7443 U-007-409.11

ANNUAL RADIONUCLIDE AIR EMISSION REPORT FOR CALENDAR YEAR 1990, NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) - (USED AS A REFERENCE IN OU 5 FS, APPENDIX H - TITLE DIFFERS SLIGHTLY FROM CITATION IN REFERENCE LIST)

00/00/91

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REPORT

U. S. Department of Energy
Air Emissions Annual Report
(under Subpart H, 40 CFR 61.94)
Calendar Year 1990

Site Name: Feed Materials Production Center, Fernald, Ohio

Operations Office Information:

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Site Information

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SECTION I: FACILITY INFORMATION

A. Site Description

The primary activity of the Feed Materials Production Center (FMPC) was the manufacture of purified uranium-metal products. On July 10, 1989, the FMPC suspended production operations, remaining on standby for certain segments of production. On February 4, 1991, DOE formally announced the termination of uranium production at the FMPC. Currently, the primary activity of the FMPC is identification and implementation of removal actions and remedial actions under CERCLA. Periodic operations of air emitting sources for non-production purposes has continued.

The FMPC is located in southwestern Ohio, approximately 20 miles northwest of the city of Cincinnati and 2 miles south of Ross, Ohio. The FMPC comprises 1050 acres (425 hectares). The Production area covers approximately 136 acres (55 hectares) in the center of the FMPC. The center of the site is located at Latitude 39^{0}-17′-56" north and Longitude 84^{0}-41′-16" west.

The area immediately surrounding the FMPC is primarily rural in nature, characterized by the predominance of agriculture, with some light industry and scattered residences. FMPC is located in an ancestral river valley known as the New Haven Trough. Today, the region is influenced by the flooding and meandering of the Great Miami River. FMPC is located on a relatively level plain which is outside the 500 year flood plain of the Great Miami River.

Data from the Greater Cincinnati Airport has been used to characterize the climate of the region. The climate is defined as continental, with average temperatures ranging from 29.2^{0}F (-1.56^{0}C) in January, to 75.7^{0}F (24.3^{0}C) in July for the period 1960 through 1989. Average annual precipitation for the period 1960 through 1989 was 40.56 inches (103.0 cm), ranging from 27.99 to 52.76 inches (71 to 134 cm). Based on data from the Cincinnati airport, prevailing wind flow is from the south-southwest.

B. Source Description

Production at the FMPC was historically divided into chemical and metallurgical operations. Chemical operations commenced with dissolving uranium ore concentrates and recycled material in nitric acid to produce a uranyl nitrate (UNH) feed solution. The solution was then purified using a solvent extraction process. Purified UNH solution was concentrated by evaporation and thermally denitrated to uranium trioxide (UO3). UO3 was converted to uranium tetrafluoride (UF4). Metallurgical processing began at this step. UF4 was reacted with magnesium metal to produce uranium metal, in the form of elemental uranium, derby metal. Metallic scraps from subsequent processing of the uranium metal were combined with derby metal and melted in graphite crucibles. When the proper temperature was achieved, the melt was bottom-poured to pre-heated molds to form ingots varying in size, weight and shape determined by their final intended use. Ingots could be further shaped at the FMPC, or other DOE contractors, with final forms being heat treated and machined at the FMPC. As discussed above, most of these operations ceased in 1989.

Radioactive materials handled and stored at the FMPC include pitchblende ore residues containing radium stored in the K-65 silos, thorium and thorium compounds stored in several locations within the FMPC production area, uranium metal, uranium compounds, contaminated magnesium fluoride (MgF_2), and contaminated metals.

In 1990, active emissions sources included drum cleaning operations (Plant 1), running of the emission control systems prior to shutting down the slag milling operation (Plant 5), filtering of waste water sludge (Plant 8), fume hoods in analytical laboratories (Laboratory Building), emissions from building vents (Pilot Plant), material decontamination (the Decontamination and Decommissioning Building), radionuclides contained in the drift loss from the Cooling Tower, and fugitive emissions from inactive waste storage pits nos. 5 and 6.

SECTION II: AIR EMISSIONS DATA

A. Accuracy of Reported Emissions

Through CY-1989, the bulk of air emissions from the FMPC were from either monitored process exhaust stacks or processes for which emission factors had been developed through direct emission testing. Emissions from sources such as fugitive emissions, for which no direct measurements were available, were determined through the best engineering estimates. Due to cessation of production activities, emissions from monitored sources have become minimal; emissions from sources such as fugitive emissions now comprise the majority of the reported offsite dose. The assumptions and calculations used in deriving these estimates are documented in the remainder of this report.

FMPC recognizes the inherent imprecision in using engineering estimates, rather than direct measurements, of emission data. in estimating fugitive emissions from the waste pits, for example, a USEPA equation developed for waste storage piles, in another climatological regime, was used as the best known method. Although the applicability of the equation to the FMPC has not been specifically verified, it is presented as a conservative estimate.

As has been done in previous years, the dose derived from measured and estimated emissions as required by 40 CFR Part 61, Subpart H, will be evaluated by comparison with ambient monitoring results as soon as the ambient monitoring results have been received and evaluated. In 1988, this evaluation verified the accuracy of the reported dose. In 1989, however, the evaluation indicated that the dose due to fugitive emissions from the waste pits had been significantly overestimated. This evaluation will be reported in the Annual Site Environmental Report.

The purpose of the data presented in this report is to demonstrate compliance with the 10 mrem/yr standard [40 CFR 61.92]. Since conservative estimates were used where direct measurements are not available, any imprecision in the data is expected to result in over estimation of the dose. The data presented in this report, therefore, succeeds in demonstrating compliance with the standard.

B. CY-1990 FMPC Uranium Air Emissions

An inventory of uranium air emissions from the FMPC was developed for CY-1990 (Tables 1A and 1B). Uranium was the primary radionuclide emission (in kilograms per year) to the air from the FMPC during the time it was actively operating; it is not expected that has changed since operations ceased. This inventory includes emissions from monitored stacks, unmonitored stacks, building ventilation ducts, laboratory fume hoods, and fugitive dust from the FMPC's waste pits. The methods utilized for estimating air emissions from the FMPC are generally consistent with the methods used to develop emissions for "Addendum to FMPC-2082, History of FMPC Radionuclide Discharges", March 1989. The methodology developed for the Addendum to FMPC-2082 is the summation of losses from monitored stacks, unmonitored stacks, building vents, fugitive sources, and specific non-routine emissions. After a review of the logs regarding accidents and other non-routine events occurring at the FMPC during CY-1990, it was determined that no significant release of materials regulated by Subpart H occurred from these activit^Es in CY-1990. The uranium emissions and the sources of those emissions for CY-1990 are listed in Table 1A, with a comparative listing of sources previously reported provided in Table 1B.

A total of 3.2 kilograms (kg) of uranium were estimated to be emitted to the air from the FMPC during CY-1990. This may be compared to estimated emissions to the air for CY-1989 of 30.1 kg and 107.8 for CY-1988. The largest source of uranium emissions in CY-1989 were the estimated fugitive dust emissions from Waste Pits 5 and 6. These provided the second largest contribution to uranium emissions in CY-1990. The largest single contributor of uranium emissions to the air were the estimated emissions from the FMPC Cooling Tower. An additional discussion of uranium emission estimation methods is provided below.

1. Monitored Stack Emissions

Included in the CY-1990 inventory are 2 stacks, as compared with 33 stacks in the CY-1989 inventory. The decreased number is directly attributable to the cessation of production at the FMPC in 1989. Collectively, these sources accounted for approximately 0.08% (2.7×10^{-3} kg) of the uranium losses for CY-1990. This is compared to accounting for 2.6% (0.8 kg) of the uranium losses calculated for CY-89. Both stacks are equipped with single point continuous isokinetic samplers (SPCIS). These samplers consist of a pleated paper filter in a cup-shaped holder. A portion of the discharge process stream is drawn through the filter leaving any particulate on the filter. At intervals, the filter elements are collected and destructively analyzed for uranium. Emissions of uranium from the monitored emission point are then estimated by a formula that takes into consideration the stack volumetric flow rate, the flow rate of the SPCIS, and the amount of uranium captured on the filter.

2. Unmonitored Stack Emissions

Unmonitored stacks accounted for approximately 54.9% (1.8 kg) of the uranium losses calculated for CY-1990. This is compared to accounting for 11% (3.3 kg) of the uranium losses calculated for CY-89. This group covers 4 sources which were operated in CY-1990, as compared to 15 sources reported for CY-1989. Again, this decrease is directly attributable to the cessation of production. The estimates of emissions were derived by either engineering calculations or engineering calculations utilizing the results of actual stack emission

measurements conducted while the FMPC was still in production. Examples of these calculations are provided in the Attachments.

Two sources are included as being operated in Plant 8. They are the East Eimco Filter and the East Oliver Filter. Emissions from these filters are estimated from the number of gallons of water treated multiplied by the average concentration of uranium in the filtrate and a correction factor for the volume of water exiting the stack.

Emissions from the Decontamination and Decommissioning Building (Building No 69), are based on the number of batches processed multiplied by an emission factor. The factor was established using data from an EPA Method 5 Stack test.

The final source contributor to this group is the Cooling Tower. Various processes at the FMPC use and recycle cooling water to the tower. This leads to contamination of the recirculating water. On returning to the tower, the water stream is cascaded down the tower fill. Contact with the air transfers the heat to the air. At the same time, some of the water is removed in the form of mist. Based on the estimated flow through the tower, the concentration of uranium in the recycle stream, and the drift loss factor for this design of cooling tower, the emission loss may be estimated for any given operating period. For CY-90, the estimated losses from the cooling tower was the largest single contributor to the overall uranium losses to the atmosphere (52.3% or 1.7 kg U).

3. Uranium Emissions from Building Exhausts

Calculated uranium losses from building vents and exhausts made up approximately 0.002% (6.7×10^{-5} kg) of the total calculated uranium losses for CY-1990. This compares to accounting for approximately 1.7% (0.52 kg) of the uranium losses in CY-1989. Examples of these calculations are provided in Attachment A.

Continuous air monitors are located in each plant near process areas which are thought to produce radionuclide emissions. The monitors measure alpha and beta radiation in microcuries per cubic centimeter. To convert from microcuries to grams of uranium, the source of all radiation measured by the continuous air monitors was assumed to be normal uranium. This was a reasonable assumption, as the plants process large quantities of depleted uranium and lesser amounts of slightly enriched uranium. Data on the uranium concentration for each air monitor in each plant was weighted by air-flow and then averaged to provide monthly concentrations in the buildings.

The total volumetric flow capacity of all the fans in each plant was determined by FMPC records or by estimation based on the size of the exhaust fan. In calculating yearly emissions for each plant, the air-flow weighted monthly average concentration for each plant was multiplied by the hours per month that the fans were operated, summed up for the entire year, and then multiplied by a 0.1 dilution factor to account for building make-up air. The justification for the 0.1 dilution factor was that activities are measured only in the areas of highest suspected concentration. The actual plant average uranium concentration in the air should thus be significantly lower than the average calculated from the continuous air monitoring results.

4. Uranium Emissions from Laboratory Fume Hoods

Estimated emissions from the FMPC laboratories constitute 0.08% (2.7×10^{-3} kg) of the total estimated emission inventory for uranium for CY-1990. This is compared to 6.3% (1.9 kg) of calculated uranium losses in CY-1989. Previously, laboratory emissions were assumed equal to the annual uranium emissions estimate developed for the report "Addendum to FMPC-2082; History of FMPC Radionuclide Discharges", March, 1989, which provided a value of 1.9 kilograms of uranium per year.

Laboratory operations changed significantly with the cessation of production in 1989. With that change, laboratory analyses became less involved with pure metal analysis and more involved with waste products analysis. These materials would be expected to have a lower concentration of uranium and other radionuclides in each sample. Additionally, with the cessation in production, fewer analyses were being conducted in the laboratory. Thus, laboratory personnel estimated that maximal emissions at each operating laboratory hood was 0.1 gram per year. At the same time, on-going renovations in the Laboratory building meant that fewer hoods were in operation. In CY-1990, lab personnel reported operating only 27 hoods. This resulted in the estimated emission rate of 27 grams of uranium from the Laboratory in CY-1990.

5. Uranium Fugitive Emissions from Waste Pits

Fugitive dust due to wind erosion of the exposed material in Waste Pit nos. 5 and 6 were calculated to contribute 44.9% (1.46 kg) of the uranium losses for CY-1990, with Waste Pit no. 6 contributing 96.4% (1.4 kg) of that estimated loss. This compares to accounting for approximately 64.7% (19.47 kg) of the uranium losses in CY-1989, with Waste Pit no. 6 providing 96.6% (18.8 kg) of the calculated uranium losses for that year.

Computations to develop emission estimates were performed in accordance with the method provided by the USEPA in "Method for Estimating Fugitive Particulate Emissions from Hazardous Waste Sites", U. S. Environmental Protection Agency, Cincinnati, Ohio, August 1987; EPA/600/2-87/066, NTIS no. PB87-232203. Although this method was developed for determining fugitive dust losses in and around storage piles, it was adapted for use in calculating losses from the waste storage pits. Basically, the expected losses are equal to the exposed acreage multiplied by the number of days in storage times the uranium mass concentration times a factor. The factor is based on the silt content of the material, the number of "dry" days during the time period, and the fraction of the time when wind speed exceeds 12 miles per hour.

Fugitive dust emissions from a given area can be considered to result from the following activities:

- Load-in of material into the area;
- Wind erosion of the stored materials;
- Vehicle movement in the area; and
- Load-out of materials from the area.

For calculation of the fugitive dust emissions from the FMPC Waste Pits, only the second category listed above was judged to contribute significantly to the overall generation of fugitive dust during CY-1990. Waste pits 1, 2, 3, and 4 were covered prior to CY-1990 and no emissions occurred from these pits. There

was no load-in or load-out of material to pits in 1990; and vehicular traffic in the actual area of the pits is minimal; so these terms were considered not applicable.

The basic methodology used in estimating the masses of contaminants (uranium) which potentially left the waste pits in CY-1990 was to first develop a factor for the wind erosion for each pit. Using this factor, the overall mass of particulate matter that could become airborne was estimated. Finally, the average weight fraction of the uranium in the pits was applied to the overall mass of particulate emissions to estimate the mass of uranium potentially leaving the waste pits.

C. CY-1990 FMPC Radionuclide Air Emissions

1. Radionuclide Emissions Estimation Method

Radionuclide release rates were calculated using radionuclide emission factors per total mass of uranium released. Radionuclide emission factors were determined according to the following hierarchy:

1. Actual measurements during the most recent year available.
2. Weighted average emission factors based on data in FMPC-2082, "History of FMPC Radionuclide Discharges", May, 1987; and/or
3. Assumption based on knowledge of processes, age of materials, and equilibrium, as appropriate.

The best available emission factors were then multiplied by the uranium emission rates to arrive at the radionuclide emission rates (Table II).

2. Radionuclide Emission Estimates - Monitored Stacks, Unmonitored Stacks, Building Vents, and Laboratory.

Radionuclide emission factors in microcuries per kilogram of uranium (uCi/kg U) were developed from composite samples of filter analysis solutions for uranium from the FMPC monitored stacks. In 1990, there was insufficient operation of processes emitting through monitored stacks to generate a composite sample from the collecting filters; the factors developed for 1989 were therefore used. The uCi/kg U emission factors are shown in Table II along with the basis for development of the factors. These factors represented a weighted average emission rate of radionuclides from all the monitored stacks at the FMPC, and are considered the best available for estimating off-site dose due to emissions from all the above cited sources.

3. Radionuclide Emission Estimates - Waste Pits.

Radionuclide emission factors in microcuries per kilogram of uranium (uCi/kg U) were developed based on analysis of core samples of the Waste Pits taken for a Characterization Investigation Study of the Waste Pit area. Some radionuclide emission factors were estimated based on equilibrium or appropriate references. The uCi/kg U emission factors are shown in Table II along with the basis for development of the factors. These factors are considered the best available

emission factors for estimation of radionuclide emissions from the Waste Pits.

SECTION III: DOSE ASSESSMENT

A. Description of Dose Model

The radionuclide dose calculations were performed using the CAP-88 package 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 U. S. Nuclear Regulatory Commission Regulatory Guide 1.109 (Revision 1, dated 10/77 is the most current version) foodchain models to calculate human exposures, both internal and external, to radionuclides deposited in the environment. The human exposure values are then used by the 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 the EPA with the CAP-88 package.

B. Summary of Input Parameters

Unless otherwise discussed, all important input parameter values used were the default values provided with the CAP-88 computer codes and data bases by the USEPA to the Oak Ridge National Laboratory, which conducted the impact analysis under contract with the FMPC.

1. Meteorological Data

CAP-88 analysis was accomplished using two separate sets of meteorological data. The data recovery from the on-site meteorological station located at the FMPC was approximately 70% for CY-90, which was judged to be insufficient to provide appropriate analysis. A conference call was held between personnel at the FMPC and USEPA - Region V to discuss this issue on February 5, 1991. At that time, USEPA approved the use of two separate sets of meteorological data, with the compliance determination being made using the set which resulted in the greatest Effective Dose Equivalent (EDE) value. The two sets approved were:

FMPC [1987-1990]	Data recovered at the FMPC on-site meteorological station from initial operation in 1987 to the end of 1990. Comprises 29,257 hours of recovered information (83.5% data recovery). [Table III]
CVG [1985-1989]	Data recovered at the National Weather Service station at the incinnati International Airport in Covington, KY for 1985 through 1989. Comprises 43,799 hours of recovered data (99.9% data recovery). [Table IV]

Other meteorological data provided were developed from the information developed by the National Weather Service at the CVG station. These inputs were:

Rainfall rate: 146 cm for the year.

Average Temperature: 20 ^{o}C

Average mixing layer height: 965 m

2. Source Characteristics Data

Information on the emission sources was gathered from plant records (Table V). The parameters were similar to those used in the 1989 compliance demonstration except those used for Waste Pits 5 and 6. A review of FMPC records and interviews with personnel indicated that the total surface areass previously utilized for both Waste Pits 5 and 6 were too high. New surface area estimates were generated by the FMPC's Drafting personnel, utilizing maps developed from aerial photographs of the site.

3. Other Input Parameters

The CAP-88 code provides dose estimates from radionuclides ingested. Beef, milk, and food crop production was assumed to be the maximum possible for the available ground area, an assumption that overstates these activities in the area. It was further assumed that 100% of the foodstuffs consumed by the local population were grown within the 80 km/50 mi radius, which also provides a conservative estimate for the impact. The actual values used were:

Fraction of foodstuffs from:	Local Area	50-mile radius	Beyond 50 milee
Vegetables & Produce:	0.700	0.300	0.000
Meat:	0.442	0.558	0.000
Milk:	0.399	0.601	0.000

To provide a collective effective dose equivalent for a fifty mile radius around the FMPC, sector-specific population estimates were needed. Attempts were made to obtain 1990 census data for the area around the FMPC by Oak Ridge National Laboratory, but the data is not yet available. A current estimate of the population distribution within 80 km(50 miles) of the FMPC had been developed by extrapolation from the 1980 census data. This distribution was utilized for the 1990 period (Tables 5A and 5B)

C. Compliance Assessment

Meteorological Data Source		Maximum Effective Dose Equivalent (mrem)	Collective Effective Dose Equivalent (50 mile Radius) (person - rem)
FMPC [1987-1990]	All Source	0.4	5
	Excluding Waste Pits	0.03	3
CVG [1985-1989]	All Source	0.6	3
	Excluding Waste Pits	0.03	1

The location of the maximally exposed individual, as determined by the CAP-88 computer code, varied slightly, dependent on the meteorological data used by the model and the sources included in determining the maximally exposed individual. All maximally exposed individuals were located at residences; they are indicated on Figures 1 and 2.

SECTION IV: ADDITIONAL INFORMATION

A) Construction/Modification at the FMPC

Title 40, Code of Federal Regulations, Subpart H [40 CFR 61.94(b)(8)], requires that this report provide information on all construction/modifications completed at the FMPC in calendar year 1990 (CY90) for which approval was not sought from the United States EPA per the provisions of 40 CFR 61.96. This section addresses that requirement.

No projects were completed in CY90 for which the requirements to apply to the United States EPA for approval to construct or modify were waived due to the provisions of 40 CFR 61.96. All projects completed were commenced prior to the date when this regulation was modified to allow for such a waiver (December 15, 1989). Thus, all projects requiring NESHAP approval either have received approval prior to commencing construction or modification, or were canceled or rendered inoperable in accordance with draft provisions of the FFCA/NESHAP being negotioated with USEPA Region V.

SECTION V: 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 individuals 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.C. 1001).

_____(name)

_____(title)

_____(date)

TABLES

TABLE 1A: FMPC Uranium Air Emission Sources; Compilation of 1990 Emitters

TABLE 1B: FMPC Uranium Air Emission Source Compilation

TABLE 2: 1990 Radionuclide Air Emission Source Compilation

TABLE 2B: Activity of Radionuclides; CY-1988 & CY-1989 Monitored Stacks Composite Sample

TABLE 3: FMPC Site Meteorological Station, STAR data, 1987 - 1990

TABLE 4: CVG Meteorological Station, STAR data, 1985 - 1989

TABLE 5: Source Characteristics

TABLE 6: Population Estimates by Sector within a Fifty-Mile Radius of the FMPC

TABLE IA

FMPC
Uranium Air Emission Sources
Compilation of 1990 emitters

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Estimated Efficiency	Air Emissions Obtained From	Distance to nearest Receptor
EP1-009	3.56000E-04	1-012	P179	Shot blaster	FFDC/G2-6014	99%	SPCIS	930
EP5-018	2.30100E-03	5-067	P091	Slag storage bin no. 1	FFDC/G55-E100	99%	SPCIS	900
		5-068	P091	Slag storage bin no. 2				
		5-069	P101	Undersized Slag Milling				
		5-070	P101	Slag storage bin no. 3A				
		5-071	P101	Slag storage bin no. 4				
		5-072	P101	Slag storage bin no. 5				
		5-073	P101	Slag storage bin no. 6				
		5-074	P101	Slag storage bin no. 7				
		5-075	P101	Slag storage bin no. 8				
		5-076	P091	Oversized Slag Milling				
		5-077		Air classifier				
EP8-013	1.02250E-02	8-009	P239	East oliver filter	None	0	EC	970
EP8-015	1.72860E-02	8-011	P248	East EIMCO filter (Filter No. 1)	None	0	EC	970
Misc.	2.70000E-03			Laboratory Building Exhausts	None	0	EC	930
Misc.	5.30000E-02			Waste Pit 5 Emissions	None	0	EC	660
Misc.	1.40600E+00			Waste Pit 6 Emissions	None	0	EC	660
Misc.	1.70000E+00			Utility Cooling Tower	None	0	EC	700
Misc.	5.59900E-02			Decontamination and Decommissioning	None	0	EC	750
Pilot Plt.	1.00000E-05			Building vents - Autoclave area	None	0	EC	810
Pilot Plt.	5.70000E-05			Building vents - Reactor area	None	0	EC	810
Total U	3.2							

LEGEND: SPCIS - Single Point Continuous Isokinetic Sampler
EC - Engineering Calculation

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP1-001	0.00000E+00	1-001	P162	Large auger sampler	FFDC/G2-172	SPCIS
EP1-002	0.00000E+00	1-002	P163	Pincutter	HEPA/G2-6042A	SPCIS
		1-003	P163	Fitzpatrick mill		
	Proposed	1-013	P258	Large Drum Sampling Station		
EP1-003	0.00000E+00	1-004	P165	Safe geom feed dumping station	HEPA/G2-76,FFDC/G2-235, FFDC/G2-76	SPCIS
	0.00000E+00	1-008	P177	Titan mill packaging station	FFDC/G2-76,FFDC/G2-235	
EP1-004	Not Monitored*	1-005	P166	D105 digester	None	
EP1-005	0.00000E+00	1-006	P167	Titan mill dumping station	FFDC/G2-2	SPCIS
EP1-006	0.00000E+00	1-007	P168	Titan mill	FFDC/G2-64	SPCIS
EP1-007	0.00000E+00	1-009	P178	East packaging station	FFDC/G2-1	SPCIS
EP1-009	3.56000E-04	1-012	P179	Shot blaster	FFDC/G2-6014	SPCIS
EP1-015	0.00000E+00			236 HYVAC System	FFDC/G2-171	SPCIS
EP2-001	0.00000E+00	2-001	P113	Slg leach digestion (D1-1)	Scrubber with Bubble Cap Tower (NAR)	EC
		2-002	P113	Slg leach digestion (D1-2)		
		2-003	P113	Slg leach digestion (D1-3)		
		2-107	P152	Denitration pot (D1-207)		
		2-113	P153	Denitration pot (D1-213)		
		2-115	P155	Denitration pot (D1-215)		
		2-118	P158	Denitration pot (D1-218)		
		2-119	P159	Denitration pot (D1-219)		
		2-178	P006	Ammonia stripper		
		2-171	P202	North Packaging Station		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		2-004	P116	RTS Process Tank (D1-4)	(Bubble Cap Tower Only)	
		2-007	P119	RTS Process Tank (D1-7)	(Bubble Cap Tower Only)	
		2-020	P214	Charcoal solv tr (F2E-1)	(Bubble Cap Tower Only)	
EP2-002	Not Monitored*	2-010	T021	Uranyl nitrate storage tank (D1-10)	None	
EP2-003	Not Monitored*	2-011	T022	Uranyl nitrate storage tank (D1-11)	None	
EP2-004	Not Monitored*	2-012	T023	Uranyl nitrate storage tank (F1-1)	None	
EP2-005	Not Monitored*	2-013	T024	Uranyl nitrate storage tank (F1-2)	None	
EP2-006	Not Monitored*	2-014	T025	Uranyl nitrate storage tank (F1-25)	None	
EP2-007	Not Monitored*	2-015	T026	Uranyl nitrate storage tank (F1-26)	None	
EP2-008	Not Monitored*	2-016	T027	Uranyl nitrate storage tank (F2E-9)	None	
EP2-009	Not Monitored*	2-017	T028	Uranylnitrate storage tank (F2E-10)	None	
EP2-010	Not Monitored*	2-018	T005	Nitric acid storage (F1-18)	None	
EP2-011	Not Monitored*	2-019	T006	Nitric acid storage (F1-17)	None	
EP2-012	0.00000E+00	2-021	P215	W. metal diss (F2E-11)	FFDC/G1-856	SPCIS
EP2-013	Not Monitored*	2-023	T007	Nitric acid storage tank (F1-23)	None	
EP2-014	Not Monitored*	2-024	T008	Dil nitric storage tank (F1-24)	None	
EP2-015	Not Monitored*	2-025	T009	Nitric acid storage tank (F1-8)		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-016	Not Monitored*	2-026	T029	Uranyl nitrate storage tank (F2E-6)	None	
EP2-017	Not Monitored*	2-027	T030	Nitric acid wash storage (F2E-7)	None	
EP2-018	Not Monitored*	2-028	T032	Uranyl nitrate storage (F2E-5)	None	
EP2-019	Not Monitored*	2-029	T031	Uranyl nitrate storage (F2E-8)	None	
EP2-020	Not Monitored*	2-030	T033	Slopwater storage tank(F2E-4(25A))	None	
EP2-021	Not Monitored*	2-031	T034	Slopwater storage tank(F2E-4(26A))	None	
EP2-022	Out of Service	2-032	P122	Slg leach dumping station	FFDC/G2-252	SPCIS
EP2-023	0.00000E+00	2-032	P122	Slg leach dumping station	FFDC/G1-94	SPCIS
EP2-024	Not Monitored*	2-033		Pot carbonate storage 3A	None	
EP2-027	Not Monitored*	2-036	T109	Solvent storage tank (G2-4)	None	
EP2-028	Not Monitored*	2-037	T110	Duty solvent storage (D1-117)	None	
EP2-029	Not Monitored*	2-038	T036	Slopwater storage tank (D1-129)	None	
EP2-030	Not Monitored*	2-039	T089	A raffinate storage tank (D1-123)	None	
EP2-031	Not Monitored*	2-040	T035	Slopwater storage tank (D1-130)	None	
EP2-032	Not Monitored*	2-041	T044	Slopwater storage tank (D1-131)	None	
EP2-033	Not Monitored*	2-042	P121	Neut. of solvent (F1-502)	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-034	Not Monitored*	2-043	P205	Water mix tank (F1-504)	None	
EP2-035	Not Monitored*	2-044	T051	Solvent storage tank (F1-506)	None	
EP2-043	Not Monitored*	2-052	P129	Extraction settler (Y7)	None	
EP2-059	Not Monitored*	2-068	T050	Caustic storage (D1-174)	None	
EP2-062	Not Monitored*	2-071	T053	Carbonate storage tank (F1-501)	None	
EP2-064	Not Monitored*	2-073	P207	Raff mixer tank (D1-110)	None	
EP2-065	Not Monitored*	2-074	T054	Raff storage tank (D1-111)	None	
EP2-066	Not Monitored*	2-075	P209	Raff mixer tank (D1-125)	None	
EP2-068	Not Monitored*	2-077	P211	TBP & kerosene mixing	None	
EP2-070	Not Monitored*	2-069	P160	Decanter (process)	None	
EP2-071	Not Monitored*	2-080	P189	A-3 column (D1-100)	None	
	Not Monitored*	2-070	T052	Carbonate storage tank (F1-500)	None	
EP2-072	Not Monitored*	2-081	P190	A-4 column (D1-127)	None	
EP2-076	Not Monitored*	2-085	P194	C-2 column (D1-112)	None	
EP2-079	Not Monitored*	2-088	T067	Sulfuric acid storage	None	
EP2-080	Not Monitored*	2-089	T066	Dirty solv storage tank 5A	None	
EP2-081	Not Monitored*	2-090	T065	Dirty solv storage tank 5B	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-082	Not Monitored*	2-091	T064	Dirty solv storage tank 17A	None	
EP2-083	Not Monitored*	2-092	T063	Dirty solv storage tank 17B	None	
EP2-084	Not Monitored*	2-093	T062	Dirty solv storage tank 17C	None	
EP2-085	Not Monitored*	2-094	T068	Solvent storage tank (F1-512)	None	
EP2-086	Not Monitored*	2-095	T010	Nitric acid storage (F2E-501)	None	
EP2-087	Not Monitored*	2-096	T011	Nitric acid storage (F2E-502)	None	
EP2-088	Not Monitored*	2-097	T069	OK liq storage tank (F3E-222)	None	
EP2-089	Not Monitored*	2-098	T070	OK liq storage tank (F3E-223)	None	
EP2-090	Not Monitored*	2-099	T071	OK liq storage tank (F3E-224)	None	
EP2-091	Not Monitored*	2-100	T072	OK liq storage tank (F3E-225)	None	
EP2-092	Not in Operation	2-171	P202	North packaging station	Scrubber	EC
EP2-093	Not in Operation	2-172	P203	South packaging station	Scrubber	EC
EP2-097	Not Monitored*	2-120	T078	Condensate storage tank (F1-208)	None	
EP2-098	Not Monitored*	2-121	P197	N. oliver filter (D1-301)	None	
EP2-099	Not Monitored*	2-122	P198	S. oliver filter (D1-302)	None	
EP2-100	Not Monitored*	2-123	T047	S.L. storage tank (F1-301)	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-101	Not Monitored*	2-124	T048	S.L. storage tank (F1-302)	None	
EP2-102	Not Monitored*	2-125	T049	S.L. storage tank (F1-303)	None	
EP2-103	Not Monitored*	2-126	T073	Filtrate storage tank (F1-308)	None	
EP2-104	Not Monitored*	2-127	T074	Filtrate storage tank (F1-309)	None	
EP2-105	Not Monitored*	2-128	P199	Neut of filter cake(F1-313)	None	
EP2-106	Not Monitored*	2-129	T075	Lime storage (F1-314)	None	
EP2-107	Not Monitored*	2-130	P200	Neut of filter cake(F1-318)	None	
EP2-108	Not Monitored*	2-131		Lime slur makeup tank (F1-319)	None	
EP2-109	Not Monitored*	2-132		Precoat storage (F1-321)	None	
EP2-110	Not Monitored*	2-133		Precoat storage (F1-324)	None	
EP2-111	Not Monitored*	2-134	T012	Nitric acid storage (D3-2)	None	
EP2-112	Not Monitored*	2-135	T013	Nitric acid storage (D3-27)	None	
EP2-113	Not Monitored*	2-136	T014	Nitric acid storage (F3-12)	None	
EP2-114	Not Monitored*	2-137	T015	Nitric acid storage (F3-19)	None	
EP2-115	Not Monitored*	2-138	T016	Dil nitric storage (F3-22)	None	
EP2-116	Not Monitored*	2-139	T017	Dil nitric storage (F3-23)	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-117	Not Monitored*	2-140	T018	Dil nitric storage (F3-24)	None	
EP2-118	Not Monitored*	2-141	T019	Dil nitric storage (F3-25)	None	
EP2-119	Not Monitored*	2-142	T020	Cond hold tank (F3E-7)	None	
EP2-120	Not Monitored*	2-143	T077	Filtrate storage (SL) (F1-310)	None	
EP2-121	Not Monitored*	2-144	T079	Filtrate storage (SL) (F1-311)	None	
EP2-122	Not Monitored*	2-145	T080	Filtrate storage (SL) (F1-312)	None	
EP2-123	Not Monitored*	2-146	T081	Filtrate storage (SL) (F1-317)	None	
EP2-124	Not Monitored*	2-147	T059	Raff storage tank (F1-400)	None	
EP2-125	Not Monitored*	2-148	T057	Raff storage tank (F1-401)	None	
EP2-126	Not Monitored*	2-149	T058	Raff storage tank (F1-402)	None	
EP2-127	Not Monitored*	2-150	T056	Raff storage tank (F1-403)	None	
EP2-128	Not Monitored*	2-151	T102	Evap storage tank (F1-405)	None	
EP2-129	Not Monitored*	2-152	T082	Acid cond storage (F1-407)	None	
EP2-130	Not Monitored*	2-153	T103	Evap prod storage (F3E-404)	None	
EP2-131	Not Monitored*	2-154	T104	Evap prod storage (F3E-405)	None	
EP2-132	Not Monitored*	2-155	T043	Uranyl nitrate storage(F3E-406)	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-133	Not Monitored*	2-156	T085	Filtrate storage (SL)(F3E-408)	None	
EP2-134	Not Monitored*	2-157	T101	Filtrate storage (SL)(F3E-409)	None	
EP2-135	Not Monitored*	2-158	T046	Slopwater storage tank (F2E-601)	None	
EP2-136	Not Monitored*	2-159	P201	Thickener tank(proc)(F2E-602)	None	
EP2-137	Not Monitored*	2-160	T045	Slopwater storage tank (F1-608)	None	
EP2-138	Not Monitored*	2-161		Slurry mix tank (F1-609)	None	
EP2-139	Not Monitored*	2-162		Slurry mix tank (F1-610)	None	
EP2-140	Not Monitored*	2-163	P206	MgO slurry tank (F1-611)	None	
EP2-141	Not Monitored*	2-164	T061	Raff thickner slur (F1-612)	None	
EP2-142	Not Monitored*	2-165	T083	Nitric acid wash storage(F1-613)	None	
EP2-143	Not Monitored*	2-166		Precoat makeup tank (F1-616)	None	
EP2-144	Not Monitored*	2-167	T042	Uranyl nitrate storage tank(F2-605)	None	
EP2-145	Not Monitored*	2-168	T041	Uranyl nitrate storage tank(F2-606)	None	
EP2-146	Not Monitored*	2-169	T040	Uranyl nitrate storage tank(F2-607)	None	
EP2-147	Not Monitored*	2-170	T039	Uranyl nitrate storage tank(F2-608)	None	
EP2-148	Out of Service	2-171	P202	North packaging station	FFDC/G2-103	SPCIS

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP2-149	Out of Service	2-172	P203	South packaging station	FFDC/G2-104	SPCIS
EP2-151	Not Monitored*	2-174	T087	Nitric acid storage tank (F1-201)	None	
Precip Tk Exh	Not Monitored*	2-181		Refinery sump wastewater treat sys	None	
Rec Tk1 Vent	Not Monitored*				None	
Rec Tk2 Vent	Not Monitored*				None	
EP4-001	0.00000E+00	4-001	P083	Bank 7	FFDC/G4-7 &	SPCIS
		4-002	P081	Bank 8	HEPA/Stainless Steel	
		4-003	P082	Bank 9		
EP4-001	0.00000E+00			Talcum Cooling Vent for Banks 7-9	FFDC/G4-7	SPCIS
EP4-002	Not Monitored*	4-004	P083	Talcum reactor bank 7	Cintered Filter, HF	
		4-005	P081	Talcum reactor bank 8	Scrubber, & KOH	
		4-006	P082	Talcum reactor bank 9	Scrubber	
EP4-003	0.00000E+00	4-007	P087	Portable packaging station	FFDC/G4-13	SPCIS
EP4-004	0.00000E+00	4-008	P088	Packaging station no. 1	FFDC/G4-14	SPCIS
EP4-005	0.00000E+00	4-009	P089	Packaging station no. 2	FFDC/G4-2	SPCIS
EP4-006	0.00000E+00	4-010	P090	Packaging station no. 3	FFDC/G4-12	SPCIS
EP4-007	Out of Service	4-011	P110	Drumming station	FFDC/G4-15	SPCIS
EP4-008	0.00000E+00	4-012	P111	Drum dumper	FFDC/G4-1	SPCIS
EP4-009	0.00000E+00	4-013	P112	Reject green salt	FFDC/G4-5	SPCIS

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP4-025	0.00000E+00			Vacuum Cleaner	FFDC/G4-4	SPCIS
EP5-004	0.00000E+00	5-014	P063	# 4 "F" machine	FFDC/G5-249	SPCIS
EP5-005	0.00000E+00	5-015	P064	# 5 "F" machine	FFDC/G5-250	SPCIS
		5-017	P064	West side capping station		
EP5-006	0.00000E+00	5-012	P061	# 1 "F" machine	FFDC/G5-251	SPCIS
EP5-007	0.00000E+00	5-013	P062	# 3 "F" machine	FFDC/G5-253	SPCIS
EP5-008	0.00000E+00	5-016	P062	East side capping station		
EP5-009	0.00000E+00	5-020	P095	Breakout, west	FFDC/G5-254	SPCIS
EP5-010	0.00000E+00	5-018	P094	Breakout, east	FFDC/G5-256	SPCIS
EP5-013	0.00000E+00	5-022	P040	E - casting no. 1	FFDC/G5-260 & Settling Chamber	SPCIS
		5-023	P040	E - casting no. 2		
		5-024	P040	E - casting no. 3		
		5-025	P040	E - casting no. 4		
		5-026	P040	E - casting no. 5		
		5-027	P040	E - casting no. 6		
		5-028	P040	E - casting no. 7		
		5-029	P040	E - casting no. 8		
		5-030	P040	E - casting no. 9		
		5-031	P040	E - casting no. 10		
		5-032	P040	E - casting no. 11		
		5-033	P040	E - casting no. 12		
		5-034	P040	E - casting no. 13		
		5-035	P040	E - casting no. 14		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP4-025	0.00000E+00			Vacuum Cleaner	FFDC/G4-4	SPCIS
EP5-004	0.00000E+00	5-014	P063	# 4 "F" machine	FFDC/G5-249	SPCIS
EP5-005	0.00000E+00	5-015	P064	# 5 "F" machine	FFDC/G5-250	SPCIS
		5-017	P064	West side capping station		
EP5-006	0.00000E+00	5-012	P061	# 1 "F" machine	FFDC/G5-251	SPCIS
EP5-007	0.00000E+00	5-013	P062	# 3 "F" machine	FFDC/G5-253	SPCIS
EP5-008	0.00000E+00	5-016	P062	East side capping station		
EP5-009	0.00000E+00	5-020	P095	Breakout, west	FFDC/G5-254	SPCIS
EP5-010	0.00000E+00	5-018	P094	Breakout, east	FFDC/G5-256	SPCIS
EP5-013	0.00000E+00	5-022	P040	E - casting no. 1	FFDC/G5-260 & Settling Chamber	SPCIS
		5-023	P040	E - casting no. 2		
		5-024	P040	E - casting no. 3		
		5-025	P040	E - casting no. 4		
		5-026	P040	E - casting no. 5		
		5-027	P040	E - casting no. 6		
		5-028	P040	E - casting no. 7		
		5-029	P040	E - casting no. 8		
		5-030	P040	E - casting no. 9		
		5-031	P040	E - casting no. 10		
		5-032	P040	E - casting no. 11		
		5-033	P040	E - casting no. 12		
		5-034	P040	E - casting no. 13		
		5-035	P040	E - casting no. 14		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP5-014	0.00000E+00	5-022	P040	E - casting no. 1	FFDC/G5-261 & Settling Chamber	SPCIS
		5-023	P040	E - casting no. 2		
		5-024	P040	E - casting no. 3		
		5-025	P040	E - casting no. 4		
		5-026	P040	E - casting no. 5		
		5-027	P040	E - casting no. 6		
		5-028	P040	E - casting no. 7		
		5-029	P040	E - casting no. 8		
		5-030	P040	E - casting no. 9		
		5-031	P040	E - casting no. 10		
		5-032	P040	E - casting no. 11		
		5-033	P040	E - casting no. 12		
		5-034	P040	E - casting no. 13		
		5-035	P040	E - casting no. 14		
		5-050	P065	E - burnout		
		5-052	P065	E - separation booth		SPCIS
		5-054	P175	Mold curing oven		
EP5-015	0.00000E+00	5-053	P054	Mold reconditioning	FFDC/G5A-100	SPCIS
		5-055	P054	E. cold saw		
		5-095	P054	W - Separation Booth		
		5-084	P008	Wagner Cold Saw		
		5-057	P008	North Cold Saw		
	Proposed	5-101	P257	Mold Handling Facility (Proposed)		
EP5-016	0.00000E+00	5-019	P038	Slag crushing (east)	FFDC/G5A-101	SPCIS
EP5-017	0.00000E+00	5-059		Gr plug machining-W&S lathe	FFDC/G5-262	SPCIS
		5-060		Horiz boring mill		
		5-061	P218	Lehmann OD turning,block gr		
		5-062	P169	O. D. turning 16A		
		5-063	P170	O. D. turning 16B		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		5-064	P171	Cutting blocks		
		5-065	P172	Horizontal milling		
		5-066	P229	Tool grinding		
		5-085	P230	Crucible grit blaster		
		5-086	P230	Crucible coating - Plasma spray		
EP5-018	2.30100E-03	5-067	P091	Slag storage bin no. 1	FFDC/G55-E100	SPCIS
		5-068	P091	Slag storage bin no. 2		
		5-069	P101	Undersized Slag Milling		
		5-070	P101	Slag storage bin no. 3A		
		5-071	P101	Slag storage bin no. 4		
		5-072	P101	Slag storage bin no. 5		
		5-073	P101	Slag storage bin no. 6		
		5-074	P101	Slag storage bin no. 7		
		5-075	P101	Slag storage bin no. 8		
		5-076	P091	Oversized Slag Milling		
		5-077		Air classifier		
EP5-019	0.00000E+00	5-021	P039	Slag C, west	FFDC/G5-267	SPCIS
EP5-024	0.00000E+00	5-007	P056	West jolters, jolter H	FFDC/G5-247	SPCIS
		5-008	P056	West jolters, jolter I		
		5-009	P056	West jolters, jolter J		
		5-010	P056	West jolters, jolter K		
		5-011	P056	West jolters, jolter L		
		5-079	P108	Slag storage bin no. 251		
	0.00000E+00	5-001	P033	East jolters, jolter A	FFDC/G5-248	SPCIS
		5-002	P033	East jolters, jolter B		
		5-003	P033	East jolters, jolter C		
		5-004	P033	East jolters, jolter D		
		5-005	P033	East jolters, jolter E		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		5-006	P033	East jolters, jolter F		
		5-078	P108	Slag storage bin no. 250		
EP6-001	0.00000E+00	6-015	P023	Blanking bar ends	ESP(North)/G6-6057	SPCIS
		6-016	P023	Extrusion core blanking no.35		
		6-017		Extrusion core blanking no. 36		
EP6-002	Out of Service	6-004	P238	Centerless grinding	ESP(Middle)	SPCIS
EP6-003	0.00000E+00	6-001	P249	Flat ingot cutting A	ESP(South)	SPCIS
		6-002	P250	Flat ingot cutting B		
		6-003	P032	Finish core machining		
		6-060	P251	Flat ingot cutting 425-20		
		6-061	P252	Flat ingot cutting No. 6		
		6-062	P253	Flat ingot machining K&T A		
		6-063	P254	Flat ingot machining K&T B		
		6-064	P255	Flat Ingot Cutting No. 4		
EP6-005	Not Monitored*	6-019	P022	Tool grinding G & L no. 62A	Settling Chamber & Cyclone	EC
		6-020	P022	Tool grinding G & L no. 62B		
		6-021	P022	Tool grinding G & L no. 70		
		6-022	P022	Tool grinding CMM - no. 1		
		6-023	P022	Tool grinding CMM - no. 2		
		6-024	P022	Internal-external grinding		
		6-025	P022	Surface grinding		
		6-026	P022	Tool grinding G & L no. 10		
		6-029	P022	Surface grinding do all		
		6-030	P022	Surface grinding Thompson		
		6-031	P022	Brazing		
		6-032	P022	Cut-off		
		6-033	P022	Tool grinding std. electric		
		6-034	P022	Surface cleaning		

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		6-035	P022	Wire brushing		
		6-036	P022	Belt sanding		
		6-037	P022	Tool grinding V & M		
		6-038	P022	Tool grinding Rockwell		
EP6-006	0.00000E+00	6-018	P212	Chip pickling & Briquetting	Cyclone Scrubber	ST
EP6-007	0.00000E+00	6-040	P217	Scrap pickling	None	ST
EP6-008	Out of Service	6-041	P210	Slug pickling	None	
EP6-009	Out of Service	6-046	P241	Oil treatment tank, system 1	None	
EP6-010		6-047	P243	Precipitation tank, system 1	None	
EP6-010	Out of Service	6-048	P242	Oil treatment tank, system 2	None	
		6-049	P244	Precipitation tank, system 2		
Tank Vent	Not Monitored*	6-042	T092	Fresh acid receiving tank	None	
Tank Vent	Not Monitored*	6-043	T093	Spent acid tank	None	
Tank Vent	Not Monitored*	6-044	T094	Spent acid tank (6000 gal)	None	
Tank Vent	Not Monitored*	6-045	T095	Decantation tank	None	
Tank Vent	Not Monitored*	6-050	T141	Ingot Pickling Hold Tank	None	
Tank Vent	Not Monitored*	6-051	T142	Acid water hold tank	None	
Tank Vent	Not Monitored*	6-052	T143	Nitric acid storage tank	None	
EP8-001	0.00000E+00	8-001	P180	Rotary kiln	FFDC/G43-27	SPCIS

000028

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		8-003	P182	Primary calciner		
EP8-002	0.00000E+00	8-001	P180	Rotary kiln	Cyclone & Scrubber	EC
EP8-005	0.00000E+00	8-003	P182	Primary calciner		
EP8-006	0.00000E+00	8-004	P183	Oxidation furnace #1	FFDC/G8-035	SPCIS
EP8-007	0.00000E+00	8-004	P183	Oxidation furnace #1	Scrubber	EC
EP8-010	0.00000E+00	8-006	P185	Box furnace	Scrubber	EC
EP8-011	0.00000E+00	8-007	P186	Rotex screening	FFDC/G43-29	SPCIS
EP8-013	1.02250E-02	8-009	P239	East oliver filter	None	EC
EP8-014	0.00000E+00	8-010	P240	West EIMCO filter	None	EC
EP8-015	1.72860E-02	8-011	P248	East EIMCO filter (Filter No. 1)	None	EC
EP8-016	Not Monitored*	8-012		Filter precoat mixing	None	
	Proposed	8-035	P260	Precoat system	Bel-Tyne DC	
EP8-017	0.00000E+00	8-013	P204	Drum washer	None	
EP8-018	Not Monitored*	8-014	T156	Neut tank (F-203)	None	
EP8-019	Not Monitored*	8-015	T157	Neut tank (F-203A)	None	
EP8-020	Out of Service	8-016	T151	Neut tank (D-101)	FFDC/G8-057	SPCIS
EP8-021	Not Monitored*	8-017	T152	Neut tank (D-102)	None	

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP8-022	Not Monitored*	8-018	T153	Neut tank (D-103)	None	
EP8-023	Not Monitored*	8-019	T154	Neut tank (D-104)	None	
EP8-024	Not Monitored*	8-020	T155	Neut tank (D-105)	None	
EP8-025	Not Monitored*	8-021	T002	Caustic storage tank A	None	
EP8-026	Not Monitored*	8-022	T003	Caustic storage tank B	None	
EP8-027	Not Monitored*	8-023	T004	Caustic storage tank (F43-108)	None	
EP8-028	Not Monitored*	8-024	T096	Filtrate storage tank (21A)	None	
EP8-029	Not Monitored*	8-025	T097	Filtrate storage tank (22A)	None	
EP8-030	Not Monitored*	8-026	T098	Filtrate storage tank (25A)	None	
EP8-031	Not Monitored*	8-027	T099	Filtrate storage tank (28A)	None	
EP8-032	Not Monitored*	8-028	T100	Accountability tank	None	
08-A159ASTK	Proposed	8-036	P265	Crusher system	08-A157(A-P)-DC, FFDC/G43-29	
EP8-011	Proposed	8-007	P186	Rotex screening	CYC SCR	
EP8-001,005	Proposed	8-003	P182	Primary calciner		
EP9-001	0.00000E+00	9-005	P013	J & L model 30 lathe	ESP/G9E2-400	SPCIS
		9-006	P012	North Duomatic lathe		
		9-007	P013	East Duomatic lathe		
		9-008	P013	North Gisholt lathe		
		9-009	P013	South Gisholt lathe		

000030

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
		9-013	P013	W & S turret lathe		
		9-014	P013	Gisholt turret lathe		
EP9-002	0.00000E+00	9-001	P020	Separation booth	Cyclone,FFDC/3DF12	SPCIS
		9-002	P020	Crucible charge/burnout station	HEPA/E-6	
		9-003	P020	Remelt furnace # 91		
		9-004	P020	Remelt furnace # 92		
		9-012	P020	Mold cleaning station		
EP9-003	0.00000E+00	9-011	P266	Zirnlo Process HN03 Declad Tank	None	
EP9-004	Not Monitored*	9-010	T001	Nitric storage tank	None	
EP9-005	Not Monitored*	9-015		Scrap pickling	None	
EP13-001	Not Monitored*	13-001	T121	North spent solvent tank	None	
EP13-003	Not Monitored*	13-002	T120	South spent solvent tank	None	
EP13-003	Not Monitored*	13-003	T107	Spill storage tank westside (F100)	None	
EP13-004	Not Monitored*	13-004	T106	Spill storage tank westside (F101)	None	
EP13-005	Not Monitored*	13-005		Thorium hold tank (T1)	None	
EP13-006	Out of Service	13-006		Thorium hold tank (T2)	None	
EP13-007	Not Monitored*	13-007		Thorium hold tank (T3)	None	
EP13-008	Not Monitored*	13-008	T108	Solvent storage tank (T5)	None	
EP13-009	Not Monitored*	13-009	T105	Solvent storage tank (T6)	None	

0000031

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
EP13-010	Not Monitored*	13-010	T086	Caustic storage tank		
Tank Vent	Not Monitored*	13-011	T088	Nitric acid storage tank	None	
EP13-015	0.00000E+00	13-020		UF6 to UF4 Process No. 1	FFDC/G-1	SPCIS
EP13-016	0.00000E+00	13-020		UF6 to UF4 Process No. 1	FFDC/G-2	SPCIS
Tank Vent	Not Monitored*	46-002	T126	Sulfuric acid tank	None	
R-41	0.00000E+00	13-015	P173	Pilot plant remelt furnace	FFDC 735-13-7041	SPCIS
		13-012	P233	Plasma spray process		
R-50	0.00000E+00	13-014	P174	Crucible grit blaster	FFDC 735-13-7051	SPCIS
EP15-001	0.00000E+00			Laboratories (Monitored Emissions)	FFDC/G15-001	SPCIS
EP78-001	Proposed	78-001	P261	Grit Blast System	Impingement Separator	
EP78-002	Proposed	78-002	P263	High Pressure Water Wash System	with HEPA	
EP78-003	Proposed	78-003	P264	Ultra High Pressure Wter Wash		
Misc.	0.00000E+00			Plant 1 Building Exhausts	None	EC
Misc.	0.00000E+00			Plant 2/3 Building Exhausts	None	EC
Misc.	0.00000E+00			Plant 4 Building Exhausts	None	EC
Misc.	0.00000E+00			Plant 5 Building Exhausts	None	EC
Misc.	0.00000E+00			Plant 6 Building Exhausts	None	EC

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
Misc.	0.00000E+00			Plant 8 Building Exhausts	None	EC
Misc.	0.00000E+00			Plant 9 Building Exhausts	None	EC
Misc.	2.70000E-03			Laboratory Building Exhausts	None	EC
Misc.	5.30000E-02			Waste Pit 5 Emissions	None	EC
Misc.	1.40600E+00			Waste Pit 6 Emissions	None	EC
Misc.	1.70000E+00			Utility Cooling Tower	None	EC
Misc.(Plt 5)	0.00000E+00			East Rockwell Air Cooling Well		SPCIS
Misc.(Plt 5)	0.00000E+00			West Rockwell Air Cooling Well		SPCIS
Misc.(Plt 5)	0.00000E+00			East Jolter Muffler		EC
Misc.(Plt 5)	0.00000E+00			West Jolter Muffler		EC
Misc.(Plt 5)	0.00000E+00			Breakout Jolter Muffler		EC
Misc.(Plt 5)	0.00000E+00			Remelt Furnace Hilco Oil Rec.		EC
Misc.(Plt 5)	0.00000E+00			East Mold Cooling Booth		SPCIS
Misc.(Plt 5)	0.00000E+00			West Mold Cooling Booth		SPCIS
Misc.(Plt 5)	0.00000E+00			Graphite Breakout Booth		SPCIS
Misc.(Plt. 8)	0.00000E+00			Eimco Filter Hood Fan		EC

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TABLE IB

FMPC
Uranium Air Emission Source
Compilation

FMPC Emission Pt.	1990 Air Emissions (kg U/Emission Pt.)	FMPC Source No.	OEPA Source No.	Source Description	Control Equipment/No.	Air Emissions Obtained From
Misc.	5.59900E-02			Bldg 69 -- D & D facility		EC
Pilot Plt.	0.00000E+00			Reactor area-Hydrogen safety system		EC
Pilot Plt.	0.00000E+00			Reactor area-scrubber C		EC
Pilot Plt.	1.00000E-05			Building vents - Autoclave area		EC
Pilot Plt.	5.70000E-05			Building vents - Reactor area		EC
Total U	3.2					

LEGEND

Not Monitored* - Contribution Insignificant
SPCIS - Single Point Continuous Isokinetic Sampler
MPCIS - Multiple Point Continuous Isokinetic Sampler
EC - Engineering Calculation
ST - Stack Testing

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

Plant 1	U	Plant 5	U
Dust Collectors	0.000356	Dust Collectors	0.002301
Plt 1 Build Vent	0.000000	Plt 5 Process	0.000000
		Plt 5 Build Vent	0.000000
Total	0.000356		

Plant 1 - Dust Collectors (EP1-009)
kg U = 0.000356

Isotope	uCi/kg U	Ci/yr
U234	298.6	1.06E-07
U235	15.8	5.62E-09
U236	11.6	4.13E-09
U238	333.6	1.19E-07
SR90	1.76	6.27E-10
TC99	36.94	1.32E-08
RU106	6.86	2.44E-09
CS137	5.13	1.83E-09
BA137M	5.13	1.83E-09
RA226	0.212	7.55E-11
RA228	0.85	3.03E-10
TH228	8.97	3.19E-09
TH230	26.4	9.40E-09
TH232	1.41	5.02E-10
TH234	1319	4.70E-07
PA234M	1319	4.70E-07
NP237	0.107	3.81E-11
PU238	0.127	4.52E-11
PU239	0.816	2.90E-10
PU240	0.204	7.26E-11
PU241	2.93	1.04E-09
PU242	0.0000466	1.66E-14

Plant 5 - Dust Collectors (EP5-018)
kg U = 0.002301

Isotope	uCi/kg U	Ci/yr
U234	298.6	6.87E-07
U235	15.8	3.64E-08
U236	11.6	2.67E-08
U238	333.6	7.68E-07
SR90	1.76	4.05E-09
TC99	36.94	8.50E-08
RU106	6.86	1.58E-08
CS137	5.13	1.18E-08
BA137M	5.13	1.18E-08
RA226	0.212	4.88E-10
RA228	0.85	1.96E-09
TH228	8.97	2.06E-08
TH230	26.4	6.07E-08
TH232	1.41	3.24E-09
TH234	1319	3.04E-06
PA234M	1319	3.04E-06
NP237	0.107	2.46E-10
PU238	0.127	2.92E-10
PU239	0.816	1.88E-09
PU240	0.204	4.69E-10
PU241	2.93	6.74E-09
PU242	0.0000466	1.07E-13

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

Plant 8	U	Laboratory	U
Dust Collectors	0.000000	Lab Dust Coll.	0.000000
Plt 8 Scrubbers	0.000000	Fume Hoods	0.002700
Plt 8 Process	0.027511		
Plt 8 Build Vent	0.000000		

Plant 8 - Process (EP8-013 + -015)
kg U = 0.027511

Isotope	uCi/kg U	Ci/yr
U234	298.6	8.21E-06
U235	15.8	4.35E-07
U236	11.6	3.19E-07
U238	333.6	9.18E-06
SR90	1.76	4.84E-08
TC99	36.94	1.02E-06
RU106	6.86	1.89E-07
CS137	5.13	1.41E-07
BA137M	5.13	1.41E-07
RA226	0.212	5.83E-09
RA228	0.85	2.34E-08
TH228	8.97	2.47E-07
TH230	26.4	7.26E-07
TH232	1.41	3.88E-08
TH234	1319	3.63E-05
PA234M	1319	3.63E-05
NP237	0.107	2.94E-09
PU238	0.127	3.49E-09
PU239	0.816	2.24E-08
PU240	0.204	5.61E-09
PU241	2.93	8.06E-08
PU242	0.000086	2.37E-12

Laboratory Fume Hoods
kg U = 0.002700

Isotope	uCi/kg U	Ci/yr
U234	298.6	8.06E-07
U235	15.8	4.27E-08
U236	11.6	3.13E-08
U238	333.6	9.01E-07
SR90	1.76	4.75E-09
TC99	36.94	9.97E-08
RU106	6.86	1.85E-08
CS137	5.13	1.39E-08
BA137M	5.13	1.39E-08
RA226	0.212	5.72E-10
RA228	0.85	2.30E-09
TH228	8.97	2.42E-08
TH230	26.4	7.13E-08
TH232	1.41	3.81E-09
TH234	1319	3.56E-06
PA234M	1319	3.56E-06
NP237	0.107	2.89E-10
PU238	0.127	3.43E-10
PU239	0.816	2.20E-09
PU240	0.204	5.51E-10
PU241	2.93	7.91E-09
PU242	0.0000466	1.26E-13

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

	U
Pilot Plant	
Dust Collectors	0.000000
Building Vents (Autoclave + Reactor Areas)	0.000067

Pilot Plant -
kg U = 0.000067

Isotope	uCi/kg U	Ci/yr
U234	298.6	2.00E-08
U235	15.8	1.06E-09
U236	11.6	7.77E-10
U238	333.6	2.24E-08
SR90	1.76	1.18E-10
TC99	36.94	2.47E-09
RU106	6.86	4.60E-10
CS137	5.13	3.44E-10
BA137M	5.13	3.44E-10
RA226	0.212	1.42E-11
RA228	0.85	5.70E-11
TH228	8.97	6.01E-10
TH230	26.4	1.77E-09
TH232	1.41	9.45E-11
TH234	1319	8.84E-08
PA234M	1319	8.84E-08
NP237	0.107	7.17E-12
PU238	0.127	8.51E-12
PU239	0.816	5.47E-11
PU240	0.204	1.37E-11
PU241	2.93	1.96E-10
PU242	0.0000466	3.12E-15

Cooling Tower
kg U = 1.700000

Isotope	uCi/kg U	Ci/yr
U234	298.6	5.08E-04
U235	15.8	2.69E-05
U236	11.6	1.97E-05
U238	333.6	5.67E-04
SR90	1.76	2.99E-06
TC99	36.94	6.28E-05
RU106	6.86	1.17E-05
CS137	5.13	8.72E-06
BA137M	5.13	8.72E-06
RA226	0.212	3.60E-07
RA228	0.85	1.45E-06
TH228	8.97	1.52E-05
TH230	26.4	4.49E-05
TH232	1.41	2.40E-06
TH234	1319	2.24E-03
PA234M	1319	2.24E-03
NP237	0.107	1.82E-07
PU238	0.127	2.16E-07
PU239	0.816	1.39E-06
PU240	0.204	3.47E-07
PU241	2.93	4.98E-06
PU242	0.0000466	7.92E-11

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

Plant 69 D&D
kg U = 0.055990

Isotope	uCi/kg U	Ci/yr
U234	298.6	1.67E-05
U235	15.8	8.85E-07
U236	11.6	6.49E-07
U238	333.6	1.87E-05
SR90	1.76	9.85E-08
TC99	36.94	2.07E-06
RU106	6.86	3.84E-07
CS137	5.13	2.87E-07
BA137M	5.13	2.87E-07
RA226	0.212	1.19E-08
RA228	0.85	4.76E-08
TH228	8.97	5.02E-07
TH230	26.4	1.48E-06
TH232	1.41	7.89E-08
TH234	1319	7.39E-05
PA234M	1319	7.39E-05
NP237	0.107	5.99E-09
PU238	0.127	7.11E-09
PU239	0.816	4.57E-08
PU240	0.204	1.14E-08
PU241	2.93	1.64E-07
PU242	0.0000466	2.61E-12

Waste Pits - Total
kg U = 1.459000

Isotope	Ci/yr
U234	2.85E-04
U235	7.17E-06
U236	3.31E-06
U238	4.87E-04
SR90	2.72E-07
TC99	3.86E-05
RU106	0.00E+00
CS137	1.19E-06
BA137M	1.19E-06
RA226	1.52E-05
RA228	1.89E-06
TH228	2.44E-06
TH230	2.73E-04
TH232	1.89E-06
TH234	4.86E-04
PA234M	4.86E-04
NP237	3.50E-07
PU238	7.62E-08
PU239	1.88E-07
PU240	1.88E-07
PU241	1.28E-06
PU242	6.80E-11

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

Waste Pit 5			Waste Pit 6		
kg U =	0.053000		kg U =	1.406000	
Isotope	uCi/kg U	Ci/yr	Isotope	uCi/kg U	Ci/yr
U234	441	2.34E-05	U234	186	2.62E-04
U235	18.2	9.65E-07	U235	4.41	6.20E-06
U236	45.5	2.41E-06	U236	0.637	8.96E-07
U238	331	1.75E-05	U238	334	4.70E-04
SR90	4.15	2.20E-07	SR90	0.037	5.20E-08
TC99	662.5	3.51E-05	TC99	2.49	3.50E-06
RU106	ND	0.00E+00	RU106	ND	0.00E+00
CS137	13.5	7.16E-07	CS137	0.34	4.78E-07
BA137M	13.5	7.16E-07	BA137M	0.34	4.78E-07
RA226	287.2	1.52E-05	RA226	ND	0.00E+00
RA228	35.4	1.88E-06	RA228	0.01	1.41E-08
TH228	45.6	2.42E-06	TH228	0.0186	2.62E-08
TH230	5135	2.72E-04	TH230	0.52	7.31E-07
TH232	35.4	1.88E-06	TH232	0.01	1.41E-08
TH234	333.3	1.77E-05	TH234	332.9	4.68E-04
PA234M	333.3	1.77E-05	PA234M	332.9	4.68E-04
NP237	5.31	2.81E-07	NP237	0.049	6.89E-08
PU238	1.04	5.51E-08	PU238	0.015	2.11E-08
PU239	1.3	6.89E-08	PU239	0.085	1.20E-07
PU240	1.3	6.89E-08	PU240	0.085	1.20E-07
PU241	8.8	4.66E-07	PU241	0.58	8.15E-07
PU242	0.0000466	2.47E-12	PU242	0.0000466	6.55E-11

1. U235 values were determined from site records indicating the enrichment of of the Uranium in the pits. U236, U234 values were calculated average value for Uranium of the specified enrichments at the FMPC. U238 value was the remainder of the Uranium on a weight percent basis.
2. SR90, TC99, RU106, CS137, RA226, TH228, TH230, TH232, NP237, PU238, PU239 values are averages of core sample analyses performed on each waste pit. The specific analyses are listed in the following document; Solow, A. J. and Phoenix, D. R.c "Characterization Investigation Study, Vol. 2: Chemical and Radiological Analyses of the Waste Storage Pits", Novermber 1987, FMPC/SUB 008, Vol. 2 UC-70, Appendix D.
3. BA137M is assumed to be in equilibrium with CS137, i.e. BA137M activity equals that of CS137.
4. RA228 is assumed to be in equilibrium with TH232, i.e. RA228 activity equals that of TH232.
5. PU239/240 - half of the analyzed values discussed in 2 above are proportioned to each.
6. TH234 and PA234M are assumed to be in equilibruium with U238, i.e. the TH234 and PA234M activities are equal to that of U238.
7. PU241 is assumed to be in the same ratio to Pu239/240 as is seen for FMPC processes as analyzed for composite dust collector filter samples for 1988.
8. PU242 is assumed to be the same as seen for the processes as analyzed for the composite dust collector filter saples for 1989.

TABLE 2

FMPC
1990 Radionuclide Air Emissions
Source Compilation

Total Kg U = 3.2 Isotope	Ci/yr
U234	8.19E-04
U235	3.54E-05
U236	2.41E-05
U238	1.08E-03
SR90	3.42E-06
TC99	1.05E-04
RU106	1.23E-05
CS137	1.04E-05
BA137M	1.04E-05
RA226	1.56E-05
RA228	3.41E-06
TH228	1.85E-05
TH230	3.20E-04
TH232	4.41E-06
TH234	2.85E-03
PA234M	2.85E-03
NP237	5.42E-07
PU238	3.03E-07
PU239	1.65E-06
PU240	5.53E-07
PU241	6.52E-06
PU242	1.52E-10

Total Kg U = 3.2 Isotope	uCi/kg U
U234	2.56E+02
U235	1.11E+01
U236	7.52E+00
U238	3.39E+02
SR90	1.07E+00
TC99	3.27E+01
RU106	3.84E+00
CS137	3.24E+00
BA137M	3.24E+00
RA226	4.88E+00
RA228	1.07E+00
TH228	5.78E+00
TH230	1.00E+02
TH232	1.38E+00
TH234	8.89E+02
PA234M	8.89E+02
NP237	1.69E-01
PU238	9.48E-02
PU239	5.15E-01
PU240	1.73E-01
PU241	2.04E+00
PU242	4.76E-05

Note: Calculations were performed using a LOTUS 1-2-3, version 1.06 spreadsheet. Additional significant figures were carried in the calculations but are not shown in Table 2, which is truncated to 3 significant figures.

TABLE 2B
ACTIVITY OF RADIONUCLIDES
CY-1988 & CY-1989 MONITORED STACKS
COMPOSITE SAMPLE

1988 Dust Collector Composite Isotope	uCi/kg U
U234	293.6
U235	14
U236	12.9
U238	333.9
SR90	2.81
TC99	36.94
RU106	6.86
CS137	4.76
BA137M	4.77
RA226	0.28
RA228	0.31
TH228	6.9
TH230	22.83
TH232	4.94
TH234	4073
PA234M	1423
NP237	0.49
PU238	0.26
PU239	0.694
PU240	0.174
PU241	2.93

1989 Dust Collector Composite Isotope		uCi/kg U
U234	[1]	298.6
U235	[1]	15.8
U236	[1]	11.6
U238	[1]	333.6
SR90	[2]	1.76
TC99	[3]	36.94
RU106	[3]	6.86
CS137	[2]	5.13
BA137M	[4]	5.13
RA226	[2]	0.212
RA228	[2]	0.85
TH228	[2]	8.97
TH230	[2]	26.4
TH232	[2]	1.41
TH234	[1]	1319
PA234M	[5]	1319
NP237	[2]	0.107
PU238	[2]	0.127
PU239	[6]	0.816
PU240	[6]	0.204
PU241	[6]	2.93
PU242	[2]	0.0000466

[1] Mass weighted average of monthly composite samples analyzed at the FMPC.
[2] Annual composite sample analyzed by an offsite contractor.
[3] From Table 5 of "Draft Assessment of Radiation Dose and Cancer Risk for Emissions from 1951 through 1984", prepared by the IT Corporation, March, 1989.
[4] Assumed in equilibrium with Cs-137 with same activity value.
[5] Assumed in equilibrium with Th-234 with the same activity value.
[6] From draft of "Annual AIr Emission Report for Calendar Year 1989 -National Emission Standards for Hazardous Air Pollutants(NESHAP), 40 CFR 61 Subpart H - Feed Materials Production Center. Values used were -2.7%, -4.7%, and -6.2%, respectively, of the values reported in [2] above.

TABLE 2B
ACTIVITY OF RADIONUCLIDES
CY-1988 & CY-1989 MONITORED STACKS
COMPOSITE SAMPLE

1988 Dust Collector
Composite

Isotope	uCi/kg U
U234	293.6
U235	14
U236	12.9
U238	333.9
SR90	2.81
TC99	36.94
RU106	6.86
CS137	4.76
BA137M	4.77
RA226	0.28
RA228	0.31
TH228	6.9
TH230	22.83
TH232	4.94
TH234	4073
PA234M	1423
NP237	0.49
PU238	0.26
PU239	0.694
PU240	0.174
PU241	2.93

1989 Dust Collector
Composite

Isotope		uCi/kg U
U234	[1]	298.6
U235	[1]	15.8
U236	[1]	11.6
U238	[1]	333.6
SR90	[2]	1.76
TC99	[3]	36.94
RU106	[3]	6.86
CS137	[2]	5.13
BA137M	[4]	5.13
RA226	[2]	0.212
RA228	[2]	0.85
TH228	[2]	8.97
TH230	[2]	26.4
TH232	[2]	1.41
TH234	[1]	1319
PA234M	[5]	1319
NP237	[2]	0.107
PU238	[2]	0.127
PU239	[6]	0.816
PU240	[6]	0.204
PU241	[6]	2.93
PU242	[2]	0.0000466

[1] Mass weighted average of monthly composite samples analyzed at the FMPC.
[2] Annual composite sample analyzed by an offsite contractor.
[3] From Table 5 of "Draft Assessment of Radiation Dose and Cancer Risk for Emissions from 1951 through 1984", prepared by the IT Corporation, March, 1989.
[4] Assumed in equilibrium with Cs-137 with same activity value.
[5] Assumed in equilibrium with Th-234 with the same activity value.
[6] From draft of "Annual Air Emission Report for Calendar Year 1989 -National Emission Standards for Hazardous Air Pollutants(NESHAP), 40 CFR 61 Subpart H - Feed Materials Production Center. Values used were -2.7%, -4.7%, and -6.2%, respectively, of the values reported in [2] above.

TABLE 3:

FMPC Site Meteorological Station, STAR data, 1987 - 1990

N	A	0.000171	0.000410	0.000581	0.000000	0.000000	0.000000
NNE	A	0.000342	0.000342	0.000820	0.000103	0.000000	0.000000
NE	A	0.000376	0.000957	0.000376	0.000034	0.000000	0.000000
ENE	A	0.000547	0.001367	0.000171	0.000000	0.000000	0.000000
E	A	0.000205	0.000581	0.000137	0.000000	0.000000	0.000000
ESE	A	0.000205	0.000171	0.000000	0.000000	0.000000	0.000000
SE	A	0.000034	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	A	0.000034	0.000068	0.000068	0.000000	0.000000	0.000000
S	A	0.000137	0.000171	0.000000	0.000000	0.000000	0.000000
SSW	A	0.000273	0.001880	0.000923	0.000000	0.000000	0.000000
SW	A	0.000342	0.002461	0.002153	0.000068	0.000000	0.000000
WSW	A	0.000308	0.003008	0.001128	0.000034	0.000000	0.000000
W	A	0.000410	0.002427	0.001538	0.000068	0.000000	0.000000
WNW	A	0.000444	0.000854	0.000820	0.000137	0.000000	0.000000
NW	A	0.000376	0.000786	0.000376	0.000000	0.000000	0.000000
NNW	A	0.000308	0.000479	0.000615	0.000000	0.000000	0.000000
N	B	0.000137	0.000786	0.000308	0.000068	0.000000	0.000000
NNE	B	0.000137	0.000308	0.000444	0.000034	0.000000	0.000000
NE	B	0.000205	0.001025	0.000479	0.000000	0.000000	0.000000
ENE	B	0.000273	0.001265	0.000171	0.000068	0.000000	0.000000
E	B	0.000547	0.000410	0.000171	0.000000	0.000000	0.000000
ESE	B	0.000137	0.000239	0.000000	0.000000	0.000000	0.000000
SE	B	0.000068	0.000068	0.000000	0.000000	0.000000	0.000000
SSE	B	0.000171	0.000068	0.000034	0.000035	0.000000	0.000000
S	B	0.000103	0.000205	0.000068	0.000000	0.000000	0.000000
SSW	B	0.000308	0.001846	0.000889	0.000103	0.000034	0.000000
SW	B	0.000581	0.002324	0.001025	0.000103	0.000000	0.000000
WSW	B	0.000547	0.002461	0.000649	0.000034	0.000000	0.000000
W	B	0.000376	0.001572	0.000923	0.000034	0.000000	0.000000
WNW	B	0.000342	0.000991	0.000752	0.000068	0.000000	0.000000
NW	B	0.000479	0.001060	0.000649	0.000000	0.000000	0.000000
NNW	B	0.000376	0.000957	0.000410	0.000034	0.000000	0.000000
N	C	0.000376	0.001196	0.000479	0.000137	0.000000	0.000000
NNE	C	0.000342	0.001299	0.000444	0.000034	0.000000	0.000000
NE	C	0.000410	0.001641	0.000718	0.000103	0.000000	0.000000
ENE	C	0.001196	0.001777	0.000205	0.000239	0.000000	0.000000
E	C	0.001025	0.000615	0.000103	0.000000	0.000000	0.000000
ESE	C	0.000547	0.000376	0.000000	0.000000	0.000000	0.000000
SE	C	0.000342	0.000410	0.000000	0.000000	0.000000	0.000000
SSE	C	0.000239	0.000444	0.000068	0.000000	0.000000	0.000000
S	C	0.000342	0.001060	0.000137	0.000000	0.000000	0.000000
SSW	C	0.000410	0.002358	0.000718	0.000068	0.000034	0.000000
SW	C	0.001265	0.003828	0.001128	0.000171	0.000000	0.000000
WSW	C	0.001572	0.003247	0.000820	0.000103	0.000000	0.000000
W	C	0.000547	0.001880	0.000957	0.000137	0.000000	0.000000
WNW	C	0.000649	0.001504	0.000923	0.000137	0.000000	0.000000
NW	C	0.000547	0.001675	0.000923	0.000000	0.000034	0.000000

TABLE 3:

FMPC Site Meteorological Station, STAR data, 1987 - 1990

NNW	C	0.000547	0.001538	0.000479	0.000034	0.000000	0.000000
N	D	0.003486	0.012476	0.004785	0.000308	0.000000	0.000000
NNE	D	0.004888	0.013672	0.004717	0.000786	0.000000	0.000000
NE	D	0.007314	0.015552	0.004067	0.000239	0.000000	0.000000
ENE	D	0.010254	0.020884	0.004684	0.000752	0.000000	0.000000
E	D	0.007656	0.004990	0.000410	0.000000	0.000034	0.000000
ESE	D	0.005503	0.001606	0.000034	0.000000	0.000000	0.000000
SE	D	0.003897	0.002290	0.000103	0.000000	0.000000	0.000000
SSE	D	0.004238	0.003384	0.000923	0.000068	0.000000	0.000000
S	D	0.005093	0.006870	0.002119	0.000239	0.000000	0.000000
SSW	D	0.008340	0.014595	0.005981	0.001128	0.000000	0.000000
SW	D	0.011143	0.017192	0.004683	0.000718	0.000137	0.000068
WSW	D	0.011655	0.011860	0.003589	0.001162	0.000205	0.000034
W	D	0.009297	0.013228	0.006494	0.000786	0.000000	0.000000
WNW	D	0.005127	0.013535	0.006050	0.000752	0.000000	0.000000
NW	D	0.005742	0.010391	0.005230	0.000172	0.000103	0.000000
NNW	D	0.005024	0.011074	0.003556	0.000479	0.000068	0.000000
N	E	0.005161	0.004102	0.000410	0.000034	0.000000	0.000000
NNE	E	0.003828	0.003315	0.000615	0.000068	0.000000	0.000000
NE	E	0.004546	0.002905	0.000239	0.000000	0.000000	0.000000
ENE	E	0.012681	0.007656	0.000513	0.000000	0.000000	0.000000
E	E	0.009844	0.001675	0.000068	0.000000	0.000000	0.000000
ESE	E	0.004717	0.000957	0.000000	0.000000	0.000000	0.000000
SE	E	0.005093	0.001060	0.000137	0.000000	0.000000	0.000000
SSE	E	0.006904	0.003418	0.000513	0.000068	0.000000	0.000000
S	E	0.007588	0.008066	0.002324	0.000581	0.000000	0.000000
SSW	E	0.013569	0.016714	0.005708	0.000615	0.000069	0.000000
SW	E	0.022969	0.021362	0.004033	0.000273	0.000034	0.000000
WSW	E	0.023071	0.009058	0.002324	0.000479	0.000000	0.000000
W	E	0.016919	0.011895	0.002871	0.000171	0.000000	0.000000
WNW	E	0.011621	0.009605	0.002222	0.000137	0.000000	0.000000
NW	E	0.009707	0.005298	0.000820	0.000068	0.000000	0.000000
NNW	E	0.006870	0.003315	0.000684	0.000103	0.000000	0.000000
N	F	0.001504	0.000137	0.000000	0.000000	0.000000	0.000000
NNE	F	0.001504	0.000034	0.000034	0.000000	0.000000	0.000000
NE	F	0.001880	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	F	0.004683	0.000786	0.000000	0.000000	0.000000	0.000000
E	F	0.006563	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	F	0.004102	0.000000	0.000000	0.000000	0.000000	0.000000
SE	F	0.003179	0.000034	0.000000	0.000000	0.000000	0.000000
SSE	F	0.003110	0.000000	0.000000	0.000000	0.000000	0.000000
S	F	0.004238	0.000205	0.000000	0.000000	0.000000	0.000000
SSW	F	0.007554	0.000581	0.000034	0.000000	0.000000	0.000000
SW	F	0.012647	0.001333	0.000000	0.000000	0.000000	0.000000
WSW	F	0.018936	0.000889	0.000000	0.000000	0.000000	0.000000
W	F	0.016133	0.000376	0.000000	0.000000	0.000000	0.000000
WNW	F	0.012988	0.000068	0.000000	0.000000	0.000000	0.000000
NW	F	0.008272	0.000068	0.000000	0.000000	0.000000	0.000000
NNW	F	0.004546	0.000239	0.000000	0.000000	0.000000	0.000000

TABLE 3:

FMPC Site Meteorological Station, STAR data, 1987 - 1990

N	G	0.003042	0.000000	0.000000	0.000000	0.000000	0.000068
NNE	G	0.003350	0.000000	0.000000	0.000000	0.000000	0.000000
NE	G	0.002871	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	G	0.003999	0.000068	0.000000	0.000000	0.000000	0.000000
E	G	0.007349	0.000034	0.000000	0.000000	0.000000	0.000000
ESE	G	0.005298	0.000000	0.000000	0.000000	0.000000	0.000000
SE	G	0.002769	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	G	0.002290	0.000000	0.000000	0.000000	0.000000	0.000000
S	G	0.003452	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	G	0.006118	0.000034	0.000000	0.000000	0.000000	0.000000
SW	G	0.011792	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	G	0.015859	0.000068	0.000000	0.000000	0.000000	0.000000
W	G	0.019688	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	G	0.020918	0.000000	0.000000	0.000000	0.000000	0.000000
NW	G	0.014902	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	G	0.006665	0.000000	0.000000	0.000000	0.000000	0.000000

TABLE 4:

CVG METEOROLOGICAL STATION
STAR DATA, 1985-1989

N	A	0.00035	0.00037	0.00000	0.00000	0.00000	0.00000
NNE	A	0.00017	0.00021	0.00000	0.00000	0.00000	0.00000
NE	A	0.00022	0.00016	0.00000	0.00000	0.00000	0.00000
ENE	A	0.00025	0.00030	0.00000	0.00000	0.00000	0.00000
E	A	0.00044	0.00041	0.00000	0.00000	0.00000	0.00000
ESE	A	0.00019	0.00018	0.00000	0.00000	0.00000	0.00000
SE	A	0.00020	0.00034	0.00000	0.00000	0.00000	0.00000
SSE	A	0.00015	0.00030	0.00000	0.00000	0.00000	0.00000
S	A	0.00044	0.00041	0.00000	0.00000	0.00000	0.00000
SSW	A	0.00014	0.00014	0.00000	0.00000	0.00000	0.00000
SW	A	0.00028	0.00043	0.00000	0.00000	0.00000	0.00000
WSW	A	0.00046	0.00043	0.00000	0.00000	0.00000	0.00000
W	A	0.00040	0.00046	0.00000	0.00000	0.00000	0.00000
WNW	A	0.00034	0.00034	0.00000	0.00000	0.00000	0.00000
NW	A	0.00023	0.00032	0.00000	0.00000	0.00000	0.00000
NNW	A	0.00025	0.00030	0.00000	0.00000	0.00000	0.00000
N	B	0.00091	0.00247	0.00144	0.00000	0.00000	0.00000
NNE	B	0.00060	0.00123	0.00066	0.00000	0.00000	0.00000
NE	B	0.00043	0.00160	0.00126	0.00000	0.00000	0.00000
ENE	B	0.00066	0.00158	0.00096	0.00000	0.00000	0.00000
E	B	0.00106	0.00215	0.00096	0.00000	0.00000	0.00000
ESE	B	0.00069	0.00139	0.00089	0.00000	0.00000	0.00000
SE	B	0.00057	0.00100	0.00053	0.00000	0.00000	0.00000
SSE	B	0.00066	0.00137	0.00027	0.00000	0.00000	0.00000
S	B	0.00127	0.00247	0.00091	0.00000	0.00000	0.00000
SSW	B	0.00110	0.00208	0.00105	0.00000	0.00000	0.00000
SW	B	0.00109	0.00180	0.00128	0.00000	0.00000	0.00000
WSW	B	0.00090	0.00190	0.00196	0.00000	0.00000	0.00000
W	B	0.00103	0.00235	0.00167	0.00000	0.00000	0.00000
WNW	B	0.00064	0.00187	0.00089	0.00000	0.00000	0.00000
NW	B	0.00064	0.00135	0.00082	0.00000	0.00000	0.00000
NNW	B	0.00055	0.00148	0.00089	0.00000	0.00000	0.00000
N	C	0.00034	0.00237	0.00420	0.00094	0.00000	0.00000
NNE	C	0.00024	0.00098	0.00212	0.00057	0.00000	0.00000
NE	C	0.00015	0.00137	0.00281	0.00048	0.00000	0.00000
ENE	C	0.00024	0.00180	0.00368	0.00053	0.00000	0.00000
E	C	0.00034	0.00242	0.00489	0.00050	0.00000	0.00000
ESE	C	0.00025	0.00164	0.00194	0.00011	0.00000	0.00000
SE	C	0.00024	0.00105	0.00110	0.00014	0.00000	0.00000
SSE	C	0.00028	0.00116	0.00187	0.00014	0.00002	0.00000
S	C	0.00049	0.00269	0.00505	0.00041	0.00000	0.00000
SSW	C	0.00044	0.00297	0.00621	0.00114	0.00009	0.00000
SW	C	0.00063	0.00345	0.00779	0.00155	0.00011	0.00000
WSW	C	0.00030	0.00219	0.00550	0.00142	0.00016	0.00000
W	C	0.00048	0.00256	0.00582	0.00160	0.00007	0.00000
WNW	C	0.00030	0.00139	0.00253	0.00062	0.00000	0.00000
NW	C	0.00025	0.00144	0.00237	0.00053	0.00005	0.00000

TABLE 4:

CVG METEOROLOGICAL STATION
STAR DATA, 1985-1989

NNW	C	0.00020	0.00110	0.00237	0.00053	0.00000	0.00000
N	D	0.00034	0.00324	0.00669	0.00580	0.00027	0.00007
NNE	D	0.00016	0.00119	0.00299	0.00274	0.00016	0.00000
NE	D	0.00020	0.00185	0.00285	0.00240	0.00009	0.00000
ENE	D	0.00025	0.00203	0.00413	0.00295	0.00016	0.00000
E	D	0.00029	0.00386	0.00532	0.00311	0.00011	0.00000
ESE	D	0.00014	0.00224	0.00267	0.00169	0.00016	0.00005
SE	D	0.00026	0.00162	0.00290	0.00153	0.00000	0.00000
SSE	D	0.00016	0.00199	0.00269	0.00210	0.00025	0.00000
S	D	0.00051	0.00418	0.00719	0.00648	0.00132	0.00037
SSW	D	0.00029	0.00381	0.00936	0.01342	0.00269	0.00082
SW	D	0.00022	0.00379	0.00979	0.01511	0.00285	0.00071
WSW	D	0.00025	0.00256	0.00678	0.00954	0.00201	0.00048
W	D	0.00037	0.00338	0.00884	0.01356	0.00285	0.00043
WNW	D	0.00018	0.00274	0.00587	0.01005	0.00176	0.00014
NW	D	0.00035	0.00274	0.00470	0.00607	0.00103	0.00007
NNW	D	0.00035	0.00196	0.00322	0.00368	0.00050	0.00011
N	E	0.00062	0.00320	0.00879	0.00566	0.00039	0.00002
NNE	E	0.00037	0.00187	0.00459	0.00311	0.00014	0.00000
NE	E	0.00036	0.00176	0.00603	0.00356	0.00016	0.00000
ENE	E	0.00045	0.00192	0.00610	0.00393	0.00018	0.00000
E	E	0.00059	0.00311	0.00868	0.00461	0.00027	0.00000
ESE	E	0.00060	0.00217	0.00516	0.00196	0.00014	0.00000
SE	E	0.00032	0.00180	0.00445	0.00144	0.00007	0.00000
SSE	E	0.00041	0.00169	0.00454	0.00160	0.00018	0.00000
S	E	0.00090	0.00400	0.01128	0.00797	0.00105	0.00011
SSW	E	0.00050	0.00267	0.01368	0.01018	0.00194	0.00032
SW	E	0.00064	0.00342	0.01089	0.01000	0.00142	0.00014
WSW	E	0.00051	0.00231	0.00674	0.00671	0.00114	0.00041
W	E	0.00085	0.00377	0.01062	0.00811	0.00205	0.00064
WNW	E	0.00060	0.00244	0.00674	0.00863	0.00190	0.00018
NW	E	0.00060	0.00267	0.00687	0.00644	0.00107	0.00005
NNW	E	0.00036	0.00169	0.00425	0.00381	0.00078	0.00009
N	F	0.00000	0.00304	0.00509	0.00000	0.00000	0.00000
NNE	F	0.00000	0.00167	0.00237	0.00000	0.00000	0.00000
NE	F	0.00000	0.00196	0.00342	0.00000	0.00000	0.00000
ENE	F	0.00000	0.00256	0.00427	0.00000	0.00000	0.00000
E	F	0.00000	0.00457	0.00662	0.00000	0.00000	0.00000
ESE	F	0.00000	0.00354	0.00164	0.00000	0.00000	0.00000
SE	F	0.00000	0.00331	0.00169	0.00000	0.00000	0.00000
SSE	F	0.00000	0.00441	0.00178	0.00000	0.00000	0.00000
S	F	0.00000	0.01084	0.00562	0.00000	0.00000	0.00000
SSW	F	0.00000	0.00760	0.00799	0.00000	0.00000	0.00000
SW	F	0.00000	0.00582	0.00591	0.00000	0.00000	0.00000
WSW	F	0.00000	0.00283	0.00384	0.00000	0.00000	0.00000
W	F	0.00000	0.00340	0.00505	0.00000	0.00000	0.00000
WNW	F	0.00000	0.00203	0.00281	0.00000	0.00000	0.00000
NW	F	0.00000	0.00187	0.00349	0.00000	0.00000	0.00000
NNW	F	0.00000	0.00146	0.00233	0.00000	0.00000	0.00000

TABLE 4:

CVG METEOROLOGICAL STATION
STAR DATA, 1985-1989

N	G	0.00408	0.00740	0.00000	0.00000	0.00000	0.00000
NNE	G	0.00214	0.00285	0.00000	0.00000	0.00000	0.00000
NE	G	0.00227	0.00434	0.00000	0.00000	0.00000	0.00000
ENE	G	0.00249	0.00575	0.00000	0.00000	0.00000	0.00000
E	G	0.00403	0.00669	0.00000	0.00000	0.00000	0.00000
ESE	G	0.00306	0.00390	0.00000	0.00000	0.00000	0.00000
SE	G	0.00252	0.00292	0.00000	0.00000	0.00000	0.00000
SSE	G	0.00403	0.00409	0.00000	0.00000	0.00000	0.00000
S	G	0.01052	0.01244	0.00000	0.00000	0.00000	0.00000
SSW	G	0.01693	0.01553	0.00000	0.00000	0.00000	0.00000
SW	G	0.01101	0.01071	0.00000	0.00000	0.00000	0.00000
WSW	G	0.00636	0.00445	0.00000	0.00000	0.00000	0.00000
W	G	0.00498	0.00489	0.00000	0.00000	0.00000	0.00000
WNW	G	0.00191	0.00283	0.00000	0.00000	0.00000	0.00000
NW	G	0.00232	0.00372	0.00000	0.00000	0.00000	0.00000
NNW	G	0.00158	0.00349	0.00000	0.00000	0.00000	0.00000

TABLE 5: Source Characteristics

Source	Type	Release Height (m)	Inner diameter (m)	Gas Exit Velocity (m)	Gas Exit Temperature (^{0} C)	Distance (m) and Direction to Maximally Exposed Individual (MEI) Site Met data	Distance (m) and Direction to Maximally Exposed Individual (MEI) CVG Met Data
Plant 1	Point	7.62	0.356	13.45	Ambient	1000 NNE	930 N
Plant 5	Point	18.9	0.305	20.37	Ambient	1220 N	1190 NNW
Plant 8							
EP8-013	Point	13.72	0.381	4.97	Ambient	1260 N	1200 N
EP8-015	Point	13.72	0.305	13.21	Ambient	1260 N	1200 N
Laboratory	Point	5.26	0.305	7.47	Ambient	1390 N	1330 N
Pilot Plant							
Autoclave Area Vents	Point	12.19	0.914	4.99	Ambient	1390 N	1390 N
Reactor Area Vents	Point	10.92	2.459	0.0	Ambient	1390 N	1310 N
Building 69 - D&D	Point	7.62	0.813	18.11	Ambient	820 NNW	820 NNW
Cooling Tower	Point	14.9	8.69	7.16	26.7	730 N	700 N
Waste Pits	Area	1.0	162.4	0	Ambient	930 NE	800 NNE

TABLE 6

POPULATION ESTIMATES BY SECTOR WITHIN A FIFTY-MILE RADIUS OF THE FMPC

TABLE 6A. INCREMENTAL POPULATION DISTRIBUTION AROUND THE FMPC FOR 1990

Distance, miles	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
N	7	64	77	108	125	1008	16676	7161	16737	12369
NNE	5	57	65	111	300	13702	7595	8288	31333	78291
NE	8	206	120	129	317	38550	45545	96440	189514	317133
ENE	16	106	2714	5	47	31258	17295	31720	13520	25702
E	24	62	119	89	235	34442	53951	39591	17675	10403
ESE	16	68	137	206	292	38965	160794	72536	24073	13277
SE	8	69	107	153	192	52064	273363	94394	26815	15853
SSE	15	67	88	256	591	20714	218659	55517	9311	8685
S	8	69	97	384	620	8376	32804	34309	9475	9575
SSW	9	77	154	290	354	4814	9492	7718	6022	9695
SW	9	85	143	129	130	1171	15147	10752	3708	4916
WSW	17	84	142	216	296	7081	3749	7092	7243	5908
W	9	79	135	215	270	2488	3650	10355	5805	16385
WNW	8	66	102	161	213	1596	4242	6469	4255	12060
NW	12	63	99	154	219	1091	1398	3222	26366	9417
NNW	17	64	102	186	316	1538	12963	4921	48181	13725
TOTAL	188	1286	4401	2792	4517	258858	877323	490485	440033	563394

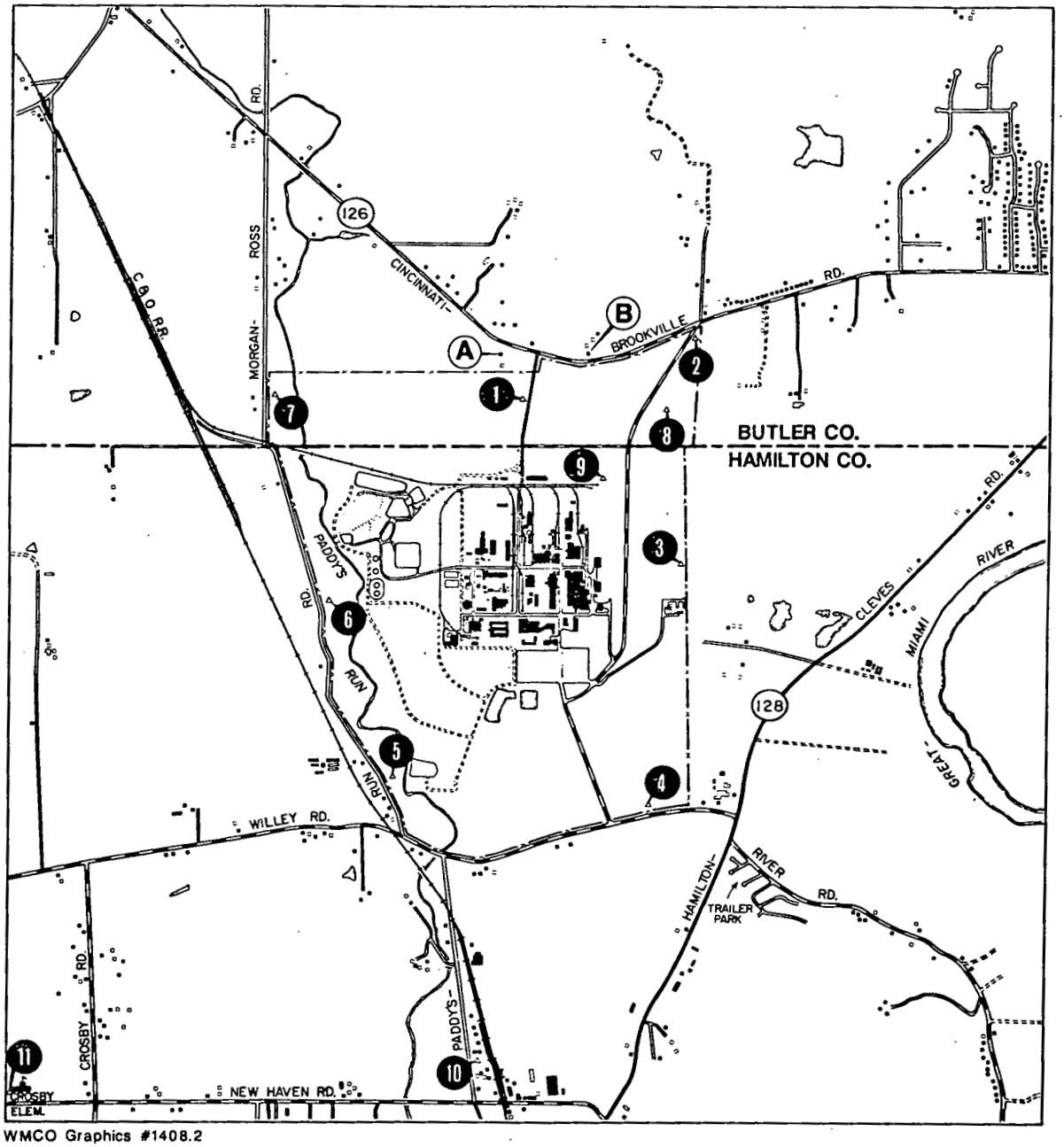
TABLE 6B. CUMULATIVE POPULATION DISTRIBUTION AROUND THE FMPC FOR 1990

Distance, miles	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
N	7	71	148	256	381	1389	18065	25226	41963	54332
NNE	5	62	127	238	538	14240	21835	30123	61456	139747
NE	8	214	334	463	780	39330	84875	181315	370829	687962
ENE	16	122	2836	2841	2888	34146	51441	83161	96681	122383
E	24	86	205	294	529	34971	88922	128513	146188	156591
ESE	16	84	221	427	719	39684	200478	273014	297087	310364
SE	8	77	184	337	529	52593	325956	420350	447165	463018
SSE	15	82	170	426	1017	21731	240390	295907	305218	313903
S	8	77	174	558	1178	9554	42358	76667	86142	95717
SSW	9	86	240	530	884	5698	15190	22908	28930	38625
SW	9	94	237	366	496	1667	16814	27566	31274	36190
WSW	17	101	243	459	755	7836	11585	18677	25290	31828
W	9	88	223	438	708	3196	6846	17201	23006	39391
WNW	8	74	176	337	550	2146	6388	12857	17112	29172
NW	12	75	174	328	547	1638	3036	6258	32624	42041
NNW	17	81	183	369	685	2223	15186	20107	68288	82013
TOTAL	188	1474	5875	8667	13184	272042	1149365	1639850	2079883	2643277

FIGURES

Figure 1: Locations of Maximally Exposed Individuals FMPC 1987-1990 Meteorological Data

Figure 2: Location of Maximally Exposed Individuals CVG 1985-1989 Meteorological Data



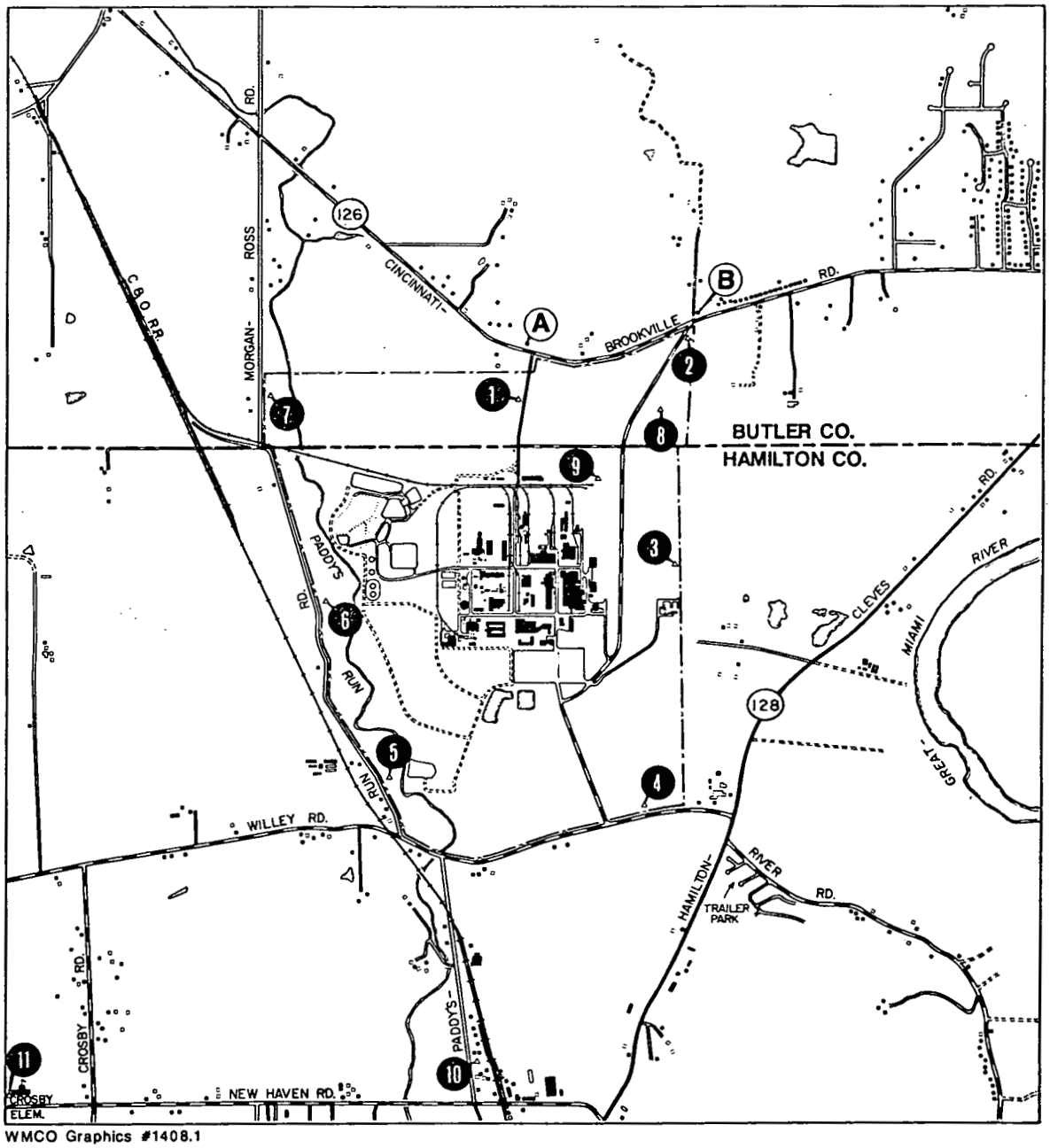
WMCO Graphics #1408.2

0 1/4 1/2 1 2
SCALE OF MILES

LEGEND

- (A) Maximally Exposed Individual (Including Waste Pit Emissions)
- (B) Maximally Exposed Individual (Excluding Waste Pit Emissions)
- Heavy Duty Roads
- Medium Duty Roads
- Light Duty Roads
- FMPC Boundary
- (1) Fixed Air Monitoring Stations

Figure 2. Locations of Maximally Exposed Individuals
CVG 1985-1989 Meteorological Data



WMCO Graphics #1408.1

0 1/4 1/2 1 2
SCALE OF MILES

LEGEND

- (A) Maximally Exposed Individual (Including Waste Pit Emissions)
- (B) Maximally Exposed Individual (Excluding Waste Pit Emissions)
- Heavy Duty Roads
- Medium Duty Roads
- Light Duty Roads
- FMPC Boundary
- (1) Fixed Air Monitoring Stations

Figure 1. Locations of Maximally Exposed Individuals
FMPC 1987-1990 Meteorological Data

ATTACHMENTS

1) Example of Engineering Calculation for Emissions from Stack Testing (Building 69)

2) Example of Engineering Calculation for Emissions from Building Vents (Pilot Plant/ Autoclave area)

3) Engineering Calculation for Emissions from Cooling Tower

4) Engineering Calculation for Emissions from Waste Pits.

5) Estimated dose due to emission of Radon-220 and Radon-222 decay products

EXAMPLES OF ENGINEERING CALCULATION FOR EMISSIONS:

1) Example of Engineering Calculation for Emissions from Stack Testing (Building 69)

EPA Method V sampling was performed August 24, 1988 at the Decontaminating and Decommissioning Building Facility HCl acid bath stack. Two sample probes were run continuously for an 8-hour period, with all personnel breaks covered. The sampling provided average emissions of 0.11 g U/hour. It was decided that the most useful emission factor would be on a mass/batch run through the acid baths.

(0.11 g U/hr) * (8 hr/day) /(8 batches/day) = 0.11 g U/ batch

2) Example of Engineering Calculation for Emissions from Building Vents (Pilot Plant/ Autoclave area)

The building is divided into two section, in terms of building ventilation fans: the Reactor section and the Autoclave area. Emissions from any structure are assumed only to occur when building vent fans are turned on; all fans in a building are operated when the system is turned on. Building operators keep a record of hours/month the ventilation fans are operated. A review of the facility records provided information on the number and capacity of the fans in the buildings. In the Autoclave area, there are 4 fans, each with a capacity of 10,570 cfm.

Portable continuous air monitoring units are stationed in areas of buildings where it is expected that emissions of radionuclides will be generated. These units provide information on the alpha radiation detected by the monitors and the volume of air sampled by the monitor. Using this information, a flow-weighted average of activity concentration is calculated in terms of uCi/cm^3. All activity is assumed to be from Uranium. It is further assumed that the activity concentration of the air vented is 1/10 of the flow-weighted average for the month as measured by the monitors. This assumption is reasonable, in that the monitors are specifically sited in areas where concentration of alpha activity are expected to be high; dilution with air in the rest of the building will result in lower concentrations.

To develop a monthly emission estimate requires: the average monthly Alpha activity , in uCi/cm^3; the number of hours the fans were operated for the month, and an emission factor to convert all the above information into consistent units. The FMPC keeps monthly records of these estimated emissions and adds them to provide an annual emission rate.

The emission factor for the autoclave area is:

$$4*(10^{-6}\ Ci/uCi)*(1kgU/6.77x10^{-4}Ci)*(28,317ccm/cf)*(10,570\ cf/min) * (60min/hr)$$

$$= 1.06x10^{8}\ ccm*kg\ U/uCi*hr$$

For the month of June, 1990, the fans were operated for 720 hours and the flow-weighted average alpha activity concentration was $5.7x10^{-18}$ uCi/ccm. The estimated emissions out of the building vents for the Pilot Plant/Autoclave

ea for that month were:

$$(1.06\times10^{8}\text{ccm*kg U/Uci*hr})*(720\text{ hrs})*(5.7\times10^{-18}\text{uCi/ccm})$$

$$= \underline{4.4\times 10^{-7}\text{ kg U}}$$

3) Engineering Calculation for Emissions from Cooling Tower

As discussed in the body of the report, cooling water comes in contact with various processes, creating the possibility for contamination. Uranium may be emitted from the tower by entrainment with the "drift loss", the small suspended water droplets which form as the water passes through the tower. It is assumed that the uranium concentration in the drift is the same as it is in the rest of the water stream. Manufacturers of cooling towers have developed design dependent drift loss factors: for the mechanical draft towers at the FMPC, the established factor is 0.003 times the flow through the tower.

Beginning in December, 1990, a monthly uranium analysis of the cooling tower discharge stream was scheduled, with records maintained. The only analysis for 1990 indicated 7.2×10^{-7} lb U/gal. The flow through the towers are determined by the pumps handling the water, which are rated at 3,300 gpm. In 1991, a flow integrator will be installed into the system to provide more accurate records of flow through the towers. Interviews with Utility Department staff indicated that average annual flow through the towers was 3,300 gpm for the entire year (525,600 min/year). Thus the emissions from the cooling towers would be:

$$(7.2\times10^{-7}\text{lb U/gal})*(3{,}300\text{ gpm})*(525{,}600\text{ min/yr})*(0.003\text{ loss}) / 2.2\text{ kg/lb}$$

$$= \underline{1.703\text{ kg U/year}}$$

Engineering Calculation for Emissions from Waste Pits.

Annual Emission Calculations for Waste Pits 5 & 6

Ew = 1.7(s/1.5)(d/235)(f/15)

where

Ew = total particulate emissions in lb/acre of storage area/day

s = silt content(%)

d = days less than 0.01 inches of precipitation

f = percent of time wind speed >12 mph at 1 ft (assumed = WS at 10 m)

= Recovered hours with WS>12 mph/Total Hours Recovered

	Pit 5	Pit 6
Total Surface area(sq.ft.)[1]	155,210.000	27,210.000
% exposed (annual average)	9.550	9.120
Silt content (%) [1] {s}	10.000	10.000
Total days recovered [2]	292.000	292.000
"Dry" days {d}	185.000	185.000
Total Hours recovered [2]	6,748.000	6,748.000
hours >12mph	149.000	149.000
Total emissions (lb/acre/day) [Ew]	1.642	1.642
Particulate emissions (lb/yr)	203.901	34.137
U in soil (%)	0.057	9.060
Uranium emissions (lb/yr)	0.116	3.093
Uranium emissions (kg/yr)	0.053	1.406
Total Annual U emission for Waste Pits		1.459

NOTES:

[1] Surface areas for 1990 determined using CAD site plan information on 1/15/91.

[2] Site Meteorological data was used. "Dry day" data was adjusted by a ratio of the number of days per year divided by the number of days of data recovery. e.g. (185/235)*(365/292)

5) Estimated dose due to emission of Radon-220 and Radon-222 decay products

Prior to December 15, 1989, NESHAP Subpart H specifically excluded the dose due to Radon, Thoron, and their respective decay products from being included in the EDE calculation. When the regulation was revised on that date, the definition of EDE was changed to read:

> "...For the purposes of this subpart, doses caused by radon-222 and its respective decay products formed after the radon is released from the facility are not to be included. [emphasis added] {40 CFR 61.91(a)}

This change implies that decay products formed prior to the release of the Radon-222, as well as Thoron and its decay products, should be considered.

WMCO has identified 5 structures storing Thorium-containing materials:

- Warehouse 60
- Warehouse 64
- Warehouse 65
- Warehouse 67
- Warehouse 68

The K-65 silos are known to store radon-generating material. However, the impact of the emissions from these structures is addressed by the provisions of NESHAP, Subpart Q.

Currently, there is no information on the radon/thoron concentration or activity in Warehouse 60. As part of a removal site evaluation (RSE), sampling was conducted in the latter four buildings to determine the total activity in the buildings of the radon and thoron. WMCO assumed that the daughters have achieved a 50% equilibrium with the parent isotope, barring empirical evidence of other conditions; this is consistent with reported USEPA practices. WMCO utilized this assumption, and further assumed that 10% of the daughters were emitted from the building in a year, via normal air exchange processes. There has been no reported operation of any building ventilation fans in these structures, so emissions were assumed to occur at ground level and with no initial velocity. The inputs to the CAP-88 model and their results are provided below.

These results indicate that the contribution to EDE from the Thorium-containing structures is insignificant, in that it will not result in a change in the EDE reported in the FMPC Annual Compliance Demonstration for 1990. Due to the above noted ambiguity in the wording of NESHAP Subpart H, it appears appropriate to provide this information with the Annual Demonstration. It may also be appropriate to address this ambiguity in the MOU being developed between DOE and EPA.

THORIUM WAREHOUSES CONTRIBUTION TO EDE IN 1990

Inputs	Warehouse 64	Warehouse 65	Warehouse 66	Warehouse 68
Radionuclides (uCi/yr)				
Rn-220	1.188	11.64	4.49	1.57
Po-216	0.594	5.82	2.245	0.785
Pb-212	0.594	5.82	2.245	0.785
Bi-212	0.594	5.82	2.245	0.785
Po-212	0.380	3.73	1.437	0.502
Tl-208	0.214	2.09	0.808	0.283
Po-218	0.046	17.845	1.620	1.620
Pb-214	0.046	17.845	1.620	1.620
Bi-214	0.046	17.845	1.620	1.620
Po-214	0.046	17.845	1.620	1.620
Po-210	0.046	17.845	1.620	1.620
Pb-210	0.046	17.845	1.620	1.620
Bi-210	0.046	17.845	1.620	1.620
Source Inputs				
Stack Height	0.0	0.0	0.0	0.0
Inside				
Effluent				
Heat Emission				
Particle Size	1 micron	1 micron	1 micron	1 micron
Met Data	CVG/85-89	CVG/85-89	CVG/85-89	CVG/85-89
Location of Impact	Contribution to EDE (mrem), at the location of the Maximally Exposed Individual previously established by CAP-88 modeling of the related FMPC sources, CVG Met data.			
Figure 2; Residence A	3 x 10-6	1 x 10-3	2 x 10-4	1 x 10-4
Figure 2; Residence B	10 x 10-5	4 x 10-3	2 x 10-4	1 x 10-4

Σ

1.3×5

4.0×5

APPENDIX I

ADDITIONAL INFORMATION REQUESTED BY DEPARTMENT OF ENERGY, NOT REQUIRED FOR NESHAP, SUBPART H COMPLIANCE DEMONSTRATION

A) DOSE EQUIVALENTS (in mrem) TO SELECTED ORGANS & TISSUES, WITH COMPARISON OF 1989 COMPLIANCE DEMONSTRATION RESULTS

Organ/Tissue	Site Met. Data: All Sources 1989//1990	Site Met Data: No Waste Pits	CVG Met Data: All Sources	CVG Met Data: No Waste Pits
Whole-Body	0.0037//0.0002	0.00003	0.0003	0.00004
Lung	34//2	0.3	4	0.3
Endosteum	27//2	0.04	3	0.04
Red Marrow	2.2//0.2	0.003	0.3	0.003

B) ESTIMATED COLLECTIVE EFFECTIVE DOSE EQUIVALENT (in mrem) FOR 1990

Calendar Year	Site Met. / All Sources	Site Met./ Exclude Pits	CVG Met./ All Sources	CVG Met./ exclude Pits
1989	5.2	1.2	Not Calculated	Not Calculated
1990	0.4	0.03	0.6	0.03

C) STATUS OF COMPLIANCE WITH NESHAP EFFLUENT MONITORING REQUIREMENTS

The FMPC has developed and submitted an alternate method proposal to the USEPA - Region V. The proposal calls for continued use of Single Point Continuous Isokinetic Samplers (SPCIS) at locations where they were previously installed and where replacement is not advisable due to safety or economic reasons. Multiple Point Continuous Isokinetic Samplers (MPCIS) will be installed at any newly constructed emission sources. This proposal is being reviewed by the USEPA. No emission sources requiring continuous monitoring are currently operating; USEPA approval of the proposed alternate method will be obtained before any sources of radionuclide air emissions are operated.

D) UNPLANNED RELEASES TO THE ATMOSPHERE AND THE ASSOCIATED DOSE

After a review of the 420 Minor Event Reports (MER) generated in 1990, it was determined that no significant unplanned releases of materials regulated by Subpart H to the atmosphere occurred during 1990.

A general summary of all 420 MERs was reviewed; if there was any

indication that a potential for air emissions could have been associated with the event, the complete MER was then reviewed. This was done for 39 MERs. If the completed MER left any question about the potential for an air release of subpart H regulated radionuclides, persons involved in the event were then contacted to obtain a clearer understanding of the event. Where possible, the Spill Advisory log was reviewed to determine the volume of material lost during an event. Following this review process, the determination was made that no significant amount of Subpart H regulated material was lost to the atmosphere during 1990.

E) SOURCES OF FUGITIVE EMISSIONS

Sources of fugitive emissions at the FMPC include waste pit nos. 5 and 6. Roadways and material storage piles are potential sources of fugitive dust emissions, but due to decontamination practices implemented in previous years, they are not considered sources for fugitive radionuclide emissions at this time.

Emissions estimates from the waste pits are estimated using a USEPA-derived equation for estimating fugitive particulate emissions from hazardous waste sites [Turner, J. H. et al; A Method for Estimating Fugitive Particulate Emissions from Hazardous Waste Sites; EPA/600/2-87-066]. The equation requires information on the silt content of the material in the waste pit, the number of days experiencing less that 0.01 inches of rainfall, and the frequency that the wind speed at 1 foot above the ground exceeds 12 mph. The equation produces a conservative estimate of pounds of particulate emitted per acre per day. The resultant is then used to generate an estimate of pounds of Uranium released/year from each pit, using the following assumptions:

1) Wind speed at 10 meters (height at which the site's meteorological station monitors wind speed and direction) is equal to the wind speed at 1 foot above ground level. This is a conservative estimate, as wind speed generally will increase with height above ground as the drag created by the ground surface is lessened by distance.

2) Uranium content in the entrained dust [emitted particulate] is the same as the content in the material in the pits, as determined by site records of material placed in the pits.

3) Particulate emissions will only be generated from those portions of the waste pits where waste is directly exposed to air. The FMPC attempts to maintain a water cap over the two pits. A special project was completed at the end of 1990 to place all of the waste in Pit 6 underwater. FMPC personnel perform a scheduled surveillance of the waste pits to estimate the surface area of the two pits which is not covered by water. A log of this surveillance, along with photo documentation of the exposed surface area, is maintained. This log was used to develop an estimate of total exposed surface area for the year.

4) The number of days with rainfall under 0.01" was adjusted to

account for data recovery problems. In 1990, the site's meteorological station experienced data recovery of approximately 70%, with the rainfall collection system experiencing a 80 % data recovery. Most of the lost data occurred in the late summer - early fall of 1990. The number of recovered days with less than 0.01" of rainfall was adjusted upward by a factor of the total number of days per year divided by the number of days where data was recovered.

Radionuclide activity in Ci/lb U were developed from core sampling of the waste pits and from process knowledge of the materials placed in the pits. These factors were used to convert the value developed by the fugitive particulate loss equation from lb U/yr to Ci/yr of each radionuclide. This information was then submitted to the Oak Ridge National Laboratories for performance of the CAP88 dispersion/dose calculation modeling. Values determined were:

Source	Total Activity (Ci/year)	Effective Dose Equivalent (EDE)*
Waste Pit 5	0.0004108	0.021 mrem
Waste Pit 6	0.0016807	0.549 mrem

* CAP-88 was run assuming the two waste pits were one area source. The EDE values here were calculated by multiplying the dose due to emissions from the waste pits by the percentage of each pit's contribution to that dose.

F) STATUS OF COMPLIANCE WITH 40 CFR 61 SUBPART Q

Two sources, the K-65 Silos 1 & 2, exist at the FMPC which have been calculated to emit a radon Ci/yr flux estimated to be in excess of 20 pCi/m^2. A preliminary estimate indicates that the flux from Silo 3, the Metal Oxide Silo, is approximately 20 pCi/m^2. Actual measurements of the flux from other potential radon sources (waste pits) are planned for the spring of 1991.

USEPA and DOE have agreed that the 20 pCi/m^2 standard for the two K-65 silos will be attained through implementation of a removal action and a final remedial action consistent with the April 9, 1990 CERCLA Consent Agreement. DOE is currently evaluating the need for a removal action, and is evaluating potential final remedial actions, for Silo 3. CERCLA remedial actions are also being identified for the waste pits.

USEPA Region V and DOE disagree concerning the present applicability of the Subpart Q standard to sources at the FMPC. The DOE position is that the standard does not apply until after completion of final remedial actions under the CERCLA process. The USEPA Region V position is that the standard applied to the FMPC sources as of March 15, 1990 except for the period while a removal action or remedial action is actually taking

place. Discussions between the two agencies to resolve this issue, as well as negotiations to formalize an agreement concerning actions to achieve compliance with the standard, are currently in progress.

G) PROVIDE INFORMATION ON Rn-220 EMISSIONS FROM SOURCES CONTAINING U-232 AND Th-232:

FMPC conducts monitoring for Radon-220 and Radon-222 using "alpha track etch cups". Cups have been placed around the perimeter of the production facility, around the perimeter of the K-65 silos, and inside some of the buildings containing thorium-bearing material. These programs were not designed to provide estimates of emissions of these two radionuclides, and estimating Radon-220 emissions from specific sources using the data is speculative.

WMCO has identified 5 structures storing Thorium-containing materials:

- Warehouse 60
- Warehouse 64
- Warehouse 65
- Warehouse 67
- Warehouse 68

The K-65 silos are known to store radon-generating material. The emissions from these structures is addressed by the provisions of NESHAP, Subpart Q.

An AIRDOS run is being conducted in May, 1991, as part of a Removal Site Evaluation (RSE) on the Thorium warehouses at the FMPC. The study will use estimated emission rates of Radon and Thoron using averaged concentration values for the radionuclides as monitored inside the warehouses (pCi/l). The total activity of the radionuclides in the buildings was estimated by multiplying the concentration by the total volume of the buildings, and assumed that 100% of the radon and thoron is released per day through one air exchange of each building per day. For the catastrophic event (tornado), it was conservatively estimated that 10% of the solids inventory is released. This source term includes:

Thorium-232	Radium -228
Thorium-228	Thorium-230
Uranium-233	

Due to the nature of this release, and the nature of the dose conversion factors used, a separate run for radon and thoron was not required. This AIRDOS modeling was completed on May 24, 1991; the results are still being reviewed.

The K-65 silos are known to store radon-generating material. However, the impact of the emissions from these structures is addressed by the provisions of NESHAP, Subpart Q.

Preliminary results of the AIRDOS run for radon and thoron assumed 100% release per day from each of the thorium warehouses. The nearest offsite receptor at 1625 meters from the center of the buildings receives 2.5×10^{-6} working levels (WL) of radon plus thoron, or 1.3 x

10^{-4} WLM/yr. This is from the source term:

Radon-222	0.15	Ci/yr
Radon-220	0.074	Ci/yr

This is roughly one fifteen thousandth (1/15,000) of the USEPA residential limit of 2 WLM/yr (4 pCi/l radon 222).

Using the risk coefficient from the HEAST, the sum of the Radon-222 plus daughters and the sum of the Radon-220 plus daughters, yields a risk of 1.94×10^{-8}.

This issue is discussed further in Attachment 5 to this report.

H) <u>EMISSIONS OF Rn-222 FROM NON-DISPOSAL/NON-STORAGE SOURCES:</u>

This request was discussed with Mr. Weldon Dillow of the DOE-Oak Ridge office during his visit to the FMPC on March 26, 1991. It appeared that this request was concerned with production-related emissions of Radon-222. Based on this understanding, it was determined that the FMPC had no sources which needed to be addressed by this request.