

CORRES. CONTROL  
OUTGOING LTR NO.

00003450Z

DOE ORDER # 4700.1

94 RF 07202

# EG&G ROCKY FLATS

DIST.	LTR	E-C
AMARAL, M.E.		
BERMAN, H.S.		
BRANCH, D.B.		
CARNIVAL, G.J.		
COPP, R.D.		
DAVIS, J.G.		
FERRERA, D.W.		
HANNI, B.J.		
HARMAN, L. K.		
HEALY, T.J.		
HEDAHL, T.		
HILBIG, J.G.		
HUTCHINGS, N.M.		
KELL, R.E.		
KIRBY, W.A.		
KUESTER, A.W.		
MAHAFFEY, J.W.		
MANN, H.P.		
MARX, G.E.		
MCDONALD, M.M.		
McKENNA, F.G.		
MONTROSE, J.K.		
MORGAN, R.V.		
POTTER, G.L.		
PIZZUTO, V.M.		
RISING, T.L.		
SANDLIN, N.B.		
SETLOCK, G.H.		
STEWART, D.L.		
STIGER, S.G.	X	
SULLIVAN, M.T.		
SWANSON, E.R.		
WILKINSON, R.B.		
WILSON, J. M.		
WYANT, R.D.		
NELSON W.R.	X	
Hogg M.L.	X	
Hopkins J.K.	X	
Roberts R.S.	X	
File (a)	X	
Burlingame AH	X	

EG&G ROCKY FLATS, INC.  
ROCKY FLATS PLANT, P.O. BOX 464, GOLDEN, COLORADO 80402-0464 • (303) 966-7000

July 5, 1994

94-RF-07202

Jessie M. Roberson  
Acting Assistant Manager  
Environmental Restoration  
DOE, RFFO

Attn: N. I. Castaneda and B. K. Thatcher

SITE SPECIFIC EXPOSURE FACTORS - SGS-393-94

Ref: J. M. Roberson ltr (05262) to S. G. Stiger, Risk Assessment Per the Rocky Flats Plant Interagency Agreement, May 6, 1994

On June 2, 1994, EG&G Rocky Flats transmitted an analysis of site specific exposure factors to the Department of Energy (DOE) Rocky Flats Field Office (RFFO) letter SGS-350-94 for review. RFFO and EG&G met on June 21, 1994 to review RFFO's comments. EG&G has incorporated RFFO's comments into the attached document.

RFFO requested that EG&G categorize the recommended exposure assessment factors according to the kind or level of justification that would be necessary to adopt these factors in place of those already specified in the Exposure Scenario Tech Memos. For purposes of justification, there are five groups of recommended factors:

- A. FACTORS SPECIFIED IN TECH MEMOS ARE INCONSISTENT
- A.1 One or More Tech Memos Specify the Correct or Preferred Value

In many instances the recommended value is already specified in at least one or even several Tech Memos and therefore, there is some credibility and commitment already established.

EXAMPLE: Years of exposure for industrial workers to oral ingestion of soil and dust are given as 1 (OU-3), 5 (OU-4, OU-7), and 25 (OU-2, OU-5, OU-6). We recommend 25 years.

- A.2 No Tech Memo Specifies the Correct or Preferred Value

There are instances where several conflicting values are specified among the six Tech Memos, but none of these appear to have a basis in the current risk literature. Therefore, there is poor credibility and careful justification will be needed to support a single, more appropriate value.

EXAMPLE: Rate of airborne contaminated soil and dust inhaled by light industrial workers is given as 0.83 (OU-2, OU-4), 1.25 (OU-3), and 1.4 (OU-5, OU-6, OU-7). We recommend 1.0 m<sup>3</sup>/hour.

CORRES CONTROL	X
ERM RECORDS	X
MGMT (2)	X
CLASSIFICATION	
UCNI	
UNCLASSIFIED	
CONFIDENTIAL	
SECRET	
AUTHORIZED CLASSIFIER SIGNATURE	
DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE	

IN REPLY TO RFP CC NO:  
Roberson ltr 05262

ACTION ITEM STATUS  
 OPEN  CLOSED

PARTIAL

LTR APPROVALS:  
JKH: JKH  
ORIG & TYPIST INITIALS  
JKH: kld

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ADMIN RECCRD

SW-A-003677

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A.2 No Tech Memo Specifies the Correct or Preferred Value (continued)

Because the typical industrial worker is breathing both indoors and outdoors, the value of 1.0 m<sup>3</sup>/hour is preferred as an average of the outdoor average rate (1.4 m<sup>3</sup>/hour) and the indoor average rate (0.63 m<sup>3</sup>/hour), as documented in The Environmental Protection Agency's (EPA's) Exposure Factors Handbook (1989). Note that an average inhalation rate of 0.4 m<sup>3</sup>/hour is suitable for the *construction worker* based on greater outdoor exposure and greater exertion as compared to the worker in light industry. *Careful justification is needed where a single, preferred value is substituted in place of conflicting values already specified in the Operable Unit (OU) Tech Memos.*

B. FACTORS SPECIFIED IN TECH MEMOS ARE CONSISTENT

B.1 No Tech Memo Specifies the Correct or Preferred Value

In other instances, while the Tech Memos may be consistent in listing the same parameter value, that value does not appear to have a basis in the current risk literature.

EXAMPLE: Skin permeability to absorption of contaminants in surface water by the future on-site resident is given as 8E-04 or 0.0008 cm/hour (OU-2, OU-5); no specification is given for other OUs. We recommend 1.0 cm/hour for organic chemicals and 0.001 cm/hour for inorganic chemicals.

EPA's Dermal Exposure Assessment (1992) establishes the recommended values as the upper limits of the absorption rate based on ethylbenzene and toluene (organic) and based on chlorides of cadmium and mercury (inorganic). The value of 0.0008 cm/hour is for *water* and cannot be defended as a default parameter. In this situation, even more justification is necessary to adopt a value different from one already agreed upon in two or more Tech Memos.

B.2 Extremely Conservative Value is Used in the Tech Memos

A number of factors have values that may represent the 99th or 100th percentile of the parameter distribution, thus representing the Maximally Exposed Individual (MEI) in the entire exposed population. EPA Exposure Assessment Guidelines (1992) indicate that suitable recommended maximum exposure values can range from the 90th to 98th percentile.

EXAMPLE: Liters per day of drinking water consumption is consistently reported at 2.0, which would apply to the shallow ground water at OU-2. But the Contaminated Fraction Ingested, as specified in the OU-2 Tech Memo, is 1.0, meaning that 100% of daily intake will come from contaminated tap water. Not only do residents consume tap water at off-site locations; they also consume many water-based beverages originating off-site. We recommend a Fraction Ingested of 0.5, not 1.0.

Although it is a long-standing convention to assume 2 L/day of tap-water ingestion, we can justify, in effect, 1 L/day based on the statistic in EPA's Exposure Factors Handbook (1989) that total beverage intake is only 46% tap water. This assumption is still conservative as it does not account for tap-water ingestion away from the on-site residence. An extra effort at justification is needed where a long established, consistently applied, superconservative assumption would be replaced.

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C. FACTORS SPECIFIED IN TECH MEMOS HAVE NO UNIFORM STANDARD

Certain factors have never been standardized or documented in the risk literature and therefore require the use of local or regional data. *Any one value may be arguable and require negotiation.*

EXAMPLE: Days per year of a construction worker's exposure to direct radiation, both indoors and outdoors, is given as 30 (OU-4, OU-5), 124 (OU-7), and 130 (OU-6); no such factor is specified in Tech Memos for OU-2 and OU-3. We recommend 60 days.

Justification of 60 days can be made on the basis that this is the value proposed by the Colorado Department of Health (Interim Final Risk Assessment Guidance, 1993) and also appears reasonable. Justification of any alternative value would require some analysis of Denver regional construction data.

Problems of local or regional variability mainly affect two receptors - the construction worker and the ecological researcher.

If you have any questions or if you would like to have a meeting to review this analysis, please do not hesitate to call John Hopkins on extension 8636.

  
S. G. Stiger  
Director, Environmental  
Restoration Programs Division  
EG&G Rocky Flats, Inc.

JKH:kld

Orig. and 1 cc - J. M. Roberson

Attachment:  
As Stated

cc:  
M. H. McBride - DOE, RFFO  
S. J. Olinger - DOE, RFFO  
M. N. Silverman - DOE, RFFO  
L. W. Smith - DOE, RFFO  
D. C. Moody - LATO

## DEFAULT VALUES FOR EXPOSURE ASSESSMENT AT ROCKY FLATS

In the Attachment are recommended default values for exposure assessment parameters that were specified in the OU Exposure Scenario Technical Memos. Recommendations are made only where conflicting or unnecessarily conservative values are listed in the OU Tech Memos. The objective in making recommendations is two-fold: (1) to deal with the issue of extreme conservatism in many default exposure factors; and (2) to eliminate inconsistency among the OU Tech Memos where conflicting exposure assumptions are adopted for different OUs. The Attachment is organized into four groupings of default factors: (1) Ingestion Routes of Exposure; (2) Inhalation Routes of Exposure; (3) Dermal Routes of Exposure; and (4) External Irradiation Routes of Exposure.

Our guidance for recommending an appropriate level of conservatism is EPA's Exposure Assessment Guidelines (57FR104, May 29, 1992, pp. 22922-23):

- When constructing the "high-end" or "reasonable worst case" exposure for risk assessment, "not all factors should be set to values that maximize exposure or dose, since this will almost always lead to an estimate that is much too conservative."

- "Although a worst-case combination of future conditions or events may result in an exposure that is conceivably possible, the assessor should not merely use a worst-case combination as an estimate of high-end exposure for possible future uses. Rather, the assessor must use judgment as to what the range of exposures or doses would plausibly be."

- "When the complete distributions [of exposure factors] are not available, the assessor should conceptually target something above the 90th percentile on the actual distribution."

- "The assessor often constructs [the high-end] estimate by using maximum or near-maximum values for *one or more* of the most sensitive variables, leaving others at their *mean* values." [italics added]

To carry out this guidance, the risk assessor requires current knowledge of central tendencies (median or mean values) in addition to reasonable-worst-case and upper-bound values. Research tables are provided in the Appendix to document all three, if available. However, it is customary to use only the *average* values for certain parameters: body weight, skin surface, inhalation rate, and lifetime duration for cancer risk.

Please note that exposure assessment factors as defined here do not extend to fate and transport variables which modify the chemical or radionuclide concentration term. Thus, EPA RAGS Part B particulate emission or volatilization factors (VFs or PEFs) are not covered here, nor are factors for particulate deposition on plant foliage, root uptake of contaminants, and contaminant washoff before consuming produce. Similarly, no physical-chemical properties are considered, such as partitioning coefficients or shielding and dilution factors. All such factors are part of the fate and transport analysis, using exposure assessment models, or using OU site-specific measurements.

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
OPERABLE UNIT TECHNICAL MEMORANDUMS**

Page One	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INGESTION ROUTES OF EXPOSURE:					
SOIL/DUST INGESTION RATE (mg/ day)—					
Resident	100 adult [B.2]	10, 50 adult	10 adult	Exposure Factors Manual (Gephart et al., 1994)	10 is very conser- vative for adults (50th %ile is 0.1) (Calabrese et al., 1990); replaces extreme upper limit of 100 mg/day
	200 child [B.2]	50, 78 child	78 child	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	78 is 95th %ile from Calabrese & Stanek, 1992; replaces ex- treme upper limit of 200 (99th %ile)
Office	50 [B.2]	10	10	Exposure Factors Manual (Gephart, et al., 1994)	50 exceeds high- end rate for <i>Indus- trial</i> worker (Finley & Paustenbach, 1994); 10 is very conserva- tive for other adults
Industrial Worker	50 [B.2]	20	20	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Average of high-end rates for outdoor worker (30) and in- door (10) industrial workers

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
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Page Two	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
<b>INGESTION ROUTES OF EXPOSURE:</b>					
<b>SOIL/DUST INGESTION RATE (mg/ day)—</b>					
Ecological Worker	50 [C]	None	30	No basis in literature or guidance documents	High-end rate for outdoor industrial worker (Finley & Paustenbach, 1994)
Construc- tion Worker	50 [B.1]	None	200	Exposure Factors Handbook, 1989, lists high-end rate of 480	Soil excavation worker would have much higher rate than industrial work- er with indoor/out- door exposure
<b>HOMEGROWN PRODUCE INGESTION RATE (g/ day)—</b>					
Resident	80, 122, 340 [A.1]	None	200 (Veg) 140 (Fruit) 340 (Total)	Exposure Factors Handbook, 1989	No data to update Exposure Factors Handbook, 1989
<b>SURFACE WATER INGESTION RATE (L/day)</b>					
Resident/ Ecological Worker	0.05 [B.1]	None	None	None	Incidental ingestion from <i>swimming</i> does not apply to <i>wading</i>

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Three	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
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INGESTION  
ROUTES OF  
EXPOSURE:

SOIL/DUST  
CONTAMINATED  
FRACTION  
INGESTED  
(unitless)

Resident	0.5, 1.0 [A.1]	None	0.5 adult 1.0 child	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Upper limits for residents
Industrial/ Construc- tion/Eco- logical Workers	0.006, 0.06 0.125, 0.17, 0.5, 1.0 [A.2]	0.1, 0.75	0.75	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Upper limit for Indus- trial worker exposed to soil outdoors
Office Worker	0.125, 0.5 [A.2]	0.4	0.4	None	Estimated half the outdoor exposure of construction/ecolog- ical worker (FI=0.75)

HOMEGROWN  
PRODUCE  
CONTAMINATED  
FRACTION  
INGESTED  
(unitless)—

Resident	0.4, 1.0 [A.1]	0.25 (Veg) 0.20 (Fruit)	0.4 (Veg) 0.3 (Fruit)	RAGS Pt. A, 1989; no up- date	Upper limit for frac- tion of consumed produce that is homegrown
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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
OPERABLE UNIT TECHNICAL MEMORANDUMS**

Page Four	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INGESTION ROUTES OF EXPOSURE:					
GROUNDWATER CONTAMINATED FRACTION INGESTED (unitless)—					
Resident	1.0 [B.2]	0.5	0.5	Exposure Factors Handbook, 1989	Total beverage in- take (2 L/day) is only 46% tap water
SOIL/DUST INGESTION ABSORPTION FACTOR (unitless)—					
All Recep- tors	(chemical- specific or 1.0) [B.2]	0.5	0.5	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Maximum value (49%) for gastroin- testinal absorption (matrix effect)
HOMEGROWN PRODUCE INGESTION ABSORPTION FACTOR (unitless)—					
Resident	(chemical- specific or 1.0) [B.2]	0.5	0.5	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Maximum value (49%) for gastroin- testinal absorption (matrix effect)

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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
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Page Five	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INGESTION ROUTES OF EXPOSURE:					
SOIL/DUST INGESTION EXPOSURE FREQUENCY (days/yr)—					
Resident	290, 350 [C]	240 (outdoor)	320	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989, for weather adjustment)	Average of 290 days outdoors (350 - 60 in snow cover) and 350 days indoors (dust exposure)
Office Worker	207, 250 [A.1]	None	250	Standard Default Ex- posure Fac- tors, 1991	Indoor workers (no weather adjustment)
Industrial Worker	124, 207, 250 [C]	None	229	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989, for weather adjustment)	Average of 207 days outdoors (250 - 43 in snow cover) and 250 days indoors (dust exposure)
Construc- tion Worker	30, 130, 207, 250 [C]	60	60	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Six	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INGESTION ROUTES OF EXPOSURE:					
SOIL/DUST INGESTION EXPOSURE FREQUENCY (days/yr)—					
Ecological Worker	65, 80, 207 [C]	None	60	No basis in literature or guidance documents	Proposed assump- tion for Colorado
HOMEGROWN PRODUCE INGESTION EXPOSURE FREQUENCY (days/yr)—					
Resident	122, 175, 350 [A.1]	175	175	Exposure Factors Handbook, 1989	OU-6 Tech Memo uses correct value (175 days per year)
SURFACE WATER INGESTION EXPOSURE FREQUENCY (days/yr)—					
Resident/ Ecological Worker	7 [B.1]	None	None	None	Inappropriate to apply <i>swimming</i> frequency to a <i>wading</i> exposure

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Seven	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INGESTION ROUTES OF EXPOSURE:					
SOIL/DUST INGESTION EXPOSURE DURATION (years)—					
Office/In- dustrial Workers	1, 5, 25 [A.1]	None	25	RAGS Pt. B, 1991	Tech Memos for OU's 2, 5 and 6 use 25 years
Construc- tion Worker	1, 25 [C]	10	10	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	2.5, 7, 25 [C]	None	10	No basis in literature or guidance documents	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
OPERABLE UNIT TECHNICAL MEMORANDUMS**

Page Eight	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
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INHALATION  
ROUTES OF  
EXPOSURE:

SOIL/DUST  
INHALATION  
RATE (m<sup>3</sup>/hr)—

Office Worker	0.63, 0.83 [A.1]	None	0.63	Exposure Factors Handbook, 1989	Average indoor rate
Industrial Worker	0.83, 1.25, 1.4 [A.2]	None	1.0	Exposure Factors Handbook, 1989	Average of outdoor average rate (1.4) and indoor average rate (0.63)
Construc- tion/Eco- logical Workers	0.63, 0.83, 1.25, 1.4 [A.1]	None	1.4	Exposure Factors Handbook, 1989	Average outdoor rate

VOC INHALA-  
TION RATE  
(m<sup>3</sup>/hr)—

Office Worker	0.63, 0.83 [A.1]	None	0.63	Exposure Factors Handbook, 1989	Average indoor rate
Construc- tion Worker	0.63, 0.83, 1.4 [A.1]	None	1.4	Exposure Factors Handbook, 1989	Average outdoor rate

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Nine	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INHALATION ROUTES OF EXPOSURE:					
SOIL/DUST CONTAMINATED FRACTION INHALED (unitless)—					
All recep- tors	0.006, 0.06 0.17, 0.5, 1.0 [A.1]	0.5	0.5	<i>Risk Anal- ysis (Finley &amp; Pausten- bach, 1994)</i>	Upper limit of con- taminated fraction from source site
VOC CONTAM- INATED FRAC- TION INHALED (unitless)—					
Resident/ Office Work- er/Construc- tion Worker	0.5, 1.0 [A.1]	None	1.0	No basis in literature or guidance documents	Upper-limit default value in absence of pathway-specific value
SOIL/DUST LUNG DEPOSI- TION FACTOR (unitless)—					
All recep- tors	0.25, 0.75 [C]	None	0.4	RFP Site En- vironmental Report, 1992	Maximum mean an- nual ratio of PM <sub>10</sub> to TSP respirable frac- tion

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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
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Page Ten	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
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INHALATION  
ROUTES OF  
EXPOSURE:

SOIL/DUST  
INHALATION  
EXPOSURE  
TIME (hr/day)

Resident	16, 24 [A.2]	17	17	Exposure Factors Handbook, 1989	Based on 115 hr/wk indoors + 3.1 hr/wk outdoors = 16.9
All workers	0.5, 4, 8 [A.1]	None	8	CDH Interim Final Risk Assessment Guidance, 1993	High-end value listed in several OU Tech Memos

VOC INHALA-  
TION EXPOSURE  
TIME (hr/day)

Resident	16, 24 [A.2]	22 (indoor)	22 (indoor)	Roy & Cour- tay, 1991, as cited by CDH, 1993	OU-4, OU-6 and OU-7 Tech Memos use maximum value (24 hours)
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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Eleven	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INHALATION ROUTES OF EXPOSURE:					
SOIL/DUST INHALATION EXPOSURE FREQUENCY (days/yr)—					
Resident	290, 350 [C]	240 (outdoor)	320	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989, for weather adjustment)	Average of 290 days outdoors (350 - 60 in snow cover) and 350 days indoors (dust exposure)
Office Worker	207, 250 [A.1]	None	250	Standard Default Ex- posure Fac- tors, 1991	Indoor workers (no weather adjustment)
Industrial Worker	124, 207, 250 [C]	None	229	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989, for weather adjustment)	Average of 207 days outdoors (250 - 43 in snow cover) and 250 days indoors (dust exposure)
Construc- tion Worker	30, 130, 207, 250 [C]	60	60	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado

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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
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Page Twelve	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
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INHALATION  
ROUTES OF  
EXPOSURE:

SOIL/DUST  
INHALATION  
EXPOSURE  
FREQUENCY  
(days/yr)—

Ecological Worker	65, 80, 207 [C]	None	60	No basis in literature or guidance documents	Proposed assump- tion for Colorado
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VOC INHALATION  
EXPOSURE FRE-  
QUENCY (days/yr)

Resident	290, 350 [A.1]	None	350	Standard Default Exposure Factors, 1991	Indoor inhalation (no weather adjust- ment)
Office Worker	207, 250 [A.1]	None	250	Standard Default Exposure Factors, 1991	Indoor inhalation (no weather adjust- ment)
Construc- tion Worker	30, 130, 207 [C]	60	60	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Thirteen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
INHALATION ROUTES OF EXPOSURE:					
SOIL/DUST INHALATION EXPOSURE DURATION (years)—					
Industrial Worker	1, 5, 25 [A.1]	None	25	RAGS Pt. B, 1991	Tech Memos for OU's 2, 5 and 6 use 25 years
Construc- tion Worker	1, 25 [C]	10	10	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	2.5, 7, 25 [C]	None	10	No basis in literature or guidance documents	Proposed assump- tion for Colorado
VOC INHALA- TION EXPOSURE DURATION (years)—					
Construc- tion Worker	1, 25 [C]	10	10	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
PARAMETERS AT VARIANCE WITH ROCKY FLATS  
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Page Fourteen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
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DERMAL  
ROUTES OF  
EXPOSURE:

SOIL/DUST  
DERMAL CON-  
TACT; EXPOSED  
SKIN SURFACE  
(cm<sup>2</sup>)—

Resident	2190, 4140, 5000 [A.2]	2163 child	5200 adult 2163 child	Dermal Exposure Assess- ment, 1992	95th %ile based on 26% (adult)/30% (child) of mean skin surface exposed
Industrial Worker	2910, 5000 [A.2]	None	3400	Exposure Factors Handbook, 1989	Average of 95th %ile for outdoor worker (4700) and office worker (2100)
Office Worker	2910, 5000 [A.2]	2100	2100	Exposure Factors Handbook, 1989	Indoor worker ex- posed skin area (head, hands)
Construc- tion/Eco- logical Workers	2910, 5000, 5750 [C]	4700	4700	Exposure Factors Handbook, 1989	Outdoor worker ex- posed skin area (head, arms, hands)

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Fifteen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
DERMAL ROUTES OF EXPOSURE:					
SURFACE WATER DERMAL CONTACT; EXPOSED SKIN SURFACE (cm <sup>2</sup> )—					
Resident	2910, 1450 (wading) [A.2]	None	7104 (wading)	Exposure Factors Handbook, 1989	Assuming arms, hands, lower legs and feet exposed while wading and reaching under- water
Ecological Worker	4850 (wading) [B.1]	None	None	No basis in literature or guidance documents	Ecologist assumed using waders and equipment; no body contact with water
SOIL/DUST DERMAL CONTACT; CONTAMINATED FRACTION CON- TACTED (unitless)—					
Industrial/ Construc- tion/Eco- logical Workers	0.006, 0.06 0.125, 0.17, 0.5, 1.0 [A.2]	None	0.75	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994)	Estimated high-end rate for industrial worker exposed to soil outdoors
Office Worker	0.125, 0.5 [A.2]	0.4	0.4	No basis in literature or guidance documents	Estimated half the outdoor exposure of construction/ ecological worker (FC=0.8)

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**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Sixteen	VALUES IN TECHNICAL MEMOS	LESS CONSERVATIVE PUBLISHED VALUES	RECOMMENDED DEFAULT VALUE	REFERENCE FOR RECOMMENDED VALUE	BASIS FOR RECOMMENDED VALUE
<b>DERMAL ROUTES OF EXPOSURE:</b>					
<b>SOIL/DUST DERMAL CONTACT; SOIL ADHERENCE (mg/cm<sup>2</sup>)—</b>					
All receptors	0.5, 0.6, 1.0 [A.1]	None	1.0	Dermal Exposure Assessment, 1992	Value adopted by CDH, 1993; range is 0.2-1.5
<b>SOIL/DUST DERMAL CONTACT; SKIN ABSORPTION FACTOR (unitless)—</b>					
All receptors	(chemical-specific or 1.0) [B.2]	0.5	0.5	Dermal Exposure Assessment, 1992	High-end value adopted by CDH, 1993
<b>SURFACE WATER DERMAL CONTACT; SKIN PERMEABILITY (cm/hr)—</b>					
Resident	0.0008 (water) [B.1]	None	1.0 (organic chemical 0.001 (inorganic chemical	Dermal Exposure Assessment, 1992	Upper-limit values (ethylbenzene, toluene; chlorides of cadmium, mercury)

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Seventeen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED- VALUE	BASIS FOR RECOMMEND- ED VALUE
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DERMAL  
ROUTES OF  
EXPOSURE:

SOIL/DUST DERMAL  
CONTACT EXPOSURE  
FREQUENCY (days/yr)—

Resident	290, 350 [C]	240 (outdoor)	320	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989 for weather adjustment)	Average of 290 days outdoors (350 - 60 in snow cover) and 350 days indoors (dust exposure)
Office Worker	207, 250 [A.1]	None	250	Standard Default Ex- posure Fac- tors, 1991	Indoor workers (no weather adjustment)
Industrial Worker	124, 207, 250 [C]	None	229	Doeskin, (pers. comm. 1992; RAGS Pt. A, 1989, for weather adjustment)	Average of 207 days outdoors (250 - 43 in snow cover) and 250 days indoors (dust exposure)
Construc- tion Worker	30, 130, 207, 250 [C]	60	60	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	65, 80, 207 [C]	None	60	No basis in literature or guidance documents	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Eighteen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
DERMAL ROUTES OF EXPOSURE:					
SOIL/DUST DERMAL CONTACT EXPOSURE DURATION (years)—					
Industrial Worker  years	1, 5, 25 [A.1]	None	25	RAGS Pt. B, 1991	Tech Memos for OU's 2, 5 and 6 use 25
Construc- tion Worker	1, 25 [C]	10	10	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	2.5, 7, 25 [C]	None	10	No basis in literature or guidance documents	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Nineteen	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
EXTERNAL IRRADIATION ROUTES OF EXPOSURE:					
IRRADIATION SOURCE FRAC- TION EXPOSED (unitless)—					
Industrial/ Construc- tion/Eco- logical Workers	0.006, 0.06, 0.5, 1.0 [A.2]	0.75	0.75	<i>Risk Anal- ysis</i> (Finley & Pausten- bach, 1994	Upper limit for indus- trial workers exposed to soil outdoors (unshielded)
Office Worker	0.125, 0.5 [A.2]	0.4	0.4	No basis in literature or guidance documents	Estimated half the outdoor exposure of construction/ecolog- ical worker (FE=0.75)
IRRADIATION SOURCE EXPO- SURE TIME (hr/day)—					
Resident	0.5, 24 [A.2]	22 (indoor) 2 (outdoor)	22 (indoor) 2 (outdoor)	Roy & Cour- tay, 1991, as cited by CDH, 1993	Assuming both out- door and shielded indoor exposures
Office Worker	1, 8 [A.2]	None	7 (indoor) 1 (outdoor)	No basis in literature or guidance documents	Assuming both out- door and shielded indoor exposures

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Page Twenty	VALUES IN TECHNICAL MEMOS	LESS CON- SERVATIVE PUBLISHED VALUES	RECOM- MENDED DEFAULT VALUE	REFERENCE FOR RECOM- MENDED VALUE	BASIS FOR RECOMMEND- ED VALUE
EXTERNAL IRRADIATION ROUTES OF EXPOSURE:					
IRRADIATION SOURCE EXPO- SURE TIME (hr/day)—					
Industrial/ Ecological Workers	4, 8 [A.1]	None	8	No basis in literature or guidance documents	Maximum value used as default, as- suming substantial outdoor exposure
IRRADIATION SOURCE EXPO- SURE FREQUENCY (days/yr)—					
Industrial/ Office Workers	124, 250 [A.1]	None	250	RAGS Pt. B, 1991	OU-4, OU-5 and OU-6 Tech Memos use 250 days per year
Construc- tion Worker	30, 124, 130 [C]	60	60	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	65, 80 [C]	None	60	No basis in literature or guidance documents	Proposed assump- tion for Colorado

**RECOMMENDED DEFAULT VALUES FOR EXPOSURE ASSESSMENT  
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Twenty-one					
EXTERNAL IRRADIATION ROUTES OF EXPOSURE:					
IRRADIATION SOURCE EXPO- SURE DURATION (years)—					
Industrial Worker	5, 25 [A.1]	None	25	RAGS Pt. B, 1991	OU-5 and OU-6 Tech Memos use 25 years
Construc- tion Worker	1, 25 [C]	10	10	CDH Interim Final Risk Assessment Guidance, 1993	Proposed assump- tion for Colorado
Ecological Worker	2.5, 7 [C]	None	10	No basis in literature or guidance documents	Proposed assump- tion for Colorado

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