

PROTOCOL

Human Health Exposure Parameters - RME

Introduction

The following protocol has been developed in order to support the Savannah River Site environmental remediation program. This protocol describes exposure factors to be used in the exposure calculations for the reasonable maximum exposure (RME) assumption. The assumptions are consistent with standard EPA values, when applicable. These are default assumptions. Unit-specific conditions at a given unit may justify the use of differing assumptions. These unit-specific assumptions must be justified, and clearly identified in the introduction to the BRA.

The human health exposure scenarios are described in the Human Health Receptors and Scenarios Protocol.

Details

1. Hypothetical SRS On-Unit Worker Exposure Scenario

This hypothetical SRS on-unit worker visits the site on an infrequent or occasional basis, therefore the exposure duration will be assumed to be 5 years, a reasonable amount of time for an individual to work on a scientific study. An exposure frequency of 6 days per year, once every other month, and an exposure time of 4 hours will be used for exposure to soils.

The Gamma Exposure Factor (TE) is a time adjustment for radiation exposure. For the SRS worker, the TE is calculated by dividing the 4.0 hour of exposure time by 24 hours in a day; this equals 0.17.

The following table contains the exposure factors for the hypothetical SRS on-unit worker for the reasonable maximum case.

Table 1. Exposure Factors for the Hypothetical SRS On-Unit Worker

Body Wt. (BW)	70	kg	EPA 1991a, p. 9
Exposure Duration (ED)	5	yr	SRS assumption
Exposure Frequency (EF)	6	d/yr	SRS assumption
Exposure Time (ET)	4	hr/d	SRS assumption
Adherence Factor Soil to Skin (AF)	1.0	mg/cm²	EPA 1995c, p. 3-4
Skin Surface Area Available For Contact (SA)	3,200	cm²	EPA 1992b, p. 8-11
Ingestion Rate (IR_o) for particulates	50	mg/d	EPA 1991a, p. B1
Inhalation Rate (IR_i) for 8 hour workday	20	m³/d	EPA 1991a, p. A2 EPA 1995c, p. 3-4
Conversion to Hourly Inhalation Rate	2.5	m³/hr	"
Fraction Ingested from Contaminated Source (FI)	1.0	unitless	EPA 1995c, p. 3-5
Absorption Factor (ABS) - organics	1%	unitless	EPA 1995c, p. 3-4
Absorption Factor (ABS) - inorganics	0.1%	unitless	EPA 1995c, p. 3-4
External Gamma Shielding Factor (S_e) (No structures present to provide shielding)	0	unitless	SRS assumption and EPA 1991b, p. 35
Gamma Exposure Factor (TE)	0.17	unitless	Explained in text

2. Hypothetical On-Unit Industrial Worker Exposure Scenario

The hypothetical on-unit industrial worker is defined by the EPA. Standard EPA values have been used when available. This worker is assumed to be engaged in light industrial work. The work may be conducted under a rain shelter, but it is not considered to be indoors. He uses and consumes groundwater from the unit. His exposure to soils is incidental.

The Gamma Exposure Factor (TE) is a time adjustment for radiation exposure. For the industrial worker, the TE is calculated by dividing the 8.0 hours of exposure time by 24 hours in a day; this equals 0.333.

The following table contains the exposure factors for the hypothetical on-unit industrial worker for the reasonable maximum case.

Table 2. Exposure Factors for the Hypothetical On-Unit Industrial Worker

Body Wt. (BW)	70	kg	EPA 1991a, p. 9
Exposure Duration (ED)	25	yr	EPA 1991a, p. 9 EPA 1995c, p. 3-5
Exposure Frequency (EF)	250	d/yr	EPA 1991a, p. 9 EPA 1995c, p. 3-4
Exposure Time (ET)	8	hr/d	EPA 1991a, p. 3
Adherence Factor Soil to Skin (AF)	1.0	mg/cm ²	EPA 1995c, p. 3-4
Skin Surface Area Available For Contact (SA)	3,200	cm ²	EPA 1992b, p. 8-11
Ingestion Rate (IR _o) for soils	50	mg/d	EPA 1991a, p. 10
Ingestion Rate (IR _o) for water	1	l/d	EPA 1991a, p. 9 EPA 1995c, p. 3-3
Inhalation Rate (IR _i) for 8 hour day	20	m ³ /d	EPA 1991a, p. A-2 EPA 1995c, p. 3-4
Conversion to Hourly Inhalation Rate	2.5	m ³ /hr	"
Fraction Ingested from Contaminated Source (FI)	1.0	unitless	EPA 1995c, p. 3-5
Absorption Factor (ABS)- organics	1%	unitless	EPA 1995c, p. 3-4
Absorption Factor (ABS) - inorganics	0.1%	unitless	EPA 1995c, p. 3-4
External Gamma Shielding Factor (S _i)	0.2	unitless	EPA 1991b, p. 35
Gamma Exposure Factor (TE)	0.333	unitless	Explained in text

3. Hypothetical On-Unit Resident Adult / Child Exposure Scenario

The hypothetical on-unit resident is defined by the EPA. Standard EPA values have been used when available.

The dermal permeability constant (PC) which is used for groundwater exposure estimates will be obtained from the EPA guidance document on dermal exposure assessment (1992b). Where a PC cannot be obtained from an EPA guidance document, a PC will be obtained from published or predicted values in open literature, or it will be calculated based on the COPCs octanol/water partition coefficient.

Intake via inhalation of VOCs released from groundwater during domestic use will be assumed equal to the intake of VOCs from ingestion of 2 liters of groundwater a day.

The Gamma Exposure Factor (TE) is a time adjustment for radiation exposure. The TE is calculated for the adult by dividing 15.0 hours of exposure time by 24 hours in a day; this equals 0.63. The TE is calculated for the child by dividing 18.0 hours of exposure time by 24 hours in a day; this equals 0.75.

The following table contains the exposure factors for the hypothetical on-unit resident for the reasonable maximum case.

Table 3. Exposure Factors for the Hypothetical On-Unit Resident

Body Wt. (BW)	70	15	kg	EPA 1991a, p. 6
Exposure Duration (ED)	24	6	yr	EPA 1991a, p. 6 EPA 1995c, p3-5
Exposure Frequency (EF)	350	350	d/yr	EPA 1991a, p. 5 EPA 1995c, p. 3-4
Exposure Time (ET) for Soil	15	18	hr/d	EPA 1990, p. 5-9 to 5-31
Exposure Time (ET) for Water	0.2	0.2	hr/d	EPA 1992b, p. 8-7
Adherence Factor Soil to Skin (AF)	1.0	1.0	mg/cm ²	EPA 1995c, p. 3-4
Skin Surface Area Available For Contact (SA) for Soil	5,000	1800	cm ²	EPA 1992b, p. 8-10 to 8-12
Skin Surface Area Available For Contact (SA) for Water	20,000	7300	cm ²	EPA 1992b, p. 8-10 to 8-12
Ingestion Rate (IR) for soil	100	200	mg/d	EPA 1991a, p. 6 EPA 1995c, p. 3-3
Ingestion Rate (IR) for water	2.0	1.0	l/d	EPA 1995c, p. 3-3
Inhalation Rate (IR)	20	15	m ³ /d	EPA 1991a, p. A2 EPA 1990, p. 3-41 EPA1995c, p. 3-4
Conversion to Hourly Inhalation Rate	0.83	0.63	m ³ /hr	"
Fraction Ingested from Contaminated Source (FI)	1.0	1.0	unitless	EPA 1995c, p. 3-5
Absorption Factor (ABS) - organics	1%	1%	unitless	EPA 1995c, p. 3-4
Absorption Factor (ABS) - inorganics	0.1%	0.1%	unitless	EPA 1995c, p. 3-4

External Gamma Shielding Factor (S _f)	0.2	0.2	unitless	EPA 1991b, p. 35
Gamma Exposure Factor (TE)	0.63	0.75	unitless	Explained in text

Sources

EPA 1989. *"Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),"* Interim Final, EPA/540/1-89/002, Office of Emergency and Remedial Response, USEPA, Washington, D.C., December 1989.

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EPA 1991a. *"Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors,"* Interim Final, OSWER Directive: 9285.6-03, Office of Emergency and Remedial Response Toxics Integration Branch, USEPA, Washington, D. C., March 25, 1991.

EPA 1991b. *"Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals),"* Interim, PB92-963333, Office of Emergency and Remedial Response Toxics Integration Branch, USEPA, Washington, D. C., December 1991.

EPA 1992a. *"Supplemental Guidance to RAGS: Calculating the Concentration Term,"* EPA Publication 9285.7-081, Office of Solid Waste and Emergency Response, Environmental Protection Agency, Washington, D.C., May 1992.

EPA 1992b. *"Dermal Assessment: Principles and Applications,"* Interim Report, EPA 600/8-91/011B, Office of Research & Development, USEPA, Washington, D.C.

EPA 1994a. *"Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure"*, Draft from Elmer Akin, 8/31/94.

EPA 1994b. *"Supplemental Guidance to RAGS: Region IV Bulletin,"* Vol. 1 No. 1, Office of Health Assessment, USEPA Region IV Waste Management Div., Atlanta, GA, March 1994.

EPA 1995c. *"Supplemental Guidance to RAGS: Region IV Bulletins, No. 3. Exposure Assessment"*, Office of Health Assessment, USEPA Region IV Waste Management Div., Atlanta, GA, November 1995.