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BJCF-552 (10/01)

Department of Energy
Oak Ridge Operations
Paducah Site Office
P.O. Box 1410
Paducah, KY 42001

COPY

June 25, 1996

Mr. Winston A. Smith, Director
Air, Pesticides, and Toxic Management Division
United States Environmental Protection Agency
Region IV
345 Courtland Street, N. E.
Atlanta, Georgia 30365

1995 NATIONAL EMISSION STANDARD FOR HAZARDOUS AIR POLLUTANT (NESHAP) ANNUAL REPORT FOR THE PADUCAH GASEOUS DIFFUSION PLANT (PGDP)

Dear Mr. Smith:

Enclosed is the annual NESHAP report required by 40 CFR 61, Subpart H, which summarizes the airborne radionuclide emissions from PGDP during calendar year (CY) 1995. If you have any questions or require additional information, please call W. David Tidwell at (502) 441-6807.

Sincerely,

Jimmie C. Hodges

Jimmie C. Hodges, Site Manager
Paducah Site Office

EF-22:Tidwell

Enclosure

cc: J. B. Benton, NE-40
N. L. Carnes/R. Blumenfeld, CC-10
R. K. Dierolf, LMUS/PGDP
L. A. Eaton, JEG/Kevil
C. S. Gist, EW-91
P. J. Gross, SE-31
C. A. Hudson, LMES/Kevil
J. C. Massey, LMES/Kevil
J. W. Parks, EF-20
T. M. Taimi, USEC/HQ
J. W. Wagoner, EM-424

USEC

United States
Enrichment Corporation

Paducah Site Office
P.O. Box 1410
Paducah, KY 42001

Tel: 502 441-5803
Fax: 502 441-5801

June 4, 1996

Mr. Jimmie Hodges, Site Manager
Paducah Site Office
Department of Energy
Post Office Box 1410
Paducah, Kentucky 42002-1410

1995 National Emission Standard for Hazardous Air Pollutant (NESHAP) Annual Report for the Paducah Gaseous Diffusion Plant (PGDP)

Attached is the annual NESHAP report required by 40 CFR 61, Subpart H, which summarizes the airborne radionuclide emissions from PGDP during CY 1995. This report is required to be submitted to the Environmental Protection Agency by June 30, 1996. The appropriate Department of Energy official should sign the certification located after the compliance assessment on page 17 of the report.

If you have any questions, please contact Ron Dierolf at (502) 441-5956.

Sincerely,

T. Michael Taimi
Environmental Assurance & Policy Manager

TMT:RKD:mjw

Attachment

cc: Dane Bartlett - LMUS/PGDP
John Dietrich - LMUS/HQ
David Hutcheson
Roger McDermott - LMUS/PORTS
Steve Polston - LMUS/PGDP

cc/att: Linda Beach - LMUS/HQ
Ron Dierolf - LMUS/PGDP
Weldon Dillow - DOE/OR
Steve Shell/Jimmie Hankins - LMUS/PGDP
Henry Fellers - LMES/OR
EC File - RC

United States Department of Energy
Air Emissions Annual Report
(40 CFR 61, Subpart H)
Calendar Year 1995

Site Name: Paducah Gaseous Diffusion Plant

OPERATIONS OFFICE INFORMATION

Office: Paducah Site Office
P. O. Box 1410
Paducah, Kentucky 42002-1410

Contact: W. David Tidwell *Phone*: (502) 441-6807

SITE INFORMATION

Operating Contractor:

United States Enrichment Corporation/Lockheed Martin Utility Services, Inc.

Address: P. O. Box 1410
Paducah, Kentucky 42002-1410

Contact: Ronald K. Dierolf Jr. *Phone:* (502) 441-5956

SECTION I–FACILITY INFORMATION

SITE DESCRIPTION

The Department of Energy (DOE) Paducah Gaseous Diffusion Plant (PGDP) is an active uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The cascade, including product and tails withdrawal, is housed in 6 process buildings covering a total of approximately 80 acres. The plant is located on a reservation consisting of approximately 1350 acres in western McCracken County approximately 10 miles west of Paducah, Kentucky, and approximately 3 miles south of the Ohio River. Roughly 740 acres of the reservation are enclosed within a fenced security area. The raw water treatment plant, residential landfill, and inert landfill are the only operating areas outside of the security area. An uninhabited buffer zone of at least 400 yards surrounds the entire fenced area. Beyond the DOE-owned buffer zone is an extensive wildlife management area consisting of approximately 2100 acres either deeded or leased to the Commonwealth of Kentucky. During World War II, the Kentucky Ordnance Works (KOW), a trinitrotoluene production facility, was operated in an area southwest of the plant on what is now the wildlife management area. The water treatment plant used by PGDP was originally a KOW facility.

Construction of the PGDP facility began in 1951 and the plant was fully operational by 1955, supplying enriched uranium for commercial reactors and military defense reactors. Enriched uranium is defined as uranium in which the concentration of the fissionable uranium-235 (^{235}U) has been increased from its natural assay. Natural uranium is mostly ^{238}U with about 0.72 percent ^{235}U and 0.0051 percent ^{234}U. Uranium mills process the ores to produce concentrated uranium oxide (U_3O_8), which is then commercially converted to gaseous uranium hexafluoride (UF_6) for enrichment at a gaseous diffusion plant. The Paducah Plant serves as a first step in the uranium enrichment process in which the ^{235}U is increased to approximately 2 percent. Product from PGDP must be further enriched prior to its use as a nuclear fuel; thus the plant provides an enriched feed stream to the Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio, and provided a similar feed stream to the Oak Ridge Gaseous Diffusion Plant in Oak Ridge, Tennessee, prior to its shutdown. PGDP is in the process of upgrading its operations to be capable of 2.75 percent ^{235}U enrichment. The proposed date for this capability is 1996. Hazardous, nonhazardous, and radioactive wastes are generated and disposed as a result of plant operations.

The Paducah Plant enriches the uranium isotope, ^{235}U, via a physical separation process. The separation is based on the faster rate at which ^{235}U diffuses through a barrier compared with the heavier ^{238}U isotope. During enriching operations from 1953 to 1975, feed material (called "reactor tails") from government reactors was also used intermittently in addition to the UF_6 typically used. Reactor tails are the fuel from nuclear reactors that have had its ^{235}U content depleted, have been reprocessed to remove most of the fission products, and which must have its ^{235}U content replenished before it can be recycled. The reactor fuel rods were processed at other DOE facilities (where most of the fission products were removed) and the enriched uranium and the remaining fission products were fed into PGDP cascade system. Use of the reactor tails resulted in the introduction of technetium-99 (^{99}Tc), a fission by-product and transuranics, most notably neptunium 237 (^{237}Np) and plutonium-239 (^{239}Pu), into the cascade. ^{99}Tc is a man-made radioactive substance (radionuclide) having a half-life estimated at between 212,000 and 250,000 years. It decays by emitting beta radiation.

Extensive support facilities are required to maintain the diffusion process. Some of the major support facilities include a steam plant, four major electrical switchyards, four cooling tower complexes, a

transuranics, and ^{230}Th. The effluent from the burp facility is routed through a bank of sodium fluoride (NaF) traps prior to being emitted from the C-310 stack. There are 2 banks of chemical traps associated with this system. The north bank has 3 sets of traps (primary, secondary, and standby). Each trap contains approximately 300 pounds of NaF. The south bank has 7 traps, the first 5 of which are operated in series with the last 2 operated in parallel with each other. These traps contain approximately 100 pounds of NaF each. The smaller size of the traps is due to criticality safety concerns. Uranium is recovered from the NaF traps back to the enrichment cascade. Emissions from the C-310 stack were estimated based on results of the continuous potassium hydroxide bubbler stack sampling system which was approved by the Environmental Protection Agency (EPA) in 1992.

Seal Exhausts

Seals on the UF_6 compressors are supplied with an intricate array of air pressures to reduce any UF_6 release which may occur in the unlikely event of a seal failure. The seal exhaust flow is removed by large, oil-filled vacuum pumps and is routed from the seals through alumina traps, the pump, and to a common exhaust vent. There is one seal exhaust vent per cascade building, one on the C-310 Product Withdrawal Building and one on the C-315 Tails Withdrawal Building. Under normal operations, only trace amounts of UF_6 are present in the seal exhaust system. Occasionally, a seal or seal control system malfunction will allow greater quantities of UF_6 to enter the exhaust system. If UF_6 is allowed to enter the pump by virtue of trap breakthrough, it reacts with the pump oil creating a thick, gummy sludge which overloads the pump in a short time. Due to the reaction between UF_6 and pump oil, the oil also serves as an excellent uranium emission control device. No credit is taken for the oil as a pollution abatement system, however, because the oil is an integral part of the pumping system and in no way is included for emission control. The list below indicates locations of the seal exhausts at PGDP:

C-331 Process Building
C-333 Process Building
C-335 Process Building
C-337 Process Building
C-310 Product Withdrawal Building
C-315 Tails Withdrawal Building

Emissions from the seal exhaust grouped source were estimated based on results of Method 5 stack sampling performed in 1992. The seal exhausts are scheduled to be resampled in 1997.

A discussion of the potential to emit from the seal exhausts and wet air exhausts, and the conclusion that the alumina traps which protect the pump oil are not pollution control devices under 40 CFR 61, Subpart H, was forwarded to EPA on January 28, 1994.

Wet Air Exhaust

When maintenance is required on cascade piping and equipment, the process gas (UF_6) is evacuated to other sections of the cascade or surge drums. The subject equipment and piping are swept in a series of purges with "dry" plant air. After maintenance, the system is closed and the ambient (wet) air is pumped from the system by the wet air pumps. In both the dry air purges and the wet air withdrawal, the air is routed through alumina traps for uranium trapping to protect the wet air pump oil, and then to an exhaust vent. In process buildings C-310, C-333, C-335, and C-337, the exhaust vent is the same one which services the seal exhaust system for those buildings.

Prior to 1995, all "whiffs or puffs" from pigtail operations were reported and recorded. This practice ceased in late 1994; consequently, there are no records for such events in 1995. Therefore, a conservative approach toward estimating the emissions was used in 1995.

The total number of pigtail disconnections in the facilities not serviced by permanently installed HEPA filter systems and an estimated quantity of UF_6 in each pigtail was used to estimated the total quantity of UF_6 which could have been released. This quantity was multiplied by the emission factor for HEPA filters in accordance with 40 CFR 61, Appendix D, to determine the quantity of UF_6 releases from pigtail disconnections.

Laboratory Hoods

The C-710 laboratory is operated by Production Support and is the main facility for sample analysis and research at PGDP. There are a total of 111 laboratory hoods and canopies in the C-710 Building. All of the hoods and canopies were not used in 1995. Fifty-four of the hoods were located in radiological areas. This number includes 11 hoods which contain closed systems with no potential for radionuclide emissions under normal conditions. The radionuclides involved in analyses consist primarily of uranium, with a slight potential for emissions of ^{99}Tc, ^{237}Np, ^{239}Pu, and the daughters of uranium (^{230}Th ^{234}Th, and protactinium-234). In some cases, the hood exhausts combine with other hood exhausts, creating a discrepancy between the number of hoods and actual emission points. There are also 8 laboratory hoods in the C-409 Stabilization Facility. Analysis and research in only one of these hoods involved radionuclides in 1995. The estimated emissions were so insignificant that for modeling purposes they were included in emissions from the C-710 laboratory. Three laboratory hoods in the C-410 Feed Plant are permanently shut down. The list below indicates the laboratory exhaust systems at PGDP:

Building	Hoods/Canopies	Hoods/Canopies Used in Radiological Areas in 1995
C-710 Laboratory	111	54
C-409	8	1
C-410	3	0

Four methods, depending on the type of operation occurring in the hood or radiological area in which the hood was located, were used to estimate emissions.

1. Estimation of the maximum quantity of uranium which could be lost based on laboratory methods (e.g., if an ASTM analytical method specifies a maximum of 1.6 percent loss of mass during analysis, all samples analyzed using the method were assume to loose, as an emissions from the hood, 1.6 percent of the uranium in the sample.)

2. Use of 40 CFR 61, Appendix D, emission factors.

3. Use of chemical trap efficiencies and uranium throughput information.

4. Knowledge of the analytical or sample preparation process.

C-400 Cylinder Drying Station

This facility is used to dry UF_6 cylinders after the "heel" has been removed in the C-400 cylinder wash stand. Dry "plant air" is passed through the cylinder to evaporate any moisture from the washing and hydrostatic testing processes. Emissions were estimated in accordance with Appendix D. The concentrations of radionuclides in water used to hydrostatically test the cylinders prior to drying, multiplied by the total volume of water used in the hydrostatic test, were considered as the curies "used."

C-746-A Low-Level Waste Compactor

This facility is used to compact bagged, low-level radiological waste. The facility consists of a telescoping compacting arm which very slowly compacts bags of low-level contaminated material into a storage drum. It is equipped with HEPA filters. This facility was not used for radiological materials in 1995.

Radiological Areas

Radiological areas are established under specific criteria listed in various worker protection procedures and standards. There are a number of minor radiological areas at PGDP which are monitored by Health Physics (HP) air samplers. The sampling systems consist of a low-volume pump (20 to 40 liters per minute) drawing the ambient building air through a Whatman No. 41 cellulose filter. The samplers run 24-hours per day and the filters are changed on 2-, 3-, 4-, or 5-day basis, depending upon weekend and holiday schedules. A minimum of 2 days of sample air is collected on each filter. After sample collection, the filters are counted for gross alpha concentrations.

For the 1995 NESHAP report, PGDP estimated the building ventilation grouped source according to the method stated in Section 3.1 of the revised PGDP NESHAP Compliance Plan submitted to EPA in January 1992.

According to PGDP's compliance plan, building emissions from non-radiological areas are not estimated due to their lack of potential for airborne radiological emissions. One of the criteria for establishing a radiological area is airborne concentrations of radionuclides in that area which are greater than 10 percent of a derived air concentration (DAC). DACs are established in 10 CFR 835 and represent the airborne radionuclide concentrations which would cause a maximum internal radiation dose of 5000 millirem (mrem)/year (50 millisieverts/year). According to the compliance plan, if an area does not have airborne radionuclide concentrations greater than 10 percent of a DAC, it is not required to be classified a radiological area and will therefore not be evaluated for radionuclide emissions. (It could be classified a radiological area due to other HP criteria, however.)

In addition to the general emissions from radiological areas, PGDP also has a number of minor sources which do not have direct exhausts into the ambient air. These minor sources are located in radiological areas and contribute to the emissions from the radiological areas as calculated by the HP samplers. A list of these minor sources with no direct exhaust to the ambient air, and which are located in radiological areas, is as follows: (This list also contains sources which did not operate in 1995.)

C-310 Burp Station, C-333-A and C-337-A Feed Cylinder Connection Activity Emissions

The pigtail systems in the C-310 Burp Station and C-333-A and C-337-A feed cylinder vaporizers have no specific ventilation system, unlike those in the C-310 Product Withdrawal Building, the C-315 Tails Withdrawal Building, and the C-360 Toll Transfer Building. Furthermore, the C-333-A and C-337-A feed cylinder vaporizers are not located in completely enclosed buildings. The C-310 Burp Station is outside with no enclosure. As stated previously, HEPA vacs are used to control any potential radionuclide emissions during the disconnection of the pigtails. The vaporizer buildings are enclosed on three sides only. Since the vaporizers and the C-310 Burp Station are not located in an enclosed structure, building ventilation data could not be used to estimate emissions. Emissions from the vaporizers and the C-310 Burp Station cylinder connection activities were estimated as described previously in the "cylinder valve connection activities" section.

C-400 Compressor Pit

This area was used for maintenance on UF_6 compressors and has not been used since 1989.

C-400 Cylinder Wash

This facility is used to remove the solid UF_6 "heel" from cylinders. The cylinder heel is dissolved in a sodium carbonate solution and the solution is transferred to the C-400 No. 5 Dissolver for uranium recovery. The only potential for radionuclide emissions are "whiffs and puffs" when the cylinder valve is opened for introduction of the sodium carbonate solution. The facility does not have a dedicated exhaust system. Any potential emissions will be included in the estimates from the C-400 HP air samplers.

Northwest Plume Interim Remedial Action Pilot Plant

On September 1, 1995, DOE began operation of a pilot plant designed for the removal of trichloroethylene and ^{99}Tc from groundwater. The facility is located at the northwest corner of PGDP's site security area. The facility consists of an air stripper to remove volatile organics from water and an ion exchange unit for the removal of ^{99}Tc. The air stripper is located upstream of the ion exchange unit.

Emissions of ^{99}Tc were estimated using the analysis of the influent groundwater and the water leaving the air stripper. The ^{99}Tc concentration in the influent and effluent of the air stripper and the quantity of the water passing through the stripper were used to estimate the total quantity of ^{99}Tc emitted from the facility. While the exhaust from the air stripper is passed through a carbon adsorption unit prior to exhaust, no data concerning ^{99}Tc retention in the unit was obtained and, therefore, no reduction in ^{99}Tc emissions due to the use of the adsorption unit were assumed.

SECTION II–AIR EMISSIONS DATA

MAJOR POINT SOURCE

Major Point Source	Type Control	Efficiency	Distance to Nearest Receptor
C-310 Purge Stack	NaF Traps[2]	>99.9%	1755 M ESE
	Alumina Traps[2]	≈98.6%	

MINOR POINT SOURCES

Minor Point Source	Type Control	Efficiency	Distance to Nearest Receptor
C-400 Cylinder Drying Station[3]	None	0	1908 M ESE
Northwest Plume Treatment Facility	None	0	1170 M NNE

MINOR GROUPED SOURCES

Grouped Sources	Type Control	Efficiency %	Distance to Nearest Receptor
Wet air/seal exhausts (6)	Alumina Traps[2]	≈ 98.6	1524 M ESE
Cylinder valve connection activities (3)	HEPA Filters and Vacuums	99.95	N/A[4]
Cylinder valve connection activities not included above; i.e., not serviced by a stack (3).[3]	HEPA Vacuums	99.0 (Appendix D)	1524 M ESE
C-400 sources (3)[3]	None	0	1901 M E NNE
C-710 laboratory hoods (54)[3]	None	0	1944 M NNE
Building ventilation (10)	None	0	1524 M ESE

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[2]See January 28, 1994, correspondence from D. F. Hutcheson to W. A. Smith discussing "Potential to Emit."

[3]Emissions estimated in accordance with 40 CFR 61, Appendix D.

[4]Stack sampling data results indicted that emissions were not distinguishable from zero, based on a statistical one-tailed test of significant difference from zero. Therefore, dose modeling was not performed and no receptor was determined.

SECTION III–DOSE ASSESSMENT

DESCRIPTION OF DOSE MODEL

The radiation dose calculations were performed using the Clean Air Act (CAA) Assessment Package-88 of computer codes. This package contains EPA's most recent version of the AIRDOS-EPA computer code, which implements a steady-state, Gaussian plume, atmospheric dispersion model to calculate environmental concentrations of released radionuclides and Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to radionuclides deposited in the environment. The human exposure values are then used by EPA's latest version of the DARTAB computer code to calculate radiation doses to man from radionuclides released during the year. The dose calculations use dose conversion factors in the latest version of the RADRISK data file, which is provided by EPA with CAA Assessment Package-88.

SUMMARY OF INPUT PARAMETERS

Except for the radionuclide parameters given in Section II and those given below, all important input parameter values used are the default values provided with the CAP-88 computer codes and databases.

Joint frequency distribution:	5-year STAR distribution from 60 meter stations on Paducah meteorological tower for the years 1989 through 1993.
Rainfall rate:	121 centimeters/year
Average air temperature:	20°C
Average mixing layer height:	930 meters

Fraction of foodstuffs from:	Local Area	50-Mile Radius	Beyond 50 Miles
Vegetables and produce:	0.700	0.300	0.000
Meat:	0.442	0.558	0.000
Milk:	0.399	0.601	0.000

DISCUSSION OF RESULTS

The method used to estimate emissions from the C-331 and C-710 Building ventilation systems (see Section 1, Radiological Areas) resulted in a substantially higher emission estimates for PGDP over previous years. The method assumed that the concentration of radionuclides in the ventilation system remained at the sample value for the entire period. In C-331, it was also assumed that all supply and exhaust fans were in operation and that the air exchange rate was at a maximum–a conservative approach considering that approximately half of the building is in standby status. These assumptions maximized the emission estimates for the time periods during which the air concentrations of radionuclides exceeded the 10 percent of the ^{237}Np DAC limit.

The conservative emission estimates resulted in the seal exhaust/wet air grouped source, of which the building ventilation systems are a part, accounting for virtually all of the off-site dose from plant operations. The C-331 estimate accounted for approximately 97 percent of the total grouped source emissions with ^{237}Np comprising a majority of the total estimated activity for C-331.

SOURCE CHARACTERISTICS (Continued)

Source Name	Nearest Individual	Distances (m) to Selected Receptors				
		Nearest Business	Nearest School	Nearest Farms		
				Dairy	Beef	Vegetable
C-310	1755	2705	3962	>5000	2896	1700
C-400	1901	2819	4267	>5000	3124	1943
C-400 Cylinder drying station	1908	2819	4267	>5000	3124	1943
C-710	1944	2705	3962	>5000	2896	1700
Seal/wet air exhausts	1524	2438	3962	>5000	3124	1524
Cylinder valve connection	1524	2705	3962	>5000	2896	1700
Northwest Plume Treatment Facility	1170	3850	5150	>5000	1475	1250
Building ventilation	1529	2438	3462	>5000	3124	1524

CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individual immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 U.S. C1001.)

Department of Energy

Date

United States Enrichment Corporation

6/3/96

Date

SECTION IV–ADDITIONAL INFORMATION

There was one construction project of a radionuclide point source at PGDP in 1995. This facility, the Northwest Plume Treatment Facility, was constructed by DOE and began operation on September 1, 1995. Refer to Section I, *Source Description,* for a discussion of this source.

For a discussion of diffuse and fugitive sources, see Section I *Nonpoint Source.*

UNPLANNED RELEASES

There were no unplanned releases occurring outside of a building not included in HP air sampling program during 1995.

SECTION V–SUPPLEMENTAL INFORMATION REQUESTED BY DOE

Collective effective dose equivalent (person-Roentgen Equivalent Man [rem]/year)-50-mile radius:

Emission Source	CEDE, person/rem
C-310 purge stack	0.003
C-400	0.003
C-400 cylinder drying facility	0.00003
C-710	0.002
Wet air/seal exhausts	2.0
Northwest Plume Treatment Facility	0.04
Total	**2.1**

COMPLIANCE WITH 40 CFR 61, SUBPARTS Q AND T

Not applicable.