensive.

Cost. Costs associated with predemolition hazard abatement activities are considered to be moderate and depend on the amount of hazardous material present in a building. Specialty contractors are required to remove some materials such as ACM.

During Demolition – Mechanical Removal
Effectiveness. The use of heavy equipment to conduct hazard abatement reduces the risk to the remediation worker. Hazards are removed from the waste stream after a pile has been generated or during building demolition. The effectiveness of segregating the waste streams depends on the integrity and size of the hazardous material. Small materials or those that release their contents easily would not be segregated effectively from the larger waste pile and may, in fact, contaminate much of the other waste. It may be more effective for segregating larger material such as transite siding.

Implementability. Use of heavy equipment is easier to implement than technologies that use manual effort. However, effectiveness can suffer. The equipment is available, but its use as a segregation tool depends on the presence of skilled operators and personnel on the ground searching for anomalies.

Cost. The costs associated with mechanical removal are moderate. There are lower labor costs but greater heavy equipment costs.

Identification of Hazard Abatement Representative Process Options. The predemolition process option of manual removal is identified as a representative process option to be combined with treatment and demolition process options. It is selected because of its increased effectiveness without a major increase in cost. However, the application would be decided during design when the hazards to be removed prior to demolition are defined, based on disposal WAC and U.S. Department of Transportation (DOT) requirements.

6.4.3.4 Treatment

Treatment process options are being evaluated to reduce potential exposure hazards to demolition workers, reduce the volume of contaminated waste, meet disposal facility WAC, meet transportation requirements for off-Site shipment, or allow unrestricted use of equipment or buildings.

Decontamination – Chemical Processes and Physical Processes
Effectiveness. Chemical processes such as acid etching and washing with surfactants have been demonstrated to be effective in removing organic, inorganic, PCB, and radiological contamination, primarily from metal and concrete surfaces. Physical processes such as needle guns, dusting/vacuuming/wiping, and abrasive blasting are effective at removing loose bound contaminants, primarily from metal and concrete surfaces. Physical processes are also effective on uranium deposits contained in process equipment and piping. These techniques were used at PORTS during operation of the GDP. For the appropriate contamination, each process option is considered to be effective.

Implementability. In general, chemical processes are more difficult to implement than physical processes. Depending on the particular chemical process used, an immersion or reaction vessel may be needed to perform the chemical reaction. Chemical processes can create large quantities of secondary waste (decontamination solution), which in most cases requires treatment prior to disposal. Physical processes are relatively easy to implement with conventional cleaning supplies and equipment. Depending on the amount of decontamination required, implementing physical processes can be labor intensive. Secondarily generated waste (e.g., wipes, paint chips, filters, grit) can usually be disposed of without treatment.

Cost. The costs to use chemical processes are considered to be moderate to high, and they include costs for the decontamination solution, construction of the decontamination unit (reaction vessel), operation of the process, and treatment and disposal of the secondary waste. The costs to use physical processes are also considered to be moderate to high and include the costs for materials (e.g., vacuum filters), operation of the process, and disposal of the secondary waste such as spent vacuum filters.

Subsidence Avoidance/Size Reduction – Segmentation, Shearing, Foaming, Filling with Sand, and Grouting

Effectiveness. Segmentation is an effective process option to minimize void spaces within PGE and piping and to provide access to equipment internals for further processing. In-situ shearing is effective at minimizing void spaces within a majority of the equipment and piping. Converters cannot be sheared in situ because of classification issues.

Foaming, filling with sand, and grouting are all considered effective at filling a large majority of the void spaces present within equipment and piping. Foam and grout are considered to be more effective than sand because of their flowability, which would equate to more internal voids being filled.

Implementability. The proposed process options for subsidence avoidance/size reduction are all technically implementable. Segmentation and shearing (including cutting) are readily implementable using experienced personnel and standard industrial equipment and techniques, and they have been used at PORTS and Oak Ridge. Segmentation, which would involve disassembly and cutting of the PGE and piping piece-by-piece, is labor-intensive and could impact the project schedule. It might require the transfer of equipment to a segmentation shop, which would involve double handling of the equipment. Security controls would be required for segmenting some process equipment. Shearing or cutting at the point of generation is less labor-intensive, has less handling of the waste and consequently, has less risk of worker exposure than segmentation; however, this process option could not be used on PGE because of classification issues or contaminant migration control needs. The PGE would require segmentation in a controlled, secure area.

Foaming could be introduced after hot cutting of the equipment and piping to remove it from its location. Foaming offers the advantage of allowing the equipment and piping (with the exception of the converters) to be sheared during demolition and handled with other building waste. Stringent safety controls would be required because of the combustible properties of the foam.

Filling with sand would be accomplished more easily at the disposal facility because the weight of the sand-filled equipment would be difficult to load and transport. This process option has not been used during any DOE D&D projects, mainly because grout is considered to be superior because of its flowability. Implementing this process option would require a covered processing area to keep the sand dry.

Grouting can be implemented during normal disposal facility operations and could avoid or minimize additional equipment movement for processing. Grouting during cold weather requires additional curing time or different grout mixtures to assure solidification.

Cost. The costs for segmentation are considered to be high and are associated with the needed security and safety controls, double handling of the equipment, and the amount of labor involved with this process option. The costs for in situ shearing, performed by the heavy equipment used for demolition, would be moderate. The costs for foaming are considered to be moderate and are primarily driven by the costs of the foam product and the safety controls required. The costs of filling with sand and grouting are considered to be moderate. Foaming, filling with sand, and grouting have significant material costs.

Contaminant Immobilization – Fixatives and Macroencapsulation

Effectiveness. Application of fixatives and macroencapsulation are effective methods for isolating contaminants and minimizing the spread of contamination. Fixatives can be used on equipment and surfaces to bind contaminants. Macroencapsulation is a process option commonly used to treat hazardous and radioactive waste prior to disposal. During D&D of the PORTS buildings/structures, these process options would most likely be used on unique, small volume waste streams to treat removed deposits or fix contamination in piping prior to shearing. The chemical composition of each is dependent on the waste it is anticipated to treat.

Implementability. Application of fixatives and macroencapsulation are implementable technologies using a trained workforce and standard equipment and tools. Fixatives can be painted on if treating small areas or sprayed on for larger areas. To effectively use macroencapsulation, forms or rigid containers are needed to ensure the concrete completely surrounds the waste. This process option is labor-intensive but fairly easy to implement. The waste must be placed carefully within the form or container, and the encapsulate must be poured slowly and evenly around the waste. Macroencapsulation results in an increase in the volume or mass of waste.

Cost. The costs for fixatives are considered to be low, and the costs for macroencapsulation are considered to be moderate.

Identification of Treatment Representative Process Options

The following techniques have been identified as representative process options for treatment:

<u>Decontamination</u>

- Chemical processes
- Physical processes.

<u>Subsidence avoidance/size reduction</u>

- Segmentation
- Shearing
- Grouting.

<u>Contaminant immobilization</u>

- Fixatives
- Macroencapsulation.

Both chemical and physical decontamination processes are identified as representative process options to represent decontamination because they have differing applicability depending on the contaminants and the material. Both segmentation and shearing (including cutting) are identified as representative process options because of the variety of types and sizes of process equipment. In general, segmentation (the more expensive process option) would be used on PGE where shearing is ineffective, where security issues preclude the use of shearing, or when controlled removal of deposits or recyclable and/or reusable material is needed. Grouting is the representative process option over sand and foam because of the improvements in effectiveness over sand and a slight reduction in cost over both sand and foam (see Appendix C for more cost details). Both fixatives and macroencapsulation are used for further development into alternatives for small, special waste streams. Both are likely to be needed to address unique waste streams or situations.

6.4.3.5 Demolition

The demolition process options carried forward from the preliminary screening are deactivation, controlled demolition by mechanical removal, and the use of explosives. These process options are evaluated below for their ability to prepare and remove a variety of different building types and contamination levels.

Deactivation – Deactivation

Effectiveness. Deactivation of utilities and systems involves isolating the utility from the building/ structure. It may include draining of process lines, which removes hazardous materials from those systems. Deactivation is a typical step in the demolition process. To be effective, all utilities need to be isolated in the right order to remove risks to workers and control any chance of releasing contaminants, while maintaining the utilities until there is no need for them and avoiding impacts on other users of the utilities. Some replacement of utilities, either new piping or even construction of a new, optimized system, may be included as part of this process option.

Implementability. Deactivation can be labor-intensive with the level of effort dependent on the number and complexity of the utilities and systems requiring isolation. The most significant challenge is planning when a utility is no longer needed and how best to isolate a building or structure from the system or how to replace a necessary utility.

Cost. The costs of deactivation are considered to be moderate.

Explosives – Implosion

Effectiveness. Explosives can be very effective at removing structures and buildings, and they have been used previously at DOE facilities. Much less labor and equipment efforts are required to implode a structure. However, considerable planning is needed to ensure the demolition results are as desired and that there are no significant releases of contaminants. Because of release of contaminants, explosives are not considered sufficiently effective for use on highly contaminated buildings.

Implementability. Specialized contractors are needed to demolish a building with explosives. Contaminant migration controls would be needed as well as air monitoring. Some structures are easier to implode than others, depending on how they were built.

Cost. The costs of implosion are considered to be moderate.

Controlled Demolition – Mechanical Removal

Effectiveness. Controlled demolition using heavy machinery is effective for demolishing the various types of buildings and structures being addressed. This method of demolition would allow for sorting and additional size reduction during demolition, as needed to facilitate material recycling and waste handling and packaging.

Implementability. Mechanical removal is readily implementable. Heavy equipment and experienced operators are available within reasonable proximity to PORTS. The heavy machinery could include trackhoes, bulldozers, and cranes. Processing heads (e.g., grapplers, shears, concrete breakers, etc.) would be selected according to the materials of construction and the size and configuration of the building or structure being demolished. Dust control measures would be implemented as needed during demolition to minimize any potential spread of contamination.

Cost. The costs for controlled demolition by mechanical removal are considered to be moderate and include costs for the equipment, operators, and safety; security; and necessary environmental controls.

Identification of Demolition Representative Process Options. Deactivation and controlled demolition using mechanical removal are identified as representative process options. Deactivation is required for worker safety and to control releases to the environment. Controlled demolition is used in the alternative evaluation over explosives because of the greater range of buildings and structures that can be demolished using this process option. Explosives may be used for small, noncontaminated building/structure demolition.

HIGHLIGHTS OF SECTION 6

- The three foundations for developing alternatives are: (1) regulatory understanding, (2) development of RAOs, and (3) selection of representative process options.

- All alternatives to be considered will be protective of human health and the environment and will not contribute to future surface water and groundwater contamination.

- The selected summarized RAOs are:

  - Protect human health to an ELCR level of 1×10^{-5} and a hazard index of 1 for an industrial user and protect ecological species.

  - Protect surface water and groundwater from further degradation.

- Controlled demolition using heavy equipment is selected to represent the range of viable demolition process options in the development of the alternatives.

NEXT STEP: SECTION 7 DEVELOPS AND DESCRIBES A RANGE OF ALTERNATIVES THAT SOLVE THE PROBLEM

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7. FINAL DEVELOPMENT OF ALTERNATIVES

Section 7 completes the identification of potential solutions. This section explains the assembly of representative process options into final remedial action alternatives, each aimed to achieve the RAOs and comply with ARARs. These alternatives are developed in Section 7.1. Section 7.2 then presents the action-specific ARARs for each of the developed alternatives. In Section 7.3, these alternatives are then described in sufficient detail to support the evaluation of alternatives, including a cost estimate, in Section 8 and are based on the process options identified as representative from Section 6.

In addition to the no-action alternative, an alternative that decommissions and demolishes the buildings/structures and infrastructure at PORTS is developed.

7.1 DEVELOPMENT OF ALTERNATIVES

Two remedial alternatives are developed to address all buildings/structures and infrastructure identified in the DFF&O, Attachment H. They are the no-action alternative and one action alternative, remove structures, treat as necessary, and package waste for final disposition. Cost and analysis of final transportation and placement options for the waste generated are not included in this RI/FS but are included in the evaluations in the Waste Disposition RI/FS.

A renovation and reuse alternative is not developed in this RI/FS. The primary reasons this alternative is not developed include the nature of the structures, their current state of deterioration, and the lack of any identified future need or use beyond their current mission use. Many of the buildings/structures were built for a specialized use (e.g., monitoring stations, storage tanks, pump stations) and are not conducive to being remodeled for other uses. Some, such as the process buildings, are so large that any decontamination and remodeling efforts would be cost prohibitive. Further, there is likely no market for the buildings. For example, despite many years of marketing and communication effort by the community reuse organization, no user could be found for the large K-31 and K-33 process buildings in Oak Ridge, even after the equipment had been removed and they had been decontaminated. All process buildings as well as the major maintenance shops and support facilities in Oak Ridge are being demolished. Many of the PORTS buildings were built in the 1950s and 1960s, making them 50 to 60 years old with few (if any) upgrades over the years. A majority of the buildings/structures and infrastructure at PORTS was used for managing nuclear materials, and they are suspected of containing radiological and other contamination.

Below is a description of the remedial alternatives to address the buildings/structures and infrastructure within the scope of this RI/FS at PORTS. Solely for purposes of the RI/FS evaluation, including the cost estimate, certain assumptions (e.g., refurbishment of on-Site facilities) are made and the identified representative process options are used to describe the alternative in more detail in Section 7.3. Specific methods may change during later phases of this project and the final methods to be used will be determined in subsequent design and construction documents.

7.1.1 Alternative 1 – No Action

Alternative 1 is the no-action alternative. The no-action alternative is required to establish and document baseline conditions and provide a basis for comparison to the other remedial action alternative. This alternative would consist of no D&D of PORTS buildings/structures, their contents, or infrastructure. As discussed in Section 5, under no action, buildings and structures would eventually degrade, resulting in releases of contaminants with migration to areas where exposure to human and ecological receptors may occur. Further, this alternative does not include controls to prevent access to the buildings, structures, their contaminants, or the associated physical hazards they present. The following are key components of this alternative:

- Buildings/structures, infrastructure, and associated equipment would not be removed or demolished but instead would be left to degrade.
- The radiological and hazardous contaminants associated with the structures and associated equipment would remain.
- No surveillance or maintenance of the buildings/structures and infrastructure to prevent degradation or migration of contaminants would occur.
- No institutional controls would be implemented to control access to radioactive and hazardous waste contaminants or physical hazards.

7.1.2 Alternative 2 – Remove Structures, Treat as Necessary, and Package Waste for Final Disposition

This alternative includes the removal of stored waste, materials, hazards, PGE, and process piping. It also includes demolition of the buildings/structures; characterization and demolition of infrastructure, if required; and packaging of the waste for disposition. It also includes preparation of materials for recycling and/or reuse, including decontamination and segmentation so long as the decision to recycle and/or reuse materials fits the definition of D&D, does not require modification of any Ohio EPA approved or concurred with Submissions (e.g., proposed plan, decision document, remedial design, etc.), and is in compliance with all ARARs. If DOE's recycling proposal requires modification of any regulatory documents (e.g., proposed plan, decision document, remedial design, etc.), DOE will submit its proposed modification to Ohio EPA for approval or concurrence, as applicable. Prior to implementing recycling and/or reuse, DOE would evaluate the benefits (including disposal volume savings) against the additional costs of completing the action, implementing issues, and efforts with implementing associated policy issues. There can be costs associated with segregating and handling materials, demonstrating the potentially recycled and/or reused material is uncontaminated, and in decontaminating the material. All GRAs and process options not eliminated during the initial technology screening comprise this alternative.

Key components of this alternative include the following:

- Before and during demolition, physical barriers, S&M, and monitoring activities would continue. These activities would no longer be required in an area upon completion of the demolition activities in that area.
- Additional characterization would be performed, as needed, to support remedial design, develop worker safety protocols, and facilitate segregation of waste streams and waste disposition planning. The amount of characterization would depend on the historical use, available process knowledge, and the anticipated disposal facility for its waste. An appropriate amount of characterization would be specified during the remedial design phase. Activities begun in the Waste Disposition RI/FS project to characterize PGE would continue under this decision.

- Each area would be prepared for demolition. Trailers and equipment would be brought on to the area, laydown areas and runoff controls would be constructed, plant transportation support facilities would be upgraded, and vegetation would be removed. Temporary structures that are constructed would be evaluated for addition to the DFF&O, Attachment H if appropriate. They would then be demolished upon completion of the action if there is no future use.

- ACM would be removed, bagged, or packaged as appropriate and disposed appropriately.

- Any remaining fluids (e.g., lubricating oils, fuels, and liquid chemicals from equipment and tanks) would be drained, drummed, and disposed at a permitted off-Site disposal facility.

- To the extent practicable and in compliance with ARARs, some materials within the buildings, including those listed above, will be removed, packaged, and appropriately dispositioned prior to building demolition. Other materials would be left in the building to be demolished with the rest of the structure. Predemolition removal of these materials would allow for waste segregation, as necessary, and appropriate disposal. In some cases, predemolition removal of some items would be done to improve the safety of demolition workers.

- Decontamination of buildings/structures and infrastructure components would be performed as needed to protect the workers, meet regulatory requirements, facilitate material recycle and/or reuse or demolition, or meet disposal facility WAC. Construction of any necessary facilities to support this treatment is included.

- Utilities and specialty systems, such as for alarms and security, would be deactivated or rerouted in concert with termination of need or removal of the hazards. New utilities may be installed.

- PGE (e.g., converters, compressors, coolers, and valves) would be removed from the three process buildings (X-333, X-330, and X-326). If required to meet transportation requirements, disposal facility WAC, or if needed to recover recyclable and/or reusable materials from the PGE, the PGE and piping would be segmented on Site, and uranium material deposits or the recyclable and/or reusable materials would be removed. The PGE, process piping, and solidified uranium deposit materials would be packaged for transportation and disposal in accordance with the appropriate WAC while recovered materials would be prepared for eventual recycling and/or reuse.

- Oversized auxiliary equipment would be removed and size reduced separately, as appropriate.

- Above-grade structures, including slabs, would be demolished using heavy equipment with specialized attachments.

- Soils as described in DFF&O Paragraph 5(e)(3) and 5(e)(4)(ii) would be removed and managed or recontoured. These soils are referred to as residual soil in this RI/FS.

- Fugitive dust would be minimized during demolition. Any storm water runoff would be controlled and monitored.

- Piping and electrical cables leaving the buildings/structures footprint would be cut or disconnected.

- Subsurface structures and infrastructure would be removed using heavy equipment with specialized attachments. Uncontaminated subsurface structures may be considered to be left behind.

- Concrete may be rubblized and used for fill at PORTS.
- Waste streams would be segregated by waste types and size reduced, treated, and packaged in accordance with applicable regulations and disposal facility acceptance criteria in preparation for disposition.
- Equipment or recyclable materials would be considered for reuse and/or recycling at DOE's discretion.
- Demolition areas would be backfilled and graded, as needed, to promote drainage. They would then be seeded to promote revegetation.
- Since DOE plans to have the Waste Disposition ROD finalized before the Process Buildings ROD is finalized, wastes from the Process Buildings decision should be able to be disposed in accordance with the Waste Disposition ROD.

The approach for final disposition of waste generated under this Process Buildings project is being evaluated, proposed, and selected through the Waste Disposition RI/FS, proposed plan, and ROD. The Process Buildings proposed plan will incorporate by reference the supporting data, information, and detailed analyses of waste disposition alternatives (i.e., on-Site versus off-Site disposal) that are presented in the Waste Disposition RI/FS and proposed plan.

If the Waste Disposition ROD is not finalized before the Process Buildings proposed plan, the Process Buildings proposed plan will include the requirement that all waste generated be disposed of off Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i through v. of the DFF&O until such time as the Waste Disposition ROD is finalized. The proposed plan will also indicate that upon finalization of the Waste Disposition ROD, the waste will be disposed of in accordance with the decision in that Waste Disposition ROD. If the decision in the Waste Disposition ROD selects an OSDC, this means that the waste generated pursuant to the Process Buildings ROD will be disposed of in the OSDC upon its becoming operational so long as the waste meets the Ohio EPA approved WAC and all Milestones for removal and disposal of staged wastes are also met.

7.2 SUMMARY OF ACTION-SPECIFIC ARARS FOR EACH ALTERNATIVE

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and removal/remedial activities.

7.2.1 Alternative 1 – No Action

Pursuant to EPA guidance, there are no ARARs for a no-action alternative (EPA 1991).

7.2.2 Alternative 2 – Remove Structures, Treat as Necessary, and Package Waste for Final Disposition

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and removal/remedial activities. This D&D alternative includes removal of scrap metal, equipment, building structures, infrastructure, residual soil , any waste materials, and (where necessary) stabilization of demolition areas. Material recovery for reuse and/or recycling, treatment, and packaging of the material or waste are also part of this decision.

Although some characterization has been performed, additional waste streams may be identified during implementation of the remedial action.

The action-specific ARARs for this alternative, listed in Table B.2 in Appendix B, include requirements related to waste characterization, scrap metal removal, decontamination, waste storage, treatment and disposal, and pre-transport preparation of hazardous materials. Requirements under the Clean Air Act govern the control of asbestos and/or radionuclide air emissions. All primary wastes (e.g., wastes sent for disposal) and secondary wastes (e.g., contaminated personal protective equipment [PPE], decontamination wastes) generated during D&D activities must be appropriately characterized and managed in accordance with ARARs and TBCs, which include federal and State of Ohio laws and regulations, DOE Orders, and other requirements as specified in Table B.2 of Appendix B. Hazardous and TSCA waste determinations would be based on available process knowledge, materials of construction calculations, and/or sampling/analysis results, as required. If no listed hazardous wastes are present and the sample does not exhibit a hazardous characteristic, the waste would be categorized as nonhazardous. Hazardous, TSCA, and non-hazardous other waste may be accumulated and stored in appropriate storage areas at PORTS consistent with ARARs. Solid wastes (e.g., trash, etc.) generated from support activities would also be managed in accordance with solid waste ARARs.

Disposal activities will have to meet the WAC of the ultimate disposal facility, whether on Site or off Site. It is anticipated that any treatment or size reduction to meet ARARs or the WAC of the disposal facility would be covered by this decision. Specific treatment technologies are described in Section 6 and the action alternative description below.

As noted in the DFF&O, Paragraph 9.a, the NCP at 40 *CFR* 300.400(e)(1) defines "on-site" as meaning "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for the implementation of the response action." Substantive ARARs requirements, however, would apply to that portion of the activities conducted entirely on Site under this alternative.

There are several existing permits at PORTS, including, but not limited to, an NPDES permit for the discharge of wastewater and a RCRA Part B permit for the storage of hazardous waste. Activities subject to any of the existing permit(s) must continue to comply with such permits as they are not being conducted under the DFF&O and CERCLA.

The following permit application or administrative notification activities would normally be triggered if this removal action were not being conducted entirely as an on-Site action. The substantive requirements of these notification and permit activities are listed as ARARs in Appendix B.

- A notice of intent for coverage under Ohio's NPDES general permit (*Authorization for Storm Water Discharges Associated with Construction Activity under NPDES*, NPDES OHC00003) for stormwater discharges associated with construction/demolition activities would normally need to be filed if the activities were not being performed as part of an entirely on-Site response action under Paragraph 9.a of the DFF&O. The stormwater runoff controls in the general permit are substantive requirements for this response action, as listed in Table B.2 of Appendix B, and would be met through the implementation of best management practices to control pollutants in runoff as detailed in the RAWP. Such practices will include soil stabilization (e.g., seeding), perimeter structural practices (e.g., gabions, silt fences, and sediment traps), and stormwater management devices.

- Planned asbestos removal activities would require formal notification to the state pursuant to 40 *CFR* 61.145(c) and *Ohio Administrative Code (OAC)* 3745-20-04, if the activities were not being performed as an entirely on-Site action under Paragraph 9.a of the DFF&O. Off-Site activities would be subject to these formal notification requirements. Substantive requirements that are identified as

ARARs and will be met for this action include those for asbestos removal, handling, and disposal activities as detailed in 40 *CFR* 61.145(a)(1) [*OAC* 3745-20-04(A)(1)]; 40 *CFR* 61.145(c)(1)(i) through (iv) [*OAC* 3745-20-04(A)(1) (a) through (d)]; 40 *CFR* 61.150(b)(1) - (2) [*OAC*-3745-20-05(A)]; 40 *CFR* 61.150(a)(3) [*OAC* 3745-20-05(B)(2)]; 40 *CFR* 61.150(b)(3) [*OAC* 3745-20(B)(5)]; 40 *CFR* 61.150(b)(1) and (2) [*OAC* 3745-20-05(A)]; and 40 *CFR* 61.150(a)(4) [*OAC* 3745-20-05(B)(4)].

- If DOE were to establish new RCRA or TSCA storage or treatment area(s) as part of this removal activity, they would have to meet applicable RCRA permit modifications or TSCA approval requirements, respectively, if the activities were not being performed as an entirely on-Site action under Paragraph 9.a of the DFF&O. The ARARs for operating new storage and treatment units for RCRA hazardous wastes and TSCA PCB wastes, as detailed in Appendix B, constitute the substantive requirements under such permit modification or approval requirements. Storage and treatment units would be designed and operated to meet the ARARs listed in Appendix B.

7.3 DETAILED DESCRIPTION OF ALTERNATIVES

This section provides detailed descriptions of the no-action alternative and a demolition alternative for the buildings/structures and infrastructure in accordance with the definition of D&D as described in Section 4. Demolition actions, any characterization and/or treatment required to meet disposal facility WAC or reuse and/or recycling opportunities, and packaging the waste appropriately for disposition are included in the action alternative. Following treatment and packaging, the generated waste or material would be managed in accordance with the decisions made in the Waste Disposition Project. More detail on the elements of this alternative would be available in future design submittals sent to Ohio EPA for review and concurrence.

7.3.1 Alternative 1 – No Action

The no-action alternative is included to serve as a baseline for comparison to the other alternative. In the no-action alternative, no S&M activities or institutional controls would occur, and the equipment, buildings/structures, and infrastructure would continue to deteriorate. There are no components or elements to describe.

7.3.2 Alternative 2 – Remove Structures, Treat as Necessary, and Package Waste for Final Disposition

The following GRAs and process options were identified as representative process options in Section 6:

- Institutional Controls
  - Physical barriers/security
  - S&M
  - Environmental monitoring

- Hazard Abatement
  - Predemolition

- Treatment
  - Chemical (decontamination) processes
  - Physical (decontamination) processes
  - Segmentation
  - Shearing
  - Grouting

  - Fixatives
  - Macroencapsulation

- Demolition
  - Deactivation
  - Mechanical removal.

This alternative includes the removal of stored waste, materials, any component requiring special handling or disposal, and equipment. It also includes demolition of the above-grade buildings/structures (including slabs) and infrastructure; demolition and removal of subsurface features; excavation or movement of residual soil; treatment, as necessary; and packaging of the waste or material for final disposition or recycling and/or reuse. All actions in this alternative would be conducted in compliance with ARARs.

The D&D approach for the three process buildings (X-326, X-330, and X-333) is presented first with emphasis on the contaminated PGE and piping. The D&D approach for the remaining buildings/ structures and infrastructure within the scope of this RI/FS is then addressed in Section 7.3.2.2. An assumption is made that the waste is prepared for disposal in both on- and off-Site facilities. This assumption is solely for the purpose of supporting this evaluation, and impacts from preparing waste for all off-Site disposal are explored in Section 8.

7.3.2.1 Process building D&D

The process buildings are unique because they contain large quantities of radioactive contaminated PGE and piping (the primary part of the gaseous diffusion enrichment process) and because of the size and weight of this PGE. D&D for the process buildings includes the following key components[1]:

- Institutional controls for the building prior to completion of demolition

- Mobilization and site preparation

- Characterization of the process buildings (including slabs), PGE, residual soil, and other equipment suspected of being contaminated

- Removal and management of soils described in DFF&O Paragraph 5(e)(3) and 5(e)(4)(ii)

- Predemolition hazard abatement

- Predemolition removal of PGE and some piping for characterization, size reduction (if required), decontamination (if required), and/or uranium deposit removal prior to disposal, and segmentation and recovery of some or all of the materials in the X-333 and X-330 converters based on the ongoing review of the viability of such an approach and upon the discretion of DOE (including construction or refurbishment of facilities to support segmentation)

- Deactivation of utilities and systems

- Demolition, segregation, and size reduction and/or treatment, if necessary, of the remaining equipment, buildings, slabs, and foundations

[1] Any permitted storage areas would be closed under the permit prior to building demolition.

- Packaging the waste for disposal
- Backfilling, grading, and/or stabilization of the demolition area.

In addition, the waste would be transported and disposed as decided in the Waste Disposition ROD consistent with as explained in Section 7.1.2.

These key components of Alternative 2 are described below.

Institutional Controls
Institutional controls are a part of the demolition alternative until the removal activities are complete. The use of institutional controls would occur until buildings are removed or determined to be clean. Depending on the security and safety issues, the level of needed controls would vary. For the process buildings, S&M activities, as currently being implemented, would be continued under this remedy until deactivation activities are complete. Until that time, through commencement of demolition activities, the level of S&M would decrease as systems come off line.

Mobilization and Site Preparation
Mobilization and site preparation would occur as necessary to support D&D activities. These could include actions, such as, relocation of continuing operations or systems to existing, new, or temporary facilities; movement or reconfiguration of existing utilities, alarms and control systems, roads, fences, lighting, and drainage; and erection of temporary facilities and support areas for D&D workers, materials, and equipment. Also included could be the installation of perimeter monitoring systems, storm water retention measures, dust suppression equipment, and runoff controls such as storm drain filtration or blocking. The detailed approach for contaminant migration control, including water and storm water management/control, would be addressed in future CERCLA documents. On-PORTS transportation facilities such as rail spurs or haul roads might need to be upgraded. Decontamination facilities might need to be constructed. Until D&D began, the buildings would be maintained in a safe configuration, and monitoring for air and surface water releases before and during demolition would occur.

Site vegetation would be removed, as needed. Equipment would be brought to the area. Laydown areas might be constructed along with the temporary construction facilities. Utilities to the facility would be cut when appropriate.

Characterization and Data Collection
Information and data collection activities occur at each stage of a remedial project. In any stage of the project, characterization activities are done in compliance with ARARs. In particular, when characterizing the waste for disposal, the ARARs associated with such characterization, waste handling, and disposal would be met. The three primary stages of a project are the decision-making stage where the RI/FS, proposed plan, and ROD are developed; the design stage; and the implementation stage where the remedy is installed or implemented. The implementation stage includes any necessary efforts to safely dispose of the waste. The general data needs in a phased remedial project, as required by the DFF&O, can be organized into these three stages:

- Decision-Making Stage: data necessary to support the development, comparison, and selection of remedial alternatives

- Design Stage: data necessary to complete the final design of the selected remedial alternative according to the approved ARAR requirements and RAOs

- Implementation/Waste Disposal Stage: data necessary to demonstrate ARAR compliance, determine WAC attainment, ensure worker safety, and document physical completion of the remediation.

Three primary types of data or information are available: (1) that available from process knowledge (such as from design drawings, past studies and reports, staff experience); (2) that from historical and recent samples collected of environmental media or materials of construction and analyzed in a laboratory; and (3) that from field instrumentation (such as radiological surveys). The various stages of a project have a different degree of reliance on the types of information as shown in Figure 7.1. Process knowledge along with historical analytical data is very useful during the decision-making stage of projects such as for this D&D project being conducted at PORTS under the DFF&O. But more analytical and field data will be needed as the project progresses beyond the decision. Additional analytical data will be needed for WAC compliance while field data can be used to guide analytical data collection efforts, for health and safety, and for anomaly detection while increasing overall data coverage of the project.

Collection of analytical data can be time consuming and expensive. Therefore, during each phase of the project, the need for additional analytical data is carefully considered. The DFF&O has specific requirements for data collection as well as specific plans identified to document the data collection activity. Figure 7.2 illustrates the various stages of the project and the information needs identified in the DFF&O.

Decision-Making Stage
During the decision-making stage of the project, the existing data and scope of the decision to be made are evaluated during development of the RI/FS work plan. The DFF&O requires consideration of additional data to evaluate alternatives and to identify waste streams and volumes. In the case of the Process Building Project, it was concluded that no new analytical data are needed to understand the scope of the problem (presence of hundreds of potentially contaminated buildings) or to evaluate a demolition alternative. Instead, existing data and other process knowledge are sufficient to make a decision regarding whether to demolish the process buildings. However, when planning the Waste Disposition Project, additional analytical data were found to be needed to supplement the available information to evaluate potential disposal alternatives. The decision on data needed for the decision-making stage of the project is documented in the RI/FS work plan as shown on Figure 7.2.

The characterization effort described as part of this alternative focuses on collecting future data that are needed to design and implement this alternative.

Design Stage
During the design stage of a project, there is considerable reliance on existing and additional analytical data. Although characterization techniques could include visual inspections to identify liquids or uranium deposits, field surveys using mobile equipment, and NDA to determine quantities of uranium-235 or other isotopes, the emphasis of this discussion is on analytical data collection. The documents developed after the ROD would outline when, where, and how any needed waste or safety characterization data would be collected. The DFF&O requires many types of work plans, including the RD/RA Work Plans, Pre-design Studies Plans, Regulatory Compliance Plans, Health and Safety Plans, and, if needed, Treatability Study Work Plans, all submitted for Ohio EPA review and approval/concurrence, as applicable. As shown on Figure 7.2, the sampling documented in these plans supports various information needs required by the DFF&O. In addition, a WAC Attainment Plan would be developed to demonstrate how any waste

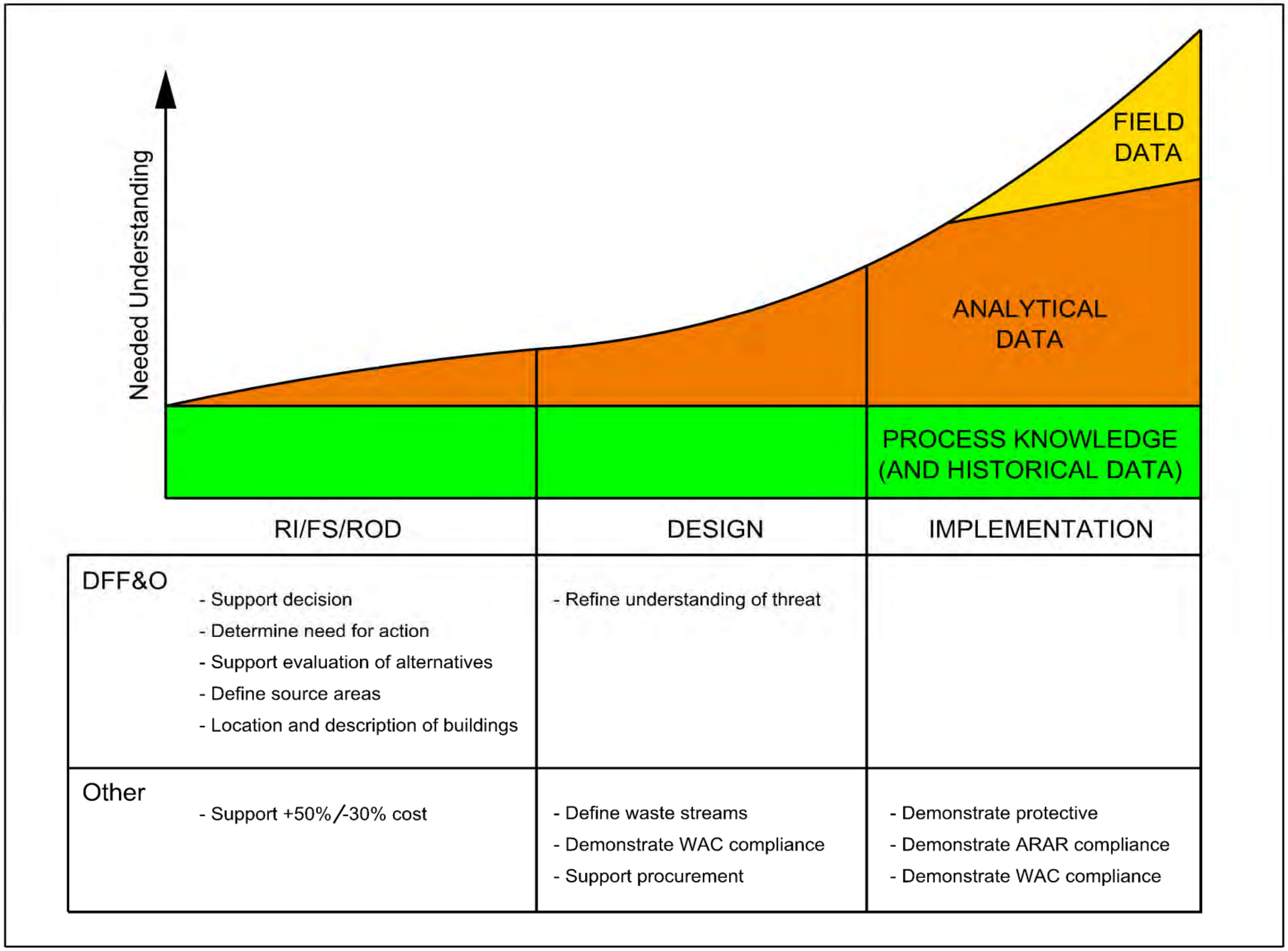

Figure 7.1. Data Needs and Type

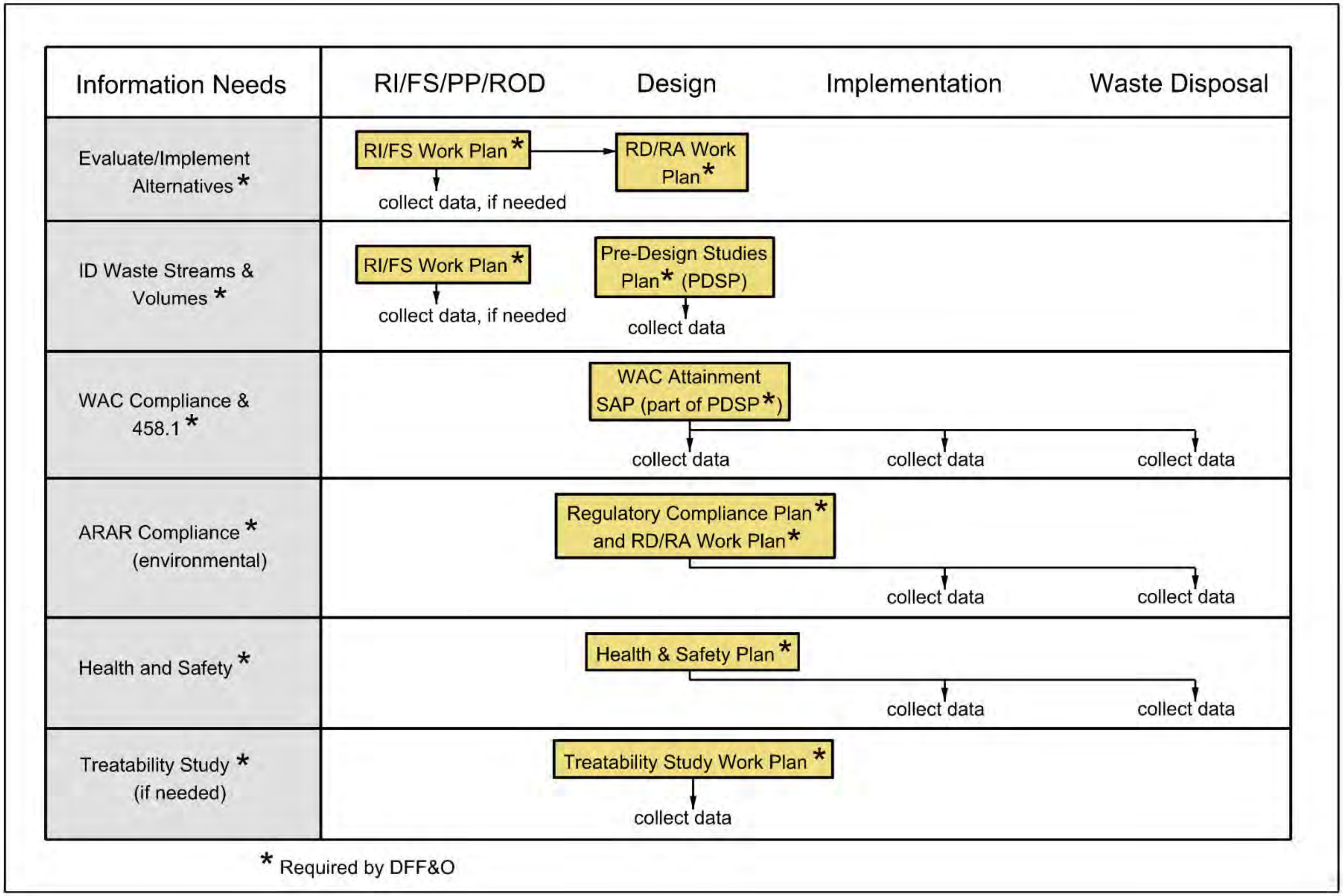

Figure 7.2. DFF&O Analytical Data Collection Requirements

generated would meet the WAC of the appropriate disposal facilities. To support these plans, a number of additional SAPs may be required, also submitted for Ohio EPA review and approval/concurrence as applicable.

Implementation of the sampling required by these SAPs and plans would be started during design and continue into the implementation stages of the project. An appropriate number of samples would be taken from each building or group of like buildings/structures or infrastructure for D&D. Each major D&D medium would be sampled in a manner consistent with the impact of its volume, the level of contamination expected, and the uncertainty of the contaminant level relative to applicable WAC and/or safety basis. The sampled media could include building steel, roofing, walls, floors, residual soil, slabs, subsurface utilities, ventilation ducting, heat exchangers, and non-process piping or equipment suspected of radiological or hazardous contamination. If needed, treatability studies may be performed on some waste streams to demonstrate compliance with land disposal restrictions or Corrective Action Management Unit treatment standards.

The actual numbers and locations of samples required during the design stage for D&D would be determined based on the applicable WAC for waste disposal, treatment requirements, and safety basis. All SAPs would be submitted to Ohio EPA for review and approval or concurrence, as applicable, prior to implementation.

Implementation/Waste Disposition Stage
NDA measurements would be performed on equipment or piping suspected of requiring uranium deposit removal and equipment being shipped for on-Site or off-Site disposal. In situ NDA might also be performed on the X-330 and X-333 converters to support material recovery, as necessary. Both sampled media results and NDA results could be used to segregate waste for recycling and/or reuse or for off-Site disposal, and they would be used to demonstrate compliance with the WAC and ARARs, as appropriate. Environmental sampling would be primarily of surface water and air to track any potential releases of contamination and potential impacts on the environment, including sensitive resources, and on human health, including to other workers and the public. Some of the data would be analytical from laboratories and some would be from field monitoring. This information would either allow a demonstration that environmental ARARs requirements are being met or would provide information that would lead to mitigation measures if a release of contamination occurs. Health and safety sampling may include radiological monitoring, industrial hygiene monitoring, or other sampling including clearance samples from asbestos remediation areas, smear samples for radiological control, and metal coupon samples from equipment (as necessary) for cadmium and beryllium control programs.

Future Plans and SAPs for Data Collection
A Process Buildings and Complex Facilities RD/RA Work Plan(s) would be finalized after the Process Buildings ROD for Ohio EPA review and approval/concurrence.

This(ese) plan(s) would provide guidelines for necessary data collection efforts during both the design and implementation/waste disposition stages to demonstrate ARARs compliance and WAC attainment according to the ROD.

Additional plans and SAPs are also planned to be developed at the building(s) or building group level in order to collect specific data according to the RD/RA Work Plan(s) and other site-wide submissions. Following is the list of these plans and SAPs that would be developed to support the Process Building and Waste Disposition projects and would be submitted for Ohio EPA review and approval/concurrence, as applicable:

- Pre-design Studies Plans
- WAC Attainment SAPs
- Integrated Remediation Design Packages
- Health and Safety Plans
- Regulatory Compliance Plans as required by the DFF&O to identify the basis and approach for compliance with ARARs/TBCs.

A discussion of grouping of the buildings would be developed in the RD/RA Work Plan(s).

Soil Excavation and Management
Soils which adhere to the removal of equipment, structures, piping, building contents, or concrete foundations conducted under the DFF&O or otherwise must be excavated as part of the D&D activities would be managed consistent with the DFF&O. Such soils are referred to as "residual soil" throughout the RI/FS. Further delineation of residual soils would be provided in the subsequent design submittals for Ohio EPA review and approval/concurrence, as applicable.

Hazard Abatement
For the purpose of this RI/FS, hazard abatement refers to the select removal of various materials in advance of building demolition to support the safe and efficient execution of work activities. Some materials within the buildings may be removed manually, packaged, and appropriately dispositioned prior to building demolition. Other materials would be left in the building to be demolished with the rest of the structure. Hazard abatement will be completed under the ROD issued for D&D, and it would be performed concurrently with characterization and PGE removal. Predemolition removal of these materials would allow for waste segregation, as necessary, and appropriate disposal. In some cases, predemolition removal of some items would be done to improve the safety of demolition workers. Some of the items that may be removed, to the extent practicable and in compliance with ARARs prior to building demolition could include, but would not be limited to, the following:

- Universal waste (e.g., mercury switches, fluorescent bulbs, batteries)
- Listed hazardous waste
- Hazardous metals in printed circuit boards (contained in the automated data processing equipment in the control rooms and specialty instrumentation such as criticality alarms and UF_6 detectors)
- Asbestos (e.g., pipe insulation, floor tiles, etc.)
- Drained oils
- Trap media.

The underground or aboveground storage tanks identified in the DFF&O and operating treatment systems would be drained and otherwise remediated, if required, and made ready for demolition.

As part of the predemolition activities, roughly 1,300 cy of asbestos-containing transite siding would be removed from the exteriors of the buildings. For this alternative, it is assumed that the siding would be manually removed and double bagged.

The drained transformers, storage tanks, and PCB gaskets contained in the X-330 and X-333 Process Buildings and the ventilation ducts would be demolished with the buildings.

In the X-333 Building, lube oil has been drained from the PGE and elsewhere in the building. In the X-330 and X-326 Buildings, lube oil has been drained from the PGE. With the exception of Units 29-2, 29-5, 27-2, and 25-7 where the lube oil system remains operational, lube oil has been removed from these facilities. Residual oil remains. The compressors and motor bearing housings and control valve hydraulic connections would be opened to drain the residual oils. Auxiliary equipment such as seal exhaust pumps, firewater pumps, diesel generators, and line recorder pumps would also be drained. Holes would be drilled at low points in tanks to drain them, or residual oils would be pumped out using portable pumps and tanks. The recovered residual oils would be containerized, characterized, and disposed of at a permitted off-Site treatment or disposal facility. Smaller amounts of residual oils may be stabilized with desiccants.

Process coolant has been removed from the X-330 Building. Process coolant remains in the X-326 Purge Cascade (Unit 25-7) and in drain tanks in the X-333 Building. All process coolant would be removed from the buildings prior to initiation of demolition. Although the coolant systems would be drained and purged, worker safety measures would be instituted when cutting coolant piping to ensure that phosgene gas is not produced. It is anticipated that all coolant would have evaporated and no liquid coolant would require disposal during D&D; however, if any coolant is found, it would be appropriately disposed.

Gas cylinders of various types would be removed, primarily as a worker safety measure, prior to demolition. Specifically, nitrogen cylinders used in the criticality alarm system, chlorine trifluoride and fluorine cylinders used in treatments, and any UF_6 cylinders would be removed prior to building demolition. The cylinders would be disposed by venting to the atmosphere (for innocuous gases), returned to vendors for purchased gases, or disposed through specialty vendors. Empty cylinders may be designated as empty and remain in the building for demolition and size reduction.

Other miscellaneous hazard abatement activities that would occur during predemolition include removal of diesel fuel from the generators; removal of coolant from Freon heating, ventilation, and air control systems; and addressing remaining underground and aboveground storage tanks.

Process Equipment and Piping Removal

Process equipment and, as needed, some process piping would be removed prior to demolition. This includes equipment assumed for off-Site disposal, equipment that must have deposits removed to meet WAC, or equipment removed to recover other materials of value. The sizes, weights, and numbers of pieces of this equipment are large. The equipment metrics are presented in Section 4. Some of the equipment has already been removed to support other activities such as characterization under the Waste Disposition Project. This alternative would remove the remainder, which is the majority of the equipment. Predemolition removal of these items would allow subsidence reduction technologies to be implemented as/if needed; segmentation and removal of uranium deposits for equipment and piping that cannot meet either DOT requirements or WAC; material recovery to the extent determined appropriate by DOE; or physical size reduction, if required to meet transportation requirements. For the purposes of this alternative description and evaluation, it is assumed that on-Site disposal is selected as the preferred Site-wide alternative under the Waste Disposition Project. For the purposes of the detailed evaluation of the D&D remedial alternative, it is assumed that the X-326 PGE would be processed for off-Site disposal, and the X-330 and X-333 PGE would be processed for material (e.g., nickel) recovery from converters and on-Site disposal. In the event that on-Site disposal is not selected, an evaluation of the impact of all waste requiring off-Site disposal is presented in Section 8 in the evaluation of costs. DOE will continue to assess the merits of material recovery throughout the remedy design and implementation phase.

The PGE would be cut, placed on transportable carts, and moved to a packaging station for off-Site disposal, to a segmentation area for size reduction and/or deposits or material removal, or to temporary staging adjacent to a potential OSDC (if selected) for future disposal, or directly into a potential OSDC, depending on the equipment and the disposal decision, and in accordance with the WAC. Unless required to be removed because of unacceptable uranium deposits, the process cell and unit bypass piping and valves are planned to remain in the process buildings for demolition with the building structures, non-PGE, and piping.

A small amount of PGE and piping and all X-330 and X-333 converters are assumed to undergo segmentation and potential removal of material and/or uranium deposit removal prior to transportation or disposal. As previously stated, the decision to recover the material from any or all converters would be at the discretion of DOE. Using the currently available NDA data, an estimate was made of the amount of uranium deposits that may remain in each of the pieces of PGE. Assuming that a potential OSDC would have a similar level of waste acceptance as the EMWMF in Oak Ridge, Tennessee, Table 7.1 presents the estimated number of equipment pieces that would require deposit removal in each process building. For the purposes of this alternative description, it is assumed that any deposits over 252 g of uranium-235 in a piece of large equipment (a package) require mining prior to off-Site transportation, and any deposits over 4,500 pCi/g total uranium require mining prior to equipment disposal in a potential OSDC.

Table 7.1. Number of Pieces of Process Equipment Assumed to Require Deposit Removal at PORTS (Rounded)

	X-326 (Off-Site Disposal)		X-330 (On-Site Disposal)		X-333 (On-Site Disposal)	
Component	**For DOT**	**For WAC**	**For DOT**	**For WAC**	**For DOT**	**For WAC**
Converter	125	0	NA	NA	NA	NA
Compressor	250	0	0	30	0	60
Cooler	80	0	0	80	0	70
Valves	40	0	0	30	0	30

DOT = U.S. Department of Transportation
NA = not applicable (Note: These PGE are assumed 100% segmented for material recovery.)
PGE = process gas equipment
WAC = waste acceptance criteria

Removed deposits may be put into 55-gal drums (much smaller container than the PGE) and macroencapsulated with grout (2,000 g of grout per gram of uranium-235). These deposits would be sent off Site to the Nevada National Security Site (NNSS) or to a potential OSDC, if they met the WAC. If shipped off Site, the macroencapsulated material would be shipped fissile-excepted in drums.

X-326. For the purposes of this alternative description, the X-326 converters, compressors, coolers, and cell piping are assumed to be shipped off Site for disposal at the NNSS in a roll-off size, fissile, Type A package. If a sufficiently sized fissile, Type A package is not available, these equipment pieces would be segmented to remove the lesser contaminated sections for shipment in excepted industrial packaging (IP) or Type A packages (depending on the activity level). The equipment sections with higher uranium levels would be shipped in fissile, Type A, 90-cf containers. Piping would be cut to fit into smaller fissile, Type A packages.

It is anticipated the X-326 converters, compressors, and coolers would be cut from the process piping, and the equipment and pipe openings would be sealed with welded plates. The attached cell piping would be cut in sections and visually inspected for uranium deposits. The open ends may be sealed with plastic if no uranium deposits are detected or sealed with welded plates if deposits are present. Each piece of equipment and section of piping would either be removed from the cell by crane through the sheet metal equipment hatches and placed on movement carts through the crane hatch or be placed on the cart at the cell by crane or jacks and moved out of the building via elevator. Process equipment and piping would be transported to a low background NDA system where more accurate measurements would be taken. If the new NDA result would allow shipment without further processing, the equipment or piping would most likely be moved to a waste packaging area and transported for disposal. If the new NDA value exceeds transportation limits, the equipment would be moved to the segmentation processing areas (assumed to be established in X-705 or X-700 for the purposes of the cost analysis). The equipment would be segmented, and sufficient uranium material would be removed to allow shipment of the equipment in fissile containers (see Figure 7.3).

Figure 7.3. Movement of X-326 Converter

Segmentation of approximately 370 X-326 compressors, coolers, and valves (and any other equipment exceeding transportation limits) would likely occur in the segmentation processing area. Uranium materials could be removed from the equipment either manually (by scraping) or using a pneumatic needle gun, with the material placed into safe geometry pans or containers or into safe geometry vacuums. Alternatively, the uranium materials could be removed by wet decontamination in the existing X-705 decontamination facility (using a 5 percent nitric acid solution and water spray booths).

After decontamination, the equipment may be further size reduced with plasma torches as necessary to fit it into fissile containers for off-Site shipment and disposal at NNSS. Each container would be NDA-measured to determine the activity of uranium-235 and compare it to shipping limits.

The uranium materials removed from the equipment and piping would most likely be mixed with grout and shipped to NNSS for disposal. Although there are no current plans to recycle the uranium material into the uranium processing industry, a uranium recovery analysis could ultimately determine this is desirable, in which case, recycling would occur.

An initial estimate of 125 X-326 converters may require segmentation and removal of uranium deposits to meet transportation limits. These converters would be processed in a segmentation processing area. The converters would be disassembled, the tube bundles would be removed, and the converter shells would be cut up for packaging. If any uranium materials are seen inside the converter shells, the materials would be removed in the same manner used for the compressors prior to size reduction. The tube bundles could also be size reduced by removing the barriers and then cutting up the barrier tubesheets, center tubes, and struts. The bundle metals would be packaged as classified waste in fissile containers, NDA-measured to verify each package meets the fissile shipping limits, and shipped to NNSS. The barriers would be containerized and NDA measured. If the uranium concentration is low, the waste would be shipped directly to NNSS for disposal. If the uranium concentration is high, the barrier materials are assumed to be mixed with grout or sand to produce a less concentrated classified low-level (radioactive) waste prior to shipment to NNSS. At DOE's discretion, appropriate action would be taken to recover materials for recycling and/or reuse.

X-330 and X-333. For the purposes of this alternative description, the PGE in X-330 and X-333 is assumed to be considered for on-Site disposal. This assumption allows for an evaluation of the activities that may be needed to support this disposal route. An evaluation of the impacts of off-Site disposal has been included in the evaluation of this alternative. The actual location for disposal of this PGE will depend on the Waste Disposition Project decision as well as any disposal facility WAC. Under the assumption of on-Site disposal, unlike that for disposition of the X-326 equipment, where off-Site disposal transportation limits are the major limiting technical factor, the limiting factor for this equipment is expected to be the radioactive material quantity limits in the nuclear safety analysis for equipment and piping disposal, a requirement for on-Site disposal. Additionally, for this FS it is assumed that nickel is recovered from all X-330 and X-333 converters.

Process equipment and piping in X-330 and X-333 would be removed in the same manner as that in X-326. The PGE and connecting cell piping would undergo in situ NDA and be cut, sealed, and transported for grouting, segmentation, and/or disposal. Cell and unit bypass piping would be characterized using existing or new NDA measurements and physical samples.

The X-330 and X-333 equipment to be segmented for uranium deposit removal or nickel removal would be handled in a manner similar to that described for the X-326 PGE above. Because of the larger equipment size and uranium assays, these operations may be conducted at different locations in X-705, X-700, and perhaps X-720. The equipment would be segmented to the extent necessary to fit it into packages for NDA measurement and disposal, or as necessary to remove materials (e.g., nickel).

Uranium materials removed from the equipment would be shipped to NNSS for disposal. Removed materials would be handled as decided in the Waste Disposition Project.

Process equipment has considerable void space. Table 7.2 presents the estimated void space fraction in each of the major pieces of PGE in X-330 and X-333. Converters from X-330 and X-333 are not considered because they are assumed to already be segmented for materials recovery. Void space fractions were calculated using the component weights and volumes in Section 4 and assuming all materials are the density of steel. These void fractions will be refined with more accurate weight and volume determinations, as well as more information on materials of construction in the D&D design phase. The void fractions are conservative for two reasons. First, the volumes of some valves are determined here by simple maximum length, width, and height, and do not take into account irregularities and dimension changes that would reduce the volume. Second, some items inside the equipment may have the materials of construction and structural integrity necessary to withstand the disposal facility stresses without collapse.

Table 7.2. Void Space in Process Equipment at PORTS

Building	Equipment	Type (Designators)	Void Fraction (%)
X-333	Compressor	X-33 or 000	88
	Recycle Coolers	X-33 or 000	97
	Surge Drums	8 ft × 40 ft	98
	Block Valves	16 to 42-in.	32 to 75
X-330	Compressor	X-31 or 00	90
	Compressor	X-29 or 0	90
	Recycle Coolers	000, 00, or 0	93
	Surge Drums	8 ft × 40 ft	98
	Block Valves	16 to 30-in.	32 to 61

The physical requirements for waste materials that would be disposed in a potential OSDC are not currently known. Assuming a requirement on minimizing the amount of void space allowed in packaged waste or intact pieces of equipment in order to control subsidence in a potential OSDC, void space reduction for PGE is included in this alternative. If final requirements for a potential OSDC did not require void space reduction for subsidence control, this element of the alternative would not be implemented.

Void space reduction can occur through introduction of inert materials of sufficient strength to withstand disposal facility waste and cap pressures after the PGE external shell has degraded (oxidized) to the point that structural integrity is lost. Grout with a sufficient compressive strength to meet physical WAC requirements could be introduced into the tops of the PGE to fill voids. Generally, grout densities of 500 to 3,000 lb/cy can be formulated to provide strengths equal to or greatly exceeding 50 lb/sq ft. Grout might be added at a disposal facility transfer area, at the disposal area face, or inside the disposal area. Each of these options is feasible, but adding grout outside of the disposal area would require heavy duty carts and cranes (or other heavy lifting equipment) to place the equipment. High efficiency particulate air ventilation for contamination control might be required. Mixtures with low viscosity could be produced to maximize infiltration of voids. Grout could be mixed on Site or purchased for delivery. On-Site mixture would require materials storage, expertise in mixing equipment and technology, procedures, and quality assurance programs. Grout filling has been successfully used for some equipment (e.g., centrifuge casings) at the EMWMF in Oak Ridge. For this alternative, it is assumed that converters, compressors, and coolers shipped intact to a potential OSDC would be filled at the facility with flowable grout.

A 100 cy/day pressure grouting system with hose delivery would be constructed at a potential OSDC. Roughly, a total of 180,000 cy of grout would be required, taking approximately 8 years to apply. A covered area is assumed to be constructed to allow production in poor weather.

Utility and System Deactivation

Deactivation of utilities and specialty systems such as criticality alarms and security alarms would occur throughout the predemolition process in concert with termination of the need for them or removal of the hazards. While some utilities can be deactivated early in the process, others would require characterization, hazard abatement, and equipment removal to be complete in the building (or a major section of the building) before deactivation.

The RCW utility is shutdown for the majority of the process buildings (or will be shut down shortly after PGE treatments end). Upon final shutdown, all lines would be verified as being drained to the cooling water pump houses. If required, the residuals would be pumped out of the lines and discharged to the sanitary sewer system. Risers inside the process buildings would be cut and plugged with pipe plugs and/or grout at a point outside the process buildings to allow slab removal.

Sanitary water to the process buildings is anticipated to remain active until near the end of predemolition to provide water for workers and abatement processes. Deactivation would entail excavation and air gapping the supplies on the building side of the isolation block valves.

The sanitary sewer to the process buildings is likely to remain active until near the end of predemolition to provide restroom facilities for workers. Deactivation would entail excavation and air gapping/plugging the sewer lines just prior to final exit from the buildings.

To a large extent, storm sewers would remain active throughout process building D&D. The building roof drains would be air gapped and plugged with grout at a point outside the process buildings just prior to final exit. Nearby surface water runoff grates would have erosion control systems such as hay bales or other filters installed prior to demolition. These surface water control systems would be routinely monitored and maintained to control storm water flow from the demolition area.

The primary process electrical system is shutdown (or will be when cell treatments end). Electrical deactivation of this system would entail removing breakers (including tiebreakers) in the switch houses under lockout/tagout procedures prior to final process motor draining, draining and flushing of transformers, removal of cabling for recycle or disposal, or other electrical system equipment removals.

The auxiliary process electrical system shutdown would most likely occur just prior to final exit of the process buildings or as predemolition activities are completed in units of the process building. This utility would remain to provide 480/120 volt power for lighting, cranes, elevators, welding receptacles for local equipment power, dry pipe fire protection air compressors, and alarm systems throughout predemolition.

Nitrogen supply to the process buildings could be deactivated early in the predemolition phase because nitrogen is no longer needed in the process buildings. The lines would be air gapped at the building perimeters and also at the air-to-nitrogen crossovers inside the buildings.
Air supply deactivation to the process buildings is anticipated to occur just prior to final exit of the process buildings. The air supply system could be used during PGE removal by using arc air cutting. As necessary, local air compressors would be used to supplement or replace the air header system (currently the case for the dry pipe fire protection headers).

Deactivation of the criticality alarm system would occur once all equipment and piping with criticality issues are removed from the process buildings, and the buildings are determined to be criticality incredible for demolition. Deactivation would include removal of the backup nitrogen cylinders and removal of the printed circuit boards. Each building system would eventually be completely deactivated, which would allow deactivation of the central alarm system in the Plant Control Facility.

Security alarms deactivation would occur as the nuclear materials are removed from secure areas. Prior to demolition, the steam pipes entering the process buildings and the steam condensate exiting the process buildings would be air gapped at a sufficient distance from the buildings to permit safe demolition.

The process and utility tie lines generally include some of the utilities above, but also other special utilities and cabling to the X-300 Central Control Facility. Process tie lines carry the major process lines, and some include feed and product withdrawal lines and evacuation lines. The process tie lines are enclosed in heated housings with uninsulated steam registers at intervals along the housing. Utility tie lines include steam, steam condensate, air, nitrogen, and specialty gas lines, some insulated with ACM. Deactivation would include abating the ACM in accordance with ARARs, verifying purging of each line, NDA measurements of the process lines or lines suspected of containing radiological contamination, and removal and disposal of sufficient sections of each pipe to safely air gap the process building from the remainder of the tie line. The process tie lines would likely be removed concurrent with the building demolition. The utility tie lines would generally be removed during abatement of the steam and condensate ACM insulation.

Demolition

Demolition of the process buildings would be accomplished using mobile tracked equipment with attachments such as bucket and thumbs, shears, concrete crushers, and grapples, as well as front end loaders, dozers, mobile cranes, and large and small forklifts. Figure 7.4 illustrates some of the heavy equipment to be used in building demolition.

Figure 7.4. Examples of Building Demolition Heavy Equipment

Demolition would likely start near the top, where the roofing and upper structure would be cut with the heavy equipment and allowed to fall down onto the cell (top) floor. Catwalks, cranes and crane rails, condensers, RCW components, and Freon piping would then be cut, and they would fall to the cell floor. Process bypass piping and housing would be cut and dropped. Upper ventilation ducts would be dragged down. In cases where there is the potential for contamination in the interior of piping to be released during the demolition process, a fixative could be applied internal to the piping. The fixative would prevent releases of contamination during cutting and shearing of the piping. This is not a long-term contaminant migration control technique at a disposal location. However, it is sufficiently effective to prevent short-term releases of contamination. The need for the use of fixation would be decided during the design effort.

It is anticipated that this waste would be removed from the upper floor either by dragging it off the floor and lowering or dropping it to the lower slab at the demolition front or by cutting the upper floor from the structural beams and letting it and any equipment and waste loaded on it to cant at an angle down to the lower slab. Concrete could then be processed (described below) at the slab level while the other waste and equipment is removed and separated, as necessary, from the slabs and rebar.

Sections of above-grade concrete slabs could be processed with special attachments to the demolition equipment to separate most of the concrete from the rebar and to crush the concrete to a mostly soil-like consistency with some small pieces of rebar entrained. Under this approach, the separated rebar would be sheared as necessary and bundled into "balls."

The roofing materials, roof decking, structural steel, catwalks, internal housings (including ventilation ducts and PCB gaskets if present), remaining process and nonprocess piping and tubing, ventilation fans, surge drums, internal structural walls in the control rooms and surge drum rooms, electrical and instrument cabinets, electrical switchgear (including transformers and any remaining cabling) would be pulled out of the demolition waste, be sheared as necessary to disconnect them from piping or cabling, and be size reduced and loaded into the appropriate trucks or containers for disposal.

Any airborne radioactive contamination present at the demolition front, the demolition piles, and the work area in general would be controlled using dust suppression techniques such as misting with sanitary or fire suppression water (Figure 7.5). Air monitors would be stationed at work areas and perimeter boundaries to monitor for radioactive releases. Surface and storm water runoff from the demolition area would be monitored, and mitigation measures (e.g., hay bales, filter fabrics, silt fencing, absorbent socks) would be implemented as necessary.

After waste is removed from the slabs and all footer columns are sheared at or near the slab elevation, slab and footer removal would begin. Basements, pits, and recessed truck alleys in the process buildings would also be demolished. The same type of excavating equipment would be used for shearing and crushing the slab and footer concrete, separating rebar, and loading the crushed concrete and rebar for disposal. Some or all of the concrete may be processed down to small lump size for use as fill in a potential OSDC. It is expected that some below-slab soils would adhere to the slabs and footers and be mixed with the concrete.

Buried utilities that meet the definition of D&D and associated residual soil would be removed during slab and footer removal. The utilities include the large RCW lines, sanitary water and sewer lines, and storm sewer lines. The underground instrument and electrical duct structures beneath the process buildings would also be removed out to a logical isolation point. The remaining ducts outside the immediate process building area would be removed separately.

The vast volume of metal in the process buildings makes it a potentially attractive target for reuse and/or recycling at DOE's discretion.

Figure 7.5. Example of Misting Technique

Waste Packaging

Once the building or structure is demolished, the waste would either be loaded directly into packages (including trucks) or be staged temporarily prior to being packaged and transported. Staging would occur in three potential areas, the location of generation, at a potential OSDC (if on-Site disposal is selected), or the rail loading station. Appropriate Milestones for disposal of all staged waste destined for off-Site disposal would be set in the RD/RA Work Plan in accordance with Paragraph 12.a.v of the DFF&O. Staged waste would be controlled in a manner to ensure compliance with ARARs. Storm water would be controlled to avoid releases of contamination during rain events. If necessary, some form of dust control may also be needed. The details of these controls would be presented in post-ROD documents. Staging at the impacted material transfer area is covered under the waste disposition decision.

Either directly or from a staged waste pile, process building waste destined for a potential OSDC would be placed in a dump truck or intermodal if it is bulk waste. Large pieces of equipment would most likely be craned onto a flatbed truck and secured appropriately. Security precautions might entail covering the load. Waste destined for an off-Site commercial facility would be bulk waste, and would likely be packaged in intermodals or gondolas for transport by rail. These packages would be reusable. Process equipment to be disposed at NNSS could be packaged in a variety of ways, depending on the size and level of contamination. Costs for packages and transportation are part of the Waste Disposition Project alternative costs.

A challenge would arise if the PGE from X-330 and X-333 must be sent off Site. Off-Site disposal requirements for extra equipment preparation are not assumed in this alternative or the associated cost estimate. However, a discussion is provided here to alert the reader because a final waste disposition decision has not yet been made. The impact of an alternate waste disposal location is addressed in Section 8 by presenting a cost sensitivity analysis.

Figure 7.6 depicts two typical PORTS PGE converter sizes. The “X-25” converter (on top) is reasonably small and can typically fit into commercially available packaging. However, the “000” converter (on the bottom) has significant packaging limitations, depending upon DOT classification. If an off-Site disposal alternative is selected in the Waste Disposition ROD, all 270,000 cy of PORTS PGE would be disposed at NNSS. In addition to satisfying WAC for the receiving disposal facility, DOE would have to meet DOT requirements. Waste characterization requirements for DOT compliance purposes, specifically PGE, at PORTS are assumed to be satisfied using NDA data.

Figure 7.6. Typical PORTS Converters Requiring Transportation and Disposition

To arrive at an assumption on how many components would be likely to be shipped off Site in their current state versus how many would be likely to require further mining or unique packaging requirements, an evaluation of the PORTS PGE was performed. Both mining and unique packaging (e.g., approved fissile containers) are necessary to safely manage uranium-235 and other fissile isotopes within waste/material packages. This evaluation used the current and accepted NDA data provided by USEC in September 2010. These data also include an uncertainty factor added to each measurement to ensure conservatism.

Table 7.3 summarizes the specific number of PGE components (by PORTS building) assumed to meet important criteria necessary to enable compliant DOT classification of each waste package based on analyses of NDA data. The key factor in determining DOT classification is the quantity of uranium-235, or fissile material, per package based on NDA data. Other fissile isotopes such as plutonium-239, uranium-233, etc. are likely present, but only in very small trace quantities, and will not be considered in packaging requirements. The information reported in Table 7.3 is based on PGE components with NDA data. However, because the data are felt to be representative of all PGE, the results have been extrapolated to represent 100 percent of the PGE.

Table 7.3. Summary of PORTS PGE Components Relative to NDA Data Results

		Key Factors for DOT Classification[a]				
PORTS Gaseous Diffusion Building	**PGE Components**	**Number of Components (using NDA data)**	**Components with Natural or Depleted Uranium[b]**	**Components Estimated to Contain < 15 g of Fissile Material[c]**	**Components Estimated to Satisfy 252-g DOT Exemption Criteria[d]**	**Maximum Number of Components Expected to Require "Mining" or Unique Packaging**
X-326	Converters	2,340	0	1,747	477	116
	Compressors	2,340	0	308	1,783	249
	Coolers	2,340	0	1,413	845	82
	Building Total	7,020	0	3,468	3,105	447
X-330	Converters[e]	1,100	300	68	649	83
	Compressors	1,091	300	2	616	173
	Coolers	89	25	7	24	33
	Building Total	2,289	625	77	1,289	289
X-333	Converters[e]	640	240	-	400	-
	Compressors	640	240	3	13	384
	Coolers	80	30	3	15	32
	Building Total	1,360	510	6	428	416
PORTS Totals	Converters	4,080	540	1,815	1,526	199
	Compressors	4,071	540	313	2,412	806
	Coolers	2,509	55	1,423	884	147
	Building Total	10,660	1,135	3,551	4,822	1,152

[a]Data presented are based on NDA data, with uncertainty added, collected by USEC, and reported in 2010. Data only cover components with NDA data. X-326 quantities are based on forecast of final cell treatments.
[b]Number of components with maximum of 1 percent uranium-235 enrichment per 49 *CFR* 173.453(d).
[c]Number of components with maximum of 15 g uranium-235 per 49 *CFR* 173.453(b), excluding components with a maximum of 1 percent uranium-235.
[d]Number of components with maximum of 252 g uranium-235 per Special Permit, excluding components with a maximum of 1 percent uranium-235 and maximum of 15 g.
[e]Assumed to be segmented to recover materials; however, if the material recovery does not occur, this PGE would need to be evaluated for disposal.

CFR = *Code of Federal Regulations*
DOT = U.S. Department of Transportation
NDA = nondestructive assay
PGE = process gas equipment
PORTS = Portsmouth Gaseous Diffusion Plant
USEC = United States Enrichment Corporation

The information in Table 7.3 contains the following:

- Number of components = Total number of components by type and PORTS building with NDA data that were available and evaluated.
- Components with less than 1 percent uranium-235 enrichment by weight = Number of components with measured NDA data for uranium-235 equal to or less than 1.0 percent, which is the generally accepted threshold for material exempt from classification as fissile material. Waste meeting this threshold can be shipped in standard containers.
- Components less than 15 g uranium-235 with at least 200 g solid nonfissile = An *excepted package* per 49 *CFR* 173.453a and b. Waste meeting these criteria can be shipped in standard containers.
- Components less than 252 g uranium-235 = Satisfies the requirements of an existing *special permit* issued by the NRC to DOE. Waste meeting this threshold can be shipped in standard 7A-Type A nonfissile containers.
- Maximum number of components expected to require mining or unique packaging (e.g., Type A fissile containers) = Total number of components not meeting the definition of natural or depleted uranium, not having less than 15 g uranium-235, or not having less than 252 g uranium-235. For the PGE components in this category, each would require segmentation (i.e., cutting) and mining (of uranium-235) to reduce total inventory to an acceptable level to enable more routine DOT classification as either an IP or Type A package.

Not considered in the evaluation is whether the 2,000 g nonfissile/1 g fissile exemption could be used to ship these components. This exemption criterion, as described under 49 *CFR* 173.453(c)(1) and (2), could allow an even greater number of components to be shipped as excepted packages using IP packaging. The use of the exemption has been very limited in similar D&D activities in Oak Ridge. Further evaluation could result in a broader use of the exemption.

A very large percentage of the PGE components could be shipped off Site in their current state. For example, 80 percent of all the X-326 PGE components could be shipped as is. The size of the X-326 PGE components is small relative to the PGE in X-330 and X-333 (Figure 7.6). Shipping options for the X-326 compressors are being evaluated; special packaging may be required to meet DOT requirements for shipment to NNSS (assumption for this alternative). For the X-330 and X-333 PGE, a similar percentage of components that satisfy one or more of the exemption criteria described above exists. However, due to the larger size of the X-330 and X-333 PGE, the items that require mining or special packaging present unique and difficult waste management challenges. No Type A fissile packaging is commercially available for the large components in X-330 and X-333. Therefore, cutting up the PGE and "mining" the uranium-235 to lower the fissile content of each component (or package) would be necessary, greatly increasing the level of effort and costs associated with packaging. For the purposes of the cost estimate for the sensitivity analysis on off-Site disposal, an assumption is made that 100 percent of the X-330 and X-333 converters are segmented for material recovery.

Site Restoration and Demobilization

Upon completion of the demolition activities, temporary roads and laydown areas would be removed. Equipment and materials used in these activities would be demobilized from the area. Removal of the building slabs, footers, basements, pits, utility lines, and tunnels would cause the demolition areas to be below grade. Most roads and sidewalks are anticipated to be removed. Site restoration would include grading and/or backfilling as necessary to achieve a safe and ARAR-compliant end-state for the facility. Where uncontaminated soil is required to support grading and/or backfill, it would be obtained from one or a combination of sources including off-PORTS borrow, on-PORTS uncontaminated soil stockpiles, and on-PORTS uncontaminated borrow locations. The uncontaminated stockpiles might include uncontaminated overburden and uncontaminated soils generated under the Waste Disposition Project. However, the evaluation of alternatives makes the assumption that no imported fill is needed and that a local cut and fill operation would be sufficient to achieve sufficient grade to allow positive drainage. Details of the final grade are presented with the site restoration discussion in the next section and Appendix D.

7.3.2.2 Remaining buildings/structures and infrastructure D&D

D&D of the remaining buildings/structures and infrastructure included in the scope of this RI/FS is essentially the same as D&D for the process buildings in that certain hazard abatement and waste management activities must occur prior to demolition to meet worker safety or WAC requirements. This allows demolition to be performed safely, and it allows the demolition wastes to be safely size reduced or segregated (as necessary) to allow transport to a disposal facility. The unique differences between the process buildings and the remaining buildings/structures and infrastructure are their construction and use, which results in different materials of construction and somewhat varying contaminants. Some of these buildings/structures and infrastructure are buried utilities, parking lots, streets, monitoring stations, and clean administration buildings. Less contamination is expected in residual soil associated with the less contaminated buildings. One additional consideration is the proximity of some of these remaining buildings/structures and infrastructure to waterways or active plant operations such as the ACP.

This section of the alternative description discusses the primary differences between the D&D approach for the process buildings and that proposed for the remaining buildings/structures and infrastructure. One additional section is added to this alternative description to address decontamination. There is little to no likelihood of a reuse potential for the process buildings, but one or more of the smaller buildings/ structures at PORTS may be reusable in the future with little need for decontamination.

Institutional Controls

Although these controls would be similar to those for the process buildings, there are areas of PORTS where the physical barriers and security controls would be less because of fewer security concerns. Some access controls would be needed for safety reasons during demolition, whereas fencing would be needed in high-security areas. The S&M and monitoring activities would be similar to those for the process buildings.

Mobilization/Site Preparation

Mobilization and site preparation activities would be necessary for many of the buildings/structures. Prior to mobilization, relocation of remaining continuing operations and systems, either to existing or new temporary facilities, might be necessary. Movement or reconfiguration of existing utilities, roads, fences, lighting, and drainage features might be required, as well as erection of new or temporary facilities and support areas for D&D activities, including laydown areas, trailers, erosion controls, etc. Also included could be the installation of perimeter monitoring stations, storm water controls (including retention, filtration, or blocking), and dust suppression equipment. Transportation systems might be upgraded. Vegetation would be cleared and equipment would be brought on to the area.

Characterization and Data Collection

The need for characterization and data collection would be similar to that described for the process buildings. Physical sampling and analysis would be the primary method of characterization, with less reliance on NDA measurements. Based on size, complexity, contaminants, and extent of process knowledge, some facilities might rely on existing documentation and judgmental sampling approaches for waste disposal characterization. If justified because of similarities in operations and/or anticipated timing of demolition, two or more facilities might be combined into one SAP. As appropriate, characterization of residual soil might occur.

Hazard Abatement

For the purpose of this RI/FS, hazard abatement refers to the select removal of various materials in advance of building demolition to support the safe and efficient execution of work activities. Some of the remaining buildings/structures and infrastructure have unique hazards not present in the process buildings. The underground or aboveground storage tanks that meet the definition of D&D and operating treatment systems would be drained and otherwise remediated, if required, and made ready for demolition. Any hazardous waste would be removed and disposed of in accordance with the ARARs.

Equipment Removal

The majority of the equipment would remain in these buildings/structures to be sheared with the structure during demolition. The autoclaves might be removed before demolition for separate shearing. Some uranium contaminated equipment in the X-705 decontamination areas might be removed and packaged for disposal separately. Some equipment might be removed for beneficial reuse by the government or sold for recycling and/or reuse.

Deactivation

Deactivation of utilities and specialty systems such as criticality alarms and security alarms would occur throughout the predemolition process because they would no longer be needed. As with the process buildings, some utilities could be deactivated early in the demolition process, while others would require characterization, hazard abatement, and equipment removal to be completed in the facility (or a major section of the facility) before deactivation.

The recirculating cooling and heating water utility is shutdown for the majority of the remaining buildings/structures and infrastructure. Upon final shutdown, all lines would be verified as drained to the cooling water pump houses, or the residuals would be pumped out of the lines and discharged to the sanitary sewer system. Risers inside the buildings would be cut and plugged with pipe plugs and/or grout at a point outside the buildings to allow slab removal.

Sanitary water and sewer systems for these buildings/structures would most likely remain active until near the end of predemolition to provide water for workers and abatement processes. Deactivation would entail excavation and air gapping the supplies on the building side of the isolation block valves. In a few instances, deactivation would entail cutting and connecting to private utilities or reconfiguration/ construction of utilities to support transfer to private non-DOE entities.

Process and utility tie lines to other plant buildings/structures include some of the utilities mentioned above as well as other special utilities and cabling to the X-300 Central Control Facility. Process tie lines to other buildings/structures commonly carry feed and product withdrawal lines and evacuation lines. The process tie lines are enclosed in heated housings with uninsulated steam registers at intervals along the housings. Utility tie lines to other buildings/structures can include steam, steam condensate, air, nitrogen, and specialty gas lines (chlorine trifluoride and fluorine), some insulated with ACM or non-ACM insulation. Deactivation would include abating the ACM in accordance with ARARs, verifying purging of each line, NDA of lines suspected of containing process contamination, and removal and disposal of sufficient sections of each pipe to safely air gap the process building from the remainder of the tie line. The process tie lines would likely be removed concurrent with the building demolition. The utility tie lines would generally be removed during abatement of the steam and condensate ACM.

Decontamination

Many process options are available to decontaminate all or part of a building/structure. Chemical and physical decontamination are the representative process options for remaining building/structure and infrastructure D&D. Other options could be selected in the future, depending on the contaminated material, the contaminant, and the level of contamination. As an example, a concrete slab could be scabbled to remove evidence of spills. Floors could be swept, and paint from walls could be scraped to remove other contamination. These minor efforts are relatively inexpensive and could render a building or structure sufficiently decontaminated to be released for unrestricted use or transfer to another entity. Although decontamination is an option under this alternative, it is not included in the cost estimate as it is expected to only have a minor contribution to cost.

Demolition

Demolition techniques would be similar to those described for the process buildings. Concrete may be further processed or disposed of in larger waste pieces with the rebar cut. For some buildings/structures, it may be advantageous to remove underground utilities prior to buildings/structures demolition to prevent surface water pathways into the demolition footprint or avoid plugging of the utilities. Figure 7.7 illustrates the siding of a large support building (K-1420 at the ETTP, the equivalent of X-705 at PORTS) being removed prior to demolishing the structure.

Figure 7.7. Example of Support Building Demolition at ETTP

Removal of long utility runs, roads, culverts, light poles with electrical and communication cabling, parking lots and areas, sidewalks, fences, and cathodic protection systems would begin after the area facilities have been removed. These features would be removed in the same manner as discussed above. Residual soil are likely to be generated during these removal activities.

Some of the structural material and equipment in appropriate facilities could be reused and/or recycled. Segregation and appropriate size reduction would occur during demolition.

For some of the buildings/structures, it is possible that demolition of the above-grade structures may occur before the subsurface work begins. An option, if the remaining slab or features are contaminated, is to coat the exposed contaminated surface with a fixative to bind the contamination until the subsurface remediation occurs. These fixatives have a finite life, so while it should not be used to stabilize the contamination for many years, it could be effective for a few years.

Waste Packaging

The majority of the waste may be a candidate for disposal at a potential OSDC. Because most of this waste would be bulk, it would most likely be packaged by putting it directly into a dump truck. Larger items could be craned onto a flatbed truck for transport. Waste that is destined for an off-Site commercial disposal facility would be bulk waste, and it would likely be packaged in intermodals or gondolas for transport by rail. No significant numbers of Type A packages are thought to be needed. Package and transportation costs are part of the Waste Disposition Project alternative costs.

Site Restoration

Site restoration would include grading and/or backfilling as necessary to provide a safe and ARAR-compliant end-state for the facility. Where uncontaminated soil is required to support grading and/or backfill, it would be obtained from one or a combination of sources, including off-PORTS borrow, on-PORTS uncontaminated soil stockpiles, and on-PORTS uncontaminated borrow locations. The uncontaminated stockpiles might include uncontaminated overburden and uncontaminated soils generated in support of the Waste Disposition Project. An estimated 1.5 million cy of cut and fill is assumed to occur. No imported backfill is assumed to be necessary, but the final grade would be different from the current grade. However, the grade would be quite flat, just sloped enough to drain. Figure 7.8 illustrates a potential final grading plan for PORTS after removal of all structures and facilities.

7.3.2.3 End state of the PORTS Facility

After completion of D&D, it is assumed that all significant buildings/structures and infrastructure associated with the PORTS GDP would be removed. The opportunity exists for noncontaminated buildings/structures to remain if a future use is identified and the buildings are transferred to another entity. For the purposes of the alternative evaluation only, the area is assumed to be graded for natural drainage, and surface vegetation would be established. Certain treatment and monitoring buildings/structures would remain, primarily on PORTS perimeter and at a potential OSDC if it is selected under the Waste Disposition Project. The utilities and roads would be removed from the interior main plant area (see Figure 1.1) with Perimeter Road remaining for plant access. This would allow continued access to utilities, roads, and electricity from local non-DOE sources. Other end-states may be considered at the time D&D is complete.

7.3.2.4 D&D schedule

Demolition of the process buildings is on the critical path for completion of the PORTS response actions. In general, the D&D schedule for the other buildings/structures and infrastructure considers when they are no longer in use. Those that have no critical near-term future use and require ongoing maintenance are identified for early demolition, as funding allows. Many of the buildings/structures and infrastructure that fit this category have already been part of an existing decision under the removal program through an EE/CA and AM. Demolition of the small EE/CA buildings could be occurring in parallel with predemolition activities in the process buildings. Demolition of smaller buildings/structures under this RI/FS will begin when they are no longer in use and the funding becomes available.

The duration of Alternative 2 is assumed to take 10 to 12 years to complete based on the funding profile in early FY 2012. If this assumption changes, the schedule, and consequently the costs, would change. As discussed in the cost analysis section, an increase in schedule of 50 percent may result in an increase of costs of nearly 25 percent, primarily due to increased project management, maintenance, and monitoring costs.

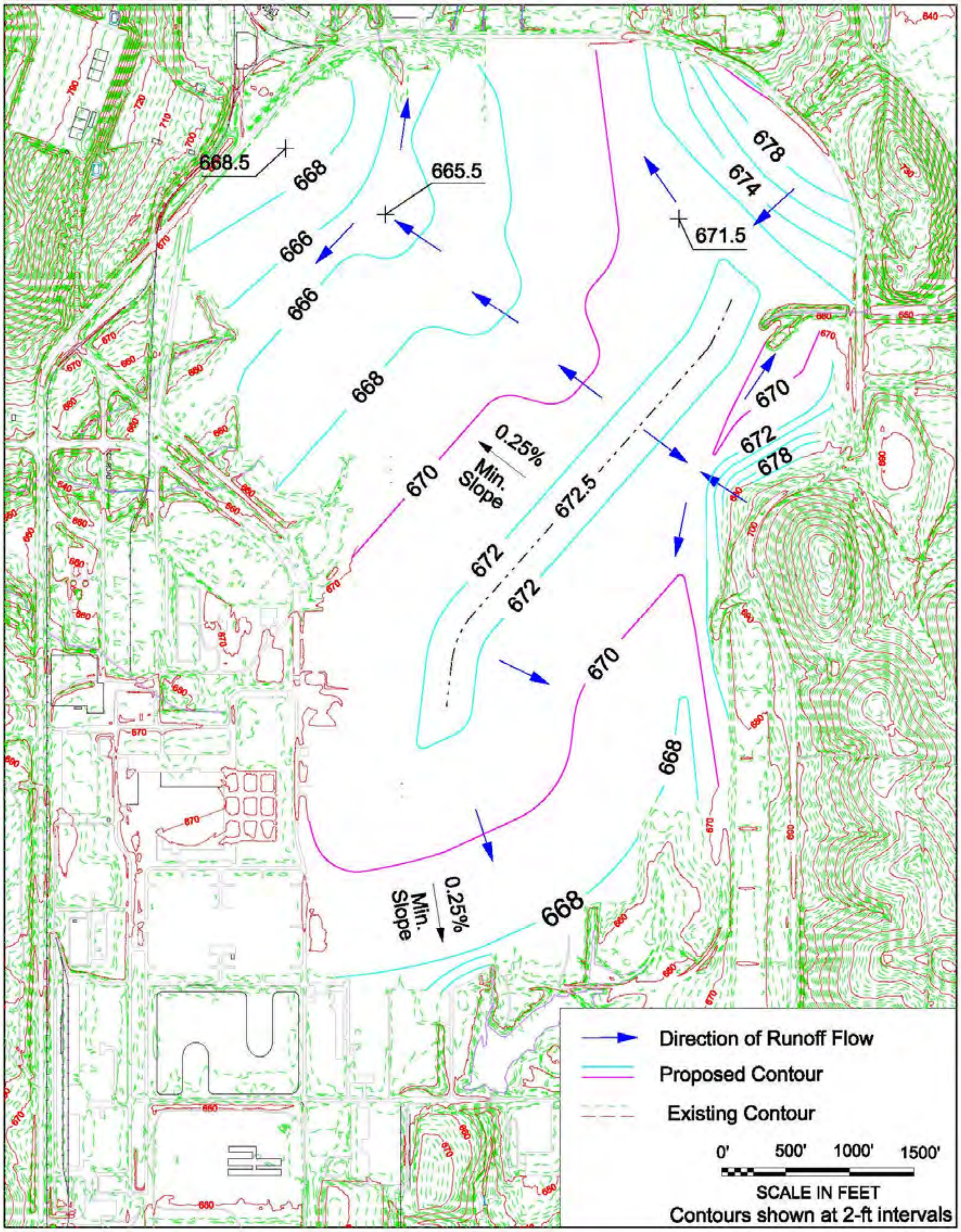

Figure 7.8. Potential Final Grade of the PORTS Facility after Completion of Response Actions

HIGHLIGHTS OF SECTION 7

- Two alternatives are developed: no action and remove structures, treat as necessary, and package waste.
- No action would mean no S&M or access controls.
- Remove structures, treat as necessary, and package waste alternative includes any treatment or preparation needed to meet potential WAC or to support recycling and/or reuse opportunities. Transportation and disposal costs are part of the Site-wide Waste Disposition Evaluation Project RI/FS.

NEXT STEP: SECTION 8 COMPLETES THE FS PHASE OF THE PROJECT BY EVALUATING THE ALTERNATIVES

8. DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of the no-action alternative and the action alternative, which removes structures, treats as needed, and packages waste for final disposition as described in Section 7. Relevant information is presented and assessed to provide the basis for identifying the preferred alternative in the proposed plan and the selected remedy in the ROD.

The detailed analysis consists of individual and comparative analyses. Section 8.2 provides the individual analysis, and Section 8.3 provides the comparative analysis. Building on the technology screening, alternative development, and detailed alternative descriptions, the individual analysis provides an in-depth evaluation of each alternative against the threshold and primary balancing criteria identified in the NCP (40 *CFR* 300.430) and the DFF&O. Following the individual analysis, the comparative analysis highlights the key advantages, disadvantages, and tradeoffs among the alternatives.

The modifying criterion of community acceptance is not addressed in the detailed analysis because it relies on stakeholder participation and feedback on the proposed plan. The proposed plan, which documents the evaluation of remedial alternatives and presents the preferred alternative, will be issued for public review and comment subsequent to regulatory agency concurrence. Public comments on the proposed plan will be placed in the Process Buildings and Complex Facilities Administrative Record File and will be addressed in the ROD. The state acceptance criterion will be addressed in the proposed plan.

8.1 CRITERIA FOR ANALYSIS

The nine CERCLA evaluation criteria are organized into threshold criteria, primary balancing criteria, and modifying criteria. NEPA values are also incorporated into the evaluation criteria.

Threshold Criteria
Alternatives must meet the following criteria for implementation:

- Overall protection of human health and the environment
- Compliance with ARARs/TBCs or otherwise satisfy conditions for ARARs waiver.

Primary Balancing Criteria
Primary balancing criteria address the performance of the remedial alternative and verify that the alternative is realistic. The ability of alternatives to meet these criteria is evaluated in sufficient detail to enable decision makers to understand the significant aspects of each alternative and any uncertainties associated with the evaluation.

- Long-term effectiveness and permanence
- Reduction of contaminant toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost.

Modifying Criteria
The viability of the preferred alternative is evaluated on the basis of the two modifying criteria:

- State acceptance
- Community acceptance.

Other Values

The irreversible and irretrievable use of resources is discussed. This analysis is done outside of the evaluation of CERCLA criteria. NEPA values are also evaluated as an additional consideration. Issues related to sensitive resources such as wetlands, floodplains, threatened and endangered species, and cultural resources are both evaluated under CERCLA and NEPA. Therefore, those discussions stay with the CERCLA criteria specifically through compliance with location-specific ARARs as well as through relevant discussions of environmental impacts under long-term and short-term effectiveness. Issues related to the impact on human welfare, including environmental justice, socioeconomics and land use, which are unique to NEPA, are covered under the NEPA values section. The issue of environmental and human welfare cumulative impacts is also presented as part of the NEPA values discussion.

8.1.1 CERCLA Criteria

8.1.1.1 Overall protection of human health and the environment

This evaluation criterion assesses each alternative's ability to protect human health and the environment and comply with project-specific RAOs.

The scope of this criterion is broad and reflects assessments discussed under other evaluation criteria, especially long-term effectiveness and permanence and short-term effectiveness. This criterion addresses how risks associated with each pathway would be eliminated, reduced, or mitigated through treatment, engineering controls, or institutional controls. It also evaluates impacts to the area resulting from implementation of the remedial action.

8.1.1.2 Compliance with ARARs/TBCs

This criterion addresses compliance with federal and state environmental requirements that are either applicable or relevant and appropriate. In certain cases, regulatory standards that address the proposed action or the COCs may not exist. In such cases, nonpromulgated advisories, criteria, or guidance developed by EPA, other federal agencies, or states can be designated as potential requirements or TBC. Other requirements that do not fall within EPA-established criteria for ARARs include DOE Orders that pertain only to DOE facilities. AEA requirements for management of DOE facility waste are incorporated into DOE Orders and developed under DOE AEA authority. Substantive requirements of DOE Orders serve as TBC requirements that, when specifically incorporated into a CERCLA ROD, become enforceable standards under CERCLA.

ARARs that significantly impact compliance of an alternative include those related to protecting the community and environment during implementation of demolition activities as well as regulations concerning packaging and preparing various kinds of waste for transportation.

If an alternative cannot meet an ARAR, a determination can be made that a waiver may be appropriate if certain conditions are satisfied.

Appendix B contains the location- and action-specific ARARs/TBCs for the action alternative under consideration.

8.1.1.3 Long-term effectiveness and permanence

This criterion evaluates an alternative's ability to achieve overall reduction in risk to human health and the environment and to provide sufficient long-term controls and reliability. It considers the degree to which the alternative provides sufficient engineering, operational, and institutional controls; the reliability of those controls to maintain exposures to human and environmental receptors within protective levels;

and the uncertainties associated with the alternative over the long term. Long-term effectiveness and permanence are evaluated by examining the following issues:

- Magnitude of residual risk and uncertainties
- Adequacy and reliability of controls
- Long-term environmental effects.

8.1.1.4 Reduction of toxicity, mobility, or volume through treatment

This criterion reflects the statutory preference for remedial action alternatives to substantially reduce toxicity, mobility, or volume of hazardous substances through treatment. It considers the extent to which alternatives can effectively and permanently fix, transform, or reduce the volume of waste materials and contaminated media. The evaluation also considers the amount of material treated; the magnitude, significance, and irreversibility of the given reduction; and the nature and quantity of treatment residuals.

8.1.1.5 Short-term effectiveness

This criterion addresses the effects on human health and the environment posed by implementation of the alternative. Potential impacts are examined, as well as appropriate mitigation measures for maintaining protectiveness for the community, workers, environmental receptors, and potentially sensitive resources. Short-term effectiveness is evaluated by examining the following issues:

- Protection of the community during remedial action
- Protection of the workers during remedial action
- Short-term environmental effects
- Duration of remedial activities.

8.1.1.6 Implementability

This criterion examines the technical and administrative factors affecting implementation of an alternative, and it consists of the following three components:

- Administrative feasibility
- Technical feasibility
- Availability of services and materials.

Administrative feasibility addresses the need for coordination with other offices and agencies, including the ability to obtain permits (for off-Site activities) and regulatory agency approvals. Technical feasibility considers difficulties and uncertainties associated with construction and operation of a given technology; the reliability of the technology; the ease of undertaking additional future remedial actions; the ability to monitor effectiveness of remedial action; and the potential risk of exposure from an undetected release. Evaluation of the availability of services and materials includes consideration of the availability of necessary facilities, equipment, technologies, and specialists, and the effect of reasonable deviations on implementability.

8.1.1.7 Costs

Cost estimates developed to support the detailed analysis are based on feasibility-level scoping and are intended to aid in comparisons between alternatives. EPA guidance states that these estimates should have an accuracy of +50 to -30 percent (EPA 1988). The cost estimates for this FS are based on the scopes of work and assumptions provided in the detailed alternative descriptions in Section 7. No direct costs are associated with the no-action alternative. The remove, treat as necessary, and package waste for final disposition alternative only includes capital costs (direct and indirect) because no O&M costs are required for this action.

Capital costs include those expenditures required to initiate and perform a remedial action, mainly including design and construction costs. Capital costs consist of direct and indirect costs. Direct costs include construction material, labor, and equipment; service equipment; and utilities. Indirect costs include such elements as Title I and Title II engineering, Title III inspection, project integration, project administration, and management. The primary capital costs are associated with: (1) characterization; (2) deactivation; (3) hazard abatement; (4) process equipment and piping removal; (5) refurbishing segmentation facilities; (6) segmenting and removing uranium or material from process equipment and piping; (7) demolition of facilities; (8) movement, segregation, and packaging of waste; and (9) restoration of the demolition areas.

Estimated costs to perform activities are presented in escalated dollars. Present worth cost provides a basis for comparing project alternatives. Escalated project costs from the year of performance are discounted at a standard rate (2.9 percent) provided by the Office of Management and Budget (OMB) for 12-year projects (OMB 2010). No contingency costs are included.

8.1.1.8 State acceptance

This criterion measures the extent to which the State of Ohio through the Ohio EPA supports the proposed alternative being considered for remediation. This modifying criterion will be addressed in the proposed plan and ROD.

8.1.1.9 Community acceptance

This criterion measures the extent to which the community supports the proposed alternative. Because formal public comments will not be received until after the proposed plan has been issued for review, this modifying criterion will be addressed in the Responsiveness Summary and ROD that will be prepared following the public comment period for the proposed plan.

8.1.2 Other Criteria

8.1.2.1 Irreversible or irretrievable commitment of resources

A commitment of resources is irreversible when the impact of the action limits the future options for that resource. An irreversible effect is one where the resource cannot be replaced in a reasonable time frame. Evaluation of the use of fuels, construction materials, land, sensitive resources, and other utilities are typically conducted.

8.1.2.2 NEPA values

As discussed in Section 8.1, most of the environmental NEPA values such as impacts on surface water, air, groundwater, etc. are addressed under the CERCLA criteria. There are three unique NEPA values that are evaluated in these NEPA values sections. The first two are the impact of an alternative on human welfare through an evaluation of environmental justice and socioeconomic impacts. This evaluation includes a discussion of jobs and the impact on land value.

Finally, the Council on Environmental Quality (CEQ) regulations that implement the procedural provisions of NEPA define cumulative impacts as the “impact on the environment which results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” (40 *CFR* 1508.7). The cumulative impacts analysis in this section is based on both the potential outcome of a D&D decision under the DFF&O for the PORTS buildings and each of the proposed alternatives in this decision, as well as impacts from historical operations and the potential construction of several new industrial parks in the area.

8.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

8.2.1 Alternative 1 – No Action

Evaluation of Alternative 1, no action, is required under the DFF&O and CERCLA (40 *CFR* 300.430[e][6]) to provide a basis for comparison with action alternatives. Under the no-action alternative for this FS, no demolition or S&M would be performed, and the buildings/structures and infrastructure would be left to degrade. Any waste would be left where generated and open to the environment with no institutional controls.

8.2.1.1 CERCLA criteria analysis

8.2.1.1.1 Overall protection of human health and the environment

Under no action, there would be no overall protection of human health and the environment. Access to the buildings/structures and infrastructure, equipment, and associated contaminants would not be controlled. Buildings/structures and infrastructure would be left to degrade, generating waste that would be left at the point of generation, moved out of the way, or potentially disposed, but not under any approved decision document. Contaminants currently protected from the weather could be released to the environment as a result of building and equipment degradation. There are risks to human health and the environment from potential contaminant releases and the physical hazards of uncontrolled access to degrading buildings/structures and infrastructure.

The evaluation of threats to human health shows unacceptable on-PORTS risks to future industrial workers and future residents from a sudden release of contamination now encased in the process equipment or from gradual releases of contamination over time.

As shown in the streamlined evaluation of threats to human health in Section 5, the modeling effort in the preliminary WAC development activity performed in support of the Waste Disposition RI/FS (DOE 2012b) and existing contaminant data in off-PORTS groundwater indicate that contaminants released to the environment on PORTS only slowly migrate at sufficient concentrations to be detected at levels of concern off PORTS. Slow migration from degrading buildings/structures and infrastructure is unlikely to contribute to unacceptable levels of on-PORTS or off-PORTS media contamination. The greater threat is from future use of the buildings or from a sudden release. Radionuclides (uranium isotopes), PCBs, metals, and asbestos could present a risk to future users of the buildings/structures or PORTS as the buildings/structures degrade. Soon, the degrading buildings/structures would increase the complexity and extent of future clean-up activities. The RAOs would not be met by the no-action alternative.

8.2.1.1.2 Compliance with ARARs/TBCs

Pursuant to the EPA Office of Solid Waste and Emergency Response *ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers* (EPA 1991), there are no ARARs for a no-action alternative; ARARs apply only to remedial actions taken under CERCLA. A no-action decision can only be made when no remedial action is necessary to reduce, control, or mitigate exposure because PORTS is already protective of human health and the environment. If the no-action alternative meets the protectiveness threshold criteria, then compliance with ARARs is not pertinent to selection of the no-action alternative.

8.2.1.1.3 Long-term effectiveness and permanence

There would be significant long-term adverse human health and environmental effects under Alternative 1.

Magnitude of residual risk and uncertainties. Remaining buildings/structures and infrastructure and rubble waste left across PORTS would cause an unacceptable risk to human health. As shown in the evaluation of threat to human health presented in Section 5, both the future on-PORTS risks from contaminant exposure and migration as well as the future on-PORTS physical risks are unacceptable. The fate of the residual waste from building degradation is unknown. It could be moved, left where generated, or disposed. If left open to the environment, contaminants could migrate from the waste and migrate through runoff or groundwater flow, contaminating adjacent soil, surface water, or underlying groundwater. With no institutional controls, humans could be exposed to the contaminants by accessing the buildings/structures or waste, or could be hurt or killed by falling building material or other physical hazards. The primary routes of exposure would be through incidental ingestion of soil or ingestion of underlying groundwater that had been contaminated. Radionuclides now safely contained in the process equipment are the greatest source of future risk through release to the environment.

Adequacy and reliability of controls. No controls are in place under the no-action alternative; therefore, the adequacy and reliability of controls is not relevant.

Long-term environmental effects. As described above in the magnitude of residual risk and uncertainties, the release of contaminants into the environment is possible under the no-action alternative. Migration of these contaminants into ecological habitats could have detrimental impacts on terrestrial and aquatic populations. Under the no-action alternative, ecological receptors (e.g., birds, bats, terrestrial biota) would be susceptible to exposure from potential contaminants in or immediately adjacent to the buildings and ecological receptors farther away would be susceptible through contaminant migration via rainwater infiltration into the buildings and subsequent runoff. There is no current off-PORTS contamination of concern for ecological receptors, and the slow migration of contamination from degrading buildings is unlikely to increase off-PORTS contamination enough to have an impact on off-PORTS ecological populations.

8.2.1.1.4 Reduction of toxicity, mobility, or volume

The no-action alternative has no reduction in toxicity, mobility, and volume of contaminated buildings or waste.

8.2.1.1.5 Short-term effectiveness

No additional hazards are raised by allowing the buildings/structures and infrastructure to degrade instead of demolishing them and disposing of the waste because there is no action. However, there would still be short-term risks under no action because S&M activities and security controls cease. Workers at PORTS who inadvertently access the degrading buildings could be injured or exposed to unacceptable levels of contamination.

8.2.1.1.6 Implementability

The no-action alternative is technically implementable. There are no material or equipment requirements and no resource needs. However, the cessation of S&M activities and security controls would be against DOE Orders and would not be administratively implementable.

Implementing future cleanup actions at PORTS would be significantly more difficult because of the condition of the degraded buildings/structures and infrastructure and the likely spread of contamination.

The uncontrolled release of contaminants as the buildings/structures and infrastructure degrade could cause storm water flow through permitted discharges to exceed the permit limits. Contaminants from the degrading buildings/structures and infrastructure could also infiltrate into soils and groundwater undetected.

8.2.1.1.7 Cost

No cost would be directly associated with implementing the no-action alternative; however, the contamination of surrounding environmental media resulting from the release of contaminants during buildings/structures and infrastructure degradation could result in fines and penalties, as well as ultimately higher remediation costs.

8.2.1.2 Other criteria analysis

8.2.1.2.1 Irreversible and irretrievable commitment of resources

Under the no-action alternative, there are no commitments of resources such as energy or materials of construction.

8.2.1.2.2 NEPA values

Socioeconomics and land use. The continuing presence of contaminated buildings/structures and infrastructure at PORTS would limit or preclude future development of PORTS land. Potential new jobs associated with such development would be lost. Eventually, a loss of population would occur as some unemployed workers and their families leave the ROI for new job opportunities. Therefore, implementation of the no-action alternative would result in adverse socioeconomic impacts on the population living in the four-county ROI.

Under the no-action alternative, existing buildings/structures and infrastructure would be left to deteriorate in place at PORTS. This would preclude future use of the land they occupy for other purposes. Potential transfers of buildings/structures and infrastructure and land to the private sector or local governments for future use would likely not occur because of the high remediation costs necessary to render the buildings reusable or to remove the buildings. Releases of contaminants to environmental media during the deterioration process would further limit future use of this land and any other on-PORTS land receiving airborne and waterborne contaminants. If contaminants are transported off PORTS, they could adversely impact the current and future use of some land areas outside of the DOE boundary.

Under no action, there are no activities and no direct impacts to any disadvantaged populations. There are no environmental justice issues (Executive Order 12898).

Cumulative impacts. A cumulative impacts assessment was conducted in accordance with the guidance in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997). The assessment was based on both geographic (spatial) and time (temporal) considerations. The past, present, and reasonably foreseeable future actions considered in the cumulative impacts assessment for the no-action alternative are as follows:

- PORTS Project (past uranium enrichment and EM operations)

- New industrial park projects in the ROI: Sarah James Industrial Park and Gettles Industrial Park (Jackson County); Zahn's Corner and Pike County Manufacturing Center (Pike County); Gateway Industrial Park (Ross County); and Ohio River Industrial Park, Haverhill Industrial Park, and the 522 Site (Scioto County). These multiple projects were considered collectively as "industrial parks."

- Site-wide Waste Disposition Evaluation Project: This is a separate DOE project devoted to the future management of potential CERCLA waste from D&D of the process buildings and complex facilities at PORTS. This project has three alternatives. Alternative 1 is the no-action alternative under which no D&D waste disposal would occur. Alternative 2 is potential disposal of D&D waste in a potential OSDC that would be constructed and operated at PORTS. Alternative 3 entails transportation of D&D waste for disposal in an existing off-Site waste disposal facility. For purposes of the cumulative impacts assessment, each Waste Disposition alternative was effectively assessed as a separate project.

Geographically, all of these actions are located within the four-county ROI for PORTS. Temporally, the PORTS Project is the only past action that was considered. The rest are present and reasonably foreseeable future actions that would coincide with the assumed duration of the Process Buildings Project.

The no-action alternative would have no cumulative impacts or only minimal cumulative impacts involving air quality, surface features, surface water hydrology, geology, population and socioeconomics, land use, transportation, ecology, and irreversible and irretrievable commitments of resources.
Scioto County is already a nonattainment area for particulate air pollution ($PM_{2.5}$), but the reduction in plant vehicular traffic would offset the addition of particulates and other airborne contaminants from the deterioration of PORTS buildings/structures and infrastructure. Contaminants from deteriorating buildings/structures and infrastructure would eventually infiltrate into soil and groundwater, adding to the contamination already present (TCE) from past PORTS operations. Deterioration of the remaining architectural resources at PORTS with no mitigation would add substantially to the loss of architectural resources.

8.2.2 Alternative 2 – Remove Structures, Treat as Necessary, and Package Waste for Final Disposition

Alternative 2 is the only alternative evaluated beyond the no-action alternative. This alternative includes the actions necessary to remove all buildings/structures and infrastructure and package the waste for final disposition. This alternative remediates all PORTS buildings/structures and infrastructure currently identified in the DFF&O, Attachment H. Section 7 presents a description of the remedial processes. The assumption used to assess handling and packaging needs is that most of the waste would be disposed on Site in a potential OSDC. However, using a sensitivity analysis, the impacts from having to prepare the waste for off-Site disposal are also discussed.

The approach for final disposition of waste generated under this Process Buildings Project is being evaluated, proposed, and selected through the Waste Disposition RI/FS, proposed plan, and ROD. The Process Buildings proposed plan will incorporate by reference the supporting data, information, and detailed analyses of waste disposition alternatives (i.e., on-Site versus off-Site disposal) that are presented in the Waste Disposition RI/FS and proposed plan.

If the Waste Disposition ROD is not finalized before the Process Buildings proposed plan, the Process Building proposed plan will include a requirement that all waste generated be disposed of off Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i through v. of the DFF&O until such time as the Waste Disposition ROD is finalized. The proposed plan will also indicate that upon finalization of the Waste Disposition ROD, the waste will be disposed of in accordance with the decision in that Waste Disposition ROD. If the decision in the Waste Disposition ROD selects an OSDC, this means that the waste generated pursuant to the Process Building ROD will be disposed of in the OSDC upon it becoming operational so long as the waste meets the Ohio EPA approved WAC and all Milestones for removal and disposal of staged wastes are met.

Taken together, the Waste Disposition decision and the Process Buildings decision provide for a complete remedy. The interplay between the two decisions and the scope of each are presented in Section 1.0. As explained in Section 7.1.2, DOE plans to make a Waste Disposition ROD finalized before this Process Buildings ROD is finalized. The disposal of the waste generated under this Process Buildings decision would follow the preceding Waste Disposition ROD. However, in the event that the Waste Disposition ROD is not finalized before the Process Buildings proposed plan, the Process Buildings proposed plan will include the requirement that all waste generated be disposed of off-Site according to approved Milestones and pursuant to the requirements of paragraph 12.a.i through v. of the DFF&O until such time as the Waste Disposition ROD is finalized. Therefore, a summary of the evaluation of off-Site transportation and disposal from the Waste Disposition RI/FS is included for each of the seven CERCLA criteria and the other criteria (irreversible and irretrievable commitment of resources and NEPA values) in the individual analysis below. A summary of this evaluation is also carried forward to the comparative analysis in Section 8.3.

8.2.2.1 CERCLA criteria analysis

8.2.2.1.1 Overall protection of human health and the environment

The remove structures, treat as necessary, and package wastes alternative, when combined with the waste disposition alternative selected in the Waste Disposition ROD, would meet risk-based RAOs and protect human health and the environment by placing all generated waste into an engineered disposal cell (either on Site or off Site), or at a treatment facility, or by reusing and/or recycling materials in accordance with all laws and regulations, thereby isolating the wastes from the environment. Placement of wastes into a secure, engineered disposal facility (either on Site or off Site) would result in an overall net reduction of risks associated with the PORTS contaminated buildings/structures and infrastructure. The projected future unacceptable risk to a hypothetical industrial worker or resident is removed by demolishing the buildings/structures and infrastructure and appropriately disposing of the waste. There would be no need for long-term S&M or monitoring.

Risks to other workers at PORTS and environmental risks from releases occurring during the removal of the structures and packaging of the waste would be minimized through compliance with ARARs, DOE Orders, and health and safety plans developed in compliance with 29 *CFR* 1910.120(b)(4). Releases from the buildings/structures and infrastructure or from equipment would be controlled during implementation through the use of storm water controls, misters, equipment maintenance, and monitoring.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, the alternative would remain overall protective. The alternative would remain protective of the local community, the workers, and the environment. The disposal location would be protective for the long-term. However, there would be increased transportation injuries and fatalities from off-Site accidents that are discussed under the short-term effectiveness evaluation.

8.2.2.1.2 Compliance with ARARs/TBCs

Alternative 2 would comply with location- and action-specific ARARs and pertinent TBC guidance, including DOE Orders. Chemical-specific ARARs generally set cleanup or discharge limits for specific hazardous substances or contaminants. Because no specific media would be remediated under this action, no chemical-specific ARARs would apply.

Location-specific ARARs/TBCs specify concentrations or impose activity restrictions on the basis of sensitive resources present at the location. Location-specific ARARs associated with wetlands, aquatic resources, and cultural resources would be triggered for this alternative. Wetland areas that could potentially be affected during the D&D efforts include Q1-06 (0.23 acres), Q2-12 (2.028 acres), Q3-30 (0.48 acres), Q3-46 (0.08 acres), Q4-18 (0.322 acres), Q4-22 (0.018 acres), and Q4-26 (0.16 acres), as shown in Figure 6.1. The total area of the potentially affected wetlands is 3.318 acres. Ohio EPA substantive requirements for a Section 401 Water Quality Certification, as listed on Table B.1 in Appendix B, would be triggered by a wetlands alteration, or inadvertent sedimentation or filling of wetlands or aquatic resources. In addition, 10 *CFR* 1022 requires that the effects of any actions taken in wetlands be considered and avoided wherever possible. If this alternative is chosen as the preferred alternative, a wetlands delineation and evaluation may need to be completed, along with mitigation integrated measures for impacted wetlands. The wetlands evaluation would be used to formulate a wetlands mitigation strategy to be part of this alternative and integrated with the final remedial design. Detailed evaluations of the potential effects on PORTS resources and plans to minimize and mitigate any negative effects would be completed before initiation of any action.

Potential impacts to nearby streams from surface or storm water runoff are addressed as action-specific ARARs and TBCs. Engineering controls and best management practices (BMPs) implemented during buildings/structures and infrastructure removal would minimize or prevent the release of PORTS contaminants to storm water. During removal activities, hydrologic control measures would be implemented to minimize the ponding of storm water and redirect its flow to the existing storm sewer system. Silt fences and other appropriate erosion control measures, as detailed on Table B.2 in Appendix B, would be implemented to control run-on/runoff and minimize concentrations of suspended particulates in storm water in accordance with ARARs/TBCs. As a result, minimal impacts on the surface water drainage system and surface water quality are expected.

The NHPA, Section 106, requires that proposed federal actions be assessed for impacts to cultural resources (e.g., buildings/historic structures) that are considered to be historic properties. DOE plans to implement, and in certain instances is already implementing, a variety of activities to comply with the NHPA ARARs. Because both above- and below-ground activities would occur under the RI/FS and its follow-up implementation of measures to address risks and hazards, DOE will be implementing a planned approach to take into account the effects the potential D&D actions may have on cultural resources. Activities proposed in this RI/FS are not expected to have any direct or indirect impacts on historic properties outside of the DOE PORTS property boundary. The project area for this proposed action includes buildings and structures located throughout PORTS as well as those areas in close proximity to each building and structure. Based on the results of the architectural inventory and the Phase I and II archaeological surveys of PORTS, a number of historic properties have been identified. DOE will evaluate impacts of the proposed actions that may directly or indirectly cause alterations in the character or use of these historic properties.

The DOE approach and proposed mitigation measures are described in detail in Section 6.2, including the development of a written historic context report and the identification and salvage of items of potential significance. DOE is working closely with Native American Tribes, OHPO, ACHP, and the public to identify appropriate mitigation measures to address proposed D&D activities at PORTS.

The variety of wastes generated under this alternative would trigger characterization, management, treatment, storage, and disposal requirements for RCRA solid and hazardous waste, radiological waste, ACM, and TSCA waste. All primary wastes (e.g., D&D waste) and secondary wastes (e.g., contaminated PPE, decontamination wastes) generated during remediation activities would be appropriately characterized and managed in accordance with the ARARs. Human health and environmental risks from removal of the structures and packaging of the waste would be maintained as low as reasonably achievable (ALARA) through compliance with these ARARs and TBCs, including DOE Orders.

Hazardous waste determinations would be based on available process knowledge, materials of construction calculations, and sampling/analysis results. If no listed hazardous wastes are present and the sample does not exhibit a hazardous characteristic, the waste would be categorized as nonhazardous. Hazardous and other wastes may be accumulated and stored in appropriately regulated short-term storage areas at PORTS in compliance with ARARs/TBCs.

Other action-specific ARARs/TBCs address management of storm water runoff, fugitive dust emissions, management and treatment of decontamination wastewater, staging of the wastes during operations, waste storage pending disposal, and packaging of wastes in preparation for transport for on-Site or off-Site disposal. These requirements would all be met. The decision for transport and disposal of wastes is being made under the Waste Disposition Project.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, all ARARs (Appendix B) associated with the on-Site activities associated with transportation would be met. Off-Site actions, including disposal, would need to meet all elements of applicable regulations.

8.2.2.1.3 Long-term effectiveness and permanence

For Alternative 2, the long-term period would begin after removal of the structures and packaged waste and final site restoration. There are no significant long-term adverse human health or environmental effects under this alternative.

Magnitude of residual risk and uncertainties. Long-term residual risk from removing the buildings/structures and infrastructure and packaging waste is minor. There is an unlikely threat of contaminant releases from adjacent or under slab buried utilities not removed with the structures. This risk would be minimized by careful remedial action planning, which would include research of historical documentation and drawings to determine the presence of all buried piping or conduits under or exiting the structures being addressed.

Removing the buildings/structures and infrastructure removes the future potential unacceptable risk that could have resulted from contamination in the process equipment being released quickly to the environment. If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, all waste would be taken off Site, and there would be no residual risk at PORTS. Meeting the WAC at the disposal location would result in a protective remedy at the off-Site locations.

Adequacy and reliability of controls. This subcriterion addresses the reliability of the elements of an alternative. Because there is no expectation of long-term O&M or monitoring, no controls are in place under this alternative. Therefore, the adequacy and reliability of controls is not relevant.

Long-term environmental effects. For the purposes of this evaluation, long-term environmental effects are those impacts that may occur following completion of the remedial action. Removing structures and packaging waste for disposition removes the sources of potential future contamination. Demolition areas would be regraded to promote surface water runoff. As discussed in Section 8.2.2.1.2, wetlands may be impacted during performance of the remedial action. However, mitigation actions, if required, would prevent any long-term impact on wetland areas. No anticipated long-term environmental effects are associated with this alternative. If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there would be no long-term environmental effects from disposing of the waste off-Site, assuming that the WAC at the disposal locations are met. The WAC from permitted units are set to be protective of the environment.

8.2.2.1.4 Reduction of toxicity, mobility, or volume

Alternative 2 does not reduce toxicity, mobility, or volume through treatment, except for a small number of waste streams treated to meet either disposal facility WAC or DOT requirements for off-Site shipment. A small volume of deposits removed from the process equipment may be macroencapsulated in grout prior to shipment. This process option reduces the mobility of the contaminants but does not reduce the toxicity or volume. In fact, it increases the volume of radiological material by considering the grout now as part of the radiological waste volume. Large pieces of process equipment (converters, compressors, and coolers) may be filled with grout to reduce voids. Although the purpose of the grouting process is to reduce the voids to prevent subsidence in the disposal cell, it may be incomplete at reducing the mobility of any contaminants internal to the process equipment pieces. However, some reduction of mobility would occur. If another material such as sand or foam were used to reduce void space, or another process such as segmentation were used, little to no reduction in mobility would occur.

The removal of material from converters would require segmentation of that PGE, which would reduce the volume of waste materials. Additionally, up to 6,400 tons of nickel may be removed from the waste stream. If all the nickel is removed and all X-330 and X-333 converters are segmented, an estimated 300,000 cy of potential OSDC capacity savings could be expected.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, some of the waste may be treated at the disposal location. Those volumes of waste would most likely have the mobility of the contaminants reduced through treatment. Most of these wastes would be from items removed early from the buildings through hazard abatement activities.

8.2.2.1.5 Short-term effectiveness

For purposes of this evaluation, “short-term” refers to the period of abatement, deactivation, equipment removal and treatment, demolition, packaging of the D&D waste, and site restoration.

Protection of the Community during Remedial Action

Risk to the public from hazard abatement and demolition activities at PORTS would be low because of the robust and conservative protective systems supporting all phases of the project. Public access to buildings/structures and infrastructure undergoing D&D would be restricted. Selection of appropriate abatement and demolition processes; compliance with DOT packaging and other requirements; and adherence to project-specific safety and spill prevention, control, and countermeasures (SPCC) plans would minimize the likelihood of an accident and the severity of a release should an accident occur. Air and storm water monitoring would be performed to detect any migration of contaminants, and mitigation measures would be implemented as needed.

All demolition, waste handling, and waste packaging activities would occur within monitored areas with access controls at the remediation locations or at a potential OSDC. Most candidate waste streams would present only minor hazards and would be handled in limited quantities. If a waste handling accident occurred, the small quantities involved would ensure that impacts would be minimized. Accident scenarios would be prepared and evaluated, and SPCC plans would be prepared and implemented to address them. High-hazard wastes would be managed with additional institutional controls and physical safeguards. All packaging and handling activities would be conducted in accordance with DOE, DOT, and state requirements. Trained personnel would conduct these activities while following an approved health and safety plan. Risks to the public from waste handling and packaging activities would be extremely low.

Although workers would be required to implement Alternative 2 at PORTS, most of these workers would come from the existing work force, so there would be no notable change in commuter traffic.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there would be a notable increase in the risk to the community by shipping the waste off Site for disposal. Calculations performed in the Waste Disposition RI/FS (DOE 2014) estimate that 18.7 accident-related injuries and 2.4 accident-related fatalities would occur. Even though there are notable risks from accidents, due to the packaging requirements, there is little chance that the waste itself would cause a risk during an accident.

Protection of Workers during Remedial Action
The primary risks to workers would result from abatement, deactivation, equipment removal, and demolition activities. These activities would be conducted by trained personnel in accordance with ARARs and DOT regulations, DOE requirements, approved health and safety plans, and ALARA principles. Risk from exposure during remedial activities would be generally limited by characterization of the buildings/structures and infrastructure and workplace monitoring by radiological, industrial hygiene, and environmental compliance support personnel. Worker exposure would be further minimized by compliance with approved work procedures; health and safety plans; DOT and DOE waste packaging, transport, and handling requirements; the use of shielding and PPE; limits on work schedules; and other operational restrictions, such as criticality and nuclear safety controls to ensure that radiation doses to workers are kept below 10 *CFR* 835 *Occupational Radiation Protection* limits.

The recovery of material could increase mechanical risks and the potential for exposures to hydrofluoric acid fumes and radiologically contaminated particulates. The exposure hazard can be controlled through the introduction of wet air during cut and cap and the converter retrieval process, proper radiological contamination controls, and proper PPE. Mechanical risks can be controlled with careful planning and oversight. A similar activity occurred successfully at the K-33 Building in Oak Ridge. Prior to beginning demolition activities, an operational readiness review would be conducted to verify procedures, physical controls, and conduct of operations requirements are in place to perform the demolition activities. The need for segmentation of PGE may be greater if the equipment is being disposed off Site due to the limited packaging available for the larger equipment. There may be a slight increase in worker risk. However, decisions to segment most of the PGE may be made even for on-Site disposal. In that case, there is no notable difference in the worker risk between using an on-Site versus off-Site disposal assumption. The overall risk to workers for this alternative is low.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there would not be an increase in risk to plant workers because the transportation and disposal actions occur off Site.

Short-term Environmental Effects
For the purposes of this evaluation, short-term environmental effects are those impacts associated with removing the structures, packaging the waste, and site restoration. The potential for short-term environmental impacts would be posed primarily by those structure removal and site restoration activities with the potential for discharge of runoff to adjacent wetlands, contaminant migration from demolition waste, and spills during waste and equipment movements. Short-term environmental impacts would be

minimized by use of BMPs, including engineered and administrative controls. Specific components of short-term environmental impacts are addressed in the following sections.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, except for air quality, there are no expected impacts to the environment (surface water, groundwater, or wetlands) because the transportation and disposal activities of the action would occur off Site.

Air Quality. Air quality would be impacted by vehicle exhaust emissions and the generation of particulate matter during demolition and site restoration activities. Vehicular exhaust emissions would include VOCs from unburned hydrocarbons, CO_2, carbon monoxide, SO_2, and nitrogen dioxide. Remediation of the structures would result in an increase in the PORTS labor pool, so a small increase in commuter traffic and an associated increase in air pollution would be expected. Most of the increase would be from the heavy equipment and trucks used to demolish and move waste about PORTS. Air releases from demolition and site restoration would be locally confined at PORTS and would be temporary. Cutting and pulling down structures is dry work. The interiors of these buildings/structures have been kept dry, and insulation and fiberboard are easily turned into particulate matter. During remedial activities, fugitive dust generation and other airborne emissions from the D&D areas would be monitored. Engineering controls, such as the application of water or chemical dust suppressants, would be implemented to minimize fugitive dust emissions. Particulate matter would be expected to fall out rather quickly because of the relatively large sizes of the particles expected to be generated, thereby limiting the area subject to fugitive dust emissions.

Another potential for impacts to air quality would result from an increase in the generation of fugitive dust from earthmoving activities and traffic on unpaved surfaces. During demolition and restoration, significant waste movement and soil excavation/earthmoving activities would occur at the D&D areas. A number of large vehicles, including tractor-trailer rigs, large dump trucks, and excavation equipment, would deliver and manipulate building waste and waste packages daily. The use of water trucks to spray down gravel or excessively dry and heavily traveled roads would ensure that Ohio EPA fugitive dust limits would be met, ensuring compliance with federal NAAQS.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, the nearly 10,000 truck trips and almost 50 million rail miles needed to transport waste off Site would increase vehicle emissions. However, these emissions would occur over thousands of miles and would not cause an unacceptable impact at an individual location.

Surface water resources. Potential impacts to surface water resources could result from sediment loading to surface water bodies or migration of contaminants. Deactivation and demolition activities would expose varying areas, depending on the size of the building/structure being demolished. The potential impacts to surface water resources would be minimized by using standard erosion controls, such as siltation fences and buffer zones of natural vegetation, during remedial activities. Vegetation preserved in the buffer zone would serve as a filter strip for eroded soil, help prevent stream banks from eroding or slumping, and moderate water temperatures. Grass would be planted in cleared areas to minimize the time soils are exposed, stabilize the soils, and control erosion. Some impacts to surface water would be expected.

Potentially contaminated runoff from the demolition areas, water used for equipment decontamination at the demolition area, and water from dust suppression would be monitored during discharge to the existing plant storm drain system. Runoff conduits such as roof drains, utility piping, and ducts would be plugged to prevent discharge. Surface grates would be protected with erosion control measures to minimize discharge of particulates. The potential for impacts to surface water resources from migration of contaminants from the demolition areas would be low because of engineered and active controls. Little or no overall short-term impacts to surface water resources would be expected from implementation of this alternative.

Currently, combined effluent discharges from PORTS to Little Beaver Creek total approximately 1.9 million gal/day (Ohio EPA 2006). Most of this effluent is storm water runoff from buildings, adjacent paved areas, and other man-made surfaces. During the D&D process, building slabs and these other surfaces would be gradually removed, leaving behind large areas of exposed soil that would be replanted with grass and other appropriate vegetation. As D&D is completed, the surface water drainage system of PORTS would be reconfigured to accommodate the needs of the remediated PORTS Facility. This system would include the already existing network of on-PORTS ponds and ditches that drain into Little Beaver Creek. Because of the large, open surface areas left behind as a result of D&D, a small portion of the storm water that falls upon them would be absorbed and gradually released to the air (evapotranspiration) by newly planted vegetation. Additional storm water would infiltrate the soil, migrate to groundwater, and eventually recharge surface water bodies such as the East Drainage Ditch, North Drainage ditch, Northeast Drainage Ditch, and Little Beaver Creek. This would cause a minor increase in the base flow of Little Beaver Creek, but this increase might be barely noticeable in the dry season. However, most of the stormwater that falls on these large areas would be captured by the reconfigured surface water drainage system of PORTS, be transported through the plant ditches and ponds, and be discharged into Little Beaver Creek. Because the quantities of transported surface water are expected to be only somewhat less than current quantities, removing large building slabs and other man-made surfaces is anticipated to have only minimal impacts on the nearby surface water bodies.

Groundwater resources. Groundwater resources could potentially be degraded in the short term by demolition contaminant releases that migrate to groundwater. Contaminant sources include spills of oil and diesel fuel and releases from demolition or waste handling equipment. Compliance with an approved Erosion and Sedimentation Control Plan and an SPCC Plan would mitigate potential impacts from surface spills. A plan would require prompt removal of any releases on the land. Continued monitoring of water falling on the demolition location, either as rainwater or as dust suppression water, would identify any potential for release of contaminants to underlying groundwater to allow for development of engineered controls to avoid an unacceptable impact to groundwater. Implementation of this alternative would result in few or no short-term impacts to groundwater resources.

Removal of building slabs, adjacent paved areas, and other man-made surfaces during D&D would allow more storm water to infiltrate through the soil to recharge groundwater beneath PORTS. Groundwater recharge would be greatest in the central portion of PORTS where the three large process buildings (X-326, X-330, and X-333) once stood. This groundwater recharge would raise the potentiometric surface elevation in the shallow water table. In addition, demolition of the X-700 and X-705 buildings would remove the active sump pumps operating in these buildings. Currently, these pumps remove approximately 0.02 million gal of groundwater per day and distort the groundwater flow direction in this area by creating a large cone of depression. In this locality on PORTS, removal of these pumps would reorient the direction of groundwater flow towards the X-230J7 Holding Pond and East Drainage Ditch. The presence of additional groundwater beneath the former plant would result in a somewhat increased groundwater discharge to Little Beaver Creek. This increased discharge may be somewhat offset by less leakage through old water pipes when the utilities are deactivated.

Terrestrial biotic resources. There are no expected impacts to terrestrial biota or habitat as a result of demolition and waste handling activities. The areas that would be impacted are already severely disturbed and are, in general, heavily industrialized. It is anticipated that any terrestrial animals in the area would move when the activity and noise associated with heavy equipment begins.

Wetlands and aquatic resources. Several wetlands are located downgradient from some of the proposed demolition areas. There is also the potential for required removal of small, man-made surface water structures in or adjacent to wetlands. Appropriate runoff and siltation controls would be implemented at the demolition area to minimize potential impacts from surface runoff to wetlands during removal of the structures. Likewise, if a small structure needs to be removed from a wetland, efforts would be made to limit the disturbance. If the removal involves significant disturbance of a wetland, a wetlands evaluation would be completed prior to removal, and the results would be used to formulate a mitigation approach.

There are no federal or state radiological standards for aquatic life. However, available evidence indicates that the potential for radiological impacts on such life would be negligible. The concentration of radionuclides released to the aquatic environment would not be expected to exceed the radiological limits established for human beings, and research indicates these limits would be protective of other species.

During removal of structures, impacts on aquatic flora and fauna as a result of sedimentation or oil spills from equipment would be of more concern. Erosion and runoff controls included in the work planning would largely protect aquatic resources from increased turbidity and siltation. Sediment, dust, oil, diesel fuel, gasoline, antifreeze, and other chemicals from remedial activities and equipment could enter the aquatic environment if there were a release. Spill control measures and quick remediation of all spills would minimize the amounts of these materials that are released to the environment and potential impacts on aquatic flora and fauna.

Duration of Remedial Activities

Implementation of this alternative is assumed to take 10 to 12 years, dependent on the actual availability of funding. In the event lack of funding extends the duration of remedial activities, there would be no anticipated impacts to the short-term effectiveness evaluation of this alternative. No S&M or long-term monitoring would be needed after the action. If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there would be a significant schedule increase. The duration to dispose of waste off Site is assumed to take 18 years, so the D&D effort would also increase to 18 years.

8.2.2.1.6 Implementability

Implementation of this alternative would entail meeting administrative and technical requirements for removal of the structures and processing and packaging of waste. This alternative is implementable because the required administrative structure is largely in place, the required technology is proven, and the services and materials required to implement the action, including an adequate body of qualified vendors, are available.

Administrative Feasibility

The administrative feasibility of Alternative 2 would depend on meeting DOE administrative requirements. This alternative does not present any unique administrative challenges and is considered feasible.

Because of the number and complexity of the buildings/structures and infrastructure to undergo D&D, remedial design and work planning would occur over several years. Close coordination between the

DFF&O parties would be necessary to obtain timely approval of RD/RA Work Plans. Currently, it is anticipated that the large process buildings would be addressed in individual plans. Other large buildings such as X-705, X-710, X- 700, and X-720, may be combined with smaller adjacent buildings to remediate portions of PORTS. Other groupings may include several buildings/structures with similar purposes and contaminants (e.g., pump houses, utility systems). Finally, some plans could combine several smaller buildings/structures in groupings intended to represent remediation for a particular period of time (FYs approximately).

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, the most significant administrative challenge would be associated with state equity. Roughly 1.3 million cy of waste would leave Ohio and would be disposed in other states. Some communication with other states, including states on the transportation route, may be needed.

Technical Feasibility
Numerous challenges exist, and although a GDP is in the process of being demolished in Oak Ridge, some of the technical challenges still have not been completely resolved. Some of the greater challenges are associated with demolishing the process buildings, but the large number of extraneous facilities ensures challenges throughout the program. Challenges exist with characterization, removal of deposits or material in process equipment, meeting physical WAC requirements at a potential OSDC, packaging large process equipment, site restoration over years of demolition activities, and the logistics of deactivating and remediating utilities while still maintaining services for future D&D or existing industrial activities (ACP). Despite these challenges, this alternative is considered technically feasible.

Characterization. Because of the number of process equipment pieces, the nonhomogeneous nature of the equipment, and the large sizes of the process buildings, any characterization effort can become a challenge. NDA is one technique that can offer a more representative characterization result for process equipment, but it is limited by which isotopes it can detect. In addition, it is of no use in characterizing the equipment for metals or organic compounds because it only detects radiation. Also, NDA has not been used at PORTS at the scale that could be needed under this alternative. It either requires moving each piece of equipment to a low background area or accepting a conservatively high result. Physical sampling introduces two major challenges: safe access for samplers and obtaining a representative sample without having to sample many locations on a piece of equipment. Currently, EPA has no accepted building/structure (including process equipment) sampling procedures. There are many different types of equipment, piping, and building structural components. Deciding which requires sampling for waste disposition and how much sampling is sufficient will require considerable effort.

Deposit/material Removal. The segmentation and mining of uranium deposits to meet disposal WAC or DOT requirements or material for eventual recycling could be implemented by refurbishing existing equipment and systems in the X-705, X-700, and X-720 facilities, which have been historically used for segmentation and removal of deposits. Use of these facilities and existing procedures would allow successful removal of the barrier in a dry form. The challenges associated with this process are well understood as it has been implemented in Oak Ridge, but segmenting equipment and mining deposits can be very time-consuming. If multiple simultaneous efforts are desired, the existing facilities may not be able to handle the throughput, even after refurbishment. The segmentation process puts workers in close proximity to the equipment and introduces significant safety hazards. PORTS has a workforce trained in segmentation and with a history of conducting segmentation safely.

Physical WAC. The physical WAC at any potential OSDC are still unknown. However, there likely would be a size limitation, and there may be a void limitation. This alternative description and evaluation assumes both. Plasma cutting of thousands of equipment flanges and sections of piping would be necessary to remove the equipment prior to demolition. This would require careful implementation of radioactive contamination control procedures and practices to prevent skin or inhalation contamination of workers and airborne releases inside the process buildings. Size reducing all the piping and building structure would require careful shearing and cutting with heavy equipment. It may be necessary to fix in place some of the contamination in piping before beginning shearing to minimize its release during the activity. An assessment of the release potential would be needed during design to make this decision. A need to reduce void space would result in another evaluation of the various options, including size reduction and filling the voids. Each has its own implementation challenges, in part because large numbers of equipment pieces contain voids.

Packaging. Process equipment and a significant portion of the process piping must be removed and packaged for transport to disposal, whether on Site or off Site, before demolition. Procedures and practices exist and are currently being used by the industrial work force at the plant. The technical challenge would be obtaining the approved packaging necessary for off-Site shipment. Major process equipment in X-326, while smaller than that in X-330 and X-333, would still require the design and certification of a larger radioactive transport container to allow shipment off Site. This has been assumed to be feasible for this alternative with regard to off-Site shipment of X-326 equipment. If some of the larger process equipment in X-330 and X-333 must be sent off Site, there are no radioactive transport containers that are considered to be economically feasible for transporting such large pieces of equipment, which may contain elevated levels of uranium isotopes. Instead, a significant segmentation effort (including uranium deposit mining) would be necessary, likely requiring significant construction of additional facilities and a longer schedule.

Site Restoration. Buildings/structures and infrastructure demolition would occur over several years. Final grading and site restoration cannot be completed until the roads are removed. Roads are one of the last items that would be removed. Therefore, interim restoration may be needed, resulting in areas of PORTS that do not necessarily drain well or resemble the final restoration vision. Mechanisms would also be needed to find interim stabilization techniques to control migration of contamination that may be left behind pending a future additional action. These techniques (e.g., adding a fixative to a slab, temporary seeding, or temporarily filling a hole) are inherently easy, but the challenge would be coordination between the interim actions and planned final actions to minimize rework.

Deactivation. Deactivation and removal of utilities would require careful coordination to maintain continued services for the PORTS Facility during D&D. For the majority of the schedule, some existing facilities would be used to house personnel and provide services for D&D. In many instances, temporary facilities would be erected to provide housing for additional personnel and parking for vehicles and equipment that cannot be met with existing facilities. As buildings/structures and infrastructure are scheduled for D&D, utility deactivation would occur, but this would often require the relocation of existing services to temporary facilities with temporary utilities so these necessary services could continue. This would result in the eventual need to remove the temporary structures and utilities. Coordination, as buildings/structures and infrastructure are demolished, would continue until eventually other infrastructure such as roads and fences could be demolished, although even these may require roads and fences be temporarily erected to provide security and emergency access. Coordinating these efforts will likely present a considerable challenge under this alternative.

Off-Site Disposal. If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there are no primary technical challenges. Transporting waste by truck or rail long distances and disposal in facilities in the western United States have been done successfully from many DOE facilities, including PORTS.

Availability of Services and Materials

Services and materials required for removal of structures and packaging of waste would be available for implementation of this alternative. Services and materials required for planning, characterization, hazard abatement, deactivation, equipment removal, demolition, segmentation, treatment, and packaging of waste are readily available, as are qualified personnel, specialists, and vendors. Remediation would involve the use of standard construction equipment, labor forces, and materials. Many companies have successfully demolished complex nuclear facilities and are available to execute the work. Remediation would occur in phases with several companies potentially executing the work.

Off-Site shipment of X-326 process equipment containing fissile quantities of uranium requires the availability and certification of a large waste package that would accommodate the equipment without size reduction (a 37-cy intermodal). An inability to acquire this package would necessitate a very significant process equipment size reduction effort and also a significant increase in pipe cutting to allow packaging in existing packages (90-cf boxes).

Another challenge to implementability could be the availability of helium-3 for use in NDA detectors. Worldwide use of this material for homeland security applications is currently affecting availability and could cause supply shortages, resulting in slower characterization of process equipment.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there are no issues on disposal capacity availability because off-Site disposal facilities are currently available. There should be no issues associated with obtaining sufficient transportation support.

8.2.2.1.7 Cost

Estimated total escalated capital costs for Alternative 2 are $1.9 billion (present worth costs are $1.6 billion). The details are presented in Table 8.1. Capital costs include those for remedial planning, characterization, deactivation, hazard abatement, equipment removal, segmentation and material recovery, demolition, and packaging of the waste, including the deactivation and demolition of any temporary facilities erected for D&D. Included in the process building D&D costs are grouting for void reduction and deposit removal for other PGE. There are no O&M costs.

Table 8.1. Cost Estimates for Alternative 2

Project Cost Item	Alternative 2
ESCALATED CAPITAL COSTS	
DOE Services and Infrastructure Support	$428,700,000
Safeguards and Security	$223,900,000
D&D of Process Buildings	$415,600,000
D&D of Balance of Plant	$460,000,000
Facility Surveillance and Maintenance	$383,400,000
TOTAL CAPITAL COST	**$1,912,000,000**
TOTAL PROJECT COST (PRESENT WORTH)	**$1,625,000,000**

D&D = decontamination and decommissioning
DOE = U.S. Department of Energy

The cost estimate is based on the estimating methodology described in Appendix E and the technical scope and assumptions described in Section 7.

The following are additional assumptions that significantly affect total project costs:

- Implementation of this alternative is assumed to take 10 to 12 years, dependent on the actual availability of funding.

- Davis-Bacon regulations regarding local prevailing wage rates would be in effect for all remediation in accordance with existing and future industrial and construction union labor agreements.

- Profit, fees, overhead, staff size, and management efforts are based on rates consistent with those of the current D&D contractor.

- The costs of purchasing the packages are part of the Waste Disposition Project costs. The costs for treating, preparing, and placing the waste into the packages are part of this cost estimate.

- No contingency costs are added to the remove structures, treat as necessary, and package waste alternative cost estimate.

- It is assumed that all wastes would meet the on-Site or off-Site disposal facilities' WAC (with treatment, if needed); there are no wastes without a disposal path.

Additional details on the cost estimates are provided in Appendix E.

A sensitivity analysis was conducted on the cost estimate to evaluate the impacts an off-Site waste disposal decision would have on preparing the waste for disposition in Alternative 2. The escalated capital cost for Alternative 2 under an off-Site disposal decision would be $2.6 billion while a present worth cost would be $2.0 billion. This increase is primarily due to a cost increase from delaying the D&D effort from a 12-year schedule to an 18-year schedule. There is an increase in PGE segmentation costs, but that is mostly offset by a decrease in void space reduction effort (grouting). The material recovery effort is the same, regardless of the assumed disposal location. The details of the sensitivity analysis are presented in Appendix F.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, the alternative capital costs would increase by roughly $1.4 billion (added present worth costs would be roughly $1.1 billion).

8.2.2.2 Other criteria analysis

8.2.2.2.1 Irreversible and irretrievable commitment of resources

There are short-term irreversible and irretrievable commitments of resources associated with any construction (or demolition) activity. Gasoline, diesel fuel, lubricants, and other petroleum products would be used in the heavy equipment and other vehicles necessary to support D&D of the PORTS buildings/structures and infrastructure. The increased number of PORTS employees would also use such products during their daily commutes to and from PORTS. The quantities of petroleum products committed to these purposes would be minimal in comparison to the large available supplies, and they would not increase the overall rates of use for such supplies or result in any substantial depletion of petroleum resources. After slabs and below-grade structures have been removed, large quantities of soil (up to over 1 million cy) could be permanently committed to filling surface depressions and subsurface void spaces. However, because the area would only be graded to drain, the majority of the soil would originate on the PORTS Facility, and hence would not be use of a new resource.

There are no permanent commitments of land or environmental resources from implementing this alternative. Any impact to nearby surface water bodies or wetlands would be controlled or mitigated. There are anticipated to be no impacts on natural resources such as air, fish, underlying groundwater, or nearby drinking water. If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, there would not be any notable irreversible and irretrievable commitment of resources other than the use of energy for the trucks and trains.

8.2.2.2.2 NEPA values

Socioeconomics and land use. Alternative 2 restores PORTS to a condition potentially suitable for industrial land use, with generally level terrain and adjacent industrial infrastructure (roads, rail, and utilities) that is usable. Future use of the land could create new jobs to partially off-set the inevitable loss of D&D jobs at PORTS. The exact nature of the future use of PORTS cannot be determined at this time. In some cases, potential future uses could involve requested transfers of PORTS land to private sector or local government entities for specific purposes. Furthermore, applying a general land use principle, any change in future land use on a particular tract of land has the potential to alter current and future land uses on adjacent tracts of land. Therefore, depending on the selected future land uses, the selections may have an influence on the current and future uses of adjacent PORTS land and potentially some nearby areas of land outside the DOE boundary.

D&D of buildings/structures and infrastructure at PORTS is assumed to last 10 to 12 years, dependent on the actual funding available. A major portion of the project budget would be infused into the economy as worker payroll and locally procured goods and services. Alternative 2 would add approximately 300 to 500 new employees to the current worker population at PORTS for a few years. (This is in addition to jobs added to support other response actions at PORTS. The numbers also do not consider that S&M jobs would be declining at the same time.) Most of these new workers would be hired from the available labor force already living in the ROI, where the unemployment rate is high. For example, Pike County had an unemployment rate of 15.1 percent in 2009. After hiring these new workers, the overall worker population at PORTS would remain steady for a number of years. However, the skill mix of the worker population might change over time. When large numbers of buildings/structures and infrastructure have been removed, the need for workers would diminish until project completion, when such workers would no longer be needed. Should insufficient funding be received to complete the project in 10 to 12 years, the schedule delays would result in continuation of S&M-related jobs for the duration of the delay.

Because it is assumed that labor resources needed for this alternative are locally available, there is no anticipated impact to the population in the ROI. Therefore, Alternative 2 would have initial beneficial socioeconomic impacts on the population of the ROI, which would diminish as D&D work is completed.

Demolition of on-Site buildings and structures does not affect any environmental justice issues (Executive Order12898) because there are no substantial off-PORTS impacts. There would only be some increase in construction traffic and noise, which could be mitigated by controlling hours of operation and monitoring both.

If off-Site transportation and disposal become part of this decision in accordance with Paragraph 12 of the DFF&O, some jobs would be added to the local community. It is estimated that these added jobs would be 40 or less.

Cumulative impacts. Alternative 2 would have minimal cumulative impacts involving surface features, meteorology, surface water hydrology, geology, soil, hydrogeology, ecology, and irreversible and irretrievable commitments of resources. The cleanup of the land at PORTS suitable for reuse and the new industrial parks could collectively put more ROI land into productive use. In the past, a number of buildings were demolished at PORTS. More DOE-built structures would be demolished under Alternative 2. These additional losses would be mitigated through recordation. However, there would still be a cumulative physical loss of architectural properties over time at PORTS. With regard to transportation, the D&D-related employment at PORTS would combine with employment at the new industrial parks to slightly increase peak daily traffic on U.S. Route 23, at the U.S. Route 23/State Route 32 intersection, and on other highways and roads in the ROI. Because the current traffic volume is considered to be low in these areas, the cumulative impact from an increase in traffic with the new industrial parks and potential selection of an on-Site disposal alternative as part of the Waste Disposition Project is anticipated to be negligible. However, if Waste Disposition Alternative 3 (off-Site disposal) were selected, waste transportation by truck would also increase local traffic volume, and there would be more trains moving through the area. Such cumulative increases in traffic volume at PORTS and in its vicinity could begin to adversely impact road serviceability and driver safety, especially during peak daily traffic hours (early morning and late afternoon rush hours) and at railroad crossings.

8.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

This comparative analysis evaluates the relative ability of the alternatives to meet the CERCLA evaluation criteria as well as the other criteria considered in the individual analysis. The no-action alternative is not considered to be protective, which is one of the threshold criteria.

8.3.1 CERCLA Criteria Analysis

8.3.1.1 Overall protection of human health and environment

Alternative 1, no action, is not considered to be protective. It allows the continued degradation of buildings/structures and infrastructure and the accumulation of waste across PORTS. This waste and the associated contaminants would pose a future unacceptable risk to on-PORTS receptors, both human and ecological. Risk is primarily from incidental ingestion of soils contaminated by radionuclides or from ingestion of underlying groundwater contaminated after a future release. Alternative 2 (remove structures, treat as necessary, and package waste) is protective when combined with either of the waste disposition actions that may be selected in the Waste Disposition Project. Human health and environmental risks during demolition and packaging would be controlled through compliance with ARARs/TBCs and site-specific work plans. The waste generated from the demolition activities would be placed in an on-Site or off-Site disposal facility engineered for containment. Long-term protection would be provided by removing contaminated buildings/structures, infrastructure, and associated equipment; packaging waste; and appropriately disposing of the demolition waste. If any of the residual soil removed is contaminated, there is protection provided by removing that contamination from the environment.

8.3.1.2 Compliance with ARARs/TBCs

No ARARs/TBCs are directly associated with the no-action alternative. Alternative 2, which removes buildings/structures and infrastructure and packages waste for final disposition, would meet all ARARs/TBCs, as discussed in Section 8.2.2.1.2, without waivers.

8.3.1.3 Long-term effectiveness and permanence

The no-action alternative is not effective at achieving the RAOs. An unacceptable long-term risk would remain from contamination in the buildings/structures and infrastructure and from building materials such as transite siding. Alternative 2 is very effective at protecting human health and the environment. Contaminated buildings/structures, infrastructure, and equipment would be demolished and packaged appropriately for on-Site or off-Site disposal. There would be no need for long-term S&M or monitoring. The demolition areas would be stabilized to promote surface water runoff.

8.3.1.4 Reduction of toxicity, mobility, or volume through treatment

The no-action alternative is not effective at reducing toxicity, mobility, or volume through treatment because no such activities are performed. Alternative 2 only has a minor reduction of toxicity, mobility, or volume through treatment from treating waste streams to meet either disposal facility WAC or DOT requirements for off-Site shipment. The segmentation of converters may reduce the required disposal capacity because of a volume reduction. The macroencapsulation of any removed deposits would result in reduction of contaminant mobility for this very small but very contaminated waste stream. If grouting is used to fill void spaces in process equipment, some mobility reduction may also occur.

8.3.1.5 Short-term effectiveness

The no-action alternative would present no specific short-term risks or benefits to the community or workers. With Alternative 2, potential risk to the public could result from runoff or windborne dispersion of contaminants or from an increase in local traffic during demolition operations. These risks to the public would be low because of the robust protective systems that would be implemented during the project and because of the only slight increase in traffic. Risk of radiological exposure or physical hazards to workers would be minimized by characterizing the facilities prior to demolition; complying with approved work procedures, health and safety plans, and regulatory requirements; and work place monitoring. These risks would be similar and comparable to risks for industrial operations. If off-Site transportation and disposal become part of Alternative 2 of this decision in accordance with Paragraph 12 of the DFF&O, there would be an increase of injuries and fatalities from truck and train accidents.

Short-term environmental impacts would be the least for the no-action alternative and minimal for the action alternative. Environmental impacts during the implementation of Alternative 2 could result from a spill during equipment or waste handling, or from runoff coming in contact with demolition waste. The risk of a spill is low, and only minor adverse impacts would result because of implementing spill control and countermeasure plans and procedures. Runoff from the demolition areas would be monitored to ensure no contaminant migration is occurring. Vehicles used in the demolition process would cause an inconsequential increase in pollution and noise levels.

Disturbance of terrestrial resources is expected to be minimal with the action alternative because the land areas are already industrialized. Several wetland areas have the potential to be impacted because of their proximity to buildings or utilities requiring removal. Mitigation measures would be implemented to minimize wetland damage and restore wetland areas as needed. Removal of the process and support buildings/structures and infrastructure would impact cultural resources. Any mitigation strategies would be implemented as part of this action.

The duration of Alternative 2 is assumed to take 10 to 12 years to complete based on the funding profile in early FY 2012. The only significant impact of an extended schedule resulting from off-Site transportation and disposal becoming part of Alternative 2 of this decision in accordance with Paragraph 12 of the DFF&O is an increase of costs.

8.3.1.6 Implementability

No services or materials would be required to implement the no-action alternative, Alternative 1, and therefore it is technically implementable. But it is not administratively implementable because it would not comply with DOE Orders.

Alternative 2 is technically and administratively feasible. The technology is currently available for demolishing the buildings/structures and infrastructure and has been proven at several other radiologically contaminated DOE facilities. However, numerous challenges are associated with demolishing the buildings/structures and infrastructure. Characterization, deposit removal, size or void reduction requirements, treatment, as necessary, packaging, site restoration, deactivation in an operating facility, and coordination with corrective action soil response actions all require significant planning. In addition, the development of new processes or procedures may be needed. Removal of the process equipment, size reducing it, and removing uranium deposits or material would be labor-intensive. However, these activities have previously been performed within the PORTS buildings and in Oak Ridge. Services and materials for Alternative 2 are available, but the quantity of appropriate waste transportation packages could be limited, especially if an off-Site disposal alternative is selected in the Waste Disposition Project or becomes part of this alternative.

8.3.1.7 Cost

The projected present worth cost for removing the structures and packaging the waste is $1.6 billion (Table 8.1) to $2.0 billion, depending on the waste disposal decision made. Up to another $1.1 billion would be added to the alternative if off-Site transportation and disposal becomes part of Alternative 2 of this decision in accordance with Paragraph 12 of the DFF&O. There are no costs for Alternative 1, no action.

8.3.2 Other Criteria Analysis

8.3.2.1 Irreversible and irretrievable commitment of resources

Alternative 1 has no commitment of resources. Alternative 2 has an irreversible and irretrievable commitment of fuel and petroleum products associated with operating heavy equipment. There will be an impact on architectural properties but any impact would be mitigated.

8.3.2.2 NEPA values

The no-action alternative would result in additional releases of contamination to the environment that, when combined with past releases at PORTS, would result in unacceptable risks to future users of PORTS and the environment. In addition, continued losses of architectural properties would occur as the buildings degrade. Some resources have already been lost at PORTS. Alternative 2, on the other hand, would record important information about the buildings and their significance in the context of local history and American history. Additionally, Alternative 2 has the potential for a beneficial impact through the reuse/reindustrialization opportunity that could exist if demolition were completed. Cleaning up the land in a manner that is suitable for reuse/reindustrialization has the potential to increase job opportunities in the area. There is the potential for traffic concerns if the increase in worker commuter traffic is combined with increases in construction materials or waste truck and rail traffic that would be needed under both alternatives for the Waste Disposition Project.

8.3.3 Summary of Differentiating Criteria

Table 8.2 summarizes the similarities and differences between the alternatives. Both CERCLA criteria and the other criteria are discussed in the table. However, the major differences are in the CERCLA criteria. The most significant differences are in the level of long-term protection afforded by each alternative (Alternative 1, no action, is not protective and Alternative 2 is considered protective) and in the effort and cost required to implement the alternative. Alternative 1 requires no cost or effort and has no short-term impacts while Alternative 2 has an associated very high cost and a considerable technical challenge to implement the remedy cost-effectively, safely, and with minimal to no environmental impacts. Alternative 1 does not pass the threshold criteria for protection of human health and the environment.

Table 8.2. Comparative Analysis Summary for Alternatives 1 and 2 at PORTS

Evaluation Criteria	Alternative 1, No Action	Alternative 2, Remove Structures, Treat as Necessary, and Package Waste for Final Disposition
Overall protection of human health and the environment	Not considered protective. Degrading buildings would release contaminants at levels of concern.	Considered protective. Contaminated buildings/structures and infrastructure would be removed and appropriately packaged for disposal or treatment at an appropriate facility.
Compliance with ARARs/TBCs	No ARARs (per EPA OSWER Directive 9234.2-01/FS-4, there are no ARARs for a no-action alternative.)	Meets all ARARs/TBCs.
Long-term effectiveness and permanence	Not effective at protecting human health or the environment in the long term	Very effective because contamination sources are removed. No requirement for long-term monitoring or S&M.
Reduction of toxicity, mobility, or volume through treatment.	No reduction of toxicity, mobility, or volume	Some reduction of toxicity, mobility, or volume achieved by treating waste to meet WAC and DOT requirements, through demolition processes, or through recycling and/or reuse preparation and segmentation (e.g., macroencapsulation).
Short-term effectiveness	No action means no short-term impacts, so effective in the short term.	Risk to public, workers, and the environment are controlled by following approved work procedures/plans, regulations, and monitoring. Is effective in the short-term.
Implementability	No implementation required	Administrative requirements are achievable. Technically implementable but there are considerable technical challenges associated with removing process buildings and equipment as well as coordinating removal of hundreds of smaller facilities while supporting other missions and conducting environmental media remediation.
Cost	No costs	Present worth costs are $1.6 billion assuming on-Site disposal is available. Present worth costs increase to $2.0 billion if on-Site disposal is not available. There are no O&M costs.
Other Evaluation Criteria	Loss of architectural resources without recording would be in addition to historical losses at PORTS. Release of contaminants would add to historical releases at PORTS, further degrading soil and groundwater.	Transportation increases with increased work force could combine with increased truck/rail traffic associated with either disposal alternative. Completion of reindustrialization efforts after D&D could increase job opportunities in the area.

ARAR = applicable or relevant and appropriate requirement
D&D = decontamination and decommissioning
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
O&M = operation and maintenance
OSWER = Office of Solid Waste and Emergency Response
PORTS = Portsmouth Gaseous Diffusion Plant
S&M = surveillance and maintenance
TBC = to-be-considered
WAC = waste acceptance criteria

HIGHLIGHTS OF SECTION 8

- Alternative 2, remove structures, treat as necessary, and package waste, meets the threshold criteria as it is protective of human health and the environment and meets ARARs. Alternative 1, no action, does not.
- Alternative 2 has numerous technical challenges but is implementable. A GDP is successfully being demolished in Oak Ridge, TN.
- Alternative 2 net present value costs are $1.6 billion, assuming packaged for on-site disposal, and $2.0 billion, assuming packaged for off-site disposal.

NEXT STEP: IDENTIFY THE PREFERRED REMEDY SO THE PROPOSED PLAN CAN BE ISSUED FOR FORMAL PUBLIC COMMENT

9. REFERENCES

ATSDR 2011, *Toxicological Profile for Uranium, 2011*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp150.pdf.

ATSDR 2010, *Toxicological Profile for Plutonium, 2010*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp143.pdf.

ATSDR 2006, *Toxicological Profile for Cyanide, 2006*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp8.pdf.

ATSDR 2005, *Toxicological Profile for Nickel, 2005*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp15.pdf.

ATSDR 2003, *Toxicological Profile for Fluorides, Hydrogen Fluoride, and Fluorines*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp11.pdf.

ATSDR 2000, *Toxicological Profile for Polychlorinated Biphenyls, 2000*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp17.pdf.

ATSDR 1997a, *Toxicological Profile for Trichloroethylene, 1997*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp19.pdf.

ATSDR 1997b, *Toxicological Profile for Titanium Tetrachloride, 1997*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp1101.pdf.

ATSDR 1995, *Toxicological Profile for Polycyclicaromatic Hydrocarbons, 1995*, Agency for Toxic Substances and Disease Registry, available at http://www.atsdr.cdc.gov/ToxProfiles/tp69.pdf.

Barbalace 2004, *Asbestos, Its Chemical and Physical Properties*, October.

Battelle 1976, *Research and Evaluation of Selected Environmental Aspects of the Portsmouth Gaseous Diffusion Plant in Scioto and Seal Townships, Pike County, Ohio*, Battelle Memorial Institute, Battelle Columbus Laboratories, Columbus, OH.

BJC 2010, *Waste Acceptance Criteria Forecasting and Analysis Capability System (WACFACS) Summary Report*, Q4, FY10, Rev 0, Bechtel Jacobs Company LLC, Piketon, OH, November.

BJC 2003, *Identification and Screening of Candidate Sites for a Potential On-site Waste Disposal Facility at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, BJC/PORTS-448, Bechtel Jacobs Company LLC, Piketon, OH, April.

BJC 2000, *Recycled Uranium Mass Balance Project, Portsmouth, Ohio, Site Report*, BJC/PORTS-139/R1, Bechtel Jacobs Company LLC, Piketon, OH, June.

Brown, K. P. 1988, *E. I. DuPont—Freon 502*, Material Safety Data Sheet, E. I. DuPont de Nemours & Company, Wilmington, DE, June.

Burks 2011, *Report of a Survey for Mound-Like Topographic Features at the Portsmouth Gaseous Diffusion Plant in Pike County, Ohio*, OVAI Contract Report #2011-34, Ohio Valley Archaeology, Inc., Columbus, OH, August.

CEQ 1997, *Considering Cumulative Effects Under the National Environmental Policy Act*, Council on Environmental Quality, Executive Office of the President, January.

Coogan, Alan H. 1996, *Ohio's Surface Rocks and Sediments*, modified from Chapter 3 of *Fossils of Ohio*, Ohio Division of Geological Survey Bulletin 70.

CRA 2011, *Portsmouth Gaseous Diffusion Plant, Pike County, Ohio: Recommended Cold War-Era Mission Documentation Model*, Contract Publication Series 10-211, Cultural Resource Analysts, Inc., May.

DOE 2014, *Remedial Investigation and Feasibility Study Report for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0246&D3, U.S. Department of Energy, Piketon, OH, February.

DOE 2013a, *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0127&D7, U.S. Department of Energy, Piketon, OH, December.

DOE 2013b, *Methods for Conducting Ecological Risk Assessments and Ecological Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0215&D2, U.S. Department of Energy, Piketon, OH, March.

DOE 2012a, *2011 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*, DOE/PPPO/03-0309&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2012b, *Remedial Investigation and Feasibility Study Work Plan for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0133&D5, U.S. Department of Energy, Piketon, OH, October.

DOE 2011a, *Pre-investigation Evaluation Report for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO-03-0199&D2, U.S. Department of Energy, Piketon, OH, May.

DOE 2011b, *Remedial Investigation and Feasibility Study Work Plan for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0204&D5, U.S. Department of Energy, Piketon, OH, September.

DOE 2011c, *Phase 1 Sampling and Analysis Plan for the Process Equipment Characterization in Support of the Site-Wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0210&D2, U.S. Department of Energy, Piketon, OH, July.

DOE 2011d, *2010 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*, DOE/PPPO/03-0209&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2011e, *U.S. Department of Energy, Portsmouth Annual Environmental Report for 2009, Piketon, Ohio*, DOE/PPPO/03-0159&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2011f, *National Historic Preservation Act Section 110 Survey of Architectural Properties at the Portsmouth Gaseous Diffusion Plant in Scioto and Seal Townships, Piketon, Ohio*, DOE/PPPO/03-0147&D0, U.S. Department of Energy, Piketon, OH.

DOE 2010a, *U.S. Department of Energy, Portsmouth Annual Environmental Report for 2008, Piketon, Ohio*, DOE/PPPO/03-0102&D1, U.S. Department of Energy, Piketon, OH, October.

DOE 2010b, *Briefing Book, U.S. Department of Energy, Portsmouth Gaseous Diffusion Plant*, PowerPoint presentation on history of the Portsmouth Gaseous Diffusion Plant and associated DOE environmental management, U.S. Department of Energy, Piketon, OH.

DOE 2009, *2008 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*, DOE/PPPO/03-0083&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2007, *DOE GNEP Detailed Site Report, Portsmouth Reservation, Piketon, Ohio, Affected Environment and Regulatory and Environmental Permitting/Licensing Requirements*, Piketon Initiative for Nuclear Independence, May 1, 2007, U.S. Department of Energy, available at http://www.ne.doe.gov/peis/sitingStudies/siteReport_Portsmouth_detailed.pdf.

DOE 2004, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio Site*, DOE/EIS-0360, U.S. Department of Energy, Piketon, OH, June.

DOE 2001a, *Quadrant II Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1223&D5, U.S. Department of Energy, Piketon, OH, February.

DOE 2001b, *Winterization Activities in Preparation for Cold Standby at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/EA-1392, U.S. Department of Energy, Piketon, OH, June.

DOE 2000a, *Independent Investigation of the Portsmouth Gaseous Diffusion Plant, Volume 1: Past Environment, Safety, and Health Practices*, Office of Oversight Environment, Safety and Health, U.S. Department of Energy, Washington, D.C., May.

DOE 2000b, *Quadrant I Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1248&D6, POEF-ER-4590&D6, U.S. Department of Energy, Washington, D.C., March.

DOE 1998a, *Quadrant III Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1360&D3, POEF-ER-4619&D3, U.S. Department of Energy, Piketon, OH, April.

DOE 1998b, *Quadrant IV Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1332&D3, POEF-ER-4609&D3, U.S. Department of Energy, Piketon, OH, August.

DOE 1996a, *Quadrant I RFI Final Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1231V1-5&D3, U.S. Department of Energy, Piketon, OH, September.

DOE 1996b, *Quadrant II RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1232/V2&D3, U.S. Department of Energy, Piketon, OH, September.

DOE 1996c, *Quadrant III RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1308/V2&D3, U.S. Department of Energy, Piketon, OH, December.

DOE 1996d, *Quadrant IV RFI Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1180/V2&D3, U.S. Department of Energy, Piketon, OH, December.

DOE 1996e, *Baseline Ecological Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1316/V1&D2, U.S. Department of Energy, Oak Ridge, TN, June.

DOE 1995, *Plant-Wide Baseline Human Health Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/11-1403/V1&D1, POEF-ER-4625/V1&D1 (draft), Oak Ridge National Laboratory, Oak Ridge, TN, December.

DOE 1994, *Secretarial Policy Statement on the National Environmental Policy Act of 1969*, DOE Headquarters, U.S. Department of Energy, Washington, D.C.

EPA 2012, IRIS (Integrated Risk Information System), U.S. Environmental Protection Agency, available at http://www.epa.gov/IRIS/.

EPA 2011a, *Currently Designated Nonattainment Areas for All Criteria Pollutants*, U.S. Environmental Protection Agency, available at http://www.epa.gov/oar/oaqps/greenbk/ancl.html, accessed September 22, 2011.

EPA 2011b, *National Primary Drinking Water Regulations*, Technical Factsheet: Chromium, U.S. Environmental Protection Agency, available at http://www.epa.gov/ogwdw/pdfs/factsheets/ioc/tech/chromium.pdf.

EPA 2010, *Technetium-99*, U.S. Environmental Protection Agency Radiation Protection, available at http://www.epa.gov/rpdweb00/radionuclides/technetium.html, accessed February 10, 2010.

EPA 2006, *Depleted Uranium Technical Brief*, EPA-402-R-06-001, U.S. Environmental Protection Agency.

EPA 2005, *Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel*, EPA420-F-05-001, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, February.

EPA 2004, *Understanding Variation in Partition Coefficient, K_d, Values, Volume III: Review of Geochemistry and Available K_d Values for Americium, Arsenic, Curium, Iodine, Neptunium, Radium, and Technetium*, EPA-402-R-04-002C, U.S. Environmental Protection Agency.

EPA 2002, *EPA Facts About Technetium-99*, U.S. Environmental Protection Agency, available at http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/technetium.pdf, accessed February 10, 2010.

EPA 1998, *RCRA, Superfund & EPCRA Hotline Training Module: Introduction to Applicable or Relevant and Appropriate Requirements*, EPA/540-R-98-020, OSWER Directive 9205.5-10A, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., June, (Updated February 1998).

EPA 1991, *ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers*, OSWER Directive 9234.2-01FS-A, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., June.

EPA 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

EPA 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*, EPA/540/G-89/004, OSWER Directive 9355.3-01, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., October.

FEMA 2009, *Flood Insurance Rate Map for Pike County, Ohio*, FEMA Website, Federal Emergency Management Agency, available at http://www.fema.gov/hazard/map/firm.shtm.

Garbarini, D. R. and L. W. Lion 1986, "Influence of the nature of soil organics on the sorption of toluene and trichloroethylene," *Environmental Science and Technology* 20: 1263-1269.

Giffells &Vallet, Inc. 1961, *Gaseous Diffusion Plant at Portsmouth, Ohio, Project History and Completion Report* (Redacted), Volume 2, U.S. Atomic Energy Commission, April.

Hansen, Michael C. 2007, *Earthquakes in Ohio*, Ohio Division of Geological Survey, Educational Leaflet No. 9.

International Agency for Research on Cancer (IARC) 2001, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, World Health Organization International Agency for Research on Cancer, 2001, *IARC Press*, Lyon, France, Volume 78, Ionizing Radiation, Part 2: Some Internally Deposited Radionuclides, available at http://monographs.iarc.fr/ENG/Monographs/vol78/mono78.pdf.

Klinge, David 2009, *Phase II Site Evaluations of 33Pk212 and 33Pk213 for the Portsmouth Gaseous Diffusion Facility, Seal Township, Pike County, Ohio*, ASC Group, Inc., Columbus, OH.

Klinge, David and Chuck Mustain 2011, *Phase II Archaeological Site Evaluations of 33Pk184, 33Pk193, 33Pk194, 33Pk195, and 33Pk197, Portsmouth Gaseous Diffusion Plant (PORTS), Piketon, Pike County, Ohio*, ASC Group, Inc., Columbus, OH, p. 82.

Law Engineering 1978, *Final Report Gas Centrifuge Enrichment Plant Geotechnical Investigation, Piketon, Ohio*, Law Engineering, Marietta, GA.

LMES 1997, *Safety Analysis Report, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, POEF-LMES-89, Lockheed Martin Energy Systems, Inc., Piketon, OH, January.

LMES 1996, *Wetland Survey Report for the Portsmouth Gaseous Diffusion Plant*, POEF-LMES-106, Lockheed Martin Energy Systems, Inc., Piketon, OH.

NRC 2006a, *Environmental Impact Statement for the American Centrifuge Plant in Piketon, Ohio*, NUREG-1834, April 2006, U.S. Nuclear Regulatory Commission, available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/v1, accessed July 2011.

NRC 2006b, *License Application for the American Centrifuge Plant in Piketon, Ohio*, Revision 15, August 2006, U.S. Nuclear Regulatory Commission, available at http://www.wba.nrc.gov:8080/ves/view_contents.jsp.

NRC 2004, *Environmental Assessment of the USEC, Inc. American Centrifuge Lead Cascade Facility at Piketon, Ohio*, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, D.C.

ODNR 2011, *Catalog and Maps of Ohio Earthquakes*, Ohio Department of Natural Resources, Division of Geological Survey, available at http://www.dnr.state.oh.us/tabid/8302/Default.aspx.

ODOD 2011a, *2010 Population Census Count by County, City, Village, and Township*, Ohio Department of Development, Policy Research and Strategic Planning Office, March.

ODOD 2011b, *Ohio County Profiles: Pike County*, Ohio Department of Development, Policy Research and Strategic Planning Office.

ODOD 2011c, *BEA per Capita Personal Income: Pike County*, Ohio Department of Development, Policy Research and Strategic Planning Office.

ODOT 2011, *Pike County Traffic Survey Report for 2007*, Ohio Department of Transportation, http://www.odotonline.org/techservapps/traffmonit/countinformation/default.htm, accessed July 26, 2011.

Ohio EPA 2012, *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*, Ohio Environmental Protection Agency, Columbus, OH, July 16.

Ohio EPA 2006, *Biological and Water Quality Study of Portsmouth Gaseous Diffusion Plant Streams*, Ohio EPA Report EAS/2006-10-4, Ohio Environmental Protection Agency, November.

Ohio EPA 2001, *Portsmouth Gaseous Diffusion Plant, Ohio Hazardous Waste Facility Installation and Operation Permit Renewal*, 04-66-0680, Ohio Environmental Protection Agency, March.

Ohio EPA 1993, *Biological, Fish Tissue and Sediment Quality in Little Beaver Creek, Big Beaver Creek, Big Run and West Ditch, Piketon (Portsmouth Gaseous Diffusion Plant), Ohio*, Ohio Environmental Protection Agency, EAS/1993-5-2, May.

Ohio University 2012, *Land-Use Mapping and Wildlife Management Plan*, Interim Report, Ohio University, Voinovich School of Leadership and Public Affairs, Athens, OH, February.

OMB 2010, *OMB Circular No. A-94, Appendix C, Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses*, Office of Management and Budget, Washington D.C., December.

ORNL 2011, The Risk Assessment Information System, Chemical Data Profiles, Aroclor-1254 and Aroclor-1260, Oak Ridge National Laboratory, available at http://rais.ornl.gov/tools/profile.php?analysis=Aroclor 1254 and at http://rais.ornl.gov/tools/profile.php?analysis=Aroclor 1260.

OVEC 2007, *Annual Report—2007*, Ohio Valley Electric Corporation and subsidiary Indiana-Kentucky Electric Corporation, Piketon, OH.

Pecora, Albert M. and Jarrod Burks 2013, *Phase II Archaeological Evaluation of Six Historic Farmstead Sites (33Pk185, 33Pk203, 33Pk206, 33Pk211, 33Pk217, and 33Pk218) within the Portsmouth Gaseous Diffusion Plant (PORTS), Pike County, Ohio*, Ohio Valley Archaeology, Inc., Columbus, OH, March.

Pecora, Albert M., Jarrod Burks, and Karen L. Leone 2013, *Summary Report of Historic-era Archeological Resources within the Portsmouth Gaseous Diffusion Plant, Pike County, Ohio*, Ohio Valley Archaeology, Inc., Columbus, OH, May, pp. 205-206.

Pro2Serve 2007, *Identification of Natural and Anthropogenic Sources of Beryllium at the Portsmouth Gaseous Diffusion Plant, Portsmouth, Ohio, Final Report*, POEF-USEC-89, Pro2Serve Professional Project Services, Inc., April.

RSI 2010, *Project Execution Plan for Phase 1 of the Decontamination and Decommissioning of the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0130&D0, Restoration Services, Inc., June.

Schweikart, J. F., K. Coleman, and F. Church 1997, *Phase I Archaeological Survey for the Portsmouth Gaseous Diffusion Plant (PORTS Facility) in Scioto and Seal Townships, Pike County, Ohio*, ASC Group, Inc., Columbus, OH.

SourceWatch 2011a, *Kyger Creek Station*, CO_2 emissions, available at http://www.sourcewatch.org/index.php?title=Kyger_Creek-Station, accessed November 7, 2011.

SourceWatch 2011b, *Clifty Creek Station*, CO_2 emissions, available at http://www.sourcewatch.org/index.php?title=Clifty_Creek_Station, accessed November 7, 2011.

TPMC 2006, *Facility Condition Survey of the Portsmouth Gaseous Diffusion Plant Facilities, Piketon, Ohio*, Theta Pro2Serve Management Company, LLC, Piketon, OH, August.

USDA 1990, *Soil Survey of Pike County, Ohio*, U.S. Department of Agriculture Washington, D.C.

USEC 2004, *Beryllium Surface Contamination Initial Characterization*, POEF-USEC-61, United States Enrichment Corporation, November.

WRCC 2011, *Waverly, Ohio, National Climate Data Center*, Western Regional Climate Center http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?oh8830.

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DFF&O COMPLIANCE MATRICES

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Crosswalk between the DFF&O RI Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report

DFF&O Requirements for the RI (Outline E-2)	Equivalent Contents of the RI/FS Report
EXECUTIVE SUMMARY	**EXECUTIVE SUMMARY**
1.0 INTRODUCTION	**1.0 INTRODUCTION**
1. PURPOSE OF THE REPORT	**1.1. PURPOSE OF THE REPORT**
2. SITE BACKGROUND	**1.2. SITE BACKGROUND**
1.2.1. Site Description This Section should consist of the information in Sections 3.0 and 3.1 of the Preliminary Evaluation Report (PER), Section 1.1 of the RI/FS Work Plan, and Section 1 of the Sampling Plan for the Process Buildings and Complex Facilities D&D Evaluation projects regarding the Site background and current Site conditions. (See Outlines A-2, B-2, and C-2, respectively, in Appendices A, B, and C to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**1.2.1. Site Description**
1.2.2. Site History This Section should consist of the information in Sections 3.0 and 3.1 of the Preliminary Evaluation Report (PER), Section 1.1 of the RI/FS Work Plan, and Section 1 of the Sampling Plan for the Process Buildings and Complex Facilities Evaluation D&D projects regarding the Site background and current Site conditions. (See Outlines A-2, B-2, and C-2, respectively in Appendices A, B, and C to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**1.2.2. Site History**

Crosswalk between the DFF&O RI Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the RI (Outline E-2)	Equivalent Contents of the RI/FS Report
1.2.3. Previous Investigations This Section should consist of the information in Section 3.2 of the Preliminary Evaluation Report (PER), Section 1.2 of the RI/FS Work Plan, and Section 1.2 of the Sampling Plan for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outlines A-2, B-2, and C-2, respectively, in Appendices A, B, and C to the Generic Statement of Work for Remedial Investigations(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**2.0 STUDY AREA INVESTIGATIONS** This information has been moved to Section 2.0 for readability.
1.2.4. Previous Emergency or Interim Actions	**1.2.2.2. PORTS environmental restoration and regulatory compliance history**
1.3 REPORT ORGANIZATION	**1.3. REPORT ORGANIZATION**
2.0 STUDY AREA INVESTIGATION As noted in the RI/FS Work Plan Outline and the Sampling Plan Outline for the Process Buildings and Complex Facilities D&D Evaluation projects, it is possible that not all of the field activities included in this Section will be required during RI/FS and included in a Sampling Plan. For those field activities conducted as part of an RI/FS, relevant information provided in the corresponding section of an RI/FS Work Plan and a Sampling Plan and additional information developed or otherwise gathered during the RI should be included in a RI Report in the appropriate Section. This Section includes any field activities conducted during an RI associated with Site characterization, including physical and chemical monitoring of the following: 2.1.1. Surface Features (e.g., topographic mapping, natural and man-made features) 2.1.2. Waste Stream/Contaminant Source Investigations/Evaluations 2.1.3. Meteorological Investigations 2.1.4. Surface-water and Sediment Investigations 2.1.5. Geological Investigations 2.1.6. Human Population Surveys 2.1.7. Interim Technical Memoranda related to field investigations as revised by Ohio EPA comments, if any, shall be included in an appendix and summarized in this Section.	**2.0 STUDY AREA INVESTIGATION** This section has been enhanced to include a summary of relevant previous investigations (required in Section 1.2.3) to improve the readability of Section 1. As stated in the PER, it has been determined that existing information is sufficient to support development of this RI/FS and that no additional data are required to support the evaluation and selection of a remedial alternative.

Crosswalk between the DFF&O RI Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the RI (Outline E-2)	Equivalent Contents of the RI/FS Report
3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA As noted in the RI/FS Work Plan Outline and the Sampling Plan Outline for the Process Buildings and Complex Facilities D&D Evaluation projects, it is possible that not all of the field activities included in this Section will be required during an RI/FS and included in a Sampling Plan. For those field activities conducted as part of an RI/FS, relevant information provided in the corresponding section of the RI/FS Work Plan and the Sampling Plan and additional information developed or otherwise gathered during the RI should be included in a RI Report in the appropriate Section. This section includes the results of any field activities conducted during an RI to determine physical characteristics, including the following: 3.1.1. Surface Features 3.1.2. Meteorology 3.1.3. Surface water hydrology 3.1.4. Geology 3.1.5 Soils 3.1.6. Hydrogeology 3.1.7. Demography and Land use 3.1.8. Ecology	**3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA** **3.1 SURFACE FEATURES** **3.2 METEOROLOGY** **3.3 SURFACE WATER HYDROLOGY** **3.4 GEOLOGY** **3.5 SOIL** **3.6 HYDROGEOLOGY** **3.7 DEMOGRAPHY AND LAND USE** **3.8 ECOLOGY**
4.0 POTENTIAL THREAT TO HUMAN HEALTH, SAFETY AND THE ENVIRONMENT This Section should include a streamlined evaluation of the potential threat to human health, safety and the environment based on the information in Sections 3.3 and 3.4 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)). See also Section 5 of the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project). In addition to the information from Sections 3.3 and 3.4 of the PER, an RI Report should include any additional information or analysis performed based on the results of the Site Characterization process.	**5.0 POTENTIAL THREAT TO HUMAN HEALTH, SAFETY AND THE ENVIRONMENT** **5.1 POTENTIAL THREAT TO HUMAN HEALTH** **5.2 POTENTIAL THREAT TO ECOLOGICAL RECEPTORS**
4.1.1. Conclusions	The conclusions are included in the text of the main sections.

Crosswalk between the DFF&O RI Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the RI (Outline E-2)	Equivalent Contents of the RI/FS Report
4.1.2. Data Limitations and Recommendations for Future Work Discuss data uncertainties/limitations and identify a description of any necessary additional investigation activities.	**5.3 RISK ASSESSMENT DATA LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK** No additional work is recommended.
4.1.3. Revised Remedial Action Objectives This Section should include the information in Section 4.2 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)), along with a discussion of any revisions or refinements to the Remedial Action Objectives set forth in the PER.	**5.4 REVISED REMEDIAL ACTION OBJECTIVES** RAOs have been revised to provide future ecological protection. These RAOs are presented in Section 6.3.
5.0 REFERENCES	**9.0 REFERENCES**
6.0 TABLES AND FIGURES (At least one set of figures shall be no larger than 11” × 17”)	Tables and figures are embedded within the text.
7.0 APPENDICES Include based on activities conducted during the Remedial Investigation. Examples may include: 1. Log Books 2. Soil Boring Logs 3. Test Pit/Trenching Logs 4. Soil Gas Probe Construction Diagrams 5 Monitoring Well Construction Diagrams 6. Sample Collection Logs 7. Private and public Well Records 8. Technical Memoranda on Field Activities 9. Analytical Data and QA/QC Evaluation Results 10. Detailed Modeling Reports	**APPENDIX A: PROCESS BUILDINGS AND COMPLEX FACILITIES DESCRIPTIONS**

D&D = decontamination and decommissioning
DFF&O = *The April 13, 2010 Director’s Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
Ohio EPA = Ohio Environmental Protection Agency
PER = Pre-investigation Evaluation Report
PORTS = Portsmouth Gaseous Diffusion Plant
QA = quality assurance
QC = quality control
RAO = remedial action objective
RI/FS = remedial investigation/feasibility study

Crosswalk between the DFF&O FS Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report

DFF&O Requirements for the FS (Outline G-2)	Equivalent Contents of the RI/FS Report
EXECUTIVE SUMMARY	**EXECUTIVE SUMMARY**
1.0 INTRODUCTION	**1.0 INTRODUCTION**
1.1 PURPOSE AND ORGANIZATION OF THE STUDY	**1.1 PURPOSE OF THE REPORT**
1.2 SITE BACKGROUND	**1.2 SITE BACKGROUND**
1.2.1 Site Description This Section should consist of appropriate information in Section 1.2.1.2.1 and 1.2.1.2.2 of the Remedial Investigation Report for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline E-2 in Appendix E to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plan (Decontamination and Decommissioning (D&D) Project)).	**1.2.1 Site Description**
1.2.2 Site History This Section should consist of appropriate information in Section 1.2.1.2.1 and 1.2.1.2.2 of the Remedial Investigation Report for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline E-2 in Appendix E to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**1.2.2 Site History**
1.2.3 Condition and Content of Buildings This Section should consist of information in Section 3.0 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**4.0 CONDITION AND CONTENT OF BUILDINGS** **4.1 BUILDING DESCRIPTIONS** **4.2 PROJECT WASTE VOLUMES AND WASTE FORMS** **4.3 BASIS FOR ANTICIPATED BUILDING CONDITION AND CONTENT AND IDENTIFICATION OF POTENTIAL UNCERTAINTIES**

Crosswalk between the DFF&O FS Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the FS (Outline G-2)	Equivalent Contents of the RI/FS Report
1.2.4 Potential Exposure Routes and Receptors This Section should consist of information in Section 3.4 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)) together with additional information, refinement or analysis developed during a remedial Investigation.	**3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA** The environmental setting is described in Section 3, as required by Outline E-2.
1.2.5 Summary of Threat to Human Health, Safety and Environment This Section consist of a streamlined evaluation of the potential threat to human health, safety and the environment based on information in Section 4.0 of the Remedial Investigation Report for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline E-2 in Appendix E to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)), together with any additional information or analysis developed during a Remedial Investigation.	**5.0 POTENTIAL THREAT TO HUMAN HEALTH, SAFETY AND THE ENVIRONMENT** The threat to human health, safety, and the environment is presented in Section 5, as required by Outline E-2.
1.3 BASIS FOR ANTICIPATED BUILDING CONDITION AND CONTENT AND IDENTIFICATION OF POTENTIAL UNCERTAINTIES This Section should consist of information in Section 3.2 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**4.3 BASIS FOR ANTICIPATED BUILDING CONDITION AND CONTENT AND IDENTIFICATION OF POTENTIAL UNCERTAINTIES**

Crosswalk between the DFF&O FS Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the FS (Outline G-2)	Equivalent Contents of the RI/FS Report
1.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS This Section should consist of a detailed list of ARARs based on information in Section 4.3 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)).	**6.2 CHEMICAL- AND LOCATION-SPECIFIC ARARS** **7.2 SUMMARY OF ACTION-SPECIFIC ARARS FOR EACH ALTERNATIVE** The ARARs are presented in two sections where they naturally fall in the process. The chemical and location-specific ARARs are presented in Section 6.2 to support the development of RAOs. The action-specific ARARs are presented in Section 7.2, as required in Outline G-2, after the alternatives are developed.
1.5 PREMINARY REMEDIATION GOALS This Section should consist of information in Section 4.1 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)), together with any additional information or analysis developed during a Remedial Investigation.	Because the decision is not media-specific, there are no contaminant-specific preliminary remediation goals. This discussion is found in Section 6.3 REMEDIAL ACTION OBJECTIVES.
2.0 PRELIMINARY IDENTIFICATION AND SCREENING OF REMEDIAL ALTERNATIVES	**6.0 PRELIMINARY IDENTIFICATION AND SCREENING OF REMEDIAL ALTERNATIVES**
2.1 INTRODUCTION	**6.1 INTRODUCTION**
2.2 REMEDIAL ACTION OBJECTIVES This Section should consist of information in Section 4.1.3 of the Remedial Investigation Report for the Process Buildings and Complex Facilities D&D Evaluation projects (See Outline E-2 in Appendix E to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)), together with any additional information or analysis developed during a Remedial Investigation.	**6.3 REMEDIAL ACTION OBJECTIVES**

Crosswalk between the DFF&O FS Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the FS (Outline G-2)	Equivalent Contents of the RI/FS Report
2.3 INITIAL IDENTIFICATION AND PRELIMINARY SCREENING OF ALTERNATIVES (includes AAD) This Section is based on the Alternative Array Document described in Section 7.2 of the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies)for the Portsmouth Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D)) Project. The AAD should be attached as an appendix to a Feasibility Study Report. This Section should take into account information in Section 4.4 of the Preliminary Evaluation Report (PER) for the Process Buildings and Complex Facilities Evaluation projects (See Outline A-2 in Appendix A to the Generic Statement of Work for Remedial Investigation(s)/Feasibility Study(ies) for the Portsmouth U.S. Gaseous Diffusion Plant (Decontamination and Decommissioning (D&D) Project)), together with any additional information or analysis developed during a Remedial Investigation.	**6.4 INITIAL IDENTIFICATION AND PRELIMINARY SCREENING OF ALTERNATIVES** This section includes the content of the initial portion of an AAD as required in Section 7.2 of the Generic Statement of Work in the DFF&O. A separate AAD was not developed because there is a limited suite of alternatives, and no alternatives screening step (or major element of an AAD) was needed. The development and description of alternatives are presented in Section 7.
3.0 FINAL DEVELOPMENT OF ALTERNATIVES	**7.0 FINAL DEVELOPMENT OF ALTERNATIVES**
3.1 DEVELOPMENT OF ALTERNATIVES TO BE PRESENTED IN THE PROPOSED PLAN AND RECORD OF DECISION	**7.1 DEVELOPMENT OF ALTERNATIVES**
3.2 SUMMARY OF ACTION-SPECIFIC ARARS FOR EACH ALTERNATIVE	**7.2 SUMMARY OF ACTION-SPECIFIC ARARS FOR EACH ALTERNATIVE**
3.3 DETAILED DESCRIPTION OF ALTERNATIVES	**7.3 DETAILED DESCRIPTION OF ALTERNATIVES**
4.0 DETAILED ANALYSIS OF ALTERNATIVES	**8.0 DETAILED ANALYSIS OF ALTERNATIVES**
4.1 CRITERIA FOR ANALYSIS The nine CERCLA evaluation criteria will be used to evaluate the remedial alternatives carried forward into the detailed analysis.	**8.1 CRITERIA FOR ANALYSIS**
4.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES	**8.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES**
4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES	**8.3 COMPARATIVE ANALYSIS OF ALTERNATIVES**

Crosswalk between the DFF&O FS Outline and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

DFF&O Requirements for the FS (Outline G-2)	Equivalent Contents of the RI/FS Report
5.0 ATTACHMENTS	**APPENDIX B: APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED GUIDANCE FOR THE PROCESS BUILDINGS AND COMPLEX FACILITIES D&D EVALUATION PROJECT** **APPENDIX C: ENGINEERING STUDY OF PROCESS BUILDING EQUIPMENT SUBSIDENCE AVOIDANCE PROCESS OPTIONS** **APPENDIX D: ENGINEERING STUDY EVALUATING OPTIONS FOR FINAL SITE RESTORATION** **APPENDIX E: COST ESTIMATE** **APPENDIX F: SENSITIVITY ANALYSIS OF D&D WITH OFF-SITE DISPOSAL OF WASTES**
6.0 REFERENCES	**9.0 REFERENCES**

AAD = Alternative Array Document
ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D&D = decontamination and decommissioning
DFF&O = *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
RAO = remedial action objective
RI/FS = remedial investigation/feasibility study

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Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
1.0 Purpose	
This Generic Statement of Work (SOW) for Conducting Remedial Investigations and Feasibility Studies sets forth the generic requirements for initiating, conducting and documenting Remedial Investigations and Feasibility Studies (RI/FS) for the Site-Wide Waste Disposition Evaluation project, and the Process Buildings and the Complex Facilities Decontamination and Decommissioning (D&D) Evaluation projects listed in Attachment H to these Orders, at the Department of Energy (DOE) Portsmouth Site.	NA
The purpose of an RI is to determine the threat to human health, safety and the environment in relation to project activities at the Site. The RI process emphasizes appropriate data collection and Site characterization, and is generally performed concurrently and in an interactive fashion with the feasibility study process. The RI process includes sampling and monitoring, as necessary, and includes gathering of sufficient information to determine the necessity for remedial action and to support the evaluation of remedial alternatives for each Remedial Action project at the Site. The purpose of a FS is to develop and evaluate options for remedial action(s) to reduce or eliminate the threat to human health, safety and the environment. The Respondent shall gather enough information to develop and evaluate remedial alternatives to provide the Ohio Environmental Protection Agency (Ohio EPA) with the information needed to concur or approve, as applicable, with a remedy(ies). The RI and FS are conducted simultaneously and in an iterative manner to allow the information gathered during the RI to influence the development of remedial alternatives, which in turn affects data needs and the scope of the RI.	All
The RI/FS shall be performed in accordance with the requirements of the consensual Director's Final Findings and Orders for the Site, referred to herein as "Orders", and this SOW, and in a manner consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Final Rule (40 CFR Part 300). Respondent shall refer to appropriate sections of U.S. EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004, October 1988) (U.S. EPA RI/FS Guidance) and other guidance that the Ohio EPA may use in conducting an RI/FS. A list of documents is provided as Attachment C to the Orders to provide direction and guidance for conducting investigations and developing and evaluating remedial action alternatives. The applicability of individual guidance will be determined by the scope of the response action and data needs as determined during the scoping phase. Sections of relevant guidance which further describe the RI/FS tasks are referenced throughout this SOW and appendices. Ohio EPA and/or Respondent may identify other relevant guidance to be used in connection with performance of the RI/FS as Work proceeds under the Orders. Respondent shall furnish all personnel, materials, and services needed or incidental to performing the RI/FS except as otherwise specified in the Orders.	NA

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
At the completion of a RI/FS for each Remedial Action project, the Respondent shall be responsible for the selection of a remedy and shall memorialize the selected remedy in a Record of Decision (ROD) for each Remedial Action project. The remedy selected by the Respondent shall be protective of human health and the environment, comply with applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws and regulations or satisfy the requirements of 42 U.S.C. Section 9621 and 40 CFR Section 300.430 pertaining to waiver or non-attainment of ARARs, be cost-effective, utilize permanent solutions and treatment technologies or resource recovery technologies to the maximum extent practicable, and address the preference for treatment as a principal element. The final RI and FS Reports for each Remedial Action project, as concurred with or approved, as applicable, by Ohio EPA, shall, with the administrative record, form the basis for selection of the remedy(ies) and provide the information needed to support development of the ROD(s). Ohio EPA shall provide oversight of Respondent's activities throughout the RI/FS for each Remedial Action project, including field activities. Respondent shall support Ohio EPA's conduct of oversight activities.	All NA
2.0 RI/FS Scoping Scoping is the planning process for the RI/FS. Consistent with the Orders and preliminary Site-specific Objectives (SSOs), and in consultation with Ohio EPA, Respondent shall determine the specific project scope and prepare and submit for review and comment a Pre-investigation Evaluation Report (PER) for each Remedial Action project.	Completed
2.1 Project Initiation Meeting (PIM) and Site Visit	Completed
2.2 Pre-investigation Evaluation Report (PER)	Completed
2.3 PER Elements	Completed
3.0 RI/FS Work Plan and Supporting Documents	
3.1 RI/FS Work Plan (U.S. EPA RI/FS Guidance Section 2.3.1) (SOW Appendix B, outlines B-1 and B-2)	Completed
3.2 Sampling Plan (SOW Appendix C, outlines C-1 and C-2)	NA (There are no field sampling activities.)
3.3 Quality Assurance Project Plan (SOW Appendix D)	NA (There are no field sampling activities.)
3.4 Health and Safety Plan (U.S. EPA RI/FS Guidance Section 2.3.3)	NA (There are no field sampling activities.)

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
3.5 Waste/Contaminant or Site Characterization (SOW Appendix B, outlines B-1 and B-2) Consistent with the applicable outline in Appendix B of this SOW, Respondent shall conduct such investigations as are necessary to obtain data of sufficient quality and quantity to support each RI/FS and identification and evaluation of potential remedial action alternatives. Geophysical characterization methods, such as ground penetrating radar, magnetometry, tomography, or other electromagnetic methods shall be used as appropriate to gather data necessary to support the tasks associated with the RI/FS for the Site-Wide Waste Disposition Evaluation project and the Process Buildings and Complex Facilities D&D Evaluation projects. All sampling, analyses, and measurements shall be conducted in accordance with the concurred upon or approved, as applicable, QAPP and SP. All sampling and measurement locations shall be documented in a project-specific field log and identified on project maps. Respondent shall document the procedures used in making the above determinations. The following sections describe the characterization elements for the Site-Wide Waste Disposition Evaluation project and the Process Buildings and Complex Facilities D&D Evaluation projects.	NA
3.5.1 Site-Wide Waste Disposition Evaluation Project (SOW Appendix B, Section 1.0 of outline B-1)	NA
3.5.2 Process Buildings and Complex Facilities D&D Evaluation Projects (SOW Appendix B, Section 1.0 of outline B-2) Consistent with outline B-2 in Appendix B to this SOW, Respondent shall collect the following data for each Remedial Action project: I. Building/Structure A. Location Building Description • Type; • Operating practices (past and present); • Period of operation; • Age; • General physical conditions. II. Anticipated Waste Streams A. Contents of facilities anticipated to be removed during performance of Work under the Orders B. Structures, including infrastructure, foundations, and residual soils anticipated to be removed during performance of Work under the Orders Information to be included with respect to II.A and II.B, above, should include: a. Nature of anticipated waste streams (e.g., radioactive, mixed waste, hazardous waste, solid waste, radioactive TSCA, non-radioactive TSCA, etc.); b. Estimated quantity or volume, including basis for estimate;	NA

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
c. Anticipated types of waste within each of the general waste stream categories (e.g., liquid, solid, rubble, equipment, etc.); and Respondent must document the procedures used in making the above determinations.	
4.0 Environmental Setting **5.0 Threat to Human Health, Safety and the Environment (SOW Appendix E, Section 4.0 of outlines E-1 and E-2)** Respondent shall prepare reports for the Site-Wide Waste Disposition Evaluation project and the Process Buildings and Complex Facilities D&D Evaluation projects consistent with the applicable outlines that appear as appendices to this SOW. Data collected for each Remedial Action project shall be sufficient to support a streamlined evaluation of threats to human health, safety and the environment as required by the applicable appendices to this SOW. Respondent shall collect any necessary data in accordance with a RI/FS Work Plan concurred with or approved, as applicable, by Ohio EPA and shall document the methods and procedures used during the investigation in each RI Report. Section 3.5 of this SOW summarizes the requirements for Waste/Contaminant and Site Characterization data that will be used in the streamlined evaluation.	NA
5.1 Site-Wide Waste Disposition Evaluation Project (SOW Appendices A and E, Sections 3.3 and 3.4 of outline A-1 and Section 4.0 of outline E-1)	NA
5.2 Process Buildings and Complex Facilities D&D Evaluation Projects (SOW Appendices A and E, Sections 3.3 and 3.4 of outline A-2 and Section 4.0 of outline E-2) Respondent shall prepare a streamlined evaluation of the risk posed to human health, safety and the environment by the release or threat of release of contaminants from the Process Buildings and Complex Facilities sufficient to support a decision whether to remove, reuse, or take no action to address the Process Buildings and Complex Facilities in each Remedial Action project area. The streamlined risk evaluation shall utilize the data collected and assembled in accordance with Section 3.5 of this SOW. The streamlined risk evaluation shall consider exposure to contaminants that might occur if the facilities continue to degrade. Respondent shall consider the following receptors: on-Site (workers) and off-Site (plant neighbors and other members of the public near the Site), and, as appropriate, environmental receptors.	Section 5
6.0 Remedial Investigation Report (SOW Appendix E, outlines E-1 and E-2) Respondent shall submit for Ohio EPA review and concurrence or approval, as applicable, RI Reports for each Remedial Action project detailing the methods and results of the remedial investigations and the potential threats to human health, safety and the environment. The sample outlines for the RI Reports are provided in Appendix E of this SOW.	Sections 1 - 5

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
7.0 Developing and Screening of Remedial Alternatives (U.S. EPA RI/FS Guidance Chapter 4) (SOW Appendix G, Section 2.0 of outlines G-1 and G-2) Consistent with the applicable outline in Appendix G of this SOW, Respondent shall develop and screen remedial alternatives to arrive at an appropriate range of alternatives for detailed analysis for the Site-Wide Waste Disposition Evaluation project and the Process Buildings and Complex Facilities D&D Evaluation projects. The following activities are to be performed by Respondent as needed during the development and screening of remedial alternatives.	Section 6
7.1 Refine Remedial Action Objectives (U.S. EPA RI/FS Guidance Section 4.2.1) (SOW Appendix G, Section 2.2 of outlines G-1 and G-2) Consistent with the applicable outline in Appendix G of this SOW, Respondent shall further refine the RAOs identified during project scoping. The refined RAOs for each Remedial Action project shall be based on the results of the RI and, in the case of the Site-Wide Waste Disposition Evaluation project, any then Ohio EPA-approved WAC if an OSDC is evaluated as a possible remedial alternative. The RAOs also shall be consistent with Section 300.430 of the NCP. Respondent shall prepare and submit for review an Interim Technical Memorandum (ITM) identifying the refined RAOs for protection of human health and the environment and detailing the methods and procedures used to refine them. The refined RAOs shall be included in the Alternatives Array Document described below.	Section 6.3
7.2 Alternatives Array Document (U.S. EPA RI/FS Guidance Chapter 4) (SOW Appendix G, Section 2.3 of outlines G-1 and G-2) Consistent with the applicable outline in Appendix G of this SOW, Respondent shall prepare an Alternatives Array Document (AAD) for each Remedial Action project which documents the methods, rationale, and results of the alternatives development and the screening process. Respondent shall include an evaluation of whether the amount and type of data existing for each Remedial Action project at the Site will support the subsequent detailed analysis of the alternatives. Respondent shall assure identification of an appropriate range of viable alternatives for consideration in the detailed analysis. The final AAD shall be combined with the detailed analysis of alternatives to form the FS Report described in Section 8 and Appendix G of this SOW. The following sections summarize the requirements for conducting the alternatives screening process and provide the required contents of the AAD as it pertains to the Site-Wide Waste Disposition Evaluation project and the Process Buildings and Complex Facilities D&D Evaluation projects.	Sections 6 and 7.

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
I. Technologies Screening (Section 4.2.2 through 4.2.5.3 of the U.S. EPA RI/FS Guidance) A. Develop General Response Actions (U.S. EPA RI/FS Guidance 4.2.2) Respondent shall refine the general response actions initially identified during project scoping. General response actions shall be identified describing actions, singly or in combination, to satisfy the RAOs. B. Identify anticipated waste/contaminant streams for each Remedial Action project area at the Site and, for the Site-Wide Waste Disposition Evaluation Project only, establish preliminary criteria for waste/contaminant acceptance if an OSDC is anticipated to be evaluated as a possible remedial alternative under the Site-Wide Waste Disposition Evaluation Project. (U.S. EPA RI/FS Guidance 4.2.3). Respondent shall identify areas or volumes of waste/contaminants to which general response actions may apply, taking into account requirements for protectiveness as identified in the RAOs, Site conditions, and the nature and extent of contamination (Section 4.2.3 of the U.S. EPA RI/FS Guidance). C. Identify, Screen, and Document Remedial Technologies (U.S. EPA RI/FS Guidance 4.2.4) Respondent shall identify, screen and evaluate remedial technologies applicable to each general response action to eliminate those that cannot be technically implemented based on contaminant types and concentrations and/or Site characteristics. Decisions made during the remedial technology screening shall be documented for inclusion in the Alternatives Array Document. D. Evaluate and Document Process Options (U.S. EPA RI/FS Guidance 4.2.5) As appropriate, process options for each surviving technology type shall be identified and evaluated on the basis of effectiveness, implementability, and cost as those criteria are defined in Section 4.2.5 of the U.S. EPA RI/FS Guidance. Respondent shall select and retain, wherever appropriate and possible, one or more representative process options for each implementable technology type. The evaluation should focus on effectiveness factors at this stage with less effort directed at the implementability and cost factors. Identifying and screening process options shall be documented for inclusion in the Alternatives Array Document. Respondent shall consider the NCP's preference for treatment over conventional containment or land disposal approaches.	Section 6.4
II. Alternatives Array Document (U.S. EPA RI/FS Guidance 4.2.6) Respondent shall submit for review and comment an AAD for each Remedial Action project consisting of the following: A. Assemble and Document Alternatives Respondent shall assemble the selected representative technologies into remedial alternatives. Each alternative should comprehensively address the Site-specific PRGs, RAOs, and ARARs. Each alternative shall describe the locations of the Site affected; approximate volumes of any wastes/contaminants to be removed or treated; and any other information needed to adequately describe the alternative and document the logic behind each specific remedial alternative.	 Section 7.1

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
B. Conduct and Document the Screening Evaluation of Each Alternative Respondent may perform, or Ohio EPA may require, that the assembled alternatives undergo a screening process based on short and long term aspects of effectiveness, implementability, and relative cost as those criteria are defined in Section 4.3 of the U.S. EPA RI/FS Guidance. Screening of the alternatives is generally performed when there are many feasible alternatives available for detailed analysis. The screening may be conducted to assure that only those alternatives with the most favorable composite evaluation of all factors are retained for further analysis, while at the same time preserving an appropriate range of remedial options. Prior to conducting a screening of alternatives, Respondent shall further define the alternatives such that design considerations for technologies and the ability of the alternatives to satisfy the RAOs are described. The purpose shall be to ensure that a basis exists for evaluating and comparing the alternatives before proceeding with the alternative screening step (Section 4.3.1 of the U.S. EPA RI/FS Guidance). Respondent shall prepare a summary of the assembled remedial alternatives and their related ARARs, specifically including an analysis of how siting criteria contained in Ohio Administrative Code (OAC) Chapters 3745-27 and 3745-50 will be met and provide the reasoning employed in the alternative screening. The alternatives summary shall be submitted with the AAD.	NA
III. Post-screening Considerations At the conclusion of the alternative screening phase, or if no screening is needed, Respondent shall determine if the amount and type of data existing for the Remedial Action project area will support the detailed analysis of the surviving remedial alternatives (Section 4.3.3.3 of the U.S. EPA RI/FS Guidance). Specifically, Respondent shall consider whether any additional field investigation or treatability testing is necessary prior to proceeding with the detailed analysis of alternatives. If Respondent determines that additional data or treatability testing is needed, Respondent shall document the determination, the specific types of data needed; and the time frame for obtaining the data in the AAD. If Ohio EPA concurs with or approves, as applicable, Respondent's determinations, Respondent shall, in accordance with the Orders, submit for review and concurrence or approval, as applicable, an addendum to the RI/FS Work Plan and supporting documents and/or a treatability study work plan for obtaining the additional data. Should Ohio EPA determine, based on review of the AAD, that additional data is needed to perform the detailed analysis of alternatives, Ohio EPA shall notify Respondent of the need for additional data, and Respondent may either submit for review and concurrence or approval, as applicable, an addendum to the RI/FS Work Plan and supporting documents and/or a Treatability Study Work Plan to obtain the additional data or dispute the Ohio EPA determination pursuant to the provisions of the Orders.	NA

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
Respondent shall begin to develop and evaluate a range of remedial alternatives during RI/FS scoping (Section 1.0 and Appendix A of this SOW; Section 2.2.3 of the U.S. EPA RI/FS Guidance). Respondent shall continue to develop and evaluate the remedial alternatives initially developed during project scoping as RI data become available. With the exception of the "no action" alternative, all alternatives under consideration must, at a minimum, ensure protection of human health and the environment and comply with the applicable or relevant and appropriate requirements of state and federal laws and regulations or satisfy the requirements of 42 U.S.C. Section 9621 and 40 CFR Section 300.430 pertaining to waiver or non-attainment of ARARs. Consistent with Section VI (Performance of the Work By Respondent) of the Orders, if an OSDC is evaluated as a possible remedial alternative under the Site-Wide Waste Disposition Evaluation project, Respondent shall evaluate at least one alternative or sub-alternative that is fully ARARs compliant, with no ARARs waived.	Section 7.1
8.0 Treatability Studies (SOW Appendix F outlines F-1 and F-2)	NA
9.0 Feasibility Study Report (U.S. EPA RI/FS Guidance Section 5.5); (SOW Appendix G, outlines G-1 and G-2) Once Ohio EPA and Respondent have determined that sufficient data exist to proceed, Respondent shall conduct a detailed analysis of the alternatives surviving the screening process to provide the information needed for selection of a remedy for each Remedial Action project area. If an alternative providing for an OSDC is carried forward for detailed analysis, the FS Report shall include a draft WAC. The detailed analysis shall consist of an individual analysis of each alternative against the nine CERCLA evaluation criteria followed by a comparative analysis of the alternatives using the same evaluation criteria as the basis for comparison. Respondent shall prepare and submit an FS Report for each Remedial Action project for review and concurrence or approval, as applicable. The final AAD shall be incorporated into the FS (SOW Appendix G, Section 2.3 of outlines G-1 and G-2). In addition, Respondent will refer to Appendix G of this SOW for an outline of the FS Report format and required report content. The detailed analysis of remedial alternatives shall consist of the following elements:	Sections 6 - 8
I. Detailed Description of Each Alternative (U.S. EPA RI/FS Guidance Sections 6.2.1 to 6.2.4) The detailed narrative description of each alternative shall include at a minimum: A. Description of each technology component;	Section 7.3.2
B. Refinement of the volumes and/or areas of contaminated media to be addressed;	Section 4
C. Special engineering considerations required to implement the alternative, (e.g., pilot treatment facility or additional studies needed to proceed with final remedial design);	Section 7.3.2
D. Operation, maintenance and monitoring requirements;	Section 7.3.2.
E. Temporary storage requirements;	Section 7.3.2.

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
F. Health and safety requirements related to implementation and operation and maintenance of the alternative, including on- and off-Site worker and general public health and safety considerations;	Section 7.3.2.
G. An analysis of how the alternative could be phased into individual operations and a discussion of how these operations could best be implemented to produce significant environmental improvement;	Section 7.3.2.
H. A review of any off-Site treatment or disposal facilities and transportation needs to ensure compliance with the Resource Conservation and Recovery Act, TSCA, and state requirements; and	NA
I. An analysis of the projected performance and expected results of the alternative with emphasis on potential for further future release of hazardous substances.	Sections 8.2.1.1.3 and 8.2.2.1.3
II. National Environmental Policy Act (NEPA) Considerations Respondent shall incorporate NEPA considerations into the CERCLA process as appropriate during evaluation of the remedial action alternatives.	Sections 8.1 and 8.2
III. Apply the Nine CERCLA Evaluation Criteria and Document the Individual Alternative Analysis Respondent shall apply the nine evaluation criteria described below to each individual alternative. Respondent shall document the decision making process and the results of the individual analysis of alternatives.	Section 8.2
A. Overall Protection of Human Health, Safety and the Environment. Respondent shall assess the alternatives to determine if they can adequately protect human health, safety and the environment from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the project area by eliminating, reducing or controlling exposures to levels established during development of remediation goals. This is a threshold requirement and the primary objective of the remediation program.	Sections 8.2.1.1.1 & 8.2.2.1.1
B. Compliance with Applicable or Relevant and Appropriate Requirements. Respondent shall assess the alternatives to determine if they attain applicable or relevant and appropriate standards, criteria and requirements of federal, state, and local laws or satisfy the criteria for ARARs waiver(s) or non-attainment as set forth in 42 U.S.C. Section 9621 and 40 CFR Section 300.430. This is also a threshold requirement	Sections 8.2.1.1.2 & 8.2.2.1.2
C. Long-term Effectiveness and Permanence. Respondent shall assess the alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, if appropriate and/or applicable to an alternative, include the following: 1. Nature and magnitude of residual risk; potential for exposure of human and environmental receptors; concentrations of hazardous substances, pollutants or contaminants remaining after implementing the remedial alternative, considering the persistence, toxicity, mobility and propensity to bio-accumulate such hazardous substances and their constituents (see Risk Assessment Guidance for Superfund (RAGS), Part C);	Sections 8.2.1.1.3 & 8.2.2.1.3

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
2. The type, degree and adequacy of long-term management required for untreated substances and treatment residuals, including engineering controls (such as containment technologies), institutional controls, monitoring and operation and maintenance; 3. Long-term reliability of the engineering and institutional controls, including uncertainties associated with land disposal of untreated hazardous substances, pollutants, contaminants, and treatment residuals, and; 4. Potential need for replacement of the remedy, and the continuing need for repairs to maintain the performance of the remedy.	
D. Reduction of Toxicity, Mobility or Volume through Treatment Respondent shall assess the degree to which alternatives employ treatment that reduces toxicity, mobility or volume of contaminants. If Respondent determines that the NCP preference for such treatment is not appropriate and/or applicable to an alternative, Respondent shall provide an explanation for that determination. Where appropriate, Respondent shall identify alternatives which, at a minimum, address the principal threats posed by the Site through treatment. Factors that shall be considered, if appropriate and/or applicable to an alternative, include the following: 1. The treatment or recycling processes the alternatives employ and materials they will treat; 2. The amount of hazardous substances, pollutants or contaminants that will be destroyed, treated, or recycled; 3. The degree of expected reduction in toxicity, mobility, or volume of the waste/contaminants due to treatment or recycling and the specifications of which reduction(s) are occurring; 4. The degree to which the treatment is irreversible; 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility and propensity to bio-accumulate; 6. The degree to which treatment will reduce the inherent hazards posed by the principal threats at the Site; and 7. The degree to which the treatment processes employed will reduce the transfer of contaminants between environmental media.	Sections 8.2.1.1.4 & 8.2.2.1.4
E. Short-term Effectiveness Respondent shall assess the short-term impacts of the alternatives during the construction and implementation phase, and until the objectives of a Remedial Action have been met. Factors that shall be considered, if appropriate and/or applicable, include the following: 1. Short-term risks that may be posed to the community during construction and implementation of an alternative and until the RAOs have been met; 2. Potential impacts on workers during remedial action and until the objectives of remedial action have been met, the effectiveness and reliability of protective measures;	Sections 8.2.1.1.5 & 8.2.2.1.5

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)	RI/FS Report Section
3. Potential environmental impacts that may result from the remedial action and the effectiveness and reliability of mitigative measures during implementation and until the objectives of the remedial action have been met; and 4. Time until response action objectives are achieved	
F. Implementability Respondent shall assess the technical and administrative feasibility of implementing the alternatives. Factors that shall be considered, if appropriate and/or applicable, include the following: 1. Technical Feasibility: a) Degree of difficulty or uncertainty associated with construction and operation of the alternative; b) Expected operational reliability of the alternative; c) Ease of undertaking additional remedial action(s); and d) Ability to monitor the effectiveness of the remedy. 2. Administrative Feasibility: Activities needed to coordinate implementation of the remedy with state, local, and federal agencies 3. Feasibility of Obtaining Services and Materials: a) Capacity and location of adequate treatment, storage, and disposal services; b) Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources; c) Availability of services and materials; and d) Availability of prospective technologies.	Sections 8.2.1.1.6 & 8.2.2.1.6
G. Cost The types of costs that shall be assessed, if appropriate and/or applicable, include the following: 1. Direct and indirect capital costs, including contingency and fees; 2. Annual operation and maintenance costs; and 3. Net present value of capital and O&M costs.	Sections 8.2.1.1.7 & 8.2.2.1.7
H. Community Acceptance This criterion shall be addressed by Respondent throughout the conduct of each RI/FS and during the public comment period for each Proposed Plan and should include analysis of community input to identify which components of the alternatives local government and other interested persons in the community support, have reservations about, or oppose.	Section 8.1.1.9
I. State Acceptance Each FS Report should indicate that this criterion will be addressed in the Record of Decision following publication of the Proposed Plan and completion of the public comment period.	Section 8.1.1.8

Crosswalk between the Generic Statement of Work for Conducting Remedial Investigation(s) and Feasibility Study(ies) and the Process Buildings and Complex Facilities D&D Evaluation Project RI/FS Report (Continued)

Generic SOW for Conducting Remedial Investigation(s)and Feasibility Study(ies)		RI/FS Report Section
IV.	Compare Alternatives Against Each Other and Document the Comparison of Alternatives (U.S. EPA RI/FS Guidance Sections 6.2.5 and 6.2.6) At the conclusion of the individual analysis of alternatives, Respondent shall perform a comparative analysis between the alternatives. That is, each alternative will be compared against the others using the nine CERCLA evaluation criteria as a basis of comparison. Respondent shall document the decision making process and the results of the comparative analysis of alternatives for inclusion in the FS.	Section 8.3

AAD = Alternatives Array Document
ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = Code of Federal Regulations
D&D = decontamination and decommissioning
ITM = Interim Technical Memorandum
NA = not applicable
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
NEPA = National Environmental Policy Act of 1969
O&M = operation and maintenance
OAC = Ohio Administrative Code
Ohio EPA = Ohio Environmental Protection Agency
OSDC = on-site disposal cell
PER = Pre-investigation Evaluation Report
PRG = preliminary remediation goal
QAPP = Quality Assurance Project Plan
RI/FS = remedial investigation/feasibility study
RAO = remedial action objective
ROD = Record of Decision
SOW = statement of work
SP = sampling plan
TBD = to be determined
TSCA = Toxic Substances Control Act of 1976
U.S. EPA = U.S. Environmental Protection Agency
WAC = waste acceptance criteria

APPENDIX A: PROCESS BUILDINGS AND COMPLEX FACILITIES DESCRIPTIONS

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TABLES

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FIGURES

ACRONYMS

ACM	asbestos-containing material
ACP	American Centrifuge Plant
ACR	Area Control Room
ASM	always-safe mass
AST	aboveground storage tank
BJC	Bechtel Jacobs Company LLC
CAAS	Criticality Accident Alarm System
CCZ	Contamination Control Zone
CIP	Cascade Improvement Program
D&D	decontamination and decommissioning
DFF&O	*April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
DOE	U.S. Department of Energy
EBS	evacuation booster station
EE/CA	Engineering Evaluation/Cost Analysis
EOC	Emergency Operations Center
ERP	Extended Range Product
FS	Feasibility Study
GCEP	Gas Centrifuge Enrichment Plant
GDP	gaseous diffusion plant
HASA	high-assay sampling area
HDPE	high-density polyethylene
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HPFWS	High Pressure Fire Water Distribution System
HVAC	heating, ventilation, and air conditioning
IRM	Interim Remedial Measure
LAW	Low-Assay Withdrawal
LEU	low-enriched uranium
LLW	low-level (radioactive) waste
LMES	Lockheed Martin Energy Systems, Inc.
NCS	nuclear criticality safety
NDA	nondestructive assay
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
PA	Public Address
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCF	Plant Control Facility
PORTS	Portsmouth Gaseous Diffusion Plant
PPE	personal protective equipment
PVC	polyvinyl chloride
PW	product withdrawal
RCRA	Resource Conservation and Recovery Act of 1976 (as amended)
RCW	recirculating cooling water

RHW	recirculating heating water
RI	Remedial Investigation
RMA	radioactive material area
RU	reprocessed uranium
SCADA	Supervisory Control and Data Acquisition
SNM	special nuclear material
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene
TLD	thermoluminescent dosimeter
TMPC	Theta Pro2Serve Management Company, LLC
UEA	uranium enrichment area
USAEC	U.S. Atomic Energy Commission
USEC	United States Enrichment Corporation
UST	underground storage tank
VOC	volatile organic compound

A.1 INTRODUCTION

The 254 buildings and structures at the Portsmouth Gaseous Diffusion Plant (PORTS) included in the Process Buildings and Complex Facilities Decontamination and Decommissioning (D&D) Evaluation Project Remedial Investigation (RI)/Feasibility Study (FS) have been categorized into four general functional groupings:

- Process Buildings and Tie Lines
- Feed, Sampling, and Transfer Facilities
- Primary Laboratory, Maintenance, and Equipment Cleaning Facilities
- Support Facilities and Systems.

The groupings were established on the basis of functionality to allow for more concise facility descriptions.

The Primary Laboratory, Maintenance, and Equipment Cleaning Facilities and the Support Facilities and Systems groupings are further subdivided on the basis of functionality to allow more concise facility descriptions. Subgroupings for the Primary Laboratory, Maintenance, and Equipment Cleaning Facilities include the X-700 Maintenance Complex, the X-705 Decontamination Complex, the X-710 Laboratory Complex, and the X-720 Maintenance Complex. Subgroupings for the Support Facilities and Systems include: Administrative Facilities; Water Treatment, Storage, and Distribution Facilities; Sewage Collection and Treatment Facilities; Electrical Distribution Systems and Facilities; Miscellaneous Utilities; Infrastructure; Storage and Warehouse Facilities and Yards; Environmental Monitoring and Treatment Facilities; and Associated Nonstructural Support Systems. The four major facility groupings and subgroupings are shown in Table A.1.

The following sections provide a detailed description of the buildings, structures, and systems included in each grouping, including known (or potential) radiological and chemical hazards and known releases of contaminants.

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS

Facility Number	Facility Name
	PROCESS BUILDINGS AND TIE LINES
X-232C1	Tie Line X-342 to X-330
X-232C2	Tie Line X-330 to X-326
X-232C3	Tie Line X-330 to X-333
X-232C4	Tie Line X-326 to X-770
X-232C5	Tie Line X-343 to X-333
X-326	Process Building & Instrumentation Tunnel
X-330	Process Building & Instrumentation Tunnel
X-333	Process Building & Instrumentation Tunnel
	FEED, SAMPLING, AND TRANSFER FACILITIES
X-342A	Feed Vaporization Building
X-342B	Fluorine Storage Building
X-342C	Waste HF Neutralization Pit (below-grade structures)
X-344A	UF_6 Sampling Facility
X-344C	Hydrogen Fluoride Storage Building (foundations and piers)
X-344D	HF Neutralization Pit (Below Grade)
X-344E	Gas Ventilation Stack (Below Grade)
X-344F	Safety Building (below-grade structures)

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
PRIMARY LABORATORY, MAINTENANCE, AND EQUIPMENT CLEANING FACILITIES	
X-700 Maintenance Complex	
X-700	Converter Shop & Cleaning Building
X-700A	Air Conditioning Equipment Building
X-700B	Sandblast Facility and Observation Booth
X-721	Radiation Instrument Calibration
E	X-700 “0000” Compressor Base Foundation
X-705 Decontamination Complex	
X-705	Decontamination Building
X-705D	Heat Booster Pump Building
X-705E	Oxide Conversion Area
X-710 Laboratory Complex	
X-710	Technical Service Building
X-710A	Technical Service Gas Manifold Shed
X-710B	Explosion Test Facility
X-720 Maintenance Complex	
X-720	Maintenance & Stores Building
X-720A	Maintenance & Stores Gas Manifold Shed (below-grade structures)
X-720B	Radio Base Station
X-720C	Paint & Storage Building
SUPPORT FACILITIES AND SYSTEMS	
Administrative Facilities	
X-100	Office Building (slab and below-grade structures)
X-104A	Indoor Firing Range Building
X-104B	Protective Forces Office Trailer
X-104C	Protective Forces Shower/Locker Trailer
X-105	Electronic Maintenance Building (front apron/concrete pad and driveway)
X-106B	Old Fire Training Building (slab and below-grade water tank)
X-108A	South Portal and Shelter-Drive Gate
X-108B	North Portal and Shelter
X-108E	Construction Entrance Portal
X-108J	West Security Portal
X-108K	North Security Portal
X-108L	East Security Portal
X-111A	SNM Monitoring Portal
X-111B	SNM Monitoring Portal
X-300	Plant Control Facility
X-300A	Process Monitoring Building
X-300B	Plant Control Facility Carport
X-300C	Emergency Communications Antenna
X-344H	Security Portal
X-530 T1	Office Trailer
X-533H	Personnel Monitoring Station
X-533 T1	Trailer
X-533 T2	Trailer
X-533 T3	Trailer
X-533 T4	Trailer
X-540	Telephone Building
X-600D	Utilities Maintenance Field Office
X-633 T1	Trailer
X-633 T2	Trailer
X-633 T3	Trailer
X-720T01	Office Trailer

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
	SUPPORT FACILITIES AND SYSTEMS
	Administrative Facilities
X-744Y T1	Trailer
X-744Y T2	Trailer
X-744Y T3	Trailer
X-744Y T4	Trailer
X-744Y T5	Trailer
X-744Y T6	Trailer
X-744Y T8	Trailer
X-744Y T9	Trailer
X-750	Mobile Equipment Maintenance Shop (slab and below-grade structures)
X-751	GCEP Mobile Equipment Garage
X-760 T1	Trailer
X-760 T2	Trailer
X-1000	Administration Building
X-1000 T1	Training Trailer
X-1007	Fire Station
XT-800	GCEP Construction Office Pad
X-1107BV	Interplant Vehicle Portal
J	X-1000 Pavilion
	Water Treatment, Storage, and Distribution Facilities
X-230	Water Supply Line
X-230A	Sanitary and Fire Water Distribution System
X-230D	Softened Water Distribution System
X-230E	Plant Water System (make-up)
X-230F	Raw Water Supply Line
X-230G	RCW System
X-230H	Fire Water Distribution System
X-240A	RCW System (Cathodic Protection System)
X-605	Sanitary Water Control House
X-605A	Well Field
X-608	Raw Water Pump House
X-608A	Well Field
X-608B	Well Field
X-611	Water Treatment Plant (slab and below-grade structures)
X-611A	Old Lime Sludge Lagoon (structures)
X-611B	Lagoon (structures)
X-611B1	Lagoon Supernatant Pumping Station
X-611B2	Lagoon Supernatant Pumping Station
X-611B3	Lagoon Supernatant Pumping Station
X-611C	Filter Building (slab and below-grade structures)
X-611E	Clear Well & Chlorine Building (slab and below-grade structures)
X-612	Elevated Storage Tank (below-grade structures)
X-626-1	Recirculating Water Pump House (slab and below-grade structures)
X-626-2	Cooling Tower (below-grade structures)
X-630-1	Recirculating Water Pump House (slab and below-grade structures)
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-630-3	Acid Handling Station (saddles and basin)
X-640-1	Fire Water Pump House (slab and below-grade structures)
X-640-2	Elevated Storage Tank (below-grade structures)
X-640-2A	Elevated Water Tank Auxiliary Building
X-680	Blowdown Sample and Treatment Building

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
	SUPPORT FACILITIES AND SYSTEMS
	Water Treatment, Storage, and Distribution Facilities
X-701A	Lime House (below-grade structures)
X-701D	Water Deionization Facility (below-grade structures)
X-701E	Neutralization Building
X-701F	Effluent Monitoring Facility
X-701 T1	Trailer
X-2230T1	Recirculating Heating Water System (East of Valve Pits “A” and “B”)
	Sewage Collection and Treatment Facilities
X-230B	Sanitary Sewers
X-230C	Storm Sewers
X-614A	Sewage Pumping Station (slab and below-grade structures)
X-614B	Sewage Pumping Station (slab and below-grade structures)
X-614D	South Sewage Lift Station
X-614P	North East Sewage Lift Station
X-614Q	Sewage Booster Pump Station
X-615	Old Sewage Treatment Plant (foundations and piers)
X-616	Liquid Effluent Control Facility (foundations and piers)
X-6619	Sewage Treatment Plant
	Electrical Distribution Systems and Facilities
X-215A	Electrical Distribution to Process Buildings
X-215B	Electrical Distribution to Other Areas
X-215C	Exterior Lighting
X-215D	Electrical Power Tunnels
X-501	Substation
X-501A	Substation
X-502	Substation
X-515	330 kV Tie Line Between X-530 and X-533
X-530A	High Voltage Switchyard (grounding system and underground cables)
X-530B	Switch House (slab and below-grade structures)
X-530C	Test and Repair Building (below-grade structures)
X-530D	Oil House (slab and below-grade structures)
X-530E	Valve House (slab and below-grade structures)
X-530F	Valve House (slab and below-grade structures)
X-530G	GCEP Oil Pumping Station
X-640-1A	Substation (required for Fire Services)
C	Old Switchyard West of X-109A Pad (near X-740)
	Miscellaneous Utilities
X-232A	Nitrogen Distribution System
X-232B	Dry Air Distribution System
X-232D	Steam and Condensate System
X-232E	Freon Distribution System
X-232F	Fluorine Distribution System
X-232G	Support for Distribution Lines
X-670	Dry Air Plant
X-670A	Cooling Tower
X-675	Plant Nitrogen Station
X-2232E	Gas Pipeline
	Infrastructure
X-114A	Outdoor Firing Range
X-202	Roads
X-204-1	Railroad and Railroad Overpass (excluding DUF_6 utilized track)
X-206A	North Main Parking Lot

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
	SUPPORT FACILITIES AND SYSTEMS
	Infrastructure
X-206B	South Main Parking Lot
X-206E	Construction Parking Lot
X-206H	Pike Avenue Parking Lot
X-206J	South Office Parking Lot
X-208	Security Fence
X-208A	Boundary Fence
X-208B	SNM Security Fence
X-210	Sidewalks
X-220A	Instrumentation Tunnels
X-600	Steam Plant (slab and below-grade structures)
X-600A	Coal Yard (structures)
X-690	Steam Plant
X-748	Truck Scale
B	Pad in Field East of X-109A (near X-740)
H	Old Firing Range Shed
I	Peter Kiewit Powder Magazine
	Storage and Warehouse Facilities and Yards
X-345	SNM Storage Building
X-741	Oil Drum Storage Facility
X-742	Gas Cylinder Storage Facility
X-744K	Warehouse-K
X-744N	Warehouse N Non-UEA
X-744P	Warehouse P Non-UEA
X-744Q	Warehouse Q Non-UEA
X-744V	Surplus and Salvage Clean Storage Area
X-744Y	Waste Storage Area
X-745B	Toll Enrichment Gas Yard
X-745D	Cylinder Storage Yard
X-745F	North Process Gas Stockpile Yard
X-745G-2	Cylinder Storage Yard
X-746	Material Receiving and Inspection (portions of above- and below-grade structures)
X-747	Clean Scrap Yard
X-747A	Material Storage Yard (below-grade structures)
X-747B	Material Storage Yard Pads and Equipment
X-747C	Material Storage Yard Pads and Equipment
X-747D	Material Storage Yard Pads and Equipment
X-747E	Material Storage Yard Pad
X-747G	Precious Metal Scrap Yard (below-grade structures)
X-747H	NW Contaminated Scrap Yard (below-grade structures)
X-747H1	Loading Pad
X-747J	Decontamination Storage Yard
XT-847	Warehouse
	Environmental Monitoring and Treatment Facilities
X-120	Old Weather Station (footers)
X-120H	Weather Station
X-230A3	Ambient Air Monitoring Station
X-230A6	Ambient Air Monitoring Station
X-230A8	Ambient Air Monitoring Station
X-230A9	Ambient Air Monitoring Station
X-230A10	Ambient Air Monitoring Station
X-230A12	Ambient Air Monitoring Station

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
	SUPPORT FACILITIES AND SYSTEMS
	Environmental Monitoring and Treatment Facilities
X-230A15	Ambient Air Monitoring Station
X-230A23	Ambient Air Monitoring Station
X-230A24	Ambient Air Monitoring Station
X-230A28	Ambient Air Monitoring Station
X-230A29	Ambient Air Monitoring Station
X-230A36	Ambient Air Monitoring Station
X-230A37	Ambient Air Monitoring Station
X-230A40	Ambient Air Monitoring Station
X-230A41	Ambient Air Monitoring Station
X-230J-1	Monitoring Station
X-230J1	East Environmental Sampling Building (slab)
X-230J2	South Environmental Sample Station
X-230J3	West Environmental Sampling Building for Intermittent Containment Basin
X-230J4	Environmental Air Sampling Station
X-230J5	West Holding Pond Oil Separation Station
X-230J6	Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
X-230J7	East Monitor Facility (East Holding Pond Oil Separation Building)
X-230J8	Environmental Storage Building (slab)
X-230M	Clean Test Site
X-235	South Groundwater Collection System
X-237	Little Beaver Groundwater Collection System
X-617	South Holding Pond pH Control Facility
X-622	South Groundwater Treatment Facility
X-623	North Groundwater Treatment Building
X-624	Little Beaver Groundwater Treatment Facility
X-625	Groundwater Passive Treatment Facility
X-627	Groundwater Pump & Treatment Facility
	Associated Nonstructural Support Systems
X-220B1	Process Instrument Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines
X-220C	Superior American Alarm System
X-220D1	General Telephone System
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCulloh Alarm System
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System

Table A.1. Groupings for Facilities Included within the Scope of the Process Buildings and Complex Facilities D&D Evaluation Project at PORTS (Continued)

Facility Number	Facility Name
	SUPPORT FACILITIES AND SYSTEMS
	Associated Nonstructural Support Systems
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System

GCEP = Gas Centrifuge Enrichment Plant
MSR = maintenance service request
PA = public address
RCW = recirculating cooling water
SCADA = Supervisory Control and Data Acquisition
SNM = special nuclear material
UEA = uranium enrichment area

A.2 PROCESS BUILDINGS AND TIE LINES

PORTS was constructed for national defense purposes in the mid-1950s to produce highly enriched uranium (HEU) using the gaseous diffusion process. The plant consists of three main process buildings known as the X-333, X-330, and X-326 Process Buildings, and various supporting and auxiliary operations. An aerial photograph of the plant showing the three primary process buildings and the three buildings that comprise the X-340 feed, sampling, and transfer complex is shown in Figure A.1. The plant was shut down in 2001 because of the declining demand for enriched uranium. Since that time, chemical treatments to remove uranium deposits in the shutdown equipment have been performed.

Figure A.1. Portsmouth Gaseous Diffusion Plant

A.2.1 FACILITY DESCRIPTIONS

A.2.1.1 Gaseous Diffusion Process

Natural uranium, as mined, contains approximately 99.3 percent of the nonfissionable uranium-238 isotope and approximately 0.7 percent of the fissionable uranium-235 isotope. Approximately 90 percent uranium-235 enrichment is required for United States defense operations. Nuclear power plants require up to 4.95 percent uranium-235 enrichment. Because the only difference in these two isotopes is a very small difference in molecular weight, separation of the isotopes uses a physical separation process. Gaseous diffusion is a physical separation process using uranium hexafluoride (UF_6), the only compound of uranium that exists as a gas at reasonable temperatures and pressures. Gaseous diffusion is similar to a distillation process in that the lighter component (uranium-235) moves “up” through the process equipment and is removed near the top, and the heavier component (uranium-238) moves “down” and is removed near the bottom.

A.2.1.2 Gaseous Diffusion Separation Equipment

The basic separation equipment for gaseous diffusion is a “stage.” At PORTS, a stage consists of the following:

1) A “diffuser” or “converter” that contains porous separation media with millions of tiny holes and the support structure to hold the separation media

2) A gas cooler

3) Compressors driven by an electric motor to move UF_6 gas through the diffuser

4) Interconnecting piping and control valves to contain and control the gas flows.

The separation media are in the form of tubes. UF_6 is a corrosive gas and internal surfaces of process equipment are primarily copper, nickel, nickel-plated steel, or aluminum to resist corrosion. A schematic of a stage, including converter, compressor, and interconnecting piping, is shown in Figure A.2.

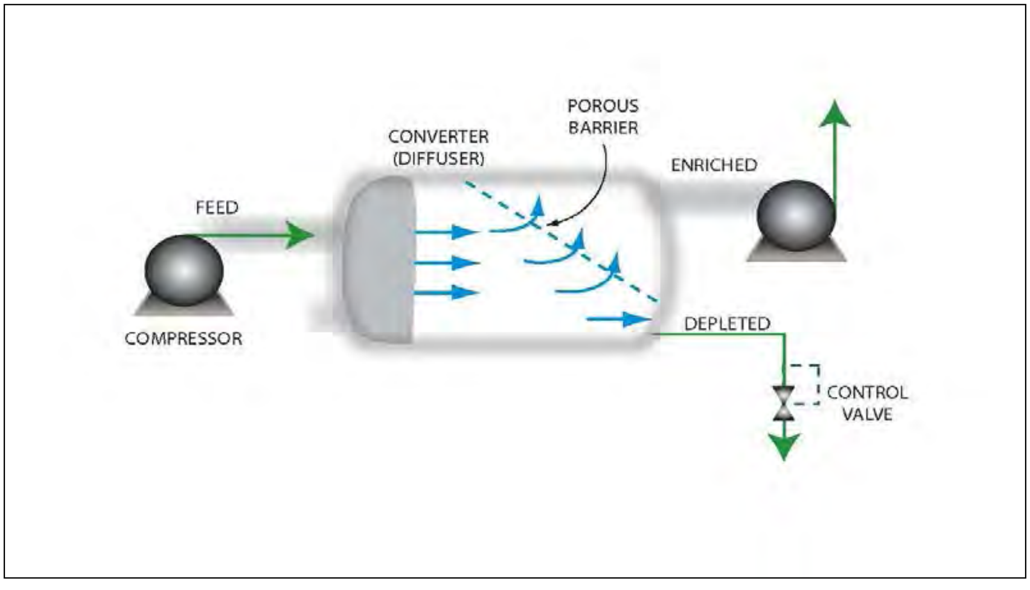


Figure A.2. Gaseous Diffusion Stage

At PORTS, the X-326 Process Building is unique because the gas coolers are external to the process converters, while the gas coolers are an integral part of the converters in the X-333 Process Building and the X-330 Process Building.

The compressors pump the gas into the diffuser, and approximately one-half of the gas passes through the tiny holes in the separation media. The other half passes out of the diffuser without passing through the holes. Material that passes through the holes is very slightly enriched in uranium-235 (very slightly enriched because the differences in molecular weight between uranium-235 and uranium-238 are very small). Because one stage is capable of only very slight enrichment, thousands of stages must be connected in series to produce HEU. The X-326 Process Building contains 2,340 stages, the X-330 Process Building contains 1,100 stages, and the X-333 Process Building contains 640 stages of gaseous diffusion equipment. Although the sizes of the three process buildings can appear overwhelming, the process is actually quite simple. Once the operation of one stage is understood, the entire complex can be understood as one stage repeated thousands of times.

The process equipment is located on the upper or "cell floor" in each of the process buildings, and the auxiliary and support equipment, including area control rooms (ACRs), is located on the bottom or "operating floor." Process equipment on the cell floor is accessible by overhead bridge cranes that run on rails above the equipment. A cross section of the X-333 Process Building is shown on Figure A.3.

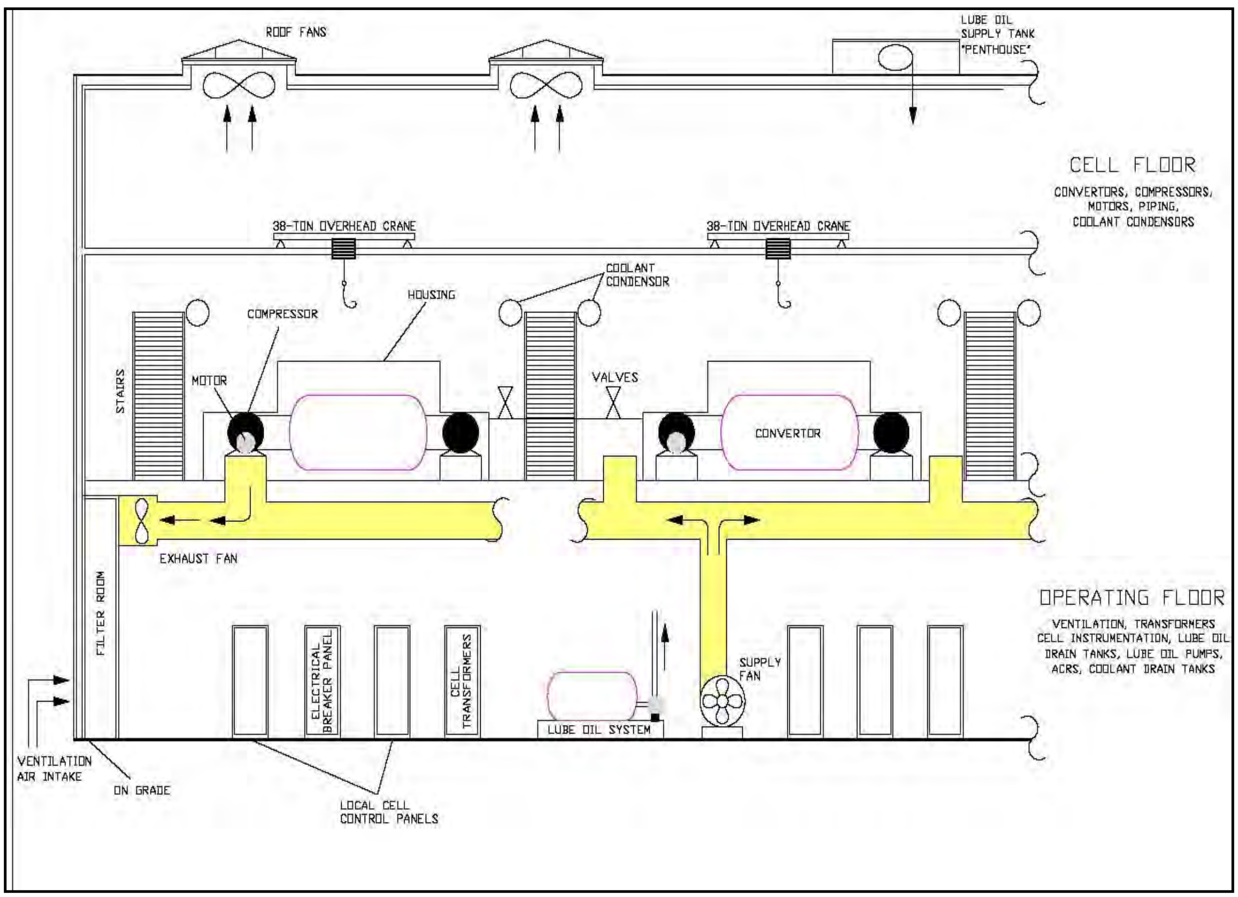


Figure A.3. Cross Section of the X-333 Process Building

Stages are grouped into “cells,” which are the smallest groups of stages that can be removed from service, bypassed, and shut down for maintenance or other purposes. If maintenance work involves breaching the process piping, the cells are “purged” of UF_6 and replaced with nitrogen or dry air before maintenance. There are 12 stages per cell in most of the cells in the X-326 Process Building, 10 stages per cell in the X-330 Process Building, and eight stages per cell in the X-333 Process Building. A schematic of a cell in the X-333 Process Building is shown on Figure A.4. There are 200 cells in the X-326 Process Building, 110 cells in the X-330 Process Building, and 80 cells in the X-333 Process Building. Ten of the cells at the south end of the X-326 Process Building comprise the “purge cascade.” Each of these 10 cells contains six stages. The purge cascades removed light gases that entered the process gas system. Similar to understanding the stage concept, once the cell is understood, the complex can be understood as hundreds of essentially identical cells. The entire series-connected process is commonly referred to as the “cascade” (Figure A.5).

On the operating floor, under each cell, are a local control center panel, valve panels, and various electrical breaker panels that contain the necessary instrumentation and controls to operate the cell. Cells are started, stopped, isolated from the cascade, and placed on stream from the local control center.

Each process building contains one or more ACRs. The X-333 Process Building has one ACR, the X-330 Process Building has two ACRs, and the X-326 Process Building has three ACRs. Each ACR is equipped with electrical and instrument panels that may contain mercury switches, rooms that are air conditioned and constructed with block walls, and potentially asbestos-containing floor tiles and suspended ceilings.

There are five sizes of process equipment at PORTS, referred to as the X-25 size, X-27 size, ‘0,’ ‘00,’ and ‘000,’ with ‘000’ being the largest and the X-25 size the smallest. The normal cascade flows included introducing the feed material into the largest size equipment in the X-333 Process Building. As the enrichment increased in the X-330 Process Building and X-326 Process Building, the equipment sizes were reduced. The X-326 Process Building contains 1,620 stages of X-25-size equipment and 720 stages of X-27-size equipment; the X-330 Process Building contains 600 stages of ‘0’ equipment and 500 stages of ‘00’ equipment; and the X-333 Process Building contains 640 stages of ‘000’ equipment. The largest size equipment is at the point where the natural uranium or “feed” material was introduced into the process, and the equipment sizes are reduced as the flow of enriched uranium moves up toward the top of the plant. The largest electric motor that drives a ‘000’ compressor in the X-333 Process Building is rated at 3,300 horsepower (hp), and the smallest electric motor that drives a 25-size compressor in the top of the X-326 Process Building is rated at 15 hp.

Cells are further grouped into “units,” which are groups of cells that share common auxiliary systems. The 200 cells in the X-326 Process Building are grouped into 10 units, the 110 cells in the X-330 Process Building are grouped into 11 units, and the 80 cells in the X-333 Process Building are grouped into 8 units. A schematic of an X-333 Process Building unit of 10 cells is shown on Figure A.6. The cell floor layout of the X-333 Process Building, with the 8 units of 10 cells in each unit, is shown on Figure A.7.

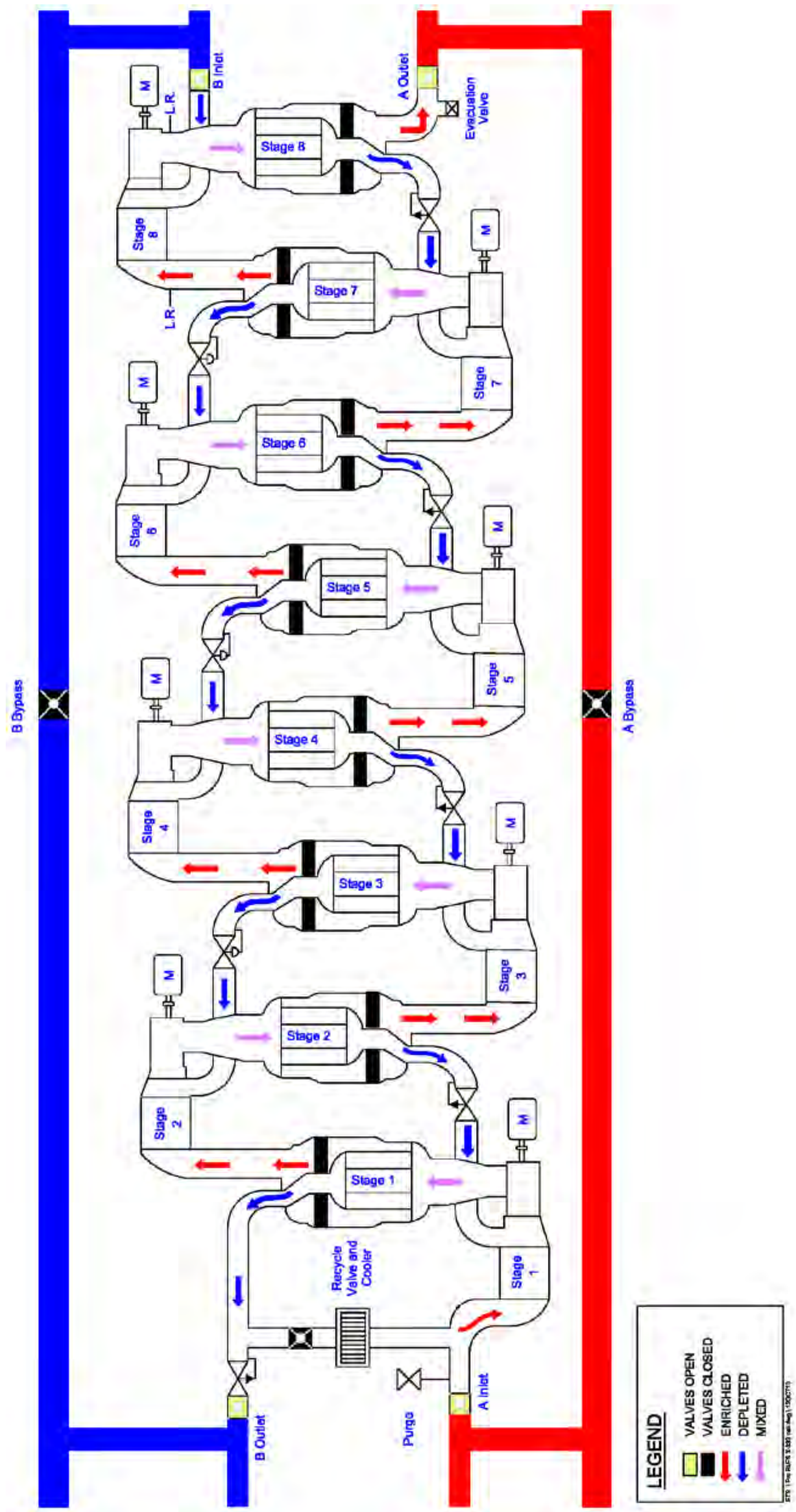


Figure A.4. Schematic of a Cell in the X-333 Process Building

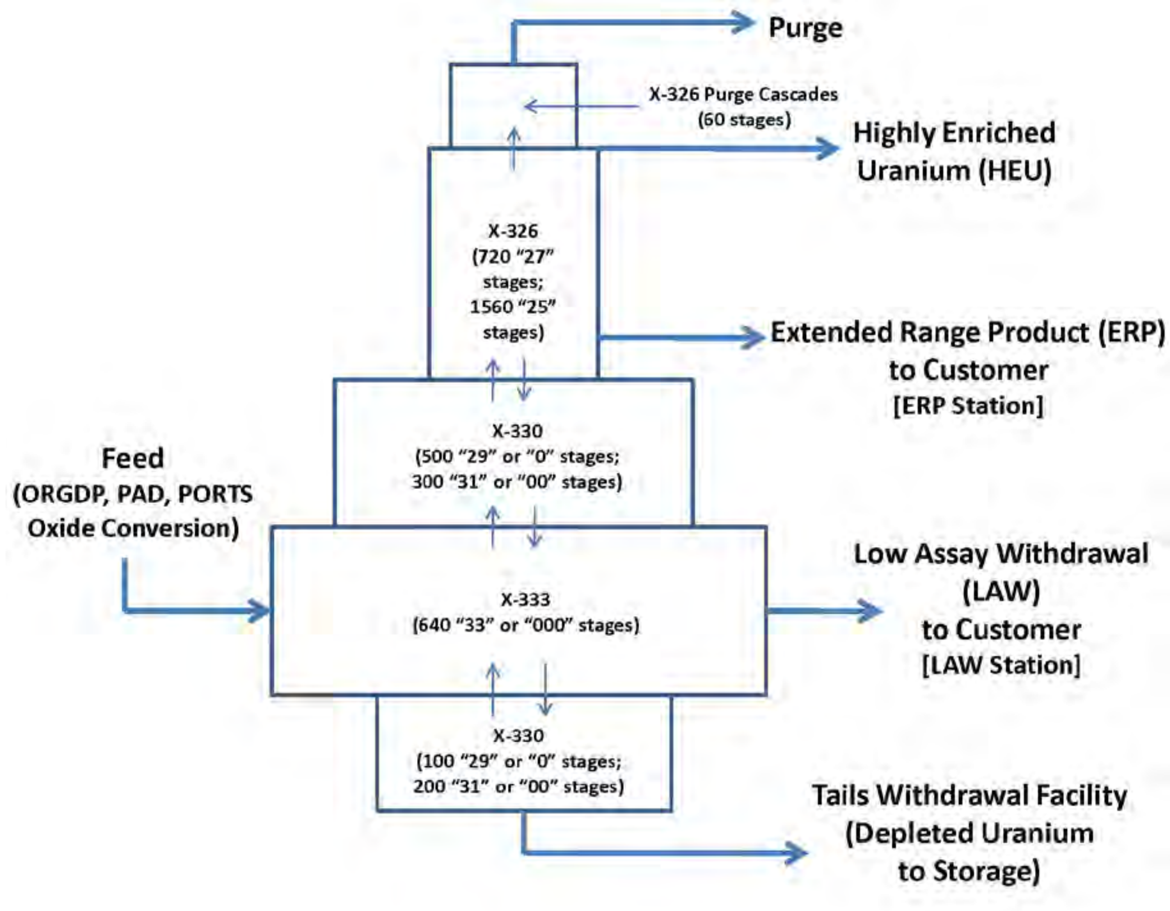


Figure A.5. PORTS Gaseous Diffusion Cascade

Each compressor at PORTS was equipped with seals designed to prevent in-leakage of atmospheric air. The gaseous diffusion process operated at pressures up to slightly above atmosphere. The process was designed to be "air tight" from atmospheric air because UF_6 reacts with moisture to form solid uranyl fluoride and gaseous hydrogen fluoride (HF). The formation of solid uranyl fluoride would have resulted in plugging of the porous media and loss of production. If the leak were large or long-lasting, the uranyl fluoride could have accumulated, which would have resulted in solid uranium deposits within process piping. This would have caused both production and nuclear criticality safety (NCS) concerns.

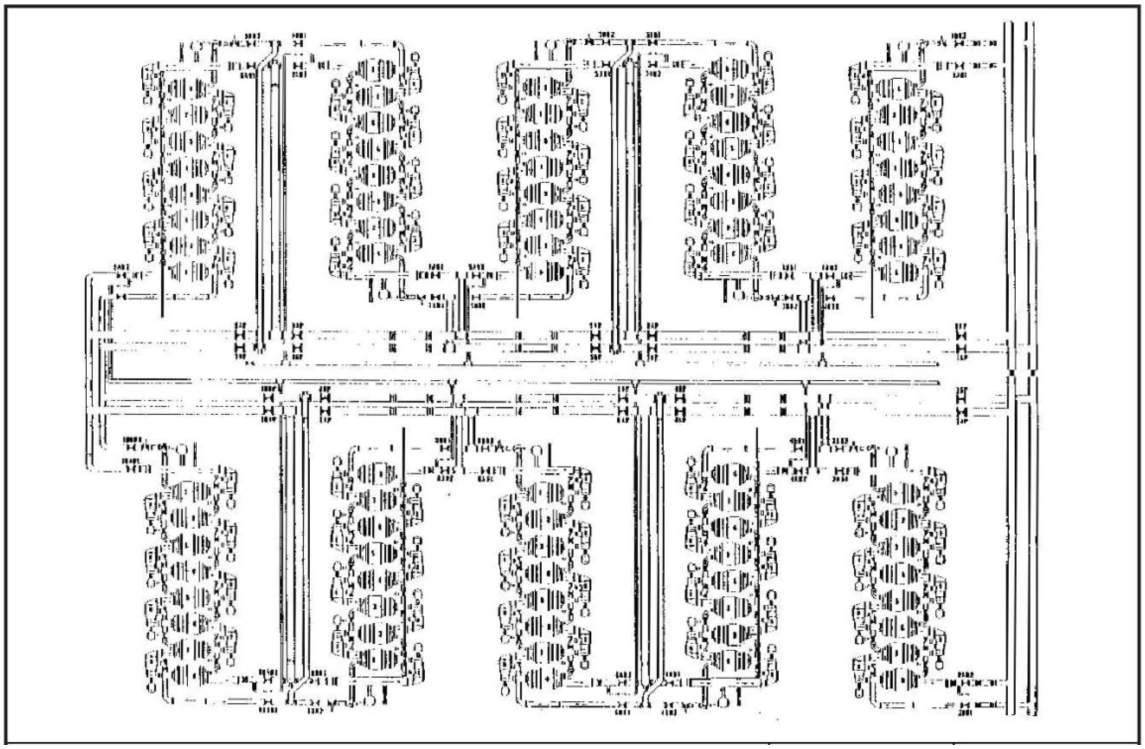


Figure A.6. Schematic of an X-333 Process Building Unit of 10 Cells

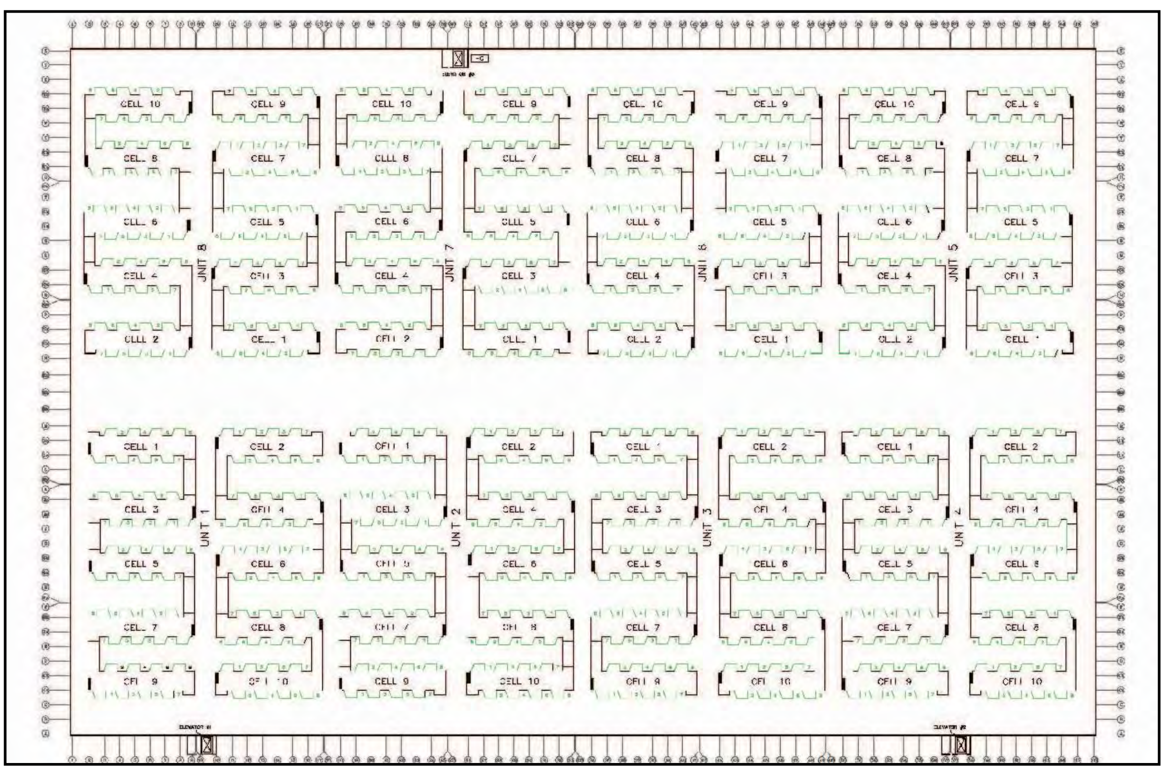


Figure A.7. Cell Floor Layout of the X-333 Process Building

During shutdown, gaseous UF_6 was removed from the process equipment and replaced with nitrogen or dry air, but some uranyl fluoride deposits remained inside the equipment. After shutdown of the X-326 Process Building and the remainder of the cascade, extensive chemical treatments were used to remove these deposits to uranium-235 levels below always-safe mass (ASM). If the chemical treatment program is continued until all deposits are below ASM, no significant uranium-235 deposits should be encountered in the treated equipment during D&D. Some few significant deposits inaccessible to treatment may have to be physically removed during D&D. Significant quantities of uranium-238 deposits may also exist in process equipment that has been treated to below ASM in the lower enrichment areas of the plant. There are no deposits above ASM in the X-333 Process Building, but several hundred pounds of uranium compound deposits may exist in some equipment, according to nondestructive assay (NDA) measurements.

Figure A.8 shows a cell in the X-326 Process Building, and Figures A.9 through A.11 show various pieces of X-326 process equipment.

Figure A.8. X-326 Cell

Figure A.9. X-326 Centrifugal Compressor

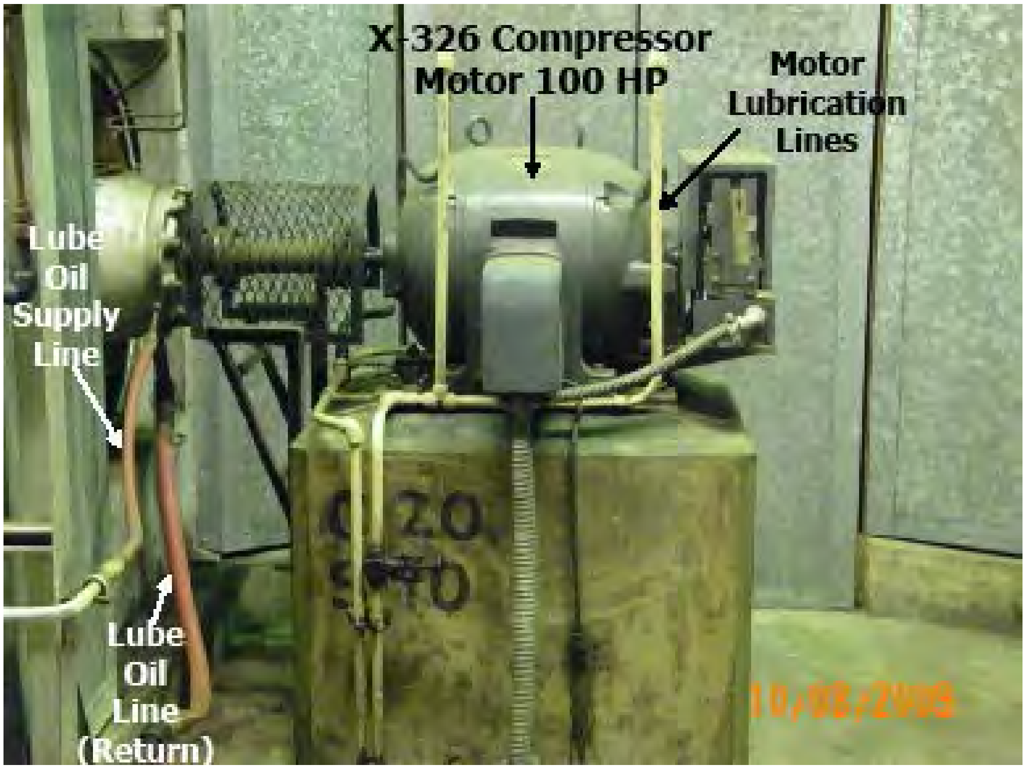


Figure A.10. X-326 Motor

Figure A.11. X-326 Process Equipment

Figure A.12 shows typical X-330 Process Building "00" stage equipment during original construction with its cell housing and piping not yet installed. Figure A.13 shows a X-333 "000" cell arrangement during original construction with its housing and piping not yet installed.

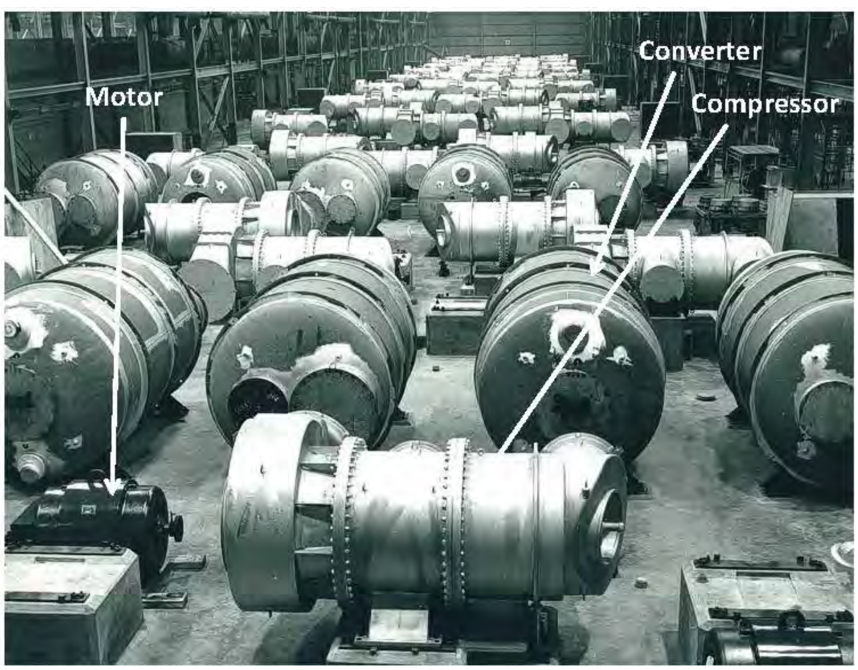


Figure A.12. Typical X-330 "00" Stage Equipment

Figure A.13. X-333 "000" Cell Arrangement

A.2.1.3 Evacuation Booster Stations, Process Gas Movers, and Surge Drums

The evacuation booster stations (EBSs) and surge drums were used for process gas inventory management when inventory was required to be removed from a portion of the cascade and returned at a later time or when cell treatment reaction products were required to be stored and processed. The X-326, X-330, and X-333 Process Buildings each have an EBS.

There is a Process Gas Mover station in the X-333 Process Building. This station was used sparingly, to not at all, over the operating life of the plant. This station allowed process gas to be moved from one point to another within the operating cascade.

Booster stations are located in the X-333 and X-330 Process Buildings to boost UF_6 process pressures from one building to the other.

A.2.1.4 Cold Traps

Cold traps were designed and installed to handle excess UF_6 inventory and to process UF_6 and light gases and/or intermediate molecular weight gases to remove the gases and return the UF_6 to the process. Each cold trap operation consisted of vacuum pumps, a refrigeration system, and groups of cold traps, chemical traps, and storage drums. Refrigeration equipment was provided to obtain temperatures cold enough to desublime or "freeze out" low concentrations of UF_6 in a gas stream. The light gases passed out of the cold traps, through chemical traps, and were vented to the atmosphere. The solidified UF_6 was then heated and returned to the process. There is one cold trap room in the X-333 Process Building, and two are in the X-330 Process Building. No cold traps are present in the X-326 Process Building. One cold trap room in the X-330 Process Building is known as the "interim purge" operation, but it is a cold trap operation similar to the others. NDA measurements of these interim purge cold traps have shown only modest holdup uranium. The cold traps in X-333 have not been measured for holdup uranium.

The cold traps were used extensively over the operating life of PORTS. They were also used extensively with the EBS stations and surge drums in the cell treatment programs that have followed shutdown. Uranium compounds may be contained or dissolved in the oil and may require stabilization prior to disposal.

A.2.1.5 Product Withdrawals

Although it was necessary to package the product in the solid phase in cylinders before it could be shipped, UF_6 was processed throughout the gaseous diffusion process in the gas phase. This was accomplished by desublimation and compression liquefaction.

A.2.1.5.1 High-assay product

The highly enriched and very highly enriched UF_6 withdrawn for military purposes was taken from near the top of the X-326 Process Building, just below the top purge cascade.

NDA measurements in the product withdrawal (PW) area were performed in 2005 on various chemical traps and piping. Significant uranium holdup has not been identified following subsequent remediation and NDA verification.

A.2.1.5.2 Low-enriched uranium product

Low-enriched uranium (LEU) product was withdrawn for use in nuclear power reactors for electric power generation. This product was limited to a maximum of 5 percent uranium-235 and was withdrawn by the compression liquefaction process into 30-in.-diameter or 48-in.-diameter cylinders.

The Extended Range Product (ERP) station is located in the northeast corner of the X-326 Process Building and was designed for withdrawal of various enrichments. Because of the shift of plant mission toward LEU, the ERP station has been primarily used for LEU withdrawal. The ERP station is capable of withdrawing two separate product streams of different enrichments simultaneously. An overhead bridge crane is located outside of the X-326 Process Building as part of the ERP station and was used to move cylinders to cooling areas and load them for transport.

The ERP station compressors were measured by NDA in 2005 and 2006, and no significant amount of holdup uranium was found. However, this equipment must be remeasured after final shutdown.

The Low-Assay Withdrawal (LAW) station is located in the west end of the X-333 Process Building, and it is similar to the ERP station. The LAW uses the compression-liquefaction process, and the product is packaged directly into cylinders located on scales. The LAW station is capable of withdrawing two separate product streams of different enrichments simultaneously. An overhead bridge crane is located outside of the X-333 Process Building and was used to move cylinders to cooling areas and load them for transport.

The compressors at the LAW station were measured for holdup uranium in 2005, and only small amounts were found.

A.2.1.6 Waste or Tails Withdrawal

The waste or tails stream was withdrawn from the bottom cell in the gaseous diffusion cascade and was packaged into 48-in. storage cylinders. The PORTS tails withdrawal station is located in the northeast corner of the X-330 Process Building and used the compression-liquefaction process. The tails material was removed from the bottom stage of the bottom cell, compressed to pressures above the liquefaction pressure, and condensed directly to a liquid that flowed by gravity to cylinders located on scales. The tails withdrawal station is served by two outside overhead bridge cranes that were used to move cylinders to cooling areas and load them for transport.

NDA measurements of the tails withdrawal station compressors, coolers, and valves found only modest amounts of uranium holdup at 0.3 - 0.4 percent assay, which is below the NCS area of concern.

A.2.1.7 Tie Lines

During operation of the gaseous diffusion cascade, UF_6 was transferred between buildings by using tie lines. The tie lines are composed of multiple UF_6 distribution piping ranging from 2 to 42 in. in diameter. The piping is enclosed in thermally insulated housings. Steam and steam condensate piping is also located inside the housings, as well as steam heaters.

X-232C1 Tie Line X-342 to X-330 connects the X-340 Complex with the X-330 Process Building. Process feed lines and cylinder evacuation lines are contained inside the insulated metal housing.

X-232C2 Tie Line X-330 to X-326 connects a diffusion process unit in the X-330 Process Building with a diffusion process unit in the X-326 Process Building.

X-232C3 Tie Line X-330 to X-333 connects the X-333 Process Building and the X-330 Process Building and contains two sets of process lines.

X-232C4 Tie Line X-326 to X-770 connected process piping from the diffusion cascade to the X-770 Cascade Test Facility (not part of the RI/FS). Although the housing carried process piping from the X-326 Process Building, the flow of UF_6 did not originate in the X-326 Process Building but rather in the low enrichment assay “tails” area. These lines have been mostly removed.

X-232C5 Tie Line X-343 to X-333 connects the X-343 Feed Vaporization and Sampling Building (not part of this RI/FS) to the X-333 Process Building and contains process gas feed lines. The X-343 Feed Vaporization and Sampling Building was constructed after the reactor returns feed program had ended in the 1980s, so the process feed lines would be expected to exhibit internal uranium contamination but not transuranic isotopic contamination.

A.2.1.8 Auxiliary Process Equipment

The auxiliary process equipment is not directly associated with enriching uranium, but it comprises support systems that have been exposed to process gas.

A.2.1.8.1 Line recorders and space recorders

Line recorders were mass spectrometers designed to provide online, real-time analysis of contaminants in the process gas stream. There is one line recorder per unit, and they are located in each ACR. Each cell was connected to the line recorder through copper tubing from a high-pressure area of the cell through a line recorder manifold. Manual valves in the line recorder manifold could be manipulated to connect any cell in the unit to the line recorder. The process gas stream was then returned through copper tubing to a low-pressure area in the same cell from which it came. The line recorder lines and manifold contained UF_6 during normal operations. No quantitative NDA data have been reported for these lines.

Space recorders were ionization-type detectors designed to measure very small (parts per million) quantities of radionuclides in light gases. They were used to monitor vent streams from the purge cascades and cold traps. Lines to these instruments also contained low levels of UF_6 during normal operations. Similar to the situation with the line recorder systems, no quantitative NDA measurements have been reported for the space recorder lines.

A.2.1.8.2 Seal exhaust systems

The unit seal exhaust headers are connected together and are connected to the building seal exhaust station or stations. The X-333 Process Building has a single, centrally located seal exhaust station consisting of chemical traps and vacuum pumps that exhaust to the atmosphere. The X-330 Process Building has two such seal exhaust stations, and the X-326 Process Building has three seal exhaust stations. A schematic of the X-333 seal exhaust system is shown on Figure A.14.

Seal exhaust piping is made of steel, will likely contain significant contamination, and may contain deposits of uranium-bearing materials. Vacuum pump oil has migrated into the headers and exacerbated the contamination and deposit problems. The piping, chemical traps, pumps, and valves of both the X-326 and X-330 seal exhaust systems have been measured for holdup uranium. Only modest amounts of uranium have been identified in a few of these components as a result of qualitative and quantitative NDA measurements. The seal exhaust system at X-333 has not been measured for holdup uranium. It is likely that seal exhaust piping and equipment will have to be handled as process piping for waste disposal purposes.

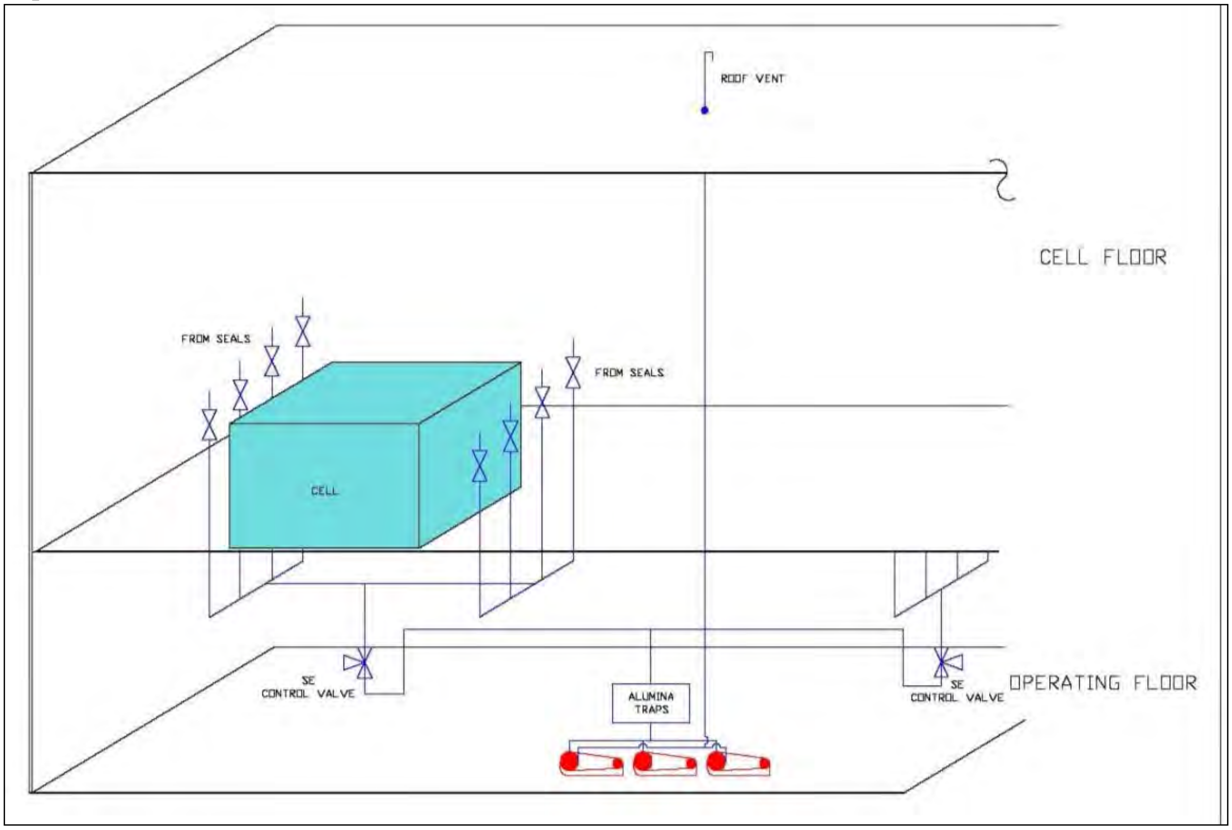


Figure A.14. Schematic of the X-333 Process Building Seal Exhaust System

A.2.1.8.3 Process monitoring and control instrumentation

Process monitoring and control instrumentation can be divided into two groups: (1) instruments that were exposed to UF_6 and (2) instruments that were only exposed to dry instrument air or nitrogen.

Waste disposal for process monitoring and control instrumentation directly exposed to UF_6 inside heated enclosures should be the same as for UF_6 process piping, while waste disposal for process monitoring and control instrumentation located outside of heated enclosures or panels can assume little or no internal uranium contamination. Because of the small line sizes, there have been no quantitative measurements of uranium holdup in process monitoring and control instrumentation systems.

Some process instrumentation may contain mercury switches.

A.2.1.9 Nonprocess Systems

Nonprocess systems are support systems that have not had contact with the process gas.

A.2.1.9.1 Nitrogen distribution system

Nitrogen was initially manufactured at the on-Site nitrogen plant located in the X-330 Process Building, and it was supplied to the process buildings at a pressure of 50 psig. At the process buildings, this pressure was reduced to 5 psig for actual use. The on-Site nitrogen plant was later shut down in favor of purchasing nitrogen. Nitrogen was purchased in the liquid phase in large tanker trucks and unloaded into the liquid nitrogen storage operation in the south end of the X-330 Process Building. From this storage operation, nitrogen continues to be distributed via steel piping to users throughout the plant.

A compressor sealing system was designed to ensure no leakage of moist air into the process system during normal operations. The compressor contained UF_6, and the seal was designed to prevent contact between atmospheric air and the UF_6. A dry nitrogen “seal feed to process” differential pressure was set and automatically maintained if process pressures changed, and dry nitrogen flowed at a measured rate into the process system. This sealing system used a “controlled leak” into the process stream, rather than a “tight seal,” to ensure moist air did not enter the process gas stream.

There were occasions when pressure excursions allowed the process pressures to exceed the purge header pressures and where the seal feed control systems failed to keep up with process pressure fluctuations, which resulted in backflow of process gas into the nitrogen systems. These events were infrequent and internal contamination is not likely to be encountered in the nitrogen headers nor in the seal feed system. The exception to this is at the junction where the seal feed line is attached to the compressor back plate.

A.2.1.9.2 Dry air distribution system

A dry air plant was located in each process building. Each system consisted of equipment to compress, dry, and distribute air to the use points. Dry air was used for instruments, ventilation control, nitrogen system backup, compressor seal air, and for purging, buffering, maintenance services, and general utilities. Diesel-powered air compressors, located in the X-326 and X-330 Process Buildings, serve as backups in case the normal power supply to the compressors is not available and to augment air system capacity as needed.

The X-326 and X-330 dry air plants are currently operational. The X-333 dry air plant physically still exists but is not operational.

The dry air systems are constructed of steel piping and are unlikely to contain contamination.

A.2.1.9.3 Steam distribution system

Steam was distributed throughout the process buildings to provide supplemental heat in various areas. Steam line insulation should be suspected of being asbestos-containing material (ACM) unless proved otherwise.

A.2.1.9.4 Coolant system

Waste heat of compression from the PORTS compressors was removed using a dual cooling system. Because water reacts with UF_6 to form solid compounds and it is also a nuclear moderator, a coolant that was nonreactive with UF_6 was chosen as the primary coolant.

There are two coolant systems per cell in the X-333 Process Building, and one system per cell in the X-330 and X-326 Process Buildings. Booster compressors and EBS stations also have their own coolant systems. Each process building has coolant storage and transfer operations that consist of drain tanks and pumps, a unit and cell coolant supply, and return headers. The X-333 Process Building has one coolant storage and transfer operation, and the X-330 and X-326 Process Buildings have two each.

Coolant system piping and the RCW piping are made of carbon steel. The RCW was initially treated with a chromate-based corrosion inhibitor and flowed through the coolant condensers located outside the cell housings and above the cells. The heated RCW then flowed to cooling towers located outside the buildings, was cooled, and pumped back to the coolant condensers. The chromate-based corrosion inhibitor was replaced with a more environmentally friendly phosphate-based system in the 1990s.

Although minor amounts of uranium could have been introduced into the coolant systems during maintenance work that lowered the pressure within the coolant system, significant contamination in this system is unlikely. Likewise, significant contamination of the cooling water system does not appear to be credible.

A.2.1.9.5 Lube oil system

A lubrication system was provided to serve the process compressors and motors. One or two drain drums on the operating floor provided oil to two oil-circulating pumps connected in parallel. One pump was in operation and one was maintained in automatic standby. Oil from the pump flowed through a filter and water-cooled lube oil cooler to a supply header above the cell floor, and then to one or two supply tanks located in a penthouse on the roof. From the supply header, the oil flowed by gravity to individual cell headers, through the compressor or motor bearings to a return header, and back to the drain drum or drums on the operating floor. The roof-mounted supply tank served as an emergency lube oil supply in the event of a lube oil system failure. If the lube oil system failed, the emergency supply allowed an orderly shutdown of the equipment without bearing damage.

The lube oil was hydrocarbon oil, and the piping consists of steel with some flexible rubber hoses. Oil leaks from compressor bearings were common, and attempts were made to catch the oil and recycle it back into the system. Over years of operation, as seals were changed and the compressor frames became somewhat contaminated with uranium, low but measurable levels of uranium contamination were introduced into the lube oil systems. This was particularly true in areas such as the EBS where oil leaks were more common than in the cell-related process equipment. Polychlorinated biphenyl (PCB) contamination also has been found in lube oil systems, but the lube oil was changed out in the 1990s to reduce PCB levels to below levels of concern.

A.2.1.9.6 Ventilation system

Ventilation systems were used to ensure UF_6 systems were maintained at temperatures to prevent freeze out and to ensure occupied areas of the process buildings were cool enough for habitation.

The ventilation systems for the X-333 and X-330 Process Buildings, and the X-27 portion of the X-326 Process Building, were similar. Air entered the process buildings through filter rooms located on the outer building walls. The air was picked up by large, centrifugal supply fans on the operating floor, discharged into supply ducts, and exhausted through vents on the cell floor. From the cell floor, the air passed through the motors and hollow concrete pads on which the motors sat, entered the exhaust ducts that run under the cell floor, and passed through exhaust fans to the atmosphere. Heated air on the cell floor also passed out of the roof through ventilators in all three buildings, and also through roof fans in the X-330 and X-333 Process Buildings.

Heated air that passed through the motors and hollow motor bases picked up oil vapors that condensed inside the exhaust ducts. The oil then passed through PCB-impregnated gaskets located in the ducting and dripped onto the operating floor, taking with it significant concentrations of PCBs. Oil collection systems fabricated from polyvinyl chloride (PVC) piping were designed and installed on the joints of the exhaust ducts to stop the PCB-laden oil drips to the operating floor. The exhaust ducts are contaminated with oil, uranium, and PCBs.

The X-25 portion of the X-326 Process Building has a similar air supply system, but the process motors sit on a solid concrete base. There are no exhaust ducts from the motors. The heated air on the cell floor was recycled back to the operating floor through grating. Heated air could also exit roof vents in the X-25 portion of the building. Because the X-25 area does not have motor exhaust ducts, the PCB-laden oil drip problem was not present in this area.

A.2.1.9.7 Power systems inside the process buildings

Power was supplied from the switchyards to the process buildings through cables in underground tunnels. The X-333 and X-330 Process Buildings have supplemental cables that were installed in overhead trays during the cascade upgrading program in the 1970s and 1980s.

The X-333 Process Building has two large transformers that served each cell (for a total of 160). Power from the switch house was stepped down to process motor voltage in the cell transformers and supplied via motor cables to the process motors driving the compressors. Half of the transformers are “dry type” and are cooled using a fan and ducting system that pulls air through the transformer windings. The other transformers are oil-cooled and contained PCB fluids that removed heat from the windings and dissipated the heat into the air through radiators on the outside of the oil tanks.

The X-333 Process Building also contains 32 auxiliary dry-type transformers that supplied power to the nonprocess systems. Since building shutdown, the X-533 Switchyard has been deactivated, and power to the X-333 Process Building is now supplied from the X-530A High Voltage Switchyard.

In each unit of the X-333, X-330, and-X-326 Process Buildings, there is a battery room containing lead-acid batteries that provide direct current power to emergency lighting, valve and breaker controls, and indicator lights.

Each cell in nine of the 11 units in the X-330 Process Building is served by one cell transformer. There are two cells per cell transformer in the top two units of the X-330 Process Building for a total of 100.

There are 44 auxiliary transformers with four in each unit. Approximately 30 of the cell transformers are oil filled, and the rest are dry type.

Each cell in the X-27 portion of the X-326 Process Building is served by one cell transformer. Most of the X-25 portion of the same building has one transformer for each two cells. In the top, lightly loaded section of X-25, one transformer serves as many as four cells.

The transformers contain large amounts of copper, as do the cables connecting the transformers with the switch houses and the cables connecting the transformers with the motors.

Contamination levels in the transformers and switchgears should be quite low.

A.2.1.10 Process Buildings

The cascade systems are housed in the X-330, X-333, and X-326 Process Buildings. These buildings were constructed to house the equipment necessary for uranium enrichment.

Built in 1955, the X-333 Process Building was constructed for the initial phase of uranium enrichment, LAW, and production and distribution of plant dry air, waste storage, and cold recovery (which is the recovery of UF_6 from purge gases).

The X-333 Process Building is a 1,456-ft × 970-ft × 82-ft, two-story building with concrete floors, a steel frame, transite-covered exterior walls, and a metal/tar/gravel roof. The two stories have a combined floor space of approximately 65 acres. The cell floor is potentially contaminated.

Also constructed in 1955, the X-330 Process Building was used for the intermediate phase of uranium enrichment, tails withdrawal, and waste storage. The 2,176-ft × 640-ft × 66-ft building is a two-story structure with concrete slab floors, steel columns, steel-framed transite walls, and a steel/gravel roof. The two stories have a combined floor space of approximately 55 acres, and the entire second floor is potentially contaminated. Less than 10 percent of the operating floor is similarly contaminated. The volume of excess equipment and material stored in the building is 157,000 cf, with 90 percent considered potentially contaminated. Less than 20,000 sq ft of the total floor space is NCS spacing-controlled storage.

Constructed in 1956, the X-326 Process Building was used for the high-enrichment phase. The 2,230-ft × 552-ft × 62-ft building is a two-story structure with transite walls and concrete floors. The two stories have a combined floor space of approximately 58 acres. Of the total floor space, the entire cell floor and half of the operating floor are potentially contaminated. The volume of excess equipment and material stored in the building is 136,000 cf, of which 98 percent is considered to be potentially contaminated. The high-assay sampling area (HASA), which consists of the top PW room, a containerizing glovebox operation, and the product purification tower, covers about 1 percent of the floor area and is potentially highly contaminated with high-assay uranium.

Process buildings have asbestos cement (transite) siding, and electrical and instrument cable trays.

The X-333 Process Building has 400,000 sq ft of siding, the X-330 Process Building has 370,000 sq ft of siding, and the X-326 Process Building has 350,000 sq ft of siding. The 390 cell housings also have 3,000,000 sq ft of transite siding. The total volume of transite siding is estimated to be 200,000 cf, and another 2,000 cf of ACM is estimated to exist as piping insulation.

Truck alleys and railroad spurs extend along the west sides of the X-326 and X-330 Process Buildings and along the east and west sides of the X-333 Process Building. These are used for the delivery and removal of process equipment. The cell floor extends over the truck alley and has hatches under each crane bay. Heavy process equipment and motors were lifted to the cell floor for installation or storage of spares.

Basements below the ACRs in the process buildings provide access to instrument cable tunnels that lead to the X-300 Plant Control Facility (PCF) and to the electrical switch houses.

A.2.2 KNOWN OR POTENTIAL RADIOLOGICAL HAZARDS

- **X-333 Process Building**
  The approximate radioactive material holdup in X-333 process equipment includes 52,000 kg of uranium, 450 kg of uranium-235, and 1.0 kg of technetium-99. There are no known locations containing a greater than ASM of fissile material deposit. Of the 65 acres on two floor levels, the entire cell floor is potentially contaminated. The personal protective equipment (PPE) items required for egress from cell floor walkdowns are coveralls and gloves. Shoe covers are required on steel stairs, walkways, and cell housings above the cell floor. Approximately 25 percent of the operating floor is similarly potentially contaminated. The volume of excess equipment and material stored in the building is 186,000 cf, 97 percent of which is considered to be potentially contaminated. A small area, about 4,000 sq ft, is used to store excess equipment and/or containerized material requiring NCS spacing controls.

- **X-330 Process Building**
  The approximate radioactive material holdup in the X-330 process equipment includes 93,400 kg of uranium, 833 kg of uranium-235, and 1.1 kg of technetium-99. There is currently a single large component in one cell that contains a greater than ASM of fissile material deposit. This deposit is the result of an equipment fire and will require physical removal of the deposit. Of the 55 acres on two floor levels, the entire second floor is potentially contaminated. PPE for egress to the cell floor (and above the cell floor) is the same as that for X-333. Less than 10 percent of the operating floor is similarly contaminated. The volume of excess equipment and material stored in the building is 157,000 cf, 90 percent of which is considered to be potentially contaminated. Less than 20,000 sq ft of the total floor space is NCS spacing controlled storage.

- **X-326 Process Building**
  The approximate radioactive material holdup in the X-326 process equipment includes 5,100 kg of uranium, 746 kg of uranium-235, and 3.4 kg of technetium-99. In the X-326 Process Building, all components that contained solid deposits that exceed the greater than ASM value have been treated to reduce deposit size below ASM. Any X-326 deposits not sufficiently reduced will be removed during D&D. In addition to the process equipment deposits, there are significant amounts of staged radiological waste. Of the total floor space, 58 acres on two levels, the entire cell floor and half of the operating floor are potentially contaminated to a level that requires coveralls, shoe covers, and double gloves (PPE). The volume of excess equipment and material stored in the building is 136,000 cf, 98 percent of which is considered potentially contaminated. A HASA, the top PW room, a containerizing glove box operation, and the product purification tower are about 1 percent of the floor area and are potentially contaminated with high-assay uranium (Theta Pro2Serve Management Company, LLC [TPMC] 2006a).

  All X-326 components were measured following HEU suspension. The 200 cells were treated during HEU suspension, measured using NDA neutron methodology, and were declared less than ASM following HEU suspension. Later, a correction added an uncertainty factor to the measurements that resulted in approximately 400 components being declared greater than ASM. The chemical treatment program was restarted to reduce these components to less than ASM, including NDA uncertainty.

- **Tie Lines**
  Internal uranium contamination is expected in the process gas lines, and residual transuranic isotope contamination may be present in these lines except for those in X-232C5. Surface contamination would also be expected inside the tie line housing but outside the process piping.

- **Uranium Deposits**
  The three primary PORTS gaseous diffusion process buildings, X-333, X-330, and X-326, contained solid deposits of uranium compounds at the time of plant shutdown in 2001. These solid deposits formed during operations primarily as a result of chemical reactions between UF_6 and moist ambient air that leaked into the process and between the corrosive UF_6 gas and metallic surfaces within the process equipment. At shutdown, many of these deposits were of NCS concern because they were above the ASM for enriched uranium. An ASM of enriched uranium is an amount that is slightly less than one-half of a minimum critical mass. Minimum critical mass is that amount of enriched uranium that cannot achieve a criticality under any circumstances. Depending on the uranium-235 enrichment of the material, ASM can range from a low of approximately 350 g of uranium for HEU to several hundred pounds for LEU. An extensive program of NDA measurements to determine the locations and sizes of deposits has been conducted in the period since shutdown and is continuing at the present time. The NDA measurements consist of initial scans of process equipment to determine if deposits exist. They are followed by more detailed measurements and analyses to determine the size and uranium-235 enrichment of the deposits. Improvements in NDA techniques and measurements have been made since 2001, and remeasurements have been made along with improvements. Deposits that were found to be in excess of ASM were chemically treated until subsequent NDA measurements confirmed the deposits had been reduced to below ASM, including NDA uncertainty. Currently, no deposits above ASM are in X-333, one above ASM is in X-330 (caused by an equipment fire that will require physical removal), and no deposits above ASM are in X-326 (CRC Technologies, Inc. 2011a). Chemical treatments to reduce deposits are completed.

  Surface uranium contamination exists in all three process buildings. Contamination resulted from maintenance activities and infrequent process gas leaks to the atmosphere. Both fixed and removable contamination can be found on the operating and cell floors. Clean walkways have been established on the lower or operating floors of all three buildings, and they can be used for access to ACRs, change houses, maintenance areas, lunch rooms, and other clean areas. Contamination areas are posted as such, and exits are well-marked and supplied with exit monitoring equipment. PPE and contamination control procedures are required to reduce the spread of contamination outside of marked and controlled areas.

- **Technetium-99 Compounds**
  During PORTS operations, technetium-99 compounds were introduced into the process as a result of feeding reprocessed uranium (RU) from reactors. This material came to PORTS through UF_6 feed produced at Oak Ridge and Paducah and through the scrap returns program. Technetium-99 is a fission product produced in nuclear reactors and tends to follow uranium through the reprocessing steps. UF_6 produced from RU was introduced into PORTS beginning in fiscal year 1955 (Bechtel Jacobs Company LLC [BJC] 2000) and continued through 1976. In addition, some technetium-99 has been added recently to the operating portion of the PORTS cascade by feeding the

UF_6 heels (in cylinders) that have been processed in technetium-99 trapping operations to reduce technetium-99 levels. Technetium compounds are lighter than UF_6 and tended to adsorb onto the interior surfaces of process equipment and slowly move up through the process buildings until withdrawn in product or discharged through chemical traps to the atmosphere. Technetium compounds were not identified in the cascade until 1974. Much of the technetium introduced into PORTS was removed during the Cascade Improvement Program (CIP) in the late 1970s and early 1980s when existing converters, compressors, and other process equipment in X-333, and most of the process equipment in X-330, were replaced with reworked process equipment that had been fully decontaminated. Cell treatments following the shutdown of PORTS included hot air treatments for technetium-99 removal in X-326.

A report outlining technetium characterization of the PORTS gaseous diffusion cascade was published in February 2006 (TPMC 2006b). According to the Executive Summary of this report, approximately 64 kg of technetium-99 were introduced into the PORTS cascade, and approximately 30 kg were removed through enriched product, equipment change outs, and vent traps. The report further estimates that of the 35 kg that remained at PORTS, some unknown portion that is likely considerably less than the 35 kg is deposited in a nonvolatile form in the shut-down cascade. Based on historical data and the observed movement of technetium-99 in the PORTS cascade, the report further states that three areas are suspected to have the largest technetium-99 concentrations: the shut-down top few isotopic cells in X-326, the top purge cells in X-326, and the top cells in the shut-down 0-size equipment in X-29-6 in the X-330 Process Building.

The published characterization data on technetium-99 in the PORTS cascade are based on knowledge of technetium introduction, removal, and movement in the cascade, and are not based on actual sampling data. In order to provide an accurate, sample-based characterization, an intrusive sampling survey of the PORTS cascade is underway (CRC Technologies, Inc. 2011b). Forty-four intrusive samples are planned, and they involve the removal of coupons from piping, process equipment, and barrier material for technetium-99 analysis. Completion of this program should provide definitive characterization data defining the locations and quantities of technetium-99 in the PORTS cascade.

Surface technetium-99 contamination is primarily located in the southern portion of the upper floor of the X-326 Process Building in the vicinity of the purge cascades. PPE and contamination control procedures are required to prevent the spread of contamination.

- **Neptunium and Plutonium Contamination in the Process Buildings**
  RU that was converted into UF_6 feed material at Oak Ridge and Paducah and shipped to PORTS also contained traces of the transuranic elements neptunium and plutonium (BJC 2000). Small fractions of the transuranic elements contained in feed cylinders were vaporized with the feed and introduced into the PORTS cascade.

  Approximately 33 percent of neptunium in feed cylinders was vaporized and introduced into the cascade with the remaining 67 percent remaining in the cylinders. Neptunium that was introduced into the cascade was estimated to have plated out on metallic internal equipment and piping surfaces within the area bounded by six cells above the feed point and four cells below the feed point. The feed point was primarily located in X-333. This equipment was included in the equipment that was removed, decontaminated, reworked, and reinstalled during the CIP. The neptunium removed in the decontamination process was recovered in the X-705 Uranium Recovery system and is discussed in more detail in Section A.5 (Support Facilities and Systems) of this report.

Trace quantities of neptunium may remain on internal surfaces of feed lines used for RU feed or cascade piping near the RU feed point.

Approximately 90 percent of the plutonium in feed cylinders remained in the cylinders in nonvolatile heels, and only 10 percent was vaporized and introduced into the cascade. Plutonium that was introduced into the cascade plated out very near the RU feed point, and all but a trace was removed during the CIP.

Trace quantities of plutonium may remain on the internal surfaces of feed lines used for RU feed or on cascade piping near the RU feed point. Measureable transuranic isotopic surface contamination above the minimum detectable level is unlikely throughout the process buildings.

A.2.3 KNOWN OR POTENTIAL CHEMICAL HAZARDS

- **PCBs**
  Process electrical transformers and capacitor banks in the X-330 and X-333 Process Buildings contained PCB oils. These oils have been removed, but residual contamination from these oils may be encountered during equipment removal. PCB-impregnated felt gaskets are in the ventilation ducts of all three process buildings. In the X-330 and X-333 Process Buildings and the 27-size equipment section of the X-326 Process Building, leaking lube oil from process motors entered these ducts, passed through the felt gaskets, and dripped onto the building operating floors. As the oils passed through the felt gaskets, PCBs were dissolved in the oils, contaminating the floor beneath the ventilation ducts with PCBs.

  In an effort to keep the PCB-laden oils from contaminating the floors, PVC piping “troughs” were fabricated and installed along with a collection system that collected the PCB oils in polybottles to facilitate disposal. The volume of gasket material, gutters, collection pipe, and associated clean up material is estimated to be 800 cf.

  Approximately 7,000 fluorescent light fixtures that have ballast transformers containing PCBs are installed in the X-333 Process Building. Similar quantities of light fixtures can be found in the X-330 and X-326 Process Buildings.

- **Lube Oil**
  Lube oils historically contained low levels of PCBs. In the X-333 Process Building, lube oil has been drained from the process equipment. The unit lube oil systems have been shut down and the lube oil has been drained and removed from the building. In the X-330 Process Building, lube oil has been drained from the process equipment. The unit lube oil systems remain operable in Units 29-2 and 29-5. With the exception of these units, the lube oil has been drained from all lube oil systems and removed from the building. The remaining lube oil in Units 29-2 and 29-5 will be removed from the building prior to the initiation of D&D. In the X-326 Process Building, lube oil has been drained from the unit lube oil systems except for Units 27-1, 27-2, and 25-7 (Purge Cascade). The remaining lube oil in these units will be removed from the building prior to initiation of D&D. Even when the lube oil has been removed from the process buildings, residual amounts of hydrocarbon oils used as bearing lubricants and hydraulic fluids will likely be encountered during equipment removal, including removal of the lubricating oil headers, filters, tanks, and hydraulic lines.

- **Asbestos**
  Process Buildings have asbestos cement (transite) siding and electrical and instrument cable trays. The X-333 Process Building has 400,000 sq ft of siding, X-330 has 370,000 sq ft, and X-326 has

350,000 sq ft. The 290 cell housings also have 3,000,000 sq ft of transite siding. The total volume of transite siding is estimated to be 200,000 cf. Two thousand cf of ACM is estimated to exist as insulation on steam lines, refrigeration systems, and process piping. ACM is in the floor tile in various areas of the process buildings.

- **Mercury**
  Several hundred electrical switches with glass-sealed mercury tubes are present, and approximately 800 mercury vapor lamps are installed above the cell housings. The total mercury volume is estimated to be approximately 1,000 cm^3 in each building.

- **Metals**
  Lead bricks for NDA instrument background measurements, lead solder, lead in scrap circuit boards, and lead-based painted surfaces exist throughout the process buildings. Process coolant condensers have inlet heads coated with lead. The total volume is negligible, but the surface area is extensive, being on all structural steel and nonprocess piping. Nickel plating is on the inside of process piping. Nickel dust or smoke will be generated by cutting or burning pipe during D&D.

- **Arsenic**
  Compounds of arsenic were introduced into the process as contaminants in UF_6 feed material. These compounds were volatile and of lower molecular weight than UF_6 and migrated to the top of the cascade, principally to the top purge cascade in X-326. A portion of the arsenic compounds was discharged through chemical traps to the atmosphere, and reaction of arsenic compounds with cascade constituents produced arsenic-containing products of low vapor pressure in process conditions. Instrument lines are typically cooler than large sections of process equipment, and arsenic compounds tended to concentrate in these lines.

  During hot air treatments to remove technetium compounds from process cells, arsenic is removed along with the technetium. Cell treatments to remove uranium deposits would also be expected to remove arsenic from process surfaces. Chemical traps that include alumina and sodium fluoride (NaF) have been shown to remove arsenic compounds from cascade gases.

  Specific air monitoring for airborne arsenic during maintenance and operating activities at PORTS was conducted between 1993 and 1995. Of 665 air samples taken, only two exceeded Occupational Safety and Health Administration limits, and both of these samples were taken during maintenance work at the X-326 EBS. Gas bulb samples taken from shutdown cells at UF_6 negatives and in on-stream cells showed elevated arsenic levels in X-326, primarily near the top purge cascade. Arsenic should be expected to be encountered primarily in X-326, preferentially toward the top of the cascade. Arsenic compounds in copper instrument lines and chemical traps associated with the top purge cascade should also be anticipated.

- **Beryllium**
  Beryllium was introduced into the PORTS plant buildings through aluminum process equipment parts that contained small but measurable amounts of beryllium. In addition, grinding wheels, sandblasting dust, and nonsparking tools used in gaseous diffusion operations maintenance activities contained small quantities of beryllium.

  Workplace sampling and laboratory analysis to identify and quantify the presence of beryllium contamination in 12 PORTS buildings were completed in September 2004 (United States Enrichment Corporation [USEC] 2004).

Beryllium contamination levels in excess of the published U.S. Department of Energy (DOE) release criterion (0.2 µg/100 cm^2) were found in all three major process buildings, and levels above DOE housekeeping limits (3 µg/100 cm^2) were found in X-326 and X-333 cell housings. Consideration of beryllium presence in the three major process buildings is necessary to ensure worker safety during equipment removal and building demolition.

- **Potential Dioxin Contamination in X-326**
  Analysis of the waste from the X-326 "fire cell" for dioxins and furans has been completed and reviewed. One sample was less than detectable for both dioxins and furans. The other sample had detectable levels, but at quantities in excess of three orders of magnitude less than the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 treatment standards. The conclusion is that waste solids from the X-326 fire could be dispositioned to a landfill without further treatment (CRC Technologies, Inc. 2011c).

- **Additional Chemical Hazards**
  Additional chemical hazards found in the three major process buildings include R-114, used as the primary process coolant to cool gaseous UF_6. Residual amounts of liquid coolant ($C_8F_{16}/C_4Cl_3F_7$ mixture) may be found in the tails withdrawal area of X-330. RCW was used as the secondary cooling medium to cool the R-114, and initially the PORTS RCW treatment system employed hexavalent chromium to prevent corrosion. In the 1990s, the treatment was changed to a more environmentally acceptable phosphate-based system, and residuals of chromium and phosphate compounds will be present in the RCW system within the three process buildings. Chemicals that may remain until building demolition would be fuels, lubricants, and cleaning solvents in quantities of tens of gallons at most.

  Chemical trapping materials present in the process buildings include alumina, NaF, and possibly magnesium fluoride. These trapping materials may also contain small amounts of uranium, HF, and possibly technetium-99 compounds.

A.2.4 KNOWN RELEASES OF CONTAMINANTS

Much of the 6 million cf of concrete slab floors is assumed to be contaminated with hexavalent chromium and greater than 50 ppm PCBs because of historic RCW and lube oil spills/leaks. They may also be contaminated with fixed radiological contamination.

A.3 FEED, SAMPLING, AND TRANSFER FACILITIES

The feed, sampling, and transfer facilities consist of the X-342A Feed Vaporization Building, X-342B Fluorine Storage Building, X-342C Waste HF Neutralization Pit (below-grade structures), X-343 Feed Vaporization and Sampling Facility (part of earlier decision), X-344A UF_6 Sampling Facility, X-344C Hydrogen Fluoride Storage Building (foundation and piers), X-344D HF Neutralization Pit (part of earlier decision, no below grade structures remain), X-344E Gas Ventilation Stack (below grade), and X-344F Safety Building (below-grade structures) (Figure A.15).

The disposition of the X-343 Feed Vaporization and Sampling Facility was addressed in an earlier removal action decision (DOE 2011a). The main functions of these facilities included UF_6 feed vaporization to the cascade, receipt and sampling of incoming cylinders, sampling and shipment of product cylinders, and storage of purified fluorine produced in the X-342A Feed Vaporization Building.

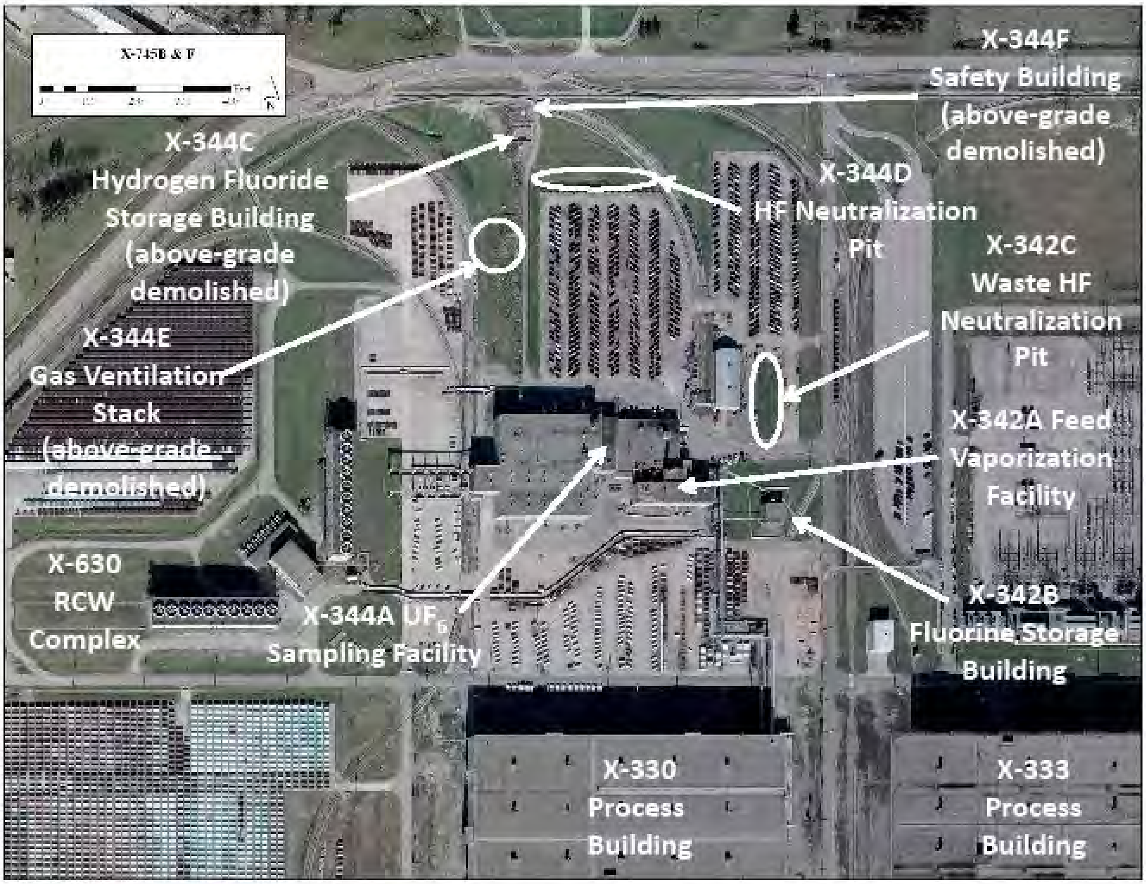


Figure A.15. X-340 Complex Buildings (2006-2007 Aerial Photography)

A.3.1 X-342A FEED VAPORIZATION BUILDING

The X-342A Feed Vaporization Building (Figure A.16) is located north of the X-330 Process Building and adjacent to the X-344A UF_6 Sampling Facility (Figure A.15). These two buildings share the north wall and half of the west wall with the X-342A building. The one-story, 13,800-sq ft building has a steel frame with exterior transite siding and rests on a reinforced concrete pad (DOE 1993, TPMC 2006a).

This building was used to feed, vaporize, and sample UF_6. The high-bay area of the building originally contained 12 steam vaporizers, but the building was shut down between 1982 and 1983. The vaporizers were replaced with two 84-in.-diameter containment autoclaves that were capable of handling up to 48-in.-diameter cylinders for feed vaporization and liquid sampling. The autoclaves were steam-heated and designed to contain the contents of a 48-in.-diameter cylinder in the event of a cylinder rupture. The building contains instrumentation used to monitor temperature, pressure, and conductivity of the steam condensate stream and other parameters to reduce and mitigate the potential for release. The building is equipped with two 20-ton-capacity bridge cranes, which were primarily used for cylinder handling and fluorine generator maintenance. The building also contains a small control area used to monitor and control the processes. Below-grade structures include a basement area below the autoclaves and a sizable pit below the cylinder scale.

Figure A.16. X-342A Feed Vaporization Building

The feed vaporization operation involved placing a cylinder of UF_6 into the autoclave by using one of the 20-ton-capacity overhead bridge cranes, hooking the cylinder up to process lines, opening the cylinder valve, closing the autoclave shell against the fixed head, and introducing steam. Once the cylinder had reached temperature, process valves were opened and the cylinder contents were vaporized to the cascade. When emptied, the autoclave was opened and the cylinder was purged, disconnected, and removed. Cylinder purging and evacuation from X-342A was also routed to the cascade. The two autoclaves operated as a pair. While one cylinder was feeding, the other autoclave was being prepared for feeding so feeding would continue uninterrupted.

The sampling operation involved placing a cylinder into the autoclave, hooking the cylinder up to the process, opening the cylinder valve, closing the autoclave shell against the fixed head, and introducing steam. Once the cylinder had reached temperature for a predetermined time period to ensure homogenization, the steam was turned off and the autoclave was reopened. The cylinder was rotated until the cylinder valve was under the liquid level inside the cylinder. The cylinder was then reconnected to the process, the autoclave was reclosed, and a liquid sample was withdrawn. The autoclave was then reopened, the cylinder valve was closed, and the cylinder was carefully removed from the autoclave to a cooling area. A 48-in.cylinder was left in the cooling area for a minimum of 5 days until its contents solidified. The cylinder could then be removed to storage. The two autoclaves are currently in use, transferring heel material from UF_6 cylinders.

A fluorine-generating plant is also housed in the X-342A building. Fluorine was produced by the electrolysis of HF to produce fluorine and hydrogen. Hydrogen (the byproduct of the operation) was vented, and the purified fluorine was stored in tanks in the X-342B Fluorine Storage Building where it could be transferred into gas cylinders at the covered porch or piped to areas within the plant via the fluorine distribution system (as needed). Power rectifiers produced the direct current power that was applied to the fluorine "cells" that produced the fluorine. The electrolyte used to produce fluorine was lithium fluoride (LiF), and potassium fluoride (KF) was used for purification. Sodium fluoride is contained in the traps. The HF for fluorine generation is stored in eight steel cylinders, each capable of holding 850 lb.

Uranium contamination should be expected throughout the interior of the process piping and valves. The autoclave closing systems contain hydraulic oil, but the autoclaves should contain very little, if any, contamination.

The fluorine-generating plant is suspected of containing residual fluorine, HF, and KF/HF electrolyte in the fluorine-generating cells.

A.3.2 X-342B FLUORINE STORAGE BUILDING

The X-342B Fluorine Storage Building (Figure A.17), constructed in 1954, is a 16-ft-high, single-story rectangular structure with reinforced concrete footings and a reinforced concrete floor occupying 1,500 sq ft of floor space. The building was located southeast of the X-342A Feed Vaporization Building (Figure A.15). The lower 8 ft of walls are constructed of 12-in.-thick reinforced concrete. The rest of the wall structure consists of corrugated cement and asbestos-containing siding (transite) hung on steel framing. This building was used to store purified fluorine, which was piped in from the X-342A Feed Vaporization Building's fluorine-generating plant (DOE 1993, TPMC 2006a).

Figure A.17. X-342B Fluorine Storage Building

The building houses three 1,000-cf metal storage tanks used for fluorine gas storage. They are connected to a covered outside manifold system, a ventilation system, piping, and two evacuation jets for discharging emissions from the fluorine generation process to the atmosphere. Control valves that regulated the tank contents are located immediately outside of the building. The piping system permitted the transfer of fluorine between the storage tanks and the X-342A Feed Vaporization Building (DOE 1993). From the storage tanks, fluorine was either transferred into gas cylinders at the building's covered porch or fed directly into the fluorine distribution system servicing the various PORTS process and support operations.

No known or potential radiological hazards are associated with the X-342B Fluorine Storage Building.

Known or potential chemical hazards associated with the X-342B Fluorine Storage Building include the following:

- Purified fluorine from the X-342A Feed Vaporization Building is pumped into tanks and stored in the building (DOE 1993).

- Fluorescent light fixture ballasts and bulbs may contain PCBs and mercury (TPMC 2006a).

- ACM is present in transite exterior siding on the upper 8 ft of the building (DOE 1993, TPMC 2006a).

- Based on the age of the building, lead-based paint may be present (DOE 1993, TPMC 2006a).

PCB equipment or PCB-contaminated equipment is not expected to be present.

Known releases of contaminants from the X-342B Fluorine Storage Building include the following:

- The X-342B building contains two evacuation jets for discharging emissions from the fluorine generation process to the atmosphere. Both jets operate regularly and have an average emission rate of 2.4 lb/hour (DOE 1993).

- An unknown quantity of fluorine was released from a faulty valve on piping connected to a fluorine storage tank. The valve was repaired and placed back into service. Residual concentrations of 0.5 ppm fluorine were measured 1 ft from the valve outside of the building. Other potential releases of fluorine could result from additional failures of valves or piping associated with the fluorine storage and distribution system (DOE 1993).

A.3.3 X-344A UF_6 SAMPLING FACILITY

The X-344A UF_6 Sampling Facility (Figure A.18) is a steel-framed structure with transite siding and concrete slab floors that cover an overall area of 63,000 sq ft. The building is adjacent to the X-342A Feed Vaporization Building and shares its north wall and half of its west wall with X-342A (Figure A.15) (DOE 1993, TPMC 2006a).

The building was originally constructed in 1958 to convert UF_4 to UF_6 and housed 40 fluorine generators and a flame tower. The building was abandoned in 1962, after the operation was discontinued. In the mid-1970s, the building was converted to an HASA, but this function was terminated in 1975. Equipment supporting the high-assay sampling was removed to open up the space needed to support an increased market for LEU to fuel nuclear power reactors. In this capacity, the building was used to transfer up to 5 percent assay of UF_6 from on-Facility-use-only cylinders into customer-owned cylinders for shipment. Sampling was also conducted. Other parts of this building are used to stage, store, and weigh UF_6 cylinders. A large cylinder yard is located to the south and west of the building. The second floor of the building is used to store used, empty 12-in. UF_6 cylinders. It is also used to store heating, ventilation, and air-conditioning (HVAC) equipment (DOE 1993, TPMC 2006a).

Figure A.18. X-344A UF_6 Sampling Facility

This building consists of two stories and a basement, with approximately 40,000 sq ft of operating area on the main (or ground) floor, which consists of three distinct areas. These are the process support area, maintenance area, and personnel support area. The main floor has two high bays, offices, a kitchen, break rooms, storage areas, and a maintenance shop area. The second floor has approximately 18,700 sq ft of floor space. The basement area, which is largely unused, has approximately 4,300 sq ft of space. Several hazardous waste management units are located within the process support area, and a settling tank is adjacent to the north side of the building (DOE 1993). The building is equipped with three 20-ton bridge cranes used to handle cylinder sampling and transfer, and two additional cranes are used to handle shipping, receiving, and weighing activities (DOE 1993, TPMC 2006a).

This building contains four 96-in.-diameter, steam-heated containment autoclaves that are elevated several feet above the floor. It had the unique capability of transferring liquid UF_6 product from 48-in.-diameter cylinders to 30-in. product cylinders suitable for shipment.

The process involved a 48-in.-diameter cylinder being placed in an autoclave and connected to process instrumentation. Then the autoclave was closed and steam was introduced. Empty 30-in. cylinders were readied and placed on scales at floor level below the autoclaves. A flow was established between the "parent" cylinder in the autoclave and the empty "daughter" cylinder on the scales below. The desired amount of product was placed in the 30-in. cylinder, and the process was repeated until the product order was filled. The 96-in.-diameter autoclaves have a tilt mechanism to allow the parent cylinder to be tilted to remove the maximum amount of product. The manifolds and lines were then purged of UF_6, and the purge gases were evacuated to the cascade.

The X-344 building was used to remove technetium from UF_6 by chemical trapping.

Known or potential radiological hazards associated with the X-344A UF_6 Sampling Facility include the following:

- Fixed contamination exists in the concrete floor in various places (sealed with epoxy paint) (DOE 1993, TPMC 2006a).
- The entire second floor is roped off because of suspected fixed radiological contamination (DOE 1993).
- The main floor, process support area, is known to have fixed uranium contamination resulting from planned and unplanned releases of UF_6 (DOE 1993).
- Contaminated PPE, tools, used pigtails, and autoclave supplies have been reported (TPMC 2006a).
- UF_6 in cylinders, autoclave manifolds, pigtails, and "heels" in empty cylinders are reported (TPMC 2006a).
- As a result of trapping operations, this building is likely to contain low levels of technetium contamination.

Known or potential chemical hazards associated with the X-344A UF_6 Sampling Facility include the following:

- An underground storage tank (UST) outside the north wall was being used for storing neutralized waste electrolytes, but is no longer in use (DOE 1993, TPMC 2006a).
- Two 1,000-gal-capacity aboveground storage tanks (ASTs) used to store electrolytes were identified in the maintenance area of the main floor. The tanks are covered with asbestos insulation (DOE 1993).
- Drums located throughout the building were used to contain contaminated burnables (DOE 1993). One drum located in the maintenance area of the main floor was used to store contaminated metal (DOE 1993). Freon is in the HVAC equipment in the building (TPMC 2006a).
- Liquid nitrogen is used for sampling (TPMC 2006a).
- Hydraulic oil is used in support of the autoclave operation (TPMC 2006a).

- Potential PCBs are present in the light fixture ballasts. Available documentation also notes the presence of PCB-impregnated gaskets in the ventilation ducts. A trough system is in place to collect potential leachate (DOE 1993).

- Waste oil/filters that may contain benzene are present (DOE 1993).

- Waste solvents that may contain Freon-113 and ethyl alcohol are present (DOE 1993).

- Compressed gas cylinders used for welding are present (TPMC 2006a).

- Lead-based paint has been indicated throughout the building. During visual inspection, it was noted that the paint was peeling badly in some places, particularly in the stairwell (DOE 1993, TPMC 2006a).

- Heavy oil and grease stains are on the floor in the main floor maintenance area (DOE 1993, TPMC 2006a).

- ACM has been reported on piping, in transite siding, and around two electrolyte storage tanks (DOE 1993, TPMC 2006a).

- Cleaners, disinfectants, and other maintenance supplies are present within the building (DOE 1993).

Known releases of contaminants from the X-344A UF_6 Sampling Facility include the following:

- An unknown quantity of gaseous UF_6 was released from the building on September 14, 1976. In an effort to contain the spill, a large quantity of water was sprayed on the area. A portion of that water flowed into the settling tank adjacent to and north of X-344A, but the majority of the water flowed through the storm sewers and the North Diversion Ditch to the X-230L North Holding Pond. The runoff to the X-230L North Holding Pond resulted in a uranium concentration of 0.46 mg/L for 2 days after the release (DOE 1993).

- Small, routine emissions of UF_6 associated with the transfer process go unmonitored. There have also been many unplanned releases.

A.3.4 X-342C WASTE HF NEUTRALIZATION PIT AND X-344D HF NEUTRALIZATION PIT (BELOW-GRADE STRUCTURES)

The X-342C Waste HF Neutralization Pit (Figure A.15) was a 26,000-gal concrete pit, originally filled with limestone designed to react with liquid HF in the event of a spill in the X-344C Hydrogen Fluoride Storage Building. Operations were discontinued in 1986 and the pit was completely removed in 2006.

The X-344D HF Neutralization Pit (Figure A.15) was a 75,000-gal concrete pit filled with limestone and designed as a filter and settling pit for pH adjustment of the waste HF effluent from the X-342A Feed Vaporization Building. Operations were discontinued in 1989 and the pit has been completely removed.

A.3.5 X-344C HYDROGEN FLUORIDE STORAGE BUILDING (FOUNDATIONS AND PIERS), X-344E GAS VENTILATION STACK (BELOW GRADE), AND X-344F SAFETY BUILDING (BELOW-GRADE STRUCTURES)

The X-344C Hydrogen Fluoride Storage Building (Figure A.15) had three 10,000-gal storage tanks that contained anhydrous HF received by rail tank car. The X-344E Gas Ventilation Stack (Figure A.15) was a 4-ft-diameter steel pipe that was approximately 30 ft high. It was contained within a metal support structure and had vents from liquid and vapor lines that connected the X-344C storage tanks with the X-342A Feed Vaporization Building. The X-344F Safety Building (Figure A.15) was a small concrete structure that contained an emergency shower, a sink, a portable eye wash station, and a control panel.

The above-grade structures and equipment have been removed after previous National Environmental Policy Act of 1969 (NEPA) reviews. This RI/FS addresses any remaining below-grade structures. No documented radiological or chemical hazards are associated with the remaining structures. However, residuals may be present in below-grade lines connecting X-344C, X-344E, and X-342A.

A.4 PRIMARY LABORATORY, MAINTENANCE, AND EQUIPMENT CLEANING FACILITIES

The primary laboratory, maintenance, and equipment cleaning operations consist of the X-700, X-705, X-710, and X-720 Complexes. The X-700, X-705 and X-720 Complexes are shown in Figure A.19.

A.4.1 X-700 COMPLEX

The X-700 Complex consists of the X-700 Converter Shop & Cleaning Building, the X-700A Air Conditioning Equipment Building, X-700B Sandblast Facility and Observation Booth, X-721 Radiation Instrument Calibration, and the “E” X-700 “0000” Compressor Base Foundation.

A.4.1.1 X-700 Converter Shop & Cleaning Building and X-700B Sandblast Facility and Observation Booth

The X-700 Converter Shop & Cleaning Building (Figure A.20), built in 1955, is a 129,000-sq ft, steel-framed, high-bay building with transite siding and concrete floors. The building was used for maintenance of contaminated and noncontaminated equipment from the diffusion cascade.

The building is divided into two main sections. The east section, Chemical Cleaning and Operations Area, is an equipment- and parts-cleaning area housing eight large tanks for dipping large equipment components, biodenitrification (Bio-D) operations, a vapor degreaser, and a solvent-contaminated wastewater treatment air stripper. The purpose of the Bio-D operations was to lower the nitrate-nitrite levels in the treated raffinate (filtrate) solution from the heavy metal precipitation and technetium ion-exchange operation located in the X-705 Decontamination Building. A partial basement exists under the tanks, and the Bio-D equipment houses two sumps: one in the northern end for the treated biodenitrification effluent and associated floor washings (from a diked area around the equipment) and one in the southern end for the cleaning tanks and floor washings from that area. Process lines run from the southern sump area (tank draining area) to the former X-701C Neutralization Pit. These lines are now blocked. In the early 1980s, the process lines were rerouted to the former X-616 Liquid Effluent Treatment Facility (only subsurface foundations and piers remain) by way of the RCW blowdown line. The process lines are no longer used for X-700 wastewater. A sandblasting area (X-700B Sandblast Facility and Observation Booth) is located just outside to the north of the eastern part of the building (Figure A.21). Currently, the east section is used for cleaning (performed in the aisle floor space) fresh air equipment. Seven of the eight cleaning tanks (Tanks No. 1, 2, 3, 4, 6, 7, and 8) have been closed under the Resource Conservation and Recovery Act of 1976 (as amended) (RCRA). Closure involved removal and treatment of tank contents and the decontamination, demolition, and disposal of tank components including piping, acid-proof brick, and other linings (if required). If linings were removed, the remaining steel tank shells were decontaminated to a clean closure performance standard. The Bio-D operation is operational. The vapor degreaser and air stripper are not in use.

The west section houses a shop area, two unused converter stabilization furnaces, and the X-721 Radiation Instrument Calibration building, which is addressed in Section A.4.1.3. The shop area is split into two halves. The south half was built to be a converter weld shop, and the north half was a humidity-controlled converter assembly area. The south half has been transformed into a set of shops (carpenter, electric, instrument, weld, paint, sign) and includes modular offices and a break room. The north half is the X-721 Radiation Instrument Calibration building on the west side and a converter storage area on the east side. Currently, the west wing is essentially used only for storage.

Figure A.19. X-700, X-705, and X-720 Complexes (2006-2007 Aerial Photography)

Figure A.20. X-700 Converter Shop & Cleaning Building

Figure A.21. X-700B Sandblast Facility and Observation Booth

Two underground chemical and petroleum storage containment tanks are located near the southeast corner of the building. The concrete tanks are 16 ft × 6 ft and have a depth of 8 ft. Each has a capacity of 4,800 gal. The tanks are interconnected at their bases by two 8-in. steel pipes. These tanks were designed to contain trichloroethene (TCE)/trichloroethane (TCA) spills that might occur during the refill operations at the outside TCE/TCA storage tank. A drain near the inlet valve for the outside tank discharges to an underground pipe that enters the containment tanks. A valve located at the base of one of the containment tanks controls the discharge to Storm Sewer E. There were no reported releases to the containment tanks. Tanks were partially filled with water as a result of precipitation runoff.

Radiological Contamination Control Zones (CCZs) are established in several areas within the X-700 Converter Shop & Cleaning Building. One is for converters in the north portion of the west high bay. Two CCZs exist in the west wing at each of the furnace stand compressors. Another is in the center of the building where radiological waste is stored. Used sand from the sandblasting operation is considered to be radiological waste. Fixed contamination is present on the concrete floors (TPMC 2006a).

Potential chemical contaminants include fluorine, acids, solvents, sodium carbonate, oils, degreasers, bases, alcohols, lead, benzene, heavy metals, and chromium. Acetylene, oxygen, nitrogen, and P10 gas were used, and ACM is believed to be present within transite siding and thermal insulation. PCBs are in ventilation duct gaskets and fluorescent light fixture ballasts. Mercury is in mercury vapor incandescent light bulbs and fluorescent light tubes. Surfaces potentially contain lead-based paint (TPMC 2006a).

One hundred and ninety-one wipe samples were collected in X-700 during a beryllium surface contamination characterization conducted in 2003 and 2004 (USEC 2004). Of these samples, 58 (30 percent) exceeded the level of concern (0.2 µg/100 cm^2), five of which exceeded the level of immediate concern (3.0 µg/100 cm^2). Levels of immediate concern were exceeded in the converter weld shop (on a grinder), furnace stand (inside wall of Furnace No. 1), and sandblasting booth (grinding dust). Levels of concern were exceeded in the equipment/parts cleaning area floor; caged hand table and overhead area; converter barrier/assembly shop miscellaneous equipment and overhead area; furnace stand miscellaneous equipment and overhead area; women's west locker room; sandblasting booth; and the weld shop compressors, welding equipment, and overhead area.

A.4.1.2 X-700A Air Conditioning Equipment Building

The X-700A Air Conditioning Equipment Building (Figure A.22) is a 2,400-sq ft, steel-framed building with a concrete floor and metal roof. It is located north of the X-700 Converter Shop & Cleaning Building. Constructed in 1975, the building has always been used to house air-conditioning equipment (three chiller units, compressors, an air-conditioning filter unit, and blower unit) that services the X-700 Converter Shop & Cleaning Building and X-721, which is located in the X-700 building. Air is circulated to/from the X-700 building via large insulated ductwork.

Nitrogen, Freon-502, and Freon-22 were used in X-700A. ACM, recirculating heating water (RHW) (initially containing chromates and later containing phosphates), lubricating oils, and PCBs and mercury associated with fluorescent lighting were used in this building and may still be present.

Figure A.22. X-700A Air Conditioning Equipment Building

A.4.1.3 X-721 Radiation Instrument Calibration

The X-721 Radiation Instrument Calibration building (Figure A.23), built in 1985, is used to test and evaluate radiation instruments and equipment and to certify plant radiation standards. The north and west walls are concrete and are shared in common with the X-700 Converter Shop & Cleaning Building. The remaining ones are stud walls, and the roof is made of steel decking. A portion of the building is located outside X-700 and has a beam room. The laboratory and training room walls are made of steel-reinforced blocks with all voids filled by concrete grout. The control room and storage room share walls in common with other rooms. These walls are made of either concrete blocks or solid concrete.

Figure A.23. X-721 Radiation Instrument Calibration

The cleaning room, located inside X-700, is used to disassemble and clean incoming instruments. Utilities are supplied from X-700 and the X-700A Air Conditioning Equipment Building.

The Radiation Instrument Calibration building houses several high-intensity radiation sources that are intrinsically safe or are used remotely inside a shielded radiation room. A gamma irradiator and one filtered 320 kV constant potential x-ray unit are located in the "beam room" at fixed positions.

The radiation protection development laboratory area, which is an integral part of the Radiation Instrument Calibration building, is located in the southwest corner of this building outside of the X-700 high-bay area. This laboratory can contain additional alpha and beta particle emission reference standards and miscellaneous low-level standard reference materials provided by the National Institute of Standards and Technology.

The north, east, and west walls of the beam room are made of reinforced concrete. The south wall is made of reinforced concrete and contains two equivalent composite shield doors. Each shield door contains steel, boron-loaded polyethylene, and lead in equivalent proportions to equal the concrete walls on the south side. The floor in the beam room has a special covering of concrete mixed with boron frits. Part of the floor in the beam room is below the main floor level.

Radioactive sources were housed in the X-721 building, along with shielding. Surface contamination is unlikely.

A.4.1.4 "E" X-700 "0000" Compressor Base Foundation

There is no "0000" Compressor Base Foundation in the X-700 Converter Shop & Cleaning Building. According to reliable sources, the "0000" compressor base foundation would have been located in the X-770 Mechanical Test Building (not part of this RI/FS), but it was never built.

A.4.2 X-705 COMPLEX

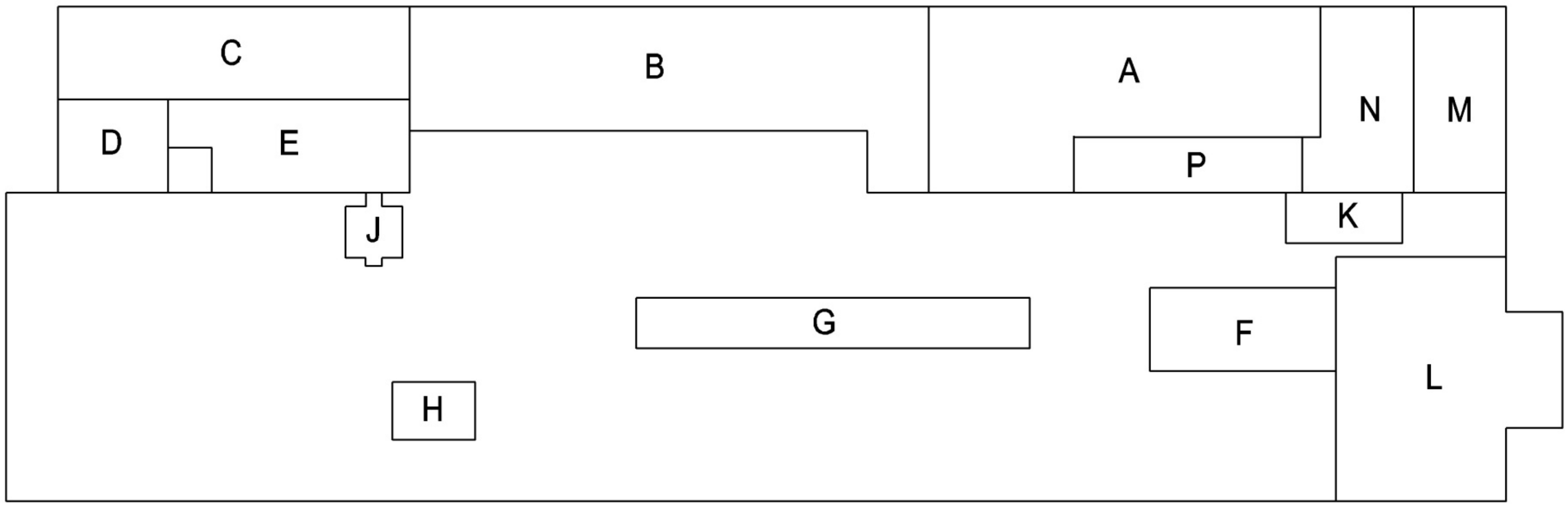
The X-705 Complex consists of the X-705 Decontamination Building, X-705D Heat Booster Pump Building, and X-705E Oxide Conversion Area (Figure A.19).

A.4.2.1 X-705 Decontamination Building

The X-705 Decontamination Building (Figure A.24), constructed in 1955, is centrally located with respect to the X-700 Converter Shop & Cleaning Building and the X-720 Maintenance & Stores Building (Figure A.19). It was used for process equipment disassembly and decontamination, small parts cleaning and decontamination, cleaning of UF_6 cylinders, uranium recovery, routine chemical analyses, and laundering company-issued clothing worn by plant personnel in areas likely to contain uranium contamination. After decontamination, the equipment and parts were transferred for maintenance, returned to service, or containerized as scrap.

Figure A.24. X-705 Decontamination Building

The X-705 Decontamination Building is a 520-ft × 160-ft (approximately 100,776 sq ft of floor space) building with steel support columns, a concrete slab floor, walls of concrete and transite, and metal roof decking supported by steel trusses. The roof is covered with insulation and built-up roofing. The building is divided into a high-bay area, a low-bay area, an annex, a mezzanine, and a tunnel. The southeast part of the building is a single story. Part of the interior of the northeast side is two stories. The entire west half is a high bay, and it has an added-on annex on the south side and another on the west side. At the center of the high bay is a "tunnel" cleaning operation that has a basement over which are enclosed wash bays for cleaning large cascade components. Tooling for disassembly of axial compressors is installed in the high bay. At the southeast corner, there is a laundry. A layout of the X-705 Decontamination Building is presented in Figure A.25. Figure A.26 shows some of the equipment in the building.



A. Office Area
B. Main Recovery Area
C. Oxide Conversion Area
D. Maintenance Area
E. Miscellaneous Recovery Area
F. Scrap Recovery Area
G. Spary Booth
H. Small Parts Dismantling Booth
J. Compressor Pit
K. Converter Destruction Equipment Area
L. Converter Head Cutting Area
M. Laundry Room
N. Clean Clothes Storage
P. Locker and Shower Rooms

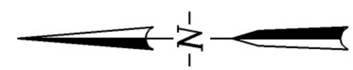


Figure A.25. X-705 Decontamination Building Layout

Figure A.26. X-705 Decontamination Building Equipment

The following ASTs exist within the building:

- One 1,500-gal tank and a 3,000-gal tank located outside and containing nitric acid (HNO_3)
- A 100-gal tank containing HNO_3 in the Area 4 mezzanine
- Two 3,000-gal tanks containing caustic soda
- A 1,000-gal tank containing liquid propane
- Two 500-gal tanks containing sulfuric acid (H_2SO_4).

Recoverable quantities of uranium in the decontamination solutions were reclaimed in a uranium recovery system located in the building. Uranium from other contaminated sources (some laboratory wastes and field decontamination solutions) was also recovered in the uranium recovery area. Uranium-bearing solutions were processed to extract uranyl nitrate solutions, which were then calcined to produce uranium oxide (U_3O_8). The recovered U_3O_8 was stored on the PORTS Facility or shipped off for further processing and use. Waste streams containing toxic or radioactive contaminants were processed prior to discharge. Wastewater streams were treated to precipitate and filter residual heavy metals. This processed wastewater was discharged to the sanitary sewer system or transferred to the Bio-D operation for further processing. The filtered solids were packaged for disposal. The waste gas stream from the calciners contained nitrous oxides (NO_x) and was passed through a scrubber to remove most of the NO_x prior to discharge.

Activities performed in the X-705 Decontamination Building and X-700 Converter Shop & Cleaning Building required laboratory analyses to meet nuclear safety requirements and ensure process efficiencies. Some of these analyses were performed in the X-705 process laboratory.

The X-705 laundry washed the company-issued clothing worn by plant personnel. The laundry equipment drained into the sanitary sewer system, which discharges to the X-6619 Sewage Treatment Plant.

The two main radioactive materials present in this building are uranium and technetium. Detectable concentrations of transuranic elements (neptunium and plutonium) are also present in the building. Radiological contamination is fixed in the floors and probably on the inside surfaces of the building and its fixed equipment, including laundry washing equipment (Lockheed Martin Energy Systems, Inc. [LMES] 1997, TPMC 2006a).

The following chemicals are either in use or present as residue from prior use: fluorine, caustic soda, nitrogen oxides, HNO_3, acetylene, tributyl phosphate, UO_2F_2, HF, propane, Stoddard solvent, citric acid, aluminum nitrate, NH_3, boric acid, sodium carbonate, sodium bisulfate, uranyl nitrate, TCE, alumina, batteries, circuit boards, glass beads, laundry detergents, U_3O_8, and flammable liquids in lockers. Removable beryllium contamination in excess of the DOE release criterion but below the DOE housekeeping surface limits has been measured in X-705 (USEC 2004). Beryllium contamination most likely came from aluminum compressor components during disassembly in X-705. PCBs are present in ventilation duct gaskets and fluorescent light fixture ballasts. Fluorescent light tubes contain mercury. Because the building is old, lead-based paint is potentially present, and ACM is present in thermal piping insulation and transite siding (TPMC 2006a).

Cleaning activities have generated numerous sludges and solutions (including floor sweepings) that contain radionuclides, hazardous chemicals, and heavy metals (TPMC 2006a).

A.4.2.2 X-705D Heat Booster Pump Building

The X-705D Heat Booster Pump Building (Figure A.27), built in 1983, is a 700-sq ft RHW pump house on the north side of X-705 (Figure A.19). It is no longer in use. Process support buildings were heated by waste heat from the gaseous diffusion process by pumping RHW from the process buildings to the process support buildings. The X-705D Heat Booster Pump Building boosted the heated water through the X-705 Decontamination Building to provide heat during cold weather. Operations were discontinued in 2001 when the gaseous diffusion cascade was shut down. The building has reinforced concrete floors and concrete block walls. The outside dimensions are approximately 25 ft × 15 ft. The building has two levels, a ground level and a lower below-grade level.

Figure A.27. X-705D Heat Booster Pump Building

The X-705D Heat Booster Pump Building is posted as a radiological contamination area.

Residual amounts of chromate may be present in the RHW system in the X-705D Heat Booster Pump Building and could be a potential source of contamination, although the system was switched to a more environmentally acceptable phosphate-based corrosion inhibitor system in the 1990s.

RCW has been observed on the floors in the X-705D Heat Booster Pump Building (DOE 1993).

A.4.2.3 X-705E Oxide Conversion Area

The X-705E Oxide Conversion Area is located within the X-705 Decontamination Building. It was used to convert U_3O_8 containing technetium-99 and transuranic elements to UF_6 for feed to the enrichment cascade. The X-705E Oxide Conversion Area covers approximately 3,000 sq ft of the first floor and a mezzanine area. The eastern wall of X-705E is part of the eastern wall of the X-705 Decontamination Building.

The X-705E Oxide Conversion Area includes four rooms: the cold trap room, tower room, sampling room, and oxide unloading room. There are no stairways or elevator shafts in the area. Some of the equipment associated with the oxide conversion process is located on, or extends to, the second floor of X-705 (Figure A.28).

Figure A.28. X-705E Equipment

The exterior walls of the X-705 Decontamination Building are constructed of concrete block to a height of approximately 8 ft with windows and corrugated cement-asbestos (transite) siding on steel framing above the blocks. The interior portions, including the X-705E Oxide Conversion Area, consist of concrete blocks and steel framing, and they do not include any combustible finishes or coverings.

The oxide conversion area reacted uranium oxides with fluorine gas to generate UF_6 gas and byproducts. It was operated as the oxide conversion area from February 1957 through July 1977 (BJC 2000). The equipment was shut down because of high airborne radiation readings in the area.

The X-705E Oxide Conversion Area is highly contaminated radiologically. The area is posted as a CCZ and is sealed because of potential or suspected contamination from transuranic elements (DOE 1993, TPMC 2006a). In addition to uranium and technetium-99 contamination in this area, transuranic elements (including neptunium and plutonium) were concentrated in flame tower ash during the process, and transuranic isotopic contamination remains in the residual tower ash within the equipment. Samples from the H-Area (mezzanine area), collected following shutdown, indicated that the transuranic element percentage was 0.12 percent (BJC 2000) (Figure A.29).

Figure A.29. X-705E Contamination

A.4.3 X-710 COMPLEX

The X-710 Complex consists of the X-710 Technical Service Building, X-710A Technical Service Gas Manifold Shed, and X-710B Explosion Test Facility (Figure A.30).

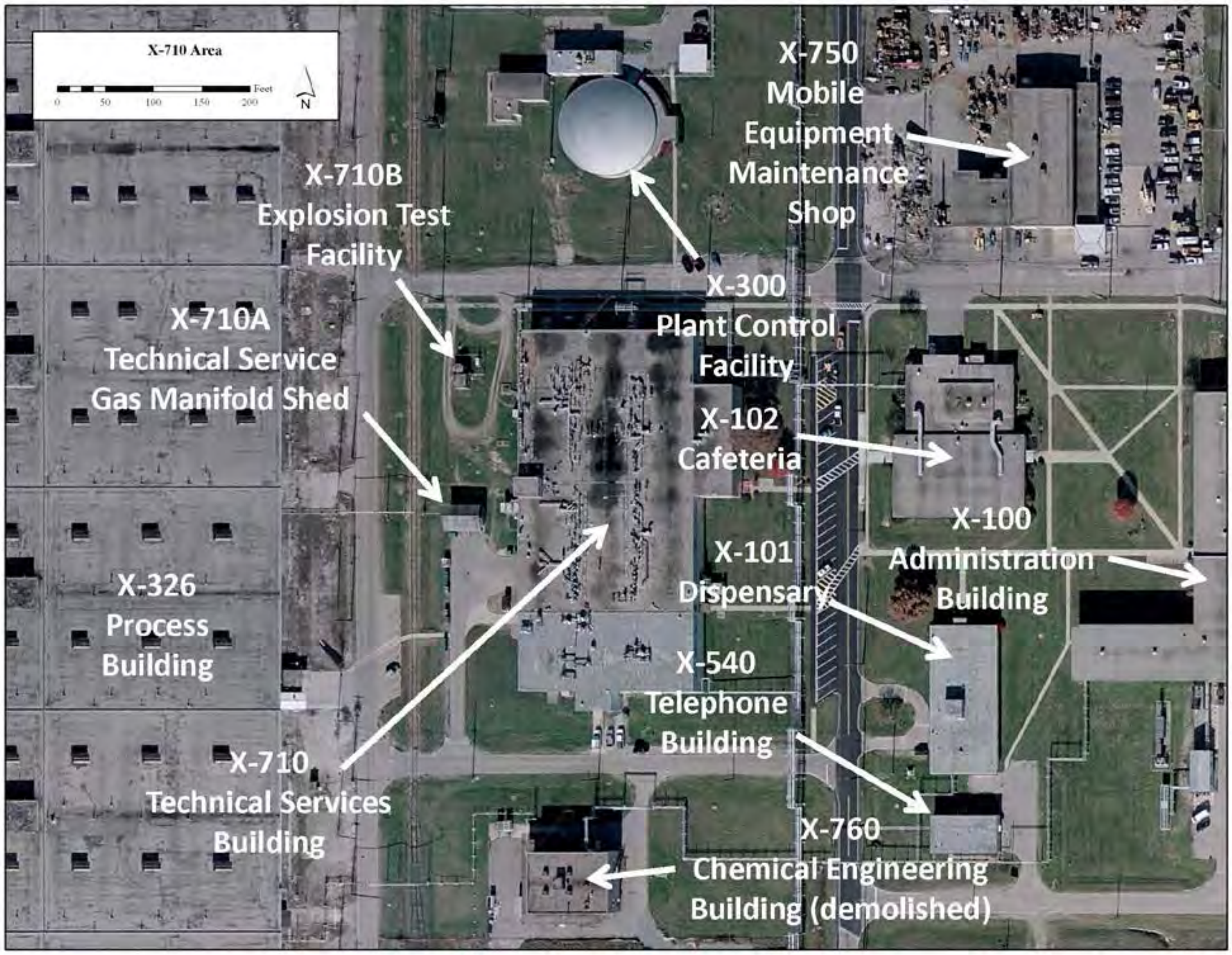


Figure A.30. X-710 Complex (2006-2007 Aerial Photography)

A.4.3.1 X-710 Technical Service Building

The X-710 Technical Service Building (Figure A.31) is a two-story, 139,000-sq ft building in two separate parts. It is located east of the X-326 Process Building and south of the X-300 PCF (Figure A.30). The northern portion, built in 1953, has an area of 109,000 sq ft. It is made of reinforced concrete and concrete blocks. Built in 1975, the southern portion has 30,000 sq ft of floor space and is a steel-framed addition with steel siding.

Figure A.31. X-710 Technical Service Building

The X-710 Technical Service Building contains laboratories (Figure A.32) and operations that provide technical, production, and development support for PORTS. Operations have included material sampling and testing, chemical analysis and laboratory services, information services and management (technical library and computer systems and procedures), instrumentation development and testing, cascade testing and evaluation, development testing/evaluation/fabrication, offices for technical services management, equipment repair and fabrication shops, a storeroom, and the mechanical equipment room. The X-710 building currently supports process cell deactivation and equipment removal, UF_6 processing for uranium programs, conducts D&D and environmental sample analysis, and is home base for the NDA Applied Nuclear Technology Lab and Industrial Hygiene Health Physics support group. The Mass Spectrometer Lab still functions.

Figure A.32. X-710 Technical Service Building Laboratory

The X-710 radiographic operations are located in Room 202B on the west side of the second floor. The x-ray room was used to radiograph small valves, sample containers, welds, and other components for determining internal soundness. The room consists essentially of an x-ray vault that contains an industrial x-ray machine. The vault measures 12 ft × 12 ft and is 13 ft high. Three walls of the vault are common with adjacent rooms, and these rooms can be isolated during radiographic procedures. The fourth wall of the vault is an exterior wall located 14 ft above ground level. The three inside walls are 2 in. thick and contain 1/8-in. lead sandwiched between steel sheets. The exterior wall is constructed of concrete blocks. The floor is made of 3 in. of reinforced concrete with 12-in. steel beams and is covered with a 3/8-in. lead sheet. The roof is concrete, and it is supported by structural steel joists. Biparting access doors open into the control room and are constructed of 1/8-in. lead sandwiched between layers of wood (LMES 1997).

A 5,000-gal neutralization pit, approximately 15 ft long, 9 ft wide, and 8 ft deep, is located just outside and west of the X-710 building. The neutralization pit, which is constructed of concrete and lined with acid-proof brick, was used to treat operations effluent (which included organic solvents) with lime before discharge to the sanitary sewer system (DOE 2000). Located on the west side of the building directly north of the neutralization pit is the X-710 Radioactive Wastewater Tank (also known as the “hot pit”). The tank is a buried, steel, 500-gal, radioactive wastewater storage tank that was installed in 1954. The tank was installed to collect effluent from the originally planned high-level radiological laboratory in the X-710 building; however, this laboratory was never fully operational. The contents of the tank were removed in the mid-1980s when the tank was taken out of service (DOE 2000).

A 250-gal diesel UST was installed on the northwest side of the building in April 1955.

Radiological contamination signs are posted at the entrances to many rooms and the RCRA 90-day storage areas in the X-710 Technical Service Building, indicating contamination exists in these areas. The “hot pit” contains radioactive contamination from materials that were discharged into the “hot” sinks. Laboratory equipment used for radionuclide analysis is also contaminated.

Chemical hazards associated with the X-710 Technical Service Building include the following:

- Heavy metals, mercury, chromium, lead, chlorine trifluoride, Freons, solvents, alcohols, arsenic, PCBs, fluorine, cyanides, oils and greases, asbestos, acids, bases, and other laboratory chemicals (DOE 1993).
- Wastes generated in the building include organic solvents and compounds, inorganic compounds, acid- and base-containing wastes, heavy metals, mixed wastes, and standard industrial wastes.
- The PORTS beryllium initial characterization identified X-710 as containing removable beryllium contamination levels in excess of the published DOE release criterion surface limit of 0.2 $\mu g/100\ cm^2$ (USEC 2004).
- Laboratory hoods may be contaminated with airborne residue from laboratory chemicals (perchloric acid, etc.).
- ACM is reported in the thermal system insulation around pipes, floor tiles, and steam condensate lines in the building (DOE 1993).
- Lead-based paint is suspected of being on the walls and piping in the building (DOE 1993).
- Equipment used to analyze for PCBs (Room 226) is contaminated. Rooms 331, 200, 201, 218, 226, and 263 were identified as testing, sample preparation, or handling areas for potential PCB-containing samples or reagents (DOE 1993).
- The machine shop (Room 160), weld shop (Rooms 146 and 149), and equipment rooms (Rooms 166, 171, and 110) contain equipment that requires lube oil and various other greases. Stains in the rooms and on the equipment may be a source of PCB contamination from lubricating oils used in the past (DOE 1993).
- Fluorescent light ballasts are a potential source of PCBs (DOE 1993).

Known releases of contaminants associated with the X-710 Technical Service Building include the following:

- Mercury spills from diffusion pumps on the mass spectrophotometer have resulted in contamination of the floor.
- Several instances of “smoking” sample U-tubes occurred when connecting or disconnecting containers to the spectrophotometer. The room containing the equipment has restricted access and is a designated radiation zone (DOE 1993).
- Several reports of spills or leaking polybottles used to store radioactive contaminated wastes were reported in Room 111 (low or unknown assay) and Room 103 (100 mL containing unknown assay of uranium, acetone, pyridine, bromopadop, ethanol, technetium-99, and arsenazo). Problems occurred when filling the polybottles because of the difficulty in visually determining the exact fill level in the bottles and the small openings on the bottles. Radioactive contamination exists around the polybottles (DOE 1993).

- A leak from a 55-gal hazardous waste drum occurred in the RCRA 90-day storage area in Room 103. The cause was unknown; either the drum was defective or the solvent was corrosive and damaged the drum. No additional information was available (DOE 1993).

- A 1 L bottle of n-heptane broke and spilled in Room 218. The air was monitored and clean-up activities were undertaken (DOE 1993).

- Dujet, a cleaning fluid (2 percent caustic), was kept in a drum in Room 103 (acid storage room). The spring-loaded valve had been left open, and Dujet overflowed a collection bucket. Less than 4 oz of Dujet had seeped through a masonry joint beneath a drain in the west wall of the room and had flowed down the exterior of the building to the ground. The drain was dry, indicating no cleaning solution had passed through it. No impact to the environment was reported (DOE 1993).

- In the uranium chain-of-custody area in Room 114, a cold trap fell onto the bench and the valve disengaged. The trap contained 935 g of UF_6. The valve was immediately repositioned, and the cold trap was moved to the fume hood in Room 111 and placed on dry ice (DOE 1993).

- Other documented spills include a 50 mL glass vial with 25 mg of dry sample from the biodenitrification operations and a tray spilling three beakers (200-300 mL) of a phenol solution that contained potassium ferricyanide. In both of these instances, the spills were cleaned up properly and control measures were taken (DOE 1993).

- Discharges from laboratory sinks and floor drains flowed into the X-710 Neutralization Pit, which then discharged into the sanitary sewer system. This included liquid samples and waste laboratory reagents (not organic solvents). Before 1985, solvent wastes were discarded down laboratory sinks. In the early days of operation, solvent wastes were discarded on the ground outside the building. A TCE plume is located nearby, and X-710 is suspected of being a potential source for the plume (DOE 1993).

- A release of 2,000 gal of RCW occurred on the north side of the building. RCW formerly contained chromates; therefore, the potential exists for chromate contamination into Storm Sewer G and the South Holding Pond (DOE 1993).

These instances are only a representative sample of occurrences related to the diverse procedures conducted in the X-710 Technical Service Building.

A.4.3.2 X-710A Technical Service Gas Manifold Shed

The X-710A Technical Service Gas Manifold Shed (Figure A.33), built in 1955, is a 37-ft-long, 26-ft-wide, open-air structure for the receiving, storing, and distribution of specialized high-pressure gases used in the laboratory areas of the X-710 Technical Service Building. It has a 6-ft-wide loading dock that extends the full length of the shed. The structure is located on the west side of the X-710 Technical Service Building (Figure A.30) and is served by a paved parking lot and driveway on 9th Street. The structure has a concrete platform and a shed-type, corrugated transite panel roof supported by steel framing. The structure is built approximately 4 ft off the ground. There are no walls, only a high chain-link fence to secure and enclose the gas manifolds and cylinder storage area. A concrete wall oriented north-south divides the shed into an east side and a west side. One area contains oxygen cylinders while the other contains hydrogen, liquid propane, and acetylene cylinders. Gas cylinders are connected to regulated piping manifolds serving the X-710 Technical Service Building. Aside from in-service cylinders, empty and full cylinders of these gases can be found at the shed. The shed is lighted by four fixtures that appear to contain mercury vapor lamps (U.S. Atomic Energy Commission [USAEC] 1957, LMES 1997, DOE 1993, TPMC 2006a, recent observations).

Figure A.33. X-710A Technical Service Gas Manifold Shed

No known radiological hazards are associated with the X-710A Technical Service Gas Manifold Shed.

ACM is present in the corrugated transite roofing on the shed. Lead-based paint may be present on the piping (connected to cylinders) that transports gases to the laboratory and on the cylinders themselves. Mercury may be present in mercury vapor lamps (DOE 1993).

No known releases are associated with the X-710A Technical Service Gas Manifold Shed.

A.4.3.3 X-710B Explosion Test Facility

The X-710B Explosion Test Facility (Figure A.34), built in 1956, is a reinforced concrete structure located approximately 75 ft west of the X-710 Technical Service Building (Figure A.30). The building was built to conduct experiments with unstable compounds that might result in an explosion. The building consists of an approximately 12-ft × 14-ft laboratory/control room area with an adjacent circular explosion test chamber, which is approximately 8 ft in diameter and 10 ft in height. It is equipped with explosion vents to relieve explosive pressure. The work area is separated from the test chamber by a shock-absorbing expansion joint. The building has 245 sq ft of floor space. A 42-cf fluorine pig is located approximately 12 ft east of the test chamber. Both the fluorine pig and the X-710B Explosion Test Facility are enclosed by a high chain link fence (USAEC 1957, LMES 1997, DOE 1993).

Figure A.34. X-710B Explosion Test Facility

The test chamber cannot be entered. A small opening between the laboratory/control room and the test chamber, which can be sealed off, is provided for piping. The explosion vents were directed toward an unoccupied controlled access area to mitigate any consequences of an explosion in the building. Blast-proof steel doors are provided for exterior access to the test chamber and to the work area. An 18- in. × 18-in., bullet-proof-glass vision panel and sleeves for remote control were provided for manipulation of test specimens. Other operational equipment included a fume hood with a powered exhauster and an acid-type sink that drained to the acid neutralization pit (USAEC 1957, LMES 1997, DOE 1993).

The building has not been used to conduct experiments for several years. Radiological contamination signs are posted on the door of the X-710B Explosion Test Facility to indicate the presence of radioactive contamination. A historical survey indicated that the radiological contamination is fixed (DOE 1993).

Chemical hazards associated with the X-710B Explosion Test Facility (DOE 1993) include the following:

- ACM associated with wiring and thermal insulation (DOE 1993)
- Due to the age of the building, lead-based paint may have been applied to surfaces.

Fluorine has been removed from the gas pig located outside the building. Small gas cylinders of unknown gases previously reported to be in the building (DOE 1993) have also been removed.

Releases of radiological contamination have occurred within the X-710B Explosion Test Facility, but the exact cause is uncertain (DOE 1993).

A.4.4 X-720 COMPLEX

The X-720 Complex consists of the X-720 Maintenance & Stores Building, X-720A Maintenance & Stores Gas Manifold Shed (below-grade structures), X-720B Radio Base Station, and X-720C Paint & Storage Building (Figure A.35).

Figure A.35. X-720 Complex (2006-2007 Aerial Photography)

A.4.4.1 X-720 Maintenance & Stores Building

The X-720 Maintenance & Stores Building contains 312,000 sq ft of space used for maintenance of process and auxiliary equipment, to house spare parts and expendables, and for equipment testing and inspection (Figure A.36). The building houses carpenter, paint, sheet metal, utility and process maintenance, electrical, compressor, motor, seal, instrument, crane, sign, valve, gauge, spectrometer, and refrigeration shops (Figures A.37 and A.38). The south one-third of the floor space is a stores supply room. A second floor office area is located on the south side. Several office areas are located throughout the building to support the various shops. At the southeast corner, there is a Code Inspection work area that includes an environmentally controlled Gage Laboratory for inspecting parts to dimensional specifications. Document Records storage has been relocated to the southwest corner.

Figure A.36. X-720 Maintenance & Stores Building

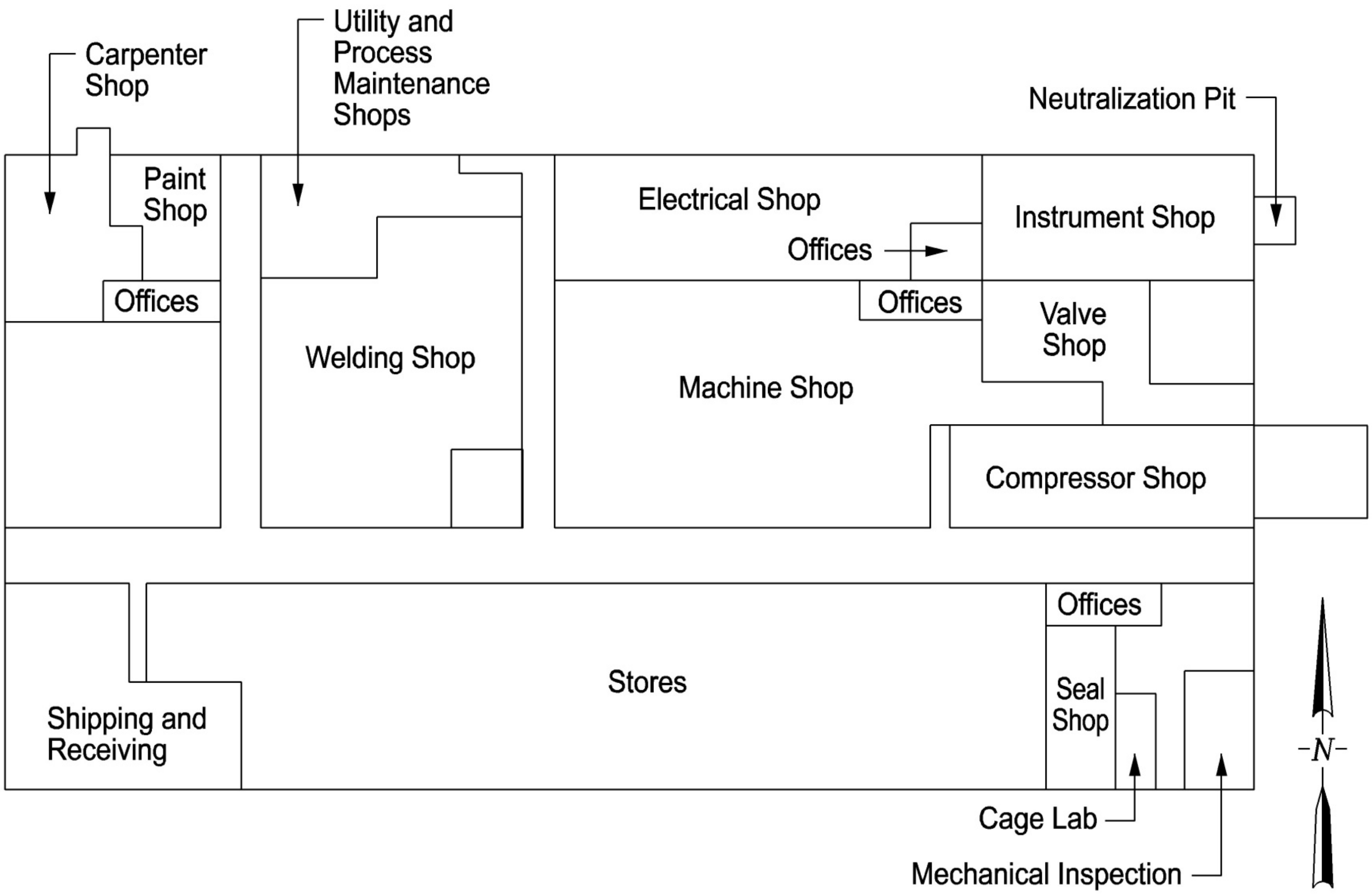


Figure A.37. **X-720 Maintenance & Stores Building Layout**

Figure A.38. X-720 Maintenance & Stores Building Shop Areas

The electrical shop has two 300-gal stainless steel tanks contained within a 16-in. dike that contained motor wash generated from motor cleaning. The tanks have been emptied. An 8-ft-deep pit in this area contains two varnish dip tanks extending above floor level. These tanks contained vinyl toluene (DOE 1993).

The paint shop includes a large spray booth (sufficient size to paint a half-ton truck) equipped with waterfall ventilation and a drying oven (LMES 1997).

Stored raw materials include paints; paint thinners; mineral spirits; glues; wood preservatives; various solvents; toluene reagent; silver plating; HNO_3; phosphoric acid; ammonia; acetone; methyl ethyl ketone; 1,1,1-trichloroethane; acetylene; mercury metal; Freon; motor oil; vinyl toluene; and cleaning/etching solutions. Stored waste included radioactive materials, used acetone, paint waste, rags, wipes, gloves, aerosol cans, fluorescent and other light bulbs, used solvents, PCB oil, and mineral oil. Any currently stored wastes are managed in radioactive materials storage areas, satellite accumulation areas, and 90-day RCRA storage areas.

Outside of the building, there are two 1,000-gal tanks that contained TCA, an abandoned neutralization pit on the northeast side, a 764-gal transformer contaminated with PCBs, a fuel oil UST of unknown size, and a 250-gal gasoline AST.

The X-720 Neutralization Pit, located outside the northeast corner of the building, and nearby soils were removed in November 1998 under other regulatory authority, except for the bottom and west wall, which were left in place because of constraints imposed by the pit's proximity to the X-720 building foundation. The resulting hole was filled with approximately 50 cy of concrete.

Portions of certain shops (machine, compressor, motor, instrument, and valve shops) are radiological CCZs. Fixed contamination is present in the floors of these shops. The Neutralization Pit and a concrete pad on the outside of the building are also contaminated (DOE 1993, TPMC 2006a).

Known or potential chemical hazards associated with the X-720 Maintenance & Stores Building include the following:

- ACM is reported to be in the building in the form of thermal system insulation (DOE 1993, TPMC 2006a).

- Considering the age of the building, lead-based paint may have been applied to various surfaces within it (DOE 1993).

- Sources of potential PCB contamination include PCB-impregnated ventilation duct gaskets that may exceed 500 ppm, fluorescent light fixtures that may contain PCB ballasts, and a transformer (764 gal) located near the north side of the building (DOE 1993, TPMC 2006a). The fluorescent bulbs may contain mercury.

- Beryllium contamination is present in the compressor shop and some elevated portions of the high-bay superstructure (TPMC 2006a).

- Raw materials used and stored in the building include toluene reagent; silver-plating chemicals; HNO_3; phosphoric acid; ammonia; acetone; methyl ethyl ketone; 1,1,1-trichloroethane; acetylene; mercury metal; lead-based paint; wood glues and preservatives; various solvents; paint thinners; mineral spirits; Freons; motor oil; vinyl toluene; PCB oils; fuel oil; and gasoline (DOE 1993, TPMC 2006a).

- Plating, cleaning, and decontamination processes utilized alcohols, acids (nitric, sulfuric, hydrochloric), sodium hypophosphate, and detergents (LMES 1997).

- Hazardous substances associated with the wastewater discharge of process water include several volatile organic compounds (VOCs) (TCE, TCA, dichloroethylene, methylene chloride), metals (nickel, cadmium, lead, mercury, and zinc), and radionuclides (uranium and technetium-99) (DOE 1993).

- Wastes stored in the building include radioactive wastes, metals, used acetone, paint wastes, rags, wipes, gloves, aerosol cans, fluorescent and other light bulbs, and PCB oils (DOE 1993).

Acidic, metal-bearing wastewaters from the X-720 Maintenance & Stores Building were discharged into the Neutralization Pit and subsequently infiltrated to the groundwater (DOE 1993).

On July 21, 1980, cyanide was discharged (12 to 20 gal) to the floor drain in the plating room located on the east side of the building. The floor drain discharged to the neutralization pit (DOE 1993).

A.4.4.2 X-720A Maintenance & Stores Gas Manifold Shed (below grade structures)

The X-720A Maintenance & Stores Gas Manifold Shed (Figure A.39), built in 1954, was a 1,000-sq ft structure consisting of steel posts and a metal roof sitting on an elevated concrete platform. The structure was located immediately northeast of the X-720 Maintenance & Stores Building (Figure A.35) and was used as a filling station for gas cylinders (oxygen, hydrogen, propane) used throughout the plant. The above-grade portion of the structure was removed in 2006 after a NEPA review. Removal of any remaining below-grade structures (foundations, etc.) is addressed in this RI/FS.

A.4.4.3 X-720B Radio Base Station

The X-720B Radio Base Station Building (Figure A.40) is an 800-sq ft, metal auxiliary shop building located west of the X-720 Maintenance & Stores Building (Figure A.35). The X-720B building, constructed in 1978, was used to store and maintain communications equipment (Figure A.41). The water used in this building is supplied by the X-611 Water Treatment Plant. The sanitary sewer from the restroom in the building discharges to the X-6619 Sewage Treatment Plant. There are no floor drains or other wastewater discharge points at the building. The storm water runoff discharges to the East Drainage Ditch (DOE 1993). Currently, the X-720B building houses the plant communications system repeater. There are no known USTs, ASTs, or below-grade structures associated with this building.

Figure A.39. X-720A Maintenance & Stores Gas Manifold Shed Prior to Demolition

No known radiological hazards are associated with the X-720B Radio Base Station (DOE 1993, TPMC 2006a).

The building has ACM in piping insulation, potential lead-based paint on surfaces, and PCBs in fluorescent light fixture ballasts (DOE 1993).

Figure A.40. X-720B Radio Base Station

Figure A.41. X-720B Radio Base Station Interior

A.4.4.4 X-720C Paint & Storage Building

The X-720C Paint & Storage Building (Figure A.42) is a 4,200-sq ft, masonry-over-concrete-block storage building that sits on a concrete slab located at the northwest corner of the X-720 Maintenance & Stores Building (Figure A.35). A 6-in. dike is formed by the foundation. For approximately 13 years, the building was used for general storage. The building stores a wide variety of paints and solvents in the north half, and a variety of lubricating fluids are stored in the south half (Figure A.43). The building was constructed in 1980 (DOE 1993, TPMC 2006a). No below-grade structures are associated with this building.

Figure A.42. X-720C Paint & Storage Building

Figure A.43. X-720C Paint & Storage Building Stored Items

No known radiological hazards are associated with the X-720C Paint & Storage Building (DOE 1993, TPMC 2006a).

Known or potential chemical hazards associated with the X-720C Paint & Storage Building include the following:

- The building stores various lubricating and hydraulic oils and greases, Freon II, flammable liquids, paints, and solvents (DOE 1993, TPMC 2006a).
- The building contains a RCRA 90-day storage area for 55-gal drums of De-Sol-It solvent with oil and grease mixed with water (mostly paint-related wastes such as solvents, thinners, etc.) (DOE 1993).
- Wastes originating from other sources but managed at this building include motor solution (oil and grease), valve oil, and spent solvent (DOE 1993).
- Considering the age of the building, it may have been painted with lead-based paint (red, yellow, and orange caution colors) (DOE 1993).
- No ACM has been found in the building (DOE 1993).
- Fluorescent light fixtures and bulbs may contain PCBs and mercury.

Small stains are on the floor in the X-720C Paint & Storage Building in the southern half of the building near the nonhazardous oil storage area. There are no known releases of hazardous materials or products in the building, and there is no known contamination to the building from historic waste management activities (DOE 1993).

A.5 SUPPORT FACILITIES AND SYSTEMS

The support facilities and systems have been further subdivided into the following major categories: Administrative Facilities; Water Treatment, Storage, and Distribution Facilities; Sewage Collection and Treatment Facilities; Electrical Distribution Systems and Facilities; Miscellaneous Utilities; Infrastructure; Storage and Warehouse Facilities and Yards; Environmental Monitoring and Treatment Facilities; and Associated Nonstructural Support Systems.

A.5.1 ADMINISTRATIVE FACILITIES

The following administrative facilities are included in the scope of this RI/FS:

- 25 trailers
- 10 portals
- X-100 Office Building (slab and below-grade structures)
- X-104A Indoor Firing Range Building
- X-105 Electronic Maintenance Building (front apron/concrete pad and driveway)
- X-106B Old Fire Training Building (slab and below-grade water tank)
- X-300 PCF
- X-300A Process Monitoring Building
- X-300B Plant Control Facility Carport

- X-300C Emergency Communications Antenna
- X-533H Personnel Monitoring Station
- X-540 Telephone Building
- X-750 Mobile Equipment Maintenance Shop (slab and below-grade structures)
- X-751 [Gas Centrifuge Enrichment Plant] GCEP Mobile Equipment Garage
- X-1000 Administration Building
- X-1007 Fire Station
- "J" X-1000 Pavilion
- XT-800 GCEP Construction Office Pad.

A.5.1.1 Trailers

Table A.2 provides a list and description of the trailers included within the scope of this RI/FS.

Table A.2. Trailers

Trailer No.	Location	Size	Construction	Concrete Pad
X-104B [XT-104B]	X-104 Guard Headquarters	4-wide (48 ft × 60 ft)	Metal	No
X-104C [XT-104C]	X-104 Guard Headquarters	5-wide (58 ft × 60 ft)	Metal	No
X-530 T1	X-530A High Voltage Switchyard	Single-wide (12 ft × 60 ft)	Metal	No
X-533 T1	X-533 Switchyard	Single-wide (12 ft × 60 ft)	Metal	No
X-533 T2	X-533 Switchyard	Single-wide (14 ft × 70 ft)	Vinyl	No
X-533 T3	X-533 Switchyard	Single-wide (14 ft × 70 ft)	Vinyl	No
X-533 T4	X-533 Switchyard	Single-wide (14 ft × 70 ft)	Vinyl	No
X-600D	X-600 Steam Plant	Single-wide (12 ft × 60 ft)	Wood	No
X-633 T1	X-633 RCW Complex	Single-wide (14 ft × 70 ft)	Vinyl	No
X-633 T2	X-633 RCW Complex	Single-wide (12 ft × 60 ft)	Metal	No
X-633 T3	X-633 RCW Complex	Single-wide (14 ft × 70 ft)	Vinyl	No
X-720 T01	X-720 Maintenance & Stores Building	Single-wide (14 ft × 60 ft)	Metal	No
X-744Y T1	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T2	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T3	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T4	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T5	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T6	X-744Y Waste Storage Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-744Y T8	X-744Y Waste Storage Area	Single-wide (12 ft × 60 ft)	Metal	No
X-744Y T9	X-744Y Waste Storage Area	Double-wide (30 ft × 60 ft)	Wood	No
X-760 T1	X-760 Chemical Engineering Building Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-760 T2	X-760 Chemical Engineering Building Area	Single-wide (14 ft × 70 ft)	Vinyl	No
X-1000 T1	X-1000 Administration Building	Double-wide (24 ft × 58 ft)	Wood	No

RCW = recirculating cooling water

A.5.1.2 X-108A South Portal and Shelter-Drive Gate

The X-108 South Portal (Figure A.44), located near the X-104 Guard Headquarters (not in this RI/FS), occupies approximately 1,000 sq ft of covered area and has been used as a security check point since it was built in 1955. There is a covered drive gate and a small restroom with sanitary water and sewer utilities. A pole-mounted transformer, located to the west of the portal, may contain PCB-contaminated oil. Fluorescent light fixtures may also contain ballasts with PCBs and bulbs containing mercury. Considering the age of the structure, lead-based paint may be present on surfaces (DOE 1993, TPMC 2006a).

Figure A.44. X-108A South Portal

A.5.1.3 X-108B North Portal and Shelter

The X-108B North Portal (Figure A.45), located near the southeast corner of the X-720 Maintenance & Stores Building, occupies approximately 330 sq ft, some of which is a porch facing Knox Avenue. It has been used as a security check point since it was built in 1955. It has no sanitary water or sewer connections. A pole-mounted transformer located outside the structure may contain PCB-contaminated oil. Fluorescent light fixtures may also contain ballasts with PCBs and bulbs containing mercury. Considering the age of the facility, lead-based paint may be present on surfaces (DOE 1993, TPMC 2006a).

Figure A.45. X-108B North Portal and Shelter

A.5.1.4 X-108E Construction Entrance Portal

The X-108E Construction Entrance Portal (Figure A.46), located on the west side of the plant between the X-330 and X-326 Process Buildings, occupies approximately 600 sq ft and includes an uncovered vehicle drive gate and a small restroom with sanitary water and sewer utilities. It has been used as a security check point since it was built in 1975. Fluorescent light fixtures may contain ballasts with PCBs and bulbs containing mercury. Considering the age of the structures, lead-based paint may be present on surfaces (DOE 1993, TPMC 2006a).

Figure A.46. X-108E Construction Entrance Portal

A.5.1.5 X-108J West Security Portal

The X-108J West Security Portal (Figure A.47) is an approximately 12-ft × 10-ft × 9-ft structure with metal siding and a roof. The interior has paneling on the walls and ceiling. The awning is approximately 43 ft × 22 ft and is constructed of steel supports, metal trusses, roofing, and siding. The smaller building measures approximately 4 ft × 3 ft × 7 ft and is constructed of 1/8-in. sheet metal.

Figure A.47. X-108J West Security Portal

A.5.1.6 X-108K North Security Portal

The X-108K North Security Portal (Figure A.48) is an approximately 12-ft × 10-ft × 9-ft structure with metal siding and a roof. The interior has paneling on the walls and ceiling.

Figure A.48. X-108K North Security Portal

A.5.1.7 X-108L East Security Portal

The X-108L East Security Portal (Figure A.49) is an approximately 8-ft × 8-ft × 8-ft structure with metal siding and a roof. The interior has paneling on the walls and ceiling.

Figure A.49. X-108L East Security Portal

A.5.1.8 X-111A SNM Monitoring Portal

The X-111A SNM Monitoring Portal (Figure A.50) is a 900-sq ft building of partial masonry construction (approximately 50 percent of the complex) with a concrete floor and steel roof. Two metal pedestrian entrance portals are attached to the masonry structure to the east and west sides (approximately 10 percent of the complex). A metal drive through portal with powered roll-up doors is attached to the south side of the masonry structure (approximately 40 percent of the complex). The complex was a security portal, built in 1981 for employees and equipment entering and exiting the X-326 Process Building, but it is no longer in use. No below-grade structures are associated with the portal (DOE 1993).

There is localized radiological contamination within the structures, and a fixed contamination area is present at one door entrance. Additional assessment is required. Floor tile may potentially contain ACM, and fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury. Paint, which may potentially be lead-based, is peeling from internal and external surfaces (DOE 1993).

Figure A.50. X-111A SNM Monitoring Portal

A.5.1.9 X-111B SNM Monitoring Portal

The X-111B SNM Monitoring Portal (Figure A.51) is a 300-sq ft building of partial masonry construction (approximately 75 percent of the complex) with a concrete floor and steel roof. One metal pedestrian entrance portal is attached to the masonry structure on the south side (approximately 25 percent of the complex). This complex was a security portal, built in 1981, for employees and equipment entering and exiting the X-326 Process Building. The portal is not currently in use. No below-grade structures are associated with this portal (DOE 1993, TPMC 2006a).

Figure A.51. X-111B SNM Monitoring Portal

The X-111B facility has internal radiological contamination. A trash can and door contain fixed contamination. Additional assessment is required. Floor tile may potentially contain ACM, and fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury. Paint, which may potentially be lead-based, is peeling from internal and external surfaces (DOE 1993; TPMC 2006a).

A.5.1.10 X-344H Security Portal

The X-344H Security Portal (Figure A.52) is an approximately 8-ft × 8-ft × 13-ft structure constructed of ¼-in. to ½-in. sheet steel. The building sits on a steel frame that is approximately 42 in. high. Lead-based paint may have been used on exterior and interior surfaces.

Figure A.52. X-344H Security Portal

A.5.1.11 X-1107BV Interplant Vehicle Portal

The X-1107BV Interplant Vehicle Portal (Figure A.53) is a cinder block building on a concrete slab. It was built in 1985 to serve as a security check point for vehicles. The building is equipped with bullet-proof glass and hardened walls to protect a security guard, and it contains a water fountain and a restroom. This building also contains a small storage area the Fire Department uses to store firefighting equipment, including portable air tanks used by firefighters as self-contained breathing apparatuses (DOE 1993).

Lead-based paint may have been used on internal and exterior surfaces. No PCB equipment or PCB-contaminated equipment is known to be present (DOE 1993).

Figure A.53. X-1107BV Interplant Vehicle Portal

A.5.1.12 X-100 Office Building (slab and below-grade structures)

Disposition of the X-100 Office Building (Figure A.54) above-grade structures is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). This RI/FS addresses the below-grade structures (concrete slabs on-grade, basement, foundations, footings, etc.) remaining following disposition of the above-grade structures. No known USTs are associated with this building.

Figure A.54. X-100 Office Building

A.5.1.13 X-104A Indoor Firing Range Building

Built in the early 1980s, the X-104A Indoor Firing Range Building (Figure A.55) is a 3,600-sq ft, single-story cinder block and reinforced concrete building. The firing range is 25 yd long, has a steel bullet trap at the east end, and contains six shooting stations. It also has an office, a training room, and an ammunition locker. An intake fan on the north side of the building and an exhaust fan equipped with a high-efficiency particulate air (HEPA) filter on the east side of the building provide negative air flow past the shooting stations. The HEPA filters remove lead particles from the air prior to discharge. Potential sources of contamination to structures and equipment include lead from waste bullets, cadmium from brass or steel casings, lead in cleaning solutions, used filters, PPE, and floor sweepings stored in satellite accumulation areas. There are no known ASTs or USTs (DOE 1993, TPMC 2006a).

Figure A.55. X-104A Indoor Firing Range Building

A.5.1.14 X-105 Electronic Maintenance Building (front apron/concrete pad and driveway)

The X-105 Electronic Maintenance Building above-grade structures and building concrete slab were removed after a NEPA review in 2006. This RI/FS addresses the remaining front apron/concrete pad, driveway, and any below-grade structures (footers, etc.) (Figure A.56).

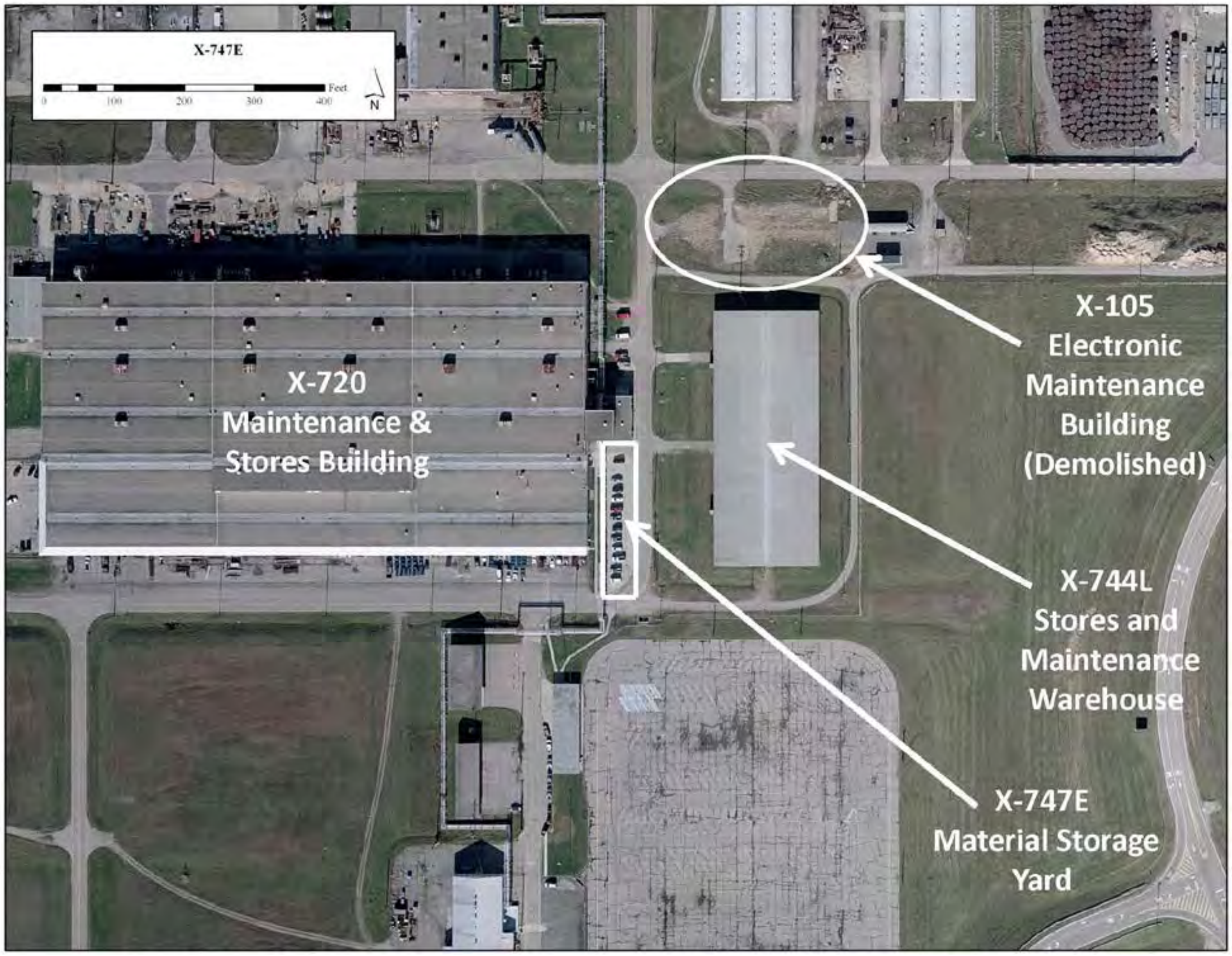


Figure A.56. X-105 Electronic Maintenance Building Location (2006-2007 Aerial Photography)

A.5.1.15 X-106B Old Fire Training Building (slab and below-grade water tank)

The X-106B Old Fire Training Building above-grade structures were removed after a NEPA review in 2006 (Figure A.57). This RI/FS addresses the remaining below-grade structures (concrete floor slab, footers, etc.) and a below-grade water tank. The water tank is located approximately 100 ft to the south of the X-106C New Fire Training Building (not part of this RI/FS), and it is approximately 12 ft long, 6 ft wide, and 12 ft deep. The PORTS Fire Department uses this tank to check the pumps on pumper trucks.

Figure A.57. X-106B Old Fire Training Building Location (2006-2007 Aerial Photography)

A.5.1.16 X-300 Plant Control Facility

The X-300 PCF (Figure A.58), located east of the X-326 Process Building (Figure A.59), was built in the early 1950s and is a dome-shaped, circular building that is approximately 110 ft in diameter. It consists of a reinforced concrete ground floor with the Plant Shift Superintendent's office, Cascade Control Center, Power Operations Supervisory Control and Data Acquisition (SCADA) Annex, and a basement, which together provide a combined floor space of 16,000 sq ft. The X-300 PCF is the control center for all gaseous diffusion plant (GDP) operations. This building houses personnel and equipment for 24-hour coordination, senior management oversight, supervision, incident command for plant emergencies, direction of GDP processes, and oversight of the DOE reservation.

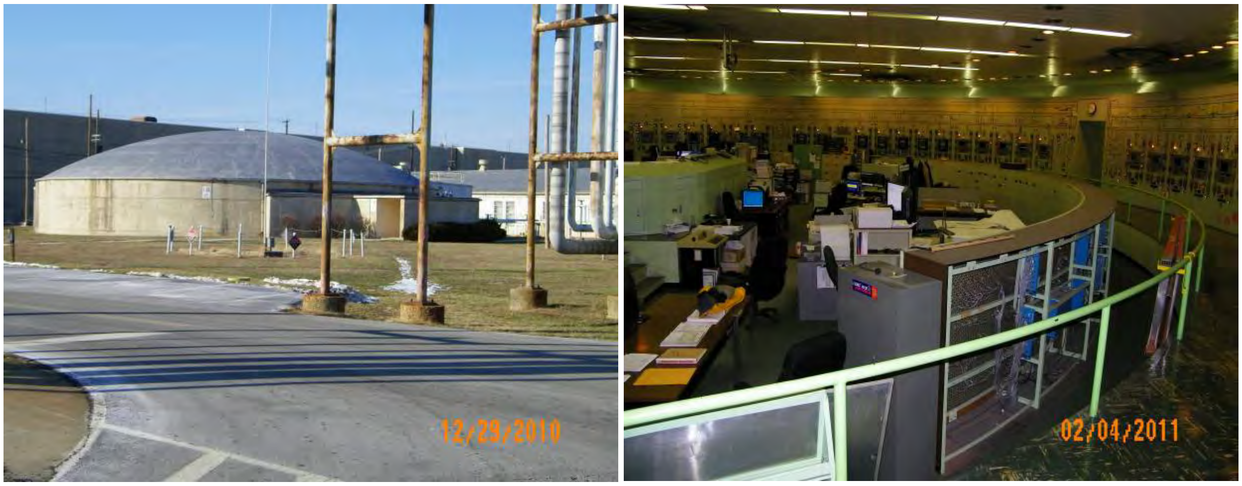


Figure A.58. X-300 Plant Control Facility

Figure A.59. X-300 Structure Location (2006-2007 Aerial Photography)

Personnel in this building oversee a variety of operations, which include the following:

- Monitoring conditions vital to the cascade and power system (shut down, sectionalize, or monitor the performance of process systems after the evacuation of operating personnel)
- Monitoring and adjusting the power load of the entire plant
- Controlling and monitoring the Criticality Accident Alarm System (CAAS), fire protection systems, emergency evacuation, plant radio system, plant accountability system, public address (PA) systems, and other alarms, which include some alarms from other plant operations (Babcock and Wilcox Conversion Services, American Centrifuge Plant [ACP], etc.).

Supervisory control equipment, offices, and auxiliary rooms are located on the ground floor, and building power equipment, communications equipment, and air-conditioning and ventilation equipment are located in the basement. The X-300 PCF has control and instrumentation tunnels that extend from the basement to each of the process buildings. Communication, control, and instrumentation cables from each of the six ACRs, the switch houses, and the telephone building enter the X-300 PCF building through these tunnels. The SCADA system provides monitoring and/or control of selected portions of the plant's electrical system (DOE 1993).

Utilities in this building include electricity, telephones, sanitary water and sewer connections, heat (provided from the steam plant), central air conditioning, and a sprinkler system. The SCADA Annex contains an emergency generator and banks of batteries for backup power. Water is supplied to the X-300 PCF building from the plant sanitary water system. This water goes to the kitchen, showers, restrooms, and a sprinkler-type fire protection system. The sanitary wastewater discharges (bathrooms, kitchen, janitor sink, and floor drains) are connected to the sanitary sewer. Surface water runoff from the buildings and grounds discharges to Storm Sewer F, which goes to the X-230K South Holding Pond. This pond is a quiescent zone for settling of suspended solids, dissipation of chlorine, and pH adjustment (DOE 1993).

A 2,000-gal, fiberglass-reinforced plastic diesel fuel UST provides fuel to the emergency generator. This tank, which replaced a steel tank of the same capacity that had been installed in 1954, was installed in August 1983 and has been used only for diesel fuel. There are no reported leaks from either the tank or generator, and there is no visible evidence of contamination (DOE 1993). No known ASTs are associated with the building.

Raw materials present include diesel fuels, battery acids, and small amounts of janitorial supplies. Fluorescent light fixtures may have ballasts containing PCBs, and the bulbs may contain mercury. Lead-based paint may have been used on painted surfaces. ACM is present in thermal insulation and cable trays, and is also suspected in floor tile. The ventilation system may contain PCB-impregnated gaskets (DOE 1993, TPMC 2006a).

The battery room inside this building shows evidence of some battery leakage to the floor. The floor drain in the battery room could allow spills from the batteries to reach the sanitary sewer (DOE 1993).

A.5.1.17 X-300A Process Monitoring Building

The X-300A Process Monitoring Building (Figure A.60), located west of the X-300 PCF (Figure A.59), was built about 1954. It covers an area of 1,400 sq ft. The building sits on a concrete slab and has masonry exterior walls and covers. The X-300A building housed the former telephone exchange, but now contains electronic monitoring equipment, including the computer processing units for the abandoned electronic cascade monitoring systems (TPMC 2006a). The building also contains a diesel generator and a battery room with batteries still present. The electronic monitoring equipment, computers, and generator in this building are not in use.

Figure A.60. X-300A Process Monitoring Building

Utilities in the building include electricity, telephones, heat, central air conditioning, smoke detectors, motion detectors, heat detectors, and a sprinkler-type fire protection system. The only known water supplied to the X-300A building was firefighting water from the sprinkler-type fire protection system. The X-300A building is not connected to the sanitary sewer and does not have any septic systems or leach fields (DOE 1993). No known ASTs or below-grade structures are associated with this building. A 5,000-gal diesel fuel UST located north of the building is currently in use and supplies diesel fuel to a generator in X-300A and one in X-300.

Considering the age of the building, lead-based paint may have been applied to the walls. Fluorescent light fixtures may contain PCBs in the ballasts and mercury in the bulbs. Floor tile may be ACM. No known radiological hazards or contamination is associated with this building (DOE 1993, TPMC 2006a).

A.5.1.18 X-300B Plant Control Facility Carport

The X-300B Plant Control Facility Carport (Figure A.61), located northeast of the X-300 PCF (Figure A.59), which was built in 1985, is a 15-ft × 25-ft (375 sq ft) concrete slab with a corrugated metal roof. This carport provides parking space for two vehicles.

The carport is not connected to the sanitary sewer and does not have any septic systems or fields. There is no known water supply to this structure (DOE 1993), and no known USTs or ASTs are associated with the carport. No below-grade structures are associated with this carport.

Considering the age of the carport, fluorescent light fixtures may contain PCBs in the ballasts and mercury in the bulbs, and lead-based paint may have been applied to the surfaces of the structure. An asbestos survey of the carport found no asbestos (DOE 1993, TPMC 2006a).

Figure A.61. X-300B Plant Control Facility Carport

A.5.1.19 X-300C Emergency Communications Antenna

The X-300C Emergency Communications Antenna (Figure A.62), located southeast of the X-300 PCF (Figure A.59), is a single, tapered metal staff centered in a 20-ft-diameter cleared area. The structure, which was built in 1985, is located southeast of the X-300 PCF (DOE 1993). This low-frequency radio transmission antenna provides support emergency communications with Oak Ridge and DOE (TPMC 2006a). There are no below-grade structures.

Considering the age of this structure, lead-based paint may have been applied to its surfaces. An asbestos survey of the antenna found no asbestos (DOE 1993, TPMC 2006a).

Figure A.62. X-300C Emergency Communications Antenna

A.5.1.20 X-533H Personnel Monitoring Station

The X-533H Personnel Monitoring Station (Figure A.63), located at the east side of the X-533 Switchyard, is a single-wide trailer used as an assembly point for personnel evacuating buildings served by the CAAS, if an alarm systems sound or PA system announcements are initiated. This trailer has been used routinely to conduct evacuation drills.

Figure A.63. X-533H Personnel Monitoring Station

A.5.1.21 X-540 Telephone Building

The X-540 Telephone Building (Figure A.64) is a 2,700-sq ft, single-story masonry building constructed on a concrete pad. This building was constructed in 1954 and is located south of the X-101 Dispensary (Figure A.65). The building contains telephone switch exchange computer equipment, offices, and a work area for telephone company contractor personnel. The building also has an 80-gal halon fire extinguishing system to protect the telephone electronic systems and 24 lead acid batteries for backup power. Waste circuit boards containing lead and silver are stored in the building. No below-grade structures are associated with the building.

Figure A.64. X-540 Telephone Building

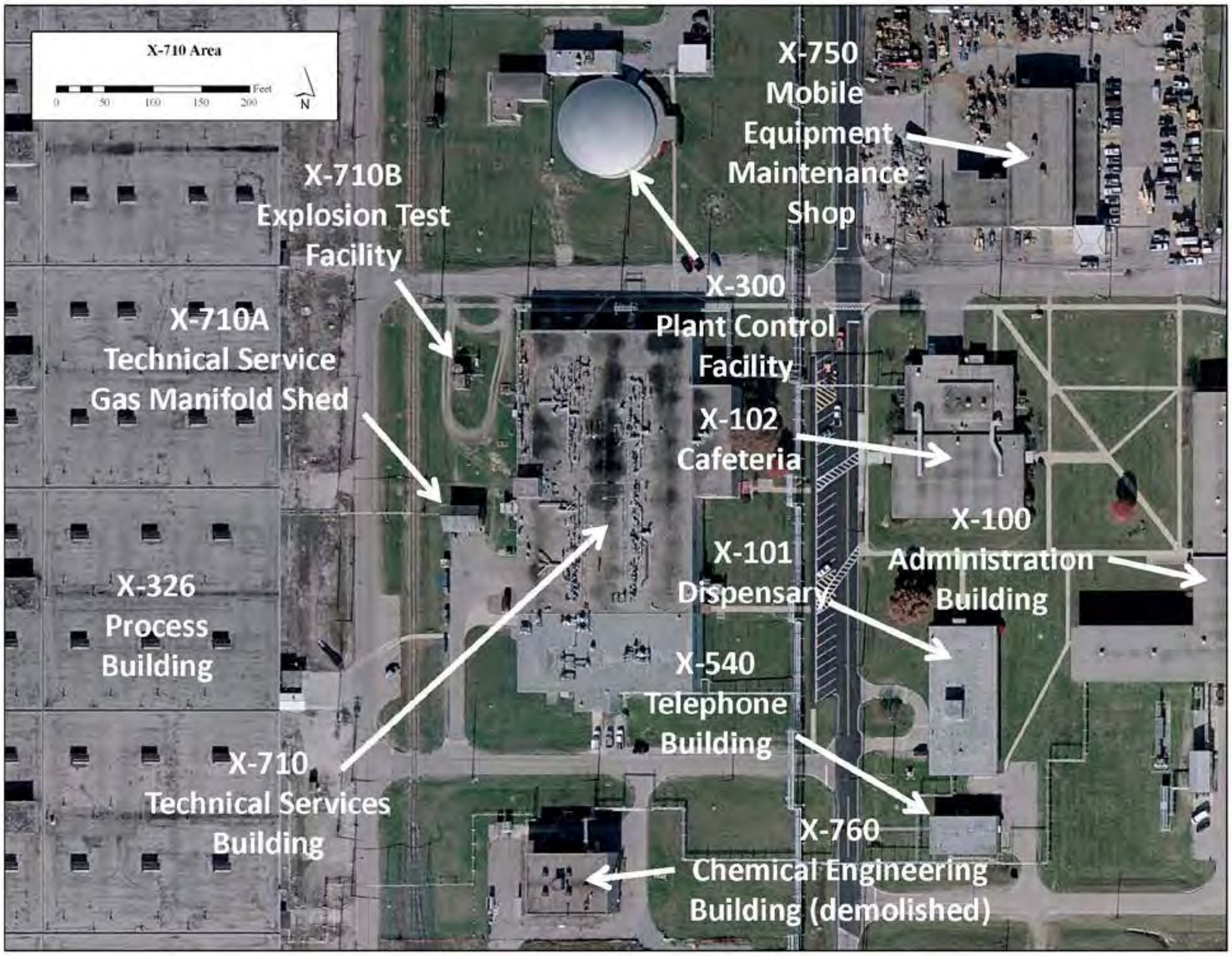


Figure A.65. X-540 Telephone Building Location (2006-2007 Aerial Photography)

A.5.1.22 X-750 Mobile Equipment Maintenance Shop (slab and below-grade structures)

Disposition of the X-750 Mobile Equipment Maintenance Shop (Figures A.65 and A.66) above-grade structures is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). This RI/FS addresses the below grade structures (pits, foundations, footings) remaining after disposition of the above-grade structures. Two USTs are associated with this building, a 20,000-gal gasoline fuel UST and a 20,000-gal diesel fuel UST. These fuels are dispensed into mobile equipment at PORTS (DOE 1993).

Figure A.66. X-750 Mobile Equipment Maintenance Shop

A.5.1.23 X-751 GCEP Mobile Equipment Garage

The X-751 Mobile Equipment Garage (Figures A.67) is a 16,360-sq ft building constructed on a concrete slab and having metal exterior walls. The building was constructed in 1979 and designed to maintain vehicles and mobile equipment for GCEP construction. Currently, the building is being used as a general Ohio National Guard mobile equipment garage and maintenance shop, and has served in this capacity since 1988. Electricity, fire water, drinking water, RHW, sanitary sewer, and telephone service are provided to the building. Fire water and drinking water are supplied to the building via the plant water treatment system. The sanitary sewer from the building discharges to the X-6619 Sewage Treatment Plant. No floor drains or catch basins are present at the building (DOE 1993).

Figure A.67. X-751 Mobile Equipment Garage

Four confirmed USTs are associated with this building, including three 15,000-gal tanks constructed of fiberglass and located near the southeast corner of the building. These tanks were removed from service in 1991. A 1,000-gal UST on the north side of the building is currently being used by the Ohio National Guard for waste oil storage. A fifth UST, a 550-gal fiberglass tank, was reportedly installed near the southwest corner of the building. Its existence has not been verified, and it is assumed not to exist. These tanks were installed in the 1978-1979 timeframe (DOE 1993). No known ASTs are associated with the building.

A.5.1.24 X-1000 Administration Building and "J" X-1000 Pavilion

The X-1000 Administration Building (Figure A.68), constructed in 1981 for GCEP, is a 73,700-sq ft (302-ft × 122-ft) modern, two-story (32 ft in height), steel-framed building on a concrete slab. It is constructed of concrete blocks, has a brick exterior, and is covered with a metal deck built-up roof. The interior is dry wall construction and contains both closed and open-module office areas. This building is located in the south central part of PORTS (Figure A.69). The "J" X-1000 Pavilion is an approximately 30-ft × 30-ft poured concrete slab with metal support posts and a roof.

Figure A.68. X-1000 Administration Building

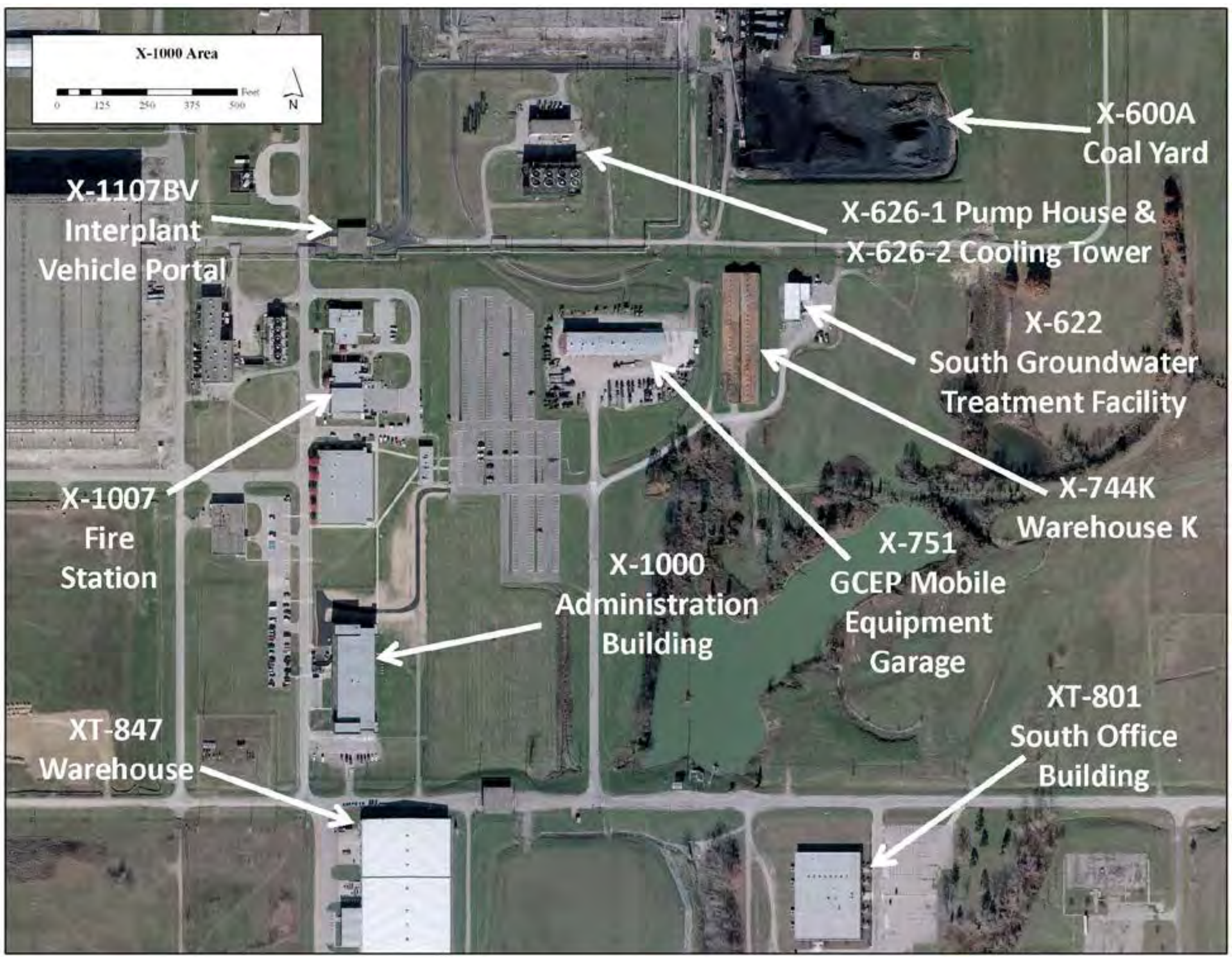


Figure A.69. X-1000 Administration Building Area (2006-2007 Aerial Photography)

Organizations formerly housed in the building include the Safety and Health Division, the Environmental and Waste Management Division, an Environmental Laboratory that prepared environmental samples, the Security Department, and a Thermoluminescent Dosimeter (TLD) Processing Laboratory that monitored and calibrated TLD badges. The majority of these organizations occupied the building until April 2000. The building was inactive and normally unoccupied, except for a second floor document storage vault and adjacent TLD badge processing area, until October 2004. It was then renovated and is currently used to support administrative functions for DOE and their contractors. Power to the building is supplied from the X-5000 Switchyard (not part of this RI/FS) by way of an outdoor, pad-mounted transformer. The building supplies power to the X-1107A and X-1107B portals (neither part of this RI/FS) and the X-1000 T1 Training Trailer.

No known radiological or chemical contamination is associated with this building.

A.5.1.25 X-1007 Fire Station

The X-1007 Fire Station (Figure A.70), built in 1981, is constructed of concrete block and brick and encloses 13,500 sq ft. It houses the Fire Department's mobile equipment, alarm room, and fire station offices. The mobile emergency equipment includes pumpers, emergency trucks, and ambulances. This building also contains a first-aid room, kitchen area, and equipment storage. The station has an emergency generator with an associated 120-gal steel diesel fuel UST located on the northeast side of the building. The building was used as administrative offices for GCEP operations from 1981 to 1984. It has served as the fire station from 1984 to the present (DOE 1993, TPMC 2006a).

Figure A.70. X-1007 Fire Station

A.5.1.26 XT-800 GCEP Construction Office Pad

The XT-800 GCEP Construction Office Building (Figure A.71) was a temporary building used during the 1970s. The building was demolished during the 1980s. The building's paved parking lot, just south of the building, was converted to a storage yard. Excavated material from a fuel tank removal was stored on the south side of the lot. This material was treated by tilling and drying.

Figure A.71. XT-800 GCEP Construction Office Pad (2006-2007 Aerial Photography)

A.5.2 WATER TREATMENT, STORAGE, AND DISTRIBUTION FACILITIES

The following water treatment, storage, and distribution facilities are included in the scope of this RI/FS. Those portions used by other operations at PORTS would remain.

- X-230 Water Supply Line
- X-230A Sanitary and Fire Water Distribution System
- X-230D Softened Water Distribution System
- X-230E Plant Water System (make up)
- X-230F Raw Water Supply Line
- X-230G RCW System
- X-230H Fire Water Distribution System
- X-240A RCW System (Cathodic Protection System)
- X-605 Sanitary Water Control House
- X-605A [X-605G] Well Field (elevated transformer structure and transformer)
- X-608 Raw Water Pump House
- X-608A Well Field (elevated transformer structure and transformer)

- X-608B Well Field (elevated transformer structure and transformer)
- X-611 Water Treatment Plant (slab and below-grade structures)
- X-611A Old Lime Sludge Lagoon (structures)
- X-611B Lagoon (structures) [X-611B Transformer]
- X-611B1 Lagoon Supernatant Pumping Station
- X-611B2 Lagoon Supernatant Pumping Station
- X-611B3 Lagoon Supernatant Pumping Station
- X-611C Filter Building (slab and below-grade structures)
- X-611E Clear Well & Chlorine Building (slab and below-grade structures)
- X-612 Elevated Storage Tank (below-grade structures)
- X-626-1 Recirculating Water Pump House (slab and below-grade structures)
- X-626-2 Cooling Tower (below-grade structures)
- X-630-1 Recirculating Water Pump House (slab and below-grade structures)
- X-630-2A Cooling Tower (below-grade structures)
- X-630-2B Cooling Tower (below-grade structures)
- X-630-3 Acid Handling Station (saddles and basin)
- X-640-1 Fire Water Pump House (slab and below-grade structures)
- X-640-2 Elevated Storage Tank (below-grade structures)
- X-640-2A Elevated Water Tank Auxiliary Building
- X-680 Blowdown Sample and Treatment Building
- X-701A Lime House (below-grade structures)
- X-701D Water Deionization Facility (below-grade structures)
- X-701E Neutralization Building
- X-701F Effluent Monitoring Facility
- X-2230T1 Recirculating Heating Water System (East of Valve Pits "A" and "B").

The X-605A Well Field is a misnomer for the X-605G Well Field.

The X-611A Old Lime Sludge Lagoon (structures) is common terminology for the four facilities X-611B, X-611B1, X-611B2, and X-611B3.

The X-611B Lagoon (structures) is a misnomer for the X-611B Transformer.

A.5.2.1 Plant Water System

The plant water system is made up of the raw and make-up water, sanitary and sanitary fire water, RCW, RHW, and high-pressure fire water systems. The plant water system is designed to procure, treat, and distribute water of the desired quality for sanitary, cooling, heating, and fire protection.

Raw water was obtained from three sources. It could have been pumped from groundwater wells at four well fields (X-605G, X-608A, X-608B, and X-6609), from the Scioto River at the X-608 Raw Water Pump House, and/or from the X-611B3 Lagoon (via the X-611B1/B3 pumping stations). The X-605G Well Field is no longer operational. From the well fields and/or the X-608 Raw Water Pump House, the raw water was pumped to the X-611 Water Treatment Complex (Figure A.72). At the X-611 Water Treatment Complex, the raw water was chemically treated and fed into the RCW, RHW, and high-pressure fire water systems via the make-up water distribution system and, after further treatment, into the sanitary and sanitary fire water systems (Figure A.73).

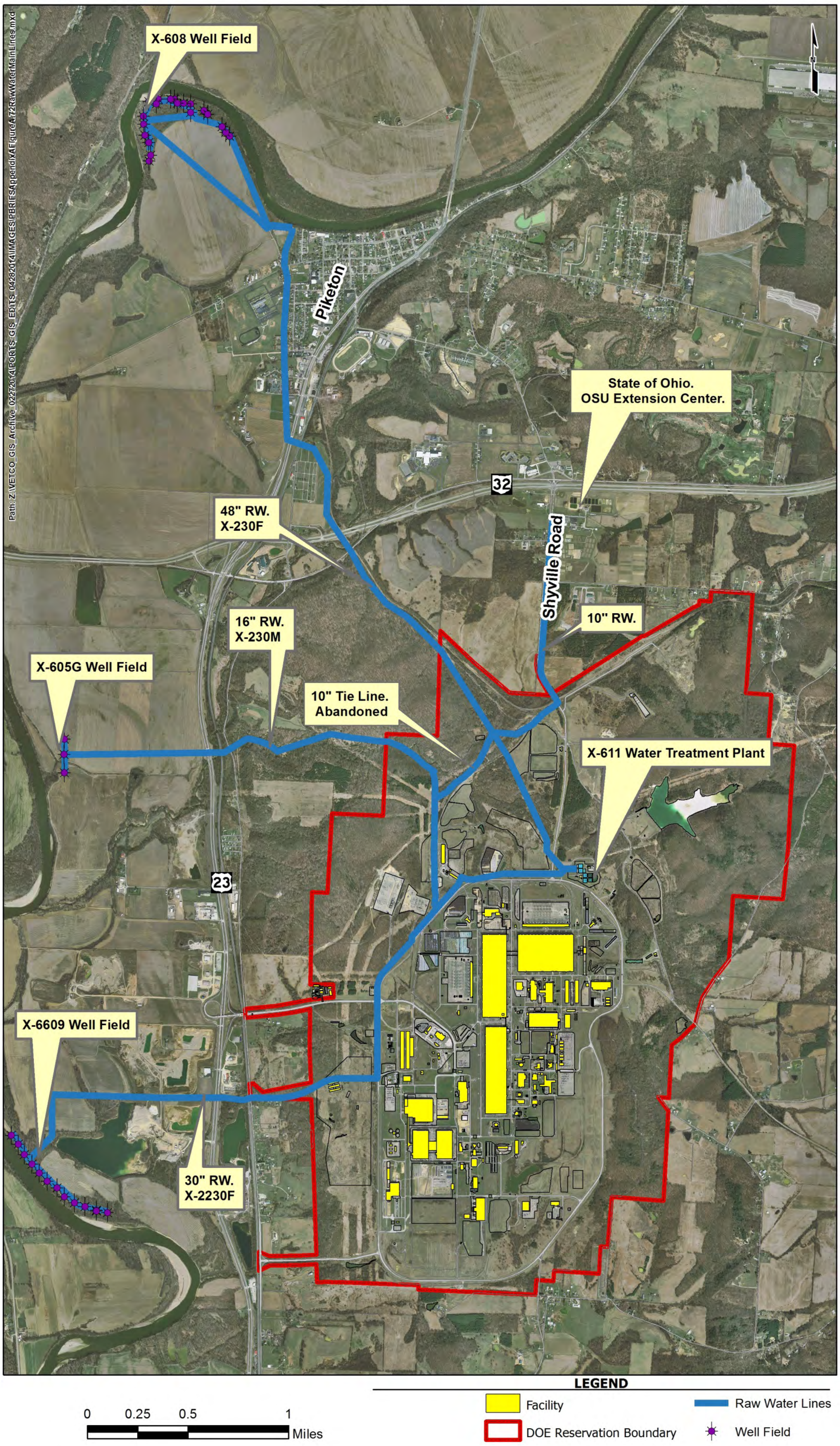


Figure A.72. Raw Water Main Lines

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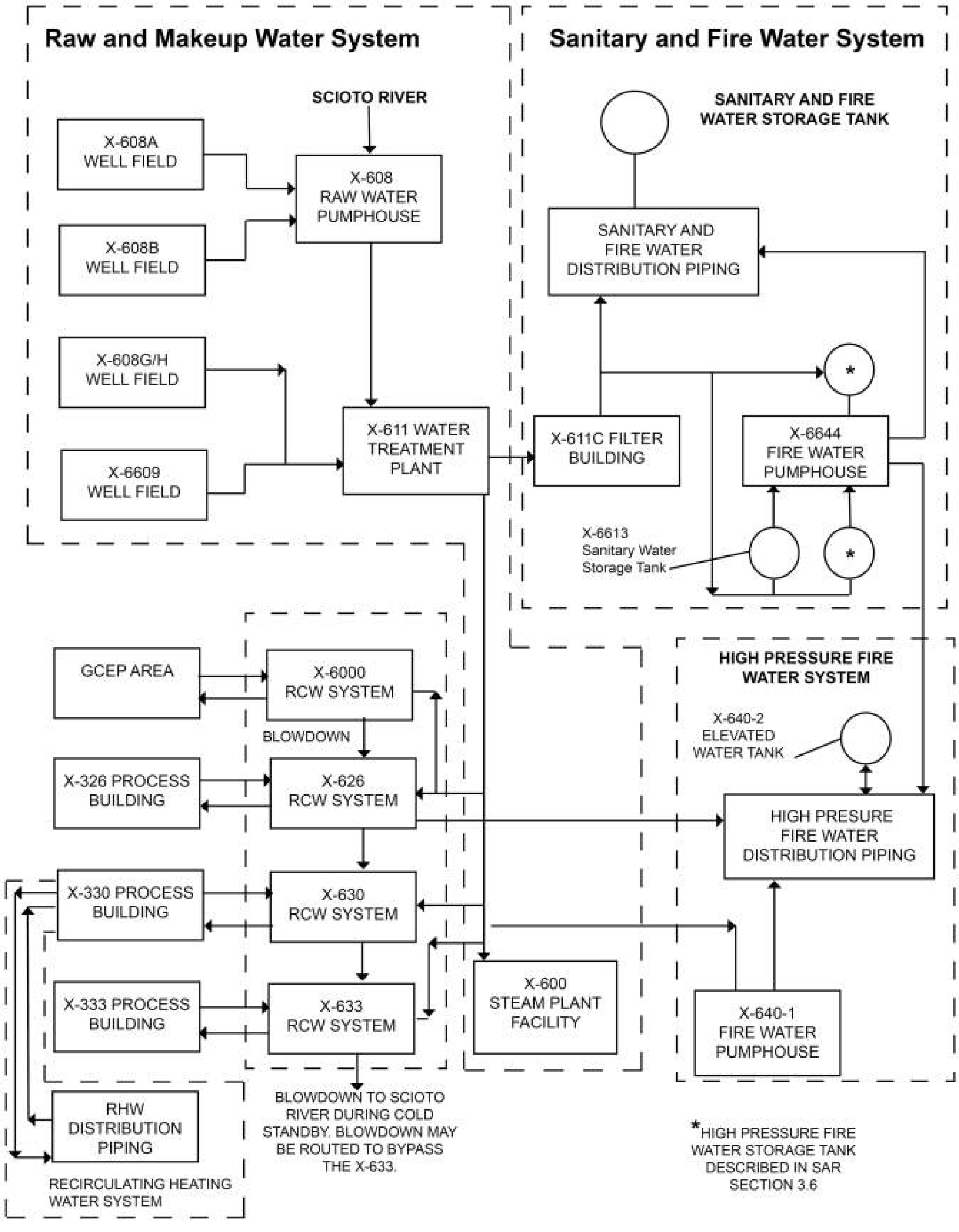

Figure A.73. Plant Water System Interconnections

A.5.2.2 Raw and Make-Up Water System

The function of the raw (X-230F) and make-up (X-230E) water system is to obtain and treat the water that is to be used on the plant.

There are three methods of water procurement in the raw and make-up water system. The primary (normal) method is the pumping of groundwater from four well fields (X-605G, X-608A, X-608B, and X-6609) into a 48-in. raw water pipeline and a 30-in. raw water pipeline (X-230F), which direct this water to the X-611 Water Treatment Complex. The second method is the pumping of Scioto River water at the X-608 Booster Pump House and sending it to the water treatment complex. River water, considered a surface water source, was used only if the well fields could not produce an adequate supply of raw water for plant needs. The third method of water procurement is recycling of the supernatant from the X-611B Lagoon through a recycle line into the X-611 Water Treatment Complex's primary slow-mix basins. Evaluation of the X-6609 well field is not within the scope of this RI/FS. Plugging and abandonment of groundwater wells is also not included in the scope of this RI/FS.

A.5.2.3 X-605G Well Field and Supporting Buildings and Structures

The X-605G Well Field and supporting buildings and structures consisted of the X-605G Well Field, X-605 Sanitary Water Control House, X-605H Pump House, X-605I Chlorinator Building, and X-605J Diesel Generator Building.

The X-605H Pump House, X-605I Chlorinator Building, and X-605J Diesel Generator Building were demolished as a maintenance action. The X-605H Pump House pumped water from the X-605G Well Field wells to the X-611 Water Treatment Plant. The X-605I Chlorinator Building provided water treatment prior to pumping the water to the treatment plant, and the X-605J Diesel Generator provided emergency power to X-605H and X-605I.

The X-605G Well Field consists of four wells, well platforms that are used to access the wells, a control house for pump and motor control, outside lighting, and security fencing (Figure A.74). None of the wells are currently operable.

The first three wells, X-605-G1, X-605-G2 and X-605-G3 (originally named X-605-A, X-605-B and X-605-C) were drilled beginning in December 1952, and all three were in place by January 1953. The wells were drilled to a depth of 68 ft and provided water for initial PORTS construction operations and interim sanitary and fire protection purposes. Later the wells provided the raw water and make-up sanitary water for plant use. The pumping system's initial design was for the provision of 2,700 gpm to the plant. A fourth well (X-605-G1A) was added later. All four wells are in place, and three of the wells (X-605-G1, G1A, and G2) have pumps and motors. All of the wells have screens.

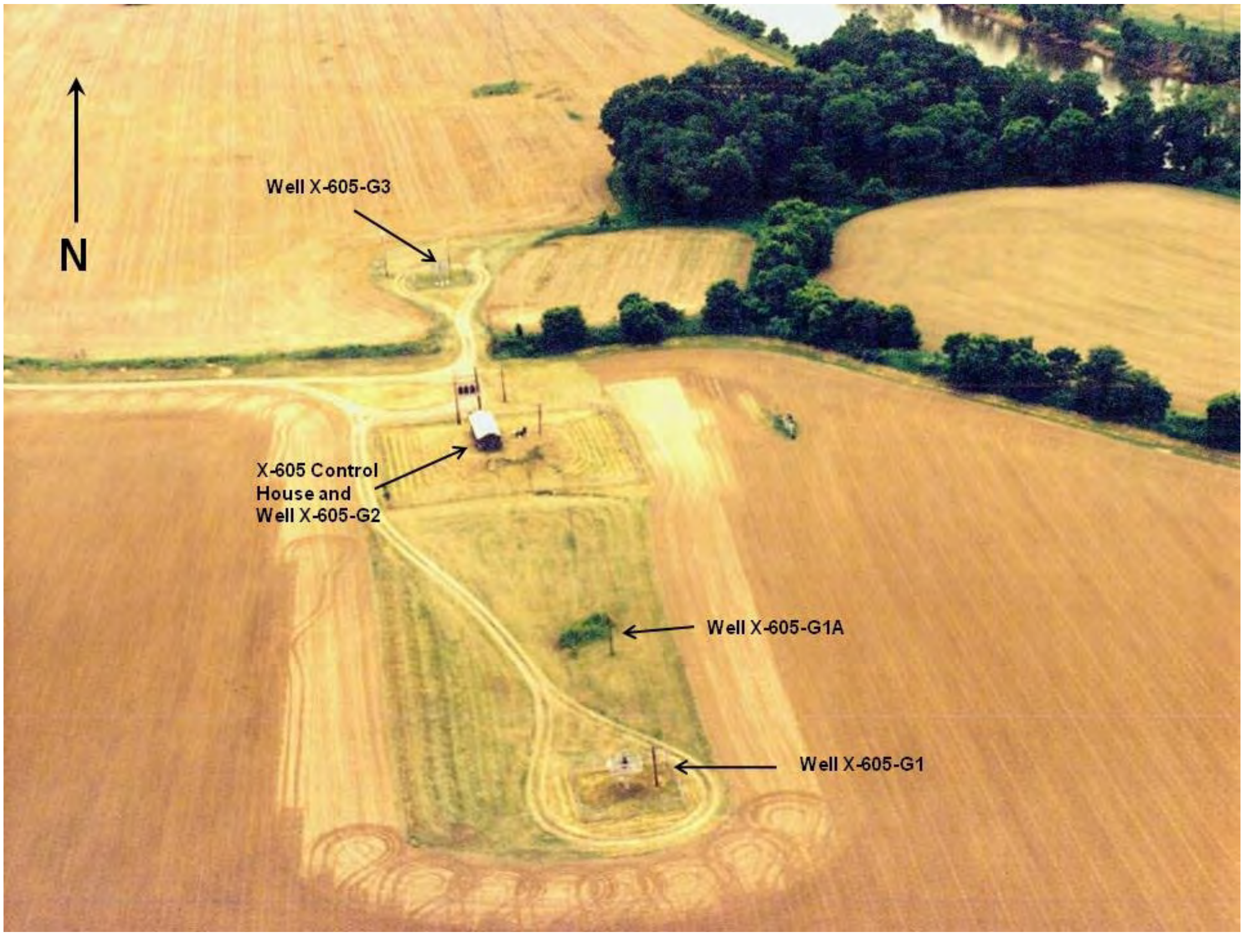

Figure A.74. X-605G Well Field (ca. 1980s)

Wells G1 (Figure A.75) and G1A are located south of the X-605 Sanitary Water Control House, Well G2 is located roughly 10 ft from the building to the west, and Well G3 (Figure A.76) is located north of the X-605 Sanitary Water Control House. Well G1A is a submerged well. Wells G1, G2, and G3 are cased in 16-in. steel pipe. The well pumps are vertical turbine-type pumps rated at 900 gpm. Wells G1 and G2 have 75-hp externally mounted electric motors. The pumps and motors for Wells G1 and G3 were mounted on platforms roughly 20 ft above the floodplain. The platforms consisted of elevated concrete slabs at the tops of foundations consisting of 30-in. corrugated metal pipe. The pump and motor for Well G-3 has been removed. Well G2 is configured similarly to that of Wells G1 and G3, except there is no need for the equipment to be on an elevated platform because it is located on the hill with the control house. The pump motor for Well G2 is supported on a concrete slab at grade. Each pumping unit is connected by mechanical joint and cast-iron pipe to a common discharge header. Each connection is equipped with a check valve and a motor-operated gate valve inside the X-605 Sanitary Water Control House. The fourth well (Well G1A) is equipped with a 500-gpm vertical turbine pump powered by a 50-hp electric motor. In 1998, the well vents were extended, and the wellheads were sealed to meet Ohio Environmental Protection Agency specifications.

Figure A.75. Well X-605-G1

Figure A.76. Well X-605-G3

When the well field was in service, power for the pump operations was supplied by a bank of three 150-kVA (12,470/7200-V) transformers located in a substation at the south end of the control house (Figure A.77). The power was fed by overhead distribution to the X-605 Sanitary Water Control House. From there, it was distributed to each of the well pumps and motors. Voltage was reduced by other transformers and supplied to the pump motors at 220/440 V by the equipment installed in the building. The pumping operation was automatically and remotely controlled by a booster station at PORTS. The pump circuits were wired and connected through the relays such that all well pumps or any designated well pump could be placed in operation.

Figure A.77. X-605A [X-605G] Sanitary Water Control House and Transformers Viewed North to South from Well X-605-G3

The X-605 Sanitary Water Control House (Figure A.78), built between January and June 1953, is a prefabricated metal building (12 ft wide × 24 ft long [288 sq ft]) with a concrete floor and foundation that is located on a vegetated mound of soil approximately 15 to 20 ft above the surrounding land surface. The building is divided into three rooms: diesel generator and control room, chlorination room, and phosphate addition room. The X-605 Sanitary Water Control House contained the control valves, automatic pump controls, flow meters for each pump, and piping. A 90-kW diesel generating unit for emergency power was located in the building prior to its removal when the system was taken out of service. The generator was fed from a 275-gal AST located outside the building at its southeast corner. Electric strip heaters were provided for building piping and equipment to prevent freezing. Normal building lighting was provided. Currently, the interior of the building is mostly empty because the majority of the pump control equipment was removed in 2000 when the system was taken out of service. The remaining items in the building consist of pump control and monitoring cabinets, telecommunication/monitoring signal lines, the main electrical shut-off, motorized controllers, gauges, and systems that were used to monitor the water levels in the wells (Figure A.79). A 10-in.-diameter pipe is located near the north end of the building, outside of the fence enclosure. Water was observed flowing from the pipe during a 2009 inspection. The pipe directs the water into a swale where it disperses into the adjacent farm field.

Figure A.78. X-605 Sanitary Water Control House Exterior

Figure A.79. X-605 Sanitary Water Control House Interior

In the initial stages of PORTS construction, the well water was treated by means of a chlorinating unit located in the X-605 Sanitary Water Control House. The unit, which fed a chlorine solution directly into the supply or discharge main, was later removed (prior to 1957).

A 16-in.-diameter pipe runs from the X-605A [X-605G] Control House to PORTS. The piping is of cast iron and was installed beginning in March 1953 and finishing in May of the same year. The piping was laid in a trench that was excavated using a backhoe.

A.5.2.4 X-608A and X-608B Well Fields

The X-608A Well Field was constructed in 1965, followed by construction of the X-608B Well Field in 1975. The X-608A and X-608B Well Fields are located approximately 1 mile from the X-608 Raw Water Pump House along a half-mile stretch of the Scioto River floodplain.

The X-608A Well Field contains four wells (1A through 4A). These wells are equipped with five-stage, 1,000-gpm pumps. Each pump is driven by a 125-hp electric motor, with the exception of Well 4A, which is equipped with a 400-hp electric motor. Wells 1A, 2A, and 3A use Byron Jackson submersible pumps. Well 4A uses a Magney submersible pump. The water is pumped from the well field through an 18-in. pipeline that is connected to the 48 in. raw water pipeline (X-230F) supplying the X-611 Water Treatment Complex.

The X-608B Well Field contains 11 wells (5B through 15B). These wells are equipped with four-stage, 1,000-gpm pumps, each driven by a 100-hp electric motor. Wells 8B, 9B, 10B, 11B, and 12B use Byron Jackson submersible pumps. Wells 5B, 7B, 13B, and 14B use Magney submersible pumps. Well 15B uses a Peabody submersible pump. Well 6B has been removed from service and no longer has a pump. The water is pumped from the well field through a 36-in. pipeline (X-230F), which is connected to the 48-in. raw water pipeline (X-230F) supplying the X-611 Water Treatment Complex.

A.5.2.5 X-608 Raw Water Pump House

The X-608 Raw Water Pump House (Figure A.80) is an 11,600-sq ft, reinforced concrete building constructed in 1954. The building is located on the east bank of the Scioto River west of Piketon and approximately 4 miles northwest of PORTS. The building is a six-story structure of which one level is above grade. The lowest level is at the river level and has sluice gates on the river side for water to enter its wet well. The pump house used a pumping system that consisted of five pump motors on the top floor that extend down via a motor shaft through openings in intermediate floors to water pumps located on the second floor. A hydraulic system serviced the cone valves on the water pumping system. The system consisted of an oil accumulator system that used a 200-gal high-pressure storage tank and a 200-gal low pressure storage tank located on the second floor, and an exterior 250-gal waste oil storage tank. From 1955 to 1965, water was routinely taken from the Scioto River by the pump house and pumped through a single 48-in. reinforced-concrete pipeline with metal liner to the X-611 Water Treatment Plant. The 48-in. pipeline, which is part of the X-230F Raw Water Supply Line, was constructed in 1954. The pipeline is buried 4 or 5 ft below the ground. Serious problems were encountered from the use of poor-quality Scioto River water, and the water from the pump house was replaced with water pumped directly from the X-608A and X-608B Well Fields. The pump house has not been used since 1979.

A PCB transformer (Kuhlman S/N B-87932, tested to contain 630 ppm PCB) containing 880 gal of oil is located at the X-608 pump house. The transformer is on a platform located approximately 20 ft above the ground. Fluorescent light ballasts may contain PCBs. Slight stains were observed on the floor of the battery room that may be from past spills or leaks from batteries. These stains could contain lead. Surfaces of the building and equipment may have been painted with lead-based paint. Peeling of paint has been observed.

Several areas of apparent oil staining have been observed. A 2 ft × 3 ft stain was observed in the southwest corner of the Chlorinator Room and a 3 ft × 3 ft stain was observed in the northwest corner of the Feed Room. An 8 ft × 10 ft stain was observed in the second floor Cone Valve Hydraulic Room. The source of these stains is unknown but may be from the hydraulic oil system that services the cone valves. Leaks were observed around cone valves of water pumps No. 2, 3, 4, and 6. Approximate 3-ft × 3-ft areas of oil staining were observed on the floor under each of the cone valves of water pumps 2, 3, 4, and 6. Stains were observed on the walls of each floor of the pump house adjacent to openings for the pump motor shaft that available evidence indicates is grease from the motor shaft of the pump system.

Wastewater from toilets and wash basins was discharged via a 4-in. sewer line to a septic system located on the west side of the building. The septic tank flows over to a 6 in. wide by 25 ft long filter drain. The filter drain leads to a 4-in. line that emptied to the Scioto River.

The pump house received drinking water from the Village of Piketon Water Treatment Plant (DOE 1993, TPMC 2006a).

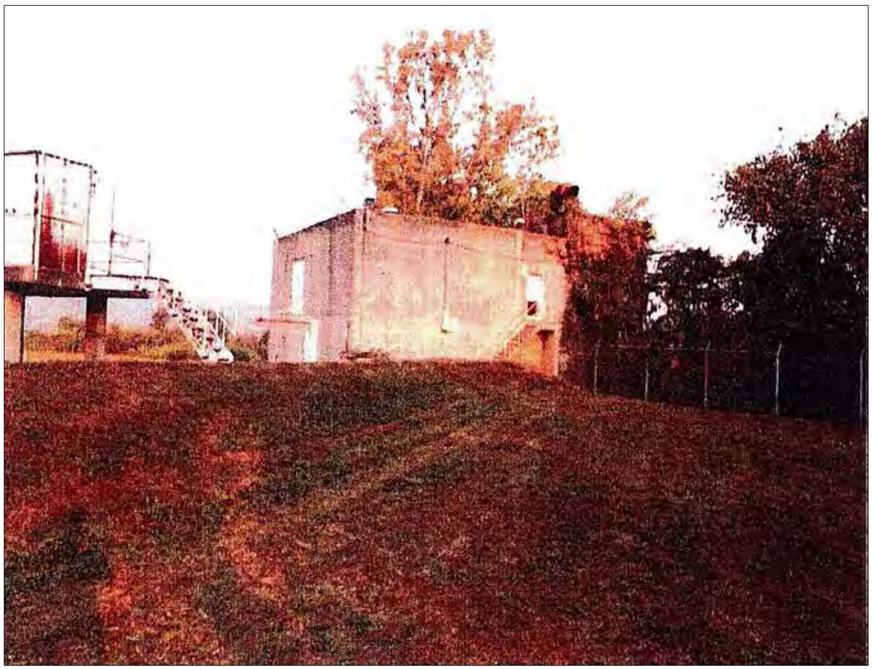

Figure A.80. X-608 Raw Water Pump House

A.5.2.6 X-230A Sanitary and Fire Water Distribution System (portion not used by ACP)

The function of the X-230A Sanitary and Fire Water Distribution System is to supply potable water to most of the buildings on the plant. The system also supplies cooling water for various types of plant equipment. In addition, the system supplies water for the fire sprinkler systems in the support buildings, the switchyards, and most of the fire hydrants in the PORTS area.

The system receives its water supply from the X-611 Water Treatment Complex. Water from the complex is pumped into distribution headers. Sanitary water is also stored in a 2 million-gal tank for reserve and to provide a controlled water pressure. Pumps in the X-6644 Fire Water Pump House (not part of this RI/FS) can feed water from the tank into the sanitary distribution headers.

The distribution system connects the X-611C Filter Building and the X-6644 Fire Water Pump House (not part of this RI/FS) with the 250,000-gal X-612 Elevated Storage Tank. The water tank level is maintained by the sanitary water pumps located in X-611C. The water tank is a reservoir that "floats" on the sanitary water loop distribution system, filling when the system demand is below the X-611C sanitary water pump(s) output. The distribution system loop pressure is controlled by the sanitary water pump discharge and storage tank level/pressure relationships.

D&D of the X-612 Elevated Storage Tank above-grade structures is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). Descriptions of this tank, along with its known or potential radiological and chemical hazards and known releases of contaminants, can be found in that Engineering Evaluation/Cost Analysis (EE/CA). This RI/FS addresses the remaining footings, valve pit, and concrete foundation piers associated with this structure.

A.5.2.7 X-230H [High Pressure] Fire Water Distribution System

The function of the [High Pressure] Fire Water Distribution System (HPFWS) (Figure A.81) is to supply water at pressures 125 to133 psig to the fire protection sprinkler systems in the process buildings and to the cooling towers on the GDP and ACP sites, X-343 Feed Vaporization and Sampling Building (not part of this RI/FS), and sprinkler protection system and fire hydrants for ACP (LMES 1997).

The HPFWS consists of the following:

- X-640-1 Fire Water Pump House
- X-6644 Fire Water Pump House (not part of this RI/FS)
- X-640-2 Elevated Storage Tank and X-640-2A Elevated Water Tank Auxiliary Building
- Wet-pipe sprinkler systems in the X-326, X-330, and X-333 Process Buildings and ACP building sprinkler systems
- Deluge sprinkler systems on cooling towers
- Associated underground piping and valves
- ACP tanks and fire hydrants (LMES 1997).

The X-611 Water Treatment Plant supplies the HPFWS with water from the make-up water system. Water can be pumped from the X-640-1 and X-6644 pump houses into the distribution system, the X-640-2 Elevated Storage Tank, and the X-6643-I and -II Storage Tanks (not part of this RI/FS). From the storage tanks, water is gravity fed to the sprinkler systems in the process buildings, on the cooling towers, in the X-343 building, and for ACP.

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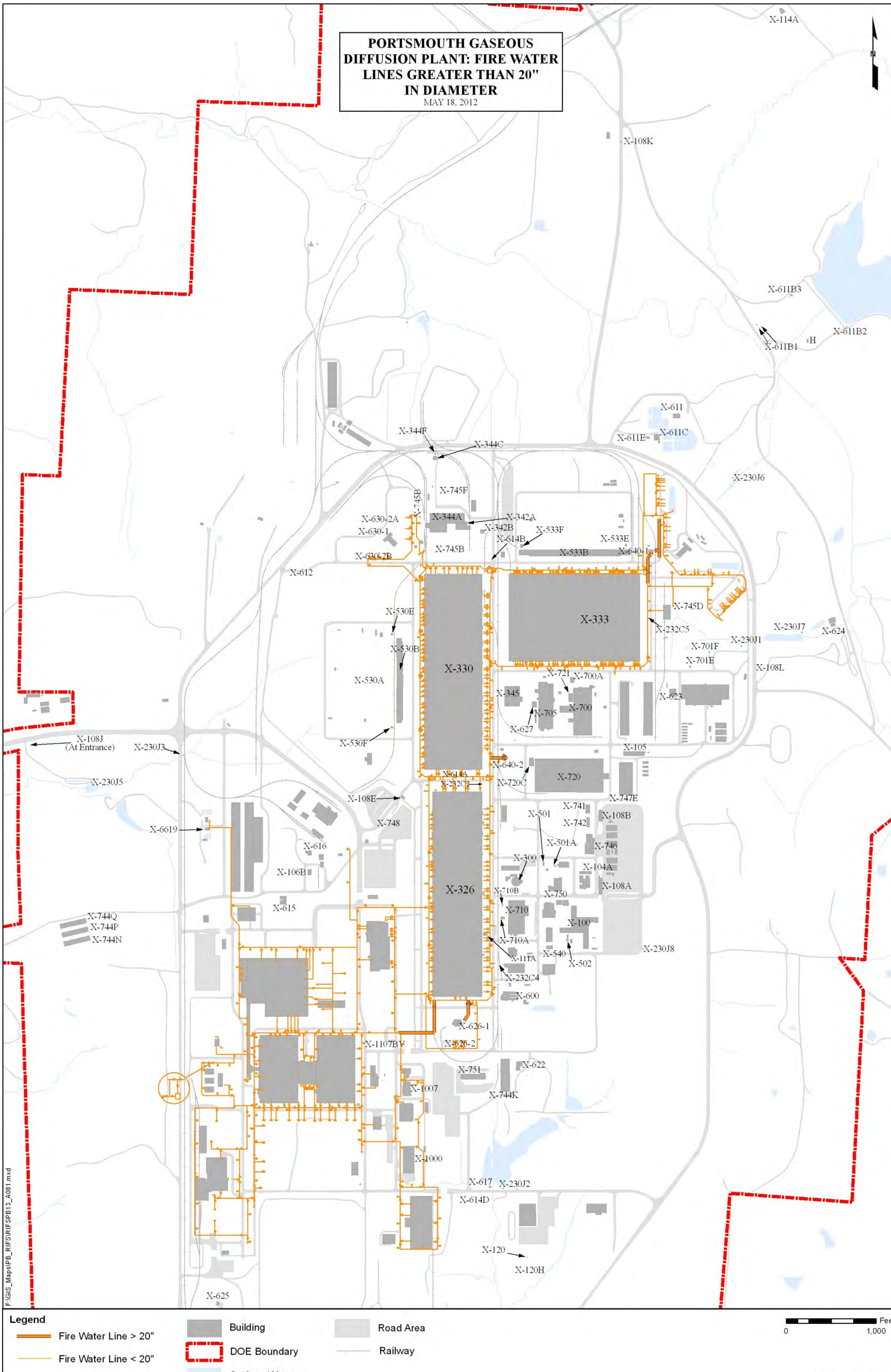

Figure A.81. PORTS Fire Water Distribution System

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The underground piping for the HPFWS is a loop system around the process buildings, cooling towers, and ACP. It supplies water to the sprinkler systems in those facilities. The pipe size varies from 8 in. to 30 in., and the system is designed to deliver 16,000 gpm at any point around the process buildings in the GDP distribution system. All piping in the distribution system is steel, except the cast iron sections around cooling towers X-633-2C and -2D. In the ACP area, the piping is ductile iron or concrete. The system also includes sectional control and shutoff valves (LMES 1997).

In 1983, the HPFWS was expanded to provide fire protection (sprinkler protection and fire hydrants) to the ACP, buildings X-112, XT-847, X-1000, X-1007, X-1020, X-3000, X-3001, X-3002, X-3012, X-3346, X-5000, X-5001, X-6000, X-6001, X-6619, X-6644, X-7721, X-7725, and X-7725A. The expansion consisted of making three 18-in. tie-ins to the existing 18-in. water lines near the southwest corner of X-326. Each tie-in is separated by a sectional valve on the GDP system and has its own section valve near the existing GDP water lines.

D&D of the X-640-1 Fire Water Pump House and the X-640-2 Elevated Storage Tank above-grade structures is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). Descriptions of these structures, along with their known or potential radiological and chemical hazards and known releases of contaminants, can be found in that EE/CA. Disposition of the X-640-2A Elevated Water Tank Auxiliary Building is addressed in this RI/FS.

The portion of the HPFWS that services the GDP is designated as X-230H and the portion servicing the ACP is designated as X-2230H. This RI/FS only addresses the X-230H distribution system (that portion not being used by the ACP) and the remaining footings, valve pits, and concrete foundation piers associated with the X-640-1 pump house and the X-640-2 Elevated Storage Tank. Sprinkler systems will be addressed with their associated buildings and structures.

The X-626-1 Recirculating Water Pump House wet well and the X-626-2 Cooling Tower basin provided a backup water supply prior to initiating operation of the X-6644 pump house in the 1984-1985 timeframe. This source was automatically activated when the water level in the water tower (X-640-2) fell below a set level. Although physically still connected to the HPFWS, this backup supply is no longer considered part of the system. The telemetry for automatic activation has been disconnected.

A.5.2.8 X-230G RCW System

The function of the RCW system was to supply cooling water to the process buildings. The heat of compression of the process gas was transferred from the process equipment to the water and then transferred to the atmosphere.

In the PORTS RCW system, there were four subsystems, one for each of the process buildings (X-626 RCW subsystem, X-630 RCW subsystem, and X-633 RCW subsystem) and the X-6000 subsystem for GCEP cooling. Each subsystem consisted of a pump house, cooling tower system, and associated piping. The X-626 RCW subsystem consists of the X-626-1 pump house and the X-626-2 Cooling Tower. The X-630 RCW subsystem consists of the X-630-1 pump house, the X-630-2A and -2B Cooling Towers, and the X-630-3 Acid Handling Station. The X-633 RCW subsystem consisted of the X-633-1 Pump House and the X-633-2A, -2B, -2C, and -2D Cooling Towers.

A non-time-critical removal action to D&D both the above-grade and below-grade structures associated with the X-633-1 Pump House and X-633-2A, -2B, -2C and -2D cooling towers has already been documented and initiated. This removal action is described in the *Engineering Evaluation/Cost Analysis for the X-633 Recirculating Cooling Water Complex at the Portsmouth Gaseous Diffusion Plant,* *Piketon, Ohio* (DOE 2009a); the *Action Memorandum for the Removal of the X-633 Recirculating Cooling Water Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2009b), and the *X-633 Recirculating Cooling Water Complex Removal Action Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2010a). Above-grade structures have been demolished. Figure A.82 shows remaining concrete slabs, basins, and other below-grade structures.

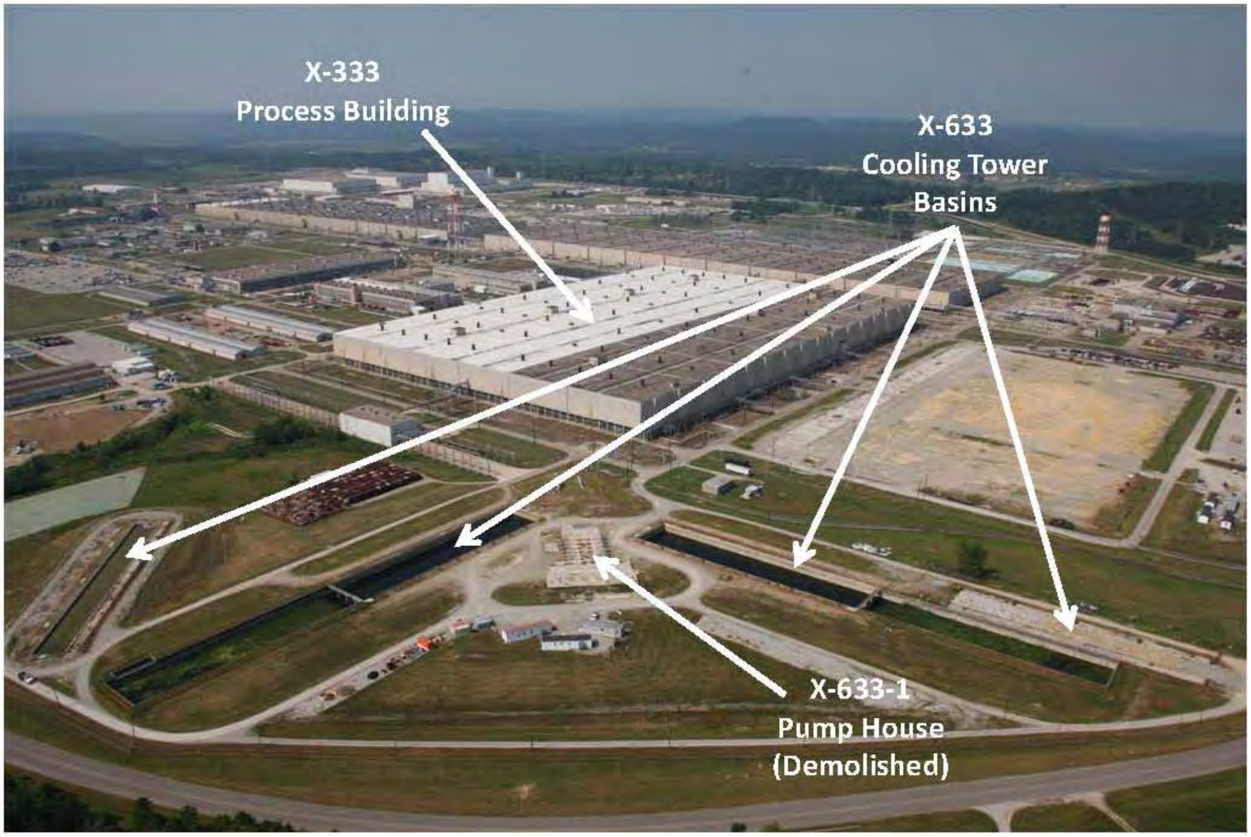

Figure A.82. X-633 RCW Complex

Another non-time-critical removal action to D&D the above-grade structures associated with the X-626-1 pump house, the X-626-2 Cooling Tower, the X-630-1 pump house, the X-630-2A and -2B Cooling Towers, and the X-630-3 Acid Handling Station has been initiated. This removal action is described in the *Engineering Evaluation/Cost Analysis for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2010b) and the *Action Memorandum for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011b). Above-grade structures associated with the X-630-1 pump house and the X-630-2A and -2B Cooling Towers have been completed. The X-626 Pump House and X-626-1 Cooling Tower will remain in service for some period providing cooling water for some facilities. D&D of the concrete slabs, basins, and other below-grade structures is included in the scope of this RI/FS.

The X-626 and X-630 RCW Complexes performed the same functions as the X-633 RCW Complex (DOE 2009a, Sect. 2.2), but they differed in size, general arrangement, capacity of equipment, and storage.

The RCW systems were supplied with water from the make-up water system. The make-up water was fed into the systems at the pump houses where it was treated, along with water that had been returned from the cooling towers (addition of sulfuric acid for pH adjustment, biocide for microbiological control, and phosphate for scale and corrosion control). The chemical treatment occurred in the pump house wet well. The treated water was pumped into the process buildings equipment cooling systems. The heated water from the process equipment cooling system was returned through risers to the top of the cooling tower and into the tower distribution system. Each cooling tower is divided into a number of cells. Each cell is a complete unit, having a riser, distribution system, and fan system. The X-633-2A and -2B Cooling Towers were exceptions, each having two cells per riser. The water was evenly distributed in the top portion of the cells and was cooled as it fell through the tower cells. To enhance cooling, a fill material was placed in each cell. The fill was made of redwood or PVC and was constructed so that the water falling through it broke into small droplets. Small droplet size allowed for better air-to-water contact and, thus, better heat transfer. Louvers were located at the bottoms of both sides of the towers. Their locations, in conjunction with the action of the fans, allowed the circulation of air through the tower cells. A portion of the returned RCW was lost through evaporation when passing through the cooling towers while the remainder accumulated in the cooling tower basins. The cooled water flowed from the tower basins through flumes back into the pump house wet well to again be circulated as cooling water.

The RCW pump houses acted as control centers for the three RCW systems. Chemical feeders, pumps, motors, valves, switchgears, and recorders are located in the pump houses.

There were eight cooling towers in the RCW system prior to implementing the X-633 RCW Complex and the X-326 and X-330 RCW Complex removal actions: one at X-626 (X-626-2), two at X-630 (X-630-2A and -2B), four at X-633 (X-633-2A, -2B, -2C, and -2D), and one at X-6000.

Two headers from each pump house supplied water to opposite sides of their respective process buildings. The X-626 RCW system supplied the X-326 Process Building with cooling water, the X-630 RCW system supplied the X-330 Process Building with cooling water, and the X-633 RCW system supplied the X-333 Process Building with cooling water.

At X-630-1 and X-633-1, there is a crossover line between the supply headers just outside each pump house. At X-626-1 the supply headers are tied together inside the pump house. There are also two return headers from the process building to the cooling tower (s). The X-630 and X-633 headers are tied together before reaching the cooling towers, while the X-626 headers are tied together at the cooling tower. The crossover piping allows any part of the building supply line or return line to be shut down for cleaning or repairs. All outside piping is underground, except for the risers on the return line to the cooling towers (Figure A.83). A cathodic protection system (X-240A) protects the piping from corrosion.

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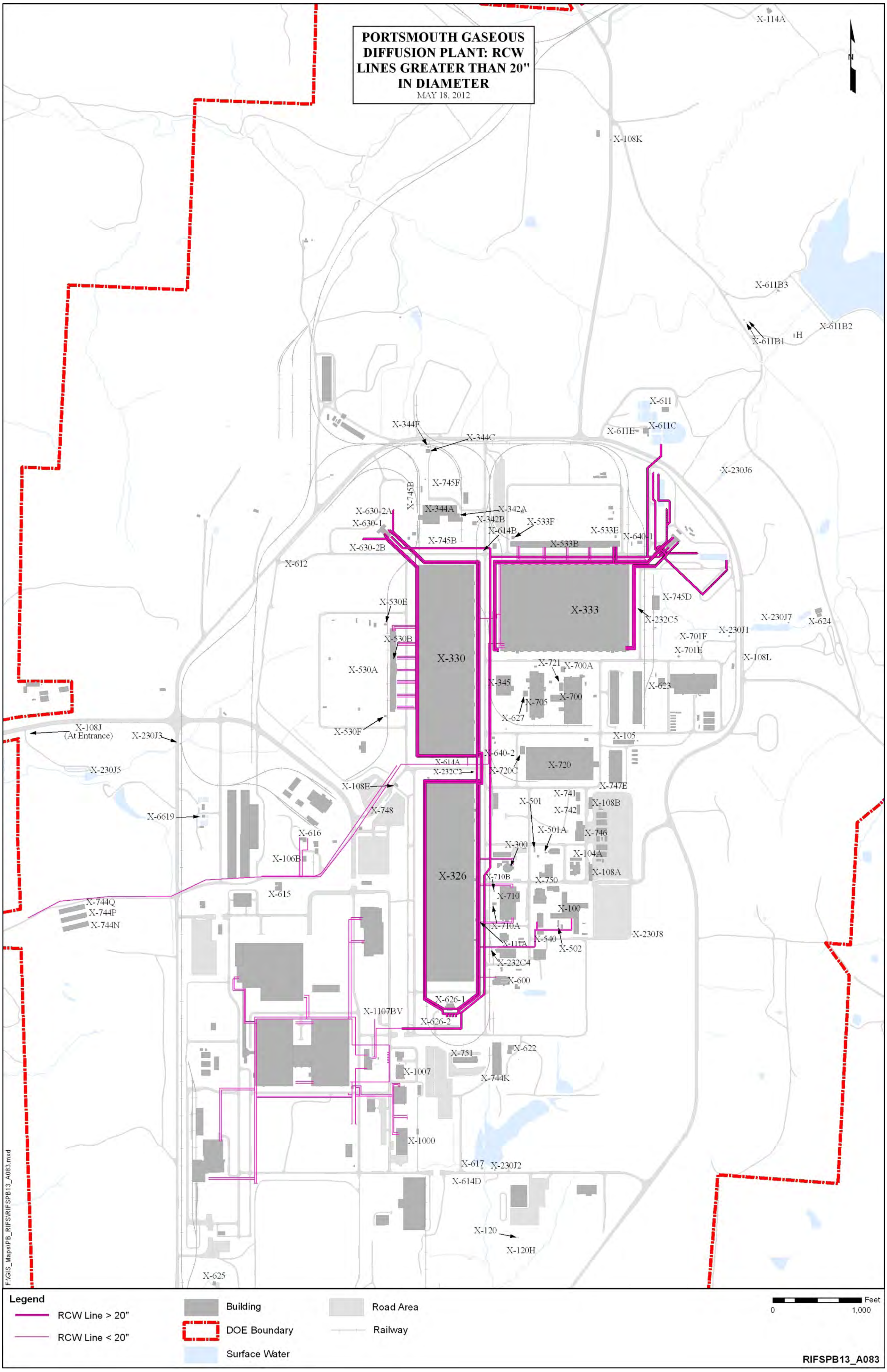

Figure A.83. PORTS RCW System

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The X-680 Blowdown Sample and Treatment Building, constructed in 2010, is a 124-sq ft concrete block building sitting on a concrete pad. Blow-down is water that is drained from the RCW system to lower the dissolved and suspended solids concentrations. Blow-down from the X-626 RCW Complex and the X-6000 RCW system is monitored for total chlorine residuals and sodium bisulfite solution from an inside 450-gal tank is added to de-halogenate the blow-down prior to discharge to the Scioto River. The building also houses the National Pollutant Discharge Elimination System (NPDES) Outfall 004 sample compositer and grab point. An outdoor emergency generator provides backup power to the building.

The original X-630-3 Acid Handling Station was located east of the X-630 RCW Complex and consisted of two 10,000-gal bulk storage tanks and three 500-gal portable tanks for direct transfer of acid by underground pipeline to the X-630-1 Recirculating Water Pump House. Sulfuric acid was used for treatment of RCW at each of the three RCW pump houses. This station was removed with the construction of the western leg of the X-745B Toll Enrichment Gas Yard (not part of this RI/FS). The current X-630-3 Acid Handling Station is located next to the X-630-2A Cooling Tower and consisted of one 10,000-gal tank sitting on support saddles in a lined concrete basin. The tank has been removed. This RI/FS addresses the remaining tank support saddles and basin.

This RI/FS addresses the below-grade structures (cooling tower basins, valve pits, interconnecting piping, etc.) associated with the X-626 and X-630 RCW systems and the distribution (supply and return) piping, valves, etc. to the process buildings. This RI/FS does not address the X-633 RCW system or the above-grade structures associated with the X-626 and X-630 RCW systems, which are addressed in other removal actions described above. This RI/FS also does not address the X-6000 Cooling Tower.

The RHW system (X-2230T1) consists of the necessary piping and equipment to circulate hot RCW return water from the X-330 Process Building to the X-700 Converter Shop & Cleaning Building, X-705 Decontamination Building, X-720 Maintenance & Stores Building, X-623 North Groundwater Treatment Building, and ACP. The primary pumping station in the X-330 Process Building is equipped with pumps, filters, flow controls, and piping. RCW return water is taken from one or more of the four return headers and is pumped into the distribution piping to flow to the various building heating systems. Each building serviced by the system has a pumping system to circulate water through the building heat exchange units and into the RHW return line. Currently, the RHW system is shut down, and the buildings listed above are heated by other means. The buried RHW utility lines will be remediated during X-230G RCW System remediation.

A.5.2.9 X-611 Water Treatment Complex

The X-611 Water Treatment Complex consists of the X-611 Water Treatment Plant (slab and below-grade structures); X-611B1, B2, and B3 Lagoon Supernatant Pumping Stations; X-611C Filter Building (slab and below-grade structures); X-611D Recarbonization Instrumentation Building; and X-611E Clear Well & Chlorine Building. Figure A.84 illustrates how water flows through the treatment system.

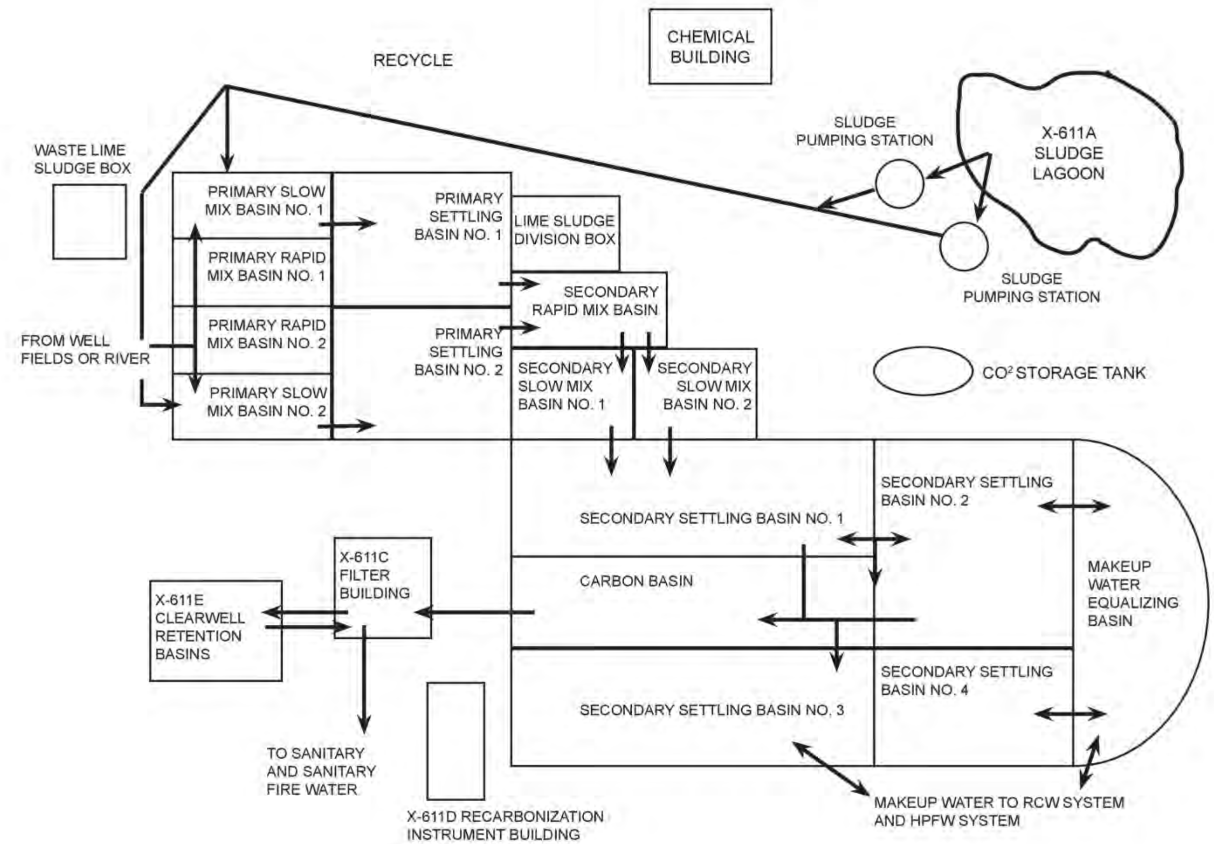

Figure A.84. X-611 Water Treatment Complex Flow Diagram

The X-611B1, B2, and B3 Supernatant Pumping Stations pump supernate liquid from the X-611B Lagoon structures back to the X-611 Water Treatment Plant where it re-enters the water softening circuit at the primary slow-mix basin(s) (Figure A.85).

Figure A.85. X-611B Structures (2006-2007 Aerial Photography)

D&D of the X-611D Recarbonization Instrumentation Building and the above-grade structures associated with the X-611 Water Treatment Plant, X-611C Filter Building, and X-611E Clear Well & Chlorine Building is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). Descriptions of these buildings, their known or potential radiological and chemical hazards, and known releases of contaminants can be found in that EE/CA. This RI/FS addresses below-grade structures associated with these buildings and the X-611B1, B2, and B3 Lagoon Supernatant Pumping Stations.

Below-grade structures to be addressed include the following:

- Two 390,000-gal primary slow mix basins
- Two 36,000-gal primary rapid mix basins
- Two 1.67 million-gal primary settling basins
- One 70,000-gal secondary rapid mix basin

- Two 390,000-gal secondary slow mix basins
- Four 1.67 million-gal secondary settling basins
- A 1 million-gal make-up water equalizing basin
- A carbon basin
- A lime sludge division box and waste lime sludge box
- Clear wells and pumping and filter rooms associated with the X-611C Filter Building
- Clear wells associated with the X-611E Clear Well & Chlorine Building
- Transfer piping and equipment such as pumps, valves, etc.
- B1, B2, and B3 Lagoon Supernatent Pumping Stations.

A.5.2.10 X-701 Buildings and Structures

The X-701A Lime House, constructed in 1955, was a 900-sq ft, nondiked building with a concrete floor, concrete block walls, a metal roof, and a basement. It was located east of the X-700 Converter Shop & Cleaning Building (Figure A.86). The building was used in a neutralization process and, more recently, it housed a drum-crushing operation. The building was demolished in 2001 as an early action. This RI/FS addresses any remaining below-grade structures.

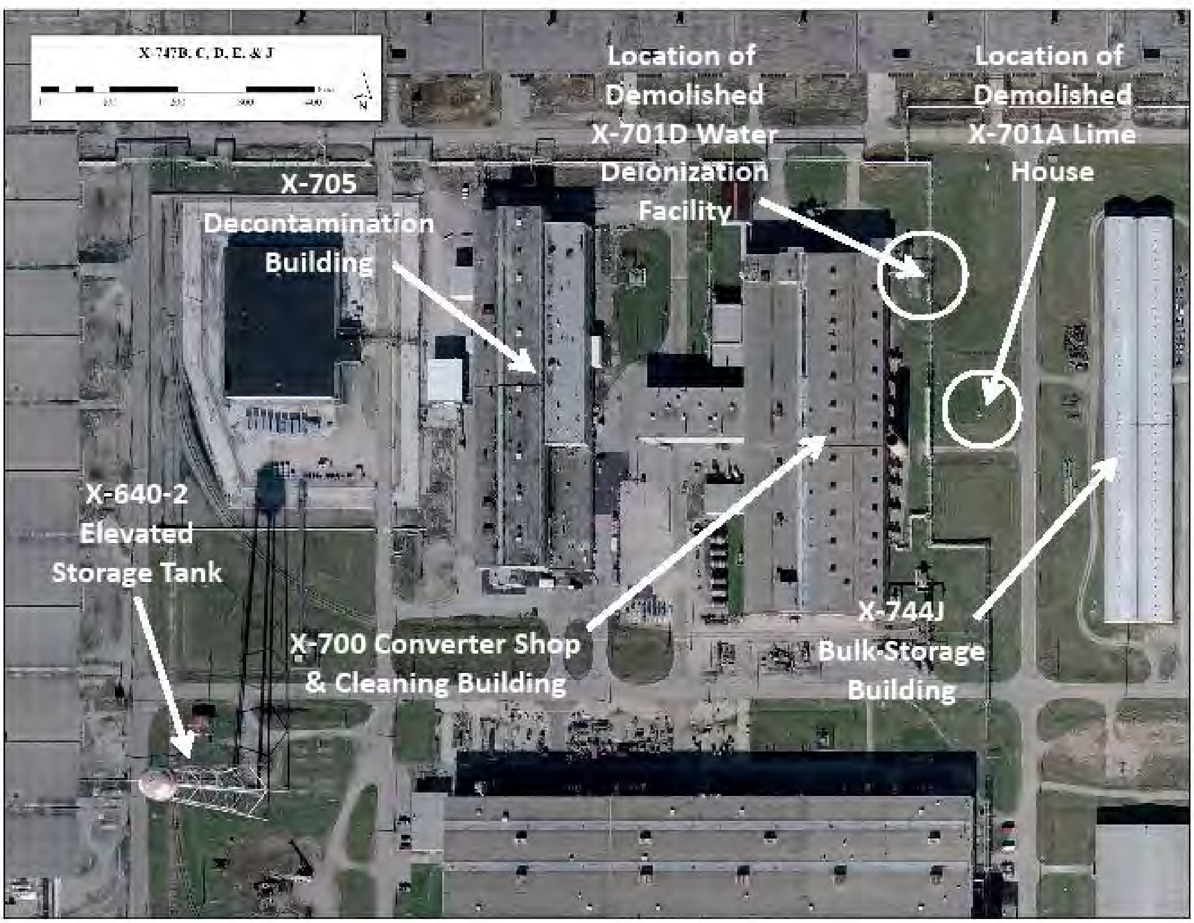

Figure A.86. X-701A Lime House and X-701D Water Deionization Facility (2006-2007 Aerial Photography)

The X-701D Water Deionization Facility, constructed in 1955, was a 700-sq ft, steel-framed building with a concrete block base and floors. It was located east of the northeast corner of the X-700 Converter Shop & Cleaning Building (Figure A.86) and was used to prepare deionized water for decontamination and cleaning operations and, more recently, for storage of chemicals. The building was demolished in 2006 as an early action. This RI/FS addresses any remaining below-grade structures.

The X-701E Neutralization Building, constructed in 1973, is a 400-sq ft, steel-framed building with a cement floor. Located near the influent to the X-701B Holding Pond (not part of this RI/FS) (Figure A.87), the operations neutralized influent to X-701B by distributing lime evenly over the influent to precipitate metals out of the flow to X-701B. After deactivation of X-701B in 1988, X-701E was not used from 1988 to 1990. In August 1990, as part of the remediation of X-701B, X-701E was established as an activated carbon filtration operation to remove TCE from groundwater leaching into the X-701B Area. The floors and walls of the building have probably been contaminated with TCE, heavy metals, and radionuclides from the wastewater treated.

Figure A.87. X-701E Neutralization Building and X-701F Effluent Monitoring Facility (2006-2007 Aerial Photography)

The X-701F Effluent Monitoring Facility was a 36-sq ft structure (Figure A.87) used between 1981 and 1988 for monitoring the effluent from the X-701B Holding Pond. The facility was demolished as an early action. This RI/FS addresses any remaining below-grade structures.

A.5.3 SEWAGE COLLECTION AND TREATMENT FACILITIES

The following sewage collection and treatment facilities are included in the scope of this RI/FS:

- X-230B Sanitary Sewers
- X-230C Storm Sewers
- X-614A Sewage Pumping Station (slab and below-grade structures)
- X-614B Sewage Pumping Station (slab and below-grade structures)
- X-614D South Sewage Lift Station
- X-614P North East Sewage Lift Station
- X-614Q Sewage Booster Pump Station
- X-615 Old Sewage Treatment Plant (foundations and piers)
- X-616 Liquid Effluent Control Facility (foundations and piers)
- X-6619 Sewage Treatment Plant.

A.5.3.1 X-230B Sanitary Sewers and Sewage Lift and Pumping Stations (X-614A, -B, -D, -P, and -Q)

The PORTS sanitary sewers (X-230B) (Figure A.88) feed, by gravity flow, into one of four lift and pumping stations (X-614B Sewage Pumping Station [slab and below-grade structures], X-614D South Sewage Lift Station [Figure A.89], X-614P North East Sewage Lift Station [Figure A.90], or X-614Q Sewage Booster Pump Station [Figure A.91]) or feed directly to the X-614A Sewage Pumping Station (slab and below-grade structures). The X-614A Sewage Pumping Station discharges through a 10-in. force main and a 12-in. gravity line to the X-6614E pump station (not part of this RI/FS). From the X-6614E pump station, the sewage goes to the X-6619 Sewage Treatment Plant.

The sewage collection system is constructed of vitrified clay tile. The lines from the pumping stations to the X-614A Sewage Pumping Station are vitrified clay pipe, and the force main from X-614A to the X-6619 Sewage Treatment Plant is cast iron pipe. The pumping stations and the lift station operate independently.

The pumping stations are used to lift sewage from a lower to higher elevation. Sewage flows into a wet well through influent sewer lines, and the pumps operate automatically, depending on the level of sewage in the wet well. Sludge collected at the pumping stations is transferred to the X-614A Sewage Pumping Station. Sewage at the X-614A Sewage Pumping Station flows into a wet well and is forced under pressure to the X-6619 Sewage Treatment Plant.

D&D of the above-grade structures associated with the X-614A Sewage Pumping Station and the X-614B Sewage Pumping Station is addressed in the *Engineering Evaluation/Cost Analysis for Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a).

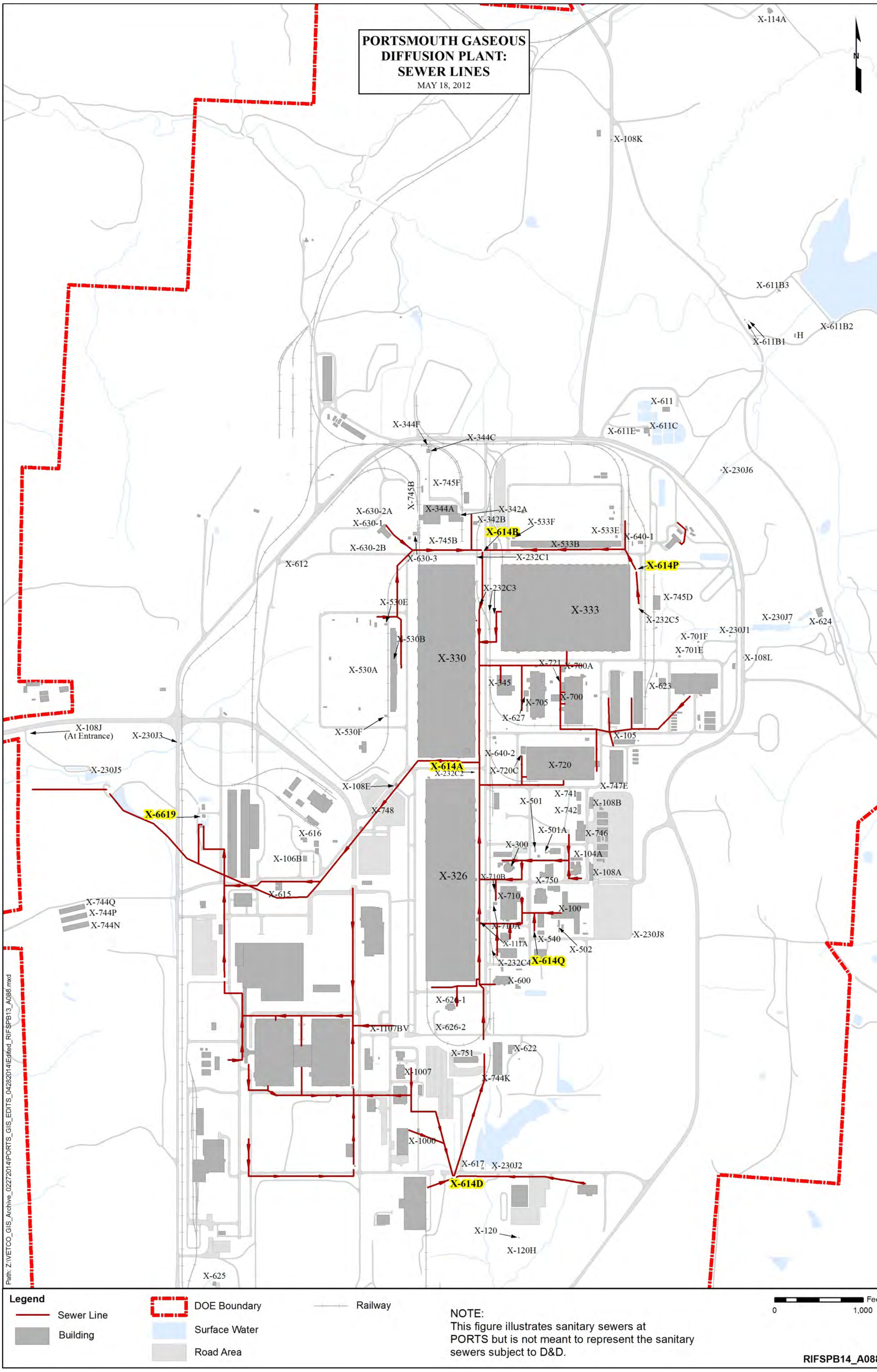

Figure A.88. PORTS Sanitary Sewers

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Figure A.89. X-614D South Sewage Lift Station

Figure A.90. X-614P North East Sewage Lift Station

Figure A.91. X-614Q Sewage Booster Pump Station

The sanitary sewer system has been radiologically contaminated as a result of contaminant releases from buildings that are serviced by the system. Radioactive contaminants have been transferred, in some cases, from below-grade structures and equipment to above-grade structures and equipment. Sewage is also assumed to contain hazardous materials such as heavy metals, volatiles, semivolatiles, and biological agents (*Escherichia coli*, etc.). Float switches in the pumping and lift station wet wells may contain mercury. Considering the age of the buildings and structures, lead-based paint is assumed to have been used on exterior and interior surfaces.

A.5.3.2 X-230C Storm Sewers

The PORTS storm sewers (Figure A.92) are used to collect storm water runoff; surface water runoff from scrap yards, storage yards, parking lots, roads, and rooftops; discharges from floor drains of several process and support buildings; boiler blowdown; treated coal pile runoff; RCW discharges; and air-conditioning system cleaning water. Generally, each sewer line discharges to a holding pond, drainage ditch, or larger stream (Table A.3) (DOE 1993).

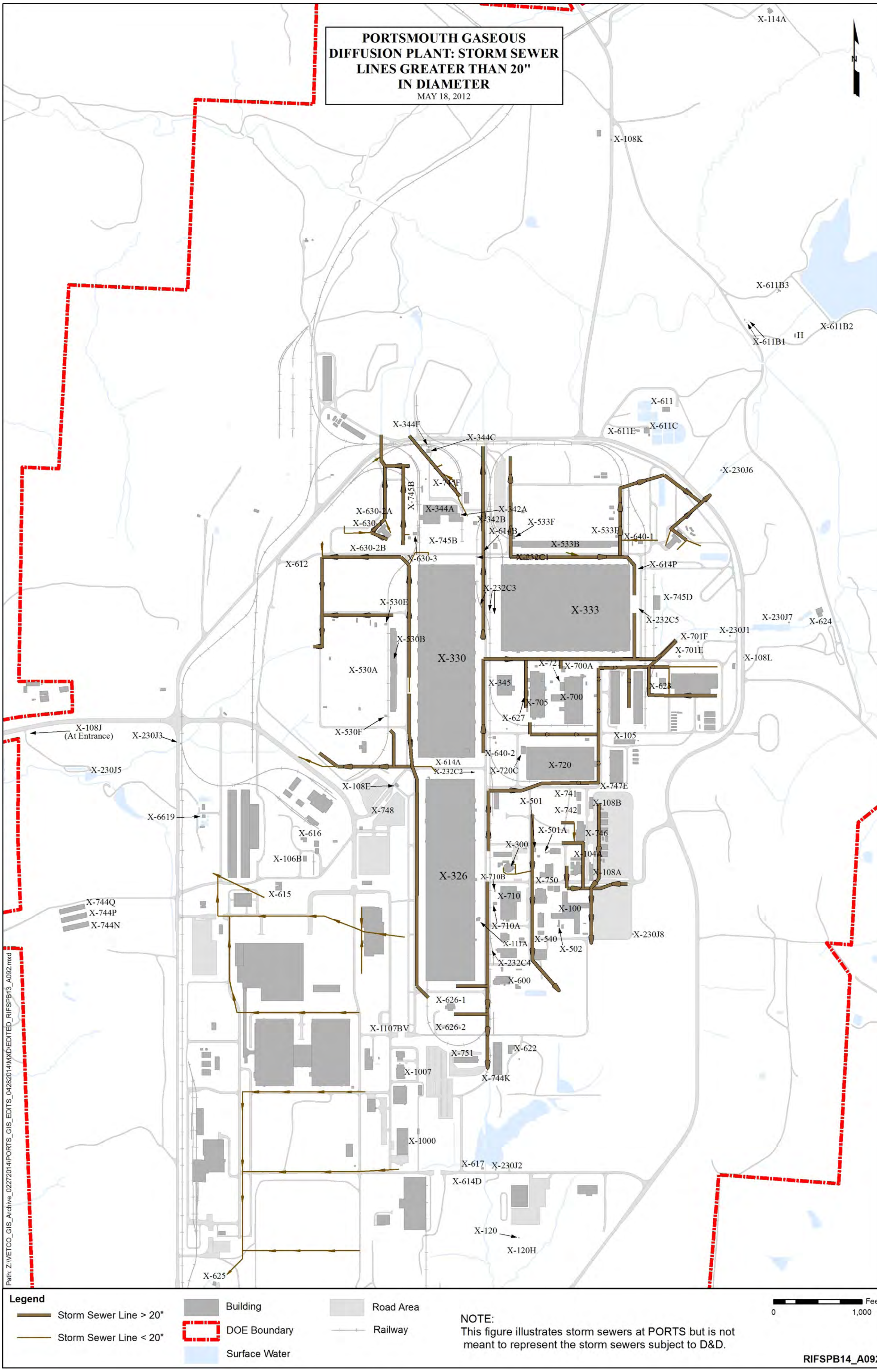

Figure A.92. PORTS Storm Sewers

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Table A.3. X-230C Storm Sewer System

Sewer Line	Quadrant	Examples of Contributions	Drainage Pathway			
A	III	X-326 Process Building sanitary cooling water floor drains; west side of X-326 and southwest side of X-330 Process Buildings surface runoff; south side of X-530A High Voltage Switchyard surface runoff; X-740 Waste Oil Handling Facility surface runoff	Northern tributaries of West Drainage Ditch	X-230J Intermittent Containment Basin	X-230J5 West Holding Pond	Scioto River (NPDES Outfall 010)
B	III/IV	X-330 Process Building sanitary cooling water floor drains; surface water runoff from northwest side of the X-330 Process Building, X-530A High Voltage Switchyard, X-612 Elevated Storage Tank, X-745C West Cylinder Storage Yard, south side of the X-630 Cooling Towers, and southwest side of the X-745B Toll Enrichment Gas Yard	Northern tributaries of West Drainage Ditch	X-230J Intermittent Containment Basin	X-230J5 West Holding Pond	Scioto River (NPDES Outfall 010)
C, K, and M	II/IV	Storm runoff from the west half of the X-333 Process Building, X-344C HF Storage Building, X-533 Switchyard, X-630-2A and -2B Cooling Towers, and the west side of the X-747H Northwest Material Storage Yard; sanitary water used to cool X-342A Feed Vaporization Building fluorine generators	North Drainage Ditch		X-230L North Holding Pond	Little Beaver Creek (monitoring occurs at pond outfall)

Table A.3. X-230C Storm Sewer System (Continued)

Sewer Line	Quadrant	Examples of Contributions	Drainage Pathway		
D	II	Floor drains from the X-326 Process Building diesel air plant; X-330 (SE) Process Building filter room drains; X-330 Process Building air and diesel air plants, and nitrogen plant; X-333 (S) Process Building filter room drains; X-333 Process Building cooling water; and X-333 Process Building air plant. Surface runoff from the X-700 Chemical Cleaning Facility; X-705 Decontamination Building; and the X-326, X-330, and X-333 Process Buildings	East Drainage Ditch	X-230J7 East Holding Pond	Little Beaver Creek (NPDES Outfall 001)
E	II	Floor drains from the X-705 Decontamination Building refrigeration unit "E," X-720 Maintenance & Stores Building cleaning floor, and the X-326 (NE) Process Building filter room drains. Surface runoff from the X-103 Auxiliary Office Building; X-741 Oil Drum Storage Facility; X-742 Gas Cylinder Storage Facility; X-743 Lumber Storage Facility; X-720 Maintenance & Stores Building; X-744G, H, and J Bulk Storage Areas; and X-747A, B, C, D, and E Material Storage Yards	East Drainage Ditch	X-230J7 East Holding Pond	Little Beaver Creek (NPDES Outfall 001)
F	I	Building drains from the X-106 Tactical Response Station, X-600 Steam Plant (ash washing and zeolite regeneration), X-770 Mechanical Testing Building, and surface water runoff from the X-600A Coal Yard	South Drainage Ditch	X-230J2 South Holding Pond	Big Run Creek (NPDES Outfall 002)
G	I	Floor drains from the X-710 Technical Service Building and X-326 Process Building filter rooms	South Drainage Ditch	X-230J2 South Holding Pond	Big Run Creek (NPDES Outfall 002)

Table A.3. X-230C Storm Sewer System (Continued)

Sewer Line	Quadrant	Examples of Contributions	Drainage Pathway			
H	I	Air-conditioning cooling water and cleanout from the X-100 Office Building; X-750 Mobile Equipment Maintenance Shop floor drains; surface water runoff from the X-100 Office Building, X-746 Material Receiving and Inspection, and X-750 Mobile Equipment Maintenance Shop parking lots	South Drainage Ditch		X-230J2 South Holding Pond	Big Run Creek (NPDES Outfall 002)
J	I/III	Surface runoff from GCEP Process Buildings; X-7721 Maintenance, Stores and Training Building; X-615 Old Sewage Treatment Plant (demolished); X-616 Liquid Effluent Control Facility (demolished); X-744S, -T, and -U Warehouses (demolished); and the X-7725 GCEP Recycle/Assembly Building	Southern tributary of West Drainage Ditch	X-2230N GCEP No. 2 Holding Pond	X-230J5 West Holding Pond	Scioto River (NPDES Outfall 010)
L	IV	Surface water runoff from the south and east portions of the X-533A Switchyard and the X-633 RCW Complex	Northeast Drainage Ditch		X-230J6 Northeast Holding Pond	Little Beaver Creek (NPDES Outfall 011)
N	I	Surface water runoff from GCEP and the X-749 Landfill	GCEP Southwest Drainage Ditch		X-2230M Southwest Holding Pond	Scioto River (NPDES Outfall 012
O	I	Southern GCEP surface water runoff	Southern most reaches of GCEP southwest drainage sector		X-2230M Southwest Holding Pond	Scioto River (NPDES Outfall 012)

GCEP = Gas Centrifuge Enrichment Plant
NPDES = National Pollutant Discharge Elimination System
RCW = recirculating cooling water

In general, fully coated corrugated metal pipe was provided for all storm sewers except those receiving hot water, which would have damaged the coating. Sewer lines receiving the high temperature water were generally of concrete pipe construction. Asphalt-coated steel pipe was provided where roof drains passed through tunnels. Some excess vitrified clay pipe and cast iron pipe were used in some areas. The sizes of some mains at their outlets varied from 42 in. to 72 in. in diameter, and the deepest main was constructed with 27 ft of cover. Reinforced concrete manholes and junction boxes were provided for all storm sewer systems. The majority of catch basins were corrugated metal structures with beehive-type inlet grates for the catch basins located in open ditches. Concrete catch basins were provided in some areas (USAEC 1957).

Potential contaminants in Storm Sewers A, B, and J include VOCs (TCE, TCA, xylenes), semivolatile organic compounds (SVOCs) (polycyclic aromatic hydrocarbons [PAHs]), 2-methylnaphthalene, dibenzofuran, 4-methylphenol (p-cresol), PCBs (Aroclor-1260), pesticides (dieldrin), hypochlorate, phosphorous, hexavalent chromium, total chromium, zinc, and radionuclides (DOE 1993). Examples of discharges to, and releases from, these sewers include the following:

- An estimated 250,000 gal of sterilization grade hypochlorate (ClO_2) were released from the X-612 Elevated Storage Tank to Storm Sewer B (July 17, 1975).

- An unspecified amount of UF_6 was released from a 14-ton feed cylinder in the X-745B Toll Enrichment Gas Yard. Much of the material was carried (by melting snow) into the Storm Sewer B (March 7, 1978).

Potential contaminants in Storm Sewers C, K, L, and M include oil and grease, fluorides, radionuclides, hexavalent chromium, PCBs, sulfuric acid, sodium hydroxide, zinc, and TCE (DOE 1993). Examples of discharges to, and releases from, these sewers include the following:

- During the 1950s, chromate reduction activities were conducted in the plant RCW discharge system in Storm Sewer L. These reduction activities included the addition of sulfuric acid and/or sulfur dioxide gas to the RCW blowdown stream.

- PCBs were released from the X-533A Switchyard (not part of this RI/FS) transformers, leaking transfer lines, and the overfilling of oil circuit breakers into Storm Sewers K and L.

- A release of liquid UF_6 from a cylinder occurred during routine sampling at the X-342A Feed Vaporization Building.

Potential contaminants in Storm Sewers D and E include VOCs (primarily TCE), oil and grease, SVOCs (PAHs), hexavalent chromium, lead-based paint solids, and radionuclides (DOE 1993). Examples of discharges to, and releases from, these sewers include the following:

- Sanitary cooling water from the X-705 Decontamination Building

- X-720 Maintenance & Stores Building
    - Floor cleaning detergent
    - Water from paint spray booth containing some paint solids
    - Caustic rinse solution (NaOH) that contains traces of oil and grease from motor cleaning operations.

- Various radionuclides and hazardous materials from scrap yard drainage.

Potential contaminants in Storm Sewers F, G, H, N, and O include: NaOH and metals (ash washing water); gasoline and oils (parking lot runoff); dichromate, polyphosphate, zinc sulfate, nitrate, and Freon (air-conditioning cleaning discharge); chlorine and hexavalent chromium (RCW discharge); and radionuclides (DOE 1993). Examples of discharges to, and releases from, these sewers include the following:

- Water containing Freon from the X-770 Mechanical Testing Building (demolished) air-conditioning system
- Miscellaneous chemicals released to the X-710 Technical Service Building laboratory floor drains
- X-750 Mobile Equipment Maintenance Shop parking lot runoff
- Ethylene glycol and glycerol from the X-106 Tactical Response Building (not part of this RI/FS)
- Unknown quantities of fuel oil, gasoline, and battery acid from the X-750 Mobile Equipment Maintenance Shop
- Water sprayed over burned coal ash at the X-600 Steam Plant
- Potential past releases of oil, hydraulic oil, kerosene, acetone, HCL, ammonia, and battery acid from the X-746 Materials Receiving and Inspection Building (demolished)
- Gas spill of unknown quantity from the X-103 Auxiliary Office Building (demolished) (March 24, 1982)
- 36,000 gal of RCW released from the X-626-1 Recirculating Water Pump House (March 9, 1985).
- 2,000-gal RCW spill from the X-710 Technical Service Building
- Unknown quantity of passivating solution (cleaning solution) leaked to Storm Sewer N. Passivating solution contains sodium nitrate, boric acid, tolytriazole, trisnitromethane, and sodium silicate. Analysis following the spill also indicated chromates.

A.5.3.3 X-615 Old Sewage Treatment Plant (foundations and piers)

D&D of the above-grade structures associated with the X-615 Old Sewage Treatment Plant was completed in 2006, as shown in Figure A.93. A schematic and cross section of the treatment plant prior to demolition is shown in Figures A.94 and A.95, respectively. Currently, the number of below-grade structures that were left in-place is unknown. Any remaining below-grade structures are addressed in this RI/FS.

Figure A.93. X-615/X-616 Area (2006-2007 Aerial Photography)

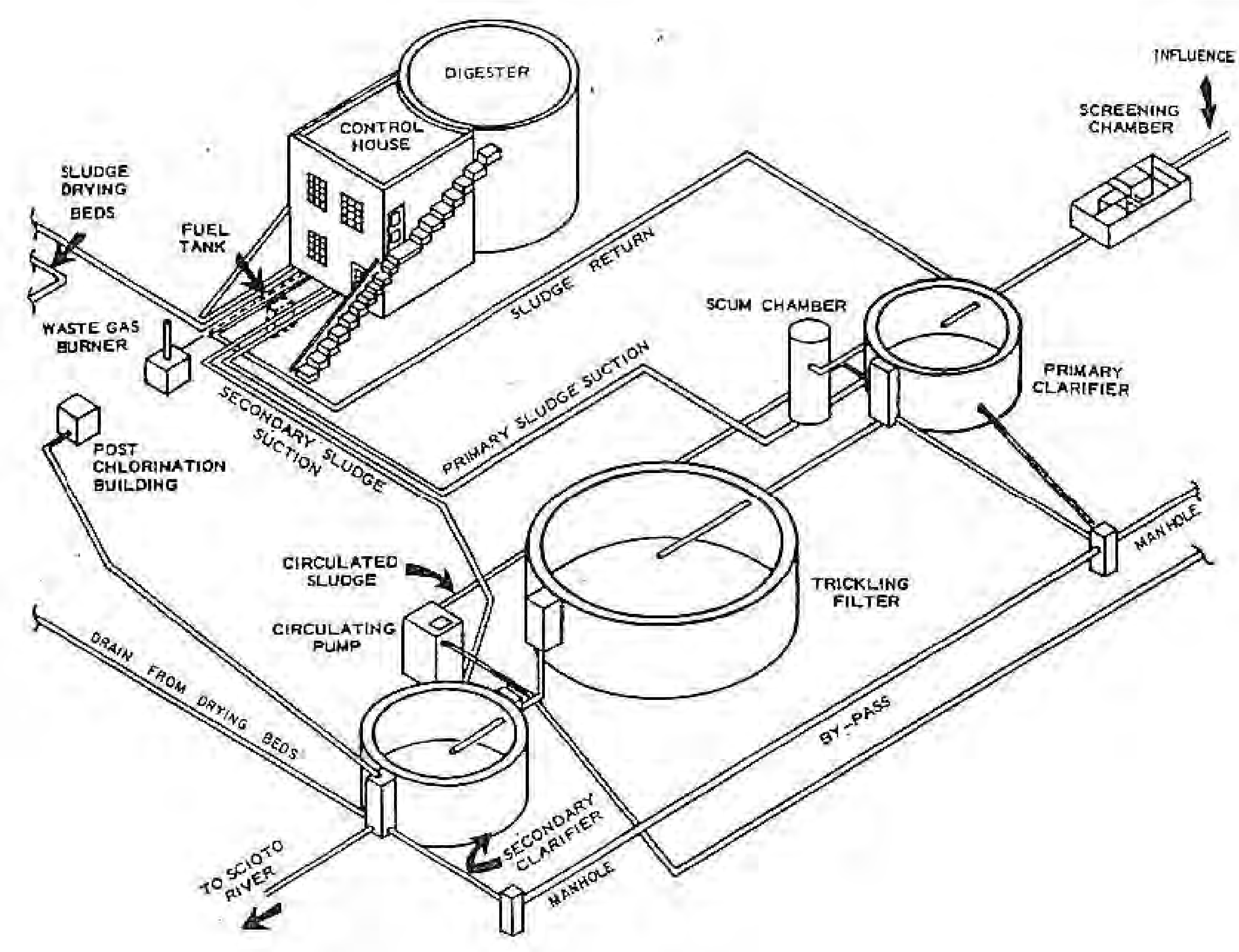

Figure A.94. X-615 Old Sewage Treatment Plant Schematic

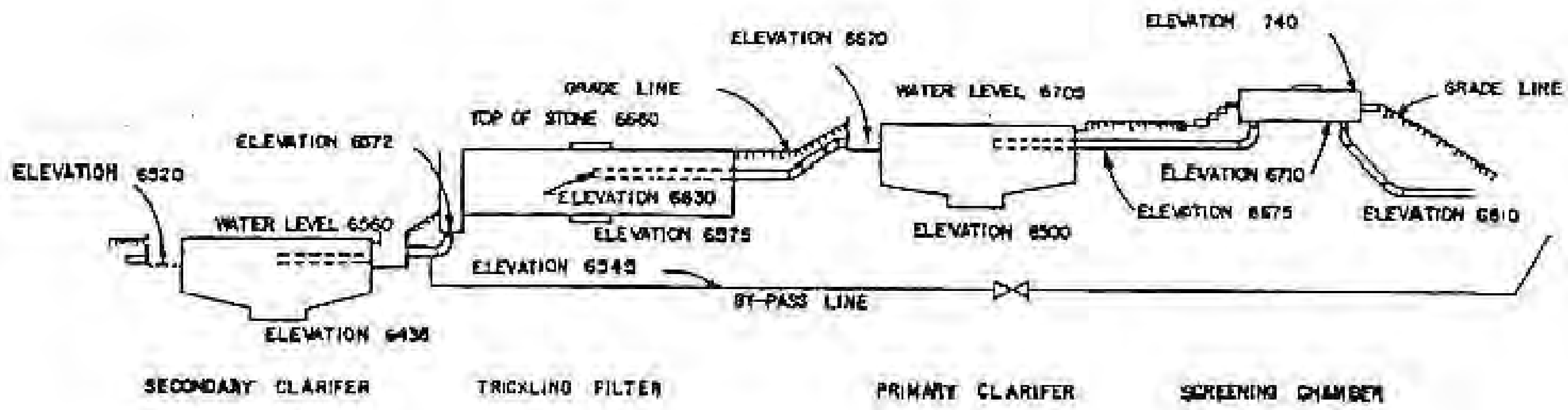

Figure A.95. X-615 Old Sewage Treatment Plant Cross Section

A.5.3.4 X-616 Liquid Effluent Control Facility (foundations and piers)

D&D of the above-grade structures associated with the X-616 Liquid Effluent Control Facility (also known as the X-616 Chrome Reduction Facility) was completed in 2006 (Figure A.93).

These structures were constructed for the purpose of treating RCW blowdown from the PORTS process cooling system. This process involved reducing hexavalent chromium to a trivalent state, precipitating the chromium as a sludge, impounding the sludge into sludge lagoons, and discharging the wastewater to the Scioto River through NPDES Outfall 004. In addition to treating the RCW blowdown, effluent from the X-700 Converter Shop & Cleaning Building and the X-705 Decontamination Building was also treated.

Portions of the below-grade structures were left in-place, but how much is unknown. Any remaining below-grade structures will be addressed in this RI/FS.

A.5.3.5 X-6619 Sewage Treatment Plant

The X-6619 Sewage Treatment Plant (Figure A.96), built in 1980 (operational in 1981), consists of four reinforced concrete buildings (screening and grit building [Figure A.97], sludge pumping building [Figure A.98], filter building [Figure A.99], and chlorine building), totaling approximately 5,000 sq ft; two circular clarifiers; four aeration tanks (Figure A.100); two aerobic digesters; and five sludge-drying beds (Figure A.96). The chlorine building is located inside the filter building in the northwest corner. The treatment plant is located on the west side of the plant, off “C” Road.

The plant is an activated-sludge operation using the plug flow process, aerobic digestion, secondary clarification, and granular-media filtration for effluent polishing (tertiary treatment). Post-chlorination is used to produce a bacteriologically safe effluent that is discharged to the Scioto River through NPDES Outfall 003. The plant can process 800,000 gal/day of influent.

Influent is received from the GDP, ACP, DUF_6 Conversion, Ohio Valley Electric Corporation, and Ohio National Guard buildings. Influent has consisted of domestic sewage; biodenitrification and air stripper effluent from the X-700 Converter Shop & Cleaning Building; microfiltration effluent from the X-705 Decontamination Building; treated groundwater from the X-627 Groundwater Pump & Treatment Facility; treated groundwater from the X-622 South Groundwater Treatment Facility; effluent from the X-622T Carbon Filtration Facility (not in this RI/FS); miscellaneous waste streams (X-710 Technical Service Building laboratory waste, cafeteria food wastes, dispensary medicinal wastes, office chemicals, miscellaneous chemicals, laundry wastewater, and floor wash water); and infiltration/inflow of groundwater.

Radionuclides, mercury, and PCBs have been detected in the waste sludge. Sewage is also assumed to contain other hazardous materials such as heavy metals, VOCs, SVOCs, and biological agents (*Escherichia coli*, etc.). The sludge is containerized and stored on concrete pads pending characterization and selection of a proper disposal method.

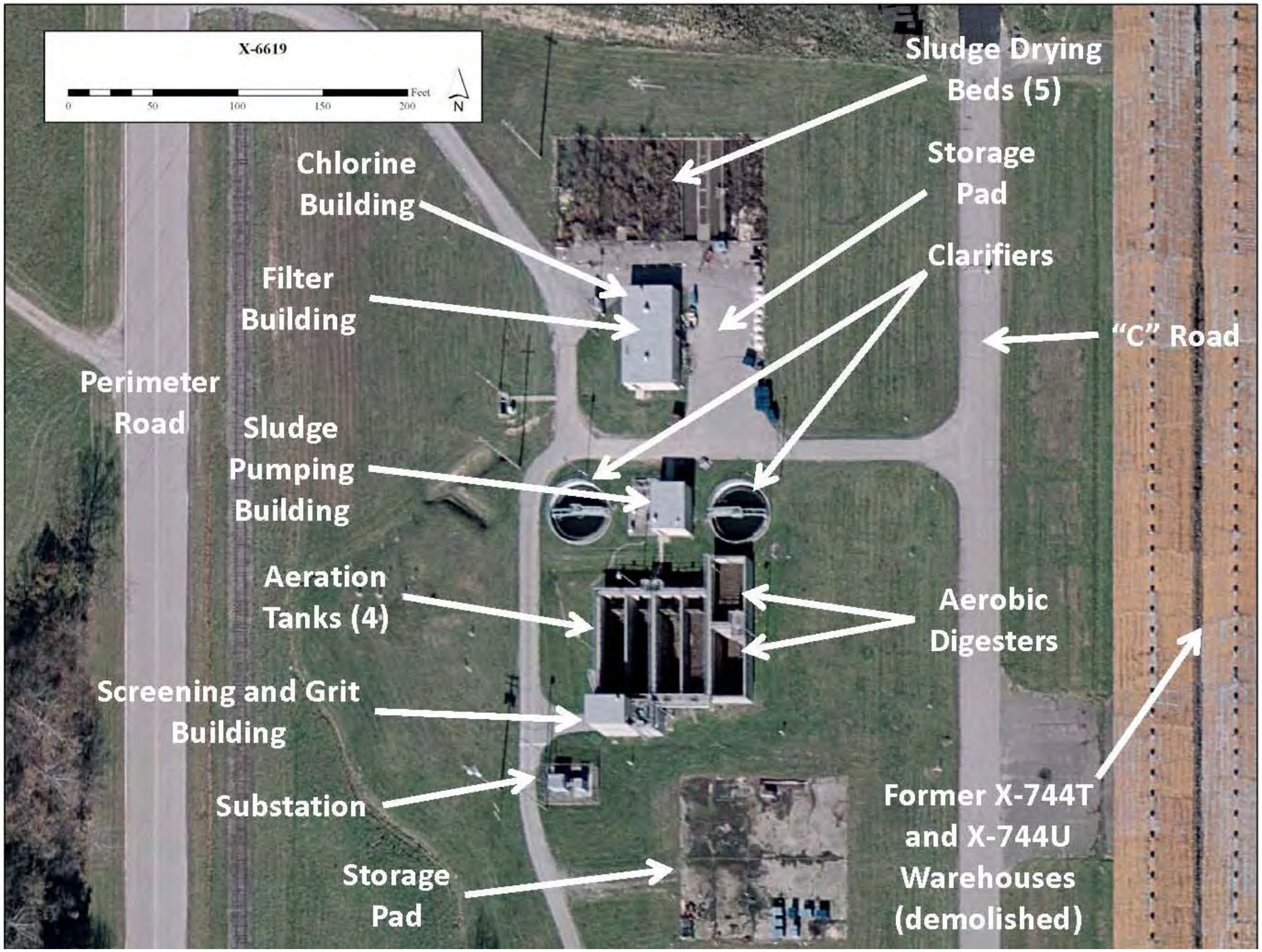

Figure A.96. X-6619 Sewage Treatment Plant (2006-2007 Aerial Photography)

Figure A.97. X-6619 Sewage Treatment Plant, Screening and Grit Building

Figure A.98. X-6619 Sewage Treatment Plant, Sludge Pumping Building

Figure A.99. X-6619 Sewage Treatment Plant, Filter and Chlorine Building

Figure A.100. X-6619 Sewage Treatment Plant, Aeration Tanks

Immediately south of the north drum storage pad is an inactive filter press and sludge tank. This area is roped off as radiologically contaminated. A small area of the concrete floor in the lower level of the Sludge Pumping Building is also roped off as radiologically contaminated. Various areas of the Filter Building (Figure A.101) and the Screening and Grit Building are also radiologically contaminated.

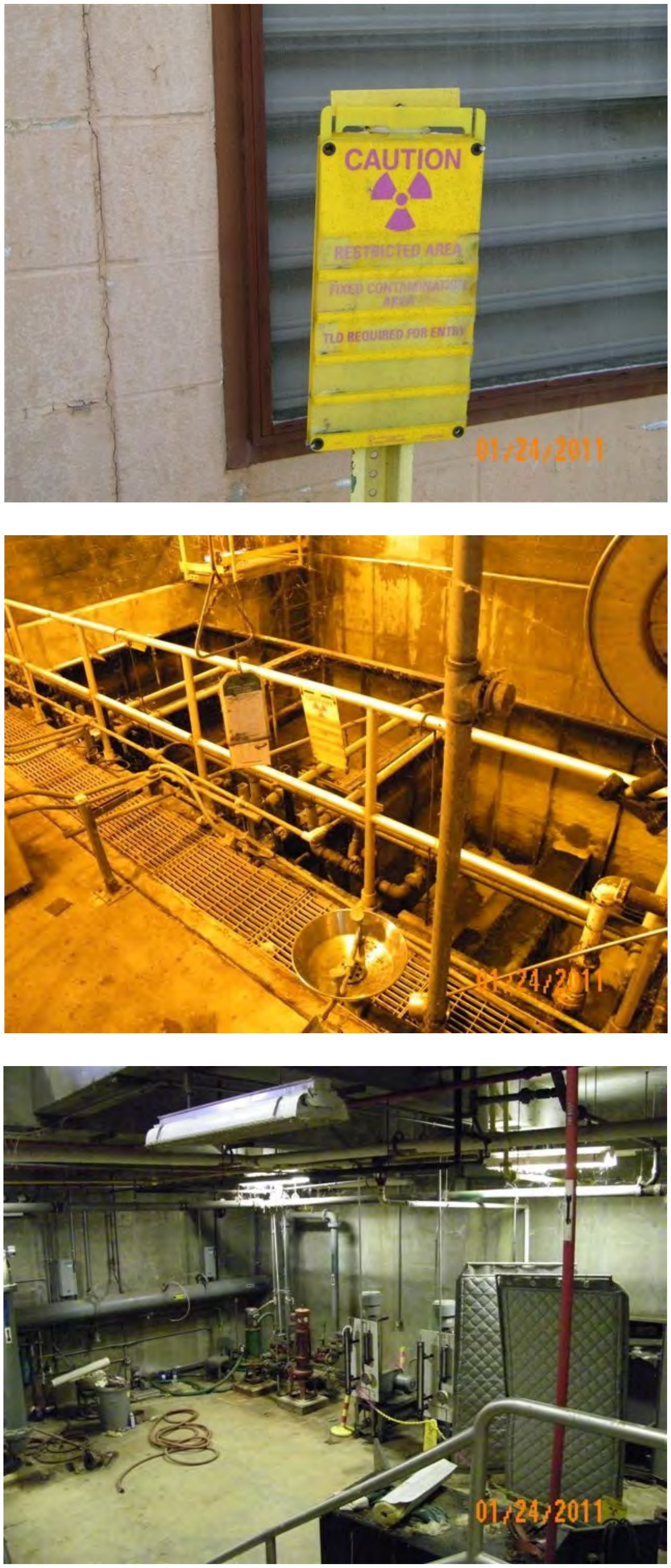

Figure A.101. X-6619 Sewage Treatment Plant Filter Building Radiological Contamination

Design and construction specifications banned the use of lead-based paint. A recent walkdown of the buildings and structures found no evidence of ACM use. No PCB equipment or PCB transformers are reported to be located within the area. Fluorescent light fixtures may have ballasts containing PCBs and bulbs containing mercury. Mercury switches and thermometers may also be found in the buildings. The chlorine building contains cylinders of chlorine.

A.5.4 ELECTRICAL DISTRIBUTION SYSTEMS AND FACILITIES

The following electrical distribution systems and facilities listed in the *April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (DFF&O) are included in the scope of this RI/FS. Although not listed in the DFF&O, field changes were approved to delete the X-533 Transformer Storage Pad, trailers, and slabs and below-grade structures associated with X-533A, X-533B, X-533E, and X-533F from the scope of the removal action and include them in this RI/FS.

- X-215A Electrical Distribution to Process Buildings
- X-215B Electrical Distribution to Other Areas
- X-215C Exterior Lighting
- X-215D Electrical Power Tunnels
- X-501 Substation
- X-501A Substation
- X-502 Substation
- X-515 330 kV Tie Line Between X-530 and X-533
- X-530A High Voltage Switchyard (grounding systems and underground cables)
- X-530B Switch House (slab and below-grade structures)
- X-530C Test and Repair Building (below-grade structures)
- X-530D Oil House (below-grade structures)
- X-530E Valve House (slab and below-grade structures)
- X-530F Valve House (slab and below-grade structures)
- X-530G GCEP Oil Pumping Station
- X-640-1A Substation (required for Fire Services)
- "C" Old Switch Yard West of X-109A Pad (near X-740).

Currently, electrical power for PORTS is purchased from the regional wholesale market by the Ohio Valley Electric Corporation and supplied to DOE under contract. The power is provided to the PORTS switchyard (X-530A High Voltage Switchyard) at 345,000 V (345 kV) over transmission lines connected to the bulk electric grid.

In addition, the switchyard is connected by a 345 kV line to the Don Marquis Switchyard, which is owned by American Electric Power. The robust power supply grid with several 345 kV power lines was necessary for the enormous GDP loads during past operations, but it now remains in place to assure bulk electric power grid interconnectivity and enhanced power system reliability.

The voltage is reduced to 13.8 kV in the switchyards for distribution to the process, auxiliary, and outlying transformers and substations. At these locations, the voltage is reduced further for operation of the GDP, auxiliary equipment, and other loads.

The layouts of the X-530A High Voltage Switchyard and X-533A Switchyard are similar. Each switchyard is enclosed by a perimeter fence on three sides and the attendant control and switch houses on the fourth side. Underground tunnels, which contain instrument and control cables, connect the switch houses and control house.

A.5.4.1 X-530 Switchyard Complex

The X-530A High Voltage Switchyard is located west of the X-330 Process Building and south of the X-630-2B Cooling Tower. The X-530A High Voltage Switchyard is part of the X-530 Switchyard Complex, which also includes the X-530B Switch House, consisting of the control house and North and South Switch Houses, the X-530C Test and Repair Building, the X-530D Oil House, the X-530E Valve House, and the X-530F Valve House. D&D of the above-grade structures associated with these buildings is addressed in the *Engineering Evaluation/Cost Analysis for Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). This RI/FS addresses the remaining on-grade slabs, equipment foundations, and below-grade structures associated with the X-530A High Voltage Switchyard, X-530B Switch House, X-530E Valve House, and X-530F Valve House. The below-grade structures include grounding systems, cables, concrete tunnels, basements, and valve and equipment vaults. The X-530C Test and Repair Building and X-530D Oil House did not actually have below-grade structures. These buildings are described in Appendix A of the EE/CA.

The X-530G GCEP Oil Pumping Station is a 500 sq ft metal building constructed in 1980. It contains pumps that maintain positive pressure on oil-filled underground pipes containing electrical power cables. The oil is pressurized with nitrogen. The building contains two pumps, a diked AST containing polybutane pipe oil, fluorescent lighting, and a sprinkler system. The building sits on a concrete vault structure. There is a below-grade structure where the oil system is connected to the tie line from the X-530A High Voltage Switchyard to the ACP Switchyard. The building supports the power feed to the ACP. There are no known radiological hazards. The building contains fluorescent light fixtures that may contain ballasts with PCBs and bulbs with mercury.

A.5.4.2 X-533 Switchyard Complex

The X-533A Switchyard is located north of the X-333 Process Building and west of the X-633-2A Cooling Tower (Figure A.102). The X-533A Switchyard is part of the X-533 Switchyard Complex, which also included the X-533 Transformer Storage Pad, X-533B Switch House, X-533C Test and Repair Building, X-533D Oil House, X-533E Valve House, X-533F Valve House, and four trailers. D&D of the these structures is addressed in the *Engineering Evaluation/Cost Analysis for the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2009c); the *Action Memorandum for the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2010c); the *X-533 Switchyard Complex Removal Action Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2010d); and the *Construction Completion Report for Removal of the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011c). Field changes were approved to delete the X-533 Transformer Storage Pad, trailers, and slabs and below-grade structures associated with X-533A, X-533B, X-533E, and X-533F from the scope of the removal action. The post-removal state of these structures to be addressed in this RI/FS is described in Section 2.10 of the Construction Completion Report.

A.5.4.3 X-501, 501A, and 502 Substations

The X-501 Substation (Figure A.103), built in 1953, is a 112-sq ft substation that feeds the X-501A Substation (Figure A.104). The X-501A Substation is a 168-sq ft substation that feeds overhead feeders, portals, X-608, X-104, X-106, several sewage lift stations, and the nitrogen unloading operation at X-330. The X-502 Substation (Figure A.105) is a 750-sq ft substation located at the X-100 Parking Lot, which feeds X-100, X-100B, X-101, X-102, and X-540.

The X-501 Substation contained PCB transformers until 1989. In 1989, a spill containing PCB oil occurred at this substation. The spill was cleaned up, but it is not known whether confirmatory wipe samples were taken. The transformers were replaced with non-PCB transformers (DOE 1993).

Figure A.102. X-533 Switchyard

Figure A.103. X-501 Substation

Figure A.104. X-501A Substation

Figure A.105. X-502 Substation

A.5.4.4 X-215A Electrical Distribution to Process Buildings, X-215B Electrical Distribution to Other Areas, X-215D Electrical Power Tunnels, and X-515 330 kV Tie Line Between X-530 and X-533

The X-215D Electrical Power Tunnels (Figure A.106) are underground, reinforced concrete power distribution tunnels built in 1954 when the X-530 switch houses were built. The tunnels lead from the X-530B Switch Houses to the X-326 and X-330 Process Buildings and provide electrical power to these buildings. A tunnel from the X-530B South Switch House (surface structure addressed as removal action) supplies power to half of X-330 and all of X-326. A north tunnel from the X-530 North Switch House supplies power to the north half of X-330. The tunnels are almost a mile long, 8 ft wide, and 10 ft in height. There are smaller branches in several places along the tunnels to convey the high-voltage power cables to different parts of the different buildings. The tunnels contain as many as six layers of cable trays along both walls. These cable trays hold the 13-kV power cables, each about 4 in. thick, to the process cells. The cable trays run the length of the tunnels, are approximately 3 ft wide, and are 1½ in. thick. They are made of formed transite (asbestos). Electrical cables may contain lead and PCBs.

Figure A.106. X-215D Electrical Power Tunnels

Several years ago at PORTS, a lightning strike caused a cable in the X-215D Electrical Power Tunnels to explode in several places and catch fire. If PCB oils were present in the cables, there could be PCB contamination in the tunnels as a result of the fire. Smoke contamination is evident in the tunnels (DOE 1993). The tunnels have water on their floors, and it is ankle-deep in many places. This water seeps into the tunnels (at certain places) through the concrete floors, walls, and surface entry ways. Drains that were once in use are now closed off, so the water must be pumped out with a mobile pumper truck and transported to one of the groundwater pump and treatment operations for treatment, usually the X-622 South Groundwater Treatment Facility. This water may be contaminated with detectable amounts of uranium, technetium-99, chromium, VOCs, and PCBs (TPMC 2006a).

A 330-kV line ties the X-530A High Voltage Switchyard and X-533 Switchyard together (X-515), and power to buildings and structures other than the process buildings is distributed both above- and below-ground (X-215B).

A.5.4.5 X-640-1A Substation (required for Fire Services)

The X-640-1A Substation (required for Fire Services) (Figure A.107) is a new substation located due north of the existing X-640-1 Fire Water Pump House, which was constructed prior to D&D of the X-633 RCW Complex cooling towers.

Figure A.107. X-640-1A Substation

A.5.4.6 "C" Old Switchyard West of X-109A Pad (near X-740)

The "C" Old Switch Yard was located west of the X-109A Personnel Monitoring Station (not part of this RI/FS) in the X-738 Phyto-Remediation Area. The "C" Old Switch Yard, built in the 1953-1955 time frame, supplied power for plant construction activities. The "C" Old Switch Yard was phased out when the X-530A High Voltage Switchyard became operational. Remaining above-grade structures include concrete pads and equipment foundations. Below-grade structures may include cables and grounding systems.

A.5.5 MISCELLANEOUS UTILITIES

The following miscellaneous utilities are included in the RI/FS:

- X-232A Nitrogen Distribution System
- X-232B Dry Air Distribution System
- X-232D Steam and Condensate System
- X-232E Freon Distribution System
- X-232F Fluorine Distribution System
- X-232G Support for Distribution Lines
- X-670 Dry Air Plant

- X-670A Cooling Tower
- X-675 Plant Nitrogen Station
- X-2232E Gas Pipeline.

A.5.5.1 Nitrogen System (X-232A Nitrogen Distribution System and X-675 Plant Nitrogen Station)

PORTS is serviced by two nitrogen systems. The first is the nitrogen system installed and maintained as part of the process buildings. This system is designated the Plant Nitrogen System, and it provides nitrogen for the X-326, X-330, and X-333 Process Buildings and the X-342A Feed Vaporization Building. The second nitrogen system is installed in the X-675 Plant Nitrogen Station. This system is designated the Site Nitrogen System, and it provides nitrogen to operations not serviced by the Plant Nitrogen System.

Plant Nitrogen System

The Plant Nitrogen System consists of a nitrogen plant, nitrogen storage, vaporization operations, and a distribution system. The system is designed to generate and distribute nitrogen gas used in the cascade for seal feed, buffer systems, and servicing equipment when dry gas is required. The principal nitrogen production and storage equipment is located in the X-330 Process Building and just south of the X-330 Process Building.

The nitrogen plant consists primarily of a separation column and support equipment in which the nitrogen is produced. From the separation column, the nitrogen can be routed as a gas to a distribution header or a bank of storage cylinders. It can also be supplied as a liquid to a low-pressure nitrogen storage tank. The tank is normally filled from a truck. Additional liquid nitrogen storage capacity is provided by a high-pressure storage tank that is filled from a tank truck.

Liquid nitrogen from the low-pressure storage tank or high-pressure storage tank may be transferred to a cold converter and vaporizing unit where it is converted to gaseous nitrogen. In addition, liquid nitrogen may be fed from the high-pressure storage tank to an ambient air vaporizer where it can be converted to gaseous nitrogen. Gas from the cylinder storage bank can be transferred to the distribution header as a supplementary source of nitrogen.

A distribution header furnishes nitrogen to the process buildings and X-342A.

Pressure-reducing stations in each process building are located on the operating floor beneath the X-25-7, X-31-5, and X-33-1 units. These stations reduce nitrogen pressure for building needs. A vent line from the low-pressure liquid storage tank furnishes additional flow to the header in X-326 and can supplement the header in X-330. The distribution systems in the process buildings are protected by pressure relief valves.

A distribution header supplies nitrogen to X-342A. X-342A contains a station where nitrogen pressure is reduced to operating pressure.

The X-333 and X-330 Process Buildings are interconnected by a nitrogen line to ensure a nitrogen supply in the event of a process building pressure-reducing station failure. In addition, an automatic air-to-nitrogen crossover is provided in each process building for emergency use of dry air in place of nitrogen.

The nitrogen system contains multiple relief valves and rupture discs, which are provided to prevent over-pressurization of various system components.

Site Nitrogen System

The Site Nitrogen System consists of nitrogen storage, vaporization operations, and a distribution system. The system is used to distribute nitrogen gas for various uses on the plant. The nitrogen production and storage equipment is located in and around the X-675 Plant Nitrogen Station (Figure A.108).

Figure A.108. X-675 Plant Nitrogen Station

The nitrogen storage tanks are normally filled by truck. Nitrogen can be routed as a gas to a distribution header or a bank of storage cylinders.

A distribution header furnishes nitrogen to various plant buildings. Nitrogen is provided to the distribution header from the vaporizer at the X-675 Plant Nitrogen Station.

The plant distribution header supplies nitrogen to auxiliary and service buildings where maintenance, testing, or plant service activities are conducted. Each of these buildings contains a station where nitrogen pressure is reduced to operating pressure.

The Site Nitrogen System contains multiple relief valves and rupture discs provided to prevent over-pressurization of various system components.

A.5.5.2 Dry Air System (X-232B Dry Air Distribution System, X-670 Dry Air Plant, and X-670A Cooling Tower)

PORTS is serviced by two air systems. The first is the air system installed and maintained as part of the process buildings. This system is designated the Plant Air System, and it provides dry compressed air to the X-326, X-330, and X-333 Process Buildings; X-342A Feed Vaporization Building; X-343 Feed

Vaporization & Sampling Building (not part of this RI/FS); X-344A UF_6 Sampling Facility; and X-626 RCW Complex. The second air system is installed in the X-670 Dry Air Plant. This system is designated the Site Air System, and it provides air to operations not serviced by the Plant Air System.

The dry air distribution system consists of an estimated 46,108 linear ft of piping in above-grade supports (X-230G).

Plant Air System

The Plant Air System consists of equipment to compress, dry, and distribute air to its use points. Typical uses for plant air include the following: purge process equipment; serve as a backup for the nitrogen system; operate instruments, controls, air ejectors, and alarms; provide process system buffers; provide air for compressor seal operation; and provide air for general maintenance and laboratory operations. The principal system components are located in the X-326 and X-330 Process Buildings.

The dry air plants are typical industrial units consisting of compressors, receivers, oil adsorbers (as applicable), and dryers. Multiple compressors, including diesel-powered backup units, are available to meet varying plant air demands.

Site Air System

The Site Air System supplies dry compressed air for auxiliary buildings that are not supplied air by the Plant Air System, although some operations have their own air supply. The principal system components are located in the X-670 Dry Air Plant (Figure A.109).

Figure A.109. X-670 Dry Air Plant

The dry air plants are typical industrial units consisting of compressors, receivers, oil adsorbers (as applicable), and dryers. Multiple compressors are available to meet varying plant air demands.

Cooling for the X-670 Dry Air Plant is provided by the X-670A Cooling Tower (Figure A.110).

The Site Air Distribution system supplies air to operations, outside the Plant Air System, where continuous air service is not required. Such operations include those involved in maintenance, testing, administration, and storage. The distribution system also provides the means for isolating portions of the system for maintenance or operational reasons while maintaining service to unaffected areas.

Figure A.110. X-670A Cooling Tower

A.5.5.3 X-232D Steam and Condensate System

Steam is produced at the X-600 Steam Plant and is distributed to the process and auxiliary buildings for heating. The steam is distributed through two lines referred to as the east and west loops. Condensate from the process and auxiliary buildings is returned to the condensate tank in X-600. The X-600 Steam Plant is described, and disposition of its above-grade structures is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a).

The steam and condensate system consists of an estimated 38,747 linear ft of piping in above-grade supports (X-232G).

A.5.5.4 X-232E Freon Distribution System

The X-232E Freon Distribution System is part of the process buildings utilities. Freon was brought into the X-330 Process Building in rail cars and was distributed from there to the X-326 and X-333 Process Buildings. The Freon distribution system will be dispositioned as part of the process buildings.

A.5.5.5 X-232F Fluorine Distribution System
Fluorine was produced in the X-342A Feed Vaporization Building, stored in the X-342B Fluorine Storage Building, and distributed throughout the process buildings and other support areas. The fluorine distribution system consists of an estimated 46,108 linear ft of piping in above-grade supports (X-232G).

A.5.5.6 X-232G Support for Distribution Lines
This system consists of concrete piers; steel poles, beams, and cross arms; and rigid and flexible hanger straps and slides. It is used to maintain the infrastructure piping (steam, air, nitrogen, fluorine, chlorine trifluoride, condensate, heating water, etc.) above-grade. It provides for vehicle and pedestrian crossings, anchorage points for thermal expansion loops, and reaction points. Included are several platforms and stairways/ladders that allow access to system isolation valves. Steam and heating water lines are generally insulated. This system provides utilities to essentially every major operation on the plant.

A.5.5.7 X-2232E Gas Pipeline
The X-2232E Gas Pipeline is a natural gas pipeline installed from the Pike National Gas Company pipeline near the East Access Road and buried about 4 ft underground to supply fuel to the X-3002 GCEP Process Building RHW Boiler System. The pipeline runs approximately parallel to the East Access Road on its north side to the east of Perimeter Road, crossing Perimeter Road and running parallel to the security fence on its south side until it reaches Grebe Avenue, and finally enters the northeast corner of the X-3002 GCEP Process Building. The original pipeline is tapped just east of Grebe Avenue and a 6-in. line runs north approximately 600 ft, where a blanked-off tap is installed for future use. At this point the gas line is reduced from 6 in. to 3 in. and runs west (under Grebe Avenue) for approximately 200 ft then north to the DUF_6 Conversion Facility.

A.5.6 INFRASTRUCTURE
The following infrastructure is included in the scope of this RI/FS:

- X-114A Outdoor Firing Range
- X-202 Roads
- X-204-1 Railroad and Railroad Overpass (excluding DUF_6 utilized track)
- X-206A North Main Parking Lot
- X-206B South Main Parking Lot
- X-206E Construction Parking Lot
- X-206H Pike Avenue Parking Lot
- X-206J South Office Parking Lot
- X-208 Security Fence
- X-208A Boundary Fence
- X-208B SNM Security Fence
- X-210 Sidewalks
- X-220A Instrumentation Tunnels
- X-230M Clean Test Site
- X-600 Steam Plant (slab and below-grade structures)
- X-600A Coal Yard (structures)
- X-690 Steam Plant
- X-748 Truck Scale
- “B” Pad in Field East of X-109A (near X-740)
- “H” Old Firing Range Shed
- “I” Peter Kiewit Powder Magazine.

A.5.6.1 X-114A Outdoor Firing Range

The X-114A Outdoor Firing Range (Figure A.111) is located in the northeastern portion of PORTS near the plant boundary. The X-114A Outdoor Firing Range structures and associated residual soils are part of the D&D decision. Remediation of the environmental media will be addressed under the Ohio Consent Decree.

Figure A.111. X-114A Outdoor Firing Range (2006-2007 Aerial Photography)

A.5.6.2 X-202 Roads

PORTS has over 16 miles of roads.

A.5.6.3 X-204-1 Railroad and Railroad Overpass (excluding DUF_6 utilized track)

The items that comprise the rail infrastructure, or fixed stock, at PORTS consist primarily of the rails, ties, ballast, switches, crossings, and signage. Currently, there are approximately 17 miles of standard gauge (56.5 in. wide) railroad track that lie within the boundaries of PORTS (Figure A.112). Beginning near the northwest corner of the plant, the track generally runs south, branches in several locations, and then runs adjacent to the process buildings (X-326, X-330, and X-333), various support structures, the DUF_6 operations, and parallel with Perimeter Road along the northern, western, and southern portions of the plant.

The on-PORTS rail system is connected to the off-PORTS rail system in the northwestern corner of PORTS. At that point, a rail spur (called the NS Lead) connects PORTS rail system with a main railroad line that runs parallel to U.S. Route 23 to the west of the plant. This rail spur and main line are both controlled by Norfolk Southern, which is a Class 1 railroad. Near the northeastern corner of PORTS, there is a rail spur (called the Mead Lead) that connects a local forest products company to a section of on-PORTS track and eventually to the rail spur controlled by Norfolk Southern. There is also another connection point (called the CSX Lead) in the northeastern corner of PORTS. However, this connection is no longer in use.

Approximately one-third of the total existing on-PORTS tracks are currently in service.

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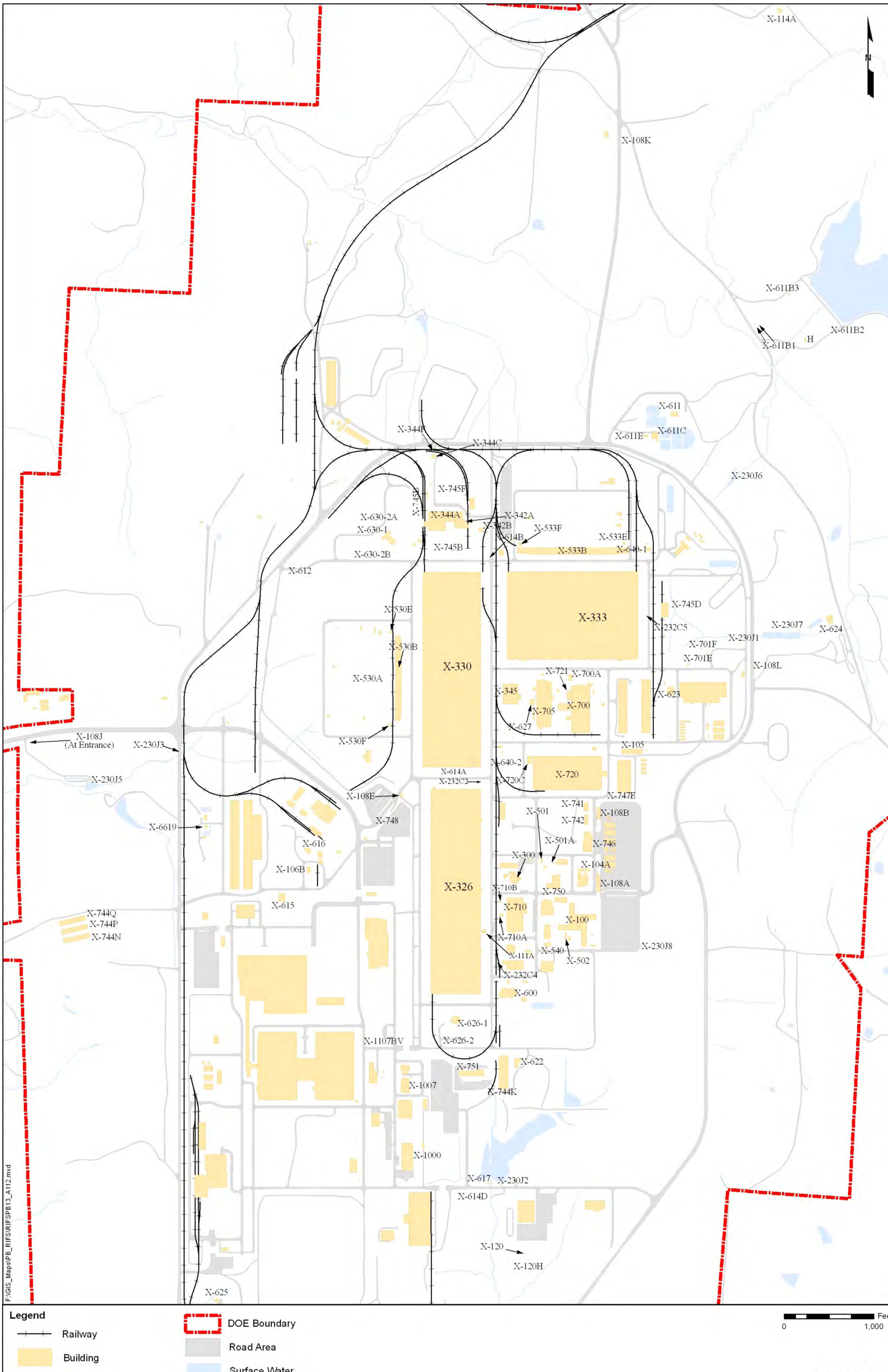

Figure A.112. PORTS Railroad System

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A.5.6.4 Parking Lots

Table A.4 provides the locations and areas occupied by each of the parking lots within the scope of this RI/FS.

Table A.4. Parking Lots

Facility No.	Description	Location	Area (sq yd/acres)
X-206A	North Main Parking Lot	Northeast of the X-100 Office Building	42,488/8.8
X-206B	South Main Parking Lot	East of the X-100 Office Building	26,667/5.5
X-206E	Construction Parking Lot	West of X-326 Process Building	10,717/2.2
X-206H	Pike Avenue Parking Lot	West of X-533A Switchyard	9,547/2
X-206J	South Office Parking Lot	XT-801 Office Building	14,285/3

Potential contaminants associated with these parking lots include PAHs from the asphalt pavement and vehicle fuel. Oil and ethylene glycol coolant that have leaked from vehicles is also anticipated to be present in these lots.

A.5.6.5 Fences

Table A.5 provides the linear footage of fences within the scope of this RI/FS.

Table A.5. Fences

Facility No.	Description	Length (lf)
X-208	Security Fence	24,000
X-208A	Boundary Fence	29,000
X-208B	SNM Security Fence (fences around the X-345 SNM Storage Building and X-326 Process Building)	300
X-230M	Clean Test Site (pole and fences)	1,400

SNM = special nuclear material

The security fencing is galvanized and may be considered a potential source of heavy metal contamination, depending on handling during D&D.

A.5.6.6 X-210 Sidewalks

The scope of this RI/FS includes approximately 21,000 ft of sidewalks.

A.5.6.7 X-220A Instrumentation Tunnels

The X-220A Instrumentation Tunnels are located underground and measure 8 ft wide × 8 ft high. All are made of reinforced concrete, and they connect the six ACRs in the process buildings with the X-300 PCF. The major part of the tunnel complex runs north/south along the west side of Pike Avenue with east/west tunnels branching off to terminate at the ACRs. The tunnel walls have ACM transite cable trays on which lie a large number of instrument cables energized at 125 V direct current. The tunnels can be accessed at the X-333 Process Building (one ACR), X-330 Process Building (two ACRs), X-326 Process Building (three ACRs), and X-300 PCF via basement rooms under the control rooms. Surface water leaks into the tunnels and accumulates to a depth that, in some places, covers the bottom cable tray. The water is contaminated with detectable concentrations of uranium and VOCs; therefore, it is disposed by pumping it into a mobile tanker for treatment at the X-622 South Groundwater Treatment Facility. Tunnel drains are closed off to prevent the water from going into the storm sewers.

A.5.6.8 X-600 Steam Plant (slab and below-grade structures)

Disposition of the above-grade structures associated with the X-600 Steam Plant (Figure A.113) is addressed in the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011a). This RI/FS addresses the disposition of the floor slab and any remaining below-grade structures (valve pits, etc.) that remain.

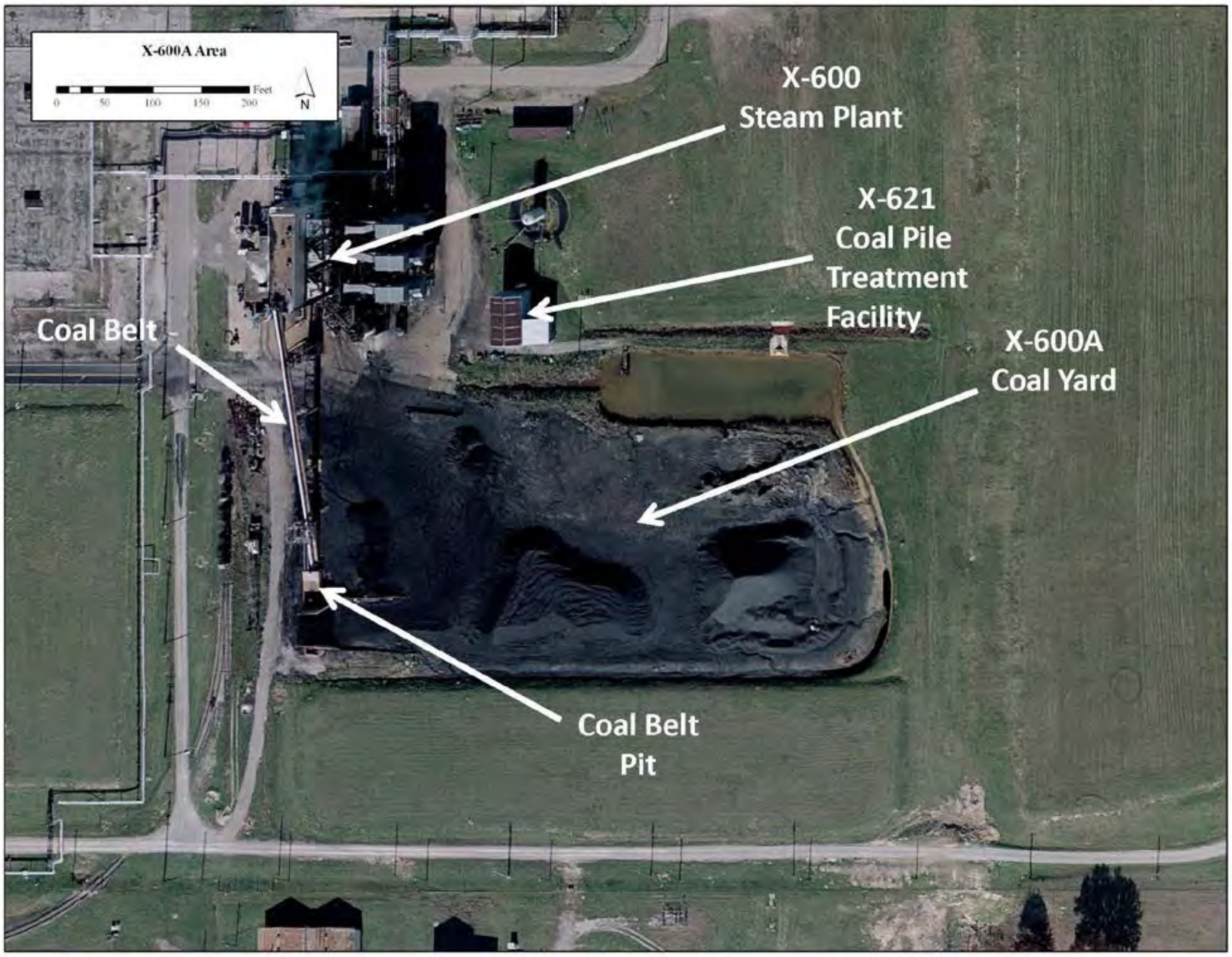

Figure A.113. X-600 Steam Plant and X-600A Coal Yard (structures) (2006-2007 Aerial Photography)

A.5.6.9 X-600A Coal Yard (below-grade structures)

This RI/FS addresses the below-grade structures associated with the X-600A Coal Yard (Figure A.113). These include such structures as the belt pit (Figure A.114) and coal unloading pit, etc.

Figure A.114. X-600A Coal Belt Pit (below-grade structure)

A.5.6.10 X-748 Truck Scale

The X-748 Truck Scale is a ramped drive, approximately 165 ft long, with a scale mounted in the center. The ramped drive to the scale diverges from the road leading to the X-108E Construction Entrance Portal. Trucks approaching the portal divert from the road onto the scale for weighing bulk materials when entering or leaving the plant. A small building adjacent to the truck scale contains personal lockers and is used for storage. No known radiological or chemical hazards are associated with this truck scale.

A.5.6.11 "B" Pad in Field East of X-109A (near X-740)

The "B" Pad is a concrete slab, approximately 60 ft × 80 ft, located south of the southeast corner of the X-530A High Voltage Switchyard and west of the X-330 Process Building (Figure A.115). There is no indication of any radiological or chemical contamination associated with the pad.

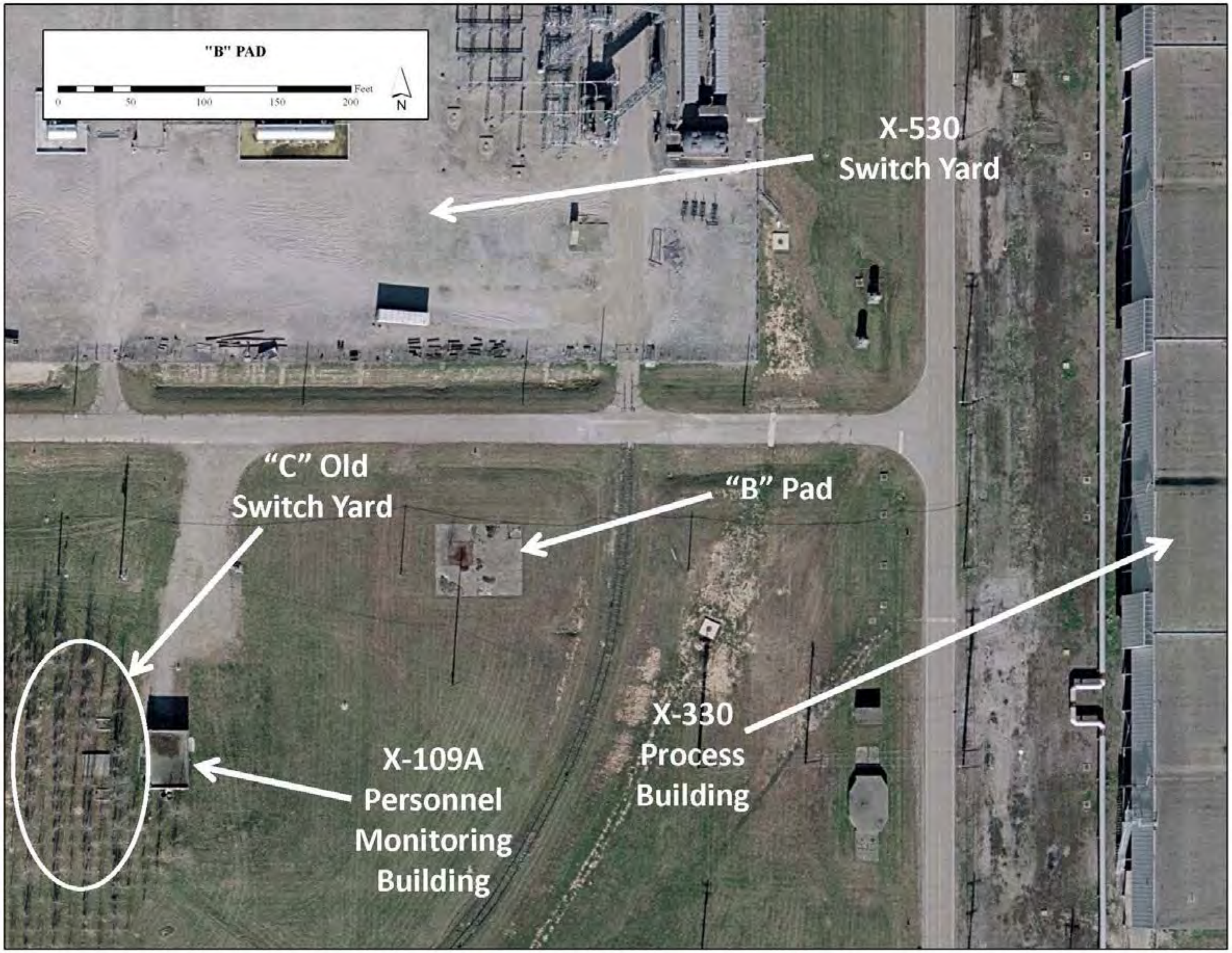

Figure A.115. "B" Pad Location (2006-2007 Aerial Photography)

A.5.6.12 "H" Old Firing Range Shed

The "H" Old Firing Range Shed is a 45-ft × 12-ft metal frame and roof structure on a concrete slab. It is located southwest of the X-611B Lagoon (Figure A.116). The shed is open on three sides and has one wall of metal siding. There is no indication of any radiological or chemical contamination associated with the pad.

Figure A.116. "H" Old Firing Range Shed (2006-2007 Aerial Photography)

A.5.6.13 "I" Peter Kiewit Powder Magazine

The "I" Peter Kiewit Powder Magazine is located in the woods just north of the plant. It is a small concrete block building, approximately 6 ft × 8 ft in size, with one steel door and a concrete roof (Figure A.117). It is speculated that this building housed explosives used to blast the original roadway into the plant. The building was located, opened, and inspected in 2010. The only thing found was a small, empty wooden box.

Figure A.117. "I" Peter Kiewit Powder Magazine

A.5.6.14 X-690 Steam Plant

The X-690 Steam Plant was built in 2012 to provide a more reliable and cost-effective source of steam following the D&D of the X-600 Steam Plant. The plant consists of the installation of two 42,000 lb/hr natural gas-fired boilers and de-aerating feed tanks installed on a concrete pad located on the north side of the X-670 Dry Air Plant. The de-aerating feed tanks remove dissolved oxygen and other dissolved gases from the boiler feed water. Control system components and other auxiliary equipment for the boilers are located within the X-670 Dry Air Plant building. A 20,000-gal double walled fuel oil tank, equipped with an electronic leak detection system, is mounted on a concrete pad just northeast of the boilers. The fuel oil is a contingency should the natural gas supply be disrupted.

A.5.7 STORAGE AND WAREHOUSE FACILITIES AND YARDS

The following storage facilities, warehouse facilities, and yards are included in the scope of this RI/FS:

- X-345 SNM Storage Building
- X-741 Oil Drum Storage Facility
- X-742 Gas Cylinder Storage Facility
- X-744K Warehouse-K
- X-744N Warehouse N Non-[Uranium Enrichment Area] UEA
- X-744P Warehouse P Non-UEA
- X-744Q Warehouse Q Non-UEA
- X-744V Surplus and Salvage Clean Storage Area
- X-744Y Waste Storage Area
- X-745B Toll Enrichment Gas Yard
- X-745D Cylinder Storage Yard
- X-745F North Process Gas Stockpile Yard

- X-745G-2 Cylinder Storage Yard
- X-746 Material Receiving and Inspection (portions of above- and below-grade structures)
- X-747 Clean Scrap Yard
- X-747A Material Storage Yard (below-grade structures)
- X-747B Material Storage Yard Pads and Equipment
- X-747C Material Storage Yard Pads and Equipment
- X-747D Material Storage Yard Pads and Equipment
- X-747E Material Storage Yard Pad
- X-747G Precious Metal Scrap Yard (below-grade structures)
- X-747H NW Contaminated Scrap Yard (below-grade structures)
- X-747H1 Loading Pad
- X-747J Decontamination Storage Yard
- XT-847 Warehouse.

A.5.7.1 X-345 SNM Storage Building

The X-345 SNM Storage Building (Figure A.118) is a single-story, reinforced concrete structure approximately 161 ft wide and 219 ft long. This building is located west of the X-705 Decontamination Building (Figure A.119). Designed as a vault, it has a total floor area of 35,260 sq ft and a minimum clear interior height of 12 ft. The foundations are also made of reinforced concrete. Provision was made for a two-truck unloading dock along the east side of the building. This unloading dock accommodates two 55-ft-long × 8-ft-wide tractor trailers that are up to 13.5 ft in height. Dock levelers were installed to accommodate trucks with different floor heights. Inside the building, there are north and south vaults for storing SNM. A central area contains the HASA, a small lab, and some area for storage. There are also lunchroom, restroom, and office accommodations in the building.

Figure A.118. X-345 SNM Storage Building

Figure A.119. X-345 SNM Storage Building Location (2006-2007 Aerial Photography)

Both the north and south vaults utilize underground storage receptacles (Figure A.120). Each in-floor storage receptacle is a welded, leak-proof, shell sleeve sized appropriately for the intended container. The tops of the sleeves are flush with the floor. In addition to the underground storage receptacles, the north vault has aboveground storage racks. Material is contained in monel UF_6 cylinders (5, 8, and 12 in. in diameter), polyethylene bottles (4.5 in. × 50 in.) for solutions, polybottles (4 in. × 9 in.) for UNH, or steel cans (5 in. × 25 in., 6 in. × 15 in., and 6 in. × 9 in.) for uranium oxides and other non-UF_6 solid uranium compounds. The non-UF_6 SNM containers are sealed inside two plastic bags before being placed in the receptacles.

The HASA is located in the work and drum storage area of the building. It provided the capabilities for the sampling, dumping, and transferring of UF_6 from small cylinders. It contains two autoclaves with associated piping for heating cylinders prior to sampling, valves, heating systems, a hydraulic system, and an evacuation system containing cold traps, chemical traps, and vacuum pumps.

Figure A.120. X-345 SNM Storage Building Vault Area

This building is used primarily for storage of well-contained, highly enriched SNM. The potential for contamination from this material is small because of the precision of the material's packaging and the care given to its handling. There is, however, known contamination around the HASA and the glove box in the central area. The available documentation designates the entire building as having fixed radiological contamination. However, the building custodian reports the contamination is localized. Given the operations carried out here, the potential exists for fixed contamination throughout the whole building.

Diesel fuel is stored in the building, but there have been no reported releases from the diesel fuel UST. A survey conducted in 1988 reported X-345 was free of asbestos. There is also no known PCB or PCB-contaminated equipment supporting operations, although fluorescent light fixtures throughout the building may have ballasts containing PCBs. Surfaces may be painted with lead-based paint. Other hazardous materials included sorbent material, prestolite acetylene, and descaler dry acid.

Byproduct oxides are also stored in the north vault. Much of this material has been shipped to PORTS from other facilities, and the rest was generated at the X-705 Decontamination Building or the X-326 Process Building. These uranium compounds are highly enriched, making secure storage a necessity.

Some wastes were generated in the laboratory (contaminated polybottles). Other wastes were generated during HASA operations, the change-out of associated ventilation chemical traps (contaminated oil, NaF, and alumina), and routine maintenance (contaminated metal) (DOE 1993, LMES 1997).

A.5.7.2 X-741 Oil Drum Storage Facility

The X-741 Oil Drum Storage Facility (Figure A.121), built in 1954, is a 3,600-sq ft concrete slab poured on grade and covered with a corrugated asbestos roof supported by steel columns. The building is located south of the X-720 Maintenance & Stores Building and adjacent to the X-206A North Main Parking Lot (Figure A.122). A ramped dike with valves has been installed to contain any spills that might occur

Figure A.121. X-741 Oil Drum Storage Facility

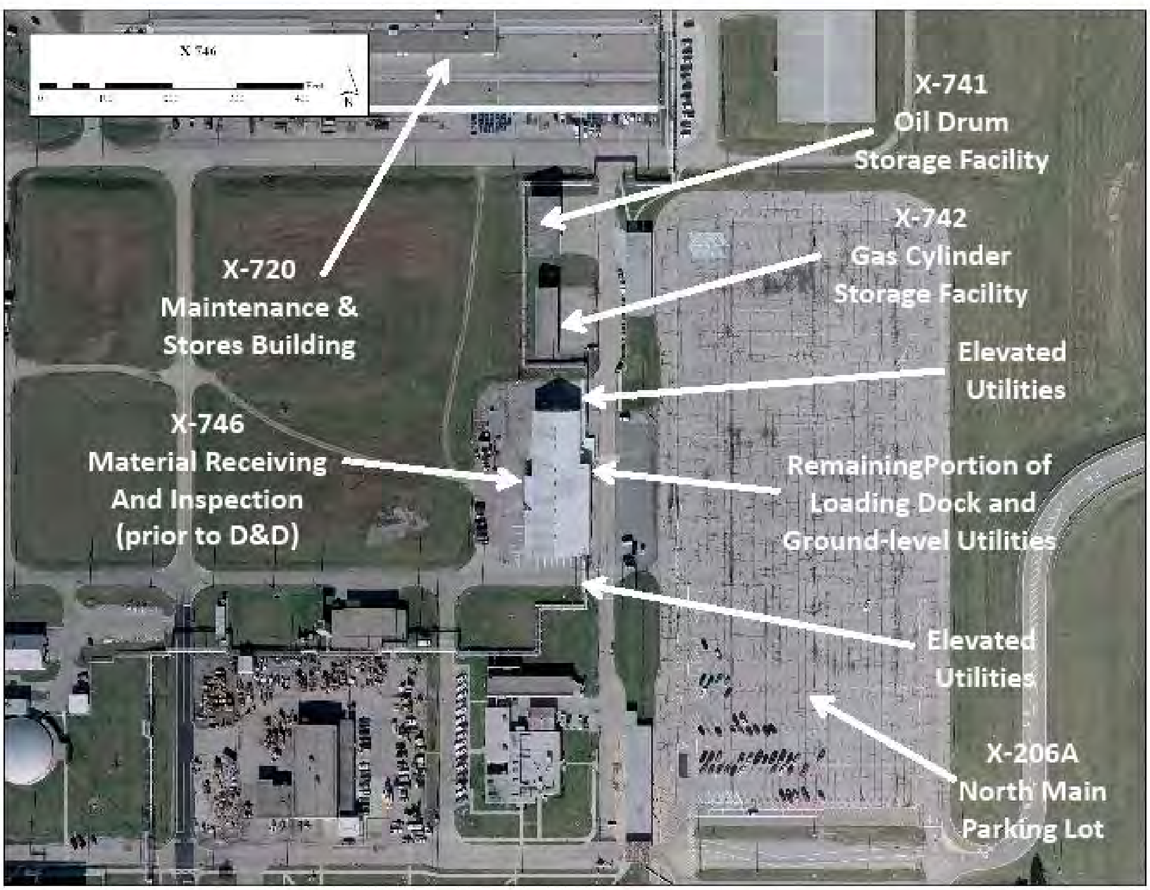

Figure A.122. X-741 Oil Drum Storage Facility, X-742 Gas Cylinder Storage Facility, and X-746 Material Receiving and Inspection Building (2006-2007 Aerial Photography)

within the building area. The facility was originally built to provide storage for 55-gal drums of waste oil and chemicals before their final disposal and was used for that purpose until recent years. The shed is now used to store drums and other containers of various chemicals and materials until they are transported to other points of use (Figure A.123). Some of the materials that have been stored include NH_4OH, TCE, boiler guard, windshield washer fluid, cleaning fluid, dry ice, mop oil, kerosene, and absorbents for spills. Although spills have not been reported, there is a potential for contamination from the materials that have been stored in the building. An unlabeled, pole-mounted transformer adjacent to the building may contain PCBs. Lead-based paint may have been used on painted surfaces and cylinders (DOE 1993, TPMC 2006a).

Figure A.123. X-741 Oil Drum Storage Facility Stored Items

A.5.7.3 X-742 Gas Cylinder Storage Facility

The X-742 Gas Cylinder Storage Facility (Figure A.124), built in 1954, is on an approximately 2,800-sq ft concrete slab on a fill-based platform with open sides and a corrugated asbestos roof supported by steel columns. The building is located south of the X-720 Maintenance & Stores Building and adjacent to the X-206 North Main Parking Lot (Figure A.122). A cinder block wall divides the concrete platform into two unequal sections. The building provides storage for full cylinders of various gases until delivered to their point of use (Figure A.125). Some of the gases stored include helium, chlorine, methane/argon, acetylene, nitrogen/hydrogen, sulfur hexafluoride, carbon dioxide, hydrogen, argon, Freon, propane, dichlorofluoromethane, SO_2, and oxygen. Cylinders are chained within separate bays to prevent tipping or falling. Lead-based paint may have been applied to the walls of the building, and a pole-mounted transformer adjacent to the building may contain PCBs. Although there are no signs of spills or releases, materials stored in the building are also potential sources of contamination (DOE 1993, TPMC 2006a). There is a small radioactive material area (RMA) in the northwest corner of the fire wall.

Figure A.124. X-742 Gas Cylinder Storage Facility

Figure A.125. X-742 Gas Cylinder Storage Facility Cylinders

A.5.7.4 X-744K Warehouse-K

The X-744K Warehouse-K (Figure A.126) encompasses approximately 30,000 sq ft and is constructed of galvanized steel on a concrete-slab floor. It is located east of the X-751 GCEP Mobile Equipment Garage (Figure A.127) and has been in its present location since 1978. Its former location was east of the X-1000 Administration Building. Previously, it was used as a storage building for tools and seasonal equipment, and as a storage building for lithium hydroxide (LiOH). The LiOH was stored in stacked steel drums. There may have been a release of LiOH in the building, but there is no documentation indicating lithium hydroxide in the soil around the warehouse. The LiOH was originally packaged in fiber drums, which were later found to be inadequate. In 1988, the drums were double wrapped in plastic and overpacked into steel drums. The LiOH may have contained mercury. The interior walls of the building may be coated with lead-based paint, and an out-of-service transformer is potentially contaminated with PCBs. Documents indicate that PCB equipment or PCB-contaminated equipment may have been present at the building (DOE 1993).

Figure A.126. X-744K Warehouse-K

All of the LiOH has been removed and sold to commercial buyers. The warehouse is currently leased to the Ohio National Guard for storage of miscellaneous materials and equipment (Figure A.128).

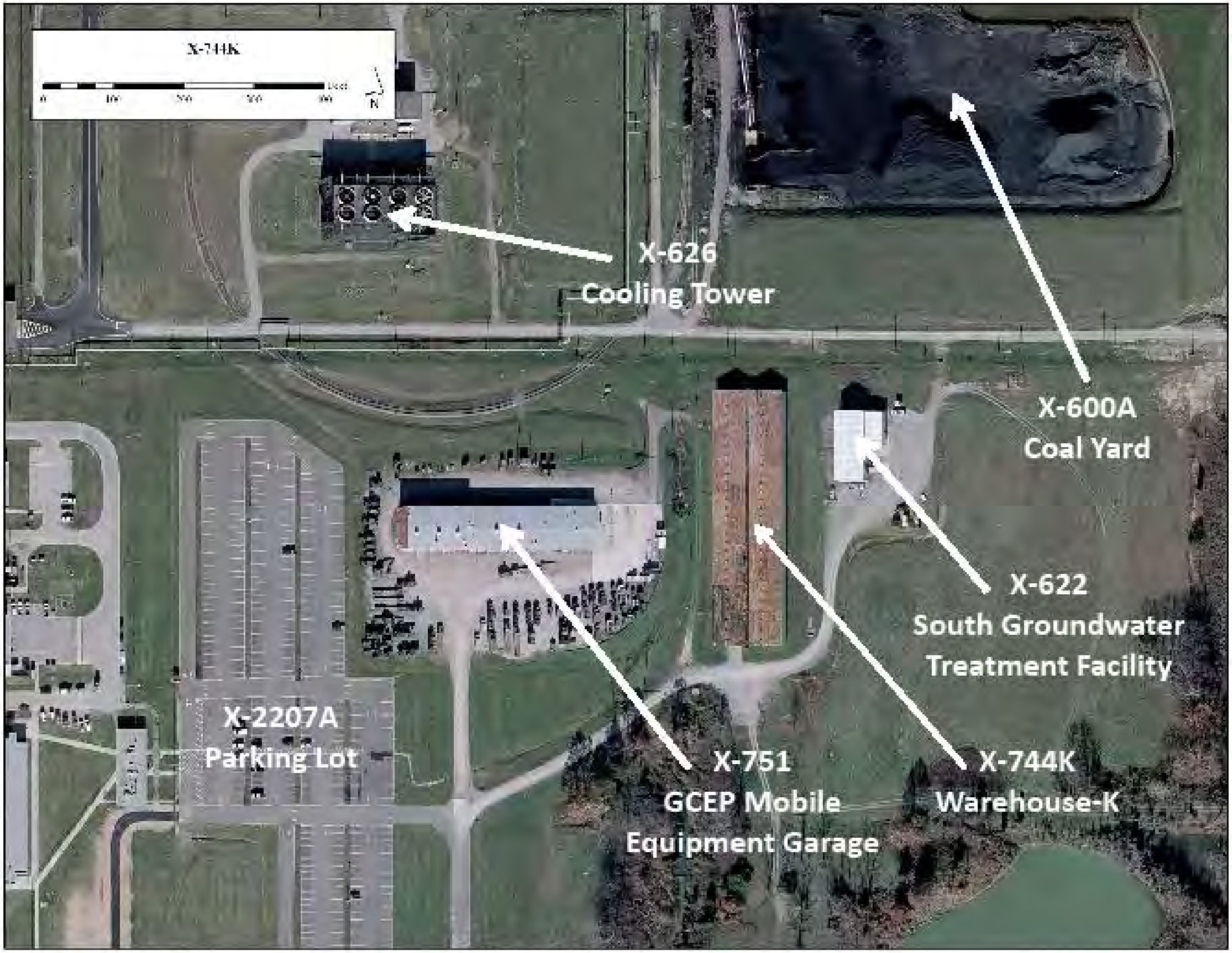

Figure A.127. X-744K Current Location (2006-2007 Aerial Photography)

Figure A.128. X-744K Miscellaneous Stored Equipment and Materials

A.5.7.5 X-744N, -P, and -Q Warehouses Non-UEA

The X-744N, -P, and -Q Warehouses Non-UEA are located on the Contractor's Access Road, which is west of Perimeter Road on the west side of the plant (Figure A.129).

Each of these warehouses encompasses approximately 14,500 sq ft. In the 1950s, the area and buildings were used as a construction company headquarters to house contractors and as a vehicle parking area. These buildings were demolished before 1976, but cement pads were left in place. In 1988, new buildings were built on the concrete pads left from demolition of the earlier buildings and are constructed of wood frames covered with corrugated aluminum siding. The roof skylights are a fiberglass material. No utilities are provided in these warehouses.

The buildings have been used to store LiOH. The LiOH stored in these buildings was originally stored in fiber drums in another warehouse approximately 2,000 ft south of these warehouses. The fiber packaging was inadequate because of deterioration. Before moving the drums, the materials were double wrapped in plastic and repackaged into 110-gal steel drums. The use of the larger overpacks increased the volume to be stored and necessitated the additional warehouses. The materials were repackaged in the old warehouses and moved to the new warehouses in 1988.

Figure A.129. X-744N, -P, and -Q Warehouses Non-UEA (2006-2007 Aerial Photography)

Data indicate a past release of the LiOH, and it is in the soil around the X-744N, -P, and -Q warehouses. The LiOH may have contained mercury. Between late 1995 and early 1996, DOE sold the LiOH to commercial buyers. All of the LiOH has been removed.

The X-744N warehouse is presently empty, but it may be used for storage of materials and equipment similar to that stored in the -P and -Q warehouses. Roads and grounds equipment, fencing, surplus furniture, and scaffolding are currently stored in the X-744P warehouse. Items currently stored in the X-744Q warehouse include office furniture and other property with resale value, which is located within a locked fence area inside the warehouse. Paper and plastic material is temporarily stored while waiting for recycling. Also stored in the warehouse are surplus pipe and electrical wiring, equipment and materials to be used for plant maintenance, and road salt for winter road use. Occasionally, trucks, graders, dozers, and other heavy equipment are temporarily parked inside the warehouses (Figure A.130).

No fissile materials are stored in the warehouses. They are not radiologically contaminated, and no radioactive materials are stored in the warehouses. All chemicals, such as road salt, that are or will be stored in the warehouses are standard industrial hazards.

Figure A.130. Miscellaneous Warehouse-stored Materials

The X-744N, -P, and -Q warehouses are RCRA solid waste management units (SWMUs) where the investigation and remediation (if required) of any media-specific (soil, groundwater, etc.) risks have been deferred until D&D because of ongoing use. If required, media-specific investigation and remediation activities will proceed in accordance with requirements of the Ohio Consent Decree. D&D of these warehouses will be coordinated with these potential activities.

A.5.7.6 X-744V Surplus and Salvage Clean Storage Area

The X-744V Surplus and Salvage Clean Storage Area is a 20,125-sq ft paved area located on Hewes Street, west of and adjacent to the XT-800 GCEP Construction Office Pad area (FigureA.131). It is fenced with a chain link fence and security wire. The pavement is breaking up and overgrown with weeds. The storage area is posted as an RMA. As listed in a 2006 cost estimate (TPMC 2006c), material and equipment stored in the area included B-25 boxes; a full-to-overflowing intermodal container; a heat exchanger; nine wire baskets of steel scrap metal; a spool of steel cable; pallets; loose steel scrap on the ground (pipe, framework, crane member); and miscellaneous loose scrap steel on the ground (including a box with a tree growing through it).

Figure A.131. X-744V Surplus and Salvage Clean Storage Area Location (2006-2007 Aerial Photography)

A.5.7.7 X-744Y Waste Storage Area

The X-744Y Waste Storage Area (formerly the "Mixed Waste Storage Yard") surrounds the X-744G Bulk Storage Building (not part of this RI/FS) (Figure A.132). The area covers approximately 15 acres and was used from 1955 to 1986 as a general purpose storage yard. A 1955 map shows that a sandblast area existed to the west of the X-744G building (a pipe fabrication shop at the time) and that "gas bottles" were placed on the pad where a gasohol tank was resting. A 1976 aerial photograph shows the northern portion of the X-744Y area being used as a material storage yard. More recently, the western portion of the X-744Y Waste Storage Area was used to store cylindrical steel containers (old converter shells), rectangular steel boxes (B-25 boxes [8 ft × 6 ft × 6 ft]), and dumpsters. The containers held radioactive wastes (burnable and scrap metal) and mixed wastes (solvent-contaminated rags used for degreasing radioactive equipment surfaces). Although most of these containers have been removed, a few "orphaned" shells remain in the southwest lot. An undetermined quantity of radioactive scrap metals and burnable wastes were stored in the area with no secondary containment. Suspected releases may have occurred from these waste management units via storm water runoff to surrounding soils. A 2,000-gal, diked AST that previously stored gasohol is located in the southern portion of the area. The tank is currently empty. It is possible that the pole-mounted transformers in the X-744Y area may contain PCB-contaminated oil (DOE 1993, LMES 1997).

Currently, the eastern portion of the yard is used as a laydown area for the X-701B remediation project. Administrative trailers (X-744Y Trailers 1-9) are located in the center of the area (not shown in Figure A.132). The footprint of the area where the converter shells were stored is posted as an underground radioactive materials area. The southwest storage pad is still used to store drums and miscellaneous materials. In its southeast corner, the pad had a flammable materials storage shed that is now being utilized as a refueling center for forklifts. There are stains that appear to have been generated by multiple spills from refueling.

Figure A.132. X-744Y Waste Storage Area (2006-2007 Aerial Photography)

A.5.7.8 X-745B Toll Enrichment Gas Yard

The X-745B Toll Enrichment Gas Yard (Figure A.133) is a 183,894-sq ft concrete pad located adjacent to the X-344A UF_6 Sampling Facility. It normally held 2.5-ton UF_6 cylinders and protective shipping packages that were used as 2.5-ton cylinder-shipping overpacks. Additionally, the bermed streets surrounding the yard were used to store new tails cylinders. Typically, these clean and empty 48-in. cylinders were triple stacked along these streets to provide convenient accessibility to the cylinders with special forklift adapters, allowing short trips when supplying the X-330 Process Building tails withdrawal operation with empty cylinders. The 2.5-ton cylinders were stored in double rows, side-by-side, directly on the concrete pad. No special clearance provisions were made because 2.5-ton cylinders were handled with the special forklift attachment.

Generally, based on the physical layout, large UF_6 cylinders with product above 1 weight percent uranium-235 may be stored in groups of up to 342 cylinders with 20 ft separating each group or array. The 10-ton cylinders containing solid uranium enriched at 5 weight percent uranium-235 are limited to an array of 308 cylinders (LMES 1997). Cylinder removal and disposition are not in the scope of this RI/FS.

On the evening of March 7, 1978, the contents of a 14-ton feed cylinder were released on the X-745B pad. Much of the material was carried into Storm Sewer B by melting snow. The spill occurred in the south-southwest portion of the unit (DOE 1998).

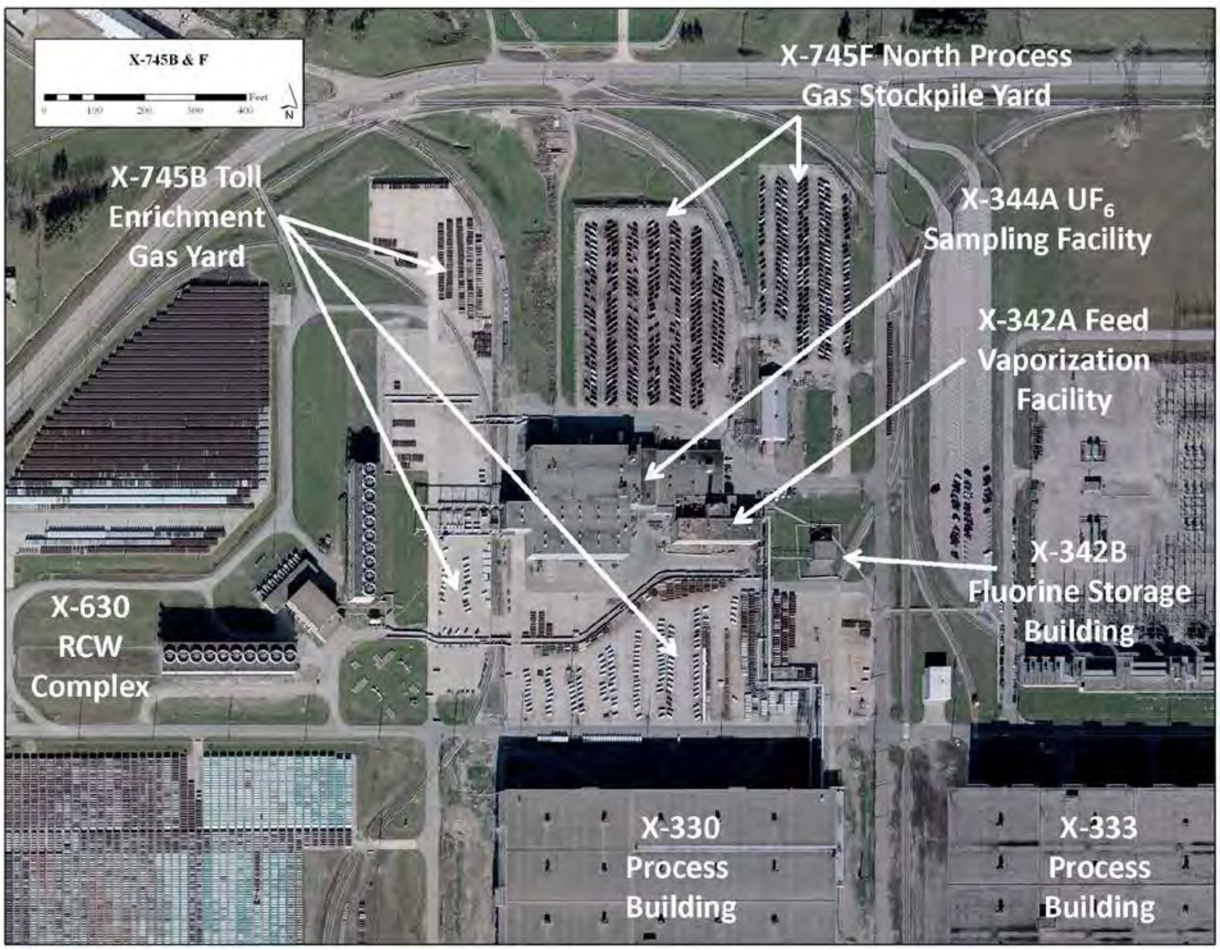

Figure A.133. X-745B Toll Enrichment Gas Yard (2006-2007 Aerial Photography)

The southern section of the X-745B Toll Enrichment Gas Yard is a RCRA SWMU where the investigation and remediation (if required) of any media-specific (soil, groundwater, etc.) risks have been deferred until D&D because of ongoing use of the yard. Media-specific investigation and remediation (if required) activities will proceed in accordance with requirements of the Ohio Consent Decree. D&D of this yard will be coordinated with these activities.

A.5.7.9 X-745D Cylinder Storage Yard

The X-745D Cylinder Storage Yard (Figure A.134) is a cylinder storage area with a total storage capacity of 40,437 sq ft. X-745D East is a 13,437-sq ft concrete pad, and X-745D West is an approximately 27,000-sq ft gravel pad. The X-745D Cylinder Storage Yard is located northeast of the X-343 Feed Vaporization and Sampling Building (not part of this RI/FS). Cylinder removal and disposition are not in the scope of this RI/FS.

Figure A.134. X-745D Cylinder Storage Yard (2006-2007 Aerial Photography)

A.5.7.10 X-745F North Process Gas Stockpile Yard

The X-745F North Process Gas Stockpile Yard (Figure A.133) is a 212,130-sq ft, concrete cylinder storage pad. The X-745F yard provided overflow storage for the X-745B Toll Enrichment Gas Yard and stockpiled enriched product in 10- and 14-ton cylinders. The portion of the yard located north of and adjacent to the X-342A Feed Vaporization Facility is referred to as the X-745F East Lot. It can store cylinders on cradles in herringbone-patterned double rows with aisles for straddle carrier access. The need for random access to the cylinders stored in the X-745F East Lot precludes double stacking of cylinders. Adjacent to the X-745F East Lot, a large gully was filled with rock and dirt from various construction excavations at PORTS. After the depression was filled, the X-745F East Lot was extended to the west. This area is now known as the X-745F West Lot. The 10- and 14-ton cylinders are stored on oak timbers or concrete cradles that have a 24-in. radius for both cylinder stability and to spread loading over a larger area of the cylinder than the cylinder stiffening rings provide. The area is lighted (LMES 1997).

Cylinder removal and disposition are not in the scope of this RI/FS.

A.5.7.11 X-745G-2 Cylinder Storage Yard

The X-745G Cylinder Storage Yard is built on a construction fill area southeast of the X-230L North Holding Pond. It is split into two sections, X-745G-1 and X-745G-2. The X-745G-1 portion of the yard is not in the scope of this RI/FS, but the other one is. The X-745G-2 Cylinder Storage Yard (Figure A.135) is an approximately 129,500-sq ft (approximately 3 acres) concrete pad surrounded with a fence.

Figure A.135. X-745G-2 Cylinder Storage Yard (2006-2007 Aerial Photography)

A.5.7.12 X-746 Material Receiving and Inspection (portions of above- and below-grade structures)

The X-746 Material Receiving and Inspection building was a 20,000-sq ft, steel-framed building constructed in 1954. It was built mostly above-grade at the loading dock elevation and was located south of the X-742 Gas Cylinder Storage Facility and adjacent to the X-206A North Main Parking Lot (Figure A.122). The building was used for storage of uranium until 1970. It then became a material receiving and inspection building until its demolition in a 2009 removal action (DOE 2009d, DOE 2009e, DOE 2009f). The only visible remnant of the building is a portion of the loading dock that protects utilities (plant air, nitrogen, steam, and condensate return) that pass beneath it (Figure A.136).

Fixed radiological contamination is associated with the loading dock remains. The remains of the loading dock and any other remaining above- and below-grade structures associated with this building are included in the scope of this RI/FS.

Figure A.136. X-746 Material Receiving and Inspection Loading Dock Remains

A.5.7.13 X-747 Clean Scrap Yard

The X-747 Clean Scrap Yard is located outside of Perimeter Road in the northwest section of PORTS (Figure A.137). It is bounded on the east and south by the X-747H NW Contaminated Scrap Yard.

The X-747 Clean Scrap Yard is a field surrounded by a fence with a locked gate. It was used to store nonradiologically contaminated and nonhazardous miscellaneous materials. The few items remaining in the yard were removed in 2006, and the vacant yard has been unused since that time.

Figure A.137. X-747 Clean Scrap Yard Area (2006-2007 Aerial Photography)

A.5.7.14 X-747A Material Storage Yard (below-grade structures)

The X-747A Material Storage Yard (below-grade structures) is a 95,148-sq ft concrete pad located between the X-744H and J Bulk Storage Buildings (not part of this RI/FS) (Figure A.138). The yard is utilized for storage of used equipment, surplus equipment, or scrap. The yard currently contains excess equipment, old cylinder carts and flat bed carts, old forklifts, old loaders, and an old truck with a flatbed trailer. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities.

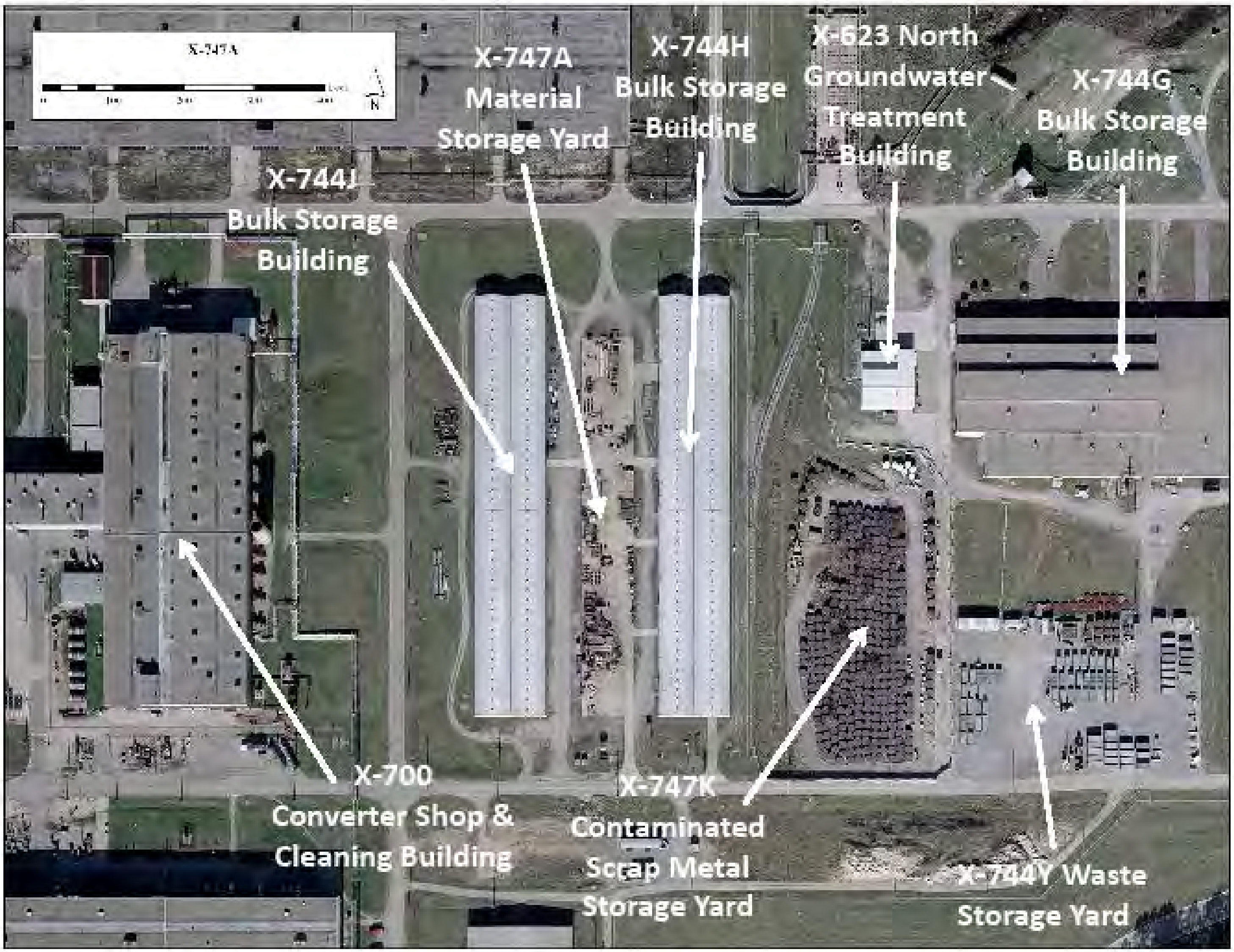

Figure A.138. X-747A Material Storage Yard (2006-2007 Aerial Photography)

A.5.7.15 X-747B Material Storage Yard Pads and Equipment

The X-747B Material Storage Yard Pads and Equipment area is an approximately 28,600-sq ft (0.7- acre) concrete pad located outside the southwest corner of the X-700 Converter Shop & Cleaning Building (Figure A.139). Historically, it has been utilized for storage of used equipment, surplus equipment, or scrap. Currently, it is being used as a vehicle parking area and a staging area for waste containers. The vehicles (tanker trailers, vacuum truck, etc.) parked on the yard appear to be equipment that is being actively used on the plant. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, Freon, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities.

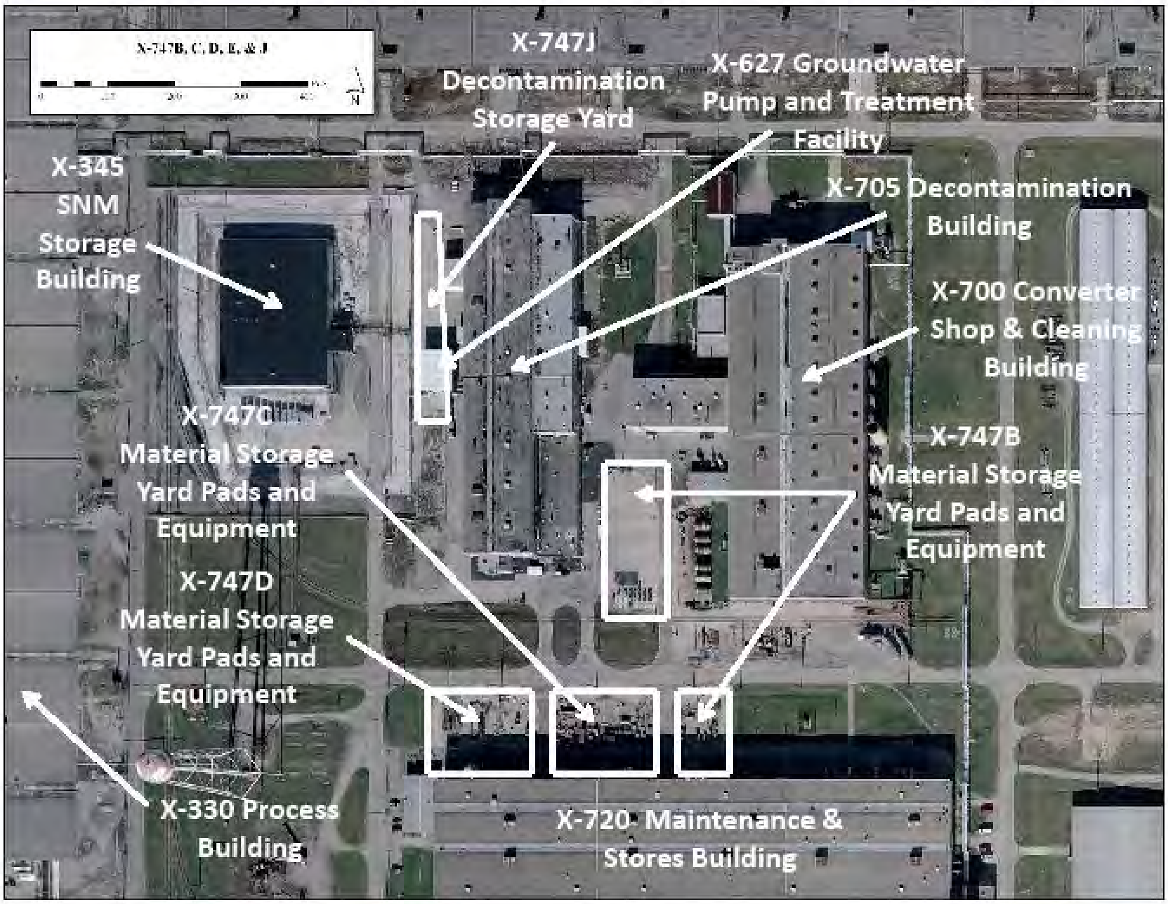

Figure A.139. X-747B Material Storage Yard (2006-2007 Aerial Photography)

A.5.7.16 X-747C Material Storage Yard Pads and Equipment

The X-747C Material Storage Yard Pads and Equipment area is an approximately 16,500-sq ft (0.4-acre) gravel and earth yard located north of the X-720 Maintenance & Stores Building (Figure A.139). This yard is utilized for storage of used equipment, surplus equipment, or scrap. The yard currently contains old scrap equipment, both new and used piles of wood, old valves, and old air-conditioning units. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, Freon, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities.

A.5.7.17 X-747D Material Storage Yard Pads and Equipment

The X-747D Material Storage Yard Pads and Equipment area is an approximately 16,200-sq ft (0.4-acre) gravel and earth yard located north of the X-720 Maintenance & Stores Building (Figure A.139). It is utilized for storage of used equipment, surplus equipment, or scrap. The yard currently contains old scrap equipment, both new and used piles of wood, old valves, and old air-conditioning units. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, Freon, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities.

A.5.7.18 X-747E Material Storage Yard Pad

The X-747E Material Storage Yard Pad is an approximately 13,800-sq ft (0.3-acre) paved area located east of the X-720 Maintenance & Stores Building (Figure A.140). It has been utilized for storage of used equipment, surplus equipment, or scrap. The yard currently is used as a parking lot. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, Freon, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities.

Figure A.140. X-747E Material Storage Yard (2006-2007 Aerial Photography)

A.5.7.19 X-747G Precious Metal Scrap Yard (below-grade structures)

The X-747G Precious Metal Scrap Yard (below-grade structures) was an approximately 3-acre gravel/earth yard measuring approximately 250 ft × 100 ft and surrounded entirely by an 8-ft-high chain-link fence. It was located just north of the X-744G Bulk Storage Building (Figure A.141), and use of the yard for storage began in 1976.

Figure A.141. X-747G Precious Metal Scrap Yard (2006-2007 Aerial Photography)

The yard was used for the storage of contaminated and uncontaminated scrap metal parts made of valuable alloys such as copper, nickel, and monel. Aluminum ingots from the X-744G Aluminum Smelter (not in RI/FS) were also stored in this yard. Scrap parts were stored uncovered on the gravel surface, in bins and racks, and on pallets. There is a potential for radiological and chemical contamination as a result of the scrap material stored in the yard. PCB contamination from pole-mounted transformers may be present in the area. Lead-based paint on scrap that was stored at the plant is another potential source of contamination. The yard was cleared of stored materials, and soils were removed as part of the X-701B Interim Remedial Measure (IRM) (Figures A.142 and A.143).

Two horizontal wells were installed at the X-701B Holding Pond (not part of RI/FS) in May 1996 (ORNL 1997). The wells, with horizontal section 234 ft in length, were installed at a depth of 32 ft using directional drilling methods. The wells were placed approximately 80 ft apart along the bedrock surface in a 3- to 7-ft thick zone of a moderately permeable, unconsolidated fluvial deposit. The horizontal sections of the wells were constructed with ductile, porous polyethylene and innovative material originally developed in Germany by Schumacher Umwelt-und Trenntechnik GmbH and now distributed in the United States by Schumacher Filters America, Inc. Figure A.141 shows the approximate location of these wells based on a map of PORTS and remedial action disposition.

Figure A.142. X-747G Precious Metal Scrap Yard during IRM

Figure A.143. X-747G Precious Metal Scrap Yard following IRM

A.5.7.20 X-747H NW Contaminated Scrap Yard (below-grade structures)

The X-747 NW Contaminated Scrap Yard (below-grade structures) is a 303,910-sq ft gravel and earth storage yard located adjacent to the X-744W Surplus and Salvage Warehouse (not part of this RI/FS) (Figure A.144). The yard is surrounded by a barbed-wire fence. This area was used for the storage of scrap metal from various locations across the plant. Operations involving the original X-747H yard inventory of scrap metal ended in 2007. Considering the nature of the materials that have been stored on the yard, there is a potential for radiological and chemical contamination. The yard also includes a poured concrete work pad on its south side (approximately 175 ft × 50 ft), which is used to size reduce equipment. This pad, along with any remaining below-grade structures, is addressed in this RI/FS.

Figure A.144. X-747H NW Contaminated Scrap Yard (2006-2007 Aerial Photography)

The X-747H NW Contaminated Scrap Yard is a RCRA SWMU where the investigation and remediation (if required) of any media-specific (soil, groundwater, etc.) risks have been deferred until D&D because of ongoing use. Media-specific investigation and remediation (if required) activities will proceed in accordance with requirements of the Ohio Consent Decree. D&D of the below-grade structures will be coordinated with these activities.

A.5.7.21 X-747H1 Loading Pad

The X-747H1 Loading Pad is an approximately 40,200-sq ft poured concrete pad located southwest of the X-752 Warehouse (not part of this RI/FS) (Figure A.145). This pad is used primarily for storing waste containers prior to shipment and for assembling U.S. Department of Transportation shipments. Low-level (radioactive) waste (LLW) waste may be transported to the loading pad from the plant in various containers (roll-off containers, B-25 boxes, supersacks, etc.). The LLW may be left in the container and shipped directly by rail or truck, or the containers may be emptied onto the pad in designated areas controlled for radioactive contamination. The waste is then loaded from the pad to a receiving super-gondola rail car. After all the waste has been loaded, the pad is emptied and decontaminated as necessary. Various projects generate recyclable materials, which are transported in intermodals and roll-offs to the pad where they are staged for shipment off PORTS.

Figure A.145. X-747H1 Loading Pad (2006-2007 Aerial Photography)

A.5.7.22 X-747J Decontamination Storage Yard

The X-747J Decontamination Storage Yard is an approximately 1,330-sq ft (0.3-acre) concrete pad located west of the X-705 Decontamination Building (Figure A.139). It has been utilized for storage of used equipment, surplus equipment, or scrap. The yard currently contains portable equipment, new waste boxes, and pallets. There is a potential for radiological and chemical contamination (oils, fuels, lead-based paint, ACM, Freon, and other unspecified chemicals) as a result of scrap and surplus equipment storage activities. The yard surrounds the X-627 Groundwater Pump & Treatment Facility.

A.5.7.23 XT-847 Warehouse

The XT-847 GCEP Construction Warehouse was built in the early 1980s and is located south of the X-1000 Administration Building (Figure A.146). It adjoins the now closed X-749 Contaminated Materials Disposal Area, which extends south from XT-847.

Figure A.146. XT-847 Warehouse (2006-2007 Aerial Photography)

The XT-847 Warehouse is a one-story, noncombustible structure with a concrete floor, steel frame, and metal exterior walls enclosing approximately 144,000 sq ft. Asphalt pavement and parking areas lie on the west side of the building (Figure A.147). A gravel access road circles the building; a railroad spur extends along the east side of it.

This building was built to receive, inspect, and store government-furnished equipment required for GCEP construction. The warehouse is currently used for handling and storage of regulated waste, universal waste, and recyclables. Within the high-bay areas of the building, a number of different staging/storage areas have been established (Figures A.148 and A.149). These include the following: areas for radioactive waste only, pretransport staging areas, 90-day accumulation areas for RCRA wastes, areas for <50 ppm PCB wastes, and areas for used oils. Some of these areas will contain mixtures of these wastes. The XT-847 Warehouse is a dynamic building where wastes are continuously moved to different areas as they go through various stages of characterization and preparation for eventual shipment to an approved disposal facility.

Figure A.147. XT-847 West Side Loading Docks and Parking

Figure A.148. XT-847 Center High Bay NDA Box Monitor

Figure A.149. XT-847 Center Bay

Utilities in the warehouse include electricity and heat provided by an electric hot water boiler. Heat was previously provided by the RHW system. Sanitary water is supplied to the building for use in the kitchen, restrooms/shower rooms, and drinking fountains. The entire building is protected by a wet-pipe sprinkler system. Hydrants are located around the building, and it is also provided with CAAS coverage.

The RHW system, previously used to heat the building, is known to have had minor leaks, which could have contained trace amounts of chromium. There are no documented or visible indications of spills or releases of chemical or radiological materials. The building may have been built partially on the old Peter Kiewit Landfill (not part of this RI/FS). However, the landfill was largely east of the existing location of the XT-847 building.

A.5.8 ENVIRONMENTAL MONITORING AND TREATMENT FACILITIES

The following environmental monitoring and treatment facilities are included in the scope of this RI/FS:

- X-120 Old Weather Station (footers)
- X-120H Weather Station
- X-230A3 Ambient Air Monitoring Station
- X-230A6 Ambient Air Monitoring Station

- X-230A8 Ambient Air Monitoring Station
- X-230A9 Ambient Air Monitoring Station
- X-230A10 Ambient Air Monitoring Station
- X-230A12 Ambient Air Monitoring Station
- X-230A15 Ambient Air Monitoring Station
- X-230A23 Ambient Air Monitoring Station
- X-230A24 Ambient Air Monitoring Station
- X-230A28 Ambient Air Monitoring Station
- X-230A29 Ambient Air Monitoring Station
- X-230A36 Ambient Air Monitoring Station
- X-230A37 Ambient Air Monitoring Station
- X-230A40 Ambient Air Monitoring Station
- X-230A41 Ambient Air Monitoring Station
- X-230J-1 Monitoring Station
- X-230J1 East Environmental Sampling Building (slab)
- X-230J2 South Environmental Sample Station
- X-230J3 West Environmental Sampling Building for Intermittent Containment Basin
- X-230J4 Environmental Air Sampling Station
- X-230J5 West Holding Pond Oil Separation Station
- X-230J6 Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
- X-230J7 East Monitor Facility (East Holding Pond Oil Separation Building)
- X-230J8 Environmental Storage Building (slab)
- X-230M Clean Test Site
- X-235 South Groundwater Collection System
- X-237 Little Beaver Groundwater Collection System
- X-617 South Holding Pond pH Control Facility
- X-622 South Groundwater Treatment Facility
- X-623 North Groundwater Treatment Building
- X-624 Little Beaver Groundwater Treatment Facility
- X-625 Groundwater Passive Treatment Facility
- X-627 Groundwater Pump & Treatment Facility.

The X-230J-1 is the same building as the X-230J East Environmental Sampling Building.

The X-230J4 Environmental Air Sampling Station is not a single building but common terminology applied to the collection of air monitoring stations (X-230A3, 6, 8, 9, 10, 12, 15, 23, 24, 28, 29, 36, 37, 40, and 41).

A.5.8.1 X-120 Old Weather Station (Footers)

The above-grade structures associated with this station were demolished as an early action. The X-120 Old Weather Station was located in close proximity to the new X-120H Weather Station (Figure A.150). The rain gauge was left in place and is in use with the new tower. Any remaining below-grade structures (cable anchors, etc.) will be removed within the scope of this RI/FS.

Figure A.150. X-120 Old Weather Station Location (2006-2007 Aerial Photography)

A.5.8.2 X-120H Weather Station

The X-120H Weather Station (Figure A.151) is a 197-ft meteorological tower, approximately 260 ft in finished height, located south of the XT-801 South Office Building (not part of this RI/FS) (Figure A.150). Instrumentation on the tower is used to collect data on air temperature, dew point, wind speed, and wind direction. Two sheds are located at the base of the tower (Figure A.152). One shed measures approximately 8 ft × 10 ft, has three wooden sides, and is covered with a corrugated roof (either metal or fiberglass). This shed was built to house instrumentation. It contains all of the electrical and electronic components necessary to operate the tower, acquire data, and store the data. The gathered data are transmitted to the X-1020 Emergency Operations Center (EOC), stored, and distributed to the X-300 PCF and the X-1000 Administration Building. Data from the weather station are used by the EOC to model and monitor airborne contaminant plumes. A second shed, approximately 10 ft × 10 ft with metal siding and a roof, houses a repeater station for the plant's emergency management pager system. An antenna for this system is located on the meteorological tower. Power for the data loggers and radio is currently supplied by a solar panel. A pole-mounted transformer that previously supplied power for operation of the data collection equipment is located to the east of the weather station and may contain PCBs. No known or potential contamination or radiological hazards are associated with these buildings and structures (LMES 1997).

Figure A.151. X-120H Weather Station

Figure A.152. X-120H Sheds

A.5.8.3 Remote Continuous Air-Sampling Stations

Fifteen remote continuous-air-sampling stations are present. The locations of these stations are presented in Table A.6.

All 15 air-sampling stations have a continuous low-volume air sampler (9 cf/hour) that collects particulate radionuclides and gaseous fluorides from ambient air. Each low-volume air sampler consists of a secure cabinet, approximately 3 ft tall, 2 ft wide, and 1 ft deep, mounted approximately 3 ft above the ground on a metal pole. Each cabinet contains an air-sampling pump, flow-metering devices, sample collection filters, and related valving and tubing. Nine of the air-sampling stations also have a high-volume particulate air sampler (40 cf/minute) that continuously collects particulate radionuclides from the ambient air. There are no hazardous materials or other systems in these stations.

Table A.6. Remote Continuous Air-Sampling Stations

Station	Location
Boundary Line	
X-230A3 Ambient Air Monitoring Station	South Access Road, south of DOE property line (Bailey Chapel Road)
X-230A8 Ambient Air Monitoring Station	DOE Power Pole 74 on dirt patrol road starting north of X-735 Landfill
X-230A9 Ambient Air Monitoring Station	Wakefield Mound (Old U.S. 23) approximately ½ mile south of Southwest Access Road
X-230A12 Ambient Air Monitoring Station	McCorkle Road north of Dutch Run Road (East Access Road)
X-230A15 Ambient Air Monitoring Station	Loop Road approximately ¼ mile north of Bailey Chapel Road
X-230A23 Ambient Air Monitoring Station	Intersection of Taylor Hollow and McCorkle Roads
X-230A24 Ambient Air Monitoring Station	Shyville Road north of Schuster Road
X-230A29 Ambient Air Monitoring Station	West Access Road just east of OVEC office building
Beyond Boundary	
X-230A6 Ambient Air Monitoring Station	DOE Power Pole 6 on access road to X-608 Raw Water Pump House in Piketon (across from Rittenour Cemetery)
X-230A28 Ambient Air Monitoring Station	Mt. Zion Church on Camp Creek Road approximately 1½ miles west of State Route104
X-230A37 Ambient Air Monitoring Station	American Telephone and Telegraph Booster Station at intersection of Mount Hope Road and State Route 348 near Otway
X-230A41 Ambient Air Monitoring Station	Located in the middle of a triangle formed by the intersections of Schuster Road, U.S. Highway 32, and State Route 220 approximately 7,000 ft northeast of the DOE property line
Within Boundary	
X-230A10 Ambient Air Monitoring Station	Don Marquis Substation
X-230A36 Ambient Air Monitoring Station	X-611 Water Treatment Plant, southeast corner of main parking lot
X-230A40 Ambient Air Monitoring Station	X-100 Office Building penthouse (decommissioned)

DOE = U.S. Department of Energy
OVEC = Ohio Valley Electric Corporation

A.5.8.4 X-230J1 East Environmental Sampling Building (slab)

The X-230J1 East Environmental Sampling Building (slab) was located on the south side of the East Drainage Ditch and served as the monitoring station for water exiting the plant from the East Drainage Ditch. This building was demolished in February 2006, except for the concrete slab it was sitting on, after a NEPA review. The concrete slab, approximately 100 sq ft, will be removed within the scope of this RI/FS.

A.5.8.5 X-230J2 South Environmental Sample Station

The X-230J2 South Environmental Sample Station (Figure A.153), built in 1968, is a 100-sq ft cinder block structure with an asphalt shingle roof. It rests on a concrete pad and is located south of the X-230K South Holding Pond (not part of this RI/FS) (Figure A.154).

The building houses water collection equipment and sampling instrumentation for monitoring the X-230K South Holding Pond effluent for environmental compliance (Figure A.155). Water is pumped from the pond to the building , sampled, and returned to the pond. The building also houses ambient air monitoring equipment. Ambient air is pumped in through an aperture in the wall, passed through a filter, and returned through another hole to the outside. Any necessary environmental sampling, control, and remediation equipment is also stored in the building (DOE 1993, TPMC 2006c).

Some sample water may have been spilled during collection. Any contaminants in the pond may be present in the equipment, on the floor of the building, and in the drain piping (DOE 1993, TPMC 2006a). Fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury. Considering the age of the building, lead-based paint is potentially present on painted surfaces.

Figure A.153. X-230J2 South Environmental Sample Station

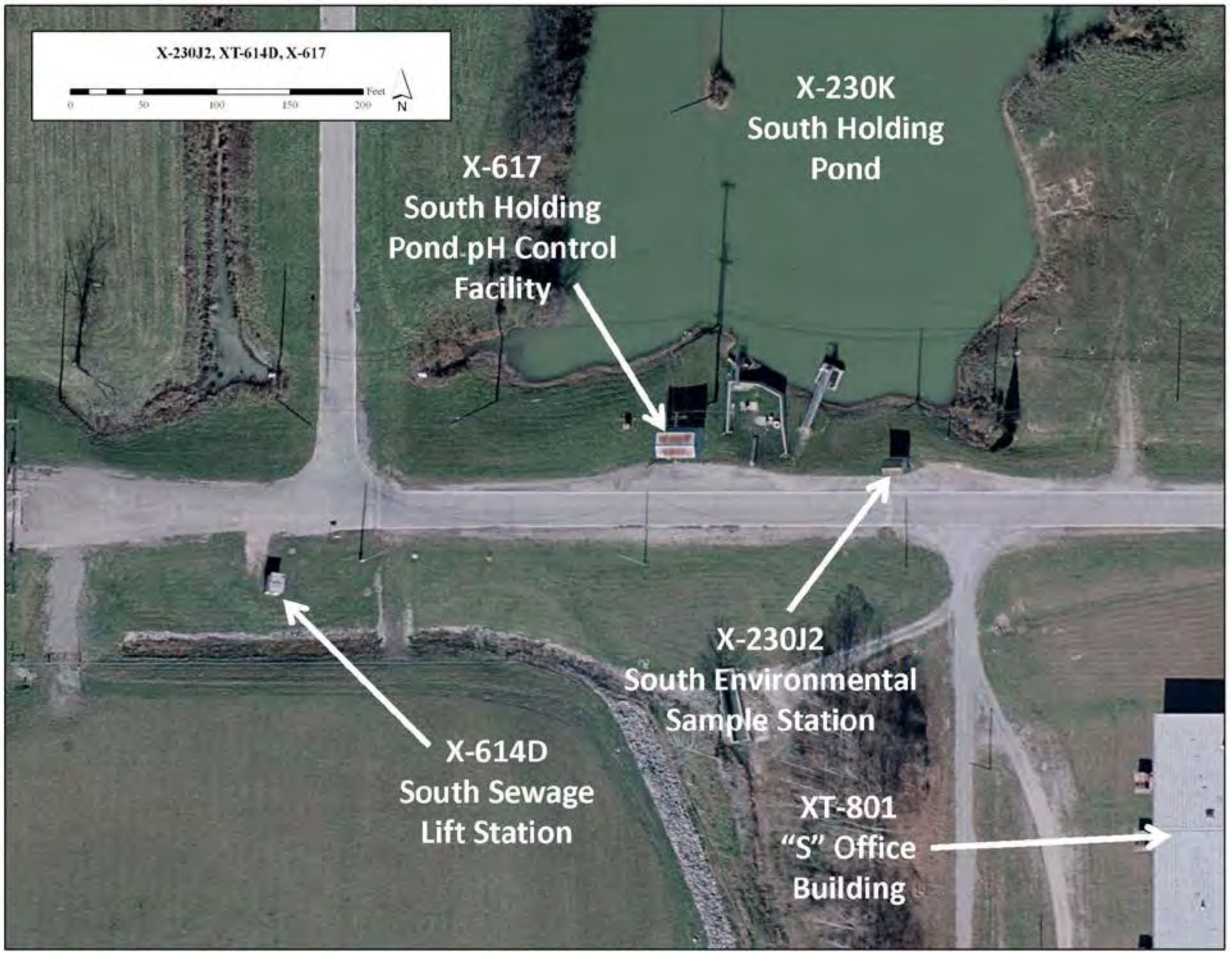

Figure A.154. Location of X-230J2 (2006-2007 Aerial Photography)

Figure A.155. Interior of X-230J2

A.5.8.6 X-230J3 West Environmental Sampling Building for Intermittent Containment Basin

The X-230J3 West Environmental Sampling Building for Intermittent Containment Basin, built in 1968, is a 100-sq ft cinder block structure with an asphalt shingle roof. It rests on a concrete pad and is located southwest of the X-230J3 Basin (Figure A.156). Currently, the facility is being used to store emergency spill response equipment. Fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury. The age of the building indicates that lead-based paint is potentially present on painted surfaces.

Figure A.156. Location of X-230J3 (2006-2007 Aerial Photography)

A.5.8.7 X-230J5 West Holding Pond Oil Separation Station

The X-230J5 West Holding Pond Oil Separation Station (Figure A.157) is a 100-sq ft, metal frame structure with metal siding and a metal roof. It sits on a concrete pad and is located adjacent to the X-230J5 West Holding Pond (not part of RI/FS) (Figure A.158).

Figure A.157. X-230J5 Exterior

Figure A.158. X-230J5 Location (2006-2007 Aerial Photography)

The building houses water collection equipment and sampling instrumentation for monitoring the West Holding Pond effluent for environmental compliance (Figure A.159). Water is pumped from the pond to the building, sampled, and returned to the pond. Any necessary environmental sampling, control, and remediation equipment is also stored in the building (DOE 1993, TPMC 2006a).

Figure A.159. X-230J5 Interior

Some sample water may have been spilled during collection. Any contaminants in the pond may be present in the equipment, on the floor of the building, and in the drain piping. The outside transformer associated with this building may contain oil with PCBs (DOE 1993, TPMC 2006a). Fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury.

A.5.8.8 X-230J6 Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building

The X-230J6 Northwest Holding Pond Monitoring Facility and Secondary Oil Collection Building (Figure A.160) is a 100-sq ft, metal frame structure with metal siding and a metal roof. It rests on a concrete pad and is located adjacent to the X-230J6 Northeast Holding Pond (not part of this RI/FS) (Figures A.161 and A.162).

Figure A.160. X-230J6 Exterior

Figure A.161. X-230J6 Location (2006-2007 Aerial Photography)

Figure A.162. X-230J6 Interior

The building houses water collection equipment and sampling instrumentation for monitoring the holding pond effluent for environmental compliance (Figure A.162). Water is pumped from the pond to the building, sampled, and returned to the pond. Any necessary environmental sampling, control, and remediation equipment is stored in the building (DOE 1993, TPMC 2006a). The building also houses the controls for the carbon dioxide infusion pH control system.

Some sample water may have been spilled during collection. Any contaminants in the pond may be present in the equipment, on the floor of the building, and in the drain piping. The outside transformer associated with this building may contain oil with PCBs (DOE 1993, TPMC 2006a). Fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury.

A.5.8.9 X-230J7 East Monitor Facility (East Holding Pond Oil Separation Building)

The X-230J7 East Monitor Facility (East Holding Pond Oil Separation Building) (Figure A.163) is a 100-sq ft, metal frame structure with metal siding and a metal roof. It is on a concrete pad and located adjacent to the X-230J6 Northeast Holding Pond (not part of this RI/FS) (Figure A.164).

Figure A.163. X-230J7 Exterior

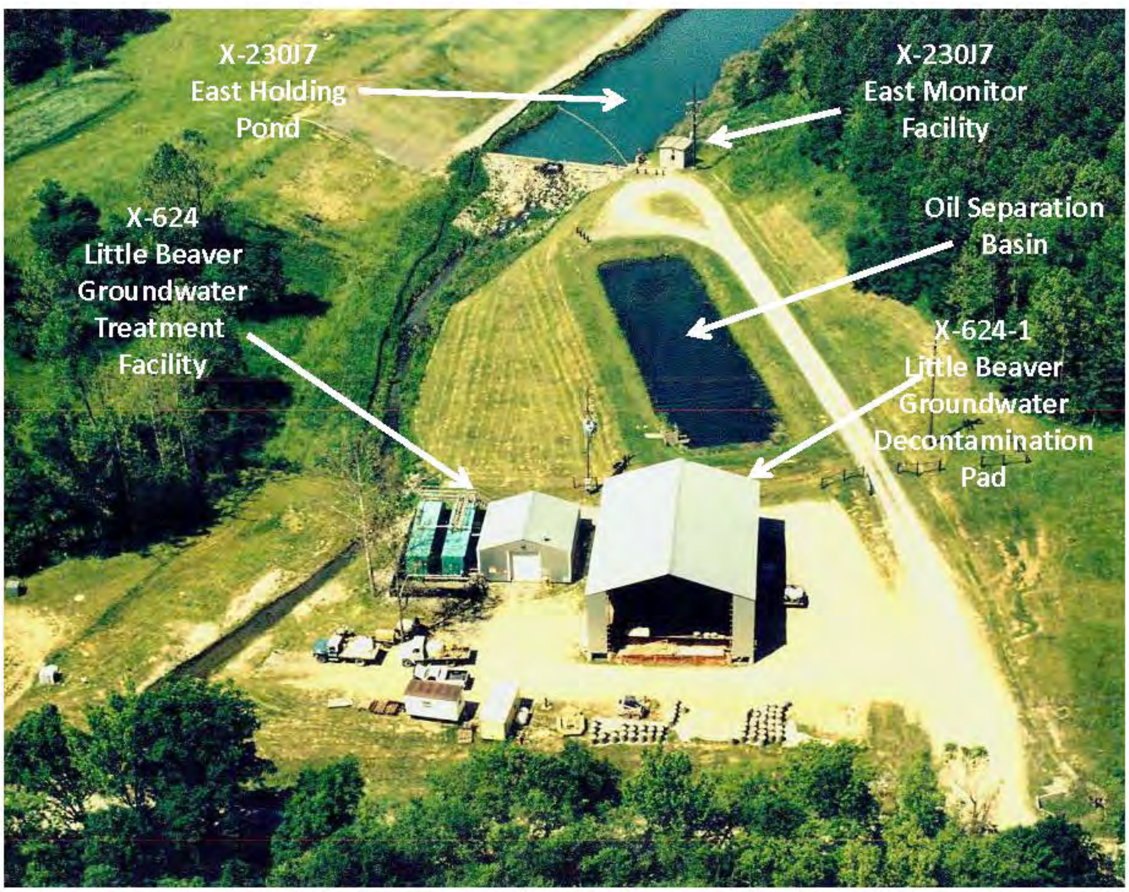

Figure A.164. X-230J7 Location

The building houses water collection equipment and sampling instrumentation for monitoring the East Holding Pond effluent for environmental compliance (Figure A.165). Water is pumped from the pond to the building, sampled, and returned to the pond. Any necessary environmental sampling, control, and remediation equipment is also stored in the building (DOE 1993, TPMC 2006a).

Figure A.165. X-230J7 Interior

Some sample water may have been spilled during collection. Any contaminants in the pond may be present in the equipment, on the floor of the building, and in the drain piping. The outside transformer associated with this building may contain oil with PCBs (DOE 1993, TPMC 2006a). Fluorescent light fixtures may contain ballasts with PCBs and bulbs with mercury.

A.5.8.10 X-230J8 Environmental Storage Building (slab)

The X-230J8 Environmental Storage Building (slab) was located just outside the southeast corner of the X-206B South Main Parking Lot, east of the X-100 Office Building. This building was demolished in February 2006, except for its concrete slab foundation. Its concrete slab, approximately 100 sq ft, will be removed within the scope of this RI/FS.

A.5.8.11 X-230M Clean Test Site

The X-230M Clean Test Site is located northwest of the intersection of Hewes Street and Perimeter Road and east of the X-230K Holding Pond (not part of this RI/FS) (Figure A.166).

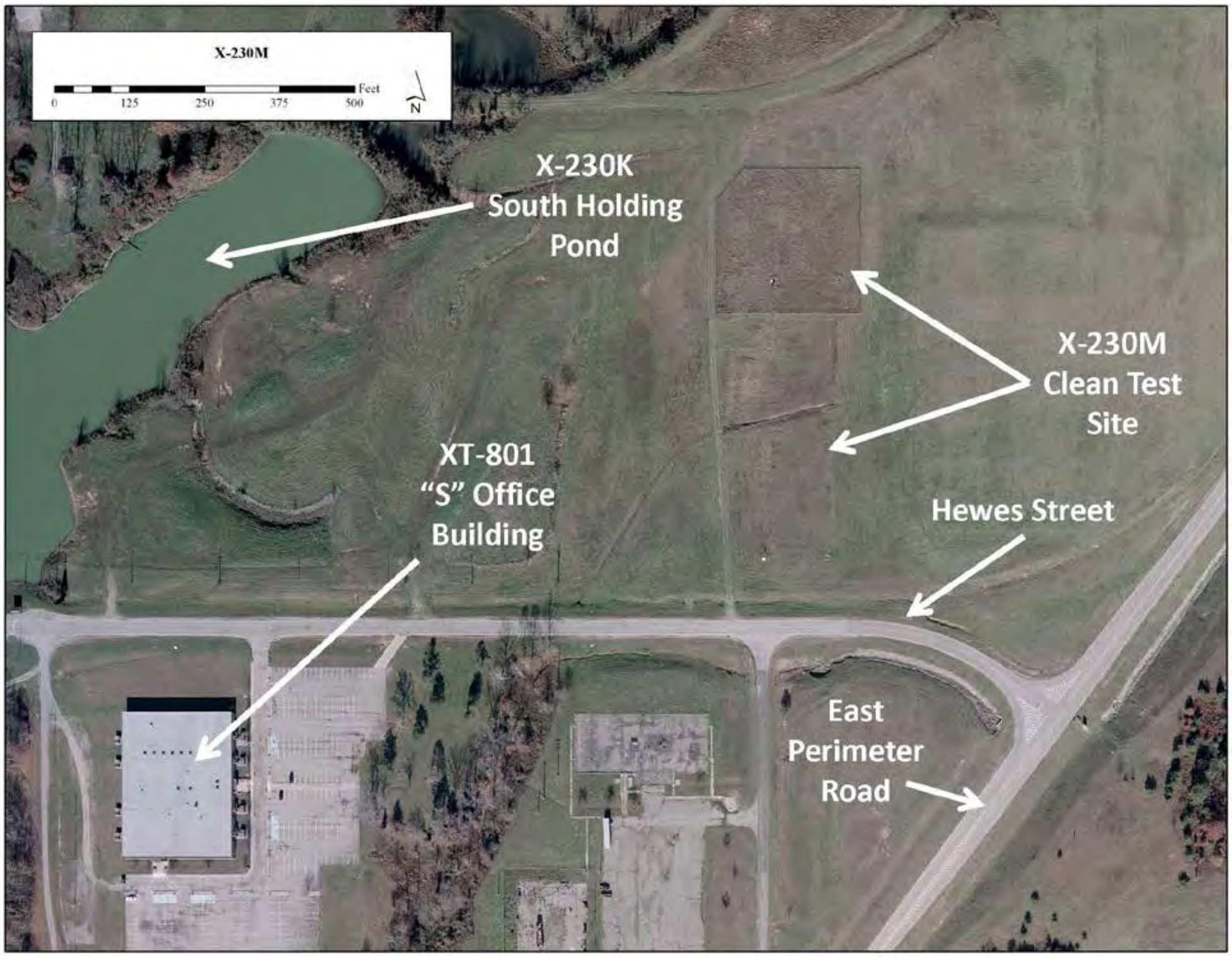

Figure A.166. X-230M Clean Test Site Location (2006-2007 Aerial Photography)

Using a directional drilling rig, two horizontal wells were installed at the X-230M Clean Test Site in October 1994. Each well was completed to land surface at both ends. The horizontal sections are approximately 230 ft long and installed at a depth of 30 ft. Slanted sections of pipe are approximately 120 to 130 ft long. Each well was constructed with a 5-in.-inner-diameter, ductile, high-density polyethylene (HDPE) casing. The horizontal sections were supplied with ductile, 3-in.-inner-diameter HDPE porous filters. A 4-in.-inner-diameter casing transfer line was installed between the two wells (Figure A.167). The horizontal wells were numbered CTS-HW-1 (the east well) and CTS-HW-2 (the west well) (Oak Ridge National Laboratory [ORNL] 1997).

The fenced area is 240 ft × 250 ft. During characterization, nine boreholes in the fenced area and its immediate vicinity were installed to bedrock at a depth of approximately 30 ft. The borehole locations are numbered BH01 through BH09 in Figure A.168. The horizontal wells extend 450 ft south of the fenced area. Using a GeoProbe rig, soil samples were collected from six locations numbered BH10 through BH15 (Figure A.168). A network of piezometers, P1 through P22 in Figure A.168, was also installed to assess the hydraulic influence of the horizontal well recirculation system on the surrounding groundwater flow field. The 4-in. PVC piezometers extend approximately 2 in. above grade (ORNL 1997).

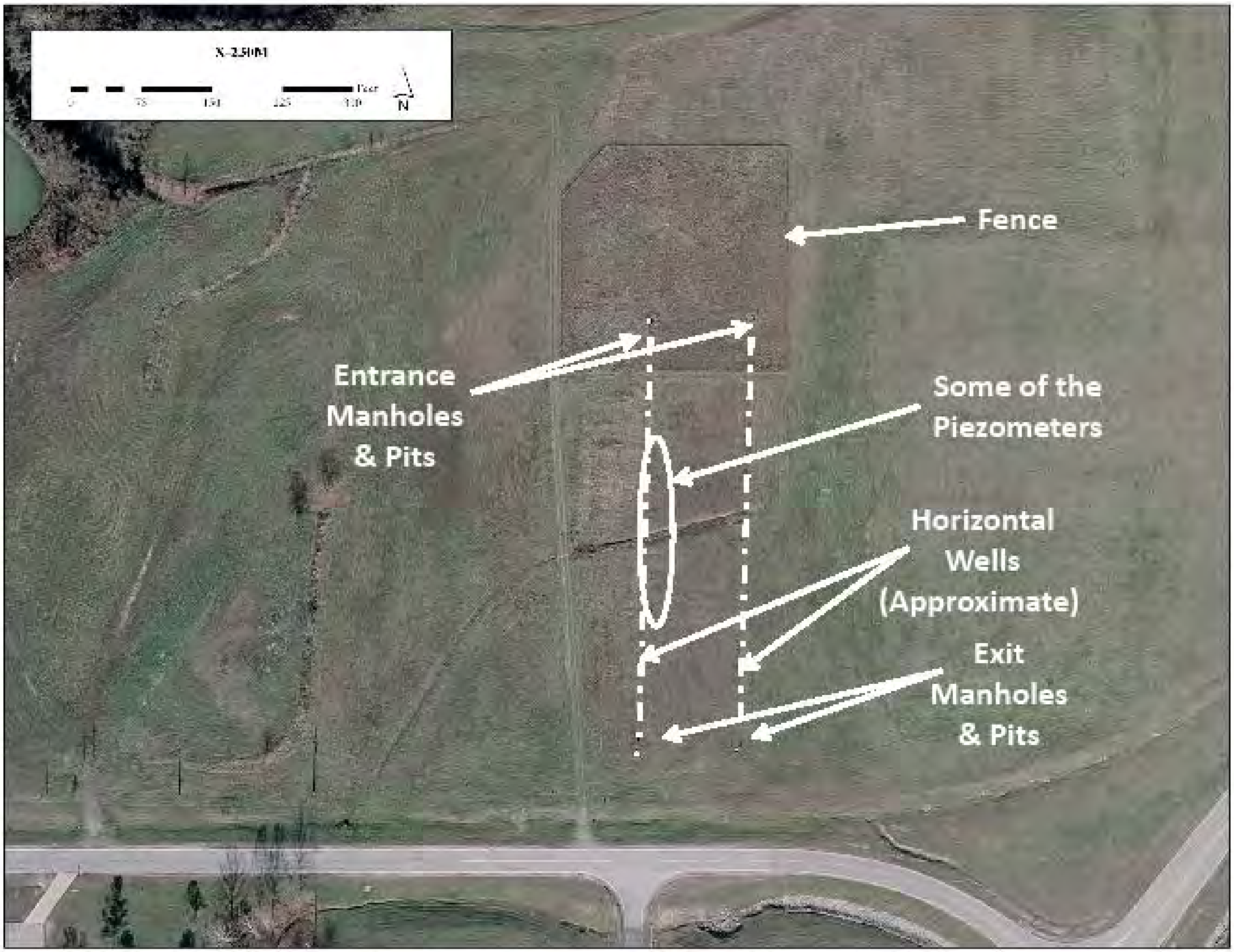

Figure A.167. X-230M Clean Test Site Structures (2006-2007 Aerial Photography)

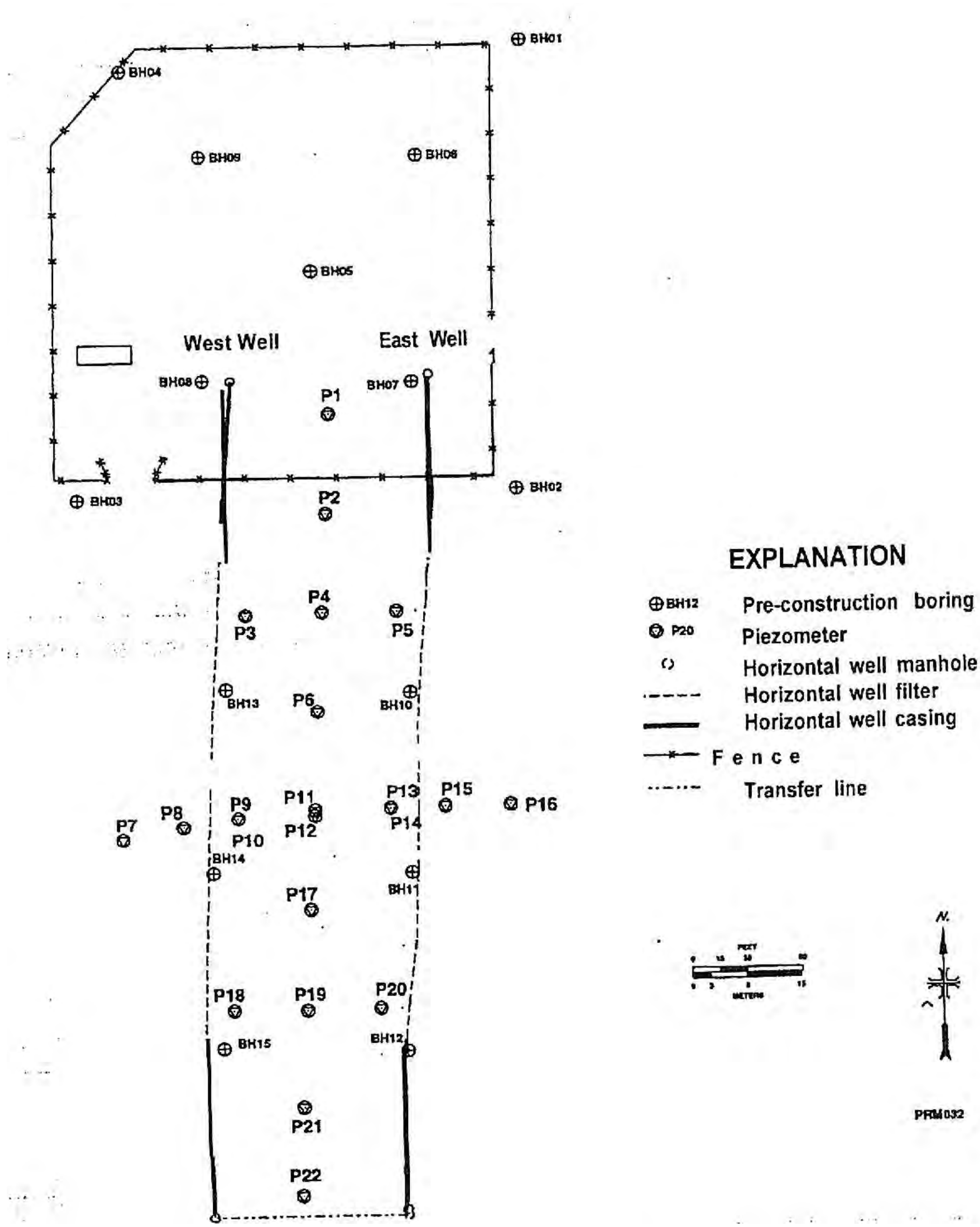

Figure A.168. X-230M Clean Test Site Piezometers and Wells

At the surface, a recessed manhole was installed at each end of each well (Figure A.167), so the blank casings from the horizontal wells terminate in the manholes. The manholes provided a clean, dry area for the plumbing and other equipment at the ends of the horizontal wells. The manholes are 4 ft deep and are constructed of 5-ft-diameter steel culvert pipe. The floors of the manholes are lined with gravel. A sump bucket was installed in the floor of each manhole so a submersible pump could be used to remove excess water. Insulated, weather-tight lids were installed over the manholes to prevent infiltration by rainwater and surface runoff. Four bumper posts were installed around each manhole to protect against vehicle traffic. Well entrance and exit pits, approximately 3 ft deep, are located adjacent to the manholes (ORNL 1997).

A.5.8.12 X-617 South Holding Pond pH Control Facility

The X-617 South Holding Pond pH Control Facility (Figure A.169), built in 1979, is a 400-sq ft, steel-framed structure sitting on a concrete slab. The building was designed to monitor and maintain a neutral pH in the X-230K South Holding Pond (not part of this RI/FS) (Figure A.170). It is equipped with two underground mixing tanks. There is also a 4,560-gal AST that contained sodium hydroxide (Figure A.171). The tank was drained of sodium hydroxide and flushed in the past, and it now contains citric acid. A second smaller tank in the building is empty and no longer used. No known PCB sources are associated with this building. Figure A.172 shows evidence of spills/leaks of potentially hazardous substances.

Figure A.169. X-617 South Holding Pond pH Control Facility

Figure A.170. X-617 Location (2006-2007 Aerial Photography)

Figure A.171. X-617 Interior

Figure A.172. X-617 Interior Leaks or Spills

A.5.8.13 X-235 South Groundwater Collection System and X-622 South Groundwater Treatment Facility

The X-235 South Groundwater Collection System is used to prevent horizontal movement of groundwater to the X-749 Landfill (not part of this RI/FS) and to remove potentially contaminated groundwater downgradient of the landfill. A slurry wall inhibits migrating groundwater while subsurface drains and pumps remove any groundwater that passes beneath the landfill. The extraction wells in the drains pump approximately 4,000 gal/day of contaminated groundwater to the X-622 South Groundwater Treatment Facility. The slurry wall was installed along the northern and northwestern corners of the landfill (and completed to bedrock) while the subsurface drains were installed on both the southwestern corner and northern half of the eastern side of the landfill.

The X-622 South Groundwater Treatment Facility (Figure A.173) is located in the eastern portion of Quadrant I, east of the X-744K Warehouse-K (Figure A.174). It is a 2,500-sq ft building constructed of steel beams, aluminum siding, metal roofing, and a concrete floor.

Figure A.173. X-622 South Groundwater Treatment Facility Exterior

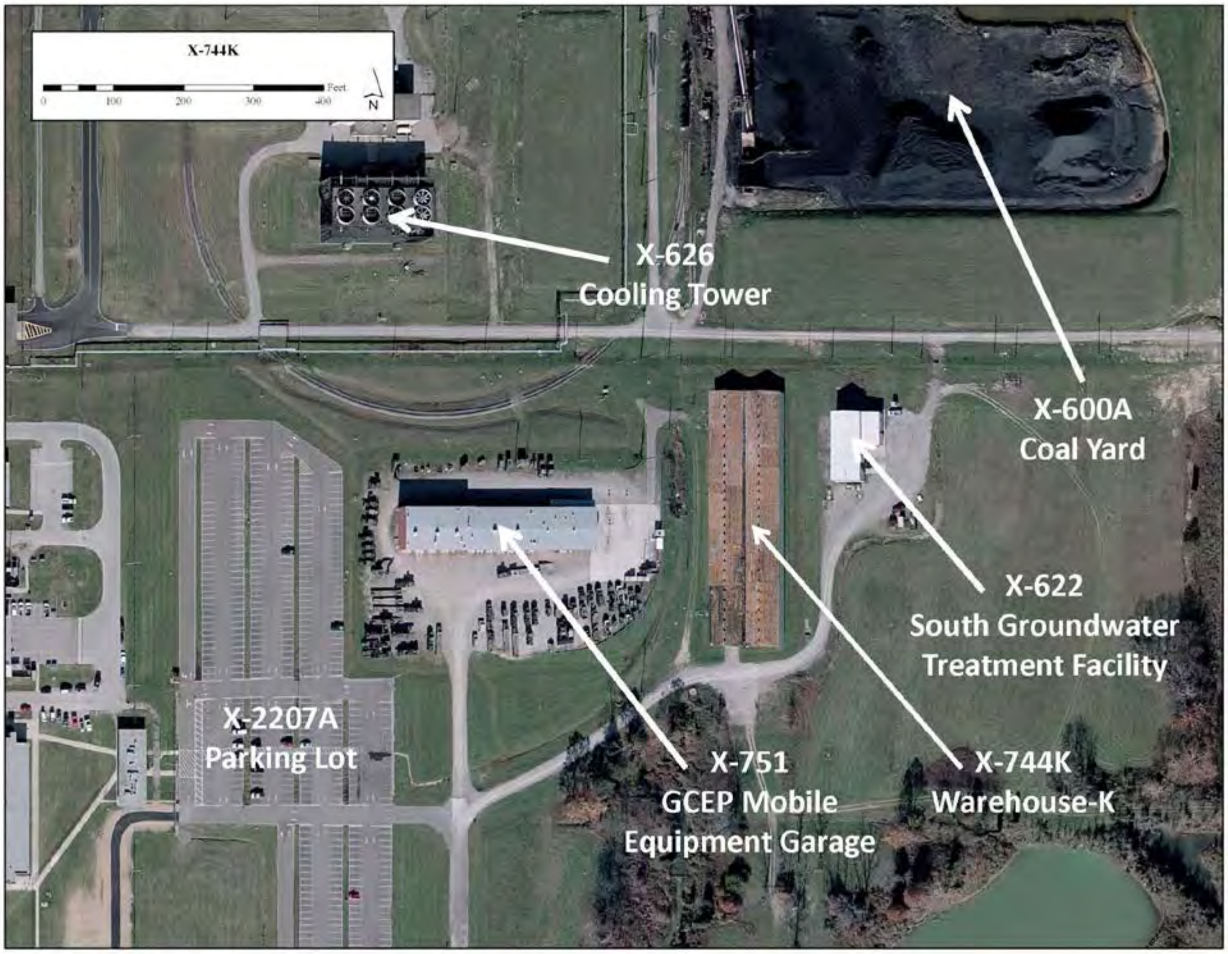

Figure A.174. X-622 South Groundwater Treatment Facility Location (2006-2007 Aerial Photography)

The operation consists of an air stripper with aqueous-phase activated carbon filtration (Figure A.175), and it processes groundwater from the following systems:

- X-235 South Groundwater Collection System
- Peter Kiewit groundwater collection system
- 14 extraction wells located in the Quadrant I Groundwater Investigation Area.

A.5.8.14 X-237 Little Beaver Groundwater Collection System and X-624 Little Beaver Groundwater Treatment Facility

The X-237 Little Beaver Groundwater Collection System, installed in 1990, is composed of two groundwater interceptor trenches. The primary trench is situated parallel to the west bank of Little Beaver Creek (west of and parallel to the Northeast Bypass Road) and is 660 ft long (Figure A.176).

Figure A.175. X-622 South Groundwater Treatment Facility Process Equipment

Figure A.176. X-237 Little Beaver Groundwater Collection System and X-624 Little Beaver Groundwater Treatment Facility (2006-2007 Aerial Photography)

The 440-ft secondary trench is situated parallel to the south bank of the X-230J7 East Holding Pond (not part of this RI/FS) and intersects the primary trench. The primary trench intercepts contaminated groundwater, from the X-701B Area Groundwater Plume, that could enter Little Beaver Creek, while the secondary trench intercepts contaminated groundwater that could enter the X-230J7 East Holding Pond. Approximately 18,700 gal are extracted from the two wells in the primary trench each day and treated in the X-624 Little Beaver Groundwater Treatment Facility. The X-237 system is part of the IRM for the X-701B Area Groundwater Plume.

The X-624 Little Beaver Groundwater Treatment Facility (Figure A.176) was built in 1990 to remove VOCs in contaminated groundwater collected from the X-237 Little Beaver Groundwater Collection System. The building is an “open” corrugated metal warehouse with an enclosed carbon filtration room and two feed tanks. The groundwater is treated using an air stripper with off-gas activated carbon filtration and aqueous-phase activated carbon filtration. The maximum flow rate is 50 gpm. This facility processed 3,503,400 gal of water in 2008 and removed 20 gal of TCE.

The X-624 effluent is discharged to Little Beaver Creek.

A.5.8.15 X-623 North Groundwater Treatment Building

The X-623 North Groundwater Treatment Building (Figure A.177) is located west of the X-744G Bulk Storage Building (not part of this RI/FS) and Brown Avenue, east of the railroad tracks, and south of 18th Street (within the northern portion of the X-744Y Waste Storage Area [Figure A.178]). Its operations remove TCE dissolved in contaminated groundwater and return clean water to the environment. Contaminated groundwater is hard-piped or trucked to the building. An air stripper removes the TCE from the water in a TCE air-gas phase and leaves the water in a liquid phase. The gas phase passes through a carbon filter where the TCE is adsorbed and the air is vented to the atmosphere. Whenever the carbon filter becomes saturated, it is steam-cleaned for removal of the hydrocarbon so the filter can be reused. In a subsequent condensing operation, relatively pure TCE is recovered while the steam condensate enters the liquid phase. The liquid phase from the stripper operation is passed through a separate carbon filter and then to a holding tank. After pH adjustment with sodium hydroxide or citric acid, the water discharges into the sanitary sewer system upstream of the X-6619 Sewage Treatment Plant. Whenever this carbon filter becomes saturated, the filter is replaced. The TCE is decanted from the flush liquid and recovered while the water is recycled for use in steam-cleaning the gas phase filter (LMES 1997).

Figure A.177. X-623 North Groundwater Treatment Building

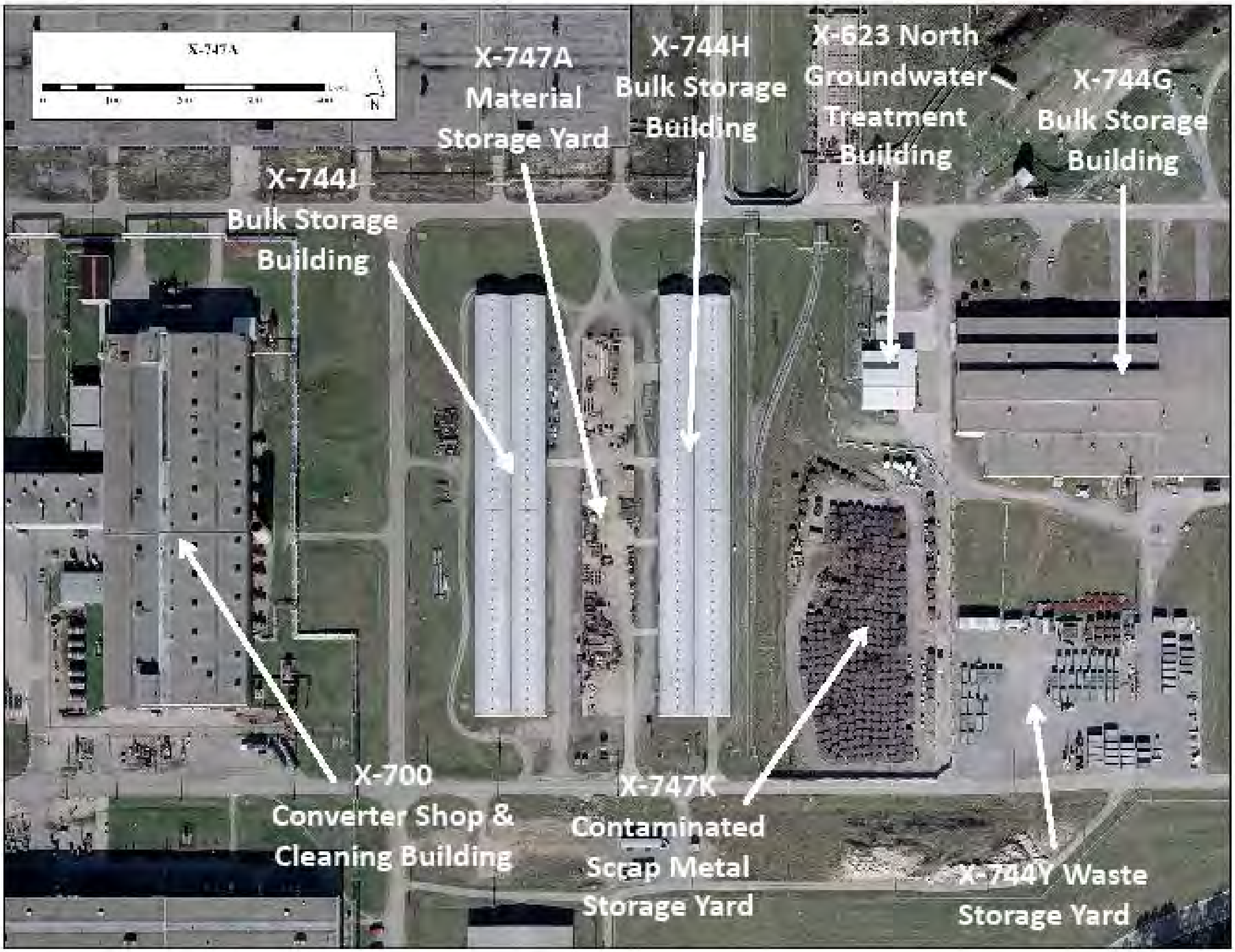

Figure A.178. X-623 North Groundwater Treatment Building Location (2006-2007 Aerial Photography)

A.5.8.16 X-625 Groundwater Passive Treatment Facility

In 1996, a single horizontal well, 1,400 ft in length with a 540-ft-long screen, was installed along the horizontal axis of the X-120 contaminated groundwater plume to capture and treat the downgradient portion of the plume that migrates to the southwest. This well passively transmitted (by gravity drainage) contaminated groundwater to the X-625 Groundwater Passive Treatment Facility, located southwest of the XT-847 Warehouse (Figure A.179). In July 2003, operations in the X-625 building ceased because of the limited amount of groundwater that was being treated, and the horizontal well discharge was capped. The X-120 groundwater plume contains primarily TCE and lesser concentrations of other VOCs.

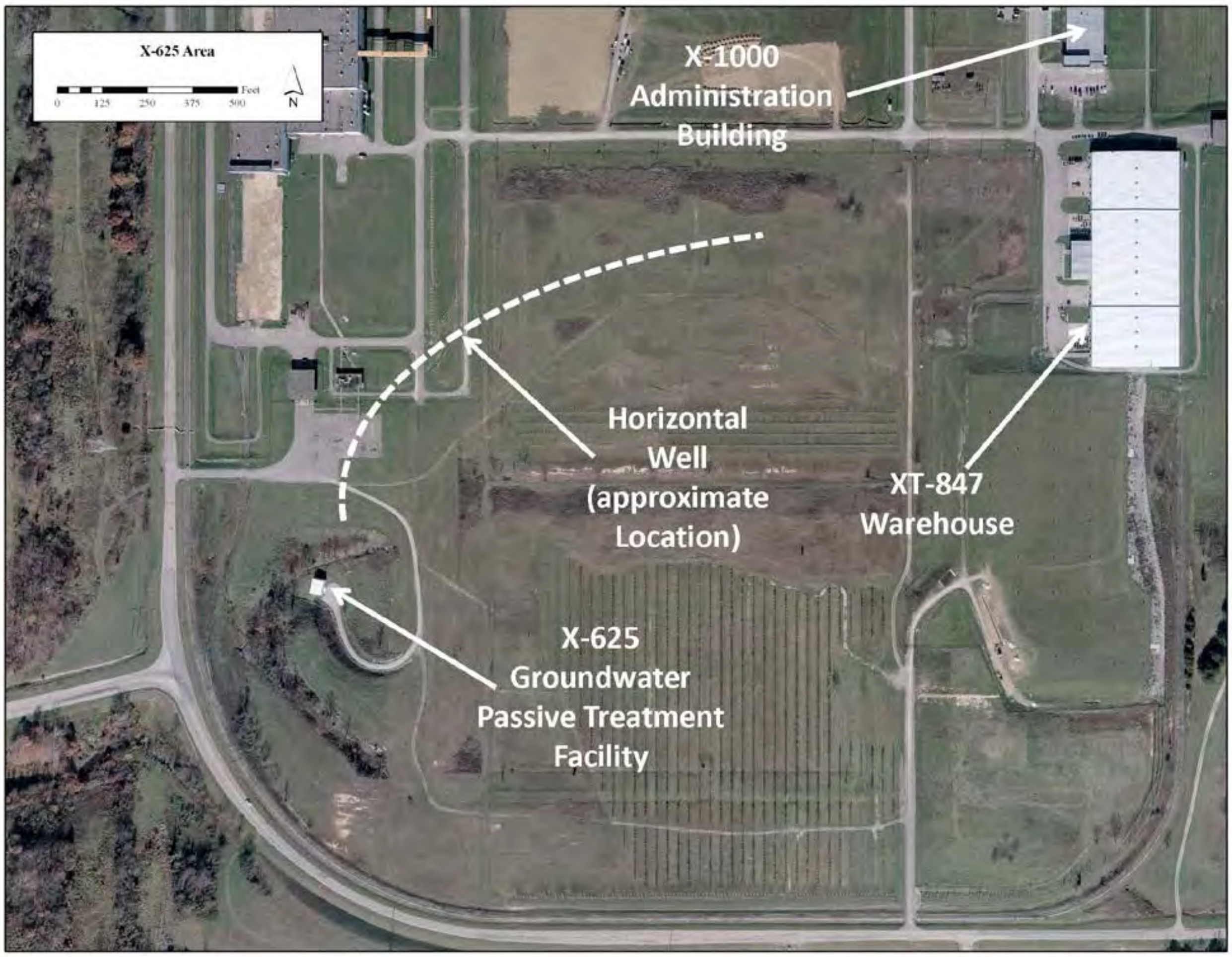

Figure A.179. Location of the X-625 Groundwater Passive Treatment Facility (2006-2007 Aerial Photography)

A.5.8.17 X-627 Groundwater Pump & Treatment Facility

The X-627 Groundwater Pump & Treatment Facility was constructed in 2003 and is located on the west side of the X-705 Decontamination Building surrounded by the X-747J Decontamination Storage Yard (Figures A.180 and A.181). The facility treats groundwater from the X-700 and X-705 building sumps.

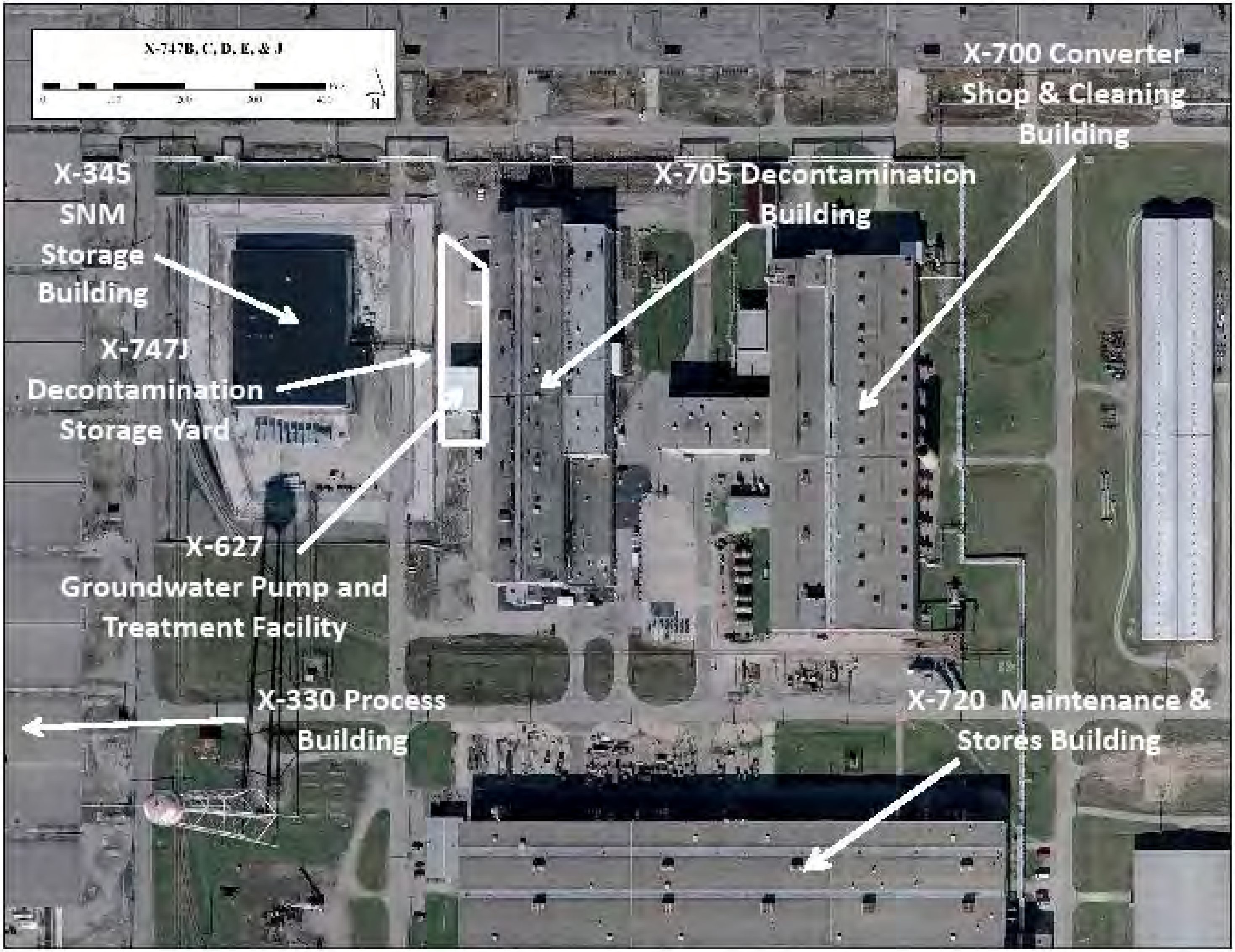

Figure A.180. X-627 Groundwater Pump & Treatment Facility Location (2006-2007 Aerial Photography)

Figure A.181. X-627 Groundwater Pump & Treatment Facility Process Equipment

A.5.9 ASSOCIATED NONSTRUCTURAL SUPPORT SYSTEMS

Nonstructural support systems are included in the scope of this RI/FS. The following nonstructural support systems are integral to the buildings and structures described in previous sections and will undergo D&D with them:

- X-220B1 Process Instrument Lines
- X-220B2 Carrier Communication Systems
- X-220B3 Water Supply Telemetering Lines
- X-220C Superior American Alarm System
- X-220D1 General Telephone System
- X-220D2 Process Telephone System
- X-220D3 Emergency Telephone System
- X-220E1 Evacuation PA System
- X-220E2 Process PA System
- X-220E3 Power Public Address System
- X-220F Plant Radio System
- X-220G Pneumatic Dispatch System
- X-220H McCulloh Alarm System
- X-220J Radiation Alarm System
- X-220K Cascade Automatic Data Processing System
- X-220L Classified Computer System
- X-220N Security Alarm and Surveillance System
- X-220P MSR System
- X-220R Public Warning Siren System
- X-220S Power Operations SCADA System.

A.6 REFERENCES

BJC 2000, *Recycled Uranium Mass Balance Project Portsmouth, Ohio Site Report*, BJC/PORTS-139/R1, Bechtel Jacobs Company LLC, Piketon, OH, June.

CRC Technologies, Inc. 2011a, *Complete Cell Data with Caretaker 031411, Ports Deposit Status 3-14-11, X-326 Cell Treatment Status*, E-mail message from Wayne Spetnagel (CRC Technologies, Inc.) to John Shoemaker (consultant), March 14.

CRC Technologies, Inc. 2011b, *Technetium*, E-mail message from Wayne Spetnagel (CRC Technologies, Inc.) to John Shoemaker (consultant), March 28.

CRC Technologies, Inc. 2011c, *Dioxin/Furan Analysis from Fire Cell*, E-mail message from Wayne Spetnagel (CRC Technologies, Inc.) to Cidney Voth, January 1.

DOE 2011a, *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0207&D4, U.S. Department of Energy, Piketon, OH, October.

DOE 2011b, *Action Memorandum for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0178&D3, U.S. Department of Energy, Piketon, OH, January.

DOE 2011c, *Construction Completion Report for Removal of the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0174&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2010a, *X-633 Recirculating Cooling Water Complex Removal Action Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-101&D2, U.S. Department of Energy, Piketon, OH, April.

DOE 2010b, *Engineering Evaluation/Cost Analysis for the X-626 and X-630 Recirculating Cooling Water Complexes at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0146&D2, U.S. Department of Energy, Piketon, OH.

DOE 2010c, *Action Memorandum for the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/-03-0107&D1, U.S. Department of Energy, Piketon, OH, January.

DOE 2010d, *X-533 Switchyard Complex Removal Action Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0104&D1, U.S. Department of Energy, Piketon, OH, January.

DOE 2009a, *Engineering Evaluation/Cost Analysis for the X-633 Recirculating Cooling Water Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0098&D1, U.S. Department of Energy, Piketon, OH, September.

DOE 2009b, *Action Memorandum for the Removal of the X-633 Recirculating Cooling Water Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-106&D1, U.S. Department of Energy, Piketon, OH, December.

DOE 2009c, *Engineering Evaluation/Cost Analysis for the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0099&D1, U.S. Department of Energy, Piketon, OH, October.

DOE 2009d, *Engineering Evaluation/Cost Analysis for the X-746 Building at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0067&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2009e, *Action Memorandum for the Removal of the X-746 Building at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0095&D1, U.S. Department of Energy, Piketon, OH, July.

DOE 2009f, *X-746 Material Receiving and Inspection Building Removal Action Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0096&D1, U.S. Department of Energy, Piketon, OH, July.

DOE 2000, *Quadrant I Cleanup Alternatives Study/Corrective Measures Study Final Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1248&D5, U.S. Department of Energy, Piketon, OH, May.

DOE 1998, *Quadrant IV Cleanup Alternatives Study/Corrective Measures Study Final Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1332&D3, U.S. Department of Energy, Piketon, OH, August.

DOE 1993, *Report for Environmental Audit Supporting Transition of the Gaseous Diffusion Plants to the United States Enrichment Corporation*, DOE/OR/1087, U.S. Department of Energy, Portsmouth, OH, June.

ORNL 1997, *Field Evaluation of a Horizontal Well Recirculation System for Groundwater Treatment: Pilot Test at the Clean Test Site, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, ORNL/TM-13531, Oak Ridge National Laboratory, March.

LMES 1997, *Safety Analysis Report*, *Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, POEF LMES 89, Lockheed Martin Energy Systems, Inc., Piketon, OH, January.

TPMC 2006a, *Facility Condition Survey of Portsmouth Gaseous Diffusion Plant Facilities, Piketon, Ohio*, TPMC/PORTS-59/R1, Theta Pro2Serve Management Company, LLC, August.

TPMC 2006b, *Technetium Characterization of the Diffusion Cascade at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, TPMC/PORTS-47, Theta Pro2Serve Management Company, LLC, February.

TPMC 2006c, *Cost Estimate for Removing Excess Equipment and Materials from the Support Buildings and Grounds at the Portsmouth Gaseous Diffusion Plant, Piketon Ohio*, TPMC/PORTS-52, Theta Pro2Serve Management Company, LLC, February.

USAEC 1957, *Gaseous Diffusion Plant at Portsmouth Ohio Project History and Completion Report (Redacted)*, GAT-2-439, U.S. Atomic Energy Commission, December.

USEC 2004, *Beryllium Surface Contamination Initial Characterization*, POEF-USEC-61, United States Enrichment Corporation, November 19.

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APPENDIX B: APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED GUIDANCE FOR THE PROCESS BUILDINGS AND COMPLEX FACILITIES D&D EVALUATION PROJECT

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TABLES

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CAA	Clean Air Act of 1970
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
D&D	decontamination and decommissioning
DFF&O	*The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHPA	National Historic Preservation Act of 1966
Ohio EPA	Ohio Environmental Protection Agency
PORTS	Portsmouth Gaseous Diffusion Plant
RI	Remedial Investigation
TBC	to-be-considered
T&E	threatened and endangered

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B.1 INTRODUCTION

In accordance with the requirements of *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (DFF&O) (Ohio Environmental Protection Agency [Ohio EPA] 2012) (and pursuant to Ohio's laws and regulations and utilizing 40 *Code of Federal Regulations* [*CFR*] 300.430(f)(1)(ii)(B) of the National Oil and Hazardous Substances Pollution Contingency Plan [NCP] and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [CERCLA] as a framework) on-Site remedial actions are required to attain applicable or relevant and appropriate requirements (ARARs), unless waived in accordance with the DFF&O. The ARARs include only federal and state environmental or facility siting laws/regulations; they do not include occupational safety or worker radiation protection requirements. Additionally, per the DFF&O and 40 *CFR* 300.400(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (to-be-considered [TBC]).

As defined in Paragraph 5.e of the DFF&O, decontamination and decommissioning (D&D) activities include deactivation of equipment; removal and cleaning of process residues and deposits from equipment structures and piping; recovery of recyclable or reusable equipment or materials; dismantlement, demolition, and removal of equipment, structures, piping, building contents, concrete foundations, and any residual soil that adheres to the foregoing or otherwise must be excavated as part of D&D activities; and treatment, disposition, and disposal, off-Site or in a secure on-Site disposal cell for the above-listed materials, wastes, and residual soil waste materials generated during the remedial action. The proposed remedial action alternatives include: (1) no action; and (2) remove structures, treat as necessary and package waste for disposition. The requirements in Paragraph 12.a of the DFF&O will apply to any Record of Decision. The proposed remedial action alternative (i.e., other than no action) would comply with all identified ARARs/TBCs.

Paragraph 9.a of the DFF&O provides that portions of response actions conducted entirely on-site pursuant to work plans or plans concurred with or approved by the Ohio EPA under the order can be conducted pursuant to Section 121(e)(1) of CERCLA, 42 United States Code Section 9621. Section 121(e)(1) specifically provides that no federal, state, or local permit shall be required for the portion of any removal or remedial action conducted entirely as an on-site response action. In addition to "permits," the U.S. Environmental Protection Agency (EPA) has interpreted this section broadly to cover "all administrative provisions from other laws, such as recordkeeping, consultation, and reporting requirements. In other words, administrative requirements do not apply to on-site response actions" (Office of Solid Waste and Emergency Response 9205.5-10A). Those portions of the remedial action that are taken off site are subject to both the substantive and administrative requirements of applicable laws. Only the substantive requirements of the ARARs and TBCs in the tables in this appendix shall be binding for entirely on-site actions.

ARARs are typically divided into three groups: (1) chemical-specific, (2) location-specific, and (3) action-specific. Tables B.1 and B.2 segregate the location- and action-specific ARARs/TBCs for the D&D project remedial action. No chemical-specific ARARs were identified. In some cases, the conditions associated with the prerequisite requirements have not been confirmed to be present. If the subject condition is encountered during implementation of the action, then the specified ARAR would apply. A brief description of key ARAR/TBC topics follows.

B.2 CHEMICAL-SPECIFIC ARARS/TBCS

Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, and air) for specific hazardous substances, pollutants, or contaminants. The scope of this action is D&D of facilities and does not include remediation of environmental media; therefore, no chemical-specific ARARs are triggered.

B.3 LOCATION-SPECIFIC ARARS/TBCS

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams). The location-specific ARARs for protection of historic properties are listed in Table B.1.

B.3.1 FLOODPLAINS AND WETLANDS

None of the activities associated with the remedial action alternative would be conducted within any floodplain. Thus, no impacts to floodplains would result from the alternatives considered for this proposed remedial action.

Seven wetland areas that could potentially be affected during D&D have been identified. These areas include Q1-06 (0.23 acres), Q2-12 (2.028 acres), Q3-30 (0.48 acres), Q3-46 (0.08 acres), Q4-18 (0.322 acres), Q4-22 (0.018 acres), and Q4-26 (0.16 acres). Total acreage of the potentially affected wetlands is 3.318 acres. These resources will be protected in accordance with the location-specific ARARs and TBCs identified in Table B.1, as appropriate. Activities will be designed to avoid or minimize impacts to wetlands. In the event wetlands would be impacted, mitigation activities would be incorporated into the remedial design for the locations where such impacts would occur.

B.3.2 THREATENED AND ENDANGERED SPECIES

None of the D&D project remedial action alternatives would adversely impact any federally- or state-listed threatened or endangered (T&E) species because none has been identified on the Portsmouth Gaseous Diffusion Plant (PORTS) plant. Consequently, none of the requirements for protection of T&E species or critical habitat are included as ARARs.

B.3.3 CULTURAL RESOURCES

Cultural resources include any prehistoric or historic district, site, building, structure, or object resulting from, or modified by, human activity. Under federal regulations (36 *CFR* 800), federal agencies must assess the impacts their actions have on historic properties and, if appropriate, avoid or mitigate adverse effects. Historic properties are cultural resources listed in, or eligible for listing in, the National Register of Historic Places because of their significance and integrity.

The National Historic Preservation Act of 1966 (NHPA), Section 106, requires that a proposed activity be assessed for impacts to buildings/historic structures that are considered to be historic properties. The U.S. Department of Energy (DOE) has plans to implement and, in certain instances, is already implementing a variety of activities to execute the NHPA ARARs (see Table B.1). Because both above-ground and below-ground activities would occur under the Remedial Investigation (RI)/Feasibility Study (FS) and its follow-up implementation of measures be taken to address risks and hazards, DOE proposes a comprehensive approach to take into account the potential effects the actions may have on cultural resources. DOE's proposed approach and mitigation measures are described in detail in Section 6.2.2.2.

B.4 ACTION-SPECIFIC ARARS/TBCS

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and removal/remedial activities. Two alternatives are evaluated in this RI/FS: Alternative 1 – No Action and Alternative 2 – Remove Structures, Treat as Necessary and Package Waste for Final Disposition. Pursuant to EPA guidance, there are no ARARs for a no-action alternative (EPA 1991). ARARs for Alternative 2 include requirements related to waste characterization; scrap metal removal; decontamination; waste storage and treatment; and preparation for transportation and disposal of hazardous materials (Table B.2).

B.4.1 BUILDING REMOVAL

The D&D project action alternative includes the removal of scrap metal, equipment, infrastructure, structural materials, man-made subsurface features, any waste materials, and (where necessary) site restoration, etc. Under the Clean Air Act of 1970 (CAA), as amended, requirements for control of asbestos and/or radionuclide emissions (Table B.2) would have to be met. In addition, requirements for the closure of any tanks containing hazardous materials would have to be met.

B.4.2 WASTE MANAGEMENT

Building removal activities may result in the generation of Resource Conservation and Recovery Act of 1976, as amended, solid or hazardous waste, low-level radioactive waste, and asbestos-containing waste materials.

Although some characterization has been performed, additional waste streams may be identified during implementation of the remedial action.

All primary wastes (e.g., D&D waste) and secondary wastes (e.g., contaminated personal protective equipment, decontamination wastes) generated during building remediation activities must be appropriately characterized and managed in accordance with ARARs, which include State of Ohio laws and regulations for hazardous and solid waste, DOE Order[1] requirements, and federal requirements as specified in the tables. Hazardous waste determinations will be made on the basis of available process knowledge, materials of construction calculations, and sampling/analysis results, as required. If no listed hazardous wastes are present and the sample does not exhibit a hazardous characteristic, the waste will be categorized as nonhazardous. Requirements associated with the characterization, storage, and treatment of the aforementioned waste types are listed in Table B.2. Hazardous, Toxic Substances Control Act of 1976, and non-hazardous waste may be accumulated and stored in appropriate short-term storage areas at PORTS. Long-term storage of waste is not anticipated. Generated waste or materials will be transported and disposed or recycled as described in the Site-wide Waste Disposition Evaluation Project decision.

B.4.3 TRANSPORTATION

As noted in the DFF&O, Paragraph 9.a, the NCP at 40 *CFR* 300.400(e)(1) defines "on-site" as meaning "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for the implementation of the response action." Off-Site disposal, by definition, is not an on-Site response action and is subject to all substantive, procedural, and administrative requirements of all applicable laws and regulations, but not ARARs.

[1] DOE Orders are internal regulations that are legally binding to DOE contractors but are not considered by EPA to be ARARs because they have not been formally promulgated through a rulemaking process. DOE Orders, however, are functionally equivalent to many of the corresponding federal and state regulations.

Any wastes transferred off Site or transported in commerce along public rights-of-way must be prepared in such a way to meet the requirements summarized on Table B.2, depending on the type of waste (e.g., hazardous, low-level, mixed, or solid waste). These requirements include packaging, labeling, marking, manifesting, and placarding for hazardous materials in accordance with 49 *CFR* 170-180 *et seq.*

B.5 REFERENCES

EPA 1991, *ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers*, U.S. Office of Solid Waste and Emergency Response Directive 9234.2-01FS-A, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., June.

Ohio EPA 2012, *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*, Ohio Environmental Protection Agency, Columbus, OH, July 16.

Table B.1. Location-specific ARARs for the Process Buildings and Complex Facilities D&D at PORTS, Piketon, Ohio

Location	Requirements[a]	Prerequisite	Citation
	Wetlands		
Presence of wetlands as defined in 10 *CFR* 1022.4	Avoid, to the extent possible, the long- and short-term adverse effects associated with destruction, occupancy, and modification of wetlands.	DOE actions that involve potential impacts to, or take place within, wetlands—**applicable**	10 *CFR* 1022.3(c)
	Take action, to extent practicable, to minimize destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.		10 *CFR* 1022.3(a)(7) and (8)
	Undertake a careful evaluation of potential effects of any new construction in wetlands. Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse impacts on wetlands.		10 *CFR* 1022.3(b) and (d)
	Measures to take to mitigate the adverse effects of actions in wetlands include, but are not limited to, minimum grading requirements, run-off controls, design and construction constraints, and protection of ecology-sensitive areas.		10 *CFR* 1022.13(a)(3)
	If no practicable alternative to locating or conducting the action in the wetland is available, then before taking action, design or modify the action in order to minimize potential harm to or within the wetland, consistent with the policies set forth in Executive Order 11990.		10 *CFR* 1022.14(a)
Presence of jurisdictional wetlands	Except as provided under the CWA Sect. 404(b)(2), no discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the United States.	Actions that involve the discharge of dredged or fill material into waters of the United States, including jurisdictional (adjacent) wetlands—**applicable**	40 *CFR* 230.10(a) and (c)

[a]The requirements portion of the ARARs table is intended to provide a summary of the cited ARAR. The omission of any particular requirement does not limit the scope of the cited ARARs.

Table B.1. Location-specific ARARs for the Process Buildings and Complex Facilities D&D at PORTS, Piketon, Ohio (Continued)

Location	Requirements[a]	Prerequisite	Citation
Presence of jurisdictional wetlands (continued)	Except as provided under the CWA Sect. 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps in accordance with 40 *CFR* 230.70 *et seq*. are taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem.		40 *CFR* 230.10(d)
Presence of wetlands as defined under *OAC* 3745-1-02(B)(90)	Wetlands designated uses, as assigned in accordance with *OAC* 3745-1-54(B) (2), shall be maintained and protected such that degradation of surface waters through direct, indirect, or cumulative impacts does not result in the net loss of wetland acreage or functions in accordance with the substantive wetland avoidance, minimization, and compensatory mitigation requirements of the paragraphs (D) and (E) of *OAC* 3745-1-54.	Activity that would cause loss of wetlands as defined under *OAC* 3745-1-02(B)(90)—**applicable**	*OAC* 3745-1-54(B)(1) *OAC* 3745-1-51 through -54
Presence of "isolated" wetlands as defined under *RC* 6111.02	No person shall engage in the filling of an isolated wetland unless authorized to do so pursuant to the substantive requirements of a general or individual state isolated wetland permit.	Actions that involve the discharge of dredged or fill material into "isolated wetlands"—**applicable**	*RC* 6111.021 – 6111.028
	Must comply with the following substantive requirements and conditions of this permit: • Only suitable material free of toxic contaminants in other than trace quantities shall be used as fill material. • Use of asphalt and rubber tires as fill is prohibited. • Wetland narrative and chemical criteria in *OAC* 3745-1-51 and 3745-1-52 shall be maintained in isolated wetlands wholly or partially avoided. • Visible signage, as detailed in the general permit, shall be placed around the delineated boundary of the avoided wetlands.	Category 1 or 2 "isolated wetlands" of a total of ½ acre or less—**TBC** Category 1 or 2 "isolated wetlands" of a total of ½ acre or less—**TBC**	Ohio General Permit for Filling Category 1 and Category 2 Isolated Wetlands (effective April 10, 2007)

Table B.1. Location-specific ARARs for the Process Buildings and Complex Facilities D&D at PORTS, Piketon, Ohio (Continued)

Location	Requirements[a]	Prerequisite	Citation
Presence of "isolated" wetlands as defined under *RC* 6111.02 (continued)	Mitigation is required either on or off site, or at a mitigation bank within the same USACE district as the project location. Mitigation must be conducted in accordance with the ratios established in the general permit depending on the wetland category designation. The mitigation site shall be protected in perpetuity, and appropriate practicable management measures including vegetative buffers shall be implemented to restrict harmful activities that jeopardize the mitigation.	Actions that involve the discharge of dredged or fill material into Category 1 or 2 "isolated wetlands" of a total of ½ acre or less—**TBC**	Ohio General Permit for Filling Category 1 and Category 2 Isolated Wetlands (effective April 10, 2007)
Aquatic resources			
Location encompassing aquatic ecosystem as defined in 40 *CFR* 230.3(c)	Except as provided under Sect. 404(b)(2), no discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the U.S.	Action that involves discharge of dredged or fill material into waters of the United States—**applicable**	40 *CFR* 230.10(a) and (c) *OAC* 3745-32-05
	Except as provided under Sect. 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps in accordance with the substantive provisions of 40 *CFR* 230.70 *et seq*. are taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem.		40 *CFR* 230.10(d) *OAC* 3745-32-05
Cultural Resources			
Presence of archaeological resources	Must provide for the preservation of significant historical and archeological data which might otherwise be irreparably lost or destroyed as a result of any alteration of terrain caused as a result of any Federal construction project.	Federal agency construction or excavation projects that would cause the irreparable loss or destruction of significant historic or archeological resources or data—**applicable**	16 USC 469
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony for Native Americans	Must stop activities in the area of the discovery and take reasonable effort to secure and protect the objects discovered before resuming activity.	Federal agency construction or excavation activities that inadvertently discover Native American cultural items on Federal lands or lands under Federal control—**applicable**	25 USC 3002(d) 43 *CFR* 10.4(c) and (d)(2)

Table B.1. Location-specific ARARs for the Process Buildings and Complex Facilities D&D at PORTS, Piketon, Ohio (Continued)

Location	Requirements[a]	Prerequisite	Citation
Presence of historic properties	Federal agencies must take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion on the National Register.	Federal agency undertaking that may impact historic properties listed or eligible for inclusion on the National Register of Historic Places—**applicable**	16 USC 470f 36 *CFR* 800.1(a)
	Federal agencies must initiate measures to assure that where, as a result of Federal action, a historic property is to be substantially altered or demolished, timely steps are taken to make or have made appropriate records.	Substantial alteration or demolition of a historic property—**applicable**	16 USC 470h-2(b)

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
CWA = Clean Water Act
DOE = U.S. Department of Energy
OAC = Ohio Administrative Code
RC = Ohio Revised Code
TBC = to-be-considered
USACE = U.S. Army Corps of Engineers
USC = United States Code

Table B.2. Action-specific ARARs for the Process Buildings and Complex Facilities D&D at PORTS, Piketon, Ohio

Action	Requirements[a]	Prerequisite	Citation
Site Preparation, Construction, and Excavation Activities			
Activities causing release of air pollutants	Shall not cause the emission or escape into the open air from any source or sources whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, or any other substances or combinations of substances in such manner or in such amounts as to endanger the health, safety, or welfare of the public, or cause unreasonable injury or damage to property.	Activities causing the release of air pollution nuisances as defined in *OAC* 3745-15-07(A)—**applicable**	*OAC* 3745-15-07
	The operation of a hazardous waste facility shall not cause, permit, or allow the emission there from of any particulate matter, dust, fumes, gas, mist, smoke, vapor, or odorous substance that unreasonably interferes with the comfortable enjoyment of life or property by persons living or working in the vicinity of the facility or that is injurious to public health.	Site where hazardous waste will be managed such that air emissions may occur—**applicable**	*RC* 3734.02(I)
Activities causing fugitive dust (particulate) emissions	Shall take reasonable achievable control measures to prevent particulate matter from becoming airborne. Reasonable achievable control measures shall include, but are not limited to, the following:	Fugitive emissions from transportation, land-disturbing, or building alteration activities located in areas identified in Appendix A to *OAC* 3745-17-08, except as exempted under *OAC* 3745-17-08(A)(3)—**relevant and appropriate**	*OAC* 3745-17-08(B)
	• Use, where possible, of water or chemicals for control of dust and in demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land;		*OAC* 3745-17-08(B)(1)
	• Periodic application of asphalt, oil (excluding used oil), water, or other suitable chemicals on dirt or gravel roads and parking lots, materials stock piles, and other surfaces that can create airborne dusts, or the use of canvas or other suitable coverings for all materials stockpiles and stockpiling operations except temporary stockpiles;		*OAC* 3745-17-08(B)(2) and (6)
	• Install and use hoods, fans, and other equipment to adequately enclose, contain, capture, vent, and control the fugitive dust at the point(s) of capture to the extent possible with good engineering design. Equipment must meet the efficiency requirements of *OAC* 3745-17-08(B)(3)(a) and (b);		*OAC* 3745-17-08(B)(3)

[a]The requirements portion of the ARARs table is intended to provide a summary of the cited ARAR. The omission of any particular requirement does not limit the scope of the cited ARARs.

Action	Requirements[a]	Prerequisite	Citation
Activities causing fugitive dust (particulate) emissions (continued)	• Use of adequate containment methods during sandblasting or similar operations;		*OAC* 3745-17-08(B)(5)
	• Cover, at all times, open-bodied vehicles when transporting materials likely to become airborne;		*OAC* 3745-17-08(B)(7)
	• Pave and maintain roadways in a clean condition; and		*OAC* 3745-17-08(B)(8)
	• Promptly remove, in such a manner as to minimize or prevent resuspension, earth or other material from paved streets onto which this material has been deposited by trucking or earth moving equipment or erosion by water or other means.		*OAC* 3745-17-08(B)(9)
Airborne radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an EDE of 10 mrem per year.	Radionuclide air emissions to the ambient air from DOE facilities—**applicable**	40 *CFR* 61.92
Radiation protection of the public and the environment	Except as provided in 458.1(4)(b)(1)(c), exposure to individual members of the public from radiation shall not exceed a total EDE of 0.1 rem/year (100 mrem/year), exclusive of the dose contributions from background radiation, any medical administration the individual has received, or voluntary participation in medical/research programs.	Radionuclide emissions from all exposure modes from all DOE activities (including remedial actions) at a DOE facility—**TBC**	DOE Order 458.1(4)(b) and (c).
	Shall use, to the extent practicable, procedures and engineering controls based on sound radiation protection principles to achieve doses to members of the public that are ALARA.		DOE Order 458.1(4)(d)
Activities causing storm water runoff (e.g., demolition)	Dischargers must utilize best management practices to control pollutants in storm water discharges during and after construction, which may include, as appropriate, soil stabilization practices (e.g., seeding), perimeter structural practices (e.g., gabions, silt fences, sediment traps), and storm water management devices as detailed in Part III.G.2 (“Controls”) of NPDES OHC000003.	Storm water runoff discharges from land disturbed by construction activity—disturbance of ≥ 1 acre total, except where otherwise exempt as specified in 40 *CFR* 122.26(b)(15)—**applicable**	Authorization for Storm Water Discharges Associated with Construction Activity under NPDES OHC000003, Part III.G.2
	Waste Generation, Characterization, and Segregation		
Characterization of solid waste	Must determine if solid waste is hazardous or is excluded under 40 *CFR* 261.4 [*OAC* 3745 51-04]; and	Generation of solid waste as defined in 40 *CFR* 261.2—**applicable**	40 *CFR* 262.11(a) *OAC* 3745-52-11(A)

Action	Requirements[a]	Prerequisite	Citation
Characterization of solid waste (continued)	Must determine if waste is listed as a hazardous waste in 40 *CFR* Part 261 [*OAC* 3745-51-30 to 3745-51-35]; or	Generation of solid waste that is not excluded under 40 *CFR* 261.4—**applicable**	40 *CFR* 262.11(b) *OAC* 3745-52-11(B)
	Must determine whether the waste is identified in subpart C of 40 *CFR* 261 [*OAC* 3745-51-20 to 3745-51-24], characterizing the waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.	Generation of solid waste that is not listed in subpart D of 40 *CFR* 261 and not excluded under 40 *CFR* 261.4—**applicable**	40 *CFR* 262.11(c) *OAC* 3745-52-11(C)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 [*OAC* 3745-51, 3745-54 to 3745-57, 3745-65 to 3745-69, 3745-205, 3745-256, 3745-266, 3745-270, and 3745-273] for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste that is determined to be hazardous—**applicable**	40 *CFR* 262.11(d) *OAC* 3745-52-11(D)
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) that, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with 40 *CFR* 264 and 268 [*OAC* 3745-54 to 3745-57, 3745-205, and 3745-270].	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 *CFR* 264.13(a)(1) and (2) *OAC* 3745-54-13(A)(1) and (2)
Determinations for land disposal of hazardous waste	Must determine if the waste meets the treatment standards in 40 *CFR* 268.40, 268.45, or 268.49 [*OAC* 3745-270-40, 3745-270-45, and 3745-270-49] by testing in accordance with prescribed methods or use of generator knowledge of waste.	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 *CFR* 268.7(a) *OAC* 3745-270-07(A)
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 *CFR* 268.40 et seq. [*OAC* 3745-270-40 et seq.].	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 *CFR* 268.9(a) *OAC* 3745-270-09(A)
	Must determine the underlying hazardous constituents [as defined in 40 *CFR* 268.2(i) and *OAC* 3745-270-02] in the waste.	Generation of RCRA characteristically hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42, Table 1) for storage, treatment, or disposal—**applicable**	40 *CFR* 268.9(a) *OAC* 3745-270-09(A)

Action	Requirements[a]	Prerequisite	Citation
Determinations for land disposal of hazardous waste (continued)	Must determine whether the waste meets other applicable treatment standards under 40 *CFR* 268.9 [*OAC* 3745-270-09] for characteristic wastes.	Generation of RCRA characteristically hazardous waste—**applicable**	40 *CFR* 268.9(b) to (d) *OAC* 3745-270-09(B) to (C)
Characterization and management of wastewater (e.g., decon water)	On-site wastewater treatment units (including tank systems, conveyance systems, and ancillary equipment used to treat, store or convey wastewater to the wastewater treatment facility) are exempt from the requirements of RCRA Subtitle C standards.	On-site wastewater treatment units subject to regulation under Section 402 or Section 307(b) of the CWA—**applicable**	40 *CFR* 264.1(g)(6) *OAC* 3745-54-01(G)(6)
Characterization and management of industrial wastewater	Industrial wastewater discharges that are point source discharges under Section 402 of the CWA, as amended, are not solid wastes for purpose of hazardous waste management.	Generation of industrial wastewater for discharge—**applicable**	40 *CFR* 261.4(a)(2) *OAC* 3745-51-04(A)(2)
Characterization of LLW	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the WAC of the receiving facility.	Generation of LLW for storage or disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(I)
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste:		DOE M 435.1-1(IV)(I)(2)
	• Physical and chemical characteristics;		DOE M 435.1-1(IV)(I)(2)(a)
	• Volume, including the waste and any stabilization or absorbent media;		DOE M 435.1-1(IV)(I)(2)(b)
	• Weight of the container and contents;		DOE M 435.1-1(IV)(I)(2)(c)
	• Identities, activities, and concentrations of major radionuclides;		DOE M 435.1-1(IV)(I)(2)(d)
	• Characterization date;		DOE M 435.1-1(IV)(I)(2)(e)
	• Generating source; and		DOE M 435.1-1(IV)(I)(2)(f)
	• Any other information that may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with performance objectives.		DOE M 435.1-1(IV)(I)(2)(g)

Action	Requirements[a]	Prerequisite	Citation
Packaging of solid LLW for storage (e.g., radioactively contaminated debris)	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.	Storage of LLW in containers at a DOE facility—**TBC**	DOE M 435.1-1(IV)(L)(1)(a)
	Vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container. Containers shall be marked such that their contents can be identified.		DOE M 435.1-1(IV)(L)(1)(b) and (c)
Segregation of scrap metal for recycle	Material is not subject to RCRA requirements for generators, transporters, and storage facilities under 40 *CFR* Parts 262 through 266, 268, 270, or 124 [*OAC* 3745-50-40 to 3745-50-235 or 3745-52, 3745-53, 3745-54 to 3745-57, 3845-65 to 3745-69, 3745-205, 3745-256, 3745-266, and 3745-270].	Scrap metal, as defined in 40 *CFR* 261.1(c)(6) intended for recycle—**applicable**	40 *CFR* 261.6(a)(3)(ii) *OAC* 3745-51-06(A)(3)(b)
Management of recyclable materials for precious metal recovery	Recyclable materials being collected, transported or stored that are being reclaimed to recover economically significant amounts of gold, silver, platinum, palladium, iridium, osmium, rhodium, ruthenium, or any combination of these must be managed in accordance with the substantive requirements of *OAC* 3745-266-70.	Management of recyclable materials for precious metal recovery—**applicable**	*OAC* 3745-266-70
Management of spent lead acid batteries being reclaimed	Spent lead acid batteries being collected, transported and stored prior to regeneration must be managed in accordance with particular hazardous waste requirements depending on permit status and whether they are being reclaimed through regeneration or in other ways. Management options are detailed in 40 *CFR* 266.80 [*OAC* 3745-266-80]. Spent lead acid batteries can also be managed as universal wastes under 40 *CFR* 273 [*OAC* 3745-273].	Management of spent lead acid batteries being reclaimed—**applicable**	40 *CFR* 266.80 *OAC* 3745-266-80
Decontamination of radioactively contaminated equipment and building structures	Property potentially containing residual radioactive material must not be released or cleared from DOE control unless it is either demonstrated not to contain residual radioactive material based on process and historical knowledge, radiological monitoring or surveys, or a combination of these; or the property is evaluated and appropriately monitored or surveyed in accordance with DOE Order 458.1(4)(k)(3)(b).	Residual radioactive material on equipment and building structures intended for unrestricted use—**TBC**	DOE Order 458.1(4)(k)(3)

Action	Requirements[a]	Prerequisite	Citation
Release of radiological materials or scrap metal for reuse	Before being released, property shall be monitored or surveyed to determine the types and quantities of residual radioactive material within the property; the quantities of removable and total residual radioactive material on property surfaces (including residual radioactive material on or under any coating); and that contamination within or on the property is in compliance with applicable DOE Authorized Limits of DOE Order 458.1(4)(k)(6).	Radionuclide-contaminated materials and equipment intended for recycle or reuse—**TBC**	DOE Order 458.1(4)(k)(3)(b)(1)–(2) and (4)
	Where potentially contaminated surfaces are difficult to access for measurement (as in some pipes, drains, and ductwork), such property may be released after case-by-case evaluation and documentation based on both the history of its use and available measurements sufficient to demonstrate that the unsurveyable surfaces are likely to meet DOE Authorized Limits.		DOE Order 458.1(4)(k)(3)(b)(3)
Torch cutting of metal coated with paint that may contain PCBs	No person may openly burn PCBs. Combustion of PCBs by incineration as approved under Section 761.60 (a) or (e), or otherwise allowed under Part 761, is not open burning.	Management of PCB waste for storage or disposal—**applicable**	40 *CFR* 761.50(a)(1)
Management of PCB items	Any person removing from use a PCB Item containing an intact and non-leaking PCB article must dispose of it in accordance with Section 761.60(b), or decontaminate it in accordance with Section 761.79. PCB Items where the PCB Articles are no longer intact and non-leaking are regulated for disposal as PCB bulk product waste under Section 761.62(a) or (c).	Management of PCB waste for storage or disposal—**applicable**	40 *CFR* 761.50(b)(2)
Demolition of a facility containing RACM	Remove all RACM from the facility before demolition and follow the procedures for asbestos emission control and RACM handling as appropriate and detailed in 40 *CFR* 61.145(c)(1) through (7) [*OAC* 3745-20-04(A)(1) through (7)].	Demolition of a facility that contains RACM exceeding the volume requirements of 40 *CFR* 61.145(a)(1) [*OAC* 3745-20-02(B)]—**applicable**	40 *CFR* 61.145(a)(1) *OAC* 3745-20-04(A)(1)
	• RACM need not be removed before demolition if: • It is Category I nonfriable ACM that is not in poor condition and is not friable;		40 *CFR* 61.145(c)(1)(i) *OAC* 3745-20-04(A)(1)(a)
	• It is on a facility component that is encased in concrete or other similarly hard material and is adequately wet whenever exposed during demolition;		40 *CFR* 61.145(c)(1)(ii) *OAC* 3745-20-04(A)(1)(b)

Action	Requirements[a]	Prerequisite	Citation
Demolition of a facility containing RACM (continued)	• It is not accessible for testing and was, therefore, not discovered until after demolition began and, as a result of the demolition, the material cannot be safely removed (exposed RACM and asbestos-contaminated debris must be adequately wet at all times); or		40 *CFR* 61.145(c)(1)(iii) *OAC* 3745-20-04(A)(1)(c)
	• It is Category II nonfriable ACM and the probability is low that the materials will become crumbled, pulverized, or reduced to powder during demolition.		40 *CFR* 61.145(c)(1)(iv) *OAC* 3745-20-04(A)(1)(d)
Management of ACM prior to disposal	Discharge no visible emissions to the outside air or use one of the emission control and waste treatment methods specified in paragraphs (a)(1) through (a)(4) of 40 *CFR* 61.150 [paragraphs (B)(1) through (B)(4) of *OAC* 3745-20-05].	Generation, collection, processing, packaging, and transportation of any asbestos-containing waste material that is not Category I or II nonfriable ACM waste that did not become crumbled, pulverized, or reduced to powder [40 *CFR* 61.150(a)(5)]—**applicable**	40 *CFR* 61.150(a) *OAC* 3745-20-05(B)
	For facilities demolished where the RACM is not removed prior to demolition according to §§61.145(c)(i) – (iv) [*OAC* 3745-20-04(A)(1) or (D)], adequately wet ACM at all times after demolition and keep wet during handling and loading for transport. Such ACM does not have to be sealed in leak-tight containers or wrapping but may be transported and disposed of in bulk in leak-tight transport vehicles that are securely covered or enclosed and cause no visible emissions.		40 *CFR* 61.150(a)(3) *OAC* 3745-20-05(B)(2)
	As applied to demolition and renovation, the requirements of 40 *CFR* 61.150(a) [*OAC* 3745-20-05(B) and (C)] do not apply to Category I or II nonfriable ACM that has not been crumbled, pulverized, or reduced to powder.		40 *CFR* 61.150(a)(5) *OAC* 3745-20-05(B)(5)
	All asbestos-containing waste material shall be deposited as soon as practicable at a waste disposal site operated in accordance with the provisions of 40 *CFR* 61.154 [*OAC* 3745-20-06] or an EPA-approved site that converts RACM and asbestos-containing waste materials into nonasbestos (asbestos-free) materials according to the provisions of 40 *CFR* 61.155 [*OAC* 3745-20-13].		40 *CFR* 61.150(b)(1) - (2) *OAC* 3745-20-05(A)
	The requirements of 40 *CFR* 61.150(b)(1) and (2) do not apply to Category I nonfriable ACM that is not RACM.		40 *CFR* 61.150(b)(3)

Action	Requirements[a]	Prerequisite	Citation
Characterization and management of universal waste	A large quantity handler of universal waste is prohibited from disposing, diluting, or treating universal waste except in accordance with 40 *CFR* 273 [*OAC* 3745-273-33 or 3745-273-37].	Generation of universal waste [as defined in 40 *CFR* 273 and *OAC* 3745-273] for disposal—**applicable**	40 *CFR* 273.31 *OAC* 3745-273-31
	A large quantity handler of universal waste must manage universal waste in accordance with 40 *CFR* 273 [*OAC* 3745-273-33] in a way that prevents releases of any universal waste or component of a universal waste to the environment.		40 *CFR* 273.33 *OAC* 3745-273-33(A)
	Must label or mark the universal waste to identify the type of universal waste.		40 *CFR* 273.34 *OAC* 3745-273-34
	May accumulate waste for no longer than one year from the date the waste is generated or received from another handler unless the requirements of 40 *CFR* 273.35(b) [*OAC* 3745-273-35 (B)] are met.		40 *CFR* 273.35(a) *OAC* 3745-273-35(A)
	May accumulate universal waste for longer than one year from the date the universal waste is generated or received from another handler if such activity is solely for the purpose of accumulation of such quantities of universal waste as necessary to facilitate proper recovery, treatment, or disposal. However, the handler bears the burden of proving that such activity was solely for this purpose.		40 *CFR* 273.35(b) *OAC* 3745-273-35(B)
	Shall ensure that all employees are thoroughly familiar with proper waste handling and emergency procedures relative to their responsibilities during normal facility operations and emergencies.		40 *CFR* 273.36 *OAC* 3745-273-36
	A large quantity handler of universal waste must immediately contain all releases of universal wastes and other residues from universal wastes, and must determine whether any material resulting from the release is hazardous waste, and if so, must manage the hazardous waste in compliance with all applicable requirements.		40 *CFR* 273.37 *OAC* 3745-273.37

Action	Requirements[a]	Prerequisite	Citation
Characterization and management of universal waste (continued)	Must keep a record of each shipment of universal waste received and sent from the facility and retain record for at least 3 years. Record must include waste handler, shipper, or destination facility name and address, quantity and type of waste, and date shipment left or was received at facility.		40 *CFR* 273.39 *OAC* 3745-273.39
Management of universal waste lamps (fluorescent, mercury vapor)	A large quantity handler of universal waste must contain any lamp in containers or packages that are structurally sound, adequate to prevent breakage, and compatible with the contents of the lamps.	Generation of universal waste lamps [as defined in 40 *CFR* 273.9 and *OAC* 3745-273-05]—**applicable**	40 *CFR* 273.33(d)(1) *OAC* 3745-273-33(D)(1)
	Such containers and packages must remain closed and must lack evidence of leakage, spillage, or damage that could cause leakage of hazardous constituents under reasonably foreseeable conditions.		
	A large quantity handler of universal waste lamps must immediately clean up and place in a container any lamp that is broken and must place in a container any lamp that shows evidence of breakage, leakage, or damage that could cause the release of mercury or other hazardous constituents to the environment.		40 *CFR* 273.33(d)(2) *OAC* 3745-273-33(D)(2)
	Each lamp or container or package in which such lamps are contained must be labeled or marked clearly with one of the following phrases: "Universal Waste-Lamp(s)," or "Waste Lamps," or "Used Lamps."		40 *CFR* 273.34(e) *OAC* 3745-273-34(E)
	Mark or label the individual item with the date the lamp(s) became a waste, or mark or label the container or package with the date the wastes were received.		40 *CFR* 273.35(c) *OAC* 3745-273-35(C)

Action	Requirements[a]	Prerequisite	Citation
Management of used oil	Used oil shall not be stored in a unit other than a tank, container, or RCRA regulated unit.	Generation and storage of used oil, as defined in 40 *CFR* 279.1 [*OAC* 3745-279-01(A)(12)], that meets the applicability requirements of 40 *CFR* 279.10—**applicable**	40 *CFR* 279.22(a) *OAC* 3745-279-22(A)
	Containers and aboveground tanks used to store used oil must be in good condition (no severe rusting, apparent structural defects, or deterioration) and not leaking (no visible leaks).		40 *CFR* 279.22(b)(1) and (2) *OAC* 3745-279-22(B)(1) and (2)
	Containers and aboveground tanks used to store used oil and fill pipes used to transfer used oil into USTs must be labeled or marked clearly with the words "Used Oil."		40 *CFR* 279.22(c)(1) and (2) *OAC* 3745-279-22 (C)(1)
	Upon detection of a release of used oil to the environment, a generator must stop the release; contain, cleanup, and properly manage the released used oil; and, if necessary, repair or replace any leaking used oil storage containers or tanks prior to returning to service.	Release of used oil to the environment—**applicable**	40 *CFR* 279.22(d) *OAC* 3745-279-22(D)
Management of PCB waste	Any person storing or disposing of PCB waste must do so in accordance with 40 *CFR* 761, Subpart D.	Storage or disposal of waste containing PCBs at concentrations ≥ 50 ppm—**applicable**	40 *CFR* 761.50(a)
	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found.	Cleanup or disposal of PCB remediation waste as defined in 40 *CFR* 761.3—**applicable**	40 *CFR* 761.61
Decontamination of PCB-contaminated materials prior to use, reuse, distribution in commerce, or disposal as a non-TSCA waste	Chopping (including wire chopping), distilling, filtering, oil/water separation, spraying, soaking, wiping, stripping of insulation, scraping, scarification or the use of abrasives or solvents may be used to remove or separate PCBs to the decontamination standards for liquids, concrete, or non-porous surfaces, as listed in 40 *CFR* 761.79(b).	Generation of PCB wastes, including water, organic liquids, non-porous surfaces (scrap metal from disassembled electrical equipment), concrete, and non-porous surfaces covered with porous surfaces, such as paint or coating on metal—**applicable**	40 *CFR* 761.79(b)
Decontamination of water containing PCBs to levels acceptable for discharge	For water discharged to a treatment works or to navigable waters, decontaminate to < 3 µg/L (approximately < 3 ppb) or a PCB discharge limit included in a permit issued under Section 304(b) or 402 of the CWA; or	Discharge of water containing PCBs to a treatment works or navigable waters—**applicable**	40 *CFR* 761.79(b)(1)(ii)

Action	Requirements[a]	Prerequisite	Citation
Decontamination of water containing PCBs to levels acceptable for unrestricted use	Decontaminate to ≤ 0.5 μg/L (approximately ≤ 0.5 ppb) for unrestricted use.	Release of water containing PCBs for unrestricted use—**applicable**	40 *CFR* 761.79(b)(1)(iii)
Decontamination of organic liquids or non-aqueous inorganic liquids containing PCBs	For organic liquids or non-aqueous inorganic liquids containing PCBs, decontamination standard is < 2 mg/kg (i.e., < 2 ppm) PCBs.	Release of organic liquids or non-aqueous liquid containing PCBs—**applicable**	40 *CFR* 761.79(b)(2)
Decontamination of non-porous surfaces in contact with liquid PCBs to levels acceptable for unrestricted use	For non-porous surfaces previously in contact with liquid PCBs at any concentration, where no free-flowing liquids are currently present, ≤ 10 μg PCBs per 100 square centimeters (≤ 10 μg/100 cm^2) as measured by a standard wipe test (40 *CFR* 761.123) at locations selected in accordance with Subpart P of 40 *CFR* 761.	Release of non-porous surfaces in contact with liquid PCBs at any concentration for unrestricted use—**applicable**	40 *CFR* 761.79(b)(3)(i)(A)
Decontamination of non-porous surfaces in contact with non-liquid PCBs to levels acceptable for unrestricted use	For non-porous surfaces in contact with non-liquid PCBs (including non-porous surfaces covered with a porous surface, such as paint or coating on metal), clean to Visual Standard No. 2, Near-White Blast Cleaned Surface Finish of the NACE. A person shall verify compliance with standard No. 2 by visually inspecting all cleaned areas.	Release of non-porous surfaces in contact with non-liquid PCBs for unrestricted use—**applicable**	40 *CFR* 761.79(b)(3)(i)(B)
Decontamination of non-porous surfaces in contact with liquid PCBs to levels acceptable for disposal in a TSCA smelter	For non-porous surfaces previously in contact with liquid PCBs at any concentration, where no free-flowing liquids are currently present, decontaminate to < 100 μg/100 cm^2 as measured by a standard wipe test (Section 761.123) at locations selected in accordance with Subpart P of 40 *CFR* 761.	Disposal of non-porous surfaces previously in contact with liquid PCBs at any concentration into a smelter operating in accordance with Section 761.72(b)—**applicable**	40 *CFR* 761.79(b)(3)(ii)(A)
Decontamination of non-porous surfaces in contact with non-liquid PCBs to levels acceptable for disposal in a TSCA smelter	For non-porous surfaces in contact with non-liquid PCBs (including non-porous surfaces covered with a porous surface, such as paint or coating on metal) clean to Visual Standard No. 3, Commercial Blast Cleaned Surface Finish, of the NACE. A person shall verify compliance with Standard No. 3 by visually inspecting all cleaned areas.	Disposal of non-porous surfaces in contact with non-liquid PCBs into a smelter operating in accordance with Section 761.72(b) —**applicable**	40 *CFR* 761.79(b)(3)(ii)(B)

Action	Requirements[a]	Prerequisite	Citation
Decontamination of concrete recently contaminated with PCBs	Decontamination standard for concrete is < 10 µg/100 cm^2 as measured by a standard wipe test (Section 761.123) if the decontamination procedure is commenced within 72 hours of the initial spill of PCBs to the concrete or portion thereof being decontaminated.	Decontamination of concrete within 72 hours of the initial spill of PCBs to the concrete—**applicable**	40 *CFR* 761.79(b)(4)
Disposal of materials previously contaminated with PCBs as non-TSCA waste	Materials from which PCBs have been removed by decontamination in accordance with 40 *CFR* 761.79, not including decontamination wastes and residuals under 40 *CFR* 761.79(g), are considered unregulated for disposal under Subpart D of TSCA (40 *CFR* 761).	Disposal of materials from which PCBs have been removed—**applicable**	40 *CFR* 761.79(a)(4)
Risk-based decontamination of PCB-containing materials	May decontaminate to an alternate risk-based decontamination standard under 40 *CFR* 761.79(h) if the standard does not pose an unreasonable risk of injury to health or the environment.	Decontamination of materials contaminated with PCBs—**applicable**	40 *CFR* 761.79(h)
Management of PCB/radioactive waste	Any person storing such waste ≥ 50 ppm PCBs must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 *CFR* 761.65(a)(1), (b)(1)(ii) and (c)(6)(i).	Generation of PCB/radioactive waste for disposal—**applicable**	40 *CFR* 761.50(b)(7)(i)
	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties.		40 *CFR* 761.50(b)(7)(ii)
	If, after taking into account only the PCB properties in the waste, the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a state as a municipal or non-municipal non-hazardous waste landfill, then the person may dispose of such waste without regard to the PCBs, based on its radioactive properties alone.		40 *CFR* 761.50(b)(7)(ii)
	Storage		
Storage of hazardous wastes restricted from land disposal	Prohibits storage of hazardous waste restricted from land disposal unless the generator stores such waste in tanks, containers, or containment buildings on site solely for the purpose of accumulating such quantities as necessary to facilitate proper recovery, treatment, or disposal.	Accumulation of hazardous wastes restricted from land disposal solely for purpose of accumulation of quantities as necessary to facilitate proper recovery, treatment, or disposal—**applicable**	40 *CFR* 268.50 *OAC* 3745-270-50

Action	Requirements[a]	Prerequisite	Citation
Temporary storage and accumulation of hazardous waste in containers on site	A generator may accumulate hazardous waste at the facility provided that:	Accumulation of RCRA hazardous waste on site as defined in 40 *CFR* 260.1—**applicable**	40 *CFR* 262.34(a)(1)(i) *OAC* 3745-52-34(A)(1)(a)
	• The waste is placed in containers that comply with the applicable requirements in 40 *CFR* 265.171-173 (Subpart I) [*OAC* 3745-66-70 to 3745-66-73],		
	• Container is marked with the date upon which each period of accumulation begins,		40 *CFR* 262.34(a)(2) *OAC* 3745-52-34(A)(2)
	• Container is marked with the words "hazardous waste,"		40 *CFR* 262.34(a)(3) *OAC* 3745-52-34(A)(3)
	• The generator complies with the requirements in paragraph (A)(5) of rule 3745-270-07 and rules 3745-65-16, 3745-65-30 to 3745-65-37, and 3745-65-50 to 3745-65-56 of the Administrative Code.		40 *CFR* 262.34(a)(4) *OAC* 3745-52-34(A)(4)
	Generator is exempt from all requirements in rules 3745- 66-10 to 3745-66-21 and 3745-66-40 to 3745-66-48 of the Administrative Code except for paragraphs (A) and (B) of rule 3745-66-11 and rule 3745-66-14 of the Administrative Code.		40 *CFR* 262.34(a)(1) *OAC* 3745-52-34(A)(1)(e)
	Container must be marked with either the words "Hazardous Wastes" or with other words that identify the contents.	Accumulation of 55 gal or less of hazardous waste or 1 qt or less of acutely hazardous waste at or near any point of generation—**applicable**	40 *CFR* 262.34(c)(1)(ii) *OAC* 3745-52-34(C)(1)(b)
	For the excess waste, must comply within 3 days with the requirements of *OAC* 3745-52-34(A) or other applicable provisions of Chapter 3745-52 of the Administrative Code. During the 3-day period, comply with *OAC* 3745-52-34(C)(1)(a) and (b). Must mark container holding excess accumulation with the date the excess accumulation began.		40 *CFR* 262.34(c)(2) *OAC* 3745-52-34(C)(2)
Accumulation of rejected shipments of hazardous waste	A generator who receives a shipment of hazardous waste back as a rejected load or residue from a facility in accordance with a manifest discrepancy may accumulate the waste on-site in accordance with paragraphs (A) and (B) or (D), (D), and (F) of *OAC* 3745-52-34 depending on the amount of hazardous waste on-site in that calendar month.	Accumulation of RCRA hazardous waste on site as defined in 40 *CFR* 260.10—**applicable**	40 *CFR* 262.34(m) *OAC* 3745-52-34(M)

Action	Requirements[a]	Prerequisite	Citation
Management of hazardous waste stored in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers—**applicable**	40 *CFR* 264.171 *OAC* 3745-55-71
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 *CFR* 264.172 *OAC* 3745-55-72
	Keep containers closed during storage, except to add/remove waste.		40 *CFR* 264.173(a) *OAC* 3745-55-73(A)
	Open, handle, and store containers in a manner that will not cause containers to rupture or leak.		40 *CFR* 264.173(b) *OAC* 3745-55-73(B)
Inspection of RCRA container storage area	At least weekly, must inspect areas where containers are stored, looking for leaking containers and for deterioration of containers and the containment system caused by corrosion or other factors.	Storage of RCRA hazardous waste in containers—**applicable**	40 *CFR* 264.174 *OAC* 3745-55-74
Operation of a RCRA container storage area	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage in containers of RCRA hazardous wastes that do not contain free liquids—**applicable**	40 *CFR* 264.175(c) *OAC* 3745-55-75(C)
Storage of RCRA hazardous waste with free liquids in containers	Area must have a containment system designed and operated in accordance with 40 *CFR* 264.175(b) [*OAC* 3745-55-75(B)] as follows:	Storage of RCRA hazardous waste with free liquids or F020, F021, F022, F023, F026, and F027 in containers—**applicable**	40 *CFR* 264.175(a) and (d) *OAC* 3745-55-75(A) and (D)
	• A base must underlie the containers that is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;		40 *CFR* 264.175(b)(1) *OAC* 3745-55-75(B)(1)
	• Base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;		40 *CFR* 264.175(b)(2) *OAC* 3745-55-75(B)(2)
	• Must have sufficient capacity to contain 10% of the volume of containers or volume of largest container, whichever is greater;		40 *CFR* 264.175(b)(3) *OAC* 3745-55-75(B)(3)

Action	Requirements[a]	Prerequisite	Citation
Storage of RCRA hazardous waste with free liquids in containers (continued)	• Run-on into the system must be prevented unless the collection system has sufficient capacity to contain along with volume required for containers; and		40 *CFR* 264.175(b)(4) *OAC* 3745-55-75(B)(4)
	• Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in a timely manner as or necessary to prevent overflow.		40 *CFR* 264.175(b)(5) *OAC* 3745-55-75(B)(5)
Storage of ignitable or reactive waste in containers	Containers holding ignitable or reactive waste must be located at least fifteen meters (50 ft) from the facility's property line.	Storage of ignitable or reactive RCRA hazardous waste in containers—**applicable**	40 *CFR* 264.176 *OAC* 3745-55-76
Storage of incompatible waste in containers	Must not place incompatible wastes in same container unless comply with 40 *CFR* 264.17(b) [*OAC* 3745-54-17(B)].	Storage of "incompatible" RCRA hazardous wastes in containers—**applicable**	40 *CFR* 264.177(a) *OAC* 3745-55-77(A)
	Waste shall not be placed in an unwashed container that previously held an incompatible waste or material.		40 *CFR* 264.177(b) *OAC* 3745-55-77(B)
	A container holding incompatible wastes must be separated from any waste or nearby materials or must protect them from one another by using a dike, berm, wall, or other device.		40 *CFR* 264.177(c) *OAC* 3745-55-77(C)
Design and operation of a hazardous waste facility (e.g., storage areas)	Facilities must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water which could threaten human health or the environment.	Construction or setup of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.31 *OAC* 3745-54-31
Required equipment	All facilities shall be equipped with the following:		40 *CFR* 264.32 *OAC* 3745-54-32
	• An internal communications or alarm system capable of providing immediate emergency instruction to facility personnel.		40 *CFR* 264.32(A) *OAC* 3745-54-32(A)
	• A device capable of summoning emergency assistance from local police departments, fire departments, or Ohio EPA or local emergency response teams.		40 *CFR* 264.32(B) *OAC* 3745-54-32(B)

Action	Requirements[a]	Prerequisite	Citation
Design and operation of a hazardous waste facility (e.g., storage areas) (continued)	• Portable fire extinguishers, fire control equipment, including but not limited to, special extinguishing equipment, such as that using foam, inert gas, or dry chemicals, spill control equipment, and decontamination equipment.		40 *CFR* 264.32(C) *OAC* 3745-54-32(C)
	• Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.		40 *CFR* 264.32(D) *OAC* 3745-54-32(D)
Hazardous waste facility – security system	Must prevent the unknowing entry, and minimize the possibility for the unauthorized entry, of persons or livestock onto the active portion of his facility.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.14(a) *OAC* 3745-54-14(A)
	Must have a 24-hour surveillance system which continuously monitors and controls entry onto the active portion of the facility; or an artificial or natural barrier which completely surrounds the active portion of the facility; and a means to control entry, at all times, through the gates or other entrances to the active portion of the facility.		40 *CFR* 264.14(b) *OAC* 3745-54-14(B)
	Must post a sign with the legend "Danger – Unauthorized Personnel Keep Out" at each entrance to the active portion of a facility and at other locations in sufficient numbers to be seen from any approach in the active portion. Legend must be written in English and be legible from a distance of at least 25 ft.		40 *CFR* 264.14(c) *OAC* 3745-54-14(C)
Hazardous waste facility – general inspection requirements	Must inspect facility for malfunctions and deterioration, operator errors, and discharges to identify any problems and remedy any deterioration or malfunction of equipment or structures on a schedule that ensures that the problem does not lead to an environmental or human health hazard.	Operation of a RCRA hazardous waste facility**—applicable**	40 *CFR* 264.15(a) and (c) *OAC* 3745-54-15(A) and (C)
Hazardous waste facility – training requirements	Facility personnel must successfully complete a program of classroom instruction or on-the-job training in accordance with the program outlined in 40 *CFR* 264.16 [*OAC* 3745-54-16] and take part in an annual review of this initial training.	Operation of a RCRA hazardous waste facility**—applicable**	40 *CFR* 264.16 *OAC* 3745-54-16
Hazardous waste facility – testing and maintenance of equipment	All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, shall be tested and maintained as necessary to assure its proper operation in time of emergency.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.33 *OAC* 3745-54-33

Action	Requirements[a]	Prerequisite	Citation
Hazardous waste facility – access to communications or alarm system	Whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all personnel involved in the operation shall have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless such a device is not required under 40 *CFR* 264.32 [*OAC* 3745-54-32].	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.34(a) *OAC* 3745-54-34(A)
	If there is only one employee on the premises while the facility is operating, such employee shall have immediate access to a device capable of summoning external emergency assistance, unless such a device is not required under 40 *CFR* 264.32 [*OAC* 3745-54-32].		40 *CFR* 264.34(b) *OAC* 3745-54-34(B)
Hazardous waste facility – required aisle space	Shall maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless it can be satisfactorily demonstrated that aisle space is not needed for any of these purposes.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.35 *OAC* 3745-54-35
Hazardous waste facility – purpose and implementation of a contingency plan	Substantive requirements will be met to minimize hazards to human health or the environment from fires, explosions or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.51(a) *OAC* 3745-54-51(A)
	Substantive requirements shall be implemented immediately whenever there is a fire, explosion or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.		40 *CFR* 264.51(b) *OAC* 3745-54-51(B)
Hazardous waste facility – content of contingency plan	Comply with the substantive requirements of §§264.51 and 264.56 [rules 3745-54-51 and 3745-54-56 of the Administrative Code] in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface waster at the facility. 40 *CFR* 264.52(a) through (f) [*OAC* 3745-54-52(A) through (F)] describes what must be included in the Plan.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.52 *OAC* 3745-54-52

Action	Requirements[a]	Prerequisite	Citation
Hazardous waste facility – emergency coordinator	At all times, there shall be at least one employee either on the facility premises or on call with responsibility for coordinating all internal emergency response measures. This coordinator shall be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the locations and characteristics of waste handled, the location of all records within the facility, and the facility layout. In addition, this person shall have the authority to commit the resources needed to implement the contingency plan.	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.55 *OAC* 3745-54-55
Hazardous waste facility – emergency procedures	Whenever there is an imminent or actual emergency situation, the emergency coordinator, or his designee when the emergency coordinator is on call, must immediately implement the substantive requirements detailed in 40 *CFR* 264.56 [*OAC* 3745-54-56].	Operation of a RCRA hazardous waste facility—**applicable**	40 *CFR* 264.56 *OAC* 3745-54-56
Temporary storage or treatment of hazardous waste in waste piles – applicability	OAC 3745-56-50 to 3745-56-59 applies to owners and operators of facilities that store or treat hazardous waste in piles, except as OAC 3745-54-01 provides otherwise.	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.250(a) OAC 3745-56-50(A)
	OAC 3745-56-50 to 3745-56-59 does not apply to owners or operators of waste piles that are closed with wastes left in place. Such waste piles are subject to regulation as landfills under OAC 3745-57-02 to 3745-57-17.		40 CFR 264.250(b) OAC 3745-56-50(B)
	Owner or operator of any waste pile that is inside or under a structure that provides protection from precipitation so that neither run-off nor leachate is generated is not subject to regulation under OAC 3745-56-51 or OAC 3745-54-90 to 3745-54-101, provided that: • Liquids or materials containing free liquids are not placed in the pile; and • Pile is protected from surface water run-on by the structure or in some other manner; and • Pile is designed and operated to control dispersal of the waste by wind, where necessary, by means other than wetting; and • Pile will not generate leachate through decomposition or other reactions.		40 CFR 264.250(c) OAC 3745-56-50(C)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – design and operating requirements	A waste pile (except for an existing portion of a waste pile) must have:	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.251(a) OAC 3745-56-51(A)
	(1) A liner that is designed, constructed, and installed to prevent any migration of wastes out of the pile into the adjacent subsurface soil or ground water or surface water at any time during the active life (including the closure period) of the waste pile. The liner may be constructed of materials that may allow waste to migrate into the liner itself (but not into the adjacent subsurface soil or ground water or surface water) during the active life of the facility. The liner must be:		40 CFR 264.251(a)(1) OAC 3745-56-51(A)(1)
	• Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climate conditions, the stress of installation, and the stress of daily operation; and		40 CFR 264.251(a)(1)(i) OAC 3745-56-51(A)(1)(a)
	• Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of liner due to settlement, compression, or uplift; and		40 CFR 264.251(a)(1)(ii) OAC 3745-56-51(A)(1)(b)
	• Installed to cover all surrounding earth likely to be in contact with the waste or leachate; and		40 CFR 264.251(a)(1)(iii) OAC 3745-56-51(A)(1)(c)
	(2) A leachate collection and removal system immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the pile. Design and operating conditions will be specified to ensure that the leachate depth over the liner does not exceed 30 cm (1 ft). The leachate collection and removal system must be:		40 CFR 264.251(a)(2) OAC 3745-56-51(A)(2)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – design and operating requirements (continued)	• Constructed of materials that are: (i) chemically resistant to waste managed in the pile and the leachate expected to be generated; and (ii) of sufficient strength and thickness to prevent collapse under the pressures exerted by overlaying wastes, waste cover materials, and by any equipment used at the pile; and		40 CFR 264.251(a)(2)(i) OAC 3745-56-51(A)(2)(a)
	• Designed and operated to function without clogging through the scheduled closure of the waste pile.		40 CFR 264.251(a)(2)(ii) OAC 3745-56-51(A)(2)(b)
	The owner or operator will be exempted from the requirements of OAC 3745-56-51(A) if the Director finds, based on a demonstration by the owner or operator, that alternate design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents into the ground water or surface water at any future time. In deciding whether to grant an exemption, the Director will consider the factors listed in OAC 3745-56-51(B)(1) through (4).		40 CFR 264.251(b) OAC 3745-56-51(B)
	The owner or operator of each new waste pile unit, each lateral expansion of a waste pile unit, and each replacement of an existing waste pile unit must install two or more liners and a leachate collection and removal system above and between such liners.		40 CFR 264.251(c) OAC 3745-56-51(C)
	The liner system must include:		40 CFR 264.251(c)(1)(i)(A) OAC 3745-56-51(C)(1)(a)(i)
	• A top liner designed and constructed of materials (e.g., a geomembrane) to prevent the migration of hazardous constituents into such liner during the active life and post-closure care period; and		

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – design and operating requirements (continued)	A composite bottom liner consisting of at least two components. The upper component must be designed and constructed of materials (e.g., a geomembrane) to prevent the migration of hazardous constituents into this component during the active life and post-closure care period. The lower component must be designed and constructed of materials to minimize migration of hazardous constituents if a breach in the upper component were to occur. Lower component must be constructed of at least 3 ft (91.0 cm) of compacted soil material with a hydraulic conductivity of no more than 1 x 10^{-7} cm/s.		40 CFR 264.251(c)(1)(i)(B) OAC 3745-56-51(C)(1)(a)(ii)
	The liners must comply with paragraphs (A)(1)(a), (A)(1)(b), and (A)(1)(c) of OAC 3745-56-51.		40 CFR 264.251(c)(1)(ii) OAC 3745-56-51(C)(1)(b)
	The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the waste pile during the active life and post-closure care period. Design and operating conditions will be specified to ensure that the leachate depth over the liner does not exceed 30 cm (1 ft). The leachate collection and removal system must comply with OAC 3745-56-51(C)(3)(c) and (C)(3)(d).		40 CFR 264.251(c)(2) OAC 3745-56-51(C)(2)
	The leachate collection and removal system between the liners, and immediately above the bottom composite liner in the case of multiple leachate collection and removal systems, is also a leak detection system. This leak detection system must be capable of detecting, collecting, and removing leaks of hazardous constituents at the earliest practicable time through all areas of the top liner likely to be exposed to waste or leachate during the active life and post-closure care period. The requirements for a leak detection system in this paragraph are satisfied by installation of a system that is, at a minimum:		40 CFR 264.251(c)(3) OAC 3745-56-51(C)(3)
	• Constructed with a bottom slope of 1 percent or more;		40 CFR 264.251(c)(3)(i) OAC 3745-56-51(C)(3)(a)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – design and operating requirements (continued)	• Constructed of granular drainage materials with a hydraulic conductivity of 1×10^{-2} cm/s or more and a thickness of 12 in. (30.5 cm) or more; or constructed of synthetic or geonet drainage materials with a transmissivity of 3×10^{-5} m^2/s or more;		40 CFR 264.251(c)(3)(ii) OAC 3745-56-51(C)(3)(b)
	• Constructed of materials that are chemically resistant to the waste managed in the waste pile and the leachate expected to be generated, and of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and equipment used at the waste pile;		40 CFR 264.251(c)(3)(iii) OAC 3745-56-51(C)(3)(c)
	• Designed and operated to minimize clogging during the active life and post-closure period; and		40 CFR 264.251(c)(3)(iv) OAC 3745-56-51(C)(3)(d)
	• Constructed with sumps and liquid removal methods of sufficient size to collect and remove liquids from sump and prevent liquids from backing up into drainage layer. Each unit must have its own sump(s). Design of each sump and removal system must provide a method for measuring and recording volume of liquids present in sump and of liquids removed.		40 CFR 264.251(c)(3)(v) OAC 3745-56-51(C)(3)(e)
	The owner or operator must collect and remove pumpable liquids in the leak detection system sumps to minimize the head on the bottom liner.		40 CFR 264.251(c)(4) OAC 3745-56-51(C)(4)
	The owner or operator of a leak detection system that is not located completely above the seasonal high water table must demonstrate that the operation of the leak detection system will not be adversely affected by the presence of ground water.		40 CFR 264.251(c)(5) OAC 3745-56-51(C)(5)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – design and operating requirements (continued)	The Director may approve alternative design or operating practices if the owner or operator demonstrates that such design and operating practices, together with location characteristics: (1) will prevent the migration of any hazardous constituent into the ground water or surface water at least as effectively as the liners and leachate collection and removal systems specified in this rule; and (2) will allow detection of leaks of hazardous constituents through the top liner at least as effectively.		40 CFR 264.251(d) OAC 3745-56-51(D)
	The owner or operator must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-year storm.		40 CFR 264.251(g) OAC 3745-56-51(G)
	The owner or operator must design, construct, operate, and maintain a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm.		40 CFR 264.251(h) OAC 3745-56-51(H)
	Collection and holding facilities (e.g., tanks or basins) associated with run-on and run-off control systems must be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system.		40 CFR 264.251(i) OAC 3745-56-51(I)
	If the pile contains any particulate matter which may be subject to wind dispersal, the owner or operator must cover or otherwise manage the pile to control wind dispersal.		40 CFR 264.251(j) OAC 3745-56-51(J)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – action leakage rate	The Director will approve an action leakage rate for waste piles subject to OAC 3745-56-51(C) or (D). The action leakage rate is the maximum design flow rate that the leak detection system can remove without the fluid head on the bottom liner exceeding 1 ft. The action leakage rate must include an adequate safety margin to allow for uncertainties in the design (e.g., slope, hydraulic conductivity, thickness of drainage material), construction, operation, and location of the leak detection system, waste and leachate characteristics, likelihood and amounts of other sources of liquids in the leak detection system, and proposed response actions (e.g., the action leakage rate must consider decreases in the flow capacity of the system over time resulting from siltation and clogging, rib layover and creep of synthetic components of the system, overburden pressures, etc.).	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.252(a) OAC 3745-56-52(A)
	To determine if the action leakage rate has been exceeded, the owner or operator must convert the weekly flow rate from the monitoring data obtained under paragraph (C) of OAC 3745-56-54 to an average daily flow rate (gal/acre/day) for each sump. Unless the Director approves a different calculation, the average daily flow rate for each sump must be calculated weekly during the active life and closure period.		40 CFR 264.252(b) OAC 3745-56-52(B)
Temporary storage or treatment of hazardous waste in waste piles – response actions	The owner or operator of waste pile units subject to paragraph (C) or (D) of OAC 3745-56-51 must have an approved response action plan before receipt of waste. The response action plan must set forth the actions to be taken if the action leakage rate has been exceeded. At a minimum, the response action plan must describe the actions specified in OAC 3745-56-53(B).	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.253(a) OAC 3745-56-53(A)
	If the flow rate into the leak detection system exceeds the action leakage rate for any sump, owner or operator must: • Notify the director in writing of the exceedance within 7 days of the determination;		40 CFR 264.253(b)(1) – (6) OAC 3745-56-53(B)(1) – (6)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – response actions (continued)	• Submit a preliminary written assessment to the Director within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned; • Determine to the extent practicable the location, size, and cause of any leak; • Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed; • Determine any other short-term and long-term actions to be taken to mitigate or stop any leaks; and • Within 30 days after notification that the action leakage rate has been exceeded, submit to the Director the results of the analyses specified in paragraphs (B)(3), (B)(4), and (B)(5) of this rule, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the owner or operator must submit a report summarizing the results of any remedial actions taken and actions planned.		
	To make the leak and/or remediation determinations in OAC 3745-56-53(B)(3), (B)(4), and (B)(5), the owner or operator must: • Assess the source of liquids and amounts of liquids by source; • Conduct fingerprint, hazardous constituent, or other analyses of liquids in the leak detection system to identify the source of liquids and possible location of any leaks, and the hazard and mobility of the liquid; and • Assess the seriousness of any leaks in terms of potential for escaping into the environment; or		40 CFR 264.253(c)(1)(i) – (iii) OAC 3745-56-53(C)(1)(a) – (c)
	• Document why such assessments are not needed.		40 CFR 264.253(c)(2) OAC 3745-56-53(C)(2)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – monitoring and inspections	During construction or installation, liners and cover systems (e.g., membranes, sheets, or coatings) must be inspected for uniformity, damage, and imperfections (e.g., holes, cracks, thin spots, or foreign materials). Immediately after construction or installation:	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.254(a) OAC 3745-56-54(A)
	• Synthetic liners and covers must be inspected to ensure tight seams and joints and the absence of tears, punctures, or blisters; and		40 CFR 264.254(a)(1) OAC 3745-56-54(A)(1)
	• Soil-based and admixed liners and covers must be inspected for imperfections including lenses, cracks, channels, root holes, or other structural non-uniformities that may cause an increase in the permeability of the liner or cover.		40 CFR 264.254(a)(2) OAC 3745-56-54(A)(2)
	While a waste pile is in operation, it must be inspected weekly and after storms to detect evidence of any of the following:		40 CFR 264.254(b) OAC 3745-56-54(B)
	• Deterioration, malfunctions, or improper operation of run-on and run-off control systems; and		40 CFR 264.254(b)(1) OAC 3745-56-54(B)(1)
	• Proper functioning of wind dispersal control systems, where present; and		40 CFR 264.254(b)(2) OAC 3745-56-54(B)(2)
	• The presence of leachate in and proper functioning of leachate collection and removal systems, where present.		40 CFR 264.254(b)(3) OAC 3745-56-54(B)(3)
	An owner or operator required to have a leak detection system under OAC 3745-56-51(C) must record the amount of liquids removed from each leak detection system sump at least once each week during the active life and closure period.		40 CFR 264.254(c) OAC 3745-56-54(C)
Temporary storage or treatment of hazardous waste in waste piles – special requirements for ignitable or reactive waste	Ignitable or reactive waste shall not be placed in a waste pile unless the waste and the waste pile satisfy all applicable requirements of OAC 3745-270, and:	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.256 OAC 3745-56-56
	• Addition of the waste to an existing pile results in waste or mixture no longer meeting the definition of ignitable or reactive waste under OAC 3745-51-21 or 3745-51-23 and complies with OAC 3745-54-17(B); or		40 CFR 264.256(a) OAC 3745-56-56(A)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – special requirements for ignitable or reactive waste (continued)	• The waste is managed in such a way that it is protected from any material or conditions which may cause it to ignite or react.		40 CFR 264.256(b) OAC 3745-56-56(B)
Temporary storage or treatment of hazardous waste in waste piles – special requirements for incompatible waste	Incompatible wastes, or incompatible wastes and materials (see the appendix to OAC 3745-55-99 for examples), shall not be placed in the same pile, unless OAC 3745-54-17(B) is complied with.	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.257(a) OAC 3745-56-57(A)
	A pile of hazardous waste that is incompatible with any waste or other material stored nearby in other containers, piles, open tanks, or surface impoundments shall be separated from the other materials, or protected from them by means of a dike, berm, wall or other device.		40 CFR 264.257(b) OAC 3745-56-57(B)
	Hazardous waste shall not be piled on the same base where incompatible wastes or materials were previously piled unless the base has been decontaminated sufficiently to ensure compliance with OAC 3745-54-17(B).		40 CFR 264.257(c) OAC 3745-56-57(C)
Temporary storage or treatment of hazardous waste in waste piles – closure and post-closure care	At closure, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste unless OAC 3745-51-03(D) applies.	Storage of RCRA hazardous waste in a waste pile—**applicable**	40 CFR 264.258(a) OAC 3745-56-58(A)
	If, after removing or decontaminating all residues and making all reasonable efforts to effect removal or decontamination of contaminated components, subsoils, structures, and equipment as required in paragraph (A) of this rule, the owner or operator finds that not all contaminated subsoils can be practicably removed or decontaminated, he must close the facility and perform post-closure care in accordance OAC 3745-57-10.		40 CFR 264.258(b) OAC 3745-56-58(B)
	The owner or operator of a waste pile that does not comply with the liner requirements of OAC 3745-56-51(A)(1) and is not exempt from them in accordance with OAC 3745-56-50(C) or OAC 3745-56-51(B) must:		40 CFR 264.258(c)(1) OAC 3745-56-58(C)(1)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage or treatment of hazardous waste in waste piles – closure and post-closure care (continued)	Include in the closure plan for the pile in accordance with OAC 3745-55-12 both a plan for complying with paragraph (A) of this rule and a contingent plan for complying with paragraph (B) of this rule in case not all contaminated subsoils can be practicably removed at closure; and		40 CFR 264.258(c)(1)(i) OAC 3745-56-58(C)(1)(a)
	Prepare a contingent post-closure plan in accordance with OAC 3745-55-18 for complying with paragraph (B) of this rule in case not all contaminated subsoils can be practicably removed at closure.		40 CFR 264.258(c)(1)(ii) OAC 3745-56-58(C)(1)(b)
	Cost estimates calculated in accordance with OAC 3745-55-42 and 3745-55-44 for closure and post-closure care of a pile subject to this paragraph must include the cost of complying with the contingent closure plan and the contingent post-closure plan but are not required to include the cost of expected closure under paragraph (A) of this rule.		40 CFR 264.258(c)(2) OAC 3745-56-58(C)(2)
Temporary storage of RCRA remediation waste in a staging pile	May be temporarily stored (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility provided that the staging pile will be designed to:	Accumulation of non-flowing hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 *CFR* 260.10—**applicable**	40 *CFR* 264.554(d)(1) *OAC* 3745-57-74
	• Facilitate a reliable, effective and protective remedy;		40 *CFR* 264.554(d)(1)(i) *OAC* 3745-57-74(D)(1)(a)
	• Prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer, as necessary, to protect human health and the environment (e.g., through the use of liners, covers, run on/run off controls, as appropriate).		40 *CFR* 264.554(d)(1)(ii) *OAC* 3745-57-74(D)(1)(b)
	Must not place incompatible wastes in same pile unless comply with 40 *CFR* 264.17(b) [*OAC* 3745-54-17(B)].	Storage of "incompatible" remediation waste in staging pile—**applicable**	40 *CFR* 264.554(f)(1) *OAC* 3745-57-74(F)(1)
	Incompatible wastes must be separated from any waste or nearby materials or must protect them from one another by using a dike, berm, wall, or other device.		40 *CFR* 264.554(f)(2) *OAC* 3745-57-74(F)(2)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage of RCRA remediation waste in a staging pile (continued)	Must not pile remediation waste on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 *CFR* 274.17(b) [*OAC* 3745-54-17(B)].		40 *CFR* 264.554(f)(3) *OAC* 3745-57-74(F)(3)
Temporary storage of PCB waste in a non-RCRA regulated area	Except as provided in 40 *CFR* 761.65 (b)(2), (c)(1), (c)(7), (c)(9), and (c)(10), after July 1, 1978, facilities used for the storage of PCBs and PCB Items designated for disposal shall comply with the requirements in 40 *CFR* 761.65(b)(1).	Storage of PCBs and PCB items at concentrations ≥ 50 ppm for disposal—**applicable**	40 *CFR* 761.65(b)
	The facilities shall meet the following criteria:		40 *CFR* 761.65(b)(1)
	• Adequate roof and walls to prevent rain water from reaching the stored PCBs and PCB Items;		40 *CFR* 761.65(b)(1)(i)
	• Adequate floor that has continuous curbing with a minimum 6-in.-high curb. Floor and curb must provide containment volume equal to at least two times the internal volume of the largest PCB article or container or 25% of the internal volume of all articles or containers stored there, whichever is greater. *Note*: 6-in. minimum curbing not required for area storing PCB/radioactive waste;		40 *CFR* 761.65(b)(1)(ii)
	• No drain valves, floor drains, expansion joints, sewer lines, or other openings that would permit liquids to flow from the curbed area;		40 *CFR* 761.65(b)(1)(iii)
	• Floors and curbing constructed of Portland cement, concrete, or a continuous, smooth, nonporous surface as defined in §761.3 that prevents or minimizes penetration of PCBs; and		40 *CFR* 761.65(b)(1)(iv)
	• Not located at a site below the 100-year flood water elevation.		40 *CFR* 761.65(b)(1)(v)
Temporary storage of PCB waste in a RCRA-regulated area	Does not have to meet storage unit requirements in 40 *CFR* 761.65(b)(1) provided unit is stored in compliance with RCRA and PCB spills are cleaned up in accordance with Subpart G of 40 *CFR* 761.	Storage of PCBs and PCB items at concentrations ≥ 50 ppm for disposal—**applicable**	40 *CFR* 761.65(b)(2)(i) to (iv)

Action	Requirements[a]	Prerequisite	Citation
Temporary storage of PCB waste in containers	Container(s) shall be marked as illustrated in 40 *CFR* 761.45(a).	Storage of PCBs and PCB items at concentrations ≥ 50 ppm for disposal—**applicable**	40 *CFR* 761.40(a)(1)
	Storage area must be properly marked as required by 40 *CFR* 761.40(a)(10).		40 *CFR* 761.65(c)(3)
	Any leaking PCB items and their contents shall be transferred immediately to a properly marked non-leaking container(s).		40 *CFR* 761.65(c)(5)
	Except as provided in 40 *CFR* 761.65(c)(6)(i) and (ii), container(s) shall be in accordance with requirements set forth in DOT HMR at 49 *CFR* 171-180.		40 *CFR* 761.65(c)(6)
	Items shall be dated when they are removed from service and the storage shall be managed so that PCB items can be located by this date. [Note: Date should be marked on the container.]	PCB items (includes PCB wastes) removed from service for disposal—**applicable**	40 *CFR* 761.65(c)(8)
Risk-based storage of PCB remediation waste or bulk product waste prior to disposal	May store in a manner other than prescribed in 40 *CFR* 761.65 if the method will not pose an unreasonable risk of injury to health or the environment.	Storage of PCB remediation waste or bulk product waste prior to disposal—**applicable**	40 *CFR* 761.61(c) 40 *CFR* 761.62(c)
Temporary storage of bulk PCB remediation waste or PCB bulk product waste in a TSCA waste pile	Waste must be placed and managed in accordance with the design and operation standards, including liner and cover requirements and run-off control systems, in 40 *CFR* 761.65(c)(9).	Storage of bulk PCB remediation waste or PCB bulk product waste at cleanup site or site of generation—**applicable**	40 *CFR* 761.65(c)(9)(i)
	Requirements of 40 *CFR* 761.65(c)(9) of this part may be modified under the risk-based disposal option of Section 761.61(c).		40 *CFR* 761.65(c)(9)(iv)
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be nonleaking.	Storage of PCB/radioactive waste in containers other than those meeting DOT HMR performance standards—**applicable**	40 *CFR* 761.65(c)(6)(i)(A)
	For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 *CFR* 761.65(b)(1)(ii); and		40 *CFR* 761.65(c)(6)(i)(B)
	For both liquid and nonliquid wastes, containers must meet all substantive requirements pertaining to nuclear criticality safety.		40 CFR 761.65(c)(6)(i)(C)
Temporary staging and storage of LLW	Ensure that radioactive waste is stored in a manner that protects the public, workers, and the environment and that the integrity of waste storage is maintained for the expected time of storage.	Management and storage of LLW at a DOE facility—**TBC**	DOE M 435.1-1(I)(F)(13)

Action	Requirements[a]	Prerequisite	Citation
Temporary staging and storage of LLW (continued)	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water.		DOE M 435.1-1(IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage.		DOE M 435.1-1(IV)(N)(3)
	Shall be managed to identify and segregate LLW from mixed waste.		DOE M 435.1-1(IV)(N)(6)
	Staging of LLW shall be for the purpose of accumulation of such quantities of waste as necessary to facilitate transportation, treatment, and disposal.		DOE M 435.1-1(IV)(N)(7)
	Treatment/Disposal		
Disposal of RCRA-prohibited hazardous waste in a land-based unit	May be land disposed only if it meets the applicable requirements in the table "Treatment Standards for Hazardous Waste" at 40 *CFR* 268.40 (*OAC* 3745-270-40) before land disposal. The table lists either "total waste" standards, "waste-extract" standards, or "technology-specific" standards [as detailed further in 40 *CFR* 268.42 (*OAC* 3745-270-42)].	Land disposal, as defined in 40 *CFR* 268.2, of RCRA prohibited waste [as listed in 40 *CFR* 268.20 to .39 (*OAC* 3745-270-20 to -39)] — **applicable**	40 *CFR* 268.40(a) *OAC* 3745-270-40(A) 40 *CFR* 268.30 to 268.40 *OAC* 3745-270-30 to -40 40 *CFR* 268.42 *OAC* 3745-270-42
	For characteristic wastes (D001 – D043) that are subject to the treatment standards, all underlying hazardous constituents must meet the UTSs specified in 40 *CFR* 268.48 (*OAC* 3745-27048).	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment unit that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well—**applicable**	40 *CFR* 268.40(e) *OAC* 3745-270-40(E) 40 *CFR* 268.48 *OAC* 3745-270-48
	May be land disposed if the wastes no longer exhibit a characteristic at the point of land disposal, unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* 628.40 (*OAC* 3745-270-48), or are D003 reactive cyanide.	Land disposal of RCRA-restricted characteristic wastes—**applicable**	40 *CFR* 268.1(c)(4)(iv) *OAC* 3745-270-01 (C)(4)

Action	Requirements[a]	Prerequisite	Citation
Disposal of RCRA-prohibited hazardous waste in a land-based unit (continued) *Debris*	May be land disposed if treated prior to disposal as provided under the “Alternative Treatment Standards for Hazardous Debris” in 40 *CFR* 268.45(a)(1)-(5) [*OAC* 3745-270-45(A)(1)-(5)] unless it is determined under 40 *CFR* 261.3(f)(2) [*OAC* 3745-51-03(F)(2)] that the debris is no longer contaminated with hazardous waste <u>or</u> the debris is treated to the waste specific treatment standard provided in 40 *CFR* 268.40 (*OAC* 3745-270-40) for the waste contaminating the debris.	Land disposal, as defined in 40 *CFR* 268.2 (*OAC* 3745-270-02), of RCRA-restricted hazardous debris—**applicable**	40 *CFR* 268.45(a) *OAC* 3745-270-45(A)
	The hazardous debris must be treated for each “contaminant subject to treatment,” which must be determined in accordance with 40 *CFR* 268.45(b) [*OAC* 3745-270-45(B)].		40 *CFR* 268.45(b) *OAC* 3745-270-45(B)
Soils	May be land disposed if treated prior to disposal according to the alternative treatment standards of 40 *CFR* 268.49(c) [*OAC* 3745-270-49(C)] or according to the UTSs specified in 40 *CFR* 268.48 (*OAC* 3745-270-48) applicable to the listed hazardous waste and/or applicable characteristic of hazardous waste if the soil is characteristic.	Land disposal, as defined in 40 *CFR* 268.2 (*OAC* 3745-270-02), of RCRA-restricted hazardous soils—**applicabl**e	40 *CFR* 268.49(b) and (c) *OAC* 3745-270-49(B) and (C)
Variance from a treatment standard for RCRA-restricted hazardous wastes	A variance from a treatment standard may be approved if: • It is not physically possible to treat the waste to the level specified in the treatment standard, or by the method specified as the treatment standard; or • It is inappropriate to require the waste to be treated to the level specified in the treatment standard or by the method specified as the treatment standard even through such treatment is technically possible. *NOTE:* Variance approval will be granted through the DFF&O document approval process and included in the appropriate DFF&O document.	Generation of a RCRA hazardous waste requiring treatment prior to land disposal—**applicable**	40 *CFR* 268.44 *OAC* 3745-270-44

Action	Requirements[a]	Prerequisite	Citation
Disposal of treated hazardous debris	Debris treated by one of the specified extraction or destruction technologies on Table 1 of this section and which no longer exhibits a characteristic is not a hazardous waste and need not be managed in RCRA subtitle C facility. Hazardous debris contaminated with listed waste that is treated by an immobilization technology must be managed in a RCRA subtitle C facility.	Treated debris contaminated with RCRA-listed or characteristic waste—**applicable**	40 *CFR* 268.45(c) *OAC* 3745-270-45(C)
Disposal of hazardous debris treatment residues	Except as provided in 268.45(d)(2) and (d)(4) [*OAC* 3745-270-45(D)(2) and (D)(4)], treatment residues must be separated from the treated debris using simple physical or mechanical means, and such residues are subject to the waste-specific treatment standards for the waste contaminating the debris. Layers of debris removed by spalling are hazardous debris that remains subject to treatment standards.	Residues from the treatment of hazardous debris—**applicable**	40 CFR 268.45(d)(1) – (5) *OAC* 3745-270-45(D)(1) – (5)
Prohibition of dilution to meet LDRs	Except as provided under 40 *CFR* 268.3(b) [*OAC* 3745-270-03(B)], must not in any way dilute a restricted waste or the residual from treatment of a restricted waste as a substitute for adequate treatment to achieve compliance with land disposal restriction levels.	Land disposal, as defined in 40 *CFR* 268.2 (*OAC* 3745-270-02), of RCRA-restricted hazardous soils—**applicable**	40 *CFR* 268.3(a) *OAC* 3745-270-03(A)
Pretreatment standards for discharges to a permitted wastewater treatment unit	Pollutants introduced to POTWs shall not pass through POTWs or interfere with the operation or performance of the POTW. Substances listed in *OAC* 3745-3-04(B) shall not be introduced into a POTW.	Discharge of wastewater containing pollutants to a POTW—**relevant and appropriate**	*OAC* 3745-3-04
	Must notify POTW immediately of all discharges that could cause problems to the POTW, including any slug loading, in accordance with *OAC* 3745-3-05.		*OAC* 3745-3-05
	Industrial users are subject to national categorical pretreatment standards under 40 *CFR* 403.6 and to the general requirements listed in *OAC* 3745-3-09 regarding the interpretation and application of pretreatment standards.		*OAC* 3745-3-09

Action	Requirements[a]	Prerequisite	Citation
Disposal of wastewaters containing RCRA hazardous constituents in a CWA wastewater treatment unit	Disposal is not prohibited if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. under the CWA unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* 268.40 (*OAC* 3745-270-40) or are D003 reactive cyanide.	Disposal of RCRA-restricted hazardous wastes that are hazardous only because they exhibit a hazardous characteristic and are not otherwise prohibited under 40 *CFR* Part 268—**applicable**	40 *CFR* 268.1(c)(4)(i) *OAC* 3745-270-01(C)(4)
Disposal of wastewaters in a CWA wastewater treatment unit	No entity shall cause pollution or place or cause to be placed any sewage, sludge, sludge materials, industrial waste, or other wastes in a location where they cause pollution of any waters of the state.	Discharge of contaminants to waters of the state – **applicable**	*RC* 6111.04
	No person shall violate or fail to perform any duty imposed by sections 6111.01 to 6111.08 of the Revised Code or violate any order, rule, or term or condition of a permit issued or adopted by the director of environmental protection pursuant to those sections.		*RC* 6111.07
Treatment and disposal of ignitable, reactive, or incompatible RCRA wastes	Must take precautions to prevent accidental ignition or reaction of waste, and waste must be separated and protected from sources of ignition or reaction.	Operation of a RCRA facility that treats or stores ignitable, reactive, or incompatible wastes—**applicable**	40 *CFR* 264.17(a) *OAC* 3745-54-17(A)
	Must take precautions to prevent reactions that: • Generate extreme heat, pressure, fire or explosion, or violent reactions. • Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment. • Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions. • Damage the structural integrity of the device or facility. • Through other like means threaten human health or the environment.		40 *CFR* 264.17(b) *OAC* 3745-54-17(B)

Action	Requirements[a]	Prerequisite	Citation
Disposal of solid wastes	Except as provided in paragraph (D) of *OAC* 3745-27-02, no person shall establish or modify a solid waste disposal facility without meeting the substantive criteria as follows:	Management and disposal of solid waste**—applicable**	*OAC* 3745-27-02(A)
	Disposal of solid wastes shall only be by the following methods or combination thereof:		*OAC* 3745-27-05(A)
	• Disposal at a licensed sanitary landfill facility		*OAC* 3745-27-05(A)(1)
	• Incinerating at a licensed incinerator		*OAC* 3745-27-05(A)(2)
	• Composting at a licensed composting facility		*OAC* 3745-27-05(A)(3)
	• Alternative disposal methods either as engineered fill or land application, provided use will not create a nuisance or harm human health or the environment and is capable of complying with other applicable laws.		*OAC* 3745-27-05(A)(4)
Prohibition on open dumping of solid wastes	Temporary storage of putrescible solid wastes in excess of seven days, or temporary storage of any solid wastes where such storage causes a nuisance or health hazard shall be considered open dumping.	Temporary storage of solid waste prior to collection for disposal or transfer—**applicable**	*OAC* 3745-27-03(A)(2)
	No person shall conduct, permit, or allow open dumping. In the event that open dumping is or has occurred, person(s) responsible shall promptly remove and dispose or otherwise manage the solid waste and shall submit verification that the waste has been properly managed.	Management and disposal of solid waste**—applicable**	*OAC* 3745-27-05(C)
Treatment of LLW	Waste treatment to provide more stable waste forms and to improve the long-term performance of a LLW disposal facility shall be implemented as necessary to meet performance objectives of the disposal facility.	Generation of LLW for disposal at a DOE LLW disposal facility—**TBC**	DOE M 435.1-1(IV)(O)
Disposal of solid LLW at DOE facilities	Shall meet waste acceptance requirements before it is transferred to the receiving facility.	Generation of LLW for disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(J)(2)
Disposal of refrigeration equipment	With the exception of the substitutes in the end uses listed in 40 *CFR* 82.154(a)(1)(i) – (vi), no person maintaining, servicing, repairing, or disposing of appliances may knowingly vent or otherwise release into the environment any refrigerant or substitute from such appliances.	Appliances that contain Class I or II substances used as a refrigerant—**applicable**	40 *CFR* 82.154(a)(1)

Action	Requirements[a]	Prerequisite	Citation
Disposal of refrigeration equipment (continued)	De minimis releases associated with good faith attempts to recycle or recover refrigerants are not subject to this prohibition.		40 *CFR* 82.154(a)(2)
	No person may dispose of such appliances, except for small appliances, MVACs, and MVAC-like appliances, without: • Observing the required practices set forth in 40 *CFR* 82.156, and • Using equipment that is certified for that type of appliance pursuant to 40 *CFR* 82.158.		40 *CFR* 82.154(b)
Disposal of asbestos-containing waste material (e.g., transite siding, pipe lagging, insulation, ceiling tiles)	All asbestos-containing waste material must be deposited as soon as practicable at a waste disposal site operated in accordance with Section 61.154 [*OAC* 3745-20-06] or a site that converts RACM and asbestos-containing waste material into nonasbestos (asbestos free) material according to the provisions of 40 *CFR* 61.155 [*OAC* 3745-20-13].	Removal and disposal of RACM except Category I nonfriable asbestos- containing material—**applicable**	40 *CFR* 61.150(b)(1) and (2) *OAC* 3745-20-05(A)
	May use an alternative emission control and waste treatment method that will control asbestos emissions equivalent to currently required methods, the alternative method is suitable for the intended application, and the alternative method will not violate other regulations and will not result in increased water or land pollution or occupational hazards.		40 *CFR* 61.150(a)(4) *OAC* 3745-20-05(B)(4)
Exclusions for disposal or reuse of construction and demolition debris, or “clean hard fill” [as defined in *OAC* 3745-400-01(E)]	Construction and demolition debris facility requirements do not apply to construction and demolition debris or clean hard fill used in one or more of the following ways: • Any construction site where construction debris and trees and brush removed in clearing the construction site are used as fill material on the site where the materials are generated or removed; • Any site where clean hard fill is used, either alone or in conjunction with clean soil, sand, gravel, or other clean aggregates, in legitimate fill operations; • Any site where debris is not disposed, such as where debris is reused or recycled in a beneficial manner, or stored for a temporary period remaining unchanged and retrievable.	Use of construction and demolition debris or clean hard fill at a site—**applicable**	*OAC* 3745-400-03

Action	Requirements[a]	Prerequisite	Citation
Disposal of construction and demolition debris	Shall be disposed of only in an authorized construction and demolition debris facility or solid waste disposal facility; by means of open burning if permitted as provided in *OAC* 3745-19; or by other methods provided such methods are demonstrated to be capable of disposing without creating a nuisance or health hazard, without causing water pollution, and without violating any regulations under Chapters 3745, 3704 or 3734.	Disposal of construction and demolition debris—**applicable**	*OAC* 3745-400-04(A) and (B)
Disposal of construction and demolition debris as "clean hard fill"	Clean hard fill (does not include materials contaminated with hazardous, solid, or infectious waste) consisting of reinforced or nonreinforced concrete, asphalt concrete, brick (includes but is not limited to refractory brick and mortar), block, tile, or stone shall be managed in one or more of the following ways: • Recycled into usable construction material; • Disposed in construction and demolition debris or other waste facilities; • Used in legitimate fill operations for construction purposes or to bring the site up to consistent grade, on the site of generation, or on a site other than the site of generation, pursuant to paragraph (C) of *OAC* 3745-400-05.	Use of clean hard fill to bring a construction site up to consistent grade—**applicable**	*OAC* 3745-400-05(A)
	Clean hard fill may be stored for a period of less than two years. "Stored" means held in a manner remaining retrievable and substantially unchanged. Clean hard fill piled adjacent to a construction materials processing facility shall not be considered stored for more than 2 years if the pile is active, i.e., if clean hard fill material is added to and removed from the pile within a 2 year period.		*OAC* 3745-400-05(B)

Action	Requirements[a]	Prerequisite	Citation
Performance-based disposal of PCB remediation waste	Shall be disposed according to 40 *CFR* 761.60(a) or (e), or decontaminated in accordance with 40 *CFR* 761.79.	Disposal of liquid PCB remediation waste—**applicable**	40 *CFR* 761.61(b)(1)
	May dispose by one of the following methods:	Disposal of nonliquid PCB remediation waste (as defined in 40 *CFR* 761.3)—**applicable**	40 *CFR* 761.61(b)(2)
	• In a high-temperature incinerator under 40 *CFR* 761.70(b);		40 *CFR* 761.61(b)(2)(i)
	• By an alternate disposal method under 40 *CFR* 761.60(e);		
	• In a chemical waste landfill under 40 *CFR* 761.75;		
	• In a facility under 40 *CFR* 761.77; or		
	• Through decontamination in accordance with 40 *CFR* 761.79.		40 *CFR* 761.61(b)(2)(ii)
Risk-based disposal of PCB remediation waste	May dispose of in a manner other than prescribed in 40 *CFR* 761.61(a) or (b) if the method will not pose an unreasonable risk of injury to health or the environment.	Disposal of PCB remediation waste—**applicable**	40 *CFR* 761.61(c)
Disposal of PCB decontamination waste and residues	Shall be disposed of at their existing PCB concentration unless otherwise specified in 40 *CFR* 761.79(g).	PCB decontamination waste and residues for disposal—**applicable**	40 *CFR* 761.79(g)
Disposal of PCB liquids (e.g., from drained electrical equipment)	Must be disposed of in an incinerator that complies with 40 *CFR* 761.70, except:	PCB liquids at concentrations ≥ 50 ppm—**applicable**	40 *CFR* 761.60(a)
	For mineral oil dielectric fluid, may be disposed in a high efficiency boiler according to 40 *CFR* 761.71(a).		40 *CFR* 761.60(a)(1)
	For liquids other than mineral oil dielectric fluid, may be disposed in a high efficiency boiler according to 40 *CFR* 761.71(b).		40 *CFR* 761.60(a)(2)
Disposal of PCB-contaminated precipitation, condensation, or leachate	May be disposed in a chemical waste landfill that complies with 40 *CFR* 761.75 if:	PCB liquids at concentrations ≥ 50 ppm from incidental sources and associated with PCB articles or non-liquid PCB wastes—**applicable**	40 *CFR* 761.60(a)(3)
	• Disposal does not violate 40 *CFR* 268.32(a) or 268.42(a)(1); and		40 *CFR* 761.60(a)(3)(i)
	• Liquids do not exceed 500 ppm and are not ignitable waste as described in 40 *CFR* 761.75(b)(8)(iii).		40 *CFR* 761.60(a)(3)(ii)

Action	Requirements[a]	Prerequisite	Citation
Disposal of PCB transformers	Shall be disposed of in either: • An incinerator that complies with 40 *CFR* 761.70, or • A chemical waste landfill that is compliant with 40 *CFR* 761.75 provided all free flowing liquid is removed from the transformer, the transformer is filled with a solvent, the transformer is allowed to stand for at least 18 continuous hours, and then the solvent is thoroughly removed.	PCB-contaminated electrical equipment (including transformers that contain PCBs at concentrations of ≥ 50 ppm and < 500 ppm in the contaminating fluid) as defined in 40 *CFR* 761.3—**applicable**	40 *CFR* 761.60(b)(1) 40 *CFR* 761.60(b)(1)(i)(A) 40 *CFR* 761.60(b)(1)(i)(B)
Performance-based disposal of PCB bulk product waste	May dispose of by one of the following: • In an incinerator under Section 761.70, • In a chemical waste landfill under Section 761.75, • In a hazardous waste landfill under Section 3004 or Section 3006 of RCRA, • Under alternate disposal under Section 761.60(e), • In accordance with decontamination provisions of Section 761.79, • In accordance with thermal decontamination provisions of Section 761.79(e)(6) for metal surfaces in contact with PCBs.	Disposal of PCB bulk product waste as defined in 40 *CFR* 761.3—**applicable**	40 *CFR* 761.62(a) 40 *CFR* 761.62(a)(1) 40 *CFR* 761.62(a)(2) 40 *CFR* 761.62(a)(3) 40 *CFR* 761.62(a)(4) 40 *CFR* 761.62(a)(5) 40 *CFR* 761.62(a)(6)
Risk-based disposal of PCB bulk product waste	May dispose of in a manner other than that prescribed in 40 *CFR* 761.62(a) if the method will not pose an unreasonable risk of injury to health or the environment.	Disposal of PCB bulk product waste as defined in 40 *CFR* 761.3—**applicable**	40 *CFR* 761.62(c)

Action	Requirements[a]	Prerequisite	Citation
Disposal of PCB bulk product waste in solid waste landfill	May dispose of the following in a municipal or non-municipal non-hazardous waste landfill:	Disposal of non-liquid PCB bulk product waste listed in 40 *CFR* 761.62(b)(1)—**applicable**	40 *CFR* 761.62(b)(1)
	• Plastics (such as plastic insulation from wire or cable; radio, television and computer casings; vehicle parts; or furniture laminates); preformed or molded rubber parts and components; applied dried paints, varnishes, waxes or other similar coatings or sealants; caulking; Galbestos; non-liquid building demolition debris; or non-liquid PCB bulk product waste from the shredding of automobiles or household appliances from which PCB small capacitors have been removed (shredder fluff), and		40 *CFR* 761.62(b)(1)(i)
	• Other PCB bulk product waste, sampled in accordance with the protocols set out in subpart R of 40 *CFR* Part 761, that leaches PCBs at < 10 μg/L of water measured using a procedure used to simulate leachate generation.		40 *CFR* 761.62(b)(1)(ii)
	May dispose of in a municipal or non-municipal nonhazardous waste landfill if:	PCB bulk product waste not meeting conditions of 40 *CFR* 761.62(b)(1) (e.g., paper/felt gaskets contaminated by liquid PCBs)—**applicable**	40 *CFR* 761.62(b)(2)
	• The PCB bulk product waste is segregated from organic liquids disposed of in the landfill, and		40 *CFR* 761.62(b)(2)(i)
	• Leachate is collected from the landfill and monitored for PCBs.		40 *CFR* 761.62(b)(2)(ii)
Disposal of fluorescent light ballasts	Must be disposed of in a TSCA disposal facility as bulk product waste under 40 *CFR* 761.62 or in accordance with the decontamination provisions of 40 *CFR* 761.79.	Generation for disposal of fluorescent light ballasts containing PCBs in the potting material—**applicable**	40 *CFR* 761.60(b)(6)(iii)
Disposal of PCB-contaminated electrical equipment (except capacitors)	Must remove all free-flowing liquid from the electrical equipment and dispose of the removed liquid in accordance with 40 *CFR* 761.60(a), and	Generation of PCB-contaminated electrical equipment (as defined in 40 *CFR* 761.3) for disposal—**applicable**	40 *CFR* 761.60(b)(4)

Action	Requirements[a]	Prerequisite	Citation
Disposal of PCB-contaminated electrical equipment (except capacitors) (continued)	Dispose of by one of the following methods: • In a facility managed as a municipal solid waste or non-municipal non-hazardous waste facility; • In an industrial furnace operating in compliance with 40 *CFR* 761.72; or • In a disposal facility under 40 *CFR* 761.60.	Drained PCB-contaminated electrical equipment, including any residual liquids—**applicable**	40 *CFR* 761.60(b)(4)(i)
Disposal of PCB capacitors	Any person must assume that a capacitor manufactured prior to July 2, 1979, whose PCB concentration is not established, contains ≥ 500 ppm PCBs. If the date of manufacture is unknown, any person must assume the capacitor contains ≥ 500 ppm PCBs.	Generation of PCB capacitors with ≥ 500 ppm PCBs for disposal—**applicable**	40 *CFR* 761.2(a)(4)
	Shall comply with all requirements of 40 *CFR* 761.60 unless it is known from label or nameplate information, manufacturer's literature, or chemical analysis that capacitor does not contain PCBs.		40 *CFR* 761.60(b)(2)(i)
	Shall dispose of in accordance with either of the following: • disposal in an incinerator that complies with 40 *CFR* 761.70; or • disposal in a chemical waste landfill that complies with 40 *CFR* 761.75.	Generation of PCB capacitors with ≥ 500 ppm PCBs for disposal—**applicable**	40 *CFR* 761.60(b)(2)(iii)
	Shall dispose of in one of the following disposal facilities approved under 40 *CFR* 761.60: • incinerator under 40 *CFR* 761.70; • chemical waste landfill under 40 *CFR* 761.75; • high efficiency boiler under 40 *CFR* 761.71; or • scrap metal recovery oven or smelter under 40 *CFR* 761.72.	Disposal of large capacitors that contain ≥ 50 ppm but < 500 ppm PCBs **—applicable**	40 *CFR* 761.60(b)(4)(ii)
	May dispose of in municipal solid waste landfill.	Generation of PCB small capacitors (as defined in 40 *CFR* 761.3) for disposal—**applicable**	40 *CFR* 761.60(b)(2)(ii)

Action	Requirements[a]	Prerequisite	Citation
Disposal of PCB-contaminated articles	Must remove all free-flowing liquid from the article, disposing of the liquid in compliance with the requirements of 40 *CFR* 761.60(a)(2) or (a)(3), and	Generation of PCB-contaminated articles (as defined in 40 *CFR* 761.3) for disposal—**applicable**	40 *CFR* 761.60(b)(6)(ii)
	Dispose by one of the following methods: • In accordance with the decontamination provisions at 40 *CFR* 761.79; • In a facility managed as a municipal solid waste or non-municipal nonhazardous waste facility; • In an industrial furnace operating in compliance with 40 *CFR* 761.72; or • In a disposal facility under 40 *CFR* 761.60.	Disposal of PCB-contaminated articles with no free-flowing liquid—**applicable**	40 *CFR* 761.60(b)(6)(ii) (A) thru (D)
	Closure		
Closure performance standard for RCRA hazardous waste management units	Must close the facility in a manner that: • Minimizes the need for further maintenance; and	Closure of a RCRA hazardous waste management unit—**applicable**	40 *CFR* 264.111(a) *OAC* 3745-55-11(A)
	• Controls, minimizes or eliminates, to the extent necessary to protect human health and environment, post-closure escape of hazardous waste, hazardous constituents, contaminated run off or hazardous waste decomposition products to ground or surface waters or to the atmosphere.		40 *CFR* 264.111(b) *OAC* 3745-55-11(B)
	• Complies with the substantive closure requirements of 40 CFR 264 [OAC 3745-54 to 3745-57 and 3745-205] for the particular type of facility, including but not limited to the requirements of Sections 264.178 (container storage area) [OAC 3745-55-78], 264.197 (tanks) [OAC 3745-55-97], 264.310 (landfills) [OAC 3745-57-10], and 264.554 (remediation waste piles) [OAC 3745-56-58].		40 *CFR* 264.111(c) *OAC* 3745-55-11(C)
	During closure periods, all contaminated equipment, structures, and soils must be properly disposed or decontaminated.		40 *CFR* 264.114 *OAC* 3745-55-14

Action	Requirements[a]	Prerequisite	Citation
Postclosure care of RCRA hazardous waste management unit	Postclosure care in accordance with the substantive requirements of *OAC* 3745-55-17 (A)(1) must begin after closure and continue for at least 30 years after that date. The Director may shorten or extend the postclosure period as indicated to protect human health and the environment.	Closure of a RCRA hazardous waste disposal unit**—applicable**	40 *CFR* 264.117(a)(1) and (2) *OAC* 3745-55-17(A)(1) and (2)
Closure of a RCRA container storage unit	Must remove all hazardous waste and residues from containment system. Remaining containers, liners, bases and soil containing or contaminated with hazardous waste or residues must be decontaminated or removed.	Closure of a RCRA hazardous waste container storage area—**applicable**	40 *CFR* 264.178 *OAC* 3745-55-78
Closure of a RCRA remediation waste staging pile	Must be closed by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate.	Closure of a remediation waste staging pile located in a previously contaminated area—**applicable**	40 *CFR* 264.554(j)(1) *OAC* 3745-57-74(J)(1)
	Must decontaminate contaminated subsoils in a manner that will protect human health and the environment.	Closure of a remediation waste staging pile located in a previously contaminated area—**applicable**	40 *CFR* 264.554(j)(2) *OAC* 3745-57-74(J)(2)
	Must be closed according to substantive requirements in 40 *CFR* 264.258(a) and 264.111 or 265.258(a) and 265.111 [*OAC* 3745-56-58(A) and 3745-55-11 or 3745-67-58 and 3745-66-11].	Closure of a remediation waste staging pile located in an uncontaminated area—**applicable**	40 *CFR* 264.554(k) *OAC* 3745-57-74(K)
Closure of RCRA hazardous waste tanks	At closure, remove all hazardous waste and hazardous waste residues from tanks, discharge control equipment, and discharge confinement structures.	Management of RCRA hazardous waste in tanks**—applicable**	40 *CFR* 264.197(a) *OAC* 3745-55-97(A)
	If all contaminated contents cannot be removed, must consider the tank system a landfill and close the facility and perform postclosure care in accordance with the landfill closure requirements of 40 *CFR* 264.310 (*OAC* 3745-57-10).		40 *CFR* 264.197(b) *OAC* 3745-55-97(B)
Closure of TSCA storage facility (i.e., storage areas established under this action)	Must close in a manner that eliminates the potential for post-closure releases of PCBs that may present an unreasonable risk to human health or the environment.	Closure of a TSCA storage facility—**applicable**	40 *CFR* 761.65(e)(1)

Action	Requirements[a]	Prerequisite	Citation
Closure of TSCA storage facility (i.e., storage areas established under this action) (continued)	Must remove or decontaminate PCB waste residues and contaminated containment system components, equipment, structures, and soils during closure in accordance with the levels specified in the PCB Spills Cleanup Policy in subpart G of 40 *CFR* 761.		40 *CFR* 761.65(e)(1)(iv)
	A TSCA/RCRA storage facility closed under RCRA is exempt from the TSCA closure requirements of 40 *CFR* 761.65(e).	Closure of TSCA/RCRA storage facility—**applicable**	40 *CFR* 761.65(e)(3)
	Transportation[b]		
Transportation of hazardous waste on site	The generator manifesting requirements of 40 *CFR* 262.20 to 262.32(b) [*OAC* 3745-52-20 to 3745-52-23 and 3745-52-32(B)] do not apply. Generator or transporter must comply with the requirements set forth in 40 *CFR* 263.30 and 263.31 [*OAC* 3745-53-30 and 3745-53-31] in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by public or private right-of-way—**applicable**	40 *CFR* 262.20(f) *OAC* 3745-52-20(F)
Transportation of hazardous materials on site	Must meet the substantive requirements of 49 *CFR* Parts 171–174, 177, and 178 or the site- or facility-specific Transportation Safety Document [i.e., *Transportation Safety Document for the On-Site Transfer of Hazardous Material at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* LPP-0021/R3].	Transport of hazardous materials on the PORTS site—**TBC**	DOE Order 460.1C(4)(b)
Transportation of radioactive waste	Shall be packed and transported in accordance with the substantive requirements of DOE Order 460.1C (*Packaging and Transportation Safety*) and DOE Order 460.2A (*Departmental Materials Transportation and Packaging Management*).	Preparation of shipment of radioactive waste—**TBC**	DOE M 435.1-1(I)(1)(E)(11)
	To the extent practicable, the volume of waste and number of shipments shall be minimized.		DOE M 435.1-1(III)(L)(2) DOE M 435.1-1(IV)(L)(2)

[b]Off-site transportation, by definition, is not an on-site response action and is subject to all substantive, procedural, and administrative requirements of all legally applicable laws but not to any requirements that might be relevant and appropriate under the ARARs process.

Action	Requirements[a]	Prerequisite	Citation
Transportation of PCB wastes off site	Must comply with the manifesting provisions at 40 *CFR* 761.207 through 218.	Relinquishment of control over PCB wastes by transporting or offering for transport—**applicable**	40 *CFR* 761.207(a)
Transportation of hazardous waste off site	Must comply with the generator requirements of 40 *CFR* 262.20 to 262.23 [*OAC* 3745-52-20 to 3745-52-23] for manifesting, Section 262.30 [*OAC* 3745-52-30] for packaging, Section 262.31 [*OAC* 3745-52-31] for labeling, Section 262.32 [*OAC* 3745-52-32] for marking, Section 262.33 [*OAC* 3745-52-33] for placarding, Section 262.40 and 262.41(a) [*OAC* 3745-52-40 and 3745-52-41(A)] for record keeping requirements, and Section 262.12 [*OAC* 3745-52-12] to obtain EPA ID number.	Preparation of RCRA hazardous waste for transport off site—**applicable**	40 *CFR* 262.10(h) *OAC* 3745-52-10(H) 40 *CFR* 262.20 to .23 *OAC* 3745-52-20 to -23 40 *CFR* 262.30 to .33 *OAC* 3745-52-30 to -33
Transportation of universal waste off site	Off-site shipments of universal waste by a large quantity handler of universal waste shall be made in accordance with 40 *CFR* 273.38 [*OAC* 3745-273-38].	Preparation of universal waste for transport off site—**applicable**	40 *CFR* 273.38(c) *OAC* 3745-273-38(C)
	Off-site shipments to a foreign destination must comply with requirements applicable to a primary exporter in *OAC* 3745-52-10, 3745-52-53, 3745-52-56 and 3745-52-57 and export waste only upon consent of the receiving country and in conformance with the EPA "Acknowledgement of Consent" as defined in *OAC* 3745-52-50 to 3745-52-57. A copy of the consent must be provided to the transporter.		40 *CFR* 273.40 *OAC* 3745-273.40
Transportation of used oil off site	Except as provided in paragraphs (a) to (c) of 40 *CFR* 279.24 [*OAC* 3745-279-24(A) to (C)], generators must ensure that their used oil is transported by transporters who have obtained EPA ID numbers.	Preparation of used oil for transport off site—**applicable**	40 *CFR* 279.24 *OAC* 3745-279-24
Transportation of asbestos-containing waste materials off site	For asbestos-containing waste material to be transported off the facility site, label containers or wrapped materials with the name of the waste generator and location at which the waste was generated.	Preparation for transport of asbestos-containing waste materials off site—**applicable**	40 *CFR* 61.150(a)(1)(v) *OAC* 3745-20-05(C)(1)
	Mark vehicles used to transport asbestos-containing waste material during the loading and unloading of waste so that the signs are visible. The markings must conform to the requirements of 40 *CFR* 61.149(d)(1)(i), (ii), and (iii).		40 *CFR* 61.150(c) *OAC* 3745-20-05(E)

Action	Requirements[a]	Prerequisite	Citation
Transportation of hazardous materials off site	Any person who, under contract with a department or agency of the Federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material, shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 *CFR* 171 – 180 related to marking, labeling, placarding, etc.	Preparation for transport or shipment "in commerce" of a hazardous material—**applicable**	49 *CFR* 171.1(c)

ACM = asbestos-containing material
ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
CMBST = combustion
CWA = Clean Water Act of 1972
DEACT = deactivation
DFF&O = *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*
DOE = U.S. Department of Energy
DOE M = Radioactive Waste Management Manual
DOT = U.S. Department of Transportation
EDE = effective dose equivalent
EPA = U.S. Environmental Protection Agency
HMR = Hazardous Materials Regulations
HMTA =Hazardous Materials Transportation Act of 1975
ID = identification
LDR = land disposal restriction
LLW = low-level (radioactive) waste
LPP = LATA/Parallax Portsmouth, LLC
MVAC = motor vehicle air conditioning
NACE = National Association of Corrosion Engineers
NPDES = National Pollutant Discharge Elimination System
OAC = Ohio Administrative Code
Ohio EPA = Ohio Environmental Protection Agency
PCB = polychlorinated biphenyl
POLYM = polymerization
PORTS = Portsmouth Gaseous Diffusion Plant
POTW = publicly owned treatment works
RACM = regulated asbestos-containing material
RC = Ohio Revised Code
RCRA = Resource Conservation and Recovery Act of 1976
RORGS = recovery of organics
TBC = to-be-considered
TSCA = Toxic Substances Control Act of 1976
UST = underground storage tank
UTS = universal treatment standards
WAC = waste acceptance

APPENDIX C: ENGINEERING STUDY OF PROCESS BUILDING EQUIPMENT SUBSIDENCE AVOIDANCE PROCESS OPTIONS

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TABLES

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ACRONYMS

BNFL	British Nuclear Fuel Limited
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
FS	Feasibility Study
FY	fiscal year
HEPA	high efficiency particulate air
LLW	low-level (radioactive) waste
NDA	nondestructive assay
ODOT	Ohio Department of Transportation
OSDC	on-Site disposal cell
PORTS	Portsmouth Gaseous Diffusion Plant
RI	Remedial Investigation
WAC	waste acceptance criteria
WBS	work breakdown structure

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The purpose of this appendix is to evaluate disposal landfill subsidence avoidance process options to support the technology screening phases of the Feasibility Study (FS) for the decontamination and decommissioning (D&D) of the large radiologically contaminated equipment in the process buildings and the FS for the waste disposition decision at the Portsmouth Gaseous Diffusion Plant (PORTS) in Piketon, Ohio. Radiologically contaminated process equipment is expected to represent the highest radiological hazards to PORTS workers and off-PORTS receptors during D&D. However, as a result of their design, they may also represent a significant technical issue for proper design and operation of disposal facilities because of the large void fractions internal to the equipment. This evaluation is conducted in the event that waste acceptance criteria (WAC) require the generating projects to control void spaces in or degradation of their waste to mitigate long-term subsidence. This document addresses subsidence avoidance process options for the process equipment and is primarily oriented toward converters and compressors. Both the Waste Disposition and Process Building FSs will use results from this study.

C.1. INTRODUCTION

The U.S. Department of Energy (DOE) is evaluating waste disposition options for up to 1.47 million cy of primarily low-level (radioactive) waste (LLW) anticipated to be generated at the PORTS Facility[1]; 272,000 cy of this volume is process gas equipment. This analysis only addresses the volumes of major equipment from the X-330 and X-333 Buildings that are assumed for on-Site disposal (219,000 cy, of which 154,000 cy are process converters). These converters are assumed in the overall evaluation to be segmented and the nickel removed for future disposition; however, the original in situ volume of 154,000 cy is used for this analysis. Another 53,000 cy (approximately 24 percent) are compressors from the X-330 and X-333 buildings, and 12,000 cy (5.5 percent) are other process gas equipment from these buildings (surge drums and recycle coolers). These three components represent one of the largest, and the most highly contaminated, waste streams requiring disposal under this remedial action.

C.2. SCOPE AND OBJECTIVES

The gaseous diffusion enrichment process equipment is among the largest waste streams expected to be disposed in a potential on-Site disposal cell (OSDC), and the anticipated waste volume for on-Site disposal is approximately 219,000 cy of original equipment. The designs of the process equipment result in significant internal voids. The radioactive contamination inside the equipment and the size of the equipment present a technical challenge, if the disposal facility requires that the disposed waste be controlled in some fashion to control subsidence at the disposal facility. This study evaluates process options to avoid subsidence at a potential OSDC. These options involve eliminating the void space by destructing the equipment, filling the voids in the equipment with a suitable material, or protecting the equipment from corrosion and subsequent degradation. This study does not address options that could be applied to OSDC design or operation to address subsidence concerns.

As remedial decisions, cell design, the WAC, and characterization information matures into a final plan, it is expected that different process options may be selected or not even be needed. This study identifies the representative process options that will be used in the FSs to allow a consideration of the impacts such a requirement may impose.

[1]These waste volumes represent uncontainerized waste with no adjustments for expansion or compaction.

The following addresses the initial scope assumptions for this evaluation. Equipment considered is as follows:

- X-330 converters and compressors-Though the converters will be disassembled and segmented to recover the nickel, the original in situ volume will be included in this analysis for comparison of alternatives.
- X-333 converters and compressors-Though the converters will be disassembled and segmented to recover the nickel, the original in situ volume will be included in this analysis for comparison of alternatives.
- Size reduction of process piping will not be evaluated. It will be demolished with the building and size-reduced with the other building steel.
- Other process equipment (e.g., recycle coolers and surge drums) is similar to the converters and compressors so that subsidence avoidance process options can be extrapolated to them.

If any process gas equipment requires disassembly to remove materials, then the logical process at that point is to continue and segment the equipment into pieces to prevent voids during disposal.

Table C.1 describes the quantities of process equipment being evaluated in this document.

Table C.1. Process Equipment at PORTS

Building	Equipment	Type (Designators)	Quantity[1]
X-333	Converter	X-33 or 000	652
	Compressor	X-33 or 000	655
	Recycle Coolers	000 Trane and Koven	82
	Surge Drums	8 ft × 40 ft and smaller	44
X-330	Converter	X-31 or 00 Sizes 4/5/7	511
	Converter	X-29 or 0 Sizes 0 thru 5	621
	Compressor	X-31 or 00	509
	Compressor	X-29 or 0	600
	Recycle Coolers	000 or 00 York	52
	Recycle Coolers	0 2X	60
	Surge Drums	8 ft × 40 ft (and smaller)	82

[1]Quantities are from Mass Flow Commodity Quantities. Some quantities are uncertain because the specific types for spare equipment are not known.

Table C.2 provides the nominal weight and installed volume of each component. There is void space associated with each type of equipment.

The readily accessible voids associated with the converters are the inlet and outlet pipes around the outside of the cooler and the outside of the barrier bundle. Inaccessible voids are inside the flow transitions, barrier tubes, cooler tubes, and the cooler inlet and outlet pipes.

Table C.2. Parameters of Process Equipment at PORTS

Building	Equipment	Type (Designators)	Component Weight (lb) Each	Component Volume (cy) Each
X-333	Converter	X-33 or 000	67,514	152.1
	Compressor	X-33 or 000	37,552	57.8
	Recycle Coolers	000 Trane and Koven	8,211 average	19.6
	Surge Drums	8 ft × 40 ft and others	17,347	67.5
X-330	Converter	X-31 or 00 Sizes 4/5/7	21,561	55.0
	Converter	X-29 or 0 Sizes 0 thru 5	16,656	42.7
	Compressor	X-31 or 00	14,152	28.2
	Compressor	X-29 or 0	14,835	28.2
	Recycle Coolers	000 or 00 York	8,403	5.2
	Recycle Coolers	0 2X	2,900	5.2
	Surge Drums	8 ft × 40 ft and others	17,421	67.9

Note:
Parameters are from Mass Flow Commodity Quantities.

The accessible voids in the compressor are the space between the stator and shell, the space between the rotor and stator where the blades are, and all of the nozzles. The inaccessible voids are the interior of the rotor and the ends of the rotor adjacent to the seals.

The accessible voids of the recycle coolers are inside the shell and process inlets. The inaccessible voids are inside the cooler tubes and the cooler inlet and outlet pipes.

Surge drums are nickel-plated steel tanks with inlet and outlet process pipes. The interior is empty and all voids are accessible.

Table C.3 presents a summary of the void spaces in the various process equipment items being evaluated in this study.

The void fractions above are conservative for two reasons. First, some components' volumes are determined here by simple maximum length, width, and height, and do not take into account irregularities and dimension changes that would reduce the volume. Second, some items inside the equipment (e.g., cooler tubes, impellers, bellows) may have the materials of construction and structural integrity to withstand the disposal facility stresses without collapse, and thus could potentially be exempted from any future potential requirement for void filling in the WAC.

Table C.3. Void Space in Process Equipment at PORTS

Building	Equipment	Type (Designators)	Void Fraction (%)
X-333	Converter	X-33 or 000	96
	Compressor	X-33 or 000	88
	Recycle Coolers	X-33 or 000	97
	Surge Drums	8 ft × 40 ft	98
X-330	Converter	X-31 or 000	95
	Converter	X-29 or 00	96
	Compressor	X-31 or 00	90
	Compressor	X-29 or 0	90
	Recycle Coolers	000, 00, or 0	93
	Surge Drums	8 ft × 40 ft	98

C.3. PROCESS OPTION DESCRIPTIONS

Subsidence avoidance process options are grouped: (1) segmenting the equipment uniquely or prior to a secondary treatment step to make the equipment void disappear (all surfaces available for fill placement), (2) filling the equipment voids with material compatible with potential future WAC of the disposal facility, or (3) protecting the equipment from degradation for the design life of the facility. Segmentation process options before or during demolition include:

- Cutting into pieces/shapes capable of bulk disposal
- Shearing into pieces/shapes capable of bulk disposal
- Cutting or disassembling to fit into a compactor to prevent subsidence
- Cutting or disassembling to fit into a shredder to prevent subsidence
- Cutting or disassembling to fit into a melter to prevent subsidence.

Void-filling process options to prevent subsidence without segmentation include:

- Foaming with an approved dense foam in situ, at a intermediate foaming station, or at the disposal facility

- Sand or other dry solid media fill at the disposal facility

- Low-density grout fill at the disposal facility.

Subsidence avoidance process options to prevent subsidence through corrosion inhibition include:

- Surrounding the equipment with concrete fill
- Applying corrosion resistant external fixatives.

C.3.1 COMMON ELEMENTS

During the evaluation of these various options, there are some common elements that will be part of the cost estimate to give an accurate reflection of program-level cost impacts. In all cases, some equipment cutting is needed prior to removal of hold-up material or to remove the equipment from the buildings. Then a capping process is used to prevent the spread of contamination after cutting. Finally, the equipment is moved to a shop for further segmentation, a storage area for additional subsidence avoidance efforts, or the disposal facility where some subsidence avoidance efforts may be used. The following process option discussion highlights the common elements that are used in the cost estimate for each subsidence avoidance process option.

Air carbon arc cutting, previously known as air arc cutting, is an arc-cutting process where metal is cut and melted by the heat of a carbon arc. Molten metal is then removed by a blast of air. It employs a consumable carbon or graphite electrode to melt the material, which is then blown away by an air jet. It is the current method used at PORTS to remove equipment that has welded flanges.

Plasma is a process used to cut steel and other metals of different thicknesses (or sometimes other materials) using a plasma torch. In this process, an inert gas (in some units, compressed air) is blown at high speed out of a nozzle; at the same time an electrical arc is formed through that gas from the nozzle to the surface being cut, turning some of that gas to plasma. The plasma is sufficiently hot to melt the metal being cut and moves sufficiently fast to blow molten metal away from the cut. Plasma is currently used at PORTS for cutting pipe and welds where reinstallation preparation will be needed.

Oxy-acetylene is a process that uses a cutting torch to heat metal to kindling temperature. A stream of oxygen is then trained on the metal. The metal burns in that oxygen and then flows out of the cut as an oxide slag. This process requires both fuel and oxygen tanks. It cuts at approximately the same speed as arc air, but tank change outs result in a lower effectiveness. Slag, gases, and fumes are also considerable. Historically, oxy-acetylene cutting has been used extensively in cutting operations at PORTS, although less often on process equipment.

Mechanical cutting is a process where machinery (e.g., circular or reciprocating saws) is used to cut out equipment. Localized heating is much less than with hot cutting. It is much slower than hot cutting, and the in-hand equipment is much heavier for manual cutting (mechanized setup and cutting is generally not feasible for gaseous diffusion equipment). Shards are minimal and gases and fumes are nonexistent. Mechanical cutting was used on the smaller K-25 equipment and piping in Oak Ridge, Tennessee, where limited equipment and piping were removed prior to demolition.

Plastic (3 to 7 mil thickness) and duct tape for capping of openings after cutting are most often used when contamination control is desired. There are minimal security concerns, and no structural strength is required for air or fill pressure on the opening. It is the most common method of capping currently employed at PORTS.

Sheet metal (14- to 18-gauge thickness) and two-part epoxy are used for capping when contamination control is required and some security concerns exist. Oftentimes, duct tape or clamps are used to allow setting of the epoxy. Generally, this process option is not applicable for grout or sand fill pressures on the openings, but it has been successfully used in sealing for foaming operations. This method is currently in use at the K-25 D&D Project in Oak Ridge.

The addition of a plate (1/8 to 1/4-in. thickness) with tack or seam welds is used to provide contamination control, security, and/or fill pressure effectiveness. In some instances, clamps and/or gaskets can be substituted for the welds. Large diameter plates may also require stiffening beams to withstand fill pressures. This method is currently in use at PORTS for sealing of equipment for security requirements or for subsequent pressurization of equipment.

Some segmentation and subsequent mining may occur to comply with a numerical or safety-based WAC. Converters would be removed by cleared workers, capped with plastic and duct tape (sheet metal or plates may be required if uncleared movers are employed), and moved by cart to the decontamination area. In a secure facility, special carts are employed to cut loose and hold the inlet head and outlet head with the cooler assembly. Then the barrier bundle is extracted from the center shell and the transition is removed. The heads and shell are inspected to determine if holdup is present. If holdup is present (not considered likely), then the subassemblies are moved for mechanical or wet decontamination of holdup.

Compressors may have the compressor seals removed in the process buildings before compressor removal by cleared workers, any visible holdup is removed from the seal cavity, and the cavity is sealed with a special bolted plate or sheet metal around the shaft. In situ nondestructive assay (NDA) may then be conducted to determine if further material removal is still required. If necessary, the compressor is then removed from the cell by cleared workers, closed with plastic and duct tape, and removed from the process building onto a cart. Uncleared workers transport the compressor to the decontamination area. The inlet and discharge nozzles are removed, and the rotor and stator are removed from the compressor body. Visible holdup is removed by mechanical scraping or by wet decontamination.

C.3.2 SEGMENTATION SUBSIDENCE AVOIDANCE OPTIONS

The segmentation subsidence avoidance options are as follows:

Segmentation to a Small Size. This process option uses the cutting techniques discussed above to continue disassembly of the equipment to remove material sufficiently to meet the WAC of a disposal facility. In this process option, future potential WAC are met by reducing the size of the residual pieces of the equipment. In general, pieces of waste no larger than 4 ft in length are anticipated.

Shearing In Situ. Shearing is used to significantly avoid subsidence by cutting equipment and piping in the field. It also crushes the equipment together to some extent and achieves some further void reduction in this manner. Special equipment is required to shear process equipment of this size, and this can result in a technology limitation because of the size of tracked equipment that can be effectively used. Shear throat sizes of 18 to 24 in. are achievable, and designs that punch through equipment metal to allow cutting in the throat can be obtained. This process option was successfully used to shear smaller diameter process piping (up to 12-in. diameter), centrifugal compressors, and structural steel during demolition of the K-25 Building in Oak Ridge.

Compaction. Compaction is often coupled with an initial shear or segmentation to facilitate the process. This process option was successfully used by British Nuclear Fuel Limited (BNFL) in the processing and disposition of process equipment from the K-29, K-31, and K-33 buildings in Oak Ridge. Compaction opening size (throat) and high efficiency particulate air (HEPA) filtration are factors affecting cost and operations, as well as the need for separate compactors if classified components are to be processed. Delivery of the subassemblies or sectioned subassemblies to the compactors requires additional movement equipment (carts, conveyors, or wheeled handling equipment). Compacted materials require transfer to conveyances, depending on the requirements of the disposal path, perhaps requiring additional movement equipment. Most of these conveyances become weight-limited rather than volume-limited for transportation. Not all equipment or subassemblies benefit from compaction.

Shredding. Equipment subassemblies could be fed to commercial shredders specially modified to handle radioactive materials by the addition of HEPA filters and ductwork to control airborne contamination. Equipment cost is primarily a factor of shredder opening size (throat) and power (metal types and thicknesses). Larger throat sizes require higher capacity HEPA filtration, so there is a tradeoff between shredder size and the need to further segment subassemblies, although perhaps not to the extent for waste packaging/void avoidance. Security concerns may also require a minimum of two shredders to process the classified waste separately from the remainder of the process equipment. Delivery of the subassemblies or sectioned subassemblies to the shredders requires additional movement equipment (e.g., carts, conveyors, or wheeled handling equipment). Shredded materials are collected in hoppers and require transfer to conveyances, depending on the requirements of the disposal path. Not all subassemblies benefit from shredding. Curved steel plate may actually result in fewer voids than shredded plate. Cooler and barrier tube shredding would reduce the voids for these subcomponents. Although separated from the equipment, they meet the future potential WAC of the disposal facilities because of their small diameters.

Melting. This process option eliminates voids in the equipment and produces ingots that are volumetrically contaminated. As with the other process options, melters require some additional segmentation of subassemblies so they can be placed in the melter. At the melter, special handling equipment is necessary to load and unload them. Slag (more highly contaminated) is either added to the melted material or segregated as a separate waste stream. After cooling, the ingots are placed into conveyances, depending on the requirements of the disposal path. Most of these conveyances would become weight-limited rather than volume-limited for transportation.

C.3.3 SUBSIDENCE AVOIDANCE WITHOUT SEGMENTATION AND SIZE REDUCTION (VOID FILLING)

Subsidence avoidance without segmentation or size reduction occurs through the introduction of inert materials of sufficient strength to withstand disposal facility waste and cap pressures after the process equipment external shell has degraded (oxidized) to the point that structural integrity is lost. The amount of necessary subsidence avoidance is a function of the design and future WAC at the disposal facility. This is still indeterminate for any potential OSDC. Using the component weights and volumes in Table C.2 and assuming all materials are the density of steel, rough total void fractions are provided in Table C.3. If needed, these void fractions will be refined with more accurate weight and volume determinations, based on materials of construction in the D&D design phase. However, for now, they are conservatively suitable for process option discussions concerning subsidence avoidance.

Three media are considered for void-filling of the PORTS process equipment, low-density grout, dry sand, or high-strength foam. Of the three, only the foam option is considered feasible for all of the equipment at a location remote from the disposal facility because of the weight gains associated with the other process options. Introduction of sand and grout is assumed to occur at a potential OSDC. The three media and their use are described in the following paragraphs:

High-density Foam. High-density foam such as isocyanate foams can be used to fill the voids in the process equipment. These foams are injected as two relatively nonviscous liquids that rapidly react and expand into a hard, solid matrix that has a density of approximately 135 lb/cy. Foaming requires commercial foam injection equipment, and injection occurs in nominally 2-ft lifts to allow the material below to react and harden. The injection equipment is portable, and hoses with mixing guns are used to inject the foam. The liquids are generally supplied in drums or slightly larger totes, which are delivered by truck or forklift. As with the grout (and sand), the same numbers of holes or ports are used for introduction, the viscosity prevents some voids from being reached (although the expansion does assist), the converter security requirements remain, and contamination control with HEPA is likewise needed.

Foaming at the point of generation is a possibility because of the relatively low weight density, the equipment required, and the method of introduction. During the K-25 Building D&D, it was successfully used in the cell enclosures for void reduction in Size 3 and 4 converters (nominally the size of the X-326 converters). Two sub-options are foaming after cutting and capping the process equipment and foaming before cutting and capping. Because of combustibility, foaming cannot be used where hot cutting techniques are employed. Therefore, if foaming occurs before cutting the equipment, piping is foamed also and mechanical cutting becomes the only alternative for removal. Foaming also has nuclear safety analysis ramifications. If a building fire is a credible nuclear accident scenario, one of the foam components is combustible, and this could cause a limit to the amount of foam inventory allowed in the facility. The operations and equipment may also be subject to nuclear safety controls dictated by the analysis.

Sand. Sand may be used from the top to fill the voids in the process equipment. Dry sand has a nominal density of 2,700 lb/cy and flows into a relatively compact form that does not compress or settle significantly. In order to introduce the sand, all openings in the process equipment must be capped with plates capable of withstanding static pressure from the sand during curing, which can be several hundred pounds per square foot of opening. This generally requires the welding-on of steel plates, or they can be tack-welded or clamped with compressed gaskets. This is assumed to occur during equipment removal from the process buildings. Three types of sand introduction are possible, gravity pour, augered, or pumped. This requires openings or ports on the top (or side near the top) of the equipment at each location where the equipment is sectioned off by the internal components. The sand introduction phase may require some method of contamination control to prevent airborne contamination from exiting the opening and contaminating the equipment or personnel. Generally, this is provided by localized portable HEPA systems. Security controls and cleared workers are also required when accessing a converter for the introduction of sand. Sand may be added at a disposal facility transfer area, at the disposal area face, or inside the disposal area. Each of these options is feasible, but adding sand outside of the disposal area requires heavy duty carts and cranes or other heavy lifting equipment to place the equipment. Sand filling is expected to be slower than grout introduction, and it is not expected to fill as much void space as grout. Dry sand does pose a storage problem prior to use, and silica can be a worker health hazard. An alternative to sand introduction at the potential OSDC could be preparation of the equipment so sand or compact gravel could be placed in its voids after placement of the equipment in the disposal facility. While this is not a viable process option for converters or centrifugal compressors, it could be employed by placing axial compressors with their nozzles in the vertical position, filling around the body, and then filling the nozzles with sand or gravel that will self-compact. A similar technique may be applicable to some models of the recycle coolers.

Low-Density Grout. Grout with a sufficient compressive strength to meet future potential WAC requirements could be introduced into the tops of the process equipment to fill voids. Generally, grout densities of 500 to 3,000 lb/cy can be formulated to provide strengths equal to or greatly exceeding 50 lb/sq ft. Robust opening caps are needed, as with sand, and the security concerns and need for cleared workers remain. The methods of movement or introduction at the disposal facility remain as with the sand. Once again, HEPA ventilation for contamination control may be required. Mixtures with low viscosity can be produced to maximize infiltration of voids. Grout could be mixed at PORTS or purchased for delivery. On-PORTS mixture requires materials storage, expertise in mixing equipment and technology, procedures, and quality assurance programs. Grout filling has been successfully used for some equipment (e.g., centrifuge casings) at the Environmental Management Waste Management Facility in Oak Ridge.

C.3.4 SUBSIDENCE AVOIDANCE THROUGH CORROSION INHIBITION

The design of the process equipment is expected to be able to withstand the soil pressures of the disposal facility without significant deflection or subsidence, although this will have to be technically verified.

The process equipment exterior surfaces are mild steel and will be subject to oxidation corrosion and slow structural degradation, eventually resulting in deflection and subsidence. If this corrosion could be arrested for the life of the disposal facility, then subsidence of the cap could be avoided. Based on highway structure designs and testing, two methods of significantly arresting mild steel corrosion is immersion in concrete rubble or application of noncorrosive protective coverings to the steel. These two process options are described as follows:

Surround with Concrete Fill. This process option can be performed if a supply of concrete fill is available during placement of the process equipment. Depending on how the equipment is placed in the disposal facility, approximately 100,000 to 150,000 cy of concrete fill would be necessary to surround the 219,000 cy of process equipment (assuming all placed without void reduction). Placement would begin with a lift of concrete fill; then placement of the process equipment; then buildup around the equipment with concrete fill, eventually filling up, over, and between the equipment with concrete; and finally a compacted lift of concrete fill above the equipment so another layer of equipment could be placed.

Corrosion-Resistant Exterior Fixatives. Fixatives similar to those used in highway structure designs could be applied to the exterior of the process equipment, forming an impervious barrier to moisture and oxidation of the steel. Application would be by brush or spray, depending on the thickness of application. Normal waste fill or procured fill could then be placed around and between the equipment as with the previously discussed concrete fill.

C.4. PROCESS OPTION EVALUATION DISCUSSION

The following discussion evaluates the effectiveness, implementability, and cost of the various subsidence avoidance process options. Effectiveness evaluates the capability of the process option to reduce disposal facility subsidence through elimination of void from the process equipment, reducing the void in intact equipment by filling it to the extent reasonable with a material that can withstand disposal facility fill pressures, or protecting the equipment from oxidation and subsequent structural degradation. Implementability addresses maturity and acceptability of the processes in comparison to current equipment, facilities, and resource experience. It highlights any significant implementation challenges or schedule impacts. It also addresses the impact of the process option on the size of the disposal facility. Health and safety issues are also discussed under implementability.

The cost evaluation presents capital costs of the entire process equipment removal, treatment, and transportation effort for on-Site disposal, including the cost of the subsidence avoidance process option. Disposal costs assuming on-Site disposition are included. The cost estimates are used only for technology screening and are not used in the detailed analysis of alternatives. More detailed estimates are used at that phase of the project. The first cost estimate on segmentation is considered the baseline case, and it assumes removal and size reduction of the X-330 and X-333 converters and compressors. Estimates from other studies have been used as available, either directly or parametrically, for the changes to each estimate brought about by differing subsidence avoidance process options. If no existing estimates exist, then an estimate has been formulated and the basis of the estimate is documented.

C.4.1 SEGMENTATION TO SMALL SIZE

Segmentation Effectiveness – Good. Disassembly and cutting up of the process equipment renders the equipment very similar to the size reduced steel waste from building demolition (e.g., structural steel, nonprocess piping) and allows it to be dumped and placed in a manner similar to that of the building waste in a potential OSDC. As with building waste, it allows mixing at the disposal point with either soil,

soil-like waste (e.g., rubblized concrete, roofing materials), or fill to meet landfill requirements. Similar to other building waste, there would be short lengths of intact tubing and curved steel surfaces that might cause localized voids (depending upon final orientation), but these would be dispersed through the disposal facility with the other waste. Thus, differential subsidence because of localized large voids would not occur.

Segmentation Implementability – Good. Existing equipment, procedures, and resources have been used to perform very similar work at PORTS in the recent past during pre-D&D activities in the X-705, X-700, and X-720 buildings. These existing buildings, and the existing processes and equipment they contain, are considered viable for executing this process option and likely represent the process option with the least impact to starting work. This process option is planned to be used to remove material from the interior of process equipment to meet the numerical WAC of any disposal facility, or to meet transportation limits for off-Site transport. Thus, this process option is expected to be implemented for some of the process equipment without respect for subsidence avoidance. It does allow segregation and reduction of classified materials, reducing the impact and size of this unique waste stream.

Segmenting the equipment is expected to reduce the total volume of process equipment waste in the cell from approximately 219,000 cy (the equipment volume for X-330 and X-333 converters and compressors) to approximately 60,000 to 70,000 cy, or perhaps less (i.e., about a 12 percent reduction in total waste volume for D&D). The 219,000 cy excludes the intact X-326 converters and compressors.

The major issue with segmenting the process gas equipment is that the removal, moving, and processing of all the equipment (piece-by-piece) is very labor-intensive and slow. It may impact the overall D&D schedule (likely it would be critical path to process building D&D startup). The size of the equipment and a significant contamination exposure potential for workers during removal and size reduction all contribute to potential safety issues for the workers. Processing the equipment requires double handling (movement and lifting) of the equipment and causes significant security concerns in dismantling and handling the classified components in the equipment. Staging areas would be required for classified and unclassified equipment and processed waste containers. Depending on the final sizing of the waste, new fixtures, containment systems, and movement equipment may need to be designed and fabricated.

Segmentation Cost. The costs for this process option are reasonably well understood, given that it has been estimated using the methods used for estimating the FS alternatives. The major costs of the segmentation-to-small-size process option are as follows:

1. Removal (X-330 and X-333 equipment)	$38.0 million
2. Movement (X-330 and X-333 equipment)	$5.7 million
3. Disassembly and segmentation systems (X-330 and X-333 equipment) capital and operating cost	$123.5 million
4. Disposal facility capital and operating cost (including trucking) for 66,000 cy	$59.7 million
Total Capital Costs	**$226.8 million**

C.4.2 SHEARING IN PLACE

Shearing Effectiveness – Good. Shearing is applicable only to compressors after the seals are removed. Converters cannot be sheared at the demolition location because of classification issues, and they must be processed using one of the other process options (assumed for this analysis to be disassembly and segmentation). Shearing with machine-mounted equipment during demolition results in metal waste for disposal that is similar to the size-reduced structural steel of the buildings. This process option is somewhat superior because curved surfaces can be flattened and metals generally can be bent into more compact or conforming shapes, depending on the amount of processing in the field.

Shearing Implementability – Excellent. Shearing of the compressors involves a much less labor-intensive approach than segmentation and the process options discussed below because of its dependence on heavy equipment. Shearing of the process equipment would use essentially the same mobile heavy equipment and shears used to process structural steel and would let the majority of the size-reduced process equipment be mixed with the building waste for shipment. This process option could reduce the labor and time (perhaps significantly) for cutting and removing the compressors from the field because it could occur during building demolition and use the same equipment. This could result in an earlier start of building demolition because process equipment removal and processing is expected to be the critical schedule driver of process building D&D. Shearing has a significant safety benefit. It removes many workers from the safety risks of cutting, moving, and segmenting the compressors. This process option would not be applicable to converters from X-330 and X-333. Because of security concerns, they would have to be segmented into disposable waste without the benefit of field shearing.

Implementing this process option during demolition would result in compressors being pulled down from the elevated cell floor along with all of the process piping and nonprocess equipment, piping, and structural steel. The primary concern is loss of contamination control and the potential spread of contamination through the storm drain system or dust migration. Commingling of these wastes is not expected to affect waste disposal, as both the process equipment and the structures are currently expected to be treated as LLW. Whether the process equipment is present or not, dust suppression techniques would be employed during demolition. Shearing of process equipment on the demolition location does increase the risk of contaminant migration to storm water. This technique was used during the K-25 Building west wing demolition, but with equipment foamed for contamination control and controlled shearing of process equipment. Also, storm water retention and storm grate filtration were employed for both particulate and contaminant control, although building radioactivity was not detected in either the storm water or the storm grates. No violations of storm water management requirements occurred because of radionuclide transport. There were pH violations resulting from incorrect gravel placement. This is attributed in part to the large amount of concrete from the structure, which tended to immobilize any radioactive contamination flowing from the demolition area in surface waters.

In order to implement this process option, a fixative to immobilize the majority of residual internal contamination in the compressors is conservatively assumed to be necessary. Contamination fixation technologies such as CCFix® or CCWet® could be employed to spray accessible sections of the compressors after cutting from the process piping. Application techniques would have to be developed, but at present, it is assumed that the number of cuts could be reduced from the amount needed during implementation of the segmentation process options. Additional access holes for the compressors would be necessary to allow the maximum feasible coverage inside the equipment.

Shearing of the compressors (with segmentation for the converters) is expected to reduce the total volume of process equipment waste in the cell from approximately 219,000 cy (as is equipment volume) to approximately 60,000 to 70,000 cy, or perhaps less, waste truck volume (i.e., about a 12 percent reduction of total waste volume for D&D). For this analysis, it was assumed that the compressors would be sheared to the same extent that converters are segmented in the segmentation shop (a volume reduction factor of 3.3).

Shearing in place at PORTS is a new process option, at least for the large process equipment D&D, which would require specialty fabrication of shearing fixtures, equipment operations training, readiness evaluation, and new procedures for safety and quality documentation.

Shearing Cost. Costs for this process option are based on shearing efforts implemented with the building structure demolition shearing (with a percentage increase to the average for the heavier work). This process option is considered to be well developed, consisting of techniques used in other contaminated D&D projects throughout the country. The major costs of shearing in place of compressors and using segmentation for removed converters are as follows:

1. Removal (X-330 and X-333 converters) and fixing with CCFix® (X-330 and X-333 compressors)	$41.1 million
2. Movement (X-330 and X-333 converters)	$4.0 million
3. Disassembly and segmentation systems (X-330 and X-333 converters) capital and operating cost	$90.5 million
4. Shearing of X-330 and X-333 compressors in place	$8.5 million
5. Disposal facility capital and operating costs, including trucking for 66,000 cy	$59.7 million
Total Capital Costs	**$203.7 million**

C.4.3 COMPACTION

Compaction Effectiveness – Very Good, Slightly Superior to Segmentation. Compaction starts with the same process of disassembly and segmentation as the baseline process option, but only segments to the point the waste can fit into the compactor(s). This process option is superior because curved surfaces are flattened, tubing is flattened or crushed, and metals are generally bent into more compact or conforming shapes. Compaction was successfully used on the K-31 and K-33 equipment removal project in Oak Ridge.

One uncertainty is the loss of compaction during placement in the disposal facility. Crushed groupings of metal may separate to some extent, depending on the equipment used to place the waste in the disposal facility (e.g., bulldozers). Also, tightly packed groupings may affect the ability to surround them with soil-like waste or fill. This could be exacerbated if bulldozer placement of waste is used, less so with front end loader placement. But if this process option is extensively used, then the suspected subsidence avoidance is expected to be quite uniform and significantly less than placement of whole equipment.

Compaction Implementability – Fair. This process option relies significantly on the disassembly and segmentation process option for implementation. It has one process advantage. Depending on the compactor design, it could somewhat reduce the segmentation effort (although not disassembly). A compactor design with shearing capabilities, similar to the one used in the BNFL process, would reduce hot work cutting. Compaction does introduce an additional handling process to move the disassembled and partially segmented materials to the compaction operation.

This process option would not be applicable to converter bundles from X-330 and X-333. They would have to be segmented to disposable waste without benefit of compaction because of security concerns.

Use of compaction is expected to reduce the total volume of process equipment waste in the cell from approximately 219,000 cy (as is equipment volume) to approximately 40,000 to 50,000 cy, or perhaps less (i.e., about a 13 percent reduction of total waste volume for D&D).

Compaction is a new process option at PORTS, requiring design, fabrication, construction, testing and checkout, training, and readiness evaluation. New procedures, safety documents, and quality documents would have to be written. Safety risks would change and may actually improve, based on the BNFL success with compaction, over complete hot work segmentation of the equipment. There may be significant schedule delays for construction of the compactor and when the compactor is not operational.

Compaction Cost. Costs for compaction are reasonably well understood; components of which have been estimated by DOE in Critical Decision-1 for budgetary as well as regulatory purposes. The major costs of compaction with some segmentation are as follows:

1. Removal (X-330 and X-333 equipment)	$38.0 million
2. Movement (X-330 and X-333 equipment)	$5.7 million
3 Disassembly and segmentation systems (X-330 and X-333 equipment) capital and operating cost, including full size reduction of converter bundles	$120.1 million
4. Compaction capital and operating cost (including movement)	$15.3 million
5. Disposal facility capital and operating costs (including trucking) for 45,000 cy	$40.7 million
Total Capital Costs	**$219.7 million**

C.4.4 SHREDDING

Shredding Effectiveness – Very Good, Slightly Superior to Segmentation and Compaction. This process option is beneficial because large metal components are reduced to shards of metal that can be placed in a landfill, easily mixed with soil-like waste or fill, and compacted. The expected subsidence is expected to be quite uniform and significantly less than for placement of whole equipment.

The only detriment to the effectiveness of this process option is that the large plate steel in the equipment may actually increase in volume from the previous two process options. The significance of this increase is dependent on the shredded shard shape and size. Partial segmentation of the equipment is still needed prior to feeding the waste into the shredder.

Shredding Implementability – Fair. Shredding relies significantly on disassembly and segmentation, but only to the extent required to access the shredder(s). Shredding could, depending on the shredder design, somewhat reduce the segmentation effort (although not disassembly). The shredder throat size would be crucial in determining the extent of segmentation required. This study assumes that some additional segmentation beyond that required for direct disposal is required for shredding.

This process option could be applicable to process converter bundles from X-330 and X-333. A smaller dedicated unit could be employed to shred partially segmented bundles and barrier to disposable waste. The shredding and landfill placement of this waste would require security controls (e.g., controlled processing area, sacrificial containers or supersacks, cleared workers).

As with compaction, shredding is expected to reduce the total volume of process equipment waste in the cell from approximately 219,000 cy (as is equipment volume) to approximately 30,000 to 40,000 cy, or perhaps less (i.e., about a 14 percent reduction of total waste volume for D&D).

Equipment shredding at PORTS is a new process option, requiring design, fabrication, construction, testing and checkout, training, and readiness evaluation. New procedures, safety documents, and quality documents would have to be written. Safety risks would change and are uncertain because of the additional handling and process steps that shredding would add. As with compaction, there is a potential for schedule delays resulting from design and construction of the facility and potential facility or equipment failure.

Shredding Cost. Costs for shredding are reasonably well understood. The capital and operating costs of the shredding operation have been evaluated as a recycling process option. The major costs of the shredding process option are as follows:

1. Removal (X-330 and X-333 equipment)	$38.0 million
2. Movement (X-330 and X-333 equipment)	$5.7 million
3. Disassembly and segmentation systems (X-330 and X-333 equipment) capital and operating cost	$126.9 million
4. Shredding capital and operating cost (including converter bundles)	$24.6 million
5. Disposal facility capital and operating cost (including trucking) for 35,000 cy	$31.6 million
Total Capital Costs	**$226.8 million**

C.4.5 MELTING

Melting Effectiveness – Excellent, Superior to Segmentation, Compaction, and Shredding. This process option is beneficial because large metal components are reduced to ingots that can be placed in a landfill, easily surrounded with soil-like waste or fill, and compacted. The expected subsidence avoidance is the ultimate that is achievable and significantly less than for placement of whole equipment. As with compaction and shredding, partial segmentation is needed prior to waste entering the melter.

Melting Implementability – Fair. Melting relies significantly on disassembly and segmentation and requires a significant new process option never utilized at PORTS. It starts with the same process of disassembly and segmentation as the baseline process option, but stops the segmentation at a point that depends on the size and capabilities of the melter(s) employed. As with the shredding, it is currently assumed that segmentation for melting would result in more cutting than the direct disposal alternative. The melter capacity/entrance size would be crucial in determining the extent of segmentation required.

This process option could be applicable to process converter bundles from X-330 and X-333 with the addition of security controls. A smaller dedicated unit could be employed to melt partially segmented bundles and barrier to disposable waste that has little or no security requirements.

Melting is expected to reduce the total volume of process equipment waste in the cell from approximately 219,000 cy (as is equipment volume) to approximately 10,000 to 20,000 cy (i.e., about a 16 percent reduction of total waste volume for D&D).

Equipment melting at PORTS is a new process option requiring design, fabrication, construction, testing and checkout, training, and readiness evaluation. New procedures, safety documents, and quality documents would be needed. Safety risks would change, but they are uncertain at this time because of the uniqueness of the process option and the additional handling and processing steps that melting would add. Depending on the design and operation of the melter(s), there is a risk of total or partial outages from unforeseen events. The risk of equipment failure is considered highest for this process option. Schedule risks and delays are also the highest for this process option because melter design and construction are anticipated to take several years.

Melting Cost. Costs for this process option are less certain, given the relatively new technology. The capital and operating cost of the melting operation has been evaluated as a recycling process option and has been reviewed. Specifically, the vacuum induction melting process option was used as a basis for a cost estimate. The major costs of the melting process option are as follows:

1. Removal (X-330 and X-333 equipment)	$38.0 million
2. Movement (X-330 and X-333 equipment)	$5.7 million
3. Disassembly and segmentation systems (X-330 and X-333 equipment) capital and operating cost	$130.4 million
4. Melting capital and operating cost (including converter bundles)	$325.1 million
5. Disposal facility capital and operating cost (including trucking) for 15,000 cy	$13.6 million
Total Capital Costs	**$512.7 million**

C.4.6 FOAMING

Foaming Effectiveness – Good. This process has the same effectiveness as grouting and is more effective than sand because of flowability. Foam is used by the K-25 D&D Project in Oak Ridge. Historically, it has effectively filled most of the void spaces in their process equipment, at least to the level required to meet a future potential WAC of the disposal facility. The foam does not appreciably enter the barrier and cooler tubes, and it does not reduce the process equipment volume in the disposal facility.

Foaming Implementability – Good. Foam is introduced after hot cutting of the process equipment to remove it from the building. Introducing foam before cutting would require mechanical cutting of the large process equipment to avoid a fire, but this is not considered to be feasible for the large equipment.

This process option has one advantage. It could allow compressor (but not converter) shearing during demolition, providing contamination control and allowing loading and movement with the other sheared building waste. Foam can also be introduced at the process buildings, which would avoid filling at the disposal facility. Lighter plates (or even sheet metal) could be used to seal the equipment after foaming, thus avoiding the heavier plates and attachment methods used with grouting and sand.

Foaming does not reduce the total in situ process equipment volume (219,000 cy) destined for the disposal facility.

Foaming Cost. Foam has some very significant material costs, although the capital cost of application equipment is considerably less than those for other process options. Costing for this process option assumes hot cutting of the equipment first. The costs also assume movement of the equipment to the disposal facility for burial without any further processing. The costs are as follows:

1. Cutting and removal and installation of plates, and foam injection and vent ports		$51.5 million
2. Foam in situ capital and operating cost		$145.2 million
3. Disposal facility capital and operating cost (including trucking) for 219,000 cy		$200.0 million
	Total Capital Costs	**$396.7 million**

C.4.7 SAND

Sand Effectiveness – Good. The introduction of dry, pourable, sand-like materials of sufficient structural strength into the equipment at the disposal cell would lessen subsidence upon equipment degradation and steel collapse. This process option, however, does nothing to reduce the overall process equipment volume placed in the disposal facility.

Sand Implementability – Good. The introduction of sand can occur during normal disposal facility operations, avoiding or minimizing additional moves for processing. The sand would be introduced at the disposal location because the weight of a sand-filled piece of equipment would make transport difficult. Sand filling is not as labor-intensive as the segmentation process options. It is applicable for both converters and compressors.

This process option has not been implemented during any DOE D&D activities, mainly because grouting process options have been considered to be superior because of flowability and weather considerations. Sand does require the installation of heavier plates to seal the equipment from the pressures of the sand. In addition, introduction of the sand requires the cutting of access ports in the equipment. Vent ports are also required, and contamination control filters must be attached. The sand needs to be kept dry, and implementing this process option would require covered storage areas and potentially dry weather operations only.

Placement of the equipment in the disposal facility could require additional equipment, depending on the location of the sand introduction. After placement, special efforts to fill and compact around the equipment would be necessary.

Sand Cost. Filling with sand has some significant material costs, but comparatively little capital cost for processing equipment. Costing for this process option assumes plates, pouring holes, and vent holes are installed during equipment removal. Placement would involve crane movement for the equipment. The costs are as follows:

1. Removal and installation of plates, and pouring and vent holes		$51.9 million
2. Sand capital and operating cost		$31.1 million
3. Disposal facility capital and operating cost (including trucking) for 219,000 cy		$200.2 million
	Total Capital Costs	**$283.2 million**

C.4.8 GROUTING

Grouting Effectiveness – Good. Introduction of grout materials with sufficient structural strength into the process equipment at the disposal cell would prevent subsidence indefinitely. This process option, however, does nothing to reduce the overall process equipment volume placed in the disposal facility.

Grouting Implementability – Very Good. Grouting can be implemented during normal disposal facility operations, and it could avoid or minimize additional equipment movement for processing. Grouting is not as labor-intensive as the segmentation process options. It is applicable to both converters and compressors.

Grouting does require the installation of heavier plates to seal the equipment from the pressures of the grout. Also, introduction of the grout requires the cutting of access ports in the equipment. Vent ports are also required, and contamination control filters must be attached. Cold weather grouting requires additional curing measures to assure solidification.

Placement of the equipment in the disposal facility could require additional equipment, depending on the location of the grouting. After placement, special efforts to fill and compact around the equipment would be necessary. Grouting operations at the disposal facility would also be somewhat weather dependent because grouting would cease during rain or snow events.

Grouting Costs. Grouting has some significant material costs, but comparatively little capital cost for processing equipment. Costing for this process option assumes plates, cutting of injection and vent holes during equipment removal, and grout injection (as opposed to gravity flow). Placement would involve crane movement for all equipment. The costs are as follows:

1. Removal, including installation of plates, injection ports, and vent ports	$51.9 million
2. Grouting capital and operating cost	$35.3 million
3. Disposal facility capital and operating cost (including trucking) for 219,000 cy	$200.0 million
Total Capital Costs	**$287.2 million**

C.4.9 SURROUND WITH CONCRETE FILL

Surround with Concrete Fill Effectiveness – Fair. The effectiveness of surrounding the process equipment with concrete fill is based on verification of two factors: (1) the ability of concrete fill to inhibit corrosion of the external steel surfaces for the design life of the disposal facility cap, and (2) the strength of the unfilled process equipment to withstand the structural pressures of the disposal facility. Surrounding with concrete does not reduce the total in situ process equipment and piping volume (219,000 cy) destined for the disposal facility.

Research shows that corrosion inhibition of concrete for oxidation of steel is significantly slower than for soils. If this slower reaction is more than a factor of 4 to 6, then it is possible for the process equipment encased in concrete fill to survive without rusting away and collapsing for the design life of the disposal facility cap.

Although the equipment strength would have to be confirmed with calculations, the cylindrical shapes of the major equipment are sufficiently similar to those of large corrugated piping (21 ft in diameter) tested at significant burial depths (up to 75 ft), which showed that the piping could potentially support the soil pressure with minimal deflection (< 5 percent) (Ohio Department of Transportation [ODOT] 2004).

Surround with Concrete Implementability – Fair. This process option's implementability is dependent upon a ready source of concrete fill, such as the concrete rubble from the process building floors and slabs. This presents a logistics problem because the process equipment would be available for burial and require staging in the process buildings well before the concrete is rubblized, at least for the first process building demolished. Concrete rubble from other demolished buildings could be used, but it would likely be deficient in quantity (nominally 10,000 - 25,000 cy would be required initially). It would also require a segregation effort to extract the concrete rubble from other D&D waste.

If available, this process option offers a direct equipment placement technique that avoids all specific processing and movements other than the initial logistics of obtaining sufficient concrete fill for placement around the equipment.

Surround with Concrete Costs. This process option has the second lowest capital and operating costs of all of the process options, assuming concrete fill is available. The costs are as follows:

1. Removal		$47.7 million
2. Concrete rubblization		$31.3 million
3. Disposal facility capital and operating cost (including trucking) for 219,000 cy		$200.0 million
	Total Capital Costs	**$279.0 million**

C.4.10 CORROSION-INHIBITING EXTERNAL FIXATIVE

Corrosion Fixative Effectiveness – Fair. This process option's effectiveness is fair, provided the fixative can withstand the burial process, and has a design life that is a significant fraction of the cap design life. As with the previously discussed concrete-fill process option, the ability of the unfilled process equipment to withstand the structural pressures of the disposal facility is a necessary element of its effectiveness. There is no reduction in volume of the process equipment with this option. External fixatives have not been used by DOE as a method of corrosion inhibition in disposal facilities.

Corrosion Fixative Implementability – Very Good. Fixatives would be easy to implement if effective spray technologies can be developed. Such technologies must provide sufficient coverage and thickness to ensure the corrosion inhibitor would not degrade within the design life of the disposal facility. If viable as a spray, the optimum method for implementing this process option would be spraying in place prior to removal, spraying at a local spraying station in the process buildings before movement to a disposal facility, or spraying at the disposal facility prior to placement. If the inhibitor requires more aggressive application (surface preparation, dipping, two-part application), then these methods would require development, and the equipment may have to be moved to a processing area similar to the one for the segmentation process options.

Corrosion Fixative Costs. The costs are somewhat uncertain and are dependent on design requirements such as containment and method of application. It is assumed for this study that surface preparation is not required and that spray gun application is possible. Curing times are assumed to be several hours, allowing application in an assembly line method. This approach would be best performed in place inside the cell enclosures just before cutting and capping for removal, or immediately afterwards. The costs are as follows:

1. Removal	$38.0 million
2. Fixative application capital and operating costs	$19.9 million
3. Disposal facility capital and operating cost (including trucking) for 219,000 cy	$200.0 million
Total Capital Costs	**$257.8 million**

Table C.4 provides an evaluation summary for the previously discussed subsidence avoidance process options.

Table C.4. Summary of the Subsidence Avoidance Process Option Evaluation for PORTS

Void Reduction Process option	Effectiveness	Implementability	Capital Cost
Segmentation to small size	Pro – Waste would be similar to construction debris; eliminates large majority of void Con – Tubing would be intact for short lengths; would be many curved surfaces that do not nest well in packages or landfill Good effectiveness	Pro – Currently in use; facilitates material removal if necessary; allows segregation of classified materials; achieves ability to cover disposal lifts; reduces process equipment volume in disposal facility from 219,000 cy to 60-70,000 cy. Con – Extensive labor; hot cutting is a safety risk; double handling; processing classified equipment is a security risk; requires some new fixtures Good Implementability	Pro – Existing space and equipment; support and documentation largely in place; people are trained Con – Removal and segmentation are both labor-intensive $227 million
Shearing In Place	Pro – Would be demolition waste; eliminates large majority of void Con – Not applicable to converters Good effectiveness	Pro – Same equipment as used to shear structural steel in field; waste shipped with other building waste; significantly reduces pre-demolition equipment removal and segmentation. Improved safety. Reduces process equipment volume to 60-70,000 cy Con – Contamination would spread if not fixed/foamed Excellent Implementability	Pro – Avoids removal, movement, and segmentation (but not cutting) of all equipment and piping except converters Con – Increases demolition equipment and labor costs; adds capital and labor cost of fixation equipment; still requires segmentation of converters $204 million

Table C.4. Summary of the Subsidence Avoidance Process Option Evaluation for PORTS (Continued)

Void Reduction Process option	Effectiveness	Implementability	Capital Cost
Compaction	Pro – Eliminates large majority of void; would crush tubing Con – Requires partial segmentation to enter compactor throat; curved heavy metal plate may not compact totally, leaving void Very good effectiveness	Pro – Same as segmentation; less hot cutting required Con – Same as segmentation but less cutting required; converter bundles must be handled separately; compaction is new operation, has new safety concerns, and is single point constraint if not operating; facility construction; 12 to 18 months to operation start Fair Implementability	Pro – Reduces segmentation to disassembly and segmentation to fit compactor; reduces disposal facility size and placement cost slightly from segmentation process option Con – Not viable for converters; double handling; construction and operating cost of compactor $220 million
Shredding	Pro – Eliminates large majority of void; good uniform waste matrix; mixes easily with fill Con – Requires partial segmentation to enter shredder throat; expands volume of plate steel walls Very good effectiveness	Pro – Same as compaction Con – Same as compaction Fair implementability	Pro – Reduces disposal facility size and placement cost slightly from segmentation process option Con – Increases amount of segmentation slightly; double handling; construction and operating cost of shredder $227 million
Melting	Pro – Eliminates all void Con – Requires partial segmentation to enter melter Excellent effectiveness	Pro – Same as compaction; eliminates classification constraints with processed waste Con – Same as compaction but greater safety issues; 2 to 4 years to operation start Fair implementability	Pro – Reduces disposal facility size and placement cost considerably from segmentation process option Con – Increases segmentation cost slightly to fit melter; double handling; construction and operating cost of melter $513 million

Table C.4. Summary of the Subsidence Avoidance Process Option Evaluation for PORTS (Continued)

Void Reduction Process option	Effectiveness	Implementability	Capital Cost
Foaming	Pro – Fills large majority of void Con – Does not appreciably enter tubes; fills void, does not eliminate it Good effectiveness	Pro – Allows pipe shearing during demolition; provides effective contamination control; avoids classified segmentation; avoids all movement and effort of other processes Con – Must foam after cutting; additional equipment movement during demolition; requires equipment placement and filling around in disposal facility; would not apply to surge drums (continue to segment) Good implementability	Pro – Avoids all equipment removal (but not cutting) and segmentation except surge tanks; avoids equipment movement to processing Con – Requires additional foam holes in equipment; adds capital, material, and operating cost of foaming $397 million
Sand	Pro – Fills majority of voids Con – Does not appreciably enter tubes; requires filling at or near disposal facility; fills void, does not eliminate it Good effectiveness	Pro – Potentially single move to disposal; equipment preparation minimal; not labor-intensive; avoids classified segmentation; sand operations can be constructed during disposal facility construction Con – Requires placement and filling around in disposal facility; material must be kept dry; material takes up disposal cell space; not as effective as grout in reducing voids; would not apply to surge drums (continue to segment) Good implementability	Pro – Avoid segmentation costs for most of the equipment; avoid movement to segmentation Con –adds capital, material, and operating cost of sand filling $283 million
Grouting	Pro – Fills majority of void; provides long term structural stability Con – Same as sand Good effectiveness	Pro – Same as sand Con – Requires placement and filling around in disposal facility; material takes up disposal cell space; cold weather grouting requires additional curing measures; would not apply to surge drums (continue to segment) Very good implementability	Pro – Same as sand Con – adds capital, material, and operating cost of grouting $287 million

Table C.4. Summary of the Subsidence Avoidance Process Option Evaluation for PORTS (Continued)

Void Reduction Process option	Effectiveness	Implementability	Capital Cost
Surround with Concrete Fill	Pro – Protects against subsidence Con – Corrosion inhibition for design life not technically proven; does not eliminate void Fair effectiveness	Pro – Eliminates need for additional move and segmentation; provides use for concrete fill waste; avoids classified segmentation Con – Introduces logistics of managing concrete; requires placement and fill in disposal facility; likely not logical for surge drums Fair implementability	Pro – Avoids all equipment removal (but not cutting) and segmentation except surge tanks; avoids equipment movement to processing Con – Requires special processing of concrete beyond that for normal demolition $280 million
Corrosion-inhibiting external fixative	Pro – Protects against subsidence Con – Corrosion inhibition for design life not technically proven; does not eliminate void Fair effectiveness	Pro – Eliminates need for additional move and segmentation; avoids classified segmentation Con – Introduces external fixation process before removal; requires placement and fill in disposal facility; likely not logical for surge drums Very good implementability	Pro – Avoids all equipment removal (but not cutting) and segmentation except surge tanks; avoids equipment movement to processing Con – Adds capital and operating cost for external fixation $258 million

C.5. SUMMARY

Numerous potential process options and approaches can be used to minimize future subsidence in a potential OSDC. An evaluation of the effectiveness, implementability, and cost of the process options that could be applied to the waste shows that some of the options are not viable for further consideration at PORTS. Those process options with a high reliance on newly designed and constructed facilities such as a compactor, shredder, or melter are no longer considered viable because of the increased schedule delays that would occur as a result of designing these facilities, constructing them, and training a work force to operate them. More importantly, these facilities could add additional costs with only a minimal improvement in effectiveness over segmentation or shearing to reduce voids and prevent subsidence. A compactor was shown to be effective in Oak Ridge, and the extra costs for the compactor could be offset by a reduction in the volume disposed on Site, but the schedule delays for design and construction are still considerations. These process options were summarized and screened out in Section 7 of the Site-wide Waste Disposition Evaluation Remedial Investigation/FS Report.

The other process options not considered to be viable are the corrosion inhibition process options. This is attributed to significant uncertainty about their long-term effectiveness. The tests necessary to demonstrate their ability to prevent equipment degradation for the required 1,000 years have not been performed. Tests to duplicate the uncertain environment of a disposal cell would be very difficult to design. Although these process options are much less expensive and easier to implement than all of the others, they are no longer considered for application at PORTS.

The two cutting options (segmentation using workers and shearing using heavy equipment) and the three filling process options remain viable for further consideration in the process building FS for PORTS. It is expected that all process equipment containing deposits or excessive deposition that would represent a criticality concern or exceed the disposal facility WAC would be removed, disassembled to remove uranium materials to abate the concern, and then segmented using workers to small pieces for disposal using the segmentation-to-small-size process option. Based on the existing NDA data, this process will be used on only a small percentage (less than 10 percent) of the process equipment.

Two representative process options for the majority of the remaining process equipment are selected for the equipment not requiring segmentation for deposit removal; grout filling and shearing. These process options will be used in the process building FS to develop alternatives. The other filling process options could be reconsidered during design as well as other techniques to control subsidence.

Grout filling is selected as the representative process option for subsidence avoidance of the major process equipment in the FS. In this scenario, the majority of the process equipment (compressors, converters, coolers) would be removed before demolition. The majority of the equipment would be transported to a staging area or a potential OSDC where they would be filled with grout. This process option avoids the large amount of effort, safety issues, and cost involved with disassembly and segmentation of the converters, compressors, and coolers to small size.

Shearing will be the representative process option in the FS for subsidence avoidance of the piping and valves. The piping and valves in the cell and unit bypasses would be sheared into waste during demolition of the process buildings. This option significantly reduces the amount of manual pipe cutting necessary for D&D and is much more cost-effective than filling.

The combined use of segmentation, shearing, and grout filling results in a safe and cost-effective method of preparing the process equipment and piping for disposal, one that recognizes the various equipment designs. It is effective in avoiding subsidence by filling or destructing the voids in the process gas equipment. Implementing these process options is reasonable because all of them have been used in demolition of like uranium enrichment buildings and equipment. This combination of representative process options will allow the FS to present a fair analysis of the impacts of avoiding subsidence at a potential OSDC by additional handling of the waste.

C.6. REFERENCE

ODOT 2004, *Pressure Distribution Around a Metal Pipe Under Deep Cover*, FHWA/OH-2004/019, Office of Research & Development, Executive Summary Report, December.

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ATTACHMENT C.1: BASIS OF ESTIMATES

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Estimates have been for comparison purposes only between possible process options. To the extent practical, existing estimates have been utilized, with adjustment to escalated dollars based on the schedule for process building decontamination and decommissioning (D&D). No contingency has been applied. If existing estimates are mostly applicable but require minor reductions or additions, those modifications are described in the basis to estimate the process option costs. Some estimates are based on existing experience and productivity factors from other D&D activities or based on communications from other D&D projects.

The scope for all estimates is assumed to be all of the X-330 and X-333 converters and compressors, but not the X-326 converters and compressors which are currently planned to be disposed off Site without processing (see Tables C.1 and C.2 in the main appendix text).

Segmentation to Small Size

Removal

1. Used the estimate for converter and compressor removal costs in escalated dollars from Appendix F of the Process Building Remedial Investigation/Feasibility Study (RI/FS) estimate for D&D work breakdown structures (WBSs) EM.PO.04.01.01.02.12 for X-333 and EM.PO.04.01.02.02.12 for X-330. Included cutting, capping, and movement to facility exit. Assume all piping or other process equipment removal in these estimates is minimal and within the accuracy of the estimate.

Movement

2. Used waste transport to on-Site disposal cell (OSDC) in RI/FS estimate for equivalent movement of components to X-700 and X-705 facilities for disassembly and segmentation. Escalated rate per cubic yard to the midpoint of X-330 and X-333 deactivation (assumed fiscal year [FY] 2019). Applied rate per in situ cubic yard for 219,000 cy of converters and compressors.

Disassembly and segmentation systems capital and operating cost

3. Used the estimate for refurbishment and capital modifications to disassemble and segment X-330 and X-333 converters and compressors from the Process Building RI/FS, Appendix F, Sensitivity Analysis of D&D with Off-Site Disposal of Wastes under Process Building D&D WBS PORTS: EM.PO.04.01.02.02.05 X-330 – X-700 Refurbishment. Costs are in escalated dollars.

4. Used the estimate for operating costs to disassemble and segment all of the X-330 and X-333 converters and compressors from the Process Building RI/FS, Appendix F, Sensitivity Analysis of D&D with Off-Site Disposal of Wastes under Process Building D&D WBS PORTS: EM.PO.04.01.01.02.05 X-333 – Material Removal-Process Deposit Mat and Recover Nickel and EM.PO.04.01.02.02.05 X-330 – Material Remove-Process Deposit Mat and Recover Nickel. Costs are in escalated dollars.

Trucking of segmented materials

5. This cost is included in the disposal facility capital and operating costs below.

Disposal facility capital and operating cost for 66,000 cy

6. Used the waste disposition RI/FS cost estimate for planning, design, capital construction, operating, and closure costs (but not long-term surveillance and maintenance) divided by the total waste volume to be disposed (1,300,000 cy) to determine a total disposal cost per cubic yard of waste. Escalated this rate per cubic yard to the midpoint of X-330 and X-333 deactivation (assumed FY 2019). Applied the rate per processed cubic yard for 66,000 cy of segmented converters and compressors.

Shearing in Place

Removal (X-330 and X-333 converters and cutting and capping compressors)

1. Used the removal estimate for Segmentation to Small Size. Note the adjustment in item 2 below.

Fixation with CCFix® (compressors only, not converters)

2. Assumed the cutting included with Removal above makes the compressors accessible for introduction of fixative. Application of the fixative inside the compressors will increase the removal labor costs by 15 percent but will avoid the lifting and crane transport of the compressors to the crane hatches for transport (assumed to be 8 percent of the removal cost). Therefore, the net labor increase for compressor fixative is 7 percent of the removal labor cost.

3. Added fixation equipment (electric-powered spray machines with hose delivery), total of three with two spares. Added material costs of $1/sq ft coated. Assumed compressors are 65,000 cy, and the conversion factor is 0.5 sq ft/cf. This equals 878,000 sq ft and is conservative because of the amount of equipment surface inaccessible for coating.

Movement (X-330 and X-333 converters)

4. Used Waste Transport to OSDC in RI/FS estimate for equivalent movement of converters to the X-700 facility for disassembly and segmentation. Escalated rate per cubic yard to the midpoint of X-330 and X-333 deactivation (assumed FY 2019). Applied rate per in situ cubic yard for 154,000 cy of converters.

Disassembly and segmentation systems (X-330 and X-333 converters) capital and operating cost

5. Used the estimate for refurbishment and capital modifications to disassemble and segment X-330 and X-333 converters from the Process Building RI/FS, Appendix E, Cost Estimate under Process Building D&D WBS PORTS: EM.PO.04.01.02.02.05 X-330 – X-700 Refurbishment. Costs are in escalated dollars.

6. Used the estimate for operating costs to disassemble and segment all of the X-330 and X-333 converters from the Process Building RI/FS, Appendix E, Cost Estimate under Process Building D&D WBS PORTS: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel and EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel. Costs are in escalated dollars.

Shearing of compressors in place

7. Used the cost estimates for X-330 and X-333 Building Demolitions in the Process Building RI/FS, Appendix E, Cost Estimate, WBSs EM.PO.04.01.01.03.03 and EM.PO.04.01.02.03.03. Assumed that compressor density and complexity would increase the demolition effort by 50 percent for the cubic yards of compressors over the average cubic yard of building waste. The total cubic yards in situ of X-330 and X-333 building waste (excluding slabs and underground structures and piping) is 426,000 cy. Used the demolition estimates divided by the waste volume to determine the rate per cubic yard. Increased this rate by 50 percent and applied it to 65,000 cy of compressors. Costs are in escalated dollars.

Trucking of sheared materials (and segmented X-330 and X-333 converters)

8. This cost is included in the disposal facility capital and operating costs below.

Disposal facility capital and operating savings for 66,000 cy

9. Used the Waste Disposition RI/FS cost estimate for planning, design, capital construction, operating, and closure costs (but not long-term surveillance and maintenance) divided by the total waste volume to be disposed (1,300,000 cy) to determine a total disposal cost per cubic yard of waste. Escalated this rate per cubic yard to the midpoint of Process Building D&D (assumed FY 2019). Applied the rate per processed cubic yard for 66,000 cy of segmented converters and sheared compressors.

Compaction

Removal

1. Same estimate as segmentation.

Movement

2. Same estimate as segmentation.

Disassembly and segmentation systems (X-330 and X-333 converters and compressors) capital and operating cost

3. Used segmentation estimate, but reduced the operating cost by 5 percent for less segmentation required to fit compactor throat.

Compaction capital and operating cost (including movement)

4. Assumed two compactors similar to those estimated in the Critical Decision-1 estimate. Added 30 percent for supporting equipment and materials. Escalated to the midpoint of capital construction (assumed FY 2015).

5. For additional compactor operations, added one foreman, six D&D laborers, four D&D workers, and four rad techs for duration of operation (assumed 6 years). Added 20 percent for support equipment and materials beyond compactors. Escalated to the midpoint of Process Building D&D (assumed FY 2019).

Trucking of compacted materials (and segmented converter bundles)

6. This cost is included in the disposal facility capital and operating costs below.

Disposal facility capital and operating savings for 45,000 cy

7. Used same approach as segmentation except for 45,000 cy.

Shredding

Removal

1. Same estimate as segmentation.

Movement

2. Same estimate as segmentation.

Disassembly and segmentation systems (X-330 and X-333 converters and compressors) capital and operating cost

3. Used segmentation estimate, but increased segmentation operations cost by 5 percent for additional segmentation necessary to meet shredder throat size.

Shredding capital and operating cost (including movement)

4. Used the shredding automated sorting process white paper as a cost basis with the changes below. Assumed classified shredding would add a single shredder and conveyor equal to the secondary shredder.

5. Deducted the cleaning station, eddy current separator, ferrous sorting belts, nonferrous sorting belts, and radiation detection and monitoring allowance.

6. Removed contingency and escalated to the midpoint of capital construction (assumed FY 2015).

7. For shredding operations, added one foreman, six D&D laborers, four D&D workers, and four rad techs for duration of operation (assumed 6 years). Added 20 percent for support equipment and materials beyond shredding equipment. Escalated to the midpoint of Process Building D&D (assumed FY 2019).

Trucking of compacted materials

8. This cost is included in the disposal facility capital and operating cost below.

Disposal facility capital and operating savings for 35,000 cy

9. Used same approach as segmentation except for 35,000 cy.

Melting

Removal

1. Same estimate as segmentation.

Movement

2. Same estimate as segmentation.

Disassembly and segmentation systems (X-330 and X-333 converters and compressors) capital and operating cost

3. Used segmentation estimate with changes below.

4. Increased the segmentation operations cost for converters and compressors by 10 percent for more cuts required.

Melting capital and operating cost (including movement)

5. Used *Cost Estimate to Meet CERCLA Needs Related to Constructing a Melter Thermal Waste Treatment Alternative* (Restoration Services, Inc. [RSI] 2011) for capital costs. Added an additional 5-ton melter for barrier. For operating costs, used shredder operating costs plus 10 percent. Escalated to the midpoint of capital construction (assumed FY 2015).

6. Used the following assumptions for melting operations costs. Assumed a standalone facility with full operations support. Labor costs included one project manager, three engineers, three health and safety specialists, one radiological engineer, five rad techs, one quality specialist, two quality techs, two waste management specialists, two foremen, five waste management workers, four laborers, three equipment operators, two mechanics, two electricians, and one truck driver. Assumed materials and equipment costs at 30 percent of labor costs. Assumed facility power costs are 4 megawatts on

average. Assumed subcontract costs are $500,000 annually. Escalated to the midpoint of Process Building deactivation (assumed FY 2019).

Trucking of melted materials

7. This cost is included in the disposal facility capital and operating cost below.

Disposal facility capital and operating savings for 15,000 cy

8. Used same approach as segmentation except for 15,000 cy.

Foaming

Cutting and preparation

1. Used segmentation process option removal costs. Added three additional D&D workers each to three crews for the period of D&D deactivation. Assumed the personnel associated with rigging and moving the equipment and piping, plus the three additional workers per crew, will now be dedicated to the foaming process after cutting and installing caps on the equipment and piping.

Installation of plates, foam injection ports, and vent ports

2. Additional cutting for foam holes adds one additional D&D worker and one additional high-lift platform to each of the three removal crews for the period of D&D deactivation.

3. Plates must be sheet metal and be taped or epoxy-attached, not covered with plastic. Added one D&D worker for each of the three removal crews. Increased material costs for 3,548 converters and compressors by $700 each.

Foam capital and operating cost

4. Capital cost for foaming assumed as one foaming unit for the three removal crews plus two spares at $75,000 per unit (total of five), heated foam storage units (three each) at $30,000, four each 5,000-lb forklifts, and two additional high-efficiency particulate air units per crew (total of six).

5. Material cost for foam assumed as $500 (FY 2013 dollars) per cy foamed. Conservatively, assumed all 219,000 cy are foamed.

6. Operating costs for foaming are included in the cutting estimate above. Foaming support costs for all the removal crews assumed as two D&D workers and one equipment operator for movement and control of foam materials for each crew for the period of D&D deactivation.

Movement to disposal facility

7. This cost is included in the disposal facility capital and operating cost below.

Disposal facility capital and operating cost for 219,000 cy

8. Used same approach as segmentation except for 219,000 cy. Added disposal facility capital and operating costs for a 100-ton crane for the period of D&D deactivation.

Sand Filling

Removal

1. Used the same estimate as segmentation. Adjusted for different plate strengths and ports in next item.

Installation of plates, pouring, and vent ports

2. Added 30 percent additional labor (including the cleared workers for converters) to removal and movement to install heavier plates, and to cut and temporarily seal pour and vent ports.

3. Added material costs of $1,200/component for 3,548 converters and compressors for heavier bracing on large plates and fabrication costs for port seals.

Movement to disposal facility

4. This cost is included in the disposal facility capital and operating cost below.

Sand capital and operating cost

5. Assumed design and construction of a covered materials storage area for 1,000 cy of sand. Assumed use of front end loaders for loading sand into dump trucks.

6. Assumed dry materials for 219,000 cy of sand, two front end loaders, and two 5,000-lb forklifts.

7. Major equipment to handle the process gas equipment and piping assumed to be two trucks, two 25-ton forklifts, and one 100-ton mobile crane. Escalated to the midpoint of capital construction (assumed FY 2015).

8. Operations personnel assumed to be one supervisor, one foreman, four waste management workers, three equipment operators, two craftsmen, and two rad techs for a period of 6 years (length of X-330 and X-333 deactivation). Escalated to the midpoint of Process Building deactivation (assumed FY 2019).

Disposal facility capital and operating cost for 219,000 cy

9. Used same approach as segmentation except for 219,000 cy. Added disposal facility capital and operating costs for a 100-ton crane and two sand auger conveyors for the period of D&D deactivation.

Grouting

Removal

1. Used the same estimate as segmentation. Adjusted for different plate strengths and ports in next item. Installation of plates, injection ports, and vent ports.

2. Added 30 percent additional labor (including the cleared workers for converters) to removal and movement to install heavier plates, injection ports, and vent ports.

3. Added material costs of $1,200 each for 3,548 converters and compressors for heavier bracing on large plates and fabrication costs for injection and vent ports.

Movement to disposal facility

4. This cost is included in the disposal facility capital and operating costs below.

Grouting capital and operating cost

5. Used the Process Building RI/FS D0 cost estimate for grouting at the OSDC. Removed the estimates for movement and trucking (included elsewhere in this estimate).

Disposal facility capital and operating cost for 219,000 cy

6. Used same approach as segmentation except for 219,000 cy. Added disposal facility capital and operating costs for a 100-ton crane for the period of D&D deactivation.

Surround with Concrete Fill

Removal

1. Used the same estimate as segmentation. Adjusted for heavy plate installation in the next item.

2. Added 20 percent additional labor (including the cleared workers for converters) to Removal to install heavier plates.

3. Added material costs of $900 each for 3,548 converters and compressors costs for heavier bracing on large plates.

Concrete rubblization and staging

4. For an in situ equipment and piping volume of 219,000 cy, the as-placed volume was assumed to be nominally 360,000 cy; therefore, assumed that 141,000 cy of rubblized concrete fill is required. Used 160,000 cy for edge effects. Because concrete is already part of the D&D waste, the process option estimate used assumption to segregate, process, and manage it for use as fill around the equipment.

5. Segregation assumed to be with one track-mounted machine outfitted with a grappler and one front end loader to remove concrete slabs and chunks. Processing assumed to be with two track-mounted machines outfitted with concrete pulverizers (this is because of the rate of generation; if faster is required, then add a concrete crusher) and two front end loaders. Trucks and drivers for movement of concrete fill are already included in the D&D estimate.

6. Labor and materials cost included one supervisor, one foreman, seven equipment operators, two D&D workers, three craftsmen (maintenance), and two rad techs for the period of D&D deactivation. Material costs included pulverizer teeth changeout each 500 cy and maintenance contracts on equipment.

Movement to disposal facility

7. This cost is included in the disposal facility capital and operating costs below.

Disposal facility capital and operating cost for 219,000 cy

8. Used same approach as segmentation except for 219,000 cy. Added disposal facility capital and operating costs for a 100-ton crane.

Corrosion-Inhibiting Fixative

Removal

1. Same estimate as segmentation.

Fixative application capital and operating costs

2. Added two additional D&D workers, two laborers, and one equipment operator to each of the three removal crews for converters and compressors. These personnel assumed to be dedicated to the fixation process after cutting and installing caps on the equipment.

3. Added coating equipment (electric-powered spray machines with hose delivery), one per cutting/coating crew with two spares for a total of five. Added material costs of $4/sq ft coated. Assumed process equipment is 219,000 cy and the conversion factor is 0.5 sq ft/cf because of the larger diameters. This equals 3.0 million sq ft.

Movement to disposal facility

4. This cost is included in the disposal facility capital and operating cost below.

Disposal facility capital and operating cost for 219,000 cy

5. Used same approach as segmentation except for 219,000 cy. Added disposal facility capital and operating costs for a 100-ton crane.

REFERENCE

RSI 2011, *Cost Estimate to Meet CERCLA Needs Related to Constructing a Melter Thermal Waste Treatment Alternative*, RSI/PORTS-187 (Rev. 0), Prepared for the U.S. Department of Energy, Portsmouth/Paducah Project Office, Lexington, KY, April.

ATTACHMENT C.2: SEGMENTATION TO SMALL SIZE COST ESTIMATE

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SEGMENTATION TO SMALL SIZE

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Segmentation to Small Size			PROJECT LOCATION:			Portsmouth, Ohio						DATE:		July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis) for both converter and compressor removal														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
												EQUIPMENT REMOVAL TOTAL			$ 37,957,687
	MOVE EQUIPMENT TO X-700/X-705														
1	Use Estimate Assembly No XWST 1060R1 (Transport Debris in Articulated Dump) for cost per cy in FY 13 dollars	219,000	CY		0			0		0		0	22.48	4,922,479	4,922,479
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										4,922,479	753,139	753,139
													MOVEMENT TOTAL		$ 5,675,619

SEGMENTATION TO SMALL SIZE

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	**Segmentation to Small Size**			PROJECT LOCATION:			Portsmouth, Ohio						DATE:	July 17, 2013	
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
	DISASSEMBLY AND SEGMENTATION														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.02.02.05 X-330 - X-700 Refurbishment Total	1	EA		256,979			14,288,014		7,182,555		4,550,730		0	26,021,300
2	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	1	Lot		513,128			29,176,434		9,729,675		998,236		0	39,904,345
3	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	1	Lot		711,540			39,561,648		11,591,495		6,427,533		0	57,580,675
											DISASSEMBLY AND SEGMENTATION TOTAL				$ 123,506,320
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long- term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	66,000	CY		0			0		0		0	784	51,744,000	51,744,000
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										51,744,000	7,916,832	7,916,832
												DISPOSAL FACILITY TOTAL			59,660,832
												SEGMENTATION TOTAL			$ 226,800,458

ATTACHMENT C.3: SHEARING IN PLACE COST ESTIMATE

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SHEARING IN PLACE

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Shearing in Place				PROJECT LOCATION:		Portsmouth, Ohio						DATE:		July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	MATERIAL $/UNIT	$ VALUE	EQUIPMENT $/UNIT	$ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	$ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
3	Coating Equipment --- Electric powered spray machines with hose delivery (1 ea). Assume 3 each required including 2 each spares.	3	Ea		0			0		0	5,000	15,000	0	0	15,000
4	Fixation material for compressors only--CCFix at $1.00 / SF ($1.15 escalated) of coated surface	878,000	SF		0			0	1.15	1,009,700		0	0	0	1,009,700
5	Increased labor to apply fixation material to compressors, assume increase of 7% of X-330 and X-333 Equipment Removal labor cost above - (12,005,899 + 18,178,253) X .07 = $2,112,891	1	Lot		0			2,112,891		0		0	0	0	2,112,891
											EQUIPMENT REMOVAL TOTAL			$	41,095,278

SHEARING IN PLACE

PROJ. ESTIMATOR: C. Oldham

TITLE Shearing in Place PROJECT LOCATION: Portsmouth, Ohio DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
	MOVE EQUIPMENT TO X-700/X-705														
1	Use Estimate Assembly No XWST 1060R1 (Transport Debris in Articulated Dump) for cost per cy in FY 13 dollars for movement of converters	154,000	CY		0			0		0		0	22.48	3,461,470	3,461,470
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										3,461,470	529,605	529,605
														MOVEMENT TOTAL	**$ 3,991,074**
	DISASSEMBLY AND SEGMENTATION														
	Use estimates prepared in Process Building RI/FS Cost Estimate (See Appendix F) for converter segmentation only														
1	WBS Ports: EM.PO.04.01.02.02.05 X-330 - X-700 Refurbishment Total	1	EA		232,560			12,930,330		6,500,050		4,118,308		0	23,548,687
2	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	1	Lot		346,589			19,707,074		8,189,943		1,866,495		0	29,763,511
3	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	1	Lot		460,199			25,587,086		8,178,769		3,410,517		0	37,176,372
														DISASSEMBLY AND SEGMENTATION TOTAL	**$ 90,488,571**

SHEARING IN PLACE

														PROJ. ESTIMATOR:		C. Oldham
TITLE	Shearing in Place					PROJECT LOCATION:			Portsmouth, Ohio					DATE:		July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	SHEARING OF COMPRESORS IN PLACE														
	Use proration of demolition estimates prepared in Process Building RI/FS document (See Appendix F)														
	WBS Ports: EM.PO.04.01.01.03.03 X-333 - Building Demolition Total													19,880,301	
	WBS Ports: EM.PO.04.01.02.03.03 X-330 - Building Demolition Total													17,192,941	
										BUILDING DEMOLITION SUBTOTAL				37,073,241	
1	COMPRESSOR SHEARING COST: Building demolition cost of $37,073,241 is for a total waste volume of ~426.000 cy equating to a cost of $87.03/cy Assume compressor shearing at a 50% increase or $130.55/cy. Compressor volume is ~65,000 cy .	65,000	CY										130.55	8,485,750	8,485,750
										SHEARING OF COMPRESORS IN PLACE TOTAL					$ 8,485,750
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	66,000	CY		0			0		0		0	784	51,744,000	51,744,000
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										51,744,000	7,916,832	7,916,832
													DISPOSAL FACILITY TOTAL		59,660,832
													SHEAR IN PLACE TOTAL		$ 203,721,505

ATTACHMENT C.4: COMPACTION COST ESTIMATE

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COMPACTION

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Compaction			PROJECT LOCATION:		Portsmouth, Ohio							DATE:		July 17, 2013
				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
Item No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis) for removal of converters and compressors.														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
												EQUIPMENT REMOVAL TOTAL			$ 37,957,687
	MOVE EQUIPMENT TO X-700/X-705														
1	Use Estimate Assembly No XWST 1060R1 (Transport Debris in Articulated Dump) for cost per cy in FY 13 dollars	219,000	CY		0			0		0		0	22.48	4,922,479	4,922,479
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										4,922,479	753,139	753,139
													MOVEMENT TOTAL		$ 5,675,619
	DISASSEMBLY AND SEGMENTATION														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														

COMPACTION

															PROJ. ESTIMATOR: C. Oldham
TITLE	Compaction				PROJECT LOCATION:		Portsmouth, Ohio							DATE:	July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	MATERIAL $/UNIT	$ VALUE	EQUIPMENT $/UNIT	$ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	$ VALUE	TOTAL ($)
1	WBS Ports: EM.PO.04.01.02.02.05 X-330 - X-700 Refurbishment Total	1	EA		256,979			14,288,014		7,182,555		4,550,730		0	26,021,300
2	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	1	Lot		513,128			29,176,434		9,729,675		998,236		0	39,904,345
3	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	1	Lot		711,540			39,561,648		11,591,495		6,427,533		0	57,580,675
4	Reduction in Material Removal labor cost due to less Segmentation required to fit Compactor throat Assume 5% reduction.	1	Lot					(3,436,904)		0		0		0	(3,436,904)
											DISASSEMBLY AND SEGMENTATION TOTAL				$ 120,069,416
	COMPACTION-CAPITAL and OPERATING														
1	Compaction equipment--procure and install--cost in FY 2015 $	2	EA		0			0		0		0	425,000	850,000	850,000
2	Supporting equipment and materials at 30% of equipment costs in FY 2015 $	1	Lot		0			0		0		0		255,000	255,000
	Compactor operations consisting of the following staff and material. Assume an operating duration of 6 years at 2,080 hrs/year /employee (12,480 hours)														
3	Foreman/supervisor	1	EA	12,480	12,480	SUP	56.68	707,366		0		0		0	707,366
4	Laborer (USW)	6	EA	12,480	74,880	LAB	44.50	3,332,160		0		0		0	3,332,160
5	D & D worker	4	EA	12,480	49,920	D/D	49.59	2,475,533		0		0		0	2,475,533
6	Radiological Control Tech	4	EA	12,480	49,920	R/T	44.64	2,228,429		0		0		0	2,228,429
7	Supporting materials and equipment for the above labor crew at 20% of labor costs	1	Lot		0			0		0		0		1,748,698	1,748,698
8	PPE Level D	187,200	Hrs						1.38	258,336		0		0	258,336
9	Indirects @ 12%	12.0%													1,422,663
														Subtotal	13,278,184
10	Operations Costs only:-Escalation to midpoint of X 333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										13,278,184	2,031,562	2,031,562

COMPACTION

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	Compaction			PROJECT LOCATION:		Portsmouth, Ohio						DATE:		July 17, 2013	
Item				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
											COMPACTION-CAPITAL and OPERATING TOTAL				$ 15,309,746
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	45,000	CY		0			0		0		0	784	35,280,000	35,280,000
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										35,280,000	5,397,840	5,397,840
												DISPOSAL FACILITY TOTAL			40,677,840
												COMPACTION TOTAL			$ 219,690,308

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ATTACHMENT C.5: SHREDDING COST ESTIMATE

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SHREDDING

														PROJ. ESTIMATOR:	C. Oldham
TITLE	Shredding				PROJECT LOCATION:		Portsmouth, Ohio							DATE:	July 17, 2013
Item				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
													EQUIPMENT REMOVAL TOTAL		$ 37,957,687
	MOVE EQUIPMENT TO X-700/X-705														
1	Use Estimate Assembly No XWST 1060R1 (Transport Debris in Articulated Dump) for cost per cy in FY 13 dollars	219,000	CY		0			0		0		0	22.48	4,922,479	4,922,479
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										4,922,479	753,139	753,139
													MOVEMENT TOTAL		$ 5,675,619

SHREDDING

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Shredding			PROJECT LOCATION:		Portsmouth, Ohio							DATE:		July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
	DISASSEMBLY AND SEGMENTATION														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.02.02.05 X-330 - X-700 Refurbishment Total	1	EA		256,979			14,288,014		7,182,555		4,550,730		0	26,021,300
2	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	1	Lot		513,128			29,176,434		9,729,675		998,236		0	39,904,345
3	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	1	Lot		711,540			39,561,648		11,591,495		6,427,533		0	57,580,675
4	Increase in Material Removal labor cost due to more Segmentation required to meet Shredder throat size. Assume 5% increase	1	Lot					3,436,904		0		0		0	3,436,904
											DISASSEMBLY AND SEGMENTATION TOTAL				**$ 126,943,224**
	SHREDDING-CAPITAL and OPERATING														
	The Capital Costs of this estimate are based on a "White Paper Study for a Shredding Automated Sorting Process" prepared by RSI in FY 2011 with modifications as noted below														
	CAPITAL COSTS														
1	Shredding equipment--procure and install-Capital cost Total in FY 2011 dollars	1	Lot		0			0		0		0		27,517,500	27,517,500

SHREDDING

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Shredding				PROJECT LOCATION:		Portsmouth, Ohio							DATE:	July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
2	Add a Shredder and Conveyor equal to the Secondary Shredder listed in the White Paper for shredding the classified waste. Use $650,000 for the Shredder plus $100,000 for the Conveyor plus $350,000 for the control station.	1	Lot											1,100,000	1,100,000
3	Deduct the Cleaning Station	1	EA		0			0		0		0		(50,000)	(50,000)
4	Deduct the Eddy Current Separator	1	EA		0			0		0		0		(200,000)	(200,000)
5	Deduct the Ferrous Sorting Belts	1	EA		0			0		0		0		(150,000)	(150,000)
6	Deduct the Non-Ferrous Sorting Belts	1	EA		0			0		0		0		(75,000)	(75,000)
7	Deduct the Rad Detection and sorting	1	EA		0			0		0		0		(10,000,000)	(10,000,000)
8	Remove Contingency cost	1	EA		0			0		0		0		(7,643,750)	(7,643,750)
	Subtotal														10,498,750
9	Capital cost-- Escalation-- FY 2011 to midpoint of facility construction --FY 2015 (4 years) @ 2.4%/year	10.0%	per cent										10,498,750	1,049,875	1,049,875
	Capital Total-Escalated $														11,548,625
	OPERATING COSTS														
	Assume Shredding operations consisting of the following staff and material. Assume an operating duration of 6 years at 2,080 hrs/ year /employee (12,480 hours)														
1	Foreman/supervisor	1	EA	12,480	12,480	SUP	56.68	707,366		0		0		0	84,884
2	Laborer (USW)	6	EA	12,480	74,880	LAB	44.50	3,332,160		0		0		0	3,332,160
3	D & D worker	4	EA	12,480	49,920	D/D	49.59	2,475,533		0		0		0	2,475,533
4	Radiological Control Tech	4	EA	12,480	49,920	R/T	44.64	2,228,429		0		0		0	2,228,429
5	Supporting materials and equipment for the above labor crew at 20% of additional labor costs	1	Lot		0			0		0		0		1,748,698	1,748,698
6	PPE Level D	187,200	Hrs						1.38	258,336		0		0	258,336
7	Indirects @ 12 %	12.0%													1,215,365
	Operating Total-FY 2013 $														11,343,404

SHREDDING

PROJ. ESTIMATOR: C. Oldham

TITLE Shredding PROJECT LOCATION: Portsmouth, Ohio DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
8	Operations cost--Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										11,343,404	1,735,541	1,735,541
															13,078,945
	Operating Total-Escalated $														
											SHREDDING-CAPITAL and OPERATING TOTAL				$ 24,627,570
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	35,000	CY		0			0		0		0	784	27,440,000	27,440,000
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										27,440,000	4,198,320	4,198,320
												DISPOSAL FACILITY TOTAL			31,638,320
												SHREDDING TOTAL			$ 226,842,420

ATTACHMENT C.6: MELTING COST ESTIMATE

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MELTING

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Melting			PROJECT LOCATION:			Portsmouth, Ohio							DATE:	July 17, 2013
Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
												EQUIPMENT REMOVAL TOTAL		$	37,957,687
	MOVE EQUIPMENT TO X-700/X-705														
1	Use Estimate Assembly No XWST 1060R1 (Transport Debris in Articulated Dump) for cost per cy in FY 13 dollars	219,000	CY		0			0		0		0	22.48	4,922,479	4,922,479
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										4,922,479	753,139	753,139
													MOVEMENT TOTAL	$	5,675,619

MELTING

PROJ. ESTIMATOR: C. Oldham

TITLE Melting PROJECT LOCATION: Portsmouth, Ohio DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
	DISASSEMBLY AND SEGMENTATION														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.02.02.05 X-330 - X-700 Refurbishment Total	1	EA		256,979			14,288,014		7,182,555		4,550,730		0	26,021,300
2	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	1	Lot		513,128			29,176,434		9,729,675		998,236		0	39,904,345
3	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	1	Lot		711,540			39,561,648		11,591,495		6,427,533		0	57,580,675
4	Increase in labor cost due to more cuts required during disassembly and segmentation. Assume 10% increase.	1	Lot					6,873,808		0		0		0	6,873,808
											DISASSEMBLY AND SEGMENTATION TOTAL				**$ 130,380,128**
	MELTING-CAPITAL and OPERATING														
	This estimate is based on Document RSI/PORTS-187, Rev 0 titled "Cost Estimate to Meet CERCLA Needs Related to Constructing a Melter Thermal Waste Treatment Alternative" prepared by RSI in FY 2011 with modifications as noted below														
	CAPITAL COSTS														
1	Capital cost of Designing and Constructing a 30-ton Melting Furnace Facility (in FY 2011 $) without Contingency.	1	Lot		0			0		0		0		192,207,020	192,207,020

MELTING

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	Melting			PROJECT LOCATION:			Portsmouth, Ohio					DATE:		July 17, 2013	
Item				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
2	Add a 5-ton Melting Furnace unit for Barrier and Security Sensitive waste. Assume 20% of the 30 Ton total cost.	1	Lot											38,441,404	38,441,404
	CAPITAL SUBTOTAL-FY 2011 $														230,648,424
3	Capital cost-- Escalation-- FY 2011 to midpoint of facility construction --FY 2015 (4 years) @ 2.4%/year	10.0%	per cent										230,648,424	23,064,842	23,064,842
	Capital Total-Escalated $														253,713,266
	OPERATING COSTS														
	Assume Melting Facility operations consisting of the following staff, materials, and utilities Assume an operating duration of 6 years at 2,080 hrs/year /employee (12,480 hours)														
1	Project Manager-Mid-FGG	1	EA	12,480	12,480	PM	99.94	1,247,254		0		0		0	1,247,254
2	Engineer-Jr-FGG	3	EA	12,480	37,440	ENG	67.90	2,542,176		0		0		0	2,542,176
3	Health and Safety Specialist	3	EA	12,480	37,440	H/S	29.57	1,107,101		0		0		0	1,107,101
4	Radiological Engineer	1	EA	12,480	12,480	R/E	53.37	666,095		0		0		0	666,095
5	Radiological Control Tech	5	EA	12,480	62,400	R/T	44.64	2,785,536		0		0		0	2,785,536
6	Quality Specialist	1	EA	12,480	12,480	Q/E	72.51	904,925		0		0		0	904,925
7	QA/QC Representative/Technician	2	EA	12,480	24,960	Q/T	48.98	1,222,541		0		0		0	1,222,541
8	Waste Management Specialist	2	EA	12,480	24,960	WM	57.60	1,437,609		0		0		0	1,437,609
9	Foreman/supervisor	2	EA	12,480	24,960	SUP	56.68	1,414,733		0		0		0	1,414,733
10	Waste Management Worker	5	EA	12,480	62,400	WW	50.40	3,144,735		0		0		0	3,144,735
11	Laborer (USW)	4	EA	12,480	49,920	LAB	44.50	2,221,440		0		0		0	2,221,440
12	Equipment Operator	3	EA	12,480	37,440	OP	48.52	1,816,589		0		0		0	1,816,589
13	Mechanic	2	EA	12,480	24,960	ME	49.88	1,244,990		0		0		0	1,244,990
14	Electrician	2	EA	12,480	24,960	ENG	49.30	1,230,486		0		0		0	1,230,486
15	Truck Driver	1	EA	12,480	12,480	TD	45.98	573,830		0		0		0	573,830
16	PPE Level D	461,760	Hrs						1.38	637,229		0		0	637,229
17	Supporting materials and equipment for the above labor crew at 30% of labor costs	1	Lot		0					0		0		7,068,012	7,068,012

MELTING

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	Melting				PROJECT LOCATION:		Portsmouth, Ohio						DATE:	July 17, 2013	
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	MATERIAL $/UNIT	$ VALUE	EQUIPMENT $/UNIT	$ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	$ VALUE	TOTAL ($)
18	Assume Power cost at 4 megawatts annually average for operating duration of 6 years. Assume 24-hour electrical required for operational needs-8,760 hr/year Cost per year at $0.10 per kW hr.=$3,504,000	6	Years		-			0		0		0	3,504,000	21,024,000	21,024,000
19	Assume Subcontracts of $500,000 annually for operating duration of 6 years	6	Years		-			0		0		0	500,000	3,000,000	3,000,000
20	Indirects @ 12%	12.0%			-					0		0			6,634,713
	Operating Total-FY 2013 $														61,923,992
21	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										61,923,992	9,474,371	9,474,371
	Operating Total-Escalated														71,398,363
											MELTING-CAPITAL and OPERATING TOTAL				$ 325,111,630
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	15,000	CY		0					0		0	784	11,760,000	11,760,000
2	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										11,760,000	1,799,280	1,799,280
												DISPOSAL FACILITY TOTAL			13,559,280
												MELTING TOTAL			$ 512,684,344

ATTACHMENT C.7: FOAMING IN SITU COST ESTIMATE

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FOAMING

															PROJ. ESTIMATOR: C. Oldham
TITLE	Foaming				PROJECT LOCATION:			Portsmouth, Ohio						DATE:	July 17, 2013
				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
Item No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
3	Additional material required for sheet metal, ports, etc., and attachments. Allow $700 ($810 escalated) for each of 3,548 converters and compressors.	3548	EA		0			0	810	2,873,880		0		0	2,873,880
4	Additional labor associated with removal, and installation of plates/ports. Assume 3 crews and an operating duration of 6 years at 2,080 hrs/year /employee (12,480 hours). Add 5 each D & D workers per crew at $49.59/hr ($57.18/hr escalated).	15	EA	12,480	187,200	D/D	57.18	10,703,585		0		0		0	10,703,585
												EQUIPMENT REMOVAL TOTAL			51,535,152

FOAMING

													PROJ. ESTIMATOR:	C. Oldham	
TITLE	Foaming			PROJECT LOCATION:		Portsmouth, Ohio							DATE:	July 17, 2013	
Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	FOAMING-CAPITAL and OPERATING														
	CAPITAL COSTS														
1	Provide one Foaming unit per removal crew (3 each), plus 2 spares for a total of 5 units.	5	EA					0		0	75,000	375,000		0	375,000
2	Heated Foam storage units	3	EA		0			0		0	30,000	90,000	0	0	90,000
3	HEPA units @ 2 per crew; 3-crews	6	EA		0			0		0	10,000	60,000	0	0	60,000
4	High-lift platform @ 1 per crew: 3 crews	3	EA		0			0		0	45,000	135,000	0	0	135,000
5	Forklift 5,000 lb capacity	4	EA		0			0		0	30,000	120,000	0	0	120,000
6	Indirects @ 12%	12.0%													93,600
	CAPITAL SUBTOTAL-FY 2013 $														873,600
7	Capital cost-- Escalation-- FY 2013 to midpoint of facility construction --FY 2015 (2 years) @ 2.4%/year	4.9%	per cent										873,600	42,806	42,806
	Capital Total-Escalated $														916,406
	OPERATING COSTS														
	Operating costs for Foaming are included in Equipment Removal costs above. Assume additional support cost to Foaming operations consisting of the following staff and materials. Assume an operating duration of 6 years at 2,080 hr/year /employee (12,480 hours)														
1	Foaming material @ $500/cy	219,000	CY					0	500	109,500,000		0		0	109,500,000
2	D & D worker	2	EA	12,480	24,960	D/D	49.59	1,237,766		0		0		0	1,237,766
3	Equipment Operator	1	EA	12,480	12,480	OP	48.52	605,530		0		0		0	605,530
4	Supporting materials and equipment for the above labor crew at 10% of additional labor costs	1	Lot					0		0		0		184,330	184,330

FOAMING

PROJ. ESTIMATOR: C. Oldham

TITLE Foaming PROJECT LOCATION: Portsmouth, Ohio DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
5	PPE Level D	37,440	Hrs						1.38	51,667		0		0	51,667
6	Equipment operating and maintenance--Allowance @ $2,000/ mo for 72 months	72	MO					0		0	2,000	144,000		0	144,000
7	Indirects @ 12%	12.0%													13,406,795
	Operating Total-FY 2013 $														125,130,088
8	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										125,130,088	19,144,903	19,144,903
	Operating Total- Escalated $														144,274,991
											FOAMING-CAPITAL and OPERATING TOTAL				$ 145,191,398
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	219,000	CY					0		0		0	784	171,696,000	171,696,000
2	Procure a 100-ton crane	1	EA					0		0	900,000	900,000	0	0	900,000
3	Equipment Operations/Maintenance: Crane @ $12,250/month for the duration of the operation of 72 months	72	MO					0		0	12,250	882,000		0	882,000
4	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										173,478,000	26,542,134	26,542,134
												DISPOSAL FACILITY TOTAL			200,020,134
												FOAMING TOTAL			$ 396,746,684

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ATTACHMENT C.8: SAND FILLING COST ESTIMATE

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SAND FILLING

PROJ. ESTIMATOR: C. Oldham

TITLE Sand Filling PROJECT LOCATION: Portsmouth, Ohio DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		TOTAL ($)
				UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
3	Additional labor required for installation of plates, pouring, and vent ports on removed equipment. Assume 30% increase in equipment removal labor above	1	Lot		0			9,055,245		0		0		0	9,055,245
4	Additional material required for plates, bracing, and fabrication cost for port seals. Allow $1,200 ($1,380 escalated) for each of 3,548 converters and compressors.	3548	EA		0			0	1,380	4,896,240		0		0	4,896,240
														EQUIPMENT REMOVAL TOTAL	$ 51,909,172

SAND FILLING

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Sand Filling				PROJECT LOCATION:			Portsmouth, Ohio					DATE:		July 17, 2013
				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
Item No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
	SAND FILLING-CAPITAL and OPERATING														
	CAPITAL COSTS														
1	Design & Construct a Material Storage Area and to hold 1,000 cy of sand and a sand Conveyor System (Located at Cell) that will process 100 cy of sand per day. Assume this area will be constructed within close proximity of the OSDC Area. Cost elements include the following: Planning & Design --- $200,000; Mob --- 50,000; Cut/Grade/Prep --- 150,000; Sand Auger Conveyor System -(2 Ea)--- 1,300,000; Storage Building --- 200,000; Demob --- 50,000.	1	Lot					0		0		0		1,950,000	1,950,000
2	Two Frontend Loaders & two 5,000 lb Forklifts.	1	Lot		0			0		0	275,000	275,000	0	0	275,000
3	Two Trucks; two 25-ton Forklifts; and one 100-ton mobile crane.	1	Lot		0			0		0	1,300,000	1,300,000	0	0	1,300,000
4	Indirects @ 12%	12.0%													423,000
	CAPITAL SUBTOTAL-FY 2013 $														3,948,000
5	Capital cost-- Escalation-- FY 2013 to midpoint of facility construction --FY 2015 (2 years) @ 2.4%/year	4.9%	per cent										3,948,000	193,452	193,452
	Capital Total-Escalated $														4,141,452
	OPERATING COSTS														
	Assume Sand Filling operations consisting of the following staff and materials. Assume an operating duration of 6 years at 2,080 hrs/year /employee (12,480 hours)														
1	Foreman/supervisor	2	EA	12,480	24,960	SUP	56.68	1,414,733		0		0		0	1,414,733
2	Waste Management worker	4	EA	12,480	49,920	WW	50.40	2,515,788		0		0		0	2,515,788
3	Equipment Operator	3	EA	12,480	37,440	OP	48.52	1,816,589		0		0		0	1,816,589
4	D & D worker	2	EA	12,480	24,960	D/D	49.59	1,237,766		0		0		0	1,237,766
5	Radiological Control Tech	2	EA	12,480	24,960	R/T	44.64	1,114,214		0		0		0	1,114,214

SAND FILLING

PROJ. ESTIMATOR: C. Oldham

TITLE Sand Filling   PROJECT LOCATION: Portsmouth, Ohio   DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
6	Supporting materials and equipment for the above labor crew at 20% of additional labor costs	1	Lot					0		0		0		1,619,818	1,619,818
7	PPE Level D	162,240	Hrs						1.38	223,891		0		0	223,891
8	Sand, clean, fine, Assume 30 mile haul	219,000	CY						50.00	10,950,000		0		0	10,950,000
9	Indirects @ 12%	12.0%													2,507,136
	Operating Total-FY 2013 $														23,399,936
9	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										23,399,936	3,580,190	3,580,190
	Operating Total- Escalated $														26,980,126
											SAND FILLING-CAPITAL and OPERATING TOTAL				$ 31,121,578
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS - DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	219,000	CY					0		0		0	784	171,696,000	171,696,000
2	Equipment Operations/Maintenance: Crane @ $12,250/month for the duration of the operation of 72 months= $882,000; Utility Trucks- 2 each @$2,000 ea/Mo for 72 months=$288,000: Front end Loaders--2 each @ $4,500 ea/mo for 72 months= $648,000; Other equipment cost=allowance of $100,000. TOTAL=$1,918,000	1	Lot					0		0	1,918,000	1,918,000		0	1,918,000
3	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										173,614,000	26,562,942	26,562,942
													DISPOSAL FACILITY TOTAL		200,176,942
													SAND FILLING TOTAL		$ 283,207,693

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ATTACHMENT C.9: GROUTING COST ESTIMATE

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GROUTING

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Grouting			PROJECT LOCATION:			Portsmouth, Ohio						DATE:		July 17, 2013
Item				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
3	Additional labor required for installation of plates, and injection and vent ports on removed equipment. Assume 30% increase in equipment removal labor above	1	Lot		0			9,055,245		0		0		0	9,055,245
4	Additional material required for plates, bracing, and fabrication cost for ports. Allow $1,200 ($1,380 escalated) for each of 3,548 converters and compressors.	3548	EA		0			0	1,380	4,896,240		0		0	4,896,240
												EQUIPMENT REMOVAL TOTAL			$ 51,909,172

GROUTING

													PROJ. ESTIMATOR:		C. Oldham	
TITLE	Grouting			PROJECT LOCATION:		Portsmouth, Ohio								DATE:	July 17, 2013	
Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	MATERIAL $/UNIT	$ VALUE	EQUIPMENT $/UNIT	$ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	$ VALUE	TOTAL ($)	
	GROUTING-CAPITAL and OPERATING															
	Use estimates prepared in Process Building D&D RI/FS D0 document (dated 2-8-2012)															
1	Grouting of Process Equipment Total	1	Lot		0			0		0		0	38,618,634	38,618,634	38,618,634	
2	Delete "Movement"	1	Lot		0			0		0		0	(1,699,164)	(1,699,164)	(1,699,164)	
3	Delete "Trucking"	1	Lot		0			0		0		0	(1,599,190)	(1,599,190)	(1,599,190)	
	Capital and Operating Total-Escalated $														35,320,280	
											GROUTING-CAPITAL and OPERATING TOTAL				$ 35,320,280	
	DISPOSAL FACILITY-(includes Trucking)															
1	Use summary cost estimate (without long- term S&M) from "Alternative 2: On-site Disposal RI/FS-DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	219,000	CY					0		0		0	784	171,696,000	171,696,000	
2	Procure a 100-ton crane	1	EA					0		0	900,000	900,000	0	0	900,000	
3	Equipment Operations/Maintenance: Crane @ $12,250/month for the duration of the operation of 72 months	72	MO					0		0	12,250	882,000		0	882,000	
4	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										173,478,000	26,542,134	26,542,134	
												DISPOSAL FACILITY TOTAL			**200,020,134**	
												GROUTING TOTAL			**$ 287,249,586**	

ATTACHMENT C.10: SURROUND WITH CONCRETE COST ESTIMATE

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SURROUND WITH CONCRETE FILL

TITLE Surround with Concrete Fill | PROJECT LOCATION: Portsmouth, Ohio | PROJ. ESTIMATOR: C. Oldham | DATE: July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
3	Additional material required for metal plates, bracing, etc., and attachments. Allow $900 ($1,040 escalated) for each of 3,548 converters and compressors.	3548	EA		0			0	1,040	3,689,920		0		0	3,689,920
4	Additional labor required for installation of plates on removed equipment. Assume 20% increase in equipment removal labor above	1	Lot		0			6,036,830				0		0	6,036,830
											EQUIPMENT REMOVAL TOTAL				47,684,437
	CONCRETE RUBBLIZATION-CAPITAL and OPERATING														
	CAPITAL COSTS														
1	Procure a track-mounted excavator w/grappler for removal of concrete slabs and chunks.	1	EA					0		0	860,000	860,000		0	860,000
2	Procure front end loaders for removal of concrete slabs and concrete processing.	3	EA		0			0		0	550,000	1,650,000	0	0	1,650,000

SURROUND WITH CONCRETE FILL

													PROJ. ESTIMATOR:		C. Oldham
TITLE	Surround with Concrete Fill			PROJECT LOCATION:		Portsmouth, Ohio							DATE:		July 17, 2013
				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
Item No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
3	Procure track-mounted excavator with concrete pulverizer for processing the concrete.	2	EA		0			0		0	1,100,000	2,200,000	0	0	2,200,000
4	Indirects @ 12%	12.0%													565,200
	CAPITAL SUBTOTAL-FY 2013 $														5,275,200
5	Capital cost-- Escalation-- FY 2013 to midpoint of facility construction --FY 2015 (2 years) @ 2.4%/year	4.9%	per cent										5,275,200	258,485	258,485
	Capital Total-Escalated $														5,533,685
	OPERATING COSTS														
	Assume Concrete fill operations consist of the following staff and materials. Assume an operating duration of 6 years (72 months) at 2,080 hrs/year /employee (12,480 hours)														
1	Foreman/supervisor	2	EA	12,480	24,960	SUP	56.68	1,414,733		0		0		0	1,414,733
2	D & D worker	2	EA	12,480	24,960	D/D	49.59	1,237,766		0		0		0	1,237,766
3	Equipment Operator	7	EA	12,480	87,360	OP	48.52	4,238,707		0		0		0	4,238,707
4	Mechanic	3	EA	12,480	37,440	ME	49.88	1,867,485		0		0		0	1,867,485
5	Radiological Control Tech	2	EA	12,480	24,960	R/T	44.64	1,114,214		0		0		0	1,114,214
6	Supporting materials and equipment for the above labor crew at 10% of additional labor costs	1	Lot					0		0		0		987,291	987,291
7	PPE Level D	199,680	Hrs						1.38	275,558		0		0	275,558
8	Equipment operating and maintenance--Excavators-3 each @ $30,400/ea/mo for 72 months	72	MO					0		0	91,200	6,566,400		0	6,566,400
9	Equipment operating and maintenance--Front end loaders- 3 each @ $8,800/ea/mo for 72 months	72	MO					0		0	26,400	1,900,800		0	1,900,800

SURROUND WITH CONCRETE FILL

PROJ. ESTIMATOR: C. Oldham

TITLE Surround with Concrete Fill **PROJECT LOCATION:** Portsmouth, Ohio **DATE:** July 17, 2013

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT or UNIT RATE $/UNIT	SUBCONTRACT or UNIT RATE $ VALUE	TOTAL ($)
10	Pulverizer teeth changeout--assume changeout required each 500 cy. Concrete fill required =141,000 cy; therefore 282 changeouts required	282	MO					0		0	1,200	338,400		0	338,400
11	Indirects @ 12%	12.0%													2,392,963
	Operating Total-FY 2013 $														22,334,317
12	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										22,334,317	3,417,151	3,417,151
	Operating Total- Escalated $														25,751,468
											CONCRETE FILL CAPITAL and OPERATING TOTA				$ 31,285,152
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	219,000	CY					0		0		0	784	171,696,000	171,696,000
2	Procure a 100 ton crane	1	EA					0		0	900,000	900,000	0	0	900,000
3	Equipment Operations/Maintenance: Crane @ $12,250/month for the duration of the operation of 72 months	72	MO					0		0	12,250	882,000		0	882,000
4	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										173,478,000	26,542,134	26,542,134
													DISPOSAL FACILITY TOTAL		200,020,134
											SURROUND WITH CONCRETE FILL TOTAL				$ 278,989,724

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ATTACHMENT C.11: CORROSION-INHIBITING FIXATIVE COST ESTIMATE

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CORROSION-INHIBITING FIXATIVE

													PROJ. ESTIMATOR:		**C. Oldham**
TITLE	**Corrosion-Inhibiting Fixative**				**PROJECT LOCATION:**		**Portsmouth, Ohio**							**DATE:**	**July 17, 2013**
				LABOR					**MATERIAL**		**EQUIPMENT**		**SUBCONTRACT or UNIT RATE**		
Item No.	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**CRAFT**	**$/MH**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**TOTAL ($)**
	EQUIPMENT REMOVAL														
	Use estimates prepared in Process Building RI/FS document (See Appendix G Sensitivity Analysis)														
1	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		211,131			12,005,899		1,216,977		2,020,980		32,618	15,276,474
2	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters, Compressors, Process Equip, & Piping Total	1	Lot		326,947			18,178,252		2,044,441		2,391,064		67,457	22,681,213
												EQUIPMENT REMOVAL TOTAL			37,957,687
	CORROSION-INHIBITING FIXATIVE-CAPITAL and OPERATING														
	CAPITAL COSTS														
1	Provide one each coating equipment (electric powered spray machine with hose delivery) per removal crew (3 each), plus 2 spares for a total of 5 units	5	EA					0		0	3,000	15,000		0	15,000

CORROSION-INHIBITING FIXATIVE

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	Corrosion-Inhibiting Fixative			PROJECT LOCATION:		Portsmouth, Ohio						DATE:		July 17, 2013	
				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
Item No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
2	Indirects @ 12%	12.0%													1,800
	CAPITAL SUBTOTAL-FY 2013 $														16,800
3	Capital cost-- Escalation-- FY 2013 to midpoint of facility construction --FY 2015 (2 years) @ 2.4%/year	4.9%	per cent										16,800	823	823
	Capital Total-Escalated $														17,623
	OPERATING COSTS														
	Operating costs for Corrosion-Inhibiting Fixative are additional to the Equipment Removal costs above. Assume additional support cost for Fixative operations consisting of the following crafts and materials. Assume an operating duration of 6 years at 2,080 hrs/year /employee (12,480 hours)														
1	Fixative material cost --- Use $4.00/SF coated. Process Equipment footage = 219,000 cy x 0.5 SF/cy x 27 CF/cy = 2,956,500 SF coated. Say 3.0 million SF	3,000,000	SF					0	4	12,000,000		0		0	12,000,000
2	D & D worker	2	EA	12,480	24,960	D/D	49.59	1,237,766		0		0		0	1,237,766
3	Laborer	2	EA	12,480	24,960	L	44.50	1,110,720		0		0		0	1,110,720
4	Equipment Operator	1	EA	12,480	12,480	OP	48.52	605,530		0		0		0	605,530
5	Supporting materials and equipment for the above labor crew at 10% of additional labor costs	1	Lot					0		0		0		295,402	295,402

CORROSION-INHIBITING FIXATIVE

												PROJ. ESTIMATOR:		C. Oldham	
TITLE	Corrosion-Inhibiting Fixative				PROJECT LOCATION:		Portsmouth, Ohio						DATE:		July 17, 2013
Item				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT or UNIT RATE		
No.	DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
6	PPE Level D	62,400	Hrs						1.38	86,112		0		0	86,112
7	Equipment operating and maintenance--Allowance @ $500/ mo for 72 months	72	MO					0		0	500	36,000		0	36,000
8	Indirects @ 12%	12.0%													1,844,584
	Operating Total-FY 2013 $														17,216,113
9	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										17,216,113	2,634,065	2,634,065
	Operating Total- Escalated $														19,850,178
										FIXATIVE--CAPITAL and OPERATING TOTAL					$ 19,867,802
	DISPOSAL FACILITY-(includes Trucking)														
1	Use summary cost estimate (without long-term S&M) from "Alternative 2: On-site Disposal RI/FS -DFFO/CERCLA Case" for cost per cy of waste in FY 2013 dollars (1,300,000 cy).	219,000	CY					0		0		0	784	171,696,000	171,696,000
2	Procure a 100-ton crane	1	EA					0		0	900,000	900,000	0	0	900,000
3	Equipment Operations/Maintenance: Crane @ $12,250/month for the duration of the operation of 72 months	72	MO					0		0	12,250	882,000		0	882,000
4	Escalation to midpoint of X-333 and X-330 Deactivation--FY 2019 (6 years) at 2.4%/year	15.3%	per cent										173,478,000	26,542,134	26,542,134
												DISPOSAL FACILITY TOTAL			200,020,134
										CORROSION-INHIBITING FIXATIVE TOTAL					$ 257,845,623

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APPENDIX D: ENGINEERING STUDY EVALUATING OPTIONS FOR FINAL AREA RESTORATION

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CONTENTS

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TABLES

Page

FIGURES

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ACRONYMS

D&D	decontamination and decommissioning
FS	Feasibility Study
Ohio EPA	Ohio Environmental Protection Agency
PORTS	Portsmouth Gaseous Diffusion Plant
RI	Remedial Investigation
USEC	United States Enrichment Corporation

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This study was performed to evaluate the quantity of soil materials required to restore all of the below grade removals of buildings/structures (including utilities) to grade in such a manner that ponding of storm water does not occur, allowing it to runoff naturally or be absorbed into the soils. Two extreme options are evaluated in this study to determine their feasibility. A combination of the options is most likely because the site restoration effort would be ongoing throughout the decontamination and decommissioning (D&D) project. Filling with trucked in soil would be preferable in some situations, and cutting and filling in the immediate area would be preferable in other situations. The first option (Option 1) is to bulldoze soils at an elevated grade across the plant and into excavated areas to reestablish a suitable topography for drainage and no ponding of water. It was evaluated to determine if there is enough rise to recontour without additional imported fill. The second option (Option 2) is to keep the existing grade by filling in holes as they are created, bringing backfill material to a demolition area, and avoiding the lowering of nearby rises. The results of Option 1 show that there is enough rise at the plant. Material could be cut and filled to a new grade to establish drainage. This could be done by using a cut of 1.5 million cy, filling existing low spots with 300,000 cy, and filling excavated areas with 1.2 million cy of fill. The results of Option 2 show approximately 1.2 million cy of fill would be needed if the current grade is desired, with roughly 400,000 cy of cut and fill occurring to ensure proper drainage.

D.1 INTRODUCTION

Remedial action decisions are being evaluated for the gaseous diffusion plant buildings/structures and infrastructure in the Process Buildings and Complex Facilities D&D Evaluation Project Remedial Investigation (RI)/Feasibility Study (FS). They include buildings/structures that contain slabs at grade; column footers; basements; basins; and pits, as well as several miles of buried large-diameter utility piping. Because of the relatively level terrain on Portsmouth Gaseous Diffusion Plant (PORTS), significant amounts of soil materials would be needed to return remedial excavation areas to a drainable grade. This study evaluates restoration options for the excavation areas.

Proper restoration of terrain generally requires a slight (0.25 to 1.0 percent) slope towards existing drainage ditches, which then feed to streams and existing bodies of water. With the planned removal of storm drain structures, restoration would require some new drainage features to direct surface runoff to existing perimeter ditches and bodies of water. With the level terrain in the central portion (major industrial area) of the plant, it is anticipated that the storm drains can be replaced with shallow drainage swales on the same footprint, except under road transitions where temporary ditch culverts may be required until road removal occurs.

D.2 AREAS AND VOLUMES OF EXCAVATIONS

To evaluate the restoration options, the excavated volumes needed to be determined. Only the excavations that are part of this RI/FS were considered. These excavations included those required to remove subsurface features at buildings and subsurface utilities. No consideration was given to the removal of contaminated media or landfills for engineered fill at a disposal cell or to the removal of any other media that may be conducted outside of *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (Ohio Environmental Protection Agency [Ohio EPA] 2012) decision. Obviously, the addition of these excavations would increase the fill needs.

D.2.1 BUILDING STRUCTURES WITH SUBSURFACE FEATURES

This study focused on the larger process and support buildings, larger auxiliary buildings, and other structures and infrastructure that would have significant excavation depressions after removal. Smaller buildings and structures were omitted from the study because they would not contribute notably to the volumes. Table D.1 shows the 23 major buildings/structures evaluated in this study.

Table D.1. PORTS Buildings/Structures Evaluated for Final Restoration Study

Building ID	Building Description
X-215D	Electrical Power Tunnels
X-220A	Instrumentation Tunnels
X-300	Plant Control Facility
X-326	Process Building
X-330	Process Building
X-333	Process Building
X-344A	UF_6 Sampling Facility
X-345	SNM Storage Building
X-530B	Switch House (slab and below-grade structures)
X-533B	Switch House (slab and below-grade structures)
X-611	In-Ground Pools
X-626-2	Cooling Tower (below-grade structures)
X-630-1	Recirculating Water Pump House (slab and below-grade structures
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-633-1	Recirculating Water Pump House (slab and below-grade structures
X-633-2A	Cooling Tower (below-grade structures)
X-633-2B	Cooling Tower (below-grade structures)
X-633-2C	Cooling Tower (below-grade structures)
X-633-2D	Cooling Tower (below-grade structures)
X-700	Converter Shop & Cleaning Building
X-705	Decontamination Building
X-720	Maintenance & Stores Building

ID = identification
SNM = special nuclear material

The total volume of excavated capacity (referred to as void volume) created by removal of subsurface structures is estimated at approximately 900,000 cy. The 23 major facilities alone result in a need for 858,000 cy of fill. Information supporting this volume estimate is provided in Attachment D.1.

D.2.2 SUBSURFACE UTILITIES

This study also evaluated the additional soil material that would potentially be required to backfill excavated trenches where steel and concrete utility piping (e.g., storm sewers, recirculating cooling water systems, firewater systems, etc.), underground tunnels, and conduit duct systems are removed. Table D.2 identifies the underground utilities analyzed. Utilities 20 in. in diameter and larger were evaluated by assuming that the soil swell (loose soil material) created by excavating utilities less than 20 in. in diameter, when returned to the excavation, would result in nominally level terrain. Figures D.1 through D.4 show the locations of the sanitary water lines, firewater lines, storm sewer lines, and recirculating water lines.

Table D.2. Subsurface Utilities at PORTS

Utility ID	Description
X-215A	Electrical Duct Banks
X-215B	Communication Duct Banks
X-230A	Sanitary and Firewater Distribution System
X-230B	Sanitary Sewer System
X-230C	Storm Sewers Drainage System
X-230G	Recirculating Water System
X-230H	Firewater Distribution System
X-230D	Softened Water Distribution System
X-230E	Plant Water System (make-up)
X-230F	Raw Water Supply Line
X-240A	RCW (Cathodic Protection System)

RCW = recirculating cooling water

The large underground tunnels, which run underneath and along the process buildings to the switch houses or Plant Control Facility, were also evaluated. Smaller instrument conduits were not considered.

The total void volume created by removing the underground utilities and adhered soils is approximately 102,000 cy. Information supporting this volume estimate is provided in Attachment D.2.

Combining the volume estimate for removal of the building subsurface structures with the void volume estimate associated with the underground utilities results in a total void volume of approximately 1,050,000 cy (rounded up to be conservative).

D.2.3 GRADING PLAN

Grading and backfill plans that would achieve each option are described below.

Option 1

In Option 1 the area is regraded, and excavated void areas are backfilled by scraping and moving existing soils within the Perimeter Road area of the plant. The accumulated soils created by regrading would be pushed into the excavated void areas to reestablish a suitable topography for proper drainage and no ponding of storm water. Regrading of the plant would be required for most areas within Perimeter Road, except for the United States Enrichment Corporation (USEC) operations, which are located at the southwest corner of the plant. The USEC facility is not involved with the PORTS D&D process.

The existing grading across the plant is established at 0.75 to 1.0 percent (Figure D.5). For Option 1, grading would begin near the existing drainage control low points (approximately at elevation 660 ft above mean sea level), near the inside of the existing Perimeter Road. Regrading would begin by scraping and excavating soil material at an approximate grade of 0.25 percent, with regrading operations pushing in a direction from the perimeter low points to the highpoints at and around the excavated void areas of the demolished building structures and underground utilities.

The regraded plant at 0.25 percent would produce approximately 1,200,000 cy of backfill soil material, which is more than enough backfill material to complete the backfilling of the excavated void areas. In addition, this regrading would create approximately 150,000 cy of surplus soil material (Figure D.6).

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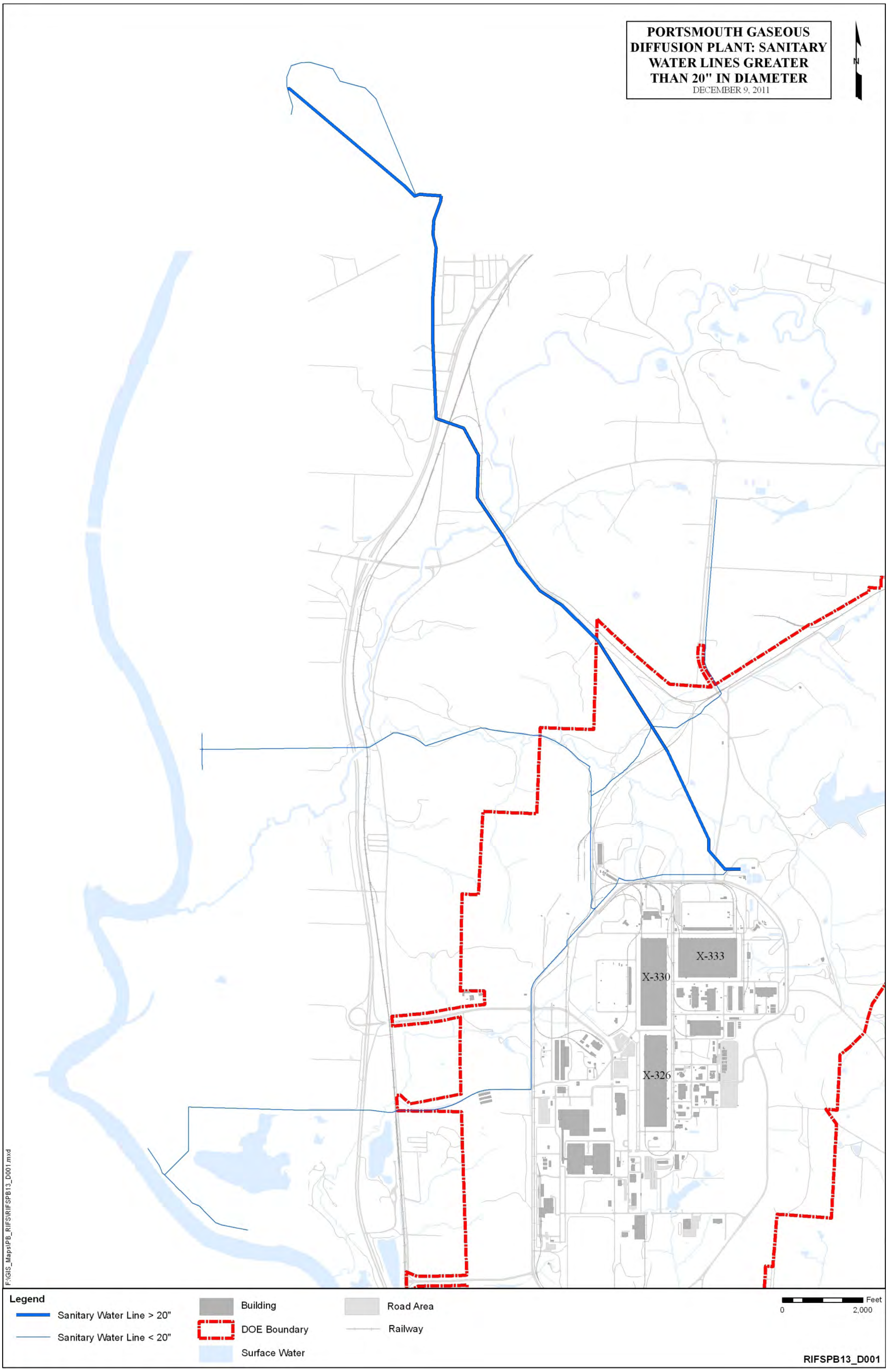

Figure D.1. Sanitary Water Lines at PORTS

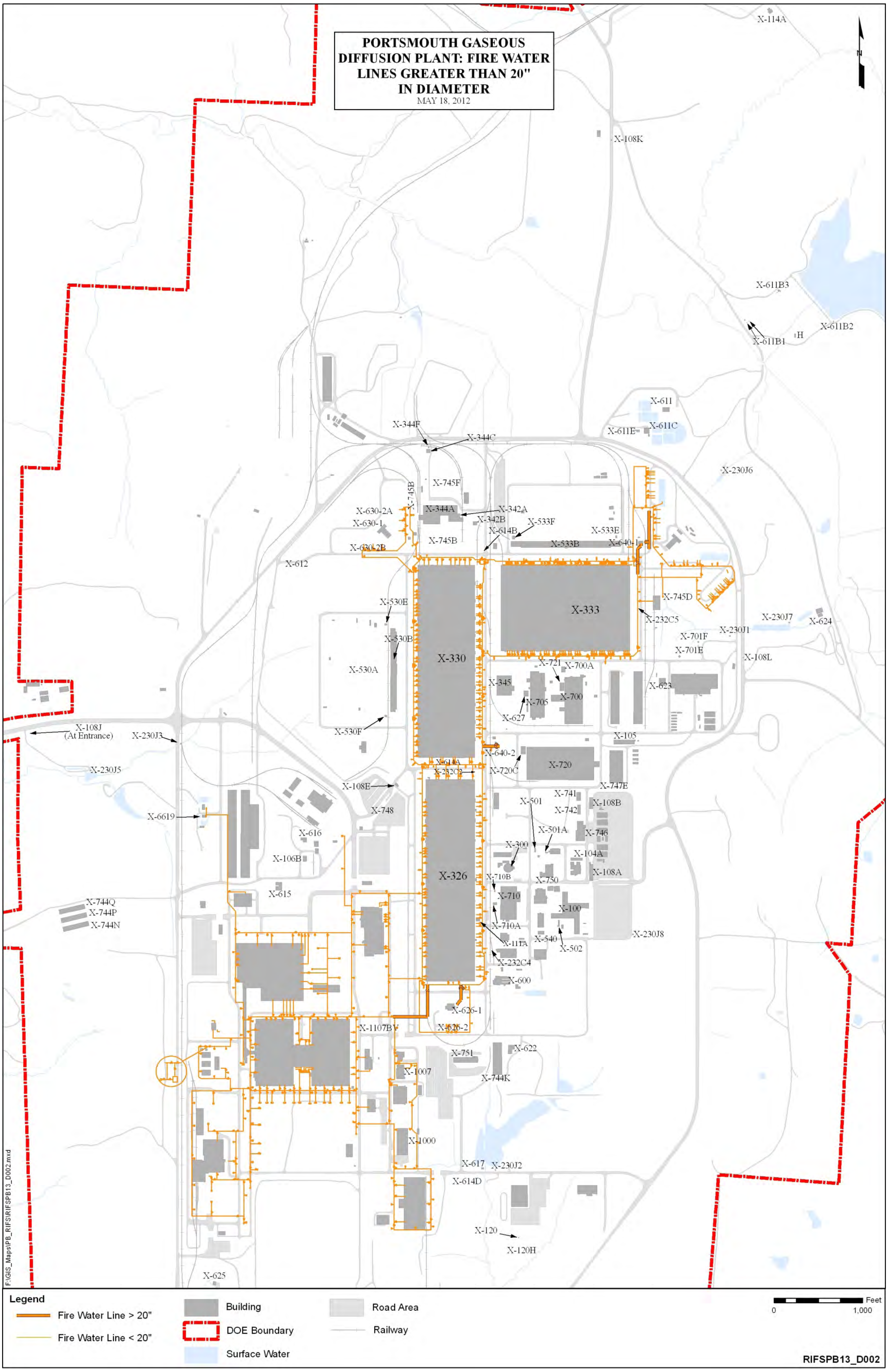

Figure D.2. Firewater Lines at PORTS

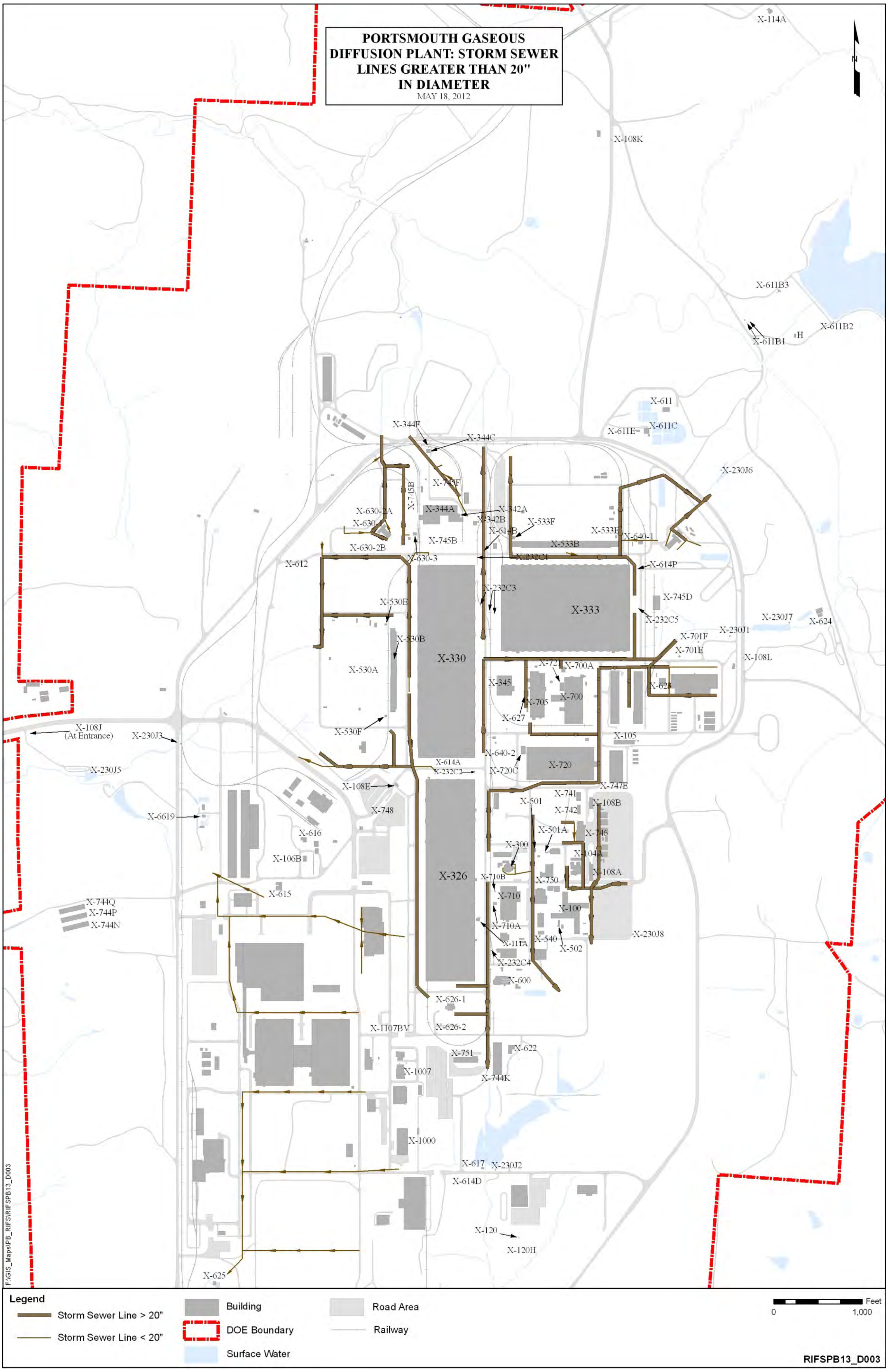

Figure D.3. Storm Sewer Lines at PORTS

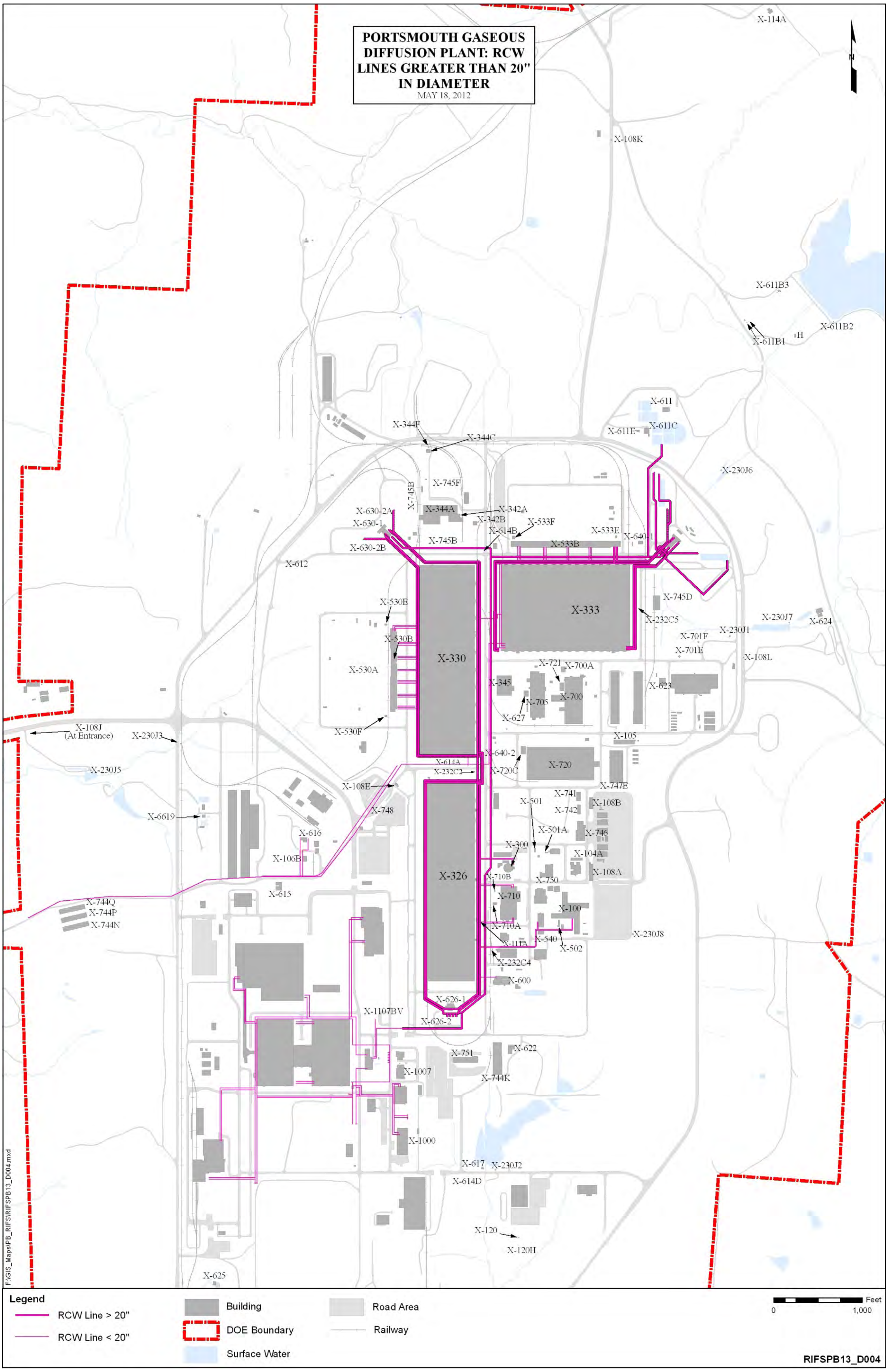

Figure D.4. Recirculating Water Lines at PORTS

Figure D.5. PORTS Existing Contours/Grade

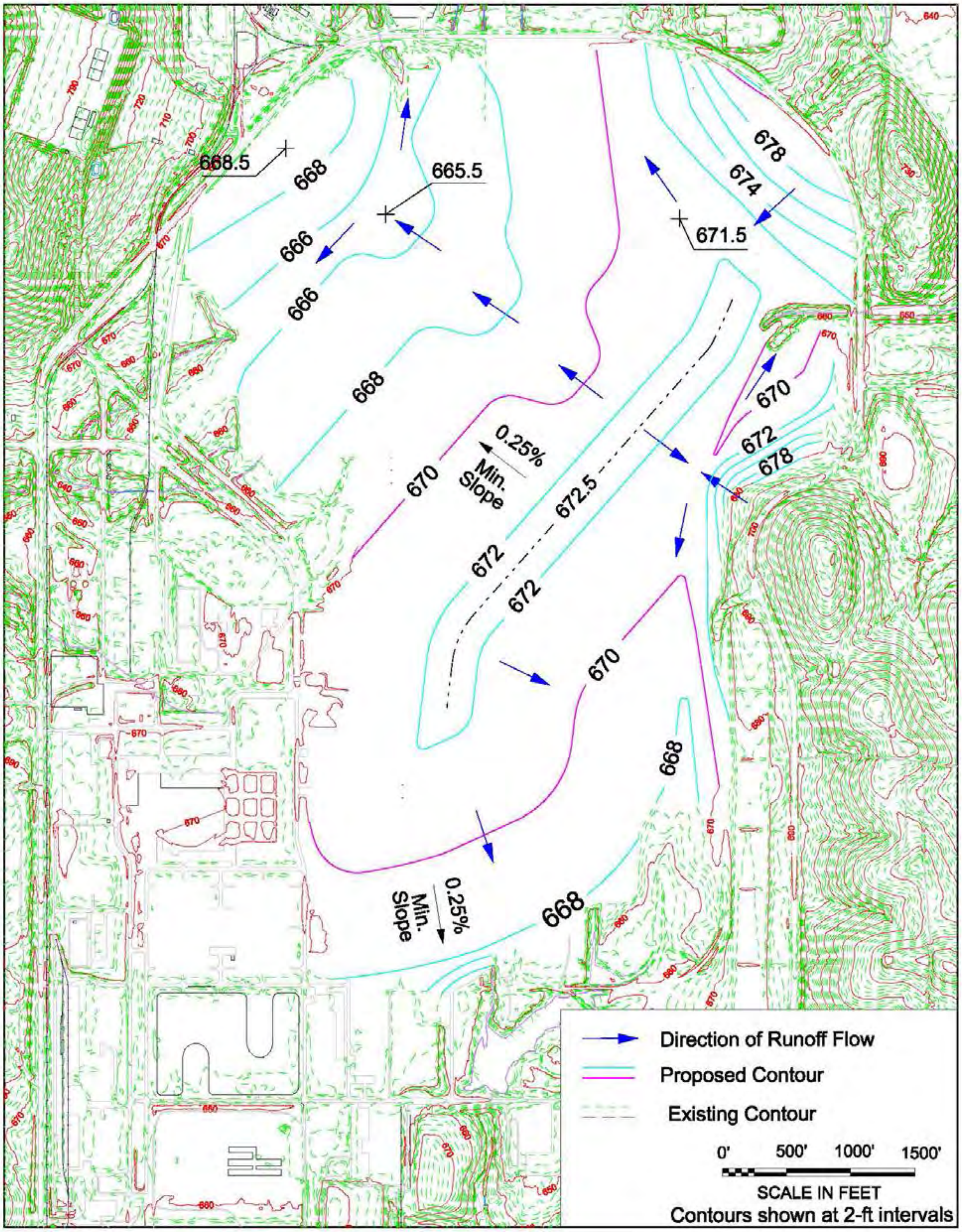

Figure D.6. Option 1 – On-PORTS Soil Borrow/Grading

To avoid overexcavating and producing surplus soil material, regrading operations would end as the excavated void areas are completely backfilled and properly graded.

Option 2

To the extent possible, excavated void areas created by the removal of subsurface structures and underground utilities at buildings would be backfilled and regraded to existing contours. Backfill material would be acquired by means of trucking soil to the demolition area.

After removing the subsurface structures and underground utilities, the cumulative amount of soil material needed to fill the excavated void areas would be approximately 1,050,000 cy. For Option 2, grading would not be as extensive as that required for Option 1 because void backfill material would be trucked to the demolition area. Some grading would be needed, and drainage swales would be graded at the ground surface to properly drain the area. This would be done after the backfilling to prevent any surface water ponding (Figure D.7).

D.3 CALCULATION ANALYSIS

Excavation volumes for the selected buildings and utilities are included in Attachments D.1 and D.2, respectively.

D.3.1 BUILDING STRUCTURES

For each building with at-grade slabs, the slab volume was determined either from information that was in the Fluor-B&W Portsmouth LLC Mass Flow Database as of December 2011 or by calculation using the at-grade slab thickness and square footage. The output from the database can be found in Appendix E of the Site-wide Waste Disposition Evaluation Project RI/FS. Footer volumes, if appropriate, were calculated from existing facility drawings. If such drawings were unavailable, calculations were made by assuming a standard footer size for each structural column penetrating the floor slab. The void volumes of underground features such as basements, pits, basins, and sumps were calculated from facility drawings or by determining the feature footprint and assuming a depth (if elevations were not available on drawings).

The volume of soil incidentally removed with the at-grade slabs and subsurface structures (including footers) was calculated by assuming a maximum 1 ft of adhered soils accompanying any slab or subsurface concrete removal.

These calculations determined a potential need for 900,000 cy of soil material to backfill building subsurface structures. The process buildings will require 356,000 cy of this total, and the remaining facilities will require 544,000 cy. Of this total, approximately 300,000 cy is currently void space that will not generate a corresponding waste. This void space is primarily contained in the X-630 and X-633 cooling tower basins and the power and instrument tunnels.

D.3.2 UNDERGROUND UTILITIES

For each underground utility, the excavated volumes were determined by using utility design drawings that included location plan views as well as utility profiles. The assumption used to calculate the adhered soil volumes is 6 in. of soil on both sides of the utility line (plus line diameter) and 6 in. of soil at the bottom (plus line diameter) for the length of the utility line.

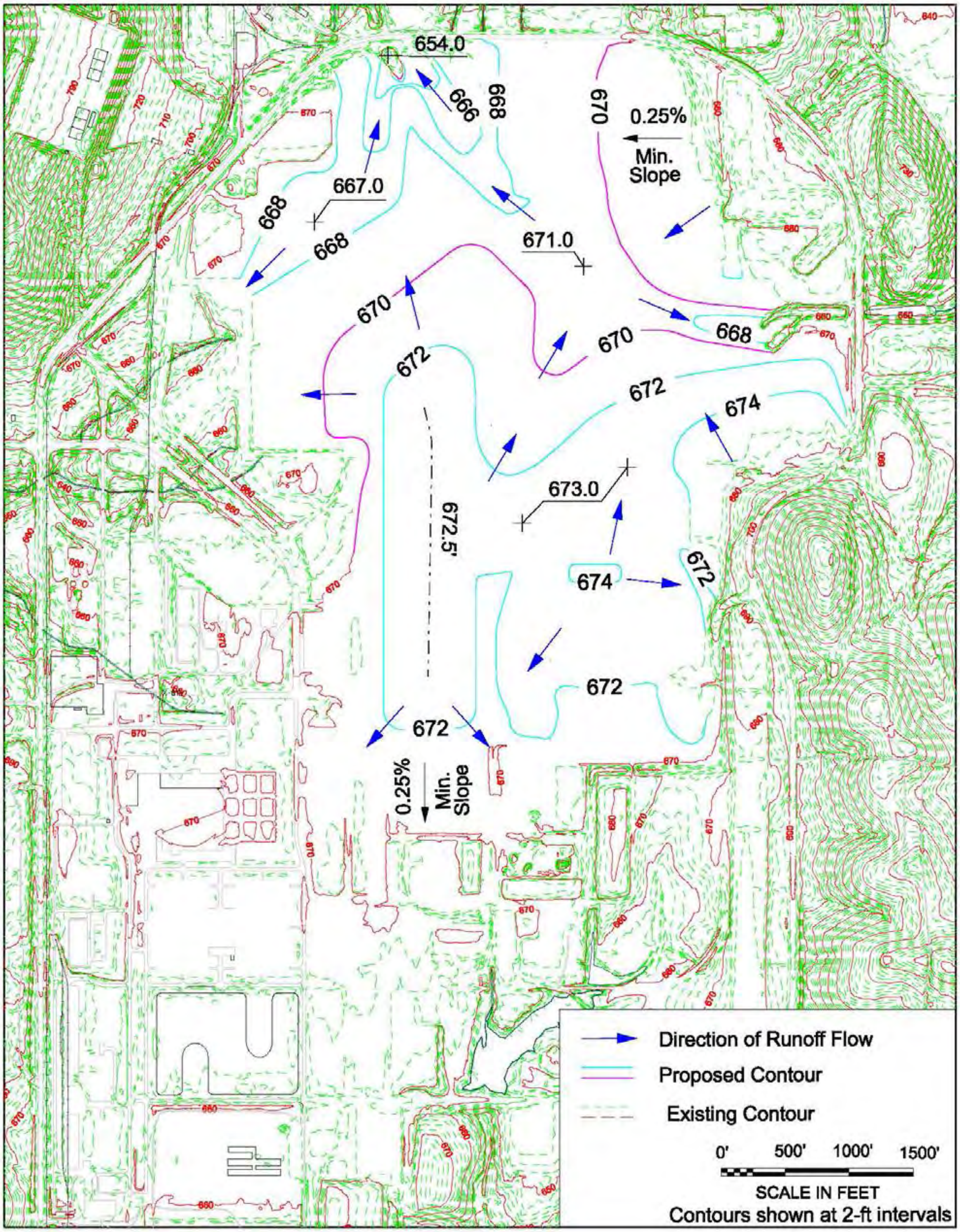

Figure D.7. Option 2 – Off-PORTS Soil Borrow/Grading

The calculations determined a potential need for soil materials to backfill utility trench excavations with a total void volume of 102,000 cy. The recirculating cooling water piping, at various diameters (20 in. to 72 in.) for a total length of 50,200 ft, yields a void volume at approximately 35,350 cy. The storm water piping, at various diameters (21 in. to 78 in.) for a total length of 43,600 ft, yields a void volume of approximately 36,130 cy. The other remaining utilities (i.e., firewater, sanitary and firewater, duct banks) yield a void volume of approximately 30,500 cy.

D.3.3 REGRADING EVALUATION

MicroStation and InRoads were the computer-aided design programs used to perform the regrading requirements for Options 1 and 2.

Option 1

For Option 1, the existing topography was taken from light detecting and ranging surveys conducted in 2006-2007 and then modeled using InRoads to create an existing base surface to be used as the point of reference for the final grade. The final grade would be the contours proposed for post-D&D activities. Start points for the final grade were determined on the basis of existing drainage paths, existing high and low points, and a minimum acceptable final grade slope of 0.25 percent. The main goal of Option 1 is to generate enough excess cut (with the final grading) that no borrow would be necessary to fill the voids generated from facilities substructure demolition and removal. Contours were drawn in MicroStation to fit these points, and InRoads was then used to model the proposed grade. InRoads was then used to generate excavated soil volumes, based on the existing grade surface versus the final grade surface.

For the case of Option 1, the cut and fill volumes are as follows:

- Cut: 1,555,800 cy (cut available to fill in low areas or excavated voids)
- Fill: 315,700 cy (cut material used to fill in existing low areas for proper drainage)
- Net Cut: 1,240,100 cy (cut material used to fill the excavated voids).

Option 2

The grading approach for Option 1 was also used for Option 2, with the same existing grade surface used as the base for Option 2. Start points for the final grade were determined on the basis of existing drainage paths, existing high and low points, and a minimum acceptable final grade slope of 0.25 percent. However, the main goal of Option 2 is to minimize cut and fill to maintain as much of the existing grade as possible while generating adequate slopes for storm water runoff.

After backfilling the voids left from D&D activities, some grade changes would be necessary to install surface water drainage swales and for a general grade rework that would guide storm water runoff away from the plant.

For the case of Option 2, the cut and fill volumes are as follows:

- Cut: 409,900 cy (cut available to fill in low areas)
- Fill: 350,800 cy (cut material used to fill in existing low areas for proper drainage)
- Net Cut: 59,100 cy (excess cut could be easily distributed along high points to create a cut and fill balance of 0 cy of excess).

D.4 OPTION EVALUATION DISCUSSION

Evaluation of the existing contours inside Perimeter Road on PORTS has determined that sufficient fill exists to backfill all facility and utility underground voids created from D&D actions and to restore the area to a relatively level terrain suitable for future industrial uses. Additionally, if an on-Site disposal facility is constructed, excavated fill is expected to be available for use. This should preclude the need to purchase and transport outside vendor fill for restoration after building D&D.

Facilities with subsurface structures would be demolished over the entire duration of the action. The presence of subsurface structures is not a significant factor in scheduling D&D, with contamination hazards, facility use, and geographical location generally establishing when demolition would occur. Additionally, the plant road infrastructure would be retained (at least all of the major thoroughfares) until near the end of D&D to facilitate personnel and materials/waste movement, including personnel, security and emergency response access.

Because of this, the restoration of PORTS is expected to be phased. After D&D of each facility, initial restoration would occur. Upon completion of demolition and removal of the waste, restoration may be delayed to perform any planned soil remediation. If soil remediation is not required, local grading would occur immediately to fill excavated areas (e.g., utility trenches with depressions, basements, footers, pits, basins) and to restore proper drainage from the area. If significant depressions cannot be filled with soil materials graded from the surrounding area (bounded by roads generally or other active facilities), phased approaches to obtaining additional fill would be undertaken. Adjacent (within several hundred yards) uncontaminated fill may be loaded into earthmovers or dump trucks by the project team for movement across local roads to the area. It would be dumped and bulldozed into the depressions to restore the grade and drainage. If not available in adjacent areas, local fill from areas inside Perimeter Road or the spoils area from construction of the potential on-Site disposal facility may be obtained. These options are expected to require trucked fill.

Near the completion of final D&D activities, plans would be made to establish grades such that the entire area drains to existing drainage tributaries in a controlled manner. Depending on the final configuration of the plant, these plans could be revised to incorporate any retained infrastructure, or new infrastructure installed for future industrial use.

It is expected that the rougher initial restoration of the plant would still result in some areas that retain surface water. Such features would consist of trenches in low areas, shallow (less than 1 ft) depressions that have been revegetated, or large basin excavations (switchhouses, cooling tower basins) where insufficient fill is available locally or near-term. These features would resemble wetlands as flora begins to naturally establish itself at their edges. Because of project length, any voluntary growth of this nature should be filled over during the final grading and contouring of the plant without any corresponding wetlands mitigation.

D.5 REFERENCE

Ohio EPA 2012, *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto*, Ohio Environmental Protection Agency, Columbus, OH, July 16.

ATTACHMENT D.1: VOID VOLUME CALCULATIONS FROM D&D OF BUILDING SUBSURFACE STRUCTURES

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Void Volume Calculations from D&D of Building Subsurface Structures

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-215D	Electrical Power Tunnels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	229,770	75,900	**305,670**	**11,321**	Volumes estimated based on approximately 4,000 ft length. Dimensions assumed to be the same as the single tunnels in X-220A.
X-220A	Instrumentation Tunnels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	735,245	208,385	**943,630**	**34,949**	All volumes from facility construction drawings.
X-300	Plant Control Facility	16,014	676	Not Used	43,584	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	117,810	2,669	**164,063**	**6,076**	Below-grade structure volume from Mass Flow Database. Underground void volume calculated from facility construction drawings.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-326	Process Building	1,283,396	673	8	Not Used	205,478	859,875	N/A	229,479	1,925,094	**3,219,912**	**119,256**	Three ACRs assumed to be the same size as X-330 ACR. Footer volume from CD-1 information. Soil removed with slab assumed to be 1 ft.
X-330	Process Building	1,398,300	672	8	Not Used	222,995	936,861	N/A	152,986	2,097,450	**3,410,308**	**126,308**	Basement void volume from drawings. Footer volume from CD-1 information.
X-333	Process Building	1,425,108	672	8	Not Used	227,077	527,290	N/A	88,349	2,137,662	**2,980,408**	**110,385**	Basement void volume from drawings. Footer volume from CD-1 information.
X-344A	UF_6 Sampling Facility	63,147	671	Not Used	80,569	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	43,000	91,586	**215,155**	**7,969**	Below-grade structure volume from Mass Flow Database and other source materials.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-345	SNM Storage Building	36,614	672	Not Used	181,801	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	13	6,010	**187,824**	**6,956**	Below-grade structure volume from Mass Flow Database. Subsurface void volume pulled from other source materials.
X-530B	Switch House (slab and below-grade structures)	74,378	672	8	Not Used	2,609	49,833	N/A	103,230	12,396	**168,068**	**6,225**	Footer volume from CD-1 information. Underground portion assumed to be similar to X-215D. Floor elevation estimated.
X-533B	Switch House (slab and below-grade structures)	74,378	672	8	N/A	2,609	49,833	N/A	103,230	12,396	**168,068**	**6,225**	Footer volume from CD-1 information. Underground portion assumed to be similar to X-215D. Floor elevation estimated.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-611 In-Ground Pools	In-Ground Pools	N/A	715	N/A	N/A	N/A	N/A	N/A	2,625,258	223,595	**2,848,853**	**105,513**	Slow mix basins: 80,494 cf × 4; Secondary settling basins: 307,966 cf × 3 and 340,384 cf; Equalizing basin: 475,280 cf; Primary settling basins: 281,860 cf × 2. Underground surface area calculated from facility drawings.
X-626-2	Cooling Tower (below-grade structures)	12,000	670	Not Used	18,683	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	356,400	2,000	**377,083**	**13,966**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-630-1	Recirculating Water Pump House (slab and below-grade structures)	10,249	671	Not Used	13,698	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	151,985	1,708	**167,391**	**6,200**	Below-grade structure volume from Mass Flow Database. Subsurface void volume calculated from facility construction drawings.
X-630-2A	Cooling Tower (below-grade structures)	13,750	671	Not Used	21,375	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	1,128,600	2,291	**1,152,266**	**42,677**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials.
X-630-2B	Cooling Tower (below-grade structures)	27,500	671	Not Used	41,250	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	1,128,600	4,583	**1,174,433**	**43,498**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-633-1	Recirculating Water Pump House (slab and below-grade structures	11,268	686	Not Used	14,895	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	159,610	1,878	**176,383**	**6,533**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from facility construction drawings.
X-633-2A	Cooling Tower (below-grade structures)	53,600	687	Not Used	82,420	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	1,797,552	8,933	**1,888,905**	**69,959**	Below-grade structure volume pulled from Mass Flow Database. Subsurface void volume from other source materials.
X-633-2B	Cooling Tower (below-grade structures)	53,600	687	Not Used	82,420	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	1,797,552	8,933	**1,888,905**	**69,959**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-633-2C	Cooling Tower (below-grade structures)	5,000	687	Not Used	7,783	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	270,000	833	**278,616**	**10,319**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials. Floor elevation estimated.
X-633-2D	Cooling Tower (below-grade structures)	20,000	687	Not Used	30,974	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	324,000	3,333	**358,307**	**13,271**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials. Floor elevation estimated.
X-700	Converter Shop & Cleaning Building	121,970	675	Not Used	133,022	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	28,800	193,278	**355,100**	**13,152**	Below-grade structure volume from Mass Flow Database. Subsurface void volume from other source materials.

Void Volume Calculations from D&D of Building Subsurface Structures (Continued)

Building ID	Building Description	Footprint Area (sq ft)	Floor Elevation	Slab Thickness (in.)	Slab/Below Grade Concrete (Mass Flow) (cf)	Footer Volume (cf) [1]	Slab Volume (cf) [1]	Utility Volume (cf)	Subsurface Void Space Volume (USTs, Basements, etc.) (cf) [1]	Soil Removed With Concrete Slab/Foundation/Other Structures (cf) [2]	Total Volume (cf)	Total Volume (cy)	Notes
X-705	Decontamination Building	89,572	674	Not Used	222,986	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	N/A	151,164	**374,150**	**13,857**	Below-grade structure volume from Mass Flow Database.
X-720	Maintenance & Stores Building	294,074	674	Not Used	320,637	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	Included in Mass Flow Database (App. E, WD RI/FS)	N/A	52,005	**372,642**	**13,802**	Below-grade structure volume from Mass Flow Database.
											23,176,152	**858,376**	

Use 900,000 cy

(1) Source: Giffells &Vallet 1961, DOE 1993, TPMC 2006
(2) Soil excavated with the removal of concrete slabs and other subsurface concrete structures. The soil volume was obtained from information formalized in the DOE-approved CD-1 baseline document.

= From drawings

= Other facilities outside the scope of this RI/FS

ACR = Area Control Room
CD = Critical Decision
DOE = U.S. Department of Energy
FS = feasibility study
ID = identification
N/A = not applicable
RI = remedial investigation
SNM = special nuclear material
TPMC = Theta Pro2Serve Management Company, LLC
WD = waste disposition

REFERENCES

DOE 1993, *Report for Environmental Audit Supporting Transition of the Gaseous Diffusion Plants to the United States Enrichment Corporation*, DOE/OR/1087&V2 and V3, U.S. Department of Energy, Piketon, OH, June.

Giffells & Vallet 1961, *Gaseous Diffusion Plant at Portsmouth, Ohio, Project History and Completion Report* (Redacted), Volume 2, U.S. Atomic Energy Commission, April.

TPMC 2006, *Facility Condition Survey of the Portsmouth Gaseous Diffusion Plant Facilities, Piketon, Ohio*, TPMC/PORTS-59/R1, Piketon, OH.

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ATTACHMENT D.2: VOID VOLUME CALCULATIONS FROM D&D OF SUBSURFACE UTILITIES

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Void Volume Calculations from D&D of Subsurface Utilities

Facility ID	Description	Pipe Diameter (in.)[a]	Length (lf)[a]	Excavation/Void Space Volume (cf)[b]	Excavation/Void Space Volume (cy)[b]
X-230G	RCW	20	2,900	16,725	620
X-230G	RCW	24	9,850	73,875	2,740
X-230G	RCW	30	9,950	104,475	3,870
X-230G	RCW	36	4,500	63,000	2,335
X-230G	RCW	42	8,300	149,400	5,535
X-230G	RCW	48	600	13,500	500
X-230G	RCW	54	2,200	60,500	2,240
X-230G	RCW	60	4,900	161,700	5,990
X-230G	RCW	72	5,850	266,175	9,860
X-230G	RCW	66	1,150	44,850	1,660
X-230C	Storm Sewers	21	1,450	9,000	335
X-230C	Storm Sewers	24	5,875	44,065	1,635
X-230C	Storm Sewers	27	550	4,920	185
X-230C	Storm Sewers	30	5,250	55,125	2,045
X-230C	Storm Sewers	36	4,750	66,500	2,465
X-230C	Storm Sewers	42	3,950	71,100	2,635
X-230C	Storm Sewers	48	5,425	122,065	4,520
X-230C	Storm Sewers	54	4,350	119,625	4,430
X-230C	Storm Sewers	60	4,550	150,150	5,560
X-230C	Storm Sewers	72	5,200	236,600	8,765
X-230C	Storm Sewers	78	600	31,500	1,170
X-230C	Storm Sewers	66	1,650	64,350	2,385
X-230H	Fire Water Distribution System	20	400	2,310	85
X-230H	Fire Water Distribution System	24	600	4,500	170
X-230H	Fire Water Distribution System	30	750	7,875	295
X-230H	Fire Water Distribution System	36	450	6,300	235
X-230A	Sanitary and Fire Water Distribution System	20	7,700	44,410	1,645

Void Volume Calculations from D&D of Subsurface Utilities (Continued)

Facility ID	Description	Pipe Diameter (in.)[a]	Length (lf)[a]	Excavation/Void Space Volume (cf)[b]	Excavation/Void Space Volume (cy)[b]
X-230A	Sanitary and Fire Water Distribution System	36	4,500	63,000	2,335
X-230A	Sanitary and Fire Water Distribution System	48	21,000	472,500	17,500
X-215B	Communication Duct Bank	21 × 30	10,250	84,565	3,135
X-215B	Communication Duct Bank	21 × 21	5,790	35,825	1,330
X-215B	Communication Duct Bank	30 × 21	10,350	81,510	3,020
X-215B	Communication Duct Bank	25 × 20	2,500	16,635	615
			TOTAL	2,748,630	101,845

Use 102,000 cy

[a]Source: WEMS 2011
[b]Excavation/void volume calculation includes 6 in. of soil excavation (adhered soils) beyond each side and bottom of each utility removed.

ID = identification
RCW = recirculating cooling water
WEMS = Wastren-EnergX Mission Support LLC

REFERENCE

WEMS 2011, Records Management System, Archived collection of facilities and utilities design/construction drawings, Portsmouth Gaseous Diffusion Plant, Piketon, OH.

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APPENDIX E: COST ESTIMATE

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TABLES

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ACRONYMS

BOP	Balance of Plant
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
HEPA	high efficiency particulate air
IH	Industrial Hygiene
NDA	nondestructive assay
RA	remedial action
RI/FS	Remedial Investigation/Feasibility Study
S&M	surveillance and maintenance
WBS	work breakdown structure

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Basis of Estimate

EM.PO.01.03 [U.S. Department of Energy] DOE Services and Infrastructure Support

1. Scope is included in escalated dollars.
2. Services and Support is required for the period of decontamination and decommissioning (D&D) and is assumed to be 2014 through 2025 (12 years).
3. The following work breakdown structure (WBS) reflects the scope of services and support necessary for D&D.
4. Complementary services and support are required for other Portsmouth Gaseous Diffusion Plant activities. These include remedial action (RA), groundwater remediation, uranium management programs, waste management activities (as described in the Waste Disposition Remedial Investigation/Feasibility Study (RI/FS), and other D&D activities (removals authorized under Engineering Evaluation/Cost Analyses and Action Memoranda). The services and support for these activities are excluded from this estimate.

EM.PO.01.03.06.01.06 Sanitary Water - Utility
EM.PO.01.03.06.01.07 Sanitary Sewage - Utility
EM.PO.01.03.06.01.08 Recycle Cooling Water - Utility
EM.PO.01.03.06.01.09 Plant Dry Air - Utility
EM.PO.01.03.06.01.10 Nitrogen System - Utility
EM.PO.01.03.06.01.11 Steam - Utility
EM.PO.01.03.06.01.12 Electrical Power Distribution - Utility
EM.PO.01.03.06.01.13 Laundry - Utility
EM.PO.01.03.06.01.14 Computer Center Implementation
EM.PO.01.03.06.01.15 Plant Shift Superintendent
EM.PO.01.03.06.01.16 X-550 Medium Voltage
EM.PO.01.03.06.01.17 X-5500 High Voltage
EM.PO.01.03.06.01.18 13.8 KV Distribution
EM.PO.01.03.06.01.20 X-6619 Sewage Treatment Plant Replacement
EM.PO.01.03.06.01.22 X-608 By-Pass
EM.PO.01.03.06.01.23 HPFW Construction
EM.PO.01.03.06.02.01 Emergency Management
EM.PO.01.03.06.02.02 Fire Protection Services
EM.PO.01.03.06.02.04 Criticality Accident Alarm System (CAAS)
EM.PO.01.03.10.01.01 Sitewide Interface
EM.PO.01.03.10.01.02 Funds Management
EM.PO.01.03.10.02.01 Project Controls
EM.PO.01.03.10.02.10 PMB Support
EM.PO.01.03.10.03.10 Records Management and Document Control
EM.PO.01.03.10.04.01 External Affairs
EM.PO.01.03.10.04.02 External Review and Support
EM.PO.01.03.10.04.03 Employee Communications
EM.PO.01.03.10.05.01 Real and Personal Property Management
EM.PO.01.03.10.07.01 Office of The President

EM.PO.01.03.10.07.02	Insurance Taxes and Other Business Expenses
EM.PO.01.03.10.07.03	Finance
EM.PO.01.03.10.07.04	HR/IR
EM.PO.01.03.10.07.05	Information Services
EM.PO.01.03.10.07.06	Contracts and Supply Chain
EM.PO.01.03.10.07.07	Legal Management
EM.PO.01.03.10.07.08	Compliance/Internal Audit
EM.PO.01.03.10.08.01	Change Control
EM.PO.01.03.10.08.02	Risk Management
EM.PO.01.03.10.09.02	Estimating & Cost Proposal Services
EM.PO.01.03.11.01.01	ESHQ Program Integration
EM.PO.01.03.11.01.02	Radiation Protection Radiological Site Services
EM.PO.01.03.11.01.03	Occupational Safety and Health
EM.PO.01.03.11.02.01	Performance Assurance
EM.PO.01.03.11.02.02	Quality Assurance
EM.PO.01.03.12.01.01	Environmental Protection
EM.PO.01.03.12.02.04	Sitewide GIS Development and Application
EM.PO.01.03.12.02.07	ER Quality Assurance Project Planning (QAPP)
EM.PO.01.03.12.03.06	Program Management
EM.PO.01.03.13.01.01	System Engineering
EM.PO.01.03.13.01.02	Design Engineering
EM.PO.01.03.13.01.03	Engineering Program Enhancement and Consolidation
EM.PO.01.03.13.02.05	Nuclear Safety/NCS Prog Enhancement/Consolidation
EM.PO.01.03.13.03.01	Conduct of Operations Consolidation
EM.PO.01.03.13.03.02	Work Planning and Control
EM.PO.01.03.13.03.03	Operational Readiness
EM.PO.01.03.13.03.04	Conduct of Operations Program Management
EM.PO.01.03.13.03.05	Work Planning and Control Consolidation
EM.PO.01.03.15.01.01	Nuclear Material Control and Accountability (NMCA)

ER = Environmental Restoration
ESHQ = Environmental, Safety Health and Quality
GIS = Geographic Information System
HPFW = high pressure fire water
HR = Human Resources
IR = Industrial Relations
NCS = Nuclear Criticality Safety
PMB = performance measurement baseline

EM.PO.01.04 Safeguards and Security

1. Scope is included in escalated dollars.

2. Safeguards and Security is required for the period of D&D and is assumed to be 2014 through 2025 (12 years).

3. The following WBS reflects the scope of security activities necessary for D&D.

4. The majority of the scope is related to facilities to be demolished by this RI/FS.

EM.PO.01.04.03.01.01	Security Program
EM.PO.01.04.03.02.01	Cyber Security
EM.PO.01.04.03.03.01	Protective Forces

EM.PO.04.01 D&D of Process Building

1. Scope is included in escalated dollars.

2. Process Building D&D will occur between 2014 through 2021 (8 years) to allow for final remediation of soils and D&D of support buildings (X-700, X-705, X-720 and others) prior to final D&D completion.

3. The following WBS reflects the scope of activities necessary for Process Building D&D.

4. Quantities of equipment and materials removed for Process Equipment D&D is assumed to be the quantities in the December 2011 version of the Mass Flow database (see Appendix E of the Site-wide Waste Disposition Evaluation Project RI/FS).

5. Limited recycle of materials from the Process Buildings is assumed. This is based on continued requirements to control recycle of materials from radiological areas. It is assumed that cost of recycle (including proceeds from recycle) will be equal to the cost of D&D of these materials, so all waste volumes are estimated to be removed and disposed via demolition approaches rather than manual removal before demolition.

EM.PO.04.01.01.01.01	X-333 Project Management
EM.PO.04.01.01.02.01	X-333 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.01.02.02	X-333 Material Removal – Hazardous Waste
EM.PO.04.01.01.02.03	X-333 Material Removal – Bulk ACM Removal
EM.PO.04.01.01.02.05	X-333 Material Removal – Remove Process Deposit Material and Recover Nickel
EM.PO.04.01.01.02.06	X-333 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.01.02.07	X-333 Characterization – Perform NDA Validation
EM.PO.04.01.01.02.08	X-333 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.01.02.09	X-333 Utility Isolation and Redistribution
EM.PO.04.01.01.02.10	X-333 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.01.02.11	X-333 Equipment Removal – Cell Housing Removal
EM.PO.04.01.01.02.12	X-333 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.01.03.02	X-333 – Exterior Transite Removal
EM.PO.04.01.01.03.03	X-333 Building Demolition
EM.PO.04.01.01.03.04	X-333 – Concrete Slab Removal
EM.PO.04.01.01.04.01	X-333 Remedial Design
EM.PO.04.01.01.04.04	X-333 Operational Readiness
EM.PO.04.01.02.01.01	X-330 Project Management
EM.PO.04.01.02.02.01	X-330 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.02.02.02	X-330 Material Removal – Hazardous Waste
EM.PO.04.01.02.02.03	X-330 Material Removal – Bulk ACM Removal
EM.PO.04.01.02.02.05	X-330 Material Removal – Remove Process Deposit Material and Recover Nickel
EM.PO.04.01.02.02.06	X-330 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.02.02.07	X-330 Characterization – Perform NDA Validation
EM.PO.04.01.02.02.08	X-330 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.02.02.09	X-330 Utility Isolation and Redistribution
EM.PO.04.01.02.02.10	X-330 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.02.02.11	X-330 Equipment Removal – Cell Housing Removal

EM.PO.04.01.02.02.12	X-330 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.02.03.02	X-330 – Exterior Transite Removal
EM.PO.04.01.02.03.03	X-330 Building Demolition
EM.PO.04.01.02.03.04	X-330 – Concrete Slab Removal
EM.PO.04.01.02.04.01	X-330 Remedial Design
EM.PO.04.01.02.04.04	X-330 Operational Readiness
EM.PO.04.01.03.01.01	X-326 Project Management
EM.PO.04.01.03.02.01	X-326 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.03.02.02	X-326 Material Removal – Hazardous Waste
EM.PO.04.01.03.02.03	X-326 Material Removal – Bulk ACM Removal
EM.PO.04.01.03.02.05	X-326 Material Removal – Remove Process Deposit Material
EM.PO.04.01.03.02.06	X-326 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.03.02.07	X-326 Characterization – Perform NDA Validation
EM.PO.04.01.03.02.08	X-326 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.03.02.09	X-326 Utility Isolation and Redistribution
EM.PO.04.01.03.02.10	X-326 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.03.02.11	X-326 Equipment Removal – Cell Housing Removal
EM.PO.04.01.03.02.12	X-326 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.03.03.02	X-326 – Exterior Transite Removal
EM.PO.04.01.03.03.03	X-326 Building Demolition
EM.PO.04.01.03.03.04	X-326 – Concrete Slab Removal
EM.PO.04.01.03.04.01	X-326 Remedial Design
EM.PO.04.01.03.04.04	X-326 Operational Readiness

ACM = asbestos containing material
LLW = low-level (radioactive) waste
NDA = nondestructive assay

6. The following process building tielines are included with the Process Building D&D.

   - X-232C1 – Tie Line X-342 to X-330
   - X-232C2 – Tie Line X-330 to X-326
   - X-232C3 – Tie Line X-330 to X-333
   - X-232C4 – Tie Line X-326 to X-770
   - X-232C5 – Tie Line X-343 to X-333.

7. The following dismantlement of equipment and removal of uranium materials for excessive deposits that prevent transportation to off-Site disposal or disposal in the on-Site disposal facility are assumed:

   - X-326 – 116 Converters, 249 compressors, 80 coolers, and 40 valves/pipes
   - X-330 – 20 converters, 30 compressors, 80 coolers, and 30 valves/pipes
   - X-333 – 10 converters, 60 compressors, 70 coolers, and 30 valves/pipes.

8. X-705 and X-720 will require refurbishment of dismantlement systems and installation of additional size reduction systems to remove deposits from X-326 equipment and X-330 and X-333 compressors and coolers, and size reduce the equipment for disposal.

9. X-700 will require refurbishment to install dismantlement systems and equipment to recover nickel and size reduce X-330 and X-333 converters.

10. Preparation of uranium materials for disposal will mix uranium materials with grout in 55-gal drums.

    - X-326 – 160,742 g uranium-235 from compressors and coolers; 10,600 g from valves – total 171,342 g. 53,820 g from barrier.
    - X-330 – 100,873 g uranium-235 from compressors, coolers and valves.
    - X-333 – 167,366 g uranium-235 from compressors, coolers; no g from valves (assume X-330 valves are conservative and represent X-333).
    - Total grams uranium-235 from equipment = 428,981. Grams grouted per drum are 150. Total of 2,860 drums of grouted material from equipment.
    - Total grams uranium-235 from barrier = 53,820. Grams grouted per container are 1,500. Total of 36 containers of grouted material from barrier.
    - Assume uranium materials can be apportioned by weight to drums from uranium containers without individual nondestructive assay (NDA) measurements. Uranium materials mixed with grout to meet fissile-excepted criteria (>2,000:1, co-mingled).
    - Grout crew can grout eight drums per 10-hour shift. Grouting is 90 percent available. Requires 331 workdays.
    - Grout crew is four workers, one foreman, one radiological technician, 0.5 Industrial Hygiene (IH) technician, one field engineer.
    - Equipment is two small forklifts, grout mixer, 50 ft of roller tables, and two high efficiency particulate air (HEPA) units. 55-gal drums included in Waste Management.
    - Materials are 720 lb of grout per drum, 7,200 lb per container (Sakrete® Type N).

11. Because of the presence of deposits in process equipment and piping, characterization for criticality requirements for on-Site waste disposal will require 59 physical samples each from the compressors, converters, coolers and piping in each building. Analysis will be for radioisotopes and metals.

12. NDA analysis will be required of the process gas equipment and piping in all three buildings.

    - In situ NDA of all process cell enclosure and auxiliary enclosure piping to include initial sodium iodide (NaI) scan of all linear feet and gamma measurement of 5 percent of the linear feet. Assumes existing NDA scans for intercell, wing bypass, cell bypass, and unit bypass will be sufficient except for 5 percent of each which will be rescanned and measured again at a pipe level after bypass housings are locally removed and visual inspection occurs.
        - X-326 cell enclosure linear feet - 48,820 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 4,880 linear ft. All bypass linear ft is 110,787 linear ft – 5 percent is 5,540 linear ft. Scan 500 linear ft per 10-hour shift. NDA measure 50 linear ft per 10-hour shift.

   - X-330 cell enclosure linear feet – 58,945 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 5,895 linear ft. All bypass linear feet is 90,381 linear ft – 5 percent is 4,520 linear ft. Scan 500 linear ft per 10-hour shift. NDA measure 50 linear ft per 10-hour shift.

   - X-333 cell enclosure linear feet – 32,640 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 3,265 linear ft. All bypass linear ft is 87,372 linear ft – 5 percent is 4,370 linear ft. Scan 400 linear ft per 10-hour shift. NDA measure 40 linear ft per 10-hour shift.

- Low background NDA of equipment and piping by gamma measurement after removal and after mining. NDA areas are mixture of inside and outside locations (smaller items/packages inside). All removed equipment and piping scanned in X-326 (off-Site disposition).

   - X-326 Ex situ NDA Measurements

      - Equipment - 2,340 converters, 2,340 compressors, 2,340 coolers equals 7,020 total pieces of equipment removed for off-Site disposal. 500 items requires mining – requires 500 equipment (including piping/valves) remeasurements and 500 uranium material container measurements. Eight per day gives 1,003 days.

      - Piping/Valves – 48,820 linear ft, 36,526 cf. Assume NDA for off-Site disposal. Assume 80 percent volume capacity per container. Assume 90-cf fissile Type A containers. Equals 508 containers. Eight per day gives 64 days.

      - 1,003 days plus 64 days is 1,067 days. With 10 percent unavailability is 1,186 days. In 1.25 years, requires 4.7 stations (round to 5).

      - Assume two outside NDA facilities and three inside NDA facilities.

      - All NDA facilities have equipment movement in and out by cart; pipe packages via forklift.

      - Assume all NDA facilities have neutron measurement instruments, shielding on three sides, and measurement lab adjoining.

      - Outside NDA facilities assume 30 ft × 50 ft metal building with roll up doors. Air ventilation only. Asphaltic approaches from existing roads. Will be spaced apart for work flow access.

   - X-330 In and Ex situ NDA Measurements

      - All converters (1,132), 30 compressors, 80 coolers, and 30 valves receive an in situ NDA to verify uranium quantities for mining and segmentation. Three pieces of equipment are measured each 10-hour shift. Assume all other piping and valves are characterized for on-Site disposal using samples and laboratory analysis. Nickel recovery results in 1,000 90-cf boxes which will receive NDA in a low-background station in the segmentation area. Six boxes are measured each 10-hour shift.

- X-333 In and Ex situ NDA Measurements

  - All converters (652), 60 compressors, 70 coolers, and 30 valves receive an in situ NDA to verify uranium quantities for mining and segmentation. Three pieces of equipment are measured each 10-hour shift. Assume all other piping and valves are characterized for on-Site disposal using samples and laboratory analysis. Nickel recovery results in 1,700 90-cf boxes which will receive NDA in a low-background station in the segmentation area. Six boxes are measured each 10-hour shift.

  - Construct an ultra-low background NDA measurement station in X-343 – use preliminary construction estimate details from Baseline planning. Gamma measurements are employed.

13. Vent, purge and draining of process equipment and piping will include a wet air purge and then a visual inspection of piping and accessible areas of equipment to verify no significant deposits as a verification of the in situ NDA measurements.

- Wet air vent/purge of process cells with cell block valves open and cell bypass valves closed. Entire unit's cells are purged together and require 6 days to mobilize, set valve arrangement and purge. X-326 purge cascades require additional 6 days to purge.

  - X-326 – 10 units = 60 days plus 6 additional = 66 days
  - X-330 – 11 units = 66 days
  - X-333 – 8 units = 48 days.

- Wet air vent/purge of cell bypasses with cell and unit isolation valves closed and cell bypass valves opened. Entire unit's bypasses are purged together and require 3 days to mobilize, set valves and purge. X-326 purge cascades require additional 3 days to purge.

  - X-326 – 10 units = 30 days plus 3 additional = 33 days
  - X-330 – 11 units = 33 days
  - X-333 – 8 units = 24 days.

- Wet air vent/purge of unit bypasses and auxiliary systems with unit isolation valves closed and unit bypass valves open. Entire building's bypasses are purged together and requires 6 days to mobilize, set valves and purge.

  - X-326 – 6 days
  - X-330 – 6 days
  - X-333 – 6 days.

- Assume all buildings can be purged using existing purging equipment, traps and stacks. Assume all HF can be discharged from stacks without exceeding National Emission Standards for Hazardous Air Pollutants limits.

  - Vent/Purge Crew - Labor is three workers, one foreman, one radiological technician, 0.25 engineer. 10 additional day's preparation time with one worker, one foreman and two engineers per building.

- Required maintenance during vent/purge:
  - Four seal changes per building with no loss of time (spare put on) - two workers, one foreman, one radiological technician for one day each.
  - Six trap changes per building with no loss of time (spares valved in) - two workers, one foreman, one radiological technician, 0.5 IH technician for one day each.
  - Four valve removals per building with pipe spool piece installed in place – Assume 3 days lost time per valve with two workers, one foreman, one radiological technician and one IH technician each.

- Visual inspection of process piping for deposits - assume cell piping is inspected by removal workers during removal (see Equipment Removal). Cell bypass, unit bypass, and auxiliary piping will be inspected by dedicated crew after vent/purge and housing removal but before removal. Desired to be before NDA but not required.
  - X-326 – Assume auxiliary enclosure linear feet is 10 percent of cell piping - 4,880 linear ft. All bypass linear feet is 110,787 linear ft. Total 115, 667 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.
  - X-330 – Assume auxiliary enclosure linear feet is 10 percent of cell piping - 5,895 linear ft. All bypass linear feet is 90,381 linear ft. Total 96,276 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.
  - X-333 – Assume auxiliary enclosure linear feet is 10 percent of cell piping – 3,265 linear ft. All bypass linear feet is 87,372 linear ft. Total 90,637 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.
  - Inspection crew is three workers, one foreman, two radiological technicians, 0.5 IH technician. Initial preparation time per building is 10 days for one worker, one foreman, and one engineer. Inspection document crew is one engineer and an administrative assistant.
  - Equipment is three digital data recording video borescopes, three spare borescope heads, and two 46-in. high definition digital televisions with digital video recorder. Also four each local HEPA units.

14. Compressors and coolers being removed for disposal in the on-Site disposal facility will have heavy plates welded on the nozzles to allow introduction of grout for subsidence avoidance at the disposal facility.

    - X-326 - Assume welded plates are required for criticality controls on all nozzles of any equipment requiring mining (500 items).
    - X-330 - Install welded plates and grout injection and vent ports on all compressors and coolers (1,181 items).
    - X-333 - Install welded plates and grout injection and vent ports on all compressors and coolers (720 items).

- Grouting capital and operating cost:
  - Design and construct a 100 cy per day pressure grouting system with hose delivery. Design and construct a covered materials storage area for 1,000 cy of materials and bring 1,000 ft of a 2-in. sanitary water line for a supply. Assume the system and materials storage is in the transfer area and will add 1 acre to its size (see below).
  - Assume dry materials for 60,000 cy of grout, two front end loaders, and two 5,000-lb forklifts.
  - Major equipment to handle the process gas equipment and piping will be two trucks and two 25-ton forklifts.
  - Operations personnel will be one supervisor, one foreman, four waste management workers, three equipment operators, two craftsmen, and two radiological technicians.
- Transfer area capital and operating cost:
  - Design and construct a transfer/grouting facility for nominally 500 pieces of equipment or piping each nominally requiring 200 sq ft of work space, the grout system space, or approximately 3.5 acres, with security fencing, lighting, three motorized gates, and three packed gravel access roads. Surface to be packed gravel.
  - Operate the transfer facility as a secure facility with two equipment operators, two waste management workers, two radiological technicians, and two dedicated trucks for duration of grouting.

15. Beyond the removal of process building basements, pits, footers, and truck alleys, the utility lines, duct banks and electric and instrument tunnels will be removed. Assume:

- Removal of under slab structures.
  - X-326
    - Tunnels are 1,365 linear ft, 6,100 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.
    - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.
    - Duct banks average 300 ft length and there are 20 of them. Average duct bank size is 2 ft high by 4 ft wide. 1,770 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.

- X-330
  - Tunnels are 1,820 linear ft, 8,100 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.
  - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.
  - Duct banks average 400 ft length and there are 22 of them. Average duct bank size is 2 ft high by 4 ft wide. 2,600 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.
- X-333
  - Tunnels are 910 linear ft, 4,000 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.
  - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.
  - Duct banks average 500 ft length and there are 16 of them. Average duct bank size is 2 ft high by 4 ft wide. 2,400 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.

- Backfill - After removal of the concrete slab, footers, utilities, duct banks and tunnels, resulting elevation of soils will require backfill before revegetation.
  - X-326 – Calculated void is 119,256 cy. Building is 1.26 million sq ft which means an average void of 2.6 ft below slab elevation. Assume at least 2 ft of backfill must be trucked in equals 93,300 cy compacted, or with 1.2 expansion rate, 112,000 cy in trucks. Assume 9 cy per truck, gives 12,450 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.
  - X-330 – Calculated void is 126,308 cy. Building is 1.39 million sq ft which means an average void of 2.5 ft below slab elevation. Assume at least 2 ft of backfill must be trucked in equals 103,000 cy compacted, or with 1.2 expansion rate, 124,000 cy in trucks. Assume 9 cy per truck, gives 13,700 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.
  - X-333 – Calculated void is 110,385 cy. Building is 1.41 million sq ft which means an average void of 2.1 ft below slab elevation. Assume at least 1.5 ft of backfill must be trucked in equals 78,000 cy compacted, or with 1.2 expansion rate, 94,000 cy in trucks. Assume 9 cy per truck, gives 10,400 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.

16. Remedial design will include the following scope due to the above:

    - Modification design to erect three NDA stations inside X-326 at 35 percent of construction and equipment costs. See Characterization – NDA.

    - Design to erect two NDA facilities outside X-326 at 30 percent of construction and equipment costs. See Characterization – NDA.

17. Operational Readiness will include a DOE Operational Readiness Review for Deposit Removal, preceded by a contractor Management Assessment. Management Assessments will be conducted for the low background NDA operations.

EM.PO.04.02 Balance of Plant (BOP) D&D

1. Scope is included in escalated dollars.

2. BOP D&D will occur in the years 2014 through 2024 (11 years) to allow closure of the disposal facility in 2025.

3. The following WBS reflects the scope of activities necessary for BOP D&D.

EM.PO.04.02.01.03.90 Other BOP Facilities Demolition

BOP = Balance of Plant

4. Quantities of equipment and materials removed for BOP D&D is assumed to be the quantities in the December 2011 version of the Mass Flow database.

5. Recycle of materials from the BOP facilities is assumed. This is limited due to continuing requirements to control recycle of materials from radiological areas. It is assumed that cost of recycle (including proceeds from recycle) will be equal to the cost of D&D of these materials, so all waste volumes are estimated to be removed and disposed via demolition approaches rather than manual removal before demolition.

6. Underground utilities removal, final grading and site restoration are assumed to occur after RA scope in each area is complete.

7. The following 252 facilities are included in the estimate (note – process tielines are shown here but estimated in Process Buildings WBS).

Facility Number	Facility Name
B	Pad in Field East of X-109A (near X-740)
C	Old Switch Yard West of X-109A Pad (near X-740)
E	X-700 “0000” Compressor Base Foundation
H	Old Firing Range Shed
I	Peter Kiewit Powder Magazine

Facility Number	Facility Name
J	X-1000 Pavilion
X-100	Administration Building (slab and below-grade structures)
X-1000	Administration Building
X-1000 T1	Training Trailer
X-1007	Fire Station
X-104A	Indoor Firing Range Building
X-104B	Protective Forces Office Trailer
X-104C	Protective Forces Shower/Locker Trailer
X-105	Electronic Maintenance Building (front apron/concrete pad and driveway)
X-106B	Old Fire Training Building (slab and below-grade water tank)
X-108A	South Portal and Shelter-Drive Gate
X-108B	North Portal and Shelter
X-108E	Construction Entrance Portal
X-108J	West Security Portal
X-108K	North Security Portal
X-108L	East Security Portal
X-1107BV	Interplant Vehicle Portal
X-111A	SNM Monitoring Portal
X-111B	SNM Monitoring Portal
X-114A	Outdoor Firing Range
X-120	Old Weather Station (footers)
X-120H	Weather Station
X-202	Roads
X-204-1	Railroad and Railroad Overpass (excluding DUF_6 utilized track)
X-206A	North Main Parking Lot
X-206B	South Main Parking Lot
X-206E	Construction Parking Lot
X-206H	Pike Avenue Parking Lot
X-206J	South Office Parking Lot
X-208	Security Fence
X-208A	Boundary Fence
X-208B	SNM Security Fence
X-210	Sidewalks
X-215D	Electrical Power Tunnels
X-220A	Instrumentation Tunnels
X-220B1	Process Instrumentation Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines

Facility Number	Facility Name
X-220C	Superior American Alarm System
X-220D1	General Telephone System
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCalloh Alarm System
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System
X-2230T1	Recirculating Heating Water System (East of Valve Pits “A” and “B”)
X-2232E	Gas Pipeline
X-230	Water Supply Line
X-230A	Sanitary and Fire Water Distribution System
X-230A10	Ambient Air Monitoring Station
X-230A12	Ambient Air Monitoring Station
X-230A15	Ambient Air Monitoring Station
X-230A23	Ambient Air Monitoring Station
X-230A24	Ambient Air Monitoring Station
X-230A28	Ambient Air Monitoring Station
X-230A29	Ambient Air Monitoring Station
X-230A3	Ambient Air Monitoring Station
X-230A36	Ambient Air Monitoring Station
X-230A37	Ambient Air Monitoring Station
X-230A40	Ambient Air Monitoring Station
X-230A41	Ambient Air Monitoring Station
X-230A6	Ambient Air Monitoring Station
X-230A8	Ambient Air Monitoring Station
X-230A9	Ambient Air Monitoring Station
X-230B	Sanitary Sewers
X-230C	Storm Sewers

Facility Number	Facility Name
X-230D	Softened Water Distribution System
X-230E	Plant Water System (make-up)
X-230F	Raw Water Supply Line
X-230G	RCW System
X-230H	Fire Water Distribution System
X-230J1	East Environmental Sampling Building (slab)
X-230J1	Monitoring Station
X-230J2	South Environmental Sample Station
X-230J3	West Environmental Sampling Building for Intermittent Containment Basin
X-230J4	Environmental Air Sampling Station
X-230J5	West Holding Pond Oil Separation Station
X-230J6	Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
X-230J7	East Monitor Facility (East Holding Pond Oil Separation Building)
X-230J8	Environmental Storage Building (slab)
X-230M	Clean Test Site
X-232A	Nitrogen Distribution System
X-232B	Dry Air Distribution System
X-232C1	Tie Line X-342 to X-330 (Included with Process Buildings)
X-232C2	Tie Line X-330 to X-326 (Included with Process Buildings)
X-232C3	Tie Line X-330 to X-333 (Included with Process Buildings)
X-232C4	Tie Line X-326 to X-770 (Included with Process Buildings)
X-232C5	Tie Line X-343 to X-333 (Included with Process Buildings)
X-232D	Steam and Condensate System
X-232E	Freon Distribution System
X-232F	Fluorine Distribution System
X-232G	Support for Distribution Lines
X-235	South Groundwater Collection System
X-237	Little Beaver Groundwater Collection System
X-240A	RCW System (Cathodic Protection System)
X-300	Plant Control Facility
X-300A	Process Monitoring Building
X-300B	Plant Control Facility Carport
X-300C	Emergency Communications Antenna
X-342A	Feed Vaporization Building
X-342B	Fluorine Storage Building
X-342C	Waste HF Neutralization Pit (below-grade structures)
X-344A	UF_6 Sampling Facility
X-344C	Hydrogen Fluoride Storage Building (foundations and piers)

Facility Number	Facility Name
X-344D	HF Neutralization Pit (below grade)
X-344E	Gas Ventilation Stack (below grade)
X-344F	Safety Building (below-grade structures)
X-344H	Security Portal
X-345	SNM Storage Building
X-501	Substation
X-501A	Substation
X-502	Substation
X-515	330 kV Tie Line Between X-530 and X-533
X-530 T1	Office Trailer
X-530A	High Voltage Switchyard (grounding systems and underground cables)
X-530B	Switch House (slab and below-grade structures)
X-530C	Test and Repair Building (below-grade structures)
X-530D	Oil House (below-grade structures)
X-530E	Valve House (slab and below-grade structures)
X-530F	Valve House (slab and below-grade structures)
X-530G	GCEP Oil Pumping Station
X-533 T1	Trailer
X-533 T2	Trailer
X-533 T3	Trailer
X-533 T4	Trailer
X-533H	Personnel Monitoring Station
X-540	Telephone Building
X-600	Steam Plant (slab and below-grade structures)
X-600A	Coal Yard (structures)
X-600D	Utilities Maintenance Field Office
X-605	Sanitary Water Control House
X-605A	Well Field
X-608	Raw Water Pump House
X-608A	Well Field
X-608B	Well Field
X-611	Water Treatment Plant (slab and below-grade structures
X-611A	Old Lime Sludge Lagoon (structures)
X-611B	Lagoon (structures)
X-611B1	Lagoon Supernatant Pumping Station
X-611B2	Lagoon Supernatant Pumping Station
X-611B3	Lagoon Supernatant Pumping Station
X-611C	Filter Building (slab and below-grade structures)

Facility Number	Facility Name
X-611E	Clear Well & Chlorine Building (slab and below-grade structures)
X-612	Elevated Storage Tank (below-grade structures)
X-614A	Sewage Pumping Station (slab and below-grade structures)
X-614B	Sewage Pumping Station (slab and below-grade structures)
X-614D	South Sewage Lift Station
X-614P	Northeast Sewage Lift Station
X-614Q	Sewage Booster Pump Station
X-615	Old Sewage Treatment Plant (foundations and piers)
X-616	Liquid Effluent Control Facility (foundations and piers)
X-617	South Holding Pond pH Control Facility
X-622	South Groundwater Treatment Facility
X-623	North Groundwater Treatment Building
X-624	Little Beaver Groundwater Treatment Facility
X-625	Groundwater Passive Treatment Facility
X-626-1	Recirculating Water Pump House (slab and below-grade structures)
X-626-2	Cooling Tower (below-grade structures)
X-627	Groundwater Pump & Treatment Facility
X-630-1	Recirculating Water Pump House (slab and below-grade structures)
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-630-3	Acid Handling Station (saddles and basin)
X-633 T1	Trailer
X-633 T2	Trailer
X-633 T3	Trailer
X-640-1	Fire Water Pump House (slab and below-grade structures)
X-640-1A	Substation (required for Fire Services)
X-640-2	Elevated Storage Tank (below-grade structures)
X-640-2A	Elevated Water Tank Auxiliary Building
X-6619	Sewage Treatment Plant
X-670	Dry Air Plant
X-670A	Cooling Tower
X-675	Plant Nitrogen Station
X-680	Blowdown Sample and Treatment Building
X-700	Converter Shop & Cleaning Building
X-700A	Air Conditioning Equipment Building
X-700B	Sandblast Facility and Observation Booth
X-701A	Lime House (below-grade structures)
X-701D	Water Deionization Facility (below-grade structures)

Facility Number	Facility Name
X-701E	Neutralization Building
X-701F	Effluent Monitoring Facility
X-705	Decontamination Building
X-705D	Heat Booster Pump Building
X-705E	Oxide Conversion Area
X-710	Technical Services Building
X-710A	Technical Service Gas Manifold Shed
X-710B	Explosion Test Facility
X-720	Maintenance and Stores Building
X-720 T01	Office Trailer
X-720A	Maintenance and Stores Gas Manifold Shed (below-grade structures)
X-720B	Radio Base Station
X-720C	Paint & Storage Building
X-721	Radiation Instrument Calibration
X-741	Oil Drum Storage Facility
X-742	Gas Cylinder Storage Facility
X-744K	Warehouse-K
X-744N	Warehouse N Non-UEA
X-744P	Warehouse P Non-UEA
X-744Q	Warehouse Q Non-UEA
X-744V	Surplus and Salvage Clean Storage Area
X-744Y	Waste Storage Area
X-744Y T1	Trailer
X-744Y T2	Trailer
X-744Y T3	Trailer
X-744Y T4	Trailer
X-744Y T5	Trailer
X-744Y T6	Trailer
X-744Y T8	Trailer
X-744Y T9	Trailer
X-745B	Toll Enrichment Gas Yard
X-745D	Cylinder Storage Yard
X-745F	North Process Gas Stockpile Yard
X-745G-2	Cylinder Storage Yard
X-746	Material Receiving and Inspection (portions of above- and below-grade structures)
X-747	Clean Scrap Yard
X-747A	Material Storage Yard (below-grade structures)
X-747B	Material Storage Yard Pads and Equipment

Facility Number	Facility Name
X-747C	Material Storage Yard Pads and Equipment
X-747D	Material Storage Yard Pads and Equipment
X-747E	Material Storage Yard Pad
X-747G	Precious Metal Scrap Yard (below-grade structures)
X-747H	NW Contaminated Scrap Yard (below-grade structures)
X-747H1	Loading Pad
X-747J	Decontamination Storage Yard
X-748	Truck Scale
X-750	Mobile Equipment Maintenance Shop (slab and below-grade structures)
X-751	GCEP Mobile Equipment Garage
X-760 T1	Trailer
X-760 T2	Trailer
XT-800	GCEP Construction Office Pad
XT-847	Warehouse

GCEP = Gas Centrifuge Enrichment Plant
MSR = maintenance service request
PA = public address
RCW = recirculating cooling water
SCADA = Supervisory Control and Data Acquisition
SNM = special nuclear materials
UEA = uranium enrichment area

8. The following 20 facilities are omitted from the estimate. These are systems primarily contained in other facilities.

Facility Number	Facility Name
X-215A	Electrical Distribution to Process Buildings
X-215B	Electrical Distribution to Other Areas
X-215C	Exterior Lighting
X-220B1	Process Instrumentation Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines
X-220C	Superior American Alarm System
X-220D1	General Telephone System
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCalloh Alarm System

Facility Number	Facility Name
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System

MSR = maintenance service request
PA = public address
SCADA = Supervisory Control and Data Acquisition

9. Estimates are included for two phases of facility D&D – deactivation and demolition.

10. Deactivation includes any necessary utilities deactivation, characterization of the facility, materials removal as necessary for reuse or separate disposal, hazards abatement and procurement of any one time use disposal packages.

11. Demolition includes mobilization for demolition, demolition, size reduction and segregation as necessary of waste and equipment, loading of waste, procurement on any one time use disposal packages.

12. Site restoration is assumed to occur after RA.

EM.PO.04.03 Facility Surveillance and Maintenance

1. Scope is included in escalated dollars.

2. Surveillance and maintenance (S&M) will occur in the years 2014 through 2024 (11 years) to allow closure of the disposal facility in 2025.

3. The following WBS reflects the scope of activities necessary for S&M of D&D facilities.

WBS Ports: EM.PO.04.03.01.01.01 S and M Project Management
WBS Ports: EM.PO.04.03.01.02.01 X-326 S and M
WBS Ports: EM.PO.04.03.01.03.01 X-330 S and M
WBS Ports: EM.PO.04.03.01.04.01 X-333 S and M
WBS Ports: EM.PO.04.03.01.05.03 Other GDP Facilities
WBS Ports: EM.PO.04.03.01.05.06 705 Complex
WBS Ports: EM.PO.04.03.01.05.07 340 Complex
WBS Ports: EM.PO.04.03.01.05.08 100 Complex
WBS Ports: EM.PO.04.03.01.05.09 720 Complex
WBS Ports: EM.PO.04.03.01.05.10 744G Complex
WBS Ports: EM.PO.04.03.01.05.11 XT-848 Total
WBS Ports: EM.PO.04.03.01.05.11 XT-849
WBS Ports: EM.PO.04.03.01.05.11 XT-850

WBS Ports: EM.PO.04.03.01.05.11 XT-851
WBS Ports: EM.PO.04.03.01.05.11 XT-852
WBS Ports: EM.PO.04.03.01.05.12 750 Complex
WBS Ports: EM.PO.04.03.01.05.13 710 Complex
WBS Ports: EM.PO.04.03.01.05.14 Warehouse
WBS Ports: EM.PO.04.03.01.05.15 Trailers
WBS Ports: EM.PO.04.03.01.06.01 Utility Optimization Planning in Support of X-326/X-330/X-333
WBS Ports: EM.PO.04.03.01.06.02 Utility Optimization Planning - Balance of Plant Facilities
WBS Ports: EM.PO.04.03.01.06.03 Site Consolidation Ph2
WBS Ports: EM.PO.04.03.01.06.09 X-720B Radio Repeater Replacement
WBS Ports: EM.PO.04.03.01.06.10 X-540/X-670 Power Feed
WBS Ports: EM.PO.04.03.01.06.11 Vault Relocation

S and M = Surveillance and Maintenance
GDP = Gaseous Diffusion Plant

PROCESS BUILDINGS AND COMPLEX FACILITIES D&D RI/FS COST ESTIMATE

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Table E.1. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Cost Summary

Summary Description		Costs Escalated
Capital Costs		
	D & D Activities	
	DOE Services and Infrastructure Support	$428,658,595
	Safeguards and Security	$223,898,769
	D & D of Process Buildings	$415,636,403
	D & D of Balance of Plant (BOP)	$459,983,206
	Facility Surveillance and Maintenance	$383,350,755
Total Capital Costs		**$1,911,527,729**
Net Present Value		
	Present Value for Capital	**$1,624,990,834**

Table E.2. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Escalation and PV

PROCESS BUILDINGS & COMPLEX FACILITIES D & D RI/FS   PROJECT LOCATION: Portsmouth, Ohio   DATE: December 20, 2012

FY	Esc Factor	Total Capital Costs		Services/Infrastructure		SECURITY		PROC BLDG		BOP		S & M			Present Value (NPV)	
		Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated		Discount Rate	Capital
	2.4%														2.9%	
														NPV	$1,624,990,834	
2013			0		0		0		0		0		0			
2014			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2015			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2016			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2017			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2018			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2019			185,301,774		35,721,550		22,389,877		58,189,096		22,999,160		46,002,091			
2020			168,676,318		35,721,550		22,389,877		41,563,640		22,999,160		46,002,091			
2021			169,174,961		35,721,550		13,433,926		24,938,184		74,747,271		20,334,030			
2022			139,236,777		35,721,550		13,433,926		0		74,747,271		15,334,030			
2023			139,236,777		35,721,550		13,433,926		0		74,747,271		15,334,030			
2024			134,236,777		35,721,550		13,433,926		0		74,747,271		10,334,030			
2025			49,155,476		35,721,550		13,433,926		0		0		0			
	TOTALS		1,911,527,729		428,658,595		223,898,769		415,636,403		459,983,206		383,350,755			
													0			

Table E.3. Process Buildings and Complex Facilities D&D RI/FS
PORTS
DOE Services and Infrastructure Support

Item No	Level 7 WBS - Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
	DOE Services and Infrastructure Support associated with Soil Remediation, Groundwater Remediation, Waste Management, and D&D of Balance of Plant (EE/CA facilities) are Excluded from the Following Estimates						
1	WBS Ports: EM.PO.01.03.06.01.06 Sanitary Water - Utility Total	187,275	$ 11,320,319	$ 2,433,215	$ 199,704	$ 110,299	$ 14,063,538
2	WBS Ports: EM.PO.01.03.06.01.07 Sanitary Sewage - Utility Total	117,359	$ 6,936,176	$ 1,552,800	$ 294,100	$ -	$ 8,783,076
3	WBS Ports: EM.PO.01.03.06.01.08 Recycle Cooling Water - Utility Total	30,682	$ 1,754,909	$ 863,816	$ 35,927	$ 15,961	$ 2,670,613
4	WBS Ports: EM.PO.01.03.06.01.09 Plant Dry Air - Utility Total	35,467	$ 2,026,501	$ 258,459	$ 85,890	$ 57,856	$ 2,428,706
5	WBS Ports: EM.PO.01.03.06.01.10 Nitrogen System - Utility Total	14,654	$ 843,612	$ 901,372	$ 16,394	$ -	$ 1,761,378
6	WBS Ports: EM.PO.01.03.06.01.11 Steam - Utility Total	141,793	$ 8,045,368	$ 3,516,098	$ 14,959,935	$ -	$ 26,521,401
7	WBS Ports: EM.PO.01.03.06.01.12 Electrical Power Distribution - Utility Total	358,576	$ 22,307,051	$ 1,577,944	$ 360,155	$ 57,635	$ 24,302,784
8	WBS Ports: EM.PO.01.03.06.01.13 Laundry - Utility Total	74,589	$ 2,668,283	$ 439,021	$ 720,027	$ 5,410,226	$ 9,237,556
9	WBS Ports: EM.PO.01.03.06.01.14 Computer Center Implementation (Mod 11) Total	5,733	$ 340,028	$ 21,133	$ -	$ 1,812,083	$ 2,173,243
10	WBS Ports: EM.PO.01.03.06.01.15 Plant Shift Superintendent Total	412,462	$ 25,218,490	$ 778,320	$ 165,663	$ -	$ 26,162,473
11	WBS Ports: EM.PO.01.03.06.01.16 X-550 Medium Voltage Total	16,215	$ 924,346	$ 8,087	$ -	$ 8,299,139	$ 9,231,573
12	WBS Ports: EM.PO.01.03.06.01.17 X-5500 High Voltage Total	32,430	$ 1,906,276	$ 16,678	$ -	$ 8,337,347	$ 10,260,301
13	WBS Ports: EM.PO.01.03.06.01.18 13.8 KV Distribution Total	21,791	$ 1,231,674	$ 10,794	$ -	$ 8,942,317	$ 10,184,784
14	WBS Ports: EM.PO.01.03.06.01.20 X-6619 Sewage Treatment Plant Replacement Total	10,716	$ 693,489	$ 20,684	$ -	$ 21,608,572	$ 22,322,744
15	WBS Ports: EM.PO.01.03.06.01.22 X-608 By-Pass Total	80	$ 4,307	$ 148	$ -	$ 41,777	$ 46,231
16	WBS Ports: EM.PO.01.03.06.01.23 HPFW Construction Total	1,824	$ 102,775	$ 3,065	$ -	$ 2,088,834	$ 2,194,674
17	WBS Ports: EM.PO.01.03.06.02.01 Emergency Management Total	60,864	$ 5,907,397	$ 179,234	$ 69,143	$ 1,767,659	$ 7,923,433
18	WBS Ports: EM.PO.01.03.06.02.02 Fire Protection Services Total	449,111	$ 25,640,394	$ 676,322	$ 270,643	$ -	$ 26,587,358
19	WBS Ports: EM.PO.01.03.06.02.04 Criticality Accident Alarm System (CAAS) Total	43,365	$ 2,491,150	$ 23,848	$ -	$ 173,587	$ 2,688,584
20	WBS Ports: EM.PO.01.03.10.01.01 Sitewide Interface Total	28,218	$ 2,188,966	$ 22,056	$ -	$ 2,272,345	$ 4,483,368
21	WBS Ports: EM.PO.01.03.10.01.02 Funds Management Total	12,129	$ 822,450	$ 6,444	$ -	$ -	$ 828,894
22	WBS Ports: EM.PO.01.03.10.02.01 Project Controls Total	60,028	$ 3,824,825	$ -	$ -	$ 7,968	$ 3,832,793
23	WBS Ports: EM.PO.01.03.10.02.10 PMB Support Total	0	$ -	$ -	$ -	$ 65,216	$ 65,216
24	WBS Ports: EM.PO.01.03.10.03.10 Records Management and Document Control Total	224,128	$ 9,659,393	$ 145,321	$ -	$ 173,368	$ 9,978,083
25	WBS Ports: EM.PO.01.03.10.04.01 External Affairs Total	51,802	$ 4,373,926	$ 106,743	$ -	$ 2,435,811	$ 6,916,480
26	WBS Ports: EM.PO.01.03.10.04.02 External Review and Support Total	2,033	$ 226,631	$ 1,064	$ -	$ -	$ 227,695
27	WBS Ports: EM.PO.01.03.10.04.03 Employee Communications Total	33,428	$ 2,300,113	$ 71,749	$ -	$ 1,043,614	$ 3,415,476
28	WBS Ports: EM.PO.01.03.10.05.01 Real and Personal Property Management Total	68,615	$ 4,840,359	$ 31,116	$ -	$ 2,241	$ 4,873,716
29	WBS Ports: EM.PO.01.03.10.07.01 Office of The President Total	138,437	$ 20,973,814	$ -	$ -	$ 8,911	$ 20,982,725

Table E.3. Process Buildings and Complex Facilities D&D RI/FS
PORTS
DOE Services and Infrastructure Support (Continued)

Item No	Level 7 WBS - Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
30	WBS Ports: EM.PO.01.03.10.07.02 Insurance Taxes and Other Business Expenses Total	0	$ -	$ -	$ -	$ 4,686,393	$ 4,686,393
31	WBS Ports: EM.PO.01.03.10.07.03 Finance Total	92,434	$ 7,293,105	$ -	$ -	$ 4,198	$ 7,297,303
32	WBS Ports: EM.PO.01.03.10.07.04 HR/IR Total	63,308	$ 4,784,846	$ 1,335,838	$ -	$ 720,932	$ 6,841,616
33	WBS Ports: EM.PO.01.03.10.07.05 Information Services Total	81,804	$ 4,414,067	$ -	$ -	$ 523,914	$ 4,937,981
34	WBS Ports: EM.PO.01.03.10.07.06 Contracts and Supply Chain Total	83,201	$ 5,159,154	$ -	$ -	$ 10,397	$ 5,169,551
35	WBS Ports: EM.PO.01.03.10.07.07 Legal Management Total	1,393	$ 200,972	$ -	$ -	$ 198	$ 201,170
36	WBS Ports: EM.PO.01.03.10.07.08 Compliance/Internal Audit Total	7,156	$ 865,468	$ 8,660	$ -	$ 38,638	$ 912,766
37	WBS Ports: EM.PO.01.03.10.08.01 Change Control Total	6,345	$ 428,740	$ 8,154	$ -	$ 620,470	$ 1,057,363
38	WBS Ports: EM.PO.01.03.10.08.02 Risk Management Total	6,216	$ 418,655	$ 6,378	$ -	$ 437,834	$ 862,867
39	WBS Ports: EM.PO.01.03.10.09.02 Estimating & Cost Proposal Services Total	110,679	$ 7,814,985	$ 478,003	$ -	$ 8,644,059	$ 16,937,047
40	WBS Ports: EM.PO.01.03.11.01.01 ESHQ Program Integration Total	49,721	$ 3,395,546	$ 6,717	$ -	$ 4,019	$ 3,406,282
41	WBS Ports: EM.PO.01.03.11.01.02 Radiation Protection Radiological Site Services Total	155,712	$ 10,978,205	$ 202,146	$ -	$ 1,368,109	$ 12,548,460
42	WBS Ports: EM.PO.01.03.11.01.03 Occupational Safety and Health Total	129,468	$ 9,285,298	$ 330,873	$ -	$ 2,356,052	$ 11,972,223
43	WBS Ports: EM.PO.01.03.11.02.01 Performance Assurance Total	63,309	$ 4,449,869	$ 12,664	$ -	$ 5,490	$ 4,468,023
44	WBS Ports: EM.PO.01.03.11.02.02 Quality Assurance Total	114,894	$ 7,769,034	$ 14,078	$ -	$ 12,324	$ 7,795,437
45	WBS Ports: EM.PO.01.03.12.01.01 Environmental Protection Total	112,649	$ 10,116,577	$ 88,423	$ 35,217	$ 932,959	$ 11,173,176
46	WBS Ports: EM.PO.01.03.12.02.04 Sitewide GIS Development and Application Total	55,254	$ 4,317,117	$ 57,627	$ -	$ 360,322	$ 4,735,066
47	WBS Ports: EM.PO.01.03.12.02.07 ER Quality Assurance Project Planning (QAPP) Total	36,840	$ 2,567,412	$ 19,676	$ -	$ -	$ 2,587,088
48	WBS Ports: EM.PO.01.03.12.03.06 Program Management Total	111,115	$ 7,468,051	$ -	$ -	$ 1,576,316	$ 9,044,367
49	WBS Ports: EM.PO.01.03.13.01.01 System Engineering Total	72,905	$ 5,285,888	$ 90,262	$ -	$ 397,116	$ 5,773,266
50	WBS Ports: EM.PO.01.03.13.01.02 Design Engineering Total	22,171	$ 1,504,295	$ 14,190	$ -	$ 559,423	$ 2,077,908
51	WBS Ports: EM.PO.01.03.13.01.03 Engineering Program Enhancement and Consolidation Total	6,486	$ 561,736	$ 7,146	$ -	$ 1,281,463	$ 1,850,344
52	WBS Ports: EM.PO.01.03.13.02.05 Nuclear Safety/NCS Prog Enhancement/Consolidation Total	3,243	$ 159,499	$ 5,558	$ -	$ 1,199,025	$ 1,364,081
53	WBS Ports: EM.PO.01.03.13.03.01 Conduct of Operations Consolidation Total	3,243	$ 255,008	$ 4,764	$ -	$ 1,025,254	$ 1,285,026
54	WBS Ports: EM.PO.01.03.13.03.02 Work Planning and Control Total	78,914	$ 5,045,264	$ 195,683	$ -	$ 2,205,162	$ 7,446,110
55	WBS Ports: EM.PO.01.03.13.03.03 Operational Readiness Total	18,010	$ 1,430,395	$ 671,451	$ -	$ 1,654,901	$ 3,756,746
56	WBS Ports: EM.PO.01.03.13.03.04 Conduct of Operations Program Management Total	0	$ -	$ 89	$ -	$ 12,529	$ 12,618
57	WBS Ports: EM.PO.01.03.13.03.05 Work Planning and Control Consolidation Total	23,495	$ 1,319,318	$ 13,092	$ -	$ 512,585	$ 1,844,994
58	WBS Ports: EM.PO.01.03.15.01.01 Nuclear Material Control and Accountability (NMCA) Total	136,188	$ 10,831,864	$ 238,617	$ 114,271	$ 232,992	$ 11,417,744
	Subtotal	4,279,956	$ 287,693,387	$ 17,475,616	$ 17,327,069	$ 96,115,837	$ 418,611,909
	TOTAL -(Includes Project Start Delay of 1 Year)		**$ 294,598,028**	**$ 17,895,031**	**$ 17,742,919**	**$ 98,422,617**	**$ 428,658,595**

Table E.4. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Safeguards and Security

TITLE: Safeguards and Security						**PROJECT LOCATION:**		**Portsmouth, Ohio**				**DATE:**	December 20, 2012	
Item					**LABOR**				**MATERIAL**		**EQUIPMENT**		**SUBCONTRACT**	
No.	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**CRAFT**	**$/MH**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$ VALUE**	**TOTAL ($)**
1	Security Program	12	Yrs		185,012			19,205,244		1,550,476		904,926		21,660,646
2	Cyber Security	12	Yrs		2,255			92,387		1,225		0		93,612
3	Protective Forces	12	Yrs		3,498,980			190,280,082		6,519,727		97,075		196,896,884
														0
	Subtotal				3,686,248			209,577,713		8,071,428		1,002,001	0	218,651,142
	Sales Tax on Material only @ 7 % (Incl'd)									0				0
	Subtotal				3,686,248			209,577,713		8,071,428		1,002,001	0	218,651,142
	Contractor Markups at 26.0% (N/A)													0
	Subtotal													218,651,142
	TOTAL -(Includes Project Start Delay of 1 Year)							**214,607,578**		**8,265,142**		**1,026,049**		**223,898,769**
													****TOTAL****	**$ 223,898,769**

Table E.5. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Process Building D&D

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
1	WBS Ports: EM.PO.04.01.01.01.01 X-333 Project Management - Deactivation Total	96,964	$ 5,704,396	$ 116,024	$ 138,671	$ 134,988	$ 6,094,079
2	WBS Ports: EM.PO.04.01.01.01.03 X-333 Project Management - Demolition Total	144,528	$ 9,040,015	$ 79,535	$ -	$ 40,811	$ 9,160,361
3	WBS Ports: EM.PO.04.01.01.02.01 X-333 Material Removal - Remove and Package LLW Equipment and Debris Total	21,358	$ 1,135,414	$ 47,348	$ 27,995	$ 684	$ 1,211,441
4	WBS Ports: EM.PO.04.01.01.02.02 X-333 Material Removal - Hazardous Waste Total	25,791	$ 1,394,035	$ 72,832	$ 109,923	$ 42,583	$ 1,619,373
5	WBS Ports: EM.PO.04.01.01.02.03 X-333 - Bulk ACM Removal Total	4,880	$ 240,130	$ 31,650	$ 60,900	$ 38,711	$ 371,391
6	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	338,466	$ 19,245,189	$ 7,997,991	$ 1,822,749	$ -	$ 29,065,929
7	WBS Ports: EM.PO.04.01.01.02.06 X-333 Characterization - Perform Rad and HazMat Surveys/Sampling Total	54,359	$ 2,791,219	$ 777,310	$ 77,870	$ 940,353	$ 4,586,752
8	WBS Ports: EM.PO.04.01.01.02.07 X-333 Characterization - Perform NDA Validation Total	64,318	$ 3,574,764	$ 1,215,020	$ 14,309	$ 61,183	$ 4,865,276
9	WBS Ports: EM.PO.04.01.01.02.08 X-333 Characterization-Vent, Purge, and Drain process System Total	28,348	$ 1,507,000	$ 151,000	$ 21,000	$ -	$ 1,679,000
10	WBS Ports: EM.PO.04.01.01.02.09 X-333 Utility Isolation and Redistribution Total	23,076	$ 1,167,630	$ 208,628	$ 296,524	$ 1,036	$ 1,673,818
11	WBS Ports: EM.PO.04.01.01.02.10 X-333 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	35,867	$ 1,934,752	$ 1,208,948	$ 329,339	$ 47,005	$ 3,520,044
12	WBS Ports: EM.PO.04.01.01.02.11 X-333 Equipment Removal - Cell Housing Removal Total	69,380	$ 3,334,539	$ 409,392	$ 275,871	$ 551,769	$ 4,571,571
13	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	207,120	$ 11,777,972	$ 1,433,394	$ 1,982,613	$ 28,827	$ 15,222,806
14	WBS Ports: EM.PO.04.01.01.03.02 X-333 - Exterior Transite Siding Removal Total	17,306	$ 885,914	$ 289,097	$ 405,042	$ 67,412	$ 1,647,465
15	WBS Ports: EM.PO.04.01.01.03.03 X-333 - Building Demolition Total	191,134	$ 9,999,201	$ 2,071,408	$ 7,336,244	$ 7,503	$ 19,414,356
16	WBS Ports: EM.PO.04.01.01.03.04 X-333 - Concrete Slab Removal Total	97,551	$ 5,091,282	$ 1,031,580	$ 3,776,870	$ 1,638	$ 9,901,370
17	WBS Ports: EM.PO.04.01.01.04.01 X-333 Remedial Design Total	34,062	$ 1,748,814	$ -	$ -	$ 4,626	$ 1,753,440
18	WBS Ports: EM.PO.04.01.01.04.04 X-333 Operational Readiness Total	58,250	$ 3,227,855	$ 16,836	$ -	$ 3,722	$ 3,248,413
19	X-232-C-3 X-330 to X-333 Tieline Demolition Total	-	$ -	$ -	$ -	$ 125,000	$ 125,000
20	X-232-C-5 X-343 to X-333 Tieline Demolition Total	-	$ -	$ -	$ -	$ 800,000	$ 800,000
21	WBS Ports: EM.PO.04.01.02.01.01 X-330 Project Management - Deactivation Total	60,178	$ 3,418,038	$ 84,565	$ 271,687	$ 129,352	$ 3,903,642
22	WBS Ports: EM.PO.04.01.02.01.03 X-330 Project Management - Demolition Total	82,425	$ 4,983,293	$ 49,694	$ 88,944	$ 32,101	$ 5,154,032
23	WBS Ports: EM.PO.04.01.02.02.01 X-330 Material Removal - Remove and Package LLW Equipment and Debris Total	18,856	$ 966,350	$ 40,773	$ 23,150	$ 606	$ 1,030,879
24	WBS Ports: EM.PO.04.01.02.02.02 X-330 Material Removal - Hazardous Waste Total	19,382	$ 1,036,672	$ 60,085	$ 97,484	$ 592	$ 1,194,833
25	WBS Ports: EM.PO.04.01.02.02.03 X-330 - Bulk ACM Removal Total	13,120	$ 638,620	$ 92,698	$ 33,520	$ 139,487	$ 904,325
26	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	449,413	$ 24,987,389	$ 7,987,079	$ 3,330,583	$ -	$ 36,305,051
27	WBS Ports: EM.PO.04.01.02.02.05 X-330 -X-700 Refurbishment Total	227,109	$ 12,627,275	$ 6,347,705	$ 4,021,785	$ -	$ 22,996,765
28	WBS Ports: EM.PO.04.01.02.02.06 X-330 Characterization - Perform Rad and HazMat Surveys/Sampling Total	66,262	$ 3,438,661	$ 947,472	$ 86,340	$ 970,639	$ 5,443,112
29	WBS Ports: EM.PO.04.01.02.02.07 X-330 Characterization - Perform NDA Validation Total	65,181	$ 4,291,338	$ 302,291	$ 13,077	$ 134,082	$ 4,740,788
30	WBS Ports: EM.PO.04.01.02.02.08 X-330 Characterization-Vent, Purge, and Drain process System Total	30,036	$ 1,670,000	$ 167,000	$ 21,000	$ -	$ 1,858,000
31	WBS Ports: EM.PO.04.01.02.02.09 X-330 Utility Isolation & Redistribution Total	23,549	$ 1,185,974	$ 217,587	$ 299,336	$ 979	$ 1,703,876
32	WBS Ports: EM.PO.04.01.02.02.10 X-330 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	36,004	$ 1,903,720	$ 1,246,549	$ 432,484	$ 46,084	$ 3,628,837
33	WBS Ports: EM.PO.04.01.02.02.11 X-330 Equipment Removal - Cell Housing Removal Total	45,488	$ 2,185,488	$ 450,459	$ 76,704	$ 335,849	$ 3,048,500
34	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	325,452	$ 18,095,142	$ 2,492,389	$ 2,380,132	$ 59,616	$ 23,027,279
35	WBS Ports: EM.PO.04.01.02.03.02 X-330 - Exterior Transite Siding Removal Total	19,989	$ 997,193	$ 252,312	$ 312,321	$ 56,951	$ 1,618,777
36	WBS Ports: EM.PO.04.01.02.03.03 X-330 - Building Demolition Total	163,480	$ 8,523,433	$ 1,808,728	$ 6,451,611	$ 6,209	$ 16,789,981
37	WBS Ports: EM.PO.04.01.02.03.04 X-330 - Concrete Slab Removal Total	88,718	$ 4,547,858	$ 713,047	$ 3,548,365	$ 1,161	$ 8,810,431
38	WBS Ports: EM.PO.04.01.02.04.01 X-330 Remedial Design Total	34,482	$ 1,721,420	$ -	$ -	$ 4,592	$ 1,726,012
39	WBS Ports: EM.PO.04.01.02.04.04 X-330 Operational Readiness Total	63,375	$ 3,492,730	$ 18,264	$ -	$ 4,037	$ 3,515,031
40	X-232-C-1 X-342 to X-330 Tieline Demolition Total	$ -	$ -	$ -	$ -	$ 125,000	$ 125,000
41	X-232-C-2 X-330 to X-326 Tieline Demolition Total	$ -	$ -	$ -	$ -	$ 125,000	$ 125,000
42	WBS Ports: EM.PO.04.01.03.01.01 X-326 Project Management - Deactivation Total	90,547	$ 5,260,318	$ 100,793	$ 132,915	$ 116,815	$ 5,610,841
43	WBS Ports: EM.PO.04.01.03.01.03 X-326 Project Management - Demolition Total	100,794	$ 6,248,364	$ 53,707	$ -	$ 44,071	$ 6,346,142
44	WBS Ports: EM.PO.04.01.03.02.01 X-326 Material Removal - Remove and Package LLW Equipment and Debris Total	14,686	$ 747,020	$ 29,976	$ 15,497	$ 470	$ 792,963
45	WBS Ports: EM.PO.04.01.03.02.02 X-326 Material Removal - Hazardous Waste Total	29,908	$ 1,570,758	$ 82,395	$ 114,666	$ 912	$ 1,768,731

Table E.5. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Process Building D&D (Continued)

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
46	WBS Ports: EM.PO.04.01.03.02.03 X-326 - Bulk ACM Removal Total	6,810	$ 326,026	$ 38,465	$ 32,722	$ 56,975	$ 454,188
47	WBS Ports: EM.PO.04.01.03.02.05 X-326 - Buildings X-705, X-720 Refurbishment Total	153,532	$ 8,410,500	$ 5,130,840	$ 330,000	$ -	$ 13,871,340
48	WBS Ports: EM.PO.04.01.03.02.05 X-326 - Material Remove- Process Deposit Mat Total	65,686	$ 3,598,268	$ 1,136,840	$ 516,000	$ -	$ 5,251,108
49	WBS Ports: EM.PO.04.01.03.02.06 X-326 Characterization - Perform Rad and HazMat Surveys/Sampling Total	52,408	$ 2,680,716	$ 744,414	$ 69,340	$ 853,521	$ 4,347,991
50	WBS Ports: EM.PO.04.01.03.02.07 X-326 Characterization - Perform NDA Validation Total	99,090	$ 6,575,510	$ 3,238,051	$ 550,266	$ 119,704	$ 10,483,531
51	WBS Ports: EM.PO.04.01.03.02.08 X-326 Characterization-Vent, Purge, and Drain process System Total	34,867	$ 1,910,000	$ 191,000	$ 21,000	$ -	$ 2,122,000
52	WBS Ports: EM.PO.04.01.03.02.09 X-326 Utility Isolation & Redistribution Total	21,692	$ 1,042,057	$ 197,420	$ 284,229	$ 944	$ 1,524,650
53	WBS Ports: EM.PO.04.01.03.02.10 X-326 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	26,762	$ 1,356,179	$ 901,427	$ 412,079	$ 110,185	$ 2,779,870
54	WBS Ports: EM.PO.04.01.03.02.11 X-326 Equipment Removal - Cell Housing Removal Total	32,560	$ 1,777,259	$ 85,974	$ 46,883	$ 402	$ 1,910,518
55	WBS Ports: EM.PO.04.01.03.02.12 X-326 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	387,090	$ 21,203,276	$ 1,446,436	$ 1,690,468	$ 98,907	$ 24,439,087
56	WBS Ports: EM.PO.04.01.03.03.02 X-326 - Exterior Transite Siding Removal Total	17,788	$ 864,082	$ 202,354	$ 292,399	$ 46,019	$ 1,404,854
57	WBS Ports: EM.PO.04.01.03.03.03 X-326 - Building Demolition Total	142,724	$ 7,319,104	$ 1,551,500	$ 5,520,211	$ 5,420	$ 14,396,235
58	WBS Ports: EM.PO.04.01.03.03.04 X-326 - Concrete Slab Removal Total	76,349	$ 3,866,141	$ 612,994	$ 3,138,018	$ 951	$ 7,618,104
59	WBS Ports: EM.PO.04.01.03.04.01 X-326 Remedial Design Total	60,628	$ 3,038,855	$ 4,275	$ -	$ 4,276	$ 3,047,406
60	WBS Ports: EM.PO.04.01.03.04.04 X-326 Operational Readiness Total	85,996	$ 4,766,826	$ 27,489	$ -	$ 4,691	$ 4,799,006
61	X-232-C-4 X-326 to X-770 Tieline Demolition Total	-	$ -	$ -	$ -	$ 25,000	$ 25,000
62	Grouting of Process Equipment Total	278,168	$ 12,659,371	$ 5,459,952	$ 3,350,001	$ 3,250,000	$ 24,719,324
	Grand Total	5,123,344	$ 279,731,345	$ 61,672,992	$ 54,681,137	$ 9,809,451	$ 405,894,925
	Subtotal	5,123,344	$ 279,731,345	$ 61,672,992	$ 54,681,137	$ 9,809,451	$ 405,894,925
	TOTAL -(Includes Project Start Delay of 1 Year)		**$ 286,444,897**	**$ 63,153,144**	**$ 55,993,484**	**$ 10,044,878**	**$ 415,636,403**

Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Project Management					$57,383,077
FPB Project Management of Balance of Plant Facilities				$57,383,077	
Waste Management					$6,156,516
Waste Management				$6,156,516	
Feed, Transfer, and Sampling Facilities					$69,775,454
	Feed, Transfer & Sampling Facilities				
X-342-A	Feed Vaporization Bldg.	$19,396,793	$2,200,290	$21,597,083	
X-342-B	Fluorine Storage Bldg.	$1,581,472	$98,371	$1,679,843	
X-342-C	Waste HF Neutralization	$0	$12,522	$12,522	
X-344-A	UF6 Sampling Facility	$34,674,130	$11,348,876	$46,023,006	
X-344-C	Hydrogen Fluoride Storage Bldg.	$0	$60,000	$60,000	
X-344-D	HF Neutralization Pit	$0	$200,000	$200,000	
X-344-E	Gas Ventilation Stack	$0	$78,000	$78,000	
X-344-F	Safety Bldg.	$0	$125,000	$125,000	
	Subtotal	$55,652,395	$14,123,059	$69,775,454	
Primary Lab, Maint. & Equip. Cleaning					$147,373,817
	Primary Labs., Maint., & Equip. Cleaning Fac.				
	X-700 Complex				
X-700	Converter Shop & Cleaning Bldg.	$28,331,183	$7,680,959	$36,012,142	
X-700A	Air Conditioning Equipment Bldg.	$1,750,601	$125,765	$1,876,366	
X-700B	Sandblast Fac. & Obs. Booth(w/X-700)	$0	$0	$0	
X-721	Radiation Instrument Calibration	$100,421	$170,182	$270,603	
E	X-700 Comp'r Base Found.(w/X-700)	$0	$0	$0	
	Subtotal	$30,182,205	$7,976,906	$38,159,111	
	X-705 Complex				
X-705	Decontamination Building	$16,565,653	$21,219,906	$37,785,559	
X-705D	Heat Booster Pump Building	$112,042	$30,196	$142,238	
X-705E	Oxide Conversion Area (with X-705)	$0	$35,239	$35,239	
	Subtotal	$16,677,695	$21,285,341	$37,963,036	
	X-710 Complex				
X-710	Technical Services Building	$14,057,433	$6,786,496	$20,843,929	
X-710A	Tech. Service Gas Manifold Shed	$6,251	$9,597	$15,848	
X-710B	Explosion Test Facility	$75,860	$9,598	$85,458	
	Subtotal	$14,139,544	$6,805,691	$20,945,235	
	X-720 Complex				
X-720	Maint. & Stores Building	$29,307,101	$19,765,725	$49,072,826	
X-720A	Maint. & Stores Gas Manifold Shed	$9,102	$4,346	$13,448	
X-720B	Radio Base Station	$968,577	$22,075	$990,652	
X-720C	Paint & Storage Building	$150,270	$79,239	$229,509	
	Subtotal	$30,435,050	$19,871,385	$50,306,435	

**Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)**

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Support Facilities & Systems					$143,693,505
	Administrative Facilities				
Portals					
X-108A	South Portal and Shelter-Drive Gate	$212,203	$279,292	$491,495	
X-108B	North Portal and Shelter	$104,106	$17,855	$121,961	
X-108E	Construction Entrance Portal	$63,958	$54,028	$117,986	
X-108J	West Security Portal	$90,028	$16,061	$106,089	
X-108K	North Security Portal	$90,028	$16,061	$106,089	
X-108L	East Security Portal	$90,028	$16,061	$106,089	
X-111A	SNM Monitoring Portal	$72,381	$26,924	$99,305	
X-111B	SNM Monitoring Portal	$27,385	$13,928	$41,313	
X-344H	Security Portal	$90,028	$16,061	$106,089	
X-1107BV	Interplant Vehicle Portal	$50,181	$23,338	$73,519	
	Subtotal	$890,326	$479,609	$1,369,935	
Trailers					
X-104B	Protective Forces Office Trailer	$211,069	$28,219	$239,288	
X-104C	Protective Forces Shower/Locker Trailer	$211,069	$28,219	$239,288	
X-530 T1	Office Trailer	$106,865	$13,779	$120,644	
X-533 T1	Trailer	$112,022	$14,444	$126,466	
X-533 T2	Trailer	$112,022	$14,444	$126,466	
X-533 T3	Trailer	$112,022	$14,444	$126,466	
X-533 T4	Trailer	$112,022	$14,444	$126,466	
X-600D	Utilities Maintenance Field Office	$101,915	$13,140	$115,055	
X-633 T1	Trailer	$101,915	$13,140	$115,055	
X-633 T2	Trailer	$101,915	$13,140	$115,055	
X-633 T3	Trailer	$101,915	$13,140	$115,055	
X-701 T1	Trailer	$106,713	$13,779	$120,492	
X-720 T01	Office Trailer	$99,251	$13,779	$113,030	
X-744Y T1	Trailer	$109,433	$14,110	$123,543	
X-744Y T2	Trailer	$109,433	$14,110	$123,543	
X-744Y T3	Trailer	$109,433	$14,110	$123,543	
X-744Y T4	Trailer	$109,433	$14,110	$123,543	
X-744Y T5	Trailer	$109,433	$14,110	$123,543	
X-744Y T6	Trailer	$109,433	$14,110	$123,543	
X-744Y T7	Trailer	$109,433	$14,110	$123,543	
X-744Y T8	Trailer	$109,433	$14,110	$123,543	
X-744Y T9	Trailer	$109,433	$14,110	$123,543	
X-760 T1	Trailer	$99,524	$12,832	$112,356	
X-760 T2	Trailer	$99,524	$12,832	$112,356	
X-1000 T1	Training Trailer	$109,277	$14,110	$123,387	
XT-800	GCEP Construction Office Pad	$8,453	$74,445	$82,898	
	Subtotal	$2,892,390	$449,320	$3,341,710	

**Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)**

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Buildings					
X-100	Administration Building (slab & below)	$0	$990,720	$990,720	
X-104A	Indoor Firing Range Building	$155,838	$92,726	$248,564	
X-105	Electronic Maintenance Building (slab)	$0	$100,000	$100,000	
X-106B	Old Fire Training Building (slab)	$0	$60,000	$60,000	
X-300	Plant Control Facility	$2,413,909	$4,385,642	$6,799,551	
X-300A	Process Monitoring Building	$98,435	$63,138	$161,573	
X-300B	Plant Control Facility Carport	$6,251	$35,370	$41,621	
X-300C	Emergency Commun'tions Antenna	$6,251	$2,076	$8,327	
X-533H	Personnel Monitoring Station	$54,188	$7,055	$61,243	
X-540	Telephone Building	$1,730,474	$71,581	$1,802,055	
X-750	Mobile Equipment Maint. Shop (slab)	$0	$101,077	$101,077	
X-751	GCEP Mobile Equipment Garage	$0	$733,783	$733,783	
X-1000	Administration Building	$450,028	$1,085,708	$1,535,736	
X-1007	Fire Station	$167,107	$820,321	$987,428	
J	X-1000 Pavilion	$6,956	$5,978	$12,934	
	Subtotal	$5,089,437	$8,555,175	$13,644,612	
Water Treatment, Storage, and Dist. Facs.					
X-230	Water Supply Line (Utilities)				
X-230A	Sanitary and Fire Water Distrib Sys (Utilities)				
X-230D	Softened Water Distribution System (Utilities)				
X-230E	Plant Water System (make-up)(Utilities)				
X-230F	Raw Water Supply Line (Utilities)				
X-230G	RCW System (Utilities)				
X-230H	Fire Water Distribution System (Utilities)				
X-240A	RCW Sys (Cathodic Protection Sys)(Utilities)				
Utilities Sum	X-230, -A, -D, -E, -F, -G, -H, X-240A	$0	$20,607,021	$20,607,021	
X-605	Sanitary Water Control House	$16,310	$23,363	$39,673	
X-605A	Well Field	$0	$60,000	$60,000	
X-608	Raw Water Pump House	$744,598	$754,400	$1,498,998	
X-608A	Well Field	$0	$60,000	$60,000	
X-608B	Well Field	$0	$60,000	$60,000	
X-611	Water Treatment Plant (slab & below)	$0	$89,918	$89,918	
X-611A	Old Lime Sludge Lagoon (below grade)	$0	$0	$0	
X-611B	Lagoon (below grade)	$0	$10,929	$10,929	
X-611B1	Lagoon Supernatant Pumping Sta.	$5,304	$24,301	$29,605	
X-611B2	Lagoon Supernatant Pumping Sta.	$4,114	$7,783	$11,897	
X-611B3	Lagoon Supernatant Pumping Sta.	$4,575	$24,301	$28,876	
X-611C	Filter Building (slab)	$0	$147,910	$147,910	
X-611E	Clear Well & Chlorine Building (below grade)	$0	$17,191	$17,191	
X-612	Elevated Storage Tank (footers)	$0	$5,027	$5,027	
X-626-1	Recirculating Water Pump House (below grade)	$0	$270,502	$270,502	
X-626-2	Cooling Tower (below grade)	$0	$514,013	$514,013	
X-630-1	Recirculating Water Pump House (below grade)	$0	$342,864	$342,864	
X-630-2A	Cooling Tower (below grade)	$0	$535,020	$535,020	
X-630-2B	Cooling Tower (below grade)	$0	$1,050,884	$1,050,884	
X-630-3	Acid Handling Station (slab)	$0	$9,718	$9,718	

Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-640-1	Fire Water Pump House (below grade)	$0	$25,272	$25,272	
X-640-2	Elevated Storage Tank (footers)	$0	$7,831	$7,831	
X-640-2A	Storage Tank Aux. Bldg.	$7,598	$856	$8,454	
X-680	Blowdown Sample and Treat. Bldg	$0	$60,000	$60,000	
X-701A	Lime House (slab)	$0	$10,000	$10,000	
X-701D	Water Deionization Facility (slab)	$0	$8,774	$8,774	
X-701E	Neutralization Building	$97,515	$8,678	$106,193	
X-701F	Effluent Monitoring Facility	$4,588	$13,428	$18,016	
X-2230T1	Recirc. Heating Water Sys.	$0	$400,000	$400,000	
	Subtotal	$884,602	$25,149,984	$26,034,586	
Sewage Collection and Treatment Facilities					
X-230B	Sanitary Sewers	$0	$1,600,000	$1,600,000	
X-230C	Storm Sewers	$0	$3,100,000	$3,100,000	
X-614A	Sewage Pumping Station (below grade)	$0	$4,127	$4,127	
X-614B	Sewage Pumping Station (below grade)	$0	$7,418	$7,418	
X-614D	South Sewage Lift Station	$4,719	$11,205	$15,924	
X-614P	Northeast Sewage Lift Station	$4,799	$31,316	$36,115	
X-614Q	Sewage Booster Pump Station	$10,200	$11,883	$22,083	
X-615	Old Sewage Treatment Plant (below grade)	$0	$200,000	$200,000	
X-616	Liquid Effluent Control Facility (below grade)	$0	$20,000	$20,000	
X-6619	Sewage Treatment Plant	$452,700	$928,132	$1,380,832	
	Subtotal	$472,418	$5,914,081	$6,386,499	
Electrical Dist. Systems and Facilities					
X-215D	Electrical Power Tunnels	$466,164	$3,738,040	$4,204,204	
X-501	Substation	$5,239	$4,197	$9,436	
X-501A	Substation	$5,239	$5,709	$10,948	
X-502	Substation	$5,686	$18,057	$23,743	
X-515	330 kV Tie Line: X-530 and X-533	$0	$400,000	$400,000	
X-530A	High Voltage Switchyd (ground sys.)	$0	$100,000	$100,000	
X-530B	Switch House (below grade)	$0	$1,285,529	$1,285,529	
X-530C	Test and Repair Building (slab)	$0	$10,469	$10,469	
X-530D	Oil House (below-grade structures)	$0	$2,040	$2,040	
X-530E	Valve House (slab)	$0	$13,892	$13,892	
X-530F	Valve House (slab)	$0	$13,892	$13,892	
X-530G	GCEP Oil Pumping Station	$84,837	$24,497	$109,334	
X-640-1A	Substation (required for Fire Services)	$7,967	$5,701	$13,668	
C	Old Switch Yard West of X-109A Pad	$0	$100,000	$100,000	
	Subtotal	$575,132	$5,722,023	$6,297,155	

Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
	Miscellaneous Utilities				
X-232A	Nitrogen Distribution System(W/X-232D)	$0	$0	$0	
X-232B	Dry Air Distribution System(W/X-232D)	$0	$0	$0	
X-232D	Steam and Condensate System	$26,217,703	$496,701	$26,714,404	
X-232E	Freon Distribution System(W/X-232D)	$0	$0	$0	
X-232F	Fluorine Distribution System(W/X-232D)	$0	$0	$0	
X-232G	Support for Distribution Lines(W/X-232D)	$0	$0	$0	
X-670	Dry Air Plant	$136,251	$578,371	$714,622	
X-670A	Cooling Tower	$9,293	$23,937	$33,230	
X-675	Plant Nitrogen Station	$9,293	$11,210	$20,503	
X-2232E	Gas Pipeline	$0	$250,000	$250,000	
	Subtotal	$26,372,540	$1,360,219	$27,732,759	
	Infrastructure				
X-114A	Outdoor Firing Range	$228,465	$41,774	$270,239	
X-202	Roads	$0	$1,400,000	$1,400,000	
X-204-1	Railroad and Railroad Overpass	$0	$3,200,000	$3,200,000	
X-206A	North Main Parking Lot	$0	$5,736,739	$5,736,739	
X-206B	South Main Parking Lot	$0	$3,632,822	$3,632,822	
X-206E	Construction Parking Lot	$0	$1,191,988	$1,191,988	
X-206H	Pike Avenue Parking Lot	$0	$1,404,590	$1,404,590	
X-206J	South Office Parking Lot	$0	$972,909	$972,909	
X-208	Security Fence	$121,256	$1,668,233	$1,789,489	
X-208A	Boundary Fence (w/X-208)	$0	$0	$0	
X-208B	SNM Security Fence (w/X-208)	$0	$0	$0	
X-210	Sidewalks (w/Facility)	$0	$0	$0	
X-220A	Instrumentation Tunnels	$2,014,579	$16,180,918	$18,195,497	
X-230M	Clean Test Site	$0	$15,000	$15,000	
X-600	Steam Plant (slab and below)	$0	$82,111	$82,111	
X-600A	Coal Yard - structures (Included with X-600)	$0	$0	$0	
X-748	Truck Scale	$8,680	$121,057	$129,737	
B	Pad in Field East of X-109A	$3,129	$16,463	$19,592	
H	Old Firing Range Shed	$0	$20,000	$20,000	
I	Peter Kiewit Powder Magazine	$8,863	$1,879	$10,742	
	Subtotal	$2,384,972	$35,686,483	$38,071,455	
	Storage and Warehouse Facilities				
X-345	SNM Storage Building	$188,612	$4,711,591	$4,900,203	
X-741	Oil Drum Storage Facility	$6,982	$29,927	$36,909	
X-742	Gas Cylinder Storage Facility	$31,590	$130,126	$161,716	
X-744K	Warehouse-K	$63,180	$260,252	$323,432	
X-744N	Warehouse N Non-UEA	$51,929	$169,438	$221,367	
X-744P	Warehouse P Non-UEA	$51,929	$169,438	$221,367	
X-744Q	Warehouse Q Non-UEA	$51,929	$169,438	$221,367	
X-744V	Surplus and Salvage Clean Stor. Area	$0	$20,000	$20,000	
X-744Y	Waste Storage Area	$0	$20,000	$20,000	
X-745B	Toll Enrichment Gas Yard	$1,492	$2,104,621	$2,106,113	

Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-745D	Cylinder Storage Yard	$4,639	$556,236	$560,875	
X-745F	North Process Gas Stockpile Yard	$1,492	$2,217,101	$2,218,593	
X-745G-2	Cylinder Storage Yard	$2,029	$2,812,079	$2,814,108	
X-746	Material Receiving and Inspection (slab)	$0	$90,065	$90,065	
X-747	Clean Scrap Yard	$0	$150,000	$150,000	
X-747A	Material Storage Yard (slab)	$0	$47,519	$47,519	
X-747B	Mat'l Storage Yard Pads and Equip	$93,719	$30,376	$124,095	
X-747C	Mat'l Storage Yard Pads and Equip	$93,719	$30,376	$124,095	
X-747D	Mat'l Storage Yard Pads and Equip	$91,489	$6,628	$98,117	
X-747E	Material Storage Yard	$0	$30,000	$30,000	
X-747H	NW Contaminated Scrap Yard (slab)	$0	$1,816,411	$1,816,411	
X-747H1	Loading Pad	$0	$150,000	$150,000	
X-747J	Decontamination Storage Yard	$0	$30,000	$30,000	
X-847	Warehouse	$315,900	$1,301,260	$1,617,160	
	Subtotal	$1,050,630	$17,052,882	$18,103,512	
Environmental Monitoring and Treatment Fac.					
X-120	Old Weather Station (footers)	$0	$22,278	$22,278	
X-120H	Weather Station	$1,046	$972,908	$973,954	
X-230A3	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A6	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A8	Ambient Air Monitoring Station	$1,025	$343	$1,368	
X-230A9	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A10	Ambient Air Monitoring Station	$1,025	$360	$1,385	
X-230A12	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A15	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A23	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A24	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A28	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A29	Ambient Air Monitoring Station	$1,025	$343	$1,368	
X-230A36	Ambient Air Monitoring Station	$1,005	$335	$1,340	
X-230A37	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A40	Ambient Air Monitoring Station	$1,136	$388	$1,524	
X-230A41	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230J1	East Env. Sampling Bldg, (slab)	$0	$1,375	$1,375	
X-230J2	South Environmental Sample Station	$6,241	$58,618	$64,859	
X-230J3	West Environmental Sampling Building	$273,408	$4,445	$277,853	
X-230J5	West Holding Pond Oil Separation Sta.	$60,456	$5,376	$65,832	
X-230J6	NE Holding Pond Monitoring Facility	$59,373	$5,039	$64,412	
X-230J7	East Holding Pond Oil Separation Bldg	$55,734	$5,301	$61,035	
X-230J8	Environmental Storage Building (slab)	$0	$5,000	$5,000	
X-235	South Groundwater Collection System	$0	$250,000	$250,000	
X-237	Little Beaver Groundwater Coll. Sys.	$0	$250,000	$250,000	

Table E.6. Process Buildings and Complex Facilities D&D RI/FS
PORTS
D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-617	South Holding Pond pH Control Fac.	$6,917	$13,098	$20,015	
X-622	South Groundwater Treatment Facility	$44,450	$173,965	$218,415	
X-623	North Groundwater Treatment Bldg.	$44,450	$173,965	$218,415	
X-624	Little Beaver Groundwater Treat. Fac	$26,670	$104,379	$131,049	
X-625	Groundwater Passive Treatment Fac.	$8,890	$34,793	$43,683	
X-627	Groundwater Pump & Treatment Fac.	$4,445	$17,397	$21,842	
	Subtotal	$607,976	$2,103,306	$2,711,282	
Associated Non-Structural Support Systems					
	The following support system costs are included with associated facilities.				
X-215A	Electrical Distrib. to Process Bldg	$0	$0	$0	
X-215B	Electrical Distrib. to Other Areas	$0	$0	$0	
X-215C	Exterior Lighting	$0	$0	$0	
X-220B1	Process Instrument Lines	$0	$0	$0	
X-220B2	Carrier Communication Systems	$0	$0	$0	
X-220B3	Water Supply Telemetering Lines	$0	$0	$0	
X-220C	Superior American Alarm System	$0	$0	$0	
X-220D1	General Telephone System	$0	$0	$0	
X-220D2	Process Telephone System	$0	$0	$0	
X-220D3	Emergency Telephone System	$0	$0	$0	
X-220E1	Evacuation PA System	$0	$0	$0	
X-220E2	Process PA System	$0	$0	$0	
X-220E3	Power Public Address System	$0	$0	$0	
X-220F	Plant Radio System	$0	$0	$0	
X-220G	Pneumatic Dispatch System	$0	$0	$0	
X-220H	McCalloh Alarm System	$0	$0	$0	
X-220J	Radiation Alarm System	$0	$0	$0	
X-220K	Cascade Automatic Data Proc. Sys.	$0	$0	$0	
X-220L	Classified Computer System	$0	$0	$0	
X-220N	Security Alarm and Surveillance Sys.	$0	$0	$0	
X-220P	MSR System	$0	$0	$0	
X-220R	Public Warning Siren System	$0	$0	$0	
X-220S	Power Operations SCADA System	$0	$0	$0	
	Subtotal	$0	$0	$0	
Site Restoration					**$24,819,981**
Site Restoration				$24,819,981	
	Balance Of Plant (BOP) Subtotal				**$449,202,350**
	Balance Of Plant (BOP) Total-(Includes Project Start Delay of 1 Year)				**$459,983,206**

Table E.7. Process Buildings and Complex Facilities D&D RI/FS
PORTS
Facility Surveillance and Maintenance

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
1	WBS Ports: EM.PO.04.03.01.01.01 S and M Project Management Total	1,392,438	$ 77,980,722	$ 560,513	$ 105,786	$ 5,657,442	$ 84,304,463
2	WBS Ports: EM.PO.04.03.01.02.01 X-326 S and M Total	436,484	$ 24,050,388	$ 16,596,952	$ 512,562	$ 37,429	$ 41,197,331
3	WBS Ports: EM.PO.04.03.01.03.01 X-330 S and M Total	403,460	$ 22,288,280	$ 17,665,878	$ 310,747	$ 41,518	$ 40,306,423
4	WBS Ports: EM.PO.04.03.01.04.01 X-333 S and M Total	440,424	$ 24,483,916	$ 20,488,169	$ 364,243	$ 48,958	$ 45,385,285
5	WBS Ports: EM.PO.04.03.01.05.03 Other GDP Facilities Total	306,791	$ 16,286,458	$ 4,524,185	$ 771,836	$ 7,857,514	$ 29,439,992
6	WBS Ports: EM.PO.04.03.01.05.06 705 Complex Total	247,210	$ 13,569,082	$ 4,744,400	$ 669,511	$ 1,216	$ 18,984,209
7	WBS Ports: EM.PO.04.03.01.05.07 340 Complex Total	251,506	$ 13,488,216	$ 4,719,306	$ 665,998	$ 714	$ 18,874,234
8	WBS Ports: EM.PO.04.03.01.05.08 100 Complex Total	9,546	$ 464,767	$ 137,208	$ 23,192	$ -	$ 625,168
9	WBS Ports: EM.PO.04.03.01.05.09 720 Complex Total	134,088	$ 7,195,426	$ 2,442,271	$ 362,129	$ 1,679	$ 10,001,504
10	WBS Ports: EM.PO.04.03.01.05.10 744G Complex Total	214,792	$ 11,586,505	$ 4,065,510	$ 574,208	$ 948	$ 16,227,172
11	WBS Ports: EM.PO.04.03.01.05.11 XT-848 Total	168,904	$ 9,598,880	$ -	$ -	$ -	$ 9,598,880
12	WBS Ports: EM.PO.04.03.01.05.11 XT-849 Total	0	$ -	$ 1,776,893	$ -	$ -	$ 1,776,893
13	WBS Ports: EM.PO.04.03.01.05.11 XT-850 Total	0	$ -	$ -	$ 478,909	$ -	$ 478,909
14	WBS Ports: EM.PO.04.03.01.05.11 XT-851 Total	0	$ -	$ 882,170	$ -	$ -	$ 882,170
15	WBS Ports: EM.PO.04.03.01.05.11 XT-852 Total	0	$ -	$ 724,849	$ -	$ -	$ 724,849
16	WBS Ports: EM.PO.04.03.01.05.12 750 Complex Total	17,988	$ 935,506	$ 289,315	$ 49,156	$ -	$ 1,273,976
17	WBS Ports: EM.PO.04.03.01.05.13 710 Complex Total	123,768	$ 6,817,250	$ 2,392,058	$ 337,937	$ 488	$ 9,547,734
18	WBS Ports: EM.PO.04.03.01.05.14 Warehouse Total	7,382	$ 335,682	$ 120,470	$ 21,104	$ -	$ 477,257
19	WBS Ports: EM.PO.04.03.01.05.15 Trailers Total	161,688	$ 8,417,447	$ 2,653,418	$ 451,916	$ -	$ 11,522,782
20	WBS Ports: EM.PO.04.03.01.06.01 Utility Optimization Planning in Support of X-326 / X-330 / X-333 Total	14,844	$ 845,292	$ 12,672	$ 56,624	$ 3,064,324	$ 3,978,912
21	WBS Ports: EM.PO.04.03.01.06.02 Utility Optimization Planning - Balance of Plant Facilities Total	0	$ -	$ -	$ -	$ 9,432,948	$ 9,432,948
22	WBS Ports: EM.PO.04.03.01.06.03 Site Consolidation Ph2 Total	0	$ -	$ -	$ -	$ 12,493,556	$ 12,493,556
23	WBS Ports: EM.PO.04.03.01.06.09 X-720B Radio Repeater Replacement Total	4,230	$ 240,959	$ 6,605	$ -	$ 1,932,820	$ 2,180,384
24	WBS Ports: EM.PO.04.03.01.06.10 X-540/X-670 Power Feed Total	338	$ 18,269	$ 437	$ -	$ 132,981	$ 151,687
25	WBS Ports: EM.PO.04.03.01.06.11 Vault Relocation Total	3,030	$ 141,586	$ 1,482	$ -	$ 4,356,185	$ 4,499,253
	Subtotal	4,338,910	$ 238,744,630	$ 84,804,762	$ 5,755,860	$ 45,060,719	$ 374,365,972
	TOTAL -(Includes Project Start Delay of 1 Year)		**$ 244,474,502**	**$ 86,840,077**	**$ 5,894,001**	**$ 46,142,176**	**$ 383,350,755**

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APPENDIX F: SENSITIVITY ANALYSIS OF D&D WITH OFF-SITE DISPOSAL OF WASTES

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TABLES

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ACRONYMS

BOP	Balance of Plant
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
HEPA	high efficiency particulate air
IH	Industrial Hygiene
IP	industrial package
NDA	nondestructive assay
OSDC	on-Site disposal cell
PORTS	Portsmouth Gaseous Diffusion Plant
RA	remedial action
RI/FS	Remedial Investigation/Feasibility Study
S&M	surveillance and maintenance
WBS	work breakdown structure

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Basis of Estimate for the Process Buildings and Complex Facilities Decontamination and Decommissioning (D&D) Evaluation Project Remedial Investigation/Feasibility Study (RI/FS) Sensitivity Analysis Cost Estimate

Introduction

Two action alternatives are presented in the Waste Disposition RI/FS: on-Site disposal and off-Site disposal. Alternative 2, on-Site disposal, involves siting, constructing, and operating an engineered on-Site disposal cell (OSDC) for disposal of anticipated clean up waste generated at the Portsmouth Gaseous Diffusion Plant (PORTS). In Alternative 2, waste not meeting the OSDC waste acceptance criteria would be shipped to appropriate off-Site disposal facilities. Alternative 3, off-Site disposal, involves packaging and transporting the PORTS waste and disposing of it at off-Site facilities. The Process Buildings and Complex Facilities D&D Evaluation Project RI/FS assumes that Alternative 2, on-Site disposal, is the selected alternative for disposition of the D&D waste.

A sensitivity analysis of the cost estimate was performed to determine the change in scope, cost, and schedule for shipping all D&D waste off Site as described in Alternative 3 of the Waste Disposition RI/FS.

The primary scope change would be the need to segment and, as necessary, mine the primary process equipment from the X-330 and X-333 process buildings (compressors and coolers) that are not already segmented for other reasons. The converters in X-330 and X-333 are already segmented for nickel recovery. This would be necessary since shipment of this equipment as fissile waste is not possible due to lack of an approved container of sufficient size and, in many cases, the presence of quantities of uranium-235 greater than the transportation limits for fissile material transport. This scope change is offset, however, by a scope reduction of managing void spaces for the same equipment. No longer would it be necessary to fill voids in the process equipment (an assumption made in this RI/FS pending approval of the on-Site disposal waste acceptance criteria).

The change in the sensitivity analysis that most impacts cost is the assumed schedule. Alternative 3 of the Waste Disposition RI/FS assumes that off-Site disposition would require an additional 6 years to implement due to funding constraints (2024 for on-Site disposal, 2030 for off-Site disposal). Without assuming that massive quantities of D&D waste be staged for years, the D&D remediation would therefore be executed through the year 2030. This causes additional years of infrastructure and services support, security, and surveillance and maintenance costs. Project management costs for D&D activities will increase. Total project cost will increase due to higher escalation factors for the later years.

A comparison of the D&D costs (escalated costs and net present value) between on-Site and off-Site disposal are shown in Table F.1. Yearly D&D costs are estimated assuming the on-Site disposal of D&D waste and the off-Site disposal of D&D waste in Table F.2.

Differences in the sensitivity analysis basis of estimate from the D&D alternative are indicated by a ►.

**Table F.1. Process Buildings and Complex Facilities D&D
Sensitivity Analysis – Off-Site Disposal
PORTS
Cost Comparison**

Summary Description		Sensitivity Analysis Dollars Escalated	Alternative 2 Dollars Escalated	Delta
Capital Costs				
	D&D Activities			
	DOE Services and Infrastructure Support	$585,727,175	$428,658,595	$157,068,580
	Safeguards and Security	$373,164,616	$223,898,769	$149,265,847
	D&D of Process Buildings	$451,446,432	$415,636,403	$35,810,029
	D&D of BOP	$541,285,128	$459,983,206	$81,301,922
	Facility Surveillance and Maintenance	$634,254,408	$383,350,755	$250,903,653
Total Capital Costs		$**2,585,877,759**	$**1,911,527,729**	$674,350,030
Net Present Value				
	Present Value for Capital	$**2,025,107,700**	$**1,624,990,834**	$400,116,866

BOP = Balance of Plant
D&D = decontamination and decommissioning
DOE = U.S. Department of Energy

**Table F.2. Process Buildings and Complex Facilities D&D
Sensitivity Analysis – Off-Site Disposal
PORTS
Yearly Costs**

	Total Capital Costs	
FY	Sensitivity Analysis Dollars Escalated	Alternative 2 Dollars Escalated
2013	$0	$0
2014	$155,443,799	$185,301,774
2015	$155,443,799	$185,301,774
2016	$155,443,799	$185,301,774
2017	$162,508,055	$185,301,774
2018	$162,508,055	$185,301,774
2019	$162,508,055	$185,301,774
2020	$162,508,055	$168,676,318
2021	$156,165,511	$169,174,961
2022	$147,136,582	$139,236,777
2023	$147,136,582	$139,236,777

**Table F.2. Process Buildings and Complex Facilities D&D
Sensitivity Analysis – Off-Site Disposal
PORTS
Yearly Costs (Continued)**

	Total Capital Costs	
FY	**Sensitivity Analysis Dollars Escalated**	**Alternative 2 Dollars Escalated**
2024	$147,136,582	$134,236,777
2025	$140,794,038	$49,155,476
2026	$140,794,038	
2027	$140,794,038	
2028	$125,074,281	
2029	$115,560,464	
2030	$115,560,464	
2031	$93,361,560	
TOTALS	**$2,585,877,759**	**$1,911,527,729**

FY = fiscal year

EM.PO.01.03 [U.S. Department of Energy] DOE Services and Infrastructure Support

1. Scope is included in escalated dollars.

2. ►Services and Support is required for the period of D&D and is assumed to be 2014 through 2031(18 years).

3. The following work breakdown structure (WBS) reflects the scope of services and support necessary for D&D.

4. Complementary services and support are required for other PORTS activities. These include remedial action (RA), groundwater remediation, uranium management programs, waste management activities (as described in the Waste Disposition RI/FS), and other D&D activities (removals authorized under Engineering Evaluation/Cost Analyses and Action Memoranda). The services and support for these activities are excluded from this estimate.

EM.PO.01.03.06.01.06	Sanitary Water - Utility
EM.PO.01.03.06.01.07	Sanitary Sewage - Utility
EM.PO.01.03.06.01.08	Recycle Cooling Water - Utility
EM.PO.01.03.06.01.09	Plant Dry Air - Utility
EM.PO.01.03.06.01.10	Nitrogen System - Utility
EM.PO.01.03.06.01.11	Steam - Utility
EM.PO.01.03.06.01.12	Electrical Power Distribution - Utility
EM.PO.01.03.06.01.13	Laundry - Utility
EM.PO.01.03.06.01.14	Computer Center Implementation
EM.PO.01.03.06.01.15	Plant Shift Superintendent

EM.PO.01.03.06.01.16	X-550 Medium Voltage
EM.PO.01.03.06.01.17	X-5500 High Voltage
EM.PO.01.03.06.01.18	13.8 KV Distribution
EM.PO.01.03.06.01.20	X-6619 Sewage Treatment Plant Replacement
EM.PO.01.03.06.01.22	X-608 By-Pass
EM.PO.01.03.06.01.23	HPFW Construction
EM.PO.01.03.06.02.01	Emergency Management
EM.PO.01.03.06.02.02	Fire Protection Services
EM.PO.01.03.06.02.04	Criticality Accident Alarm System (CAAS)
EM.PO.01.03.10.01.01	Sitewide Interface
EM.PO.01.03.10.01.02	Funds Management
EM.PO.01.03.10.02.01	Project Controls
EM.PO.01.03.10.02.10	PMB Support
EM.PO.01.03.10.03.10	Records Management and Document Control
EM.PO.01.03.10.04.01	External Affairs
EM.PO.01.03.10.04.02	External Review and Support
EM.PO.01.03.10.04.03	Employee Communications
EM.PO.01.03.10.05.01	Real and Personal Property Management
EM.PO.01.03.10.07.01	Office of The President
EM.PO.01.03.10.07.02	Insurance Taxes and Other Business Expenses
EM.PO.01.03.10.07.03	Finance
EM.PO.01.03.10.07.04	HR/IR
EM.PO.01.03.10.07.05	Information Services
EM.PO.01.03.10.07.06	Contracts and Supply Chain
EM.PO.01.03.10.07.07	Legal Management
EM.PO.01.03.10.07.08	Compliance/Internal Audit
EM.PO.01.03.10.08.01	Change Control
EM.PO.01.03.10.08.02	Risk Management
EM.PO.01.03.10.09.02	Estimating & Cost Proposal Services
EM.PO.01.03.11.01.01	ESHQ Program Integration
EM.PO.01.03.11.01.02	Radiation Protection Radiological Site Services
EM.PO.01.03.11.01.03	Occupational Safety and Health
EM.PO.01.03.11.02.01	Performance Assurance
EM.PO.01.03.11.02.02	Quality Assurance
EM.PO.01.03.12.01.01	Environmental Protection
EM.PO.01.03.12.02.04	Sitewide GIS Development and Application
EM.PO.01.03.12.02.07	ER Quality Assurance Project Planning (QAPP)
EM.PO.01.03.12.03.06	Program Management
EM.PO.01.03.13.01.01	System Engineering
EM.PO.01.03.13.01.02	Design Engineering
EM.PO.01.03.13.01.03	Engineering Program Enhancement and Consolidation
EM.PO.01.03.13.02.05	Nuclear Safety/NCS Prog Enhancement/Consolidation
EM.PO.01.03.13.03.01	Conduct of Operations Consolidation
EM.PO.01.03.13.03.02	Work Planning and Control
EM.PO.01.03.13.03.03	Operational Readiness
EM.PO.01.03.13.03.04	Conduct of Operations Program Management

EM.PO.01.03.13.03.05	Work Planning and Control Consolidation
EM.PO.01.03.15.01.01	Nuclear Material Control and Accountability (NMCA)

ER = Environmental Restoration
ESHQ = Environmental, Safety Health and Quality
GIS = Geographic Information System
HPFW = high pressure fire water
HR = Human Resources
IR = Industrial Relations
NCS = Nuclear Criticality Safety
PMB = performance measurement baseline

EM.PO.01.04 Safeguards and Security

1. Scope is included in escalated dollars.
2. ►Safeguards and Security is required for the period of D&D and is assumed to be 2014 through 2031 (18 years).
3. The following WBS reflects the scope of security activities necessary for D&D.
4. The majority of the scope is related to facilities to be demolished by this RI/FS.

EM.PO.01.04.03.01.01	Security Program
EM.PO.01.04.03.02.01	Cyber Security
EM.PO.01.04.03.03.01	Protective Forces

EM.PO.04.01 D&D of Process Building

1. Scope is included in escalated dollars.
2. ►Process Building D&D will occur between 2014 through 2027 (14 years) to allow for final remediation of soils and D&D of support buildings (X-700, X-705, X-720 and others) prior to final completion in 2030.
3. The following WBS reflects the scope of activities necessary for Process Building D&D.
4. Quantities of equipment and materials removed for Process Equipment D&D is assumed to be the quantities in the December 2011 version of the Mass Flow database (see Appendix E of the Site-wide Waste Disposition Evaluation project RI/FS).
5. Limited recycle of materials from the Process Buildings is assumed. This is based on continued requirements to control recycle of materials from radiological areas. It is assumed that cost of recycle (including proceeds from recycle) will be equal to the cost of D&D of these materials, so all waste volumes are estimated to be removed and disposed via demolition approaches rather than manual removal before demolition.

EM.PO.04.01.01.01.01	X-333 Project Management
EM.PO.04.01.01.02.01	X-333 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.01.02.02	X-333 Material Removal – Hazardous Waste
EM.PO.04.01.01.02.03	X-333 Material Removal – Bulk ACM Removal
EM.PO.04.01.01.02.05	X-333 Material Removal – Remove Process Deposit Material
EM.PO.04.01.01.02.06	X-333 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.01.02.07	X-333 Characterization – Perform NDA Validation
EM.PO.04.01.01.02.08	X-333 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.01.02.09	X-333 Utility Isolation and Redistribution
EM.PO.04.01.01.02.10	X-333 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.01.02.11	X-333 Equipment Removal – Cell Housing Removal
EM.PO.04.01.01.02.12	X-333 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.01.03.02	X-333 – Exterior Transite Removal
EM.PO.04.01.01.03.03	X-333 Building Demolition
EM.PO.04.01.01.03.04	X-333 – Concrete Slab Removal
EM.PO.04.01.01.04.01	X-333 Remedial Design
EM.PO.04.01.01.04.04	X-333 Operational Readiness
EM.PO.04.01.02.01.01	X-330 Project Management
EM.PO.04.01.02.02.01	X-330 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.02.02.02	X-330 Material Removal – Hazardous Waste
EM.PO.04.01.02.02.03	X-330 Material Removal – Bulk ACM Removal
EM.PO.04.01.02.02.05	X-330 Material Removal – Remove Process Deposit Material
EM.PO.04.01.02.02.06	X-330 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.02.02.07	X-330 Characterization – Perform NDA Validation
EM.PO.04.01.02.02.08	X-330 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.02.02.09	X-330 Utility Isolation and Redistribution
EM.PO.04.01.02.02.10	X-330 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.02.02.11	X-330 Equipment Removal – Cell Housing Removal
EM.PO.04.01.02.02.12	X-330 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.02.03.02	X-330 – Exterior Transite Removal
EM.PO.04.01.02.03.03	X-330 Building Demolition
EM.PO.04.01.02.03.04	X-330 – Concrete Slab Removal
EM.PO.04.01.02.04.01	X-330 Remedial Design
EM.PO.04.01.02.04.04	X-330 Operational Readiness
EM.PO.04.01.03.01.01	X-326 Project Management
EM.PO.04.01.03.02.01	X-326 Material Removal – Remove and Package LLW Equipment and Debris
EM.PO.04.01.03.02.02	X-326 Material Removal – Hazardous Waste
EM.PO.04.01.03.02.03	X-326 Material Removal – Bulk ACM Removal
EM.PO.04.01.03.02.05	X-326 Material Removal – Remove Process Deposit Material
EM.PO.04.01.03.02.06	X-326 Characterization – Perform Rad and Hazmat Surveys/Sampling
EM.PO.04.01.03.02.07	X-326 Characterization – Perform NDA Validation
EM.PO.04.01.03.02.08	X-326 Characterization – Vent, Purge, and Drain Process System
EM.PO.04.01.03.02.09	X-326 Utility Isolation and Redistribution
EM.PO.04.01.03.02.10	X-326 Equipment Removal – Bridge Crane and Elevator Refurbishing
EM.PO.04.01.03.02.11	X-326 Equipment Removal – Cell Housing Removal

EM.PO.04.01.03.02.12	X-326 Equipment Removal – Remove and Package Converters, Compressors, Process Equipment and Piping
EM.PO.04.01.03.03.02	X-326 – Exterior Transite Removal
EM.PO.04.01.03.03.03	X-326 Building Demolition
EM.PO.04.01.03.03.04	X-326 – Concrete Slab Removal
EM.PO.04.01.03.04.01	X-326 Remedial Design
EM.PO.04.01.03.04.04	X-326 Operational Readiness

ACM = asbestos containing material
LLW = low-level (radioactive) waste
NDA = nondestructive assay

6. The following process building tie lines are included with the Process Building D&D.

   - X-232C1 – Tie Line X-342 to X-330
   - X-232C2 – Tie Line X-330 to X-326
   - X-232C3 – Tie Line X-330 to X-333
   - X-232C4 – Tie Line X-326 to X-770
   - X-232C5 – Tie Line X-343 to X-333.

7. ►The following dismantlement of compressors, coolers, valves, and pipes and removal of uranium materials for excessive deposits that prevent transportation to off-Site disposal are assumed. All converters will be dismantled and the nickel recovered prior to segmentation of the remaining converter parts for disposal (no change).

   - X-326 – 116 Converters, 249 compressors, 80 coolers, and 40 valves/pipes (remainder will be transported in intermodal sized fissile container)

   - X-330 – 1,132 converters, 1,109 compressors, 112 coolers, and 60 valves/pipes

   - X-333 – 652 converters, 655 compressors, 82 coolers, and 60 valves/pipes.

8. X-705 and X-720 will require refurbishment of dismantlement systems and installation of additional size reduction systems to remove deposits from X-326 equipment and X-330 and X-333 compressors and coolers, and size reduce the equipment for disposal.

9. X-700 will require refurbishment to install dismantlement systems and equipment to recover nickel and size reduce X-330 and X-333 converters.

10. ►Preparation of uranium materials for disposal will mix uranium materials with grout in 55-gal drums. Will mix barrier materials with grout in 90 cf industrial package (IP)-1 boxes. This assumes all grams from converters are in the barrier and that the grout will result in a fissile excepted package.

    - X-326 – 160,742 g uranium-235 from converters, compressors, coolers; 10,600 g from valves – total 171,342 g; 53,820 g from barrier

    - X-330 – 195,351 g uranium-235 from compressors and coolers; 64,180 g uranium-235 from valves

    - X-333 – 355,831 g uranium-235 from compressors, coolers; no grams from valves (assume X-330 valves are conservative and represent X-333)

- Total grams uranium-235 from equipment = 786,704; grams grouted per drum = 150; total of 5,245 drums of grouted material from equipment
- Total grams uranium-235 from barrier = 53,820; grams grouted per container are 1,500; total of 36 containers of grouted material from barrier.
- Assume uranium materials can be apportioned by weight to drums from uranium containers without individual nondestructive assay (NDA) measurements. Uranium materials mixed with grout to meet fissile-excepted criteria (>2,000:1, co-mingled).
- Grout crew can grout eight drums per 10-hour shift. Grouting is 90 percent available.
- Grout crew is four workers, one foreman, one radiological technician, 0.5 Industrial Hygiene (IH) technician, one field engineer.
- Equipment is two small forklifts, grout mixer, 50 ft of roller tables, and two high efficiency particulate air (HEPA) units. 55-gal drums and 90 cf IP-1 boxes are included in Waste Management.
- Materials are 720 lb of grout per drum, 7,200 lb per container for barrier (Sakrete® Type N).

11. ►NDA analysis will be required of the process gas equipment and piping in all three buildings.

    - In situ NDA of all process cell enclosure and auxiliary enclosure piping to include initial sodium iodide (NaI) scan of all linear feet and gamma measurement of 5 percent of the linear feet. Assumes existing NDA scans for intercell, wing bypass, cell bypass, and unit bypass will be sufficient except for 5 percent of each which will be rescanned and measured again at a pipe level after bypass housings are locally removed and visual inspection occurs. Assume in situ NDA campaign must occur within 54 months per building (4.5 years with 200 10-hour workdays per year). Assumes NDA measurement plus visual inspection of piping will be sufficient to allow demolition of remaining process piping and valves after removal of any deposits of significance and shipment with other non-fissile low-level (radioactive) waste building waste to disposal.
        - X-326 cell enclosure linear feet - 48,820 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 4,882 linear ft. All bypass linear ft is 110,787 linear ft – 5 percent is 5,540 linear ft. Scan 500 linear ft plus any valves per 10-hour shift (164,439 linear ft in 329 shifts). NDA measure 50 linear ft plus any valves per 10-hour shift (8,224 linear feet in 164 shifts).
        - X-330 cell enclosure linear feet – 58,945 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 5,895 linear ft. All bypass linear ft is 90,381 linear ft – 5 percent is 4,520 linear ft. Scan 500 linear ft plus any valves per 10-hour shift (155, 221 linear ft in 310 shifts). NDA measure 50 linear ft plus any valves per 10-hour shift (7,761 linear ft in 155 shifts).
        - X-333 cell enclosure linear feet – 32,640 linear ft. Assume auxiliary enclosure linear feet is 10 percent - 3,264 linear ft. All bypass linear ft is 87,372 linear ft – 5 percent is 4,370 linear ft. Scan 400 linear ft plus any valves per 10-hour shift (123,276 linear feet in 308 shifts). NDA measure 40 linear ft plus any valves per 10-hour shift (6,164 linear ft in 154 shifts).

- ►Low background NDA of equipment and piping by gamma measurement after removal and after mining. NDA areas are mixture of inside and outside locations (smaller items/packages inside). All removed equipment and piping measured in X-326 (for off-Site disposition).
  - X-326 Ex situ NDA Measurements
    - Equipment - 2,400 converters, 2,405 compressors, 2,342 coolers equals 7,147 total pieces of equipment removed for off-Site disposal. 500 items requires mining – requires 500 equipment (including piping/valves) remeasurements and 1,000 uranium material container measurements. Eight per day gives 1,081 days.
    - Piping/Valves – 10,457 cy in situ in 4,954 fissile B-25 boxes; at 8 boxes per day, equals 619 days.
    - 1,081 days plus 619 days is 1,700 days. With 10 percent unavailability is 1,889 days. In 4.5 years, requires 2.1 stations (assume 3).
    - Assume two outside NDA facilities and one inside NDA facilities.
    - All NDA facilities have equipment movement in and out by cart; pipe packages via forklift.
    - All NDA facilities assume neutron measurement instruments, shielding on three sides, and measurement lab adjoining.
    - Outside NDA facilities assume 30 ft x 50 ft metal building with roll up doors. Air ventilation only. Asphaltic approaches from existing roads. Will be spaced apart for work flow access.
  - X-330 In and Ex situ NDA Measurements
    - ►All converters (1,132), compressors (1,109), coolers (112), and 60 valves receive an in situ NDA to verify uranium quantities for mining and segmentation. Three pieces of equipment are measured each 10-hour shift. Assume all other piping and valves are characterized for on-Site disposal using samples and laboratory analysis. Nickel recovery results in 1,000 90-cf boxes which will receive NDA in a low-background station in the segmentation area. Six boxes are measured each 10-hour shift.
    - ►Segmented process equipment intermodal containers (1,270 from 85,872 cy divided by 4.5 reduction factor divided by 15 cy/container) requires NDA in nominally 4 years. Assume a field NDA crew of two with an office crew of two can NDA four boxes per day with one NDA unit.
  - X-333 In and Ex situ NDA Measurements
    - ►All converters (652), compressors (655), coolers (82), and 60 valves receive an in situ NDA to verify uranium quantities for mining and segmentation. Three pieces of equipment are measured each 10-hour shift. Assume all other piping and valves are characterized for on-Site disposal using samples and laboratory analysis. Nickel recovery results in 1,700 90-cf boxes which will receive NDA in a low-background station in the segmentation area. Six boxes are measured each 10-hour shift.

- ►Segmented process equipment intermodal containers (2,030 from 137,107 cy divided by 4.5 reduction factor divided by 15 cy/container) requires NDA in nominally 4 years. Assume a field NDA crew of two with an office crew of two can NDA four boxes per day with one NDA unit.

12. Vent, purge and draining of process equipment and piping will include a wet air purge and then a visual inspection of piping and accessible areas of equipment to verify no significant deposits as a verification of the in situ NDA measurements.

- Wet air vent/purge of process cells with cell block valves open and cell bypass valves closed. Entire unit's cells are purged together and require 6 days to mobilize, set valve arrangement and purge. X-326 purge cascades require additional 6 days to purge.

  - X-326 – 10 units = 60 days plus 6 additional = 66 days
  - X-330 – 11 units = 66 days
  - X-333 – 8 units = 48 days.

- Wet air vent/purge of cell bypasses with cell and unit isolation valves closed and cell bypass valves opened. Entire unit's bypasses are purged together and require 3 days to mobilize, set valves and purge. X-326 purge cascades require additional 3 days to purge.

  - X-326 – 10 units = 30 days plus 3 additional = 33 days
  - X-330 – 11 units = 33 days
  - X-333 – 8 units = 24 days.

- Wet air vent/purge of unit bypasses and auxiliary systems with unit isolation valves closed and unit bypass valves open. Entire building's bypasses are purged together and requires 6 days to mobilize, set valves and purge.

  - X-326 – 6 days
  - X-330 – 6 days
  - X-333 – 6 days.

- Assume all buildings can be purged utilizing existing purging equipment, traps and stacks. Assume all HF can be discharged from stacks without exceeding National Emission Standards for Hazardous Air Pollutants limits.

  - Vent/Purge Crew - Labor is three workers, one foreman, one radiological technician, 0.25 engineer. 10 additional day's preparation time with one worker, one foreman and two engineers per building.

  - Required maintenance during vent/purge:

    - Four seal changes per building with no loss of time (spare put on) - two workers, one foreman, one radiological technician for one day each.

    - Six trap changes per building with no loss of time (spares valved in) - two workers, one foreman, one radiological technician, 0.5 IH technician for one day each.

    - Four valve removals per building with pipe spool piece installed in place – Assume 3 days lost time per valve with two workers, one foreman, one radiological technician and one IH technician each.

- Visual inspection of process piping for deposits - assume cell piping is inspected by removal workers during removal (see Equipment Removal). Cell bypass, unit bypass, and auxiliary piping will be inspected by dedicated crew after vent/purge and housing removal but before removal. Desired to be before NDA but not required.

  - X-326 – Assume auxiliary enclosure linear feet is 10 percent of cell piping - 4,880 linear ft. All bypass linear feet is 110,787 linear ft. Total 115, 667 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.

  - X-330 – Assume auxiliary enclosure linear feet is 10 percent of cell piping - 5,895 linear ft. All bypass linear feet is 90,381 linear ft. Total 96,276 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.

  - X-333 – Assume auxiliary enclosure linear feet is 10 percent of cell piping – 3,265 linear ft. All bypass linear feet is 87,372 linear ft. Total 90,637 linear ft. Inspect 500 linear ft per 10-hour day. 10 percent additional time for equipment transfer.

  - Inspection crew is three workers, one foreman, two radiological technicians, and 0.5 IH technician. Initial preparation time per building is 10 days for one worker, one foreman, and one engineer. Inspection document crew is one engineer and an administrative assistant.

  - Equipment is three digital data recording video borescopes, three spare borescope heads, and two 46-in. high definition digital televisions with digital video recorder. Also four each local HEPA units.

13. ►No introduction of grout to fill process equipment voids is required for shipment and disposal off Site.

14. Beyond the removal of process building basements, pits, footers, and truck alleys, the utility lines, duct banks and electric and instrument tunnels will be removed. Assume:

- Removal of under slab structures

  - X-326

    - Tunnels are 1,365 linear ft, 6,100 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.

    - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.

    - Duct banks average 300 ft length and there are 20 of them. Average duct bank size is 2 ft high by 4 ft wide. 1,770 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.

- X-330
  - Tunnels are 1,820 linear ft, 8,100 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.
  - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.
  - Duct banks average 400 ft length and there are 22 of them. Average duct bank size is 2 ft high by 4 ft wide. 2,600 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.
- X-333
  - Tunnels are 910 linear ft, 4,000 cy. Top of tunnel is 4 ft below grade, bottom 12 ft below grade. Demolition includes segregation of instrument and electrical conduits from concrete/rebar and transite cable trays.
  - Utility lines are 1,940 linear ft, 225 cy. Top of pipe is 6 ft below grade, diameter is 2 ft. Piping is in 40 separate locations. Requires plugging of connection at location of air gapping.
  - Duct banks average 500 ft length and there are 16 of them. Average duct bank size is 2 ft high by 4 ft wide. 2,400 cy total. Top of duct is 4 ft below grade. Demolition includes segregation of electrical conduits from concrete/rebar and asbestos conduits.

- Backfill **-** After removal of the concrete slab, footers, utilities, duct banks and tunnels, resulting elevation of soils will require backfill before revegetation.
  - X-326 – Calculated void is 119,256 cy. Building is 1.26 million sq ft which means an average void of 2.6 ft below slab elevation. Assume at least 2 ft of backfill must be trucked in equals 93,300 cy compacted, or with 1.2 expansion rate, 112,000 cy in trucks. Assume 9 cy per truck, gives 12,450 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.
  - X-330 – Calculated void is 126,308 cy. Building is 1.39 million sq ft which means an average void of 2.5 ft below slab elevation. Assume at least 2 ft of backfill must be trucked in equals 103,000 cy compacted, or with 1.2 expansion rate, 124,000 cy in trucks. Assume 9 cy per truck, gives 13,700 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.
  - X-333 – Calculated void is 110,385 cy. Building is 1.41 million sq ft which means an average void of 2.1 ft below slab elevation. Assume at least 1.5 ft of backfill must be trucked in equals 78,000 cy compacted, or with 1.2 expansion rate, 94,000 cy in trucks. Assume 9 cy per truck, gives 10,400 truckloads of fill. Travel is 2 miles. Spread and compacted by dozer.

15. Remedial design will include the following scope due to the above:

    - Modification design to erect one NDA stations inside X-326 at 35 percent of construction and equipment costs. See Characterization – NDA.

    - Design to erect two NDA facilities outside X-326 at 30 percent of construction and equipment costs. See Characterization – NDA.

16. Operational Readiness will include a DOE Operational Readiness Review for Deposit Removal, preceded by a contractor Management Assessment. Management Assessments will be conducted for the low background NDA operations.

EM.PO.04.02 Balance of Plant (BOP) D&D

1. Scope is included in escalated dollars.

2. ►BOP D&D will occur in the years 2014 through 2031 (18 years).

3. The following WBS reflects the scope of activities necessary for BOP D&D.

EM.PO.04.02.01.03.90 Other BOP Facilities Demolition

BOP = Balance of Plant

4. Quantities of equipment and materials removed for BOP D&D is assumed to be the quantities in the December 2011 version of the Mass Flow database.

5. Recycle of materials from the BOP facilities is assumed. This is limited due to continuing requirements to control recycle of materials from radiological areas. It is assumed that cost of recycle (including proceeds from recycle) will be equal to the cost of D&D of these materials, so all waste volumes are estimated to be removed and disposed via demolition approaches rather than manual removal before demolition.

6. Underground utilities removal, final grading and site restoration are assumed to occur after RA scope in each area is complete.

7. The following 252 facilities are included in the estimate (note – process tie lines are shown here but estimated in Process Buildings WBS).

Facility Number	Facility Name
B	Pad in Field East of X-109A (near X-740)
C	Old Switch Yard West of X-109A Pad (near X-740)
E	X-700 “0000” Compressor Base Foundation
H	Old Firing Range Shed
I	Peter Kiewit Powder Magazine
J	X-1000 Pavilion
X-100	Administration Building (slab and below-grade structures)

Facility Number	Facility Name
X-1000	Administration Building
X-1000 T1	Training Trailer
X-1007	Fire Station
X-104A	Indoor Firing Range Building
X-104B	Protective Forces Office Trailer
X-104C	Protective Forces Shower/Locker Trailer
X-105	Electronic Maintenance Building (front apron/concrete pad and driveway)
X-106B	Old Fire Training Building (slab and below-grade water tank)
X-108A	South Portal and Shelter-Drive Gate
X-108B	North Portal and Shelter
X-108E	Construction Entrance Portal
X-108J	West Security Portal
X-108K	North Security Portal
X-108L	East Security Portal
X-1107BV	Interplant Vehicle Portal
X-111A	SNM Monitoring Portal
X-111B	SNM Monitoring Portal
X-114A	Outdoor Firing Range
X-120	Old Weather Station (footers)
X-120H	Weather Station
X-202	Roads
X-204-1	Railroad and Railroad Overpass (excluding DUF_6 utilized track)
X-206A	North Main Parking Lot
X-206B	South Main Parking Lot
X-206E	Construction Parking Lot
X-206H	Pike Avenue Parking Lot
X-206J	South Office Parking Lot
X-208	Security Fence
X-208A	Boundary Fence
X-208B	SNM Security Fence
X-210	Sidewalks
X-215D	Electrical Power Tunnels
X-220A	Instrumentation Tunnels
X-220B1	Process Instrumentation Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines
X-220C	Superior American Alarm System
X-220D1	General Telephone System

Facility Number	Facility Name
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCalloh Alarm System
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System
X-2230T1	Recirculating Heating Water System (East of Valve Pits “A” and “B”)
X-2232E	Gas Pipeline
X-230	Water Supply Line
X-230A	Sanitary and Fire Water Distribution System
X-230A10	Ambient Air Monitoring Station
X-230A12	Ambient Air Monitoring Station
X-230A15	Ambient Air Monitoring Station
X-230A23	Ambient Air Monitoring Station
X-230A24	Ambient Air Monitoring Station
X-230A28	Ambient Air Monitoring Station
X-230A29	Ambient Air Monitoring Station
X-230A3	Ambient Air Monitoring Station
X-230A36	Ambient Air Monitoring Station
X-230A37	Ambient Air Monitoring Station
X-230A40	Ambient Air Monitoring Station
X-230A41	Ambient Air Monitoring Station
X-230A6	Ambient Air Monitoring Station
X-230A8	Ambient Air Monitoring Station
X-230A9	Ambient Air Monitoring Station
X-230B	Sanitary Sewers
X-230C	Storm Sewers
X-230D	Softened Water Distribution System
X-230E	Plant Water System (make-up)

Facility Number	Facility Name
X-230F	Raw Water Supply Line
X-230G	RCW System
X-230H	Fire Water Distribution System
X-230J1	East Environmental Sampling Building (slab)
X-230J1	Monitoring Station
X-230J2	South Environmental Sample Station
X-230J3	West Environmental Sampling Building for Intermittent Containment Basin
X-230J4	Environmental Air Sampling Station
X-230J5	West Holding Pond Oil Separation Station
X-230J6	Northeast Holding Pond Monitoring Facility and Secondary Oil Collection Building
X-230J7	East Monitor Facility (East Holding Pond Oil Separation Building)
X-230J8	Environmental Storage Building (slab)
X-230M	Clean Test Site
X-232A	Nitrogen Distribution System
X-232B	Dry Air Distribution System
X-232C1	Tie Line X-342 to X-330 (Included with Process Buildings)
X-232C2	Tie Line X-330 to X-326 (Included with Process Buildings)
X-232C3	Tie Line X-330 to X-333 (Included with Process Buildings)
X-232C4	Tie Line X-326 to X-770 (Included with Process Buildings)
X-232C5	Tie Line X-343 to X-333 (Included with Process Buildings)
X-232D	Steam and Condensate System
X-232E	Freon Distribution System
X-232F	Fluorine Distribution System
X-232G	Support for Distribution Lines
X-235	South Groundwater Collection System
X-237	Little Beaver Groundwater Collection System
X-240A	RCW System (Cathodic Protection System)
X-300	Plant Control Facility
X-300A	Process Monitoring Building
X-300B	Plant Control Facility Carport
X-300C	Emergency Communications Antenna
X-342A	Feed Vaporization Building
X-342B	Fluorine Storage Building
X-342C	Waste HF Neutralization Pit (below-grade structures)
X-344A	UF_6 Sampling Facility
X-344C	Hydrogen Fluoride Storage Building (foundations and piers)
X-344D	HF Neutralization Pit (below grade)
X-344E	Gas Ventilation Stack (below grade)

Facility Number	Facility Name
X-344F	Safety Building (below-grade structures)
X-344H	Security Portal
X-345	SNM Storage Building
X-501	Substation
X-501A	Substation
X-502	Substation
X-515	330 kV Tie Line Between X-530 and X-533
X-530 T1	Office Trailer
X-530A	High Voltage Switchyard (grounding systems and underground cables)
X-530B	Switch House (slab and below-grade structures)
X-530C	Test and Repair Building (below-grade structures)
X-530D	Oil House (below-grade structures)
X-530E	Valve House (slab and below-grade structures)
X-530F	Valve House (slab and below-grade structures)
X-530G	GCEP Oil Pumping Station
X-533 T1	Trailer
X-533 T2	Trailer
X-533 T3	Trailer
X-533 T4	Trailer
X-533H	Personnel Monitoring Station
X-540	Telephone Building
X-600	Steam Plant (slab and below-grade structures)
X-600A	Coal Yard (structures)
X-600D	Utilities Maintenance Field Office
X-605	Sanitary Water Control House
X-605A	Well Field
X-608	Raw Water Pump House
X-608A	Well Field
X-608B	Well Field
X-611	Water Treatment Plant (slab and below-grade structures
X-611A	Old Lime Sludge Lagoon (structures)
X-611B	Lagoon (structures)
X-611B1	Lagoon Supernatant Pumping Station
X-611B2	Lagoon Supernatant Pumping Station
X-611B3	Lagoon Supernatant Pumping Station
X-611C	Filter Building (slab and below-grade structures
X-611E	Clear Well & Chlorine Building (slab and below-grade structures)
X-612	Elevated Storage Tank (below-grade structures)

Facility Number	Facility Name
X-614A	Sewage Pumping Station (slab and below-grade structures
X-614B	Sewage Pumping Station (slab and below-grade structures
X-614D	South Sewage Lift Station
X-614P	Northeast Sewage Lift Station
X-614Q	Sewage Booster Pump Station
X-615	Old Sewage Treatment Plant (foundations and piers)
X-616	Liquid Effluent Control Facility (foundations and piers)
X-617	South Holding Pond pH Control Facility
X-622	South Groundwater Treatment Facility
X-623	North Groundwater Treatment Building
X-624	Little Beaver Groundwater Treatment Facility
X-625	Groundwater Passive Treatment Facility
X-626-1	Recirculating Water Pump House (slab and below-grade structures
X-626-2	Cooling Tower (below-grade structures)
X-627	Groundwater Pump & Treatment Facility
X-630-1	Recirculating Water Pump House (slab and below-grade structures
X-630-2A	Cooling Tower (below-grade structures)
X-630-2B	Cooling Tower (below-grade structures)
X-630-3	Acid Handling Station (saddles and basin)
X-633 T1	Trailer
X-633 T2	Trailer
X-633 T3	Trailer
X-640-1	Fire Water Pump House (slab and below-grade structures)
X-640-1A	Substation (required for Fire Services)
X-640-2	Elevated Storage Tank (below-grade structures)
X-640-2A	Elevated Water Tank Auxiliary Building
X-6619	Sewage Treatment Plant
X-670	Dry Air Plant
X-670A	Cooling Tower
X-675	Plant Nitrogen Station
X-680	Blowdown Sample and Treatment Building
X-700	Converter Shop & Cleaning Building
X-700A	Air Conditioning Equipment Building
X-700B	Sandblast Facility and Observation Booth
X-701A	Lime House (below-grade structures)
X-701D	Water Deionization Facility (below-grade structures)
X-701E	Neutralization Building
X-701F	Effluent Monitoring Facility

Facility Number	Facility Name
X-705	Decontamination Building
X-705D	Heat Booster Pump Building
X-705E	Oxide Conversion Area
X-710	Technical Services Building
X-710A	Technical Service Gas Manifold Shed
X-710B	Explosion Test Facility
X-720	Maintenance and Stores Building
X-720 T01	Office Trailer
X-720A	Maintenance and Stores Gas Manifold Shed (below-grade structures)
X-720B	Radio Base Station
X-720C	Paint & Storage Building
X-721	Radiation Instrument Calibration
X-741	Oil Drum Storage Facility
X-742	Gas Cylinder Storage Facility
X-744K	Warehouse-K
X-744N	Warehouse N Non-UEA
X-744P	Warehouse P Non-UEA
X-744Q	Warehouse Q Non-UEA
X-744V	Surplus and Salvage Clean Storage Area
X-744Y	Waste Storage Area
X-744Y T1	Trailer
X-744Y T2	Trailer
X-744Y T3	Trailer
X-744Y T4	Trailer
X-744Y T5	Trailer
X-744Y T6	Trailer
X-744Y T8	Trailer
X-744Y T9	Trailer
X-745B	Toll Enrichment Gas Yard
X-745D	Cylinder Storage Yard
X-745F	North Process Gas Stockpile Yard
X-745G-2	Cylinder Storage Yard
X-746	Material Receiving and Inspection (portions of above- and below-grade structures)
X-747	Clean Scrap Yard
X-747A	Material Storage Yard (below-grade structures)
X-747B	Material Storage Yard Pads and Equipment
X-747C	Material Storage Yard Pads and Equipment
X-747D	Material Storage Yard Pads and Equipment

Facility Number	Facility Name
X-747E	Material Storage Yard Pad
X-747G	Precious Metal Scrap Yard (below-grade structures)
X-747H	NW Contaminated Scrap Yard (below-grade structures)
X-747H1	Loading Pad
X-747J	Decontamination Storage Yard
X-748	Truck Scale
X-750	Mobile Equipment Maintenance Shop (slab and below-grade structures)
X-751	GCEP Mobile Equipment Garage
X-760 T1	Trailer
X-760 T2	Trailer
XT-800	GCEP Construction Office Pad
XT-847	Warehouse

GCEP = Gas Centrifuge Enrichment Plant
MSR = maintenance service request
PA = public address
RCW = recirculating cooling water
SCADA = Supervisory Control and Data Acquisition
SNM = special nuclear materials
UEA = uranium enrichment area

8. The following 20 facilities are omitted from the estimate. These are systems primarily contained in other facilities.

Facility Number	Facility Name
X-215A	Electrical Distribution to Process Buildings
X-215B	Electrical Distribution to Other Areas
X-215C	Exterior Lighting
X-220B1	Process Instrumentation Lines
X-220B2	Carrier Communication Systems
X-220B3	Water Supply Telemetering Lines
X-220C	Superior American Alarm System
X-220D1	General Telephone System
X-220D2	Process Telephone System
X-220D3	Emergency Telephone System
X-220E1	Evacuation PA System
X-220E2	Process PA System
X-220E3	Power Public Address System
X-220F	Plant Radio System
X-220G	Pneumatic Dispatch System
X-220H	McCalloh Alarm System
X-220J	Radiation Alarm System
X-220K	Cascade Automatic Data Processing System

Facility Number	Facility Name
X-220L	Classified Computer System
X-220N	Security Alarm and Surveillance System
X-220P	MSR System
X-220R	Public Warning Siren System
X-220S	Power Operations SCADA System

MSR = maintenance service request
PA = public address
SCADA = Supervisory Control and Data Acquisition

9. Estimates are included for two phases of facility D&D – deactivation and demolition.
10. Deactivation includes any necessary utilities deactivation, characterization of the facility, materials removal as necessary for reuse or separate disposal, hazards abatement and procurement of any one time use disposal packages.
11. Demolition includes mobilization for demolition, demolition, size reduction and segregation as necessary of waste and equipment, loading of waste, procurement on any one time use disposal packages.
12. Site restoration is assumed to occur after RA.

EM.PO.04.03 Facility Surveillance and Maintenance

1. Scope is included in escalated dollars.
2. ►Surveillance and maintenance (S&M) will occur in the years 2014 through 2030 (17 years).
3. The following WBS reflects the scope of activities necessary for S&M of D&D facilities.

EM.PO.04.03.01.01.01	S and M Project Management
EM.PO.04.03.01.02.01	X-326 S and M
EM.PO.04.03.01.03.01	X-330 S and M
EM.PO.04.03.01.04.01	X-333 S and M
EM.PO.04.03.01.05.03	Other GDP Facilities
EM.PO.04.03.01.05.06	705 Complex
EM.PO.04.03.01.05.07	340 Complex
EM.PO.04.03.01.05.08	100 Complex
EM.PO.04.03.01.05.09	720 Complex
EM.PO.04.03.01.05.10	744G Complex
EM.PO.04.03.01.05.11	XT-848 Total
EM.PO.04.03.01.05.11	XT-849
EM.PO.04.03.01.05.11	XT-850
EM.PO.04.03.01.05.11	XT-851
EM.PO.04.03.01.05.11	XT-852
EM.PO.04.03.01.05.12	750 Complex

EM.PO.04.03.01.05.13	710 Complex
EM.PO.04.03.01.05.14	Warehouse
EM.PO.04.03.01.05.15	Trailers
EM.PO.04.03.01.06.01	Utility Optimization Planning in Support of X-326 / X-330 / X-333
EM.PO.04.03.01.06.02	Utility Optimization Planning - Balance of Plant Facilities
EM.PO.04.03.01.06.03	Site Consolidation Ph2
EM.PO.04.03.01.06.09	X-720B Radio Repeater Replacement
EM.PO.04.03.01.06.10	X-540/X-670 Power Feed
EM.PO.04.03.01.06.11	Vault Relocation

S and M = Surveillance and Maintenance
GDP = Gaseous Diffusion Plant

PROCESS BUILDINGS AND COMPLEX FACILITIES D&D RI/FS SENSITIVITY ANALYSIS COST ESTIMATE

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Table F.3. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Cost Summary

Summary Description		Costs Escalated
Capital Costs		
	D&D Activities	
	DOE Services and Infrastructure Support	$585,727,175
	Safeguards and Security	$373,164,616
	D&D of Process Buildings	$451,446,432
	D&D of BOP	$541,285,128
	Facility Surveillance and Maintenance	$634,254,408
Total Capital Costs		**$2,585,877,759**
Net Present Value		
	Present Value for Capital	**$2,025,107,700**

BOP = Balance of Plant
D&D = decontamination and decommissioning
DOE = U.S. Department of Energy

Table F.4. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Escalation and PV

PROCESS BUILDINGS & COMPLEX FACILITIES D & D RI/FS

PROJECT LOCATION: Portsmouth, Ohio   DATE: December 20, 2012

FY	Esc Factor	Total Capital Costs		SERVICES &/INFRASTRUCT		SECURITY		PROC BLDG		BOP		S & M		Present Value (NPV)	
		Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Unescalated	Escalated	Discount Rate	Capital
	2.4%													2.9%	
														NPV	$2,025,107,700
2013			0		0		0		0		0		0		
2014			155,443,799		32,540,399		22,389,877		36,115,715		20,000,000		44,397,809		
2015			155,443,799		32,540,399		22,389,877		36,115,715		20,000,000		44,397,809		
2016			155,443,799		32,540,399		22,389,877		36,115,715		20,000,000		44,397,809		
2017			162,508,055		32,540,399		22,389,877		36,115,715		27,064,256		44,397,809		
2018			162,508,055		32,540,399		22,389,877		36,115,715		27,064,256		44,397,809		
2019			162,508,055		32,540,399		22,389,877		36,115,715		27,064,256		44,397,809		
2020			162,508,055		32,540,399		22,389,877		36,115,715		27,064,256		44,397,809		
2021			156,165,511		32,540,399		22,389,877		36,115,715		27,064,256		38,055,264		
2022			147,136,582		32,540,399		22,389,877		27,086,786		27,064,256		38,055,264		
2023			147,136,582		32,540,399		22,389,877		27,086,786		27,064,256		38,055,264		
2024			147,136,582		32,540,399		22,389,877		27,086,786		27,064,256		38,055,264		
2025			140,794,038		32,540,399		22,389,877		27,086,786		27,064,256		31,712,720		
2026			140,794,038		32,540,399		22,389,877		27,086,786		27,064,256		31,712,720		
2027			140,794,038		32,540,399		22,389,877		27,086,786		27,064,256		31,712,720		
2028			125,074,281		32,540,399		14,926,585		0		45,894,577		31,712,720		
2029			115,560,464		32,540,399		14,926,585		0		45,894,577		22,198,904		
2030			115,560,464		32,540,399		14,926,585		0		45,894,577		22,198,904		
2031			93,361,560		32,540,399		14,926,585		0		45,894,577		0		
	TOTALS		2,585,877,759		585,727,175		373,164,616		451,446,432		541,285,128		634,254,408		

Table F.5. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
DOE Services and Infrastructure Support

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
	DOE Services and Infrastructure Support associated with Soil Remediation, Groundwater Remediation, Waste Management, and D&D of Balance of Plant (EE/CA facilities) are Excluded from the Following Estimates						
1	WBS Ports: EM.PO.01.03.06.01.06 Sanitary Water - Utility Total	260,556	$ 15,750,010	$ 3,385,342	$ 277,850	$ 198,347	$ 19,611,549
2	WBS Ports: EM.PO.01.03.06.01.07 Sanitary Sewage - Utility Total	163,282	$ 9,650,332	$ 2,160,418	$ 409,182	$ -	$ 12,219,932
3	WBS Ports: EM.PO.01.03.06.01.08 Recycle Cooling Water - Utility Total	42,688	$ 2,441,612	$ 1,201,831	$ 49,985	$ 22,207	$ 3,715,635
4	WBS Ports: EM.PO.01.03.06.01.09 Plant Dry Air - Utility Total	49,345	$ 2,819,480	$ 359,595	$ 119,499	$ 80,495	$ 3,379,070
5	WBS Ports: EM.PO.01.03.06.01.10 Nitrogen System - Utility Total	20,389	$ 1,173,721	$ 1,254,083	$ 22,809	$ -	$ 2,450,613
6	WBS Ports: EM.PO.01.03.06.01.11 Steam - Utility Total	197,278	$ 11,193,555	$ 4,891,962	$ 20,813,823	$ -	$ 36,899,341
7	WBS Ports: EM.PO.01.03.06.01.12 Electrical Power Distribution - Utility Total	498,889	$ 31,035,897	$ 2,195,400	$ 501,086	$ 80,187	$ 33,812,570
8	WBS Ports: EM.PO.01.03.06.01.13 Laundry - Utility Total	103,776	$ 3,712,394	$ 610,811	$ 1,001,776	$ 7,527,271	$ 12,852,252
9	WBS Ports: EM.PO.01.03.06.01.14 Computer Center Implementation (Mod 11) Total	5,733	$ 340,028	$ 21,133	$ -	$ 1,812,083	$ 2,173,243
10	WBS Ports: EM.PO.01.03.06.01.15 Plant Shift Superintendent Total	573,860	$ 35,086,594	$ 1,082,880	$ 230,488	$ -	$ 36,399,962
11	WBS Ports: EM.PO.01.03.06.01.16 X-550 Medium Voltage Total	22,560	$ 1,286,047	$ 11,252	$ -	$ 11,546,629	$ 12,843,928
12	WBS Ports: EM.PO.01.03.06.01.17 X-5500 High Voltage Total	45,120	$ 2,652,210	$ 23,204	$ -	$ 11,599,787	$ 14,275,201
13	WBS Ports: EM.PO.01.03.06.01.18 13.8 KV Distribution Total	30,318	$ 1,713,633	$ 15,018	$ -	$ 12,441,484	$ 14,170,134
14	WBS Ports: EM.PO.01.03.06.01.20 X-6619 Sewage Treatment Plant Replacement Total	10,716	$ 693,489	$ 20,684	$ -	$ 21,608,572	$ 22,322,744
15	WBS Ports: EM.PO.01.03.06.01.22 X-608 By-Pass Total	80	$ 4,307	$ 148	$ -	$ 41,777	$ 46,231
16	WBS Ports: EM.PO.01.03.06.01.23 HPFW Construction Total	1,824	$ 102,775	$ 3,065	$ -	$ 2,088,834	$ 2,194,674
17	WBS Ports: EM.PO.01.03.06.02.01 Emergency Management Total	84,681	$ 8,218,987	$ 249,370	$ 96,199	$ 2,459,351	$ 11,023,907
18	WBS Ports: EM.PO.01.03.06.02.02 Fire Protection Services Total	624,850	$ 35,673,591	$ 940,970	$ 376,546	$ -	$ 36,991,107
19	WBS Ports: EM.PO.01.03.06.02.04 Criticality Accident Alarm System (CAAS) Total	60,334	$ 3,465,948	$ 33,179	$ -	$ 241,512	$ 3,740,639
20	WBS Ports: EM.PO.01.03.10.01.01 Sitewide Interface Total	39,260	$ 3,045,518	$ 30,686	$ -	$ 3,161,524	$ 6,237,729
21	WBS Ports: EM.PO.01.03.10.01.02 Funds Management Total	16,875	$ 1,144,278	$ 8,966	$ -	$ -	$ 1,153,244
22	WBS Ports: EM.PO.01.03.10.02.01 Project Controls Total	83,518	$ 5,321,495	$ -	$ -	$ 11,086	$ 5,332,582
23	WBS Ports: EM.PO.01.03.10.02.10 PMB Support Total	0	$ -	$ -	$ -	$ 90,735	$ 90,735
24	WBS Ports: EM.PO.01.03.10.03.10 Records Management and Document Control Total	311,830	$ 13,439,156	$ 202,186	$ -	$ 241,208	$ 13,882,550
25	WBS Ports: EM.PO.01.03.10.04.01 External Affairs Total	72,072	$ 6,085,462	$ 148,512	$ -	$ 3,388,954	$ 9,622,929
26	WBS Ports: EM.PO.01.03.10.04.02 External Review and Support Total	2,828	$ 315,312	$ 1,481	$ -	$ -	$ 316,793
27	WBS Ports: EM.PO.01.03.10.04.03 Employee Communications Total	46,509	$ 3,200,157	$ 99,825	$ -	$ 1,451,985	$ 4,751,966
28	WBS Ports: EM.PO.01.03.10.05.01 Real and Personal Property Management Total	95,465	$ 6,734,413	$ 43,291	$ -	$ 3,118	$ 6,780,822
29	WBS Ports: EM.PO.01.03.10.07.01 Office of The President Total	192,608	$ 29,180,958	$ -	$ -	$ 12,398	$ 29,193,356

Table F.5. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
DOE Services and Infrastructure Support (Continued)

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
30	WBS Ports: EM.PO.01.03.10.07.02 Insurance Taxes and Other Business Expenses Total	0	$ -	$ -	$ -	$ 6,520,198	$ 6,520,198
31	WBS Ports: EM.PO.01.03.10.07.03 Finance Total	128,603	$ 10,146,928	$ -	$ -	$ 5,841	$ 10,152,769
32	WBS Ports: EM.PO.01.03.10.07.04 HR/IR Total	88,081	$ 6,657,178	$ 1,858,557	$ -	$ 1,003,035	$ 9,518,770
33	WBS Ports: EM.PO.01.03.10.07.05 Information Services Total	113,814	$ 6,141,310	$ -	$ -	$ 728,924	$ 6,870,234
34	WBS Ports: EM.PO.01.03.10.07.06 Contracts and Supply Chain Total	115,758	$ 7,177,954	$ -	$ -	$ 14,465	$ 7,192,418
35	WBS Ports: EM.PO.01.03.10.07.07 Legal Management Total	1,938	$ 279,613	$ -	$ -	$ 275	$ 279,888
36	WBS Ports: EM.PO.01.03.10.07.08 Compliance/Internal Audit Total	9,956	$ 1,204,130	$ 12,048	$ -	$ 53,758	$ 1,269,935
37	WBS Ports: EM.PO.01.03.10.08.01 Change Control Total	8,828	$ 596,507	$ 11,345	$ -	$ 863,262	$ 1,471,114
38	WBS Ports: EM.PO.01.03.10.08.02 Risk Management Total	8,648	$ 582,476	$ 8,874	$ -	$ 609,161	$ 1,200,511
39	WBS Ports: EM.PO.01.03.10.09.02 Estimating & Cost Proposal Services Total	153,988	$ 10,873,022	$ 665,048	$ -	$ 12,026,517	$ 23,564,587
40	WBS Ports: EM.PO.01.03.11.01.01 ESHQ Program Integration Total	69,178	$ 4,724,238	$ 9,346	$ -	$ 5,591	$ 4,739,174
41	WBS Ports: EM.PO.01.03.11.01.02 Radiation Protection Radiological Site Services Total	216,643	$ 15,274,024	$ 281,247	$ -	$ 1,903,456	$ 17,458,727
42	WBS Ports: EM.PO.01.03.11.01.03 Occupational Safety and Health Total	180,130	$ 12,918,675	$ 460,345	$ -	$ 3,277,986	$ 16,657,006
43	WBS Ports: EM.PO.01.03.11.02.01 Performance Assurance Total	88,082	$ 6,191,122	$ 17,619	$ -	$ 7,638	$ 6,216,379
44	WBS Ports: EM.PO.01.03.11.02.02 Quality Assurance Total	159,852	$ 10,809,091	$ 19,587	$ -	$ 17,146	$ 10,845,825
45	WBS Ports: EM.PO.01.03.12.01.01 Environmental Protection Total	156,730	$ 14,075,238	$ 123,023	$ 48,998	$ 1,298,030	$ 15,545,288
46	WBS Ports: EM.PO.01.03.12.02.04 Sitewide GIS Development and Application Total	76,875	$ 6,006,424	$ 80,176	$ -	$ 501,318	$ 6,587,918
47	WBS Ports: EM.PO.01.03.12.02.07 ER Quality Assurance Project Planning (QAPP) Total	51,255	$ 3,572,051	$ 27,375	$ -	$ -	$ 3,599,426
48	WBS Ports: EM.PO.01.03.12.03.06 Program Management Total	154,595	$ 10,390,332	$ -	$ -	$ 2,193,135	$ 12,583,467
49	WBS Ports: EM.PO.01.03.13.01.01 System Engineering Total	101,434	$ 7,354,278	$ 125,582	$ -	$ 552,509	$ 8,032,370
50	WBS Ports: EM.PO.01.03.13.01.02 Design Engineering Total	30,846	$ 2,092,933	$ 19,742	$ -	$ 778,327	$ 2,891,002
51	WBS Ports: EM.PO.01.03.13.01.03 Engineering Program Enhancement and Consolidation Total	9,024	$ 781,546	$ 9,942	$ -	$ 1,782,905	$ 2,574,392
52	WBS Ports: EM.PO.01.03.13.02.05 Nuclear Safety/NCS Prog Enhancement/Consolidation Total	4,512	$ 221,911	$ 7,733	$ -	$ 1,668,208	$ 1,897,852
53	WBS Ports: EM.PO.01.03.13.03.01 Conduct of Operations Consolidation Total	4,512	$ 354,794	$ 6,628	$ -	$ 1,426,440	$ 1,787,862
54	WBS Ports: EM.PO.01.03.13.03.02 Work Planning and Control Total	109,793	$ 7,019,498	$ 272,254	$ -	$ 3,068,052	$ 10,359,805
55	WBS Ports: EM.PO.01.03.13.03.03 Operational Readiness Total	25,057	$ 1,990,114	$ 934,192	$ -	$ 2,302,470	$ 5,226,777
56	WBS Ports: EM.PO.01.03.13.03.04 Conduct of Operations Program Management Total	0	$ -	$ 123	$ -	$ 17,432	$ 17,555
57	WBS Ports: EM.PO.01.03.13.03.05 Work Planning and Control Consolidation Total	32,688	$ 1,835,573	$ 18,214	$ -	$ 713,162	$ 2,566,949
58	WBS Ports: EM.PO.01.03.15.01.01 Nuclear Material Control and Accountability (NMCA) Total	189,478	$ 15,070,419	$ 331,989	$ 158,986	$ 324,163	$ 15,885,557
	Subtotal	5,947,539	$ 399,822,739	$ 24,296,281	$ 24,107,226	$ 123,772,948	$ 571,999,195
	TOTAL -(Includes Project Start Delay of 1 Year)		$ 409,418,485	$ 24,879,392	$ 24,685,800	$ 126,743,498	$ 585,727,175

Table F.6. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Safeguards and Security

TITLE: **Safeguards and Security** PROJECT LOCATION: **Portsmouth, Ohio** DATE: **December 20, 2012**

Item No.	DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT $ VALUE	TOTAL ($)
1	Security Program	18	Yrs		308,354			32,008,740		2,584,126		1,508,210		36,101,076
2	Cyber Security	18	Yrs		3,758			153,978		2,042		0		156,020
3	Protective Forces	18	Yrs		5,831,634			317,133,470		10,866,212		161,792		328,161,474
														0
	Subtotal				6,143,746			349,296,188		13,452,380		1,670,002	0	364,418,570
	Sales Tax on Material only @ 7 % (Incl'd)									0				0
	Subtotal				6,143,746			349,296,188		13,452,380		1,670,002	0	364,418,570
	Contractor Markups at 26.0% (N/A)													0
	Subtotal													364,418,570
	TOTAL -(Includes Project Start Delay of 1 Year)							**357,679,297**		**13,775,237**		**1,710,082**	**0**	**373,164,616**

TOTAL $ **373,164,616**

Table F.7. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Process Building D&D

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
1	WBS Ports: EM.PO.04.01.01.01.01 X-333 Project Management - Deactivation Total	96,964	$ 5,704,396	$ 116,024	$ 138,671	$ 134,988	$ 6,094,079
2	WBS Ports: EM.PO.04.01.01.01.03 X-333 Project Management - Demolition Total	144,528	$ 9,040,015	$ 79,535	$ -	$ 40,811	$ 9,160,361
3	WBS Ports: EM.PO.04.01.01.02.01 X-333 Material Removal - Remove and Package LLW Equipment and Debris Total	21,358	$ 1,135,414	$ 47,348	$ 27,995	$ 684	$ 1,211,441
4	WBS Ports: EM.PO.04.01.01.02.02 X-333 Material Removal - Hazardous Waste Total	25,791	$ 1,394,035	$ 72,832	$ 109,923	$ 42,583	$ 1,619,373
5	WBS Ports: EM.PO.04.01.01.02.03 X-333 - Bulk ACM Removal Total	4,880	$ 240,130	$ 31,650	$ 60,900	$ 38,711	$ 371,391
6	WBS Ports: EM.PO.04.01.01.02.05 X-333 - Material Removal-Process Deposit Mat and Recover Nickel Total	453,485	$ 25,785,169	$ 8,598,765	$ 882,208	$ -	$ 35,266,142
7	WBS Ports: EM.PO.04.01.01.02.06 X-333 Characterization - Perform Rad and HazMat Surveys/Sampling Total	54,359	$ 2,791,219	$ 777,310	$ 77,870	$ 940,353	$ 4,586,752
8	WBS Ports: EM.PO.04.01.01.02.07 X-333 Characterization - Perform NDA Validation Total	102,042	$ 5,671,486	$ 1,430,448	$ 24,587	$ 61,183	$ 7,187,704
9	WBS Ports: EM.PO.04.01.01.02.08 X-333 Characterization-Vent, Purge, and Drain process System Total	28,341	$ 1,506,600	$ 150,800	$ 21,000	$ -	$ 1,678,400
10	WBS Ports: EM.PO.04.01.01.02.09 X-333 Utility Isolation and Redistribution Total	23,076	$ 1,167,630	$ 208,628	$ 296,524	$ 1,036	$ 1,673,818
11	WBS Ports: EM.PO.04.01.01.02.10 X-333 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	35,867	$ 1,934,752	$ 1,208,948	$ 329,339	$ 47,005	$ 3,520,044
12	WBS Ports: EM.PO.04.01.01.02.11 X-333 Equipment Removal - Cell Housing Removal Total	69,380	$ 3,334,539	$ 409,392	$ 275,871	$ 551,769	$ 4,571,571
13	WBS Ports: EM.PO.04.01.01.02.12 X-333 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	186,590	$ 10,610,417	$ 1,075,524	$ 1,786,075	$ 28,827	$ 13,500,843
14	WBS Ports: EM.PO.04.01.01.03.02 X-333 - Exterior Transite Siding Removal Total	17,306	$ 885,914	$ 289,097	$ 405,042	$ 67,412	$ 1,647,465
15	WBS Ports: EM.PO.04.01.01.03.03 X-333 - Building Demolition Total	191,134	$ 9,999,201	$ 2,071,408	$ 7,336,244	$ 7,503	$ 19,414,356
16	WBS Ports: EM.PO.04.01.01.03.04 X-333 - Concrete Slab Removal Total	97,551	$ 5,091,282	$ 1,031,176	$ 3,776,870	$ 1,638	$ 9,900,966
17	WBS Ports: EM.PO.04.01.01.04.01 X-333 Remedial Design Total	34,062	$ 1,748,814	$ -	$ -	$ 4,626	$ 1,753,440
18	WBS Ports: EM.PO.04.01.01.04.04 X-333 Operational Readiness Total	58,250	$ 3,227,855	$ 16,836	$ -	$ 3,722	$ 3,248,413
19	X-232-C-3 X-330 to X-333 Tieline Demolition Total Total	-	$ -	$ -	$ -	$ 125,000	$ 125,000
20	X-232-C-5 X-343 to X-333 Tieline Demolition Total Total	-	$ -	$ -	$ -	$ 800,000	$ 800,000
21	WBS Ports: EM.PO.04.01.02.01.01 X-330 Project Management - Deactivation Total	60,178	$ 3,418,038	$ 84,565	$ 271,687	$ 129,352	$ 3,903,642
22	WBS Ports: EM.PO.04.01.02.01.03 X-330 Project Management - Demolition Total	82,425	$ 4,983,293	$ 49,694	$ 88,944	$ 32,101	$ 5,154,032
23	WBS Ports: EM.PO.04.01.02.02.01 X-330 Material Removal - Remove and Package LLW Equipment and Debris Total	18,856	$ 966,350	$ 40,773	$ 23,150	$ 606	$ 1,030,879
24	WBS Ports: EM.PO.04.01.02.02.02 X-330 Material Removal - Hazardous Waste Total	19,382	$ 1,036,672	$ 60,085	$ 97,484	$ 592	$ 1,194,833
25	WBS Ports: EM.PO.04.01.02.02.03 X-330 - Bulk ACM Removal Total	13,120	$ 638,620	$ 92,698	$ 33,520	$ 139,487	$ 904,325
26	WBS Ports: EM.PO.04.01.02.02.05 X-330 - Material Remove-Process Deposit Mat and Recover Nickel Total	628,836	$ 34,963,278	$ 10,244,180	$ 5,680,441	$ -	$ 50,887,899
27	WBS Ports: EM.PO.04.01.02.02.05 X-330 -X-700 Refurbishment Total	227,109	$ 12,627,275	$ 6,347,705	$ 4,021,785	$ -	$ 22,996,765
28	WBS Ports: EM.PO.04.01.02.02.06 X-330 Characterization - Perform Rad and HazMat Surveys/Sampling Total	66,262	$ 3,438,661	$ 947,472	$ 86,340	$ 970,639	$ 5,443,112
29	WBS Ports: EM.PO.04.01.02.02.07 X-330 Characterization - Perform NDA Validation Total	97,658	$ 6,429,659	$ 553,465	$ 1,201,484	$ 134,082	$ 8,318,690
30	WBS Ports: EM.PO.04.01.02.02.08 X-330 Characterization-Vent, Purge, and Drain process System Total	30,040	$ 1,670,200	$ 167,120	$ 21,000	$ -	$ 1,858,320
31	WBS Ports: EM.PO.04.01.02.02.09 X-330 Utility Isolation & Redistribution Total	23,549	$ 1,185,974	$ 217,587	$ 299,336	$ 979	$ 1,703,876
32	WBS Ports: EM.PO.04.01.02.02.10 X-330 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	36,004	$ 1,903,720	$ 1,246,549	$ 432,484	$ 46,084	$ 3,628,837
33	WBS Ports: EM.PO.04.01.02.02.11 X-330 Equipment Removal - Cell Housing Removal Total	45,488	$ 2,185,488	$ 450,459	$ 76,704	$ 335,849	$ 3,048,500
34	WBS Ports: EM.PO.04.01.02.02.12 X-330 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	288,945	$ 16,065,339	$ 1,806,809	$ 2,113,143	$ 59,616	$ 20,044,907
35	WBS Ports: EM.PO.04.01.02.03.02 X-330 - Exterior Transite Siding Removal Total	19,989	$ 997,193	$ 252,312	$ 312,321	$ 56,951	$ 1,618,777
36	WBS Ports: EM.PO.04.01.02.03.03 X-330 - Building Demolition Total	163,480	$ 8,523,433	$ 1,808,728	$ 6,451,611	$ 6,209	$ 16,789,981
37	WBS Ports: EM.PO.04.01.02.03.04 X-330 - Concrete Slab Removal Total	88,756	$ 4,549,796	$ 713,470	$ 3,550,303	$ 1,161	$ 8,814,730
38	WBS Ports: EM.PO.04.01.02.04.01 X-330 Remedial Design Total	34,482	$ 1,721,420	$ -	$ -	$ 4,592	$ 1,726,012
39	WBS Ports: EM.PO.04.01.02.04.04 X-330 Operational Readiness Total	63,375	$ 3,492,730	$ 18,264	$ -	$ 4,037	$ 3,515,031
40	X-232-C-1 X-342 to X-330 Tieline Demolition Total Total	$ -	$ -	$ -	$ -	$ 125,000	$ 125,000
41	X-232-C-2 X-330 to X-326 Tieline Demolition Total Total	$ -	$ -	$ -	$ -	$ 125,000	$ 125,000

Table F.7. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Process Building D&D (Continued)

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
42	WBS Ports: EM.PO.04.01.03.01.01 X-326 Project Management - Deactivation Total	90,547	$ 5,260,318	$ 100,793	$ 132,915	$ 116,815	$ 5,610,841
43	WBS Ports: EM.PO.04.01.03.01.03 X-326 Project Management - Demolition Total	100,794	$ 6,248,364	$ 53,707	$ -	$ 44,071	$ 6,346,142
44	WBS Ports: EM.PO.04.01.03.02.01 X-326 Material Removal - Remove and Package LLW Equipment and Debris Total	14,686	$ 747,020	$ 29,976	$ 15,497	$ 470	$ 792,963
45	WBS Ports: EM.PO.04.01.03.02.02 X-326 Material Removal - Hazardous Waste Total	29,908	$ 1,570,758	$ 82,395	$ 114,666	$ 912	$ 1,768,731
46	WBS Ports: EM.PO.04.01.03.02.03 X-326 - Bulk ACM Removal Total	6,810	$ 326,026	$ 38,465	$ 32,722	$ 56,975	$ 454,188
47	WBS Ports: EM.PO.04.01.03.02.05 X-326 - Buildings X-705, X-720 Refurbishment Total	153,532	$ 8,410,500	$ 5,130,840	$ 330,000	$ -	$ 13,871,340
48	WBS Ports: EM.PO.04.01.03.02.05 X-326 - Material Remove-Remove Process Hold Up Total	67,504	$ 3,697,853	$ 1,136,840	$ 552,000	$ -	$ 5,386,693
49	WBS Ports: EM.PO.04.01.03.02.06 X-326 Characterization - Perform Rad and HazMat Surveys/Sampling Total	52,408	$ 2,680,716	$ 744,414	$ 69,340	$ 853,521	$ 4,347,991
50	WBS Ports: EM.PO.04.01.03.02.07 X-326 Characterization - Perform NDA Validation Total	116,772	$ 7,748,859	$ 1,995,449	$ 331,017	$ 119,704	$ 10,195,029
51	WBS Ports: EM.PO.04.01.03.02.08 X-326 Characterization-Vent, Purge, and Drain process System Total	34,859	$ 1,909,600	$ 191,060	$ 21,000	$ -	$ 2,121,660
52	WBS Ports: EM.PO.04.01.03.02.09 X-326 Utility Isolation & Redistribution Total	21,692	$ 1,042,057	$ 197,420	$ 284,229	$ 944	$ 1,524,650
53	WBS Ports: EM.PO.04.01.03.02.10 X-326 Equipment Removal - Bridge Crane and Elevator Refurbishing Total	26,762	$ 1,356,179	$ 901,427	$ 412,079	$ 110,185	$ 2,779,870
54	WBS Ports: EM.PO.04.01.03.02.11 X-326 Equipment Removal - Cell Housing Removal Total	32,560	$ 1,777,259	$ 85,974	$ 46,883	$ 402	$ 1,910,518
55	WBS Ports: EM.PO.04.01.03.02.12 X-326 Equipment Removal - Remove and Package Converters Compressors Process Equip & Piping Total	329,354	$ 18,040,454	$ 1,446,436	$ 1,438,306	$ 98,907	$ 21,024,103
56	WBS Ports: EM.PO.04.01.03.03.02 X-326 - Exterior Transite Siding Removal Total	17,788	$ 864,082	$ 202,354	$ 292,399	$ 46,019	$ 1,404,854
57	WBS Ports: EM.PO.04.01.03.03.03 X-326 - Building Demolition Total	142,724	$ 7,319,104	$ 1,551,500	$ 5,520,211	$ 5,420	$ 14,396,235
58	WBS Ports: EM.PO.04.01.03.03.04 X-326 - Concrete Slab Removal Total	76,432	$ 3,870,348	$ 612,994	$ 3,142,225	$ 951	$ 7,626,518
59	WBS Ports: EM.PO.04.01.03.04.01 X-326 Remedial Design Total	48,196	$ 2,415,730	$ 2,400	$ -	$ 4,276	$ 2,422,406
60	WBS Ports: EM.PO.04.01.03.04.04 X-326 Operational Readiness Total	85,996	$ 4,766,826	$ 27,489	$ -	$ 4,691	$ 4,799,006
61	X-232-C-4 X-326 to X-770 Tieline Demolition Total Total	-	$ -	$ -	$ -	$ 25,000	$ 25,000
62	Grouting of Process Equipment Total	-	$ -	$ -	$ -	$ -	$ -
	Grand Total	5,102,222	$ 282,118,060	$ 57,249,589	$ 53,046,345	$ 6,559,451	$ 398,973,445
	Schedule Adjustment						$ 41,892,212
	Subtotal						$ 440,865,657
	TOTAL -(Includes Project Start Delay of 1 Year)						**$ 451,446,432**

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Project Management					**$95,638,462**
FPB Project Management of Balance of Plant Facilities				$47,819,231	
	Schedule Adjustment			$47,819,231	
Waste Management					**$6,802,950**
Waste Management				$6,156,516	
	Schedule Adjustment			$646,434	
Feed, Transfer, and Sampling Facilities					**$77,101,877**
	Schedule Adjustment			$7,326,423	
Feed, Transfer & Sampling Facilities-Total				$69,775,454	
X-342-A	Feed Vaporization Bldg.	$19,396,793	$2,200,290	$21,597,083	
X-342-B	Fluorine Storage Bldg.	$1,581,472	$98,371	$1,679,843	
X-342-C	Waste HF Neutralization	$0	$12,522	$12,522	
X-344-A	UF6 Sampling Facility	$34,674,130	$11,348,876	$46,023,006	
X-344-C	Hydrogen Fluoride Storage Bldg.	$0	$60,000	$60,000	
X-344-D	HF Neutralization Pit	$0	$200,000	$200,000	
X-344-E	Gas Ventilation Stack	$0	$78,000	$78,000	
X-344-F	Safety Bldg.	$0	$125,000	$125,000	
	Subtotal	$55,652,395	$14,123,059	$69,775,454	
Primary Lab, Maint. & Equip. Cleaning Fac.					**$162,848,068**
	Schedule Adjustment			$15,474,251	
Primary Labs., Maint., & Equip. Cleaning Fac-Total.				$147,373,817	
	X-700 Complex				
X-700	Converter Shop & Cleaning Bldg.	$28,331,183	$7,680,959	$36,012,142	
X-700A	Air Conditioning Equipment Bldg.	$1,750,601	$125,765	$1,876,366	
X-700B	Sandblast Fac. & Obs. Booth(w/X-700)	$0	$0	$0	
X-721	Radiation Instrument Calibration	$100,421	$170,182	$270,603	
E	X-700 Comp'r Base Found.(w/X-700)	$0	$0	$0	
	Subtotal	$30,182,205	$7,976,906	$38,159,111	
	X-705 Complex				
X-705	Decontamination Building	$16,565,653	$21,219,906	$37,785,559	
X-705D	Heat Booster Pump Building	$112,042	$30,196	$142,238	
X-705E	Oxide Conversion Area (with X-705)	$0	$35,239	$35,239	
	Subtotal	$16,677,695	$21,285,341	$37,963,036	
	X-710 Complex				
X-710	Technical Services Building	$14,057,433	$6,786,496	$20,843,929	
X-710A	Tech. Service Gas Manifold Shed	$6,251	$9,597	$15,848	
X-710B	Explosion Test Facility	$75,860	$9,598	$85,458	
	Subtotal	$14,139,544	$6,805,691	$20,945,235	
	X-720 Complex				
X-720	Maint. & Stores Building	$29,307,101	$19,765,725	$49,072,826	
X-720A	Maint. & Stores Gas Manifold Shed	$9,102	$4,346	$13,448	
X-720B	Radio Base Station	$968,577	$22,075	$990,652	
X-720C	Paint & Storage Building	$150,270	$79,239	$229,509	
	Subtotal	$30,435,050	$19,871,385	$50,306,435	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Support Facilities & Systems					$158,781,322
	Schedule Adjustment			$15,087,818	
	Support Facilities & Systems-Total			$143,693,505	
	Administrative Facilities				
Portals					
X-108A	South Portal and Shelter-Drive Gate	$212,203	$279,292	$491,495	
X-108B	North Portal and Shelter	$104,106	$17,855	$121,961	
X-108E	Construction Entrance Portal	$63,958	$54,028	$117,986	
X-108J	West Security Portal	$90,028	$16,061	$106,089	
X-108K	North Security Portal	$90,028	$16,061	$106,089	
X-108L	East Security Portal	$90,028	$16,061	$106,089	
X-111A	SNM Monitoring Portal	$72,381	$26,924	$99,305	
X-111B	SNM Monitoring Portal	$27,385	$13,928	$41,313	
X-344H	Security Portal	$90,028	$16,061	$106,089	
X-1107BV	Interplant Vehicle Portal	$50,181	$23,338	$73,519	
	Subtotal	$890,326	$479,609	$1,369,935	
Trailers					
X-104B	Protective Forces Office Trailer	$211,069	$28,219	$239,288	
X-104C	Protective Forces Shower/Locker Trailer	$211,069	$28,219	$239,288	
X-530 T1	Office Trailer	$106,865	$13,779	$120,644	
X-533 T1	Trailer	$112,022	$14,444	$126,466	
X-533 T2	Trailer	$112,022	$14,444	$126,466	
X-533 T3	Trailer	$112,022	$14,444	$126,466	
X-533 T4	Trailer	$112,022	$14,444	$126,466	
X-600D	Utilities Maintenance Field Office	$101,915	$13,140	$115,055	
X-633 T1	Trailer	$101,915	$13,140	$115,055	
X-633 T2	Trailer	$101,915	$13,140	$115,055	
X-633 T3	Trailer	$101,915	$13,140	$115,055	
X-701 T1	Trailer	$106,713	$13,779	$120,492	
X-720 T01	Office Trailer	$99,251	$13,779	$113,030	
X-744Y T1	Trailer	$109,433	$14,110	$123,543	
X-744Y T2	Trailer	$109,433	$14,110	$123,543	
X-744Y T3	Trailer	$109,433	$14,110	$123,543	
X-744Y T4	Trailer	$109,433	$14,110	$123,543	
X-744Y T5	Trailer	$109,433	$14,110	$123,543	
X-744Y T6	Trailer	$109,433	$14,110	$123,543	
X-744Y T7	Trailer	$109,433	$14,110	$123,543	
X-744Y T8	Trailer	$109,433	$14,110	$123,543	
X-744Y T9	Trailer	$109,433	$14,110	$123,543	
X-760 T1	Trailer	$99,524	$12,832	$112,356	
X-760 T2	Trailer	$99,524	$12,832	$112,356	
X-1000 T1	Training Trailer	$109,277	$14,110	$123,387	
XT-800	GCEP Construction Office Pad	$8,453	$74,445	$82,898	
	Subtotal	$2,892,390	$449,320	$3,341,710	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
Buildings					
X-100	Administration Building (slab & below)	$0	$990,720	$990,720	
X-104A	Indoor Firing Range Building	$155,838	$92,726	$248,564	
X-105	Electronic Maintenance Building (slab)	$0	$100,000	$100,000	
X-106B	Old Fire Training Building (slab)	$0	$60,000	$60,000	
X-300	Plant Control Facility	$2,413,909	$4,385,642	$6,799,551	
X-300A	Process Monitoring Building	$98,435	$63,138	$161,573	
X-300B	Plant Control Facility Carport	$6,251	$35,370	$41,621	
X-300C	Emergency Commun'tions Antenna	$6,251	$2,076	$8,327	
X-533H	Personnel Monitoring Station	$54,188	$7,055	$61,243	
X-540	Telephone Building	$1,730,474	$71,581	$1,802,055	
X-750	Mobile Equipment Maint. Shop (slab)	$0	$101,077	$101,077	
X-751	GCEP Mobile Equipment Garage	$0	$733,783	$733,783	
X-1000	Administration Building	$450,028	$1,085,708	$1,535,736	
X-1007	Fire Station	$167,107	$820,321	$987,428	
J	X-1000 Pavilion	$6,956	$5,978	$12,934	
	Subtotal	$5,089,437	$8,555,175	$13,644,612	
Water Treatment, Storage, and Dist. Facs.					
X-230	Water Supply Line (Utilities)				
X-230A	Sanitary and Fire Water Distrib Sys (Utilities)				
X-230D	Softened Water Distribution System (Utilities)				
X-230E	Plant Water System (make-up)(Utilities)				
X-230F	Raw Water Supply Line (Utilities)				
X-230G	RCW System (Utilities)				
X-230H	Fire Water Distribution System (Utilities)				
X-240A	RCW Sys (Cathodic Protection Sys)(Utilities)				
Utilities Sum	X-230, -A, -D, -E, -F, -G, -H, X-240A	$0	$20,607,021	$20,607,021	
X-605	Sanitary Water Control House	$16,310	$23,363	$39,673	
X-605A	Well Field	$0	$60,000	$60,000	
X-608	Raw Water Pump House	$744,598	$754,400	$1,498,998	
X-608A	Well Field	$0	$60,000	$60,000	
X-608B	Well Field	$0	$60,000	$60,000	
X-611	Water Treatment Plant (slab & below)	$0	$89,918	$89,918	
X-611A	Old Lime Sludge Lagoon (below grade)	$0	$0	$0	
X-611B	Lagoon (below grade)	$0	$10,929	$10,929	
X-611B1	Lagoon Supernatant Pumping Sta.	$5,304	$24,301	$29,605	
X-611B2	Lagoon Supernatant Pumping Sta.	$4,114	$7,783	$11,897	
X-611B3	Lagoon Supernatant Pumping Sta.	$4,575	$24,301	$28,876	
X-611C	Filter Building (slab)	$0	$147,910	$147,910	
X-611E	Clear Well & Chlorine Building (below grade)	$0	$17,191	$17,191	
X-612	Elevated Storage Tank (footers)	$0	$5,027	$5,027	
X-626-1	Recirculating Water Pump House (below grade)	$0	$270,502	$270,502	
X-626-2	Cooling Tower (below grade)	$0	$514,013	$514,013	
X-630-1	Recirculating Water Pump House (below grade)	$0	$342,864	$342,864	
X-630-2A	Cooling Tower (below grade)	$0	$535,020	$535,020	
X-630-2B	Cooling Tower (below grade)	$0	$1,050,884	$1,050,884	
X-630-3	Acid Handling Station (slab)	$0	$9,718	$9,718	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-640-1	Fire Water Pump House (below grade)	$0	$25,272	$25,272	
X-640-2	Elevated Storage Tank (footers)	$0	$7,831	$7,831	
X-640-2A	Storage Tank Aux. Bldg.	$7,598	$856	$8,454	
X-680	Blowdown Sample and Treat. Bldg	$0	$60,000	$60,000	
X-701A	Lime House (slab)	$0	$10,000	$10,000	
X-701D	Water Deionization Facility (slab)	$0	$8,774	$8,774	
X-701E	Neutralization Building	$97,515	$8,678	$106,193	
X-701F	Effluent Monitoring Facility	$4,588	$13,428	$18,016	
X-2230T1	Recirc. Heating Water Sys.	$0	$400,000	$400,000	
	Subtotal	$884,602	$25,149,984	$26,034,586	
Sewage Collection and Treatment Facilities					
X-230B	Sanitary Sewers	$0	$1,600,000	$1,600,000	
X-230C	Storm Sewers	$0	$3,100,000	$3,100,000	
X-614A	Sewage Pumping Station (below grade)	$0	$4,127	$4,127	
X-614B	Sewage Pumping Station (below grade)	$0	$7,418	$7,418	
X-614D	South Sewage Lift Station	$4,719	$11,205	$15,924	
X-614P	Northeast Sewage Lift Station	$4,799	$31,316	$36,115	
X-614Q	Sewage Booster Pump Station	$10,200	$11,883	$22,083	
X-615	Old Sewage Treatment Plant (below grade)	$0	$200,000	$200,000	
X-616	Liquid Effluent Control Facility (below grade)	$0	$20,000	$20,000	
X-6619	Sewage Treatment Plant	$452,700	$928,132	$1,380,832	
	Subtotal	$472,418	$5,914,081	$6,386,499	
Electrical Dist. Systems and Facilities					
X-215D	Electrical Power Tunnels	$466,164	$3,738,040	$4,204,204	
X-501	Substation	$5,239	$4,197	$9,436	
X-501A	Substation	$5,239	$5,709	$10,948	
X-502	Substation	$5,686	$18,057	$23,743	
X-515	330 kV Tie Line: X-530 and X-533	$0	$400,000	$400,000	
X-530A	High Voltage Switchyd (ground sys.)	$0	$100,000	$100,000	
X-530B	Switch House (below grade)	$0	$1,285,529	$1,285,529	
X-530C	Test and Repair Building (slab)	$0	$10,469	$10,469	
X-530D	Oil House (below-grade structures)	$0	$2,040	$2,040	
X-530E	Valve House (slab)	$0	$13,892	$13,892	
X-530F	Valve House (slab)	$0	$13,892	$13,892	
X-530G	GCEP Oil Pumping Station	$84,837	$24,497	$109,334	
X-640-1A	Substation (required for Fire Services)	$7,967	$5,701	$13,668	
C	Old Switch Yard West of X-109A Pad	$0	$100,000	$100,000	
	Subtotal	$575,132	$5,722,023	$6,297,155	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
	Miscellaneous Utilities				
X-232A	Nitrogen Distribution System(W/X-232D)	$0	$0	$0	
X-232B	Dry Air Distribution System(W/X-232D)	$0	$0	$0	
X-232D	Steam and Condensate System	$26,217,703	$496,701	$26,714,404	
X-232E	Freon Distribution System(W/X-232D)	$0	$0	$0	
X-232F	Fluorine Distribution System(W/X-232D)	$0	$0	$0	
X-232G	Support for Distribution Lines(W/X-232D)	$0	$0	$0	
X-670	Dry Air Plant	$136,251	$578,371	$714,622	
X-670A	Cooling Tower	$9,293	$23,937	$33,230	
X-675	Plant Nitrogen Station	$9,293	$11,210	$20,503	
X-2232E	Gas Pipeline	$0	$250,000	$250,000	
	Subtotal	$26,372,540	$1,360,219	$27,732,759	
	Infrastructure				
X-114A	Outdoor Firing Range	$228,465	$41,774	$270,239	
X-202	Roads	$0	$1,400,000	$1,400,000	
X-204-1	Railroad and Railroad Overpass	$0	$3,200,000	$3,200,000	
X-206A	North Main Parking Lot	$0	$5,736,739	$5,736,739	
X-206B	South Main Parking Lot	$0	$3,632,822	$3,632,822	
X-206E	Construction Parking Lot	$0	$1,191,988	$1,191,988	
X-206H	Pike Avenue Parking Lot	$0	$1,404,590	$1,404,590	
X-206J	South Office Parking Lot	$0	$972,909	$972,909	
X-208	Security Fence	$121,256	$1,668,233	$1,789,489	
X-208A	Boundary Fence (w/X-208)	$0	$0	$0	
X-208B	SNM Security Fence (w/X-208)	$0	$0	$0	
X-210	Sidewalks (w/Facility)	$0	$0	$0	
X-220A	Instrumentation Tunnels	$2,014,579	$16,180,918	$18,195,497	
X-230M	Clean Test Site	$0	$15,000	$15,000	
X-600	Steam Plant (slab and below)	$0	$82,111	$82,111	
X-600A	Coal Yard - structures (Included with X-600)	$0	$0	$0	
X-748	Truck Scale	$8,680	$121,057	$129,737	
B	Pad in Field East of X-109A	$3,129	$16,463	$19,592	
H	Old Firing Range Shed	$0	$20,000	$20,000	
I	Peter Kiewit Powder Magazine	$8,863	$1,879	$10,742	
	Subtotal	$2,384,972	$35,686,483	$38,071,455	
	Storage and Warehouse Facilities				
X-345	SNM Storage Building	$188,612	$4,711,591	$4,900,203	
X-741	Oil Drum Storage Facility	$6,982	$29,927	$36,909	
X-742	Gas Cylinder Storage Facility	$31,590	$130,126	$161,716	
X-744K	Warehouse-K	$63,180	$260,252	$323,432	
X-744N	Warehouse N Non-UEA	$51,929	$169,438	$221,367	
X-744P	Warehouse P Non-UEA	$51,929	$169,438	$221,367	
X-744Q	Warehouse Q Non-UEA	$51,929	$169,438	$221,367	
X-744V	Surplus and Salvage Clean Stor. Area	$0	$20,000	$20,000	
X-744Y	Waste Storage Area	$0	$20,000	$20,000	
X-745B	Toll Enrichment Gas Yard	$1,492	$2,104,621	$2,106,113	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-745D	Cylinder Storage Yard	$4,639	$556,236	$560,875	
X-745F	North Process Gas Stockpile Yard	$1,492	$2,217,101	$2,218,593	
X-745G-2	Cylinder Storage Yard	$2,029	$2,812,079	$2,814,108	
X-746	Material Receiving and Inspection (slab)	$0	$90,065	$90,065	
X-747	Clean Scrap Yard	$0	$150,000	$150,000	
X-747A	Material Storage Yard (slab)	$0	$47,519	$47,519	
X-747B	Mat'l Storage Yard Pads and Equip	$93,719	$30,376	$124,095	
X-747C	Mat'l Storage Yard Pads and Equip	$93,719	$30,376	$124,095	
X-747D	Mat'l Storage Yard Pads and Equip	$91,489	$6,628	$98,117	
X-747E	Material Storage Yard	$0	$30,000	$30,000	
X-747H	NW Contaminated Scrap Yard (slab)	$0	$1,816,411	$1,816,411	
X-747H1	Loading Pad	$0	$150,000	$150,000	
X-747J	Decontamination Storage Yard	$0	$30,000	$30,000	
X-847	Warehouse	$315,900	$1,301,260	$1,617,160	
	Subtotal	$1,050,630	$17,052,882	$18,103,512	
Environmental Monitoring and Treatment Fac.					
X-120	Old Weather Station (footers)	$0	$22,278	$22,278	
X-120H	Weather Station	$1,046	$972,908	$973,954	
X-230A3	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A6	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A8	Ambient Air Monitoring Station	$1,025	$343	$1,368	
X-230A9	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A10	Ambient Air Monitoring Station	$1,025	$360	$1,385	
X-230A12	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A15	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A23	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A24	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A28	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A29	Ambient Air Monitoring Station	$1,025	$343	$1,368	
X-230A36	Ambient Air Monitoring Station	$1,005	$335	$1,340	
X-230A37	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230A40	Ambient Air Monitoring Station	$1,136	$388	$1,524	
X-230A41	Ambient Air Monitoring Station	$1,068	$360	$1,428	
X-230J1	East Env. Sampling Bldg, (slab)	$0	$1,375	$1,375	
X-230J2	South Environmental Sample Station	$6,241	$58,618	$64,859	
X-230J3	West Environmental Sampling Building	$273,408	$4,445	$277,853	
X-230J5	West Holding Pond Oil Separation Sta.	$60,456	$5,376	$65,832	
X-230J6	NE Holding Pond Monitoring Facility	$59,373	$5,039	$64,412	
X-230J7	East Holding Pond Oil Separation Bldg	$55,734	$5,301	$61,035	
X-230J8	Environmental Storage Building (slab)	$0	$5,000	$5,000	
X-235	South Groundwater Collection System	$0	$250,000	$250,000	
X-237	Little Beaver Groundwater Coll. Sys.	$0	$250,000	$250,000	

Table F.8. Process Buildings and Complex Facilities D&D RI/FS Sensitivity Analysis - Off-Site Disposal PORTS D&D of Balance of Plant (Continued)

Facility No.	Facility Name	Deactivation $	Demolition $	Subtotal	Total $
X-617	South Holding Pond pH Control Fac.	$6,917	$13,098	$20,015	
X-622	South Groundwater Treatment Facility	$44,450	$173,965	$218,415	
X-623	North Groundwater Treatment Bldg.	$44,450	$173,965	$218,415	
X-624	Little Beaver Groundwater Treat. Fac	$26,670	$104,379	$131,049	
X-625	Groundwater Passive Treatment Fac.	$8,890	$34,793	$43,683	
X-627	Groundwater Pump & Treatment Fac.	$4,445	$17,397	$21,842	
	Subtotal	$607,976	$2,103,306	$2,711,282	
Associated Non-Structural Support Systems					
	The following support system costs are included with associated facilities.				
X-215A	Electrical Distrib. to Process Bldg	$0	$0	$0	
X-215B	Electrical Distrib. to Other Areas	$0	$0	$0	
X-215C	Exterior Lighting	$0	$0	$0	
X-220B1	Process Instrument Lines	$0	$0	$0	
X-220B2	Carrier Communication Systems	$0	$0	$0	
X-220B3	Water Supply Telemetering Lines	$0	$0	$0	
X-220C	Superior American Alarm System	$0	$0	$0	
X-220D1	General Telephone System	$0	$0	$0	
X-220D2	Process Telephone System	$0	$0	$0	
X-220D3	Emergency Telephone System	$0	$0	$0	
X-220E1	Evacuation PA System	$0	$0	$0	
X-220E2	Process PA System	$0	$0	$0	
X-220E3	Power Public Address System	$0	$0	$0	
X-220F	Plant Radio System	$0	$0	$0	
X-220G	Pneumatic Dispatch System	$0	$0	$0	
X-220H	McCalloh Alarm System	$0	$0	$0	
X-220J	Radiation Alarm System	$0	$0	$0	
X-220K	Cascade Automatic Data Proc. Sys.	$0	$0	$0	
X-220L	Classified Computer System	$0	$0	$0	
X-220N	Security Alarm and Surveillance Sys.	$0	$0	$0	
X-220P	MSR System	$0	$0	$0	
X-220R	Public Warning Siren System	$0	$0	$0	
X-220S	Power Operations SCADA System	$0	$0	$0	
	Subtotal	$0	$0	$0	
Site Restoration					**$27,426,079**
	Site Restoration			$24,819,981	
	Schedule Adjustment			$2,606,098	
	Balance Of Plant (BOP) Subotal				**$528,598,758**
	Balance Of Plant (BOP) Total-(Includes Project Start Delay of 1 Year)				**$541,285,128**

Table F.9. Process Buildings and Complex Facilities D&D RI/FS
Sensitivity Analysis - Off-Site Disposal
PORTS
Facility Surveillance and Maintenance

Item No	Level 7 WBS--Description	Labor Hours	Labor $	Material $	Equipment $	Subcontract $	Total Dollars
1	WBS Ports: EM.PO.04.03.01.01.01 S and M Project Management Total	2,320,730	$ 129,967,870	$ 934,188	$ 176,310	$ 9,429,070	$ 140,507,438
2	WBS Ports: EM.PO.04.03.01.02.01 X-326 S and M Total	727,474	$ 40,083,980	$ 27,661,586	$ 854,270	$ 62,382	$ 68,662,218
3	WBS Ports: EM.PO.04.03.01.03.01 X-330 S and M Total	672,434	$ 37,147,134	$ 29,443,130	$ 517,912	$ 69,196	$ 67,177,372
4	WBS Ports: EM.PO.04.03.01.04.01 X-333 S and M Total	734,040	$ 40,806,526	$ 34,146,948	$ 607,072	$ 81,596	$ 75,642,142
5	WBS Ports: EM.PO.04.03.01.05.03 Other GDP Facilities Total	511,318	$ 27,144,096	$ 7,540,308	$ 1,286,394	$ 13,095,856	$ 49,066,654
6	WBS Ports: EM.PO.04.03.01.05.06 705 Complex Total	412,016	$ 22,615,136	$ 7,907,334	$ 1,115,852	$ 2,026	$ 31,640,348
7	WBS Ports: EM.PO.04.03.01.05.07 340 Complex Total	419,176	$ 22,480,360	$ 7,865,510	$ 1,109,996	$ 1,190	$ 31,457,056
8	WBS Ports: EM.PO.04.03.01.05.08 100 Complex Total	15,910	$ 774,612	$ 228,680	$ 38,654	$ -	$ 1,041,946
9	WBS Ports: EM.PO.04.03.01.05.09 720 Complex Total	223,480	$ 11,992,376	$ 4,070,452	$ 603,548	$ 2,798	$ 16,669,174
10	WBS Ports: EM.PO.04.03.01.05.10 744G Complex Total	357,986	$ 19,310,842	$ 6,775,850	$ 957,014	$ 1,580	$ 27,045,286
11	WBS Ports: EM.PO.04.03.01.05.11 XT-848 Total	281,506	$ 15,998,134	$ -	$ -	$ -	$ 15,998,134
12	WBS Ports: EM.PO.04.03.01.05.11 XT-849 Total	0	$ -	$ 2,961,488	$ -	$ -	$ 2,961,488
13	WBS Ports: EM.PO.04.03.01.05.11 XT-850 Total	0	$ -	$ -	$ 798,182	$ -	$ 798,182
14	WBS Ports: EM.PO.04.03.01.05.11 XT-851 Total	0	$ -	$ 1,470,284	$ -	$ -	$ 1,470,284
15	WBS Ports: EM.PO.04.03.01.05.11 XT-852 Total	0	$ -	$ 1,208,082	$ -	$ -	$ 1,208,082
16	WBS Ports: EM.PO.04.03.01.05.12 750 Complex Total	29,980	$ 1,559,176	$ 482,192	$ 81,926	$ -	$ 2,123,294
17	WBS Ports: EM.PO.04.03.01.05.13 710 Complex Total	206,280	$ 11,362,084	$ 3,986,764	$ 563,228	$ 814	$ 15,912,890
18	WBS Ports: EM.PO.04.03.01.05.14 Warehouse Total	12,304	$ 559,470	$ 200,784	$ 35,174	$ -	$ 795,428
19	WBS Ports: EM.PO.04.03.01.05.15 Trailers Total	269,480	$ 14,029,078	$ 4,422,364	$ 753,194	$ -	$ 19,204,636
20	WBS Ports: EM.PO.04.03.01.06.01 Utility Optimization Planning in Support of X-326 / X-330 / X-333 Total	24,740	$ 1,408,820	$ 21,120	$ 94,374	$ 5,107,206	$ 6,631,520
21	WBS Ports: EM.PO.04.03.01.06.02 Utility Optimization Planning - Balance of Plant Facilities Total	0	$ -	$ -	$ -	$ 15,721,580	$ 15,721,580
22	WBS Ports: EM.PO.04.03.01.06.03 Site Consolidation Ph2 Total	0	$ -	$ -	$ -	$ 20,822,594	$ 20,822,594
23	WBS Ports: EM.PO.04.03.01.06.09 X-720B Radio Repeater Replacement Total	4,230	$ 240,959	$ 6,605	$ -	$ 1,932,820	$ 2,180,384
24	WBS Ports: EM.PO.04.03.01.06.10 X-540/X-670 Power Feed Total	338	$ 18,269	$ 437	$ -	$ 132,981	$ 151,687
25	WBS Ports: EM.PO.04.03.01.06.11 Vault Relocation Total	3,030	$ 141,586	$ 1,482	$ -	$ 4,356,185	$ 4,499,253
	Subtotal	7,226,452	$ 397,640,508	$ 141,335,588	$ 9,593,100	$ 70,819,874	$ 619,389,070
	TOTAL -(Includes Project Start Delay of 1 Year)		**$ 407,183,880**	**$ 144,727,642**	**$ 9,823,334**	**$ 72,519,551**	**$ 634,254,408**

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