144898
m·600

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for Maywood, New Jersey

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831— 8723

August 5, 1996

Ms. Angela Carpenter
U.S. Environmental Protection Agency
Region II
290 Broadway, 18th Floor.,
New York, New York 10007-1866

Dear Ms. Carpenter:

MAYWOOD SITE - CALCULATION RESULTS FOR NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPs)

Enclosed for your information are the results of the radionuclide emission calculation performed for material handling from opening the storage pile at the Maywood Interim Storage Site (MISS) and removing the remaining 18,400 cubic yards of soil.

This calculation estimates the inhalation dose from airborne radioactivity emission generated by opening the storage pile and transferring the material to shipping containers. The total calculated dose is 0.002 mrem to the nearest resident and offsite workers whoare assumed to be present, at all times, 100 meters from these activities.

The calculation represents a maximum exposure scenario in terms of soil volume and duration of activities. The calculation does not assume the application of engineering controls. Actual radionuclide concentration and duration of activities is anticipated to be much less. Continuous air samplers will be employed at perimeter locations during activities and engineering controls, such as dust suppression and erosion control will be in effect. These measures will be taken to ensure the exposure from air particulates is minimized and that the 10 mrem annual dose is not exceeded.

If you have any questions or need further information, please contact me at (423) 576-5724.

Sincerely,

Susan M. Cange, Site Manger
Former Sites Restoration Division

Enclosure

cc: Paul Giardina, EPA II
    Nick Marton, NJDEP

CALCULATION COVER SHEET

Project   FUSRAP - MISS

Job No.   14501

Discipline   Environmental Technology   Calc. No.   138-CV-077

Subject   18400 yd3 Soil Removal Air Dose

Computer Program   None   Program No.   N/A

Committed Calculation   X   Preliminary __ Superseded __

Rev.	Sheets	Originator	Checker	Reviewer	Approval	Date
0	12	β 27-Jun-96 Carl Eric von Buelow	Andrea George 6/28/96	V. Jzyka 7/2/96	_(signature)_	7/3/96

Summary of Revision

Microfilmed:	Rev	Date	Spool Number	Rev	Date	Spool Number

Logged / SN

PURPOSE

This calculation estimates the inhalation dose from airborne radioactivity releases at the Maywood Interim Storage Site (MISS) generated by material handling from opening the storage pile and removing the remaining 18,400 cubic yards of soil.

SCOPE

This calculation uses the U.S. Environmental Protection Agency's (EPA) air pollution emission factor methodology to estimate radioactivity releases and inputs them to the Clean Air Act Assessment Package - 1988- Personal Computer (CAP88-PC) model to estimate air dose to the hypothetical maximally exposed individual.

REFERENCES

Bechtel National, Inc. (BNI), 1991. *Characterization Report for the Interim Storage Pile at the Maywood Interim Storage Site*, DOE/OR/21949-296, Oak Ridge, TN (October).

Bechtel National, Inc. (BNI), 1995. "Natural Uranium Specific Activity," 14501-191-CV-005 rev 2, Oak Ridge, TN.

Controls for Environmental Pollution, Inc. (CEP), 1994. "Geotechnical Analysis of MISS Pile Soil," 14501-191-TSC-3906, Sante Fe, NM.

Environmental Protection Agency (EPA), 1993. *Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites*, EPA-451/R-93/004, Office of Air Quality Planning and Standards, Research Triangle Park, NC (April).

MathSoft Inc., 1995. *User's Guide for Mathcad ver 6.0*, Cambridge, MA (September).

National Oceanic and Atmospheric Administration (NOAA), 1995. *Preliminary Local Climatological Data for Newark, NJ*, National Climatic Data Center, Asheville, NC.

Shleien, B., 1992. *The Health Physics and Radiological Health Handbook, Revised Edition*, Scinta Inc., Silver Spring, MD.

ASSUMPTIONS

The planned operation for 1996 will transfer approximately 18,400 cubic yards of soil from an opening in the storage pile not exceeding 1000 square feet and only during working hours (i.e., 10 hours per day, 4 days per week). The operation will take approximately 14 weeks.

The maximally exposed individual is based on site knowledge of the nearest resident and offsite worker (see attached figure). The nearest residents and offsite workers are approximately 100 meters in an arc from northwest to northeast.

All numbers in this calculation are carried forward with a precision of 15 decimal digits and all conversions made using the factors preceding each equation (MathSoft 1995).

Daughters in the decay chains of radionuclides are considered to be in secular equilibrium with their parents until a radionuclide in the chain is encountered with a measured concentration, in which case the measured concentration is used. Radium daughters are not included since the immediate daughter of Radium is Radon, a gas, which is not applicable to the analysis of particulate behavior.

The assumptions for the CAP88-PC model are documented in the user's guide (EPA 1992).

CALCULATIONS

CAP88-PC Computer Program

The CAP88-PC model is a set of computer programs, databases, and associated utility programs that estimate the dose and risk from airborne radioactivity emissions. The EPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) compliance procedures for airborne radioactivity emissions at Department of Energy (DOE) facilities (40 CFR 61.93a) require the use of the CAP88-PC model, or other approved procedures, to calculate effective dose equivalents to members of the public. CAP88-PC is a Bechtel Standard Application Program (BSAP) number EV101. A detailed description of CAP88-PC is provided in the user's guide (EPA 1992).

Computer Hardware Configuration

The CAP88-PC program was run on a COMPAQ ProLinea 4/50 (serial number A450HKC9D093), which is a 486DX2 microcomputer running at 66 MHz using MS-DOS ver 6.20/Windows ver 3.11 and networked through a Digital Equipment Corporation (DEC) VAX using PCSA/Pathworks for print and file services.

Input

The input parameters are listed in the attached "Synopsis Report." Input includes nearest resident and offsite worker (assumption), weather (NOAA 1995), and emission data calculated below.

Output

Selected pages from the CAP88-PC output are in the attached "Synopsis" and "Summary" reports. The hypothetical maximally exposed individual results are taken from the "Summary Report" for the distance and direction to the nearest resident and offsite worker with the appropriate occupancy factors applied (assumption).

Test Problem

Prior to running this calculation, a test run was successfully completed using the Reactive Metals data set described in the CAP88-PC user's guide (EPA 1992).

Pile Opening Wind Erosion

The average silt content (s) given as the percent of the soil particles that would pass through a 200 mesh (0.075 mm) screen (CEP 1994) is:

$$s := 22.1 \cdot \%$$

The number of days (p) with over 0.01 inches of precipitation per year (NOAA 1995) is:

$$p := 115$$

The fraction of time (f) that the unobstructed wind speed exceeds 5.4 meters per second (13.8 knots) is derived from the wind speed observations at 3-hour intervals (NOAA 1995). Dividing the number of intervals with wind speeds exceeding 13.8 knots by the total number of intervals in a year, the fraction is:

$$f := \frac{321}{2920} \qquad\qquad f = 0.110$$

ORG:Carl von Buelow 06/27/96   CALC:14501-138-CV-077rev0   CHK: _MKG 6/28/96_

The total suspended particulate (TSP) emission factor (F_w) for wind erosion of continuously active piles (EPA 1993 Equation 9 Page 8) is:

$$F_w := \left(1.9 \cdot \frac{gm}{m^2 \cdot day}\right) \cdot \left(\frac{s}{15 \cdot \%}\right) \cdot \frac{(365 - p)}{235} \cdot \left(\frac{f}{15}\right) \qquad F_w = 0.022 \cdot \frac{gm}{m^2 \cdot day}$$

The fraction of TSP (f_{10}) that is less than 10 microns (EPA 1993 Page 8) is:

$$f_{10} := 0.5$$

The area (A) of the pile opening (assumption) is:

conversion factor: $1 \cdot m^2 = 10.763910416709720 \cdot ft^2$

$A := 1000 \cdot ft^2$ $A = 92.903040 \cdot m^2$

The time (T) that the pile opening is exposed to the wind (assumption) is:

conversion factor: $1 \cdot day = 24 \cdot hr$

$T := 10 \cdot \frac{hr}{day} \cdot 4 \cdot \frac{day}{wk} \cdot 14 \cdot wk$ $T = 23.333 \cdot day$

The emission (E_w) from wind erosion of the pile opening is thus:

$E_w := f_{10} \cdot F_w \cdot A \cdot T$ $E_w = 23.656 \cdot gm$

Material Handling Operations

The material handling particle size multiplier (k_h) corresponding to aerodynamic particle sizes less than 10 microns (EPA 1993 Page 5), which is the particle size of concern for inhalation, is:

$$k_h := 0.35$$

The volume (V) of soil transferred (assumption) is:

conversion factor: $1 \cdot yd^3 = 764554.8579840001 \cdot cm^3$

$V := 18400 \cdot yd^3$ $V = 1.407 \cdot 10^{10} \cdot cm^3$

The maximum dry bulk density (ρ) of the soil (CEP 1994) is:

conversion factor: $1 \cdot \frac{gm}{cm^3} = 62.427960576144610 \cdot \frac{lb}{ft^3}$

$\rho := 120.5 \cdot \frac{lb}{ft^3}$ $\rho = 1.930 \cdot \frac{gm}{cm^3}$

Multiplying the volume by the density, the mass (M) of soil transferred is:

conversion factor: $1 \cdot kg = 1000 \cdot gm$

$M := \rho \cdot V$ $M = 2.715 \cdot 10^7 \cdot kg$

The mean annual wind speed (U) (NOAA 1995) is:

conversion factor: $1 \cdot \frac{m}{sec} = 2.236936292054403 \cdot mph$

Page 3

$$U := 10 \cdot mph \qquad\qquad U = 4.470 \cdot \frac{m}{sec}$$

The moisture content (X) of the soil (CEP 1994) is:

$$X := 14.4 \cdot \%$$

The emission (E_h) from material handling (EPA 1993 Equation 1 Page 5) is:

$$E_h := \frac{k_h \cdot \left(0.0016 \cdot \frac{gm}{kg}\right) \cdot M \cdot \left(\frac{U}{2.2 \cdot \frac{m}{sec}}\right)^{1.3}}{\left(\frac{X}{2 \cdot \%}\right)^{1.4}} \qquad\qquad E_h = 2.410 \cdot 10^3 \cdot gm$$

Total Annual Emission

Adding the emissions from wind erosion and material handling together, the total emission (E) is:

$$E := E_w + E_h \qquad\qquad E = 2.434 \cdot kg$$

Radionuclide Source Concentration

The average radionuclide source concentrations in the MISS storage pile (BNI 1991) are:

$$S_{U238} := 17.0 \cdot \frac{pCi}{gm} \qquad\quad S_{Ra226} := 2.4 \cdot \frac{pCi}{gm} \qquad\quad S_{Th232} := 18.1 \cdot \frac{pCi}{gm}$$

Ratios of uranium isotopes can be calculated from the percentage of specific activity of U-238, U-234, and U-235 in natural uranium since these components make up total uranium. The percentage (P) contributed by each isotope to the total specific activity of natural uranium (BNI 1995) is:

$$P_{U238} := 47.249 \cdot \% \qquad\quad P_{U234} := 50.539 \cdot \% \qquad\quad P_{U235} := 2.212 \cdot \%$$

The source concentrations (S) of total uranium, U-234, and U-235 are:

$$S_{Utot} := \frac{S_{U238}}{P_{U238}} \qquad\qquad S_{Utot} = 35.980 \cdot \frac{pCi}{gm}$$

$$S_{U234} := P_{U234} \cdot S_{Utot} \qquad\qquad S_{U234} = 18.184 \cdot \frac{pCi}{gm}$$

$$S_{U235} := P_{U235} \cdot S_{Utot} \qquad\qquad S_{U235} = 0.796 \cdot \frac{pCi}{gm}$$

Annual Emissions

Multiplying the annual emission (E) by each known radionuclide source concentration (S), and using secular equilibrium for unknown radionuclide source concentrations (assumption) in the decay chains (Shleien 1992), the annual radioactivity releases (R) are:

$$\text{conversion factor:} \quad 1 \cdot pCi = 1.000 \cdot 10^{-12} \cdot Ci$$

$$R_{U238} := E \cdot S_{U238} \qquad\qquad R_{U238} = 4.138 \cdot 10^{-8} \cdot Ci$$

$$R_{Th234} := R_{U238} \qquad\qquad R_{Th234} = 4.138 \cdot 10^{-8} \cdot Ci$$

$$R_{Pa234m} := R_{Th234} \qquad\qquad R_{Pa234m} = 4.138 \cdot 10^{-8} \cdot Ci$$

Page 4

$R_{Pa234} := 99.87 \cdot \% \cdot R_{Pa234m}$ $R_{Pa234} = 4.132 \cdot 10^{-8} \cdot Ci$

$R_{U234} := E \cdot S_{U234}$ $R_{U234} = 4.426 \cdot 10^{-8} \cdot Ci$

$R_{Th230} := R_{U234}$ $R_{Th230} = 4.426 \cdot 10^{-8} \cdot Ci$

$R_{Ra226} := E \cdot S_{Ra226}$ $R_{Ra226} = 5.841 \cdot 10^{-9} \cdot Ci$

$R_{U235} := E \cdot S_{U235}$ $R_{U235} = 1.937 \cdot 10^{-9} \cdot Ci$

$R_{Th231} := R_{U235}$ $R_{Th231} = 1.937 \cdot 10^{-9} \cdot Ci$

$R_{Pa231} := R_{Th231}$ $R_{Pa231} = 1.937 \cdot 10^{-9} \cdot Ci$

$R_{Ac227} := R_{Pa231}$ $R_{Ac227} = 1.937 \cdot 10^{-9} \cdot Ci$

$R_{Th227} := 98.62 \cdot \% \cdot R_{Ac227}$ $R_{Th227} = 1.910 \cdot 10^{-9} \cdot Ci$

$R_{Fr223} := 1.38 \cdot \% \cdot R_{Ac227}$ $R_{Fr223} = 2.673 \cdot 10^{-11} \cdot Ci$

$R_{Ra223} := R_{Th227} + R_{Fr223}$ $R_{Ra223} = 1.937 \cdot 10^{-9} \cdot Ci$

$R_{Th232} := E \cdot S_{Th232}$ $R_{Th232} = 4.405 \cdot 10^{-8} \cdot Ci$

$R_{Ra228} := R_{Th232}$ $R_{Ra228} = 4.405 \cdot 10^{-8} \cdot Ci$

$R_{Ac228} := R_{Ra228}$ $R_{Ac228} = 4.405 \cdot 10^{-8} \cdot Ci$

$R_{Th228} := R_{Ac228}$ $R_{Th228} = 4.405 \cdot 10^{-8} \cdot Ci$

$R_{Ra224} := R_{Th228}$ $R_{Ra224} = 4.405 \cdot 10^{-8} \cdot Ci$

CAP88-PC Results

The CAP88-PC annual doses for the nearest resident (d_r) and offsite worker (d_w) at the corresponding distances (assumption) are:

$$d_r := 2.0 \cdot 10^{-3} \cdot \frac{mrem}{yr} \qquad\qquad d_w := 2.0 \cdot 10^{-3} \cdot \frac{mrem}{yr}$$

The occupancy factors for residents (f_r) and offsite workers (f_w) are:

$$f_r := \frac{24 \cdot \frac{hr}{day} \cdot 7 \cdot \frac{day}{wk} \cdot 52 \cdot \frac{wk}{yr}}{24 \cdot \frac{hr}{day} \cdot 7 \cdot \frac{day}{wk} \cdot 52 \cdot \frac{wk}{yr}} \qquad f_r = 100 \cdot \% \qquad f_w := \frac{8 \cdot \frac{hr}{day} \cdot 5 \cdot \frac{day}{wk} \cdot 50 \cdot \frac{wk}{yr}}{24 \cdot \frac{hr}{day} \cdot 7 \cdot \frac{day}{wk} \cdot 52 \cdot \frac{wk}{yr}} \qquad f_w = 23 \cdot \%$$

Multiplying the annual doses by the occupancy factors, the actual doses (D_r and D_w) are:

$$D_r := f_r \cdot d_r \qquad D_r = 0.002 \cdot \frac{mrem}{yr} \qquad\qquad D_w := f_w \cdot d_w \qquad D_w = 4.579 \cdot 10^{-4} \cdot \frac{mrem}{yr}$$

SUMMARY OF RESULTS

The dose to the hypothetical maximally exposed individual (resident 100 m N) from inhalation of airborne radioactive releases from the MISS pile removal (as defined above) is 0.002 mrem.

CALCULATION SHEET   144898

				CALC. NO.	138-CV-077	REV.	0
ORIGINATOR	Carl Eric von Buelow	DATE	27-Jun-96	CHECKED	AKG	DATE	6/28/96
PROJECT	FUSRAP - MISS			JOB NO.	14501	SHEET	6
SUBJECT			18400 yd3 Soil Removal Air Dose				

ATTACHMENTS

CALCULATION SHEET

144898

				CALC. NO.	138-CV-077	REV.	0
ORIGINATOR	Carl Eric von Buelow	DATE	27-Jun-96	CHECKED	AKa	DATE	4/28/96
PROJECT	FUSRAP - MISS			JOB NO.	14501	SHEET	1 5
SUBJECT			18400 yd3 Soil Removal Air Dose				

Figure 1 - MISS Site Plan
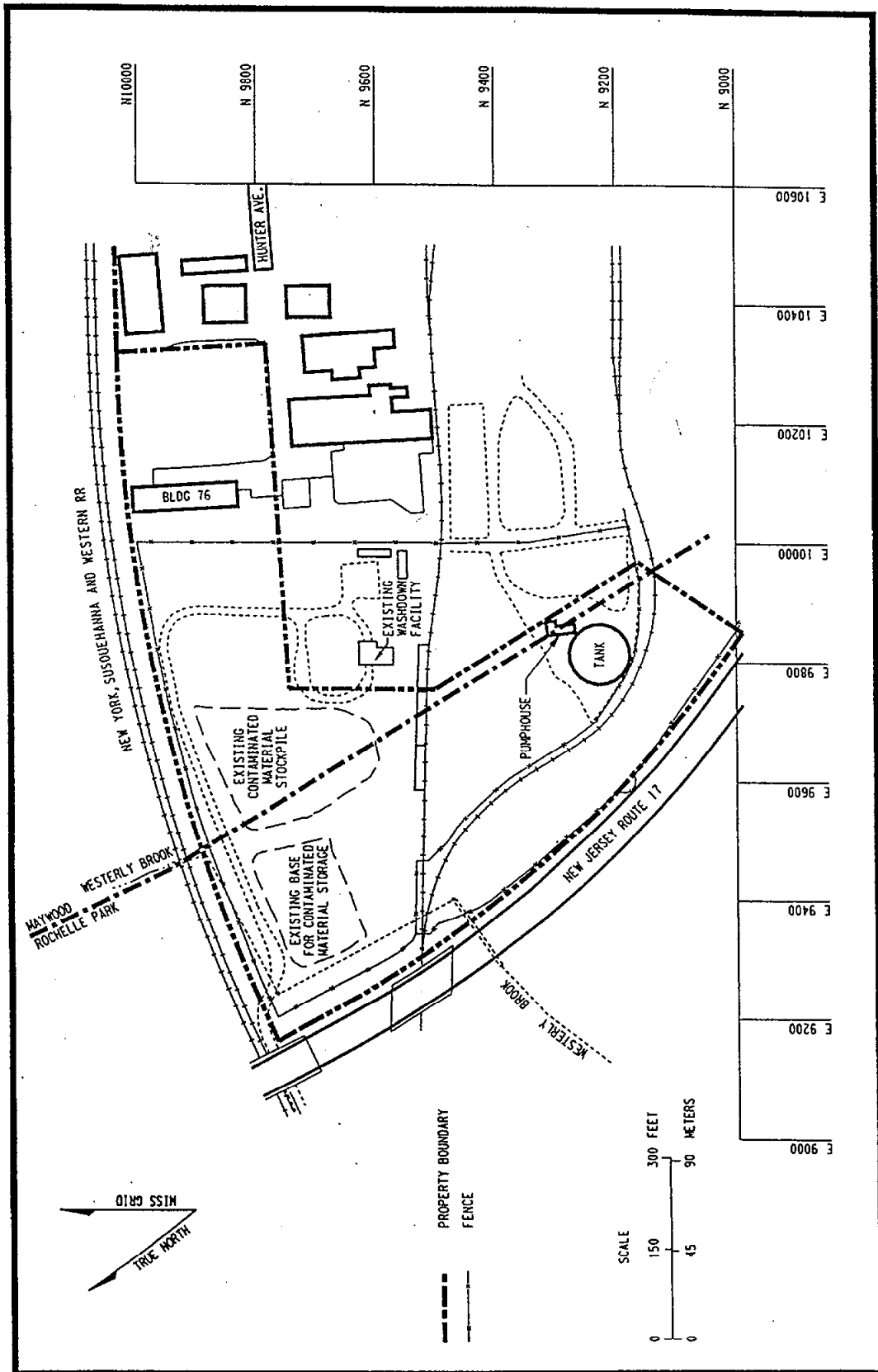
CALCULATION SHEET   144898

ORIGINATOR Carl Eric von Buelow DATE 27-Jun-96	CALC. NO. 138-CV-077	REV. 0
PROJECT FUSRAP - MISS	CHECKED AKG	DATE 6/28/96
	JOB NO. 14501	SHEET 8
SUBJECT 18400 yd3 Soil Removal Air Dose		

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S   R E P O R T

Non-Radon Individual Assessment
Jun 27, 1996   10:29 am

Facility: Maywood Interim Storage Site
Address: 100 West Hunter Avenue
    City: Maywood
   State: NJ   Zip: 07607

Source Category: Airborne Radioactive Particulate
   Source Type: Area
Emission Year: 1996

Comments: Bechtel National, Inc.
           Calculation No. 14501-138-CV-077 rev 0

Dataset Name: MIS-PILEMOVE-IND
Dataset Date: Jun 27, 1996   10:29 am
   Wind File: WNDFILES\LEA0189.WND

CALCULATION SHEET   144898

		CALC. NO.	138-CV-077	REV.	0
ORIGINATOR	Carl Eric von Buelow β DATE 27-Jun-96	CHECKED	HCG	DATE	6/28/96
PROJECT	FUSRAP - MISS	JOB NO.	14501	SHEET	9
SUBJECT		18400 yd3 Soil Removal Air Dose			

Jun 27, 1996 10:29 am

RADIONUCLIDE EMISSIONS DURING THE YEAR 1996

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
U-238	Y	1.00	4.1E-08	4.1E-08
TH-234	Y	1.00	4.1E-08	4.1E-08
PA-234M	Y	1.00	4.1E-08	4.1E-08
PA-234	Y	1.00	4.1E-08	4.1E-08
U-234	Y	1.00	4.4E-08	4.4E-08
TH-230	Y	1.00	4.4E-08	4.4E-08
RA-226	W	1.00	5.8E-09	5.8E-09
U-235	Y	1.00	1.9E-09	1.9E-09
TH-231	Y	1.00	1.9E-09	1.9E-09
PA-231	Y	1.00	1.9E-09	1.9E-09
AC-227	Y	1.00	1.9E-09	1.9E-09
TH-227	Y	1.00	1.9E-09	1.9E-09
FR-223	D	1.00	2.7E-11	2.7E-11
RA-223	W	1.00	1.9E-09	1.9E-09
TH-232	Y	1.00	4.4E-08	4.4E-08
RA-228	W	1.00	4.4E-08	4.4E-08
AC-228	Y	1.00	4.4E-08	4.4E-08
TH-228	Y	1.00	4.4E-08	4.4E-08
RA-224	W	1.00	4.4E-08	4.4E-08

SITE INFORMATION

Temperature:	9 degrees C
Precipitation:	96 cm/y
Mixing Height:	1000 m

CALCULATION SHEET

I44898

ORIGINATOR Carl Eric von Buelow $^\beta$ DATE 27-Jun-96	CALC. NO. 138-CV-077	REV. 0		
PROJECT FUSRAP - MISS	CHECKED AKG	DATE 6/28/96		
	JOB NO. 14501	SHEET 10'		
SUBJECT 18400 yd3 Soil Removal Air Dose				

SOURCE INFORMATION

Source Number: 1

Source Height (m):   0.00
Area (sq m):   9.29E+01

Plume Rise
Pasquill Cat:

	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

100

CALCULATION SHEET

144898

		CALC. NO.	138-CV-077	REV. 0
ORIGINATOR Carl Eric von Buelow β	DATE 27-Jun-96	CHECKED AKG		DATE 6/28/96
PROJECT FUSRAP - MISS		JOB NO.	14501	SHEET 11
SUBJECT	18400 yd3 Soil Removal Air Dose			

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

D O S E   A N D   R I S K   E Q U I V A L E N T   S U M M A R I E S

Non-Radon Individual Assessment
Jun 27, 1996 10:29 am

Facility: Maywood Interim Storage Site
Address: 100 West Hunter Avenue
City: Maywood
State: NJ   Zip: 07607

Source Category: Airborne Radioactive Particulate
Source Type: Area
Emission Year: 1996

Comments: Bechtel National, Inc.
Calculation No. 14501-138-CV-077 rev 0

Dataset Name: MIS-PILEMOVE-IND
Dataset Date: Jun 27, 1996 10:29 am
Wind File: WNDFILES\LEA0189.WND

CALCULATION SHEET   I,44898

ORIGINATOR Carl Eric von Buelow DATE 27-Jun-96
PROJECT FUSRAP - MISS
SUBJECT 18400 yd3 Soil Removal Air Dose

CALC. NO. 138-CV-077   REV. 0
CHECKED _AKa_   DATE 6/28/96
JOB NO. 14501   SHEET 12

Jun 27, 1996 10:29 am

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)
Direction	100
N	2.0E-03
NNW	4.8E-04
NW	4.5E-04
WNW	3.7E-04
W	9.8E-04
WSW	1.3E-03
SW	1.4E-03
SSW	1.1E-03
S	1.2E-03
SSE	9.8E-04
SE	1.2E-03
ESE	1.3E-03
E	1.1E-03
ENE	1.1E-03
NE	1.3E-03
NNE	1.1E-03