

APPENDIX E
Source Term/Dose
Calculations

TABLE E-1 SOURCE TERM ANALYSIS FOR CH1 DRUM FIRE IN THE WHB

CD	CI	DR	CF	CRF	CARF	NCF	NCRF	NCARF	Mit. LPF W/HEPA	Mit. Q (PE-Ci)	Unmit. Q (PE-Ci)
1	80	1	0.95	1	5.00E-04	0.05	1.00E-02	6.00E-03	1.0E-06	3.8E-08	3.8E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * ((\text{CF} * \text{CRF} * \text{CARF}) + (\text{NCF} * \text{NCRF} * \text{NCARF}))) * \text{LPF} \quad (\text{Ref. Eq. 5-1})$$

where:

Q = the source term (Ci)

CD = # of containers damaged

CI = the waste container (drum) inventory

$$\text{MAR} = \text{CD} * \text{CI}$$

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

RF = Respirable Fraction = Fraction of the airborne radioactive particles that are in the respirable size range, i.e. < 10 um in aerodynamic equivalent diameter.

LPF = Leakpath Factor = The cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e. HEPA Filtration, plateout)

DR = Damage Ratio = 1 = The DR is that fraction of the MAR actually impacted by the accident condition.

CF = Combustible Fraction = Percentage of MAR that is combustible

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

CARF = Combustible airborne release fraction

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

NCARF = Noncombustible airborne release fraction.

TABLE E-2 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH1 DRUM FIRE IN THE WHB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary (2982 meters) CEDE (rem)
Mitigated									
Drum	3.8E-08	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	3.3E-05	3.8E-06	2.6E-07
Unmitigated									
Drum	3.8E-02	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	3.3E+01	3.8E+00	2.6E-01

Committed Effective Dose Equivalent (CEDE) = D = Q * X/Q * BR * DCF (Ref. Eq. 5-5)

where:

Q = the source term (Ci)

X/Q = Site specific air dispersion factor (s/m3)

BR = Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)

DCF = Internal Dose Conversion Factor (Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-3 CHEMICAL SOURCE TERM ANALYSIS FOR CH1 DRUM FIRE IN THE WHB												
Compound	WF Per Drum	CI (mg)	CD	MAR	DR	CF	NCF	CARF	NCARF	CRF	NCRF	Q (mg)
Chemical (Solids)												
Asbestos	2.74E-03	3.02E+05	1.00E+00	3.02E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.44E+02
Beryllium	2.10E-04	2.31E+04	1.00E+00	2.31E+04	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.11E+01
Cadmium	3.00E-06	3.31E+02	1.00E+00	3.31E+02	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.58E-01
Lead	8.26E-03	9.10E+05	1.00E+00	9.10E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.35E+02
Chemical (Liquids)												
Butyl Alcohol	3.00E-03	3.31E+05	1.00E+00	3.31E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.58E+02
Carbon Tetrachloride	6.27E-03	6.91E+05	1.00E+00	6.91E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	3.30E+02
Mercury	3.54E-03	3.90E+05	1.00E+00	3.90E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.87E+02
Methyl Alcohol	8.00E-06	8.82E+02	1.00E+00	8.82E+02	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.21E-01
Methylene Chloride	4.00E-04	4.41E+04	1.00E+00	4.41E+04	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	2.11E+01
Polychlorinated Biphenyl	8.54E-03	9.41E+05	1.00E+00	9.41E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.50E+02
Trichloroethylene	3.92E-03	4.32E+05	1.00E+00	4.32E+05	1.00E+00	9.50E-01	5.00E-02	5.00E-04	6.00E-03	1.00E+00	1.00E-02	2.07E+02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * ((\text{CF} * \text{CRF} * \text{CARF}) + (\text{NCF} * \text{NCRF} * \text{NCARF}))) \quad (\text{Ref. Eq. 5.1})$$

where:

- Q = The source term (mg)
- CD = # of containers damaged
- CI = The waste container (drum) inventory
- MAR = CD * CI
- DR = Damage Ratio = 1 = The DR is that fraction of the MAR actually impacted by the accident condition.
- CF = Combustible Fraction = Percentage of the MAR that is combustible.
- CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range
- CARF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range
- ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.
- RF = Respirable Fraction = Fraction of the airborne radioactive particles that are in the respirable size range, i.e. < 10 um in aerodynamic equivalent diameter.
- NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.
- NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.
- NCARF = Noncombustible airborne release fraction.
- WF = Weight Fraction = Fraction of compound anticipated in a drum (INEL) = (WF) x (243 lb drum) x (453592.37 mg/lb)

TABLE E-4 CHEMICAL CONSEQUENCE ANALYSIS FOR CH1 DRUM FIRE IN THE WHB														
Compound	Q (mg)	RR (sec.)	On-site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3) or (f/cc)	Exclusive Use Area (350 meters) C (mg/m3) or (f/cc)	Site Boundary C (mg/m3) or (f/cc)	Most Restricted Criteria for Extremely Unlikely Case C (mg/m3)	Most Restrictive Onsite/Offsite Criteria (mg/m3)	TOX-2 Criteria (mg/m3)	Ratio (Conc./Limit) @ On-site (100 m) (mg/m3)	Ratio (Conc./Limit) @ Exclusive Use Area (mg/m3)	Ratio (Conc./Limit) @ Secured Site Boundary (mg/m3)
Chemical (Solids)														
Asbestos (f/cc)	1.44E+02	900	5.11E-03	5.96E-04	4.05E-05	6.31E-03	7.35E-04	5.00E-05	0.2	1	1	6.31E-03	7.35E-04	5.00E-05
Beryllium	1.11E+01	900	5.11E-03	5.96E-04	4.05E-05	6.28E-05	7.33E-06	4.98E-07	0.002	10/0.005	0.01	6.28E-06	1.47E-03	9.96E-05
Cadmium	1.58E-01	900	5.11E-03	5.96E-04	4.05E-05	8.97E-07	1.05E-07	7.11E-09	0.002	50/0.01	0.01	1.79E-08	1.05E-05	7.11E-07
Lead	4.35E+02	900	5.11E-03	5.96E-04	4.05E-05	2.47E-03	2.88E-04	1.96E-05	0.15	700/0.75	0.75	3.53E-06	3.84E-04	2.61E-05
Chemical (Liquids)														
Butyl Alcohol	1.58E+02	900	5.11E-03	5.96E-04	4.05E-05	8.97E-04	1.05E-04	7.11E-06	150	24,640/150	150	3.64E-08	6.98E-07	4.74E-08
Carbon Tetrachloride	3.30E+02	900	5.11E-03	5.96E-04	4.05E-05	1.88E-03	2.19E-04	1.49E-05	31	1,917/63	155	9.78E-07	3.47E-06	2.36E-07
Mercury	1.87E+02	900	5.11E-03	5.96E-04	4.05E-05	1.06E-03	1.24E-04	8.39E-06	0.1	28/0.1	0.1	3.78E-05	1.24E-03	8.39E-05
Methyl Alcohol	4.21E-01	900	5.11E-03	5.96E-04	4.05E-05	2.39E-06	2.79E-07	1.90E-08	266	33,250/266	266	7.20E-11	1.05E-09	7.13E-11
Methylene Chloride	2.11E+01	900	5.11E-03	5.96E-04	4.05E-05	1.20E-04	1.40E-05	9.48E-07	174	21,000/870	870	5.70E-09	1.60E-08	1.09E-09
Polychlorinated Biphenyl	4.50E+02	900	5.11E-03	5.96E-04	4.05E-05	2.55E-03	2.98E-04	2.02E-05	0.5	10/2.5	2.5	2.55E-04	1.19E-04	8.10E-06
Trichloroethylene	2.07E+02	900	5.11E-03	5.96E-04	4.05E-05	1.17E-03	1.37E-04	9.29E-06	1092	1000/200	1092	1.17E-06	6.84E-07	4.65E-08

a. fibers/cc = (asbestos concentration mg/m3)(1 fiber/1.3E-7mg)(1 m3/1E6 cc)

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m3)

Q = The source term (mg)

RR = Release Rate=The RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Site specific air dispersion factor (s/m3)

TABLE E-5 SOURCE TERM ANALYSIS FOR CH 2 CRANE DROP IN THE WHB												
CI (PE-Ci)	CD	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Mit. Q (PE-Ci)	Unmit. Q (PE-Ci)
Drums												
80	1	80	0.025	0.001	0.050	0.100	0.950	1	1.9E-03	1.0E-06	1.9E-09	1.9E-03
8	6	48	0.025	0.001	0.050	0.100	0.950	1	1.1E-03	1.0E-06	1.1E-09	1.1E-03
										Total	3.1E-09	3.1E-03
SWBs												
130	1	130	0.010	0.001	0.050	0.100	0.950	1	1.2E-03	1.0E-06	1.2E-09	1.2E-03
										Total	1.2E-09	1.2E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF}))) * \text{LPF}$$

where:

Q = the source term (Ci)

CD = # of containers damaged

CI = the waste container inventory

$$\text{MAR} = \text{CD} * \text{CI}$$

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction Percentage of the MAR that is combustible

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e. HEPA Filtration, plateau)

TABLE E-6 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB									
	Q (PE-Ci)	On-Site (100 m) X/Q (s/m3)	Exclusive Use Area (350 m) X/Q (s/m3)	Site Boundary (2982 m) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 m) CEDE (rem)	Exclusive Use Area (350 m) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	3.1E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.7E-06	3.1E-07	2.1E-08
SWBS	1.2E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.1E-06	1.3E-07	8.5E-09
Unmitigated									
Drums	3.1E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.7E+00	3.1E-01	2.1E-02
SWBs	1.2E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.1E+00	1.3E-01	8.5E-03

Committed Effective Dose Equivalent (CEDE) = $D = Q * X/Q * BR * DCF$ (Ref. Eq. 5-5)

where:

- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Internal Dose Conversion Factor (Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-7 CH2 CHEMICAL SOURCE TERM/ CONSEQUENCE ANALYSIS FOR CRANE DROP IN THE WHB															
Compound	MAR (mg/drum)	CD (drums)	Q (drums) (mg)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (350 meters) C (mg/m3)	Site Boundary (2982 meters) C (mg/m3)	Limiting On site Criteria (mg/m3)	Limiting Off site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (350 meters)	Ratio (conc/limit) (2982 meters)
DRUMS															
methylene chloride*	205.23	7	1436.6	1	5.11E-03	5.96E-04	4.05E-05	7.34E+00	8.56E-01	5.8E-02	21000.00	870.0	0.03%	0.10%	0.007%
chloroform	19.80	7	138.6	1	5.11E-03	5.96E-04	4.05E-05	7.08E-01	8.26E-02	5.6E-03	5000.00	50.0	0.01%	0.17%	0.011%
carbon tetrachloride*	379.00	7	2653	1	5.11E-03	5.96E-04	4.05E-05	1.36E+01	1.58E+00	1.1E-01	1917.00	63.0	0.71%	2.51%	0.171%
1,1,2,2-Tetrachloroethane	10.40	7	72.8	1	5.11E-03	5.96E-04	4.05E-05	3.72E-01	4.34E-02	2.9E-03	1505.00	35.0	0.02%	0.12%	0.008%

$$C = (Q*X/Q)/RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate- the RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Site specific air dispersion factor (s/m3)

TABLE E-8 CH2 CHEMICAL SOURCE TERM/ CONSEQUENCE ANALYSIS FOR CRANE DROP IN THE WHB														
Compound	MAR (mg/SWB)	CD (SWB)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Use Area (350 meters) X/Q (s/m3)	Boundary (2982 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (350 meters)	Boundary (2982 mete rs) C (mg/m3)	Limiting On- site Criteria (mg/m3)	Limiting Off- site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (350 meters)	Ratio (conc/limit) (2982 meters)
SWBs														
methylene chloride	820.90	1	1	5.11E-03	5.96E-04	4.05E-05	4.19E+00	4.9E-01	3.3E-02	21000.00	870.0	0.02 %	0.06%	0.004%
chloroform	79.30	1	1	5.11E-03	5.96E-04	4.05E-05	4.05E-01	4.7E-02	3.2E-03	5000.00	50.0	0.01 %	0.09%	0.006%
carbon tetrachloride	1515.40	1	1	5.11E-03	5.96E-04	4.05E-05	7.74E+00	9.0E-01	6.1E-02	1917.00	63.0	0.40 %	1.43%	0.097%
1,1,2,2-Tetrachloroethane	41.40	1	1	5.11E-03	5.96E-04	4.05E-05	2.12E-01	2.5E-02	1.7E-03	1505.00	35.0	0.01 %	0.07%	0.005%

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg) = MAR * CD

RR = Release Rate- the RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Site specific air dispersion factor (s/m3)

TABLE E-9 SOURCE TERM ANALYSIS FOR CH2 CRANE DROP IN THE WHB w/SOLIDIFIED 1800 PE-Ci DRUM										
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF/RF	Source Term (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	1800	1	1800.0	1.00E-02	1.64E-05	3.0E-04	1.0E-06	1.0E+00	3.0E-10	3.0E-04

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout)

TABLE E-10 SOURCE TERM ANALYSIS FOR CH2 CRANE DROP IN THE WHB w/OVERPACKED 1100 PE-Ci DRUM												
CI (PE-Ci)	CD	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Mit. Q (PE-Ci)	Unmit. Q (PE-Ci)
Drums												
1100	1	1100	2.50E-04	0.001	0.050	0.100	0.950	1	2.6E-04	1.0E-06	2.6E-10	2.6E-04

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF}))) * \text{LPF}$$

where:

Q = the source term (Ci)

CD = # of containers damaged

CI = the waste container inventory

MAR = CD * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e. HEPA Filtration, plateout)

TABLE E-11 CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHBw/SOLIDIFIED 1800 PE-Ci DRUM									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drum	3.0E-10	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.6E-07	3.0E-08	2.0E-09
Unmitigated									
Drum	3.0E-04	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.6E-01	3.0E-02	2.0E-03

Committed Effective Dose Equivalent (CEDE) = $D = Q \cdot X/Q \cdot BR \cdot DCF$ (Ref. Eq. 5-5)

where:

D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)

Q = the source term (Ci)

X/Q = Site specific air dispersion factor (s/m3)

BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)

DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public

(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-12 CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB w/OVERPACKED 1100 PE-Ci DRUM									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drum	2.6E-10	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.3E-07	2.7E-08	1.8E-09
Unmitigated									
Drum	2.6E-04	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.3E-01	2.7E-02	1.8E-03

Committed Effective Dose Equivalent (CEDE) = $D = Q \cdot X/Q \cdot BR \cdot DCF$ (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-13 SOURCE TERM ANALYSIS FOR BEYOND DESIGN BASIS CH2 CRANE DROP IN THE WHB														
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	80	7	560.0	2.50E-02	0.001	0.050	0.100	0.950	1	1.3E-02	1.0E-06	1.0E+00	1.3E-08	1.3E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e.,HEPA filtration; plateout)

TABLE E-14 CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH2 CRANE DROP IN THE WHB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	1.3E-08	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.2E-05	1.4E-06	9.2E-08
Unmitigated									
Drums	1.3E-02	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.2E+01	1.4E+00	9.2E-02

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)

Q = the source term (Ci)

X/Q = Site specific air dispersion factor (s/m3)

BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)

DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public

(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-15 SOURCE TERM ANALYSIS FOR CH3 PUNCTURE AND DROP BY FORK LIFT IN THE WHB													
CI (PE-Ci)	CD (punct.)	CD (drop)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Source Term (PE-Ci)	LPF Mit.w/HE PA	Mit. Q (PE-Ci)	Unmit.Q (PE-Ci)
Drums													
80	1		80	0.050	0.001	0.050	0.100	0.950	1.000	3.8E-03	1.0E-06	3.8E-09	3.8E-03
8	1		8	0.050	0.001	0.050	0.100	0.950	1.000	3.8E-04	1.0E-06	3.8E-10	3.8E-04
8		2	16	0.010	0.001	0.050	0.100	0.950	1.000	1.5E-04	1.0E-06	1.5E-10	1.5E-04
											Total	4.4E-09	4.4E-03
SWBs													
130	1		130	0.010	0.001	0.050	0.100	0.950	1.000	1.2E-03	1.0E-06	1.2E-09	1.2E-03
32		1	32	0.010	0.001	0.050	0.100	0.950	1.000	3.1E-04	1.0E-06	3.1E-10	3.1E-04
											Total	1.5E-09	1.5E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF}))) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (with HEPA filtration)

Unmit. Q = the unmitigated source term (without HEPA filtration)

CD (puncture) = # of containers damaged by puncture

CD (drop) = # of containers damaged by drop

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout).

TABLE E-16 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE AND DROP BY FORK LIFT IN THE WHB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary (2982 meters) CEDE (rem)
Mitigated									
Drums	4.4E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	3.8E-06	4.4E-07	3.0E-08
SWBS	1.5E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.3E-06	1.6E-07	1.1E-08
Unmitigated									
Drums	4.4E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	3.8E+00	4.4E-01	3.0E-02
SWBS	1.5E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.3E+00	1.6E-01	1.1E-02

Committed Effective Dose Equivalent (CEDE) = D = Q * X/Q * BR * DCF (Ref. Eq. 5-5)

where:

- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public (Pu-239 Class W CEDE Inhalation
'5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-17 CHEMICAL SOURCE TERM AND CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE AND DROP OF DRUMS BY FORK LIFT IN THE WHB

Compound	MAR (mg/drum)	CD (drums)	Q (drums) (mg)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (350 meters) C (mg/m3)	Site Boundary (2982 meters) C (mg/m3)	Limiting On-site Criteria (mg/m3)	Limiting Off-site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (350 meters)	Ratio (conc/limit) (2982 meters)
DRUMS															
methylene chloride*	205.23	4	820.9	1	5.11E-03	5.96E-04	4.05E-05	4.19E+00	4.89E-01	3.3E-02	21000.00	870.0	0.02%	0.06%	0.004%
chloroform	19.80	4	79.2	1	5.11E-03	5.96E-04	4.05E-05	4.05E-01	4.72E-02	3.2E-03	5000.00	50.0	0.01%	0.09%	0.006%
carbon tetrachloride*	379.00	4	1516	1	5.11E-03	5.96E-04	4.05E-05	7.75E+00	9.04E-01	6.1E-02	1917.00	63.0	0.40%	1.43%	0.097%
1,1,2,2-Tetrachloroethane	10.40	4	41.6	1	5.11E-03	5.96E-04	4.05E-05	2.13E-01	2.48E-02	1.7E-03	1505.00	35.0	0.01%	0.07%	0.005%

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate- the RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Site specific air dispersion factor (s/m3)

TABLE E-18 CHEMICAL SOURCE TERM AND CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE AND DROP OF SWB BY FORKLIFT IN THE WHB

Compound	MAR (mg/SWB)	CD (SWBs)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 mete rs) X/Q (s/m3)	On-site (100 mete rs) C (mg/m3)	Exclusive Use Area (350 mete rs) C (mg/m3)	Site Boundary (2982 meters) C (mg/m3)	Limiting On-site Criteria (mg/m3)	Limiting Off-site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (350 meters)	Ratio (conc/limit) (2982 meters)
SWBs														
methylene chloride	820.90	2	1	5.11E-03	5.96E-04	4.05E-05	8.39E+00	9.8E-01	6.6E-02	21000.00	870.0	0.04 %	0.11 %	0.008 %
chloroform	79.30	2	1	5.11E-03	5.96E-04	4.05E-05	8.10E-01	9.5E-02	6.4E-03	5000.00	50.0	0.02 %	0.19 %	0.013 %
carbon tetrachloride	1515.40	2	1	5.11E-03	5.96E-04	4.05E-05	1.55E+01	1.8E+00	1.2E-01	1917.00	63.0	0.81 %	2.87 %	0.195 %
1,1,2,2-Tetrachloroethane	41.40	2	1	5.11E-03	5.96E-04	4.05E-05	4.23E-01	4.9E-02	3.4E-03	1505.00	35.0	0.03 %	0.14 %	0.010 %

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m³)

Q = Source Term (mg) = MAR * CD

RR = Release Rate- the RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Site specific air dispersion factor (s/m³)

TABLE E-19 SOURCE TERM ANALYSIS FOR CH3 WASTE CONTAINER PUNCTURE IN THE WHB w/SOLIDIFIED 1800 PE-Ci DRUM

	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF/RF	Source Term (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	1800	1	1800.0	1.00E-02	1.60E-05	2.9E-04	1.0E-06	1.0E+00	2.9E-10	2.9E-04

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

DR = Material Release Fraction = Fraction of contents of each waste container released during event

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e.,HEPA filtration; plateout)

TABLE E-20 SOURCE TERM ANALYSIS FOR CH3 PUNCTURE IN THE WHB w/1100 PE-Ci DRUM OVERPACKED IN SWB

CI (PE-Ci)	CD (punct.)	CD (drop)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Source Term (PE-Ci)	LPF Mit.w/HE PA	Mit. Q (PE-Ci)	Unmit.Q (PE-Ci)
Drums													
1100	1		1100	0.010	0.001	0.050	0.100	0.950	1.000	1.1E-02	1.0E-06	1.1E-08	1.1E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF}))) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD (puncture) = # of containers damaged by puncture

CD (drop) = # of containers damaged by drop

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout).

TABLE E-21 CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB w/SOLIDIFIED 1800 PE-Ci DRUM									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	2.9E-10	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.5E-07	2.9E-08	2.0E-09
Unmitigated									
Drums	2.9E-04	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.5E-01	2.9E-02	2.0E-03

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E +02 rem/uCi or 5.1E +08 rem/Ci)

TABLE E-22 CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB w/1100 PE-Ci DRUM OVERPACKED IN SWB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	1.1E-08	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	9.1E-06	1.1E-06	7.2E-08
Unmitigated									
Drums	1.1E-02	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	9.1E+00	1.1E+00	7.2E-02

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31 Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-23 SOURCE TERM ANALYSIS FOR BEYOND DESIGN BASIS CH3 PUNCTURE AND DROP												
CI (PE-Ci)	CD (punct.)	CD (drop)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	Source Term (PE-Ci)	LPF Mit.w/HEP A	Mit. Q (PE-Ci)	Unmit.Q (PE-Ci)
Drums												
80	1		80	0.050	0.001	0.050	0.100	0.950	3.8E-03	1.0E-06	3.8E-09	3.8E-03
80	1		80	0.050	0.001	0.050	0.100	0.950	3.8E-03	1.0E-06	3.8E-09	3.8E-03
80		2	160	0.010	0.001	0.050	0.100	0.950	1.5E-03	1.0E-06	1.5E-09	1.5E-03
										Total	9.2E-09	9.2E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + \text{NCF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD (puncture) = # of containers damaged by puncture

CD (drop) = # of containers damaged by drop

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

TABLE E-24 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH3 PUNCTURE AND DROP									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary (2982 meters) CEDE (rem)
Mitigated									
Drums	9.2E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	8.0E-06	9.3E-07	6.3E-08
Unmitigated									
Drums	9.2E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	8.0E+00	9.3E-01	6.3E-02

Committed Effective Dose Equivalent (CEDE) = $D = Q * X/Q * BR * DCF$ (Ref. Eq. 5-5)

where:

- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public (Pu-239 Class W CEDE Inhalation '5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-25 SOURCE TERM ANALYSIS FOR CH4 DROP OF WASTE CONTAINER FROM FORK LIFT IN THE WHB													
CD (PE-Ci)	CI (dropped)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Source Term (PE-Ci)	Mit. LPF w/HEPA	Mit. Q (PE-Ci)	Unmit. Q w/o HEPA (PE- Ci)	
Drums													
80	1	80	0.010	0.001	0.050	0.100	0.950	1.000	7.6E-04	1.0E-06	7.6E-10	7.6E-04	
8	3	24	0.010	0.001	0.050	0.100	0.950	1.000	2.3E-04	1.0E-06	2.3E-10	2.3E-04	
											Total	9.93E-10	9.9E-04
SWBs													
130	1	130	0.001	0.001	0.050	0.100	0.950	1.000	1.2E-04	1.0E-06	1.2E-10	1.2E-04	
32	1	32	0.001	0.001	0.050	0.100	0.950	1.000	3.1E-05	1.0E-06	3.1E-11	3.1E-05	
											Total	1.5E-10	1.5E-04

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF}))) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (with HEPA filtration)

Unmit. Q = the unmitigated source term (without HEPA filtration)

CD (drop) = # of containers damaged by drop

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout)

TABLE E-26 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH4 DROP OF WASTE CONTAINER IN WHB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	9.9E-10	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	8.6E-07	1.0E-07	6.8E-09
SWBS	1.5E-10	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.3E-07	1.6E-08	1.1E-09
Unmitigated									
Drums	9.9E-04	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	8.6E-01	1.0E-01	6.8E-03
SWBS	1.5E-04	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	1.3E-01	1.6E-02	1.1E-03

Committed Effective Dose Equivalent (CEDE) = D = Q * X/Q * BR * DCF

where:

- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-27 SOURCE TERM ANALYSIS FOR CH4 DROP IN THE WHB w/1100 PE-Ci DRUM OVERPACKED IN SWB														
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Source Term (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	1100	1	1100.0	1.00E-05	0.001	0.050	0.100	0.950	1	1.1E-05	1.0E-06	1.0E+00	1.1E-11	1.1E-05

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtrations; plateout)

TABLE E-28 CONSEQUENCE ANALYSIS FOR CH4 DROP IN THE WHB w/1100 PE-Ci DRUM OVERPACKED IN SWB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	1.1E-11	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	9.1E-09	1.1E-09	7.2E-11
Unmitigated									
Drums	1.1E-05	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	9.1E-03	1.1E-03	7.2E-05

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31 Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-29 SOURCE TERM ANALYSIS FOR BEYOND DESIGN BASIS CH4 DROP IN THE WHB														
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	80	4	320.0	1.00E-02	0.001	0.050	0.100	0.950	1	3.1E-03	1.0E-06	1.0E+00	3.1E-09	3.1E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout)

TABLE E-30 CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH4 DROP IN THE WHB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (350 meters) X/Q (s/m3)	Site Boundary (2982 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (350 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	3.1E-09	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.7E-06	3.1E-07	2.1E-08
Unmitigated									
Drums	3.1E-03	5.11E-03	5.96E-04	4.05E-05	3.33E-04	5.1E+08	2.7E+00	3.1E-01	2.1E-02

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-31 SOURCE TERM ANALYSIS FOR CH5 WASTE HOIST DROP											
Q (PE-Ci)	CD (dropped)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	MR (PE-Ci)	Mit. LPF w/HEPA	Mit. Q (PE-Ci)	Unmit. Q (PE-Ci)
Drums											
80	1	80	0.250	0.001	0.050	0.100	0.950	1.9E-02	1.0E-06	1.9E-08	1.9E-02
8	27	216	0.250	0.001	0.050	0.100	0.950	5.2E-02	1.0E-06	5.2E-08	5.2E-02
Total										7.1E-08	7.1E-02
SWBs											
130	1	130	0.250	0.001	0.050	0.100	0.950	3.1E-02	1.0E-06	3.1E-08	3.1E-02
32	3	96	0.250	0.001	0.050	0.100	0.950	2.3E-02	1.0E-06	2.3E-08	2.3E-02
Total										5.4E-08	5.4E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + \text{NCF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD (drop) = # of containers damaged by drop

CI = the waste container inventory

MAR = CD * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction = The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of the MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere (i.e., HEPA filtration; plateout)

TABLE E-32 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH5 WASTE HOIST DROP									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary (3029 meters) CEDE (rem)
Mitigated									
Drums	7.1E-08	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	6.1E-05	1.0E-05	4.8E-07
SWBS	5.4E-02	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	4.7E+01	7.7E+00	3.7E-01
Unmitigated									
Drums	7.1E-02	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	6.1E+01	1.0E+01	4.8E-01
SWBS	5.4E-02	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	4.7E+01	7.7E+00	3.7E-01

Committed Effective Dose Equivalent (CEDE) = D = Q * X/Q * BR * DCF (Ref. Eq. 5-5)

where:

- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR =Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF =Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public (Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-33 CHEMICAL SOURCE TERM/CONSEQUENCE ANALYSIS FOR CH5 WASTE HOIST DROP															
Compound	MAR (mg/drum)	CD (drums)	Q (drums) (mg)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (285 meters) C (mg/m3)	Site Boundary (3029 meters) C (mg/m3)	Limiting On site Criteria (mg/m3)	Limiting Off-site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (285 meters)	Ratio (conc/limit) (3029 meters)
Drums															
methylene chloride	205.2	28.0	5746.4	1.0	5.11E-03	8.43E-04	4.05E-05	2.94E+01	4.84E+00	2.33E-01	2.10E+04	8.70E+02	0.140 %	0.557 %	0.027 %
chloroform	19.8	28.0	554.4	1.0	5.11E-03	8.43E-04	4.05E-05	2.83E+00	4.67E-01	2.25E-02	5.00E+03	5.00E+01	0.057 %	0.935 %	0.045 %
carbon tetrachloride	379.0	28.0	10612.0	1.0	5.11E-03	8.43E-04	4.05E-05	5.42E+01	8.95E+00	0.4298	1.92E+03	6.30E+01	2.829 %	14.200 %	0.682 %
1,1,2,2-Tetrachloroethane	10.4	28.0	291.2	1.0	5.11E-03	8.43E-04	4.05E-05	1.49E+00	2.45E-01	1.18E-02	1.51E+03	3.50E+01	0.099 %	0.701 %	0.034 %
SWBs															
methylene chloride	820.9	4.0	3283.6	1.0	5.11E-03	8.43E-04	4.05E-05	1.68E+01	1.11E+01	5.32E-01	2.10E+04	8.70E+02	0.080 %	1.273 %	0.061 %
chloroform	79.3	4.0	317.2	1.0	5.11E-03	8.43E-04	4.05E-05	6.48E+00	1.07E+00	5.14E-02	5.00E+03	5.00E+01	0.130 %	2.139 %	0.103 %
carbon tetrachloride	1515.4	4.0	6061.6	1.0	5.11E-03	8.43E-04	4.05E-05	1.24E+02	2.04E+01	9.82E-01	1.92E+03	6.30E+01	6.463 %	32.444 %	1.559 %
1,1,2,2-Tetrachloroethane	41.4	4.0	165.6	1.0	5.11E-03	8.43E-04	4.05E-05	3.38E+00	5.58E-01	2.68E-02	1.51E+03	3.50E+01	0.225 %	1.595 %	0.077 %

CONCENTRATION (C)=(MAR*X/Q)/RR (Ref. Eq. 5-6)

where:

MAR = Material At Risk- the amount of material present that may be acted upon with the potentially dispersive energy source

RR =release rate- the RR is the amount of material suspended in air as a function of time.

X/Q =Site specific air dispersion factor (s/m3)

TABLE E-34 SOURCE TERM ANALYSIS FOR CH7 INTERNAL DRUM FIRE IN THE UNDERGROUND													
CI (PE-Ci)	CD (drums)	MAR (PE-Ci)	CF	CRF	CARF	NCF	NCARF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
80	1	80	0.95	1.00	0.0005	0.050	0.006	0.010	3.82E-02	1.0E-06	1.0E+00	3.8E-08	3.8E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CD} * \text{CI} * \text{DR} * ((\text{CF} * \text{CRF} * \text{CARF}) + (\text{NCF} * \text{NCRF} * \text{NCARF}))) * \text{LPF} \text{ (Ref. Eq. 5-1)}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (with HEPA filtration)

Unmit. Q = the unmitigated source term (without HEPA filtration)

CD = # of containers involved

CI = the waste container inventory (PE-Ci)

MAR = Material at Risk = CD * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

CF = Combustible Fraction = Fraction of the waste that is combustible=1 for this analysis.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

CARF = Combustible airborne release fraction

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

NCARF = Noncombustible Airborne Release Fraction = The percentage of noncombustible material that is suspended in air.

LPF = Leakpath Factor = The cumulative fraction of airborne material that escapes to the atmosphere (i.e., HEPA filtration; plateout)

TABLE E-35 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH7 DRUM FIRE IN THE UNDERGROUND									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drum	3.8E-08	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	3.3E-05	5.5E-06	2.6E-07
Unmitigated									
Drum	3.8E-02	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	3.3E+01	5.5E+00	2.6E-01

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

CEDE = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)

Q = the source term (Ci)

X/Q = Site specific air dispersion factor (s/m3)

BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)

DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public

(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-36 CHEMICAL SOURCE TERM/CONSEQUENCE ANALYSIS FOR CH7 DRUM FIRE/SPONTANEOUS IGNITION IN THE WHB

Compound	WF	CI (mg) 243 (lbs drum)	CD	MAR	CF	NCF	CARF	NCARF	C RF	NC RF	Combustible Source Term (Q)	Noncombust Source Term (Q)	Total (Q) (mg)
Chemical (Solids)													
Asbestos	2.74E-03	3.02E+05	1	3.02E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.43E+02	9.06E-01	1.44E+02
Beryllium	2.10E-04	2.31E+04	1	2.31E+04	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.10E+01	6.94E-02	1.11E+01
Cadmium	3.00E-06	3.31E+02	1	3.31E+02	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.57E-01	9.92E-04	1.58E-01
Lead	8.26E-03	9.10E+05	1	9.10E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.32E+02	2.73E+00	4.35E+02
Chemical (Liquids)													
Butyl Alcohol	3.00E-03	3.31E+05	1	3.31E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.57E+02	9.92E-01	1.58E+02
Carbon Tetrachloride	6.27E-03	6.91E+05	1	6.91E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	3.28E+02	2.07E+00	3.30E+02
Mercury	3.54E-03	3.90E+05	1	3.90E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	1.85E+02	1.17E+00	1.87E+02
Methyl Alcohol	8.00E-06	8.82E+02	1	8.82E+02	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.19E-01	2.65E-03	4.21E-01
Methylene Chloride	4.00E-04	4.41E+04	1	4.41E+04	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	2.09E+01	1.32E-01	2.11E+01
Nitric Acid	1.90E-03	2.09E+05	1	2.09E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	9.95E+01	6.28E-01	1.00E+02
Polychlorinated Biphenyl	8.54E-03	9.41E+05	1	9.41E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	4.47E+02	2.82E+00	4.50E+02
Trichloroethylene	3.92E-03	4.32E+05	1	4.32E+05	0.95	0.05	5.00E-04	6.00E-03	1.00E+00	1.00E-02	2.05E+02	1.30E+00	2.07E+02

where:

Weight Fraction = Fraction of compound anticipated in a drum (INEL)

243 lb drum = Weight of the average drum anticipated (INEL)

Q = the source term (Ci)

MAR = Material At Risk is the maximum amount and type of material present that may be acted upon with the potentially dispersive energy source

DR = Damage Ratio = 1 = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction is the fraction of radioactive material that is suspended in air.

RF = Respirable Fraction-fraction less than 10um in aerodynamic equivalent diameter.

LPF = Leakpath Factor is the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident. (i.e. HEPA Filtration, Plateout)

TABLE E-37 CHEMICAL SOURCE TERM/CONSEQUENCE ANALYSIS FOR CH 7 DRUM FIRE IN THE UNDERGROUND

Compound	Q (mg)	RR (sec.)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	Concentration @ Off Limits Area Boundary	On-site (100 m) (mg/m3) or (f/cc)	Exclusive Use Area (285 meters) (mg/m3) or (f/cc)	Concentration Site Boundary	Site Boundary (3029 meters) (mg/m3) or (f/cc)	Most Restricted Criteria for Extremely Unlikely Case	Most Restrictive Criteria for Extremely Unlikely Case(mg/m3)	TOX-2 Criteria	Ratio (Conc./Limit) @ On-site (100 m) (mg/m3)	Ratio (Conc./Limit) @ Exclusive Use Area Boundary (mg/m3)	Ratio (Conc./Limit) @ Site Boundary (mg/m3)
Chemical (Solids)																
Asbestos (f/cc)	1.44E+02	900	5.11E-03	8.43E-04	3.99E-05	1.04E-03	6.31E-03	1.04E-03	4.92E-05	4.92E-05	0.2	0.2	1	3.15E-02	5.20E-03	2.46E-04
Beryllium	1.11E+01	900	5.11E-03	8.43E-04	3.99E-05	1.04E-05	6.28E-05	1.04E-05	4.91E-07	4.91E-07	0.002	0.002	0.01	3.14E-02	5.18E-03	2.45E-04
Cadmium	1.58E-01	900	5.11E-03	8.43E-04	3.99E-05	1.48E-07	8.97E-07	1.48E-07	7.01E-09	7.01E-09	0.002	0.002	0.01	4.49E-04	7.40E-05	3.50E-06
Lead	4.35E+02	900	5.11E-03	8.43E-04	3.99E-05	4.08E-04	2.47E-03	4.08E-04	1.93E-05	1.93E-05	0.15	0.15	0.75	1.65E-02	2.72E-03	1.29E-04
Chemical (Liquids)																
Butyl Alcohol	1.58E+02	900	5.11E-03	8.43E-04	3.99E-05	1.48E-04	8.97E-04	1.48E-04	7.01E-06	7.01E-06	150	150	150	5.98E-06	9.87E-07	4.67E-08
Carbon Tetrachloride	3.30E+02	900	5.11E-03	8.43E-04	3.99E-05	3.09E-04	1.88E-03	3.09E-04	1.46E-05	1.46E-05	31	31	155	6.05E-05	9.98E-06	4.72E-07
Mercury	1.87E+02	900	5.11E-03	8.43E-04	3.99E-05	1.75E-04	1.06E-03	1.75E-04	8.27E-06	8.27E-06	0.1	0.1	0.1	1.06E-02	1.75E-03	8.27E-05
Methyl Alcohol	4.21E-01	900	5.11E-03	8.43E-04	3.99E-05	3.95E-07	2.39E-06	3.95E-07	1.87E-08	1.87E-08	266	266	266	9.00E-09	1.48E-09	7.02E-11
Methylene Chloride	2.11E+01	900	5.11E-03	8.43E-04	3.99E-05	1.97E-05	1.20E-04	1.97E-05	9.34E-07	9.34E-07	174	174	870	6.88E-07	1.13E-07	5.37E-09
Polychlorinated Biphenyl	4.50E+02	900	5.11E-03	8.43E-04	3.99E-05	4.21E-04	2.55E-03	4.21E-04	1.99E-05	1.99E-05	0.5	0.5	2.5	5.11E-03	8.43E-04	3.99E-05
Trichloroethylene	2.07E+02	900	5.11E-03	8.43E-04	3.99E-05	1.93E-04	1.17E-03	1.93E-04	9.16E-06	9.16E-06	1092	1092	1092	1.07E-06	1.77E-07	8.38E-09

a. fibers/cc = (asbestos concentration mg/m3)(1 fiber/1.3E-7mg)(1 m3/1E6 cc)

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate- the RR is the amount of material suspended in air as a function of time (Assumed 900 sec, 15 min.)

X/Q = Dispersion Coefficient (mg)

TABLE E-38 SOURCE TERM ANALYSIS FOR CH9 DROP OF WASTE CONTAINERS IN THE UNDERGROUND											
CI (PE-Ci)	CD (containers)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	MR (PE-Ci)	Mit. LPF w/HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drums											
80	1	80	0.025	0.001	0.050	0.100	0.950	1.9E-03	1.0E-06	1.9E-09	1.9E-03
8	6	48	0.025	0.001	0.050	0.100	0.950	1.1E-03	1.0E-06	1.1E-09	1.1E-03
									Total	3.1E-09	3.1E-03
SWBs											
130	1	130	0.010	0.001	0.050	0.100	0.950	1.2E-03	1.0E-06	1.2E-09	1.2E-03
									Total	1.2E-09	1.2E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CI} * \text{CD}) * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers involved

CI = the waste container inventory (PE-Ci)

MAR = Material at Risk = CD * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Fraction of the waste that is combustible=1 for this analysis.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

Mit.LPF = Leakpath Factor = The cumulative fraction of airborne material that escapes to the atmosphere (i.e., HEPA filtration; plateout)

Unmit. LPF = Unmitigated Leakpath Factor = (1 for this scenario and, therefore, not represented in the table) = The cumulative fraction of airborne material that escapes to the atmosphere.

TABLE E-39 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH9 DROP OF WASTE CONTAINERS IN THE UNDERGROUND

	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	3.1E-09	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.7E-06	4.4E-07	2.1E-08
SWBS	1.2E-09	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	1.1E-06	1.8E-07	8.4E-09
Unmitigated									
Drums	3.1E-03	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.7E+00	4.4E-01	2.1E-02
SWBS	1.2E-03	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	1.1E+00	1.8E-01	8.4E-03

Committed Effective Dose Equivalent (CEDE) = $D = Q \cdot X/Q \cdot BR \cdot DCF$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-40 CHEMICAL SOURCE TERM/CONSEQUENCE ANALYSIS FOR CH9 DROP OF WASTE CONTAINERS FROM FORKLIFT IN THE UNDERGROUND

Compound	MAR (mg/drum)	CD (drums)	Q (drums) (mg)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (285 meters) C (mg/m3)	Site Boundary (3029 meters) C (mg/m3)	Limiting On-site Criteria (mg/m3)	Limiting Off-site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (285 meters)	Ratio (conc/limit) (3029 meters)
Drums															
methylene chloride*	205.23	7	1436.61	1	5.11E-03	8.43E-04	3.99E-05	7.34E+00	1.21E+00	5.7E-02	21000.0	870.0	0.03 %	0.14 %	0.007 %
chloroform	19.80	7	138.6	1	5.11E-03	8.43E-04	3.99E-05	7.08E-01	1.17E-01	5.5E-03	5000.0	50.0	0.01 %	0.23 %	0.011 %
carbon tetrachloride*	379.00	7	2653	1	5.11E-03	8.43E-04	3.99E-05	1.36E+01	2.24E+00	1.1E-01	1917.0	63.0	0.71 %	3.55 %	0.168 %
1,1,2,2-Tetrachloroethane	10.40	7	72.8	1	5.11E-03	8.43E-04	3.99E-05	3.72E-01	6.14E-02	2.9E-03	1505.0	35.0	0.02 %	0.18 %	0.008 %
SWBs															
methylene chloride*	820.90	1	820.90	1	5.11E-03	8.43E-04	3.99E-05	4.19E+00	6.9E-01	3.3E-02	21000.0	870.0	0.02 %	0.08 %	0.004 %
chloroform	79.30	1	79.30	1	5.11E-03	8.43E-04	3.99E-05	4.05E-01	6.7E-02	3.2E-03	5000.0	50.0	0.01 %	0.13 %	0.006 %
carbon tetrachloride*	1515.40	1	1515.40	1	5.11E-03	8.43E-04	3.99E-05	7.74E+00	1.3E+00	6.0E-02	1917.0	63.0	0.40 %	2.03 %	0.096 %
1,1,2,2-Tetrachloroethane	41.40	1	41.40	1	5.11E-03	8.43E-04	3.99E-05	2.12E-01	3.5E-02	1.7E-03	1505.0	35.0	0.01 %	0.10 %	0.005 %

$$C = (Q * X / Q) / RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate=The RR is the amount of material suspended in air as a function of time = 1/1 sec.G24:G25

X/Q =Dispersion Coefficient (mg)

TABLE E-41 SOURCE TERM ANALYSIS FOR CH9 DROP IN THE U/G w/1100 PE-Ci DRUM OVERPACKED IN SWB														
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Source Term (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	1100	1	1100.0	2.50E-04	0.001	0.050	0.100	0.950	1	2.6E-04	1.0E-06	1.0E+00	2.6E-10	2.6E-04

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e.,HEPA filtration; plateout)

TABLE E-42 CONSEQUENCE ANALYSIS FOR CH9 DROP IN THE U/G w/1100 PE-Ci DRUM OVERPACKED IN SWB									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	2.6E-10	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.3E-07	3.8E-08	1.8E-09
Unmitigated									
Drums	2.6E-04	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.3E-01	3.8E-02	1.8E-03

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31 Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-43 SOURCE TERM ANALYSIS FOR BEYOND DESIGN BASIS CH9 DROP IN THE U/G														
	CI (PE-Ci)	CD (damaged)	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	Q (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drum	80	7	560.0	2.50E-02	0.001	0.050	0.100	0.950	1	1.3E-02	1.0E-06	1.0E+00	1.3E-08	1.3E-02

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = \text{CD} * \text{CI} * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Q = the source term (Ci)

Mit.Q = the mitigated source term (with HEPA filtration)

Unmit. Q = the unmitigated source term (without HEPA filtration)

CD = # of containers damaged by drop or puncture

CI = the waste container inventory

MAR = (CD puncture + CD drop) * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Percentage of MAR that is combustible.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

LPF = Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e., HEPA filtration; plateout)

TABLE E-44 CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH9 DROP IN THE U/G									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	1.3E-08	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	1.2E-05	1.9E-06	9.1E-08
Unmitigated									
Drums	1.3E-02	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	1.2E+01	1.9E+00	9.1E-02

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF (Ref. Eq. 5-5)

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.1E+08 rem/Ci)

TABLE E-45 SOURCE TERM ANALYSIS FOR CH11 ROOF FALL IN THE UNDERGROUND													
CI (PE-Ci)	CD	MAR (PE-Ci)	DR	ARF	CF	CRF	NCF	NCRF	MR (PE-Ci)	Mit. LPF w/HEPA	Unmit. LPF w/o HEPA	Mit. Q w/HEPA (PE-Ci)	Unmit. Q w/o HEPA (PE-Ci)
Drums													
80	1	80	0.025	0.001	0.500	0.100	0.950	1	2.0E-03	1.0E-06	1	2.0E-09	2.0E-03
8	20	160	0.025	0.001	0.500	0.100	0.950	1	4.0E-03	1.0E-06	1	4.0E-09	4.0E-03
											Total	6.0E-09	6.0E-03
SWBs													
130	1	130	0.010	0.001	0.500	0.100	0.950	1	1.3E-03	1.0E-06	1	1.3E-09	1.3E-03
32	4	128	0.010	0.001	0.500	0.100	0.950	1	1.3E-03	1.0E-06	1	1.3E-09	1.3E-03
											Total	2.6E-09	2.6E-03

$$Q = \text{MAR} * \text{DR} * \text{ARF} * \text{RF} * \text{LPF}$$

$$Q = (\text{CI} * \text{CD}) * \text{DR} * \text{ARF} * ((\text{CF} * \text{CRF}) + (\text{NCF} * \text{NCRF})) * \text{LPF}$$

where:

Mit.Q = the mitigated source term (*with* HEPA filtration)

Unmit. Q = the unmitigated source term (*without* HEPA filtration)

CD = # of containers involved

CI = the waste container inventory (PE-Ci) less than 10um in aerodynamic equivalent diameter.

MAR = Material at Risk = CD * CI

DR = Damage Ratio = The DR is that fraction of the MAR actually impacted by the accident condition.

ARF = Airborne Release Fraction-The fraction of radioactive material that is suspended in air.

CF = Combustible Fraction = Fraction of the waste that is combustible=1 for this analysis.

CRF = Combustible Respirable Fraction = The percentage of combustible material that is in the respirable size range

NCF = Noncombustible Fraction = Percentage of the MAR that is noncombustible.

NCRF = Noncombustible Respirable Fraction = The percentage of noncombustible material that is in the respirable size range.

Mit.LPF = Leakpath Factor = The cumulative fraction of airborne material that escapes to the atmosphere (i.e.,HEPA filtration; plateout)

Unmit. LPF =Leakpath Factor = the cumulative fraction of airborne material that escapes to the atmosphere from the postulated accident (i.e.,HEPA filtration; plateout)

TABLE E-46 ON-SITE AND OFF-SITE CONSEQUENCE ANALYSIS FOR CH11 ROOF FALL IN THE UNDERGROUND									
	Q (PE-Ci)	On-Site (100 meters) X/Q (s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	BR (m3/s)	DCF (rem/Ci)	On-Site (100 meters) CEDE (rem)	Exclusive Use Area (285 meters) CEDE (rem)	Site Boundary CEDE (rem)
Mitigated									
Drums	6.0E-09	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	5.2E-06	8.6E-07	4.1E-08
SWBS	2.6E-09	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.2E-06	3.7E-07	1.7E-08
Unmitigated									
Drums	6.0E-03	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	5.2E+00	8.6E-01	4.1E-02
SWBS	2.6E-03	5.11E-03	8.43E-04	3.99E-05	3.33E-04	5.1E+08	2.2E+00	3.7E-01	1.7E-02

Committed Effective Dose Equivalent (CEDE) = D = Q*X/Q*BR*DCF

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = the source term (Ci)
- X/Q = Site specific air dispersion factor (s/m3)
- BR = C31Breathing rate (standard man) (m3/s) International Commission on Radiological Protection (ICRP) No. 23 (Light activity 20.0 liters/min or 3.33 E-04 m3/s)
- DCF = Dose Conversion Factor (rem/Ci) Internal Dose Conversion Factors for Calculation of Dose to the Public
(Pu-239 Class W CEDE Inhalation 5.1E+02 rem/uCi or 5.10E+08 rem/Ci)

TABLE E-47 CHEMICAL SOURCE TERM/CONSEQUENCE ANALYSIS FOR CH11 ROOF FALL IN THE UNDERGROUND

Compound	MAR (mg/drum)	CD (drums)	Q (drums) (mg)	RR (1/1 sec)	On-site (100 meters) X/Q(s/m3)	Exclusive Use Area (285 meters) X/Q (s/m3)	Site Boundary (3029 meters) X/Q (s/m3)	On-site (100 meters) C (mg/m3)	Exclusive Use Area (285 meters) C (mg/m3)	Site Boundary (3029 meters) C (mg/m3)	Limiting On-site Criteria (mg/m3)	Limiting Off-site Criteria (mg/m3)	Ratio (conc/limit) (100 meters)	Ratio (conc/limit) (285 meters)	Ratio (conc/limit) (3029 meters)
Drums															
methylene ch	205.23	21	4309.83	1	5.11E-03	8.43E-04	3.99E-05	2.20E+01	3.63E+00	1.7E-01	21000.0	870.0	0.10%	0.42%	0.020%
chloroform	19.80	21	415.8	1	5.11E-03	8.43E-04	3.99E-05	2.12E+00	3.51E-01	1.7E-02	5000.0	50.0	0.04%	0.70%	0.033%
carbon tetrach	379.00	21	7959	1	5.11E-03	8.43E-04	3.99E-05	4.07E+01	6.71E+00	3.2E-01	1917.0	63.0	2.12%	10.65%	0.504%
1,1,2,2-Tetra	10.40	21	218.4	1	5.11E-03	8.43E-04	3.99E-05	1.12E+00	1.84E-01	8.7E-03	1505.0	35.0	0.07%	0.53%	0.025%
SWBs															
methylene ch	820.90	5	4104.50	1	5.11E-03	8.43E-04	3.99E-05	2.10E+01	3.5E+00	1.6E-01	21000.0	870.0	0.10%	0.40%	0.019%
chloroform	79.30	5	396.50	1	5.11E-03	8.43E-04	3.99E-05	2.03E+00	3.3E-01	1.6E-02	5000.0	50.0	0.04%	0.67%	0.032%
carbon tetrach	1515.40	5	7577.00	1	5.11E-03	8.43E-04	3.99E-05	3.87E+01	6.4E+00	3.0E-01	1917.0	63.0	2.02%	10.14%	0.480%
1,1,2,2-Tetra	41.40	5	207.00	1	5.11E-03	8.43E-04	3.99E-05	1.06E+00	1.7E-01	8.3E-03	1505.0	35.0	0.07%	0.50%	0.024%

$$C = (Q*X/Q)/RR$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate = The RR is the amount of material suspended in air as a function of time = 1/1 sec. G24:G25

X/Q = Dispersion Coefficient (mg)

TABLE E-48 EXPANDING CLOUD NUMERICAL ANALYSIS CALCULATIONS

$$D = (Q \cdot T \cdot BR \cdot DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

D	= Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
Q	= Radiological source term (Ci)
T	= Exposure time in seconds (depends on the scenario)
BR	= Breathing rate (standard man) (m ³ /s)
DCF	= Dose conversion factor (rem/Ci)
V	= Volume of expanding cloud at time to reach receptor (m ³) = 2/3 (Pi)(radius cubed)
r	= cloud radius at time t = (cloud speed)(time) + initial cloud radius
V	= 2/3 (Pi) [(0.25 m/s)(t) + (2m)] ³ (SAR Section 5.2.1.2)

t (sec)	Radius (m)	Vol (m ³)	[(BR)(DCF)(T)/V] (rem/ci)
12.00	5.00	261.67	6.49E+02
13.00	5.25	302.91	5.61E+02
14.00	5.50	348.28	4.88E+02
15.00	5.75	397.96	4.27E+02
16.00	6.00	452.16	3.76E+02
17.00	6.25	511.07	3.32E+02
18.00	6.50	574.88	2.95E+02
19.00	6.75	643.80	2.64E+02
20.00	7.00	718.01	2.37E+02
21.00	7.25	797.72	2.13E+02
		Total	<hr/> 3.84E+03

TABLE E-49 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH1 SPONTANEOUS IGNITION IN			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	4.2E-04	3.6E+03	1.5E+00

$$D = (Q \cdot T \cdot BR \cdot DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci) * (10 Sec exposure / 900 sec release)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-50 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	3.1E-03	3.6E+03	1.1E+01
SWBs	1.2E-03	3.6E+03	4.5E+00

$$D = (Q \cdot T \cdot BR \cdot DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-51 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	4.4E-03	7.3E+03	3.2E+01
SWBs	1.5E-03	7.3E+03	1.1E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-52 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH4 DROP IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	9.9E-04	3.6E+03	3.6E+00
SWBs	1.5E-04	3.6E+03	5.6E-01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-53 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH5 WASTE HOIST DROP						
	Q (PE-Ci)	V (m3)	T (sec)	BR (m3/s)	DCF (rem/Ci)	CEDE (rem)
Waste Container						
Drums	7.1E-02	2.40E+01	1.00E+00	3.33E-04	5.1E+08	5.0E+02

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-54 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH7 SPONTANEOUS IGNITION IN THE U/G						
	Q (PE-Ci)	V (m3)	T (sec)	BR (m3/s)	DCF (rem/Ci)	CEDE (rem)
Waste Container						
Drums	4.2E-04	2.40E+01	1.00E+00	3.33E-04	5.1E+08	3.0E+00

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci) * (10 Sec exposure / 900 sec release)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-55 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH9 DROP IN THE U/G						
	Q (PE-Ci)	V (m ³)	T (sec)	BR (m ³ /s)	DCF (rem/Ci)	CEDE (rem)
Waste Container						
Drums	3.1E-03	2.40E+01	1.00E+00	3.33E-04	5.1E+08	2.2E+01
SWBs	1.2E-03	2.40E+01	1.00E+00	3.33E-04	5.1E+08	8.8E+00

$$D = (Q*T*BR*DCF)/V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-56 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH11 ROOF FALL IN THE U/G						
	Q (PE-Ci)	V (m3)	T (sec)	BR (m3/s)	DCF (rem/Ci)	CEDE (rem)
Waste Container						
SWBs	6.0E-03	2.40E+01	1.00E+00	3.33E-04	5.1E+08	4.2E+01

$$D = (Q*T*BR*DCF)/V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-57 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB W/1800 PE CI SOLIDIFIED DRUM			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	3.0E-04	3.6E+03	1.1E+00

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-58 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB W/1100 PE CI OVERPACKED DRUM			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	2.6E-04	3.6E+03	9.5E-01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-59 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB w/SOLIDIFIED 1800 PE-Ci DRUMS			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	2.9E-04	7.3E+03	2.1E+00

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-60 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB w/OVERPACKED 1100 PE-Ci DRUM			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	1.1E-02	7.3E+03	7.7E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-61 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH2 CRANE DROP IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	1.3E-02	3.6E+03	4.8E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-62 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH3 PUNCTURE IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	9.2E-03	7.3E+03	6.6E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-63 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH4 DROP IN THE WHB			
	Q (PE-Ci)	[(BR)(DCF)(T)/V] (rem/ci) Table E-48 and SAR Section 5.2.1.2	CEDE (rem)
Waste Container			
Drums	3.1E-03	3.6E+03	1.1E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m³/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m³)

TABLE E-64 IMMEDIATE WORKER CONSEQUENCE ANALYSIS FOR BEYOND DESIGN BASIS CH9 DROP IN THE U/G						
	Q (PE-Ci)	V (m3)	T (sec)	BR (m3/s)	DCF (rem/Ci)	CEDE (rem)
Waste Container						
Drums	1.3E-02	2.40E+01	1.00E+00	3.33E-04	5.1E+08	9.5E+01

$$D = (Q * T * BR * DCF) / V \text{ (Ref. Eq. 5-7)}$$

where:

- D = Radiological dose (Committed Effective Dose Equivalent (CEDE)) (rem)
- Q = Radiological source term (Ci)
- T = Exposure time in seconds (depends on the scenario)
- BR = Breathing rate (standard man) (m3/s)
- DCF = Dose conversion factor (rem/Ci)
- V = Volume of expanding cloud at time to reach receptor (m3)

TABLE E-65 IMMEDIATE WORKER CHEMICAL CONSEQUENCE ANALYSIS FOR CH2 CRANE DROP IN THE WHB													
	MAR drum (mg)	MAR SWB (mg)	CD (drums)	CD (SWBs)	RR (1/1 sec)	Q (drums) (mg)	Q (SWBs) (mg)	V (m3)	Drum C (mg/m3)	SWB C (mg/m3)	Limit (mg/m3)	Drum Ratio (Conc /limit)	SWB Ratio (Conc /limit)
methylene chloride	205.2	820.9	7.0	1.0	1.0	1436.6	820.9	261.7	5.49E+00	3.14E+00	2.10E+04	0.026%	0.015%
chloroform	19.8	79.3	7.0	1.0	1.0	138.6	79.3	261.7	5.30E-01	3.03E-01	5.00E+03	0.011%	0.006%
carbon tetrachloride	379.0	1515.4	7.0	1.0	1.0	2653.0	1515.4	261.7	1.01E+01	5.79E+00	1.92E+03	0.529%	0.302%
1,1,2,2-Tetrachloroethane	10.4	41.4	7.0	1.0	1.0	72.8	41.4	261.7	2.78E-01	1.58E-01	1.51E+03	0.018%	0.011%

$$C = (Q * T) / (RR * V) \text{ (Ref. Eq. 5-8)}$$

where:

- C = Concentration (mg/m³)
- Q = Source Term (mg)
- RR = Release Rate = The amount of material suspended in air as a function of time.
- T = Time of exposure = 1 second for this scenario.
- V = Volume (m³)

TABLE E-66 IMMEDIATE WORKER CHEMICAL CONSEQUENCE ANALYSIS FOR CH3 PUNCTURE IN THE WHB													
	MAR drum (mg)	MAR SWB (mg)	CD (drums)	CD (SWBs)	RR (1/1 sec)	Q (drums) (mg)	Q (SWBs) (mg)	V (m3)	Drum C (mg/m3)	SWB C (mg/m3)	Limit (mg/m3)	Drum Ratio (Conc /limit)	SWB Ratio (Conc /limit)
methylene chloride	205.2	820.9	4.0	2.0	1.0	820.9	1641.8	261.7	3.14E+00	6.27E+00	2.10E+04	0.015%	0.030%
chloroform	19.8	79.3	4.0	2.0	1.0	79.2	158.6	261.7	3.03E-01	6.06E-01	5.00E+03	0.006%	0.012%
carbon tetrachloride	379.0	1515.4	4.0	2.0	1.0	1516.0	3030.8	261.7	5.79E+00	1.16E+01	1.92E+03	0.302%	0.604%
1,1,2,2-Tetrachloroethane	10.4	41.4	4.0	2.0	1.0	41.6	82.8	261.7	1.59E-01	3.16E-01	1.51E+03	0.011%	0.021%

$$C = (Q * T) / (RR * V) \text{ (Ref. Eq. 5-8)}$$

where:

C = Concentration (mg/m3)

Q = Source Term (mg)

RR = Release Rate = The amount of material suspended in air as a function of time.

T = Time of exposure = 1 second for this scenario.

V = Volume (m3)

TABLE E-67 IMMEDIATE WORKER CHEMICAL CONSEQUENCE ANALYSIS FOR CH4 DROP OF WASTE CONTAINER FROM FORKLIFT

	MAR drum (mg)	MAR SWB (mg)	CD (drums)	CD (SWBs)	RR (1/1 sec)	Q (drums) (mg)	Q (SWBs) (mg)	V (m3)	Drum C (mg/m3)	SWB C (mg/m3)	Limit (mg/m3)	Drum Ratio (Conc /limit)	SWB Ratio (Conc /limit)
methylene chloride	205.2	820.9	4.0	2.0	1.0	820.9	1641.8	261.7	3.14E+00	6.27E+00	2.10E+04	0.015 %	0.030 %
chloroform	19.8	79.3	4.0	2.0	1.0	79.2	158.6	261.7	3.03E-01	6.06E-01	5.00E+03	0.006 %	0.012 %
carbon tetrachloride	379.0	1515.4	4.0	2.0	1.0	1516.0	3030.8	261.7	5.79E+00	1.16E+01	1.92E+03	0.302 %	0.604 %
1,1,2,2-Tetrachloroethane	10.4	41.4	4.0	2.0	1.0	41.6	82.8	261.7	1.59E-01	3.16E-01	1.51E+03	0.011 %	0.021 %

$$C = (Q * T) / (RR * V) \text{ (Ref. Eq. 5-8)}$$

where:

- C = Concentration (mg/m3)
- Q = Source Term (mg)
- RR = Release Rate = The amount of material suspended in air as a function of time.
- T = Time of exposure = 1 second for this scenario.
- V = Volume (m3)

TABLE E-68 IMMEDIATE WORKER CHEMICAL CONSEQUENCE ANALYSIS FOR CH9 DROP IN THE U/G													
	MAR drum (mg)	MAR SWB (mg)	CD (drums)	CD (SWBs)	RR (1/1 sec)	Q (drums) (mg)	Q (SWBs) (mg)	V (m3)	Drum C (mg/m3)	SWB C (mg/m3)	Limit (mg/m3)	Drum Ratio (Conc /limit)	SWB Ratio (Conc /limit)
methylene chloride	205.2	820.9	7.0	1.0	1.0	1436.6	820.9	24.0	5.99E+01	3.42E+01	2.10E+04	0.285%	0.163%
chloroform	19.8	79.3	7.0	1.0	1.0	138.6	79.3	24.0	5.78E+00	3.30E+00	5.00E+03	0.116%	0.066%
carbon tetrachloride	379.0	1515.4	7.0	1.0	1.0	2653.0	1515.4	24.0	1.11E+02	6.31E+01	1.92E+03	5.766%	3.294%
1,1,2,2-Tetrachloroethane	10.4	41.4	7.0	1.0	1.0	72.8	41.4	24.0	3.03E+00	1.73E+00	1.51E+03	0.202%	0.115%

$$C = (Q * T) / (RR * V) \text{ (Ref. Eq. 5-8)}$$

where:

- C = Concentration (mg/m3)
- Q = Source Term (mg)
- RR = Release Rate = The amount of material suspended in air as a function of time.
- T = Time of exposure = 1 second for this scenario.
- V = Volume (m3)

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