

Oak Ridge Building Trades Medical Screening Program for Portsmouth & Paducah Gaseous Diffusion Plants

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1. Institutional History Databases and Interviews to Ascertain Risks and Health

Concerns

Institutional History Databases for the Portsmouth GDP and Paducah GDP were completed using historical documents, the PACE Needs Assessment, and worker comments. Examples from the Institutional History Database for each site are included in Appendix A. The Oak Ridge interview was modified for use at the Portsmouth and Paducah GDP's.

2. Outreach to Portsmouth GDP Workers

- a) February 2003, Eula Bingham and Bill McGowan (University of Cincinnati), and Mike Dorsey (CPWR) met with the Tri-States Building and Construction Trades Council (Portsmouth GDP) to describe the screening program and encourage participation.
- b) October 2003, at the request of the Tri-States Building and Construction Trades Council, Eula Bingham and Bill McGowan, Mike Dorsey and Trish Quinn (CPWR), Kim Cranford and Sue Boone (Zenith Administrators) presented additional program information to a meeting in Portsmouth, Ohio attended by approximately 250 construction workers and community members and answered their questions.
- c) The Tri-States Building and Construction Trades Council polled their members and identified 825 GDP construction workers who have expressed an interest in screening. As a result of local media coverage, additional interested workers have called. Altogether, more than 1,145 former Portsmouth GDP construction workers expressed interest in participating in the program and 650 have been interviewed as of November 30, 2006. Medical exam diagnoses from exams completed by this date are provided in Appendix B. Results of medical exams authorized before December 1, 2006 for Portsmouth GDP construction workers, which have been completed and entered into the DMS, are included in quarterly reports submitted by CPWR

for the Building Trades National Medical Screening Program.

3. Opened Portsmouth GDP Office in December 2003 and Started Screenings

- a) Identified, hired, and trained a building trades worker to be the interviewer.
- b) Rented space at a centrally-located office for interviews and outreach.
- c) Screening exams began on January 22, 2004.

4. Outreach to Paducah GDP Workers

- a) May 2003, Eula Bingham and Mike Dorsey (CPWR) met with the West Kentucky Building and Construction Trades Council (Paducah GDP) to describe the screening program and encourage participation.
- b) The West Kentucky Building and Construction Trades Council polled their members and identified 650 GDP construction workers who have expressed an interest in screening. Local media coverage of the interview and outreach office opening resulted in numerous telephone calls from interested workers. Altogether, more than 1,035 former Paducah GDP construction workers expressed interest in participating in the program and 627 have been interviewed as of November 30, 2006. Medical exam diagnoses from exams completed by this date are provided in Appendix C. Results of medical exams authorized before December 1, 2006 for Paducah GDP construction workers, which have been completed and entered into the DMS, are included in quarterly reports submitted by CPWR for the Building Trades National Medical Screening Program.

5. Opened Paducah GDP Office April 2004 and Started Screenings

- a) Identified and hired, and a building trades worker to be the interviewer.
- b) Rented space at a centrally-located office for interviews and outreach.
- c) Training of the interviewer and first interviews in May 2004; medical exams began May 10, 2004.

6. Additional Outreach Activities

- a) The DOE-Lexington Office staff, now responsible for operations at the Portsmouth and Paducah GDP's, and Bechtel-Jacobs representatives at both sites were kept informed and prepared for questions that may come to them as a result of our outreach and medical exam activities.
- b) DOE Lexington Office staff were contacted for assistance in locating records that would identify former construction workers at the Portsmouth and Paducah GDP sites to facilitate contacting and notifying them about the

program. Laura Schachter of the DOE Lexington Office identified Steven A. Wagner of the United States Enrichment Corporation (USEC) as the contact person to assist us. A meeting with Steve Wagner (USEC Paducah) and Shannon E. Coriell (USEC Portsmouth) was held on June 17, 2004 at the Portsmouth GDP.

- c) The information provided by USEC was limited to construction worker and contractor names from visitor logs at Portsmouth GDP for various periods between 1983 and 1992 and at Paducah GDP for various periods between 1976 and 1991. The information we requested to facilitate former worker recruitment including name, SSN, and last known address and/or telephone number was said to have been available, but was never approved for release by the DOE Lexington Office.
- d) November 2006, Eula Bingham and Bill McGowan (University of Cincinnati), George Jones and Trish Quinn (CPWR), and Kim Cranford (Zenith) met with the Tri-States Building and Construction Trades Council (Portsmouth GDP) to inform them of the program's transition to the Building Trades National Medical Screening Program scheduled to occur on December 1, 2006. In February 2007, Eula Bingham and George Jones met with the West Kentucky Building and Construction Trades Council (Paducah GDP) to inform them of the program's transition to the Building Trades National Medical Screening Program which occurred on December 1, 2006.

7. Protocol Manual and IRB

A revised protocol manual for the Oak Ridge Building Trades Medical Screening Program for the Portsmouth and Paducah GDP's was prepared and submitted to the Program Office, the Oak Ridge Site-Wide IRB (ORSIRB) and the Central Beryllium IRB (CBeIRB). The program at both sites was approved by both IRB's.

The Oak Ridge Site-Wide IRB (ORSIRB) and the Central Beryllium IRB (CBeIRB) were both notified in writing that the administrative responsibility for the Oak Ridge Building Trades Medical Screening Program for the Portsmouth and Paducah GDP's would transition from the University of Cincinnati to The Center to Protect Workers' Rights on December 1, 2006 and be incorporated into the Building Trades National Medical Screening Program.

Building Number: X-345

Report of Building No X-345

Date Constructed: 1978 Year Closed: 2003

Construction Type:

Size: 36,061 sq. ft. (914.04, p. C-5)

Unique Features:**Renovations:**

Function-Table

Year	Function
1978	Special Nuclear Materials Storage Building (909.01, p. 7)

Process-Table

From year	To year	Process
		X-345 glovebox was originally used for sampling of uranium oxide by the uranium recovery operations, and had a particulate sampler on the exhaust. For several years, it was used only for repackaging of damaged oxide containers (914.03, p. 65)
		The central area houses a high-assay sampling area (HASA) and a small laboratory (909.01, p. 7)
		North and South Vaults stored highly enriched uranium (HEU) (909.01, p. 7)
1978		X-345 was designed to fill the mission of X-744G for storage of HEU materials in a more secure environment. After initial construction, it was also used to sample HEU UF ₆ small diameter cylinders using autoclaves (914.02, p. 46)
1985		Fourteen ton cylinders stored (904.02, p. 11)

Contaminations

Year	Contamination
	Some metal HEU oxide storage containers have been opened and not resealed with a new lid (810.01, p. 32).

Building Number:

X-345

DOE described the sampling facility as a source of fluoride and uranium emissions (909.01, p. 7)

The entire building has been designated as having fixed radiological contamination (909.01, p. 7)

The area around the HASA was known to be contaminated. (909.01, p. 7)

- 1978 Due to its high atomic weight, and because thorium-230 is a decay product of U-234, it tends to concentrate with the highly enriched U-235 stored in Building X-345. This makes the alpha emitting Th-230 an inhalation hazard for workers in the area. (915.10, p. 10)
- 1978 Most uptakes of uranium indicate a fast indicate a fast absorption type unless otherwise indicated in the bioassay records. Both Th-230 and U-234 should be considered as predominant radionuclides. Ambient gamma and neutron radiation are of concern. (915.10, p. 11)

Hazards: radiation, uranium, fluoride (909.01, p. 7), highly enriched uranium (HEU) (909.01, p. 7), highly enriched uranium oxide (910.10, p. 32), UF₆ (914.02, p. 45), U-234, Th-230, alpha radiation, ambient gamma and neutron radiation (915.10, p. 10, 11)

Inferred hazards:

References

- 810.01 Highly Enriched Uranium Working Group Report on Environmental Safety and Health Vulnerabilities Associated with Department's Storage of Highly Enriched Uranium, Vol. I, DOE/EH-0525; U.S. Department of Energy, December 1996.
- 904.02 Independent Investigation of the Portsmouth Gaseous Diffusion Plant, Vol. II: Current Environment, Safety, and Health Practices, Prepared by Office of Oversight of Environment, Safety, and Health, U. S. Department of Energy, May, 2000.
- 909.01 A Guide to Key Facilities at the Portsmouth Gaseous Diffusion Plant, Mary Byrd Davis; Uranium Enrichment Project, Yggdrasil Institute, undated.
- 914.02 Recycled Uranium Mass Balance Project Portsmouth, Ohio Site Report, BJC/PORTS-139/R1, Environmental Management & Enrichment Facilities Management and Integration Contract, June 19, 2000.
- 914.03 Public Health Assessment- US DOE Portsmouth Gaseous Diffusion Plant Piketon, County, Ohio,, www.atsdr.cdc.gov/HAC/pha/portsmouthgaa/pgdp2.html
- 914.04 Environmental Assessment Reindustrialization Program at the Portsmouth Gaseous Diffusion Plant Piketon, Ohio, Draft, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee, May 2001.
- 915.10 ORAU Team NIOSH Dose Reconstruction Project; Technical Basis Document for Portsmouth Gaseous Diffusion Plant-Site Description; ORAU-TKBS-0015-2: November 18, 2003.

Building Number: X-616

Report of Building No X-616

Date Constructed: 1976 Year Closed: 1992

Construction Type:

Size:

Unique Features:

Renovations: Early 1980s-CPVC pipeline constructed to reroute effluents to X-616 via the RCW blowdown lines (909.02, p. A-62)

Function-Table

Year	Function
1976	Liquid Effluent Control Facility (909.02, p. A-62)
1976	Chromate Reduction Facility (904.01, p. 68)

Process-Table

From year	To year	Process
1976	1990	Treated water was piped to the Scioto River (909.01, p. 18).
1976	1990	The chromium hydroxide sludge formed as a result of treating hexavalent chromium and was stored in two surface impoundments to the west of the facility. Closure began in 1990. At that time sludge was removed, treated, and taken to X-736 (909.01, pp. 17-18)
1976	1990	Also, treated effluent from X-700 and A-706 (909.01, p. 18)
1976	1990	At the onset of Plant operations, hexavalent chromium had been used as a corrosion inhibitor in the eight cooling towers at the Plant. In 1976, hexavalent chromium was reduced to the less toxic, trivalent form in the X-616 chromate reduction facility, thereby eliminating the more toxic hexavalent chromium from the waste stream. SO ₂ was used to accomplish this. Its use was suspended when the chromium-based inhibitor was discontinued (904.01, p. 68; 909.01, p. 18; 914.03, p. 64).
2000		More than six million pounds shipped to Envirocare in Utah (909.01, p. 18)

Building Number: X-616

Contaminations

Year	Contamination
	Inorganic constituents including chromium, nickel, manganese, and TCE have been detected in groundwater associated with the X-616 area (914.04, p. 3-10).
1991	The maximum concentrations of hexavalent chromium and total chromium were 20 micrograms/liter and 1560 micrograms/liter respectively (909.02, p.18)
	Hazards: hexavalent chromium, trivalent, SO ₂ (904.01, p. 68), nickel, manganese, TCE (914.04, p. 3-10), SO ₂ (914.03, p. 64)

Inferred hazards:

References

- 904.01 Independent Investigation of the Portsmouth Gaseous Diffusion Plant, Vol. I: Past Environment, Safety, and Health Practices, Prepared by Office of Oversight of Environment, Safety, and Health, U.S. Department of Energy, May 2000.
- 909.01 A Guide to Key Facilities at the Portsmouth Gaseous Diffusion Plant, Mary Byrd Davis; Uranium Enrichment Project, Yggdrasil Institute, undated.
- 909.02 Information Briefing on the Natural Resource Damage Assessment Rule, Presented to the Portsmouth Gaseous Diffusion Plant Trustees, U.S. Department of Energy Field Office, Oak Ridge, December 18, 1991.
- 914.03 Public Health Assessment- US DOE Portsmouth Gaseous Diffusion Plant Piketon, County, Ohio, www.atsdr.cdc.gov/HAC/pha/portsmouthgas/pgdp2.html
- 914.04 Environment Assessment Reindustrialization Program at the Portsmouth Gaseous Diffusion Plant Piketon, Ohio, Draft, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee, May 2001.

Building Number: X-760

Report of Building No X-760

Date Constructed: 1953 Year Closed:

Construction Type:

Size: ~60 by 80 ft (909.02, p. A-47)

Unique Features: 2000 gal. neutralization pit (909.02, A-47)

Renovations:

Function-Table

Year	Function
1953	Pilot Investigation Building (909.02, p. A-47)
1954	Chemical Engineering Building (Environmental Assessment Reindustrialization Program Document uses this name) (914.04, p. C-8)

Process-Table

From year	To year	Process
1953		X-760 contained a small process laboratory, a small machine/fabrication shop, a worker change/shower area, and essentially all plant site utilities (914.02, p. 44)
1953		This building was used for chemical and mechanical engineering pilot and demonstration scale investigations. "Early development projects, including decontamination process experiments, boiling freon heat exchanger experiments, UF ₆ heating studies, uranium oxide pelletizing experiments, freon drying tests, and controlled UF ₆ releases in a sealed environmental chamber, were conducted in this facility." Development work on the "fluorox process," which appeared to have involved a prototype fluorination tower for the Feed Manufacturing or Oxide Conversion Facility (909.01, p. 15; 909.02, p. A-47)
1953		The neutralization pit, north of X-760, was associated with X-760 for the storage and transfer of chemical wastes. The waste character varied according to the operations in X-760. The waste solids have contained uranium, nickel, and PCBs. (909.02, p. A-48)

Building Number: X-760

- 1955 Some of the wastes generated in the X-710 Laboratory were discharged to the sanitary sewers via the neutralization pit located in X-760. These included potassium fluoride, potassium hydroxide, and waste oil (909.02, p. A-48).
- 1957 X-760 received 0.86 MTU of UF₄, 0.4 MTU of UO₂, and 3.3TU of UO₃ from K-25. It was classified as recycled uranium. (909.01, p. 15)

Hazards: uranium, nickel, PCBs, potassium fluoride, potassium hydroxide, waste oil (909.02, p. A-48), UF₄, UO₂, UO₃ (909.01)

Inferred hazards:

References

- 909.01 A Guide to Key Facilities at the Portsmouth Gaseous Diffusion Plant, Mary Byrd Davis, Uranium Enrichment Project, Yggdrasil Institute, undated.
- 909.02 Information Briefing on the Natural Resource Damage Assessment Rule, Presented to the Portsmouth Gaseous Diffusion Plant Trustees, U.S. Department of Energy Field Office, Oak Ridge, December 18, 1991.
- 914.02 Recycled Uranium Mass Balance Project Portsmouth, Ohio Site Report, BJC/PORTS-139/R1, Environmental Management & Enrichment Facilities Management and Integration Contract, June 19, 2000.
- 914.04 Environmental Assessment Reindustrialization Program at the Portsmouth Gaseous Diffusion Plant Piketon, Ohio, Draft, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee, May 2001.

Building Number: C-746A

Report of Building No C-746A

Date Constructed: Year Closed:

Construction Type:

Size:

Unique Features:

Renovations:

Function-Table

Year	Function
1952	Smelter (404.01, p. 60, 414.20, p. 1)

Process-Table

From year	To year	Process
		Pantex shipped foam and plastics contaminated with beryllium, tritium, and uranium oxide. The foam and plastics were temporarily piled in a corner until an amount large enough to fill the burial container was collected. (414.04, p. 17) Also, cited in "Needs Assessment for Screening Former Paducah and Portsmouth GDP Workers for Beryllium Exposure" (967.02, p. 5)
	1985	Three smelters operated in C-746A, including a nickel induction furnace, a reverberatory furnace used to melt clean aluminum, and an aluminum sweating furnace. Little data on smelter operations at the plant was available because records were stored in contaminated waste drums or were removed by a DOE team investigating scrap metal recovery at the Plant. (404.01, p. 60)
		Lead fabrication work such as the pouring of melted lead to form massive shielding doors. It is estimated that approximately 10-20 tons of lead were used in the door. Additional doors were made in 1971 and 1978-1979. (414.04, ppp 9-10)

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C-746A

		<p>Large quantities of clean and contaminated nickel powder were recovered by smelting into ingots in Building C-746A. One or more sample buttons were made with each pour. Approximately 17 million pounds of clean nickel were released into commerce. Nickel free of radioactivity and that which was below the AEC and site criteria were routinely transferred to the National Stockpile or sold. Nearly 20 million pounds of this material was sold or otherwise released from radiological control, and the material is currently maintained in the PGDP contaminated scrap yard. Samples of "clean" ingots sold into commerce contained low levels of both Tc 99 and plutonium 239 contamination. (414.03, p. 2)</p> <p>Lead was received and recovered from several sources, including weapons parts. The Smelter Production Logbooks indicate approximately 258,990 lbs of shredded lead were produced and sold into commerce. (414.03, p. 22)</p>
1952	1986	About 37 million pounds of nickel were smelted (414.20, p.
1952		In the 1950's, early smelting activities mainly involved aluminium. (414.02, p. 13)
1952		The nickel was first ground to produce a small, uniform feed material. The process occurred in enclosed containers and emissions were subject to filtration before release to the atmosphere. All nickel was run through a large calciner to remove hydrogen fluoride from the scrap before it was fed to the smelter. Particulates and gas from this process were released to a chemical trap system that did not function well. (414.20, p. 7)
1952	1986	Nickel releases from all sources were predominately in a nickel oxide form. Particulate releases from the smelter were predominately about 30 microns in diameter with a small fraction in the 10 and 20 micron diameter size ranges.
1964	1985	Gold-bearing scrap was accumulated in C-746A before it was transported in lots to C-400 gold recovery area. (414.03, p. 7)
1970	1986	Approximately 4.5 million lbs of aluminium were smelted into ingots in Building C-746A from 1970-1986. Records prior to 1984 could not be found. Analysis of aluminium samples has revealed low levels of thorium-230, Pu 239, Pu-240, and uranium 233. Both aluminium melting furnaces were used to melt classified aluminium scrap (clean and contaminated) received from various locations. Melting was necessary to destroy the classified nature of the material. The Sweat Furnace was used solely to melt clean aluminium scrap and the Reverberatory Furnace was used to melt contaminated aluminium scrap. Approximately 4.5 million lbs. of aluminium was processed into ingots and sold into commerce. (414.03, p. 2, 17)
1977	1986	Years of significant nickel smelting inclusively. (414.02, p. 13)
1977	1982	17 million pounds of non-radiologically contaminated nickel were smelted. (414.20, p. 1)

Building Number:

C-746A

1981	1985	The major process source of the monel (a copper-nickel alloy) was the manufacture of new barrier. Monel was used to fabricate the ferrules of the barrier tube. Off-specification monel feedback and monel recovered from off-specification barrier tubes accumulated, and was smelted to be destroyed for classification concerns, and sold for recycle. Cobalt was used as a consumable component of processes at the K-25 Plant. 882,440 lbs of monel were released into commerce as well as 20,800 lbs of cobalt. 50,700 lbs. of cobalt were "shipped to Oak Ridge" (414.03, p. 21)
1983	1988	Twenty million pounds of radiologically contaminated nickel were smelted. (414.20, p. 1)
1983	1986	Annual smelter nickel emissions were estimated to be 794 pounds per year.
1986		In September 1986, the C-746A facility was placed in "Standby" As of 2000, the smelter facility still existed, although in a state of disrepair. Contaminated metal ingots are stored near the facility, including most of the nickel ingots that were made from the recycle of cascade materials during gaseous diffusion plant improvement programs. Empty casings for nuclear weapon components could be seen above ground behind the smelter facility (414.04, pp. 8-9).
1986		On April 29, 1986, a sintering program for a monel-nickel run was started. Records indicated that eight 55-gallon drums of monel were mixed with one drum of contaminated nickel pellets. (414.03, p. 21)

Contaminations/Incidents

Year	Contamination
	Primary hazards in smelting operations were heat, working with molten metals, noxious fumes, and the potential for airborne radioactive contaminants. (404.01, p. 18)
	The highest average annual nickel concentration at 1000m from the smelter was 0.004 ug/cu m. (414.20, p.3)
1952	Probably, nickel particulates reaching the final stack of the C-746A induction furnace would have been dominantly nickel oxide, releases from the other portions of the smelter were composed of other nickel compounds. (414.20, p. 7)
1952	Activities of radiological contaminants from nickel samples (Th-230, Th-232, U-235 and Tc-99 and stack emission monitoring (U-234, U-235 and U-238) were used to determine the quantity of radionuclides released during nickel smelting. (414.20, p. 3)
1972	A 1972 study of radionuclides in scrap indicated the potential for airborne concentrations of uranium during loading of melting pots; however, no uranium fumes were detected during alloy melting or pouring. (404.01, p.60)
Hazards: beryllium, tritium, uranium oxide (414.04, p. 17), uranium, aluminum, HF (404.01, p. 60, 86), nickel, monel, copper (414.03, p. 21), nickel oxide (414.20, p. 7), Th-230, Th-232, U-234, U-235, U-238, Tc-99 (414.20, p. 3)	

Building Number: C-746A

Inferred hazards:

References

- 404.01 Independent Investigation of the Paducah Gaseous Diffusion Plant, Phase II, Prepared by Office of Oversight, Office of Environment, Safety, and Health, U.S. Department of Energy, February 2000.
- 414.03 Report on the Paducah Gaseous Diffusion Plant, Metals Recovery Program; Department of Energy, Oak Ridge Operations, December 2000.
- 414.04 Report on the Paducah Gaseous Diffusion Plant "Work for Others" Program Including Weapons Support and Disposition, Department of Energy Oak Ridge Operations, December 2000.
- 414.20 Public Health Assessment Paducah Gaseous Diffusion Plant (U.S. DOE) Paducah, Mcracken County, Kentucky, Appendix I: Exposure Assessment of Airborne Nickel and Other Metal Particulates from Historical Smelter Operations at the Paducah Gaseous Diffusion Plant; http://www.atsdr.odc.gov/HAC/PHA/paducah2/pgd_p12.html
- 967.02 Addendum to PACE Needs Assessment, Paducah and Portsmouth, Mark Griffon, 2000.

Building Number: C-310

Report of Building No C-310**Date Constructed:** 1952 **Year Closed:****Construction Type:** asbestos siding, asbestos pipe insulation (416.10, p. 8, 12)**Size:** 53 X 30 ft. (414.01, p. C-8)**Unique Features:** equipped to handle two 10 to 14 ton cylinders simultaneously, two roll up doors (414.01, p. C-8); 61 meter stack (414.05, p.28)**Renovations:** 1953: Three months after opening- ventilation system modified to accommodate local exhaust hoods positioned over the pigtalls (414.01, p. C-8)
January 1963: magnesium fluoride pellet traps installed in product withdrawal station to recover neptunium and technetium (404.01, p. 17)
1983: modifications to the stack to reduce uranium emissions (414.05, p. 28)
no date found: Continuous stack sampler for HP installed in C-310 stack. (414.05, p. 29)
By Oct. 1994: C-310 South Bank NaF Trap System completed
By Oct. 1994: Seal Exhaust/Wet Air Stations installed (425.01)

Function-Table

Year	Function
1953	Product Withdrawal Facility (C-310A) (404.01, p. 53, 402.01)
1953	Purge and Product Building (406.01)

Process-Table

From year	To year	Process
1953		In the cascades, UF ₆ passed through barriers in the converters allowing isotopes of lower molecular weight to pass through resulting in two streams of UF ₆ . The one with a progressively higher percentage U-235 was withdrawn in C-310. Product U-235 (enriched UF ₆) were withdrawn from the cascade by pumps that discharged through a condenser, piping, and cylinder pigtalls to the intended receiving UF ₆ cylinder. Product cylinders were not supposed to be filled to more than 95 percent (liquid) of capacity. Those that were overfilled were tagged and subject to special handling to resolve the overfilled condition. UF ₆ cylinders still containing liquid could not be transported around the site without special consideration. Before solid UF ₆ cylinders were moved to storage, they were "burped" of light gases through sodium fluoride traps. (404.01, p. 16, 53)

Contaminations/Incidents

Year	Contamination
	<p>One report indicated that 20 dpm/m³ from individual puffs based on test run by environmental committee. Maximum allowable is 20 dpm/m³. When there were large spills, the premise was evacuated (414.01, p. F-18)</p> <p>An incident was reported in the C-310 product withdrawal building (C-310A) where an instrument heater control malfunctioned, melted tubing solder, and initiated a significant release that filled C-310 and was working its way across the bridge to C-331. Mechanics were reportedly sent without PPE to shut doors in the bridge. The original instrument line leak was secured by crimping the line by another worker outfitted in a Gra-Lite suit. Reportedly there was no special monitoring of the involved individuals, and work resumed after the cloud dispersed. (404.01, p. 53)</p> <p>The beta radiation dose rate at the surface of uranium metal is typically 230 millirems per hour or less. However, when uranium is melted or separated by chemical or physical means, less dense daughter products of uranium, primarily thorium-234 and protactinium-234m, can be concentrated. When the uranium is further processed, significant quantities of these daughter products can remain behind in the form of oxides or ash or on the surface of process vessels. Locations of daughter products at PGDP include C-310 in cylinder heels (feed and withdrawal). The beta radiation dose rate from these daughter products is much higher than that of the original uranium. In addition, these daughter products are loose and easily transferred by contact. Exposure to these daughter products as a result of transfer to clothing, tools, or other items is likely to result in unanticipated beta radiation doses to workers. Protactinium-234m emits a high-energy beta particle, which contributes most of the beta dose from the uranium-238 daughter products (404.01, p. 29)</p>
1953	Based on process chemistry, neptunium and plutonium concentrations would not be increased in the product withdrawal. Identified wipe data with elevated TRU levels confound this conclusion. (414.01, p. 26)
1953	Accidental UF ₆ releases during the connection and disconnection of cylinders was one of the leading causes of individuals reporting to the dispensary for medical attention in 1953, according to a PGDP quarterly report. UF ₆ releases often occurred when burping recently-filled UF ₆ cylinders. (404.01, p. 53) (not sure which building)
1953	A former operations supervisor reported that operators turned up "hot" in the product withdrawal area more than any other area of the cascade. Portions of the product withdrawal system operated at approximately 30 psig. As a result, small leaks in this area released enriched process gas into the room atmosphere and provided a higher potential for an intake. Air monitoring sampling indicated moderately high activity readings for the withdrawal room from the time of initial operations up through the early 1960s. (404.01, p. 53)
1956	Year most uranium was released. (414.05, p. 28)
1956	A major fire occurred in C-310 which had a high potential for increased radiation exposure. Carl Walter stated that this fire resulted as a direct result of high pressure on production (414.01, p. 49; 967.01, p. 27)
1989	Oct. 1989-Release of uranium from the C-310 purge stack. Approximately 205 grams (a little less than 1/2 pound) were released to the atmosphere when the primary and secondary trap system malfunctioned. (414.05, p. 33)

Building Number:

C-310

- 1994 Some of the largest quantities of asbestos found at Paducah Gaseous Diffusion Plant were in C-310 (425.04)
- 2000 Puffs of gas sometimes occurred when the connection between the cylinders and the UF₆ pipeline were broken without adequate purging. There were at least three instances where coupling between the cylinder and the gas line was broken, releasing large amounts of gas into the atmosphere. Primary exposures were UO₂F₂ and Tc-99. (414.01, p. F-15)
- 2000 Releases of trapped gas were a frequent occurrence while maintaining instruments. (414.01, p. F-14)
- 2000 Workers had a potential radiation exposure when baghouse changing. (414.01, p. F-13)

Hazards: enriched UF₆, sodium fluorides (404.01, p. 53), noise, heat, TCE, Tc-99, ClF₃, HF (967.01, p.29); beryllium (967.02), transuranics (414.01, p. F-13), asbestos (425.04, 416.10, p. 8, 12)

Inferred hazards:

References

- 402.01 EBASCO Services Incorporated OR-ERWM Program Technical Summary Document for the ER of the GDPs.
- 404.01 Independent Investigation of the Paducah Gaseous Diffusion Plant, Phase II, Prepared by Office of Oversight, Office of Environment, Safety, and Health, U.S. Department of Energy, February 2000.
- 414.01 Exposure Assessment Project at the Paducah Gaseous Plant Submitted by Paper, Allied Industrial, Chemical and Energy Workers (PACE) International Union, University of Utah Division of Utah Division of Radiology Center for Advanced Medical Technologies Center by U.S. Department of Energy Office of Environment, Safety and Health, December 2000.
- 414.05 Public Health Assessment Paducah Gaseous Diffusion (USDOE) Paducah, MaCracken County, Kentucky, EPA Facility ID: KY8890089982, March 30, 2001; Prepared by: Energy Section Federal Facilities Assessment Branch Division of Health Assessment and Consultation Agency for Toxic Substances and Disease Registry, http://www.atsdr.cdc.gov/HAC/PHA/paducah/pad_toc.html
- 416.10 Extracted from Document KZ-6945, Project History and Completion Report- Paducah Area Base Program [As Relaying to Work Performed by Prime Contractors, and Construction Sub-contractors from November 1950 Through February 1954]; Compiled by R.P. Prince, ETTP Inactive Records Center, Distribution of ETTP-3382, USDOE-HQ, Germantown, MD, Roger Anders, Bechtel Jacobs Company LLC, EMEF Inactive Records Center (RC); Distribution of ETTP-3382, USDOE-HQ, Germantown, MD, Roger Anders, Bechtel Jacobs Company LLC, EMEF Inactive Records Center (RC); April 2002.
- 425.01 Paducah Gaseous Diffusion Plant, National Academy of Sciences National Research Council, Committee on Decontamination & Decommissioning (D&D) of the Uranium Enrichment Facilities, Paducah Site Visit, October 20, 1994.
- 425.04 Paducah Gaseous Diffusion Plant- Considerations Affecting D&D, Stephen J. Davis, D&D Program Manager, June 15, 1994.

Building Number:

C-310

- 967.01 Wages, R., et al. Former Worker Medical Surveillance Program at Department of Energy.
- 967.02 Addendum to PACE Needs Assessment, Paducah and Portsmouth, Mark Griffon.

Portsmouth Former Worker's Program
Health Conditions by Duration of Site Work from History, Lab Results, or Physician
Preliminary Data

Diagnosis Description	Possible Workplace Causative Exposures	Number in All Workers Tested	Number in Workers 5 or More Years at Site
Abnormal Liver Function	Solvents	47	21
Anemia	Radiation, Benzene	32	7
Arthritis, Degenerative Joint Disease	Lifting, hammering, repetitive motion	219	74
Asbestosis	Asbestos	130	37
Asthma	Dusts, chemicals	56	15
Bronchitis, Chronic (Unspec.)	Particulates	86	24
Bursitis Disorders	Lifting, hammering, repetitive motion	50	17
Cancer: Bile duct	Radiation	1	
Cancer: Bladder	Chemical carcinogens, radiation	6	
Cancer: Bone	Radiation	2	
Cancer: Colon	Radiation	6	1
Cancer: Gallbladder	Radiation	2	
Cancer: Kidney	Radiation, heavy metals, solvents	3	1
Cancer: Laryngeal	Radiation	1	
Cancer: Leukemia (OT chr.lymph.leuk.)	Radiation, Benzene	3	2
Cancer: Lung	Radiation, nickel, welding fumes, asbestos	4	3
Cancer: Multiple myeloma	Radiation, benzene	4	
Cancer: Non-Hodgkin's lymphoma	Radiation, Benzene	2	2
Cancer: Oral-pharyngeal	Radiation, benzene	3	
Cancer: Pancreatic	Radiation	1	
Cancer: Prostate	Radiation	35	9

Appendix B

Diagnosis Description	Possible Workplace Causative Exposures	Number in All Workers Tested	Number in Workers 5 or More Years at Site
Cancer: Skin cancer of face	Radiation, sunlight	2	
Cancer: Skin, Melanoma	Radiation, sunlight	7	3
Cancer: Skin, non-melanoma	Radiation, sunlight	29	10
Cancer: Skin, Site Unspecified	Radiation, sunlight	35	8
Cancer: Stomach	Radiation	2	1
Cancer: Throat	Radiation	4	
Cancer: Thyroid	Radiation	1	
Carpal Tunnel Syndrome	Repetitive motion	14	6
COPD	Dusts, metals, welding fumes	121	35
Dermatitis, Contact, due to metals	Chromium, nickel, metals	1	1
Dermatitis, Contact, NEC	Allergens e.g. cement dust, nickel	19	4
Hearing Loss, Sensorineural	Noise	382	121
Hepatitis, Unspecified	Solvents	4	
Hyperthyroidism	Radiation	7	5
Hypothyroidism, Acquired, Unspec.	Radiation	27	9
Lung mass	Radiation, asbestos, metals	1	1
Lung nodule(s)	Radiation, asbestos, metals	4	1
Lung nodule, questionable	Radiation, asbestos, metals	6	1
Neuropathy, Peripheral	Solvents	7	3
Pleural Plaques	Asbestos	77	22
Renal Failure	Metals, solvents	15	2
Rhinitis, Allergic	Dusts, solvents	62	20
Sarcoidosis	Organic dusts	2	1
Silicosis	Silica	13	2
Thyroid disease	Radiation	8	2
Tremor (Unspecified)	Mercury	34	12

Paducah Former Worker's Program
Health Conditions by Duration of Site Work from History, Lab Results, or Physician
Preliminary Data

Diagnosis Description	Possible Workplace Causative Exposures	Number in All Workers Tested	Number in Workers 5 or More Years at Site
Abnormal Liver Function	Solvents	28	6
Abnormal Lung Function	Asbestos, silica, dusts	209	21
Anemia	Radiation, Benzene	42	5
Arthritis, Degen, Joint Disease	Lifting, hammering, repetitive motion	239	36
Asbestosis	Asbestos	101	19
Asthma	Dusts, chemicals	39	7
Bronchitis, Chronic (Unspec.)	Particulates	76	7
Bursitis Disorders	Lifting, hammering, repetitive motion	48	8
Cancer: Bladder	Chemical carcinogens, radiation	9	
Cancer: Bone	Radiation	2	
Cancer: Colon	Radiation	15	1
Cancer: Esophageal	Radiation	1	
Cancer: Gallbladder	Radiation	1	
Cancer: Hodgkin's disease	Radiation	1	
Cancer: Kidney	Radiation, heavy metals, solvents	3	
Cancer: Laryngeal	Radiation	3	1
Cancer: Leukemia (OT chr.lymph.leuk.)	Radiation, Benzene	1	
Cancer: Liver	Radiation, solvents	2	
Cancer: Lung	Radiation, nickel, welding fumes, asbestos	9	1
Cancer: Multiple myeloma	Radiation, benzene	8	1
Cancer: Non-Hodgkin's lymphoma	Radiation, Benzene	1	

Appendix C

Diagnosis Description	Possible Workplace Causative Exposures	Number in All Workers Tested	Number in Workers 5 or More Years at Site
Mercury Poisoning	Mercury	1	
Neuropathy, Peripheral	Solvents	29	4
Nodule(s), lung, questionable	Radiation, asbestos, metals	21	1
Pleural Plaques	Asbestos	62	7
Radiation sickness, acute, b/o	Radiation	1	
Renal Failure	Metals, solvents	18	3
Rhinitis, Allergic	Dusts, solvents	67	9
Silicosis	Silica	11	
Skin cancer of face	Radiation, sunlight	1	
Thyroid disease	Radiation	7	
Tremor (Unspecified)	Mercury	31	4
Tremor from mercury	Mercury	1	1