WP 12-ER4916

Revision 15

Consequence Assessment Dose Projection

Technical Procedure

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APPROVED FOR USE

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INTRODUCTION [1, 2]

The purpose of this procedure is to provide guidance to the Radiological Engineer (RE) and Consequence Assessment Representative supporting the Emergency Operations Center (EOC) in estimating the potential dose consequence from a release or suspected release of radioactive material from the Waste Isolation Pilot Plant (WIPP) facility.

This procedure generates records which are maintained by the EOC in accordance with WP 12-ER3002. The record generated is the Table Output in Section 1.0 or the Dose Projection Sheet (use Attachment 1, Example Dose Projection Sheet, for an example) in Sections 2.0 and 3.0.

REFERENCES

BASELINE DOCUMENTS

- EPA 402-R-97-001, *Guidance for the Implementation of EPA's Standards for Management and Storage of Transuranic Waste (40 CFR 191, Subpart A) at the WIPP*
- DOE Order 151.1C, *Comprehensive Emergency Management System*, Chapter V, "Operational Emergency Events And Conditions"
- DOE Guide 151.1-1 V4-1, Section 1.3, *Consequence Assessment Process*
- DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*
- DOE/WIPP-07-3372, *Waste Isolation Pilot Plant Documented Safety Analysis*
- Federal Guidance Report (FGR) 13, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, EPA-402-R-99-001, 09/1999

REFERENCED DOCUMENTS

- WP 12-ER3002, Emergency Operations Center Activation
- *The Health Physics and Radiological Health Handbook*, edited by Bernard Shleien, 1992
- Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, February 2000. (http://www.epa.556gov/scram001/guidance/met/mmgrma.pdf)

PREREQUISITE ACTIONS

1.0 RE or Consequence Assessment Representative assigned as EOC Liaison receives notice of an event requiring EOC activation.

2.0 RE or Consequence Assessment Representative reports to the EOC.

PRECAUTIONS AND LIMITATIONS

1.0 Only RE or Consequence Assessment Representative who has completed the RE-02 Qual Card may perform this procedure.

PERFORMANCE

NOTE

The order of preference in performing consequence assessment is Section 1.0 (Hotspot) first, then Section 2.0 (NARAC). If neither program is available, use Section 3.0 and estimate offsite doses.

NOTE

Values for Material at Risk (MAR), Airborne Release Fractions (ARF), Respirable Fractions (RF) and Damage Ratios (DR) used in the procedure are conservative selections from the WIPP Documented Safety Analysis (DSA). More appropriate values may be used based on knowledge of the event for a better estimate of the potential radiological conditions.

NOTE

If the National Atmospheric Release Advisory Center (NARAC) System cannot be operated, or a problem occurs during the run, the NARAC may be called at (925) 424-6465, 24 hours a day, to provide assistance.

NOTE

Meteorological information at 10 meters (32.8 feet) can be obtained from intranet web page at http://bellview/cms by clicking on Meteorological Data Report or from WIPPnet Neighborhood//Roy/CMS/eoc folder by clicking on EOC_WTHR.cvs file to access the 30 minutes data archive. Also note that the unit of wind speed at 10-meter elevation in EOC-WTHR file is already in meter/second (m/s). If the meteorological information is not up to the current date and time, it can be obtained by calling either Security (Ext. 8324), or the Central Monitoring Room (Ext. 8125 or Ext. 8457).

A change in the stability class may warrant recalculation if the prior projected dose is less conservative.

1.0 PERFORMING CONSEQUENCE ASSESSMENT USING THE HOTSPOT PROGRAM

1.1 **IF** the "Hotspot" icon is available,
THEN double click on the icon on the desktop.

1.2 **IF** the "Hotspot" icon is not available on the desktop **AND** can be installed immediately,
THEN install and **GO TO** Step ?.

OR

IF the "Hotspot" icon CANNOT be installed immediately,
THEN GO TO Section 2.0.

1.3 Double click on the "Hotspot" icon.

NOTE

Attachment 1 is provided to record data and perform calculations to input in the HotSpot.

1.4 Enter the specific information under the described tabs as follows:

NOTE

The General Plume model is appropriate for WIPP releases; explosion and/or fire models should only be used if the incident occurs in outside areas.

1.4.1 Under "Models" Tab: Choose an appropriate Atmospheric Dispersion Model (e.g., General Plume, General Explosion, or General Fire).

1.4.2 Under "Source Term" **IF** the radionuclide window indicates "No Selection" or does not indicate Pu-239 M, **THEN** perform the following:

[A] Go to the "Setup" tab.

[B] Select "FGR13."

[C] Click on "Select New Nuclide."

[D] Select "Pu-239 M" from the list.

[E] When the "Inhalation Dose Conversion Factors" are displayed, click on "Return."

[F] Return to the "Source Term" menu.

1.4.3 Under "Source Term" Tab:

- Input the MAR multiplied by the appropriate Damage Ratio from Attachment 5 for the "Material at Risk."

NOTE

The effective release heights are 7.7 meters for Station A, 6.7 meters for Station B, and 20 meters for Station C stack releases, or an appropriate height for general explosion or fire scenarios.

- Input "Effective Release Height" value.

- Keep "Deposition Velocity" value as 0.30 cm/sec or input an appropriate value if desired.

NOTE

The WIPP DSA combines the Airborne Release Fraction and Respirable Fraction (RF) into one term. Therefore, for Hotspot, input this term for the RF and input 1.0 for the Airborne Fraction. The MAR for Hotspot is the MAR from Attachment 5, multiplied by the Damage Ratio from Attachment 5.

- Input 1.0 for "Airborne Fraction" value.

- Input the ARF x RF from Attachment 6 for the "RF."

- Input appropriate"Leakpath Factor":

  - "1" for no High-Efficiency Particulate Air (filter) (HEPA) filtration

  - 0.0003 for single-stage HEPA

  - 1E-6 for two stage HEPA

  - "1" is used when determining strength using Underground (U/G) Continuous Air Monitors (CAMs) or effluent release point sample filter

1.4.4 Under "Meteorology" Tab:

NOTE

The conversion of mile per hour (mph) to meter per second is: 1 mph = 0.447 m/s.

- Input "10-meter Wind Speed" value in unit of m/s.

- Input "10-meter Wind Direction" in degree.

- Choose an appropriate "Atmospheric Stability" by entering applicable "Solar Information," or enter the "Actual Stability" of choice from Attachment 3, Stability Classes.

1.4.5 Under "Receptors" Tab:

- Input "1.5 meters" for "Receptor Height."

NOTE

Distance inputs should include 0.03, 0.1, 0.3, 1.0, 3.0 km and the distance (in km) to the Exclusive Use Boundary using Attachment 2, Conversion of (from) Wind Direction in Degree to Affected Sector and Distance to Exclusive Use Boundary.

- Choose appropriate "Coordinate Positions for Table Output (km)" by clicking D1, D2,..., D6 and input the desired distances in km. Then select the box for that distance to be included in the Table Output.

1.4.6 Under "Setup" Tab:

- Choose "Standard: Conservative Option" under "Terrain" block.
- Choose "Classic (rem, rad, Ci)" under "Radiological Units" block.
- Choose "Metric" under "Distance Units" block.
- Input 10 meters under "Wind Input Height" block.
- Input a Sample Time to be the same as the Holdup Time (i.e., the duration of the release) (e.g., a default of 10 minutes is reasonable if release duration is not known).
- Choose "Simple" under "Source Geometry" block.
- Enter appropriate values for inner, middle, and outer TEDE in rem contour settings under "Contour Values" block (e.g., the default values are 0.001 for outer, 0.1 for middle, and 1 for inner contours).
- Enter appropriate values for inner, middle, and outer deposition (dpm/100 cm^2) contour settings under "Deposition (dpm/100 cm^2)" block (e.g., the default values are 20 for outer, 1,000 for middle, and 2,000 for inner contours). And choose the "dpm/(100 cm^2)" as the unit.
- Choose "FGR 13" under "DCF Library" block.
- If the DCF Library is changed, enter Pu-239 as "Radionuclide of Interest" if requested.
- Input an appropriate Holdup Time (i.e., the duration of the release).

- Keep "breathing rate" at 3.33E-04 m^3/s and "Non-respirable Deposition Velocity" at 8 cm/sec.

- Keep "Coordinate Format" in Degrees and "Ellipsoid" in WGS 84.

1.4.7 Under "Output" Tab:

NOTE

In the following step, if the automatic file name does not appear, user must save the file to the Output folder at C:/Program files/HotSpot20/.

[A] Click on the "Default Source Location" button

1. Set "Source Altitude" to 0 meters
2. Click on "Set Location"

[B] If the default location is not the required point, set the release location to:

1. 32.37180N, 103.79162W for Station A
2. 32.37234N, 103.79161W for Station B
3. 32.37166N, 103.79396W for Station C

[C] Click on "Return."

[D] Click "Save Table Output" then "Save" (the file name is automatically set using date, year, time format) and close (or select "Cancel") to return to the "Hotspot Output" page.

[E] Click "View Saved Table Output Files" on the "Output" tab to retrieve the saved output.

[F] Select "File" and "Open."

[G] When the selected file is displayed, add the scenario description, date and time to the top of the page.

[H] Highlight the output text and set the font size to 9 point.

[I] Print out the form and provide to the Safety Representative.

1.4.8 If a plume map is desired, complete the following:

[A] Click "Hotspot Mapping" to display local WIPP map.

NOTE

The local WIPP maps are "WIPP.bmp," "WIPP1.bmp," and "WIPP2.bmp." They are arranged from a larger WIPP area to a smaller WIPP area (zoom-out map to zoom-in map) which may include Off Limits Area, Exclusive Use Area or Property Protection Area depending on the level of enlargement and display that is appropriate. More WIPP maps may be available in the "Maps" folder and could be used if desired.

[B] Click "File" then choose "Open Map." Choose an appropriate local WIPP map file for display (e.g., "WIPP.bmp," "WIPP1.bmp," or "WIPP2.bmp" [from larger area to smaller area]).

[C] Click "Plumes" then choose "Display Dose Contours on Map" for contour display on local WIPP map. If deposition contour map is desired, then choose "Display Deposition Contours on Map" for display.

NOTE

If none of the current contour values are exceeded as preset under Step 1.4.6, the "Hotspot Temporary Contour Adjustment Option" box would appear with message of "None of the current contour values are exceeded. Do you want Hotspot to automatically select valid contour values?" The option of "Yes" would allow the newer and smaller contour map to display on the local WIPP map (meaning the new inner, middle, and outer contour values are different than the preset values). The option of "No" would not display any contours since they are below the specified values set under Step 1.4.6.

[D] Click "Plumes" then choose "Re-position release point" if the release location needs to be changed. The "Change Release Location" box would appear with message of "Position the cursor over the new release location, and left-click the mouse. Click "OK" then position the cursor to the desired location on map and left-click the mouse to set the new release location.

[E] If a hard copy of the isopleth map is desired, click on "File", "Print", and "Print to Printer."

[F] When complete, exit mapping.

1.4.9 Supply the table output and if requested, the plume contour map to the safety representatives.

1.4.10 If desired to display the plume on another computer or EOC large screen:

[A] Select the "File" tap on the plume display.

[B] Select "Save Map as Picture File...."

NOTE

In the following step, saving the bitmap with a descriptive file name will label the displayed map with the appropriate information. For example: 2009 10 09 1500 TRUPACT 158 no filtration.

[C] Save the file to Gallina\RadSafety\EOC work.

[D] On the EOC display device computer:

1. Go to the above folder.
2. Double click on the saved bitmap file.
3. When finished with the picture, close the window.

1.4.11 If necessary, provide additional data as specified below.

- Click "TEDE Graph" to display plume centerline TEDE (rem) as function of downwind distances graph if desired.
- Click "Ground Deposition Graph" to display plume centerline ground deposition as function of downwind distances graph if desired.
- Choose "Compass" and Click "TEDE Contour Plot" for plume contour-TEDE plot if necessary.
- Choose "Compass" and Click "Ground Deposition Contour Plot" for plume contour-Ground Deposition plot if necessary.

1.5 Recalculate additional values by repeating Section 1.0 as information is received with a better estimate on the MAR or changes in meteorological conditions that could impact offsite doses or areas affected.

NOTE

"Hotspot" may resort to default values if you exit out of the program. The program may be minimized while working on other files/programs to preclude having to re-input all scenario information.

2.0 PERFORMING CONSEQUENCE ASSESSMENT USING NARAC SYSTEM

NOTE

When using the NARAC web page there is a delay between a selection/input and the page refresh. Adequate time must be allowed until the screen has refreshed before entering another change.

2.1 Complete the applicable sections of Attachment 1.

2.1.1 Determine distance to Exclusive Use Boundary from Attachment 2.

2.1.2 Determine Stability Class from Attachment 3.

2.1.3 Determine the HEPA Factor for Attachment 1:

[A] "1" for no HEPA filtration

[B] 0.0003 for single-stage HEPA

[C] 1E-6 for two stage HEPA

[D] "1" is used when determining strength using U/G CAMs or effluent release point sample filter

2.1.4 Calculate and record "Strength" using:

[A] the factors for the incident from Attachment 5 and Attachment 6 and the HEPA factor from Step 2.1.3.

[B] Filter effluent filter sample activity using Attachment 1.

[C] U/G CAM indications using Attachment 1.

2.2 Connect to NARAC from WIPPnet (https://narac.llnl.gov) or click the NARAC icon on the desktop.

2.3 Select "NARAC Web" and enter User ID and Password.

2.4 Select "New Run" and Click on the "Scenarios" tab.

2.5 Select "Basic Source."

2.6 Select "Continue."

2.7 Complete required items on the "Basic Source Model Input" screen view.

2.7.1 Time duration of release: a default of 10 minutes is reasonable if release duration is not known.

2.7.2 For Release Location, select "DOE Sites" and "WIPP."

2.7.3 Choose WIPPA for Stack A, WIPPB for Stack B, or WIPPC for Stack C release.

2.7.4 For location set the default location to:

- 32.37180N, 103.79162W for Station A
- 32.37234N, 103.79161W for Station B
- 32.37166N, 103.79396W for Station C

NOTE

The effective release heights are 7.7 meters for Station A, 6.7 meters for Station B, and 20 meters for Station C stack releases, or an appropriate height for general explosion or fire scenarios.

2.7.5 Enter "Height" as specified in note above.

2.7.6 Set downwind distance to 10 km.

2.8 For Material Properties Select:

2.8.1 "Commonly Used"

2.8.2 "Radiological"

2.8.3 "Pu-239"

2.8.4 Strength Type = "Radioactivity"

2.8.5 Strength Amount = "Reduced Material at Risk"

2.8.6 Set model to "NARAC 3D"

2.8.7 For "Weather Data" select, "I will provide it"

2.9 When requested, enter an appropriate "Stability Class" based on the range of wind speed using Attachment 3.

- "1" for number of vertical levels
- 10m for Wind Height
- Wind direction
- Wind speed

2.10 When all data has been entered, click on "Continue."

2.11 Review the input data on the "Review Request" screen and click "Submit Run."

NOTE

An Execution Log will be displayed showing the progress of the model. When the model is complete, the screen will change to "Summary"; this may take a few minutes.

2.12 When the Summary appears, click on "Interactive Map."

2.13 When the plume display appears, click on the "Create Report" icon.

2.14 Enter a name for the report, select "Consequence Repot," and click on "Create Report."

2.15 Click on "Show Centerline Data."

2.16 Click on "Create Report."

NOTE

NARAC uses fixed distances in the report. If a required distance is not provided in the NARAC report, use the higher dose value at the distances bounding the desired point.

2.17 When the report is generated, transfer the appropriate "Total Effective Dose Equivalent" data to Attachment 1.

2.17.1 Mark "RMAR" and "Dose from Attachment 7" as N/A on all rows.

2.18 If an isopleth is desired, perform the following:

2.18.1 Select “Recent Activity” from "View" and select the file for the plume plot.

2.18.2 Click on "Interactive Map."

2.18.3 When the plume is displayed, click on the "Map and Data Layer Control" icon.

2.18.4 **WHEN** the Layer Controls screen is displayed, **THEN**, perform the following:

[A] Click on "Plume."

[B] Select the type of plume required from "Which plume":

1. "Total Effective Dose Equivalent."
2. "Total Deposition for estimated contamination levels."

[C] Click on "Update Map."

[D] Select "Map" from the "Layer Controls" screen.

[E] Select "Satellite Image" from the "Map Selection" pull down menu.

[F] Click on "Update Map."

[G] Cancel Layer Control Screen.

[H] If the plume is not in the correct position on the map, click on the "Center and Scale Map on Plume" icon.

2.18.5 If a hard copy of the isopleth map is desired, use [ALT][Print Scrn] and [Ctrl] V to paste image for hard copy (Word or WordPerfect Document) or transfer to EOC display screen (Power Point).

2.18.6 If desired to display the isopleth map on the EOC large screen display:

[A] Save the Power Point or document to a folder that can be accessed from the EOC display device computer.

[B] Save the file to Gallina\RadSafety\EOC work.

[C] On the display device computer, double click on the saved bitmap file.

2.19 Make a copy of the paperwork, if necessary.

2.20 Give the completed Attachment 1 and plume map to Safety Representative.

2.21 Recalculate additional values by repeating this section as information is received with a better estimate on the MAR or changes in meteorological conditions that could impact offsite doses or areas affected when complete.

3.0 DETERMINING TEDE DOSE PROJECTION WHEN HOTSPOT OR NARAC SYSTEM IS NOT AVAILABLE

3.1 Record the following information on a Dose Projection Sheet (Attachment 1):

- Incident description.
- Wind speed.

- Ten meters wind direction to determine affected sector. See Attachment 2 for proper conversion to Affected Sector.

- Stability class (as determined using Attachment 3 for guidance).

3.2 Determine the MAR, or estimated curie (Ci) release value. Maximum MAR for accidents is available in Attachment 5.

3.3 Calculate the RMAR, using Attachments 4, 5, and 6.

3.4 Document the calculations on the Dose Projection Sheet (Attachment 1).

3.5 Determine TEDE doses (from 1 Ci plutonium release) for the desired distances using Attachment 7, Plume Centerline TEDE Dose as Function of Distance for Common Dispersion Models, Figures 1, 2, or 3, depending on the most appropriate model.

3.6 Input the TEDE dose values as determined in Step 3.5 onto TEDE DOSE CALCULATIONS portions of Attachment 1.

3.7 Input the RMAR value as determined in Step 3.4 onto TEDE DOSE CALCULATIONS portions of Attachment 1.

3.8 Determine the "Dose" by multiplying the R-MAR columns times the Dose from Attachment 7.

3.9 Ensure all necessary data is available on the Dose Projection Sheet.

3.10 Sign the Dose Projection Sheet.

3.11 Make a copy of the paperwork, if necessary.

3.12 Give the paperwork and any supporting paperwork to the Safety Representative.

Attachment 1 - Dose Projection Sheet

DOSE PROJECTION

Date:_____ Time:_____ (Release Started)

Description:_____

WIND:_____ / _____ / _____ / _____

Speed x 0.45 = Speed (mph)	(m/s)	Wind From (Degrees)	Distance to Exclusive Use Boundary (m)	Stability Class	HEPA Stages (0, 1, or 2)

SOURCE TERM DETERMINATION

	=		x			
Hotspot Material at Risk	=	Material at Risk (Attachment 5)	x	Damage Ratio (Attachment 5)		Respirable Fraction ARF x RF (Attachment 6)

NARAC STRENGTH - USE FOR DOSE PROJECTION WHEN NARAC AND HOTSPOT NOT AVAILABLE

	=		x		x		x	
RMAR (Ci)	=	Material at Risk (Attachment 5)	x	Damage Ratio (Attachment 5)	x	ARF x RF (Attachment 6)	x	HEPA Factor

Filter DPM to Ci Released Calculation:

Hotspot RMAR NARAC Strength	=	(F (Exhaust flow cfm)	X	A) (Sample Activity dpm)	/	(R (Sample Flow cfm)	X	CF) (dpm/Ci)
_____		_____		_____		_____		2.22E12

Underground CAM DAC to CI Released RMAR) Calculation

Hotspot RMAR NARAC Strength	=	U/G CAM (DAC)	x	Duration of release (Min.)		1.6E4 [dpm/(min-DAC)]
	=		x		x	

TEDE DOSE CALCULATIONS

Distance (kilometers)	DOSE (mrem)	DOSE (rem)	=	R MAR (PE-Ci or Ci)	X	DOSE from Attachment 7 (rem)
0.030						
0.100						
0.300						
1.000						
3.000						

Comments:_____

_____

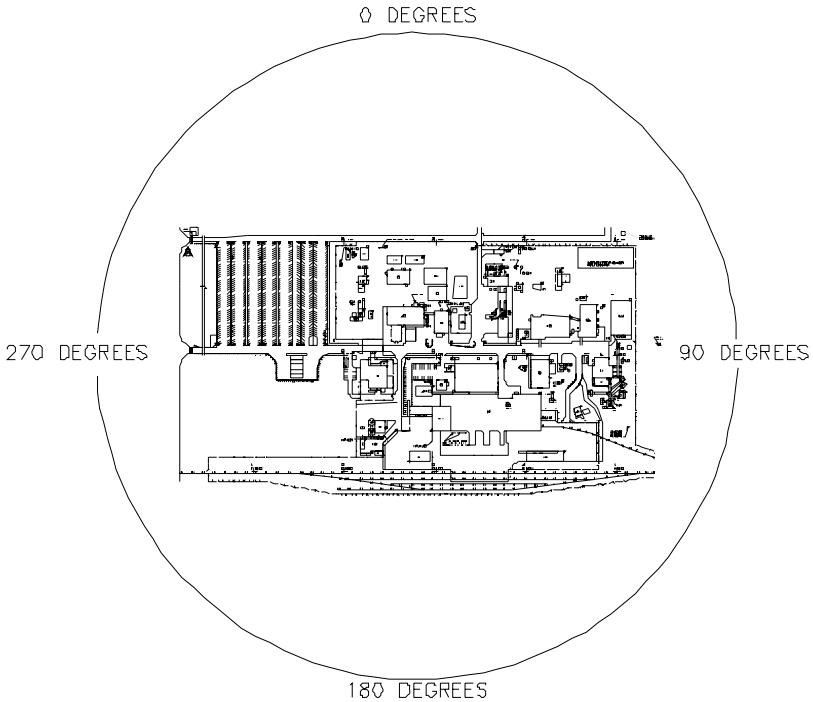
_____ / _____

Name (printed) Signature

Attachment 2 - Conversion of (from) Wind Direction in Degree to Affected Sector and Distance to Exclusive Use Boundary

Wind Direction in Degree Range		Affected	Input Distance (m)	Input Distance (m)
Minimum	Maximum	Sector	for Stations A or B	for Station C
348.76	360	S	286	471
0	11.25	S	286	471
11.26	33.75	SSW	482	471
33.76	56.25	SW	524	409
56.26	78.75	WSW	576	378
78.76	101.25	W	576	378
101.26	123.75	WNW	576	378
123.76	146.25	NW	597	409
146.26	168.75	NNW	553	534
168.76	191.25	N	553	565
191.26	213.75	NNE	553	565
213.76	236.25	NE	599	613
236.26	258.75	ENE	626	802
258.76	281.25	E	626	706
281.26	303.75	ESE	402	384
303.76	326.25	SE	308	345
326.26	348.75	SSE	286	345

Boundary



Attachment 3 - Stability Classes

NOTE: Stability Classes shown below are based upon Table 6-3 of *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, EPA-454/R-99-005, February 2000.

STABILITY CLASS					
DAYTIME				NIGHTTIME	
Wind Speed (m/s)	Intensity of Sunlight			Thin, Overcast ≥ 50% Cloud Cover	≤ 40% Cloud Cover
	Strong	Moderate	Slight		
< 2	A	A-B	B	--	--
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

STABILITY CLASS	CLASS DESCRIPTION
A (1)	Extremely Unstable - good vertical and horizontal mixing, most common on bright sunny days, peak downwind concentration near release point.
B (2)	Moderately Unstable - common on sunny days with higher winds or with some cloudiness.
C (3)	Slightly Unstable - common on cloudy days with low wind speeds.
D (4)	Neutral Stability - most common condition with heavy overcast, day or night.
E (5)	Slightly Stable - most common condition with heavy overcast, day or night.
F (6)	Moderately Stable - very low wind speeds at night or just before dawn, peak concentration furthest from the release point.
G (7)	Very Stable - use at night with very low wind speeds.

Attachment 4 - Information and Formulas

CONVERSIONS

(TBq / 27) = curie mph X 0.447 = m/s

ABATEMENT OF SOURCE TERM

Reduced MAR = MAR X DR X ARF X RF X HEPA (Leak Path Factor)
Reduced MAR is Source Term (ST)
MAR = Material-at-Risk (Ci or PE-Ci)
DR = Damage Ratio
ARF = Airborne Release Fraction
RF = Respirable Fraction
HEPA = 1E-6 for normal HEPA banks (If HEPA is not used, input 1.)
(Loss of HEPA filter differential pressure (DP) indicates loss of HEPA filters.)

ACTIVITY RELEASED BASED ON FILTER SAMPLE EQUATION

NARAC Strength Amount (Hotspot Material at Risk use 1.0 for Hotspot filter mitigation Airborne Fraction and respirable fraction)
MAR/Strength = (F)(A)/(R)(CF)
MAR/Strength = Source Term Activity (Ci or PE-Ci)
F = Flow rate out of the station in cubic feet per minute (cfm)
A = Net activity on the sample in disintegrations per minute (dpm)
(Net activity may come from FAS, PAS, and/or CAM filter data.)
R = Sample flow rate (cfm)
CF = Conversion factor of 2.22E12 dpm/Ci

ACTIVITY RELEASED BASED ON UNDERGROUND CAM INDICATIONS

NARAC Strength Amount (Hotspot Material at Risk 1.0 for Hotspot filter mitigation Airborne Fraction and respirable fraction)
MAR/Strength = Estimated release in PE-Ci based on CAM indications
U/G CAM (DAC) = Average indication of U/G CAM in DAC for release
Duration of Release (min) =Estimated time of the release in minutes
1.6E4 (dpm/min-DAC) = Panel air flow past CAMs (125,000 ft3/minute x 0.125 dpm/(ft3 - DAC)

DISTANCES

Far Field Station: 965 meters
East and South Stations: 480 meters
Distance to exclusive use boundary: see maps on Attachment 4

STATION FLOW RATES

Typical flow rates: (per leg)
Station A = 2 cfm
Station B = 2 cfm
Station C = 0.8 cfm

Stack flow rates:
Station A = 425,000 cfm
Station B = 60,000 cfm
Station C = 47,000 cfm

Exhaust flow rates past Station D = 200,000 cfm

Attachment 5 - Materials at Risk and Accident Damage Ratios

Materials at Risk (From DSA Table 3.3-6)

Waste Container/Configuration	MAR Plutonium Equivalent Curies (PE-Ci)
55, 85, or 100 gallon	80
Standard Waste Box (SWB)	560
Overpacked SWB	1,200
Ten-Drum Overpack	800
Pipe Overpack Container (POC)/Solidified/Vitrified Waste Container	1,800
Overpacked drum/Assembly with Overpacked drum limit	1,100/1,200
72-B RH	240
10-160B	800

Waste Container Damage Ratios (From DSA Table 3.4-1)

Accident	Drums	SWB & RH Canister	Overpacked Container	Pipe Overpack	Solidified/Vitrified Waste
Container Failure	1.0	1.0	0.1	0	0.1
Container Puncture	0.1	0.05	0.05	0.05	0.05
Container Impact	1.0	1.0	0.5	0	0.5
Dropped Container	0.1	0.1	0.05	0	0.05
Vertical Crush	0.5	0.5	0.25	0	0.25
Drop Down Shaft	1.0	1.0	1.0	0.5	0.5
Building Collapse	0.01	0.01	0.005	0	0.005

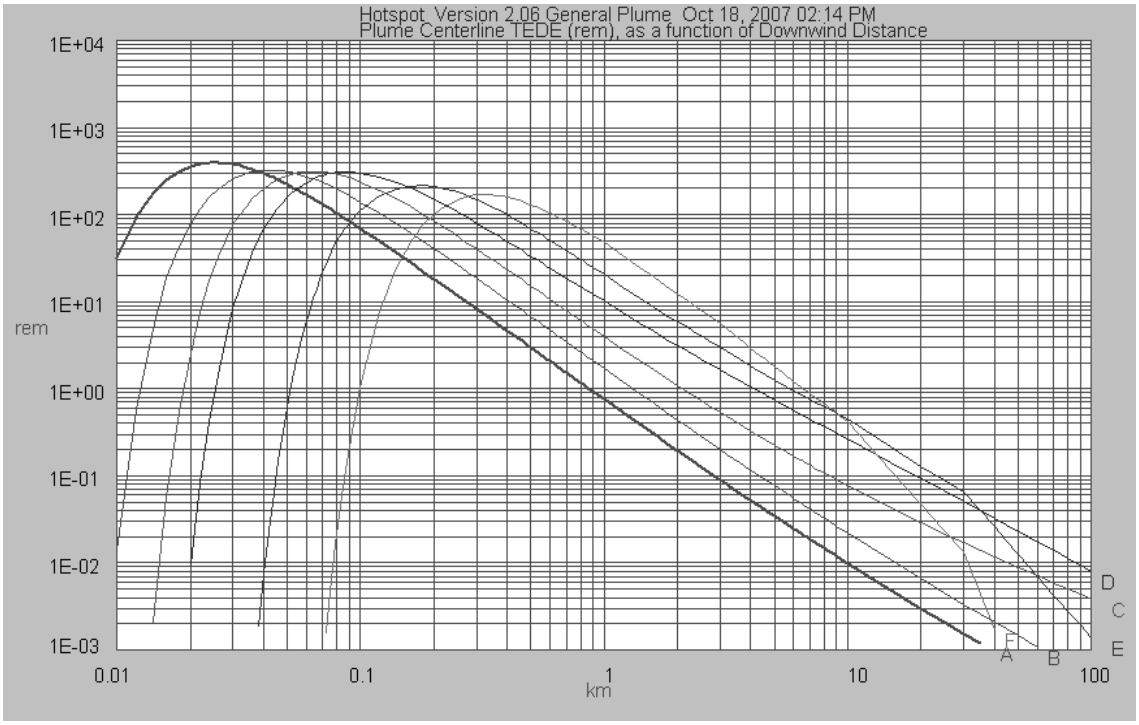
Attachment 6 - Airborne Release Fractions and Respirable Fractions for Release Mechanisms

(From DSA Table 3.4-2 and 3.4-3)

Release Mechanism	Airborne Release Fraction x Respirable Fraction
Impacted /Dropped Waste Container	2E-3
Fire Around Container	2E-3
Waste on Fire Outside Waste Container	1E-2

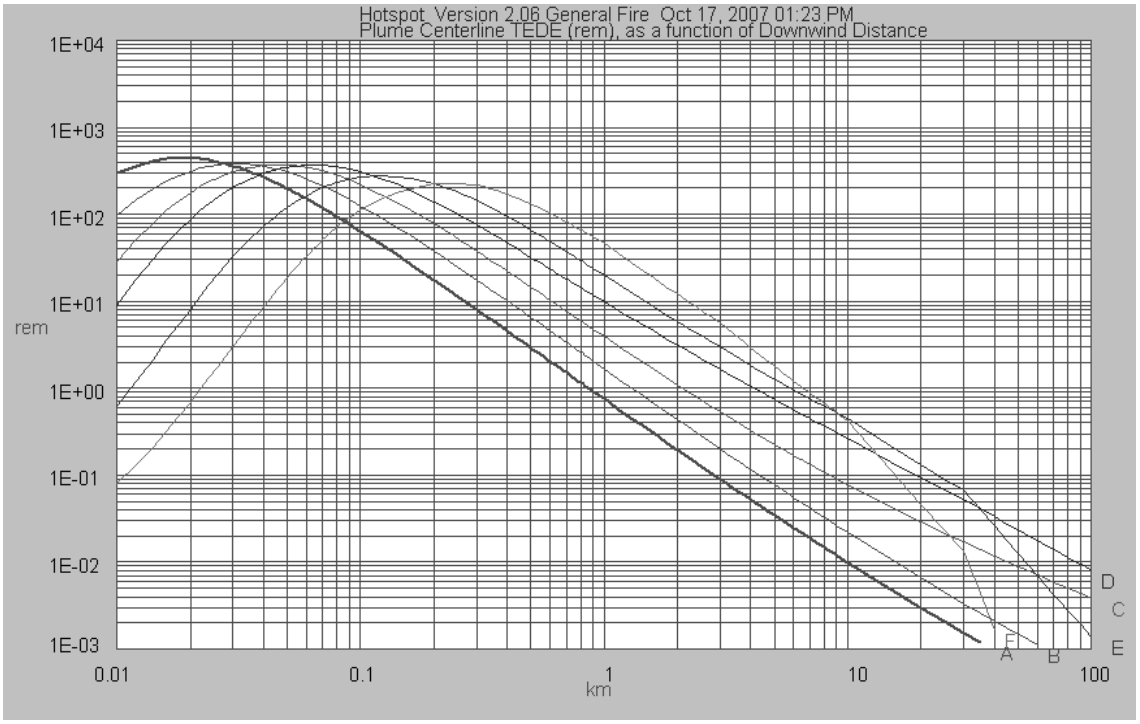
Attachment 7 - Plume Centerline TEDE Dose as Function of Distance for Common Dispersion Models

Figure 1 - General Plume Case Using 1 Ci Plutonium Release



Attachment 7 - Plume Centerline TEDE Dose as Function of Distance for Common Dispersion Models

Figure 2 - General Fire Case Using 1 Ci Plutonium Release and Assuming Release Radius of 1 Meter, Cloud Top of 10 Meters, and Fire Physical Height of 1 Meter



Attachment 7 - Plume Centerline TEDE Dose as Function of Distance for Common Dispersion Models

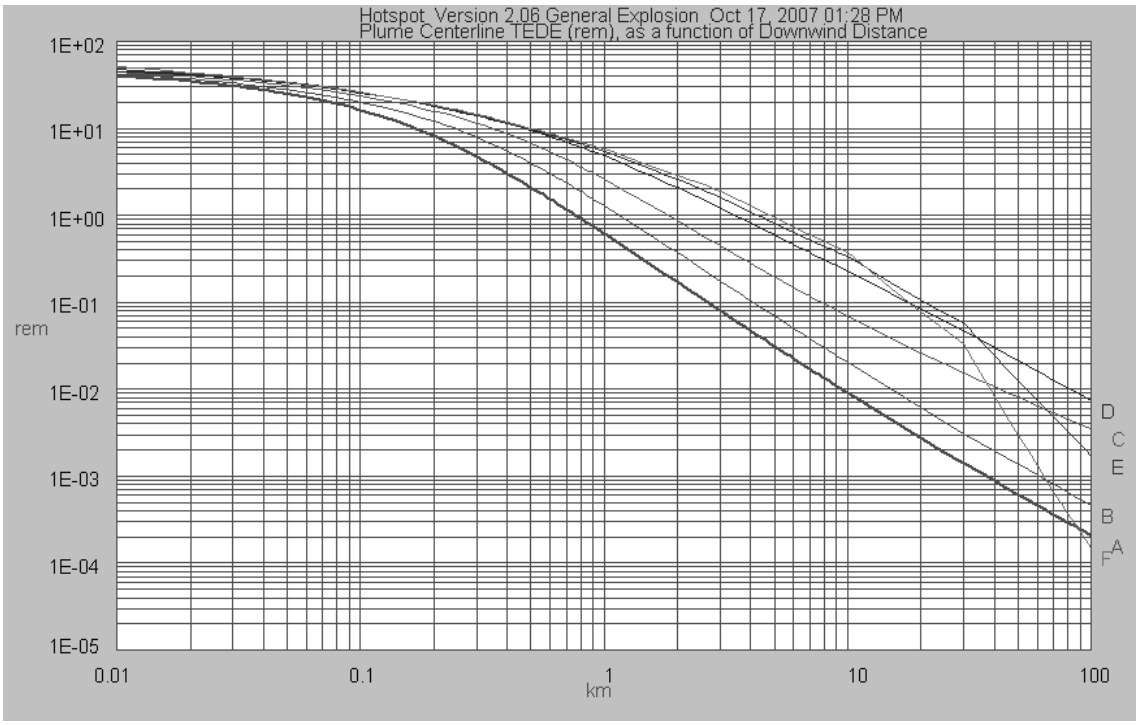



Figure 3 - General Explosion Case Using 1 Ci Plutonium Release and Assuming 1 Pound of High-Explosive TNT (trinitrotoluene)