Relocation Impacts of a Major Release from SRTC

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DOE Contract No. **DE-AC09-96SR18500**

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WSRC-TR-99-00105
Revision 0

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April 1999

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09-96SR18500

Abstract

The relocation impacts of an accidental release, scenario 1-RD-3, are evaluated for the Savannah River Technology Center (SRTC). The extent of the area potentially contaminated to a level that would result in doses exceeding the relocation protective action guide (PAG) is calculated. The maximum calculated distance downwind from the accident at which the relocation PAG is exceeded is also determined. The consequences of the particulate portion of the release are evaluated using the HOTSPOT model and an EXCEL spreadsheet. The consequences of the tritium release are evaluated using UFOTRI.

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TABLES

Introduction

The relocation impacts of an accidental release, scenario 1-RD-3, are evaluated for the Savannah River Technology Center (SRTC). For the particulate release, the size of the area, as well as the maximum distance out to which relocation would be recommended are calculated. For the tritium release, the dose at the site boundary due to re-emission in the first year following the release is calculated and compared to the Protective Action Guide (PAG)

Approach

The methodology for determining the areas potentially requiring relocation is outlined below.

1. Determine the source terms (radionuclide-specific respirable and total airborne releases).
2. Determine the relocation PAGs for the radionuclides in the source terms in accordance with the *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (EPA 1992).
3. Calculate the doses (from inhalation and ground shine) associated with a unit deposition of (respirable) particulates. The inhalation source term is derived from the respirable airborne release. The ground shine source term is derived from the total (nonrespirable plus respirable) airborne release.
4. Sum the doses resulting from the unit deposition. Divide the relocation PAG by the sum of the doses to obtain the Derived Response Level (DRL) for relocation.
5. Run the dispersion/deposition model HOTSPOT (Homann 1994) to determine areas impacted.
6. If tritium is released, use the UFOTRI model (Raskob 1990 and 1993) to calculate doses from residual tritium in the environment, and compare to PAGs.

Background

The area affected is considered to be that area in which the deposition due to an accidental release causes an individual in that area to receive a dose that exceeds the PAG. The PAG values being used for this work, as derived in WSMS-SAE-M-99-0019 (E. Thompson 1999), are 2 rem (0.02 Sv) total effective dose equivalent (TEDE) or 20 rem (0.2 Sv) dose equivalent to any organ; except the skin, for which a value of 100 rem (1 Sv) is being used. The value of a measurable quantity that corresponds to a dose value of interest (such as a PAG) is referred to as a derived response level (DRL). Spreadsheet calculations will be performed to determine the relocation DRL for the particulate portion of the nuclide mix of interest. This DRL will then be used in conjunction with the HOTSPOT computer model to determine the size or extent of the area affected by the release of particulates.

The dose resulting from tritium will be evaluated using the UFOTRI model.

Analysis

Derivation of the Total Release

The postulated respirable source terms for SRTC release scenario 1-RD-3 are found in Attachments 2, 3, and 5 of the SRTC Emergency Planning Hazards Assessment (EPHA) (S-EHA-A-00001), Rev. 1, Appendix B, Calculation 1. These respirable source terms are derived from a detailed analysis involving consideration of physical forms and dispersing mechanisms. An overall damage ratio (DR) is applied to the overall source term from the Attachments in S-EHA-A-00001, Rev. 1, Appendix B, Calculation 1 (see sheet 8 of 30 for the DR specification). To determine the total release, it is necessary to "back out" the respirable fraction (RF) from the respirable release source terms. This is done in calculation S-CLC-A-00104 and summarized in Table 1. The activities in Table 1 do not include a correction for a DR less than unity, and the Pu-239/241 and Pu-242 activities are for mixes.

Table 1. Total airborne releases for SRTC scenario 1-RD-3, with mixes and DR not applied

Nuclide	Pre-DR total airborne release (Ci)
Am-241	1.21E-02
Am-243	9.68E-04
Ba-133	5.38E-13
Ce-144	1.90E-05
Cf-249	1.27E-05
Cf-252	1.59E-02
Cm-244	2.03E-02
Cm-246	1.00E-03
Co-60	7.19E-01
Cs-137	1.19E+00
H-3	2.14E+04
Np-237	4.20E-05
Pm-147	2.52E-08
Pu-238	5.10E-02
Pu-239	1.78E-05
Pu-239/241mix	4.56E-01
Pu-240	9.72E-07
Pu-241	2.91E-01
Pu-242mix	1.28E-02
Sr-90	1.18E+00
Tc-99	3.60E-13
Th-232	1.93E-06
Tl-204	9.00E-10
U-235	1.78E-06
U-238	2.15E-04

Reference: S-CLC-A-00104 Table 1, Sheet 6

Two additional steps are applied to the potential release activities in Table 1. First, the Pu-239/241 and Pu-242 mixes must be separated into their constituents. The makeups of these mixes are given in Tables 2 and 3.

Table 2. Pu-239/241 mix activity fractions

Nuclide	Activity fraction
Pu-238	0.0073
Pu-239	0.2029
Pu-240	0.0462
Pu-241	0.6761
Pu-242	0.0003
Am-241	0.0675

Reference: S-CLC-A-00080 Rev. 0, Sheet 4 of 26

Table 3. Pu-242 mix activity fractions

Nuclide	Activity fraction
Pu-238	0.0786
Pu-239	0.00024
Pu-240	0.01184
Pu-241	0.88886
Pu-242	0.00074
Am-241	0.01977

Reference: S-CLC-A-00080 Rev. 0, Sheet 4 of 26

The final step is to apply a damage ratio (DR) of 0.75, consistent with the DR assumed for respirable releases in the SRTC EPHA. These total releases are shown in Table 4.

Table 4. Total airborne releases for SRTC scenario 1-RD-3, unmixed and with DR applied

Nuclide	DR=0.75, unmixed total release (Ci)
Am-241	3.23E-02
Am-243	7.26E-04
Ba-133	4.04E-13
Ce-144	1.42E-05
Cf-249	9.53E-06
Cf-252	1.19E-02
Cm-244	1.53E-02
Cm-246	7.50E-04
Co-60	5.40E-01
Cs-137	8.91E-01
H-3	1.61E+04
Np-237	3.15E-05
Pm-147	1.89E-08
Pu-238	4.15E-02
Pu-239	6.94E-02

Nuclide	DR=0.75, unmixed total release (Ci)
Pu-240	1.59E-02
Pu-241	4.58E-01
Pu-242	1.10E-04
Sr-90	8.84E-01
Tc-99	2.70E-13
Th-232	1.45E-06
Tl-204	6.75E-10
U-235	1.34E-06
U-238	1.62E-04

Reference: SourceSRTC.xls, Worksheet "Nonresp + resp", columns L to N

Details of these spreadsheet calculations are presented in Attachment A. The total airborne particulate activity released is 2.96 Ci.

Determination of respirable release

The respirable source terms for SRTC release scenario 1-RD-3 are found in Attachments 2, 3, and 5 of S-EHA-A-00001, Rev. 1, Appendix B, Calculation 1. Respirable source terms from S-EHA-A-00001, Rev. 1, Appendix B, Calculation 1, without a DR of 0.75 and with Pu-239/241 and Pu-242 mixed, are listed in Table 5.

Table 5. Respirable airborne releases for SRTC scenario 1-RD-3, with mixes and DR not applied

Nuclide	Table 5 Pre-DR respirable airborne release (Ci)	Table 52 Pre-DR respirable airborne release (Ci)	Table 71 Pre-DR respirable airborne release (Ci)
Am-241	2.21E-03	1.86E-03	5.80E-03
Am-243	2.08E-04	6.59E-05	3.33E-04
Ba-133	2.69E-13	0.00E+00	2.69E-13
Ce-144	9.97E-07	7.75E-06	1.02E-05
Cf-249	2.13E-06	0	8.86E-06
Cf-252	7.85E-03	1.78E-03	6.29E-03
Cm-244	6.23E-03	3.99E-03	1.26E-02
Cm-246	3.70E-04	2.01E-05	2.75E-04
Co-60	3.30E-01	2.75E-02	3.62E-01
Cs-137	6.53E-02	4.88E-01	6.35E-01
H-3	1.07E+04	9.66E+00	1.07E+04
Np-237	8.86E-06	2.33E-08	2.37E-05
Pm-147	1.26E-08	0	1.26E-08
Pu-238	1.28E-02	1.00E-03	9.21E-03
Pu-239	8.88E-06	0	8.88E-06
Pu-239/241mix	5.96E-02	4.21E-03	8.09E-02
Pu-240	6.85E-07	0	0
Pu-241	4.80E-02	0	2.03E-01
Pu-242mix	2.31E-03	0	7.15E-03
Sr-90	6.04E-02	4.86E-01	6.31E-01

Nuclide	Table 5 Pre-DR respirable airborne release (Ci)	Table 52 Pre-DR respirable airborne release (Ci)	Table 71 Pre-DR respirable airborne release (Ci)
Tc-99	1.80E-13	0	1.80E-13
Th-232	1.02E-06	7.28E-09	8.89E-07
Tl-204	4.50E-10	0	4.50E-10
U-235	3.64E-07	2.27E-08	5.30E-07
U-238	2.66E-05	2.73E-07	4.13E-05

Reference: Source.xls, Worksheets Table 5, Table 52, and Table 71, Column C

Two additional steps are applied to the potential release activities in the preceding table. First, the Pu-239/241 and Pu-242 mixes must be separated into their constituents. The makeups of these mixes are in Tables 2 and 3.

The final step is to apply a damage ratio of 0.75, consistent with the SRTC EPHA. These respirable releases are shown in Table 6. The respirable source term for 1-RD-3 is the sum of the three cases, and also presented in Table 6. Details of the calculation are presented in Attachment A. The summed respirable source term in Table 6 is used for subsequent calculations. The total respirable particulate airborne activity, summed over all nuclides and all three cases, is 2.67 Ci.

Table 6. Respirable airborne releases for SRTC scenario 1-RD-3, unmixed and DR applied

Nuclide	Table 5 DR'd respirable airborne release (Ci)	Table 52 DR'd respirable airborne release (Ci)	Table 71 DR'd respirable airborne release (Ci)	Summed DR'd respirable airborne release (Ci)
Am-241	4.71E-03	1.61E-03	8.55E-03	1.49E-02
Am-243	1.56E-04	4.94E-05	2.50E-04	4.55E-04
Ba-133	2.02E-13	0.00E+00	2.02E-13	4.04E-13
Ce-144	7.48E-07	5.81E-06	7.65E-06	1.42E-05
Cf-249	1.60E-06	0.00E+00	6.65E-06	8.24E-06
Cf-252	5.89E-03	1.34E-03	4.72E-03	1.19E-02
Cm-244	4.67E-03	2.99E-03	9.45E-03	1.71E-02
Cm-246	2.78E-04	1.51E-05	2.06E-04	4.99E-04
Co-60	2.48E-01	2.06E-02	2.72E-01	5.40E-01
Cs-137	4.90E-02	3.66E-01	4.76E-01	8.91E-01
H-3	8.03E+03	7.25E+00	8.03E+03	1.61E+04
Np-237	6.65E-06	1.75E-08	1.78E-05	2.44E-05
Pm-147	9.45E-09	0.00E+00	9.45E-09	1.89E-08
Pu-238	9.94E-03	7.73E-04	7.39E-03	1.81E-02
Pu-239	9.43E-03	6.41E-04	1.34E-02	2.35E-02
Pu-239/241mix				
Pu-240	2.15E-03	1.46E-04	3.05E-03	5.34E-03
Pu-241	6.74E-02	2.13E-03	1.97E-01	2.66E-01
Pu-242 pure	1.39E-05	9.47E-07	1.98E-05	3.47E-05
Sr-90	4.53E-02	3.65E-01	4.73E-01	8.83E-01
Tc-99	1.35E-13	0.00E+00	1.35E-13	2.70E-13
Th-232	7.65E-07	5.46E-09	6.67E-07	1.44E-06
Tl-204	3.38E-10	0.00E+00	3.38E-10	6.75E-10

Nuclide	Table 5 DR'd respirable airborne release (Ci)	Table 52 DR'd respirable airborne release (Ci)	Table 71 DR'd respirable airborne release (Ci)	Summed DR'd respirable airborne release (Ci)
U-235	2.73E-07	1.70E-08	3.98E-07	6.88E-07
U-238	2.00E-05	2.05E-07	3.10E-05	5.11E-05

Reference: Source.xls, Worksheet "resp sums", Columns A to F

Determination of the DRL

For the general case when the total (respirable plus nonrespirable particulates) release may be different from the respirable release, the following approach is used. Tritium will be treated as a special case.

This analysis is ultimately referenced to a unit deposition of respirable material. The unit respirable deposition has a corresponding deposition of total particulate material. Figure 1 illustrates the steps of this analysis.

The first step is to assume a unit respirable deposition (1 $\mu Ci/m^2$) of the nuclide mix of interest.

This mix is then apportioned to the individual nuclides based on the activity fraction (the ratio of the individual nuclide activity to the sum of the activity released). That is:

$$dep_i = dep_{sum}\left(\frac{A_i}{A_{sum}}\right)$$

where

dep_i = the respirable deposition concentration of the i^{th} nuclide in $\mu Ci/m^2$,
dep_{sum} = the sum over all nuclides of the respirable deposition concentration (1 $\mu Ci/m^2$),
A_i = the respirable activity of the i^{th} nuclide (Ci), and
A_{sum} = the sum of the respirable activities released (Ci).

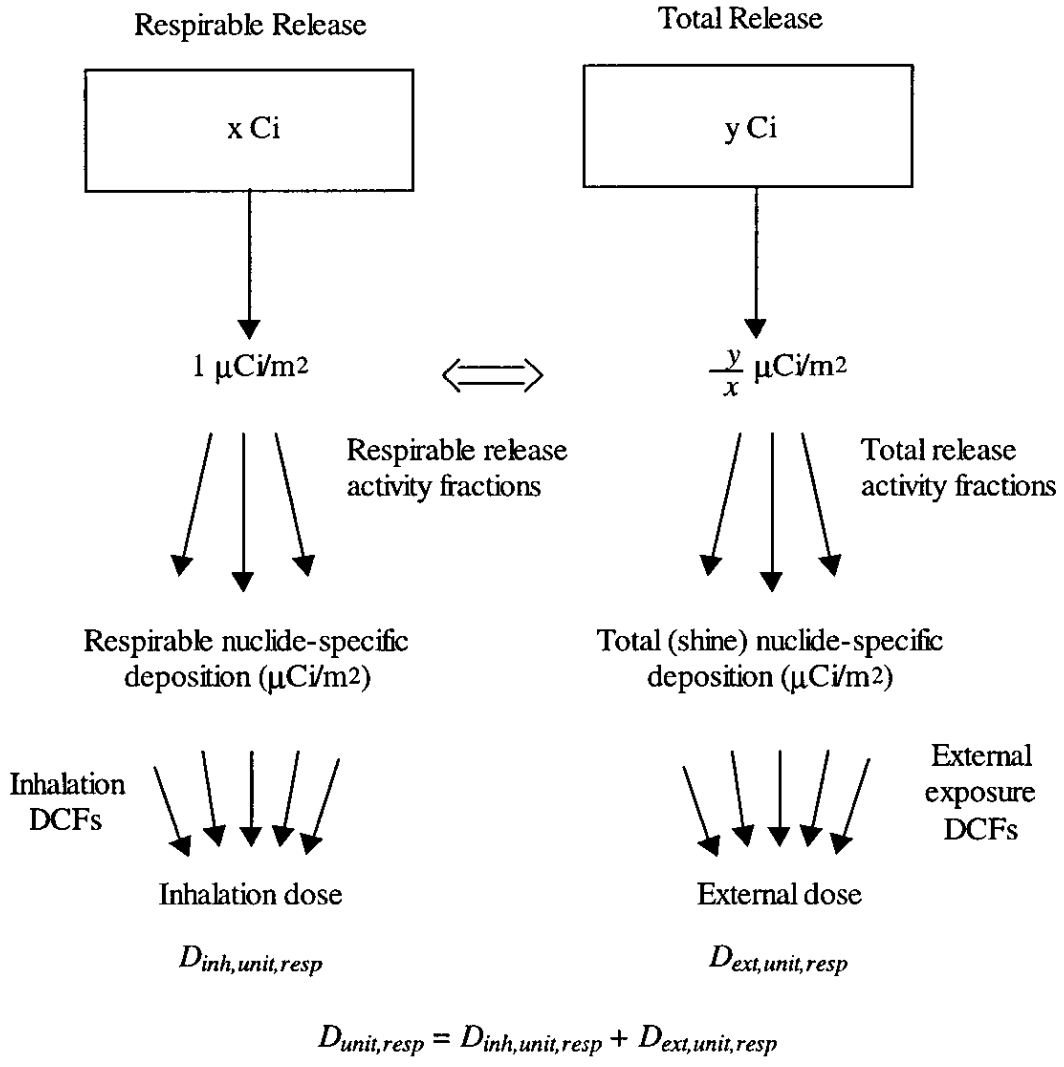
This calculation is performed in Spreadsheet "Source_terms_reloc.xls", Worksheet "Relo_SRTC", Columns D and E. Daughter radionuclide activity fractions are also calculated. Details of the spreadsheet calculations are in Attachment A.

The respirable deposition for each nuclide determined above is used to calculate the dose contributed by that nuclide for inhalation of resuspended material pathways for both effective and organ doses.

The skin dose from beta radiation and external whole-body dose from gamma exposure result from emanations from both respirable and nonrespirable particles that have been deposited on the ground. To find the total (respirable plus nonrespirable) deposition for each radionuclide that corresponds to a unit respirable deposition, two steps are performed. First, total depositions for each nuclide are found for a unit total deposition, using the preceding equation for respirable deposition, except substituting total depositions and activities for respirable depositions and activities. This is performed in Worksheet "Relo_SRTC", Columns B and C. Column C is the

activity fraction, which is equivalent to the total deposition of the i^{th} nuclide that results from a unit total deposition.

The postulated respirable release is x = 2.67 Ci (Worksheet "Relo_SRTC", Cell D35) and the total release is y = 2.96 Ci (Worksheet "Relo_SRTC", Cell B35). The assumption is made that nonrespirable particles are deposited at the same rate as respirable particles, so the ratio of total activity deposited per unit area to the respirable activity deposited per unit area, at any location, will be in the same ratio as the total to respirable activity released. A respirable deposition of 1 μCi/m^2 corresponds to a total deposition y/x = 2.96 / 2.67 = 1.11 times as large, or 1.11 μCi/m^2. Multiplication of the total deposition of the i^{th} nuclide that results from a unit total deposition by this factor of 1.11 results in the total deposition of the i^{th} nuclide that results from a unit respirable deposition.



$$D_{unit,resp} = D_{inh,unit,resp} + D_{ext,unit,resp}$$

Figure 1. Determination of the dose from a unit respirable release

In Worksheet "Relo_SRTC", this *y/x* term is found in the external EDE (Column H) and skin dose (Column J) formulas as $B$35/$D$35.

Once the respirable and total nuclide-specific depositions are found that correspond to a unit respirable deposition, doses of interest may be found by applying dose conversion factors. Respirable depositions are used to calculate committed dose equivalents to the bone surfaces and committed effective dose equivalents. Total depositions are used to calculate skin doses and doses from external gamma exposure. These calculations are in Columns G, H, J, and K of Worksheet "Relo_SRTC".

The CEDE from a unit respirable deposition is calculated in Column G. The CEDE from inhalation of each radionuclide is summed (Cell G47). The CEDE from each nuclide is the product of the following terms:

$B$7	unit respirable deposition, 1 $\mu Ci/m^2$
$B$3	resuspension factor, m^{-1}
$B$4	breathing rate, m^3/yr
$B$5	conversion factor, Bq/μCi
$B$6	conversion factor, mrem/Sv
$B$8	exposure period, 1 yr
E(10 to 34)	respirable activity fraction
Relocation!H(10 to 34)	CEDE DCF, Sv/Bq

The external dose equivalent from the total deposition corresponding to a unit respirable deposition is calculated in Column H. The external dose from each radionuclide is summed (Cell H47). The external dose equivalent for each nuclide is calculated as the product of the factors below:

$B$7	unit respirable deposition, 1 $\mu Ci/m^2$
$B$8	exposure period, 1 yr
C(10 to 45)	total activity fraction
Relocation!E(10 to 45)	external EDE DCF, mrem/yr per $\mu Ci/m^2$
$B$35/$D$35	ratio of total deposition to respirable deposition

The skin dose from the total deposition corresponding to a unit respirable deposition is calculated in Column J. The skin dose from each radionuclide is summed (Cell J47). The skin dose for each nuclide is calculated as the product of the factors below:

$B$7	unit respirable deposition, 1 $\mu Ci/m^2$
$B$8	exposure period, 1 yr
C(10 to 45)	total activity fraction
Relocation!F(10 to 45)	skin dose DCF, mrem/yr per $\mu Ci/m^2$
$B$35/$D$35	ratio of total deposition to respirable deposition

The bone surfaces committed dose equivalent (CDE) from a unit respirable deposition is calculated in Column K. The sum of the CDE from inhalation of each radionuclide is summed (Cell K47). The CDE from each nuclide is the product of the following terms:

$B$7	unit respirable deposition, 1 μCi/m^2
$B$3	resuspension factor, m^{-1}
$B$4	breathing rate, m^3/yr
$B$5	conversion factor, Bq/μCi
$B$6	conversion factor, mrem/Sv
$B$8	exposure period, 1 yr
E(10 to 34)	respirable activity fraction
Relocation!H(10 to 34)	bone surfaces CDE DCF, Sv/Bq

Inhalation dose conversion factors (DCFs) are from Federal Guidance Report 11 (EPA 1988). External exposure DCFs are from DOE/EH-0070 (1988).

In Figure 1, $D_{unit,resp}$ is the dose due to a unit deposition of respirable material. It includes the CEDE (or the CDE for organ doses) from inhalation of resuspended material (respirable portion of deposited material only) plus the external exposure from ground shine due to the total deposited activity corresponding to the unit respirable deposition.

For a deposition of 1 μCi m^{-2} of respirable activity of the 1-RD-1.3 mix, the inhalation dose is 142 mrem CEDE (Worksheet "Relo_SRTC, Cell G47) and 2370 mrem CDE to the bone surfaces (Worksheet "Relo_SRTC, Cell K47). A respirable deposition of 1 μCi m^{-2} corresponds to a total deposition of 1.11 μCi m^{-2}. A total deposition of 1.11 μCi m^{-2} gives an external dose of 66 mrem (Worksheet "Relo_SRTC, Cell H47)and a skin dose of 480 mrem (Worksheet "Relo_SRTC, Cell J47). Adding the external and internal doses gives 208 mrem CEDE and 2440 mrem CDE to the bone surfaces per deposition of 1 μCi m^{-2} of respirable activity.

The DRLs may now be determined by dividing the PAGs by their corresponding dose per unit deposition. DRLs are presented in Table 7. "BS Dose" is the CDE to the bone surfaces. Details of the spreadsheet calculations are in Attachment A.

Table 7. PAGs and DRLs for SRTC particulate release

PAG (mrem)	Description	DRL (μCi m^{-2})	DRL Formula
2000	TEDE	9.6	DRL = PAG/(CEDE+External)
20000	Organ-specific Dose (BS)	8.2	DRL = PAG/(BS Dose + External)
100000	Skin Dose	210	DRL = PAG/(Skin Dose)

Reference: Source_terms_reloc.xls, Worksheet "Relo_H", rows 44-46, column E.

Tritium exposures will be evaluated by direct comparisons to the PAG, instead of using a DRL.

Determination of range and area of consequences

The HOTSPOT computer code was selected to evaluate the consequences of particulate releases (WSRC-TR-98-00392). In the following calculations, a source term equal to the respirable particulate activity of 2.67 Ci (summed over all radionuclides except tritium) is used, and the range and area affected for different meteorological parameters and DRLs found. Pasquill-Briggs dispersion parameters are used.

HOTSPOT Parameters used for the SRTC release are listed in Table 8. These meteorological data were taken from the SRTC EPHA (S-EHA-A-00001, Rev.1).

Table 8. HOTSPOT input parameters for SRTC release 1-RD-3

Parameter	Average Meteorology	95% Adverse Meteorology
Release height	Ground	Ground
Wind speed	2.5 m/s	1.7 m/s
Surface roughness	100 cm	100 cm
Stability class	C	E
Deposition velocity	0.1/1/10 cm/sec	0.1/1/10 cm/sec
Release duration	60 min	60 min
Inversion layer	500 m	200 m

The tritium release is evaluated using the computer dose model UFOTRI (Raskob 1990, 1993) and the meteorological parameters in Table 8 (particulate deposition velocity is not applicable). Table 9 provides a listing of some of the additional parameters required in UFOTRI.

Table 9. Additional Input parameters for UFOTRI

Additional Information		Meteorology	
Chemical Forms	0% HT / 100% HTO	Air temperature	32.22°C
No building wake		No Rainfall	0 mm/h
Initial soil water content	35%	Thermal energy of release	0 cal/sec
Relative humidity	0.8	Wind direction (in degrees)	315
		Dispersion parameters	Briggs
Soil and vegetation		Code coefficients	
Soil type	Sandy loam	HTO dry deposition velocity*	0.5 cm/s
Pore volume (default)	50 %	HT dry deposition velocity*	0.05 cm/s

* Deposition is calculated in UFOTRI without user-specified constants; values are place holders.

Results

Particulates

Tables 10 through 13 summarize the results obtained for SRTC accident scenario 1-RD-3 using the HOTSPOT computer code. For the average meteorology case, Tables 10 and 11 present the ranges and areas, respectively. "N/E" is used to indicate cases where the DRL was not exceeded, and/or the area affected was insignificant. Tables 12 and 13 contain results for runs made using adverse meteorological data.

Table 10. Ranges (in km) until deposition less than relocation DRL, average meteorology, SRTC

Basis for DRL	DRL	Deposition Velocity		
	(μCi m^{-2})	0.1 cm s-1	1 cm s-1	10 cm s-1
TEDE	9.60E+00	0.023	0.07	0.19
Bone Surface Dose	8.23E+00	0.025	0.08	0.21
Skin Dose	2.08E+02	N/E	0.016	0.045

"N/E" indicates the DRL was not exceeded.

Table 11. Areas (in km^2) with deposition above relocation DRL, average meteorology, SRTC

Basis for DRL	DRL	Deposition Velocity		
	($\mu Ci\ m^{-2}$)	0.1 cm s^{-1}	1 cm s^{-1}	10 cm s^{-1}
TEDE	9.60E+00	N/E	N/E	1.0E-02
Bone Surface Dose	8.23E+00	N/E	N/E	1.2E-02
Skin Dose	2.08E+02	N/E	N/E	N/E

"N/E" indicates the area affected is insignificant.

Table 12. Ranges (in km) until deposition less than relocation DRL, 95% adverse meteorology, SRTC

Basis for DRL	DRL	Deposition Velocity		
	($\mu Ci\ m^{-2}$)	0.1 cm s^{-1}	1 cm s^{-1}	10 cm s^{-1}
TEDE	9.60E+00	0.065	0.019	0.27
Bone Surface Dose	8.23E+00	0.07	0.021	0.3
Skin Dose	2.08E+02	0.014	0.04	0.08

Table 13. Areas (in km^2) with deposition above relocation DRL, 95% adverse meteorology, SRTC

Basis for DRL	DRL	Deposition Velocity		
	($\mu Ci\ m^{-2}$)	0.1 cm s^{-1}	1 cm s^{-1}	10 cm s^{-1}
TEDE	9.60E+00	N/E	5.4E-03	1.1E-02
Bone Surface Dose	8.23E+00	N/E	6.4E-03	1.2E-02
Skin Dose	2.08E+02	N/E	N/E	N/E

"N/E" indicates the area affected is insignificant.

Tritium

UFOTRI was run to evaluate the dose due to tritium re-emission. The dose due to re-emission (for the first year following the accidental release) was calculated by subtracting the plume passage dose from the dose due to plume passage plus re-emission. These values are presented in Table 14 for the site boundary, a distance of 670 m from the release point.

Table 14. Dose due to tritium re-emission at 670 m from the release point

	HTO plume passage dose (mrem)	HTO plume passage plus re-emission (mrem)	Re-emission (mrem)
Average meteorology	5.12	6.43	1.3
Adverse meteorology	38.6	50.5	12

The dose due to tritium re-emission is small compared to the 2000 mrem PAG which governs relocation recommendations.

Conclusion

Even though SRTC is near the site boundary (a distance of approximately 0.67 km), no relocation protective actions are likely to be recommended for either the particulate release or the tritium release from this scenario.

References

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Attachments

Attachment A
Spreadsheet calculations

Attachment B
HOTSPOT results - average meteorology, 0.1 cm s^{-1}

Attachment C
HOTSPOT results - average meteorology, 1.0 cm s^{-1}

Attachment D
HOTSPOT results - average meteorology, 10 cm s^{-1}

Attachment E
HOTSPOT results - adverse meteorology, 0.1 cm s^{-1}

Attachment F
HOTSPOT results - adverse meteorology, 1.0 cm s^{-1}

Attachment G
HOTSPOT results - adverse meteorology, 10 cm s^{-1}

Attachment A

Spreadsheet calculations

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			STRC		release	release	release		release
8	Element	At. No.	Att. 3		Ci	Ci	Ci	DR=0.75	Ci
9			Table 5						
10	Am	241	2.21E-03		4.02E-03	4.57E-05	6.28E-03	0.75	4.71E-03
11	Am	243	2.08E-04				2.08E-04	0.75	1.56E-04
12	Ba	133	2.69E-13				2.69E-13	0.75	2.02E-13
13	Ce	144	9.97E-07				9.97E-07	0.75	7.48E-07
14	Cf	249	2.13E-06				2.13E-06	0.75	1.60E-06
15	Cf	252	7.85E-03				7.85E-03	0.75	5.89E-03
16	Cm	244	6.23E-03				6.23E-03	0.75	4.67E-03
17	Cm	246	3.70E-04				3.70E-04	0.75	2.78E-04
18	Co	60	3.30E-01				3.30E-01	0.75	2.48E-01
19	Cs	137	6.53E-02				6.53E-02	0.75	4.90E-02
20	H	3	1.07E+04				1.07E+04	0.75	8.03E+03
21	Np	237	8.86E-06				8.86E-06	0.75	6.65E-06
22	Pm	147	1.26E-08				1.26E-08	0.75	9.45E-09
23	Pu	238	1.28E-02		4.35E-04	1.69E-05	1.33E-02	0.75	9.94E-03
24	Pu	239	8.88E-06		1.21E-02	0.000469	1.26E-02	0.75	9.43E-03
25	Pu mix	239/241	5.96E-02						
26	Pu	240	6.85E-07		2.75E-03	0.000107	2.86E-03	0.75	2.15E-03
27	Pu	241	4.80E-02		4.03E-02	0.001562	8.99E-02	0.75	6.74E-02
28	Pu mix	242	2.31E-03	pure->	1.79E-05	6.93E-07	1.86E-05	0.75	1.39E-05
29	Sr	90	6.04E-02				6.04E-02	0.75	4.53E-02
30	Tc	99	1.80E-13				1.80E-13	0.75	1.35E-13
31	Th	232	1.02E-06				1.02E-06	0.75	7.65E-07
32	Tl	204	4.50E-10				4.50E-10	0.75	3.38E-10
33	U	235	3.64E-07				3.64E-07	0.75	2.73E-07
34	U	238	2.66E-05				2.66E-05	0.75	2.00E-05

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			STRC		release	release	release		release
8	Element	At. No.	Att. 3		Ci	Ci	Ci	DR=0.75	Ci
9			Table 5						
10	Am	241	0.00221		=$C$25*C43	=$C$28*C52	=C10+E10+F10	0.75	=G10*H10
11	Am	243	0.000208				=C11+E11+F11	0.75	=G11*H11
12	Ba	133	0.000000000000269				=C12+E12+F12	0.75	=G12*H12
13	Ce	144	0.000000997				=C13+E13+F13	0.75	=G13*H13
14	Cf	249	0.00000213				=C14+E14+F14	0.75	=G14*H14
15	Cf	252	0.00785				=C15+E15+F15	0.75	=G15*H15
16	Cm	244	0.00623				=C16+E16+F16	0.75	=G16*H16
17	Cm	246	0.00037				=C17+E17+F17	0.75	=G17*H17
18	Co	60	0.33				=C18+E18+F18	0.75	=G18*H18
19	Cs	137	0.0653				=C19+E19+F19	0.75	=G19*H19
20	H	3	10700				=C20+E20+F20	0.75	=G20*H20
21	Np	237	0.00000886				=C21+E21+F21	0.75	=G21*H21
22	Pm	147	0.0000000126				=C22+E22+F22	0.75	=G22*H22
23	Pu	238	0.0128		=$C$25*C38	=$C$28*C38	=C23+E23+F23	0.75	=G23*H23
24	Pu	239	0.00000888		=$C$25*C39	=$C$28*C39	=C24+E24+F24	0.75	=G24*H24
25	Pu mix	239/241	0.0596						
26	Pu	240	0.000000685		=$C$25*C40	=$C$28*C40	=C26+E26+F26	0.75	=G26*H26
27	Pu	241	0.048		=$C$25*C41	=$C$28*C41	=C27+E27+F27	0.75	=G27*H27
28	Pu mix	242	0.00231	pure->	=$C$25*C42	=$C$28*C42	=E28+F28	0.75	=G28*H28
29	Sr	90	0.0604				=C29+E29+F29	0.75	=G29*H29
30	Tc	99	0.00000000000018				=C30+E30+F30	0.75	=G30*H30
31	Th	232	0.00000102				=C31+E31+F31	0.75	=G31*H31
32	Tl	204	0.00000000045				=C32+E32+F32	0.75	=G32*H32
33	U	235	0.000000364				=C33+E33+F33	0.75	=G33*H33
34	U	238	0.0000266				=C34+E34+F34	0.75	=G34*H34

	A	B	C
36	Pu 239/241 mix activity fractions		
37	nuclide		activity frac
38	Pu	238	0.0073
39	Pu	239	0.2029
40	Pu	240	0.0462
41	Pu	241	0.6761
42	Pu	242	0.0003
43	Am	241	0.0675
44			
45	Pu 242 mix activity fractions		
46	nuclide		activity frac
47	Pu	238	0.0786
48	Pu	239	0.00024
49	Pu	240	0.01184
50	Pu	241	0.88886
51	Pu	242	0.00074
52	Am	241	0.01977

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			SRTC		release	release	release		release
8	Element	At. No.	Att. 5		Ci	Ci	Ci	DR=0.75	Ci
9			Table 52						
10	Am	241	1.86E-03		2.84E-04	0	2.14E-03	0.75	1.61E-03
11	Am	243	6.59E-05				6.59E-05	0.75	4.94E-05
12	Ba	133	0.00E+00				0.00E+00	0.75	0.00E+00
13	Ce	144	7.75E-06				7.75E-06	0.75	5.81E-06
14	Cf	249	0				0.00E+00	0.75	0.00E+00
15	Cf	252	1.78E-03				1.78E-03	0.75	1.34E-03
16	Cm	244	3.99E-03				3.99E-03	0.75	2.99E-03
17	Cm	246	2.01E-05				2.01E-05	0.75	1.51E-05
18	Co	60	2.75E-02				2.75E-02	0.75	2.06E-02
19	Cs	137	4.88E-01				4.88E-01	0.75	3.66E-01
20	H	3	9.66E+00				9.66E+00	0.75	7.25E+00
21	Np	237	2.33E-08				2.33E-08	0.75	1.75E-08
22	Pm	147	0				0.00E+00	0.75	0.00E+00
23	Pu	238	1.00E-03		3.07E-05	0	1.03E-03	0.75	7.73E-04
24	Pu	239	0		8.54E-04	0	8.54E-04	0.75	6.41E-04
25	Pu mix	239/241	4.21E-03						
26	Pu	240	0		1.95E-04	0	1.95E-04	0.75	1.46E-04
27	Pu	241	0		2.85E-03	0	2.85E-03	0.75	2.13E-03
28	Pu mix	242	0	pure->	1.26E-06	0	1.26E-06	0.75	9.47E-07
29	Sr	90	4.86E-01				4.86E-01	0.75	3.65E-01
30	Tc	99	0				0.00E+00	0.75	0.00E+00
31	Th	232	7.28E-09				7.28E-09	0.75	5.46E-09
32	Tl	204	0				0.00E+00	0.75	0.00E+00
33	U	235	2.27E-08				2.27E-08	0.75	1.70E-08
34	U	238	2.73E-07				2.73E-07	0.75	2.05E-07

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			SRTC		release	release	release		release
8	Element	At. No.	Att. 5		Ci	Ci	Ci	DR=0.75	Ci
9			Table 52						
10	Am	241	0.00186		=$C$25*C43	=$C$28*C52	=C10+E10+F10	0.75	=G10*H10
11	Am	243	0.0000659				=C11+E11+F11	0.75	=G11*H11
12	Ba	133	0				=C12+E12+F12	0.75	=G12*H12
13	Ce	144	0.00000775				=C13+E13+F13	0.75	=G13*H13
14	Cf	249	0				=C14+E14+F14	0.75	=G14*H14
15	Cf	252	0.00178				=C15+E15+F15	0.75	=G15*H15
16	Cm	244	0.00399				=C16+E16+F16	0.75	=G16*H16
17	Cm	246	0.0000201				=C17+E17+F17	0.75	=G17*H17
18	Co	60	0.0275				=C18+E18+F18	0.75	=G18*H18
19	Cs	137	0.488				=C19+E19+F19	0.75	=G19*H19
20	H	3	9.66				=C20+E20+F20	0.75	=G20*H20
21	Np	237	0.0000000233				=C21+E21+F21	0.75	=G21*H21
22	Pm	147	0				=C22+E22+F22	0.75	=G22*H22
23	Pu	238	0.001		=$C$25*C38	=$C$28*C38	=C23+E23+F23	0.75	=G23*H23
24	Pu	239	0		=$C$25*C39	=$C$28*C39	=C24+E24+F24	0.75	=G24*H24
25	Pu mix	239/241	0.00421						
26	Pu	240	0		=$C$25*C40	=$C$28*C40	=C26+E26+F26	0.75	=G26*H26
27	Pu	241	0		=$C$25*C41	=$C$28*C41	=C27+E27+F27	0.75	=G27*H27
28	Pu mix	242	0	pure->	=$C$25*C42	=$C$28*C42	=E28+F28	0.75	=G28*H28
29	Sr	90	0.486				=C29+E29+F29	0.75	=G29*H29
30	Tc	99	0				=C30+E30+F30	0.75	=G30*H30
31	Th	232	0.00000000728				=C31+E31+F31	0.75	=G31*H31
32	Tl	204	0				=C32+E32+F32	0.75	=G32*H32
33	U	235	0.0000000227				=C33+E33+F33	0.75	=G33*H33
34	U	238	0.000000273				=C34+E34+F34	0.75	=G34*H34

	A	B	C
36	Pu 239/241 mix activity fractions		
37	nuclide		activity frac
38	Pu	238	0.0073
39	Pu	239	0.2029
40	Pu	240	0.0462
41	Pu	241	0.6761
42	Pu	242	0.0003
43	Am	241	0.0675
44			
45	Pu 242 mix activity fractions		
46	nuclide		activity frac
47	Pu	238	0.0786
48	Pu	239	0.00024
49	Pu	240	0.01184
50	Pu	241	0.88886
51	Pu	242	0.00074
52	Am	241	0.01977

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			STRC		release	release	release		release
8	Element	At. No.	Att. 2		Ci	Ci	Ci	DR=0.75	Ci
9			Table 71						
10	Am	241	5.80E-03		5.46E-03	0.000141	1.14E-02	0.75	8.55E-03
11	Am	243	3.33E-04				3.33E-04	0.75	2.50E-04
12	Ba	133	2.69E-13				2.69E-13	0.75	2.02E-13
13	Ce	144	1.02E-05				1.02E-05	0.75	7.65E-06
14	Cf	249	8.86E-06				8.86E-06	0.75	6.65E-06
15	Cf	252	6.29E-03				6.29E-03	0.75	4.72E-03
16	Cm	244	1.26E-02				1.26E-02	0.75	9.45E-03
17	Cm	246	2.75E-04				2.75E-04	0.75	2.06E-04
18	Co	60	3.62E-01				3.62E-01	0.75	2.72E-01
19	Cs	137	6.35E-01				6.35E-01	0.75	4.76E-01
20	H	3	1.07E+04				1.07E+04	0.75	8.03E+03
21	Np	237	2.37E-05				2.37E-05	0.75	1.78E-05
22	Pm	147	1.26E-08				1.26E-08	0.75	9.45E-09
23	Pu	238	9.21E-03		5.91E-04	5.22E-05	9.85E-03	0.75	7.39E-03
24	Pu	239	8.88E-06		1.64E-02	0.001451	1.79E-02	0.75	1.34E-02
25	Pu mix	239/241	8.09E-02						
26	Pu	240	0		3.74E-03	0.00033	4.07E-03	0.75	3.05E-03
27	Pu	241	2.03E-01		5.47E-02	0.004834	2.63E-01	0.75	1.97E-01
28	Pu mix	242	7.15E-03	pure->	2.43E-05	2.15E-06	2.64E-05	0.75	1.98E-05
29	Sr	90	6.31E-01				6.31E-01	0.75	4.73E-01
30	Tc	99	1.80E-13				1.80E-13	0.75	1.35E-13
31	Th	232	8.89E-07				8.89E-07	0.75	6.67E-07
32	Tl	204	4.50E-10				4.50E-10	0.75	3.38E-10
33	U	235	5.30E-07				5.30E-07	0.75	3.98E-07
34	U	238	4.13E-05				4.13E-05	0.75	3.10E-05

	A	B	C	D	E	F	G	H	I
4					Pu239/241	Pu242	pre-DR		DR'd
5					unmix	unmix	unmixed		unmixed
6			respirable		respirable	respirable	respirable		respirable
7			STRC		release	release	release		release
8	Element	At. No.	Att. 2		Ci	Ci	Ci	DR=0.75	Ci
9			Table 71						
10	Am	241	0.0058		=$C$25*C43	=$C$28*C52	=C10+E10+F10	0.75	=G10*H10
11	Am	243	0.000333				=C11+E11+F11	0.75	=G11*H11
12	Ba	133	0.000000000000269				=C12+E12+F12	0.75	=G12*H12
13	Ce	144	0.0000102				=C13+E13+F13	0.75	=G13*H13
14	Cf	249	0.00000886				=C14+E14+F14	0.75	=G14*H14
15	Cf	252	0.00629				=C15+E15+F15	0.75	=G15*H15
16	Cm	244	0.0126				=C16+E16+F16	0.75	=G16*H16
17	Cm	246	0.000275				=C17+E17+F17	0.75	=G17*H17
18	Co	60	0.362				=C18+E18+F18	0.75	=G18*H18
19	Cs	137	0.635				=C19+E19+F19	0.75	=G19*H19
20	H	3	10700				=C20+E20+F20	0.75	=G20*H20
21	Np	237	0.0000237				=C21+E21+F21	0.75	=G21*H21
22	Pm	147	0.0000000126				=C22+E22+F22	0.75	=G22*H22
23	Pu	238	0.00921		=$C$25*C38	=$C$28*C38	=C23+E23+F23	0.75	=G23*H23
24	Pu	239	0.00000888		=$C$25*C39	=$C$28*C39	=C24+E24+F24	0.75	=G24*H24
25	Pu mix	239/241	0.0809						
26	Pu	240	0		=$C$25*C40	=$C$28*C40	=C26+E26+F26	0.75	=G26*H26
27	Pu	241	0.203		=$C$25*C41	=$C$28*C41	=C27+E27+F27	0.75	=G27*H27
28	Pu mix	242	0.00715	pure->	=$C$25*C42	=$C$28*C42	=E28+F28	0.75	=G28*H28
29	Sr	90	0.631				=C29+E29+F29	0.75	=G29*H29
30	Tc	99	0.00000000000018				=C30+E30+F30	0.75	=G30*H30
31	Th	232	0.000000889				=C31+E31+F31	0.75	=G31*H31
32	Tl	204	0.00000000045				=C32+E32+F32	0.75	=G32*H32
33	U	235	0.00000053				=C33+E33+F33	0.75	=G33*H33
34	U	238	0.0000413				=C34+E34+F34	0.75	=G34*H34

	A	B	C
36	Pu 239/241 mix activity fractions		
37	nuclide		activity frac
38	Pu	238	0.0073
39	Pu	239	0.2029
40	Pu	240	0.0462
41	Pu	241	0.6761
42	Pu	242	0.0003
43	Am	241	0.0675
44			
45	Pu 242 mix activity fractions		
46	nuclide		activity frac
47	Pu	238	0.0786
48	Pu	239	0.00024
49	Pu	240	0.01184
50	Pu	241	0.88886
51	Pu	242	0.00074
52	Am	241	0.01977

	A	B	C	D	E	F	H
3			5	52	71	Sum	Sum
4			DR'd	DR'd	DR'd	DR'd	DR'd
5			unmixed	unmixed	unmixed	unmixed	unmixed
6			respirable	respirable	respirable	respirable	TOTAL
7			release	release	release	release	release
8	Element	At. No.	Ci	Ci	Ci	Ci	Ci
9							
10	Am	241	4.71E-03	1.61E-03	8.55E-03	1.49E-02	3.23E-02
11	Am	243	1.56E-04	4.94E-05	2.50E-04	4.55E-04	7.26E-04
12	Ba	133	2.02E-13	0.00E+00	2.02E-13	4.04E-13	4.04E-13
13	Ce	144	7.48E-07	5.81E-06	7.65E-06	1.42E-05	1.42E-05
14	Cf	249	1.60E-06	0.00E+00	6.65E-06	8.24E-06	9.53E-06
15	Cf	252	5.89E-03	1.34E-03	4.72E-03	1.19E-02	1.19E-02
16	Cm	244	4.67E-03	2.99E-03	9.45E-03	1.71E-02	1.53E-02
17	Cm	246	2.78E-04	1.51E-05	2.06E-04	4.99E-04	7.50E-04
18	Co	60	2.48E-01	2.06E-02	2.72E-01	5.40E-01	5.40E-01
19	Cs	137	4.90E-02	3.66E-01	4.76E-01	8.91E-01	8.91E-01
20	H	3	8.03E+03	7.25E+00	8.03E+03	1.61E+04	1.61E+04
21	Np	237	6.65E-06	1.75E-08	1.78E-05	2.44E-05	3.15E-05
22	Pm	147	9.45E-09	0.00E+00	9.45E-09	1.89E-08	1.89E-08
23	Pu	238	9.94E-03	7.73E-04	7.39E-03	1.81E-02	4.15E-02
24	Pu	239	9.43E-03	6.41E-04	1.34E-02	2.35E-02	6.94E-02
25	Pu mix	239/241					
26	Pu	240	2.15E-03	1.46E-04	3.05E-03	5.34E-03	1.59E-02
27	Pu	241	6.74E-02	2.13E-03	1.97E-01	2.66E-01	4.58E-01
28	Pu pure	242	1.39E-05	9.47E-07	1.98E-05	3.47E-05	1.10E-04
29	Sr	90	4.53E-02	3.65E-01	4.73E-01	8.83E-01	8.84E-01
30	Tc	99	1.35E-13	0.00E+00	1.35E-13	2.70E-13	2.70E-13
31	Th	232	7.65E-07	5.46E-09	6.67E-07	1.44E-06	1.45E-06
32	Tl	204	3.38E-10	0.00E+00	3.38E-10	6.75E-10	6.75E-10
33	U	235	2.73E-07	1.70E-08	3.98E-07	6.88E-07	1.34E-06
34	U	238	2.00E-05	2.05E-07	3.10E-05	5.11E-05	1.62E-04

	A	B	C	D	E	F	H
3			5	52	71	Sum	Sum
4			DR'd	DR'd	DR'd	DR'd	DR'd
5			unmixed	unmixed	unmixed	unmixed	unmixed
6			respirable	respirable	respirable	respirable	TOTAL
7			release	release	release	release	release
8	Element	At. No.	Ci	Ci	Ci	Ci	Ci
9							
10	Am	241	=Table5!I10	='Table 52'!I10	=Table71!I10	=C10+D10+E10	='Nonresp + resp'!N10
11	Am	243	=Table5!I11	='Table 52'!I11	=Table71!I11	=C11+D11+E11	='Nonresp + resp'!N11
12	Ba	133	=Table5!I12	='Table 52'!I12	=Table71!I12	=C12+D12+E12	='Nonresp + resp'!N12
13	Ce	144	=Table5!I13	='Table 52'!I13	=Table71!I13	=C13+D13+E13	='Nonresp + resp'!N13
14	Cf	249	=Table5!I14	='Table 52'!I14	=Table71!I14	=C14+D14+E14	='Nonresp + resp'!N14
15	Cf	252	=Table5!I15	='Table 52'!I15	=Table71!I15	=C15+D15+E15	='Nonresp + resp'!N15
16	Cm	244	=Table5!I16	='Table 52'!I16	=Table71!I16	=C16+D16+E16	='Nonresp + resp'!N16
17	Cm	246	=Table5!I17	='Table 52'!I17	=Table71!I17	=C17+D17+E17	='Nonresp + resp'!N17
18	Co	60	=Table5!I18	='Table 52'!I18	=Table71!I18	=C18+D18+E18	='Nonresp + resp'!N18
19	Cs	137	=Table5!I19	='Table 52'!I19	=Table71!I19	=C19+D19+E19	='Nonresp + resp'!N19
20	H	3	=Table5!I20	='Table 52'!I20	=Table71!I20	=C20+D20+E20	='Nonresp + resp'!N20
21	Np	237	=Table5!I21	='Table 52'!I21	=Table71!I21	=C21+D21+E21	='Nonresp + resp'!N21
22	Pm	147	=Table5!I22	='Table 52'!I22	=Table71!I22	=C22+D22+E22	='Nonresp + resp'!N22
23	Pu	238	=Table5!I23	='Table 52'!I23	=Table71!I23	=C23+D23+E23	='Nonresp + resp'!N23
24	Pu	239	=Table5!I24	='Table 52'!I24	=Table71!I24	=C24+D24+E24	='Nonresp + resp'!N24
25	Pu mix	239/241					
26	Pu	240	=Table5!I26	='Table 52'!I26	=Table71!I26	=C26+D26+E26	='Nonresp + resp'!N26
27	Pu	241	=Table5!I27	='Table 52'!I27	=Table71!I27	=C27+D27+E27	='Nonresp + resp'!N27
28	Pu pure	242	=Table5!I28	='Table 52'!I28	=Table71!I28	=C28+D28+E28	='Nonresp + resp'!N28
29	Sr	90	=Table5!I29	='Table 52'!I29	=Table71!I29	=C29+D29+E29	='Nonresp + resp'!N29
30	Tc	99	=Table5!I30	='Table 52'!I30	=Table71!I30	=C30+D30+E30	='Nonresp + resp'!N30
31	Th	232	=Table5!I31	='Table 52'!I31	=Table71!I31	=C31+D31+E31	='Nonresp + resp'!N31
32	Tl	204	=Table5!I32	='Table 52'!I32	=Table71!I32	=C32+D32+E32	='Nonresp + resp'!N32
33	U	235	=Table5!I33	='Table 52'!I33	=Table71!I33	=C33+D33+E33	='Nonresp + resp'!N33
34	U	238	=Table5!I34	='Table 52'!I34	=Table71!I34	=C34+D34+E34	='Nonresp + resp'!N34

	A	B	F	G	H	L
3				deconvolute mixes		
4						pre-DR
5			mixed	unmix	unmix	unmixed
6			total	Pu239/241		total
7			release		Pu242	release
8	Element	At. No.	Ci	Ci	Ci	Ci
9						
10	Am	241	1.21E-02	3.08E-02	2.52E-04	4.31E-02
11	Am	243	9.68E-04			9.68E-04
12	Ba	133	5.38E-13			5.38E-13
13	Ce	144	1.90E-05			1.90E-05
14	Cf	249	1.27E-05			1.27E-05
15	Cf	252	1.59E-02			1.59E-02
16	Cm	244	2.03E-02			2.03E-02
17	Cm	246	1.00E-03			1.00E-03
18	Co	60	7.19E-01			7.19E-01
19	Cs	137	1.19E+00			1.19E+00
20	H	3	2.14E+04			2.14E+04
21	Np	237	4.20E-05			4.20E-05
22	Pm	147	2.52E-08			2.52E-08
23	Pu	238	5.10E-02	3.33E-03	1.00E-03	5.53E-02
24	Pu	239	1.78E-05	9.25E-02	3.06E-06	9.25E-02
25	Pu mix	239/241	4.56E-01			
26	Pu	240	9.72E-07	2.11E-02	1.51E-04	2.12E-02
27	Pu	241	2.91E-01	3.08E-01	1.14E-02	6.11E-01
28	Pu mix	242	1.28E-02			1.46E-04
29	Sr	90	1.18E+00			1.18E+00
30	Tc	99	3.60E-13			3.60E-13
31	Th	232	1.93E-06			1.93E-06
32	Tl	204	9.00E-10			9.00E-10
33	U	235	1.78E-06			1.78E-06
34	U	238	2.15E-04			2.15E-04
35	Pu	242		1.37E-04	9.45E-06	

	A	B	F	G	H	L
3				deconvolute mixes		
4						pre-DR
5			mixed	unmix	unmix	unmixed
6			total	Pu239/241		total
7			release		Pu242	release
8	Element	At. No.	Ci	Ci	Ci	Ci
9						
10	Am	241	=C10+D10+E10	=C43*F25	=F28*C52	=F10+G10+H10
11	Am	243	=C11+D11+E11			=F11+G11+H11
12	Ba	133	=C12+D12+E12			=F12+G12+H12
13	Ce	144	=C13+D13+E13			=F13+G13+H13
14	Cf	249	=C14+D14+E14			=F14+G14+H14
15	Cf	252	=C15+D15+E15			=F15+G15+H15
16	Cm	244	=C16+D16+E16			=F16+G16+H16
17	Cm	246	=C17+D17+E17			=F17+G17+H17
18	Co	60	=C18+D18+E18			=F18+G18+H18
19	Cs	137	=C19+D19+E19			=F19+G19+H19
20	H	3	=C20+D20+E20			=F20+G20+H20
21	Np	237	=C21+D21+E21			=F21+G21+H21
22	Pm	147	=C22+D22+E22			=F22+G22+H22
23	Pu	238	=C23+D23+E23	=C38*+$F$25	=$F$28*C47	=F23+G23+H23
24	Pu	239	=C24+D24+E24	=C39*+$F$25	=$F$28*C48	=F24+G24+H24
25	Pu mix	239/241	=C25+D25+E25			
26	Pu	240	=C26+D26+E26	=$F$25*C40	=$F$28*C49	=F26+G26+H26
27	Pu	241	=C27+D27+E27	=$F$25*C41	=$F$28*C50	=F27+G27+H27
28	Pu mix	242	=C28+D28+E28			=G35+H35
29	Sr	90	=C29+D29+E29			=F29+G29+H29
30	Tc	99	=C30+D30+E30			=F30+G30+H30
31	Th	232	=C31+D31+E31			=F31+G31+H31
32	Tl	204	=C32+D32+E32			=F32+G32+H32
33	U	235	=C33+D33+E33			=F33+G33+H33
34	U	238	=C34+D34+E34			=F34+G34+H34
35	Pu	242		=F25*C42	=$F$28*C51	

	A	B	C
36	Pu 239/241 mix activity fractions		
37	nuclide		activity frac
38	Pu	238	0.0073
39	Pu	239	0.2029
40	Pu	240	0.0462
41	Pu	241	0.6761
42	Pu	242	0.0003
43	Am	241	0.0675
44			
45	Pu 242 mix activity fractions		
46	nuclide		activity frac
47	Pu	238	0.0786
48	Pu	239	0.00024
49	Pu	240	0.01184
50	Pu	241	0.88886
51	Pu	242	0.00074
52	Am	241	0.01977

	A	B	L	M	N	O	P
3							
4			pre-DR		DR'd		
5			unmixed		unmixed		
6			total		total	HTO	particulate
7			release		release	release	release
8	Element	At. No.	Ci	DR=0.75	Ci	Ci	Ci
9							
10	Am	241	4.31E-02	0.75	3.23E-02		3.23E-02
11	Am	243	9.68E-04	0.75	7.26E-04		7.26E-04
12	Ba	133	5.38E-13	0.75	4.04E-13		4.04E-13
13	Ce	144	1.90E-05	0.75	1.42E-05		1.42E-05
14	Cf	249	1.27E-05	0.75	9.53E-06		9.53E-06
15	Cf	252	1.59E-02	0.75	1.19E-02		1.19E-02
16	Cm	244	2.03E-02	0.75	1.53E-02		1.53E-02
17	Cm	246	1.00E-03	0.75	7.50E-04		7.50E-04
18	Co	60	7.19E-01	0.75	5.40E-01		5.40E-01
19	Cs	137	1.19E+00	0.75	8.91E-01		8.91E-01
20	H	3	2.14E+04	0.75	1.61E+04	1.61E+04	
21	Np	237	4.20E-05	0.75	3.15E-05		3.15E-05
22	Pm	147	2.52E-08	0.75	1.89E-08		1.89E-08
23	Pu	238	5.53E-02	0.75	4.15E-02		4.15E-02
24	Pu	239	9.25E-02	0.75	6.94E-02		6.94E-02
25	Pu mix	239/241					
26	Pu	240	2.12E-02	0.75	1.59E-02		1.59E-02
27	Pu	241	6.11E-01	0.75	4.58E-01		4.58E-01
28	Pu mix	242	1.46E-04	0.75	1.10E-04		1.10E-04
29	Sr	90	1.18E+00	0.75	8.84E-01		8.84E-01
30	Tc	99	3.60E-13	0.75	2.70E-13		2.70E-13
31	Th	232	1.93E-06	0.75	1.45E-06		1.45E-06
32	Tl	204	9.00E-10	0.75	6.75E-10		6.75E-10
33	U	235	1.78E-06	0.75	1.34E-06		1.34E-06
34	U	238	2.15E-04	0.75	1.62E-04		1.62E-04
35	Pu	242				Sum Ci	2.96E+00

	A	B	L	M	N	O	P
3							
4			pre-DR		DR'd		
5			unmixed		unmixed		
6			total		total	HTO	particulate
7			release		release	release	release
8	Element	At. No.	Ci	DR=0.75	Ci	Ci	Ci
9							
10	Am	241	=F10+G10+H10	0.75	=L10*M10		=N10
11	Am	243	=F11+G11+H11	0.75	=L11*M11		=N11
12	Ba	133	=F12+G12+H12	0.75	=L12*M12		=N12
13	Ce	144	=F13+G13+H13	0.75	=L13*M13		=N13
14	Cf	249	=F14+G14+H14	0.75	=L14*M14		=N14
15	Cf	252	=F15+G15+H15	0.75	=L15*M15		=N15
16	Cm	244	=F16+G16+H16	0.75	=L16*M16		=N16
17	Cm	246	=F17+G17+H17	0.75	=L17*M17		=N17
18	Co	60	=F18+G18+H18	0.75	=L18*M18		=N18
19	Cs	137	=F19+G19+H19	0.75	=L19*M19		=N19
20	H	3	=F20+G20+H20	0.75	=L20*M20	=N20	
21	Np	237	=F21+G21+H21	0.75	=L21*M21		=N21
22	Pm	147	=F22+G22+H22	0.75	=L22*M22		=N22
23	Pu	238	=F23+G23+H23	0.75	=L23*M23		=N23
24	Pu	239	=F24+G24+H24	0.75	=L24*M24		=N24
25	Pu mix	239/241					
26	Pu	240	=F26+G26+H26	0.75	=L26*M26		=N26
27	Pu	241	=F27+G27+H27	0.75	=L27*M27		=N27
28	Pu mix	242	=G35+H35	0.75	=L28*M28		=N28
29	Sr	90	=F29+G29+H29	0.75	=L29*M29		=N29
30	Tc	99	=F30+G30+H30	0.75	=L30*M30		=N30
31	Th	232	=F31+G31+H31	0.75	=L31*M31		=N31
32	Tl	204	=F32+G32+H32	0.75	=L32*M32		=N32
33	U	235	=F33+G33+H33	0.75	=L33*M33		=N33
34	U	238	=F34+G34+H34	0.75	=L34*M34		=N34
35	Pu	242				Sum Ci	=SUM(P10:P34)

	A	B	E	F	G	H	J
3						CEDE	CDE B.S.
4						Inhalation	Inhalation
5					Class	DCF	DCF
6			DCF External			FGR-11	FGR-11
7			Effective	Skin	(D,W,Y)	Sv/Bq	Sv/Bq
8	Element	At. No.	mrem/yr	pemrem/yr	per uCi/m^2		
9							
10	Am	241	2.99E+00	6.39E+00	W# BS	1.20E-04	2.17E-03
11	Am	243	6.61E+00	1.06E+01	W#	1.19E-04	2.17E-03
12	Ba	133	4.19E+01	5.82E+01	D	2.11E-09	9.51E-09
13	Ce	144	2.16E+00	2.86E+00	Y	1.01E-07	4.72E-09
14	Cf	249	3.52E+01	4.76E+01	W#	1.56E-04	3.32E-03
15	Cf	252	6.34E-02	4.66E-01	Y *	4.24E-05	1.37E-04
16	Cm	244	8.29E-02	6.56E-01	W#	6.70E-05	1.17E-03
17	Cm	246	7.34E-02	5.84E-01	W#	1.22E-04	2.22E-03
18	Co	60	2.27E+02	3.05E+02	Y	5.91E-08	1.35E-08
19	Cs	137	0.00E+00	2.81E+01	D	8.63E-09	7.94E-09
20	H	3	0.00E+00	0.00E+00	V*	1.73E-11	1.73E-11
21	Np	237	3.24E+00	7.54E+00	W#	1.46E-04	3.27E-03
22	Pm	147	4.10E-04	4.96E-04	Y *	1.06E-08	2.01E-08
23	Pu	238	8.58E-02	7.17E-01	W#	1.06E-04	1.90E-03
24	Pu	239	3.78E-02	2.80E-01	W#	1.16E-04	2.11E-03
25	Pu	239/241					
26	Pu	240	8.20E-02	6.83E-01	W#	1.16E-04	2.11E-03
27	Pu	241	0.00E+00	0.00E+00	W#	2.23E-06	4.20E-05
28	Pu	242	6.82E-02	5.67E-01	W#	1.11E-04	2.01E-03
29	Sr	90	0.00E+00	1.73E+01	Y *	3.51E-07	7.09E-08
30	Tc	99	6.26E-05	7.73E-05	W	2.25E-09	3.99E-11
31	Th	232	6.66E-02	4.85E-01	W	4.43E-04	1.11E-02
32	Tl	204	1.30E-01	1.35E+02	D	6.50E-10	4.15E-10
33	U	235	1.71E+01	2.27E+01	Y *	3.32E-05	1.05E-06
34	U	238	6.46E-02	5.30E-01	Y *	3.20E-05	1.01E-06
35							
36	Ba	137m	6.11E+01	1.91E+02			
37	Y	90	0.00E+00	1.03E+03			
38	Pr	144	2.98E+00	1.49E+03	* = Different limiting organ for different solubility class		
39	Pa	233	2.36E+01	3.28E+01			
40	Th	234	1.01E+00	1.77E+00			
41	Pa	234	1.96E+02	4.04E+02			
42	Np	239	1.92E+01	2.98E+01			
43	Th	231	1.91E+00	6.42E+00			
44	Ra	228	6.67E-08	8.02E-07			
45	Ac	228	9.10E+01	5.03E+02			

	A	B	C	D	E	F	G	H	I	J
1	Relocation calculation for SRTC accident. Particulates ONLY; tritium considered separately.									
2	Calculation of dose from deposited radionuclides (EPA PAG manual 1991, section 7.3.2, p. 7-15) (resuspension and external radiation)									
3		1.00E-06	Resuspension factor (1/m)					2000	Protective Action Guide (PAG) -- Effective Dose (mrem)	
4		1.05E+04	BreathRate (m^3/yr)					20000	PAG -- Organ-specific Dose (mrem)	
5		3.70E+04	CF (Bq/microCi)					100000	PAG -- Skin (mrem)	
6		1.00E+05	CF (mrem/Sv)							
7		1.00E+00	microCi/m^2				CEDE and BS Dose are based on respirable particulate release			
8		1.00E+00	Exposure period (1 year)				External EDE and Skin Dose are based on total particulate release			

	A	B	C
9		Total Release (Ci)	Activity fraction (Total)
10	Am-241	3.23E-02	1.09E-02
11	Am-243	7.26E-04	2.45E-04
12	Ba-133	4.04E-13	1.36E-13
13	Ce-144	1.42E-05	4.80E-06
14	Cf-249	9.53E-06	3.22E-06
15	Cf-252	1.19E-02	4.03E-03
16	Cm-244	1.53E-02	5.15E-03
17	Cm-246	7.50E-04	2.53E-04
18	Co-60	5.40E-01	1.82E-01
19	Cs-137	8.91E-01	3.01E-01
20	H-3	0.00E+00	0.00E+00
21	Np-237	3.15E-05	1.06E-05
22	Pm-147	1.89E-08	6.38E-09
23	Pu-238	4.15E-02	1.40E-02
24	Pu-239	6.94E-02	2.34E-02
25	Pu mix-239/241	0.00E+00	0.00E+00
26	Pu-240	1.59E-02	5.37E-03
27	Pu-241	4.58E-01	1.55E-01
28	Pu pure-242	1.10E-04	3.70E-05
29	Sr-90	8.84E-01	2.99E-01
30	Tc-99	2.70E-13	9.12E-14
31	Th-232	1.45E-06	4.90E-07
32	Tl-204	6.75E-10	2.28E-10
33	U-235	1.34E-06	4.52E-07
34	U-238	1.62E-04	5.45E-05
35	Total	2.96E+00	1.00E+00
36	Ba-137m	8.91E-01	3.01E-01
37	Y-90	8.84E-01	2.99E-01
38	Pr-144	1.42E-05	4.80E-06
39	Pa-233	3.15E-05	1.06E-05
40	Th-234	1.62E-04	5.45E-05
41	Pa-234	1.62E-04	5.45E-05
42	Np-239	7.26E-04	2.45E-04
43	Th-231	1.34E-06	4.52E-07
44	Ra-228	1.45E-06	4.90E-07
45	Ac-228	1.45E-06	4.90E-07
46			
47	Total		

	A	B	C
9		Total Release (Ci)	Activity fraction (Total)
10		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H10	=B10/$B$35
11		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H11	=B11/$B$35
12		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H12	=B12/$B$35
13		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H13	=B13/$B$35
14		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H14	=B14/$B$35
15		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H15	=B15/$B$35
16		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H16	=B16/$B$35
17		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H17	=B17/$B$35
18		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H18	=B18/$B$35
19		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H19	=B19/$B$35
20		=0	=B20/$B$35
21		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H21	=B21/$B$35
22		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H22	=B22/$B$35
23		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H23	=B23/$B$35
24		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H24	=B24/$B$35
25		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H25	=B25/$B$35
26		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H26	=B26/$B$35
27		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H27	=B27/$B$35
28		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H28	=B28/$B$35
29		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H29	=B29/$B$35
30		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H30	=B30/$B$35
31		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H31	=B31/$B$35
32		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H32	=B32/$B$35
33		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H33	=B33/$B$35
34		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$H34	=B34/$B$35
35		=SUM(B10:B34)	=SUM(C10:C34)
36		==B19	=C19
37		==B29	=C29
38		==B13	=C13
39		==B21	=C21
40		==B34	=C34
41		==B34	=C34
42		==B11	=C11
43		==B33	=C33
44		==B31	=C31
45		==B31	=C31
46			
47			

	A	D	E
9		Respirable Release (Ci)	Activity fraction (Resp)
10	Am-241	1.49E-02	5.56E-03
11	Am-243	4.55E-04	1.70E-04
12	Ba-133	4.04E-13	1.51E-13
13	Ce-144	1.42E-05	5.32E-06
14	Cf-249	8.24E-06	3.08E-06
15	Cf-252	1.19E-02	4.47E-03
16	Cm-244	1.71E-02	6.40E-03
17	Cm-246	4.99E-04	1.87E-04
18	Co-60	5.40E-01	2.02E-01
19	Cs-137	8.91E-01	3.34E-01
20	H-3	0.00E+00	0.00E+00
21	Np-237	2.44E-05	9.14E-06
22	Pm-147	1.89E-08	7.07E-09
23	Pu-238	1.81E-02	6.77E-03
24	Pu-239	2.35E-02	8.78E-03
25	Pu mix-239/241	0.00E+00	0.00E+00
26	Pu-240	5.34E-03	2.00E-03
27	Pu-241	2.66E-01	9.97E-02
28	Pu pure-242	3.47E-05	1.30E-05
29	Sr-90	8.83E-01	3.30E-01
30	Tc-99	2.70E-13	1.01E-13
31	Th-232	1.44E-06	5.38E-07
32	Tl-204	6.75E-10	2.53E-10
33	U-235	6.88E-07	2.57E-07
34	U-238	5.11E-05	1.91E-05
35	Total	2.67E+00	1.00E+00
36	Ba-137m	8.91E-01	3.34E-01
37	Y-90	8.83E-01	3.30E-01
38	Pr-144	1.42E-05	5.32E-06
39	Pa-233	2.44E-05	9.14E-06
40	Th-234	5.11E-05	1.91E-05
41	Pa-234	5.11E-05	1.91E-05
42	Np-239	4.55E-04	1.70E-04
43	Th-231	6.88E-07	2.57E-07
44	Ra-228	1.44E-06	5.38E-07
45	Ac-228	1.44E-06	5.38E-07
46			
47	Total		

	A	D	E
9		Respirable Release (Ci)	Activity fraction (Resp)
10		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F10	=D10/$D$35
11		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F11	=D11/$D$35
12		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F12	=D12/$D$35
13		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F13	=D13/$D$35
14		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F14	=D14/$D$35
15		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F15	=D15/$D$35
16		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F16	=D16/$D$35
17		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F17	=D17/$D$35
18		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F18	=D18/$D$35
19		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F19	=D19/$D$35
20		=0	=D20/$D$35
21		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F21	=D21/$D$35
22		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F22	=D22/$D$35
23		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F23	=D23/$D$35
24		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F24	=D24/$D$35
25		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F25	=D25/$D$35
26		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F26	=D26/$D$35
27		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F27	=D27/$D$35
28		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F28	=D28/$D$35
29		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F29	=D29/$D$35
30		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F30	=D30/$D$35
31		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F31	=D31/$D$35
32		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F32	=D32/$D$35
33		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F33	=D33/$D$35
34		='I:\jay.thompson\H att\[SourceSRTC.xls]resp sums'!$F34	=D34/$D$35
35		=SUM(D10:D34)	=SUM(E10:E34)
36		==D19	=E19
37		==D29	=E29
38		==D13	=E13
39		==D21	=E21
40		==D34	=E34
41		==D34	=E34
42		==D11	=E11
43		==D33	=E33
44		==D31	=E31
45		==D31	=E31
46			
47			

	A	G	H
9		CEDE (mrem per uCI/m^2)	External EDE (mrem per uCi/m^2)
10	Am-241	2.59E+01	3.62E-02
11	Am-243	7.87E-01	1.80E-03
12	Ba-133	1.24E-14	6.33E-12
13	Ce-144	2.09E-05	1.15E-05
14	Cf-249	1.87E-02	1.26E-04
15	Cf-252	7.36E+00	2.83E-04
16	Cm-244	1.67E+01	4.73E-04
17	Cm-246	8.85E-01	2.06E-05
18	Co-60	4.64E-01	4.58E+01
19	Cs-137	1.12E-01	0.00E+00
20	H-3	0.00E+00	0.00E+00
21	Np-237	5.19E-02	3.82E-05
22	Pm-147	2.91E-09	2.90E-12
23	Pu-238	2.79E+01	1.33E-03
24	Pu-239	3.96E+01	9.81E-04
25	Pu mix-239/241	0.00E+00	0.00E+00
26	Pu-240	9.01E+00	4.88E-04
27	Pu-241	8.64E+00	0.00E+00
28	Pu pure-242	5.60E-02	2.80E-06
29	Sr-90	4.51E+00	0.00E+00
30	Tc-99	8.83E-15	6.32E-18
31	Th-232	9.26E-03	3.62E-08
32	Tl-204	6.38E-12	3.28E-11
33	U-235	3.32E-04	8.57E-06
34	U-238	2.38E-02	3.90E-06
35	Total		
36	Ba-137m		2.04E+01
37	Y-90		0.00E+00
38	Pr-144		1.59E-05
39	Pa-233		2.78E-04
40	Th-234		6.10E-05
41	Pa-234		1.18E-02
42	Np-239		5.22E-03
43	Th-231		9.57E-07
44	Ra-228		3.62E-14
45	Ac-228		4.94E-05
46			
47	Total	1.42E+02	6.63E+01

	A	G	H
9		CEDE (mrem per uCi/m^2)	External EDE (mrem per uCi/m^2)
10	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E10*Relocation!H10	=$B$7*$B$8*$C10*Relocation!E10*$B$35/$D$35
11	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E11*Relocation!H11	=$B$7*$B$8*$C11*Relocation!E11*$B$35/$D$35
12	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E12*Relocation!H12	=$B$7*$B$8*$C12*Relocation!E12*$B$35/$D$35
13	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E13*Relocation!H13	=$B$7*$B$8*$C13*Relocation!E13*$B$35/$D$35
14	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E14*Relocation!H14	=$B$7*$B$8*$C14*Relocation!E14*$B$35/$D$35
15	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E15*Relocation!H15	=$B$7*$B$8*$C15*Relocation!E15*$B$35/$D$35
16	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E16*Relocation!H16	=$B$7*$B$8*$C16*Relocation!E16*$B$35/$D$35
17	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E17*Relocation!H17	=$B$7*$B$8*$C17*Relocation!E17*$B$35/$D$35
18	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E18*Relocation!H18	=$B$7*$B$8*$C18*Relocation!E18*$B$35/$D$35
19	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E19*Relocation!H19	=$B$7*$B$8*$C19*Relocation!E19*$B$35/$D$35
20	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E20*Relocation!H20	=$B$7*$B$8*$C20*Relocation!E20*$B$35/$D$35
21	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E21*Relocation!H21	=$B$7*$B$8*$C21*Relocation!E21*$B$35/$D$35
22	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E22*Relocation!H22	=$B$7*$B$8*$C22*Relocation!E22*$B$35/$D$35
23	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E23*Relocation!H23	=$B$7*$B$8*$C23*Relocation!E23*$B$35/$D$35
24	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E24*Relocation!H24	=$B$7*$B$8*$C24*Relocation!E24*$B$35/$D$35
25	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E25*Relocation!H25	=$B$7*$B$8*$C25*Relocation!E25*$B$35/$D$35
26	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E26*Relocation!H26	=$B$7*$B$8*$C26*Relocation!E26*$B$35/$D$35
27	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E27*Relocation!H27	=$B$7*$B$8*$C27*Relocation!E27*$B$35/$D$35
28	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E28*Relocation!H28	=$B$7*$B$8*$C28*Relocation!E28*$B$35/$D$35
29	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E29*Relocation!H29	=$B$7*$B$8*$C29*Relocation!E29*$B$35/$D$35
30	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E30*Relocation!H30	=$B$7*$B$8*$C30*Relocation!E30*$B$35/$D$35
31	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E31*Relocation!H31	=$B$7*$B$8*$C31*Relocation!E31*$B$35/$D$35
32	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E32*Relocation!H32	=$B$7*$B$8*$C32*Relocation!E32*$B$35/$D$35
33	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E33*Relocation!H33	=$B$7*$B$8*$C33*Relocation!E33*$B$35/$D$35
34	='	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*E34*Relocation!H34	=$B$7*$B$8*$C34*Relocation!E34*$B$35/$D$35
35			
36	=R		=$B$7*$B$8*$C36*Relocation!E36*$B$35/$D$35
37	=R		=$B$7*$B$8*$C37*Relocation!E37*$B$35/$D$35
38	=R		=$B$7*$B$8*$C38*Relocation!E38*$B$35/$D$35
39	=R		=$B$7*$B$8*$C39*Relocation!E39*$B$35/$D$35
40	=R		=$B$7*$B$8*$C40*Relocation!E40*$B$35/$D$35
41	=R		=$B$7*$B$8*$C41*Relocation!E41*$B$35/$D$35
42	=R		=$B$7*$B$8*$C42*Relocation!E42*$B$35/$D$35
43	=R		=$B$7*$B$8*$C43*Relocation!E43*$B$35/$D$35
44	=R		=$B$7*$B$8*$C44*Relocation!E44*$B$35/$D$35
45	=R		=$B$7*$B$8*$C45*Relocation!E45*$B$35/$D$35
46			
47	T=	SUM(G10:G46)	=SUM(H10:H46)

	A	J	K
9		Skin Dose (mrem per uCi/m^2)	BS Dose (mrem per uCi/m^2)
10	Am-241	7.73E-02	4.69E+02
11	Am-243	2.88E-03	1.44E+01
12	Ba-133	8.79E-12	5.58E-14
13	Ce-144	1.52E-05	9.75E-07
14	Cf-249	1.70E-04	3.98E-01
15	Cf-252	2.08E-03	2.38E+01
16	Cm-244	3.74E-03	2.91E+02
17	Cm-246	1.64E-04	1.61E+01
18	Co-60	6.16E+01	1.06E-01
19	Cs-137	9.37E+00	1.03E-01
20	H-3	0.00E+00	0.00E+00
21	Np-237	8.89E-05	1.16E+00
22	Pm-147	3.51E-12	5.52E-09
23	Pu-238	1.11E-02	5.00E+02
24	Pu-239	7.27E-03	7.20E+02
25	Pu mix-239/241	0.00E+00	0.00E+00
26	Pu-240	4.06E-03	1.64E+02
27	Pu-241	0.00E+00	1.63E+02
28	Pu pure-242	2.33E-05	1.01E+00
29	Sr-90	5.72E+00	9.10E-01
30	Tc-99	7.81E-18	1.57E-16
31	Th-232	2.63E-07	2.32E-01
32	Tl-204	3.41E-08	4.07E-12
33	U-235	1.14E-05	1.05E-05
34	U-238	3.20E-05	7.51E-04
35	Total		
36	Ba-137m	6.37E+01	
37	Y-90	3.39E+02	
38	Pr-144	7.93E-03	
39	Pa-233	3.87E-04	
40	Th-234	1.07E-04	
41	Pa-234	2.44E-02	
42	Np-239	8.09E-03	
43	Th-231	3.22E-06	
44	Ra-228	4.35E-13	
45	Ac-228	2.73E-04	
46			
47	Total	4.80E+02	2.37E+03

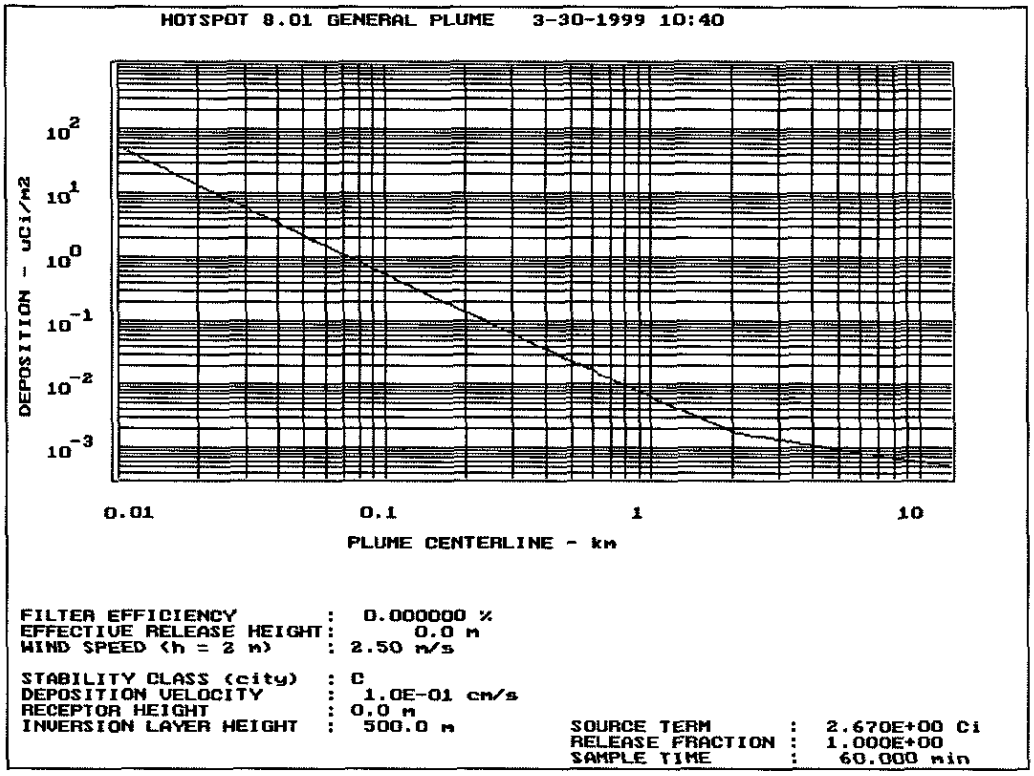
	A	J	K
9		Skin Dose (mrem per uCi/m^2)	BS Dose (mrem per uCI/m^2)
10		='=$B$7*$B$8*$C10*Relocation!$F10*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E10*Relocation!$J10
11		='=$B$7*$B$8*$C11*Relocation!$F11*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E11*Relocation!$J11
12		='=$B$7*$B$8*$C12*Relocation!$F12*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E12*Relocation!$J12
13		='=$B$7*$B$8*$C13*Relocation!$F13*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E13*Relocation!$J13
14		='=$B$7*$B$8*$C14*Relocation!$F14*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E14*Relocation!$J14
15		='=$B$7*$B$8*$C15*Relocation!$F15*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E15*Relocation!$J15
16		='=$B$7*$B$8*$C16*Relocation!$F16*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E16*Relocation!$J16
17		='=$B$7*$B$8*$C17*Relocation!$F17*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E17*Relocation!$J17
18		='=$B$7*$B$8*$C18*Relocation!$F18*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E18*Relocation!$J18
19		='=$B$7*$B$8*$C19*Relocation!$F19*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E19*Relocation!$J19
20		='=$B$7*$B$8*$C20*Relocation!$F20*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E20*Relocation!$J20
21		='=$B$7*$B$8*$C21*Relocation!$F21*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E21*Relocation!$J21
22		='=$B$7*$B$8*$C22*Relocation!$F22*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E22*Relocation!$J22
23		='=$B$7*$B$8*$C23*Relocation!$F23*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E23*Relocation!$J23
24		='=$B$7*$B$8*$C24*Relocation!$F24*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E24*Relocation!$J24
25		='=$B$7*$B$8*$C25*Relocation!$F25*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E25*Relocation!$J25
26		='=$B$7*$B$8*$C26*Relocation!$F26*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E26*Relocation!$J26
27		='=$B$7*$B$8*$C27*Relocation!$F27*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E27*Relocation!$J27
28		='=$B$7*$B$8*$C28*Relocation!$F28*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E28*Relocation!$J28
29		='=$B$7*$B$8*$C29*Relocation!$F29*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E29*Relocation!$J29
30		='=$B$7*$B$8*$C30*Relocation!$F30*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E30*Relocation!$J30
31		='=$B$7*$B$8*$C31*Relocation!$F31*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E31*Relocation!$J31
32		='=$B$7*$B$8*$C32*Relocation!$F32*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E32*Relocation!$J32
33		='=$B$7*$B$8*$C33*Relocation!$F33*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E33*Relocation!$J33
34		='=$B$7*$B$8*$C34*Relocation!$F34*$B$35/$D$35	=$B$7*$B$3*$B$4*$B$5*$B$6*$B$8*$E34*Relocation!$J34
35			
36		=R=$B$7*$B$8*$C36*Relocation!$F36*$B$35/$D$35	
37		=R=$B$7*$B$8*$C37*Relocation!$F37*$B$35/$D$35	
38		=R=$B$7*$B$8*$C38*Relocation!$F38*$B$35/$D$35	
39		=R=$B$7*$B$8*$C39*Relocation!$F39*$B$35/$D$35	
40		=R=$B$7*$B$8*$C40*Relocation!$F40*$B$35/$D$35	
41		=R=$B$7*$B$8*$C41*Relocation!$F41*$B$35/$D$35	
42		=R=$B$7*$B$8*$C42*Relocation!$F42*$B$35/$D$35	
43		=R=$B$7*$B$8*$C43*Relocation!$F43*$B$35/$D$35	
44		=R=$B$7*$B$8*$C44*Relocation!$F44*$B$35/$D$35	
45		=R=$B$7*$B$8*$C45*Relocation!$F45*$B$35/$D$35	
46			
47		T=SUM(J10:J46)	=SUM(K10:K46)

	F	G
52	9.60E+00	DRL (uCi/m^2) -- PAG/(CEDE+External)
53	8.23E+00	DRL (uCi/m^2) -- PAG/(BS Dose + External)
54	2.08E+02	DRL (uCi/m^2) -- PAG/(Skin Dose)

	F	G
52	=H3/(G47+H47)	DRL (uCi/m^2) -- PAG/(CEDE+External)
53	=H4/(K47+H47)	DRL (uCi/m^2) -- PAG/(BS Dose + External)
54	=H5/J47	DRL (uCi/m^2) -- PAG/(Skin Dose)

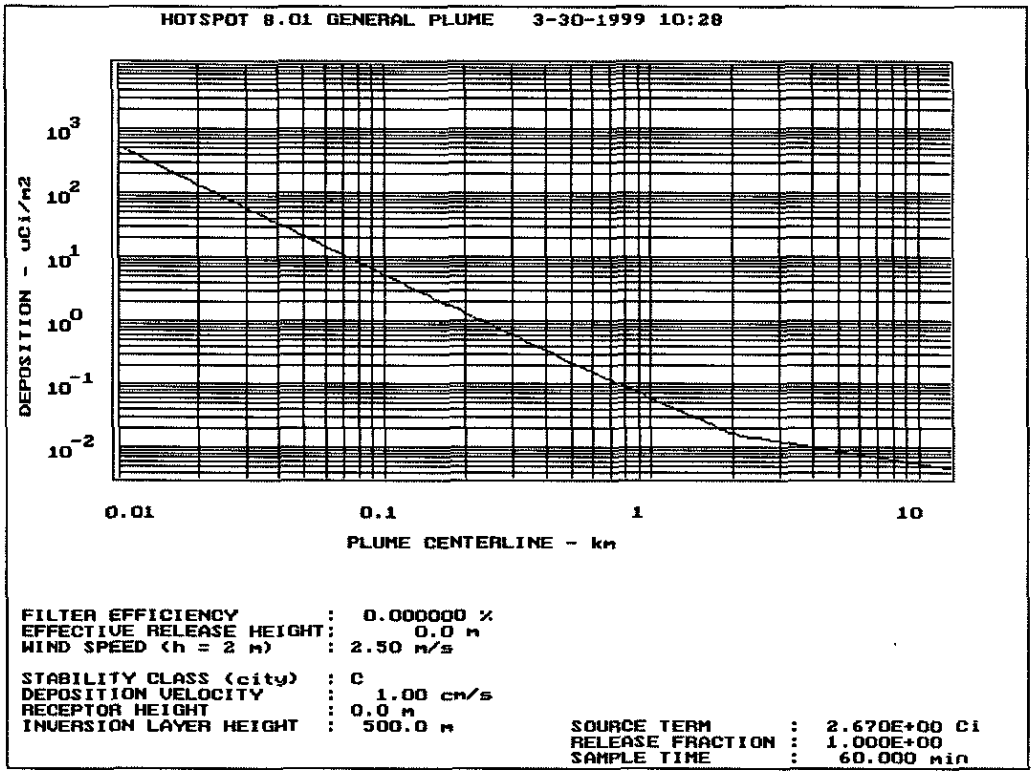
Attachment B

HOTSPOT results - average meteorology, 0.1 cm s^{-1}


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 10:40
DEPOSITION - uCi/m2
10^2
10^1
10^0
10^-1
10^-2
10^-3
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 2.50 m/s
STABILITY CLASS (city) : C
DEPOSITION VELOCITY : 1.0E-01 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 500.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min

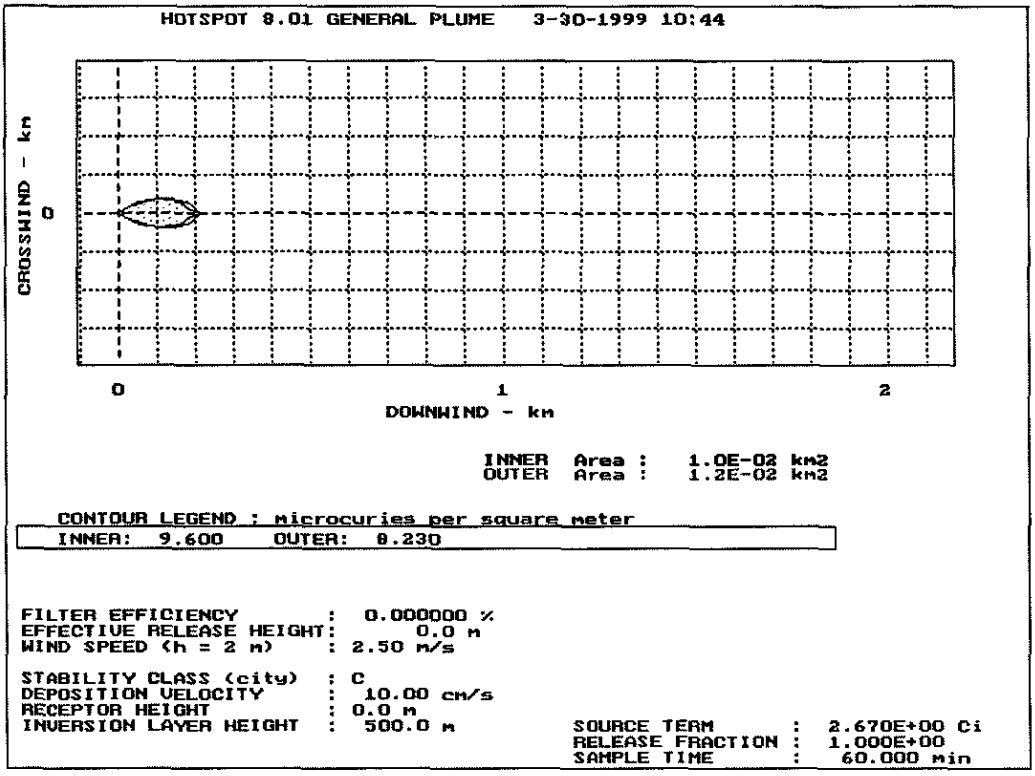
Attachment C

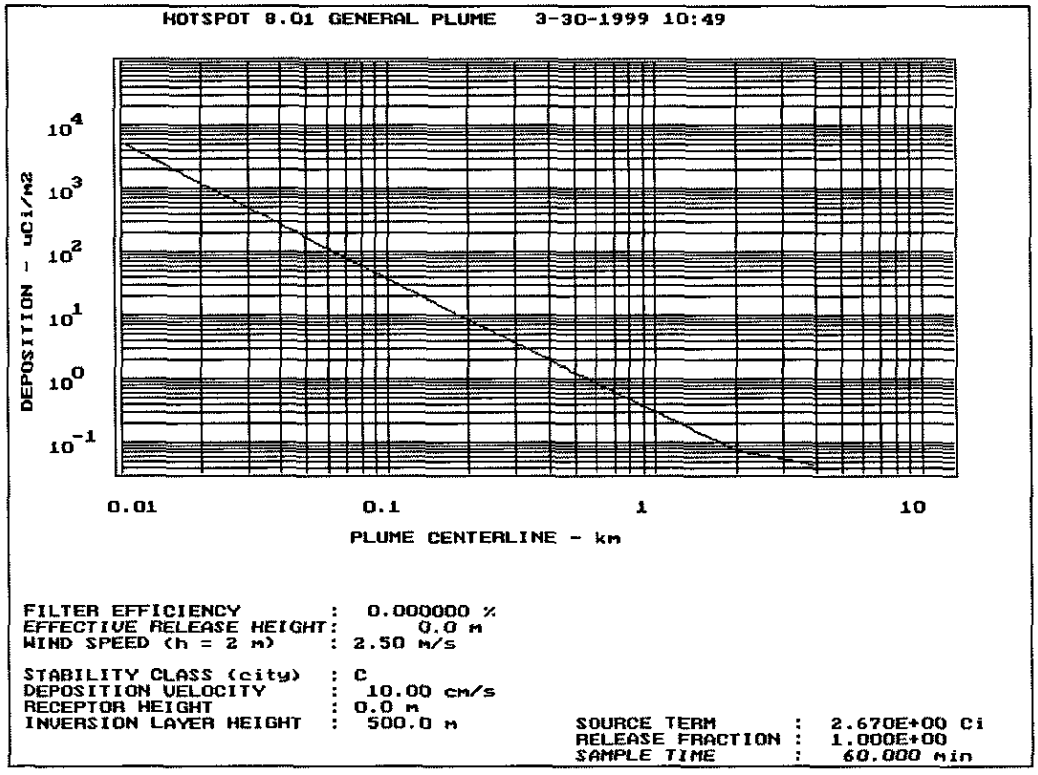
HOTSPOT results - average meteorology, 1.0 cm s^{-1}


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 10:28
DEPOSITION - uCi/m2
10^3
10^2
10^1
10^0
10^-1
10^-2
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 2.50 m/s
STABILITY CLASS (city) : C
DEPOSITION VELOCITY : 1.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 500.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min

Attachment D

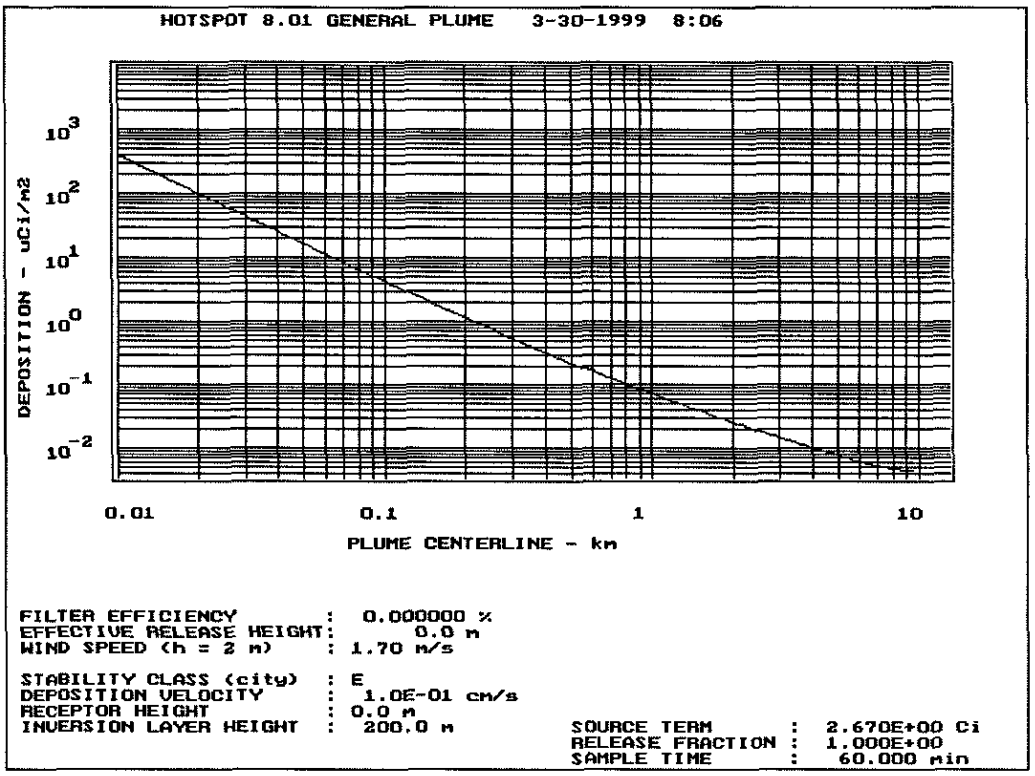
HOTSPOT results - average meteorology, 10 cm s^{-1}


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 10:44
CROSSWIND - km
0
0
1
2
DOWNWIND - km
INNER Area : 1.0E-02 km2
OUTER Area : 1.2E-02 km2
CONTOUR LEGEND : microcuries per square meter
INNER: 9.600 OUTER: 8.230
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 2.50 m/s
STABILITY CLASS (city) : C
DEPOSITION VELOCITY : 10.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 500.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 10:49
DEPOSITION - uCi/m2
10^4
10^3
10^2
10^1
10^0
10^-1
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 2.50 m/s
STABILITY CLASS (city) : C
DEPOSITION VELOCITY : 10.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 500.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min

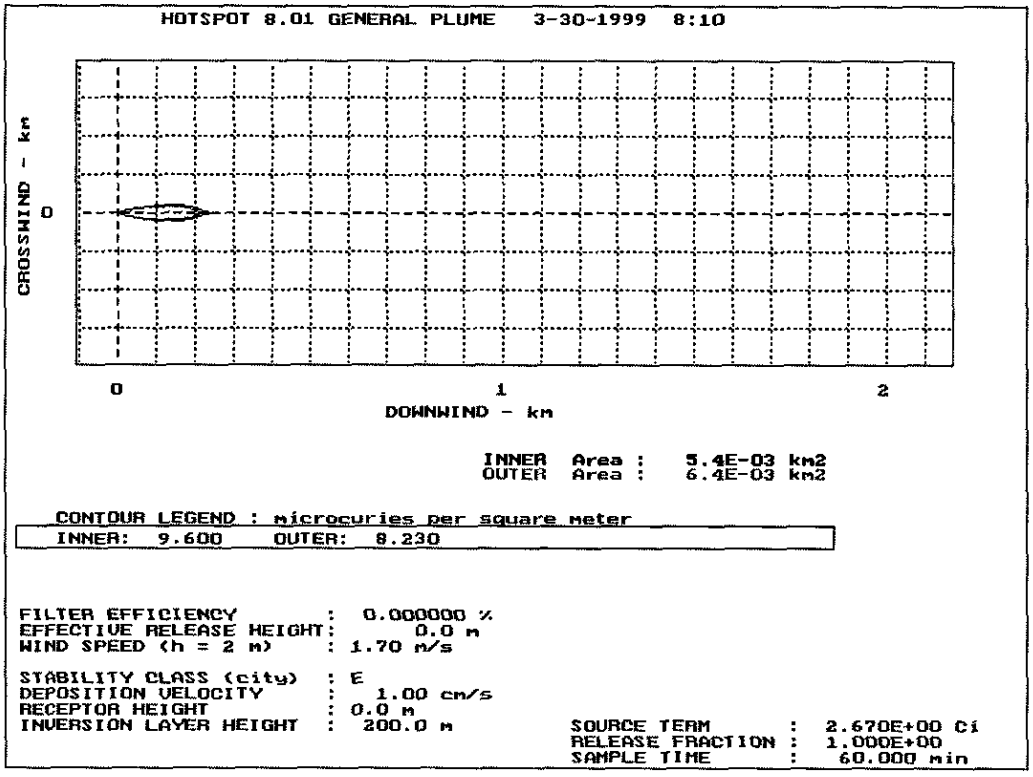
Attachment E

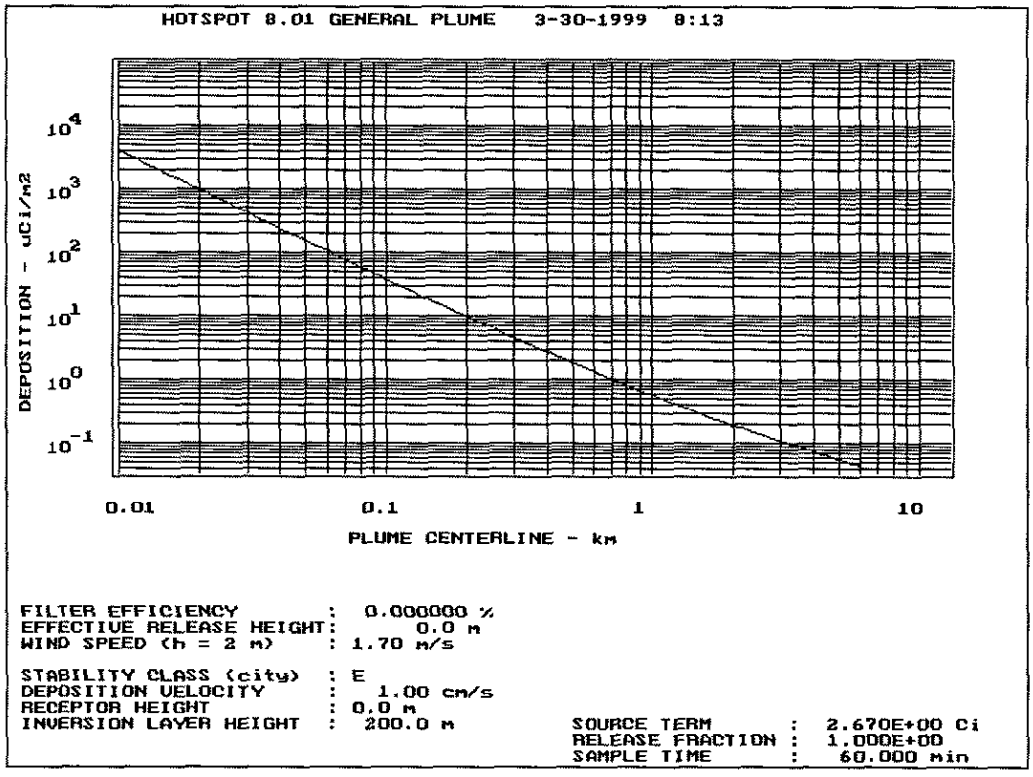
HOTSPOT results - adverse meteorology, 0.1 cm s^{-1}


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 8:06
DEPOSITION - uCi/m2
10^3
10^2
10^1
10^0
10^-1
10^-2
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 1.70 m/s
STABILITY CLASS (city) : E
DEPOSITION VELOCITY : 1.0E-01 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 200.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min

Attachment F

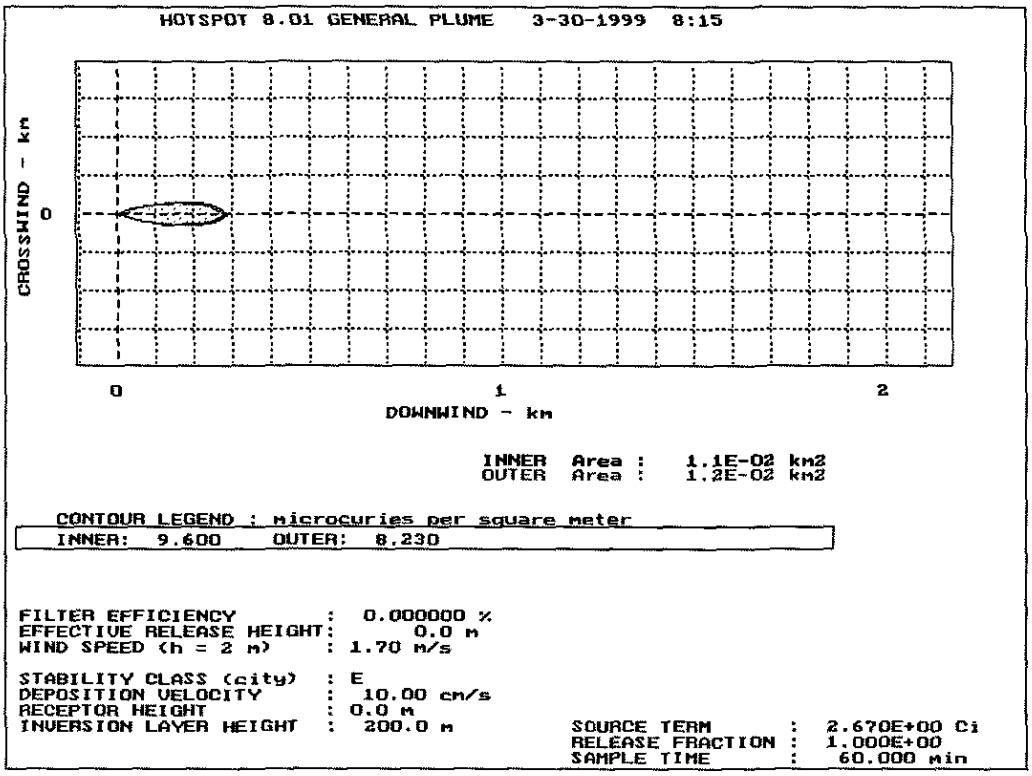
HOTSPOT results - adverse meteorology, 1.0 cm s^{-1}

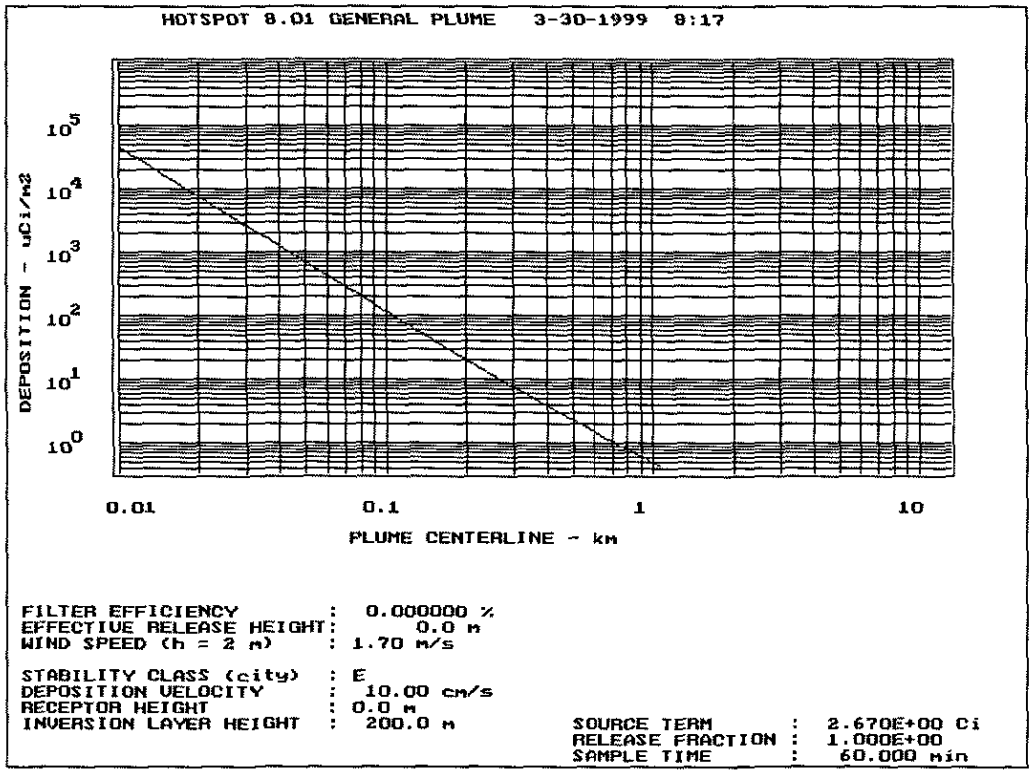

HOTSPOT 8.01 GENERAL PLUME 3-30-1999 8:10
CROSSWIND - km
0
0
1
2
DOWNWIND - km
INNER Area : 5.4E-03 km2
OUTER Area : 6.4E-03 km2
CONTOUR LEGEND : microcuries per square meter
INNER: 9.600 OUTER: 8.230
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 1.70 m/s
STABILITY CLASS (city) : E
DEPOSITION VELOCITY : 1.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 200.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 8:13
DEPOSITION - uCi/m2
10^4
10^3
10^2
10^1
10^0
10^-1
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 1.70 m/s
STABILITY CLASS (city) : E
DEPOSITION VELOCITY : 1.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 200.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min

Attachment G

HOTSPOT results - adverse meteorology, 10 cm s^{-1}


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 8:15
CROSSWIND - km
0
0
1
2
DOWNWIND - km
INNER Area : 1.1E-02 km2
OUTER Area : 1.2E-02 km2
CONTOUR LEGEND : microcuries per square meter
INNER: 9.600 OUTER: 8.230
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 1.70 m/s
STABILITY CLASS (city) : E
DEPOSITION VELOCITY : 10.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 200.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min


HOTSPOT 8.01 GENERAL PLUME 3-30-1999 8:17
DEPOSITION - uCi/m2
10^5
10^4
10^3
10^2
10^1
10^0
0.01
0.1
1
10
PLUME CENTERLINE - km
FILTER EFFICIENCY : 0.000000 %
EFFECTIVE RELEASE HEIGHT: 0.0 m
WIND SPEED (h = 2 m) : 1.70 m/s
STABILITY CLASS (city) : E
DEPOSITION VELOCITY : 10.00 cm/s
RECEPTOR HEIGHT : 0.0 m
INVERSION LAYER HEIGHT : 200.0 m
SOURCE TERM : 2.670E+00 Ci
RELEASE FRACTION : 1.000E+00
SAMPLE TIME : 60.000 min