7707 G-000-106.65

1995 NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS ANNUAL REPORT FOR THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

06/20/1996

DOE-1026-96
DOE-FN 25
REPORT

USEPA

7707

Department of Energy
Ohio Field Office
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

JUN 2 0 1996
DOE-1026-96

Mr. David A. Kee, Director
c/o Mike Murphy
Air & Radiation Division
U.S. Environmental Protection Agency
Region 5 - A-18J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Dear Mr. Kee:

1995 NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS ANNUAL REPORT FOR THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Enclosed is the Calendar Year 1995 National Emissions Standards for Hazardous Air Pollutants (NESHAP) Annual Report required by 40 CFR 61.94(b), for the Fernald Environmental Management Project (FEMP). Enclosed with the report are the CAP88-PC files used to assess the annual dose.

This report estimates an Effective Dose Equivalent (EDE) to the Maximally Exposed Individual (MEI) using 1995 meteorological data of 0.19 millirem (mrem), as compared to the NESHAP Subpart H standard of 10 mrem.

If you have any questions, please contact Ed Skintik at (513) 648-3151.

Sincerely,

Jack R. Craig
Director

FN:Skintik

Enclosure: As Stated

cc w/enc (annual report only):

P. J. Sturdevant, HC-DOES
T. Tucker, OEPA-Columbus
AR Coordinator, FERMCO, 78

cc w/o enc:

S. Beckman, FERMCO

U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR Part 61)
Calendar Year 1995

Site Name: Fernald Environmental Management Project (FEMP), Fernald, Ohio

Field Office Information:

Office: Fernald Area Office (FN), U. S. Department of Energy
Address: Post Office Box 538705
Mail Stop 45
Cincinnati, Ohio 45253-8705

Contact: Mr. Ed Skintik Phone: (513) 648-3151

Site Information

Operating
Contractor: Fernald Environmental Restoration Management Corp.

Address: 7400 Willey Road
Fernald, Ohio 45030 (Site location)

Post Office Box 538704
Cincinnati, Ohio 45253-8704 (mailing address)

Contact: Kip Klee Phone: (513) 648-5289

SECTION I: FACILITY INFORMATION

A. Site Description

The Fernald Environmental Management Project (FEMP) is located on a 425 hectare (1050 acre) area approximately 27 km (17 miles) northwest of Cincinnati, Ohio. The Production area covers approximately 136 acres (55 hectares) in the center of the FEMP. The facility is sited just north of the small farming community of Fernald, Ohio.

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

The climate is characterized as continental, with average temperatures ranging from approximately 29°F (-1.7°C) in January, to 76°F (24.4°C) in July. Average annual precipitation is approximately 40 inches (102 cm) per year. Prevailing wind flow is from the south-southwest.

For 37 years, the former Feed Materials Production Center (Fernald site) produced uranium metals for the United States Department of Energy (DOE) and its predecessors. On July 10, 1989, uranium metals production was suspended. Management responsibilities of the Fernald site were transferred from the Defense Programs organization to the DOE's Office of Environmental Restoration and Waste Management.

Currently, most activities at the FEMP are conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). These activities include sample analysis, waste characterization, the management, treatment, storage, and disposal of hazardous, mixed, low-level and solid wastes, and the decontamination and cleanup of radioactively contaminated buildings, equipment, soils, and waters. The site also manages thorium wastes, and K-65 silo waste material which contains radium and produces radon gas.

B. Source Descriptions

The majority of the radioactive contamination at the FEMP is due to uranium, uranium compounds, and thorium. Additional contamination comes from the resulting daughter products.

Calendar year 1995 (CY-1995) radionuclide emission sources at the FEMP include:

- Plant 4: Cleanup activities in preparation of the removal of the Plant 4 building;
- Plant 8: Radionuclide releases via entrainment in mists generated during vacuum filtration operations; General Ventilation vents (2 vents), during periods of ventilation fan operation;

- Plant 9: Unplanned fugitive emission release;
- Building 11: Emissions from the laundry facilities resulting from the processing of contaminated clothing used at the FEMP, and from the Respirator Washing Facility located in the building;
- Building 15: Emissions resulting from laboratory operations;
- Building 20: Emissions resulting from laboratory operations, and emissions from the Cooling Water Tower via mist loss (due to dissolved radionuclides in the cooling water);
- Building 53: Emissions resulting from laboratory operations; and.
- Thorium Nitrate: Cementation — Emissions resulting from the Thorium Nitrate Cementation project located Southwest of the Pilot Plant Complex:
- Waste Pits: Portions of Waste Pit No. 5 were exposed during CY-1995 so repairs could be made to the pit liner. No portion of Waste Pit No. 6 was exposed during CY-1995.

SECTION II: AIR EMISSIONS DATA

Tables 1 and 2 provide monitoring status, control equipment information, and the distance and direction to the nearest receptor for the point sources and grouped sources at the FEMP. Tables 3 and 4 list the annual quantities (in Curies) of Point Source and Non-point Source radionuclides likely to contribute to more than 10% of the effective dose equivalent (EDE) from the specific source.

With the exception of the Thorium Nitrate Cementation project, particulate samples were collected from monitored stacks via isokinetic samplers. Due to the high efficiency of the MEPA/HEPA filters, the amount of particulate sample collected from each stack was small. A composite sample for each stack was generated from these filters and analyzed for those radionuclides likely to contribute to more than 10% of the EDE.

For the unmonitored sources, engineering calculations were used to develop radionuclide release estimates. Estimates were made of total uranium emissions. The total uranium emission estimates were used to calculate radionuclide-specific emission rates, using radionuclide-specific activity to mass total uranium values (Ci/kg U) developed from past source sampling activities at the FEMP.

SECTION III: DOSE ASSESSMENT

A. Description of Dose Model

1. Dose Model

The radionuclide dose calculations were performed using the CAP88-PC Version 1.0 computer code. This package contains the AIRDOS-EPA (Mo79) 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 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 DARTAB computer code to calculate radiation doses to man from radionuclides released during the year. The dose calculations use dose conversion factors found in the RADRISK data file provided with the CAP88-PC package.

2. Maximally Exposed Individual

Estimates were made of the EDE from each FEMP source at the locations of forty (40) off-site receptors surrounding the FEMP. The maximally exposed individual (MEI) was determined to be an individual at the receptor location with the highest collective EDE from the point sources.

B. Summary of Input Parameters

Unless otherwise discussed, the input parameter values used were the default values provided with the CAP88-PC computer codes and databases by the EPA.

1. Source Data

Source information was gathered from site records, and is provided in the attached CAP88-PC Synopsis files. All point source emissions occur at or near ambient temperatures; plume rise is momentum dominated. Source to receptor distances were calculated using information from site maps using Ohio State Planar Coordinate System coordinates.

2. Meteorological Data

Meteorological data was obtained from the on-site FEMP meteorological station. The CY-1995 data recovery rate was 97%, considered acceptable for running the CAP88-PC code. Wind speed and direction data were compiled in a Statistical Array (STAR) format and converted using the GETWIND utility provided with the CAP88-PC package. The STAR formatted data is provided in Table 5. Additional site station data includes:

Annual Average Temperature:	51.3°F (10.7°C)
Annual Rainfall:	45.21 in. (114.8 cm)

An estimate for the average mixing height for the FEMP site was obtained from the book *Potential for Urban Air Pollution Throughout the Contiguous United States*, by George Holzworth. This estimate was:

Annual Average Mixing Height: 950 meters

3. Other Input Parameters

The CAP88-PC code provides dose estimates from radionuclides ingested. Beef, milk, and food crop production were 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 default values used were:

Fraction of foodstuffs	Local Area	50-mile radius	Beyond 50 miles
Vegetables &	0.700	0.300	0.00
Meat:	0.442	0.558	0.00
Milk:	0.399	0.601	0.00

C. Compliance Assessment

The results of the CAP88-PC modeling are summarized in Table 6. The estimated CY-1995 dose received by the MEI from point sources was 6.1E-02 mrem (6.1E-04 mSv). This individual was located 1113 meters east-southeast of the center of the FEMP.

These results indicate that, during CY-1995, the FEMP was in compliance with the 10 mrem dose limitation of 40 CFR 61, Subpart H.

SECTION IV: ADDITIONAL INFORMATION

A. Construction/Modifications at the FEMP

No projects were completed in CY-1995 for which the requirements to apply to the EPA for approval to construct or modify were waived due to the provisions of 40 CFR 61.96.

B. Unplanned Releases of Radionuclides

A review of the CY-1995 reports related to the 233 notifications received by the site's release evaluators yielded one occurrence of an unplanned radionuclide release. On 4/3/95 a colored substance was observed coming out of a Zirnlo stack of the West side of Plant 9. An investigation determined that a leak from a broken instrument air line valve blew accumulated dust from an empty tank into the air. Local airborne activity readings were taken, and, based on inquires by the release evaluator, the duration could have lasted for as long as 9 hours. This information was used to estimate a radionuclide release from the stack.

C. Diffuse Sources - Dose assessment

In CY-1995 there were four (4) diffuse emission sources at the FEMP. The four sources are (1) the Plant 4 Demolition (Preparation) activities, (2) the Plant 8 Fugitive emissions, (3) the Plant 9 Zirnlo release, and (4) the estimated emissions from Waste Pit 5 surface exposure. These sources provided an EDE of 1.3E-01 mrem (1.3E-03 mSv) to the MEI.

For the Plant 4 Demolition (Preparation) activities, data from seven ambient air monitoring stations were used to determine the average airborne radionuclide activity due to Plant 4 cleanup operations. This activity, along with the average annual wind speed, duration of the cleanup operations, and an estimated plane of dispersion were used to estimate the amount of Uranium released. It was assumed that all of the activity in the Plant 4 monitors was due only to Uranium.

Plant 8 fugitive emissions were calculated from Plant 8 room area sampler air quality data. Although the activity measured is total alpha, for calculation purposes, this activity was assumed to come entirely from Uranium. The area sampler data was used to determine the percent of the Derived Air Concentration (DAC) value for Uranium. This value was used to estimate an amount of Uranium released for 1995 through the building vents.

The unplanned release from the Zirnlo area of Plant 9, as described above was also a diffuse source of emissions. An estimate of stack flow, using an equation for natural ventilation, was made. Local readings of airborne activities were taken immediately after discovery of the release. This data was used to estimate the total amount of Uranium released.

The estimate of Uranium emissions from the final diffuse source, Waste Pit 5, was made by summing the calculated daily releases of Uranium from the waste pit. Equation 25 from A METHOD FOR ESTIMATING FUGITIVE PARTICULATE EMISSIONS FROM HAZARDOUS WASTE SITES, by James H. Turner, et. al. (EPA/600/2-87/066), was modified to calculate a daily release rate. Emissions were assumed to be zero for days with greater than or equal to 0.01 inches of precipitation. Emissions were also assumed to occur only when wind speeds were greater than 12 mph.

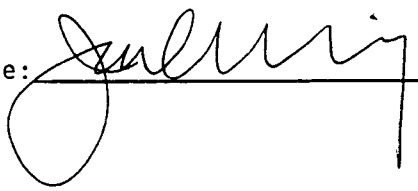
In the cases described above, releases of additional radionuclides were made using radionuclide-specific activity to mass total Uranium values (Ci/kg U) developed from past source sampling activities at the FEMP.

The results of the CAP88-PC modeling for these sources are included in Table 6. The estimated dose received by the MEI from non-point sources was 1.3E-01 mrem (1.3E-3 mSv). The location of this individual was also 1113 meters east-southeast of the center of the FEMP.

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: JACK R CRAIG

Signature:  Date: 6/19/96

LIST OF TABLES

TABLE 1: POINT SOURCES

POINT SOURCE	MONITORED STACK ? (YES/NO)	TYPE CONTROL	CONTROL EFFICIENCY	DISTANCE & DIRECTION FROM SOURCE TO NEAREST RECEPTOR
PLANT 8:				
Oliver Filter	NO	NONE	N/A	969 m WSW
BUILDING 11:				
Laundry Dryer Exhaust	YES	HEPA filter	99.97%	1016 m WSW
Respirator Wash. Facility	NO	HEPA filter	99.97%	1017 m WSW
BUILDING 20:				
Cooling Water Tower	NO	NONE	N/A	924 m N
PILOT PLANT COMPLEX:				
Thorium Nitrate Cementation Project	YES	HEPA filter	99.97%	772 m WSW

TABLE 2: GROUPED SOURCES

GROUPED SOURCES	MONITORED STACK ? (YES/NO)	TYPE OF CONTROL	CONTROL EFFICIENCY	DISTANCE & DIRECTION FROM SOURCE TO NEAREST RECEPTOR
PLANT 8:				
Eimco Filters	NO	NONE	N/A	947 m WSW
BUILDING 15:				
Perchloric Stacks (12)	NO	NONE	N/A	921 m WSW
MEPA/HEPA Exhaust (32)	YES	HEPA filter	99.97%	921 m WSW
General Exhaust (101)	NO	NONE	N/A	921 m WSW
BUILDING 20:				
Water Plant Lab Hoods (2)	NO	NONE	N/A	858 m N
BUILDING 53:				
Industrial Hygiene Lab Hoods (6)	NO	NONE	N/A	929 m ESE
Bio-Assay/Low-Level Lab Hoods (6)	NO	NONE	N/A	939 m ESE

TABLE 3: POINT SOURCE RADIONUCLIDE

POINT SOURCE	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Th-228 (Ci)	Th-230 (Ci)	Th-232 (Ci)	Th-234 (Ci)
PLANT 8:										
Oliver Filter	1.37E-04	7.34E-06	5.01E-06	1.81E-04	1.23E-07	4.91E-07	5.19E-06	3.64E-07	8.15E-07	7.62E-04
Elmco Filters	5.93E-05	3.18E-06	2.17E-06	7.85E-05	5.32E-08	2.13E-07	2.25E-06	1.58E-07	3.54E-07	3.31E-04
BUILDING 11:										
Laundry Dryer Exhaust	2.07E-07	4.175E-08	4.175E-08	8.60E-08	2.76E-15	1.11E-14	3.95E-08	1.32E-07	1.81E-08	N/A
Respirator Wash. Facility	4.79E-06	2.54E-07	1.86E-07	5.36E-06	3.40E-09	1.36E-08	1.44E-07	4.24E-07	2.26E-08	2.12E-05
BUILDING 15:										
Perchloric Stacks (12)	8.66E-05	4.58E-06	3.36E-06	9.67E-05	6.15E-08	2.47E-07	2.60E-06	7.66E-06	4.09E-07	3.83E-04
MEPA/HEPA Exhaust (32)	6.30E-07	5.70E-08	5.70E-08	2.27E-06	9.58E-14	3.84E-13	1.66E-08	9.96E-08	1.73E-08	N/A
General Exhaust (101)	2.96E-06	1.56E-07	1.15E-07	3.30E-06	2.10E-09	8.42E-09	8.88E-08	2.61E-07	1.40E-08	1.31E-05
BUILDING 20:										
Water Plant Lab Hoods (2)	2.84E-09	1.52E-10	1.04E-10	3.75E-09	2.54E-12	1.02E-11	1.08E-10	7.56E-12	1.69E-11	1.58E-08
Cooling Water Tower	4.13E-07	2.21E-08	1.51E-08	5.45E-07	3.70E-10	1.48E-09	1.56E-08	1.10E-09	2.46E-09	2.30E-06
BUILDING 53:										
IH Lab Hoods (2)	7.76E-12	4.11E-13	3.02E-13	8.67E-12	5.51E-15	2.21E-14	2.33E-13	6.86E-13	3.67E-14	3.43E-11
Bio-Assay/Low-Level Lab Hoods (6)	1.64E-08	8.69E-10	6.38E-10	1.83E-08	1.17E-11	4.68E-11	4.93E-10	1.45E-09	7.76E-11	7.25E-08
PILOT PLANT COMPLEX:										
Thorium Nitrate Cementation Project	----	----	----	----	----	3.50E-09	2.05E-10	5.70E-11	2.24E-10	----
TOTALS	2.92E-04	1.56E-05	1.10E-05	3.68E-04	2.44E-07	9.78E-07	1.03E-05	9.10E-06	1.65E-06	1.51E-03

N/A = Analysis not available due to insufficient sample size.

TABLE 4: NON-POINT SOURCE RADIONUCLIDE

NON-POINT SOURCE	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Th-228 (Ci)	Th-230 (Ci)	Th-232 (Ci)	Th-234 (Ci)
PLANT 4: Demolition (Preparation)	1.07E-04	5.64E-06	4.14E-06	1.19E-04	7.57E-08	3.03E-07	3.20E-06	9.42E-06	5.03E-07	4.71E-04
PLANT 8: Fugitive Emissions	4.99E-04	2.68E-05	1.83E-05	6.60E-04	4.47E-07	1.79E-06	1.89E-05	1.33E-06	2.97E-06	2.78E-03
PLANT 9: Zirnlo Release	2.09E-07	1.11E-08	8.12E-09	2.34E-07	1.48E-10	5.95E-10	6.28E-09	1.85E-08	9.87E-10	9.23E-07
WASTE PITS: Waste Pit 5	1.05E-07	4.31E-09	1.08E-08	7.84E-08	6.81E-08	8.39E-09	1.08E-08	1.22E-06	8.39E-09	7.90E-08
TOTALS	6.06E-04	3.25E-05	2.25E-05	7.79E-04	5.91E-07	2.10E-06	2.21E-05	1.20E-05	3.48E-06	3.25E-03

NOTE: To convert from Curies to Becquerels, use 1 Ci = 3.7 x 10^{10} Bq

TABLE 5: CY-1995 STAR FORMAT METEOROLOGICAL FILE

```
  N A 0.000240.000000.000590.000240.000000.00000
NNE A 0.000000.000000.000000.000000.000000.00000
 NE A 0.000120.000000.000240.000000.000000.00000
ENE A 0.000000.000000.000240.000000.000000.00000
  E A 0.000120.000000.000000.000000.000000.00000
ESE A 0.000000.000000.000000.000000.000000.00000
 SE A 0.000000.000000.000000.000000.000000.00000
SSE A 0.000000.000000.000000.000000.000000.00000
  S A 0.000000.000000.000710.000000.000000.00000
SSW A 0.000000.001180.001530.000240.000000.00000
 SW A 0.000000.000350.001290.000120.000000.00000
WSW A 0.000000.000710.002940.001290.000000.00000
  W A 0.000240.000710.002590.000240.000000.00000
WNW A 0.000000.000000.000940.000710.000000.00000
 NW A 0.000000.000000.000120.000350.000000.00000
NNW A 0.000000.000120.000240.000000.000000.00000
  N B 0.000000.000240.001530.000000.000000.00000
NNE B 0.000000.000240.001060.000000.000000.00000
 NE B 0.000120.001060.001180.000000.000000.00000
ENE B 0.000000.000940.000820.000000.000000.00000
  E B 0.000000.000470.000350.000000.000000.00000
ESE B 0.000000.000120.000120.000000.000000.00000
 SE B 0.000000.000240.000120.000000.000000.00000
SSE B 0.000000.000120.000590.000000.000000.00000
  S B 0.000120.000820.003530.000240.000000.00000
SSW B 0.000120.001760.004000.000000.000000.00000
 SW B 0.000000.001530.001410.000120.000000.00000
WSW B 0.000000.001530.002350.000350.000000.00000
  W B 0.000000.002700.002590.000000.000000.00000
WNW B 0.000000.000470.002820.000240.000000.00000
 NW B 0.000000.000710.001410.000120.000000.00000
NNW B 0.000000.000000.001760.000470.000000.00000
  N C 0.000120.001410.002590.000000.000000.00000
NNE C 0.000240.001180.001290.000240.000000.00000
 NE C 0.000000.002820.001530.000120.000000.00000
ENE C 0.000590.004000.002230.000000.000000.00000
  E C 0.000590.003290.000710.000000.000000.00000
ESE C 0.000350.001180.000000.000000.000000.00000
 SE C 0.000120.001530.000350.000000.000000.00000
SSE C 0.000350.001180.000710.000120.000000.00000
  S C 0.000120.001290.002940.000240.000000.00000
SSW C 0.000350.002700.003410.000120.000000.00000
 SW C 0.000240.002700.001410.000470.000000.00000
WSW C 0.000470.004700.001880.000590.000000.00000
  W C 0.000350.002820.002470.000120.000000.00000
WNW C 0.000350.002120.002820.000820.000000.00000
 NW C 0.000120.002470.002230.000000.000000.00000
NNW C 0.000470.002940.001530.000240.000000.00000
  N D 0.001650.008810.006930.000710.000000.00000
NNE D 0.002820.008460.004000.000470.000000.00000
 NE D 0.002000.015280.004470.001060.000000.00000
ENE D 0.004350.020920.006110.001060.000000.00000
  E D 0.004230.005410.000820.000120.000000.00000
ESE D 0.002120.003170.000240.000000.000000.00000
 SE D 0.001880.004700.001060.000120.000000.00000
SSE D 0.001650.004350.001530.000350.000000.00000
  S D 0.003060.007400.008580.001530.000000.00000
SSW D 0.004470.010220.009280.002590.000000.00000
 SW D 0.007050.018570.006930.000820.000000.00000
WSW D 0.005050.014340.012100.000940.000000.00000
  W D 0.007640.017510.010690.001410.000000.00000
WNW D 0.002820.013750.011630.003170.000000.00000
 NW D 0.003760.010460.006460.000350.000000.00000
NNW D 0.002590.010460.004580.001290.000000.00000
  N E 0.001760.003060.000820.000120.000000.00000
NNE E 0.001760.002230.000820.000590.000000.00000
 NE E 0.003060.004820.000710.001060.000000.00000
ENE E 0.006580.009400.000940.000000.000000.00000
  E E 0.006110.003410.000240.000000.000000.00000
ESE E 0.003530.001060.000000.000000.000000.00000
 SE E 0.003530.002590.000470.000000.000000.00000
SSE E 0.003760.005050.001410.000590.000000.00000
  S E 0.003760.010220.006930.001410.000000.00000
SSW E 0.006460.009170.004820.001060.000000.00000
 SW E 0.011160.013040.002700.000470.000000.00000
WSW E 0.009400.006460.001760.000120.000000.00000
  W E 0.007520.007170.001410.000000.000000.00000
WNW E 0.005640.005520.002820.000120.000000.00000
 NW E 0.007400.002940.000350.000120.000000.00000
NNW E 0.003060.003530.000350.000000.000000.00000
  N F 0.002120.000940.000000.000000.000000.00000
NNE F 0.001650.000470.000240.000240.000000.00000
 NE F 0.001880.001760.001290.000240.000000.00000
ENE F 0.004470.001410.000820.000000.000000.00000
  E F 0.005760.000820.000120.000000.000000.00000
ESE F 0.003760.000350.000120.000000.000000.00000
 SE F 0.003290.000240.000000.000000.000000.00000
SSE F 0.003530.001180.000120.000000.000000.00000
  S F 0.004820.001530.000240.000000.000000.00000
SSW F 0.006230.001060.000350.000000.000000.00000
 SW F 0.008460.002120.000000.000000.000000.00000
WSW F 0.008700.002350.000000.000000.000000.00000
  W F 0.008340.000820.000000.000000.000000.00000
WNW F 0.007050.000590.000000.000000.000000.00000
 NW F 0.005410.000470.000000.000000.000000.00000
NNW F 0.004230.001180.000000.000350.000000.00000
  N G 0.007170.000820.000000.000000.000000.00000
NNE G 0.004700.000120.000240.000120.000000.00000
 NE G 0.004700.000350.000820.000000.000000.00000
ENE G 0.006930.000710.000470.000000.000000.00000
  E G 0.010580.000240.000000.000000.000000.00000
ESE G 0.008110.000000.000000.000000.000000.00000
 SE G 0.005050.000000.000000.000000.000000.00000
SSE G 0.005050.000470.000000.000000.000000.00000
  S G 0.008230.000470.000000.000000.000000.00000
SSW G 0.014570.000710.000000.000000.000000.00000
 SW G 0.018680.000470.000000.000000.000000.00000
WSW G 0.022560.000120.000000.000000.000000.00000
  W G 0.027970.000470.000000.000000.000000.00000
WNW G 0.027970.000240.000000.000000.000000.00000
 NW G 0.023970.000350.000000.000000.000000.00000
NNW G 0.012930.000940.000000.000000.000000.00000
```

TABLE 6: SUMMARY OF CAP88-PC RESULTS

CUMULATIVE DOSE

SOURCES> RECEPTORS	PLANT 4 (Prep)	PLANT 8 Oliver	PLANT 8 Elmcos	PLANT 8 Fugitive	PLANT 9 Zirnlo	BLDG. 11 Laundry	BLDG. 11 RWF	BLDG. 15 Perc	BLDG. 15 HEPA	BLDG. 15 Gen.	BLDG 20 Wtr Plt	BLDG 20 CWT	BLDG 53 IH labs	BLDG 53 Bio labs	WASTE Plt 5	Th Nitrate Cementation	POINT SOURCES	DIFFUSE SOURCES	ALL SOURCES
R1	3.4E-02	1.5E-02	6.5E-03	3.9E-02	5.9E-05	5.7E-05	9.4E-04	1.4E-02	1.5E-04	3.4E-04	6.0E-07	1.8E-05	8.6E-10	1.9E-06	9.5E-04	1.7E-07	3.7E-02	7.4E-02	1.1E-01
R2	3.5E-02	1.6E-02	6.8E-03	4.1E-02	3.8E-05	5.9E-05	9.7E-04	1.5E-02	1.5E-04	3.5E-04	6.2E-07	1.8E-05	8.7E-10	1.9E-06	1.3E-03	1.3E-07	3.9E-02	7.7E-02	1.2E-01
R3	8.8E-03	5.9E-03	2.6E-03	1.5E-02	1.6E-05	2.3E-05	3.0E-04	6.1E-03	5.8E-05	1.3E-04	1.6E-07	4.0E-06	3.0E-10	6.8E-07	1.8E-04	5.8E-08	1.5E-02	2.4E-02	3.9E-02
R4	1.5E-02	6.1E-03	2.7E-03	1.4E-02	2.4E-05	2.2E-05	3.7E-04	6.7E-03	5.5E-05	1.3E-04	2.0E-07	3.0E-06	3.5E-10	8.0E-07	4.1E-04	6.1E-08	1.6E-02	2.9E-02	4.6E-02
R5	2.0E-02	7.7E-03	3.4E-03	1.6E-02	2.8E-05	2.8E-05	4.8E-04	9.8E-03	5.7E-05	1.2E-04	2.2E-07	3.2E-06	4.4E-10	1.0E-06	1.1E-03	7.7E-08	2.2E-02	3.7E-02	5.9E-02
R6	3.5E-02	2.6E-02	1.2E-02	6.6E-02	4.5E-05	1.1E-04	1.7E-03	2.6E-02	2.9E-04	6.3E-04	5.0E-07	1.6E-05	9.7E-10	2.2E-06	2.2E-04	3.2E-07	6.7E-02	1.0E-01	1.7E-01
R7	1.9E-02	1.3E-02	5.9E-03	3.8E-02	2.5E-05	6.3E-05	1.0E-03	1.5E-02	1.8E-04	3.9E-04	2.6E-07	1.1E-05	7.6E-10	1.6E-06	1.6E-04	1.8E-07	3.6E-02	5.7E-02	9.3E-02
R8	1.8E-02	8.6E-03	3.8E-03	2.4E-02	2.4E-05	6.0E-05	9.7E-04	1.5E-02	1.7E-04	3.7E-04	1.8E-07	7.6E-06	7.4E-10	1.6E-06	1.3E-04	1.1E-07	2.9E-02	4.2E-02	7.1E-02
R9	1.4E-02	8.2E-03	3.6E-03	2.3E-02	2.4E-05	5.8E-05	9.4E-04	1.0E-02	1.1E-04	2.5E-04	1.7E-07	7.5E-06	7.2E-10	1.5E-06	1.2E-04	1.0E-07	2.3E-02	3.7E-02	6.0E-02
R10	1.2E-02	7.2E-03	3.2E-03	2.0E-02	1.8E-05	3.4E-05	5.5E-04	9.2E-03	9.7E-05	2.2E-04	1.6E-07	6.9E-06	6.6E-10	1.0E-06	9.6E-05	9.1E-08	2.1E-02	3.2E-02	5.3E-02
R11	1.3E-02	7.2E-03	3.2E-03	2.1E-02	1.8E-05	3.4E-05	5.6E-04	9.2E-03	9.8E-05	2.2E-04	1.6E-07	7.0E-06	4.8E-10	1.0E-06	9.4E-05	9.1E-08	2.1E-02	3.4E-02	5.5E-02
R12	1.7E-02	7.5E-03	3.3E-03	2.0E-02	1.8E-05	3.4E-05	5.8E-04	1.1E-02	9.2E-05	2.1E-04	1.8E-07	6.9E-06	5.0E-10	1.1E-06	8.4E-05	9.5E-08	2.3E-02	3.7E-02	6.0E-02
R13	1.9E-02	8.0E-03	3.5E-03	2.1E-02	2.7E-05	3.8E-05	6.3E-04	1.1E-02	9.9E-05	2.3E-04	1.9E-07	7.4E-06	6.0E-10	1.3E-06	1.4E-04	1.4E-07	2.4E-02	4.0E-02	6.4E-02
R14	2.0E-02	1.2E-02	5.1E-03	2.9E-02	2.7E-05	3.8E-05	6.3E-04	1.7E-02	1.3E-04	2.9E-04	1.9E-07	7.4E-06	6.1E-10	1.3E-06	1.3E-04	1.4E-07	3.5E-02	4.9E-02	8.4E-02
R15	1.8E-02	7.8E-03	3.4E-03	1.9E-02	3.0E-05	3.7E-05	6.4E-04	1.2E-02	8.2E-05	1.8E-04	2.4E-07	6.3E-06	6.4E-10	1.4E-06	7.8E-05	1.0E-07	2.4E-02	3.7E-02	6.1E-02
R16	5.0E-02	1.4E-02	5.9E-03	3.2E-02	4.6E-05	6.1E-05	1.0E-03	2.3E-02	1.4E-04	3.0E-04	2.9E-07	8.2E-06	1.2E-09	2.6E-06	1.8E-04	1.7E-07	4.4E-02	8.2E-02	1.3E-01
R17	8.1E-02	1.8E-02	7.8E-03	4.3E-02	1.0E-04	8.1E-05	1.4E-03	2.8E-02	1.8E-04	4.2E-04	4.6E-07	1.6E-05	1.6E-09	3.5E-06	2.7E-04	2.4E-07	5.6E-02	1.2E-01	1.8E-01
R18	8.2E-02	1.8E-02	7.8E-03	4.3E-02	1.2E-04	1.1E-04	1.8E-03	3.2E-02	2.5E-04	5.6E-04	5.8E-07	1.7E-05	2.1E-09	4.8E-06	2.7E-04	2.4E-07	6.1E-02	1.3E-01	1.9E-01
R19	4.4E-02	1.8E-02	7.0E-03	4.6E-02	8.9E-05	7.3E-05	1.2E-03	2.0E-02	1.6E-04	4.1E-04	5.6E-07	1.5E-05	1.3E-09	2.9E-06	2.3E-04	1.6E-07	4.7E-02	9.0E-02	1.4E-01
R20	4.3E-02	1.8E-02	8.0E-03	4.8E-02	6.5E-05	5.4E-05	9.2E-04	2.0E-02	1.8E-04	4.1E-04	6.6E-07	1.8E-05	9.2E-10	2.1E-06	3.1E-04	1.7E-07	4.8E-02	9.1E-02	1.4E-01
R21	5.2E-02	1.8E-02	8.0E-03	4.8E-02	6.3E-05	7.2E-05	1.2E-03	2.0E-02	1.8E-04	4.1E-04	7.5E-07	2.1E-05	8.8E-10	1.9E-06	6.8E-04	1.6E-07	4.8E-02	1.0E-01	1.5E-01
R22	1.5E-02	1.1E-02	5.0E-03	3.1E-02	2.6E-05	4.4E-05	7.4E-04	1.2E-02	1.2E-04	2.7E-04	2.7E-07	6.6E-06	4.4E-10	9.8E-07	6.1E-04	1.0E-07	2.9E-02	4.7E-02	7.6E-02
R23	1.4E-02	4.8E-03	2.1E-03	1.0E-02	2.3E-05	1.8E-05	3.3E-04	6.4E-03	3.9E-05	8.3E-05	2.4E-07	5.0E-06	3.3E-10	7.6E-07	2.1E-04	5.8E-08	1.4E-02	2.4E-02	3.8E-02
R24	4.1E-02	1.5E-02	6.4E-03	3.4E-02	8.0E-05	6.3E-05	1.1E-03	2.2E-02	1.4E-04	3.1E-04	4.3E-07	1.2E-05	1.2E-09	2.8E-06	1.6E-04	1.7E-07	4.5E-02	7.5E-02	1.2E-01
R25	2.1E-02	1.1E-02	4.9E-03	2.4E-02	5.2E-05	4.6E-05	8.0E-04	1.3E-02	9.8E-05	2.2E-04	4.1E-07	1.1E-05	8.8E-10	2.0E-06	1.2E-04	1.1E-07	3.0E-02	4.5E-02	7.5E-02
R26	1.1E-02	7.1E-03	3.2E-03	1.6E-02	1.9E-05	2.8E-05	4.9E-04	8.5E-03	6.5E-05	1.4E-04	2.2E-07	9.2E-06	4.7E-10	1.1E-06	1.2E-04	8.2E-08	2.0E-02	2.7E-02	4.7E-02
R27	2.2E-02	9.1E-03	4.0E-03	1.8E-02	4.0E-05	4.0E-05	7.2E-04	1.4E-02	7.3E-05	1.7E-04	3.1E-07	6.1E-06	7.9E-10	1.9E-06	8.9E-05	1.2E-07	2.8E-02	4.0E-02	6.8E-02
R28	1.3E-02	6.9E-03	4.7E-03	1.8E-02	2.4E-05	2.7E-05	4.6E-04	1.1E-02	1.1E-04	2.5E-04	2.4E-07	6.4E-06	4.2E-10	9.2E-07	3.7E-04	9.7E-08	2.3E-02	3.1E-02	5.5E-02
R29	4.6E-02	1.3E-02	5.5E-03	2.9E-02	4.4E-05	5.6E-05	9.7E-04	2.2E-02	1.2E-04	2.8E-04	4.0E-07	8.5E-06	1.1E-09	2.5E-06	1.6E-04	1.6E-07	4.2E-02	7.5E-02	1.2E-01
R30	2.9E-02	1.3E-02	5.6E-03	2.6E-02	6.2E-05	5.0E-05	8.9E-04	1.5E-02	1.1E-04	2.5E-04	4.5E-07	1.2E-05	9.7E-10	2.2E-06	1.4E-04	1.2E-07	3.5E-02	5.5E-02	9.0E-02
R31	2.8E-02	1.2E-02	5.2E-03	2.7E-02	5.9E-05	4.9E-05	8.6E-04	1.5E-02	1.1E-04	2.4E-04	4.4E-07	1.2E-05	9.5E-10	2.2E-06	1.3E-04	1.2E-07	3.3E-02	5.5E-02	8.9E-02
R32	1.2E-02	6.6E-03	2.9E-03	1.7E-02	2.2E-05	2.6E-05	4.4E-04	6.8E-03	6.4E-05	1.4E-04	2.3E-07	6.2E-06	4.0E-10	8.9E-07	3.4E-04	9.4E-08	1.7E-02	2.9E-02	4.6E-02
R-A	1.1E-02	7.0E-03	3.1E-03	1.6E-02	1.8E-05	2.7E-05	4.8E-04	8.2E-03	6.3E-05	1.4E-04	2.1E-07	4.4E-06	4.6E-10	1.0E-06	1.2E-04	7.9E-08	1.9E-02	2.7E-02	4.6E-02
R-B	1.1E-02	5.9E-03	2.6E-03	1.4E-02	2.3E-05	2.1E-05	3.6E-04	6.4E-03	5.2E-05	1.2E-04	1.9E-07	2.8E-06	3.4E-10	7.7E-07	3.8E-04	5.8E-08	1.5E-02	2.5E-02	4.1E-02
R-C	8.6E-03	4.8E-03	2.1E-03	1.1E-02	1.5E-05	1.7E-05	3.0E-04	6.0E-03	5.9E-05	1.3E-04	1.5E-07	3.9E-06	2.9E-10	6.7E-07	1.9E-04	5.7E-08	1.3E-02	2.0E-02	3.3E-02
R-D	7.9E-03	4.6E-03	2.0E-03	1.1E-02	1.4E-05	1.6E-05	2.9E-04	4.9E-03	4.1E-05	9.3E-05	1.5E-07	3.8E-06	2.8E-10	6.4E-07	1.4E-04	5.5E-08	1.2E-02	1.9E-02	3.1E-02
R-E	8.2E-03	4.7E-03	2.1E-03	1.1E-02	1.5E-05	1.7E-05	2.9E-04	5.1E-03	4.2E-05	9.5E-05	1.5E-07	3.8E-06	2.9E-10	6.6E-07	1.5E-04	5.6E-08	1.2E-02	1.9E-02	3.2E-02
R-F	1.4E-02	1.1E-02	5.0E-03	3.1E-02	2.2E-05	5.0E-05	8.1E-04	1.2E-02	1.4E-04	3.2E-04	1.7E-07	7.5E-06	6.8E-10	1.5E-06	8.3E-05	1.3E-07	2.9E-02	4.5E-02	7.4E-02
R-G	1.4E-02	1.1E-02	4.9E-03	3.1E-02	2.2E-05	4.9E-05	8.0E-04	1.2E-02	1.4E-04	3.1E-04	1.6E-07	7.4E-06	6.7E-10	1.4E-06	8.1E-05	1.2E-07	2.9E-02	4.5E-02	7.4E-02
R-H	2.9E-02	1.2E-02	5.3E-03	3.1E-02	5.8E-05	5.0E-05	8.6E-04	1.4E-02	1.2E-04	2.8E-04	6.1E-07	1.8E-05	8.6E-10	1.9E-06	2.8E-04	1.6E-07	3.3E-02	6.0E-02	9.3E-02
Totals =	1.0E+00	4.3E-01	1.9E-01	1.1E+00	1.5E-03	1.8E-03	3.1E-02	5.4E-01	4.6E-03	1.0E-02	1.3E-05	3.7E-04	2.9E-08	6.5E-05	1.1E-02	4.9E-06			
Maximum =	8.2E-02	2.6E-02	1.2E-02	6.6E-02	1.2E-04	1.1E-04	1.8E-03	3.2E-02	2.9E-04	6.3E-04	7.5E-07	2.1E-05	2.1E-09	4.6E-06	1.3E-03	3.2E-07	6.7E-02	1.3E-01	1.9E-01

2022