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DOE FEED MATERIALS PRODUCTION CENTER (FMPC) FERNALD, OHIO 1988 COMPLIANCE WITH 40 CRF 61, SUBPART H, NESHAP FOR RADIONUCLIDES

07/06/89

DOE-1187-89
DOE-FMPC/USEPA
21
REPORT

Department of Energy
Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831—

5267

July 6, 1989
DOE-1187-89

Mr. David Kee, Director
Air and Radiation Division
U. S. Environmental Protection Agency
Region V - 5AR-26
230 South Dearborn Street
Chicago, IL 60604

Dear Mr. Kee:

DOE FEED MATERIALS PRODUCTION CENTER (FMPC) FERNALD, OHIO 1988 COMPLIANCE WITH 40 CFR 61, SUBPART H, NESHAP FOR RADIONUCLIDES

The purpose of this letter is to provide information to demonstrate compliance with NESHAP for radionuclides for 1988 at the FMPC.

Attachment 1 is the report describing the basis and results of the 1988 NESHAP compliance demonstration provided by ORNL from the running of the AIRDOS/DARTAB program using FMPC input data. This report includes the following items, per U. S. EPA guidance:

- A separate analysis for the 1988 accidental release. A release of 0.9 kg of uranium from a chip fire was included as an accidental release for the AIRDOS model even though a review of the event concluded that there was no uranium loss offsite to the atmosphere and/or to the ground. The 0.9 kg loss was based on an inventory difference before and after the chip fire, and was included as a worst-case assumption.

- On-site meteorology was used for the 1988 demonstration. All calibration and quality assurance data for meteorological data is documented and kept on file. Semiannual instrument calibrations were preformed and documented by independent subcontractors during 1988. A software routine supplied with the meteorological monitoring system validates and compiles the data over the course of the year. Data recovery for calendar year 1988 was 90.5% complete.

- The use of a single stack for each plant at the FMPC. In each case, the single stack for each plant was parameterized using EPA's method for selecting a single stack to represent multiple stacks.

Attachment 2 is a copy of the FMPC Air Emissions Annual Report for 1988. This report indicates the estimated calendar year 1988 emission rates in curies per year for 21 radionuclides. Attachment 2 also presents the doses to a maximally exposed individual. Values are listed for the whole body dose, effective dose, dose to the lung, dose to the bone, dose to the liver, and dose to the red marrow for the maximally exposed individual. Please note that values in Attachment 2 are rounded to two significant figures from the computer output data. These values are the final values for reporting purposes. The values in the ORNL report (Attachment 1) are sometimes rounded to one significant figure and sometimes to three significant figures from the computer output data. These values are equivalent to those previously reported to two significant figures.

Attachment 3 provides a description of the methods used to develop emissions estimates for uranium. Uranium emissions along with best estimates of the relative emission of other radionuclides were used to develop input to the AIRDOS/DARTAB computer codes for modeling of off-site dose.

Attachment 4 contains a copy of the AIRDOS/DARTAB computer printouts for the FMPC.

We believe that the 1988 FMPC annual compliance demonstration submitted with this letter fulfills the requirements of previous EPA guidance for compliance demonstrations. However, it is our view that this submittal exceeds the requirements of 40 CFR 61, Subparts A and H. We are providing this extra information in an effort to expedite approval of our 1988 compliance demonstration.

After you have reviewed the enclosed information, we would appreciate a response as to whether we have demonstrated compliance with NESHAP for radionuclides at FMPC for 1988. If you have any questions, please contact Jack Craig, of my staff, at FTS 774-6159.

Sincerely,

Ray Hansen for

James A. Reafsnyder
FMPC Site Manager

DP-84:Craig

Attachments:
1. Report of Results of AIRDOS/DARTAB Modeling by ORNL
2. 1988 Air Emissions Annual Report 40 CFR 61.94
3. Methods used for Estimating Emissions Feed Materials Production Center
4. AIRDOS/DARTAB Computer Printouts

cc w/attachments (1 - 3):

W. D. Dillow, DOE/ORO
M. Wilson, DOE/ORO
B. J. Davis, DOE/ORO
W. J. Neuffer, DOE/ORO
W. A. Weinreich, WMCO
M. J. Galper, WMCO
D. E. Faris, WMCO
T. N. Tucker, LWA/FMPC

ATTACHMENT 1

REPORT OF RESULTS OF

AIRDOS/DARTAB MODELING

BY ORNL

METHODS OF EVALUATION

Characterization of the radiological consequences of radionuclides released to the atmosphere from Feed Materials Production Center (FMPC) operations during 1988 was accomplished by calculating dose equivalents to the maximally exposed off-site individual (Table 1) and to the population residing within 80 km (Table 2). Doses were calculated using a suite of computer codes (Moore et al., 1979; Begovich et al., 1981; Dunning et al., 1980; Sjoreen and Miller, 1984) developed under sponsorship of the EPA for use in demonstrating compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) - Radionuclides (CFR, 1986). The atmospheric transport code, AIRDOS-EPA, calculates concentrations of released radionuclides in air, on the ground, and in foodstuffs (meat, milk, and vegetation). Through the DARTAB computer code, the DCFs in the RADRISK database are applied to the calculated concentrations to give estimates of individual and collective committed dose equivalents from inhalation of an immersion in contaminated air, from exposure to contaminated ground surfaces, and from ingestion of locally grown foodstuffs (milk, meat, and vegetables).

Site specific meteorological data (1988), population distributions, and source terms were used in all calculations. Meteorological data were obtained from the FMPC met tower. The population distribution is based on 1980 census data. 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 one-third of the foodstuffs consumed by the local population was grown locally; the remaining two-thirds was assumed to be imported from outside an 80-km radius of the FMPC. The source term is described elsewhere.

RESULTS OF THE DOSE CALCULATIONS FOR AIRBORNE RELEASES

The maximally exposed off-site individual is located 1337 m west-northwest of the center of the FMPC. The major portion (87%) of this individual's dose is from waste pit emissions (Table 3). During 1988, this individual could have received a whole-body dose of 0.0009 mrem, effective dose of 2.9 mrem, and a maximum organ (lung) dose of 19.5 mrem. These dose equivalents are well below the NESHAP dose limits, 25 mrem to whole body and 75 mrem to any organ, specified in the Clean Air Act for DOE facilities.

The estimated collective committed effective dose equivalent to the approximately 2.6 million persons living within 80 km (50 m) of the FMPC is 59 person-rem.

The primary exposure pathway was found to be inhalation of airborne radionuclides. Two radionuclides, U-234 and U-238, were major contributors to the calculated dose equivalents.

REFERENCES

C. L. Begovich et al., 1981. "DARTAB: A Program to Combine Airborne Radionuclide Environmental Exposure Data with Dosimetric and Health Effects Data to Generate Tabulations of Predicted Health Impacts", ORNL-5692, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

CFR, 1986. Title 40, Part 61, U.S. Government Printing Office, Washington, D.C.

D. E. Dunning, Jr., R. W. Leggett, and M. G. Yalcintas, 1980. "A Combined Methodology for Estimating Dose Rates and Health Effects from Radioactive Pollutants", ORNL/TM-7105, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

ICRP, 1977. "Recommendations of the International Commission on Radiological Protection, Publication 30", Pergamon Press, Oxford.

R. E. Moore et al., 1979. "AIRDOS-EPA: A computerized Methodology for Estimating Environmental Concentration Dose to Man from Airborne Releases of Radionuclides", ORNL-5532, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

A. L. Sjoreen and C. W. Miller, 1984. "PREPAR - A User-Friendly Preprocessor to Create AIRDOS-EPA Input Data Sets", ORNL-5952, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 1. Calculated dose equivalents to the maximally exposed individual[a] due to airborne releases from the FMPC

Source	Dose equivalents (mrem/y)			
	Whole Body[b]	Effective	Bone[c]	Lung
Routine	9.0×10^{-4}	2.9	14.3	19.5
Accident	3.0×10^{-7}	0.6	0.02	4.6

[a]Resides 1337 m west-northwest of the plant center for routine and 976 m east- southeast of plant center for accident.

[b]The whole-body dose includes internal doses from Cs-137.

[c]Endosteal cells of the bone.

Table 2. Calculated collective committed dose equivalents due to airborne releases from the FMPC[a]

Effective dose equivalents (person-rem/y)			
Whole body[b]	Effective[c]	Bone[d]	Lung
6.6×10^{-2}	5.9×10^{1}	1.8×10^{2}	4.3×10^{2}

[a]To approximately 2.6 million persons residing within 80 km of FMPC.

[b]The whole-body dose includes internal doses of Cs-137.

[c]This is the only collective dose equivalent that should be reported.

[d]Endosteal cells of the bone.

Table 3. Effective doses from each facility (1988 airborne releases)

Facility	Effective dose (mrem/y)	
1	0.0004	0.001
2/3	0.013	0.044
2/3 gulping	0.022	0.104
4	0.067	0.16
5	0.012	0.12
6	0.004	0.05
8	0.181	1.14
9	0.003	0.022
Laboratory	0.036	0.194
Pilot plant	0.019	0.102
Cooling towers	0.022	0.093
Waste pits	2.54	0.67
Total	2.9[a]	2.7[b]

[a]Maximally exposed individual at 1337 m west-northwest of plant center.

[b]Second-highest individual dose at 976 m east-southeast of plant center.

ADDITIONAL AIRDOS/DARTAB MODELING OF CY 1988 RADIONUCLIDE RELEASES FROM THE FEED MATERIALS PRODUCTION CENTER

Characterization of airborne concentrations and resulting radiation doses due to radionuclide emissions from the FMPC can be accomplished in a variety of ways. This report describes the methods used and the results of such a characterization for radionuclides released to the atmosphere during CY 1988. The methods used in this study are similar to those used in the 1987 FMPC annual report. In this case, the centrally located emission point (stack) for each facility was parameterized using the EPA method for selecting a single stack to represent multiple stacks at a given facility (EPA 1977). This representative stack and the AIRDOS/DARTAB computer codes were used to calculate dose equivalents to the maximally exposed off-site individual and to hypothetical individuals at various locations around the FMPC and to calculate and compare with measured values the concentrations of specific radionuclides at the locations of seven FMPC perimeter air monitoring stations.

The EPA method for selecting a single stack to represent multiple stacks will select as representative a stack that has a relatively high pollutant emission rate and will give the highest ground-level concentrations. This selection process uses the following formula (EPA 1977):

$$K = hVT/Q,$$

where K = selection index (lowest value to be used),
h = stack height (m),
V = exit-gas volume flow rate (m^3/s) = $0.785\ v\ d^2$,
v = exit-gas velocity (m/s),
d = stack diameter (m),
T = exit-gas temperature (K), and
Q = radionuclide release rate (g/s).

Table 4 gives the stack dimensions used for each facility emitting airborne radionuclides. For the waste pits, a ground-level release was assumed.

Table 4. Assumptions for release heights

Source facility	Stack		
	Height (m)	Diameter (m)	Exit velocity m/s
1	12.2	0.46	14.5
2/3 gulping	25.9	0.43	6.3
process	21.9	0.43	14.5
exhausts	19.8	0.30	0.1
4 process	32.0	0.61	7.2
exhausts	30.3	1.24	11.4
5	17.4	0.61	13.3
6	7.6	1.2	14.0
8	16.2	0.31	13.8
9	11.6	0.89	0.1
Laboratory	5.3	0.30	7.5

Table 4 (continued)

Source facility	Stack Height (m)	Diameter (m)	Exit velocity m/s
Pilot plant	15.2	0.30	13.6
Cooling towers	14.9	6.2	7.2
Waste pits	Ground level release, area source of 162.4 m diam		

The dose to the nearest resident from each emitting facility (in the 16 major compass directions) was calculated. Then, the individual receiving the highest dose (total of all facilities) was located. Since the waste pit emissions account for most of the dose, the off-site individual located 651 m west of the pits (1337 m west-northwest of the center of FMPC) is the maximally exposed individual, and that person's dose from other facilities is added to that from the waste pits to give the FMPC total.

For both ground-level and elevated releases, the dose falls off with increasing distance off-site. Tables 5 and 6 give values of atmospheric dilution factors (taken from AIRDOS runs) for off-site distances for elevated (Table 5) and ground-level (Table 6) releases. Only prevailing wind direction values are given. The printouts, of course, contain values for all 16 compass directions.

Table 5. Atmospheric dispersion factors (X/Q) for an elevated release[a] from FMPC

Distance (m)	X/Q (x 10^{-6})[b]
900	4.1
1000	3.6
1100	3.2
1200	2.8
1300	2.5
1400	2.3
1500	2.1
1600	1.9
1700	1.8
1800	1.6
1900	1.5

[a]Stack is 16.2 m high, 0.31 m diameter, and 13.8 m/s velocity (Plant 8 stack which is major contributor to dose from stack releases).

[b]Values for prevailing wind direction

Table 6. Atmospheric dispersion factors for a ground-level release from FMPC

Distance (m)	X/Q (x 10^{-6})[a]
651	14.9
807	10.0
928	7.7
1072	5.9
1229	4.7
1482	3.4
1687	2.8
1867	2.3
1916	2.2

[a]Values for the prevailing wind direction.

Radionuclide concentrations and 50-year committed effective dose equivalents were calculated at the locations of the seven FMPC perimeter air monitoring stations. The calculated and measured dose equivalents are summarized and compared in Table 7. That agreement between calculated and measured values is this close is unusual. Measured concentrations include radionuclides from sources other than 1988 FMPC emissions (e.g., naturally occurring and previously deposited radionuclides resuspended from soil). Usually, modeled doses are higher than measured doses due to conservatism built into models. While effective total-body and lung doses for measured and calculated concentrations are very similar, calculated (model) endosteal bone doses are higher than those estimated from monitored concentrations. This is because the relative mix of radionuclides is different for emitted versus monitored radionuclides. Since models such as AIRDOS are known to be valid only within a factor of two or more, it is probably accidental that doses based on monitored concentrations and calculated concentrations are as close as those given in Table 7.

Finally, individual source terms (uranium and other radionuclides) which vary from facility to facility are given in AIRDOS printouts for each facility.

Table 7. 1988 doses at air monitoring stations

AMS	Dose (mrem/y) Effective total body	Lungs	Endosteal bone
1	2.9	22.5	3.7
	(3.5)[a]	(7.8)	(15.7)
2	3.1	23.4	6.8
	(3.1)	(22.5)	(10.1)
3	4.0	31.9	5.0
	(4.0)	(29.8)	(10.2)
4	1.0	7.3	2.1
	(1.0)	(7.3)	(3.1)
5	1.0	7.7	1.8
	(1.0)	(7.1)	(3.6)
6	1.1	8.5	2.6
	(2.3)	(16.7)	(7.5)
7	0.7	4.9	1.8
	(0.7)	(4.7)	(2.9)
8	5.2	39.4	10.6
9	7.5	59.5	8.3
10	0.5	3.1	2.4
11	0.5	3.4	2.2
12	0.4	2.2	2.3
13	1.1	7.2	5.3
14	0.6	3.6	3.8

[a]Numbers in parentheses calculated with AIRDOS; other numbers calculated from measured concentrations at monitoring stations.

ATTACHMENT 2

Air Emissions Annual Report
40 CFR 61.94
Calendar Year 1988

Air Emissions Annual Report
40 CFR 61.94
Calendar Year 1988

Owner: U. S. Department of Energy

Operations Office: Oak Ridge

Site Address: P. O. Box 398705

Cincinnati, Ohio 45239-8705

Section I
Annual Air Emissions

Radionuclides	Quantity (Ci/yr)
U-234	.0379
U-235	.00208
U-236	.00053
U-238	.0354
Sr-90	.000159
Tc-99	.00517
Ru-106	.00021
Cs-137	.00121
Ba-137m	.00121
Ra-226	.000145
Ra-228	.000026
Th-228	.000229
Th-230	.00291
Th-232	.000159
Th-234	.165
Pa-234m	.0727
Np-237	.000031
Pu-238	.00000969
Pu-239	.0000307
Pu-240	.0000163
Pu-241	.0000921

Air Emissions Annual Report (continued)
40 CFR 61.94
Calendar Year 1988

Section II
Methods for Dose Assessment

Indicate the methods used in addition to AIRDOS-EPA and RADRISK for evaluating doses from the air emissions.

Ambient Air Monitoring and Dose Assessment

Thermoluminescent Dosimetry and Dose Assessment

X Other (Explain) AIRDOS-EPA, DARTAB and RADRISK

Section III
Dose Estimates

External and Uniform Internal Irradiation

EPA Air Emission Standard: 25 mrem/yr

Whole body dose equivalent: 0.00089 mrem/yr, (Effective dose: 2.9 mrem/yr)

Internally-Deposited Radionuclides (All Air Pathways)

EPA Air Emission Standard: 75 mrem/yr

Organ #1	(Pulmonary Tissue):	19	mrem/yr
Organ #2	(Bone):	14	mrem/yr
Organ #3	(Liver):	0.047	mrem/yr
Organ #4	(Red Marrow):	1.2	mrem/yr

Section IV
Source(s) of Additional Information

1. 1988 Effluent and Discharge Report, DOE Form 5821.1
2. Feed Materials Production Center Environmental Monitoring Annual Report for 1988.

ATTACHMENT 3

METHODS USED FOR ESTIMATING EMISSIONS

FEED MATERIALS PRODUCTION CENTER

METHODS USED FOR ESTIMATING EMISSIONS

FEED MATERIALS PRODUCTION CENTER

The methods utilized to estimate emissions from the Feed Materials Production Center (FMPC) for calendar year (CY) 1988 are outlined in this attachment. These methods are consistent with the methods used to develop emissions for Addendum to FMPC-2082, "History of FMPC Radionuclide Discharges", March, 1989. Mass emissions of uranium from FMPC sources are presented in Table 1 of this attachment.

Monitored Dust Collectors

There are currently 59 dust collectors operating at the FMPC which handle uranium dust. During CY1988, all but one of these collectors were equipped with single point particulate samplers. Dust Collector G9N1-1035 was equipped with a multiple point continuous isokinetic sampler. A sampler consists of a pleated paper filter in a cup-shaped holder. Air is drawn through the filter leaving any particulate on the paper. At regular intervals, the filters are destructively analyzed for uranium.

Uranium Gulping

The quantity of uranium emitted from the Plant 2/3 gulping system was estimated based on uranium production records, recent measurements of the uranium content of mists re-entrained from the scrubbing system, combined measurements of mist and particulate emissions that occur when the contents of a denitration pot are gulped, and the collection efficiency expected from the particle control train. This determination method is discussed in detail in FMPC/Sub-019, "Uranium Emissions from Gulping of Uranium Trioxide". The 1988 emissions are those presented in DOE-ORO-897, "Investigation Report on Plant 2/3 Gulping Emission at the Feed Materials Production Center". Emissions are 8.2% UO_3 with a class W lung solubility and 91.8% uranyl nitrate with a class D lung solubility.

Unmonitored Uranium Processes Other Than Gulping

A systematic evaluation was made of all unmonitored process stacks at FMPC. Estimates of radioactive emissions were made by engineering calculations or by actual stack emission measurements.

In general, a detailed analysis was made of the number of operating hours, the number of tons processed, and the probable emissions for each unmonitored process for the year 1987. This information was utilized to estimate an emission factor per ton of uranium processed for each unmonitored process. These emission factors per ton were then utilized together with the plant-by-plant production data to estimate the emissions from the unmonitored processes for CY1988.

Attachment 3 (cont'd)

Uranium Emissions From Building Exhausts

Building ventilation emissions were calculated based on data collected by continuous air monitors located in each plant. Continuous air monitors are located throughout the plants near processes suspected to produce radionuclide emissions. The monitors are used to measure alpha and beta radiation in microcuries per cubic centimeter. In order 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 assumption is reasonable since the plants process large quantities of depleted uranium and lesser amounts of slightly enriched uranium. Data on the uranium concentration in each plant for each month was averaged to provide an annual concentration for 1987.

The total volumetric flow capacity of all the fans in each plant was determined from FMPC records or by estimation based on the size of the exhaust fan. To calculate yearly emissions for each plant, the average annual concentration reported from the plant continuous air monitors was multiplied by: 1) the estimated hours each fan is operated per year; and 2) by 0.1 to account for dilution by building make-up air (since the air concentration in the plants is only measured in the areas of highest suspected concentration, the actual plant average uranium concentration in air is significantly lower than the average calculated from continuous air monitor results).

It was also assumed that emissions from building exhausts would be proportional to production rates. CY1988 emissions levels for each plant were estimated by multiplying its 1987 emission value by a ratio of production in 1988 to 1987.

Uranium Emissions from Laboratory

Estimates were based upon the average number of samples processed per year in each hood, the probable loss per sample and the estimated uranium concentration of the samples.

Fugitive Uranium from Waste Pits

Fugitive dust generated from storage piles can generally be categorized as follows:

1. Load-in of material into the storage area,
2. Wind erosion of the stored material,
3. Vehicle movement in the storage area, and
4. Load-out of material from the storage area.

In the calculation of the fugitive dust emissions from the FMPC waste pits,

Attachment 3 (cont'd)

only the first two categories are judged to contribute significantly to the overall generation of dust emissions. Calculations for vehicle movement are based on wheeled vehicle movement over paved or unpaved roadways. Since the amount of this type of traffic in the waste pits was minimal, this term was not considered. The load-out factor is not applicable since the material has not been removed from the waste pits. No material was loaded into the waste pits during CY1988, so the load-in contribution to fugitive emissions from the waste pits can be neglected.

The basic methodology used in determining the masses of contaminants (uranium) that potentially left the waste pits in 1988 was first to determine a factor for wind erosion for each waste pit. Once this emission factor was determined, the overall mass of material that could become airborne was estimated. Finally, an average contaminant concentration was applied to the overall mass to estimate the mass of contaminant potentially leaving the waste pits.

Computations were performed in accordance with the method recommended by EPA 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, PB87-232203.

Uranium Emissions from Non-Routine Events

The estimate of emissions from non-routine events was based upon review of historical site documents and interviews with plant personnel to determine the types and sequences of events. One non-routine event was identified for CY1988 to be included in annual dose modeling. This event was a uranium chip fire, which occurred on October 4, 1988. Five drums of uranium chips from Plant 6 ingot machining caught fire at 4:37 PM. All but 2 pounds of uranium was recovered. It has been assumed for modeling purposes that the 2 pounds of uranium was emitted to the air as U3O8 with a Y lung solubility.

Other Radionuclides

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. assumptions based on knowledge of processes, age of materials, and equilibrium as appropriate.

The best available emission factors are then multiplied by the uranium emission rate for a specific process to arrive at the radionuclide emission

Attachment 3 (cont'd)

rate. Emissions were assessed for the radionuclides listed below for modeling of off-site dose for CY1988.

Radionuclides Estimated for Calendar Year 1988 Off-site Dose Modeling

Isotopes For Modeling
U-234
U-235
U-236
U-238
Sr-90
Tc-99
Ru-106
Cs-137
Ba-137M
Ra-226
Ra-228
Th-228
Th-230
Th-232
Th-234
Pa-234M
Np-237
Pu-238
Pu-239
Pu-240
Pu-241

Attachment 3

Table 1
Calendar Year 1988 Uranium Emissions

1. CY1988 Monitored Stack Emissions

Plant	Kg Uranium
Plant 1	0.0267
Plant 2/3	0.0114
Plant 4	1.122
Plant 5	1.475
Plant 6	0.239
Plant 8	0.497
Plant 9	0.0329
Pilot Plant	1.639
Lab	0.00153
Total	5.045

2. CY1988 Scrubber Emissions

Plant	Scrubber	Kg Uranium
Plant 2/3	UO3 Gulping	66
Plant 8	Rotary Kiln	11.009
	Oxidation Furnace No. 1	1.859
	Oxidation Furnace No. 2	0
	Box Furnace	2.005
	Primary Calciner	0.77
	Total	81.643

3. CY1988 Uranium Process Emissions

Plant	Source	Kg Uranium
Plant 6	Briqueting	0
	Pickling	0.3
Plant 2/3	NAR	0.3
Util	Cooling Tower	2.9
	Total	3.5

4. CY1988 Uranium Emissions from Building Exhausts

Plant	Kg Uranium
Plant 2/3	0.06
Plant 4	1.08
Plant 5	0.12
Plant 6	0
Plant 8	0.09
Plant 9	0.18
Pilot Plant	0.01
Total	1.54

Attachment 3, Table 1 (cont'd)

5. CY1988 Uranium Emissions From Laboratories

Plant	Kg Uranium
Laboratories	1.9

6. CY1988 Uranium Emissions from Waste Pits

Location	Kg Uranium
Waste Pit 4	0.41
Waste Pit 5	0.44
Waste Pit 6	12.40
Total	13.25

7. CY1988 Accidental Uranium Releases

Event	kg Uranium
Chip Fire 10/4/88	0.9

8. CY1988 Total Site Emissions for Modeling (sum of 1 through 7)

Total FMPC Uranium Emissions = 107.8 kg