NUREG-1640, Vol. 2

Radiological Assessments for Clearance of Equipment and Materials From Nuclear Facilities

Appendices

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
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ABSTRACT

This report documents the technical basis for the Nuclear Regulatory Commission to use in developing regulatory standards for clearing equipment and materials with residual radioactivity from nuclear facilities. In addition to equipment reuse, the analysis identifies material flow models, based on U.S. industry practices, for recycle of steel, copper, aluminum, and concrete. Using information from the material flow models, likely potential exposure scenarios were realistically modeled for the recycle of these materials. Scenarios for copper, aluminum, and concrete were based on the steel scenarios, but were modified to reflect differences in each industry, and additional exposure scenarios unique to each material were included. The modeling includes all significant exposure pathways, and scenarios include handling and processing, storage, transportation, product use, and disposal. The results of the analyses are expressed in both mass and surficial units. Using Monte Carlo techniques, distributions of radionuclide concentrations were estimated in the material flow model, and concentrations at selected points in the process were used as inputs to the dose assessment model for each scenario. Probability distributions for dose factors (along with the mean, median, and 5th and 95th percentile values) were estimated for each radionuclide and each scenario. For each material (e.g., steel), a critical group was identified for each radionuclide, which represents the scenario with the highest mean dose factor. Appendices containing details of the analysis and tabulations of results are included.

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APPENDIX A

EXPOSURE SCENARIO TITLES AND ABBREVIATIONS

CONTENTS

Tables

A EXPOSURE SCENARIO TITLES AND ABBREVIATIONS

This appendix provides tables identifying the exposure scenario titles and their abbreviations for all exposure scenarios in this analysis. The abbreviations are used throughout both volumes of the report. There is one table for each material analyzed (steel, copper, aluminum, concrete) and one for the equipment reuse scenario.

The first two letters of the abbreviation indicate the overall material type (e.g., iron/steel = FE); the second group of letters indicate the specific "product" (e.g., refinery slag = SLAG); the next group indicates the scenario category (e.g., handling scenarios = HANDLIN); the final letter indicates the type of receptor (work-related = W, non-worker-related = N).

The last column in these tables indicates the file name used for each electronic scenario spreadsheet file (see Section 8 of Volume 1 for the naming convention). The extension of the file name is excluded from the tables to simplify the listing. This information is not needed by most users of this report, but is provided for NRC staff that may need to access the spreadsheet files.

Table A.1 Exposure scenarios for the recycle of steel

Scenario abbreviation	Scenario title	Electronic filename
Handling and Processing Scenarios		
FE-SCRP-HANDLIN-W	Handling scrap metal at the scrapyard	HMU01FEI
FE-SLAG-HANDLIN-W	Handling slag at the refinery	HSU02FEI
FE-EAFD-HANDLIN-W	Handling EAF dust at the refinery	HDU04FEI
FE-EAFD-BAGHOUS-W	Refinery baghouse operations	HDU03FEI
FE-METL-HANDREF-W	Handling refined metal product at the refinery	HRU16FEI
FE-BOFM-HANDMAN-W	Handling BOF refined metal during product manufacture	HRU17FEI
FE-METL-HANDDIS-W	Handling EAF refined metal product during distribution	HRU17EAF
FE-EAFD-PROCESS-W	Processing EAF dust for disposal	HDU05FEI
FE-SLAG-PROCESS-W	Processing slag for use as aggregate or as roadbed	HSU12FEI
FE-ATMO-REFINER-N	Atmospheric release during refining	HAU15FEG
Storage Scenario		
FE-SLAG-STORAGE-N	Storage of slag at the refinery	SSU01FEG
Product Use Scenarios		
FE-SLAG-ROADBED-W	Road construction activities using refinery slag	PSU15FEI
FE-METL-LGMASS-N	In proximity of a large metal mass	PRU10FEI
FE-METL-SMMASS-N	In proximity of a small metal mass	PRU11FEI
FE-METL-SMOBJCT-N	Small steel mass close to the body	PRU12FEI
FE-METL-VEHICLE-N	Inside an automobile	PRU13FEI
FE-METL-BLDGSTR-N	Inside a building structure	PRU14FEI
FE-SLAG-CONCBAS-N	Use of slag as aggregate in basement construction	PSU09FEI
FE-SLAG-ROADBED-N	Use of slag in a roadbed	PSU02FEG

Table A.1 Exposure scenarios for the recycle of steel

Scenario abbreviation	Scenario title	Electronic filename
Transport Scenarios		
FE-SCRP-TRANSPO-W	Transport of scrap metal	TMU01FEX
FE-SLAG-TRANSPO-W	Transport of slag	TSU02FEX
FE-EAFD-TRANSPO-W	Transport of untreated EAF dust	TDU03FEX
FE-METL-TRANSPO-W	Transport of refined metal product	TRU08FEX
Disposal Scenarios		
FE-BOFD-DISPOSL-W	Disposal of BOF dust in a sanitary landfill	DDU16FEI
FE-SLAG-DISPOSL-W	Disposal of refinery slag in a sanitary landfill	DSU03FEI
FE-SCRP-DISPOSL-W	Disposal of scrap metal in a sanitary landfill	DMU01FEI
FE-EAFD-DISPOSL-W	Disposal of EAF dust in a hazardous waste landfill	DDU05FEI
Landfill Resident Scenarios		
FE-BOFD-LANDFIL-N	Resident on a closed landfill after disposal of BOF dust	DDU17FEG
FE-SLAG-LANDFIL-N	Resident on a closed landfill after disposal of refinery slag	DSU13FEG
FE-SCRP-LANDFIL-N	Resident on a closed landfill after disposal of scrap metal	DMU11FEG
FE-EAFD-LANDFIL-N	Resident on a closed landfill after disposal of EAF dust	DDU15FEG

Table A.2 Exposure scenarios for the recycle of copper

Scenario abbreviation	Scenario title	Electronic filename
Handling and Processing Scenarios		
CU-SCRP-HANDLIN-W	Handling copper scrap metal at the scrapyard	HMU01CUI
CU-REVD-BAGHOUS-W	Copper reverberatory furnace baghouse operations	HDU05CUI
CU-CNVD-BAGHOUS-W	Copper converter baghouse operations	HDU06CUI
CU-REVM-HANDREF-W	Handling refined copper metal product at the refinery (reverberatory furnace)	HRU08CUI
CU-CNVM-HANDREF-W	Handling refined copper metal product at the refinery (converter)	HRU09CUI
CU-ELRM-HANDREF-W	Handling refined copper metal product at the refinery (electrorefiner)	HRU10CUI
CU-REVM-HANDMAN-W	Handling refined copper metal product during product manufacture (reverberatory furnace)	HRU11CUI
CU-REVM-HANDDIS-W	Handling refined copper metal product during product distribution (reverberatory furnace)	HRU12CUI
CU-REVS-HANDLIN-W	Handling copper slag at the refinery (reverberatory furnace)	HSU02CUI
CU-CNVS-HANDLIN-W	Handling copper slag at the refinery (converter)	HSU03CUI
CU-ELRS-HANDLIN-W	Handling copper slag at the refinery (electrorefiner)	HSU04CUI
CU-ATMO-REVERAT-N	Atmospheric releases during copper refining (reverberatory furnace)	HAU13CUG
CU-ATMO-CONVERT-N	Atmospheric releases during copper refining (converter)	HAU14CUG
Transport Scenarios		
CU-REVD-TRANSPO-W	Transport of reverberatory furnace dust	TDU02CUX
CU-CNVD-TRANSPO-W	Transport of converter dust	TDU03CUX
CU-SCRP-TRANSPO-W	Transport of copper scrap metal	TMU01CUX
CU-REVM-TRANSPO-W	Transport of copper refined metal product (reverberatory furnace)	TRU08CUX
CU-ELRM-TRANSPO-W	Transport of copper refined metal product (electrorefiner)	TRU10CUX
Disposal Scenarios		
CU-SCRP-DISPOSL-W	Disposal activities for copper scrap in a sanitary landfill	DMU03CUI
Product Use Scenarios		
CU-ELRM-LGMASS-N	In proximity of a large roll of copper wire (electrorefiner)	PRU03CUI
CU-REVM-SMMASS-N	In proximity of a small metal mass (reverberatory furnace)	PRU04CUI
CU-REVM-SMOBJCT-N	Small copper mass close to the body (reverberatory furnace)	PRU05CUI
CU-METL-PIPES-N	Use of copper water pipes	PRU17CUI

Table A.3 Exposure scenarios for the recycle of aluminum

Scenario abbreviation	Scenario title	Electronic filename
Handling and Processing Scenarios		
AL-SCRP-HANDLIN-W	Handling aluminum scrap metal at the scrapyard	HMU01ALI
AL-DUST-BAGHOUS-W	Aluminum refinery baghouse operations	HDU03ALI
AL-METL-HANDREF-W	Handling refined aluminum metal product at the refinery	HRU04ALI
AL-METL-HANDMAN-W	Handling refined aluminum metal product during manufacture	HRU05ALI
AL-METL-HANDDIS-W	Handling refined aluminum metal product during product distribution	HRU06ALI
AL-DROS-HANDLIN-W	Handling aluminum dross at the refinery	HSU02ALI
AL-ATMO-REFINER-N	Atmospheric releases during aluminum refining	HAU07ALG
Transport Scenarios		
AL-DUST-TRANSPO-W	Transport of refinery dust	TDU02ALX
AL-SCRP-TRANSPO-W	Transport of aluminum scrap metal	TMU01ALX
AL-METL-TRANSPO-W	Transport of aluminum refined metal product	TRU04ALX
AL-DROS-TRANSPO-W	Transport of aluminum dross	TSU03ALX
Disposal Scenarios		
AL-SCRP-DISPOSL-W	Disposal activities for aluminum scrap in a sanitary landfill	DMU01ALI
Product Use Scenarios		
AL-METL-LGMASS-N	In proximity of a large metal mass	PRU03ALI
AL-METL-SMMASS-N	In proximity of a small metal mass	PRU04ALI
AL-METL-SMOBJCT-N	Small aluminum mass close to the body	PRU05ALI
AL-METL-ENGINE-N	Aluminum engine block in a car	PRU06ALI
AL-METL-COOKWAR-N	Use of aluminum cookware	PRU16ALI

Table A.4 Exposure scenarios for the recycle of concrete

Scenario abbreviation	Scenario title	Electronic filename
Handling and Processing Scenario		
CN-SCRP-HANDLIN-W	Processing concrete	HMU01CNI
Transport Scenario		
CN-SCRP-TRANSPO-W	Transport of concrete	TMU01CNX
Disposal Scenario		
CN-SCRP-DISPOSL-W	Disposal activities for concrete in a sanitary landfill	DMU01CNI
Product Use Scenarios		
CN-SCRP-ROADBED-W	Road construction activities using recycled concrete	PMU01CNI
CN-SCRP-ROADBED-N	Use of recycled concrete in a roadbed	PMU02CNI
CN-SCRP-LGMASS-N	In proximity of a large concrete object	PRU04CNI
Landfill Resident Scenario		
CN-SCRP-LANDFIL-N	Resident on a sanitary landfill after disposal of concrete	DMU02CNG

Table A.5 Exposure scenario for reuse of equipment

Scenario abbreviation	Scenario title	Electronic filename
Product Use Scenario		
XX-EQUIP-REUSE-W	Direct reuse of surficially-contaminated equipment	RMU02FEI

APPENDIX B

PARAMETER VALUES

CONTENTS

Tables

B PARAMETER VALUES

This appendix contains details of the reuse and recycle analyses that pertain to scenarios and parameter values used in the scenario evaluations for all materials. The appendix consists of tables that list detailed information that is not included in Volume 1 of this report (e.g., parameter symbols, distributions, and values, as well as information pertaining to scenarios). A description of the conventions used to determine parameter value distributions is provided, followed by a brief description of the content of each table.

B.1 Conventions for Determining Parameter Distributions

The intent of this analysis is to evaluate realistic scenarios rather than overly conservative ones. Therefore, realism of individual parameter values is judged relative to the potential critical group described by each scenario. In particular, each material flow model is intended to represent standard industry practice, so parameter values and distributions should be realistic estimates for the industrial process described by the model. Similarly, each exposure scenario is intended to represent a realistic potential critical group. Therefore, parameter values and distributions used in modeling should be as realistic as the data allow for the population described by the scenario. In this context, a realistic parameter value means a likely value in the distribution that represents the industry practice or exposed population group.

In addition, this analysis takes a probabilistic approach that requires estimating distributions for all key input parameters. The assumed distribution of each parameter is determined by the quality of the supporting data, expert consultation, and professional judgement. The quality of the underlying data and the degree of knowledge for each parameter vary widely. The approach used here for characterizing parameter distributions follows the practices recommended by the IAEA and others (IAEA, 1989). In the case of minimum knowledge, distributions are uniform over the maximum reasonable range. With additional data and expert knowledge, distributions may be further characterized. For example, triangular distributions are used where there is sufficient information to determine the most likely value within the range. For parameters with large ranges (a maximum greater than 10 times the minimum) loguniform, logtriangular or lognormal distributions are used. The convention for assigning distributional types is in Table B.1.

Table B.1 Relationship between data quality and parameter frequency distributions

Data Quality Level	Criteria	Assumed Parameter Distribution
Level 1	1. Estimates are specific to population described in the scenario. 2. Data describe the shape of the distribution for the parameter and provide estimates of central tendency and dispersion.	Normal or lognormal as appropriate, based on available data
Level 2	1. Estimates are generic (i.e., not specific to population). 2. Data describe the shape of the distribution for the parameter and provide estimates of central tendency and dispersion.	Normal or lognormal as appropriate, based on available data
Level 3	1. Estimates are specific to population described in the scenario. 2. Data provide a best estimate, a maximum, and a minimum.	Triangular if max/min < 10 Log-triangular if max/min> 10
Level 4	1. Estimates are generic. 2. Data provide a best estimate, a maximum, and a minimum.	Triangular if max/min < 10 Log-triangular if max/min> 10
Level 5	1. Data provide a maximum and minimum but no basis for a best estimate.	Uniform if max/min < 10 Log-uniform if max/min> 10
Level 6	1. Data provide only a point estimate with little or no basis for a range.	Uniform if max/min < 10 Log-uniform if max/min> 10

Some values used in the exposure scenario modeling are not described by distributions; these parameters are fixed (i.e., a single, non-changing value is used in the probabilistic calculations). Fixed values are of four types: physical constants, such as radioactive decay rates; parameters fundamental to the definition of the *individual* addressed by the scenario; parameters fundamental to the definition of the *scenario* itself, and parameters whose uncertainty has been combined with the uncertainty of other parameters into a specific uncertainty factor.

Some fundamental characteristics of the individuals that comprise the exposed groups are considered constants by definition, and are not subject to uncertainty. Therefore, the analysis does not include variability or uncertainty in such things as internal dose conversion factors. Other parameters within a scenario are considered constants because they are fundamental to the definition of the scenario. That is, because they are assumed for purposes of constructing the scenario, they are not subject to either natural variability or lack of knowledge. Examples include the time period over which potential exposures occur (a 1-year period), initial radioactivity in soil (no radioactivity above background), and thickness of the surface soil layer (value is dependent on the specific scenario). Finally, the uncertainty and variability in some parameter values has been combined into specific uncertainty factors. The uncertainty factors typically represent an attempt to capture the most significant or the best known sources of uncertainty and variability in an exposure pathway or environmental transport pathway. An example is the food pathway, where individual parameter values such as growing periods for plants, hold-up periods, and translocation fractions were held constant, and an input distribution was developed for the parameter for the fraction of the diet derived from a home-grown garden.

For these fixed parameters, the values used in the modeling are appropriate to each scenario and they also reflect expert judgement regarding the degree to which each parameter is unknown. However, instead of determining a distribution, only a single value has been determined. The data quality of the single value used in the modeling was determined using the same general framework as shown in Table B.1. However, because no distributional information is needed, the data quality was determined only by identifying whether the parameter value is specific to the exposed population described in the scenario (data quality level 3) or whether the parameter value is generic (i.e., not specific to the exposed population), and appropriate for general radiological assessments (data quality level 4).

B.2 Content of Tables Containing Radionuclide-Independent Data

Table B.2 contains parameter distributions and values used in the equipment reuse scenario analysis. Tables B.3–B.6 describe the parameter distributions and values used in each of the four material flow models in the recycle analyses, respectively (iron/steel, copper, aluminum, and concrete). These tables list parameter symbols and descriptions, the assumed parameter distributions, the data quality level assigned to each parameter value, and selected values from the parameter distributions. The three columns under the heading "Parameter distribution values" in these tables contain values that correspond to the type of distribution used for the parameter, as listed below:

Fixed: fixed value only;
Uniform and loguniform distributions: minimum and maximum values;
Triangular distribution: mode, minimum, and maximum values;
Normal distribution: arithmetic mean and the standard deviation;
Lognormal distribution: geometric mean and the geometric standard deviation;
Beta distribution: alpha and beta values, and the scale.

This convention for listing parameter values is also used in subsequent tables in this appendix. A discussion of these distribution types is outside the scope of this report, but is available in standard statistical texts and also in the user's manual for Crystal Ball® (Decisioneering 1996).

Table B.7 is a lengthy table that contains the parameter distributions and values used for the evaluation of all iron/steel recycle scenarios as well as many of the scenarios for copper, aluminum, and concrete. Table B.8 contains the source of the specific output concentration from the iron/steel material flow model used as input for each steel scenario.

Table B.9 contains the parameter distributions and values used for the evaluation of the copper scenarios (similar to Table B.7 for steel). This table contains parameters and values that are unique to the copper scenarios, and only those values that are different from those used for the evaluation for steel (Table B.7). Table B.10 contains a listing identifying which steel scenario was modified and used to evaluate each copper scenario. Table B.11 contains the source of the specific output concentration from the copper material flow model used as input for each copper scenario.

Tables B.12, B.13, and B.14 contain the corresponding information for aluminum as is contained in Tables B.9, B.10, and B.11 described above for the evaluation of copper.

Table B.15 contains the parameter distributions and values used for the evaluation of the concrete scenarios (similar to Table B.7 for steel). This table contains parameters and values that are unique to the concrete scenarios, and only those that are different from the values used for the evaluation for steel (Table B.7). Table B.16 contains a listing identifying which steel scenario was modified and used to evaluate each concrete scenario.

Tables B.17–B.22 contain radionuclide or element-specific data used in the evaluation of all materials. Table B.17 contains radiological information such as radiological half life [values were obtained from FGR 12 (EPA 1993)]. Table B.18 and B.19 list the inhalation dose conversion factors used in the analyses. These values were initially obtained from FGR 11 (EPA 1988), but have been modified to incorporate progeny ingrowth effects as described in Appendix E. Both FGR 11 and modified values are listed in these tables. Table B.18 lists dose conversion factors based on the highest values listed in FGR 11 for each radionuclide, and Table B.19 lists the values corresponding to the oxide form of each radionuclide. Tables B.20 and B.21 list the ingestion dose conversion factors used in the analyses. These values were also obtained from FGR 11 (EPA 1988), and were also modified for progeny ingrowth as appropriate. Similar to the inhalation dose conversion factors, Table B.20 lists the highest values listed in FGR 11, and Table B.21 lists the values corresponding to the oxide form of each radionuclide. Finally, Table B.22 lists the root uptake values and soil distribution coefficients used for each element; these values were obtained from NUREG/CR-5512 (Kennedy and Strenge 1992).

Table B.2 Radionuclide independent parameter definitions for equipment reuse scenario

Symbol	Parameter Description/Scenario	Parameter data quality[b]	Parameter distribution	Parameter Values[a] FV, GM, or Mode	GSD or Minimum	Maximum
t_s	time from release of cleared material to time scenario begins (d)					
	XX-EQUIP-REUSE-W	6	uniform	—	5.50E+00	1.65E+01
t_{xs}	daily number of hours of exposure for the scenario (h/d)					
	XX-EQUIP-REUSE-W	4	triangular	4.00E+00	1.00E+00	8.00E+00
t_{ys}	annual number of days of exposure for the scenario (d/y)					
	XX-EQUIP-REUSE-W	4	fixed	2.50E+02	—	—
U_{GF}	geometry factor uncertainty factor (unitless)					
	XX-EQUIP-REUSE-W	5	uniform	—	5.00E-01	1.00E+00
RF_{sc}	resuspension factor for surface contamination (cm^{-1})					
	XX-EQUIP-REUSE-W	2	lognormal	1.00E-10	3.20E+01	—
BR	breathing rate for moderate physical activity (m^3/h)					
	XX-EQUIP-REUSE-W	3	triangular	1.20E+00	6.00E-01	3.00E+00
IR_{sc}	effective transfer rate for ingestion of surface contamination cm^2/h					
	XX-EQUIP-REUSE-W	2	lognormal	1.00E-04	3.20E+00	—

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows.

- for a *fixed parameter*, the first column contains the fixed value (FV), and the second and third columns do not contain values;
- for a *uniform or loguniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectivel;
- for a *lognormal distribution*, the first and second columns contain the geometric mean (GM) and the geometric standard deviation (GSD) of the distribution, respectively, and the third column does not contain a value.

Table B.3 Parameter definitions and default values for steel material flow model

Symbol	Parameter Description/Scenario		Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
M_0	mass of cleared material entering the furnace per charge (g)						
	EAF	single charge	5	loguniform	-	1.76E+07	8.81E+07
		annual average	5	loguniform	-	8.81E+05	1.76E+07
	BOF	single charge	5	loguniform	-	1.16E+07	5.81E+07
		annual average	5	loguniform	-	5.81E+05	1.16E+07
M_{NC}	mass of non-contaminated scrap metal entering the refining process per charge (g)						
	EAF	single charge	5	loguniform	-	0.00E+00	7.05E+07
		annual average	5	loguniform	-	7.05E+07	8.72E+07
	BOF	single charge	5	loguniform	-	0.00E+00	4.65E+07
		annual average	5	loguniform	-	4.65E+04	5.75E+07
f_g	off gases elemental partitioning factors during the refining process (dimensionless)						
	Ac, Ag, Am, Ba, C, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, Ir, K, Mn, Mo, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zn, Zr		5	fixed	0.00E+00	-	-
	Bi, Na		3	triangular	5.00E-02	0.00E+00	5.00E-02
	Cl		5	uniform	-	0.00E+00	9.00E-01
	I, Rn		3	fixed	1.00E+00	none	none
	H		3	triangular	1.00E+00	9.00E-01	1.00E+00
f_d	dust elemental partitioning factory during the refining process (dimensionless)						
	Ag, C, Co, Cu, Fe, Mo, Ni, Ru, Tc		3	triangular	1.00E-02	0.00E+00	2.00E-02
	Sb		3	triangular	0.00E+00	0.00E+00	1.00E-02
	Se		5	uniform	-	0.00E+00	8.00E-01
	Pb		3	triangular	9.60E-01	9.50E-01	1.00E+00
	Zn		5	uniform	-	8.00E-01	1.00E+00
	Cd, Cs, Po,		3	triangular	9.70E-01	9.50E-01	1.00E+00
	S		5	uniform	-	4.00E-02	9.70E-01
	Re		5	uniform	-	1.00E-02	9.70E-01
	P		5	uniform	-	4.00E-02	9.70E-01
	K		5	uniform	-	5.00E-01	1.00E+00
	Ir		5	uniform	-	0.00E+00	1.00E+00
	Bi		5	uniform	-	4.50E-01	1.00E+00
	Cr		3	triangular	1.00E-02	0.00E+00	1.00E-02
	Mn		3	triangular	1.00E-02	0.00E+00	4.00E-02
	Na		3	triangular	4.50E-01	4.00E-01	5.00E-01
	Cl		5	uniform	-	8.00E-02	5.00E-01
	H, I, Rn		3	fixed	0.00E+00	-	-

Table B.3 Parameter definitions and default values for steel material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a]		
				Mode or fixed value	Minimum	Maximum
	Ac, Am, Ba, Ca, Ce, Cm, Eu, Nb, Np, Pa, Pm, Pu, Ra, Sr, Th, U, Y, Zr	3	triangular	1.00E-02	0.00E+00	5.00E-02
f	slag elemental partitioning factors during the refining process					
	Ag, C, Co, Cu, Mo, Ni, Ru, Tc, Zn	3	triangular	0.00E+00	0.00E+00	1.00E-02
	Sb	5	uniform	-	0.00E+00	2.00E-01
	Se	5	uniform	-	2.00E-01	7.70E-01
	Fe, Pb	3	triangular	2.00E-02	0.00E+00	5.00E-02
	Cd, Cs, Po	3	triangular	3.00E-02	0.00E+00	5.00E-02
	S	5	uniform	-	3.00E-02	7.70E-01
	Re, Ir	3	triangular	3.00E-02	0.00E+00	3.00E-02
	P	5	uniform	-	3.00E-02	8.70E-01
	K	5	uniform	-	3.00E-02	5.00E-01
	Bi	5	uniform	-	0.00E+00	2.50E-01
	Mn	5	uniform	-	5.00E-01	7.50E-01
	Cr	5	uniform	-	0.00E+00	5.00E-01
	Na	3	triangular	5.00E-01	4.50E-01	5.50E-01
	Ra	3	triangular	9.80E-01	9.50E-01	1.00E+00
	Cl	5	uniform	-	0.00E+00	5.00E-01
	H, I, Rn	3	fixed	0.00E+00	-	-
	Ac, Am, Ba, Ca, Ce, Cm, Eu, Nb, Np, Pa, Pm, Pu, Sr, Th, U, Y, Zr	3	triangular	9.90E-01	9.50E-01	1.00E+00
f	metal product elemental partitioning factors during the refining process (dimensionless)					
	Ag, C, Co, Cu, Mo, Ni, Ru, Tc	3	triangular	9.90E-01	9.50E-01	1.00E+00
	Sb	5	uniform	-	8.00E-01	1.00E+00
	Se	5	uniform	-	0.00E+00	8.00E-01
	Fe	3	triangular	9.70E-01	9.50E-01	1.00E+00
	Pb	3	triangular	2.00E-02	0.00E+00	5.00E-02
	S, Zn	5	uniform	-	0.00E+00	2.00E-01
	Ac, Am, Ba, Ca, Cd, Ce, Cm, Cs, Eu, K, Na, Nb, Np, Pa, Pm, Po, Pu, Sr, Th, U, Y, Zr	3	triangular	0.00E+00	0.00E+00	1.00E-02
	Re	5	uniform	-	0.00E+00	9.90E-01
	H, P	3	triangular	0.00E+00	0.00E+00	1.00E-01
	Ir	5	uniform	-	0.00E+00	1.00E+00
	Bi	5	uniform	-	0.00E+00	2.50E-01
	Mn	5	uniform	-	2.40E-01	5.00E-01
	Cr	5	uniform	-	4.90E-01	9.90E-01
	Ra	3	triangular	1.00E-02	0.00E+00	5.00E-02
	Cl	3	triangular	1.00E-02	0.00E+00	1.00E-02

Table B.3 Parameter definitions and default values for steel material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
	I, Rn	3	fixed	0.00E+00	-	-
f_{d1}	mass partitioning factor for dust during the refining process					
	EAF (dimensionless)	3	triangular	1.40E-02	9.00E-03	2.30E-02
	BOF	3	triangular	3.90E-02	3.80E-02	4.20E-02
f_{s1}	mass partitioning factor for slag during the refining process (dimensionless)					
	EAF	3	triangular	1.60E-01	1.00E-01	2.10E-01
	BOF	3	triangular	7.70E-01	5.40E-01	8.60E-01
f_{p1}	mass partitioning factor for metal product during the refining process (dimensionless)					
	EAF	3	triangular	9.00E-01	8.50E-01	9.5E-01
	BOF	3	triangular	2.75E+00	2.66E+00	2.97E+00
f_H	annual fraction of total EAF dust sent to a hazardous landfill (dimensionless)					
	EAF	3	fixed	1.12E-01	-	-
BH_{eff}	baghouse efficiency (dimensionless)					
	EAF	4	triangular	9.80E-01	9.50E-01	9.90E-01
	BOF	4	triangular	9.99E-01	9.50E-01	9.99E-01
CPY	number of charges per refinery per year (charges)					
	EAF	3	triangular	5.58E+03	2.00E+03	1.13E+04
	BOF	3	triangular	5.58E+03	2.00E+03	1.13E+04
df_H	dilution factor for immobilization process (dimensionless)					
	EAF	3	fixed	7.70E-01	-	-

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value, and the second and third columns do not contain values;
- for a *uniform or loguniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.

Table B.4 Parameter definitions and default values for copper material flow model

Symbol	Parameter Description/Scenario		Parameter data quality	Parameter distribution	Mode or fixed value	Minimum	Maximum
					Parameter Values[a]		
M_0	mass of cleared material entering the furnace per charge (g/charge)						
	reverberatory furnace	single charge	5	log uniform	-	2.27E+07	2.27E+08
		annual average	5	loguniform	-	1.36E+06	8.09E+06
	converter	single charge	5	loguniform	-	2.16E+08	2.27E+08
		annual average	5	loguniform	-	2.16E+08	2.27E+08
	electrorefiner	single charge	5	loguniform	-	1.81E+10	1.90E+10
		annual average	5	loguniform	-	1.81E+10	1.90E+10
M_{NC}	mass of non-contaminated scrap metal entering the refining process per charge (g)						
	reverberatory furnace	single charge	5	loguniform		0.00E+00	2.04E+08
		annual average	5	loguniform		2.18E+08	2.26E+08
	converter	single charge	5	loguniform		0.00E+00	1.14E+07
		annual average	5	loguniform		0.00E+00	1.14E+07
	electrorefiner	single charge	5	loguniform		0.00E+00	9.50E+08
		annual average	5	loguniform		0.00E+00	9.50E+08
f_g	off gases elemental partitioning factors during the refining process - reverberatory (dimensionless)						
	Ac, Ag, Am, Ba, Bi, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, Ir, K, Mn, Mo, Na, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zn, Zr		3	fixed	0.00E+00	-	-
	C		5	uniform	-	7.13E-01	1.00E+00
	I		5	uniform	-	6.00E-03	1.40E-02
	Cl		3	triangular	1.00E-02	9.00E-03	1.10E-02
	H, Rn		3	triangular	1.00E+00	9.50E-01	1.00E+00
f_d	dust elemental partitioning factors during the refining process - reverberatory (dimensionless)						
	Ac, Ag, Am, Ba, Bi, C, Cd, Ce, Cm, Co, Cr, Cu, Eu, Fe, I, Ir, Mn, Mo, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zr		3	fixed	0.00E+00	-	-
	Zn		3	triangular	5.00E-02	4.75E-02	5.25E-02
	Ca, Cs, K, Na		3	triangular	1.00E-02	9.50E-03	1.05E-02
	Cl		5	uniform	-	2.94E-01	6.86E-01
	H, Rn		3	fixed	0.00E+00	-	-
f_s	slag elemental partitioning factors during the refining process - reverberatory (dimensionless)						
	Cu		3	triangular	1.00E-02	9.90E-03	1.01E-02
	Ag, Bi, Cd, Co, Cr, Fe, Ir, Mn, Mo, Nb, Ni, Pb, Sb, Zn		3	triangular	1.00E-02	9.50E-03	1.05E-02
	Po, Re, Ru, Tc, Zr		5	uniform	-	7.00E-03	1.30E-02
	Ba, Sr		5	uniform	-	3.50E-01	6.50E-01
	Ra		5	uniform	-	1.88E-01	3.13E-01

Table B.4 Parameter definitions and default values for copper material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
	Y, Ce, Pm, Eu	5	uniform	-	5.63E-01	9.38E-01
	P, S, Se	5	uniform	-	7.00E-01	1.00E+00
	Ac, Am, Cm, Np, Pa, Pu, Th, U	3	triangular	1.00E+00	9.50E-01	1.00E+00
	Ca, Cs, K, Na	3	triangular	9.90E-01	9.41E-01	1.00E+00
	C	5	uniform	-	3.75E-02	6.25E-02
	I	5	uniform	-	5.94E-01	1.00E+00
	Cl	5	uniform	-	3.00E-01	7.00E-01
	H, Rn	3	fixed	0.00E+00		
f_p	metal product elemental partitioning factors during the refining process - reverberatory (dimensionless)					
	Cu	3	triangular	9.90E-01	9.80E-01	1.00E+00
	Ag, Bi, Cd, Co, Cr, Fe, Ir, Mn, Mo, Nb, Ni, Pb, Sb	3	triangular	9.90E-01	9.41E-01	1.00E+00
	Po, Re, Ru, Tc, Zr	5	uniform	-	6.93E-01	1.00E+00
	Zn	3	triangular	9.40E-01	8.93E-01	9.87E-01
	Ba, Sr	5	uniform	-	3.50E-01	6.50E-01
	Eu, Ce, Pm, Ra, Y	5	uniform	-	1.88E-01	3.13E-01
	Ac, Am, Cm, H, Np, Pa, Pu, Rn, Th, U	3	triangular	0.00E+00	0.00E+00	5.00E-02
	P, S, Se	5	uniform	-	0.00E+00	3.00E-01
	C, Ca, Cl, Cs, I, K, Na	3	triangular	0.00E+00	-	-
f_g	off gases elemental partitioning factors during the refining process - converter (dimensionless					
	Ac, Ag, Am, Ba, Bi, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, Ir, K, Mn, Mo, Na, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zn, Zr	3	fixed	0.00E+00	-	-
	C	3	triangular	9.50E-01	7.13E-01	1.00E+00
	I	5	uniform	-	6.00E-03	1.40E-02
	Cl	3	triangular	1.00E-02	9.00E-03	1.10E-02
	H, Rn	3	triangular	1.00E+00	9.50E-01	1.00E+00
f_f	dust elemental partitioning factors during the refining process - converter (dimensionless)					
	Ac, Ag, Am, Ba, Bi, C, Ce, Cm, Co, Cr, Cu, Eu, Fe, H, I, Ir, Mn, Mo, Nb, Ni, Np, P, Pa, Pm, Pu, Ra, Re, Rn, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zr	3	fixed	0.00E+00	-	-
	Cd, Pb, Zn	3	triangular	9.00E-01	8.55E-01	9.45E-01
	Po	5	uniform	-	6.30E-01	1.00E+00
	Ca, Cs, K, Na	3	triangular	1.00E-02	9.50E-03	1.05E-02
	Cl	5	uniform	-	2.94E-01	6.86E-01
f_s	slag elemental partitioning factors during the refining process - converter (dimensionless)					
	Cu	3	triangular	1.00E-02	9.90E-03	1.01E-02

Table B.4 Parameter definitions and default values for copper material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
	Ag, Ir	3	triangular	1.00E-02	5.00E-04	1.05E-02
	Bi, Co, Cr, Fe, Mn, Mo, Nb, Ni, Sb	3	triangular	9.00E-01	8.55E-01	9.45E-01
	Re, Ru, Tc, Zr	5	uniform	-	6.30E-01	1.00E+00
	Cd, Pb, Po, Zn	3	fixed	0.00E+00	-	-
	Ac, Am, Cm, H, Np, Pa, Pu, Rn, Th, U	3	triangular	1.00E+00	9.50E-01	1.00E+00
	P, S, Se	3	uniform	-	7.00E-01	1.00E+00
	Ca, Cs, K, Na	3	triangular	9.90E-01	9.41E-01	1.00E+00
	Ba, Sr	3	triangular	5.00E-01	3.50E-01	6.50E-01
	Ce, Eu, Pm, Ra, Y	3	triangular	7.50E-01	5.63E-01	9.38E-01
	C	3	triangular	5.00E-02	3.75E-02	6.25E-02
	I	5	uniform	-	5.94E-01	1.00E+00
	Cl	5	uniform	-	3.00E-01	7.00E-01
f_p	metal product elemental partitioning factors during the refining process - converter (dimensionless)					
	Cu	3	triangular	9.90E-01	9.80E-01	1.00E+00
	Ag, Ir	3	triangular	9.90E-01	9.41E-01	1.00E+00
	Bi, Cd, Co, Cr, Fe, Mn, Mo, Nb, Ni, Pb, Po, Sb, Zn	3	triangular	1.00E-01	9.50E-02	1.05E-01
	Re, Ru, Tc, Zr	5	uniform	-	7.00E-02	1.30E-01
	Ac, Am, Cm, H, Np, Pa, Pu, Rn, Th, U	3	triangular	0.00E+00	0.00E+00	5.00E-02
	P, S, Se	5	uniform	-	0.00E+00	3.00E-01
	C, Ca, Cl, Cs, I, K, Na	3	fixed	0.00E+00	-	-
	Ba, Sr	3	triangular	5.00E-01	3.50E-01	6.5E-01
	Ce, Eu, Pm, Ra, Y	3	triangular	2.50E-01	1.88E-01	3.13E-01
f_g	Off gases elemental partitioning factors during the refining process - electrorefiner (dimensionless)					
	Ac, Ag, Am, Ba, Bi, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, Ir, K, Mn, Mo, Na, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zn, Zr	3	fixed	0.00E+00	-	-
	C, H, Rn	3	triangular	1.00E+00	9.50E-1	1.00E+00
	I	5	uniform	-	8.00E-1	1.00E+00
	Cl	5	uniform	-	3.75E-01	6.25E-01
f_d	dust elemental partitioning factors during the refining process - electrorefiner (dimensionless)					
	Ac, Ag, Am, Ba, Bi, C, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, H, I, Ir, K, Mn, Mo, Na, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Rn, Ru, S, Sb, Se, Sr, Th, Tc, U, Y, Zn, Zr	3	fixed	0.00E+00	-	-
	Cl	5	uniform	-	3.75E-01	6.25E-01
f_s	slag elemental partitioning factors during the refining process - electrorefiner (dimensionless)					
	Cu	3	triangular	0.00E+00	0.00E+00	1.00E-02

Table B.4 Parameter definitions and default values for copper material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
	Ac, Ag, Am, Ba, Bi, Ca, Cd, Ce, Cm, Co, Cr, Cs, Eu, Fe, Ir, K, Mn, Mo, Na, Nb, Ni, Np, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, Sb, Sr, Tc, Th, U, Y, Zn, Zr	3	triangular	1.00E+00	9.90E−01	1.00E+00
	P, S, Se	3	uniform	-	7.00E−01	1.00E+00
	C, Cl, H, I, Rn	3	fixed	0.00E+00	-	-
f_p	metal product elemental partitioning factors during the refining process - electrorefiner (dimensionless)					
	Cu	3	triangular	1.00 E+00	9.90E−01	1.00E+00
	Ac, Ag, Am, Ba, Bi, Ca, Cd, Ce, Cm, Co, Cr, Cs, Eu, Fe, Ir, K, Mn, Mo, Na, Nb, Ni, Np, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, Sb, Sr,Tc, Th, U, Y, Zn, Zr	3	triangular	0.00E+00	0.00E+00	1.00E−02
	P, S, Se	5	uniform	-	0.00E+00	3.00E−01
	C, H, Rn	3	triangular	0.00E+00	0.00E+00	5.00E−02
	I	5	uniform	-	0.00E+00	2.00E−01
	Cl	3	fixed	0.00E+00	-	-
f_{d1}	mass partitioning factor for dust during the refining process (dimensionless)					
	reverberatory furnace	3	triangular	1.00E−02	5.00E−03	2.00E−02
	converter	3	triangular	1.00E−02	5.00E−03	2.00E−02
	electrorefiner	3	triangular	5.00E−03	2.50E−03	1.00E−02
f_{s1}	mass partitioning factor for slag during the refining process (dimensionless)					
	reverberatory furnace	3	triangular	6.00E−02	3.50E−02	8.00E−02
	converter	3	triangular	6.00E−02	3.50E−02	8.00E−02
	electrorefiner	3	triangular	1.50E−02	7.50E−03	3.00E−02
f_{p1}	mass partitioning factor for metal product during the refining process (dimensionless)					
	reverberatory furnace	3	triangular	9.30E−01	9.00E−01	9.60E−01
	converter	3	triangular	9.30E−01	9.00E−01	9.60E−01
	electrorefiner	3	triangular	9.80E−01	9.60E−01	9.90E−01
BH_{eff}	baghouse efficiency (dimensionless)					
	all scenarios where parameter is used	4	triangular	9.99E−01	9.50E−01	9.99E−01
CPY	number of charges per refinery per year					
	reverberatory furnace (charges)	3	triangular	1.46E+03	7.43E+02	2.06E+04
	converter	3	triangular	1.36E+03	6.91E+02	1.92E+04
	electrorefiner	5	uniform	-	1.30E+01	1.80E+01

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value, and the second and third columns do not contain values;
- for a *uniform or loguniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.

Table B.5 Parameter definitions and default values for aluminum material flow model

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter Values[a] Mode or fixed value	Minimum	Maximum
M_0	mass of cleared material entering the furnace per charge (g)					
	single charge	5	uniform	-	4.47E+05	1.79E+06
	annual average	5	loguniform	-	4.47E+03	4.47E+04
M_{NC}	mass of non-contaminated scrap metal entering the furnace per charge (g)					
	single charge	5	uniform	-	4.29E+07	4.43E+07
	annual average	5	uniform	-	4.466E+07	4.470E+07
f_g	off gases elemental partitioning factors during the refining process (dimensionless)					
	Ac, Ag, Am, Ba, Bi, C, Ca, Cd, Ce, Cm, Co, Cr, Cs, Cu, Eu, Fe, H, Ir, K, Mn, Mo, Na, Nb, Ni, Np, P, Pa, Pb, Pm, Po, Pu, Ra, Re, Ru, S, Sb, Se, Sr, Tc, Th, U, Y, Zn, Zr	3	fixed	0.00E+00	-	-
	I	5	uniform	-	6.00E-03	1.40E-02
	Cl	3	triangular	1.00E-02	9.00E-03	1.10E-02
f_d	dust elemental partitioning factors during the refining process (dimensionless)					
	Ac, Ag, Am, Ba, Bi, C, Cd, Ce, Cm, Co, Cr, Cu, Eu, Fe, H, I, Ir, Mo, Nb, Ni, Np, Pa, Pb, Pm, Po, Pu, Ra, Re, Rn, Ru, Sb, Sr, Tc, Th, U, Y, Zr	3	fixed	0.00E+00	-	-
	Zn	3	triangular	5.00E-02	4.75E-02	5.25E-02
	Ca, Cs, K, Mn, Na	3	triangular	1.00E-02	9.50E-03	1.05E-02
	P, S, Se	5	uniform	-	0.00E+00	3.00E-01
	Cl	5	uniform	-	2.94E-01	6.86E-01
f_s	dross elemental partitioning factors during the refining process (dimensionless)					
	Ac, Ag, Am, Bi, Cd, Cm, Co, Cr, Cu, Fe, Ir, Mo, Nb, Ni, Np, Pa, Pb, Pu, Ra, Sb, Th, U	3	triangular	0.00E+00	0.00E+00	5.00E-02
	Po, Re, Ru, Tc	5	uniform	-	0.00E+00	3.00E-01
	C	5	uniform	-	3.75E-02	6.25E-02
	H, Rn, Zn	3	fixed	0.00E+00	-	-
	Ba, Sr, Zr	5	uniform	-	3.75E-01	6.25E-01
	Ce, Eu, Pm, Y	5	uniform	-	5.63E-01	9.38E-01
	Ca, Cs, K, Mn, Na	3	triangular	9.90E-01	9.41E-01	1.00E+00
	P, S, Se	5	uniform	-	7.00E-01	1.00E+00
	I	5	uniform	-	5.94E-01	1.00E+00
	Cl	5	uniform	-	3.00E-01	7.00E-01
f_p	metal product elemental partitioning factors during the refining process (dimensionless)					
	Ac, Ag, Am, Bi, Cd, Cm, Co, Cr, Cu, Fe, Ir, Mo, Nb, Np, Ni, Pa, Pb, Pu, Ra, Sb, Th, U	3	triangular	1.00E+00	9.50E-01	1.00E+00
	Po, Re, Ru, Tc	5	uniform	-	7.00E-01	1.00E+00

Table B.5 Parameter definitions and default values for aluminum material flow model

				Parameter Values[a]		
Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Mode or fixed value	Minimum	Maximum
	C	5	uniform	-	7.13E-01	1.00E+00
	Zn	3	triangular	9.50E-01	9.03E-01	9.98E-01
	Ba, Sr, Zr	5	uniform	-	3.75E-01	6.25E-01
	Ce, Eu, Pm, Y	5	uniform	-	1.88E-01	3.13E-01
	Ca, Cl, Cs, I, K, Mn, Na, P, S, Se	3	fixed	0.00E+00	-	-
	H, Rn	3	triangular	0.00E+00	0.00E+00	5.00E-02
f_{d1}	mass partitioning factor for dust during the refining process (dimensionless)					
	single charge and annual average cases	3	triangular	1.00E-02	5.00E-03	2.00E-02
f_{r1}	mass partitioning factor for dross during the refining process (dimensionless)					
	single charge and annual average cases	3	triangular	1.40E-01	9.50E-02	5.80E-01
f_{p1}	mass partitioning factor for metal product during the refining process (dimensionless)					
	single charge and annual average cases	3	triangular	8.50E-01	4.00E-01	9.00E-01
BH_{eff}	baghouse efficiency (dimensionless)					
	single charge and annual average cases	4	triangular	9.99E-01	9.50E-01	9.99E-01
CPY	number of charges per refinery per year (charges)					
	single charge and annual average cases	5	uniform		2.79E+03	8.37E+03

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value, and the second and third columns do not contain values;
- for a *uniform or loguniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.

Table B.6 Parameter definitions and default values for concrete material flow model

Symbol	Parameter Description/Scenario	Parameter distribution	Parameter data quality	Parameter values Minimum	Parameter values Maximum
M_C	mass of scrap concrete entering the recycling center per year (g/yr)				
	large object	loguniform	5	1.70E+11	2.16E+11
	other scenarios	loguniform	5	1.82E+11	2.27E+11
M_{CA}	mass of non-contaminated scrap concrete/aggregate entering the recycling facility per year (g/yr)				
	large object	loguniform	5	1.14E+10	5.68E+10
	other scenarios	loguniform	5	0.00E+00	4.54E+10

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
$A_{2(0)}$	initial activity in box 2 (unsaturated zone) (pCi)					
	all scenarios where parameter is used	4	fixed	0.00E+00	-	-
$A_{3(0)}$	initial activity in box 3 (aquifer) (pCi)					
	all scenarios where parameter is used	4	fixed	0.00E+00	-	-
A_c	area of land under cultivation (m^2)					
	all landfill resident scenarios	2	lognormal	2.49E+03	3.20E+00	-
A_d	area of contaminated land (m^2)					
	FE-SLAG-STORAGE-N	4	triangular	3.18E+03	1.20E+02	1.37E+04
BR	breathing rate for moderate physical activity (m^3/h)					
	all scenarios where parameter is used	4	triangular	1.20E+00	6.00E-01	3.00E+00
BR_{dust}	breathing rate for dusty activities outdoors (m^3/h)					
	all scenarios where parameter is used	4	triangular	1.20E+00	6.00E-01	3.00E+00
BR_{in}	breathing rate for indoor activities (m^3/h)					
	all scenarios where parameter is used	4	triangular	1.20E+00	5.00E-01	1.20E+00
BR_{out}	breathing rate for normal activities outdoors (m^3/h)					
	all scenarios where parameter is used	4	triangular	1.20E+00	5.00E-01	3.00E+00
Chi/Q	annual average atmospheric dispersion factor (s/m^3)					
	FE-ATMO-REFINER-N	2	lognormal	3.76E-06	2.59E+00	-
DF	dilution factor (dimensionless)					
	FE-SLAG-CONCBAS-N	3	triangular	1.50E-02	5.00E-03	3.00E-02
DIET	fraction of annual diet derived from home-grown garden (dimensionless)					
	all scenarios where parameter is used	4	triangular	8.00E-02	0.00E+00	2.50E-01
$DIET_i$	fraction of annual diet from irrigated plants (dimensionless)					
	all landfill resident scenarios	4	triangular	8.00E-02	0.00E+00	2.50E-01
$DIET_n$	fraction of annual diet from non-irrigated plants (dimensionless)					
	all landfill resident scenarios	4	triangular	8.00E-02	0.00E+00	2.50E-01
f_1	saturation ratio for box 1 (surface layer) (dimensionless)					
	all scenarios where parameter is used	4	triangular	1.00E+00	3.00E-02	1.00E+00
f_2	saturation ratio for box 2 (unsaturated zone) (dimensionless)					
	all scenarios where parameter is used	4	triangular	1.00E+00	3.00E-02	1.00E+00
FSC_A	fraction of time that stability class A occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	1.00E-02	-	-
FSC_B	fraction of time that stability class B occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	6.60E-02	-	-
FSC_C	fraction of time that stability class C occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	1.12E-01	-	-
FSC_D	fraction of time that stability class D occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	4.77E-01	-	-
FSC_E	fraction of time that stability class E occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	1.18E-01	-	-
FSC_F	fraction of time that stability class F occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	1.34E-01	-	-
FSC_G	fraction of time that stability class G occurs (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	8.70E-02	-	-
FW	fraction of volume of all waste in landfill from cleared material (dimensionless)					
	FE-EAFD-LANDFIL-N	3	triangular	2.00E-04	1.00E-04	3.00E-04

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a] FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
	FE-BOFD-LANDFIL-N	3	triangular	2.00E−04	1.00E−04	3.00E−04
	FE-SCRP-LANDFIL-N	3	triangular	7.00E−03	3.00E−03	1.00E−02
	FE-SLAG-LANDFIL-N	3	triangular	1.80E−03	9.00E−04	2.70E−03
H	absolute humidity of the atmosphere at receptor (g/m^3)					
	FE-ATMO-REFINER-N	4	triangular	7.00E+00	3.00E+00	1.60E+01
H_1	thickness of surface soil layer (m)					
	FE-SCRP-LANDFIL-N	2	lognormal	1.36E+01	3.06E+00	-
	FE-SLAG-LANDFIL-N	2	lognormal	1.36E+01	3.06E+00	-
	FE-EAFD-LANDFIL-N	4	normal	1.30E+01	5.18E+00	-
	FE-BOFD-LANDFIL-N	2	lognormal	1.36E+01	3.06E+00	-
	FE-ATMO-REFINER-N	4	fixed	1.50E−01	-	-
	FE-SLAG-STORAGE-N	4	fixed	4.00E+00	-	-
H_2	thickness of box 2 (unsaturated zone) (m)					
	all landfill residential scenarios	2	lognormal	2.68E+01	1.13E+00	-
	FE-SLAG-STORAGE-N	2	lognormal	1.14E+00	1.10E+00	-
H_s	effective stack height (m)					
	FL-ATMO-REFINER-N	4	fixed	4.00E+01	-	-
I	infiltration rate (m/yr)					
	all scenarios where parameter is used	2	lognormal	1.79E−01	1.45E+00	-
IR	secondary ingestion rate (g/h)					
	all scenarios where parameter is used	5	uniform	-	2.10E−03	3.00E−02
IRR	average annual application rate of irrigation water (L/m^2-d)					
	all landfill resident scenarios	4	fixed	2.08E+00	-	-
L_{vs}	rate constant for movement of radionuclide from box 1 to box 2 (1/d)					
	FE-SCRP-LANDFIL-N	4	fixed	1.14E−06	-	-
M	total mass of material in box 1 (slag pile) (g)					
	FE-SLAG-STORAGE-N	4	triangular	2.00E+10	7.36E+09	8.60E+10
ML	mass loading of source material (mg/m^3)					
	FE-SCRP-HANDLIN-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-SLAG-HANDLIN-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-EAFD-BAGHOUS-W	4	triangular	1.00E+01	1.00E+00	1.50E+01
	FE-BOFD-DISPOSL-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-SLAG-DISPOSL-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-EAFD-HANDLIN-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-EAFD-PROCESS-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-METL-HANDREF-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-BOFM-HANDMAN-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-SLAG-PROCESS-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
	FE-SLAG-ROADBED-W	4	triangular	3.90E+00	1.30E+00	7.40E+00
ML_{dust}	mass loading factor for resuspended soil for dusty activities outdoors (g/m^3)					
	all residential scenarios	2	lognormal	3.00E−03	1.45E+00	-
ML_{in}	mass loading factor for resuspended soil blown indoors (g/m^3)					
	all residential scenarios	2	lognormal	3.00E−03	1.45E+00	-
ML_{out}	mass loading factor for resuspended soil for normal activities outdoors (g/m^3)					
	all residential scenarios	5	uniform	-	1.00E−05	2.00E−03

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
ML_v	plant soil mass-loading factor for resuspended soil to plant v (all plants) (pCi/kg dry-weight plant per pCi/kg dry-weight soil)					
	all scenarios where parameter is used	4	fixed	1.00E-01	-	-
M_n	total mass of dust that escapes the refinery baghouse in a year (g)					
	FE-ATMO-REFINER-N	4	fixed	1.38E+08	-	-
n_1	total porosity of box 1 (surface layer) (dimensionless)					
	all scenarios where parameter is used	4	triangular	3.00E-01	1.00E-02	6.00E-01
n_2	total porosity of box 2 (unsaturated zone) (dimensionless)					
	all scenarios where parameter is used	4	triangular	3.00E-01	1.00E-02	6.00E-01
P	areal soil density (kg dry-weight soil/m^2)					
	all scenarios where parameter is used	4	fixed	2.40E+02	-	-
p_{C-14}	fractional equilibrium ratio (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	1.00E+00	-	-
P_d	indoor dust-loading on floors (g/m^2)					
	all scenarios where parameter is used	4	fixed	4.00E-01	-	-
PF	protection factor for respirator (dimensionless)					
	FE-EAFD-BAGHOUS-W	3	triangular	5.00E-02	3.00E-03	1.00E-01
	all other scenarios where parameter is used	4	fixed	1.00E+00	-	-
QT	total mass of material in box 1 (surface layer) (g dry-weight soil)					
	FE-EAFD-LANDFIL-N	2	lognormal	6.12E+11	4.79E+00	-
	all other landfill residential scenarios	2	lognormal	4.03E+12	8.23E+00	-
r	the fraction of total material being deposited that is intercepted by the crops (dimensionless)					
	FE-ATMO-REFINER-N (iodines)	4	fixed	1.00E+00	-	-
	FE-ATMO-REFINER-N (other particulates)	4	fixed	2.50E-01	-	-
	FE-ATMO-REFINER-N (noble gases)	4	fixed	000E+00	-	-
RD	duration of release of refinery atmospheric effluent (s)					
	FE-ATMO-REFINER-N	3	fixed	3.16E+07	-	-
RF	respirable fraction of resuspended source material (dimensionless)					
	FE-SCRP-HANDLIN-W	4	triangular	1.00E+00	6.00E-00	1.00E+00
	FE-SLAG-HANDLIN-W	3	triangular	3.30E-01	2.30E-01	4.20E-01
	FE-BOFD-DISPOSL-W	4	triangular	1.00E+00	6.00E-01	1.00E+00
	FE-SLAG-DISPOSL-W	3	triangular	3.30E-01	2.30E-01	4.20E-01
	FE-EAFD-BAGHOUS-W	3	triangular	6.00E-01	4.00E-01	7.00E-01
	FE-EAFD-HANDLIN-W	3	triangular	6.00E-01	4.00E-01	7.00E-01
	FE-EAFD-PROCESS-W	3	triangular	6.00E-01	4.00E-01	7.00E-01
	FE-METL-HANDREF-W	4	triangular	3.30E-01	2.30E-01	4.20E-01
	FE-BOFM-HANDMAN-W	4	triangular	3.30E-01	2.30E-01	4.20E-01
	FE-SLAG-PROCESS-W	3	triangular	3.30E-01	2.30E-01	4.20E-01
	FE-SLAG-ROADBED-W	3	triangular	3.30E-01	2.30E-01	4.20E-01
RFI	indoor fraction of outdoor concentration (dimensionless)					
	FE-ATMO-REFINER-N	4	fixed	4.00E-01	-	-
RF_r	indoor resuspension factor (1/m)					
	all scenarios where parameter is used	4	fixed	5.00E-05	-	-
RL	thickness of soil layer available for resuspension (resuspension layer) (m)					

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Parameter distribution values[a]: Minimum SD or GSD	Parameter distribution values[a]: Maximum
	FE-ATMO-REFINER-N	4	fixed	1.00E-02	-	
r_v	fraction of initial deposition of irrigation water retained on plant v (all plants) (pCi retained/ pCi deposited)					
	all landfill resident scenarios	4	fixed	2.50E-01	-	-
SF	Vehicle Shielding Factor (dimensionless)					
	all disposal scenarios	3	triangular	5.00E-01	3.00E-01	7.00E-01
SFI	shielding factor during indoor activities (dimensionless)					
	all residential scenarios	5	uniform	-	4.00E-02	7.00E-01
SFO	shielding factor during outdoor activities (dimensionless)					
	all scenarios where parameter is used	4	fixed	1.00E+00	-	-
SM	surface-to-mass ratio for cleared material (cm^2/g)					
	all scenarios where parameter is used	4	loguniform	-	1.00E-01	2.00E+00
t	time from beginning of leaching to time activity is determined (d)					
	FE-SCRP-LANDFIL-N	4	uniform	-	1.83E+04	5.48E+04
	FE-SLAG-LANDFIL-N	4	uniform	-	1.83E+04	5.48E+04
	FE-EAFD-LANDFIL-N	4	uniform	-	1.83E+04	3.65E+04
	FE-BOFD-LANDFIL-N	4	uniform	-	1.83E+04	5.48E+04
	FE-SLAG-STORAG-N	4	loguniform	-	1.00E+00	3.65E+02
t_b	the period of long-term buildup for activity in soil (d)					
	FE-ATMO-REFINER-N	4	fixed	5.48E+03	-	-
t_{dd}	annual number of days spent on dusty activities outdoors (d/y)					
	all residential scenarios	5	uniform	-	0.00E+00	3.00E+01
t_{gv}	growing period for plant v (d)					
	all scenarios where parameter is used (leafy vegetables)	4	fixed	4.50E+01	-	-
	all scenarios where parameter is used (vegetables)	4	fixed	9.00E+01	-	-
t_h	hold-up period between harvesting and consumption of plant product (d)					
	all scenarios where parameter is used (leafy vegetables)	4	fixed	1.00E+00	-	-
	all scenarios where parameter is used (vegetables)	4	fixed	1.40E+01	-	-
T_i	time period for infiltration and irrigation (yr)					
	all scenarios where parameter is used	4	fixed	1.00E+00	-	-
t_{id}	annual number of days spent indoors (d/y)					
	all residential scenarios	5	uniform	-	2.00E+02	3.00E+02
t_{od}	annual number of days spent outdoors (d/y)					
	all residential scenarios	5	uniform	-	3.52E+01	1.65E+02
T_p	time period for pumping (d)					
	all scenarios where parameter is used	3	fixed	3.65E+02	-	-
t_s	time from release of cleared material from nuclear facility to time scenario begins (d)					
	FE-SCRP-HANDLIN-W	6	uniform	-	2.00E+00	6.00E+00
	FE-SLAG-HANDLIN-W	6	uniform	-	1.45E+01	4.35E+01
	FE-EAFD-HANDLIN-W	6	uniform	-	1.60E+01	4.80E+01
	FE-EAFD-BAGHOUS-W	6	uniform	-	1.45E+01	4.35E+01
	FE-METL-HANDREF-W	6	uniform	-	1.45E+01	4.35E+01

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
	FE-BOFM-HANDMAN-W	6	uniform	-	2.20E+01	6.60E+01
	FE-METL-HANDDIS-W	6	uniform	-	2.00E+01	6.00E+01
	FE-EAFD-PROCESS-W	6	uniform	-	1.60E+01	4.80E+01
	FE-SLAG-PROCESS-W	6	uniform	-	1.60E+01	4.80E+01
	FE-ATMO-REFINER-N	6	uniform	-	1.45E+01	4.35E+01
	FE-SLAG-STORAGE-N	6	uniform	-	1.45E+01	4.35E+01
	FE-SLAG-ROADBED	6	uniform	-	1.80E+01	5.40E+01
	FE-METL-LGMASS-N	6	uniform	-	2.35E+01	7.05E+01
	FE-METL-SMMASS-N	6	uniform	-	3.65E+01	1.10E+02
	FE-METL-SMOBJCT-N	6	uniform	-	3.65E+01	1.10E+02
	FE-METL-VEHICLE-N	6	uniform	-	2.35E+01	7.05E+01
	FE-METL-BLDGSTR-N	6	uniform	-	2.35E+01	7.05E+01
	FE-SLAG-CONCBAS-N	6	uniform	-	1.80E+01	5.40E+01
	FE-SLAG-ROADBED-N	6	uniform	-	1.80E+01	5.40E+01
	FE-SCRP-TRANSPO-W	6	uniform	-	2.00E+00	6.00E+00
	FE-SLAG-TRANSPO-W	6	uniform	-	1.70E+01	5.40E+01
	FE-EAFD-TRANSPO-W	6	uniform	-	1.60E+01	4.80E+01
	FE-METL-TRANSPO-W	6	uniform	-	2.00E+01	6.00E+01
	FE-BOFD-DISPOSL-W	6	uniform	-	2.00E+01	6.00E+01
	FE-SLAG-DISPOSL-W	6	uniform	-	1.80E+01	5.40E+01
	FE-SCRP-DISPOSL-W	6	uniform	-	5.50E+00	1.65E+01
	FE-EAFD-DISPOSL-W	6	uniform	-	1.80E+01	5.40E+01
	FE-METL-DISPOSL-W	6	uniform	-	5.50E+03	1.65E+04
	FE-BOFD-LANDFIL-N	4	uniform	-	2.00E+01	6.00E+01
	FE-SLAG-LANDFIL-N	6	uniform	-	1.80E+01	5.40E+01
	FE-SCRP-LANDFIL-N	6	uniform	-	5.50E+00	1.65E+01
	FE-EAFD-LANDFIL-N	6	uniform	-	8.25E+03	2.48E+04
T_v	fraction of retained activity translocated to edible part of plant v (pCi translocated/ pCi retained)					
	all landfill resident scenarios (leafy vegetables)	4	fixed	1.00E+00	-	-
	all landfill resident scenarios (vegetables)	4	fixed	1.00E-01	-	-
t_{e}	daily number of hours of exposure for the scenario (h/d)					
	FE-SCRP-HANDLIN-W	5	uniform	-	6.00E-02	1.20E+00
	FE-SLAG-HANDLIN-W	5	uniform	-	2.00E+00	6.00E+00
	FE-EAFD-HANDLIN-W	5	uniform	-	5.00E-01	1.00E+00
	FE-EAFD-BAGHOUS-W	5	uniform	-	3.00E-02	1.00E+00
	FE-METL-HANDREF-W	5	uniform	-	4.00E+00	8.00E+00
	FE-BOFM-HANDMAN-W	5	uniform	-	4.00E+00	8.00E+00
	FE-METL-HANDDIS-W	5	uniform	-	4.00E+00	8.00E+00
	FE-EAFD-PROCESS-W	5	uniform	-	2.00E+00	6.00E+00
	FE-SLAG-PROCESS-W	5	uniform	-	2.00E+00	6.00E+00
	FE-SLAG-ROADBED-W	5	uniform	-	5.00E-01	5.00E+00
	FE-METL-SMMASS-N	4	triangular	4.00E+00	2.00E+00	8.00E+00
	FE-METL-LGMASS-N	4	triangular	4.00E+00	2.00E+00	8.00E+00
	FE-METL-SMOBJCT-N	4	triangular	5.00E+00	2.86E+00	1.60E+01

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
	FE-METL-VEHICLE-N	4	triangular	4.00E+00	1.00E+00	8.00E+00
	FE-METL-BLDGSTR-N	4	triangular	8.00E+00	4.00E+00	1.60E+01
	FE-SLAG-CONCBAS-N	4	triangular	1.60E+01	4.00E+00	1.60E+01
	FE-SLAG-ROADBED-N	4	triangular	2.00E+00	1.00E+00	3.00E+00
	FE-BOFD-DISPOSL-W	5	uniform	-	8.00E-04	2.40E-03
	FE-SLAG-DISPOSL-W	5	uniform	-	7.20E-03	2.20E-02
	FE-SCRP-DISPOSL-W	5	uniform	-	8.40E-04	2.40E-03
	FE-EAFD-DISPOSL-W	5	uniform	-	8.00E-04	2.40E-03
	FE-METL-DISPOSL-W	5	uniform	-	2.40E+00	7.20E+00
	all transportation scenarios	4	triangular	4.00E+00	2.00E+00	5.00E+00
t_{yi}	annual number of days of exposure (d/y)					
	FE-METL-LGMASS-N	4	fixed	3.50E+02	-	-
	FE-METL-SMMASS-N	4	fixed	3.50E+02	-	-
	FE-METL-SMOBJCT-N	4	fixed	3.50E+02	-	-
	FE-METL-BLDGSTR-N	4	fixed	3.50E+02	-	-
	FE-SLAG-CONCBAS-N	4	fixed	3.50E+02	-	-
	all other scenarios	4	fixed	2.50E+02	-	-
u_A	average windspeed for stability class A (m/s)					
	FE-ATMO-REFINER-N	4	fixed	2.50E+00	-	-
u_B	average windspeed for stability class B (m/s)					
	FE-ATMO-REFINER-N	4	fixed	3.50E+00	-	-
u_C	average windspeed for stability class C (m/s)					
	FE-ATMO-REFINER-N	4	fixed	4.00E+00	-	-
u_D	average windspeed for stability class D (m/s)					
	FE-ATMO-REFINER-N	4	fixed	4.50E+00	-	-
u_E	average windspeed for stability class E (m/s)					
	FE-ATMO-REFINER-N	4	fixed	3.50E+00	-	-
u_F	average windspeed for stability class F (m/s)					
	FE-ATMO-REFINER-N	4	fixed	2.50E+00	-	-
u_G	average windspeed for stability class G (m/s)					
	FE-ATMO-REFINER-N	4	fixed	1.00E+00	-	-
U_{GF}	uncertainty on Geometry Factor					
	FE-SCRP-HANDLIN-W	4	uniform	-	2.00E-01	1.00E+00
	FE-SLAG-HANDLIN-W	5	uniform	-	3.00E-01	1.00E+00
	FE-EAFD-HANDLIN-W	5	uniform	-	2.00E-01	1.00E+00
	FE-EAFD-BAGHOUS-W	5	uniform	-	2.00E-01	1.00E+00
	FE-METL-HANDREF-W	5	uniform	-	3.00E-01	1.00E+00
	FE-BOFM-HANDMAN-W	5	uniform	-	3.00E-01	1.00E+00
	FE-METL-HANDDIS-W	5	uniform	-	3.00E-01	1.00E+00
	FE-EAFD-PROCESS-W	5	uniform	-	2.00E-01	1.00E+00
	FE-SLAG-PROCESS-W	5	uniform	-	2.00E-01	1.00E+00
	FE-SLAG-ROADBED-W	5	uniform	-	3.00E-01	1.00E+00
	FE-METL-LGMASS-N	4	triangular	5.00E-01	3.00E-01	1.00E+00
	FE-METL-SMMASS-N	4	triangular	7.00E-01	2.50E-01	4.00E+00
	FE-METL-SMOBJCT-N	4	triangular	1.00E-01	3.00E-01	1.00E+00

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
	FE-METL-VEHICLE-N	3	triangular	2.00E-01	3.00E-03	1.00E+00
	FE-METL-BLDGSTR-N	3	triangular	2.50E-01	1.00E-01	1.00E+00
	FE-SLAG-CONCBAS-N	3	triangular	2.00E-01	7.00E-02	8.00E-01
	FE-SLAG-ROADBED-N	5	uniform	-	4.00E-01	1.00E+00
	all disposal scenarios	5	uniform	-	3.00E-01	1.00E+00
	all transportation scenarios	4	triangular	1.00E+00	5.00E-01	1.05E+00
	all landfill resident scenarios	5	uniform	-	3.00E-01	1.00E+00
U_{lv}	human consumption rate of leafy vegetables (kg wet-weight plant/ yr)					
	all scenarios where parameter is used	4	fixed	1.10E+01	-	-
U_{soil}	human consumption rate of soil (kg dry-weight soil/yr)					
	all scenarios where parameter is used	2	lognormal	3.70E-02	3.20E+00	-
U_{veg}	human consumption rate of vegetables (kg wet-weight plant/ yr)					
	all scenarios where parameter is used	4	fixed	5.10E+01	-	-
U_w	human consumption rate of water (L/d)					
	all scenarios where parameter is used	2	lognormal	7.10E-01	1.78E+00	-
V_{dd}	volume of water used for domestic purposes during a year (L)					
	FE-SLAG-STORAGE-N	2	lognormal	9.08E+05	1.10E+00	-
$V_d(T)$	total deposition velocity (m/d)					
	FE-ATMO-REFINER-N (I)	4	triangular	1.70E+03	8.65E+02	2.60E+03
	FE-ATMO-REFINER-N (H, Rn)	4	fixed	0.00E+00	-	-
	FE-ATMO-REFINER-N (all other elements)	4	fixed	4.32E+02	-	-
V_{dr}	volume of water used for domestic purposes during a year (L)					
	all landfill resident scenarios	2	lognormal	9.08E+05	1.10E+00	-
V_{irr}	volume of water used for irrigation purposes during a year (L)					
	all scenarios where parameter is used	4	beta	2.00E+00	3.00E+00	1.90E+06
V_w	volume of all waste in landfill (m^3)					
	FE-EAFD-LANDFIL-N	1	lognormal	1.90E+06	8.23E+00	-
	all residential scenarios except EAF dust	2	lognormal	2.38E+05	4.79E+00	
W_v	dry-weight-to-wet-weight conversion factor for plant v (kg dry-weight plant/kg wet-weight plant)					
	all scenarios where parameter is used (leafy vegetables)	4	fixed	2.00E-01	-	-
	all scenarios where parameter is used (vegetables)	4	fixed	2.50E-01	-	-
x	distance from release point to receptor (m)					
	FE-ATMO-REFINER-N	4	fixed	1.00E+03	-	-
Y_v	yield of plant v (kg wet-weight plant/m^2)					
	all scenarios where parameter is used (leafy vegetables)	4	fixed	2.00E+00	-	-
	all scenarios where parameter is used (vegetables)	4	fixed	4.00E+00	-	-
λ_w	weathering constant at harvest (1/d)					
	all resident scenarios	4	fixed	4.95E-02	-	-

Table B.7 Radionuclide independent parameter definitions for exposure scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: FV, Mode, Mean, or GM	Minimum SD or GSD	Maximum
ρ_1	bulk density of soil in box 1 (surface layer) (g/ml)					
	all scenarios where parameter is used	4	triangular	1.60E+00	1.00E+00	2.00E+00
ρ_2	bulk density of soil in box 2 (unsaturated zone) (g/ml)					
	all scenarios where parameter is used	4	triangular	1.60E+00	1.00E+00	2.00E+00
ρ_s	average density of soil in surface layer (g dry-weight soil/m^3)					
	FE-SLAG-HANDLIN-W	4	fixed	2.00E+06	-	-
	FE-ATMO-REFINER-N	4	triangular	1.60E+06	1.00E+06	2.00E+06
	FE-SLAG-ROADBED-N	4	fixed	2.40E+06	-	-
	FE-SLAG-ROADBED-W	4	triangular	1.60E+06	1.00E+06	2.00E+06
	all landfill resident scenarios	4	fixed	2.40E+06	-	-
ρ_w	density of waste from cleared material (g waste/m^3)					
	FE-BOFD-DISPOSL-W	3	fixed	1.60E+06	-	-
	FE-SLAG-DISPOSL-W	3	fixed	2.00E+06	-	-
	FE-SCRP-DISPOSL-W	3	fixed	3.93E+06	-	-
	FE-BOFD-LANDFIL-N	3	fixed	1.60E+06		
	FE-SLAG-LANDFIL-N	3	fixed	2.00E+06	-	-
	FE-SCRP-LANDFIL-N	3	fixed	3.93E+06	-	-
	FE-EAFD-LANDFIL-N	3	fixed	1.36E+06	-	-

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value (FV), and the second and third columns do not contain values;
- for a *uniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively;
- for a *normal distribution*, the first and second columns contain the mean and the standard deviation (SD) of the distribution, respectively, and the third column does not contain a value;
- for a *lognormal distribution*, the first and second columns contain the geometric mean (GM) and the geometric standard deviation (GSD) of the distribution, respectively, and the third column does not contain a value;
- for a *beta distribution*, the first column contains the alpha value, the second contains the beta value, and the third column contains the scale of the distribution.

Table B.8 Source of material radioactivity concentration (C_s), for iron and steel exposure scenarios[1]

Scenario	Mixing[2]	Material flow model concentration used: Symbol	Description
FE-ATMO-REFINER-N	AA	A_g, C_d	activity in the off gases leaving the refinery stack in a year (EAF); concentration in dust after the refining process (EAF)
FE-SCRP-HANDLIN-W	n/a	C_0	original concentration in cleared material
FE-SCRP-DISPOSL-W	n/a		
FE-SCRP-TRANSPO-W	n/a		
FE-SCRP-LANDFIL-N	n/a		
FE-METL-HANDREF-W	AA	C_p	concentration in EAF metal product after the refining process
FE-METL-VEHICLE-N	SC		
FE-METL-BLDGSTR-N	SC		
FE-METL-SMOBJCT-N	SC		
FE-METL-TRANSPO-W	AA		
FE-METL-HANDDIS-W	AA		
FE-METL-LGMASS-N	SC	C_p	concentration in BOF metal product after the refining process
FE-METL-SMMASS-N	SC		
FE-BOFM-HANDMAN-W	AA		
FE-BOFD-DISPOSL-W	AA	C_d	concentration in BOF dust after the refining process
FE-BOFD-LANDFIL-N	AA		
FE-EAFD-BAGHOUS-W	AA	C_d	concentration in EAF dust after the refining process
FE-EAFD-TRANSPO-W	AA		
FE-EAFD-PROCESS-W	AA		
FE-EAFD-HANDLIN-W	AA		
FE-EAFD-DISPOSL-W	AA	C_H	concentration in immobilized dust (EAF refinery)
FE-EAFD-LANDFIL-N	AA		
FE-SLAG-ROADBED-N	AA	C_s	concentration in EAF slag after the refining process
FE-SLAG-STORAGE-N	AA		
FE-SLAG-LANDFIL-N	AA		
FE-SLAG-DISPOSL-W	AA		
FE-SLAG-TRANSPO-W	AA		
FE-SLAG-PROCESS-W	AA		
FE-SLAG-CONCBAS-N	AA		
FE-SLAG-ROADBED-W	AA		
FE-SLAG-HANDLIN-W	AA		

1. This table indicates which material concentration from the material flow model was used as the source material input concentration in each exposure scenario.
2. This column indicates scrap mixing assumptions used. AA indicates annual average mixing concentration; SC indicates single charge concentrations; n/a indicates no mixing in material flow model.

Table B.9 Radionuclide independent parameter definitions specific to copper scenarios

Symbol	Parameter description/scenario	Parameter data quality[b]	Parameter distribution	Parameter distribution values[a]: FV, mode, or GM	Minimum	Maximum
CR_{Cu}	concentration of Cu in water due to leaching from pipes (mg Cu/L water)					
	CU-METL-PIPES-N	4	triangular	3.00E-01	1.60E-01	1.30E+00
DI_W	total water intake (L water/d)					
	CU-METL-PIPES-N	2	lognormal	1.40E+0	1.78E+00	-
F_W	fraction of total water intake that is from copper pipes (dimensionless)					
	CU-METL-PIPES-N	5	uniform	-	5.00E-01	1.00E+00
M_a	total mass of dust that escapes the refinery baghouse in a year (g)					
	CU-ATMO-REVERAT-N	4	fixed	3.31E+6	-	-
	CU-ATMO-CONVERT-N	4	fixed	3.08E+6	-	-
SM	surface-to-mass ratio for cleared material (cm^2/g)					
	All scenarios	4	loguniform	-	2.00E-01	2.00E+00
t_r	time from release of cleared material from nuclear facility to time scenario begins (d)					
	CU-CNVS-HANDLIN-W	5	uniform	-	2.20E+01	6.60E+01
	CU-ELRS-HANDLIN-W	5	uniform	-	2.95E+01	8.85E+01
	CU-CNVD-BAGHOUS-W	5	uniform	-	2.20E+01	6.60E+01
	CU-ELRD-BAGHOUS-W	5	uniform	-	2.95E+01	8.85E+01
	CU-ERLM-HANDREF-W	5	uniform	-	2.95E+01	8.85E+01
	CU-REVM-HANDDIS-W	5	uniform	-	3.30E+01	9.90E+01
	CU-METL-PIPES-N	5	uniform	-	3.65E+01	1.10E+03
	CU-ERLM-LGMASS-N	5	uniform	-	5.15E+01	1.55E+02
	CU-REVD-TRANSPO-W	5	uniform	-	1.80E+01	5.40E+01
	CU-CNVM-HANDREF-W	5	uniform	-	2.20E+01	6.60E+01
	CU-ERLM-TRANSPO-W	5	uniform	-	3.30E+01	9.90E+01
	CU-REVM-TRANSPO-W	5	uniform	-	2.20E+01	6.60E+01
t_{ex}	daily number of hours of exposure for the scenario (h/d)					
	CU-SCRP-HANDLIN-W	5	uniform	-	3.60E-02	2.40E-01
	CU-ERLM-LGMASS-N	4	triangular	2.00E+00	1.00E+00	7.00E+00
	CU-REVM-SMMASS-N	4	triangular	4.00E+00	2.00E+00	3.00E+00
	CU-SCRP-DISPOSL-W	5	uniform	-	8.00E-02	3.20E-01
t_y	annual number of days of exposure for the scenario (d/y)					
	CU-METL-PIPES-N	3	triangular	3.00E+02	2.50E+02	3.50E+02
	CU-ERLM-LGMASS-N	4	fixed	2.50E+02	-	-
	CU-REVM-SMMASS-N	4	fixed	2.50E+02	-	-
U_{GF}	uncertainty in geometry factor (dimensionless)					
	CU-ERLM-LGMASS-N	3	triangular	6.50E-01	3.00E-01	1.00E+00
ρ_w	density of waste (g waste/m^3)					
	CU-SCRP-DISPOSAL-W	3	fixed	4.47E+06	-	-

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value (FV), and the second and third columns do not contain values;
- for a *uniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.
- for a *lognormal distribution*, the first and second columns contain the geometric mean (GM) and the geometric standard deviation (GSD) of the distribution, respectively, and the third column does not contain a value.

Table B.10 Copper scenarios and corresponding iron and steel scenarios	
Copper scenario title and abbreviation	Corresponding steel scenario
Handling and Processing Scenarios	
Handling copper scrap metal at the scrapyard (CU-SCRP-HANDLIN-W)	FE-SCRP-HANDLIN-W
Baghouse operations	
reverberatory furnace (CU-REVD-BAGHOUS-W)	FE-EAFD-BAGHOUS-W
converter (CU-CNVD-BAGHOUS-W)	FE-EAFD-BAGHOUS-W
Handling refined copper metal product at the refinery	
reverberatory furnace (CU-REVM-HANDREF-W)	FE-METL-HANDREF-W
converter (CU-CNVM-HANDREF-W)	FE-METL-HANDREF-W
electrorefiner (CU-ELRM-HANDREF-W)	FE-METL-HANDREF-W
Handling refined copper metal product during product manufacture (reverberatory furnace) (CU-REVM-HANDMAN-W)	FE-BOFM-HANDMAN-W
Handling refined copper metal product during product distribution (reverberatory furnace) (CU-REVM-HANDDIS-W)	FE-METL-HANDDIS-W
Handling copper slag at the refinery	
reverberatory furnace (CU-REVS-HANDLIN-W)	FE-SLAG-HANDLIN-W
converter (CU-CNVS-HANDLIN-W)	FE-SLAG-HANDLIN-W
electrorefiner (CU-ELRS-HANDLIN-W)	FE-SLAG-HANDLIN-W
Atmospheric releases during copper refining	
reverberatory furnace (CU-ATMO-REVERAT-N)	FE-ATMO-REFINER-N
converter (CU-ATMO-CONVERT-N)	FE-ATMO-REFINER-N
Transport Scenarios	
Transport of baghouse dust	
reverberatory furnace (CU-REVD-TRANSPO-W)	FE-EAFD-TRANSPO-W
converter (CU-CNVD-TRANSPO-W)	FE-EAFD-TRANSPO-W
Transport of copper scrap metal (CU-SCRP-TRANSPO-W)	FE-SCRP-TRANSPO-W
Transport of copper refined metal product	
reverberatory furnace (CU-REVM-TRANSPO-W)	FE-METL-TRANSPO-W
electrorefiner (CU-ELRM-TRANSPO-W)	FE-METL-TRANSPO-W
Disposal Scenarios	
Disposal activities in a sanitary landfill	
copper scrap (CU-SCRP-DISPOSL-W)	FE-SCRP-DISPOSL-W
Product Use Scenarios	
In proximity of a large roll of copper wire (electrorefiner) (CU-ELRM-LGMASS-N)	FE-METL-LGMASS-N
In proximity of a small metal mass (reverberatory furnace) (CU-REVM-SMMASS-N)	FE-METL-SMMASS-N
Small copper mass close to the body (reverberatory furnace) (CU-REVM-SMOBJCT-N)	FE-METL-SMOBJCT-N
Use of copper water pipes (CU-METL-PIPES-N)	None

Table B.11 Source of material radioactivity concentration (C_x), for copper exposure scenarios[1]

Scenario	Mixing[2]	Symbol	Description
		A_g, C_d	activity in the off gases leaving the refinery stack in a year; concentration in the dust after the refining process:
CU-ATMO-REVERAT-N	AA		reverberatory furnace
CU-ATMO-CONVERT-N	AA		converter
CU-SCRP-TRANSPO-B	n/a	C_0	original concentration in cleared material
CU-SCRP-HANDLIN-W	n/a		
CU-SCRP-DISPOSL-W	n/a		
CU-REVM-HANDDIS-W	AA	C_p	concentration in the reverberatory furnace metal product after the refining process
CU-REVM-SMMASS-N	SC		
CU-REVM-SMOBJCT-N	SC		
CU-REVM-HANDMAN-W	AA		
CU-REVM-HANDREF-W	AA		
CU-METL-PIPES-N	SC		
CU-REVM-TRANSPO-W	AA		
CU-CNVM-HANDREF-W	AA	C_p	concentration in the converter metal product after the refining process
CU-ELRM-HANDREF-W	AA	C_p	concentration in the electrorefiner metal product after the refining process
CU-ELRM-LGMASS-N	SC		
CU-ELRM-TRANSP-W	AA		
CU-REVD-BAGHOUS-W	AA	C_d	concentration in reverberatory furnace dust after the refining process
CU-REVD-TRANSPO-W	AA		
CU-CNVD-BAGHOUS-W	AA	C_d	concentration in converter dust after the refining process
CU-CNVD-TRANSPO-W	AA		
CU-REVS-HANDLIN-W	AA	C_s	concentration in reverberatory slag after the refining process
CU-CNVS-HANDLIN-W	AA	C_s	concentration in converter slag after the refining process
CU-ELRS-HANDLIN-W	AA	C_s	concentration in electrorefiner slag after the refining process

1. This table indicates which material concentration from the material flow model was used as the source material input concentration in each exposure scenario.
2. This column indicates scrap mixing assumptions used. AA indicates annual average mixing concentration; SC indicates single charge concentrations; n/a indicates no mixing in the material flow model.

Table B.12 Radionuclide independent parameter definitions specific to aluminum scenarios

Symbol	Parameter Description/Scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a] Mode or fixed value	Minimum	Maximum
CR_{Al}	corrosion and transfer rate for aluminum (mg/kg)					
	AL-METL-COOKWAR-N	3	triangular	5.18E+01	1.40E−01	1.03E+02
DI_t	total dietary intake (kg/d)					
	AL-METL-COOKWAR-N	5	uniform	-	1.30E+00	1.60E+00
F_{DI}	fraction of total dietary intake that is cooked in aluminum pot (dimensionless)					
	AL-METL-COOKWAR-N	5	uniform	-	3.30E−01	1.00E+00
M_{rt}	total mass of dust that escapes the refinery baghouse in a year (g)					
	AL-ATMO-REFINER-N	4	fixed	2.53E+6	-	-
SM	surface-to-mass ratio for cleared material (cm^2/g)					
	All scenarios	4	uniform	-	1.00E+00	7.00E+00
t_1	time from release of cleared material from nuclear facility to time scenario begins (d)					
	AL-METL-HANDDIS-W	5	uniform	-	3.30E+01	9.90E+01
	AL-METL-COOKWAR-N	5	uniform	-	3.65E+01	1.10E+02
	AL-METL-ENGINE-N	5	uniform	-	3.65E+01	1.10E+02
	AL-METL-TRANSPO-W	5	uniform	-	2.20E+01	6.60E+01
	AL-DROS-TRANSPO-W	5	uniform	-	2.20E+01	6.60E+01
t_{ss}	daily number of hours of exposure for the scenario (h/d)					
	AL-METL-ENGINE-N	4	triangular	4.00E+00	1.00E+00	8.00E+00
	AL-METL-COOKWAR-N (external)	5	uniform	-	3.75E−01	5.00E−01
	AL-METL-LGMASS-N	4	triangular	4.00E+00	2.00E+00	7.00E+00
	AL-SCRP-HANDLIN-W	5	uniform	-	6.00E−04	6.00E−03
	AL-SCRP-DISPOSL-W	5	uniform	-	6.00E-04	6.00E−03
t_{ya}	annual number of days of exposure for the scenario (d/y)					
	AL-METL-ENGINE-N	4	fixed	2.50E+00	-	-
	AL-METL-COOKWAR-N (ingestion)	5	uniform	-	2.50E+02	3.50E+02
	AL-METL-COOKWAR-N (external)	4	fixed	3.50E+02	-	-
	AL-METL-LGMASS-N	4	fixed	2.50E+02	-	-
	AL-SCRP-TRANSPO-W	4	fixed	5.00E+00		
U_{GF}	uncertainty in geometry factor (dimensionless)					
	AL-METL-ENGINE-N	3	triangular	8.00E−01	6.00E−01	1.00E+00
	AL-METL-COOKWAR-N	3	triangular	7.00E−01	2.50E−01	4.00E+00
ρ_w	density of waste (g waste/m^3)					
	AL-SCRP-DISPOSL-W	3	fixed	1.35E+06	-	-

a The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value, and the second and third columns do not contain values;
- for a *uniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.

Table B.13 Aluminum scenarios and corresponding iron and steel scenarios

Aluminum scenario title and abbreviation	Corresponding steel scenario
Handling and Processing Scenarios	
Handling aluminum scrap metal at the scrapyard (AL-SCRP-HANDLIN-W)	FE-SCRP-HANDLIN-W
Aluminum refinery baghouse operations (AL-DUST-BAGHOUS-W)	FE-EAFD-BAGHOUS-W
Handling refined aluminum metal product at the refinery (AL-METL-HANDREF-W)	FE-METL-HANDREF-W
Handling refined aluminum metal product during manufacture (AL-METL-HANDMAN-W)	FE-BOFM-HANDMAN-W
Handling refined aluminum metal product during product distribution (AL-METL-HANDDIS-W)	FE-METL-HANDDIS-W
Handling aluminum dross at the refinery (AL-DROS-HANDLIN-W)	FE-SLAG-HANDLIN-W
Atmospheric releases during aluminum refining (AL-ATMO-REFINER-N)	FE-ATMO-REFINER-N
Transport Scenarios	
Transport of refinery dust (AL-DUST-TRANSPO-W)	FE-EAFD-TRANSPO-W
Transport of aluminum scrap metal (AL-SCRP-TRANSPO-W)	FE-SCRP-TRANSPO-W
Transport of aluminum refined metal product (AL-METL-TRANSPO-W)	FE-METL-TRANSPO-W
Transport of aluminum dross (AL-DROS-TRANSPO-W)	FE-SLAG-TRANSPO-W
Disposal Scenarios	
Disposal activities for aluminum scrap in a sanitary landfill (AL-SCRP-DISPOSL-W)	FE-SCRP-DISPOSL-W
Product Use Scenarios	
In proximity of a large metal mass (AL-METL-LGMASS-N)	FE-METL-LGMASS-N
In proximity of a small metal mass (AL-METL-SMMASS-N)	FE-METL-SMMASS-N
Small aluminum mass close to the body (AL-METL-SMOBJCT-N)	FE-METL-SMOBJCT-N
Aluminum engine block in a car (AL-METL-ENGINE-N)	FE-METL-SMMASS-N
Use of aluminum cookware (AL-METL-COOKWAR-N)	None

Table B.14 Source material radioactivity concentration (C_s), for aluminum exposure scenarios[1]

Scenario title	Material flow model parameter		
	Mixing[2]	Symbol	Description
AL-ATMO-REFINER-N	AA	A_g, C_d	activity in the off gases leaving the refinery stack in a year; concentration in dust after the refining process
AL-SCRP-HANDLIN-W	n/a	C_0	original concentration in cleared material
AL-SCRP-TRANSPO-W	n/a		
AL-SCRP-DISPOSL-W	n/a		
AL-DUST-BAGHOUS-W	AA	C_d	concentration in dust after the refining process
AL-DUST-TRANSPO-W	AA		
AL-METL-HANDDIS-W	AA	C_p	concentration in metal product after the refining process
AL-METL-HANDREF-W	AA		
AL-METL-ENGINE-N	SC		
AL-METL-HANDMAN-W	AA		
AL-METL-COOKWAR-N	SC		
AL-METL-LGMASS-N	SC		
AL-METL-TRANSPO-W	AA		
AL-METL-SMMASS-N	SC		
AL-METL-SMOBJCT-N	SC		
AL-DROS-HANDLIN-W	AA	C_s	concentration in dross after the refining process
AL-DROS-TRANSPO-W	AA		

1. This table indicates which material concentration from the material flow model was used as the source material input concentration in each exposure scenario.
2. This column indicates scrap mixing assumptions used. AA indicates annual average mixing concentration; SC indicates single charge concentrations.

Table B.15 Radionuclide independent parameter definitions specific to concrete scenarios

Symbol	Parameter description/scenario	Parameter data quality	Parameter distribution	Parameter distribution values[a]: Mode or fixed value	Minimum	Maximum
FW	fraction of volume of all waste in the landfill from cleared material					
	CN-SCRP-LANDFIL-N	5	uniform	-	7.00E-02	1.35E-01
SM	surface-to-mass ratio for cleared material (cm^2/g)					
	all scenarios	4	uniform	-	7.00E-03	4.00E-02
t_s	time from release of cleared material from nuclear facility to time scenario begins (d)					
	CN-SCRP-TRANSPO-B	5	uniform	-	0.00E+00	6.00E+00
	CN-SCRP-HANDLIN-W	5	uniform	-	2.00E+00	6.00E+00
	CN-SCRP-ROADBED-W	5	uniform	-	5.50E+00	1.65E+01
	CN-SCRP-ROADBED-N	5	uniform	-	5.50E+00	1.65E+01
	CN-SCRP-LGMASS-N	5	uniform	-	5.50E+00	1.65E+01
	CN-SCRP-DISPOSL-W	5	uniform	-	2.00E+00	6.00E+00
	CN-SCRP-LANDFIL-N	5	uniform	-	2.00E+00	6.00E+00
t_{ss}	daily number of hours of exposure for the scenario (h/d)					
	CN-SCRP-HANDLIN-W	5	uniform	-	2.00E+00	6.00E+00
	CN-SCRP-DISPOSL-W	5	uniform	-	5.60E-01	1.08E+00
	CN-SCRP-LGMASS-N	4	triangular	4.00E+00	2.00E+00	7.00E+00
t_{sy}	annual number of days of exposure for the scenario (d/y)					
	CN-SCRP-LGMASS-N	4	fixed	2.50E+02	-	-
U_{GF}	uncertainty in geometry factor (dimensionless)					
	CN-SCRP-LGMASS-N	3	triangular	6.50E-01	3.00E-01	1.00E+00
ρ_w	density of waste from cleared material (g waste/m^3)					
	CN-SCRP-DISPOSL-W	3	fixed	2.33E+6	-	-
	CN-SCRP-LANDFIL-N	3	fixed	2.33E+6	-	-

a. The values listed in the three columns under "Parameter distribution values" depend on the type of parameter distribution, as follows:

- for a *fixed parameter*, the first column contains the fixed value, and the second and third columns do not contain values;
- for a *uniform distribution*, the first column does not contain a value, and the second and third columns contain the minimum and maximum values of the distribution, respectively;
- for a *triangular distribution*, the first, second, and third columns contain the mode, the minimum, and the maximum values of the distribution, respectively.

Table B.16 Concrete scenarios and corresponding steel scenarios

Scenario title and abbreviation	Corresponding steel scenario
Handling and Processing Scenario	
Processing concrete (CN-SCRP-HANDLIN-W)	FE-SLAG-PROCESS-W
Transport Scenario	
Transport of concrete (CN-SCRP-TRANSPO-W)	FE-SCRP-TRANSPO-B
Disposal Scenario	
Disposal activities for concrete in a sanitary landfill (CN-SCRP-DISPOSL-W)	FE-SLAG-DISPOSL-W
Product Use Scenarios	
Road construction activities using recycled concrete (CN-SCRP-ROADBED-W)	FE-SLAG-ROADBED-W
Use of recycled concrete in a roadbed (CN-SCRP-ROADBED-N)	FE-SLAG-ROADBED-N
In proximity of a large concrete object (CN-SCRP-LGMASS-N)	FE-METL-LGMASS-N
Landfill Resident Scenario	
Resident on a sanitary landfill after disposal of concrete (CN-SCRP-LANDFIL-N)	FE-SLAG-LANDFIL-N

Table B.17 Radiological parameter values

Nuclide	Half-life (days)	Decay constant (1/d)	Decay factor (unitless)	Nuclide	Half-life (days)	Decay constant (1/d)	Decay factor (unitless)
H-3	4.51E+03	1.54E-04	9.72E-01	Cs-134	7.53E+02	9.20E-04	8.49E-01
C-14	2.09E+06	3.32E-07	1.00E+00	Cs-137	1.10E+04	6.30E-05	9.89E-01
Na-22	9.50E+02	7.29E-04	8.78E-01	Ce-141	3.25E+01	2.13E-02	1.28E-01
P-32	1.43E+01	4.85E-02	5.65E-02	Ce-144	2.84E+02	2.44E-03	6.62E-01
S-35	8.74E+01	7.93E-03	3.26E-01	Pm-147	9.58E+02	7.23E-04	8.79E-01
Cl-36	1.10E+08	6.30E-09	1.00E+00	Eu-152	4.87E+03	1.42E-04	9.74E-01
K-40	4.67E+11	1.48E-12	1.00E+00	Eu-154	3.21E+03	2.16E-04	9.62E-01
Ca-41	5.11E+07	1.36E-08	1.00E+00	Eu-155	1.81E+03	3.83E-04	9.33E-01
Ca-45	1.63E+02	4.25E-03	5.08E-01	Re-186	3.78E+00	1.83E-01	1.49E-02
Cr-51	2.77E+01	2.50E-02	1.09E-01	Ir-192	7.40E+01	9.36E-03	2.83E-01
Mn-54	3.13E+02	2.21E-03	6.86E-01	Pb-210	8.14E+03	8.51E-05	9.85E-01
Fe-55	9.86E+02	7.03E-04	8.82E-01	Po-210	1.38E+02	5.02E-03	4.58E-01
Co-57	2.71E+02	2.56E-03	6.50E-01	Bi-210	5.01E+00	1.38E-01	1.98E-02
Co-58	7.08E+01	9.79E-03	2.72E-01	Rn-222	3.82E+00	1.81E-01	1.51E-02
Fe-59	4.45E+01	1.56E-02	1.75E-01	Ra-223	1.14E+01	6.06E-02	4.52E-02
Ni-59	2.74E+07	2.53E-08	1.00E+00	Ra-224	3.66E+00	1.89E-01	1.45E-02
Co-60	1.93E+03	3.59E-04	9.37E-01	Ac-225	1.00E+01	6.93E-02	3.95E-02
Ni-63	3.51E+04	1.97E-05	9.96E-01	Ra-225	1.48E+01	4.68E-02	5.85E-02
Zn-65	2.44E+02	2.84E-03	6.22E-01	Ra-226	5.84E+05	1.19E-06	1.00E+00
Cu-67	2.58E+00	2.69E-01	1.02E-02	Ac-227	7.95E+03	8.72E-05	9.84E-01
Se-75	1.20E+02	5.78E-03	4.17E-01	Th-227	1.87E+01	3.71E-02	7.39E-02
Sr-85	6.50E+01	1.07E-02	2.52E-01	Th-228	6.98E+02	9.93E-04	8.39E-01
Sr-89	5.05E+01	1.37E-02	1.98E-01	Ra-228	2.10E+03	3.30E-04	9.42E-01
Sr-90	1.06E+04	6.54E-05	9.88E-01	Th-229	2.68E+06	2.59E-07	1.00E+00
Y-91	5.85E+01	1.18E-02	2.28E-01	Th-230	2.81E+07	2.47E-08	1.00E+00
Mo-93	1.28E+06	5.41E-07	1.00E+00	Pa-231	1.20E+07	5.78E-08	1.00E+00
Nb-93m	4.97E+03	1.39E-04	9.75E-01	Th-231	1.06E+00	6.54E-01	4.19E-03
Nb-94	7.41E+06	9.35E-08	1.00E+00	Th-232	5.13E+12	1.35E-13	1.00E+00
Nb-95	3.52E+01	1.97E-02	1.39E-01	Pa-233	2.70E+01	2.57E-02	1.07E-01
Zr-95	6.40E+01	1.08E-02	2.48E-01	U-233	5.79E+07	1.20E-08	1.00E+00
Tc-99	7.78E+07	8.91E-09	1.00E+00	Th-234	2.41E+01	2.88E-02	9.52E-02
Ru-103	3.93E+01	1.76E-02	1.55E-01	U-234	8.92E+07	7.77E-09	1.00E+00
Ru-106	3.68E+02	1.88E-03	7.23E-01	U-235	2.57E+11	2.70E-12	1.00E+00
Ag-108m	4.64E+04	1.49E-05	9.97E-01	Np-237	7.81E+08	8.87E-10	1.00E+00
Cd-109	4.64E+02	1.49E-03	7.71E-01	Pu-238	3.20E+04	2.17E-5	9.96E-01
Ag-110m	2.50E+02	2.77E-03	6.29E-01	U-238	1.63E+12	4.25E-13	1.00E+00
Sb-124	6.02E+01	1.15E-02	2.34E-01	Pu-239	8.79E+06	7.88E-08	1.00E+00
I-125	6.01E+01	1.15E-02	2.34E-01	Pu-240	2.39E+06	2.90E-07	1.00E+00
Sb-125	1.01E+03	6.86E-04	8.85E-01	Pu-241	5.26E+03	1.32E-04	9.76E-01
I-129	5.73E+09	1.21E-10	1.00E+00	Am-241	1.58E+05	4.39E-06	9.99E-01
I-131	8.04E+00	8.62E-02	3.18E-02	Cm-242	1.63E+02	4.25E-03	5.08E-01
Ba-133	3.92E+03	1.77E-04	9.68E-01	Pu-242	1.38E+08	5.04E-09	1.00E+00
				Cm-244	6.61E+03	1.05E-04	9.81E-01

Table B.18 Inhalation dose factors (highest FGR 11 values)

			DF_{inh} (mrem/pCi)			
	Federal Guidance Report 11		Early scenarios		Late scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
H-3	1.73E-11	6.40E-08	6.40E-08	6.40E-08	6.40E-08	6.40E-08
C-14	5.64E-10	2.09E-06	2.09E-06	2.09E-06	2.09E-06	2.09E-06
Na-22	2.07E-09	7.66E-06	7.66E-06	7.66E-06	7.66E-06	7.66E-06
P-32	4.19E-09	1.55E-05	1.55E-05	1.55E-05	1.55E-05	1.55E-05
S-35	6.69E-10	2.48E-06	2.48E-06	2.48E-06	2.48E-06	2.48E-06
Cl-36	5.93E-09	2.19E-05	2.19E-05	2.19E-05	2.19E-05	2.19E-05
K-40	3.34E-09	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05
Ca-41	3.64E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Ca-45	1.79E-09	6.62E-06	6.62E-06	6.62E-06	6.62E-06	6.62E-06
Cr-51	9.03E-11	3.34E-07	3.34E-07	3.34E-07	3.34E-07	3.34E-07
Mn-54	1.81E-09	6.70E-06	6.70E-06	6.70E-06	6.70E-06	6.70E-06
Fe-55	7.26E-10	2.69E-06	2.69E-06	2.69E-06	2.69E-06	2.69E-06
Co-57	2.45E-09	9.07E-06	9.07E-06	9.07E-06	9.07E-06	9.07E-06
Co-58	2.94E-09	1.09E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05
Fe-59	4.00E-09	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05
Ni-59	7.31E-10	2.70E-06	2.70E-06	2.70E-06	2.70E-06	2.70E-06
Co-60	5.91E-08	2.19E-04	2.19E-04	2.19E-04	2.19E-04	2.19E-04
Ni-63	1.70E-09	6.29E-06	6.29E-06	6.29E-06	6.29E-06	6.29E-06
Zn-65	5.51E-09	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05
Cu-67	3.32E-10	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06
Se-75	2.29E-09	8.47E-06	8.47E-06	8.47E-06	8.47E-06	8.47E-06
Sr-85	1.36E-09	5.03E-06	5.03E-06	5.03E-06	5.03E-06	5.03E-06
Sr-89	1.12E-08	4.14E-05	4.14E-05	4.14E-05	4.14E-05	4.14E-05
Sr-90	3.51E-07	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03
Y-91	1.32E-08	4.88E-05	4.88E-05	4.88E-05	4.88E-05	4.88E-05
Mo-93	7.68E-09	2.84E-05	2.84E-05	2.84E-05	2.84E-05	2.84E-05
Nb-93m	7.90E-09	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05
Nb-94	1.12E-07	4.14E-04	4.14E-04	4.14E-04	4.14E-04	4.14E-04
Nb-95	1.57E-09	5.81E-06	5.81E-06	5.81E-06	5.81E-06	5.81E-06
Zr-95	6.39E-09	2.36E-05	2.36E-05	2.36E-05	2.36E-05	2.36E-05
Tc-99	2.25E-09	8.33E-06	8.33E-06	8.33E-06	8.33E-06	8.33E-06
Ru-103	2.42E-09	8.95E-06	8.95E-06	8.95E-06	8.95E-06	8.95E-06
Ru-106	1.29E-07	4.77E-04	4.77E-04	4.77E-04	4.77E-04	4.77E-04
Ag-108m	7.66E-08	2.83E-04	2.83E-04	2.83E-04	2.83E-04	2.83E-04
Cd-109	3.09E-08	1.14E-04	1.14E-04	1.14E-04	1.14E-04	1.14E-04
Ag-110m	2.17E-08	8.03E-05	8.03E-05	8.03E-05	8.03E-05	8.03E-05
Sb-124	6.80E-09	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.52E-05
I-125	6.53E-09	2.42E-05	2.42E-05	2.42E-05	2.42E-05	2.42E-05
Sb-125	3.30E-09	1.22E-05	1.22E-05	1.22E-05	1.22E-05	1.22E-05
I-129	4.69E-08	1.74E-04	1.74E-04	1.74E-04	1.74E-04	1.74E-04
I-131	8.89E-09	3.29E-05	3.29E-05	3.29E-05	3.29E-05	3.29E-05
Ba-133	2.11E-09	7.81E-06	7.81E-06	7.81E-06	7.81E-06	7.81E-06
Cs-134	1.25E-08	4.63E-05	4.63E-05	4.63E-05	4.63E-05	4.63E-05
Cs-137	8.63E-09	3.19E-05	3.19E-05	3.19E-05	3.19E-05	3.19E-05
Ce-141	2.42E-09	8.95E-06	8.95E-06	8.95E-06	8.95E-06	8.95E-06

Table B.18 Inhalation dose factors (highest FGR 11 values)

	Federal Guidance Report 11		DF_{inh}^{i} (mrem/pCi)			
			Early scenarios		Late scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
Ce-144	1.01E-07	3.74E-04	3.74E-04	3.74E-04	3.74E-04	3.74E-04
Pm-147	1.06E-08	3.92E-05	3.92E-05	3.92E-05	7.47E+04	3.92E-05
Eu-152	5.97E-08	2.21E-04	2.21E-04	2.21E-04	2.21E-04	2.21E-04
Eu-154	7.73E-08	2.86E-04	2.86E-04	2.86E-04	2.86E-04	2.86E-04
Eu-155	1.12E-08	4.14E-05	4.14E-05	4.14E-05	4.14E-05	4.14E-05
Re-186	8.64E-10	3.20E-06	3.20E-06	3.20E-06	3.20E-06	3.20E-06
Ir-192	7.61E-09	2.82E-05	2.82E-05	2.82E-05	2.82E-05	2.82E-05
Pb-210	3.67E-06	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02
Po-210	2.54E-06	9.40E-03	9.40E-03	9.40E-03	9.40E-03	9.40E-03
Bi-210	5.29E-08	1.96E-04	1.96E-04	1.96E-04	1.96E-04	1.96E-04
Rn-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-223	2.12E-06	7.84E-03	7.84E-03	7.84E-03	7.84E-03	7.84E-03
Ra-224	8.53E-07	3.16E-03	3.16E-03	3.16E-03	3.16E-03	3.16E-03
Ac-225	2.92E-06	1.08E-02	1.08E-02	1.08E-02	1.08E-02	1.08E-02
Ra-225	2.10E-06	7.77E-03	7.77E-03	7.77E-03	7.77E-03	7.77E-03
Ra-226	2.32E-06	8.58E-03	8.58E-03	8.58E-03	3.16E-02	1.55E-02
Ac-227	1.81E-03	6.70E+00	6.70E+00	6.70E+00	6.70E+00	6.70E+00
Th-227	4.37E-06	1.62E-02	1.62E-02	1.62E-02	1.62E-02	1.62E-02
Th-228	9.23E-05	3.42E-01	3.42E-01	3.42E-01	3.42E-01	3.42E-01
Ra-228	1.29E-06	4.77E-03	7.31E-02	1.16E-02	5.17E-01	5.17E-01
Th-229	5.80E-04	2.15E+00	2.15E+00	2.15E+00	2.15E+00	2.15E+00
Th-230	8.80E-07	3.26E-03	3.26E-03	3.26E-03	3.26E-03	3.26E-03
Pa-231	3.47E-04	1.28E+00	1.28E+00	1.28E+00	7.98E+00	1.28E+00
Th-231	2.37E-10	8.77E-07	8.77E-07	8.77E-07	8.77E-07	8.77E-07
Th-232	4.43E-04	1.64E+00	1.64E+00	1.64E+00	1.64E+00	1.64E+00
Pa-233	2.58E-09	9.55E-06	9.55E-06	9.55E-06	9.55E-06	9.55E-06
U-233	3.66E-05	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.35E-01
Th-234	9.47E-09	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05
U-234	3.58E-05	1.32E-01	1.32E-01	1.32E-01	1.32E-01	1.32E-01
U-235	3.32E-05	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01
Np-237	1.46E-04	5.40E-01	5.40E-01	5.40E-01	5.40E-01	5.40E-01
Pu-238	1.06E-04	3.92E-01	3.92E-01	3.92E-01	3.92E-01	3.92E-01
U-238	3.20E-05	1.18E-01	1.18E-01	1.18E-01	1.18E-01	1.18E-01
Pu-239	1.16E-04	4.29E-01	4.29E-01	4.29E-01	4.29E-01	4.29E-01
Pu-240	1.16E-04	4.29E-01	4.29E-01	4.29E-01	4.29E-01	4.29E-01
Pu-241	2.23E-06	8.25E-03	8.25E-03	8.25E-03	1.29E+01	1.71E-02
Am-241	1.20E-04	4.44E-01	4.44E-01	4.44E-01	4.44E-01	4.44E-01
Cm-242	4.67E-06	1.73E-02	1.73E-02	1.73E-02	3.92E+04[a]	1.18E+04
Pu-242	1.11E-04	4.11E-01	4.11E-01	4.11E-01	4.11E-01	4.11E-01
Cm-244	6.70E-05	2.48E-01	2.48E-01	2.48E-01	2.48E-01	2.48E-01

[a]This apparently unreasonable value for Cm-242 is correct. The derivation of the number is explained in Appendix E.

Table B.19 Inhalation dose conversion factors for oxide clearance classes

	Federal Guidance Report 11		DF$_{inh}$ (mrem/pCi) Early Scenarios		DF$_{inh}$ (mrem/pCi) Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
H-3	1.73E-11	6.40E-08	6.40E-08	6.40E-08	6.40E-08	6.40E-08
C-14	6.36E-12	2.35E-08	2.35E-08	2.35E-08	2.35E-08	2.35E-08
Na-22	2.07E-09	7.66E-06	7.66E-06	7.66E-06	7.66E-06	7.66E-06
P-32	1.64E-09	6.07E-06	6.07E-06	6.07E-06	6.07E 06	6.07E-06
S-35	6.69E-10	2.48E-06	2.48E-06	2.48E-06	2.48E-06	2.48E-06
Cl-36	5.93E-09	2.19E-05	2.19E-05	2.19E-05	2.19E-05	2.19E-05
K-40	3.34E-09	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05
Ca-41	3.64E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Ca-45	1.79E-09	6.62E-06	6.62E-06	6.62E-06	6.62E-06	6.62E-06
Cr-51	9.03E-11	3.34E-07	3.34E-07	3.34E-07	3.34E-07	3.34E-07
Mn-54	1.81E-09	6.70E-06	6.70E-06	6.70E-06	6.70E-06	6.70E-06
Fe-55	3.61E-10	1.34E-06	1.34E-06	1.34E-06	1.34E-06	1.34E-06
Co-57	7.12E-10	2.63E-06	2.63E-06	2.63E-06	2.63E-06	2.63E-06
Co-58	1.72E-09	6.36E-06	6.36E-06	6.36E-06	6.36E-06	6.36E-06
Fe-59	3.30E-09	1.22E-05	1.22E-05	1.22E-05	1.22E-05	1.22E-05
Ni-59	2.48E-10	9.18E-07	9.18E-07	9.18E-07	9.18E-07	9.18E-07
Co-60	8.94E-09	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05
Ni-63	6.22E-10	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
Zn-65	5.51E-09	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05
Cu-67	3.32E-10	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06
Se-75	2.29E-09	8.47E-06	8.47E-06	8.47E-06	8.47E-06	8.47E-06
Sr-85	1.36E-09	5.03E-06	5.03E-06	5.03E-06	5.03E-06	5.03E-06
Sr-89	1.12E-08	4.14E-05	4.14E-05	4.14E-05	4.14E-05	4.14E-05
Sr-90	3.51E-07	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03
Y-91	1.32E-08	4.88E-05	4.88E-05	4.88E-05	4.88E-05	4.88E-05
Mo-93	7.68E-09	2.84E-05	2.84E-05	2.84E-05	2.84E-05	2.84E-05
Nb-93m	7.90E-09	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05
Nb-94	1.12E-07	4.14E-04	4.14E-04	4.14E-04	4.14E-04	4.14E-04
Nb-95	1.57E-09	5.81E-06	5.81E-06	5.81E-06	5.81E-06	5.81E-06
Zr-95	4.29E-09	1.59E-05	1.59E-05	1.59E-05	1.59E-05	1.59E-05
Tc-99	2.25E-09	8.33E-06	8.33E-06	8.33E-06	8.33E-06	8.33E-06
Ru-103	2.42E-09	8.95E-06	8.95E-06	8.95E-06	8.95E-06	8.95E-06
Ru-106	1.29E-07	4.77E-04	4.77E-04	4.77E-04	4.77E-04	4.77E-04
Ag-108m	7.66E-08	2.83E-04	2.83E-04	2.83E-04	2.83E-04	2.83E-04
Cd-109	1.22E-08	4.51E-05	4.51E-05	4.51E-05	4.51E-05	4.51E-05
Ag-110m	2.17E-08	8.03E-05	8.03E-05	8.03E-05	8.03E-05	8.03E-05
Sb-124	6.80E-09	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.52E-05
I-125	6.53E-09	2.42E-05	2.42E-05	2.42E-05	2.42E-05	2.42E-05
Sb-125	3.30E-09	1.22E-05	1.22E-05	1.22E-05	1.22E-05	1.22E-05
I-129	4.69E-08	1.74E-04	1.74E-04	1.74E-04	1.74E-04	1.74E-04
I-131	8.89E-09	3.29E-05	3.29E-05	3.29E-05	3.29E-05	3.29E-05
Ba-133	2.11E-09	7.81E-06	7.81E-06	7.81E-06	7.81E-06	7.81E-06
Cs-134	1.25E-08	4.63E-05	4.63E-05	4.63E-05	4.63E-05	4.63E-05
Cs-137	8.63E-09	3.19E-05	3.19E-05	3.19E-05	3.19E-05	3.19E-05
Ce-141	2.42E-09	8.95E-06	8.95E-06	8.95E-06	8.95E-06	8.95E-06

Table B.19 Inhalation dose conversion factors for oxide clearance classes

			DF$_{inh}$ (mrem/pCi)			
	Federal Guidance Report 11		Early Scenarios		Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
Ce-144	1.01E-07	3.74E-04	3.74E-04	3.74E-04	3.74E-04	3.74E-04
Pm-147	1.06E-08	3.92E-05	3.92E-05	3.92E-05	7.47E+04	3.92E-05
Eu-152	5.97E-08	2.21E-04	2.21E-04	2.21E-04	2.21E-04	2.21E-04
Eu-154	7.73E-08	2.86E-04	2.86E-04	2.86E-04	2.86E-04	2.86E-04
Eu-155	1.12E-08	4.14E-05	4.14E-05	4.14E-05	4.14E-05	4.14E-05
Re-186	8.64E-10	3.20E-06	3.20E-06	3.20E-06	3.20E-06	3.20E-06
Ir-192	7.61E-09	2.82E-05	2.82E-05	2.82E-05	2.82E-05	2.82E-05
Pb-210	3.67E-06	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02
Po-210	2.32E-06	8.58E-03	8.58E-03	8.58E-03	8.58E-03	8.58E-03
Bi-210	5.29E-08	1.96E-04	1.96E-04	1.96E-04	1.96E-04	1.96E-04
Rn-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-223	2.12E-06	7.84E-03	7.84E-03	7.84E-03	7.84E-03	7.84E-03
Ra-224	8.53E-07	3.16E-03	3.16E-03	3.16E-03	3.16E-03	3.16E-03
Ac-225	2.19E-06	8.10E-03	8.10E-03	8.10E-03	8.10E-03	8.10E-03
Ra-225	2.10E-06	7.77E-03	7.77E-03	7.77E-03	7.77E-03	7.77E-03
Ra-226	2.32E-06	8.58E-03	8.58E-03	8.58E-03	3.07E-02	1.52E-02
Ac-227	3.49E-04	1.29E+00	1.29E+00	1.29E+00	1.29E+00	1.29E+00
Th-227	4.37E-06	1.62E-02	1.62E-02	1.62E-02	1.62E-02	1.62E-02
Th-228	9.23E-05	3.42E-01	3.42E-01	3.42E-01	3.42E-01	3.42E-01
Ra-228	1.29E-06	4.77E-03	7.31E-02	1.16E-02	5.17E-01	5.17E-01
Th-229	4.67E-04	1.73E+00	1.73E+00	1.73E+00	1.73E+00	1.73E+00
Th-230	7.07E-05	2.62E-01	2.62E-01	2.62E-01	2.62E-01	2.62E-01
Pa-231	2.32E-04	8.58E-01	8.58E-01	8.58E-01	2.15E+00	8.58E-01
Th-231	2.37E-10	8.77E-07	8.77E-07	8.77E-07	8.77E-07	8.77E-07
Th-232	3.11E-04	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00
Pa-233	2.58E-09	9.55E-06	9.55E-06	9.55E-06	9.55E-06	9.55E-06
U-233	3.66E-05	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.35E-01
Th-234	9.47E-09	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05
U-234	3.58E-05	1.32E-01	1.32E-01	1.32E-01	1.32E-01	1.32E-01
U-235	3.32E-05	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01
Np-237	1.46E-04	5.40E-01	5.40E-01	5.40E-01	5.40E-01	5.40E-01
Pu-238	7.79E-05	2.88E-01	2.88E-01	2.88E-01	2.88E-01	2.88E-01
U-238	3.20E-05	1.18E-01	1.18E-01	1.18E-01	1.18E-01	1.18E-01
Pu-239	8.33E-05	3.08E-01	3.08E-01	3.08E-01	3.08E-01	3.08E-01
Pu-240	8.33E-05	3.08E-01	3.08E-01	3.08E-01	3.08E-01	3.08E-01
Pu-241	1.34E-06	4.96E-03	4.96E-03	4.96E-03	1.29E+01	1.38E-02
Am-241	1.20E-04	4.44E-01	4.44E-01	4.44E-01	4.44E-01	4.44E-01
Cm-242	4.67E-06	1.73E-02	1.73E-02	1.73E-02	2.88E+04[a]	8.65E+03
Pu-242	7.92E-05	2.93E-01	2.93E-01	2.93E-01	2.93E-01	2.93E-01
Cm-244	6.70E-05	2.48E-01	2.48E-01	2.48E-01	2.48E-01	2.48E-01

[a]This apparently unreasonable value for Cm-242 is correct. The derivation of the number is explained in Appendix E.

Table B.20 Ingestion dose conversion factors (highest FGR 11 values)

			DF_{inh} (mrem/pCi)			
	Federal Guidance Report 11		Early Scenarios		Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
H-3	1.73E-11	6.40E-08	6.40E-08	6.40E-08	6.40E-08	6.40E-08
C-14	5.64E-10	2.09E-06	2.09E-06	2.09E-06	2.09E-06	2.09E-06
Na-22	3.10E-09	1.15E-05	1.15E-05	1.15E-05	1.15E-05	1.15E-05
P-32	2.37E-09	8.77E-06	8.77E-06	8.77E-06	8.77E-06	8.77E-06
S-35	1.98E-10	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07
Cl-36	8.18E-10	3.03E-06	3.03E-06	3.03E-06	3.03E-06	3.03E-06
K-40	5.02E-09	1.86E-05	1.86E-05	1.86E-05	1.86E-05	1.86E-05
Ca-41	3.44E-10	1.27E-06	1.27E-06	1.27E-06	1.27E-06	1.27E-06
Ca-45	8.55E-10	3.16E-06	3.16E-06	3.16E-06	3.16E-06	3.16E-06
Cr-51	3.98E-11	1.47E-07	1.47E-07	1.47E-07	1.47E-07	1.47E-07
Mn-54	7.48E-10	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06
Fe-55	1.64E-10	6.07E-07	6.07E-07	6.07E-07	6.07E-07	6.07E-07
Co-57	3.20E-10	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06
Co-58	9.68E-10	3.58E-06	3.58E-06	3.58E-06	3.58E-06	3.58E-06
Fe-59	1.81E-09	6.70E-06	6.70E-06	6.70E-06	6.70E-06	6.70E-06
Ni-59	5.67E-11	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07
Co-60	7.28E-09	2.69E-05	2.69E-05	2.69E-05	2.69E-05	2.69E-05
Ni-63	1.56E-10	5.77E-07	5.77E-07	5.77E-07	5.77E-07	5.77E-07
Zn-65	3.90E-09	1.44E-05	1.44E-05	1.44E-05	1.44E-05	1.44E-05
Cu-67	3.55E-10	1.31E-06	1.31E-06	1.31E-06	1.31E-06	1.31E-06
Se-75	2.60E-09	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06
Sr-85	5.34E-10	1.98E-06	1.98E-06	1.98E-06	1.98E-06	1.98E-06
Sr-89	2.50E-09	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06
Sr-90	3.85E-08	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04
Y-91	2.57E-09	9.51E-06	9.51E-06	9.51E-06	9.51E-06	9.51E-06
Mo-93	3.64E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Nb-93m	1.41E-10	5.22E-07	5.22E-07	5.22E-07	5.22E-07	5.22E-07
Nb-94	1.93E-09	7.14E-06	7.14E-06	7.14E-06	7.14E-06	7.14E-06
Nb-95	6.95E-10	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06
Zr-95	1.02E-09	3.77E-06	8.92E-06	3.77E-06	3.77E-06	3.77E-06
Tc-99	3.95E-10	1.46E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06
Ru-103	8.24E-10	3.05E-06	3.05E-06	3.05E-06	3.05E-06	3.05E-06
Ru-106	7.40E-09	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05
Ag-108m	2.06E-09	7.62E-06	7.62E-06	7.62E-06	7.62E-06	7.62E-06
Cd-109	3.55E-09	1.31E-05	1.31E-05	1.31E-05	1.31E-05	1.31E-05
Ag-110m	2.92E-09	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05
Sb-124	2.74E-09	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
I-125	1.04E-08	3.85E-05	3.85E-05	3.85E-05	3.85E-05	3.85E-05
Sb-125	7.59E-10	2.81E-06	2.81E-06	2.81E-06	2.81E-06	2.81E-06
I-129	7.46E-08	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04
I-131	1.44E-08	5.33E-05	5.33E-05	5.33E-05	5.33E-05	5.33E-05
Ba-133	9.19E-10	3.40E-06	3.40E-06	3.40E-06	3.40E-06	3.40E-06
Cs-134	1.98E-08	7.33E-05	7.33E-05	7.33E-05	7.33E-05	7.33E-05
Cs-137	1.35E-08	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05
Ce-141	7.83E-10	2.90E-06	2.90E-06	2.90E-06	2.90E-06	2.90E-06

Table B.20 Ingestion dose conversion factors (highest FGR 11 values)

	Federal Guidance Report 11		DF$_{inh}$ (mrem/pCi) Early Scenarios		Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
Ce-144	5.68E-09	2.10E-05	2.10E-05	2.10E-05	2.10E-05	2.10E-05
Pm-147	2.83E-10	1.05E-06	1.05E-06	1.05E-06	1.85E+002	1.05E-06
Eu-152	1.75E-09	6.48E-06	6.48E-06	6.48E-06	6.48E-06	6.48E-06
Eu-154	2.58E-09	9.55E-06	9.55E-06	9.55E-06	9.55E-06	9.55E-06
Eu-155	4.13E-10	1.53E-06	1.53E-06	1.53E-06	1.53E-06	1.53E-06
Re-186	7.95E-10	2.94E-06	2.94E-06	2.94E-06	2.94E-06	2.94E-06
Ir-192	1.55E-09	5.74E-06	5.74E-06	5.74E-06	5.74E-06	5.74E-06
Pb-210	1.45E-06	5.37E-03	5.37E-03	5.37E-03	5.37E-03	5.37E-03
Po-210	5.14E-07	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03
Bi-210	1.73E-09	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06
Rn-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-223	1.78E-07	6.59E-04	6.59E-04	6.59E-04	6.59E-04	6.59E-04
Ra-224	9.89E-08	3.66E-04	3.66E-04	3.66E-04	3.66E-04	3.66E-04
Ac-225	3.00E-08	1.11E-04	1.11E-04	1.11E-04	1.11E-04	1.11E-04
Ra-225	1.04E-07	3.85E-04	3.85E-04	3.85E-04	3.85E-04	3.85E-04
Ra-226	3.58E-07	1.32E-03	1.32E-03	1.32E-03	8.59E-03	3.50E-03
Ac-227	3.80E-06	1.41E-02	1.41E-02	1.41E-02	1.41E-02	1.41E-02
Th-227	1.03E-08	3.81E-05	3.81E-05	3.81E-05	3.81E-05	3.81E-05
Th-228	1.07E-07	3.96E-04	7.62E-04	7.62E-04	7.62E-04	7.62E-04
Ra-228	3.88E-07	1.44E-03	1.44E-03	1.44E-03	1.44E-03	1.44E-03
Th-229	9.54E-07	3.53E-03	3.53E-03	3.53E-03	3.53E-03	3.53E-03
Th-230	1.48E-07	5.48E-04	5.48E-04	5.48E-04	5.48E-04	5.48E-04
Pa-231	2.86E-06	1.06E-02	1.06E-02	1.06E-02	2.46E-02	1.06E-02
Th-231	3.65E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Th-232	7.38E-07	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03
Pa-233	9.81E-10	3.63E-06	3.63E-06	3.63E-06	3.63E-06	3.63E-06
U-233	7.81E-08	2.89E-04	2.89E-04	2.89E-04	2.89E-04	2.89E-04
Th-234	3.69E-09	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
U-234	7.66E-08	2.83E-04	2.83E-04	2.83E-04	2.83E-04	2.83E-04
U-235	7.19E-08	2.66E-04	2.66E-04	2.66E-04	2.66E-04	2.66E-04
Np-237	1.20E-06	4.44E-03	4.44E-03	4.44E-03	4.44E-03	4.44E-03
Pu-238	8.65E-07	3.20E-03	3.20E-03	3.20E-03	3.20E-03	3.20E-03
U-238	6.88E-08	2.55E-04	2.55E-04	2.55E-04	2.55E-04	2.55E-04
Pu-239	9.56E-07	3.54E-03	3.54E-03	3.54E-03	3.54E-03	3.54E-03
Pu-240	9.56E-07	3.54E-03	3.54E-03	3.54E-03	3.54E-03	3.54E-03
Pu-241	1.85E-08	6.85E-05	6.85E-05	6.85E-05	1.06E-01	1.41E-04
Am-241	9.84E-07	3.64E-03	3.64E-03	3.64E-03	3.64E-03	3.64E-03
Cm-242	3.10E-08	1.15E-04	1.15E-04	1.15E-04	3.20E+92[a]	9.60E+01
Pu-242	9.08E-07	3.36E-03	3.36E-03	3.36E-03	3.36E-03	3.36E-03
Cm-244	5.45E-07	2.02E-03	2.02E-03	2.02E-03	4.49E-03	2.02E-03

[a]This apparently unreasonable value for Cm-242 is correct. The derivation of the number is explained in Appendix E.

Table B.21 Ingestion dose conversion factors for oxide fractional uptake

			DF_{inh} (mrem/pCi)			
	Federal Guidance Report 11		Early Scenarios		Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
H-3	1.73E-11	6.40E-08	6.40E-08	6.40E-08	6.40E-08	6.40E-08
C-14	5.64E-10	2.09E-06	2.09E-06	2.09E-06	2.09E-06	2.09E-06
Na-22	3.10E-09	1.15E-05	1.15E-05	1.15E-05	1.15E-05	1.15E-05
P-32	2.37E-09	8.77E-06	8.77E-06	8.77E-06	8.77E-06	8.77E-06
S-35	1.21E-10	4.48E-07	4.48E-07	4.48E-07	4.48E-07	4.48E-07
Cl-36	8.18E-10	3.03E-06	3.03E-06	3.03E-06	3.03E-06	3.03E-06
K-40	5.02E-09	1.86E-05	1.86E-05	1.86E-05	1.86E-05	1.86E-05
Ca-41	3.44E-10	1.27E-06	1.27E-06	1.27E-06	1.27E-06	1.27E-06
Ca-45	8.55E-10	3.16E-06	3.16E-06	3.16E-06	3.16E-06	3.16E-06
Cr-51	3.98E-11	1.47E-07	1.47E-07	1.47E-07	1.47E-07	1.47E-07
Mn-54	7.48E-10	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06
Fe-55	1.64E-10	6.07E-07	6.07E-07	6.07E-07	6.07E-07	6.07E-07
Co-57	2.01E-10	7.44E-07	7.44E-07	7.44E-07	7.44E-07	7.44E-07
Co-58	8.09E-10	2.99E-06	2.99E-06	2.99E-06	2.99E-06	2.99E-06
Fe-59	1.81E-09	6.70E-06	6.70E-06	6.70E-06	6.70E-06	6.70E-06
Ni-59	5.67E-11	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07
Co-60	2.77E-09	1.02E-05	1.02E-05	1.02E-05	1.02E-05	1.02E-05
Ni-63	1.56E-10	5.77E-07	5.77E-07	5.77E-07	5.77E-07	5.77E-07
Zn-65	3.90E-09	1.44E-05	1.44E-05	1.44E-05	1.44E-05	1.44E-05
Cu-67	3.55E-10	1.31E-06	1.31E-06	1.31E-06	1.31E-06	1.31E-06
Se-75	2.60E-09	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06
Sr-85	5.34E-10	1.98E-06	1.98E-06	1.98E-06	1.98E-06	1.98E-06
Sr-89	2.50E-09	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06
Sr-90	3.85E-08	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04
Y-91	2.57E-09	9.51E-06	9.51E-06	9.51E-06	9.51E-06	9.51E-06
Mo-93	3.64E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Nb-93m	1.41E-10	5.22E-07	5.22E-07	5.22E-07	5.22E-07	5.22E-07
Nb-94	1.93E-09	7.14E-06	7.14E-06	7.14E-06	7.14E-06	7.14E-06
Nb-95	6.95E-10	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06
Zr-93	1.02E-09	3.77E-06	8.92E-06	3.77E-06	3.77E-06	3.77E-06
Tc-99	3.95E-10	1.46E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06
Ru-103	8.24E-10	3.05E-06	3.05E-06	3.05E-06	3.05E-06	3.05E-06
Ru-106	7.40E-09	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05
Ag-108m	2.06E-09	7.62E-06	7.62E-06	7.62E-06	7.62E-06	7.62E-06
Cd-109	3.55E-09	1.31E-05	1.31E-05	1.31E-05	1.31E-05	1.31E-05
Ag-110m	2.92E-09	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05
Sb-124	2.74E-09	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
I-125	1.04E-08	3.85E-05	3.85E-05	3.85E-05	3.85E-05	3.85E-05
Sb-125	7.57E-10	2.80E-06	2.80E-06	2.80E-06	2.80E-06	2.80E-06
I-129	7.46E-08	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04
I-131	1.44E-08	5.33E-05	5.33E-05	5.33E-05	5.33E-05	5.33E-05
Ba-133	9.19E-10	3.40E-06	3.40E-06	3.40E-06	3.40E-06	3.40E-06
Cs-134	1.98E-08	7.33E-05	7.33E-05	7.33E-05	7.33E-05	7.33E-05
Cs-137	1.35E-08	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05
Ce-141	7.83E-10	2.90E-06	2.90E-06	2.90E-06	2.90E-06	2.90E-06
Ce-144	5.68E-09	2.10E-05	2.10E-05	2.10E-05	2.10E-05	2.10E-05
Pm-147	2.83E-10	1.05E-06	1.05E-06	1.05E-06	1.85E+02	1.05E-06

Table B.21 Ingestion dose conversion factors for oxide fractional uptake

			DF_{inh} (mrem/pCi)			
	Federal Guidance Report 11		Early Scenarios		Late Scenarios	
Nuclide	(Sv/Bq)	(mrem/pCi)	single input	continuous input	single input	continuous input
Eu-152	1.75E-09	6.48E-06	6.48E-06	6.48E-06	6.48E-06	6.48E-06
Eu-154	2.58E-09	9.55E-06	9.55E-06	9.55E-06	9.55E-06	9.55E-06
Eu-155	4.13E-10	1.53E-06	1.53E-06	1.53E-06	1.53E-06	1.53E-06
Re-186	7.95E-10	2.94E-06	2.94E-06	2.94E-06	2.94E-06	2.94E-06
Ir-192	1.55E-09	5.74E-06	5.74E-06	5.74E-06	5.74E-06	5.74E-06
Pb-210	1.45E-06	5.37E-03	5.37E-03	5.37E-03	5.37E-03	5.37E-03
Po-210	5.14E-07	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03
Bi-210	1.73E-09	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06
Rn-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-223	1.78E-07	6.59E-04	6.59E-04	6.59E-04	6.59E-04	6.59E-04
Ra-224	9.89E-08	3.66E-04	3.66E-04	3.66E-04	3.66E-04	3.66E-04
Ac-225	3.00E-08	1.11E-04	1.11E-04	1.11E-04	1.11E-04	1.11E-04
Ra-225	1.04E-07	3.85E-04	3.85E-04	3.85E-04	3.85E-04	3.85E-04
Ra-226	3.58E-07	1.32E-03	1.32E-03	1.32E-03	8.59E-03	3.50E-03
Ac-227	3.80E-06	1.41E-02	1.41E-02	1.41E-02	1.41E-02	1.41E-02
Th-227	1.03E-08	3.81E-05	3.81E-05	3.81E-05	3.81E-05	3.81E-05
Th-228	1.07E-07	3.96E-04	7.62E-04	7.62E-04	7.62E-04	7.62E-04
Ra-228	3.88E-07	1.44E-03	1.44E-03	1.44E-03	1.44E-03	1.44E-03
Th-229	9.54E-07	3.53E-03	3.53E-03	3.53E-03	3.53E-03	3.53E-03
Th-230	1.48E-07	5.48E-04	5.48E-04	5.48E-04	5.48E-04	5.48E-04
Pa-231	2.86E-06	1.06E-02	1.06E-02	1.06E-02	2.46E-02	1.06E-02
Th-231	3.65E-10	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06
Th-232	7.38E-07	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03
Pa-233	9.81E-10	3.63E-06	3.63E-06	3.63E-06	3.63E-06	3.63E-06
U-233	7.15E-09	2.65E-05	2.65E-05	2.65E-05	2.65E-05	2.65E-05
Th-234	3.69E-09	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
U-234	7.06E-09	2.61E-05	2.61E-05	2.61E-05	2.61E-05	2.61E-05
U-235	7.22E-09	2.67E-05	2.67E-05	2.67E-05	2.67E-05	2.67E-05
Np-237	1.20E-06	4.44E-03	4.44E-03	4.44E-03	4.44E-03	4.44E-03
Pu-238	1.34E-08	4.96E-05	4.96E-05	4.96E-05	4.96E-05	4.96E-05
U-238	6.42E-09	2.38E-05	2.38E-05	2.38E-05	2.38E-05	2.38E-05
Pu-239	1.40E-08	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05
Pu-240	1.40E-08	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05
Pu-241	2.07E-10	7.66E-07	7.66E-07	7.66E-07	1.06E-01	7.36E-05
Am-241	9.84E-07	3.64E-03	3.64E-03	3.64E-03	3.64E-03	3.64E-03
Cm-242	3.10E-08	1.15E-04	1.15E-04	1.15E-04	4.96E+90[a]	1.49E+00
Pu-242	1.33E-08	4.92E-05	4.92E-05	4.92E-05	4.92E-05	4.92E-05
Cm-244	5.45E-07	2.02E-03	2.02E-03	2.02E-03	2.05E-03	2.02E-03

[a] This apparently unreasonable value for Cm-242 is correct. The derivation of the number is explained in Appendix E.

Table B.22 Root uptake factors (B_{iv}) and soil distribution coefficients (K_d)

	B_{iv} (pCi/kg dry-weight per pCi/kg soil)		K_d (mL/g)	
Element	leafy vegetables	root vegetables	Geometric mean	GSD[a]
Actinium (Ac)	3.50E-03	3.50E-04	1.50E+03	3.20E+00
Antimony (Sb)	1.30E-04	5.60E-04	9.44E+03	3.20E+00
Americium (Am)	5.80E-04	4.10E-04	1.89E+03	1.10E+00
Barium (Ba)	1.50E-01	1.50E-02	1.80E+02	3.20E+00
Bismuth (Bi)	3.50E-02	5.00E-03	4.12E+02	3.20E+00
Carbon (C)	7.00E-01	7.00E-01	6.67E+00	3.20E+00
Calcium (Ca)	3.50E+00	3.50E-01	8.86E+00	3.20E+00
Cadmium (Cd)	5.50E-01	1.50E-01	1.78E+02	3.20E+00
Cerium (Ce)	1.00E-02	4.00E-03	3.16E+03	3.20E+00
Chlorine (Cl)	7.00E+01	7.00E+01	1.69E+00	3.20E+00
Curium (Cm)	3.00E-04	2.40E-04	7.76E+03	3.20E+00
Cobalt (Co)	8.10E-02	4.00E-02	2.45E+02	3.20E+00
Chromium (Cr)	7.50E-03	4.50E-03	1.41E+02	3.20E+00
Cesium (Cs)	1.30E-01	4.90E-02	1.49E+01	3.20E+00
Copper (Cu)	4.00E-01	2.50E-01	9.00E+01	3.20E+00
Europium (Eu)	1.00E-02	4.00E-03	8.22E+02	3.20E+00
Hydrogen (H)	-	-	2.34E+00	3.20E+00
Iodine (I)	3.40E-03	5.00E-02	5.00E+00	1.10E+00
Iridium (Ir)	5.50E-02	1.50E-02	3.20E+02	3.20E+00
Iron (Fe)	4.00E-03	1.00E-03	3.16E+02	3.20E+00
Lead (Pb)	5.80E-03	3.20E-03	1.48E+03	3.20E+00
Manganese (Mn)	5.60E-01	1.50E-01	1.95E+02	3.20E+00
Molybdenum (Mo)	2.50E-01	6.00E-02	9.95E+00	3.20E+00
Neptunium (Np)	1.30E-02	9.40E-03	4.98E+00	3.20E+00
Nickel (Ni)	2.80E-01	6.00E-02	3.98E+02	3.20E+00
Niobium (Nb)	2.00E-02	5.00E-03	8.22E+02	3.20E+00
Phosphorus (P)	3.50E+00	3.50E+00	3.08E+01	3.20E+00
Plutonium (Pu)	3.90E-04	2.00E-04	5.47E+02	3.20E+00
Polonium (Po)	2.50E-03	9.00E-03	9.77E+02	3.20E+00
Potassium (K)	1.00E+00	5.50E-01	1.79E+01	3.20E+00
Prome a. thium (Pm)	1.00E-02	4.00E-03	8.22E+02	3.20E+00
Protactinium (Pa)	2.50E-03	2.50E-04	5.07E+02	3.20E+00
Radium (Ra)	7.50E-02	3.20E-03	4.12E+02	3.20E+00
Radon (Rn)	-	-	0.00E+00	3.20E+00
Rhenium (Re)	1.50E+00	3.50E-01	5.00E+01	3.20E+00
Ruthenium (Ru)	5.20E-01	2.00E-02	1.91E+03	3.20E+00
Selenium (Se)	2.50E-02	2.50E-02	6.80E+01	3.20E+00
Silver (Ag)	2.70E-04	1.30E-03	1.16E+03	3.20E+00
Sodium (Na)	7.50E-02	5.50E-02	2.66E+02	3.20E+00
Strontium (Sr)	1.60E+00	8.10E-01	1.49E+01	3.20E+00
Sulfur (S)	1.50E+00	1.50E+00	5.00E+01	3.20E+00
Technetium (Tc)	4.40E+01	1.10E+00	9.95E-02	3.20E+00
Thorium (Th)	6.60E-03	1.20E-04	3.18E+03	3.20E+00
Uranium (U)	1.70E-02	1.40E-02	1.49E+01	3.20E+00
Yttrium (Y)	1.50E-02	6.00E-03	6.53E+02	3.20E+00
Zinc (Zn)	1.40E+00	5.90E-01	2.04E+03	3.20E+00
Zirconium (Zr)	2.00E-03	5.00E-04	2.04E+03	3.20E+00

GSD = geometric standard deviation

B.3 References

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APPENDIX C

EXTERNAL EXPOSURE DOSE FACTORS

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C EXTERNAL EXPOSURE DOSE FACTORS

As used in this report, the dose factors for external exposure to radiation are referred to as geometry factors. A geometry factor, therefore, is a dose coefficient that relates the concentration of radioactivity in a contaminated material to the external dose rate for organs and tissues of the body. Each geometry factor is unique to a specific geometric configuration, contaminated material, and radionuclide. The units are dose rate per mass radioactivity concentration (Sv/s per Bq/g or mrem/h per pCi/g) or surficial concentration (Sv/s per Bq/cm^2 or mrem/h per pCi/cm^2).

The calculated geometry factors are similar to the dose coefficients tabulated in the Environmental Protection Agency's Federal Guidance Report No. 12, with two important differences. First, these factors are for specific geometries that are more complicated than those in the EPA report. The Federal Guidance Report is intended for generic assessment purposes and is, therefore, limited to a few simple, idealized geometries. Second, the geometry factors used here include the effects of shielding by the specific constituents of the materials associated with each geometric configuration. Eleven configurations are addressed by geometry factors: 1) a large pile, 2) a large metal object, 3) a small metal object, 4) a truck as seen by the driver, 5) a truck as seen by a bystander, 6) a small metal object close to the body, 7) a continuous shell of material representing the walls and floor of a concrete basement, 8) a refinery baghouse, 9) a specialized baghouse dust truck, 10) a steel framed room, and 11) a typical passenger vehicle.

Some scenarios in this report (post-closure landfill residents and the disposal activities scenarios) address geometries and shielding materials that are very similar to those used in calculating the values in Federal Guidance Report No. 12. In those cases, the Federal Guidance Report No. 12 values were used rather than recalculating a new set of geometry factors. Values from Federal Guidance Report No. 12 were determined to be adequate for use in calculations involving external exposure from contaminated soil and for calculations involving external exposure to buried materials (wastes).

C.1 Calculational Methods

A radiation dose rate depends strongly on the spatial distribution of the radionuclide and shielding materials associated with each geometry factor. Estimating the dose to tissues of the body from radiations emitted by an arbitrary spatial distribution of a radionuclide is a difficult computational task. Therefore, it has become common practice to consider simplified and idealized exposure geometries. For example, Federal Guidance Report 12 tabulates dose coefficients for external exposure to photons and electrons emitted by radionuclides distributed in air, water, and soil. For each of these geometries, the radionuclide concentration, as seen from the location of an exposed individual, is treated as uniform and effectively infinite in extent. These assumptions simplify the calculations of dose coefficients.

The geometry factors used in this report represent finite volumes of specified size and shape containing non-uniform distributions of materials. Calculations of this type require specialized computational tools. The geometry factors used here are based on shielding calculations made using the computer code Monte Carlo N-Particle (MCNP) (Briesmeister 1993). MCNP is a three dimensional radiation transport code that treats an arbitrary configuration of materials in cells bounded by surfaces. Pointwise continuous-energy cross section data are used and the transport equation is solved by a random walk method.

The MCNP code calculates radiation transport from the source to the surface of the body. To estimate doses to the tissues of the body, dose response functions that incorporate subsequent transport of radiation in the body and deposition of energy in tissues of body, are used. For this study, the dose response used was the 1 cm deep dose equivalent for photons, as described in Table 6 of ICRP Publication 51.

The presence of radioactive decay products complicates the treatment of photon spectra. Two criteria were used to determine the contribution of photons from decay products: 1) photons of progeny nuclides whose half-lives are less than one day were assigned to the photon group of the parent, and 2) photons of progeny nuclides whose half-lives are greater than one day were treated as discrete nuclides, and assigned their own photon energies.

Decay product branching fractions were applied to calculate effective frequencies of emission for photon spectra. Those photon energies that were less than 8.65 KeV, and those whose frequencies of emission were less than 0.1% were excluded from the calculations. Using 8.65 KeV as the threshold for excluding photon energies follows the practice used in Federal Guidance Report No. 12 (Eckerman & Ryman, 1993).

The geometry factors include photons from progeny nuclides in proportion to the radioactivity of each nuclide present under the circumstances of each scenario. The radioactivity of progeny nuclides depends on two factors: 1) the amount of time available for ingrowth and 2) how radioactive material is introduced into the scenario. The time available for ingrowth is the period from clearance of the material to the beginning of each scenario. Radioactive material can be introduced into the scenario in two ways. In some cases, the scenario starts with a certain amount of radioactivity present and no new radioactivity is introduced over the duration of the exposure period. For other scenarios, radioactivity is introduced continuously over the exposure period as new material is cleared and processed. These two factors are addressed by calculating four dose rates for each geometric configuration. These address: 1) scenarios occurring early in time with a single initial input of radioactivity, 2) early scenarios with continuous input of radioactivity, 3) late scenarios with an initial input, and 4) late scenarios with continuous input. Further discussion of the methods used to treat radioactive decay and progeny ingrowth is presented in Appendix E.

C.2 Sensitivity Analysis

Geometry factors (GFs) are dependent on parameters such as the material composition, the density, the geometric configuration of the object, the distance from the object to the receptor, and the photon energy. Some of these parameters do not have a significant influence on the value of the geometry factor and therefore do not contribute significantly to dose. Diagnostic calculations were done to decide which parameters do and do not have a significant influence on the size of the geometry factors. Figures C.1 through C.5 illustrate the results of these calculations.

Figures C.1 through C.3 show the effects that varying density, radius, and length have on the size of the geometry factors for a large pile of scrap metal. Figure C.1 illustrates the relative insensitivity of the geometry factor to density. For both the 0.1 and 1 MeV photon energies the GF curve remains flat over a density range of approximately 1 to 8 g/cm^3. Over this density range the GF values for 0.1 MeV energy photons vary by approximately 30% and for the 1 MeV photons the GF values vary by approximately 5%. This information provides justification for limiting the number of material densities used in the GF calculations. It also supports using a GF calculated of a single density to describe large piles of different densities. Figure C.2 illustrates that at a radius greater than approximately 4 meters, the geometry factor for a pile of scrap metal becomes insensitive to an increase in the radius of the pile. It shows that for 1 MeV photons the size of the GF increases by approximately 10% when the radius is increased from 4 to 6 meters. For 0.1 MeV photons, as the radius is increased from 4 to 6 meters the GF increases by approximately 20%. Therefore, a radius of 4 meters was chosen for use in the calculation of the large pile geometry factor (GF-1). As illustrated in Figure C.3, the geometry factor loses sensitivity to increases in object length beyond a length of approximately 15 meters and the size of the GF, beyond this length, is determined primarily by the distance to the receptor and the photon energy. At approximately 15 meters, for both 0.1 and 1 MeV photons, the GF curve flattens and from 15 to 20 meters there is approximately a 5% increase in the size of the GF. Therefore a length of 15 meters was chosen for use in the calculation of the large pile geometry factor (GF-1).

Figure C.4 shows the results of geometry factor calculations for large metal objects of varying mass. As the figure illustrates, the size of the GF for the large metal object for a 1 MeV photon increases by approximately 120% when the mass is increased from 200 to 2000 kg. For 0.1 MeV photons, as the mass is increased from 200 to 2000 kg the GF increases by approximately 4%. Based on this information a mass of 200 kg was chosen for use in the geometry factor calculations for the large metal object. The use of the 200-kg mass value essentially bounds all low energy GF values and provides a reasonable estimate of GF values for high energy photons without assuming worse case. This information provides a basis for the selection of 200 kg for use in the large metal object geometry factor (GF-2) calculations.

Figure C.5 shows calculated geometry factors for dose point inside an enclosure. It illustrates the effect that increasing the mass of the enclosure has on the size of the geometry factor. As the mass reaches approximately three thousand kilograms the curve flattens and further increases in mass do not affect the size of the geometry factor. As the figure shows, an increase in mass from three thousand to four thousand kilograms increases the value of the GF by approximately 2%. This information provides justification for using a mass of approximately 3000 kg for the calculation of the inside an object geometry factor (GF-7) and provides a basis for applicability to other scenarios involving similar geometric configurations.

FIGURE C.1: Geometry Factors for "Scrap Piles" of Varying Density at 2 and 4 Meters for 1 and 0.1 MeV photons

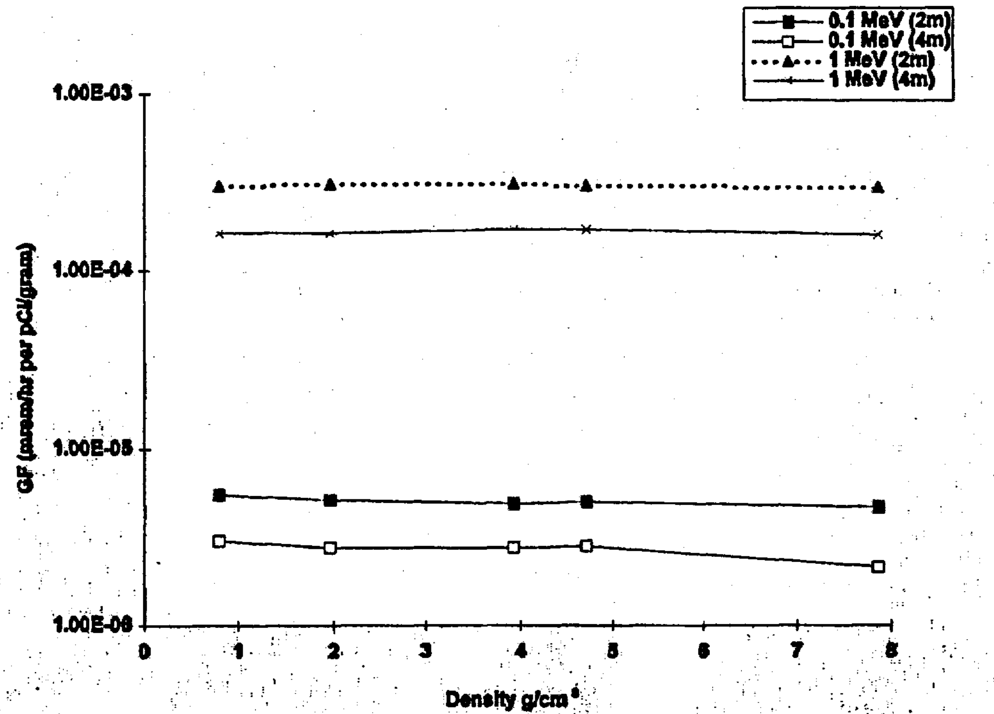

FIGURE C.2: Geometry Factors for "Scrap Piles" of Varying Radius and Constant Density at 2 and 4 Meters for 1 and 0.1 MeV photons

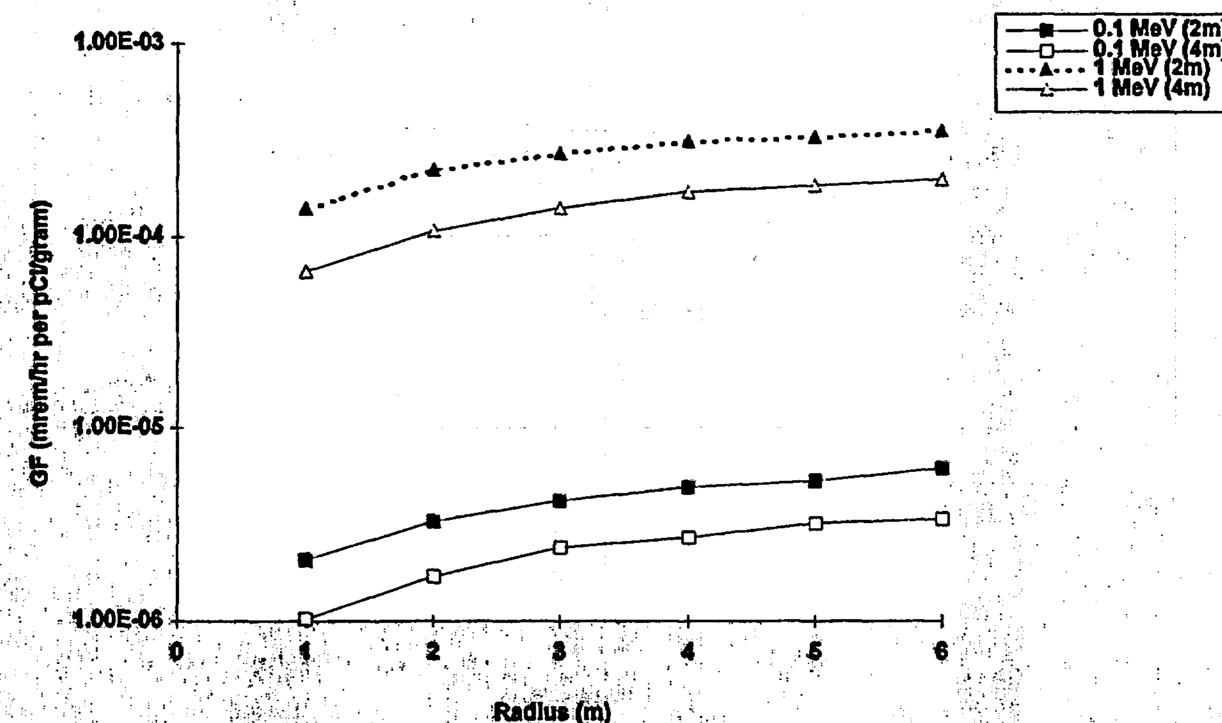

FIGURE C.3: Geometry Factors for "Scrap Piles" of Varying Length and Constant Density at 2 and 4 Meters for 1 and 0.1 MeV photons

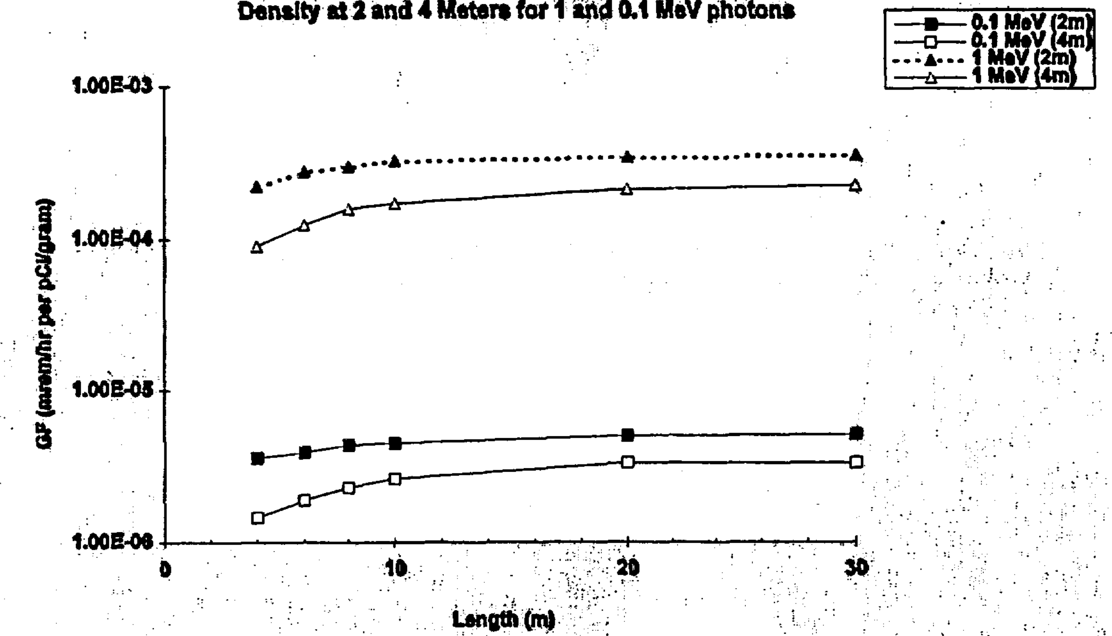

FIGURE C.4: Geometry Factors for Large Metal Objects of Varying Mass at 100 and 200 cm for 1 and 0.1 MeV photons

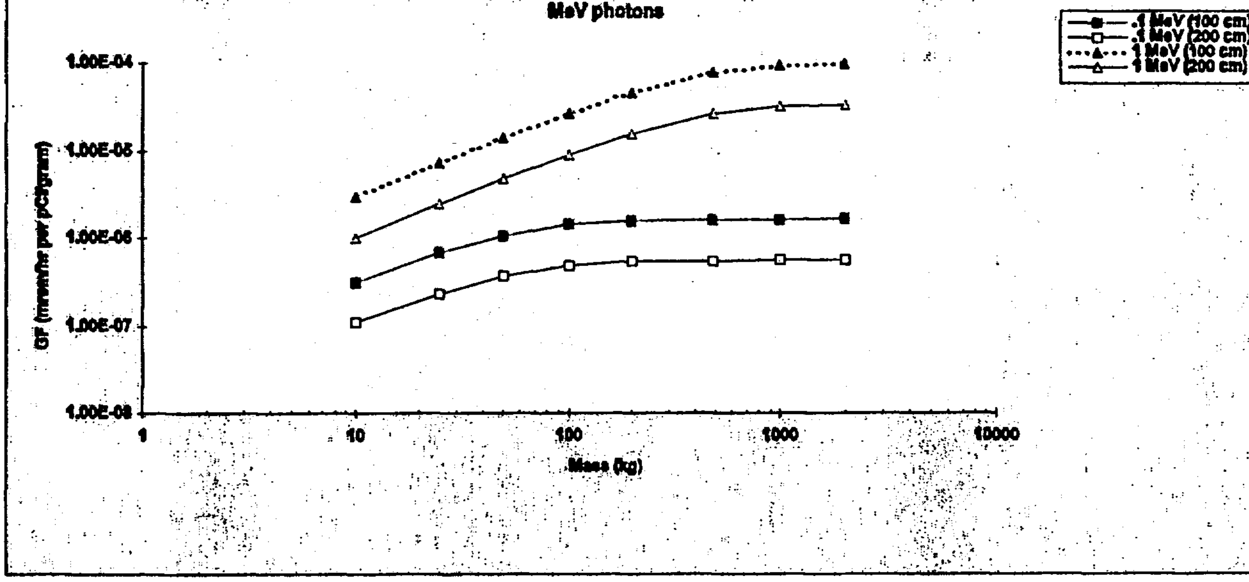

Figure C.5 Geometry Factors--Inside an Object as Object Mass Increases

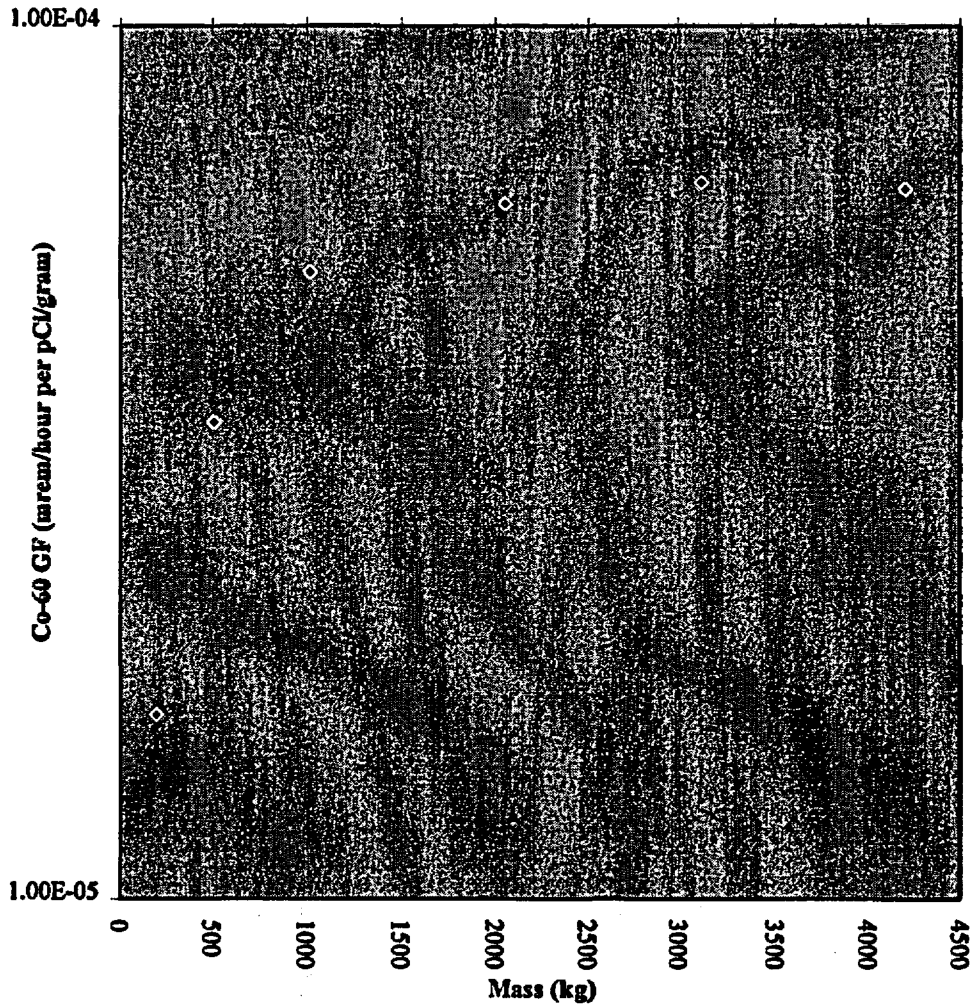

Figure C.6. Relative dose rates for three models of a steel-framed structure (Normalized to 1.0 for the dose rate inside a comparable sphere)

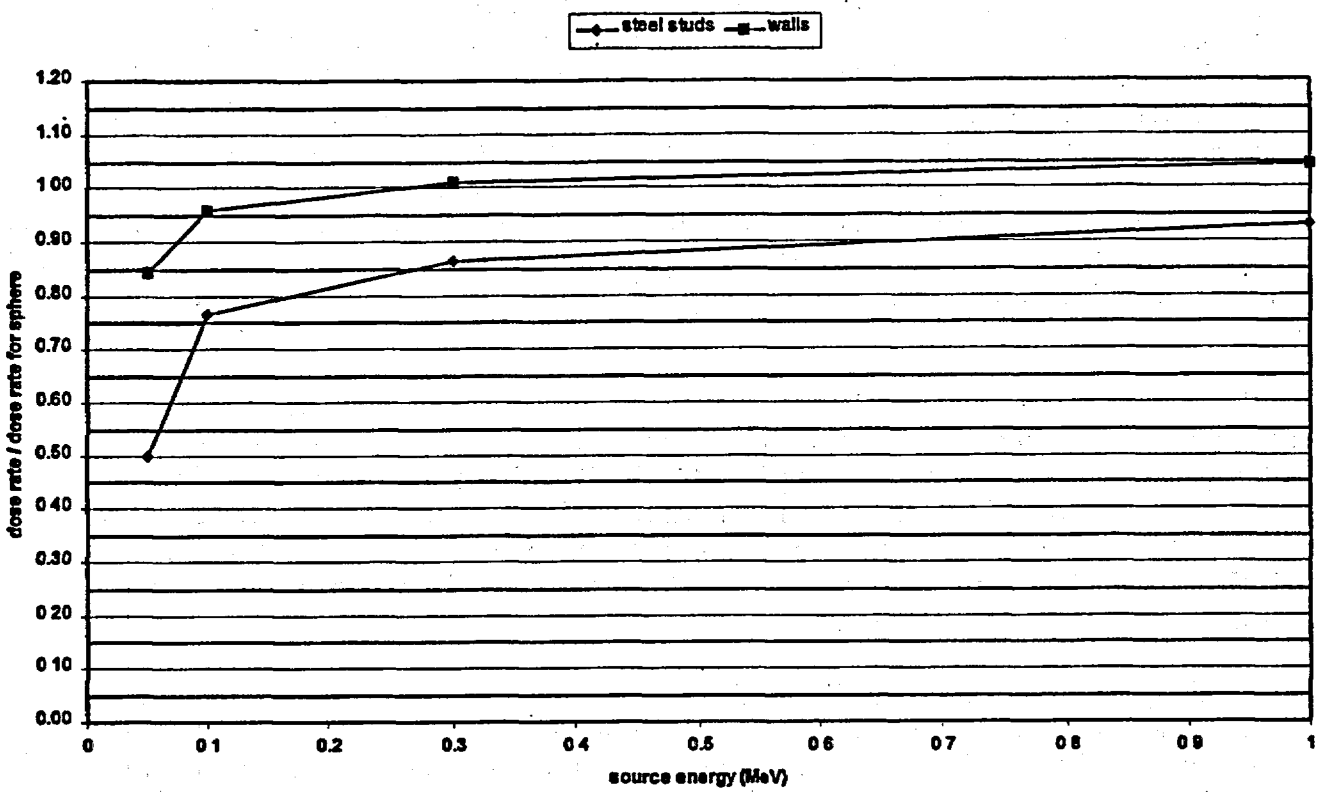

Figure C.6 illustrates the results of calculations that compare three possible approaches to modeling a steel framed room. The first model represents a framework of steel studs using the masses, dimensions, and spacing of typical construction practices. Dose is calculated for a point in the center of a 12' x 12' x 8' room. The second model represents a room of the same dimensions encased in steel sheet metal having the same source strength as the steel studs in the first model. The third model is a sphere of the same source strength and a radius that is equivalent to the average distance to all points on the studs in the first model. The calculated dose rates for the first and second models have been normalized to the results for the sphere and plotted as a function of the source energy. A value of 1.0 would be agreement with the sphere result. At low energies, both the stud and wall models are below the sphere value. At 1 MeV, the stud model is about 7% lower than the sphere, and the wall model is 4% higher than the sphere. The wall is effectively closer than the other two models. The spherical model was chosen to represent the steel framed room. It is much simpler to calculate and gives adequate agreement with the more complex geometry of the steel stud model.

Finally, a set of calculations were performed to compare MCNP results with those tabulated in Federal Guidance Report No.12 (EPA 1993). External dose rate values were calculated for contamination of an infinite depth of material using a density and elemental composition for typical silty soils. However, these external dose rate values are appropriate for materials other than soil if the geometry of the contaminated volume is sufficiently similar. Diagnostic calculations conducted for this study show that these values are not extremely sensitive to the density of the material for most photon energies. For photon energies near 1 MeV, these values are not sensitive to elemental composition of the material over a wide range of atomic numbers that includes all of the materials of interest. For lower photon energies, near 0.1 Mev, external dose rate values show a small dependence on elemental composition (up to a factor of about 3x). This dependence is due to differences in photoelectric absorption coefficients among the materials of concern. However, this energy dependence at lower energy levels makes an insignificant contribution to the total dose for any of the exposure scenarios considered in this study. This is partly because low energy photons do not product high dose rates and partly because self-sheilding by the volume of soil dramatically reduces exposure rates for these photons.

Table C.1 shows a comparison of MCNP calculations and the corresponding FGR 12 dose coefficient values for soil contaminated to an infinite depth. Since MCNP calculations were done for specific photon energies (1 Mev and 0.1 Mev) and FGR 12 values are radionuclide specific, relevant radionuclides with photon energies approximately equal to 1 Mev and 0.1 Mev were selected from FGR 12 for presentation in Table C.1. Co 57 was selected for comparison with MCNP calculations for 0.1 Mev photons and Co 60 was selected for comparison with the MCNP calculations for 1 Mev photons.

Bremsstrahlung is typically a very small contributor to total external dose. However, for pure beta-emitters it constitutes the entire external dose pathway and should be included in developing geometry factors. Values of bremsstrahlung sources for nine beta-emitting radionuclides were estimated based on ratios to the values for Y 90. These ratios were developed using values from Federal Guidance Report 12 for exposure to soil contaminated to a depth of 1 cm. A photon source for Y-90 (Roberts and Kaul, 1997) was used in the MCNP calculations. This source was checked against the value in Federal Guidance Report 12 and gave good agreement. Bremsstralung Results for other bremsstrahlung sources of lesser strength were estimated based on their relative values to Y-90 as tabulated in Federal Guidance Report 12. Table C.2 lists the nine beta-emitters and the strength of their bremsstralung doses relative to Y-90.

Table C.1 Comparison of MCNP geometry factor calculations and FGR 12 dose coefficients for exposure to contaminated soil

Radionuclide	Material	MCNP (Sv/s per Bq/m^3)	FGR 12 (Sv/s per Bq/m^3)	MCNP/FGR
Co-57	soil	2.59E-18	2.68E-18	0.97
Co-57	dust	1.12E-18	2.68E-18	0.42
Co-57	slag	1.55E-18	2.68E-18	0.58
Co-57	steel	1.04E-18	2.68E-18	0.39
Co-60	soil	9.35E-17	8.68E-17	1.08
Co-60	dust	9.87E-17	8.68E-17	1.14
Co-60	slag	9.83E-17	8.68E-17	1.13
Co-60	steel	1.01E-16	8.68E-17	1.17

Table C.2 Bremsstrahlung dose rates compared to Y-90

Radionuclide	FGR 12 (Sv/s per Bq/m³)	Ratio to Y-90
Y-90	3.10E-20	1.000
P-32	1.64E-20	0.529
Sr-89	1.27E-20	0.410
Bi-210	5.54E-21	0.179
Cl-36	3.53E-21	0.114
Sr-90	1.318E-21	0.042
Tc-99	2.92E-22	0.009
Ca-45	1.59E-22	0.005
S-35	4.62E-23	0.001
C-14	4.30E-23	0.001

C.3 Description of Geometry Factors

Eleven geometry factors were chosen to represent the various scenarios. The following sections provide information on the modeling assumptions used for the calculation of each geometry factor.

Tables C.3 through C.14, at the end of this appendix, list the geometry factors in conventional units (mrem/hr per pCi/g or mrem/hr per pCi/cm²). Four columns of values are tabulated for each geometry factor representing early and late occurring scenarios with either an initial or contiguous input of radioactivity. Values in these tables that appear in bold type have progeny radiations incorporated.

C.3.1 Geometry Factor Calculation for Large Pile, GF-1 (Large Pile)

This geometry factor is applicable for a worker near a large pile of scrap steel containing a gamma-emitting radionuclide. It is also applicable to other, similar scenarios. This geometry factor is designated GF-1 (Large Pile). Figure C.7 is a schematic illustrating the relative position of a person to the pile. The following is a listing of the modeling assumptions used for the calculation.

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is a half-cylinder of steel, with a radius of four meters and a length of 15 meters. The volume of the pile is 3.77E+08 cm³. The density is 3.93 g/cm³. The mass of the steel is 1.48E+09 g, or 1480 metric tons. Beneath the steel is soil. Above the soil and outside the cylinder is air.

Materials: The steel is carbon steel, which is 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel is approximately half the normal density, to account for the air spaces in a pile of scrap. The air and soil are "ATR moist" air and soil as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm³. The soil density is 1.61 g/cm³.

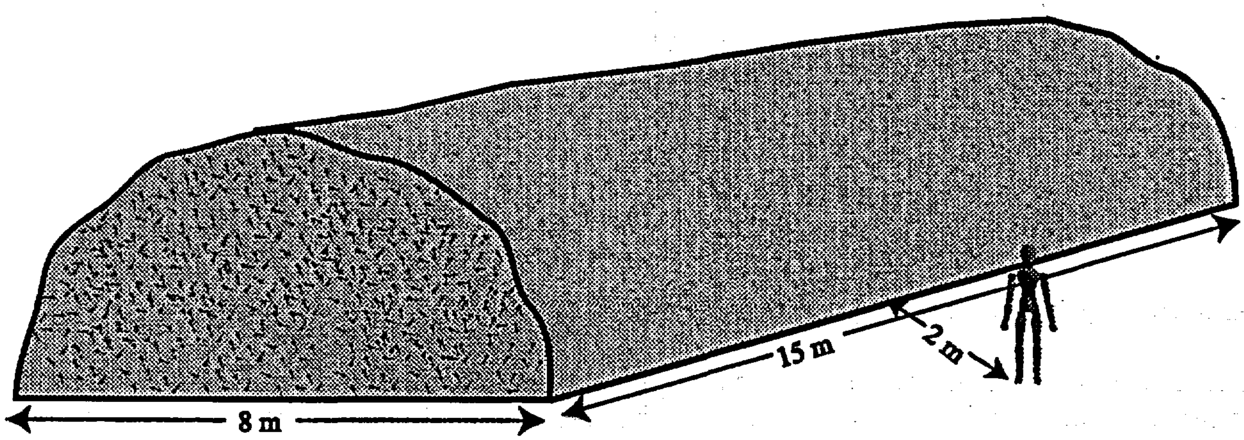

Figure C.7 Illustration of large pile geometry

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the surface of the pile down to a depth corresponding to at least four mean paths. Photons originating from deeper within the pile do not contribute significantly to dose.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point one meter above the ground, two meters from the bottom edge of the cylinder, and equidistant from the ends of the cylinder.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR) as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987). Units are Sv-cm^2.

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the sampled outer volume of the pile times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.2 Geometry Factor Calculation for Large Metal Object, GF-2 (Large Metal Object)

This geometry factor was developed to calculate the dose rate to a person positioned two meters from a large metal object as illustrated in Figure C.8. Calculations are based upon the following modeling assumptions:

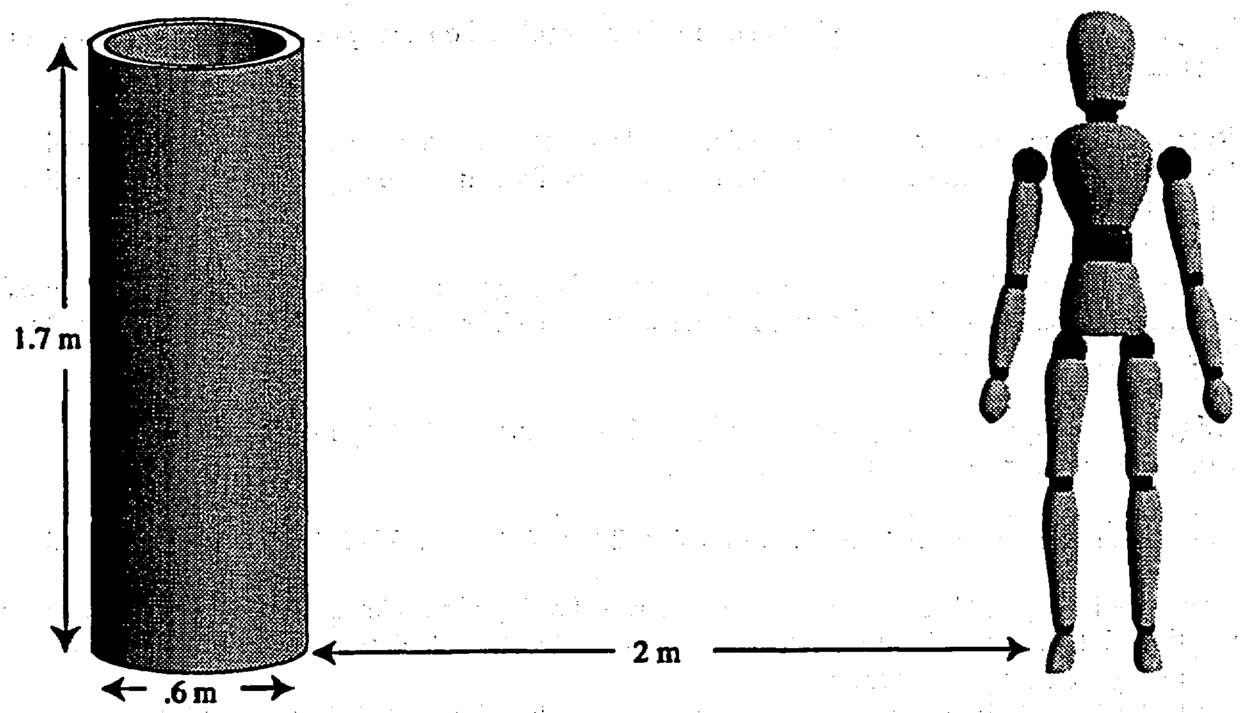

Figure C.8 Illustration of large metal object geometry

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is a hollow cylinder of steel with an outside radius of 30 cm and an inside radius of 29.2 cm. The cylinder is 170 cm long. The volume of the steel is 2.529E+04 cm^3. The density is 7.86 g/cm^3. The mass of the steel is 1.988E+05 g. Spaces outside and inside the cylinder are occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters to include sufficient air for calculating back scatter. The cylinder is centered at the origin.

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is " moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated on a ring centered two meters from outside the cylinder.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted per sec, per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/g).

C.3.3 Geometry Factor Calculation for Small Metal Object, GF-3 (Small Metal Object)

As shown in Figure C.9, this geometry factor was developed to calculate the dose rate to a person positioned two meters from outside a small metal object. Calculations are based upon the following modeling assumptions:
Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993).

Geometry: The source is a hollow sphere of steel with an outside radius of 13 cm and an inside radius of 12.24 cm. The volume of the steel is 1.522E+03 cm^3. The density is 7.86 g/cm^3. The mass of the steel is 1.196E+04 g. Spaces outside and inside the sphere are occupied by moist air. The geometry is bounded by a sphere of radius 300 meters to include enough air for calculating back scatter. Both spheres are centered at the origin.

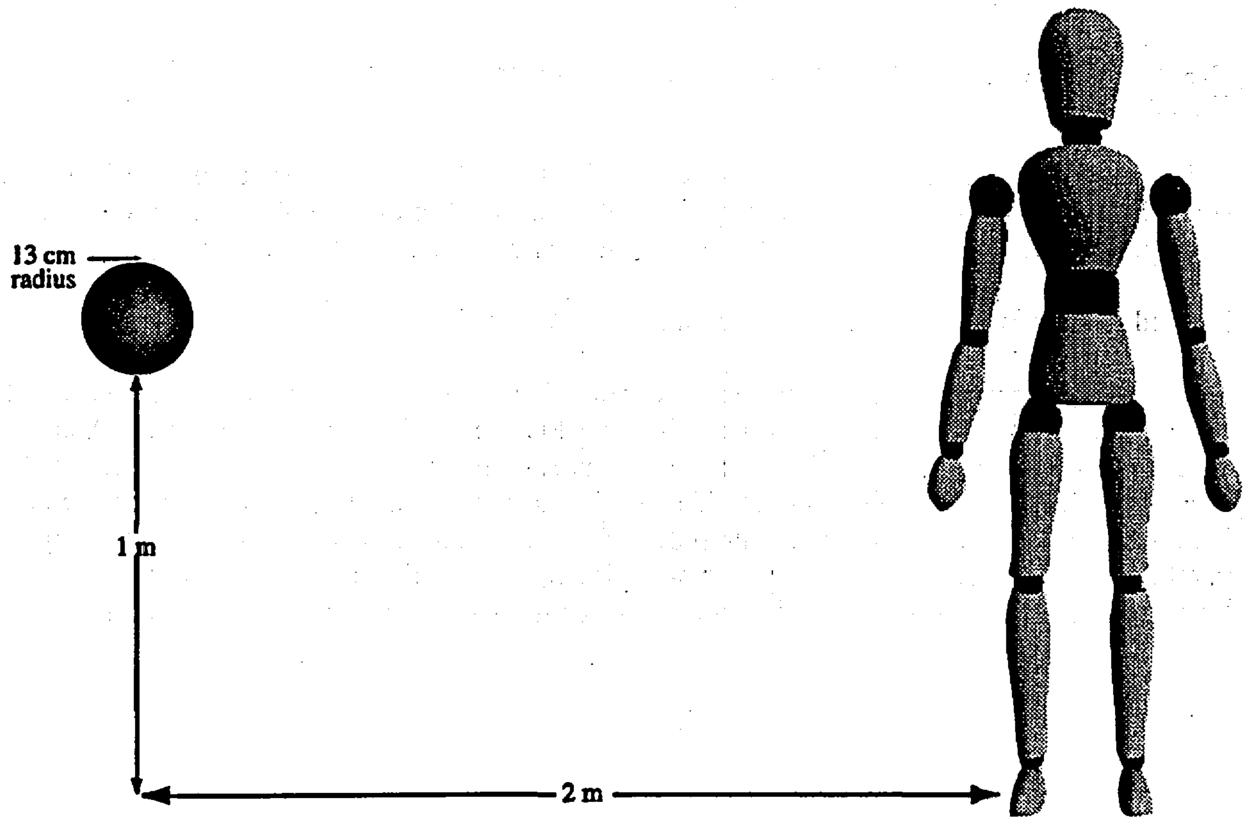

Figure C.9 Illustration of small metal object geometry

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is "ATR moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated on a ring centered two meters from outside the sphere.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv-cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.4 Geometry Factor Calculation for the Transportation of Material; GF-4 (Driver of Truck)

This geometry factor was developed to calculate the dose rate to the driver of a truck filled with scrap metal, baghouse dust, slag, or refined metal products. Figure C.10 illustrates the position of the driver. Calculations are based upon the following modeling assumptions:

Method of calculation: Three-dimensional Monte Carlo using MCNP

Geometry: The source is a rectangular parallelepiped of steel 48 feet long by 102 inches wide by 114 inches deep (14.6 m x 2.6 m x 2.9 m). The steel is encased in a shell of aluminum 0.05 inches (0.13 cm) thick. The volume of the steel is 1.098E+08 cm^3. The density is 0.236 g/cm^3. The mass of the steel is 57,000 pounds. The truck cab is represented by a sphere of air one meter in radius encased in a shell of aluminum 0.05 inches thick, centered at one end of the rectangular parallelepiped. Space outside the truck is occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. The bottom of the truck is at the center of the sphere.

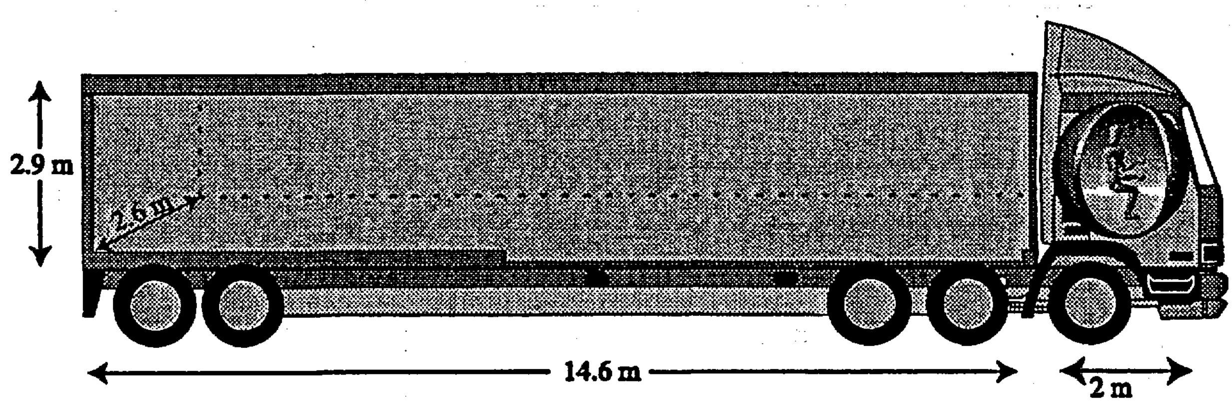

Figure C.10 Illustration of truck geometry for driver

For the four radionuclides for which the use of this GF in the baghouse dust transport scenario resulted in a limiting dose, (see Table C.5), a different geometry corresponding more closely to the description of a baghouse dust truck was used. In this case, the source was a rectangular parallelepiped of EAF dust 29.3 ft long by 8.5 ft wide by 9.5 ft high (8.9 m by 2.6 m by 2.9 m), encased in .05 inches (0.13 cm) aluminum, with a volume of 2.4E+3 ft^3 (6.694E+7 cm^3), a density of 0.386 g/cm^3, and a mass of 57,000 lbs (2.6E+7 g).

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (CRC Handbook of Chemistry and Physics, p E-119, 1986). The steel density accounts for the truck payload and volume. The air is "ATR moist air," as described in DNA-TR-91-237 pp 13, 33. The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point inside the aluminum sphere one-half meter from the center of the end of the truck. For the alternate geometry for baghouse dust truck, the flux was calculated at a point 11.37 ft from the end of the load.
Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51.

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted per sec, per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/g).

C.3.5 Geometry Factor Calculation for Transport of Material; Lateral Exposure, GF-5 (Beside Truck)

This geometry factor was developed to calculate the dose rate to a person standing to the side of a truck filled with scrap metal. The truck is modeled as shown in Figure C.10 with the person located 1 meter from the center of the longest side. Calculations are based upon the following modeling assumptions:

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993).

Geometry: The source is a rectangular parallelepiped of steel 48 feet long by 102 inches wide, by 114 inches deep. The steel is encased in a shell of aluminum 0.05 inches thick. The volume of the steel is 1.098E+08 cm^3. The density is 0.236 g/cm^3. The mass of the steel is 57,000 pounds. The truck cab is represented by a sphere of air one meter in radius encased in a shell of aluminum 0.05 inches thick centered at one end of the rectangular parallelepiped. Space outside the truck is occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. The bottom of the truck is at the center of the sphere.

For the four radionuclides for which the use of this GF in the baghouse dust transport scenario resulted in a limiting dose, a different geometry corresponding more closely to the description of a baghouse dust truck was used. In this case, the source was a rectangular parallelepiped of EAF dust 29.3 ft long by 8.5 ft wide by 9.5 ft high (8.9 m by 2.6 m by 2.9 m), encased in .05 inches (0.13 cm) aluminum, with a volume of 2.4E+3 ft^3 (6.694E+7 cm^3), a density of 0.386 g/cm^3, and a mass of 57,000 lbs (2.6E+7 g).

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (CRC Handbook of Chemistry and Physics, p E-119, 1986). The steel density accounts for the truck payload and volume. The air is "moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point one meter from outside the rectangular parallelepiped, centered on the largest side, for both geometries.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s, per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv-cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.6 Geometry Factor Calculation for Small Metal Object Close to Body, GF-6 (Small Metal Object Close to Body)

This geometry factor was developed to calculate the dose rate to a person from a small metal object positioned on the body as illustrated in Figure C.11. Calculations are based upon thefollowing modeling assumptions:

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is a cylindrical disk of steel with a radius of 24.0 cm and a thickness of 0.456 cm. The density is 7.86 g/cm^3. The mass of the steel is 45 grams. The dose point is in air 1 cm form the center of the disk. The geometry is bounded by a sphere of radius 300 m, occupied by ATR moist air. The tissue cylinder is centered at the origin.

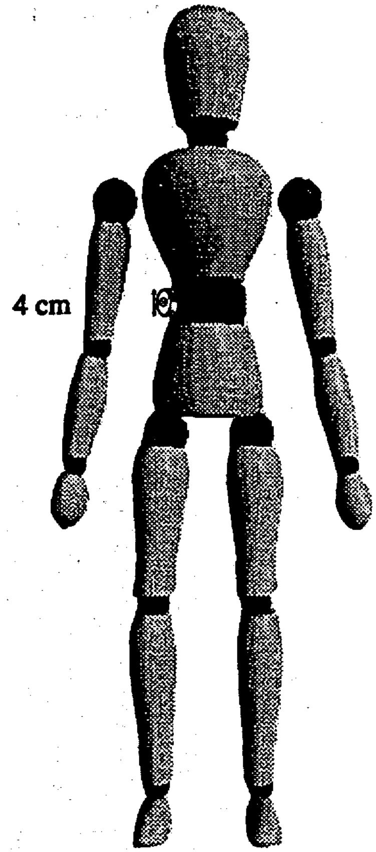

Figure C.11 Illustration of geometry for a small object close to the body

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is "moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point 1 cm from the center of the face of the steel disk.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted per sec, per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Gy/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Gy-cm^2) * Normalization (photons emitted/s per Bq/g).

C.3.7 Geometry Factor Calculation for Inside an Object or Structure, GF-7 (Inside Structure)

This geometry factor was developed to calculate the dose rate from an thick-walled object or structure, delivered to a person located inside as shown in Figure C.12 Calculations are based upon the following modeling assumptions:

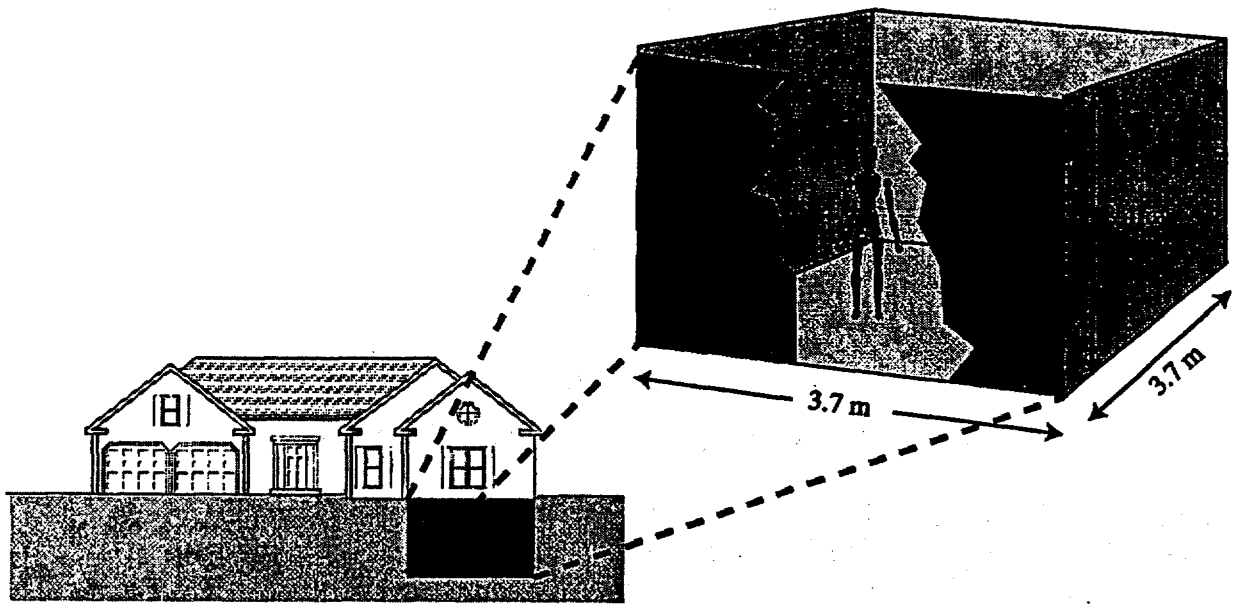

Figure C.12 Illustration of geometry for an individual inside a structure

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is a hollow sphere of steel with an inside radius of one meter and an outside radius of 103 cm. The volume of the steel is 3.884E+05 cm^3. The density is 7.86 g/cm^3. The mass of the steel is 3.053E+06 g. For a limited number of radionuclides for which this GF resulted in a limiting scenario dose (see Table C.8), a less massive sphere was used. This was done in order to approximate the mass of recycled steel in a U.S. automobile. For these radionuclides, a thinner hollow sphere of steel was used, with an inside radius of one meter and an outside radius of 101.1 cm, which resulted in a volume of the steel of 1.4E+05 cm^3, and a mass of steel of 1.1E+06 g. Spaces outside and inside both spheres are occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. Both spheres are centered at the origin.

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is "ATR moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1986). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at the origin.

Response: The response function used is the deep dose equivalent index for an isotropic source of photons (ISO) in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted per sec, per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.8 Geometry Factor Calculation for Baghouse Worker, GF-8 (Inside Refinery Baghouse)

This geometry factor was developed to calculate the external dose rate to a worker inside a refinery baghouse as shown in Figure C.13. Calculations are based upon the following modeling assumptions:

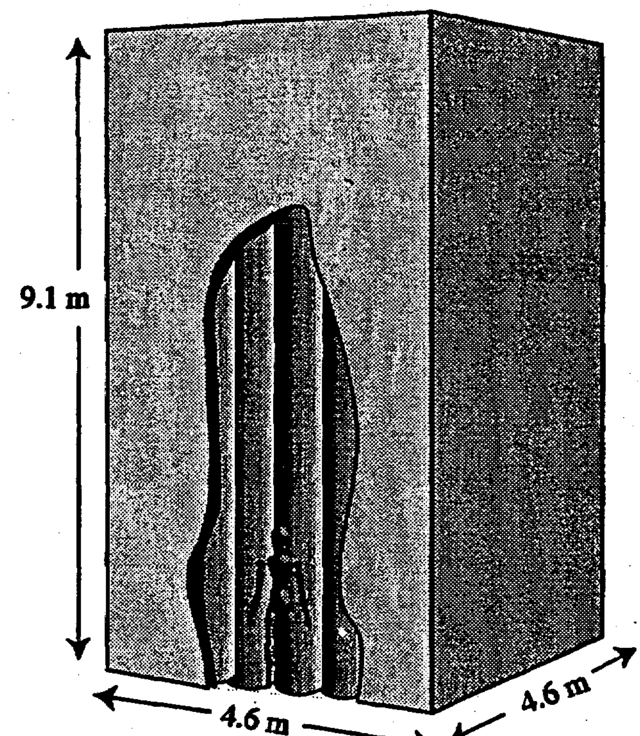

Figure C.13 Illustration of geometry for an individual inside a refinery baghouse

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)
Geometry: A baghouse module is modeled as a rectangular parallelepiped with interior dimensions 15 feet long by 15 feet wide by 30 feet high. The exterior walls, ceiling and floor are 1/4 inch steel. The interior is a mixture of EAF dust, fiberglass, and air representing 66 fiberglass filtration bags weighing 5.9 pounds each with a dust load of 10 pounds per bag in a room filled with air. Outside the baghouse is air. The geometry is bounded by a sphere of radius 300 meters. The baghouse is at the center of the sphere. Two geometries are employed. For most radionuclide sources, an array of nine adjoining modules in a square, 3 by 3 configuration, is used. This allows for contributions from source in adjacent rooms. For very weak photon sources, with negligible transport through the steel walls, a single module is used in order to improve the efficiency of the Monte Carlo calculation.

Materials: The dust is EAF dust, which is described in the dust report (SAIC 1995). The air is ATR moist air as described in DNA-TR-91-237 pp 13, 33. The air density is 1.121E-03 g/cm^3. The fiberglass is modeled as $CHSiO_2$. The density of the mixture is 3.608E-3 g/cm^3. The steel is carbon steel, which is 98.1% Fe, 1% Mn, 0.9% C by weight (CRC Handbook of Chemistry and Physics, p E-119, 1986), with a density of 7.86 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the dust mixture.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point one meter above the center of the (center) baghouse floor.

Response: The response function used is the deep dose equivalent index for a rotated plane parallel beam of photons (ROT) as described in Table 4, p 15 of ICRP 51. Units are Sv cm^2.

Normalization: The dust is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the dust (either 660 lbs, or $660 \times 9 = 5{,}940$ lbs) times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.9 Geometry Factor Calculation for Refinery Baghouse Dust Truck Worker, GF-9 (Baghouse Dust Truck)

This geometry factor was developed to calculate the dose rate to a worker handling EAF dust at a refinery. The worker is assumed to be positioned on top of a truck filled with EAF dust. Figure C.14 illustrates this situation. Calculations are based upon the following modeling assumptions:
Method of calculation: Three-dimensional Monte Carlo using MCNP.

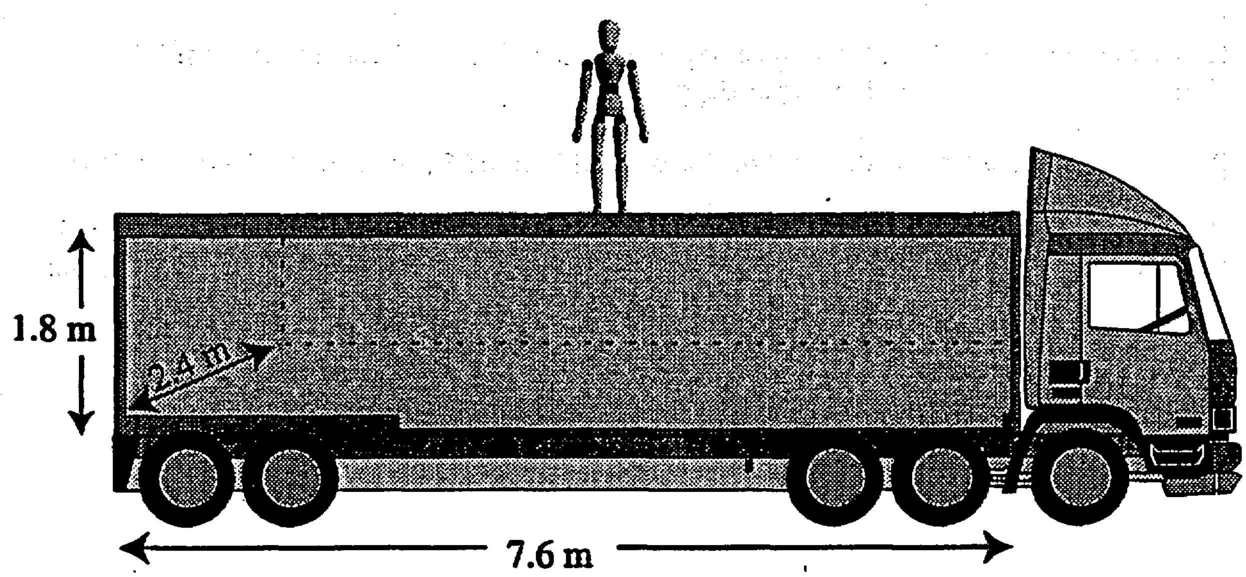

Figure C.14 Illustration of geometry for an individual loading a baghouse dust truck

Geometry: The source is a rectangular parallelepiped of EAF dust 25 feet long by eight feet wide by six feet deep. The dust is encased in a shell of steel three-sixteenths of an inch thick. The volume of the dust is 3.40E+07 cm^3. The density is 0.51 g/cm^3. The mass of the dust is 1.733E+07 grams. The steel shell is surrounded by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. The top of the truck is at the center of the sphere.

Materials: The dust is EAF dust, as described in the dust report (SAIC 1995). The dust density accounts for the truck payload and volume. The steel is carbon steel, which is 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The air is "ATR moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the dust layer.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point one-half meter above the center of the truck.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 ICRP 1987).

Normalization: The dust is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the dust times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv-cm^2) * Normalization (photons emitted/s per Bq/g).

C.3.10 Geometry Factor Calculation for a Steel-Framed Structure, GF-10 (Steel Structure)

This geometry factor was developed to calculate dose to an individual inside a steel framed structure as portrayed in Figure C.15. Calculations are based on the following assumptions:

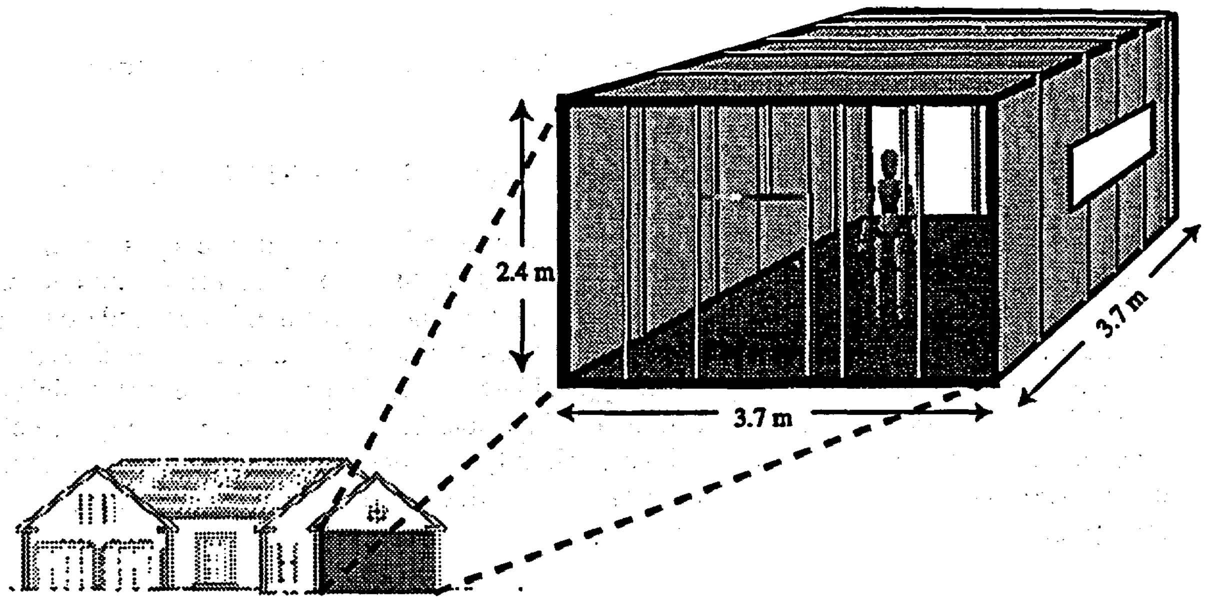

Figure C.15 Illustration of geometry for an individual in a steel framed structure

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993).

Geometry: The source is a holllow sphere of steel with an outside radius of 202 cm and a thickness of 2 cm. The density is 8.032 g/cm³. The mass of the steel is 8.042E+05 g. Space inside the sphere is occupied by moist air.

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is "ATR moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm³.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm² per photon emitted) is calculated at a point at the center of the sphere..

Response: The response function used is the deep dose equivalent index for an isotropic source of photons (ISO), in units of Sv-cm², as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv-cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.11 Geometry Factor Calculation for a Passenger Vehicle, GF-11 (Automobile)

This geometry factor was developed to calculate dose to an individual inside a passenger vehicle as portrayed in Figure C.16. The model is in two parts - a thin slab of steel represents the chassis and undercarriage of the vehicle and steel cube, representing the engine, is centered on the slab at one end. The dimensions of the slab and the masses of the undercarriage and engine are based on the average amounts of recycled steel in typical late-model American passenger vehicles. Since it is unlikely that all components of a vehicle would be made from the same source of steel and contain recycled metal from cleared material, only the undercarriage slab was used as a source. The engine serves to scatter photons. Calculations are based on the following assumptions:

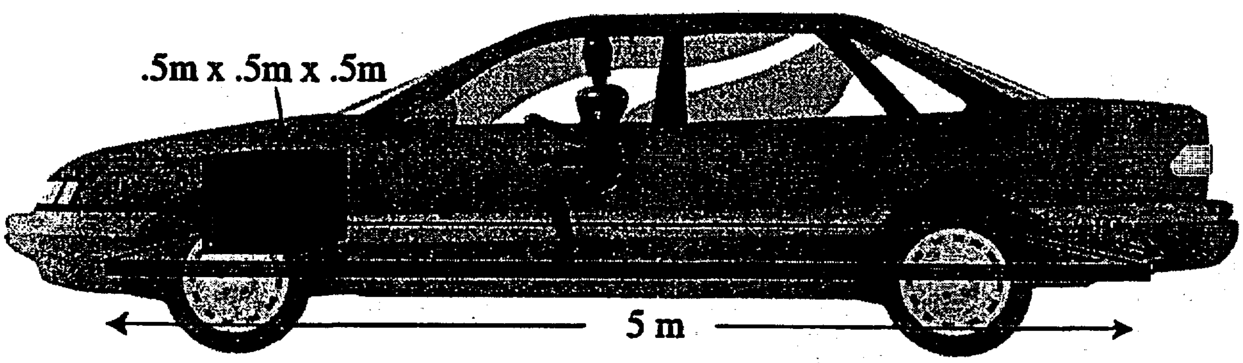

Figure C.16 Illustration of geometry for a passenger vehicle

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993).

Geometry: The source is a thin slab of steel with dimensions of 5 m x 170 cm x 1.05 cm. The center of the top of the slab is at the origin. It's density is 7.86 g/cm^3. The mass is 700 kg A 50 cm steel cube, representing the engine, is centered on the slab at one end. It has a mass of 300 kg and a density of 2.4 g/cm^3. The geometry is bounded by a sphere of radius 300 meters

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is "ATR moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at a point 50 cm above the center of the

Response: The response function used is the deep dose equivalent index for a rotated plane parallel beam of photons (ROT) as described in Table 4, p 15 of ICRP 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per g. The total sampled source (photons emitted/s per Bq/g) is the mass of the steel times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/g) = Flux (photons/cm^2 per photon emitted) * Response (Sv-cm^2) * Normalization (photons emitted/s per Bq/g)

C.3.12 Geometry Factor Calculation for Surface Contamination - Inside a Sphere

This geometry factor was developed to calculate the dose rate to a person positioned inside a metal sphere with surficial contamination on the inside surface. The sphere is used to represent the interior of a truck cab similar to that illustrated in Figure C.10. Calculations are based upon the following modeling assumptions:

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is the inside surface of a hollow sphere of steel with an outside radius of 103 cm and an inside radius of 100 cm. The volume of the steel is 3.884E+05 cm^3. The density is 7.86 g/cm^3. The mass of the steel is 3.053E+06 g. Spaces outside and inside the cylinder are occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. Both spheres are centered at the origin.

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is " moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from just inside the inner surface of the steel.

Tally: Flux (photons/cm^2 per photon emitted) is calculated at the origin.

Response: The response function used is the deep dose equivalent index for an isotropic source of photons (ISO), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The inside surface is assumed to contain 1 Bq per cm^2. The total sampled source (photons emitted per sec, per Bq/cm^2) is the surface area of the 100 cm sphere (1.257 E+05cm ^{2}) times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/cm^2 = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/cm^2).

C.3.13 Geometry Factor for Surface Contamination - Close to Small Object

This geometry factor was developed to calculate the dose rate to a person positioned one and two meters from the outside of a small metal object. The geometry factor is intentionally generic by design so that it may be applied to other, similar scenarios. Calculations are based upon the following modeling assumptions:

Method of calculation: Three-dimensional Monte Carlo using MCNP (LANL 1993)

Geometry: The source is on the outside of a hollow sphere of steel with an outside radius of 13 cm and an inside radius of 12.24 cm. The volume of the steel is 1.522E+03 cm^3. The density is 7.86 g/cm^3. The mass of the steel is 1.196E+04 g. Spaces outside and inside the sphere are occupied by ATR moist air. The geometry is bounded by a sphere of radius 300 meters. Both spheres are centered at the origin.

Materials: The steel is carbon steel, consisting of 98.1% Fe, 1% Mn, 0.9% C by weight (Weast 1986, p E-119). The steel density is for solid steel. The air is " moist" air as described in DNA-TR-91-237 pp 13, 33 (Kaul 1992). The air density is 1.121E-03 g/cm^3.

Source: For each radionuclide of interest, photons of appropriate discrete energies are started isotropically from just outside the surface of the steel.

Tally: Fluxes (photons/cm^2 per photon emitted) are calculated on rings centered one and two meters from the outside of the sphere.

Response: The response function used is the deep dose equivalent index for a plane parallel beam of photons (PAR), in units of Sv-cm^2, as described in Table 4, p 15 of ICRP Publication 51 (ICRP 1987).

Normalization: The steel is assumed to contain 1 Bq per cm^2 of outside surface area. The total sampled source (photons emitted per sec, per Bq/cm^2) is the surface area of the 13 cm sphere (2124 cm ^{2}) times the number of photons emitted per Bq. The geometry factor is given by:

GF (Sv/s per Bq/cm^2 = Flux (photons/cm^2 per photon emitted) * Response (Sv cm^2) * Normalization (photons emitted/s per Bq/cm^2).

C.4 Uncertainty in External Exposure Factors

The geometry factors used in this report are point-estimate values for each nuclide that are specific to each steel source geometry. They are not treated as a distribution of values in the probabilistic analysis. It is not practical to perform the number of MCNP calculations required to develop nuclide-specific, probabilistic geometry factors. In addition, some scenarios use the dose rate factors published in Federal Guidance Report Number 12 which are published as single values only.

A separate parameter, U_{GF}, is included in the analysis to account for uncertainty in external exposure rates. U_{GF} is a multiplicative factor based on an evaluation of the circumstances described in each scenario. This evaluation was conducted for each material so that differences between steel objects and aluminum, copper, or concrete objects could be addressed.

There are three general approaches used in the development of U_{GF}. The first approach is to base U_{GF} on subjective estimates of uncertainty in the mass of the object and the relative position of the exposed individual. This rationale is used for GFs representing generic, non-specific objects of finite size such as the"large pile", the "small metal object", the "large metal object", and the "small metal object close to the body". In these cases, the description of each scenario is evaluated to determine a reasonable range of mass for the object and distance to the exposed individual. . For example, the GF for the small metal object is calculated for a person 2 m from a 12 kg steel object. More massive objects and greater distances are not considered realistic for the circumstances of the scenario. Less massive objects and slightly closer distances are reasonable to postulate. A person half as far away (at 1 m) would receive approximately 4 times the dose, and an object one quarter the mass would give about one quarter the dose for a 2 m distance. A value of 0.7 approximates the geometric mean of 0.25 and 4.0 and best represents the intended circumstances of the scenario. The U_{GF} for the Small Steel Mass (GF-3) is described by a triangular distribution with a minimum of 0.25, a maximum of 4.0 and a most likely value of 0.7.

The second approach is to use available data regarding the mass and shape of specific objects. This approach was used for objects such as the refinery baghouse, the steel framed structure, and the passenger vehicle. For example, the GF for the passenger vehicle is based on the physical dimensions and the total recycled steel content of a typical automobile sold in the United States in the late 1990s. It is calculated assuming a 5 m x 1.7 m auto chassis weighing 700 kg. This is an upper-bound estimate. It is more likely that some parts could originate from cleared material, but unlikely that the entire recycled steel content would originate from cleared material. If the source were only the engine block, or the equivalent, the exposure rate would be similar to that of the Large Steel Mass (GF-2). This is about 20% of the GF calculated for the chassis. If the source were composed of smaller parts such as breaks and springs, or the equivalent, at a greater distance form the driver the exposure rate would be similar to four Small Steel Mass objects (GF-3) at the corners of the vehicle. This is about 0.3% of the GF for the chassis. The U_{GF} for the Passenger Vehicle (GF-11) is described by a triangular distribution with a minimum of 0.003, a maximum of 1.0 and a most likely value of 0.2.

The final approach is used to estimate uncertainty in external exposure rates for scenarios using Federal Guidance Report Number 12 values. The Federal Guidance values are based on a semi-infinite plane for which considerations of mass and distance are not relevant. However, some scenarios involve exposure to a finite but uncertain portion of the infinite plane. In these cases the scenario is evaluated to determine a realistic range for the solid angle of the source as seen by the exposed individual. One example is the scenario describing the use of roadbed constructed using steel slag. The external exposure calculation for this scenario uses an external dose rate factor for soil contaminated to infinite depth. For a person near the center of a 20 ft wide road, the solid angle is approximately 70% of that for an infinite plane for a dose point 1 m above the surface. For a person near the edge of the road, the solid angle is about 40% of that for an infinite plane. A maximum of 100% accounts for situations such as a very wide road or a large area such as parking lot. In this case there is no basis for determining which situation is most likely within the description of the scenario. The U_{GF} for use of a roadbed containing slag is described by a uniform distribution with a minimum of 0.4 and a maximum of 1.0.

Values for the distributions of U_{GF} in each scenario are presented in Appendix B.

C.5 References

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Table C.3 Geometry Factors for the large pile (GF-1) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.2E-09	1.2E-09	1.2E-09	1.2E-09
Na-22	6.9E-04	6.9E-04	6.9E-04	6.9E-04
P-32	4.6E-07	4.6E-07	4.6E-07	4.6E-07
S-35	1.3E-09	1.3E-09	1.3E-09	1.3E-09
Cl-36	1.0E-07	1.0E-07	1.0E-07	1.0E-07
K-40	5.3E-05	5.3E-05	5.3E-05	5.3E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	4.5E-09	4.5E-09	4.5E-09	4.5E-09
Cr-51	7.6E-06	7.6E-06	7.6E-06	7.6E-06
Mn-54	2.7E-04	2.7E-04	2.7E-04	2.7E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	9.3E-06	9.3E-06	9.3E-06	9.3E-06
Co-58	3.1E-04	3.1E-04	3.1E-04	3.1E-04
Fe-59	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	8.6E-04	8.6E-04	8.6E-04	8.6E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.2E-04	1.2E-04	1.2E-04	1.2E-04
Cu-67	1.5E-05	1.5E-05	1.5E-05	1.5E-05
Se-75	7.2E-05	7.2E-05	7.2E-05	7.2E-05
Sr-85	1.6E-04	1.6E-04	1.6E-04	1.6E-04
Sr-89	3.6E-07	3.6E-07	3.6E-07	3.6E-07
Sr-90	3.7E-08	3.7E-08	3.7E-08	3.7E-08
Y-91	1.2E-06	1.2E-06	1.2E-06	1.2E-06
Mo-93	1.9E-08	1.9E-08	1.9E-08	1.9E-08
Nb-93m	3.4E-09	3.4E-09	3.4E-09	3.4E-09
Nb-94	5.1E-04	5.1E-04	5.1E-04	5.1E-04
Nb-95	2.4E-04	2.4E-04	2.4E-04	2.4E-04
Zr-95	2.3E-04	2.3E-04	2.3E-04	2.3E-04
Tc -99	8.3E-09	8.3E-09	8.3E-09	8.3E-09
Ru-103	1.4E-04	1.4E-04	1.4E-04	1.4E-04
Ru-106	6.3E-05	6.3E-05	6.3E-05	6.3E-05
Ag-108m	5.0E-04	5.0E-04	5.0E-04	5.0E-04
Cd-109	6.2E-08	6.2E-08	6.2E-08	6.2E-08
Ag-110m	8.9E-04	8.9E-04	8.9E-04	8.9E-04
Sb-124	6.0E-04	6.0E-04	6.0E-04	6.0E-04
I-125	2.6E-07	2.6E-07	2.6E-07	2.6E-07
Sb-125	1.2E-04	1.2E-04	1.2E-04	1.2E-04
I-129	1.8E-07	1.8E-07	1.8E-07	1.8E-07
I-131	9.6E-05	9.6E-05	9.6E-05	9.6E-05
Ba-133	7.7E-05	7.7E-05	7.7E-05	7.7E-05
Cs-134	4.8E-04	4.8E-04	4.8E-04	4.8E-04

Table C.3 Geometry Factors for the large pile (GF-1) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
Cs-137	1.9E-04	1.9E-04	1.9E-04	1.9E-04
Ce-141	7.0E-06	7.0E-06	7.0E-06	7.0E-06
Ce-144	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Pm-147	2.5E-10	2.5E-10	2.5E-10	2.5E-10
Eu-152	3.4E-04	3.4E-04	3.4E-04	3.4E-04
Eu-154	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Eu-155	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Re-186	1.4E-06	1.4E-06	1.4E-06	1.4E-06
Ir-192	2.0E-04	2.0E-04	2.0E-04	2.0E-04
Pb-210	5.5E-09	1.1E-08	1.1E-08	1.1E-08
Po-210	2.7E-09	2.7E-09	2.7E-09	2.7E-09
Bi-210	1.6E-07	1.6E-07	1.6E-07	1.6E-07
Rn-222	5.6E-04	5.6E-04	5.6E-04	5.6E-04
Ra-223	6.4E-05	6.4E-05	6.4E-05	6.4E-05
Ra-224	3.4E-04	3.4E-04	3.4E-04	3.4E-04
Ac-225	5.4E-05	5.4E-05	5.4E-05	5.4E-05
Ra-225	1.7E-08	1.7E-08	1.7E-08	1.7E-08
Ra-226	9.0E-07	5.6E-04	5.6E-04	5.6E-04
Ac-227	3.6E-09	2.9E-05	8.3E-05	8.3E-05
Th-227	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Th-228	1.6E-07	3.4E-04	3.4E-04	3.4E-04
Ra-228	2.7E-04	2.7E-04	2.7E-04	2.7E-04
Th-229	5.5E-06	2.2E-05	5.9E-05	5.9E-05
Th-230	3.4E-09	3.4E-09	3.4E-05	2.3E-06
Pa-231	5.8E-06	5.8E-06	8.9E-05	3.1E-05
Th-231	3.8E-07	3.8E-07	3.8E-07	3.8E-07
Th-232	4.6E-09	1.9E-06	6.2E-04	4.3E-04
Pa-233	4.5E-05	4.5E-05	4.5E-05	4.5E-05
U-233	2.3E-18	2.3E-18	2.3E-18	2.3E-18
Th-234	2.7E-06	2.7E-06	2.7E-06	2.7E-06
U-234	2.3E-10	2.3E-10	2.3E-10	2.3E-10
U-235	2.0E-05	2.0E-05	2.0E-05	2.0E-05
Np-237	8.1E-07	1.9E-05	4.5E-05	4.5E-05
Pu-238	9.4E-15	9.4E-15	9.4E-15	9.4E-15
U-238	2.0E-09	1.1E-06	2.7E-06	2.7E-06
Pu-239	3.7E-15	3.7E-15	3.7E-15	3.7E-15
Pu-240	4.5E-10	4.5E-10	4.5E-10	4.5E-10
Pu-241	8.7E-11	1.1E-10	5.9E-06	4.1E-09
Am-241	2.0E-07	2.0E-07	2.0E-07	2.0E-07
Cm-242	1.8E-15	1.8E-15	9.4E+80	2.8E-10
Pu-242	1.5E-10	1.5E-10	1.5E-10	1.5E-10
Cm-244	1.6E-15	1.6E-15	1.6E-15	1.6E-15

Table C.4 Geometry Factors for the large object (GF-2) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	7.8E-11	7.8E-11	7.8E-11	7.8E-11
Na-22	3.3E-05	3.3E-05	3.3E-05	3.3E-05
P-32	3.0E-08	3.0E-08	3.0E-08	3.0E-08
S-35	8.4E-11	8.4E-11	8.4E-11	8.4E-11
Cl-36	6.4E-09	6.4E-09	6.4E-09	6.4E-09
K-40	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.9E-10	2.9E-10	2.9E-10	2.9E-10
Cr-51	4.9E-07	4.9E-07	4.9E-07	4.9E-07
Mn-54	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	8.6E-07	8.6E-07	8.6E-07	8.6E-07
Co-58	1.5E-05	1.5E-05	1.5E-05	1.5E-05
Fe-59	1.7E-05	1.7E-05	1.7E-05	1.7E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	3.6E-05	3.6E-05	3.6E-05	3.6E-05
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	8.5E-06	8.5E-06	8.5E-06	8.5E-06
Cu-67	1.2E-06	1.2E-06	1.2E-06	1.2E-06
Se-75	5.0E-06	5.0E-06	5.0E-06	5.0E-06
Sr-85	8.2E-06	8.2E-06	8.2E-06	8.2E-06
Sr-89	2.3E-08	2.3E-08	2.3E-08	2.3E-08
Sr-90	2.4E-09	2.4E-09	2.4E-09	2.4E-09
Y-91	5.2E-08	5.2E-08	5.2E-08	5.2E-08
Mo-93	2.6E-09	2.6E-09	2.6E-09	2.6E-09
Nb-93m	4.3E-10	4.3E-10	4.3E-10	4.3E-10
Nb-94	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Nb-95	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Zr-95	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Tc -99	5.3E-10	5.3E-10	5.3E-10	5.3E-10
Ru-103	7.9E-06	7.9E-06	7.9E-06	7.9E-06
Ru-106	3.1E-06	3.1E-06	3.1E-06	3.1E-06
Ag-108m	2.6E-05	2.6E-05	2.6E-05	2.6E-05
Cd-109	7.4E-09	7.4E-09	7.4E-09	7.4E-09
Ag-110m	4.3E-05	4.3E-05	4.3E-05	4.3E-05
Sb-124	2.7E-05	2.7E-05	2.7E-05	2.7E-05
I-125	3.0E-08	3.0E-08	3.0E-08	3.0E-08
Sb-125	6.5E-06	6.5E-06	6.5E-06	6.5E-06
I-129	1.9E-08	1.9E-08	1.9E-08	1.9E-08
I-131	5.9E-06	5.9E-06	5.9E-06	5.9E-06
Ba-133	5.4E-06	5.4E-06	5.4E-06	5.4E-06
Cs-134	2.5E-05	2.5E-05	2.5E-05	2.5E-05

Table C.4 Geometry Factors for the large object (GF-2) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
Cs-137	9.6E-06	9.6E-06	9.6E-06	9.6E-06
Ce-141	6.6E-07	6.6E-07	6.6E-07	6.6E-07
Ce-144	5.4E-07	5.4E-07	5.4E-07	5.4E-07
Pm-147	2.6E-11	2.6E-11	2.6E-11	2.6E-11
Eu-152	1.6E-05	1.6E-05	1.6E-05	1.6E-05
Eu-154	1.8E-05	1.8E-05	1.8E-05	1.8E-05
Eu-155	2.5E-07	2.5E-07	2.5E-07	2.5E-07
Re-186	1.2E-07	1.2E-07	1.2E-07	1.2E-07
Ir-192	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Pb-210	4.8E-09	4.8E-09	4.8E-09	4.8E-09
Po-210	1.3E-10	1.3E-10	1.3E-10	1.3E-10
Bi-210	1.0E-08	1.0E-08	1.0E-08	1.0E-08
Rn-222	2.4E-05	2.4E-05	2.4E-05	2.4E-05
Ra-223	3.8E-06	3.8E-06	3.8E-06	3.8E-06
Ra-224	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Ac-225	2.9E-06	2.9E-06	2.9E-06	2.9E-06
Ra-225	1.4E-08	1.4E-08	1.4E-08	1.4E-08
Ra-226	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Ac-227	5.2E-06	1.8E-06	5.2E-06	5.2E-06
Th-227	1.3E-06	1.3E-06	1.3E-06	1.3E-06
Th-228	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Ra-228	[redacted]			
Th-229	3.5E-06	1.4E-06	3.5E-06	3.5E-06
Th-230	8.1E-09	8.0E-10	1.5E-06	9.9E-08
Pa-231	4.0E-07	4.0E-07	5.6E-06	2.0E-06
Th-231	4.5E-08	4.5E-08	4.5E-08	4.5E-08
Th-232	1.6E-06	8.8E-08	3.1E-05	2.2E-05
Pa-233	2.9E-06	2.9E-06	2.9E-06	2.9E-06
U-233	2.0E-10	2.0E-10	2.0E-10	2.0E-10
Th-234	1.5E-07	1.5E-07	1.5E-07	1.5E-07
U-234	3.6E-10	3.6E-10	3.6E-10	3.6E-10
U-235	1.7E-06	1.7E-06	1.7E-06	1.7E-06
Np-237	3.0E-06	1.3E-06	3.0E-06	3.0E-06
Pu-238	4.1E-10	4.1E-10	4.1E-10	4.1E-10
U-238	1.5E-07	5.9E-08	1.5E-07	1.5E-07
Pu-239	1.6E-10	1.6E-10	1.6E-10	1.6E-10
Pu-240	4.2E-10	4.2E-10	4.2E-10	4.2E-10
Pu-241	8.6E-11	1.3E-11	1.1E-06	7.8E-10
Am-241	3.8E-08	3.8E-08	3.8E-08	3.8E-08
Cm-242	6.4E-10	6.4E-10	4.1E+85	1.2E-05
Pu-242	3.4E-10	3.4E-10	3.4E-10	3.4E-10
Cm-244	5.6E-10	5.6E-10	5.6E-10	5.6E-10

Table C.5 Geometry Factors for the small object (GF-3) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	5.03E-12	5.03E-12	5.03E-12	5.03E-12
Na-22	2.19E-06	2.19E-06	2.19E-06	2.19E-06
P-32	1.92E-09	1.92E-09	1.92E-09	1.92E-09
S-35	5.41E-12	5.41E-12	5.41E-12	5.41E-12
Cl-36	4.13E-10	4.13E-10	4.13E-10	4.13E-10
K-40	1.48E-07	1.48E-07	1.48E-07	1.48E-07
Ca-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-45	1.86E-11	1.86E-11	1.86E-11	1.86E-11
Cr-51	3.17E-08	3.17E-08	3.17E-08	3.17E-08
Mn-54	8.74E-07	8.74E-07	8.74E-07	8.74E-07
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	5.41E-08	5.41E-08	5.41E-08	5.41E-08
Co-58	1.02E-06	1.02E-06	1.02E-06	1.02E-06
Fe-59	1.17E-06	1.17E-06	1.17E-06	1.17E-06
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	2.44E-06	2.44E-06	2.44E-06	2.44E-06
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-07	5.76E-07	5.76E-07	5.76E-07
Cu-67	7.47E-08	7.47E-08	7.47E-08	7.47E-08
Se-75	3.17E-07	3.17E-07	3.17E-07	3.17E-07
Sr-85	5.31E-07	5.31E-07	5.31E-07	5.31E-07
Sr-89	1.49E-09	1.49E-09	1.49E-09	1.49E-09
Sr-90	1.53E-10	1.53E-10	1.53E-10	1.53E-10
Y-91	3.65E-09	3.55E-09	3.55E-09	3.55E-09
Mo-93	1.61E-10	1.61E-10	1.61E-10	1.61E-10
Nb-93m	2.68E-11	2.68E-11	2.68E-11	2.68E-11
Nb-94	1.63E-06	1.63E-06	1.63E-06	1.63E-06
Nb-95	8.02E-07	8.02E-07	8.02E-07	8.02E-07
Zr-95	7.71E-07	7.71E-07	7.71E-07	7.71E-07
Tc -99	3.42E-11	3.42E-11	3.42E-11	3.42E-11
Ru-103	5.17E-07	5.17E-07	5.17E-07	5.17E-07
Ru-106	2.07E-07	2.07E-07	2.07E-07	2.07E-07
Ag-108m	1.72E-06	1.72E-06	1.72E-06	1.72E-06
Cd-109	4.34E-10	4.34E-10	4.34E-10	4.34E-10
Ag-110m	2.78E-06	2.78E-06	2.78E-06	2.78E-06
Sb-124	1.79E-06	1.79E-06	1.79E-06	1.79E-06
I-125	1.59E-09	1.59E-09	1.59E-09	1.59E-09
Sb-125	4.30E-07	4.30E-07	4.30E-07	4.30E-07
I-129	1.09E-09	1.09E-09	1.09E-09	1.09E-09
I-131	3.73E-07	3.73E-07	3.73E-07	3.73E-07
Ba-133	3.36E-07	3.36E-07	3.36E-07	3.36E-07
Cs-134	1.63E-06	1.63E-06	1.63E-06	1.63E-06

Table C.5 Geometry Factors for the small object (GF-3) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
Cs-137	6.28E-07	6.28E-07	6.28E-07	6.28E-07
Ce-141	3.99E-08	3.99E-08	3.99E-08	3.99E-08
Ce-144	3.52E-08	3.52E-08	3.52E-08	3.52E-08
Pm-147	1.54E-12	1.54E-12	1.54E-12	1.54E-12
Eu-152	1.10E-06	1.10E-06	1.10E-06	1.10E-06
Eu-154	1.21E-06	1.21E-06	1.21E-06	1.21E-06
Eu-155	1.51E-08	1.51E-08	1.51E-08	1.51E-08
Re-186	7.20E-09	7.20E-09	7.20E-09	7.20E-09
Ir- 192	8.19E-07	8.19E-07	8.19E-07	8.19E-07
Pb-210	3.02E-10	3.02E-10	3.02E-10	3.02E-10
Po-210	8.84E-12	8.84E-12	8.84E-12	8.84E-12
Bi-210	6.48E-10	6.48E-10	6.48E-10	6.48E-10
Rn-222	1.65E-06	1.65E-06	1.65E-06	1.65E-06
Ra-223	2.53E-07	2.53E-07	2.53E-07	2.53E-07
Ra-224	1.29E-06	1.29E-06	1.29E-06	1.29E-06
Ac-225	1.98E-07	1.98E-07	1.98E-07	1.98E-07
Ra-225	7.45E-10	7.45E-10	7.45E-10	7.45E-10
Ra-226	1.65E-06	1.65E-06	1.65E-06	1.65E-06
Ac-227	3.35E-07	1.17E-07	3.35E-07	3.35E-07
Th-227	8.26E-08	8.26E-08	8.26E-08	8.26E-08
Th-228	1.29E-06	1.29E-06	1.29E-06	1.29E-06
Ra-228	8.41E-07	8.41E-07	8.41E-07	8.41E-07
Th-229	2.30E-07	9.14E-08	2.30E-07	2.30E-07
Th-230	5.41E-10	4.72E-11	9.89E-08	6.64E-09
Pa-231	2.67E-08	2.67E-08	3.62E-07	1.27E-07
Th-231	2.93E-09	2.93E-09	2.93E-09	2.93E-09
Th-232	1.10E-07	5.97E-09	2.13E-06	1.49E-06
Pa-233	1.79E-07	1.79E-07	1.79E-07	1.79E-07
U-233	1.26E-11	1.26E-11	1.26E-11	1.26E-11
Th-234	9.57E-09	9.57E-09	9.57E-09	9.57E-09
U-234	2.18E-11	2.18E-11	2.18E-11	2.18E-11
U-235	1.08E-07	1.08E-07	1.08E-07	1.08E-07
Np-237	1.85E-07	7.77E-08	1.85E-07	1.85E-07
Pu-238	2.54E-11	2.54E-11	2.54E-11	2.54E-11
U-238	9.59E-09	3.84E-09	9.59E-09	9.59E-09
Pu-239	9.78E-12	9.78E-12	9.78E-12	9.78E-12
Pu-240	2.56E-11	2.56E-11	2.56E-11	2.56E-11
Pu-241	5.53E-12	7.88E-13	7.25E-08	5.05E-11
Am-241	2.50E-09	2.50E-09	2.50E-09	2.50E-09
Cm-242	3.88E-11	3.88E-11	2.54E+84	7.61E-07
Pu-242	2.08E-11	2.08E-11	2.08E-11	2.08E-11
Cm-244	3.41E-11	3.41E-11	3.41E-11	3.41E-11

Table C.6 Geometry Factors for the truck driver (GF-4) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Na-22	1.0E-03	1.0E-03	1.0E-03	1.0E-03
P-32	7.5E-07	7.5E-07	7.5E-07	7.5E-07
S-35	2.1E-09	2.1E-09	2.1E-09	2.1E-09
Cl-36	1.6E-07	1.6E-07	1.6E-07	1.6E-07
K-40	7.7E-05	7.7E-05	7.7E-05	7.7E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	7.3E-09	7.3E-09	7.3E-09	7.3E-09
Cr-51	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Mn-54	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.8E-05	1.8E-05	1.8E-05	1.8E-05
Co-58	4.7E-04	4.7E-04	4.7E-04	4.7E-04
Fe-59	5.8E-04	5.8E-04	5.8E-04	5.8E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.2E-03	1.2E-03	1.2E-03	1.2E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.9E-04	2.9E-04	2.9E-04	2.9E-04
Cu-67	2.8E-05	2.8E-05	2.8E-05	2.8E-05
Se-75	1.2E-04	1.2E-04	1.2E-04	1.2E-04
Sr-85	2.3E-04	2.3E-04	2.3E-04	2.3E-04
Sr-89	5.8E-07	5.8E-07	5.8E-07	5.8E-07
Sr-90	6.0E-08	6.0E-08	6.0E-08	6.0E-08
Y-91	1.7E-06	1.7E-06	1.7E-06	1.7E-06
Mo-93	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Nb-93m	3.4E-10	3.4E-10	3.4E-10	3.4E-10
Nb-94	7.8E-04	7.8E-04	7.8E-04	7.8E-04
Nb-95	3.7E-04	3.7E-04	3.7E-04	3.7E-04
Zr-95	3.6E-04	3.6E-04	3.6E-04	3.6E-04
Tc -99	1.3E-08	1.3E-08	1.3E-08	1.3E-08
Ru-103	2.4E-04	2.4E-04	2.4E-04	2.4E-04
Ru-106	9.9E-05	9.9E-05	9.9E-05	9.9E-05
Ag-108m	7.7E-04	7.7E-04	7.7E-04	7.7E-04
Cd-109	3.4E-08	3.4E-08	3.4E-08	3.4E-08
Ag-110m	1.4E-03	1.4E-03	1.4E-03	1.4E-03
Sb-124	9.0E-04	9.0E-04	9.0E-04	9.0E-04
I-125	3.2E-07	3.2E-07	3.2E-07	3.2E-07
Sb-125	1.9E-04	1.9E-04	1.9E-04	1.9E-04
I-129	2.4E-07	2.4E-07	2.4E-07	2.4E-07
I-131	1.7E-04	1.7E-04	1.7E-04	1.7E-04
Ba-133	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Cs-134	7.6E-04	7.6E-04	7.6E-04	7.6E-04

Table C.6 Geometry Factors for the truck driver (GF-4) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
Cs-137	2.9E-04	2.9E-04	2.9E-04	2.9E-04
Ce-141	1.4E-05	1.4E-05	1.4E-05	1.4E-05
Ce-144	1.6E-05	1.6E-05	1.6E-05	1.6E-05
Pm-147	5.0E-10	5.0E-10	5.0E-10	5.0E-10
Eu-152	5.3E-04	5.3E-04	5.3E-04	5.3E-04
Eu-154	5.8E-04	5.8E-04	5.8E-04	5.8E-04
Eu-155	5.0E-06	5.0E-06	5.0E-06	5.0E-06
Re-186	2.4E-06	2.4E-06	2.4E-06	2.4E-06
Ir- 192	3.5E-04	3.5E-04	3.5E-04	3.5E-04
Pb-210	7.6E-08	7.6E-08	7.6E-08	7.6E-08
Po-210	4.0E-09	4.0E-09	4.0E-09	4.0E-09
Bi-210	2.5E-07	2.5E-07	2.5E-07	2.5E-07
Rn-222	8.2E-04	8.2E-04	8.2E-04	8.2E-04
Ra-223	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Ra-224	6.1E-04	6.1E-04	6.1E-04	6.1E-04
Ac-225	8.9E-05	8.9E-05	8.9E-05	8.9E-05
Ra-225	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Ra-226	8.2E-04	8.2E-04	8.2E-04	8.2E-04
Ac-227	1.4E-04	4.9E-05	1.4E-04	1.4E-04
Th-227	3.2E-05	3.2E-05	3.2E-05	3.2E-05
Th-228	6.1E-04	6.1E-04	6.1E-04	6.1E-04
Ra-228	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Th-229	9.9E-05	3.7E-05	9.9E-05	9.9E-05
Th-230	2.6E-07	1.1E-08	4.9E-05	3.3E-06
Pa-231	9.7E-06	9.7E-06	1.5E-04	5.2E-05
Th-231	7.4E-07	7.4E-07	7.4E-07	7.4E-07
Th-232	5.2E-05	2.8E-06	1.0E-03	7.0E-04
Pa-233	7.0E-05	7.0E-05	7.0E-05	7.0E-05
U-233	9.6E-11	9.6E-11	9.6E-11	9.6E-11
Th-234	3.9E-06	3.9E-06	3.9E-06	3.9E-06
U-234	1.8E-09	1.8E-09	1.8E-09	1.8E-09
U-235	3.9E-05	3.9E-05	3.9E-05	3.9E-05
Np-237	7.1E-05	3.0E-05	7.1E-05	7.1E-05
Pu-238	5.6E-10	5.6E-10	5.6E-10	5.6E-10
U-238	3.9E-06	1.6E-06	3.9E-06	3.9E-06
Pu-239	2.1E-10	2.1E-10	2.1E-10	2.1E-10
Pu-240	1.8E-09	1.8E-09	1.8E-09	1.8E-09
Pu-241	1.6E-09	2.5E-10	2.1E-05	1.4E-08
Am-241	7.1E-07	7.1E-07	7.1E-07	7.1E-07
Cm-242	8.2E-10	8.2E-10	5.6E+85	1.7E-05
Pu-242	9.6E-10	9.6E-10	9.6E-10	9.6E-10
Cm-244	7.2E-10	7.2E-10	7.2E-10	7.2E-10

Table C.7 Geometry Factors for lateral exposure to a truck (GF-5) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Na-22	1.0E-03	1.0E-03	1.0E-03	1.0E-03
P-32	7.8E-07	7.8E-07	7.8E-07	7.8E-07
S-35	2.2E-09	2.2E-09	2.2E-09	2.2E-09
Cl-36	1.7E-07	1.7E-07	1.7E-07	1.7E-07
K-40	7.6E-05	7.6E-05	7.6E-05	7.6E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	7.6E-09	7.6E-09	7.6E-09	7.6E-09
Cr-51	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Mn-54	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.7E-05	1.7E-05	1.7E-05	1.7E-05
Co-58	4.6E-04	4.6E-04	4.6E-04	4.6E-04
Fe-59	5.8E-04	5.8E-04	5.8E-04	5.8E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.2E-03	1.2E-03	1.2E-03	1.2E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.8E-04	2.8E-04	2.8E-04	2.8E-04
Cu-67	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Se-75	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Sr-85	2.3E-04	2.3E-04	2.3E-04	2.3E-04
Sr-89	6.0E-07	6.0E-07	6.0E-07	6.0E-07
Sr-90	6.2E-08	6.2E-08	6.2E-08	6.2E-08
Y-91	1.7E-06	1.7E-06	1.7E-06	1.7E-06
Mo-93	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Nb-93m	3.3E-10	3.3E-10	3.3E-10	3.3E-10
Nb-94	7.7E-04	7.7E-04	7.7E-04	7.7E-04
Nb-95	3.7E-04	3.7E-04	3.7E-04	3.7E-04
Zr-95	3.5E-04	3.5E-04	3.5E-04	3.5E-04
Tc -99	1.4E-08	1.4E-08	1.4E-08	1.4E-08
Ru-103	2.2E-04	2.2E-04	2.2E-04	2.2E-04
Ru-106	9.1E-05	9.1E-05	9.1E-05	9.1E-05
Ag-108m	7.4E-04	7.4E-04	7.4E-04	7.4E-04
Cd-109	2.9E-08	2.9E-08	2.9E-08	2.9E-08
Ag-110m	1.3E-03	1.3E-03	1.3E-03	1.3E-03
Sb-124	8.6E-04	8.6E-04	8.6E-04	8.6E-04
I-125	2.4E-07	2.4E-07	2.4E-07	2.4E-07
Sb-125	1.9E-04	1.9E-04	1.9E-04	1.9E-04
I-129	2.0E-07	2.0E-07	2.0E-07	2.0E-07
I-131	1.5E-04	1.5E-04	1.5E-04	1.5E-04
Ba-133	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Cs-134	7.3E-04	7.3E-04	7.3E-04	7.3E-04

Table C.7 Geometry Factors for lateral exposure to a truck (GF-5) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
Cs-137	2.8E-04	2.8E-04	2.8E-04	2.8E-04
Ce-141	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Ce-144	1.6E-05	1.6E-05	1.6E-05	1.6E-05
Pm-147	4.7E-10	4.7E-10	4.7E-10	4.7E-10
Eu-152	5.1E-04	5.1E-04	5.1E-04	5.1E-04
Eu-154	5.6E-04	5.6E-04	5.6E-04	5.6E-04
Eu-155	4.4E-06	4.4E-06	4.4E-06	4.4E-06
Re-186	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Ir- 192	3.3E-04	3.3E-04	3.3E-04	3.3E-04
Pb-210	7.1E-08	7.1E-08	7.1E-08	7.1E-08
Po-210	4.0E-09	4.0E-09	4.0E-09	4.0E-09
Bi-210	2.6E-07	2.6E-07	2.6E-07	2.6E-07
Rn-222	7.7E-04	7.7E-04	7.7E-04	7.7E-04
Ra-223	9.7E-05	9.7E-05	9.7E-05	9.7E-05
Ra-224	6.2E-04	6.2E-04	6.2E-04	6.2E-04
Ac-225	8.6E-05	8.6E-05	8.6E-05	8.6E-05
Ra-225	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Ra-226	7.7E-04	7.7E-04	7.7E-04	7.7E-04
Ac-227	1.3E-04	4.4E-05	1.3E-04	1.3E-04
Th-227	3.0E-05	3.0E-05	3.0E-05	3.0E-05
Th-228	6.2E-04	6.2E-04	6.2E-04	6.2E-04
Ra-228	3.9E-04	3.9E-04	3.9E-04	3.9E-04
Th-229	9.7E-05	3.7E-05	9.7E-05	9.7E-05
Th-230	2.4E-07	1.0E-08	4.6E-05	3.1E-06
Pa-231	9.6E-06	9.6E-06	1.4E-04	4.8E-05
Th-231	7.0E-07	7.0E-07	7.0E-07	7.0E-07
Th-232	5.1E-05	2.8E-06	1.0E-03	7.1E-04
Pa-233	7.1E-05	7.1E-05	7.1E-05	7.1E-05
U-233	8.9E-11	8.9E-11	8.9E-11	8.9E-11
Th-234	4.2E-06	4.2E-06	4.2E-06	4.2E-06
U-234	1.6E-09	1.6E-09	1.6E-09	1.6E-09
U-235	3.6E-05	3.6E-05	3.6E-05	3.6E-05
Np-237	7.2E-05	3.0E-05	7.2E-05	7.2E-05
Pu-238	4.7E-10	4.7E-10	4.7E-10	4.7E-10
U-238	4.2E-06	1.7E-06	4.2E-06	4.2E-06
Pu-239	1.7E-10	1.7E-10	1.7E-10	1.7E-10
Pu-240	1.8E-09	1.8E-09	1.8E-09	1.8E-09
Pu-241	1.5E-09	2.3E-10	1.9E-05	1.3E-08
Am-241	6.6E-07	6.6E-07	6.6E-07	6.6E-07
Cm-242	8.2E-10	8.2E-10	4.7E+85	1.4E-05
Pu-242	1.1E-09	1.1E-09	1.1E-09	1.1E-09
Cm-244	7.2E-10	7.2E-10	7.2E-10	7.2E-10

Table C.8 Geometry Factors for a small object close to the body (GF-6) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.3E-10	5.3E-10	5.3E-10	5.3E-10
Na-22	1.8E-04	1.8E-04	1.8E-04	1.8E-04
P-32	2.0E-07	2.0E-07	2.0E-07	2.0E-07
S-35	5.7E-10	5.7E-10	5.7E-10	5.7E-10
Cl-36	4.4E-08	4.4E-08	4.4E-08	4.4E-08
K-40	1.1E-05	1.1E-05	1.1E-05	1.1E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Cr-51	3.0E-06	3.0E-06	3.0E-06	3.0E-06
Mn-54	6.8E-05	6.8E-05	6.8E-05	6.8E-05
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	8.9E-06	8.9E-06	8.9E-06	8.9E-06
Co-58	8.1E-05	8.1E-05	8.1E-05	8.1E-05
Fe-59	8.9E-05	8.9E-05	8.9E-05	8.9E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.8E-04	1.8E-04	1.8E-04	1.8E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	4.4E-05	4.4E-05	4.4E-05	4.4E-05
Cu-67	9.4E-06	9.4E-06	9.4E-06	9.4E-06
Se-75	3.4E-05	3.4E-05	3.4E-05	3.4E-05
Sr-85	4.5E-05	4.5E-05	4.5E-05	4.5E-05
Sr-89	1.6E-07	1.6E-07	1.6E-07	1.6E-07
Sr-90	1.6E-08	1.6E-08	1.6E-08	1.6E-08
Y-91	2.7E-07	2.7E-07	2.7E-07	2.7E-07
Mo-93	5.4E-08	5.4E-08	5.4E-08	5.4E-08
Nb-93m	9.1E-09	9.1E-09	9.1E-09	9.1E-09
Nb-94	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Nb-95	6.4E-05	6.4E-05	6.4E-05	6.4E-05
Zr-95	6.1E-05	6.1E-05	6.1E-05	6.1E-05
Tc -99	3.6E-09	3.6E-09	3.6E-09	3.6E-09
Ru-103	4.4E-05	4.4E-05	4.4E-05	4.4E-05
Ru-106	1.7E-05	1.7E-05	1.7E-05	1.7E-05
Ag-108m	1.4E-04	1.4E-04	1.4E-04	1.4E-04
Cd-109	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Ag-110m	2.2E-04	2.2E-04	2.2E-04	2.2E-04
Sb-124	1.4E-04	1.4E-04	1.4E-04	1.4E-04
I-125	4.8E-07	4.8E-07	4.8E-07	4.8E-07
Sb-125	3.7E-05	3.7E-05	3.7E-05	3.7E-05
I-129	3.2E-07	3.2E-07	3.2E-07	3.2E-07
I-131	3.4E-05	3.4E-05	3.4E-05	3.4E-05
Ba-133	3.2E-05	3.2E-05	3.2E-05	3.2E-05
Cs-134	1.3E-04	1.3E-04	1.3E-04	1.3E-04

Table C.8 Geometry Factors for a small object close to the body (GF-6) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
Cs-137	5.1E-05	5.1E-05	5.1E-05	5.1E-05
Ce-141	5.7E-06	5.7E-06	5.7E-06	5.7E-06
Ce-144	3.3E-06	3.3E-06	3.3E-06	3.3E-06
Pm-147	2.7E-10	2.7E-10	2.7E-10	2.7E-10
Eu-152	8.8E-05	8.8E-05	8.8E-05	8.8E-05
Eu-154	9.6E-05	9.6E-05	9.6E-05	9.6E-05
Eu-155	3.2E-06	3.2E-06	3.2E-06	3.2E-06
Re-186	1.2E-06	1.2E-06	1.2E-06	1.2E-06
Ir- 192	7.4E-05	7.4E-05	7.4E-05	7.4E-05
Pb-210	8.7E-08	8.7E-08	8.7E-08	8.7E-08
Po-210	7.0E-10	7.0E-10	7.0E-10	7.0E-10
Bi-210	6.9E-08	6.9E-08	6.9E-08	6.9E-08
Rn-222	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Ra-223	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Ra-224	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ac-225	1.8E-05	1.8E-05	1.8E-05	1.8E-05
Ra-225	2.2E-07	2.2E-07	2.2E-07	2.2E-07
Ra-226	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Ac-227	3.4E-05	1.2E-05	3.4E-05	3.4E-05
Th-227	8.7E-06	8.7E-06	8.7E-06	8.7E-06
Th-228	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ra-228	6.6E-05	6.6E-05	6.6E-05	6.6E-05
Th-229	2.3E-05	1.1E-05	2.3E-05	2.3E-05
Th-230	5.3E-08	1.4E-08	7.8E-06	5.3E-07
Pa-231	2.5E-06	2.5E-06	3.6E-05	1.3E-05
Th-231	6.4E-07	6.4E-07	6.4E-07	6.4E-07
Th-232	8.6E-06	4.7E-07	1.7E-04	1.2E-04
Pa-233	1.8E-05	1.8E-05	1.8E-05	1.8E-05
U-233	4.4E-09	4.4E-09	4.4E-09	4.4E-09
Th-234	9.9E-07	9.9E-07	9.9E-07	9.9E-07
U-234	7.2E-09	7.2E-09	7.2E-09	7.2E-09
U-235	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Np-237	1.9E-05	8.4E-06	1.9E-05	1.9E-05
Pu-238	8.4E-09	8.4E-09	8.4E-09	8.4E-09
U-238	9.9E-07	4.0E-07	9.9E-07	9.9E-07
Pu-239	3.2E-09	3.2E-09	3.2E-09	3.2E-09
Pu-240	7.1E-09	7.1E-09	7.1E-09	7.1E-09
Pu-241	1.4E-09	1.7E-10	2.0E-05	1.4E-08
Am-241	6.7E-07	6.7E-07	6.7E-07	6.7E-07
Cm-242	1.3E-08	1.3E-08	8.4E+86	2.5E-04
Pu-242	6.7E-09	6.7E-09	6.7E-09	6.7E-09
Cm-244	1.1E-08	1.1E-08	1.1E-08	1.1E-08

Table C.9 Geometry Factors for inside an object or structure (GF-7) (mrem/hr per pCi/g)

Radionuclide	Early scenarios Single input	Early scenarios Continuous input	Late scenarios Single input	Late scenarios Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.4E-10	5.4E-10	5.4E-10	5.4E-10
Na-22	2.2E-03	2.2E-03	2.2E-03	2.2E-03
P-32	2.0E-07	2.0E-07	2.0E-07	2.0E-07
S-35	5.8E-10	5.8E-10	5.8E-10	5.8E-10
Cl-36	4.4E-08	4.4E-08	4.4E-08	4.4E-08
K-40	1.5E-04	1.5E-04	1.5E-04	1.5E-04
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.0E-09	2.0E-09	2.0E-09	2.0E-09
Cr-51	2.8E-05	2.8E-05	2.8E-05	2.8E-05
Mn-54	8.6E-04	8.6E-04	8.6E-04	8.6E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.5E-05	3.5E-05	3.5E-05	3.5E-05
Co-58	1.0E-03	1.0E-03	1.0E-03	1.0E-03
Fe-59	1.2E-03	1.2E-03	1.2E-03	1.2E-03
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.5E-03	2.5E-03	2.5E-03	2.5E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	5.9E-04	5.9E-04	5.9E-04	5.9E-04
Cu-67	5.6E-05	5.6E-05	5.6E-05	5.6E-05
Se-75	2.5E-04	2.5E-04	2.5E-04	2.5E-04
Sr-85	5.0E-04	5.0E-04	5.0E-04	5.0E-04
Sr-89	1.6E-07	1.6E-07	1.6E-07	1.6E-07
Sr-90	1.6E-08	1.6E-08	1.6E-08	1.6E-08
Y-91	3.6E-06	3.6E-06	3.6E-06	3.6E-06
Mo-93	3.8E-08	3.8E-08	3.8E-08	3.8E-08
Nb-93m	6.4E-09	6.4E-09	6.4E-09	6.4E-09
Nb-94	1.6E-03	1.6E-03	1.6E-03	1.6E-03
Nb-95	7.9E-04	7.9E-04	7.9E-04	7.9E-04
Zr-95	7.6E-04	7.6E-04	7.6E-04	7.6E-04
Tc -99	3.6E-09	3.6E-09	3.6E-09	3.6E-09
Ru-103	4.9E-04	4.9E-04	4.9E-04	4.9E-04
Ru-106	1.1E-03	1.1E-03	1.1E-03	1.1E-03
Ag-108m	1.6E-03	1.6E-03	1.6E-03	1.6E-03
Cd-109	1.4E-07	1.4E-07	1.4E-07	1.4E-07
Ag-110m	2.8E-03	2.8E-03	2.8E-03	2.8E-03
Sb-124	1.8E-03	1.8E-03	1.8E-03	1.8E-03
I-125	6.4E-07	6.4E-07	6.4E-07	6.4E-07
Sb-125	4.1E-04	4.1E-04	4.1E-04	4.1E-04
I-129	4.6E-07	4.6E-07	4.6E-07	4.6E-07
I-131	3.5E-04	3.5E-04	3.5E-04	3.5E-04
Ba-133	3.1E-04	3.1E-04	3.1E-04	3.1E-04
Cs-134	1.6E-03	1.6E-03	1.6E-03	1.6E-03

Table C.9 Geometry Factors for inside an object or structure (GF-7) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
Cs-137	6.1E-04	6.1E-04	6.1E-04	6.1E-04
Ce-141	2.6E-05	2.6E-05	2.6E-05	2.6E-05
Ce-144	3.2E-05	3.2E-05	3.2E-05	3.2E-05
Pm-147	2.7E-10	2.7E-10	2.7E-10	2.7E-10
Eu-152	1.1E-03	1.1E-03	1.1E-03	1.1E-03
Eu-154	1.2E-03	1.2E-03	1.2E-03	1.2E-03
Eu-155	8.7E-06	8.7E-06	8.7E-06	8.7E-06
Re-186	4.6E-06	4.6E-06	4.6E-06	4.6E-06
Ir- 192	7.4E-04	7.4E-04	7.4E-04	7.4E-04
Pb-210	1.4E-07	1.4E-07	1.4E-07	1.4E-07
Po-210	7.1E-10	7.1E-10	7.1E-10	7.1E-10
Bi-210	6.9E-08	6.9E-08	6.9E-08	6.9E-08
Rn-222	1.6E-03	1.6E-03	1.6E-03	1.6E-03
Ra-223	2.2E-04	2.2E-04	2.2E-04	2.2E-04
Ra-224	1.3E-03	1.3E-03	1.3E-03	1.3E-03
Ac-225	1.8E-04	1.8E-04	1.8E-04	1.8E-04
Ra-225	3.3E-07	3.3E-07	3.3E-07	3.3E-07
Ra-226	1.6E-03	1.6E-03	1.6E-03	1.6E-03
Ac-227	2.9E-04	1.0E-04	2.9E-04	2.9E-04
Th-227	6.9E-05	6.9E-05	6.9E-05	6.9E-05
Th-228	1.3E-03	1.3E-03	1.3E-03	1.3E-03
Ra-228	8.7E-04	8.7E-04	8.7E-04	8.7E-04
Th-229	2.0E-04	7.4E-05	2.0E-04	2.0E-04
Th-230	5.1E-07	2.2E-08	9.7E-05	6.5E-06
Pa-231	2.2E-05	2.2E-05	3.1E-04	1.1E-04
Th-231	1.4E-06	1.4E-06	1.4E-06	1.4E-06
Th-232	1.1E-04	6.1E-06	2.2E-03	1.5E-03
Pa-233	1.5E-04	1.5E-04	1.5E-04	1.5E-04
U-233	2.9E-09	2.9E-09	2.9E-09	2.9E-09
Th-234	8.6E-06	8.6E-06	8.6E-06	8.6E-06
U-234	6.8E-09	6.8E-09	6.8E-09	6.8E-09
U-235	7.9E-05	7.9E-05	7.9E-05	7.9E-05
Np-237	1.6E-04	6.4E-05	1.6E-04	1.6E-04
Pu-238	6.2E-09	6.2E-09	6.2E-09	6.2E-09
U-238	8.6E-06	3.4E-06	8.6E-06	8.6E-06
Pu-239	2.3E-09	2.3E-09	2.3E-09	2.3E-09
Pu-240	5.2E-09	5.2E-09	5.2E-09	5.2E-09
Pu-241	2.5E-09	2.2E-10	3.5E-05	2.4E-08
Am-241	1.2E-06	1.2E-06	1.2E-06	1.2E-06
Cm-242	1.0E-08	1.0E-08	6.2E+86	1.8E-04
Pu-242	5.3E-09	5.3E-09	5.3E-09	5.3E-09
Cm-244	8.8E-09	8.8E-09	8.8E-09	8.8E-09

Table C.10 Geometry Factors for inside a refinery baghouse (GF-8) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.2E-10	2.2E-10	2.2E-10	2.2E-10
Na-22	8.6E-05	8.6E-05	8.6E-05	8.6E-05
P-32	8.3E-08	8.3E-08	8.3E-08	8.3E-08
S-35	2.3E-10	2.3E-10	2.3E-10	2.3E-10
Cl-36	1.8E-08	1.8E-08	1.8E-08	1.8E-08
K-40	6.0E-06	6.0E-06	6.0E-06	6.0E-06
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	8.1E-10	8.1E-10	8.1E-10	8.1E-10
Cr-51	1.1E-06	1.1E-06	1.1E-06	1.1E-06
Mn-54	3.4E-05	3.4E-05	3.4E-05	3.4E-05
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	2.6E-06	2.6E-06	2.6E-06	2.6E-06
Co-58	4.0E-05	4.0E-05	4.0E-05	4.0E-05
Fe-59	4.7E-05	4.7E-05	4.7E-05	4.7E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.4E-05	1.4E-05	1.4E-05	1.4E-05
Cu-67	3.0E-06	3.0E-06	3.0E-06	3.0E-06
Se-75	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Sr-85	2.0E-05	2.0E-05	2.0E-05	2.0E-05
Sr-89	6.4E-08	6.4E-08	6.4E-08	6.4E-08
Sr-90	6.6E-09	6.6E-09	6.6E-09	6.6E-09
Y-91	1.4E-07	1.4E-07	1.4E-07	1.4E-07
Mo-93	5.6E-08	5.6E-08	5.6E-08	5.6E-08
Nb-93m	9.9E-09	9.9E-09	9.9E-09	9.9E-09
Nb-94	6.4E-05	6.4E-05	6.4E-05	6.4E-05
Nb-95	3.1E-05	3.1E-05	3.1E-05	3.1E-05
Zr-95	3.0E-05	3.0E-05	3.0E-05	3.0E-05
Tc-99	1.5E-09	1.5E-09	1.5E-09	1.5E-09
Ru-103	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Ru-106	8.4E-06	8.4E-06	8.4E-06	8.4E-06
Ag-108m	6.6E-05	6.6E-05	6.6E-05	6.6E-05
Cd-109	1.6E-07	1.6E-07	1.6E-07	1.6E-07
Ag-110m	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Sb-124	7.4E-05	7.4E-05	7.4E-05	7.4E-05
I-125	5.7E-07	5.7E-07	5.7E-07	5.7E-07
Sb-125	1.7E-05	1.7E-05	1.7E-05	1.7E-05
I-129	3.9E-07	3.9E-07	3.9E-07	3.9E-07
I-131	1.4E-05	1.4E-05	1.4E-05	1.4E-05
Ba-133	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Cs-134	6.3E-05	6.3E-05	6.3E-05	6.3E-05

Table C.10 Geometry Factors for inside a refinery baghouse (GF-8) (mrem/hr per pCi/g)

Radionuclide	Early scenarios: Single input	Early scenarios: Continuous input	Late scenarios: Single input	Late scenarios: Continuous input
Cs-137	2.3E-05	2.3E-05	2.3E-05	2.3E-05
Ce-141	1.8E-06	1.8E-06	1.8E-06	1.8E-06
Ce-144	1.6E-06	1.6E-06	1.6E-06	1.6E-06
Pm-147	9.0E-11	9.0E-11	9.0E-11	9.0E-11
Eu-152	4.5E-05	4.5E-05	4.5E-05	4.5E-05
Eu-154	5.0E-05	5.0E-05	5.0E-05	5.0E-05
Eu-155	1.2E-06	1.2E-06	1.2E-06	1.2E-06
Re-186	4.0E-07	4.0E-07	4.0E-07	4.0E-07
Ir- 192	3.0E-05	3.0E-05	3.0E-05	3.0E-05
Pb-210	8.5E-08	8.5E-08	8.5E-08	8.5E-08
Po-210	3.4E-10	3.4E-10	3.4E-10	3.4E-10
Bi-210	2.8E-08	2.8E-08	2.8E-08	2.8E-08
Rn-222	6.6E-05	6.6E-05	6.6E-05	6.6E-05
Ra-223	9.9E-06	9.9E-06	9.9E-06	9.9E-06
Ra-224	5.3E-05	5.3E-05	5.3E-05	5.3E-05
Ac-225	7.7E-06	7.7E-06	7.7E-06	7.7E-06
Ra-225	2.4E-07	2.4E-07	2.4E-07	2.4E-07
Ra-226	6.6E-05	6.6E-05	6.6E-05	6.6E-05
Ac-227	1.3E-05	4.6E-06	1.3E-05	1.3E-05
Th-227	3.2E-06	3.2E-06	3.2E-06	3.2E-06
Th-228	5.3E-05	5.3E-05	5.3E-05	5.3E-05
Ra-228	3.7E-05	3.7E-05	3.7E-05	3.7E-05
Th-229	9.5E-06	4.1E-06	9.5E-06	9.5E-06
Th-230	3.0E-08	9.9E-09	3.9E-06	2.7E-07
Pa-231	9.7E-07	9.7E-07	1.4E-05	4.9E-06
Th-231	3.0E-07	3.0E-07	3.0E-07	3.0E-07
Th-232	4.8E-06	2.6E-07	9.0E-05	6.3E-05
Pa-233	7.1E-06	7.1E-06	7.1E-06	7.1E-06
U-233	4.5E-09	4.5E-09	4.5E-09	4.5E-09
Th-234	4.7E-07	4.7E-07	4.7E-07	4.7E-07
U-234	6.6E-09	6.6E-09	6.6E-09	6.6E-09
U-235	4.0E-06	4.0E-06	4.0E-06	4.0E-06
Np-237	7.6E-06	3.3E-06	7.6E-06	7.6E-06
Pu-238	2.3E-09	2.3E-09	2.3E-09	2.3E-09
U-238	4.7E-07	1.9E-07	4.7E-07	4.7E-07
Pu-239	8.9E-10	8.9E-10	8.9E-10	8.9E-10
Pu-240	7.9E-09	7.9E-09	7.9E-09	7.9E-09
Pu-241	8.7E-10	7.3E-11	1.2E-05	8.4E-09
Am-241	4.2E-07	4.2E-07	4.2E-07	4.2E-07
Cm-242	3.9E-09	3.9E-09	2.3E+86	7.0E-05
Pu-242	6.7E-09	6.7E-09	6.7E-09	6.7E-09
Cm-244	3.5E-09	3.5E-09	3.5E-09	3.5E-09

Table C.11 Geometry Factors for the top of a baghouse truck (GF-9) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.7E-09	1.7E-09	1.7E-09	1.7E-09
Na-22	1.1E-03	1.1E-03	1.1E-03	1.1E-03
P-32	6.6E-07	6.6E-07	6.6E-07	6.6E-07
S-35	1.9E-09	1.9E-09	1.9E-09	1.9E-09
Cl-36	1.4E-07	1.4E-07	1.4E-07	1.4E-07
K-40	8.8E-05	8.8E-05	8.8E-05	8.8E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	6.4E-09	6.4E-09	6.4E-09	6.4E-09
Cr-51	1.1E-05	1.1E-05	1.1E-05	1.1E-05
Mn-54	4.3E-04	4.3E-04	4.3E-04	4.3E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	7.9E-06	7.9E-06	7.9E-06	7.9E-06
Co-58	4.9E-04	4.9E-04	4.9E-04	4.9E-04
Fe-59	6.5E-04	6.5E-04	6.5E-04	6.5E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.4E-03	1.4E-03	1.4E-03	1.4E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.1E-04	3.1E-04	3.1E-04	3.1E-04
Cu-67	1.7E-05	1.7E-05	1.7E-05	1.7E-05
Se-75	9.8E-05	9.8E-05	9.8E-05	9.8E-05
Sr-85	2.3E-04	2.3E-04	2.3E-04	2.3E-04
Sr-89	5.1E-07	5.1E-07	5.1E-07	5.1E-07
Sr-90	5.3E-08	5.3E-08	5.3E-08	5.3E-08
Y-91	2.0E-06	2.0E-06	2.0E-06	2.0E-06
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	8.0E-04	8.0E-04	8.0E-04	8.0E-04
Nb-95	3.9E-04	3.9E-04	3.9E-04	3.9E-04
Zr-95	3.7E-04	3.7E-04	3.7E-04	3.7E-04
Tc -99	1.2E-08	1.2E-08	1.2E-08	1.2E-08
Ru-103	2.2E-04	2.2E-04	2.2E-04	2.2E-04
Ru-106	9.4E-05	9.4E-05	9.4E-05	9.4E-05
Ag-108m	7.5E-04	7.5E-04	7.5E-04	7.5E-04
Cd-109	1.2E-31	1.2E-31	1.2E-31	1.2E-31
Ag-110m	1.4E-03	1.4E-03	1.4E-03	1.4E-03
Sb-124	9.7E-04	9.7E-04	9.7E-04	9.7E-04
I-125	2.1E-17	2.1E-17	2.1E-17	2.1E-17
Sb-125	1.8E-04	1.8E-04	1.8E-04	1.8E-04
I-129	6.9E-15	6.9E-15	6.9E-15	6.9E-15
I-131	1.5E-04	1.5E-04	1.5E-04	1.5E-04
Ba-133	1.2E-04	1.2E-04	1.2E-04	1.2E-04
Cs-134	7.7E-04	7.7E-04	7.7E-04	7.7E-04

Table C.11 Geometry Factors for the top of a baghouse truck (GF-9) (mrem/hr per pCi/g)

Radionuclide	Early scenarios Single input	Early scenarios Continuous input	Late scenarios Single input	Late scenarios Continuous input
Cs-137	2.9E-04	2.9E-04	2.9E-04	2.9E-04
Ce-141	7.3E-06	7.3E-06	7.3E-06	7.3E-06
Ce-144	1.8E-05	1.8E-05	1.8E-05	1.8E-05
Pm-147	2.2E-10	2.2E-10	2.2E-10	2.2E-10
Eu-152	5.5E-04	5.5E-04	5.5E-04	5.5E-04
Eu-154	6.4E-04	6.4E-04	6.4E-04	6.4E-04
Eu-155	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Re-186	1.1E-06	1.1E-06	1.1E-06	1.1E-06
Ir-192	3.1E-04	3.1E-04	3.1E-04	3.1E-04
Pb-210	2.8E-12	2.8E-12	2.8E-12	2.8E-12
Po-210	4.4E-09	4.4E-09	4.4E-09	4.4E-09
Bi-210	2.2E-07	2.2E-07	2.2E-07	2.2E-07
Rn-222	8.7E-04	8.7E-04	8.7E-04	8.7E-04
Ra-223	9.4E-05	9.4E-05	9.4E-05	9.4E-05
Ra-224	7.4E-04	7.4E-04	7.4E-04	7.4E-04
Ac-225	8.2E-05	8.2E-05	8.2E-05	8.2E-05
Ra-225	8.3E-14	8.3E-14	8.3E-14	8.3E-14
Ra-226	8.8E-04	8.8E-04	8.8E-04	8.8E-04
Ac-227	1.2E-04	4.1E-05	1.2E-04	1.2E-04
Th-227	2.4E-05	2.4E-05	2.4E-05	2.4E-05
Th-228	7.4E-04	7.4E-04	7.4E-04	7.4E-04
Ra-228	4.2E-04	4.2E-04	4.2E-04	4.2E-04
Th-229	8.7E-05	3.0E-05	8.7E-05	8.7E-05
Th-230	2.6E-07	2.6E-10	5.2E-05	3.5E-06
Pa-231	8.7E-06	8.7E-06	1.3E-04	4.4E-05
Th-231	1.7E-07	1.7E-07	1.7E-07	1.7E-07
Th-232	5.7E-05	3.0E-06	1.2E-03	8.1E-04
Pa-233	6.2E-05	6.2E-05	6.2E-05	6.2E-05
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	3.9E-06	3.9E-06	3.9E-06	3.9E-06
U-234	1.2E-12	1.2E-12	1.2E-12	1.2E-12
U-235	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Np-237	6.2E-05	2.5E-05	6.2E-05	6.2E-05
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	3.9E-06	1.6E-06	3.9E-06	3.9E-06
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	3.5E-10	3.5E-10	3.5E-10	3.5E-10
Pu-241	7.5E-11	6.7E-11	1.1E-07	1.4E-10
Am-241	3.9E-09	3.9E-09	3.9E-09	3.9E-09
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	1.1E-10	1.1E-10	1.1E-10	1.1E-10
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table C.12 Geometry Factors for inside a steel-framed structure (GF-10) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	9.6E-11	9.6E-11	9.6E-11	9.6E-11
Na-22	3.2E-05	3.2E-05	3.2E-05	3.2E-05
P-32	3.7E-08	3.7E-08	3.7E-08	3.7E-08
S-35	1.0E-10	1.0E-10	1.0E-10	1.0E-10
Cl-36	7.9E-09	7.9E-09	7.9E-09	7.9E-09
K-40	2.1E-06	2.1E-06	2.1E-06	2.1E-06
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.6E-10	3.6E-10	3.6E-10	3.6E-10
Cr-51	5.0E-07	5.0E-07	5.0E-07	5.0E-07
Mn-54	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.5E-06	1.5E-06	1.5E-06	1.5E-06
Co-58	1.5E-05	1.5E-05	1.5E-05	1.5E-05
Fe-59	1.7E-05	1.7E-05	1.7E-05	1.7E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	3.5E-05	3.5E-05	3.5E-05	3.5E-05
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	8.3E-10	8.3E-10	8.3E-10	8.3E-10
Cu-67	1.6E-06	1.6E-06	1.6E-06	1.6E-06
Se-75	5.7E-06	5.7E-06	5.7E-06	5.7E-06
Sr-85	7.9E-06	7.9E-06	7.9E-06	7.9E-06
Sr-89	2.8E-08	2.8E-08	2.8E-08	2.8E-08
Sr-90	2.9E-09	2.9E-09	2.9E-09	2.9E-09
Y-91	5.2E-08	5.2E-08	5.2E-08	5.2E-08
Mo-93	6.9E-09	6.9E-09	6.9E-09	6.9E-09
Nb-93m	1.2E-09	1.2E-09	1.2E-09	1.2E-09
Nb-94	2.4E-05	2.4E-05	2.4E-05	2.4E-05
Nb-95	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Zr-95	1.1E-05	1.1E-05	1.1E-05	1.1E-05
Tc-99	6.5E-10	6.5E-10	6.5E-10	6.5E-10
Ru-103	7.7E-06	7.7E-06	7.7E-06	7.7E-06
Ru-106	3.1E-06	3.1E-06	3.1E-06	3.1E-06
Ag-108m	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Cd-109	2.6E-08	2.6E-08	2.6E-08	2.6E-08
Ag-110m	4.0E-05	4.0E-05	4.0E-05	4.0E-05
Sb-124	2.6E-05	2.6E-05	2.6E-05	2.6E-05
I-125	1.2E-07	1.2E-07	1.2E-07	1.2E-07
Sb-125	6.5E-06	6.5E-06	6.5E-06	6.5E-06
I-129	8.4E-08	8.4E-08	8.4E-08	8.4E-08
I-131	5.9E-06	5.9E-06	5.9E-06	5.9E-06
Ba-133	5.6E-06	5.6E-06	5.6E-06	5.6E-06
Cs-134	2.4E-05	2.4E-05	2.4E-05	2.4E-05

Table C.12 Geometry Factors for inside a steel-framed structure (GF-10) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
Cs-137	9.1E-06	9.1E-06	9.1E-06	9.1E-06
Ce-141	9.7E-07	9.7E-07	9.7E-07	9.7E-07
Ce-144	6.1E-07	6.1E-07	6.1E-07	6.1E-07
Pm-147	4.9E-11	4.9E-11	4.9E-11	4.9E-11
Eu-152	1.6E-05	1.6E-05	1.6E-05	1.6E-05
Eu-154	1.8E-05	1.8E-05	1.8E-05	1.8E-05
Eu-155	6.5E-07	6.5E-07	6.5E-07	6.5E-07
Re-186	2.1E-07	2.1E-07	2.1E-07	2.1E-07
Ir-192	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Pb-210	2.4E-08	2.4E-08	2.4E-08	2.4E-08
Po-210	1.3E-10	1.3E-10	1.3E-10	1.3E-10
Bi-210	1.2E-08	1.2E-08	1.2E-08	1.2E-08
Rn-222	2.4E-05	2.4E-05	2.4E-05	2.4E-05
Ra-223	4.4E-06	4.4E-06	4.4E-06	4.4E-06
Ra-224	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Ac-225	3.2E-06	3.2E-06	3.2E-06	3.2E-06
Ra-225	6.1E-08	6.1E-08	6.1E-08	6.1E-08
Ra-226	2.4E-05	2.4E-05	2.4E-05	2.4E-05
Ac-227	5.8E-06	2.0E-06	5.8E-06	5.8E-06
Th-227	1.5E-06	1.5E-06	1.5E-06	1.5E-06
Th-228	1.9E-05	1.9E-05	1.9E-05	1.9E-05
Ra-228	1.2E-05	1.2E-05	1.2E-05	1.2E-05
Th-229	4.1E-06	1.9E-06	4.1E-06	4.1E-06
Th-230	1.0E-08	2.9E-09	1.5E-06	1.0E-07
Pa-231	4.3E-07	4.3E-07	6.3E-06	2.2E-06
Th-231	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Th-232	1.6E-06	8.7E-08	3.1E-05	2.2E-05
Pa-233	3.0E-06	3.0E-06	3.0E-06	3.0E-06
U-233	5.1E-10	5.1E-10	5.1E-10	5.1E-10
Th-234	2.0E-07	2.0E-07	2.0E-07	2.0E-07
U-234	1.1E-09	1.1E-09	1.1E-09	1.1E-09
U-235	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Np-237	3.3E-06	1.4E-06	3.3E-06	3.3E-06
Pu-238	1.1E-09	1.1E-09	1.1E-09	1.1E-09
U-238	2.0E-07	8.0E-08	2.0E-07	2.0E-07
Pu-239	4.2E-10	4.2E-10	4.2E-10	4.2E-10
Pu-240	9.4E-10	9.4E-10	9.4E-10	9.4E-10
Pu-241	3.7E-10	3.6E-11	5.2E-06	3.6E-09
Am-241	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Cm-242	1.8E-09	1.8E-09	1.1E+86	3.3E-05
Pu-242	9.4E-10	9.4E-10	9.4E-10	9.4E-10
Cm-244	1.6E-09	1.6E-09	1.6E-09	1.6E-09

Table C.13 Geometry Factors for inside a vehicle(GF-11) (mrem/hr per pCi/g)

	Early scenarios		Late scenarios	
Radionuclide	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	9.7E-10	9.7E-10	9.7E-10	9.7E-10
Na-22	4.6E-04	4.6E-04	4.6E-04	4.6E-04
P-32	3.7E-07	3.7E-07	3.7E-07	3.7E-07
S-35	1.0E-09	1.0E-09	1.0E-09	1.0E-09
Cl-36	7.9E-08	7.9E-08	7.9E-08	7.9E-08
K-40	3.3E-05	3.3E-05	3.3E-05	3.3E-05
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.6E-09	3.6E-09	3.6E-09	3.6E-09
Cr-51	6.1E-06	6.1E-06	6.1E-06	6.1E-06
Mn-54	1.8E-04	1.8E-04	1.8E-04	1.8E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	9.8E-06	9.8E-06	9.8E-06	9.8E-06
Co-58	2.1E-04	2.1E-04	2.1E-04	2.1E-04
Fe-59	2.6E-04	2.6E-04	2.6E-04	2.6E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.4E-04	5.4E-04	5.4E-04	5.4E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Cu-67	1.4E-05	1.4E-05	1.4E-05	1.4E-05
Se-75	6.0E-05	6.0E-05	6.0E-05	6.0E-05
Sr-85	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Sr-89	2.9E-07	2.9E-07	2.9E-07	2.9E-07
Sr-90	2.9E-08	2.9E-08	2.9E-08	2.9E-08
Y-91	7.8E-07	7.8E-07	7.8E-07	7.8E-07
Mo-93	1.7E-08	1.7E-08	1.7E-08	1.7E-08
Nb-93m	2.8E-09	2.8E-09	2.8E-09	2.8E-09
Nb-94	3.5E-04	3.5E-04	3.5E-04	3.5E-04
Nb-95	1.7E-04	1.7E-04	1.7E-04	1.7E-04
Zr-95	1.6E-04	1.6E-04	1.6E-04	1.6E-04
Tc -99	6.6E-09	6.6E-09	6.6E-09	6.6E-09
Ru-103	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ru-106	4.3E-05	4.3E-05	4.3E-05	4.3E-05
Ag-108m	3.4E-04	3.4E-04	3.4E-04	3.4E-04
Cd-109	5.1E-08	5.1E-08	5.1E-08	5.1E-08
Ag-110m	5.9E-04	5.9E-04	5.9E-04	5.9E-04
Sb-124	3.8E-04	3.8E-04	3.8E-04	3.8E-04
I-125	2.3E-07	2.3E-07	2.3E-07	2.3E-07
Sb-125	8.8E-05	8.8E-05	8.8E-05	8.8E-05
I-129	1.6E-07	1.6E-07	1.6E-07	1.6E-07
I-131	7.6E-05	7.6E-05	7.6E-05	7.6E-05
Ba-133	6.5E-05	6.5E-05	6.5E-05	6.5E-05
Cs-134	3.4E-04	3.4E-04	3.4E-04	3.4E-04

Table C.13 Geometry Factors for inside a vehicle(GF-11) (mrem/hr per pCi/g)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
Cs-137	1.3E-04	1.3E-04	1.3E-04	1.3E-04
Ce-141	7.1E-06	7.1E-06	7.1E-06	7.1E-06
Ce-144	7.1E-06	7.1E-06	7.1E-06	7.1E-06
Pm-147	2.8E-10	2.8E-10	2.8E-10	2.8E-10
Eu-152	2.3E-04	2.3E-04	2.3E-04	2.3E-04
Eu-154	2.6E-04	2.6E-04	2.6E-04	2.6E-04
Eu-155	2.6E-06	2.6E-06	2.6E-06	2.6E-06
Re-186	1.3E-06	1.3E-06	1.3E-06	1.3E-06
Ir- 192	1.6E-04	1.6E-04	1.6E-04	1.6E-04
Pb-210	4.7E-08	4.7E-08	4.7E-08	4.7E-08
Po-210	1.8E-09	1.8E-09	1.8E-09	1.8E-09
Bi-210	1.2E-07	1.2E-07	1.2E-07	1.2E-07
Rn-222	3.5E-04	3.5E-04	3.5E-04	3.5E-04
Ra-223	4.9E-05	4.9E-05	4.9E-05	4.9E-05
Ra-224	2.8E-04	2.8E-04	2.8E-04	2.8E-04
Ac-225	3.9E-05	3.9E-05	3.9E-05	3.9E-05
Ra-225	1.1E-07	1.1E-07	1.1E-07	1.1E-07
Ra-226	3.6E-04	3.6E-04	3.6E-04	3.6E-04
Ac-227	6.5E-05	2.3E-05	6.5E-05	6.5E-05
Th-227	1.6E-05	1.6E-05	1.6E-05	1.6E-05
Th-228	2.8E-04	2.8E-04	2.8E-04	2.8E-04
Ra-228	1.7E-04	1.7E-04	1.7E-04	1.7E-04
Th-229	4.5E-05	1.7E-05	4.5E-05	4.5E-05
Th-230	1.1E-07	7.2E-09	2.1E-05	1.4E-06
Pa-231	4.9E-06	4.9E-06	7.0E-05	2.4E-05
Th-231	4.7E-07	4.7E-07	4.7E-07	4.7E-07
Th-232	2.3E-05	1.2E-06	4.5E-04	3.1E-04
Pa-233	3.4E-05	3.4E-05	3.4E-05	3.4E-05
U-233	1.3E-09	1.3E-09	1.3E-09	1.3E-09
Th-234	1.9E-06	1.9E-06	1.9E-06	1.9E-06
U-234	2.5E-09	2.5E-09	2.5E-09	2.5E-09
U-235	2.0E-05	2.0E-05	2.0E-05	2.0E-05
Np-237	3.5E-05	1.5E-05	3.5E-05	3.5E-05
Pu-238	2.5E-09	2.5E-09	2.5E-09	2.5E-09
U-238	1.9E-06	7.7E-07	1.9E-06	1.9E-06
Pu-239	1.0E-09	1.0E-09	1.0E-09	1.0E-09
Pu-240	2.2E-09	2.2E-09	2.2E-09	2.2E-09
Pu-241	8.6E-10	1.4E-10	1.1E-05	7.7E-09
Am-241	3.8E-07	3.8E-07	3.8E-07	3.8E-07
Cm-242	4.2E-09	4.2E-09	2.5E+86	7.6E-05
Pu-242	2.4E-09	2.4E-09	2.4E-09	2.4E-09
Cm-244	3.7E-09	3.7E-09	3.7E-09	3.7E-09

Table C.14 Geometry Factors for inside a sphere with surface contamination (GF-12) (mrem/hr per pCi/cm²)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	6.0E-10	6.0E-10	6.0E-10	6.0E-10
Na-22	1.4E-04	1.4E-04	1.4E-04	1.4E-04
P-32	2.3E-07	2.3E-07	2.3E-07	2.3E-07
S-35	6.5E-10	6.5E-10	6.5E-10	6.5E-10
Cl-36	4.9E-08	4.9E-08	4.9E-08	4.9E-08
K-40	8.7E-06	8.7E-06	8.7E-06	8.7E-06
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.2E-09	2.2E-09	2.2E-09	2.2E-09
Cr-51	2.3E-06	2.3E-06	2.3E-06	2.3E-06
Mn-54	5.3E-05	5.3E-05	5.3E-05	5.3E-05
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	6.9E-06	6.9E-06	6.9E-06	6.9E-06
Co-58	6.3E-05	6.3E-05	6.3E-05	6.3E-05
Fe-59	7.0E-05	7.0E-05	7.0E-05	7.0E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.5E-04	1.5E-04	1.5E-04	1.5E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.5E-05	3.5E-05	3.5E-05	3.5E-05
Cu-67	7.0E-06	7.0E-06	7.0E-06	7.0E-06
Se-75	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Sr-85	3.5E-05	3.5E-05	3.5E-05	3.5E-05
Sr-89	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Sr-90	1.8E-08	1.8E-08	1.8E-08	1.8E-08
Y-91	2.1E-07	2.1E-07	2.1E-07	2.1E-07
Mo-93	1.6E-06	1.6E-06	1.6E-06	1.6E-06
Nb-93m	2.8E-07	2.8E-07	2.8E-07	2.8E-07
Nb-94	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Nb-95	5.0E-05	5.0E-05	5.0E-05	5.0E-05
Zr-95	4.8E-05	4.8E-05	4.8E-05	4.8E-05
Tc-99	4.1E-09	4.1E-09	4.1E-09	4.1E-09
Ru-103	3.4E-05	3.4E-05	3.4E-05	3.4E-05
Ru-106	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Ag-108m	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Cd-109	2.5E-06	2.5E-06	2.5E-06	2.5E-06
Ag-110m	1.7E-04	1.7E-04	1.7E-04	1.7E-04
Sb-124	1.1E-04	1.1E-04	1.1E-04	1.1E-04
I-125	5.8E-06	5.8E-06	5.8E-06	5.8E-06
Sb-125	3.1E-05	3.1E-05	3.1E-05	3.1E-05
I-129	3.1E-06	3.1E-06	3.1E-06	3.1E-06
I-131	2.7E-05	2.7E-05	2.7E-05	2.7E-05
Ba-133	3.0E-05	3.0E-05	3.0E-05	3.0E-05
Cs-134	1.0E-04	1.0E-04	1.0E-04	1.0E-04

Table C.14 Geometry Factors for inside a sphere with surface contamination (GF-12) (mrem/hr per pCi/cm²)

Radionuclide	Early scenarios		Late scenarios	
	Single input	Continuous input	Single input	Continuous input
Cs-137	4.0E-05	4.0E-05	4.0E-05	4.0E-05
Ce-141	4.7E-06	4.7E-06	4.7E-06	4.7E-06
Ce-144	2.8E-06	2.8E-06	2.8E-06	2.8E-06
Pm-147	2.7E-10	2.7E-10	2.7E-10	2.7E-10
Eu-152	7.1E-05	7.1E-05	7.1E-05	7.1E-05
Eu-154	7.5E-05	7.5E-05	7.5E-05	7.5E-05
Eu-155	3.7E-06	3.7E-06	3.7E-06	3.7E-06
Re-186	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Ir- 192	5.7E-05	5.7E-05	5.7E-05	5.7E-05
Pb-210	5.7E-07	5.7E-07	5.7E-07	5.7E-07
Po-210	5.4E-10	5.4E-10	5.4E-10	5.4E-10
Bi-210	7.8E-08	7.8E-08	7.8E-08	7.8E-08
Rn-222	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ra-223	2.0E-05	2.0E-05	2.0E-05	2.0E-05
Ra-224	7.9E-05	7.9E-05	7.9E-05	7.9E-05
Ac-225	1.4E-05	1.4E-05	1.4E-05	1.4E-05
Ra-225	1.4E-06	1.4E-06	1.4E-06	1.4E-06
Ra-226	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Ac-227	2.7E-05	9.7E-06	2.7E-05	2.7E-05
Th-227	7.6E-06	7.6E-06	7.6E-06	7.6E-06
Th-228	8.0E-05	8.0E-05	8.0E-05	8.0E-05
Ra-228	5.3E-05	5.3E-05	5.3E-05	5.3E-05
Th-229	2.0E-05	1.0E-05	2.0E-05	2.0E-05
Th-230	2.2E-07	1.8E-07	6.3E-06	5.9E-07
Pa-231	3.3E-06	3.3E-06	3.1E-05	1.1E-05
Th-231	3.5E-06	3.5E-06	3.5E-06	3.5E-06
Th-232	7.0E-06	5.4E-07	1.3E-04	9.3E-05
Pa-233	1.5E-05	1.5E-05	1.5E-05	1.5E-05
U-233	1.4E-07	1.4E-07	1.4E-07	1.4E-07
Th-234	1.2E-06	1.2E-06	1.2E-06	1.2E-06
U-234	1.7E-07	1.7E-07	1.7E-07	1.7E-07
U-235	1.0E-05	1.0E-05	1.0E-05	1.0E-05
Np-237	1.8E-05	9.2E-06	1.8E-05	1.8E-05
Pu-238	2.4E-07	2.4E-07	2.4E-07	2.4E-07
U-238	1.4E-06	6.5E-07	1.4E-06	1.4E-06
Pu-239	9.3E-08	9.3E-08	9.3E-08	9.3E-08
Pu-240	2.1E-07	2.1E-07	2.1E-07	2.1E-07
Pu-241	4.6E-09	3.4E-10	6.5E-05	4.5E-08
Am-241	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Cm-242	3.5E-07	3.5E-07	2.4E+88	7.3E-03
Pu-242	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Cm-244	3.1E-07	3.1E-07	3.1E-07	3.1E-07

APPENDIX D

MIXING OF CLEARED MATERIAL

CONTENTS

Tables

D MIXING OF CLEARED MATERIAL

The goal of the analysis of clearance of equipment and material is to develop realistic scenarios based on actual industry practices. The possible mixing of cleared scrap metal from licensees with similar material from non-nuclear facilities has a direct and potentially large effect on the estimated concentrations of radionuclides used as input to the exposure scenarios. Therefore the potential for mixing of cleared scrap must be incorporated into the modeling, and it must be done using assumptions that represent current industry practice to the maximum extent possible. It is possible that significant mixing of cleared scrap will occur, although the degree of mixing is difficult to predict because under clearance of material no uses are precluded. The discussion in this section supports the development of scrap mixing assumptions by addressing the issue of mixing of cleared material in the context current industry practices.

D.1 Definition of Mixing

In the context of clearance of material, mixing refers to the mixing of cleared material from NRC licensees with similar material from sources other than NRC licensees (i.e., non-nuclear facilities). For example, scrap from a licensee could be transported to a scrap yard, where it could be mixed with the existing inventory of scrap at the yard. This mixed scrap could then be transported to a refinery where it could be mixed with material from other scrap yards, prior to melting and generation of refined metal and other co-products. Mixing of cleared material reduces the calculated impacts from recycle and disposal in a linear fashion, i.e., a 10× mixing would result in a 10× reduction in the calculated dose factors as compared to no mixing.

The calculated ranges of potential mixing were incorporated in the material flow models for each material by establishing the appropriate range of values for the masses of input materials (cleared material and other material), based on the calculated mixing ranges. There is no basis for a best estimate value, so the distributions for input masses were initially specified as uniform. Then, because of the large range of the resulting mass values (a range often greater than a factor of 10×), the distributions actually used in the calculational models for mass values were specified as log-uniform.

D.2 Difficulty of Estimating Mixing

Estimates of mixing depend heavily upon assumptions about the spatial and temporal patterns of the clearance of material from licensees, as well as on assumed future recycle industry practices. At one extreme of the mixing issue, a set of assumptions could be postulated that would have cleared material from licensees imperceptibly entering the existing public domain over many years, thereby being mixed to a large degree by whatever amount of similar material is generated in the geographic region over the same time frame. For a well-developed industry like the steel scrap industry, this situation could result in a dilution of residual radioactivity concentrations by a factor of 1000× or more.

At the other extreme, very little or no mixing would occur if material to be cleared is stockpiled and cleared from licensees over a much shorter period of time. This assumption could be combined with one of general avoidance of cleared material by the recycle industry due to its origin, and isolation from other material. For steel scrap, this would be the case if one or a very small number of low-capacity refineries accepted cleared scrap in large quantities from a local utility, e.g., in the case of decommissioning a large power plant. Also, a small refinery dedicated to melting licensee scrap may be able to negotiate favorable terms with distant facilities and thus accept scrap from a larger geographic region than is currently economical for scrap.

An approach midway between these two extremes is taken by the EPA for the recycle of steel scrap. They examined the geographic distribution of large amounts of potential licensee scrap steel associated with nuclear power plants and considered the economics of shipping scrap to steel refineries (EPA 1997). This regional and time-dependent analysis suggests that licensee scrap is likely to be mixed by a minimum factor of about 10 even for areas with large amounts of scrap available for release over fairly short periods of time. The EPA data were reviewed and used in the development of mixing estimates for this analysis.

D.3 Mixing Assumptions for Steel Scrap

Ranges for two estimates of mixing have been made for clearance of steel scrap. The first ("single charge") is appropriate for those scenarios that involve potential exposure to material (scrap or refinery co-products) containing radionuclide concentrations resulting from one, or at most a few sequential, refinery charges. This would include the product use scenarios, where many types of constructions and consumer products could be made from a single refinery furnace charge. A second estimate was made for those scenarios that involve material that would most likely contain average radionuclide concentrations from many refinery furnace charges ("annual average"). The annual average estimate is appropriate for most scenarios, including handling and processing scenarios, as well as scenarios for disposal activities, landfill resident, storage, transport, and refinery atmospheric releases (see Table D.1). The range of mixing estimates is defined by the use of a minimum and maximum value for each of the two types of estimates.

D.3.1 Single Charge Mixing for Steel Scrap

It is possible that a refined metal product could be manufactured from a single furnace charge consisting entirely of cleared licensee scrap metal. This could be the case if a large shipment of licensee scrap were received at a scrapyard and in turn transported to a refinery relatively intact, as when the shipment consisted of relatively clean and homogeneous scrap material. It could also occur if scrap from several licensees were stockpiled and shipped together. The refinery products could include many construction and consumer products, but is most likely to occur for small consumer products such as household items.

Table D.1 Application of mixing assumptions to steel scenarios[a]

Single charge (0.2 to 1.0)	Annual average (0.01 to 0.2)
FE-METL-LGMASS-N	FE-SCRP-HANDLIN-W
FE-METL-SMMASS-N	FE-SLAG-HANDLIN-W
FE-METL-SMOBJCT-N	FE-EAFD-HANDLIN-W
FE-METL-VEHICLE-N	FE-EAFD-BAGHOUS-W
FE-METL-BLDGSTR-N	FE-METL-HANDREF-W
	FE-BOFM-HANDMAN-W
	FE-METL-HANDDIS-W
	FE-EAFD-PROCESS-W
	FE-SLAG-PROCESS-W
	FE-ATMO-REFINER-N
	FE-SLAG-STORAGE-N
	FE-SLAG-CONCBAS-N
	FE-SLAG-ROADBED-N
	FE-SLAG-ROADBED-W
	FE-SCRP-TRANSPO-W
	FE-SLAG-TRANSPO-W
	FE-EAFD-TRANSPO-W
	FE-METL-TRANSPO-W
	FE-BOFD-DISPOSL-W
	FE-SLAG-DISPOSL-W
	FE-SCRP-DISPOSL-W
	FE-EAFD-DISPOSL-W
	FE-BOFD-LANDFIL-N
	FE-SLAG-LANDFIL-N
	FE-SCRP-LANDFIL-N
	FE-EAFD-LANDFIL-N

a. Corresponding copper and aluminum scenarios use the same mixing assumption as these steel scenarios

The goal of this analysis is to incorporate current industry practices, therefore the characteristics of steel industry scrap refineries was used for this mixing estimate. Industry information relevant to the "single charge" mixing consists primarily of knowledge of EAF refinery furnace sizes (range 20 t - 360 t, average of 88 t [AISE 1993]). Even the smallest furnaces are large enough that a great many types of consumer products could result from a single furnace charge. It is possible—perhaps even likely—that scrap from a single licensee could remain together through processing at a scrap yard or refinery, and could end up entering a single furnace charge. If a single, 20-t truck-load of scrap were input to one of the smaller furnaces, an upper-end assumption of no mixing can reasonably be expected for some consumer products.

$$\textit{High-end single charge mixing} = \frac{20\ t\ \textit{truckload}}{20\ t\ \textit{furnace}} = 1.0$$

For the low-end of the "product use" mixing, a similar argument can be used. For example, if a single, 20-t truck-load of scrap were input to an average size EAF furnace, a mixing factor of approximately 0.2 is calculated.

$$\text{Low-end single charge mixing} = \frac{20\ t\ \text{truckload}}{88\ t\ \text{furnace}} \approx 0.2$$

There is no defensible basis for a best estimate, therefore a uniform distribution over the mixing range of 0.2 - 1.0 was used to calculate input masses for the "single charge" steel scrap material flow model. These mixing factors were applied to the total scrap input to a furnace to calculate the masses of cleared and other scrap input to a furnace. A total scrap input of 8.81 E+07 g/charge was used for an EAF, and a value of 5.81E+07 g/charge was used for the BOF. The calculated scrap input values are listed in Appendix B.

D.3.2 Annual Average Mixing for Steel Scrap

Information available to use for estimating an annual average mixing estimate consists of two sets of information: availability of licensee scrap, and steel industry characteristics. Data on licensee scrap consist of estimates of the total amount of scrap available from licensees, the total annual amount available, the amount available in a geographic region, and the fraction of each of the preceding amounts that would be suitable for recycling (based on radioactive contamination levels). This information has been developed previously in various formats (e.g., Bryan and Dudley 1974; NRC 1994; NUREG/CR-5610[1]), and more recently by the EPA as part of their evaluation of recycling scrap metals (EPA 1997). The draft EPA Technical Support Document (TSD) (EPA 1997) contains estimates of the time-dependent nature of the generation of steel scrap from NRC licensees. In addition, the draft TSD contains an estimate of the fraction of total scrap from licensees that would be contaminated at levels appropriate for recycling (i.e., not contamination-free, but also not excessively contaminated); the fraction suitable for recycle used by EPA is approximately 15% of total licensee steel scrap. Other studies have estimated higher fractions (on the order of 50% [Charles and Smith, 1992]), although it is pointed out that this fraction is dependent on type of facility, operating history, and the numerical value of the clearance level(s) assumed for release. These values contain variability and uncertainty, including technical factors (e.g., effectiveness of decontamination techniques), data quality factors (e.g., accuracy of reactor facility metal mass estimates and accuracy of decommissioning schedule estimates), and social/economic factors (e.g., nuclear and steel industries responses to clearance).

The absolute range of possible values for this mixing estimate is 0.0 to 1.0 (i.e., no cleared material recycled up to 100% of a refinery capacity consisting of cleared material, respectively). However, neither of these two extremes is reasonable(0.0 is outside the scope of the analysis, and 1.0 is very unlikely to occur over an entire one-year period). If the entire range of available supporting information is considered, the potential range is only slightly reduced (various combinations of available licensee scrap and industry characteristics yield mixing factors ranging

[1]"Recycle/Reuse Literature Search Report," SAIC, 1994, scheduled to be published as NUREG/CR-5610.

from 0.0004 up to values greater than 1.0). However, if data considerations are restricted to more "realistic" situations, a smaller range can be estimated.

Relevant current steel scrap industry characteristics used here are regional and individual refinery scrap metal capacities. Although individual refinery capacities cover a wide range (e.g., 50,000 t/y to greater than 2 million t/y), a representative annual capacity is 300,000 t/y; for many furnaces, 95% of this capacity could be filled with scrap metal. In order to estimate a reasonably-expected value for capacity, it is also assumed that a single geographic region contains four average-capacity steel refineries, and the combined capacities of these four refineries is used as the capacity to process cleared scrap from a geographic region. This assumption is adopted from the regional analysis contained in EPA's TSD (EPA 1997).

An estimate of the annual amount of licensee scrap available within a geographic region (approximately 100,000 t) was obtained from EPS's TSD (EPA 1997). If this amount is assumed to be mixed with the scrap capacity of a single, average-sized refinery [approximately 450,000 t (AISE 1993)], a mixing factor of approximately 0.2 can be calculated for the upper-end of the range for an annual average estimate.

$$\textit{High-end annual average mixing:} = \frac{100{,}000\ \textit{t/y available in region}}{450{,}000\ \textit{t/y single refinery capacity}} \approx 0.2$$

For a low-end estimate, the amount of *suitable* scrap (not excessively contaminated) within a geographic region [20,000 t (EPA 1997)] can be mixed with the scrap capacity of four average refineries (1.8E+06 t):

$$\textit{Low-end annual average mixing:} = \frac{20{,}000\ \textit{t/y suitable in region}}{(4 \times 450{,}000\ \textit{t/y})\ \textit{regional capacity}} \approx 0.01$$

Although mixing estimates above and below these values are possible, this discussion represents the basis for a reasonable range. There is no defensible basis for a best estimate, therefore a uniform distribution over the range of 0.01 - 0.2 was used to calculate input masses for the "annual average" steel scrap material flow model. As with the single charge estimates these mixing factors were applied to the total scrap input to a furnace to calculate the masses of cleared and other scrap input to a furnace.

As a comparison to the ranges determined here, the EPA draft TSD uses values in the range 0.11 to 1.0 (specific values used are 0.11, 0.115, 0.13, 1.0), and the IAEA (IAEA 1992) suggests values in the range 0.1 to 1.0 (specific values used are 0.1, 0.5, 1). The TSD contains an explanation for the choices of the factors used, but no basis is given for the IAEA values.

D.4 Mixing Assumptions for Copper and Aluminum Scrap

Similar to steel scrap, ranges for two mixing estimates have been made for clearance of copper and aluminum scrap. The single charge mixing factor is appropriate for those scenarios that involve potential exposure to material (scrap or refinery co-products) containing radionuclide concentrations resulting from one, or at most a few sequential, refinery charges. An annual average mixing factor estimate was made for those scenarios that involve material that would most likely contain average radionuclide concentrations from many refinery furnace charges. The copper and aluminum ranges are defined by the use of a minimum and maximum value for each of the two types of estimates.

Even though there are several aspects of both the current copper and aluminum industries that could actually tend to *decrease* mixing (fewer refineries, smaller refineries, smaller overall industry), there are much smaller amounts of copper and aluminum scrap at licensees that could potentially be cleared. This represents an over-riding factor that would tend to increase mixing of cleared copper and aluminum scrap. The maximum annual mass of copper scrap postulated to be available from NRC licensees is approximately 8,000 t, and the corresponding value for aluminum scrap is 200 t (EPA, 1997). These represent less than 20% and less than 1% of typical annual refinery capacities in the secondary copper and aluminum industries, respectively. Even if the all of the entire annual available suitable scrap were processed at a single refinery, the available masses would represent only 2%of the capacity of a copper refinery and less than 1% of an aluminum refinery. The following equations show the calculations for the copper and aluminum mixing factors. Average copper and aluminum refinery capacities were taken from Volume 1 of this report. Regional amounts were estimated from the information in EPA (1997); including the estimate that 33% of annual available scrap is from a single region, and that 15% of total scrap available is suitable for recycling.

Copper scrap:

Single charge:

$$\textit{High-end single charge mixing:}\ \frac{20\ t\ truckload}{20\ t\ furnace} = 1.0$$

$$\textit{Low-end single charge mixing:}\ \frac{20\ t\ truckload}{227\ t\ furnace} \approx 0.1$$

Annual average:

$$\textit{High-end annual average mixing:}\quad \frac{1{,}800 \text{ t/y available in region}}{45{,}000 \text{ t/y single refinery capacity}} \approx 0.04$$

$$\textit{Low-end annual average mixing:}\quad \frac{270 \text{ t/y suitable in region}}{45{,}000 \text{ t/y single refinery capacity}} \approx 0.006$$

Similar to steel, these mixing factors were applied to the total scrap input to calculate the masses of cleared and other scrap input to a copper furnace. Copper scrap is primarily used in a reverberatory furnace. A total scrap input of 2.27 E+08 g/charge was used for a reverberatory furnace. The calculated scrap input values for copper are listed in Appendix B.

Aluminum scrap (2t is a reasonable truckload for aluminum scrap):

Single charge:

$$\textit{High-end single charge mixing:}\quad \frac{2 \text{ t truckload}}{50 \text{ t furnace}} = 0.04$$

$$\textit{Low-end single charge mixing:}\quad \frac{2 \text{ t truckload}}{200 \text{ t furnace}} \approx 0.01$$

Annual ave^rage:

$$\textit{High-end annual average mixing:}\quad \frac{48 \text{ t/y available in region}}{50{,}000 \text{ t/y refinery capacity}} \approx 0.001$$

$$\textit{Low-end annual average mixing:}\quad \frac{7 \text{ t/y suitable in region}}{50{,}000 \text{ t/y refinery capacity}} \approx 0.0001$$

Similar to steel and copper, these mixing factors were applied to the total scrap input to calculate the masses of cleared and other scrap input to an aluminum furnace. A total scrap input of

4.47 E+07 g/charge was used for an aluminum furnace. The calculated scrap input values for aluminum are listed in Appendix B.

D.5 Mixing Assumptions for Concrete Debris

The material flow model for cleared concrete simulates the processing of concrete debris into aggregate. There is only one point at which the original concrete debris concentration is potentially changed: dilution with other concrete debris or aggregate before being processed. Processing involves removal of rebar, followed by crushing and sizing the concrete. Concrete is not likely to be cleared during normal operations of a nuclear facility. It is more likely that large masses of concrete would be cleared during the decommissioning of a facility. This would result in a large amount of concrete available to be recycled during a short period of time. According to the Task 1 report (NUREG/CR-5610), decommissioning a typical large pressurized water reactor (PWR) and boiling water reactor (BWR) would result in about 180,000 t and 350,000 t of concrete, respectively. A typical concrete facility can process about 227,000 t (250,000 tons) of concrete (Dykes 1997).

When using recycled concrete to make end products, such as large items (e.g., non-structural concrete blocks) or asphalt, a small amount of additives is added to the aggregate, in order to promote adhesion. A value of 5% of the concrete debris is typically the maximum amount added. When the processed concrete is used as aggregate, such as base for a roadbed, no additives are added during processing.

Based on the values above, if the concrete debris from one PWR were sent to a single processing facility, it would constitute about 80% of the annual amount processed. If the concrete debris from a single BWR were to be sent to one processing facility it would make up more that 100% of the annual capacity. Furthermore, if the recycled concrete is used in a large roadway project, it is likely that one aggregate supplier would be used for the entire project. Therefore all the aggregate used would come from a single facility.

In order to incorporate the potential mixing of cleared concrete debris with other concrete and additives during processing, a range of mixing values is calculated as follows:

$$\textit{concrete mixing:}\ \frac{(\textit{mass of cleared concrete})}{\textit{mass of}\ (\textit{cleared concrete} + \textit{other concrete debris} + \textit{additives})}$$

For recycle exposure scenarios involving large concrete objects, the calculated range of mixing factors is from 0.8 to 0.95 (mixing with 5% to 25% other material). For all other scenarios, calculated the range of mixing factors is from 0.83 to 1.0 (mixing with 0% to 20% other material). There is no defensible basis for a best estimate, therefore uniform distributions over these ranges were used to calculate input masses for the "large object" and "all other" concrete dilution material flow models. A processing capacity of 2.27 E+ 11 g/y was used. The calculated values for input masses are listed in Appendix B.

D.6 References

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APPENDIX E

RADIOACTIVE DECAY AND PROGENY INGROWTH

CONTENTS

Tables

E RADIOACTIVE DECAYAND PROGENY INGROWTH

This appendix describes the conventions used to model radioactive decay of radionuclides, and the ingrowth of progeny radionuclides over the time periods assumed for scenario evaluations. The goal of the modeling was to describe decay and ingrowth as realistically as possible (i.e., minimize intentional conservative bias) within the limitations of a prospective dose assessment. The modeling scheme is based on *dose effect* rather than solely on *ingrowth* of progeny radioactivity levels. That is, the dose effects of progeny ingrowth were examined first, followed by an evaluation of radioactivity ingrowth.

The scenarios included in the overall assessment involve many different types of scenarios. For radioactive decay and progeny ingrowth, a key factor is the way that residual radioactivity is introduced to the scenario.

The following procedure was used to address radioactive decay and progeny ingrowth:

1. All radionuclides that do not have radioactive progeny or that have very short half lives (less than 30 days) were identified. These radionuclides were eliminated from further consideration for incorporation of progeny dose effects. Those radionuclides with short half lives were eliminated because it is unlikely that they would be present except as part of another decay chain.

> 48 radionuclides were identified and eliminated from further consideration in this step. This includes 9 radionuclides with very short half lives (Rn-222, Ra-223, Ra-224, Ra-225, Ac-225, Th-227, Th-231, Th-234, and Pa-233).

2. Of the remaining radionuclides, all radionuclides with progeny that have very short half lives and reach equilibrium with the parent in a very short time (i.e., within 1 day) were identified. For these radionuclides, all progeny were assumed to be in equilibrium with the parent at all times (see step #7), and no further progeny considerations were needed.

> 8 parent/progeny radionuclides were identified and assumed to be in equilibrium at all times (Sr-90/Y-90, Ru-103/Rh-103m, Ru-106/Rh-106, Ag-108m/Ag-108, Cd-109/Ag-109m, Ag-110m/Ag-110, Cs-137/Ba-137m, and Ce-144/Pr-144m/Pr-144).

To incorporate progeny radiations into these parent radionuclides, the progeny dose conversion factor (DCF) was multiplied by the decay branching fraction, and then added to the parent DCF; this modified DCF was then multiplied by the parent radioactivity as follows:

$$\text{Parent Dose} = \text{parent radioactivity} \times [\, DCF_{parent} + (BR \times DCF_{daughter})\,]$$

where BR is the decay branching ratio. For radionuclides in this group, the progeny dose effect is constant over time.

3. For the remaining radionuclides, the effect on each exposure pathway dose resulting from progeny ingrowth for critical time periods was evaluated. For this step, two critical time periods are identified:

   a. For scenarios that involve a continuous input of material (e.g., refinery worker scenarios), the critical time is the time prior to the beginning of the scenario, i.e. from clearance up to the time at which the scenario occurs;
   b. For scenarios that involve a single input of material (e.g., use of refined metal product scenarios), the critical time is the 1-year period following beginning of the scenario.

These two types of scenarios must be considered because of the different manner in which residual radioactivity would be introduced into the scenario, and the resulting different ways that an individual might be exposed to residual radioactivity. These two scenario types also determine the incorporation of a decay factor into the introduced residual radioactivity. The decay factor (DK) integrates the decay of parent radioactivity over the one-year period of exposure. For scenarios in category 3(a) above, i.e., those that involve a continuous input of material, adjustment for decay over the period of exposure is not necessary because residual radioactivity is modeled as being introduced to the scenario on a regular basis, and the duration of exposure to any one input of residual radioactivity is small compared to most half lives. For scenarios in category 3(b) above, i.e., that involve a single input of material, an integrated decay over the exposure time is appropriate because only a single source of residual radioactivity is introduced to the scenario, and the duration of exposure is over a one-year period.

4. If there is no change in the dose factor for any exposure pathway (no greater than a 2× increase in any exposure pathway) over either time period, the ingrowth of progeny was ignored. A factor of 2× is convenient and appropriate, and was used because previous analyses conducted for this assessment indicated that the final doses are generally not known any better than this. Progeny dose effects were thus considered and were determined to be negligible for these radionuclides, so progeny for these radionuclides are considered to be implicitly incorporated.

   13 radionuclides were identified and set aside (for progeny considerations) in this step. (Mo-93, Sb-125, I-131, Eu-152, Re-186, U-233, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-242, and Am-241.

5. For those radionuclides that exhibit a significant change in any dose pathway over the time period of interest, the key progeny that cause the increase were identified, and their ingrowth over the time period(s) was examined. "Significant change" means greater than a factor of 2× increase in the parent dose factor for any exposure pathway, as described above.

   The 16 radionuclides that were carried forward to step 6 are Zr-95, Pm-147, Pb-210, Ra-226, Ac-227, Th-228, Th-229, Th-230, Th-232, Ra-228, Pa-231, Np-237, U-238, Pu-241, Cm-242, and Cm-244.

6. Based on the ingrowth pattern of key progeny radionuclides, nominal values were determined for ingrowth factors for each scenario type (as described in step 3 above). The ingrowth factor is defined as the ratio of progeny radioactivity to parent radioactivity level at a given time. Times were selected based the nominal scenario timing estimates, using the time of clearance as t = 0. An ingrowth estimate was made for the scenario categories as identified in Table E.1. Tables E.2–E.6 list the specific scenario classifications used for progeny considerations.

Table E.1 Scenario categories for radioactive decay and progeny ingrowth considerations

Scenario category	Important decay and ingrowth period
Early scenarios that involve a continuous input of material *Nominal times of 4–44 days after clearance;* *20 steel scenarios in this category.*	The ingrowth representative of the time period between 0 and 70 days after clearance
Early scenarios that involve a single input of material *Nominal times of 11–73 days after clearance;* *7 steel scenarios in this category.*	The ingrowth representative of the 1-year period following beginning of the scenario
Late scenarios that involve a single input of material *Nominal times for scenario beginning of 10y and 45y after clearance; radioactivity becomes available to receptor at approximately 145y following clearance because of scenario assumptions (institutional control of landfills and environmental transport);* *4 steel scenarios in this category.*	The ingrowth representative of the time at 145 y–180 y following clearance, which is essentially the same as the 1-year period following beginning of the time that radioactivity becomes available to a receptor

7. The ingrowth factors were applied to the pathway-specific dose conversion factors of all key progeny. The fractional ingrowth at representative times (that were selected to match scenario timing) was calculated using the RadDecay software (Negin and Worku 1992), and was incorporated in the parent radionuclide dose as illustrated below:

$$\text{Parent Dose} = \text{parent radioactivity} \times [\, DCF_{parent} + (\text{Ingrowth} \times DCF_{progeny})\,]$$

This procedure uses a modified dose conversion factor that is multiplied times the parent radioactivity at the time the scenario occurs. The modified dose conversion factor incorporates the ratio of progeny radioactivity to parent radioactivity (i.e., the "ingrowth" factor), which is sometimes a very large number (e.g., Sm-147/Pm-147 at 145 years, see Table E.7). This is accounted for in the modeling because for these situations, the parent radioactivity is a very small number. Dose effects and progeny ingrowth factors determined are listed in Table E.7.

Modified dose conversion factors calculated using this procedure are listed for each scenario category in Appendix C (external) and Appendix B (internal).

Table E.2 Steel scenario classification for progeny considerations

Scenario abbreviation	Scenario title
	Early, Continuous Input Scenarios
FE-SCRP-HANDLIN-W	Handling scrap metal at the scrapyard
FE-SLAG-HANDLIN-W	Handling slag at the refinery
FE-EAFD-HANDLIN-W	Handling EAF dust at the refinery
FE-EAFD-BAGHOUS-W	Refinery baghouse operations
FE-METL-HANDREF-W	Handling refined metal product at the refinery
FE-BOFM-HANDMAN-W	Handling BOF refined metal during product manufacture
FE-METL-HANDDIS-W	Handling EAF refined metal product during distribution
FE-EAFD-PROCESS-W	Processing EAF dust for disposal
FE-SLAG-PROCESS-W	Processing slag for use as aggregate or as roadbed
FE-ATMO-REFINER-N	Atmospheric release during refining
FE-SLAG-STORAGE-N	Storage of slag at the refinery
FE-SLAG-ROADBED-W	Road construction activities using refinery slag
FE-SCRP-TRANSPO-W	Transport of scrap metal
FE-SLAG-TRANSPO-W	Transport of slag
FE-EAFD-TRANSPO-W	Transport of untreated EAF dust
FE-METL-TRANSPO-W	Transport of refined metal product
FE-BOFD-DISPOSL-W	Disposal of BOF dust in a sanitary landfill
FE-SLAG-DISPOSL-W	Disposal of refinery slag in a sanitary landfill
FE-SCRP-DISPOSL-W	Disposal of scrap metal in a sanitary landfill
FE-EAFD-DISPOSL-W	Disposal of EAF dust in a hazardous waste landfill
	Early, Single Input Scenarios
FE-METL-LGMASS-N	In proximity of a large metal mass
FE-METL-SMMASS-N	In proximity of a small metal mass
FE-METL-SMOBJCT-N	Small steel mass close to the body
FE-METL-VEHICLE-N	Inside an automobile
FE-METL-BLDGSTR-N	Inside a building structure
FE-SLAG-CONCBAS-N	Use of slag as aggregate in basement construction
FE-SLAG-ROADBED-N	Use of slag in a roadbed
	Late, Single Input Scenarios
FE-BOFD-LANDFIL-N	Resident on a closed landfill after disposal of BOF dust
FE-SLAG-LANDFIL-N	Resident on a closed landfill after disposal of refinery slag
FE-SCRP-LANDFIL-N	Resident on a closed landfill after disposal of scrap metal
FE-EAFD-LANDFIL-N	Resident on a closed landfill after disposal of EAF dust

Table E.3 Copper scenario classification for progeny considerations

Scenario abbreviation	Scenario title
	Early, Continuous Input Scenarios
CU-SCRP-HANDLIN-W	Handling copper scrap metal at the scrapyard
CU-REVD-BAGHOUS-W	Copper reverberatory furnace baghouse operations
CU-CNVD-BAGHOUS-W	Copper converter baghouse operations
CU-REVM-HANDREF-W	Handling refined copper metal product at the refinery (reverberatory furnace)
CU-CNVM-HANDREF-W	Handling refined copper metal product at the refinery (converter)
CU-ELRM-HANDREF-W	Handling refined copper metal product at the refinery (electrorefiner)
CU-REVM-HANDMAN-W	Handling refined copper metal product during product manufacture (reverberatory furnace)
CU-REVM-HANDDIS-W	Handling refined copper metal product during product distribution (reverberatory furnace)
CU-REVS-HANDLIN-W	Handling copper slag at the refinery (reverberatory furnace)
CU-CNVS-HANDLIN-W	Handling copper slag at the refinery (converter)
CU-ELRS-HANDLIN-W	Handling copper slag at the refinery (electrorefiner)
CU-ATMO-REVERAT-N	Atmospheric releases during copper refining (reverberatory furnace)
CU-ATMO-CONVERT-N	Atmospheric releases during copper refining (converter)
CU-REVD-TRANSPO-W	Transport of reverberatory furnace dust
CU-CNVD-TRANSPO-W	Transport of converter dust
CU-SCRP-TRANSPO-W	Transport of copper scrap metal
CU-REVM-TRANSPO-W	Transport of copper refined metal product (reverberatory furnace)
CU-ELRM-TRANSPO-W	Transport of copper refined metal product (electrorefiner)
CU-SCRP-DISPOSL-W	Disposal activities for copper scrap in a sanitary landfill
	Early, Single Input Scenarios
CU-ELRM-LGMASS-N	In proximity of a large roll of copper wire (electrorefiner)
CU-REVM-SMMASS-N	In proximity of a small metal mass (reverberatory furnace)
CU-REVM-SMOBJCT-N	Small copper mass close to the body (reverberatory furnace)
CU-METL-PIPES-N	Use of copper water pipes

Table E.4 Aluminum scenario classification for progeny considerations

Scenario abbreviation	Scenario title
	Early, Continuous Input Scenarios
AL-SCRP-HANDLIN-W	Handling aluminum scrap metal at the scrapyard
AL-DUST-BAGHOUS-W	Aluminum refinery baghouse operations
AL-METL-HANDREF-W	Handling refined aluminum metal product at the refinery
AL-METL-HANDMAN-W	Handling refined aluminum metal product during manufacture
AL-METL-HANDDIS-W	Handling refined aluminum metal product during product distribution
AL-DROS-HANDLIN-W	Handling aluminum dross at the refinery
AL-ATMO-REFINER-N	Atmospheric releases during aluminum refining
AL-DUST-TRANSPO-W	Transport of refinery dust
AL-SCRP-TRANSPO-W	Transport of aluminum scrap metal
AL-METL-TRANSPO-W	Transport of aluminum refined metal product
AL-DROS-TRANSPO-W	Transport of aluminum dross
AL-SCRP-DISPOSL-W	Disposal activities for aluminum scrap in a sanitary landfill
	Early, Single Input Scenarios
AL-METL-LGMASS-N	In proximity of a large metal mass
AL-METL-SMMASS-N	In proximity of a small metal mass
AL-METL-SMOBJCT-N	Small aluminum mass close to the body
AL-METL-ENGINE-N	Aluminum engine block in a car
AL-METL-COOKWAR-N	Use of aluminum cookware

Table E.5 Concrete scenario classification for progeny considerations

Scenario abbreviation	Scenario Title
	Early, Continuous Input Scenarios
CN-SCRP-HANDLIN-W	Processing concrete
CN-SCRP-ROADBED-W	Road construction activities using recycled concrete
CN-SCRP-TRANSPO-W	Transport of concrete
CN-SCRP-DISPOSL-W	Disposal activities for concrete in a sanitary landfill
	Early, Single Input Scenarios
CN-SCRP-ROADBED-N	Use of recycled concrete in a roadbed
CN-SCRP-LGMASS-N	In proximity of a large concrete object
	Late, Single Input Scenario
CN-SCRP-LANDFIL-N	Resident on a sanitary landfill after disposal of concrete

Table E.6 Equipment reuse scenario classification for progeny considerations

Scenario abbreviation	Scenario title
	Early, Single Input Scenario
XX-EQUIP-REUSE-W	Direct reuse of surficially-contaminated equipment

Table E.7 Dose effect and progeny ingrowth factors

Parent	Pathway[a] and key progeny	Dose effect (factor above parent DCF)[b] / Ingrowth (progeny activity ÷ parent activity)								
		10 d	20 d	30 d	70 d	110 d	1 y	10 y	30 y	145 y
Zr-95	external	1×	1×	1×	1×	1×	1×			
	inhalation	1×	1×	1×	1×	1×	1×			
	ingestion	1×	1×	1×	1.6×	1.8×	2.3×			
	Nb-95	0.19	0.36	0.51	1.0	1.4	2.1			
Pm-147	external	1×	1×	1×	1×	1×	1×	1×	1×	1×
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	2E+9×
	ingestion	1 ×	1×	1×	1×	1×	1×	1×	1×	2E+8×
	Sm-147 (inh & ing)									1.09E+6
Pb-210	external	1×	1×	2.4×	2.5×	2.5×	2.5×	2.5×	2.5×	2.5×
	Bi-210		0.06	0.98	1.0	1.0	1.0	1.0	1.0	1.0
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1×
Ra-226	external	300×	340×	350×	350×	350×	350×	350×	350×	350×
	Rn-222+chain	0.84	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	inhalation	1×	1×	1×	1×	1×	1×	2×	3×	4×
	ingestion	1×	1×	1×	1×	1×	1×	2×	4×	6×
	Pb-210, Po-210 (inh & ing)							0.3	0.6	1.0
Ac-227	external	580×	1300×	3200×	3400×	3900×	4100×	4100×	4100×	4200×
	Th-227 Ra-223+chain	0.3 0.1	0.5 0.25	0.7 0.8	0.8 0.8	0.97 0.96	0.99 1.0	1.0 1.0	1.0 1.0	1.0 1.0
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1×
Th-228	external	1100×	1240×	1300×	1300×	1280×	1290×	1290×	1300×	1300×
	Ra-224 Tl-208 Pb,Bi-212	0.86 0.3 0.8	0.96 0.34 0.96	0.97 0.35 0.97	1.0 0.35 1.0	1.0 0.35 1.0	1.0 0.35 1.0	1.0 0.35 1.0	1.0 0.35 1.0	1.0 0.35 1.0
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1.9×	2.0×	2.0×	2.0×	2.0×	2.0×	2.1×	×2.0	2.0×

Table E.7 Dose effect and progeny ingrowth factors

Parent	Pathway[a] and key progeny	Dose effect (factor above parent DCF)[b] / Ingrowth (progeny activity ÷ parent activity)								
		10 d	20 d	30 d	70 d	110 d	1 y	10 y	30 y	145 y
	Ra-224	0.86	0.96	0.97	1.0	1.0	1.0	1.0	1.0	1.0
Ra-228	external	∞	∞	∞	∞	∞	∞	∞	∞	∞
	Ac-228 Tl-208	1.0 .002	1.0 0.005	1.0 0.01	1.0 0.02	1.0 0.03	1.0 0.11	1.0 0.67	1.0 0.56	1.0 0.54
	inhalation	1×	2×	3×	6×	9×	24×	98×	110×	110×
	Th-228	0.01	0.02	0.03	0.07	0.1	0.32	1.3	1.5	1.5
	ingestion	1×	1×	1×	1×	1×	1×	1.8×	1.8×	1.8×
Th-229	external	1×	2×	3×	5×	5×	5×	5×	5×	5×
	Ac-225 Tl-209	0.1 0.002	0.3 0.007	0.5 0.01	0.9 0.02	0.98 0.02	1.0 0.02	1.0 0.02	1.0 0.02	1.0 0.02
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1×
Th-230	external	1×	1×	1×	2×	2×	5×	40×	120×	570×
	Rn-222	6E-6	2E-5	3E-5	8E-5	1E-4	4E-4	0.004	0.13	0.06
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1.8×
Pa-231	external	1×	1×	1×	1×	1×	1×	4×	8×	12×
	Ac-227 Th-227 Ra-223	9E-4 1E-4 3E-5	0.002 5E-4 2E-4	0.003 0.001 5E-4		.01 .007 .006	.03 .03 .03	0.3 0.3 0.3	0.6 0.6 0.6	1.0 0.97 1.0
	inhalation	1×	1×	1×	1×	1×	1×	1×	2.0×	2.5×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1.9×	2.4×
	Ac-227 (inh. & ing.)							0.3	0.6	1.0
Th-232	external	36×	76×	110×	280×	450×	1700×	19000×	30000×	31000×
	Ra-228, Ac-228 Ra-224 Tl-208	0.003 6E-6 2E-6	0.007 4E-5 1E-5	0.01 1E-4 3E-5	.02 7E-4 2E-4	.04 .002 6E-4	0.1 0.02 0.006	0.7 0.56 0.2	0.97 0.96 0.34	1.0 1.0 0.36
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1.3×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1.8×	1.8×

Table E.7 Dose effect and progeny ingrowth factors

Parent	Pathway[a] and key progeny	Dose effect (factor above parent DCF)[b] / Ingrowth (progeny activity ÷ parent activity)								
		10 d	20 d	30 d	70 d	110 d	1 y	10 y	30 y	145 y
Np-237	external	4×	6×	8×	12×	13×	14×	14×	14×	14×
	Pa-233	0.23	0.4	0.5	0.8	0.9	1.0	1.0	1.0	1.0
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1×
U-238	external	320×	560×	740×	1100×	1200×	1300×	1300×	1300×	1300×
	Th-234, Pa-234m Pa-234	0.25 4E-4	0.44 7E-4	0.6 9E-4	0.9 0.001	0.96 0.002	1.0 0.002	1.0 0.002	1.0 0.002	1.0 0.002
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	1×
Pu-241	external	1×	1.7×	4×	3.2×	5×	15×	160×	785×	2E+5×
	inhalation	1×	1×	1×	1×	1×	1×	3×	10×	3E+3×
	ingestion	1×	1×	1×	1×	1×	1×	2×	7×	2E+3×
	Am-241 (all pathways)	4E-5	9E-5	1E-4	3E-4	5E-4	0.002	0.02	0.1	29
Cm-242[c]	external	1×	1×	1×	1×	1×	1×	2E+4×	6E+17×	9E+94×
	inhalation	1×	1×	1×	1×	1×	1×	4E+5×	1E+19×	2E+96×
	ingestion	1×	1×	1×	1×	1×	1×	7E+5×	2E+19×	3E+96×
	Pu-238 (all pathways)							2.6E+4	7E+17	1E+95
Cm-244	external	1×	1×	1×	1×	1×	1×	1×	1×	1.8×
	inhalation	1×	1×	1×	1×	1×	1×	1×	1×	1.9×
	ingestion	1×	1×	1×	1×	1×	1×	1×	1×	2.2×
	Pu-240								0.006	0.7(2.7 @180y)

a. External based on FGR#12 Infinite Depth values; inhalation and ingestion based on FGR#11 values.
b. Dose Effect = $\{DCF_{parent} + DCF_{progeny}\} \div \{DCF_{parent}\}$
c. What appear to be unreasonable values at 30y and 145y for Cm-242 are correct. These values are normalized to the parent radioactivity, which is at extremely low levels at these times, thus the extremely high values here. This is compensated for in the modeling so that reasonable values are derived for Cm-242 dose factors.

APPENDIX F

DOSE FACTORS FOR STEEL RECYCLE SCENARIOS

CONTENTS

Tables

F DOSE FACTORS FOR STEEL RECYCLE SCENARIOS

This appendix presents tabulated values from the distribution of radionuclide-specific dose factors for steel recycle exposure scenarios. Dose factors for landfill resident scenarios are not included here; they are summarized in Appendix J. The volumetric (mass) dose factors are based on volumetrically distributed residual radioactivity in cleared material. The surficial dose factors are calculated by multiplying the mass dose factors by a surface-to-mass ratio distribution appropriate for cleared steel. Both sets of dose factors are listed in SI units; the conversion factor to convert the dose factors to conventional units is listed in the footnote at the end of each table.

The tabulated values from the frequency distribution of each dose factor consists of the mean (arithmetic average) and three percentile values (5^{th}, 50^{th}, and 95^{th}). A 90% confidence interval for any dose factor is the range between the 5^{th} percentile value and the 95^{th} percentile value.

The shading in the tables in this appendix is only to facilitate reading the values in the tables.

Table F.1 Dose factors[a] for FE-SCRP-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm^2)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	5.9E-05	1.6E-05	5.0E-05	1.4E-04	4.5E-05	9.6E-06	3.6E-05	1.2E-04
C-14	1.5E-03	2.0E-04	1.2E-03	3.8E-03	1.1E-03	1.4E-04	8.3E-04	3.1E-03
Na-22	1.8E+01	2.5E+00	1.5E+01	4.2E+01	1.4E+01	1.7E+00	1.0E+01	3.6E+01
P-32	1.6E-02	5.3E-03	1.5E-02	3.2E-02	1.2E-02	2.9E-03	1.0E-02	2.8E-02
S-35	9.2E-04	2.8E-04	8.2E-04	1.9E-03	7.0E-04	1.9E-04	5.6E-04	1.6E-03
Cl-36	1.0E-02	3.8E-03	9.2E-03	1.9E-02	7.6E-03	2.2E-03	6.3E-03	1.6E-02
K-40	1.4E+00	2.1E-01	1.1E+00	3.3E+00	1.1E+00	1.4E-01	8.2E-01	2.9E+00
Ca-41	1.2E-03	3.2E-04	1.0E-03	2.7E-03	9.0E-04	2.0E-04	7.3E-04	2.3E-03
Ca-45	3.8E-03	1.2E-03	3.4E-03	8.0E-03	2.9E-03	7.2E-04	2.4E-03	6.9E-03
Cr-51	1.8E-01	2.6E-02	1.4E-01	4.2E-01	1.4E-01	1.7E-02	1.1E-01	3.6E-01
Mn-54	6.9E+00	9.7E-01	5.6E+00	1.6E+01	5.2E+00	6.5E-01	4.1E+00	1.4E+01
Fe-55	7.4E-04	2.2E-04	6.5E-04	1.6E-03	5.6E-04	1.3E-04	4.6E-04	1.4E-03
Co-57	2.4E-01	3.4E-02	2.0E-01	5.6E-01	1.8E-01	2.3E-02	1.4E-01	4.9E-01
Co-58	7.7E+00	1.1E+00	6.3E+00	1.8E+01	5.8E+00	7.2E-01	4.6E+00	1.6E+01
Fe-59	9.8E+00	1.4E+00	7.9E+00	2.3E+01	7.4E+00	9.1E-01	5.8E+00	2.0E+01
Ni-59	3.7E-04	1.1E-04	3.3E-04	7.6E-04	2.8E-04	7.1E-05	2.3E-04	6.5E-04
Co-60	2.2E+01	3.1E+00	1.8E+01	5.2E+01	1.7E+01	2.1E+00	1.3E+01	4.5E+01
Ni-63	9.6E-04	2.7E-04	8.4E-04	2.0E-03	7.3E-04	1.8E-04	6.0E-04	1.7E-03
Zn-65	3.0E+00	4.4E-01	2.5E+00	7.1E+00	2.3E+00	2.9E-01	1.8E+00	6.2E+00
Cu-67	1.4E-01	1.8E-02	1.1E-01	3.6E-01	1.1E-01	1.1E-02	7.7E-02	3.0E-01
Se-75	1.8E+00	2.6E-01	1.5E+00	4.3E+00	1.4E+00	1.7E-01	1.1E+00	3.7E+00
Sr-85	3.9E+00	5.5E-01	3.2E+00	9.2E+00	3.0E+00	3.7E-01	2.3E+00	7.9E+00
Sr-89	2.4E-02	1.0E-02	2.3E-02	4.3E-02	1.9E-02	5.2E-03	1.6E-02	4.0E-02
Sr-90	4.2E-01	1.1E-01	3.6E-01	9.3E-01	3.2E-01	7.1E-02	2.5E-01	7.9E-01
Y-91	4.7E-02	1.7E-02	4.3E-02	8.9E-02	3.6E-02	9.5E-03	3.1E-02	8.2E-02
Mo-93	8.5E-03	2.2E-03	7.1E-03	1.9E-02	6.4E-03	1.2E-03	5.0E-03	1.6E-02
Nb-93m	7.7E-03	1.4E-03	6.4E-03	1.8E-02	5.8E-03	8.3E-04	4.4E-03	1.5E-02
Nb-94	1.3E+01	1.9E+00	1.1E+01	3.1E+01	1.0E+01	1.3E+00	7.8E+00	2.7E+01
Nb-95	5.7E+00	8.1E-01	4.6E+00	1.3E+01	4.3E+00	5.3E-01	3.4E+00	1.2E+01
Zr-95	5.6E+00	7.9E-01	4.6E+00	1.3E+01	4.3E+00	5.3E-01	3.4E+00	1.1E+01
Tc-99	3.3E-03	1.1E-03	2.9E-03	6.8E-03	2.5E-03	6.9E-04	2.0E-03	5.6E-03
Ru-103	3.4E+00	4.9E-01	2.8E+00	8.1E+00	2.6E+00	3.2E-01	2.0E+00	7.0E+00
Ru-106	1.8E+00	3.5E-01	1.5E+00	3.9E+00	1.3E+00	2.5E-01	1.0E+00	3.4E+00
Ag-108m	1.3E+01	1.9E+00	1.1E+01	3.0E+01	9.9E+00	1.3E+00	7.6E+00	2.6E+01
Cd-109	2.2E-02	7.1E-03	1.9E-02	4.3E-02	1.6E-02	4.4E-03	1.4E-02	3.8E-02
Ag-110m	2.3E+01	3.2E+00	1.9E+01	5.3E+01	1.7E+01	2.1E+00	1.3E+01	4.6E+01
Sb-124	1.5E+01	2.1E+00	1.2E+01	3.5E+01	1.1E+01	1.4E+00	8.9E+00	3.0E+01
I-125	3.7E-02	1.2E-02	3.2E-02	8.0E-02	2.8E-02	7.5E-03	2.2E-02	6.6E-02
Sb-125	3.0E+00	4.3E-01	2.5E+00	7.1E+00	2.3E+00	2.9E-01	1.8E+00	6.1E+00
I-129	2.4E-01	5.6E-02	2.0E-01	5.5E-01	1.8E-01	3.7E-02	1.4E-01	4.8E-01
I-131	1.8E+00	2.8E-01	1.5E+00	4.1E+00	1.4E+00	1.8E-01	1.1E+00	3.5E+00
Ba-133	2.0E+00	2.8E-01	1.6E+00	4.7E+00	1.5E+00	1.9E-01	1.2E+00	4.1E+00
Cs-134	1.2E+01	1.8E+00	1.0E+01	2.9E+01	9.5E+00	1.2E+00	7.3E+00	2.5E+01
Cs-137	4.9E+00	7.2E-01	4.0E+00	1.1E+01	3.7E+00	4.7E-01	2.9E+00	1.0E+01

Table F.1 Dose factors[a] for FE-SCRP-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.7E-01	2.7E-02	1.4E-01	3.9E-01	1.3E-01	1.9E-02	1.0E-01	3.4E-01
Ce-144	4.1E-01	1.2E-01	3.6E-01	8.2E-01	3.1E-01	7.3E-02	2.5E-01	7.5E-01
Pm-147	1.0E-02	2.1E-03	8.6E-03	2.4E-02	7.9E-03	1.2E-03	6.0E-03	2.0E-02
Eu-152	8.9E+00	1.3E+00	7.3E+00	2.1E+01	6.8E+00	8.9E-01	5.2E+00	1.8E+01
Eu-154	1.0E+01	1.5E+00	8.5E+00	2.4E+01	7.9E+00	1.0E+00	6.1E+00	2.1E+01
Eu-155	6.8E-02	1.7E-02	5.8E-02	1.4E-01	5.1E-02	1.1E-02	4.1E-02	1.3E-01
Re-186	1.9E-02	3.2E-03	1.6E-02	4.5E-02	1.4E-02	2.2E-03	1.1E-02	3.6E-02
Ir-192	5.0E+00	7.0E-01	4.0E+00	1.2E+01	3.8E+00	4.7E-01	3.0E+00	1.0E+01
Pb-210	7.0E+00	2.0E+00	6.1E+00	1.5E+01	5.3E+00	1.3E+00	4.4E+00	1.3E+01
Po-210	3.4E+00	9.5E-01	3.0E+00	6.9E+00	2.5E+00	6.4E-01	2.1E+00	5.9E+00
Bi-210	3.3E-02	7.3E-03	2.8E-02	7.6E-02	2.5E-02	4.3E-03	1.9E-02	6.5E-02
Rn-222	7.2E+00	1.0E+00	5.9E+00	1.8E+01	5.5E+00	6.1E-01	4.2E+00	1.5E+01
Ra-223	3.2E+00	1.1E+00	3.0E+00	5.9E+00	2.4E+00	6.6E-01	2.1E+00	5.4E+00
Ra-224	4.8E+00	9.7E-01	3.9E+00	1.1E+01	3.6E+00	5.9E-01	2.8E+00	9.0E+00
Ac-225	2.6E+00	8.3E-01	2.4E+00	5.1E+00	2.0E+00	5.1E-01	1.7E+00	4.5E+00
Ra-225	1.8E+00	4.0E-01	1.5E+00	4.1E+00	1.4E+00	2.3E-01	1.1E+00	3.6E+00
Ra-226	1.8E+01	4.6E+00	1.5E+01	3.7E+01	1.3E+01	2.9E+00	1.0E+01	3.3E+01
Ac-227	3.3E+02	5.5E+01	2.8E+02	7.9E+02	2.5E+02	3.2E+01	1.9E+02	6.6E+02
Th-227	3.9E+00	8.6E-01	3.3E+00	9.1E+00	3.0E+00	4.8E-01	2.3E+00	7.5E+00
Th-228	9.4E+01	2.1E+01	8.0E+01	2.2E+02	7.1E+01	1.1E+01	5.5E+01	1.8E+02
Ra-228	1.1E+01	3.7E+00	9.7E+00	2.1E+01	8.2E+00	2.1E+00	6.9E+00	1.9E+01
Th-229	4.3E+02	6.2E+01	3.6E+02	1.0E+03	3.3E+02	3.8E+01	2.4E+02	8.6E+02
Th-230	6.5E+01	9.3E+00	5.4E+01	1.6E+02	4.9E+01	5.6E+00	3.7E+01	1.3E+02
Pa-231	2.2E+02	3.7E+01	1.8E+02	5.2E+02	1.7E+02	2.3E+01	1.2E+02	4.4E+02
Th-231	1.1E-03	1.0E-04	6.7E-04	3.5E-03	8.3E-04	6.9E-05	4.9E-04	2.8E-03
Th-232	2.9E+02	4.1E+01	2.4E+02	6.9E+02	2.2E+02	2.5E+01	1.6E+02	5.8E+02
Pa-233	1.0E+00	1.5E-01	8.5E-01	2.4E+00	8.0E-01	9.9E-02	6.2E-01	2.1E+00
U-233	3.4E+01	4.6E+00	2.8E+01	8.1E+01	2.5E+01	2.8E+00	1.9E+01	6.8E+01
Th-234	7.7E-02	2.0E-02	6.6E-02	1.6E-01	5.9E-02	1.3E-02	4.6E-02	1.4E-01
U-234	3.3E+01	4.5E+00	2.7E+01	7.9E+01	2.5E+01	2.7E+00	1.9E+01	6.6E+01
U-235	3.1E+01	4.7E+00	2.6E+01	7.5E+01	2.3E+01	2.8E+00	1.8E+01	6.2E+01
Np-237	1.4E+02	2.2E+01	1.1E+02	3.3E+02	1.0E+02	1.3E+01	7.8E+01	2.7E+02
Pu-238	7.1E+01	9.8E+00	5.9E+01	1.7E+02	5.4E+01	6.0E+00	4.0E+01	1.4E+02
U-238	2.9E+01	4.1E+00	2.4E+01	7.1E+01	2.2E+01	2.5E+00	1.7E+01	5.9E+01
Pu-239	7.6E+01	1.0E+01	6.3E+01	1.8E+02	5.8E+01	6.4E+00	4.3E+01	1.5E+02
Pu-240	7.6E+01	1.0E+01	6.3E+01	1.8E+02	5.8E+01	6.4E+00	4.3E+01	1.5E+02
Pu-241	1.2E+00	1.7E-01	1.0E+00	3.0E+00	9.3E-01	1.0E-01	7.0E-01	2.5E+00
Am-241	1.1E+02	1.8E+01	9.4E+01	2.7E+02	8.5E+01	1.1E+01	6.3E+01	2.2E+02
Cm-242	4.3E+00	6.7E-01	3.6E+00	1.0E+01	3.2E+00	4.1E-01	2.4E+00	8.6E+00
Pu-242	7.3E+01	9.9E+00	6.0E+01	1.8E+02	5.5E+01	6.1E+00	4.1E+01	1.5E+02
Cm-244	6.3E+01	1.0E+01	5.3E+01	1.5E+02	4.8E+01	6.0E+00	3.5E+01	1.3E+02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.2 Dose factors[a] for FE-SLAG-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.3E-05	2.8E-07	6.1E-06	5.3E-05	9.7E-06	1.7E-07	4.2E-06	3.6E-05
Na-22	2.7E+01	3.8E+00	2.0E+01	7.4E+01	2.1E+01	2.6E+00	1.3E+01	6.4E+01
P-32	7.8E-03	4.0E-04	4.4E-03	2.8E-02	5.8E-03	3.1E-04	2.9E-03	2.0E-02
S-35	4.7E-04	3.2E-05	2.6E-04	1.7E-03	3.6E-04	2.5E-05	1.9E-04	1.3E-03
Cl-36	5.2E-03	3.0E-04	3.0E-03	1.9E-02	3.9E-03	1.8E-04	2.1E-03	1.5E-02
K-40	1.2E+00	8.9E-02	6.1E-01	4.1E+00	8.8E-01	6.1E-02	4.1E-01	3.1E+00
Ca-41	2.6E-03	2.9E-04	1.5E-03	8.4E-03	2.0E-03	1.8E-04	1.2E-03	6.4E-03
Ca-45	6.6E-03	8.4E-04	4.3E-03	2.0E-02	4.9E-03	5.5E-04	3.1E-03	1.5E-02
Cr-51	9.2E-02	3.5E-03	5.0E-02	3.4E-01	7.1E-02	2.0E-03	3.5E-02	2.7E-01
Mn-54	1.2E+01	1.8E+00	8.7E+00	3.4E+01	9.2E+00	1.2E+00	5.8E+00	2.8E+01
Fe-55	3.2E-05	3.1E-06	1.9E-05	1.1E-04	2.4E-05	1.7E-06	1.3E-05	7.8E-05
Co-57	6.4E-03	1.9E-04	3.0E-03	2.4E-02	4.8E-03	1.3E-04	2.0E-03	1.7E-02
Co-58	6.2E-02	1.9E-03	3.0E-02	2.4E-01	4.7E-02	1.2E-03	2.2E-02	1.7E-01
Fe-59	4.6E-01	5.0E-02	2.5E-01	1.6E+00	3.5E-01	3.1E-02	1.8E-01	1.3E+00
Ni-59	2.0E-06	6.9E-08	1.0E-06	7.4E-06	1.5E-06	4.9E-08	7.1E-07	5.4E-06
Co-60	2.1E-01	8.4E-03	1.2E-01	7.5E-01	1.6E-01	5.8E-03	7.7E-02	6.2E-01
Ni-63	5.6E-06	1.5E-07	2.6E-06	2.0E-05	4.2E-06	1.1E-07	1.8E-06	1.6E-05
Zn-65	4.7E-02	1.3E-03	2.3E-02	1.7E-01	3.6E-02	1.2E-03	1.6E-02	1.4E-01
Cu-67	2.0E-05	1.9E-08	1.5E-06	8.9E-05	1.5E-05	1.2E-08	9.8E-07	7.0E-05
Se-75	3.4E+00	3.5E-01	2.0E+00	9.8E+00	2.5E+00	2.3E-01	1.5E+00	8.8E+00
Sr-85	9.1E+00	1.2E+00	5.8E+00	2.9E+01	6.8E+00	7.4E-01	3.8E+00	2.1E+01
Sr-89	4.2E-02	7.6E-03	3.0E-02	1.2E-01	3.1E-02	4.4E-03	2.0E-02	9.6E-02
Sr-90	5.6E-01	7.6E-02	3.9E-01	1.7E+00	4.1E-01	5.1E-02	2.8E-01	1.2E+00
Y-91	1.1E-01	1.8E-02	8.0E-02	3.1E-01	8.7E-02	1.1E-02	5.4E-02	2.6E-01
Mo-93	4.0E-05	1.4E-06	1.9E-05	1.4E-04	3.0E-05	9.3E-07	1.3E-05	1.1E-04
Nb-93m	8.4E-03	1.2E-03	5.6E-03	2.6E-02	6.4E-03	8.0E-04	3.7E-03	2.1E-02
Nb-94	3.9E+01	5.4E+00	2.7E+01	1.2E+02	3.0E+01	3.4E+00	1.9E+01	9.3E+01
Nb-95	1.1E+01	1.5E+00	7.2E+00	3.4E+01	8.0E+00	1.0E+00	5.1E+00	2.7E+01
Zr-95	1.3E+01	1.9E+00	8.5E+00	3.9E+01	9.9E+00	1.2E+00	6.2E+00	2.7E+01
Tc-99	1.7E-05	7.2E-07	9.2E-06	6.4E-05	1.3E-05	4.4E-07	5.7E-06	4.6E-05
Ru-103	2.3E-02	6.2E-04	1.1E-02	8.0E-02	1.7E-02	5.1E-04	8.3E-03	6.3E-02
Ru-106	5.0E-04	2.1E-05	2.6E-04	1.8E-03	3.7E-04	1.1E-05	1.7E-04	1.5E-03
Ag-108m	1.2E-01	4.3E-03	7.1E-02	4.5E-01	9.3E-02	3.3E-03	4.8E-02	3.3E-01
Cd-109	2.5E-03	2.7E-04	1.5E-03	8.6E-03	1.8E-03	1.5E-04	1.1E-03	6.7E-03
Ag-110m	2.1E-01	6.8E-03	1.1E-01	7.9E-01	1.6E-01	5.2E-03	7.7E-02	5.8E-01
Sb-124	3.6E+00	1.6E-01	1.8E+00	1.4E+01	2.6E+00	1.1E-01	1.4E+00	8.8E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.5E-01	4.1E-02	5.1E-01	3.1E+00	7.4E-01	2.9E-02	3.6E-01	2.7E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	7.8E+00	1.1E+00	5.5E+00	2.2E+01	5.9E+00	6.9E-01	3.8E+00	1.8E+01
Cs-134	1.0E+00	1.0E-01	6.2E-01	3.4E+00	7.8E-01	6.8E-02	4.2E-01	2.6E+00
Cs-137	2.7E-03	2.1E-04	1.5E-03	9.4E-03	2.1E-03	1.6E-04	1.1E-03	7.2E-03

Table F.2 Dose factors[a] for FE-SLAG-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	7.1E-01	9.7E-02	4.5E-01	2.1E+00	5.3E-01	6.1E-02	3.2E-01	1.7E+00
Ce-144	3.9E-01	6.6E-02	2.6E-01	1.1E+00	3.0E-01	4.1E-02	1.8E-01	9.4E-01
Pm-147	1.1E-02	1.6E-03	7.4E-03	3.3E-02	8.4E-03	9.4E-04	5.2E-03	2.5E-02
Eu-152	2.9E+01	4.0E+00	1.8E+01	8.5E+01	2.2E+01	2.5E+00	1.3E+01	7.0E+01
Eu-154	3.0E+01	4.7E+00	2.2E+01	8.6E+01	2.3E+01	3.1E+00	1.4E+01	7.4E+01
Eu-155	7.4E-01	1.0E-01	5.1E-01	2.3E+00	5.6E-01	6.4E-02	3.5E-01	1.7E+00
Re-186	8.3E-05	9.1E-07	1.8E-05	3.7E-04	6.4E-05	5.7E-07	1.2E-05	3.0E-04
Ir-192	2.9E-01	2.8E-02	1.9E-01	9.4E-01	2.2E-01	1.6E-02	1.4E-01	7.2E-01
Pb-210	3.0E-01	2.9E-02	1.7E-01	1.0E+00	2.2E-01	1.9E-02	1.2E-01	7.7E-01
Po-210	1.3E-01	1.3E-02	7.9E-02	3.9E-01	9.5E-02	8.7E-03	5.6E-02	3.4E-01
Bi-210	3.1E-04	4.5E-06	8.2E-05	1.6E-03	2.3E-04	3.4E-06	6.0E-05	1.1E-03
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.1E+00	1.3E-01	6.6E-01	3.6E+00	7.9E-01	9.0E-02	4.6E-01	2.8E+00
Ra-224	1.8E-02	2.5E-04	4.4E-03	9.7E-02	1.4E-02	1.5E-04	3.1E-03	7.1E-02
Ac-225	3.9E-01	3.4E-02	2.1E-01	1.3E+00	3.0E-01	2.3E-02	1.4E-01	1.1E+00
Ra-225	7.4E-01	8.8E-02	4.4E-01	2.6E+00	5.6E-01	5.8E-02	3.0E-01	1.9E+00
Ra-226	4.9E+01	7.0E+00	3.4E+01	1.4E+02	3.8E+01	4.4E+00	2.3E+01	1.2E+02
Ac-227	3.4E+02	4.1E+01	2.1E+02	1.1E+03	2.5E+02	2.5E+01	1.5E+02	7.7E+02
Th-227	2.2E+00	2.7E-01	1.5E+00	6.4E+00	1.7E+00	1.7E-01	1.1E+00	5.2E+00
Th-228	1.2E+02	1.8E+01	8.3E+01	3.6E+02	9.4E+01	1.1E+01	5.8E+01	3.0E+02
Ra-228	2.9E+01	4.8E+00	2.0E+01	8.6E+01	2.2E+01	2.9E+00	1.4E+01	7.1E+01
Th-229	4.2E+02	5.1E+01	2.7E+02	1.2E+03	3.2E+02	3.5E+01	1.9E+02	1.1E+03
Th-230	6.4E+01	8.4E+00	3.8E+01	1.9E+02	4.9E+01	5.0E+00	2.9E+01	1.4E+02
Pa-231	2.3E+02	3.0E+01	1.3E+02	6.7E+02	1.7E+02	2.0E+01	9.7E+01	5.3E+02
Th-231	6.2E-07	1.0E-13	5.9E-10	3.5E-06	4.5E-07	6.4E-14	4.3E-10	2.3E-06
Th-232	2.8E+02	3.4E+01	1.8E+02	8.6E+02	2.1E+02	2.3E+01	1.2E+02	6.5E+02
Pa-233	2.0E+00	2.6E-01	1.3E+00	6.1E+00	1.5E+00	1.6E-01	9.3E-01	4.9E+00
U-233	3.3E+01	4.1E+00	2.1E+01	9.1E+01	2.5E+01	2.7E+00	1.5E+01	7.7E+01
Th-234	5.8E-02	8.0E-03	4.0E-02	1.6E-01	4.4E-02	4.6E-03	2.8E-02	1.5E-01
U-234	3.2E+01	4.2E+00	2.0E+01	9.5E+01	2.5E+01	2.5E+00	1.4E+01	8.4E+01
U-235	3.2E+01	4.1E+00	2.2E+01	9.3E+01	2.4E+01	2.6E+00	1.5E+01	7.5E+01
Np-237	1.3E+02	2.0E+01	8.8E+01	4.0E+02	1.0E+02	1.3E+01	6.1E+01	3.3E+02
Pu-238	6.8E+01	8.6E+00	4.4E+01	2.0E+02	5.2E+01	5.4E+00	3.1E+01	1.6E+02
U-238	2.8E+01	3.6E+00	1.8E+01	8.3E+01	2.1E+01	2.3E+00	1.3E+01	6.3E+01
Pu-239	7.3E+01	9.5E+00	4.9E+01	2.3E+02	5.6E+01	5.6E+00	3.4E+01	1.8E+02
Pu-240	7.2E+01	1.0E+01	5.0E+01	2.1E+02	5.5E+01	6.0E+00	3.4E+01	1.5E+02
Pu-241	1.1E+00	1.5E-01	7.6E-01	3.2E+00	8.6E-01	9.7E-02	5.4E-01	2.6E+00
Am-241	1.1E+02	1.3E+01	8.0E+01	3.4E+02	8.5E+01	9.0E+00	5.5E+01	2.6E+02
Cm-242	3.8E+00	4.9E-01	2.5E+00	1.1E+01	2.9E+00	3.1E-01	1.9E+00	9.6E+00
Pu-242	7.0E+01	9.4E+00	4.4E+01	2.1E+02	5.3E+01	6.1E+00	3.2E+01	1.7E+02
Cm-244	6.3E+01	7.4E+00	4.1E+01	1.9E+02	4.8E+01	4.6E+00	2.9E+01	1.5E+02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.3 Dose factors[a] for FE-EAFD-HANDLIN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	7.8E-05	4.8E-06	4.4E-05	2.9E-04	5.9E-05	3.0E-06	3.1E-05	2.1E-04
Na-22	6.4E+01	8.7E+00	4.3E+01	2.0E+02	4.9E+01	5.2E+00	3.0E+01	1.6E+02
P-32	1.4E-02	9.7E-04	7.6E-03	5.3E-02	1.1E-02	6.7E-04	5.0E-03	4.1E-02
S-35	1.5E-03	1.2E-04	8.2E-04	5.3E-03	1.1E-03	8.0E-05	5.9E-04	4.1E-03
Cl-36	1.4E-02	1.6E-03	8.5E-03	4.4E-02	1.0E-02	9.2E-04	6.0E-03	3.7E-02
K-40	8.8E+00	1.1E+00	5.5E+00	2.9E+01	6.6E+00	7.4E-01	3.7E+00	2.1E+01
Ca-41	1.1E-04	9.1E-06	6.3E-05	3.9E-04	8.0E-05	5.4E-06	4.4E-05	3.0E-04
Ca-45	3.0E-04	2.3E-05	1.9E-04	9.1E-04	2.3E-04	1.6E-05	1.3E-04	8.0E-04
Cr-51	4.6E-03	3.9E-04	2.6E-03	1.5E-02	3.6E-03	2.4E-04	1.7E-03	1.3E-02
Mn-54	8.6E-01	7.3E-02	5.1E-01	3.0E+00	6.7E-01	4.0E-02	3.4E-01	2.4E+00
Fe-55	3.1E-05	2.6E-06	2.0E-05	9.7E-05	2.4E-05	1.6E-06	1.3E-05	8.2E-05
Co-57	9.7E-03	8.1E-04	6.0E-03	3.2E-02	7.4E-03	5.1E-04	4.0E-03	2.6E-02
Co-58	4.5E-01	4.5E-02	2.9E-01	1.5E+00	3.4E-01	3.0E-02	1.9E-01	1.1E+00
Fe-59	5.1E-01	5.0E-02	2.9E-01	1.7E+00	4.0E-01	3.0E-02	2.2E-01	1.4E+00
Ni-59	1.5E-05	1.7E-06	9.2E-06	5.0E-05	1.1E-05	1.0E-06	6.5E-06	4.0E-05
Co-60	1.8E+00	1.4E-01	1.1E+00	5.4E+00	1.4E+00	9.8E-02	7.4E-01	5.0E+00
Ni-63	3.9E-05	4.0E-06	2.4E-05	1.3E-04	3.0E-05	2.3E-06	1.7E-05	1.0E-04
Zn-65	3.5E+01	4.6E+00	2.2E+01	1.1E+02	2.6E+01	2.8E+00	1.4E+01	9.1E+01
Cu-67	3.8E-05	3.0E-08	2.7E-06	1.8E-04	2.8E-05	1.9E-08	1.8E-06	1.6E-04
Se-75	4.2E+00	1.5E-01	2.5E+00	1.4E+01	3.2E+00	9.2E-02	1.6E+00	1.1E+01
Sr-85	4.2E-01	3.4E-02	2.3E-01	1.4E+00	3.2E-01	2.4E-02	1.6E-01	1.2E+00
Sr-89	1.7E-03	1.3E-04	1.1E-03	5.0E-03	1.3E-03	9.4E-05	7.4E-04	4.4E-03
Sr-90	3.1E-02	2.6E-03	2.0E-02	1.0E-01	2.4E-02	1.5E-03	1.3E-02	8.3E-02
Y-91	4.5E-03	3.3E-04	2.6E-03	1.5E-02	3.4E-03	2.3E-04	1.8E-03	1.1E-02
Mo-93	2.8E-04	2.8E-05	1.7E-04	9.5E-04	2.1E-04	1.8E-05	1.2E-04	6.6E-04
Nb-93m	5.4E-04	4.0E-05	2.7E-04	2.0E-03	4.1E-04	2.8E-05	2.0E-04	1.7E-03
Nb-94	2.2E+00	1.5E-01	1.2E+00	8.5E+00	1.7E+00	9.6E-02	8.0E-01	6.0E+00
Nb-95	5.5E-01	3.8E-02	3.2E-01	1.8E+00	4.1E-01	2.5E-02	2.3E-01	1.5E+00
Zr-95	6.9E-01	5.2E-02	3.6E-01	2.3E+00	5.2E-01	3.5E-02	2.7E-01	1.7E+00
Tc-99	1.3E-04	1.5E-05	8.6E-05	4.1E-04	1.0E-04	9.9E-06	6.2E-05	3.4E-04
Ru-103	1.6E-01	1.4E-02	9.6E-02	5.3E-01	1.3E-01	7.4E-03	6.6E-02	4.1E-01
Ru-106	1.2E-01	1.1E-02	7.7E-02	3.9E-01	9.0E-02	7.5E-03	5.2E-02	3.2E-01
Ag-108m	1.0E+00	8.7E-02	5.8E-01	3.3E+00	7.6E-01	5.5E-02	4.3E-01	2.7E+00
Cd-109	7.8E-02	1.0E-02	5.3E-02	2.3E-01	6.0E-02	6.5E-03	3.6E-02	1.9E-01
Ag-110m	1.7E+00	1.3E-01	1.0E+00	5.2E+00	1.2E+00	9.3E-02	7.5E-01	3.9E+00
Sb-124	3.0E-01	9.1E-03	1.5E-01	1.1E+00	2.3E-01	5.9E-03	1.0E-01	8.4E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.6E-02	2.5E-03	4.0E-02	2.7E-01	5.9E-02	1.5E-03	2.9E-02	2.2E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	3.1E-01	2.7E-02	1.8E-01	1.0E+00	2.4E-01	1.7E-02	1.1E-01	8.2E-01
Cs-134	9.8E+01	1.2E+01	6.0E+01	3.0E+02	7.5E+01	7.2E+00	4.4E+01	2.6E+02
Cs-137	3.6E+01	4.9E+00	2.4E+01	1.1E+02	2.7E+01	2.9E+00	1.7E+01	9.8E+01

Table F.3 Dose factors[a] for FE-EAFD-HANDLIN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.1E-02	8.0E-04	5.3E-03	4.1E-02	7.9E-03	4.8E-04	3.8E-03	3.0E-02
Ce-144	5.1E-02	3.0E-03	3.0E-02	1.7E-01	3.9E-02	2.2E-03	2.1E-02	1.3E-01
Pm-147	7.1E-04	5.6E-05	3.9E-04	2.5E-03	5.4E-04	3.7E-05	2.6E-04	1.9E-03
Eu-152	1.4E+00	1.3E-01	7.8E-01	4.4E+00	1.1E+00	7.9E-02	5.3E-01	3.8E+00
Eu-154	1.7E+00	1.3E-01	8.5E-01	5.8E+00	1.3E+00	8.5E-02	6.2E-01	4.4E+00
Eu-155	3.2E-03	8.2E-04	2.0E-03	1.0E-02	2.5E-03	2.1E-04	1.3E-03	8.8E-03
Re-186	6.9E-04	3.1E-06	1.2E-04	3.1E-03	5.2E-04	2.2E-06	8.0E-05	2.6E-03
Ir-192	1.5E+01	6.9E-01	7.9E+00	5.3E+01	1.1E+01	4.2E-01	5.6E+00	3.8E+01
Pb-210	2.9E+01	4.3E+00	1.8E+01	8.0E+01	2.2E+01	2.7E+00	1.4E+01	6.9E+01
Po-210	1.1E+01	1.8E+00	8.2E+00	3.1E+01	8.6E+00	1.1E+00	5.7E+00	2.6E+01
Bi-210	3.6E-03	9.5E-05	1.2E-03	1.5E-02	2.6E-03	7.3E-05	8.7E-04	1.1E-02
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	6.8E-02	4.1E-03	3.7E-02	2.3E-01	5.1E-02	3.2E-03	2.5E-02	1.9E-01
Ra-224	1.9E-02	7.0E-05	2.4E-03	8.3E-02	1.4E-02	3.9E-05	1.6E-03	6.0E-02
Ac-225	4.5E-02	2.6E-03	2.5E-02	1.6E-01	3.3E-02	1.7E-03	1.7E-02	1.1E-01
Ra-225	3.8E-02	2.6E-03	2.0E-02	1.4E-01	2.8E-02	1.6E-03	1.4E-02	1.1E-01
Ra-226	2.5E+00	2.0E-01	1.5E+00	8.5E+00	1.9E+00	1.3E-01	1.1E+00	5.9E+00
Ac-227	2.3E+01	1.7E+00	1.3E+01	7.7E+01	1.7E+01	1.1E+00	8.6E+00	5.7E+01
Th-227	1.1E-01	7.1E-03	5.9E-02	3.4E-01	8.1E-02	4.7E-03	4.4E-02	3.0E-01
Th-228	7.5E+00	6.1E-01	4.3E+00	2.6E+01	5.8E+00	3.9E-01	3.0E+00	2.1E+01
Ra-228	1.3E+00	1.1E-01	7.6E-01	4.5E+00	1.0E+00	7.7E-02	5.4E-01	3.5E+00
Th-229	2.8E+01	2.4E+00	1.6E+01	1.1E+02	2.1E+01	1.5E+00	1.1E+01	7.5E+01
Th-230	4.4E+00	2.7E-01	2.3E+00	1.5E+01	3.3E+00	1.8E-01	1.8E+00	1.2E+01
Pa-231	1.5E+01	1.2E+00	8.6E+00	4.9E+01	1.1E+01	8.3E-01	5.7E+00	3.6E+01
Th-231	8.1E-10	2.1E-17	2.3E-13	3.7E-09	5.7E-10	1.4E-17	1.5E-13	2.6E-09
Th-232	2.0E+01	1.4E+00	1.1E+01	6.8E+01	1.5E+01	8.0E-01	7.8E+00	5.7E+01
Pa-233	7.3E-02	5.7E-03	4.0E-02	2.6E-01	5.7E-02	3.5E-03	3.0E-02	2.2E-01
U-233	2.3E+00	1.5E-01	1.2E+00	8.0E+00	1.7E+00	9.4E-02	8.5E-01	6.0E+00
Th-234	4.9E-03	3.2E-04	2.9E-03	1.7E-02	3.8E-03	2.0E-04	2.0E-03	1.3E-02
U-234	2.3E+00	1.6E-01	1.2E+00	8.6E+00	1.7E+00	1.1E-01	8.3E-01	7.2E+00
U-235	2.2E+00	1.4E-01	1.1E+00	8.3E+00	1.7E+00	8.6E-02	8.5E-01	5.6E+00
Np-237	9.5E+00	6.0E-01	5.3E+00	3.0E+01	7.4E+00	4.5E-01	3.7E+00	2.6E+01
Pu-238	4.6E+00	3.3E-01	2.6E+00	1.7E+01	3.6E+00	2.2E-01	1.9E+00	1.2E+01
U-238	2.1E+00	1.3E-01	1.1E+00	7.9E+00	1.6E+00	7.6E-02	8.0E-01	5.9E+00
Pu-239	5.1E+00	3.5E-01	2.7E+00	1.7E+01	3.8E+00	2.3E-01	2.0E+00	1.4E+01
Pu-240	4.9E+00	4.2E-01	2.9E+00	1.6E+01	3.6E+00	2.7E-01	1.9E+00	1.2E+01
Pu-241	8.1E-02	4.8E-03	4.2E-02	2.7E-01	6.2E-02	3.5E-03	3.1E-02	2.3E-01
Am-241	7.2E+00	5.2E-01	4.2E+00	2.4E+01	5.5E+00	3.7E-01	3.0E+00	2.0E+01
Cm-242	2.5E-01	2.0E-02	1.5E-01	9.1E-01	2.0E-01	1.2E-02	9.9E-02	6.7E-01
Pu-242	4.7E+00	3.7E-01	2.8E+00	1.5E+01	3.6E+00	2.2E-01	1.8E+00	1.3E+01
Cm-244	4.2E+00	3.3E-01	2.5E+00	1.5E+01	3.2E+00	1.9E-01	1.7E+00	1.1E+01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.4 Dose factors[a] for FE-EAFD-BAGHOUS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.0E-05	2.0E-06	2.4E-05	2.0E-04	3.8E-05	1.4E-06	1.7E-05	1.4E-04
Na-22	3.6E+00	1.7E-01	2.0E+00	1.2E+01	2.8E+00	1.2E-01	1.4E+00	1.0E+01
P-32	3.8E-03	1.8E-04	1.8E-03	1.5E-02	2.8E-03	1.0E-04	1.3E-03	1.1E-02
S-35	5.0E-04	2.1E-05	2.6E-04	1.9E-03	3.8E-04	1.4E-05	1.7E-04	1.5E-03
Cl-36	2.9E-03	2.2E-04	1.7E-03	9.5E-03	2.2E-03	1.5E-04	1.2E-03	7.7E-03
K-40	4.5E-01	3.7E-02	2.4E-01	1.5E+00	3.4E-01	2.1E-02	1.8E-01	1.1E+00
Ca-41	6.1E-05	2.6E-06	2.8E-05	2.4E-04	4.5E-05	1.7E-06	2.0E-05	1.8E-04
Ca-45	1.5E-04	4.3E-06	6.2E-05	5.7E-04	1.1E-04	3.2E-06	4.5E-05	4.5E-04
Cr-51	3.4E-04	1.7E-05	1.8E-04	1.3E-03	2.7E-04	9.8E-06	1.2E-04	1.0E-03
Mn-54	4.8E-02	2.3E-03	2.3E-02	1.8E-01	3.6E-02	1.4E-03	1.6E-02	1.3E-01
Fe-55	1.5E-05	6.4E-07	7.8E-06	5.2E-05	1.1E-05	4.7E-07	5.5E-06	3.6E-05
Co-57	2.2E-03	9.5E-05	1.1E-03	7.5E-03	1.7E-03	6.9E-05	7.8E-04	6.7E-03
Co-58	2.6E-02	1.2E-03	1.4E-02	1.0E-01	2.0E-02	8.2E-04	9.4E-03	7.1E-02
Fe-59	2.7E-02	1.1E-03	1.4E-02	8.4E-02	2.1E-02	7.6E-04	9.9E-03	6.9E-02
Ni-59	5.5E-06	2.8E-07	2.9E-06	2.1E-05	4.1E-06	1.9E-07	1.9E-06	1.6E-05
Co-60	9.3E-02	4.1E-03	4.6E-02	3.5E-01	7.4E-02	2.8E-03	3.1E-02	2.9E-01
Ni-63	1.6E-05	9.0E-07	8.4E-06	6.2E-05	1.2E-05	5.3E-07	5.5E-06	4.4E-05
Zn-65	1.2E+00	7.5E-02	5.9E-01	4.2E+00	9.0E-01	4.8E-02	4.1E-01	3.5E+00
Cu-67	6.9E-06	9.0E-09	5.3E-07	3.5E-05	5.7E-06	4.5E-09	4.0E-07	3.0E-05
Se-75	3.8E-01	1.2E-02	1.8E-01	1.6E+00	2.9E-01	8.0E-03	1.1E-01	1.2E+00
Sr-85	2.7E-02	1.1E-03	1.3E-02	9.6E-02	2.1E-02	6.6E-04	9.0E-03	7.8E-02
Sr-89	4.1E-04	2.6E-05	2.2E-04	1.5E-03	3.1E-04	1.6E-05	1.6E-04	1.1E-03
Sr-90	8.5E-03	4.0E-04	4.1E-03	3.0E-02	6.4E-03	3.1E-04	2.8E-03	2.7E-02
Y-91	5.4E-04	3.8E-05	3.1E-04	1.8E-03	1.8E-06	2.2E-05	2.1E-04	1.6E-03
Mo-93	9.9E-05	8.7E-06	6.0E-05	3.1E-04	4.1E-04	6.0E-06	4.1E-05	2.7E-04
Nb-93m	7.9E-05	5.2E-06	4.5E-05	2.9E-04	7.5E-05	3.3E-06	3.0E-05	2.1E-04
Nb-94	1.2E-01	4.8E-03	5.6E-02	4.1E-01	6.0E-05	3.0E-03	3.6E-02	3.3E-01
Nb-95	3.3E-02	1.2E-03	1.5E-02	1.3E-01	9.0E-02	8.7E-04	1.0E-02	1.0E-01
Zr-95	4.0E-02	1.7E-03	1.8E-02	1.6E-01	2.6E-02	1.0E-03	1.3E-02	1.1E-01
Tc-99	4.3E-05	2.6E-06	2.3E-05	1.7E-04	3.0E-02	1.5E-06	1.5E-05	1.2E-04
Ru-103	1.1E-02	5.7E-04	5.0E-03	4.1E-02	3.2E-05	3.7E-04	3.7E-03	3.6E-02
Ru-106	8.2E-03	4.6E-04	4.3E-03	2.9E-02	8.6E-03	3.3E-04	2.9E-03	2.2E-02
Ag-108m	5.9E-02	2.7E-03	3.1E-02	2.2E-01	6.3E-03	1.5E-03	2.1E-02	1.9E-01
Cd-109	4.5E-02	5.4E-03	2.8E-02	1.4E-01	4.5E-02	3.3E-03	1.9E-02	1.1E-01
Ag-110m	9.1E-02	4.6E-03	4.5E-02	3.2E-01	3.4E-02	3.1E-03	3.2E-02	2.7E-01
Sb-124	1.6E-02	2.8E-04	6.5E-03	6.2E-02	7.0E-02	1.9E-04	4.3E-03	4.6E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-02	0.0E+00	0.0E+00	0.0E+00
Sb-125	5.1E-03	9.2E-05	2.0E-03	1.8E-02	0.0E+00	6.6E-05	1.3E-03	1.5E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-03	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.2E-02	9.6E-04	1.1E-02	7.4E-02	0.0E+00	6.6E-04	7.2E-03	5.6E-02
Cs-134	5.5E+00	4.2E-01	3.0E+00	2.0E+01	1.7E-02	2.7E-01	2.2E+00	1.6E+01
Cs-137	2.2E+00	2.0E-01	1.1E+00	7.7E+00	4.3E+00	1.1E-01	8.3E-01	6.7E+00

Table F.4 Dose factors[a] for FE-EAFD-BAGHOUS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	2.0E-03	7.7E-05	9.2E-04	7.3E-03	1.7E+00	5.4E-05	6.6E-04	5.9E-03
Ce-144	4.4E-03	2.8E-04	2.2E-03	1.5E-02	1.5E-03	1.7E-04	1.6E-03	1.3E-02
Pm-147	9.3E-05	5.5E-06	4.8E-05	3.3E-04	3.3E-03	3.5E-06	3.5E-05	2.5E-04
Eu-152	7.9E-02	3.5E-03	3.8E-02	2.9E-01	6.8E-05	1.9E-03	2.8E-02	2.5E-01
Eu-154	8.4E-02	4.2E-03	4.3E-02	2.8E-01	6.3E-02	2.8E-03	3.1E-02	2.6E-01
Eu-155	2.3E-03	8.9E-05	1.1E-03	8.2E-03	6.5E-02	7.1E-05	7.7E-04	6.7E-03
Re-186	2.8E-04	2.0E-06	4.4E-05	1.3E-03	1.8E-03	1.2E-06	3.1E-05	1.0E-03
Ir-192	1.0E+00	2.7E-02	4.6E-01	4.0E+00	2.2E-04	1.6E-02	3.3E-01	3.0E+00
Pb-210	1.3E+01	7.8E-01	7.3E+00	4.8E+01	7.9E-01	5.0E-01	5.2E+00	3.6E+01
Po-210	4.4E+00	2.7E-01	2.4E+00	1.5E+01	9.9E+00	2.0E-01	1.7E+00	1.2E+01
Bi-210	7.6E-04	1.5E-05	2.5E-04	3.7E-03	3.3E+00	9.3E-06	1.7E-04	2.9E-03
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-04	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E-02	5.8E-04	5.4E-03	5.2E-02	0.0E+00	3.5E-04	4.0E-03	3.9E-02
Ra-224	1.5E-03	1.1E-05	2.2E-04	6.9E-03	9.3E-03	7.1E-06	1.6E-04	5.3E-03
Ac-225	4.7E-03	2.3E-04	2.1E-03	1.7E-02	1.1E-03	1.3E-04	1.6E-03	1.4E-02
Ra-225	8.3E-03	4.0E-04	3.7E-03	3.1E-02	3.3E-03	2.7E-04	2.6E-03	2.4E-02
Ra-226	2.0E-01	1.3E-02	9.9E-02	6.9E-01	6.3E-03	8.7E-03	7.0E-02	5.3E-01
Ac-227	2.2E+00	1.4E-01	1.1E+00	8.3E+00	1.5E-01	9.2E-02	7.8E-01	6.8E+00
Th-227	9.5E-03	5.2E-04	4.8E-03	3.4E-02	1.7E+00	3.0E-04	3.6E-03	2.7E-02
Th-228	5.3E-01	3.0E-02	2.5E-01	1.8E+00	7.0E-03	1.9E-02	1.7E-01	1.6E+00
Ra-228	1.5E-01	9.1E-03	8.8E-02	5.4E-01	3.9E-01	6.3E-03	5.9E-02	4.0E-01
Th-229	2.2E+00	8.3E-02	1.1E+00	8.3E+00	1.2E-01	5.0E-02	7.7E-01	6.5E+00
Th-230	3.4E-01	1.3E-02	1.5E-01	1.4E+00	1.7E+00	8.9E-03	1.1E-01	8.9E-01
Pa-231	1.6E+00	8.6E-02	7.7E-01	5.2E+00	2.5E-01	5.4E-02	5.4E-01	4.3E+00
Th-231	2.1E-09	2.7E-16	1.6E-12	1.1E-08	1.1E+00	1.6E-16	1.2E-12	7.3E-09
Th-232	1.5E+00	5.9E-02	6.8E-01	5.7E+00	1.7E-09	3.7E-02	5.2E-01	4.5E+00
Pa-233	6.2E-03	2.5E-04	3.0E-03	2.2E-02	1.2E+00	1.7E-04	2.1E-03	1.9E-02
U-233	1.7E-01	4.3E-03	6.4E-02	5.9E-01	4.8E-03	3.1E-03	4.6E-02	4.7E-01
Th-234	7.0E-04	4.0E-05	3.5E-04	2.6E-03	1.3E-01	2.4E-05	2.6E-04	1.8E-03
U-234	1.6E-01	5.2E-03	6.4E-02	5.9E-01	5.2E-04	3.2E-03	4.7E-02	4.5E-01
U-235	1.6E-01	7.2E-03	6.6E-02	6.1E-01	1.2E-01	4.2E-03	4.6E-02	4.7E-01
Np-237	8.4E-01	3.8E-02	4.9E-01	2.5E+00	1.2E-01	2.8E-02	3.2E-01	1.9E+00
Pu-238	3.6E-01	8.5E-03	1.5E-01	1.4E+00	6.2E-01	6.4E-03	1.1E-01	1.1E+00
U-238	1.5E-01	3.3E-03	5.7E-02	6.1E-01	2.7E-01	2.5E-03	4.4E-02	4.2E-01
Pu-239	3.6E-01	1.4E-02	1.6E-01	1.4E+00	1.1E-01	7.8E-03	1.0E-01	1.1E+00
Pu-240	3.9E-01	1.2E-02	1.5E-01	1.4E+00	2.6E-01	8.4E-03	1.1E-01	1.2E+00
Pu-241	5.6E-03	1.8E-04	2.5E-03	2.1E-02	2.9E-01	9.8E-05	1.9E-03	1.8E-02
Am-241	6.6E-01	4.1E-02	3.8E-01	2.1E+00	4.3E-03	2.7E-02	2.6E-01	1.7E+00
Cm-242	2.2E-02	1.2E-03	1.2E-02	7.8E-02	5.2E-01	7.9E-04	7.8E-03	6.9E-02
Pu-242	3.7E-01	1.1E-02	1.5E-01	1.5E+00	1.7E-02	7.9E-03	1.0E-01	1.1E+00
Cm-244	3.7E-01	2.4E-02	1.9E-01	1.4E+00	2.7E-01	1.5E-02	1.3E-01	1.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.5 Dose factors[a] for FE-METL-HANDREF-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	1.0E-06	4.1E-08	5.6E-07	3.9E-06	7.9E-07	2.7E-08	4.0E-07	2.9E-06
C-14	9.5E-04	8.9E-05	5.9E-04	2.9E-03	7.3E-04	5.9E-05	4.2E-04	2.6E-03
Na-22	2.0E-03	7.8E-05	1.0E-03	7.9E-03	1.5E-03	4.9E-05	7.7E-04	5.6E-03
P-32	4.8E-05	1.0E-06	2.0E-05	1.8E-04	3.6E-05	7.0E-07	1.4E-05	1.5E-04
S-35	2.8E-05	1.6E-06	1.6E-05	9.8E-05	2.1E-05	1.1E-06	1.1E-05	7.5E-05
Cl-36	1.9E-05	2.4E-06	1.3E-05	5.8E-05	1.4E-05	1.4E-06	8.9E-06	4.4E-05
K-40	1.7E-04	6.2E-06	8.1E-05	6.0E-04	1.3E-04	4.6E-06	5.8E-05	4.5E-04
Ca-41	2.2E-06	6.6E-08	1.1E-06	8.4E-06	1.7E-06	4.4E-08	7.9E-07	7.6E-06
Ca-45	5.6E-06	1.8E-07	2.8E-06	2.2E-05	4.1E-06	1.4E-07	2.1E-06	1.5E-05
Cr-51	3.4E-03	4.3E-04	2.3E-03	1.1E-02	2.6E-03	2.5E-04	1.6E-03	7.6E-03
Mn-54	8.4E-02	1.3E-02	5.7E-02	2.4E-01	6.3E-02	7.8E-03	4.0E-02	2.0E-01
Fe-55	3.4E-04	5.1E-05	2.3E-04	9.7E-04	2.6E-04	3.0E-05	1.6E-04	8.1E-04
Co-57	1.5E-02	2.2E-03	1.1E-02	4.2E-02	1.2E-02	1.3E-03	7.1E-03	3.4E-02
Co-58	2.1E-01	3.4E-02	1.4E-01	6.2E-01	1.6E-01	2.0E-02	1.0E-01	5.2E-01
Fe-59	2.1E-01	3.1E-02	1.4E-01	6.1E-01	1.6E-01	1.8E-02	9.9E-02	5.3E-01
Ni-59	1.5E-04	2.4E-05	1.0E-04	4.4E-04	1.2E-04	1.5E-05	7.5E-05	3.5E-04
Co-60	6.7E-01	9.9E-02	4.7E-01	1.9E+00	5.1E-01	6.2E-02	3.3E-01	1.6E+00
Ni-63	4.1E-04	6.1E-05	2.8E-04	1.2E-03	3.1E-04	3.3E-05	1.8E-04	9.4E-04
Zn-65	1.5E-02	7.6E-04	9.2E-03	5.1E-02	1.2E-02	4.4E-04	6.5E-03	4.0E-02
Cu-67	6.1E-05	1.4E-07	5.5E-06	3.2E-04	4.5E-05	8.8E-08	4.3E-06	2.6E-04
Se-75	3.3E-02	1.2E-03	1.9E-02	1.1E-01	2.5E-02	8.5E-04	1.4E-02	8.4E-02
Sr-85	3.7E-04	1.2E-05	2.0E-04	1.3E-03	2.9E-04	1.0E-05	1.5E-04	1.2E-03
Sr-89	1.6E-05	6.3E-07	8.9E-06	5.9E-05	1.2E-05	4.3E-07	6.2E-06	4.2E-05
Sr-90	4.9E-04	1.8E-05	2.5E-04	1.6E-03	3.8E-04	1.1E-05	1.9E-04	1.3E-03
Y-91	2.0E-05	1.0E-06	1.1E-05	7.3E-05	1.5E-05	6.2E-07	7.2E-06	5.4E-05
Mo-93	2.4E-03	3.9E-04	1.6E-03	6.4E-03	1.8E-03	2.6E-04	1.1E-03	5.8E-03
Nb-93m	6.8E-06	2.3E-07	3.7E-06	2.3E-05	5.1E-06	1.4E-07	2.6E-06	1.7E-05
Nb-94	1.6E-03	5.2E-05	9.5E-04	5.7E-03	1.2E-03	3.9E-05	6.6E-04	4.4E-03
Nb-95	4.2E-04	1.5E-05	2.2E-04	1.5E-03	3.3E-04	1.1E-05	1.5E-04	1.3E-03
Zr-95	5.3E-04	1.7E-05	2.8E-04	2.0E-03	4.1E-04	1.1E-05	1.8E-04	1.4E-03
Tc-99	1.2E-03	1.7E-04	8.2E-04	3.3E-03	9.0E-04	1.1E-04	5.8E-04	2.7E-03
Ru-103	8.7E-02	1.3E-02	6.0E-02	2.5E-01	6.8E-02	7.6E-03	4.3E-02	2.1E-01
Ru-106	9.4E-02	1.6E-02	7.0E-02	2.4E-01	7.0E-02	9.5E-03	5.1E-02	2.1E-01
Ag-108m	4.8E-01	8.4E-02	3.4E-01	1.3E+00	3.8E-01	4.9E-02	2.5E-01	1.2E+00
Cd-109	2.9E-05	1.2E-06	1.4E-05	1.0E-04	2.1E-05	7.4E-07	1.0E-05	7.7E-05
Ag-110m	7.4E-01	1.1E-01	4.9E-01	2.1E+00	5.7E-01	6.8E-02	3.5E-01	1.9E+00
Sb-124	3.4E-01	4.4E-02	2.2E-01	9.8E-01	2.5E-01	3.0E-02	1.6E-01	8.1E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.1E-01	1.7E-02	7.4E-02	2.9E-01	8.3E-02	1.1E-02	5.4E-02	2.4E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	3.5E-04	1.3E-05	1.8E-04	1.3E-03	2.6E-04	7.7E-06	1.2E-04	9.8E-04
Cs-134	1.6E-03	6.9E-05	8.7E-04	5.6E-03	1.2E-03	4.2E-05	5.9E-04	4.5E-03
Cs-137	6.6E-04	2.8E-05	4.0E-04	2.2E-03	4.9E-04	1.9E-05	2.6E-04	1.9E-03

Table F.5 Dose factors[a] for FE-METL-HANDREF-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.7E-05	7.9E-07	1.4E-05	9.7E-05	2.0E-05	5.5E-07	1.0E-05	6.5E-05
Ce-144	1.4E-04	4.6E-06	7.0E-05	4.7E-04	1.1E-04	2.6E-06	5.1E-05	3.9E-04
Pm-147	9.8E-06	2.8E-07	4.8E-06	3.7E-05	7.4E-06	2.1E-07	3.3E-06	2.7E-05
Eu-152	1.1E-03	4.1E-05	5.5E-04	3.8E-03	8.5E-04	2.8E-05	3.7E-04	3.0E-03
Eu-154	1.2E-03	4.8E-05	6.5E-04	4.4E-03	9.3E-04	2.8E-05	4.5E-04	3.5E-03
Eu-155	2.7E-05	8.7E-07	1.4E-05	1.0E-04	2.0E-05	7.2E-07	9.6E-06	7.5E-05
Re-186	2.4E-05	1.8E-07	4.7E-06	1.3E-04	1.8E-05	1.0E-07	3.0E-06	9.6E-05
Ir-192	9.5E-02	4.0E-03	5.3E-02	3.6E-01	7.3E-02	2.7E-03	3.7E-02	2.7E-01
Pb-210	8.0E-02	6.0E-03	4.7E-02	2.8E-01	6.2E-02	3.8E-03	3.3E-02	2.1E-01
Po-210	4.0E-03	1.2E-04	2.0E-03	1.6E-02	3.0E-03	9.7E-05	1.4E-03	1.1E-02
Bi-210	6.6E-05	7.8E-07	1.9E-05	3.0E-04	5.0E-05	4.8E-07	1.4E-05	2.1E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.4E-03	2.1E-04	1.9E-03	1.2E-02	2.5E-03	1.5E-04	1.4E-03	9.1E-03
Ra-224	1.8E-04	1.4E-06	3.6E-05	7.9E-04	1.3E-04	8.8E-07	2.4E-05	6.7E-04
Ac-225	3.2E-04	8.6E-06	1.5E-04	1.2E-03	2.4E-04	6.0E-06	1.1E-04	9.2E-04
Ra-225	4.0E-03	2.5E-04	2.0E-03	1.4E-02	2.9E-03	1.6E-04	1.4E-03	1.0E-02
Ra-226	3.3E-02	2.5E-03	2.0E-02	1.1E-01	2.3E-02	1.7E-03	1.4E-02	7.3E-02
Ac-227	3.0E-01	1.0E-02	1.4E-01	1.1E+00	2.3E-01	7.7E-03	1.0E-01	8.8E-01
Th-227	1.2E-03	3.6E-05	6.4E-04	4.5E-03	9.1E-04	2.1E-05	4.3E-04	3.2E-03
Th-228	7.3E-02	2.5E-03	3.1E-02	2.7E-01	5.5E-02	1.7E-03	2.3E-02	2.0E-01
Ra-228	3.3E-02	2.6E-03	2.1E-02	1.0E-01	2.5E-02	1.6E-03	1.4E-02	8.0E-02
Th-229	3.7E-01	1.2E-02	1.8E-01	1.4E+00	2.8E-01	7 8E-03	1.2E-01	9.8E-01
Th-230	5.7E-02	1.8E-03	2.7E-02	2.4E-01	4.3E-02	1.1E-03	1.9E-02	1.6E-01
Pa-231	1.9E-01	6.7E-03	1.0E-01	6.4E-01	1.4E-01	3.9E-03	7.7E-02	4.5E-01
Th-231	1.8E-11	2.0E-18	1.5E-14	9.0E-11	1.5E-11	1.5E-18	1.1E-14	7.1E-11
Th-232	2.5E-01	6.9E-03	1.1E-01	9.8E-01	1.8E-01	5.5E-03	8.1E-02	6.5E-01
Pa-233	8.7E-05	3.2E-06	5.0E-05	3.1E-04	6.4E-05	2.0E-06	3.3E-05	2.2E-04
U-233	3.1E-02	6.6E-04	1.4E-02	1.2E-01	2.4E-02	5.3E-04	9.6E-03	9.2E-02
Th-234	1.7E-05	7.0E-07	8.8E-06	6.2E-05	1.2E-05	4.8E-07	5.8E-06	4.6E-05
U-234	2.9E-02	7.9E-04	1.4E-02	1.0E-01	2.1E-02	5.2E-04	9.7E-03	7.5E-02
U-235	2.5E-02	9.0E-04	1.5E-02	9.3E-02	1.9E-02	5.3E-04	9.7E-03	6.8E-02
Np-237	1.2E-01	3.5E-03	5.7E-02	4.6E-01	9.3E-02	2.5E-03	4.1E-02	3.3E-01
Pu-238	6.1E-02	2.3E-03	3.0E-02	2.3E-01	4.7E-02	1.5E-03	2.0E-02	1.9E-01
U-238	2.5E-02	7.8E-04	1.2E-02	1.0E-01	1.9E-02	6.2E-04	8.5E-03	8.8E-02
Pu-239	6.4E-02	2.3E-03	3.1E-02	2.5E-01	4.8E-02	1.3E-03	2.3E-02	2.0E-01
Pu-240	6.3E-02	2.2E-03	3.1E-02	2.4E-01	4.5E-02	1.4E-03	2.2E-02	1.7E-01
Pu-241	1.0E-03	3.5E-05	4.6E-04	4.1E-03	7.9E-04	2.3E-05	3.5E-04	2.8E-03
Am-241	9.5E-02	3.3E-03	5.0E-02	3.2E-01	7.4E-02	2.3E-03	3.4E-02	2.6E-01
Cm-242	3.3E-03	1.1E-04	1.6E-03	1.2E-02	2.5E-03	6.1E-05	1.2E-03	9.8E-03
Pu-242	6.2E-02	2.1E-03	2.9E-02	2.2E-01	4.5E-02	1.5E-03	2.0E-02	1.7E-01
Cm-244	5.6E-02	1.9E-03	2.8E-02	2.0E-01	4.2E-02	1.1E-03	1.9E-02	1.6E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.6 Dose factors[a] for FE-BOFM-HANDMAN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	3.3E-06	6.9E-08	1.7E-06	1.2E-05	2.5E-06	4.8E-08	1.2E-06	9.4E-06
C-14	2.8E-03	1.7E-04	2.1E-03	7.8E-03	2.1E-03	1.3E-04	1.4E-03	6.5E-03
Na-22	5.7E-03	1.4E-04	3.4E-03	1.8E-02	4.4E-03	1.1E-04	2.3E-03	1.5E-02
P-32	6.9E-05	1.0E-06	3.0E-05	2.6E-04	5.3E-05	6.1E-07	2.1E-05	2.1E-04
S-35	7.6E-05	2.8E-06	4.9E-05	2.4E-04	5.7E-05	1.9E-06	3.7E-05	1.9E-04
Cl-36	5.7E-05	2.9E-06	4.5E-05	1.5E-04	4.4E-05	1.9E-06	3.0E-05	1.4E-04
K-40	4.9E-04	1.1E-05	2.8E-04	1.6E-03	3.7E-04	7.0E-06	2.1E-04	1.2E-03
Ca-41	6.4E-06	1.7E-07	3.5E-06	2.3E-05	4.8E-06	1.2E-07	2.5E-06	1.7E-05
Ca-45	1.5E-05	4.2E-07	9.2E-06	5.5E-05	1.2E-05	2.4E-07	6.2E-06	4.3E-05
Cr-51	7.1E-03	4.6E-04	5.8E-03	1.9E-02	5.4E-03	2.7E-04	3.9E-03	1.6E-02
Mn-54	2.4E-01	1.6E-02	2.1E-01	5.7E-01	1.8E-01	1.0E-02	1.4E-01	5.3E-01
Fe-55	1.0E-03	5.6E-05	8.4E-04	2.6E-03	7.6E-04	4.7E-05	5.6E-04	2.1E-03
Co-57	4.2E-02	3.2E-03	3.8E-02	1.0E-01	3.2E-02	1.8E-03	2.5E-02	9.0E-02
Co-58	5.4E-01	3.8E-02	4.7E-01	1.3E+00	4.1E-01	2.8E-02	3.2E-01	1.2E+00
Fe-59	4.6E-01	3.5E-02	4.0E-01	1.1E+00	3.5E-01	2.3E-02	2.6E-01	1.0E+00
Ni-59	4.5E-04	3.2E-05	4.0E-04	1.1E-03	3.4E-04	2.2E-05	2.7E-04	9.3E-04
Co-60	1.9E+00	1.4E-01	1.7E+00	4.4E+00	1.4E+00	1.0E-01	1.2E+00	4.1E+00
Ni-63	1.2E-03	7.3E-05	1.1E-03	2.8E-03	9.1E-04	5.2E-05	7.6E-04	2.5E-03
Zn-65	4.2E-02	1.4E-03	2.8E-02	1.2E-01	3.2E-02	8.7E-04	1.9E-02	1.1E-01
Cu-67	1.6E-05	1.3E-09	3.0E-07	9.6E-05	1.1E-05	8.7E-10	2.1E-07	7.1E-05
Se-75	8.6E-02	4.2E-03	5.8E-02	2.6E-01	6.6E-02	2.7E-03	4.0E-02	2.3E-01
Sr-85	9.0E-04	2.7E-05	5.7E-04	2.8E-03	6.6E-04	1.8E-05	3.8E-04	2.2E-03
Sr-89	4.0E-05	9.8E-07	2.4E-05	1.4E-04	3.1E-05	6.5E-07	1.6E-05	1.2E-04
Sr-90	1.4E-03	3.9E-05	8.9E-04	4.3E-03	1.0E-03	2.5E-05	5.9E-04	3.3E-03
Y-91	5.0E-05	1.2E-06	3.0E-05	1.7E-04	3.8E-05	7.6E-07	2.0E-05	1.4E-04
Mo-93	7.2E-03	5.1E-04	6.6E-03	1.7E-02	5.3E-03	3.4E-04	4.3E-03	1.5E-02
Nb-93m	2.0E-05	4.3E-07	1.1E-05	7.3E-05	1.6E-05	2.8E-07	8.1E-06	6.3E-05
Nb-94	4.8E-03	1.4E-04	2.6E-03	1.6E-02	3.6E-03	8.3E-05	1.9E-03	1.2E-02
Nb-95	9.4E-04	2.7E-05	5.0E-04	3.2E-03	7.0E-04	1.6E-05	3.3E-04	2.4E-03
Zr-95	1.3E-03	3.4E-05	7.4E-04	4.4E-03	1.0E-03	1.9E-05	5.2E-04	3.3E-03
Tc-99	3.5E-03	2.6E-04	3.0E-03	8.2E-03	2.6E-03	1.6E-04	2.1E-03	7.1E-03
Ru-103	2.0E-01	1.5E-02	1.8E-01	4.8E-01	1.5E-01	9.2E-03	1.2E-01	4.0E-01
Ru-106	2.7E-01	2.2E-02	2.6E-01	5.7E-01	2.0E-01	1.4E-02	1.7E-01	5.2E-01
Ag-108m	1.4E+00	1.1E-01	1.2E+00	3.3E+00	1.1E+00	8.0E-02	8.0E-01	2.8E+00
Cd-109	8.4E-05	1.6E-06	4.9E-05	2.9E-04	6.6E-05	8.7E-07	3.6E-05	2.3E-04
Ag-110m	2.1E+00	1.4E-01	1.8E+00	4.7E+00	1.6E+00	1.0E-01	1.3E+00	4.5E+00
Sb-124	8.2E-01	5.0E-02	7.4E-01	2.0E+00	6.3E-01	3.6E-02	4.9E-01	1.7E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.1E-01	2.2E-02	2.9E-01	7.3E-01	2.4E-01	1.6E-02	1.9E-01	6.2E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	9.9E-04	1.8E-05	5.6E-04	3.4E-03	7.6E-04	1.3E-05	3.8E-04	2.7E-03
Cs-134	4.7E-03	1.2E-04	2.6E-03	1.6E-02	3.5E-03	8.1E-05	1.8E-03	1.2E-02
Cs-137	2.0E-03	4.5E-05	1.1E-03	6.6E-03	1.6E-03	3.0E-05	8.7E-04	5.6E-03

Table F.6 Dose factors[a] for FE-BOFM-HANDMAN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	5.7E-05	1.4E-06	3.7E-05	1.8E-04	4.3E-05	9.8E-07	2.3E-05	1.5E-04
Ce-144	3.8E-04	1.2E-05	2.3E-04	1.3E-03	2.9E-04	8.7E-06	1.6E-04	9.8E-04
Pm-147	2.8E-05	7.2E-07	1.6E-05	9.1E-05	2.1E-05	4.3E-07	1.2E-05	7.1E-05
Eu-152	3.0E-03	7.1E-05	1.9E-03	9.5E-03	2.2E-03	3.9E-05	1.3E-03	7.7E-03
Eu-154	3.4E-03	7.6E-05	2.1E-03	1.2E-02	2.7E-03	5.9E-05	1.4E-03	9.8E-03
Eu-155	7.5E-05	1.6E-06	4.9E-05	2.3E-04	5.6E-05	1.4E-06	3.3E-05	1.8E-04
Re-186	1.0E-05	8.9E-09	8.6E-07	5.3E-05	8.2E-06	6.1E-09	6.3E-07	4.2E-05
Ir-192	2.3E-01	9.0E-03	1.4E-01	6.9E-01	1.7E-01	5.2E-03	1.0E-01	6.4E-01
Pb-210	2.2E-01	1.4E-02	1.6E-01	6.4E-01	1.7E-01	7.6E-03	1.1E-01	5.2E-01
Po-210	1.1E-02	3.1E-04	6.3E-03	3.5E-02	8.5E-03	1.9E-04	4.2E-03	3.1E-02
Bi-210	4.6E-05	1.4E-07	5.6E-06	2.3E-04	3.4E-05	9.7E-08	3.9E-06	1.7E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	4.5E-03	1.2E-04	2.3E-03	1.6E-02	3.5E-03	8.3E-05	1.6E-03	1.3E-02
Ra-224	7.1E-05	9.5E-08	6.1E-06	4.5E-04	5.6E-05	6.1E-08	4.3E-06	3.1E-04
Ac-225	3.8E-04	5.6E-06	1.6E-04	1.4E-03	2.9E-04	4.0E-06	1.0E-04	1.2E-03
Ra-225	6.1E-03	2.6E-04	3.3E-03	2.2E-02	4.6E-03	1.5E-04	2.1E-03	1.7E-02
Ra-226	9.4E-02	4.9E-03	7.0E-02	2.7E-01	7.1E-02	3.6E-03	4.9E-02	2.3E-01
Ac-227	8.2E-01	2.1E-02	5.2E-01	2.7E+00	6.3E-01	1.5E-02	3.2E-01	2.0E+00
Th-227	2.2E-03	3.7E-05	1.0E-03	8.3E-03	1.6E-03	2.2E-05	7.5E-04	6.5E-03
Th-228	2.0E-01	3.8E-03	1.1E-01	6.7E-01	1.5E-01	2.8E-03	8.0E-02	5.0E-01
Ra-228	9.4E-02	4.5E-03	7.0E-02	2.7E-01	7.2E-02	3.3E-03	4.5E-02	2.2E-01
Th-229	1.1E+00	2.1E-02	5.9E-01	3.9E+00	8.3E-01	1.3E-02	4.2E-01	2.9E+00
Th-230	1.6E-01	3.2E-03	9.2E-02	5.1E-01	1.2E-01	2.2E-03	5.7E-02	4.5E-01
Pa-231	5.7E-01	1.6E-02	3.2E-01	1.8E+00	4.3E-01	9.1E-03	2.3E-01	1.4E+00
Th-231	3.6E-13	5.2E-24	1.5E-18	1.6E-12	2.6E-13	2.6E-24	1.2E-18	1.3E-12
Th-232	7.2E-01	1.7E-02	3.9E-01	2.5E+00	5.4E-01	1.2E-02	2.6E-01	2.0E+00
Pa-233	1.9E-04	5.0E-06	1.0E-04	7.1E-04	1.4E-04	2.9E-06	7.2E-05	5.0E-04
U-233	8.2E-02	1.6E-03	4.6E-02	2.6E-01	6.4E-02	9.6E-04	3.2E-02	2.4E-01
Th-234	3.4E-05	6.9E-07	1.8E-05	1.2E-04	2.6E-05	4.4E-07	1.3E-05	9.6E-05
U-234	8.1E-02	1.6E-03	4.9E-02	2.7E-01	6.1E-02	1.1E-03	3.1E-02	2.0E-01
U-235	7.3E-02	1.4E-03	4.2E-02	2.4E-01	5.6E-02	9.8E-04	3.1E-02	2.0E-01
Np-237	3.5E-01	6.0E-03	1.9E-01	1.2E+00	2.7E-01	4.8E-03	1.4E-01	9.4E-01
Pu-238	1.7E-01	3.6E-03	9.3E-02	6.1E-01	1.3E-01	2.4E-03	6.6E-02	4.9E-01
U-238	7.3E-02	1.8E-03	3.8E-02	2.7E-01	5.6E-02	9.5E-04	2.9E-02	2.2E-01
Pu-239	1.8E-01	4.8E-03	1.1E-01	6.4E-01	1.4E-01	3.9E-03	7.3E-02	4.9E-01
Pu-240	1.9E-01	3.8E-03	1.0E-01	6.5E-01	1.5E-01	2.8E-03	7.3E-02	6.1E-01
Pu-241	3.1E-03	7.2E-05	1.7E-03	1.1E-02	2.3E-03	4.6E-05	1.1E-03	8.7E-03
Am-241	2.9E-01	8.3E-03	1.6E-01	1.1E+00	2.3E-01	5.9E-03	1.1E-01	9.1E-01
Cm-242	9.2E-03	2.0E-04	5.7E-03	2.9E-02	7.1E-03	1.1E-04	3.7E-03	2.6E-02
Pu-242	1.8E-01	3.5E-03	8.9E-02	6.4E-01	1.4E-01	2.6E-03	5.8E-02	5.0E-01
Cm-244	1.6E-01	3.3E-03	9.2E-02	5.0E-01	1.2E-01	2.0E-03	6.6E-02	4.7E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.7 Dose factors[a] for FE-METL-HANDDIS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.4E-06	2.5E-07	9.3E-07	4.1E-06	1.0E-06	1.7E-07	6.7E-07	3.5E-06
Na-22	2.0E-03	8.3E-05	9.6E-04	7.2E-03	1.5E-03	5.6E-05	6.7E-04	5.4E-03
P-32	3.0E-06	8.8E-08	1.4E-06	1.2E-05	2.3E-06	5.3E-08	9.4E-07	8.5E-06
S-35	1.2E-07	5.2E-09	6.6E-08	4.1E-07	8.8E-08	3.3E-09	4.5E-08	3.2E-07
Cl-36	7.8E-07	1.0E-07	4.8E-07	2.4E-06	5.9E-07	6.3E-08	3.6E-07	2.0E-06
K-40	1.4E-04	4.1E-06	6.8E-05	5.1E-04	1.1E-04	3.3E-06	4.9E-05	4.3E-04
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.5E-08	4.9E-10	7.9E-09	5.6E-08	1.1E-08	3.9E-10	5.8E-09	3.9E-08
Cr-51	2.6E-03	3.5E-04	1.6E-03	7.9E-03	2.0E-03	2.0E-04	1.2E-03	5.8E-03
Mn-54	8.1E-02	1.2E-02	5.5E-02	2.3E-01	6.0E-02	7.4E-03	4.1E-02	1.8E-01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.5E-02	2.3E-03	9.7E-03	4.5E-02	1.1E-02	1.5E-03	6.9E-03	3.4E-02
Co-58	1.9E-01	2.9E-02	1.3E-01	5.7E-01	1.5E-01	2.0E-02	9.0E-02	4.2E-01
Fe-59	1.7E-01	2.5E-02	1.1E-01	5.0E-01	1.3E-01	1.7E-02	8.2E-02	3.8E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	6.5E-01	9.9E-02	4.7E-01	1.8E+00	4.8E-01	6.5E-02	3.2E-01	1.3E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.4E-02	6.7E-04	8.1E-03	4.7E-02	1.0E-02	3.8E-04	5.8E-03	3.4E-02
Cu-67	1.0E-05	1.7E-09	3.5E-07	5.4E-05	7.3E-06	9.7E-10	2.4E-07	3.7E-05
Se-75	3.0E-02	1.3E-03	1.7E-02	1.1E-01	2.3E-02	7.8E-04	1.2E-02	8.9E-02
Sr-85	3.4E-04	1.3E-05	1.6E-04	1.2E-03	2.6E-04	6.4E-06	1.1E-04	9.8E-04
Sr-89	8.4E-07	2.5E-08	4.5E-07	3.1E-06	6.3E-07	1.9E-08	3.0E-07	2.3E-06
Sr-90	1.4E-07	7.9E-09	7.5E-08	5.0E-07	1.0E-07	4.8E-09	5.4E-08	4.0E-07
Y-91	6.0E-04	9.5E-05	4.3E-04	1.7E-03	4.6E-04	6.0E-05	2.9E-04	1.5E-03
Mo-93	1.5E-07	5.5E-09	8.7E-08	5.5E-07	1.1E-07	3.9E-09	6.2E-08	4.1E-07
Nb-93m	2.6E-08	9.2E-10	1.4E-08	8.6E-08	1.9E-08	6.4E-10	1.0E-08	6.9E-08
Nb-94	1.5E-03	4.8E-05	8.8E-04	5.4E-03	1.2E-03	3.0E-05	5.7E-04	4.3E-03
Nb-95	3.6E-04	1.2E-05	1.6E-04	1.3E-03	2.7E-04	7.1E-06	1.3E-04	9.6E-04
Zr-95	1.4E-01	2.2E-02	9.3E-02	4.1E-01	1.0E-01	1.4E-02	6.5E-02	3.2E-01
Tc-99	9.7E-06	1.6E-06	6.6E-06	2.8E-05	7.2E-06	9.0E-07	4.8E-06	2.0E-05
Ru-103	7.4E-02	9.9E-03	5.3E-02	2.2E-01	5.6E-02	6.8E-03	3.4E-02	1.7E-01
Ru-106	5.4E-02	7.6E-03	3.8E-02	1.6E-01	4.0E-02	5.1E-03	2.7E-02	1.2E-01
Ag-108m	1.6E-03	6.5E-05	8.6E-04	5.3E-03	1.2E-03	4.3E-05	6.0E-04	4.3E-03
Cd-109	1.3E-04	1.8E-05	9.1E-05	3.9E-04	1.0E-04	1.3E-05	6.1E-05	3.1E-04
Ag-110m	6.5E-01	9.8E-02	4.2E-01	1.9E+00	4.9E-01	6.4E-02	2.9E-01	1.6E+00
Sb-124	2.9E-01	4.4E-02	2.0E-01	8.1E-01	2.3E-01	2.7E-02	1.4E-01	6.9E-01
I-125	1.2E-06	3.8E-08	5.9E-07	4.0E-06	8.9E-07	2.3E-08	4.2E-07	3.3E-06
Sb-125	3.8E-04	1.5E-05	2.2E-04	1.2E-03	2.9E-04	9.5E-06	1.6E-04	1.0E-03
I-129	1.2E-06	4.4E-08	6.3E-07	3.8E-06	8.9E-07	2.6E-08	4.5E-07	3.1E-06
I-131	1.9E-05	2.5E-07	5.9E-06	8.3E-05	1.4E-05	1.4E-07	4.2E-06	6.4E-05
Ba-133	3.4E-04	1.1E-05	1.6E-04	1.3E-03	2.6E-04	7.8E-06	1.2E-04	9.1E-04
Cs-134	1.5E-03	4.3E-05	8.1E-04	5.7E-03	1.1E-03	2.9E-05	5.0E-04	4.1E-03
Cs-137	6.1E-04	2.0E-05	3.3E-04	2.1E-03	4.6E-04	1.3E-05	2.2E-04	1.8E-03

Table F.7 Dose factors[a] for FE-METL-HANDDIS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	1.8E-05	6.5E-07	9.4E-06	6.6E-05	1.4E-05	4.7E-07	6.1E-06	5.0E-05
Ce-144	3.2E-05	8.8E-07	1.5E-05	1.2E-04	2.4E-05	6.5E-07	1.1E-05	8.7E-05
Pm-147	2.3E-07	9.1E-09	1.3E-07	7.9E-07	1.7E-07	7.6E-09	9.0E-08	6.1E-07
Eu-152	1.6E-01	6.4E-03	8.7E-02	5.8E-01	1.2E-01	4.6E-03	5.6E-02	3.9E-01
Eu-154	7.9E-03	6.2E-04	4.7E-03	2.5E-02	5.9E-03	4.5E-04	3.5E-03	2.0E-02
Eu-155	1.6E-05	5.4E-07	7.9E-06	5.9E-05	1.2E-05	3.0E-07	5.9E-06	4.4E-05
Re-186	1.0E-06	1.5E-09	9.8E-08	5.3E-06	7.1E-07	9.3E-10	7.1E-08	4.0E-06
Ir-192	3.4E-03	2.4E-04	1.9E-03	1.1E-02	2.6E-03	1.7E-04	1.3E-03	9.6E-03
Pb-210	1.8E-06	1.3E-07	1.0E-06	5.9E-06	1.4E-06	8.8E-08	7.2E-07	5.1E-06
Po-210	6.7E-09	2.1E-10	3.7E-09	2.3E-08	5.2E-09	1.5E-10	2.4E-09	2.0E-08
Bi-210	4.7E-08	3.1E-10	8.6E-09	2.2E-07	3.5E-08	2.1E-10	6.2E-09	1.4E-07
Rn-222	3.7E-05	6.5E-08	3.7E-06	2.2E-04	2.7E-05	4.0E-08	2.5E-06	1.3E-04
Ra-223	2.6E-05	5.8E-07	1.1E-05	1.1E-04	1.9E-05	3.9E-07	7.5E-06	7.3E-05
Ra-224	3.6E-06	4.0E-09	2.4E-07	1.8E-05	2.6E-06	2.4E-09	1.7E-07	1.3E-05
Ac-225	1.7E-05	3.6E-07	5.1E-06	7.4E-05	1.2E-05	2.4E-07	3.7E-06	4.9E-05
Ra-225	9.2E-07	5.1E-08	4.9E-07	3.4E-06	7.0E-07	3.3E-08	3.3E-07	2.7E-06
Ra-226	1.5E-03	5.6E-05	7.8E-04	5.3E-03	1.1E-03	3.7E-05	5.5E-04	3.7E-03
Ac-227	1.1E-04	4.7E-06	5.1E-05	4.2E-04	8.6E-05	3.0E-06	3.7E-05	3.3E-04
Th-227	2.0E-05	5.4E-07	1.0E-05	6.9E-05	1.4E-05	3.6E-07	7.0E-06	5.2E-05
Th-228	1.1E-03	3.7E-05	5.5E-04	4.3E-03	8.4E-04	3.0E-05	3.7E-04	2.8E-03
Ra-228	7.9E-04	2.9E-05	3.7E-04	3.0E-03	5.9E-04	2.0E-05	2.4E-04	2.3E-03
Th-229	8.7E-05	2.4E-06	4.4E-05	3.1E-04	6.3E-05	1.8E-06	3.1E-05	2.3E-04
Th-230	5.1E-08	1.6E-09	2.6E-08	2.0E-07	3.8E-08	1.5E-09	2.0E-08	1.6E-07
Pa-231	2.5E-05	8.9E-07	1.2E-05	9.3E-05	1.9E-05	6.5E-07	8.7E-06	7.6E-05
Th-231	2.5E-13	4.1E-23	4.9E-18	9.7E-13	1.8E-13	2.6E-23	3.2E-18	6.1E-13
Th-232	5.6E-06	1.7E-07	3.1E-06	2.0E-05	4.4E-06	1.4E-07	2.1E-06	1.6E-05
Pa-233	6.9E-05	1.6E-06	3.5E-05	2.7E-04	5.3E-05	1.1E-06	2.3E-05	2.1E-04
U-233	1.2E-08	5.1E-10	6.7E-09	4.2E-08	9.4E-09	3.5E-10	4.5E-09	3.5E-08
Th-234	3.1E-06	9.2E-08	1.5E-06	1.1E-05	2.2E-06	5.6E-08	1.1E-06	7.9E-06
U-234	2.1E-08	8.7E-10	1.1E-08	7.9E-08	1.6E-08	5.5E-10	8.3E-09	5.6E-08
U-235	1.1E-04	4.3E-06	5.0E-05	3.9E-04	7.9E-05	2.9E-06	3.5E-05	2.8E-04
Np-237	7.7E-05	3.0E-06	4.2E-05	2.8E-04	5.5E-05	1.9E-06	2.8E-05	1.9E-04
Pu-238	2.5E-08	9.2E-10	1.3E-08	8.8E-08	1.8E-08	6.1E-10	9.2E-09	6.8E-08
U-238	3.6E-06	1.4E-07	1.9E-06	1.2E-05	2.6E-06	1.0E-07	1.3E-06	9.1E-06
Pu-239	9.9E-09	4.2E-10	4.8E-09	3.7E-08	7.4E-09	2.6E-10	3.4E-09	2.9E-08
Pu-240	2.7E-08	9.9E-10	1.3E-08	9.9E-08	2.1E-08	7.5E-10	9.1E-09	8.0E-08
Pu-241	7.7E-09	2.9E-10	3.9E-09	2.9E-08	5.8E-09	2.1E-10	2.9E-09	2.1E-08
Am-241	6.9E-04	1.1E-04	4.8E-04	2.0E-03	5.2E-04	6.9E-05	3.4E-04	1.5E-03
Cm-242	3.2E-08	1.4E-09	1.7E-08	1.2E-07	2.5E-08	1.0E-09	1.1E-08	9.5E-08
Pu-242	2.2E-07	7.9E-09	1.1E-07	8.5E-07	1.8E-07	5.4E-09	7.3E-08	6.6E-07
Cm-244	1.0E-06	5.5E-08	5.7E-07	3.6E-06	7.8E-07	3.7E-08	3.9E-07	2.5E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.8 Dose factors[a] for FE-EAFD-PROCESS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.0E-04	2.6E-05	2.1E-04	1.4E-03	3.0E-04	1.8E-05	1.5E-04	1.1E-03
Na-22	2.1E+02	2.8E+01	1.3E+02	6.5E+02	1.6E+02	1.6E+01	9.2E+01	5.2E+02
P-32	6.2E-02	3.6E-03	3.0E-02	2.2E-01	4.7E-02	2.0E-03	2.1E-02	1.9E-01
S-35	7.6E-03	7.1E-04	4.4E-03	2.5E-02	5.6E-03	3.9E-04	3.1E-03	2.1E-02
Cl-36	6.5E-02	7.2E-03	4.1E-02	2.0E-01	4.9E-02	4.8E-03	2.8E-02	1.7E-01
K-40	2.8E+01	3.4E+00	1.8E+01	8.7E+01	2.0E+01	2.2E+00	1.3E+01	6.4E+01
Ca-41	5.9E-04	4.2E-05	3.2E-04	2.0E-03	4.5E-04	2.6E-05	2.2E-04	1.6E-03
Ca-45	1.6E-03	1.2E-04	9.4E-04	5.2E-03	1.2E-03	7.3E-05	6.7E-04	4.2E-03
Cr-51	1.6E-02	1.3E-03	1.0E-02	5.6E-02	1.2E-02	7.8E-04	6.8E-03	3.9E-02
Mn-54	3.0E+00	2.4E-01	1.5E+00	1.2E+01	2.1E+00	1.6E-01	1.1E+00	8.9E+00
Fe-55	1.7E-04	1.5E-05	1.1E-04	5.6E-04	1.2E-04	9.8E-06	7.4E-05	4.0E-04
Co-57	5.9E-02	4.9E-03	3.6E-02	1.9E-01	4.4E-02	3.4E-03	2.5E-02	1.6E-01
Co-58	1.5E+00	1.1E-01	9.2E-01	4.9E+00	1.2E+00	8.1E-02	7.1E-01	3.9E+00
Fe-59	1.7E+00	1.5E-01	9.5E-01	5.8E+00	1.3E+00	9.4E-02	6.6E-01	4.3E+00
Ni-59	8.0E-05	8.2E-06	4.5E-05	2.7E-04	5.8E-05	4.9E-06	3.4E-05	1.8E-04
Co-60	5.9E+00	4.5E-01	3.6E+00	2.0E+01	4.3E+00	2.8E-01	2.6E+00	1.4E+01
Ni-63	2.1E-04	2.2E-05	1.2E-04	7.1E-04	1.5E-04	1.5E-05	8.4E-05	4.8E-04
Zn-65	6.9E+01	8.6E+00	4.4E+01	2.1E+02	5.2E+01	5.1E+00	3.3E+01	1.7E+02
Cu-67	1.7E-04	1.1E-07	1.2E-05	1.0E-03	1.3E-04	7.7E-08	7.9E-06	7.8E-04
Se-75	1.7E+01	4.5E-01	9.6E+00	5.9E+01	1.3E+01	3.6E-01	6.5E+00	4.7E+01
Sr-85	1.6E+00	1.0E-01	8.9E-01	5.2E+00	1.2E+00	6.8E-02	6.0E-01	4.5E+00
Sr-89	7.8E-03	6.2E-04	4.5E-03	2.6E-02	5.8E-03	3.4E-04	3.4E-03	2.0E-02
Sr-90	1.6E-01	1.3E-02	9.0E-02	4.8E-01	1.2E-01	8.9E-03	6.8E-02	4.3E-01
Y-91	1.8E-02	1.4E-03	9.3E-03	5.9E-02	1.3E-02	1.0E-03	6.6E-03	5.5E-02
Mo-93	1.6E-03	1.4E-04	1.0E-03	4.8E-03	1.2E-03	1.1E-04	7.3E-04	3.9E-03
Nb-93m	2.7E-03	2.2E-04	1.5E-03	8.9E-03	2.1E-03	1.4E-04	1.1E-03	7.2E-03
Nb-94	6.9E+00	5.2E-01	4.0E+00	2.4E+01	5.2E+00	3.9E-01	2.7E+00	1.8E+01
Nb-95	1.8E+00	1.1E-01	9.4E-01	6.2E+00	1.3E+00	8.3E-02	7.0E-01	4.7E+00
Zr-95	2.2E+00	1.8E-01	1.2E+00	6.7E+00	1.7E+00	1.1E-01	8.7E-01	6.2E+00
Tc-99	6.8E-04	7.1E-05	4.3E-04	2.0E-03	5.0E-04	4.6E-05	3.0E-04	1.6E-03
Ru-103	5.7E-01	4.6E-02	3.3E-01	2.0E+00	4.3E-01	2.9E-02	2.3E-01	1.4E+00
Ru-106	4.3E-01	4.1E-02	2.4E-01	1.5E+00	3.2E-01	2.8E-02	1.9E-01	1.0E+00
Ag-108m	3.4E+00	3.3E-01	2.1E+00	1.1E+01	2.5E+00	1.9E-01	1.4E+00	8.4E+00
Cd-109	4.4E-01	6.2E-02	3.0E-01	1.2E+00	3.3E-01	3.9E-02	2.2E-01	1.0E+00
Ag-110m	5.7E+00	4.3E-01	3.3E+00	1.9E+01	4.4E+00	2.6E-01	2.4E+00	1.7E+01
Sb-124	1.0E+00	3.7E-02	4.4E-01	3.8E+00	7.5E-01	2.0E-02	3.1E-01	2.5E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.7E-01	9.2E-03	1.2E-01	9.8E-01	2.1E-01	5.7E-03	9.3E-02	7.8E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.1E+00	9.0E-02	5.6E-01	4.0E+00	7.9E-01	4.8E-02	3.9E-01	2.7E+00
Cs-134	3.1E+02	4.3E+01	2.0E+02	9.5E+02	2.4E+02	2.8E+01	1.4E+02	8.1E+02
Cs-137	1.3E+02	1.7E+01	7.8E+01	4.0E+02	9.8E+01	1.0E+01	5.5E+01	3.0E+02

Table F.8 Dose factors[a] for FE-EAFD-PROCESS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	5.3E-02	3.7E-03	2.7E-02	1.9E-01	4.0E-02	2.0E-03	2.0E-02	1.5E-01
Ce-144	1.9E-01	1.5E-02	1.1E-01	6.2E-01	1.4E-01	9.5E-03	7.8E-02	4.5E-01
Pm-147	3.7E-03	2.6E-04	2.1E-03	1.3E-02	2.9E-03	1.6E-04	1.4E-03	1.1E-02
Eu-152	4.7E+00	3.8E-01	2.4E+00	1.7E+01	3.5E+00	2.1E-01	1.8E+00	1.2E+01
Eu-154	5.5E+00	4.3E-01	2.9E+00	1.9E+01	4.1E+00	2.7E-01	2.0E+00	1.6E+01
Eu-155	3.4E-02	3.4E-03	1.9E-02	1.2E-01	2.5E-02	1.9E-03	1.3E-02	8.5E-02
Re-186	4.5E-03	1.8E-05	7.5E-04	2.0E-02	3.6E-03	1.4E-05	4.9E-04	1.7E-02
Ir-192	5.3E+01	1.8E+00	2.5E+01	2.0E+02	3.8E+01	1.4E+00	1.9E+01	1.5E+02
Pb-210	1.5E+02	2.4E+01	9.9E+01	4.3E+02	1.2E+02	1.4E+01	6.8E+01	3.5E+02
Po-210	6.0E+01	8.1E+00	4.2E+01	1.6E+02	4.4E+01	5.3E+00	3.0E+01	1.3E+02
Bi-210	1.9E-02	3.9E-04	6.4E-03	8.6E-02	1.5E-02	2.4E-04	4.4E-03	5.8E-02
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.0E-01	1.7E-02	1.5E-01	1.1E+00	2.3E-01	1.1E-02	1.1E-01	9.5E-01
Ra-224	4.4E-02	2.2E-04	5.3E-03	2.3E-01	3.5E-02	1.5E-04	4.0E-03	1.8E-01
Ac-225	2.1E-01	8.7E-03	1.0E-01	7.9E-01	1.6E-01	5.0E-03	6.5E-02	6.7E-01
Ra-225	2.1E-01	1.1E-02	1.0E-01	7.4E-01	1.6E-01	7.2E-03	6.8E-02	6.2E-01
Ra-226	9.1E+00	5.8E-01	5.2E+00	3.2E+01	6.7E+00	4.4E-01	3.5E+00	2.2E+01
Ac-227	1.2E+02	8.2E+00	6.3E+01	4.1E+02	8.5E+01	5.5E+00	5.0E+01	2.8E+02
Th-227	5.5E-01	3.4E-02	3.0E-01	1.8E+00	4.2E-01	2.2E-02	2.0E-01	1.6E+00
Th-228	3.5E+01	2.5E+00	1.8E+01	1.2E+02	2.6E+01	1.9E+00	1.3E+01	9.5E+01
Ra-228	5.5E+00	4.4E-01	3.1E+00	2.0E+01	4.1E+00	2.7E-01	2.2E+00	1.6E+01
Th-229	1.6E+02	1.0E+01	8.3E+01	5.9E+02	1.2E+02	6.1E+00	6.0E+01	4.2E+02
Th-230	2.3E+01	1.5E+00	1.4E+01	8.5E+01	1.7E+01	9.1E-01	9.7E+00	6.2E+01
Pa-231	7.7E+01	6.3E+00	4.6E+01	2.6E+02	5.8E+01	3.8E+00	3.2E+01	1.9E+02
Th-231	9.3E-09	1.4E-16	2.4E-12	4.5E-08	8.0E-09	9.4E-17	1.6E-12	3.0E-08
Th-232	1.0E+02	6.5E+00	5.3E+01	3.5E+02	7.8E+01	4.3E+00	3.9E+01	2.7E+02
Pa-233	2.7E-01	2.0E-02	1.4E-01	9.5E-01	2.0E-01	1.2E-02	1.0E-01	7.3E-01
U-233	1.2E+01	8.1E-01	v.4E+00	4.7E+01	9.1E+00	4.9E-01	4.4E+00	3.4E+01
Th-234	1.9E-02	1.4E-03	9.9E-03	6.1E-02	1.4E-02	8.1E-04	7.1E-03	5.0E-02
U-234	1.2E+01	7.3E-01	6.2E+00	3.7E+01	8.7E+00	5.2E-01	4.0E+00	3.2E+01
U-235	1.2E+01	8.1E-01	6.2E+00	4.3E+01	8.8E+00	5.5E-01	4.1E+00	3.2E+01
Np-237	5.0E+01	3.8E+00	2.7E+01	1.8E+02	3.9E+01	2.3E+00	2.0E+01	1.4E+02
Pu-238	2.5E+01	1.9E+00	1.4E+01	8.1E+01	1.9E+01	1.3E+00	9.5E+00	6.7E+01
U-238	1.0E+01	7.5E-01	5.8E+00	3.8E+01	7.8E+00	4.9E-01	3.9E+00	2.9E+01
Pu-239	2.7E+01	2.0E+00	1.4E+01	9.3E+01	2.0E+01	1.2E+00	1.0E+01	6.6E+01
Pu-240	2.8E+01	1.7E+00	1.5E+01	9.8E+01	2.1E+01	1.1E+00	1.0E+01	7.3E+01
Pu-241	4.2E-01	3.2E-02	2.3E-01	1.5E+00	3.2E-01	1.9E-02	1.6E-01	1.1E+00
Am-241	3.9E+01	3.0E+00	2.3E+01	1.3E+02	2.9E+01	1.7E+00	1.6E+01	9.9E+01
Cm-242	1.3E+00	1.0E-01	7.3E-01	4.7E+00	9.9E-01	7.1E-02	5.4E-01	3.4E+00
Pu-242	2.5E+01	1.7E+00	1.4E+01	9.7E+01	1.9E+01	1.1E+00	1.0E+01	6.3E+01
Cm-244	2.2E+01	1.7E+00	1.1E+01	7.2E+01	1.6E+01	1.3E+00	8.6E+00	5.3E+01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.9 Dose factors[a] for FE-SLAG-PROCESS-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.4E-05	3.4E-07	6.0E-06	5.1E-05	1.1E-05	1.9E-07	3.8E-06	4.0E-05
Na-22	2.3E+01	2.9E+00	1.5E+01	6.6E+01	1.8E+01	1.7E+00	1.0E+01	6.0E+01
P-32	5.1E-03	2.6E-04	2.6E-03	2.0E-02	3.8E-03	1.5E-04	1.9E-03	1.4E-02
S-35	4.7E-04	3.6E-05	2.6E-04	1.5E-03	3.5E-04	2.5E-05	1.9E-04	1.3E-03
Cl-36	4.3E-03	2.3E-04	2.5E-03	1.5E-02	3.2E-03	1.5E-04	1.7E-03	1.2E-02
K-40	9.6E-01	7.0E-02	5.4E-01	3.1E+00	7.3E-01	4.7E-02	3.6E-01	2.6E+00
Ca-41	2.6E-03	2.8E-04	1.7E-03	7.9E-03	2.0E-03	1.9E-04	1.1E-03	7.0E-03
Ca-45	6.6E-03	8.6E-04	4.2E-03	2.0E-02	5.1E-03	5.0E-04	3.2E-03	1.7E-02
Cr-51	5.8E-02	1.9E-03	3.0E-02	2.0E-01	4.4E-02	1.4E-03	2.2E-02	1.6E-01
Mn-54	1.0E+01	1.3E+00	6.7E+00	3.1E+01	7.6E+00	8.2E-01	5.3E+00	2.4E+01
Fe-55	3.2E-05	2.9E-06	1.9E-05	1.2E-04	2.5E-05	2.0E-06	1.3E-05	9.2E-05
Co-57	1.8E-03	6.9E-05	9.9E-04	6.7E-03	1.4E-03	4.3E-05	6.6E-04	4.8E-03
Co-58	5.0E-02	1.6E-03	2.5E-02	1.8E-01	3.8E-02	1.0E-03	1.7E-02	1.3E-01
Fe-59	4.0E-01	3.6E-02	2.2E-01	1.4E+00	2.9E-01	2.2E-02	1.5E-01	9.9E-01
Ni-59	2.2E-06	7.1E-08	9.6E-07	8.8E-06	1.7E-06	4.2E-08	6.7E-07	6.7E-06
Co-60	1.8E-01	6.8E-03	8.9E-02	6.7E-01	1.4E-01	4.1E-03	6.4E-02	5.2E-01
Ni-63	5.8E-06	1.7E-07	2.4E-06	2.4E-05	4.5E-06	1.3E-07	1.7E-06	2.0E-05
Zn-65	2.4E-02	8.1E-04	1.1E-02	1.0E-01	1.9E-02	4.9E-04	8.4E-03	7.1E-02
Cu-67	6.7E-06	2.1E-09	2.7E-07	3.5E-05	5.0E-06	1.4E-09	1.9E-07	2.5E-05
Se-75	2.1E+00	2.1E-01	1.2E+00	7.4E+00	1.6E+00	1.3E-01	8.2E-01	5.3E+00
Sr-85	7.2E+00	9.7E-01	4.5E+00	2.1E+01	5.3E+00	5.6E-01	3.4E+00	1.6E+01
Sr-89	3.3E-02	5.2E-03	2.3E-02	9.6E-02	2.5E-02	2.9E-03	1.6E-02	8.1E-02
Sr-90	5.7E-01	7.7E-02	4.0E-01	1.7E+00	4.4E-01	4.7E-02	2.9E-01	1.5E+00
Y-91	7.3E-02	1.1E-02	5.0E-02	2.0E-01	5.5E-02	6.9E-03	3.8E-02	1.6E-01
Mo-93	3.6E-05	1.1E-06	1.7E-05	1.2E-04	2.7E-05	6.9E-07	1.2E-05	9.5E-05
Nb-93m	8.5E-03	1.1E-03	5.4E-03	2.5E-02	6.5E-03	5.9E-04	3.8E-03	2.2E-02
Nb-94	3.3E+01	4.2E+00	2.1E+01	1.0E+02	2.5E+01	2.8E+00	1.5E+01	7.3E+01
Nb-95	8.3E+00	1.1E+00	5.5E+00	2.5E+01	6.1E+00	7.4E-01	3.9E+00	2.0E+01
Zr-95	1.0E+01	1.3E+00	7.4E+00	3.2E+01	8.0E+00	8.7E-01	5.0E+00	2.4E+01
Tc-99	1.8E-05	6.1E-07	9.1E-06	6.5E-05	1.3E-05	4.2E-07	6.6E-06	5.3E-05
Ru-103	1.8E-02	6.1E-04	8.7E-03	6.8E-02	1.3E-02	3.4E-04	6.1E-03	5.2E-02
Ru-106	1.4E-02	4.7E-04	6.3E-03	5.2E-02	1.1E-02	3.1E-04	4.9E-03	4.5E-02
Ag-108m	1.1E-01	2.3E-03	5.6E-02	4.1E-01	8.5E-02	1.6E-03	3.9E-02	3.0E-01
Cd-109	9.9E-04	1.0E-04	6.2E-04	3.2E-03	7.4E-04	6.2E-05	4.4E-04	2.3E-03
Ag-110m	1.7E-01	4.7E-03	9.1E-02	6.0E-01	1.3E-01	3.7E-03	6.2E-02	4.8E-01
Sb-124	2.8E+00	1.0E-01	1.5E+00	1.0E+01	2.0E+00	6.7E-02	1.0E+00	7.5E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.4E-01	3.1E-02	4.0E-01	2.5E+00	5.5E-01	2.5E-02	2.6E-01	2.2E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	5.0E+00	6.8E-01	3.2E+00	1.5E+01	3.8E+00	4.1E-01	2.2E+00	1.3E+01
Cs-134	8.0E-01	7.7E-02	5.0E-01	2.4E+00	6.0E-01	4.6E-02	3.6E-01	1.7E+00
Cs-137	3.3E-01	3.1E-02	1.9E-01	1.0E+00	2.5E-01	2.0E-02	1.4E-01	7.7E-01

Table F.9 Dose factors[a] for FE-SLAG-PROCESS-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm^2)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.4E-01	3.0E-02	1.7E-01	7.3E-01	1.8E-01	2.0E-02	1.1E-01	5.3E-01
Ce-144	8.6E-01	1.1E-01	5.7E-01	2.5E+00	6.4E-01	7.2E-02	3.9E-01	2.1E+00
Pm-147	1.1E-02	1.5E-03	7.3E-03	3.5E-02	8.6E-03	1.0E-03	5.2E-03	2.6E-02
Eu-152	2.2E+01	3.0E+00	1.5E+01	6.8E+01	1.7E+01	2.0E+00	1.0E+01	4.9E+01
Eu-154	2.6E+01	3.4E+00	1.8E+01	8.2E+01	1.9E+01	2.2E+00	1.3E+01	6.0E+01
Eu-155	1.5E-01	2.0E-02	1.0E-01	4.7E-01	1.1E-01	1.5E-02	7.3E-02	3.5E-01
Re-186	1.8E-05	1.4E-07	3.1E-06	8.0E-05	1.3E-05	9.5E-08	2.1E-06	6.7E-05
Ir-192	2.0E-01	2.0E-02	1.1E-01	7.0E-01	1.6E-01	1.4E-02	8.0E-02	5.8E-01
Pb-210	3.0E-01	3.1E-02	1.8E-01	1.0E+00	2.3E-01	2.0E-02	1.2E-01	8.1E-01
Po-210	1.2E-01	1.1E-02	8.0E-02	3.8E-01	9.5E-02	8.2E-03	5.8E-02	3.2E-01
Bi-210	2.4E-04	2.4E-06	5.4E-05	1.2E-03	1.8E-04	1.4E-06	3.7E-05	7.7E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E+00	1.2E-01	7.3E-01	4.3E+00	9.3E-01	8.1E-02	5.1E-01	3.0E+00
Ra-224	2.1E-01	1.4E-03	4.0E-02	1.1E+00	1.6E-01	9.8E-04	2.5E-02	8.0E-01
Ac-225	7.8E-01	7.3E-02	4.5E-01	2.8E+00	5.7E-01	4.1E-02	2.9E-01	2.1E+00
Ra-225	6.2E-01	7.8E-02	3.9E-01	2.0E+00	4.8E-01	4.6E-02	2.6E-01	1.5E+00
Ra-226	4.1E+01	5.8E+00	2.9E+01	1.1E+02	3.1E+01	3.8E+00	1.9E+01	9.2E+01
Ac-227	3.6E+02	4.4E+01	2.1E+02	1.2E+03	2.7E+02	2.7E+01	1.5E+02	8.9E+02
Th-227	1.7E+00	2.1E-01	1.1E+00	4.7E+00	1.3E+00	1.3E-01	7.5E-01	3.9E+00
Th-228	1.0E+02	1.5E+01	7.1E+01	3.1E+02	7.9E+01	8.1E+00	4.9E+01	2.4E+02
Ra-228	2.3E+01	3.7E+00	1.5E+01	6.8E+01	1.7E+01	2.3E+00	1.1E+01	5.6E+01
Th-229	4.4E+02	5.6E+01	2.6E+02	1.5E+03	3.4E+02	3.1E+01	1.8E+02	1.1E+03
Th-230	6.5E+01	7.8E+00	4.2E+01	2.0E+02	4.9E+01	4.5E+00	2.9E+01	1.5E+02
Pa-231	2.3E+02	2.6E+01	1.5E+02	7.0E+02	1.8E+02	1.9E+01	1.1E+02	5.7E+02
Th-231	3.4E-08	9.1E-16	1.5E-11	2.0E-07	2.6E-08	6.6E-16	1.2E-11	1.5E-07
Th-232	2.8E+02	3.8E+01	1.7E+02	9.0E+02	2.2E+02	2.1E+01	1.2E+02	7.3E+02
Pa-233	1.4E+00	1.6E-01	8.1E-01	4.5E+00	1.0E+00	1.1E-01	5.9E-01	3.6E+00
U-233	3.4E+01	4.0E+00	2.1E+01	9.6E+01	2.5E+01	2.4E+00	1.5E+01	8.1E+01
Th-234	8.6E-02	1.2E-02	5.3E-02	2.5E-01	6.4E-02	7.5E-03	4.1E-02	2.1E-01
U-234	3.2E+01	4.0E+00	2.0E+01	1.0E+02	2.4E+01	2.4E+00	1.4E+01	7.6E+01
U-235	3.1E+01	4.1E+00	2.0E+01	1.0E+02	2.4E+01	2.5E+00	1.4E+01	7.6E+01
Np-237	1.4E+02	1.6E+01	9.3E+01	4.6E+02	1.1E+02	9.9E+00	6.3E+01	3.5E+02
Pu-238	7.3E+01	8.0E+00	4.1E+01	2.4E+02	5.4E+01	5.1E+00	2.9E+01	1.8E+02
U-238	2.9E+01	3.6E+00	1.8E+01	9.5E+01	2.3E+01	2.1E+00	1.2E+01	7.1E+01
Pu-239	7.6E+01	8.8E+00	4.9E+01	2.3E+02	5.7E+01	5.0E+00	3.4E+01	1.8E+02
Pu-240	7.6E+01	8.3E+00	4.7E+01	2.3E+02	5.7E+01	5.7E+00	3.3E+01	2.0E+02
Pu-241	1.2E+00	1.4E-01	7.4E-01	4.0E+00	9.3E-01	8.4E-02	5.4E-01	3.1E+00
Am-241	1.2E+02	1.5E+01	6.9E+01	3.6E+02	9.0E+01	9.3E+00	4.8E+01	3.1E+02
Cm-242	3.8E+00	4.4E-01	2.6E+00	1.1E+01	2.9E+00	2.9E-01	1.8E+00	9.3E+00
Pu-242	7.4E+01	8.2E+00	4.4E+01	2.4E+02	5.6E+01	5.1E+00	3.2E+01	1.9E+02
Cm-244	6.5E+01	8.0E+00	4.2E+01	2.0E+02	4.8E+01	5.0E+00	2.9E+01	1.6E+02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm^2), multiply by 3.70 E-03

Table F.10 Dose factors[a] for FE-ATMO-REFINER-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	6.4E-04	3.8E-05	2.8E-04	2.4E-03	4.8E-04	2.2E-05	2.1E-04	1.7E-03
C-14	3.6E-06	1.7E-07	1.6E-06	1.6E-05	2.8E-06	1.3E-07	1.2E-06	1.1E-05
Na-22	4.5E+00	3.5E-01	2.5E+00	1.6E+01	3.3E+00	1.9E-01	1.7E+00	1.2E+01
P-32	1.8E-04	7.6E-06	6.7E-05	6.5E-04	1.4E-04	4.3E-06	4.5E-05	5.2E-04
S-35	1.8E-04	6.5E-06	7.0E-05	7.8E-04	1.4E-04	4.3E-06	5.1E-05	5.9E-04
Cl-36	2.7E+00	5.1E-02	9.3E-01	1.1E+01	2.1E+00	3.1E-02	6.6E-01	8.6E+00
K-40	4.1E-01	2.4E-02	2.1E-01	1.6E+00	3.0E-01	1.5E-02	1.6E-01	1.1E+00
Ca-41	1.8E-05	7.3E-07	8.9E-06	6.2E-05	1.4E-05	4.8E-07	6.3E-06	4.9E-05
Ca-45	2.5E-05	1.0E-06	1.0E-05	9.8E-05	1.9E-05	7.8E-07	7.9E-06	7.5E-05
Cr-51	3.3E-06	1.3E-07	1.3E-06	1.4E-05	2.5E-06	8.7E-08	9.5E-07	1.1E-05
Mn-54	3.9E-03	2.1E-04	1.5E-03	1.4E-02	3.0E-03	1.2E-04	1.2E-03	1.2E-02
Fe-55	3.2E-06	1.5E-07	1.4E-06	1.2E-05	2.4E-06	8.7E-08	1.0E-06	8.4E-06
Co-57	2.8E-04	1.5E-05	1.3E-04	1.0E-03	2.0E-04	9.7E-06	9.2E-05	8.0E-04
Co-58	5.4E-04	2.3E-05	2.4E-04	1.9E-03	4.1E-04	1.6E-05	1.6E-04	1.8E-03
Fe-59	3.6E-04	1.7E-05	1.5E-04	1.3E-03	2.9E-04	1.1E-05	1.0E-04	1.1E-03
Ni-59	2.8E-06	1.3E-07	1.2E-06	1.0E-05	2.2E-06	7.3E-08	8.6E-07	8.5E-06
Co-60	3.8E-02	1.6E-03	1.8E-02	1.4E-01	2.9E-02	9.6E-04	1.3E-02	1.0E-01
Ni-63	6.5E-06	3.7E-07	3.1E-06	2.8E-05	4.9E-06	2.6E-07	2.1E-06	2.1E-05
Zn-65	1.1E-01	6.8E-03	5.8E-02	3.8E-01	8.9E-02	4.3E-03	4.0E-02	3.2E-01
Cu-67	1.2E-08	1.6E-11	8.9E-10	5.9E-08	9.1E-09	1.2E-11	5.7E-10	4.2E-08
Se-75	1.6E-02	4.4E-04	6.9E-03	6.4E-02	1.2E-02	2.3E-04	4.6E-03	5.2E-02
Sr-85	5.2E-04	2.1E-05	2.1E-04	2.0E-03	3.9E-04	1.1E-05	1.6E-04	1.5E-03
Sr-89	1.0E-04	4.2E-06	4.5E-05	3.7E-04	7.7E-05	3.1E-06	3.0E-05	2.7E-04
Sr-90	7.8E-03	3.2E-04	3.4E-03	2.8E-02	6.1E-03	1.9E-04	2.4E-03	2.2E-02
Y-91	1.4E-04	5.0E-06	5.7E-05	5.2E-04	1.0E-04	2.8E-06	3.9E-05	3.9E-04
Mo-93	2.8E-04	1.2E-05	1.3E-04	1.1E-03	2.1E-04	7.2E-06	9.0E-05	8.2E-04
Nb-93m	1.7E-04	9.5E-06	8.1E-05	6.7E-04	1.4E-04	5.4E-06	6.0E-05	5.4E-04
Nb-94	1.2E-01	4.4E-03	4.9E-02	5.0E-01	9.3E-02	2.7E-03	3.5E-02	3.7E-01
Nb-95	3.3E-04	1.1E-05	1.3E-04	1.3E-03	2.5E-04	7.0E-06	9.1E-05	1.0E-03
Zr-95	7.2E-04	2.6E-05	3.4E-04	2.5E-03	5.5E-04	1.6E-05	2.3E-04	1.8E-03
Tc-99	7.3E-05	3.0E-06	3.4E-05	2.8E-04	5.5E-05	2.2E-06	2.4E-05	2.5E-04
Ru-103	1.1E-04	6.2E-06	5.5E-05	4.3E-04	8.8E-05	4.6E-06	4.0E-05	3.4E-04
Ru-106	8.3E-04	3.7E-05	3.7E-04	3.2E-03	6.5E-04	2.0E-05	2.6E-04	2.5E-03
Ag-108m	5.7E-02	3.1E-03	2.9E-02	1.9E-01	4.4E-02	1.7E-03	2.1E-02	1.5E-01
Cd-109	2.0E-02	1.1E-03	9.3E-03	7.3E-02	1.5E-02	8.2E-04	6.8E-03	6.3E-02
Ag-110m	6.4E-03	2.9E-04	2.9E-03	2.6E-02	4.9E-03	1.8E-04	2.1E-03	2.3E-02
Sb-124	2.5E-04	4.5E-06	9.6E-05	9.3E-04	2.0E-04	2.9E-06	6.8E-05	7.1E-04
I-125	2.7E+00	1.2E-01	1.3E+00	1.0E+01	2.1E+00	8.1E-02	9.0E-01	8.0E+00
Sb-125	1.3E-03	2.1E-05	5.1E-04	5.1E-03	9.3E-04	1.4E-05	3.5E-04	3.6E-03
I-129	6.1E+01	3.3E+00	2.7E+01	2.4E+02	4.6E+01	2.1E+00	1.9E+01	1.8E+02
I-131	2.4E-01	6.5E-03	7.0E-02	1.0E+00	1.9E-01	4.7E-03	5.1E-02	8.2E-01
Ba-133	1.8E-02	6.8E-04	8.8E-03	6.4E-02	1.4E-02	4.8E-04	6.4E-03	5.5E-02
Cs-134	1.1E+00	7.4E-02	5.6E-01	3.8E+00	8.2E-01	4.4E-02	3.9E-01	3.1E+00
Cs-137	1.6E-02	9.0E-04	8.4E-03	5.6E-02	1.2E-02	6.4E-04	5.8E-03	4.5E-02

Table F.10 Dose factors[a] for FE-ATMO-REFINER-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	4.5E-05	1.9E-06	1.8E-05	1.6E-04	3.5E-05	1.2E-06	1.2E-05	1.3E-04
Ce-144	1.3E-03	5.4E-05	5.3E-04	5.1E-03	1.1E-03	4.0E-05	4.2E-04	3.8E-03
Pm-147	1.4E-04	5.3E-06	6.8E-05	5.0E-04	1.1E-04	3.4E-06	4.8E-05	3.9E-04
Eu-152	5.8E-02	3.0E-03	2.3E-02	2.2E-01	4.4E-02	1.8E-03	1.8E-02	1.8E-01
Eu-154	5.1E-02	2.6E-03	2.4E-02	2.1E-01	3.9E-02	1.7E-03	1.6E-02	1.4E-01
Eu-155	2.1E-03	9.3E-05	8.4E-04	8.4E-03	1.6E-03	5.8E-05	5.8E-04	6.7E-03
Re-186	4.4E-06	1.9E-08	5.7E-07	2.0E-05	3.3E-06	1.1E-08	3.7E-07	1.3E-05
Ir-192	2.3E-02	5.6E-04	1.0E-02	8.4E-02	1.8E-02	3.2E-04	7.5E-03	6.2E-02
Pb-210	4.2E+00	2.7E-01	1.9E+00	1.7E+01	3.2E+00	1.5E-01	1.4E+00	1.2E+01
Po-210	1.4E+00	9.1E-02	6.2E-01	5.4E+00	1.1E+00	5.6E-02	4.4E-01	4.6E+00
Bi-210	2.9E-03	6.8E-05	8.1E-04	1.2E-02	2.3E-03	3.4E-05	5.9E-04	8.9E-03
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	5.3E-03	1.7E-04	1.8E-03	1.9E-02	4.2E-03	1.0E-04	1.2E-03	1.4E-02
Ra-224	1.2E-04	6.8E-07	1.7E-05	6.9E-04	9.2E-05	4.1E-07	1.2E-05	5.0E-04
Ac-225	4.0E-03	1.2E-04	1.5E-03	1.5E-02	3.3E-03	8.5E-05	1.0E-03	1.2E-02
Ra-225	7.1E-03	2.3E-04	2.7E-03	2.6E-02	5.3E-03	1.4E-04	2.0E-03	1.9E-02
Ra-226	1.7E-01	6.3E-03	7.4E-02	6.1E-01	1.3E-01	4.1E-03	5.0E-02	5.2E-01
Ac-227	6.4E+00	3.0E-01	2.4E+00	2.6E+01	5.0E+00	1.8E-01	1.7E+00	1.7E+01
Th-227	2.0E-02	7.2E-04	6.8E-03	6.3E-02	1.5E-02	4.2E-04	5.0E-03	5.8E-02
Th-228	1.4E+00	4.6E-02	5.3E-01	6.0E+00	1.0E+00	3.2E-02	3.8E-01	4.1E+00
Ra-228	8.3E-02	3.2E-03	4.0E-02	2.8E-01	6.4E-02	2.1E-03	2.8E-02	2.2E-01
Th-229	9.2E+00	3.5E-01	3.7E+00	3.5E+01	6.8E+00	2.1E-01	2.7E+00	2.9E+01
Th-230	1.3E+00	5.9E-02	5.4E-01	5.5E+00	1.0E+00	3.9E-02	4.0E-01	3.8E+00
Pa-231	4.6E+00	1.9E-01	1.9E+00	1.9E+01	3.5E+00	1.1E-01	1.4E+00	1.3E+01
Th-231	1.5E-11	1.2E-18	9.1E-15	5.2E-11	1.1E-11	6.8E-19	6.8E-15	4.4E-11
Th-232	5.9E+00	2.2E-01	2.6E+00	2.1E+01	4.6E+00	1.5E-01	1.9E+00	1.8E+01
Pa-233	6.6E-05	2.8E-06	3.0E-05	2.4E-04	5.1E-05	1.7E-06	2.1E-05	1.9E-04
U-233	7.0E-01	2.7E-02	3.0E-01	2.4E+00	5.3E-01	1.7E-02	2.2E-01	2.0E+00
Th-234	6.6E-05	2.1E-06	2.5E-05	2.4E-04	5.3E-05	1.3E-06	1.7E-05	2.2E-04
U-234	6.3E-01	2.9E-02	2.9E-01	2.3E+00	5.0E-01	1.9E-02	2.0E-01	2.0E+00
U-235	6.6E-01	2.8E-02	2.9E-01	2.6E+00	5.0E-01	1.8E-02	1.9E-01	1.9E+00
Np-237	2.9E+00	1.2E-01	1.2E+00	1.1E+01	2.1E+00	6.4E-02	8.5E-01	8.0E+00
Pu-238	1.5E+00	6.7E-02	6.3E-01	6.6E+00	1.1E+00	4.4E-02	4.4E-01	4.2E+00
U-238	6.4E-01	2.6E-02	2.7E-01	2.2E+00	4.8E-01	1.6E-02	1.8E-01	1.9E+00
Pu-239	1.6E+00	6.2E-02	7.2E-01	6.1E+00	1.2E+00	4.3E-02	4.8E-01	4.5E+00
Pu-240	1.5E+00	7.8E-02	7.1E-01	5.5E+00	1.1E+00	4.9E-02	5.0E-01	4.6E+00
Pu-241	2.1E-02	9.7E-04	1.1E-02	8.0E-02	1.6E-02	6.6E-04	7.3E-03	5.6E-02
Am-241	2.3E+00	9.9E-02	9.4E-01	8.4E+00	1.7E+00	7.4E-02	6.4E-01	7.5E+00
Cm-242	4.8E-02	1.8E-03	2.2E-02	1.8E-01	3.6E-02	1.2E-03	1.7E-02	1.3E-01
Pu-242	1.6E+00	7.3E-02	6.2E-01	6.6E+00	1.2E+00	4.2E-02	4.5E-01	4.7E+00
Cm-244	1.1E+00	5.5E-02	4.9E-01	3.7E+00	8.3E-01	3.4E-02	3.3E-01	3.3E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.11 Dose factors[a] for FE-SLAG-STORAGE-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.5E-03	2.3E-06	2.0E-04	8.1E-03	1.2E-03	1.6E-06	1.3E-04	6.1E-03
Na-22	5.5E-04	8.1E-06	1.1E-04	2.3E-03	4.0E-04	4.8E-06	8.3E-05	1.5E-03
P-32	1.8E-10	1.2E-12	3.2E-11	6.6E-10	1.4E-10	9.3E-13	2.3E-11	5.5E-10
S-35	2.6E-05	1.9E-07	5.6E-06	9.8E-05	2.0E-05	1.5E-07	3.8E-06	7.2E-05
Cl-36	1.8E+00	6.1E-03	2.5E-01	6.7E+00	1.3E+00	4.6E-03	1.8E-01	4.7E+00
K-40	9.7E-02	4.2E-04	1.4E-02	3.3E-01	7.1E-02	2.9E-04	1.0E-02	2.6E-01
Ca-41	1.3E-01	7.4E-04	2.7E-02	5.7E-01	9.8E-02	5.4E-04	1.9E-02	3.6E-01
Ca-45	8.2E-02	3.7E-04	1.2E-02	3.4E-01	6.1E-02	2.7E-04	8.1E-03	2.3E-01
Cr-51	1.6E-09	9.2E-12	2.6E-10	8.1E-09	1.1E-09	6.0E-12	1.9E-10	5.0E-09
Mn-54	1.6E-04	1.5E-06	4.0E-05	7.4E-04	1.1E-04	1.2E-06	2.8E-05	5.8E-04
Fe-55	5.4E-07	9.3E-09	1.5E-07	2.3E-06	4.1E-07	6.4E-09	1.0E-07	1.7E-06
Co-57	1.3E-07	6.1E-10	2.0E-08	5.3E-07	9.1E-08	3.6E-10	1.5E-08	3.4E-07
Co-58	4.1E-08	1.1E-10	4.7E-09	1.7E-07	3.1E-08	7.5E-11	3.4E-09	1.2E-07
Fe-59	1.7E-08	3.2E-10	4.6E-09	6.5E-08	1.2E-08	2.1E-10	3.2E-09	4.8E-08
Ni-59	5.1E-08	7.8E-11	5.4E-09	2.3E-07	4.1E-08	5.9E-11	3.7E-09	1.6E-07
Co-60	3.9E-06	2.2E-08	7.1E-07	1.9E-05	2.9E-06	1.4E-08	5.0E-07	1.2E-05
Ni-63	1.1E-07	3.1E-10	1.5E-08	4.8E-07	7.4E-08	1.7E-10	1.1E-08	3.4E-07
Zn-65	3.3E-08	1.4E-10	5.9E-09	1.2E-07	2.2E-08	8.5E-11	3.9E-09	9.8E-08
Cu-67	6.0E-51	4.0E-55	6.4E-53	8.7E-51	4.6E-51	2.8E-55	5.3E-53	7.1E-51
Se-75	2.5E-03	3.8E-06	1.9E-04	8.3E-03	1.8E-03	2.6E-06	1.4E-04	5.4E-03
Sr-85	2.1E-03	6.3E-06	2.4E-04	9.5E-03	1.5E-03	4.3E-06	1.8E-04	7.0E-03
Sr-89	2.6E-03	8.0E-06	3.8E-04	9.7E-03	2.0E-03	5.1E-06	2.6E-04	7.8E-03
Sr-90	1.0E+01	3.9E-02	1.0E+00	3.4E+01	7.5E+00	2.3E-02	7.3E-01	2.2E+01
Y-91	2.0E-06	2.1E-08	3.8E-07	8.7E-06	1.5E-06	1.4E-08	2.9E-07	5.7E-06
Mo-93	5.8E-04	9.4E-07	5.7E-05	2.1E-03	4.2E-04	8.2E-07	4.2E-05	1.6E-03
Nb-93m	5.8E-06	7.5E-08	1.4E-06	3.1E-05	4.5E-06	5.6E-08	9.8E-07	2.1E-05
Nb-94	9.0E-05	1.3E-06	1.9E-05	3.6E-04	6.5E-05	1.1E-06	1.3E-05	2.6E-04
Nb-95	1.2E-08	1.7E-10	3.3E-09	4.7E-08	8.8E-09	1.2E-10	2.4E-09	3.4E-08
Zr-95	1.2E-07	1.3E-09	2.3E-08	4.3E-07	8.4E-08	1.0E-09	1.7E-08	3.3E-07
Tc-99	1.9E-01	1.8E-03	4.4E-02	9.2E-01	1.4E-01	1.3E-03	3.4E-02	6.7E-01
Ru-103	4.6E-11	5.2E-14	3.3E-12	2.6E-10	3.4E-11	3.2E-14	2.7E-12	1.9E-10
Ru-106	2.2E-07	1.7E-10	1.9E-08	6.1E-07	1.5E-07	1.3E-10	1.3E-08	4.8E-07
Ag-108m	3.1E-07	5.1E-10	2.4E-08	1.2E-06	2.2E-07	3.1E-10	1.8E-08	9.2E-07
Cd-109	6.0E-05	5.0E-07	1.1E-05	2.4E-04	4.2E-05	3.2E-07	8.2E-06	1.8E-04
Ag-110m	1.2E-07	2.2E-10	1.3E-08	5.0E-07	9.0E-08	1.6E-10	9.1E-09	3.6E-07
Sb-124	9.6E-10	7.6E-12	2.0E-10	4.1E-09	6.9E-10	4.5E-12	1.3E-10	3.0E-09
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.1E-08	1.2E-10	3.6E-09	8.7E-08	1.6E-08	7.9E-11	2.6E-09	5.9E-08
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	8.0E-04	1.1E-05	1.9E-04	3.6E-03	5.9E-04	7.2E-06	1.3E-04	2.7E-03
Cs-134	2.4E-02	1.4E-04	4.3E-03	7.2E-02	1.9E-02	9.1E-05	3.1E-03	7.2E-02
Cs-137	2.7E-02	1.2E-04	3.7E-03	9.5E-02	2.2E-02	8.0E-05	2.5E-03	6.8E-02

Table F.11 Dose factors[a] for FE-SLAG-STORAGE-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	6.5E-10	6.3E-12	1.2E-10	2.9E-09	5.0E-10	4.3E-12	9.1E-11	2.3E-09
Ce-144	9.0E-06	7.1E-08	1.6E-06	3.3E-05	6.4E-06	5.1E-08	1.1E-06	2.5E-05
Pm-147	9.8E-06	1.4E-07	2.2E-06	4.1E-05	7.1E-06	9.6E-08	1.4E-06	3.1E-05
Eu-152	7.6E-05	8.0E-07	1.7E-05	4.2E-04	5.7E-05	6.4E-07	1.2E-05	3.2E-04
Eu-154	1.0E-04	1.2E-06	2.5E-05	4.4E-04	8.0E-05	9.3E-07	1.8E-05	3.6E-04
Eu-155	1.5E-05	2.3E-07	3.4E-06	7.0E-05	1.1E-05	1.6E-07	2.3E-06	5.5E-05
Re-186	2.5E-35	3.8E-38	2.0E-36	7.3E-35	1.8E-35	2.2E-38	1.3E-36	4.8E-35
Ir-192	2.6E-07	2.8E-09	5.2E-08	9.8E-07	2.0E-07	1.9E-09	3.5E-08	8.0E-07
Pb-210	8.7E-04	3.0E-06	9.0E-05	4.0E-03	6.7E-04	2.1E-06	6.1E-05	3.3E-03
Po-210	1.0E-04	4.1E-07	1.3E-05	3.2E-04	7.4E-05	3.2E-07	8.6E-06	2.4E-04
Bi-210	1.6E-28	2.4E-31	1.2E-29	5.6E-28	1.2E-28	1.9E-31	9.8E-30	4.2E-28
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E-12	1.3E-14	3.2E-13	5.1E-12	9.1E-13	1.0E-14	2.3E-13	4.4E-12
Ra-224	1.6E-34	2.4E-37	1.4E-35	4.4E-34	1.3E-34	1.7E-37	9.8E-36	2.8E-34
Ac-225	7.6E-16	7.6E-18	1.3E-16	2.6E-15	6.3E-16	4.8E-18	8.6E-17	1.9E-15
Ra-225	1.9E-10	2.0E-12	4.3E-11	7.7E-10	1.5E-10	1.6E-12	2.9E-11	5.0E-10
Ra-226	6.8E-02	8.5E-04	1.6E-02	2.3E-01	5.0E-02	5.6E-04	1.1E-02	1.8E-01
Ac-227	4.8E-02	7.6E-04	1.1E-02	1.8E-01	3.5E-02	4.9E-04	7.8E-03	1.4E-01
Th-227	3.0E-11	7.3E-14	3.5E-12	9.1E-11	2.2E-11	4.8E-14	2.4E-12	6.2E-11
Th-228	8.6E-04	2.6E-06	1.0E-04	3.2E-03	6.3E-04	1.6E-06	6.9E-05	2.3E-03
Ra-228	6.3E-02	6.5E-04	1.5E-02	2.5E-01	4.9E-02	5.1E-04	9.9E-03	1.7E-01
Th-229	8.0E-03	1.7E-05	6.2E-04	2.9E-02	6.1E-03	1.2E-05	4.1E-04	2.5E-02
Th-230	1.7E-03	2.5E-06	9.7E-05	5.8E-03	1.1E-03	1.3E-06	6.7E-05	4.3E-03
Pa-231	1.2E-01	1.4E-03	3.5E-02	5.1E-01	8.6E-02	9.4E-04	2.5E-02	3.6E-01
Th-231	1.2E-115	3.2E-123	2.4E-119	2.9E-115	8.9E-116	2.0E-123	1.9E-119	1.8E-115
Th-232	6.9E-03	1.6E-05	5.2E-04	1.9E-02	4.4E-03	1.1E-05	3.7E-04	1.2E-02
Pa-233	2.4E-09	2.2E-11	4.3E-10	1.0E-08	1.8E-09	1.2E-11	3.1E-10	6.1E-09
U-233	1.7E+00	5.1E-03	2.4E-01	7.8E+00	1.2E+00	3.5E-03	1.6E-01	5.5E+00
Th-234	2.3E-10	7.7E-13	3.6E-11	9.0E-10	1.7E-10	5.8E-13	2.4E-11	6.9E-10
U-234	1.8E+00	5.5E-03	1.9E-01	7.0E+00	1.3E+00	3.5E-03	1.4E-01	5.5E+00
U-235	1.8E+00	5.0E-03	2.3E-01	6.8E+00	1.3E+00	3.5E-03	1.5E-01	5.5E+00
Np-237	2.0E+03	8.4E+00	3.1E+02	7.3E+03	1.4E+03	6.1E+00	2.2E+02	6.0E+03
Pu-238	3.3E-03	9.4E-06	2.9E-04	1.3E-02	2.6E-03	4.7E-06	2.2E-04	1.1E-02
U-238	2.2E+00	5.8E-03	2.0E-01	5.8E+00	1.8E+00	4.3E-03	1.5E-01	4.5E+00
Pu-239	4.3E-03	9.1E-06	3.3E-04	1.4E-02	3.4E-03	5.3E-06	2.5E-04	8.6E-03
Pu-240	2.9E-03	9.1E-06	3.5E-04	8.8E-03	2.0E-03	7.3E-06	2.5E-04	7.6E-03
Pu-241	3.3E-05	1.2E-07	4.5E-06	1.3E-04	2.5E-05	1.0E-07	3.4E-06	1.0E-04
Am-241	6.0E-03	1.6E-04	2.1E-03	2.2E-02	4.4E-03	1.1E-04	1.4E-03	1.6E-02
Cm-242	2.5E-06	5.4E-08	6.9E-07	8.1E-06	1.9E-06	3.4E-08	4.9E-07	6.7E-06
Pu-242	4.9E-03	7.9E-06	3.0E-04	1.3E-02	3.7E-03	5.4E-06	2.1E-04	9.0E-03
Cm-244	2.3E-04	4.5E-06	6.0E-05	8.6E-04	1.8E-04	3.3E-06	4.0E-05	6.6E-04

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.12 Dose factors[a] for FE-SLAG-ROADBED-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	9.5E-06	2.2E-07	3.7E-06	4.2E-05	7.3E-06	1.6E-07	2.3E-06	3.4E-05
Na-22	3.9E+01	3.7E+00	2.4E+01	1.3E+02	2.9E+01	2.2E+00	1.7E+01	9.9E+01
P-32	7.1E-03	3.3E-04	3.3E-03	2.7E-02	5.3E-03	2.3E-04	2.4E-03	2.1E-02
S-35	3.2E-04	2.3E-05	1.7E-04	1.1E-03	2.4E-04	1.5E-05	1.2E-04	8.4E-04
Cl-36	5.2E-03	2.7E-04	2.9E-03	1.9E-02	3.9E-03	1.7E-04	2.1E-03	1.4E-02
K-40	1.6E+00	8.4E-02	8.0E-01	6.1E+00	1.1E+00	5.5E-02	5.6E-01	3.8E+00
Ca-41	1.8E-03	1.5E-04	1.1E-03	5.5E-03	1.4E-03	9.9E-05	7.0E-04	4.6E-03
Ca-45	4.6E-03	4.9E-04	2.8E-03	1.4E-02	3.4E-03	3.1E-04	2.0E-03	1.1E-02
Cr-51	1.1E-01	3.4E-03	5.7E-02	3.8E-01	7.7E-02	2.5E-03	3.7E-02	2.9E-01
Mn-54	1.7E+01	1.5E+00	1.0E+01	5.6E+01	1.3E+01	1.0E+00	6.8E+00	4.3E+01
Fe-55	2.3E-05	1.5E-06	1.2E-05	8.0E-05	1.7E-05	1.1E-06	8.6E-06	6.4E-05
Co-57	8.0E-03	3.4E-04	3.7E-03	3.1E-02	6.2E-03	2.0E-04	2.5E-03	2.4E-02
Co-58	8.2E-02	2.7E-03	3.7E-02	3.2E-01	6.3E-02	1.8E-03	2.5E-02	2.5E-01
Fe-59	6.1E-01	3.3E-02	3.2E-01	2.2E+00	4.6E-01	2.1E-02	2.4E-01	1.7E+00
Ni-59	1.5E-06	4.6E-08	6.2E-07	5.8E-06	1.1E-06	2.9E-08	4.2E-07	4.4E-06
Co-60	3.1E-01	9.2E-03	1.4E-01	1.2E+00	2.4E-01	5.2E-03	9.2E-02	8.9E-01
Ni-63	4.1E-06	1.0E-07	1.5E-06	1.4E-05	3.1E-06	8.1E-08	1.1E-06	1.2E-05
Zn-65	6.1E-02	1.5E-03	2.9E-02	2.4E-01	4.4E-02	1.1E-03	2.2E-02	1.7E-01
Cu-67	9.9E-06	1.2E-09	2.0E-07	4.8E-05	7.2E-06	9.2E-10	1.4E-07	4.0E-05
Se-75	4.8E+00	3.5E-01	2.5E+00	1.8E+01	3.5E+00	2.4E-01	1.8E+00	1.2E+01
Sr-85	1.2E+01	1.0E+00	7.0E+00	3.8E+01	8.6E+00	7.0E-01	4.7E+00	3.0E+01
Sr-89	4.2E-02	5.5E-03	2.9E-02	1.2E-01	3.2E-02	3.5E-03	2.0E-02	1.0E-01
Sr-90	3.9E-01	4.5E-02	2.5E-01	1.3E+00	3.0E-01	2.8E-02	1.7E-01	9.5E-01
Y-91	1.3E-01	1.6E-02	8.2E-02	4.3E-01	1.0E-01	1.2E-02	5.5E-02	3.4E-01
Mo-93	3.4E-05	9.8E-07	1.6E-05	1.3E-04	2.6E-05	6.0E-07	1.0E-05	9.8E-05
Nb-93m	6.1E-03	6.7E-04	3.9E-03	2.0E-02	4.7E-03	4.6E-04	2.7E-03	1.7E-02
Nb-94	5.5E+01	5.5E+00	3.3E+01	1.8E+02	4.2E+01	3.1E+00	2.3E+01	1.4E+02
Nb-95	1.3E+01	1.3E+00	7.7E+00	4.8E+01	1.0E+01	8.6E-01	5.3E+00	3.3E+01
Zr-95	1.8E+01	1.5E+00	1.0E+01	6.4E+01	1.4E+01	9.5E-01	7.2E+00	4.6E+01
Tc-99	1.3E-05	5.0E-07	6.6E-06	5.0E-05	1.0E-05	3.7E-07	4.5E-06	4.0E-05
Ru-103	2.8E-02	6.4E-04	1.3E-02	1.1E-01	2.2E-02	4.9E-04	9.5E-03	7.7E-02
Ru-106	3.5E-04	1.1E-05	1.8E-04	1.4E-03	2.7E-04	6.3E-06	1.2E-04	1.0E-03
Ag-108m	1.8E-01	4.5E-03	8.8E-02	6.5E-01	1.3E-01	2.8E-03	6.4E-02	4.6E-01
Cd-109	2.7E-03	2.6E-04	1.7E-03	8.7E-03	2.1E-03	1.6E-04	1.1E-03	7.2E-03
Ag-110m	2.9E-01	5.9E-03	1.4E-01	1.1E+00	2.2E-01	4.4E-03	9.7E-02	8.2E-01
Sb-124	4.6E+00	1.8E-01	2.1E+00	1.7E+01	3.3E+00	1.0E-01	1.5E+00	1.2E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.3E+00	4.8E-02	7.1E-01	4.9E+00	9.7E-01	2.8E-02	5.1E-01	3.4E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.1E+01	1.1E+00	6.6E+00	3.8E+01	8.4E+00	7.4E-01	4.6E+00	2.7E+01
Cs-134	1.4E+00	1.0E-01	7.9E-01	5.0E+00	1.0E+00	6.4E-02	5.2E-01	4.0E+00
Cs-137	2.0E-03	1.3E-04	1.0E-03	7.2E-03	1.5E-03	8.4E-05	7.3E-04	5.4E-03

Table F.12 Dose factors[a] for FE-SLAG-ROADBED-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	8.4E-01	7.3E-02	5.1E-01	2.8E+00	6.2E-01	4.4E-02	3.8E-01	2.1E+00
Ce-144	4.6E-01	5.0E-02	3.0E-01	1.4E+00	3.4E-01	3.2E-02	2.1E-01	1.1E+00
Pm-147	8.4E-03	7.3E-04	5.0E-03	2.7E-02	6.6E-03	4.5E-04	3.3E-03	2.3E-02
Eu-152	3.9E+01	4.2E+00	2.3E+01	1.2E+02	2.9E+01	2.7E+00	1.6E+01	9.5E+01
Eu-154	4.3E+01	4.2E+00	2.6E+01	1.4E+02	3.3E+01	3.0E+00	1.9E+01	1.1E+02
Eu-155	1.0E+00	9.4E-02	6.1E-01	3.6E+00	7.6E-01	6.1E-02	4.4E-01	2.3E+00
Re-186	5.5E-05	1.5E-07	6.8E-06	2.6E-04	4.1E-05	1.0E-07	4.6E-06	2.0E-04
Ir-192	3.7E-01	2.6E-02	2.1E-01	1.3E+00	2.7E-01	1.9E-02	1.5E-01	8.2E-01
Pb-210	2.1E-01	1.6E-02	1.2E-01	7.9E-01	1.5E-01	1.0E-02	7.8E-02	5.0E-01
Po-210	8.5E-02	8.2E-03	5.0E-02	2.6E-01	6.4E-02	4.6E-03	3.4E-02	2.1E-01
Bi-210	1.3E-04	8.6E-07	2.7E-05	6.7E-04	1.0E-04	5.7E-07	2.0E-05	4.5E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	8.0E-01	6.7E-02	3.8E-01	2.9E+00	5.9E-01	4.2E-02	2.6E-01	2.2E+00
Ra-224	6.9E-03	2.5E-05	9.1E-04	4.1E-02	5.1E-03	2.1E-05	6.4E-04	2.8E-02
Ac-225	1.8E-01	1.5E-02	9.7E-02	6.0E-01	1.4E-01	9.5E-03	6.5E-02	4.9E-01
Ra-225	3.9E-01	3.6E-02	2.1E-01	1.5E+00	3.0E-01	2.3E-02	1.5E-01	1.1E+00
Ra-226	6.6E+01	7.0E+00	4.0E+01	2.1E+02	4.9E+01	4.5E+00	2.8E+01	1.4E+02
Ac-227	2.3E+02	2.3E+01	1.5E+02	7.1E+02	1.8E+02	1.5E+01	1.1E+02	5.7E+02
Th-227	1.6E+00	1.8E-01	9.9E-01	4.9E+00	1.2E+00	1.0E-01	7.4E-01	4.0E+00
Th-228	1.1E+02	1.5E+01	7.2E+01	3.5E+02	8.4E+01	9.7E+00	5.3E+01	2.5E+02
Ra-228	3.8E+01	4.0E+00	2.3E+01	1.2E+02	2.8E+01	2.9E+00	1.6E+01	9.8E+01
Th-229	2.9E+02	2.3E+01	1.8E+02	9.9E+02	2.3E+02	1.6E+01	1.2E+02	8.0E+02
Th-230	4.6E+01	3.6E+00	2.6E+01	1.5E+02	3.6E+01	2.1E+00	1.9E+01	1.2E+02
Pa-231	1.6E+02	1.4E+01	9.4E+01	5.5E+02	1.3E+02	8.7E+00	6.9E+01	5.0E+02
Th-231	8.7E-08	1.8E-16	6.0E-12	5.1E-07	6.0E-08	1.0E-16	4.5E-12	3.6E-07
Th-232	2.0E+02	1.5E+01	1.2E+02	6.1E+02	1.5E+02	9.9E+00	8.3E+01	5.1E+02
Pa-233	2.3E+00	1.9E-01	1.4E+00	7.2E+00	1.8E+00	1.4E-01	9.3E-01	5.8E+00
U-233	2.3E+01	1.9E+00	1.3E+01	8.0E+01	1.8E+01	1.2E+00	9.1E+00	6.5E+01
Th-234	6.0E-02	6.0E-03	3.6E-02	1.9E-01	4.5E-02	4.1E-03	2.5E-02	1.6E-01
U-234	2.2E+01	1.8E+00	1.3E+01	7.7E+01	1.7E+01	1.2E+00	9.1E+00	6.3E+01
U-235	2.5E+01	2.8E+00	1.6E+01	8.1E+01	1.9E+01	1.9E+00	1.1E+01	7.0E+01
Np-237	1.0E+02	9.9E+00	5.8E+01	3.6E+02	8.1E+01	5.9E+00	4.2E+01	2.7E+02
Pu-238	4.9E+01	3.7E+00	2.9E+01	1.7E+02	3.8E+01	2.4E+00	1.9E+01	1.3E+02
U-238	2.0E+01	1.8E+00	1.1E+01	7.4E+01	1.6E+01	1.1E+00	8.1E+00	6.4E+01
Pu-239	5.4E+01	4.1E+00	2.9E+01	1.8E+02	4.2E+01	2.8E+00	2.2E+01	1.5E+02
Pu-240	5.2E+01	3.9E+00	3.0E+01	1.8E+02	4.1E+01	2.8E+00	2.1E+01	1.5E+02
Pu-241	8.5E-01	7.1E-02	4.4E-01	2.8E+00	6.9E-01	4.0E-02	3.3E-01	2.6E+00
Am-241	8.0E+01	8.1E+00	4.2E+01	2.7E+02	6.0E+01	4.7E+00	3.4E+01	2.0E+02
Cm-242	2.6E+00	2.4E-01	1.6E+00	8.5E+00	2.0E+00	1.5E-01	1.1E+00	6.7E+00
Pu-242	5.0E+01	3.9E+00	2.9E+01	1.8E+02	3.8E+01	2.3E+00	2.1E+01	1.4E+02
Cm-244	4.3E+01	4.3E+00	2.5E+01	1.3E+02	3.3E+01	2.9E+00	1.9E+01	1.0E+02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.13 Dose factors[a] for FE-METL-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	6.1E-06	2.3E-06	5.5E-06	1.1E-05	4.6E-06	1.4E-06	3.9E-06	1.1E-05
Na-22	7.6E-03	4.6E-04	5.9E-03	2.0E-02	5.6E-03	2.8E-04	3.9E-03	1.7E-02
P-32	5.8E-07	2.5E-08	3.2E-07	2.1E-06	4.3E-07	1.7E-08	2.1E-07	1.4E-06
S-35	1.5E-07	1.4E-08	1.2E-07	3.7E-07	1.1E-07	8.0E-09	9.1E-08	3.2E-07
Cl-36	3.4E-06	6.9E-07	3.1E-06	7.2E-06	2.6E-06	4.7E-07	2.1E-06	6.1E-06
K-40	5.9E-04	3.4E-05	4.3E-04	1.6E-03	4.4E-04	2.5E-05	2.9E-04	1.3E-03
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.3E-08	1.6E-09	2.5E-08	8.5E-08	2.4E-08	1.2E-09	1.8E-08	6.9E-08
Cr-51	1.0E-03	3.1E-04	8.7E-04	2.4E-03	7.9E-04	1.9E-04	6.0E-04	1.8E-03
Mn-54	2.4E-01	7.1E-02	2.2E-01	4.6E-01	1.8E-01	4.3E-02	1.5E-01	4.2E-01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.9E-02	1.6E-02	3.6E-02	7.1E-02	2.9E-02	9.0E-03	2.5E-02	6.6E-02
Co-58	2.1E-01	8.1E-02	1.9E-01	4.1E-01	1.6E-01	4.5E-02	1.3E-01	3.5E-01
Fe-59	1.2E-01	4.0E-02	1.1E-01	2.3E-01	8.8E-02	2.4E-02	7.6E-02	1.9E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.6E+00	9.9E-01	2.4E+00	4.8E+00	2.0E+00	5.3E-01	1.6E+00	4.5E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.7E-02	3.0E-03	3.0E-02	9.6E-02	2.8E-02	2.3E-03	2.0E-02	8.1E-02
Cu-67	1.5E-07	9.8E-12	3.1E-09	9.2E-07	1.2E-07	6.0E-12	2.0E-09	5.6E-07
Se-75	5.1E-02	4.1E-03	4.3E-02	1.3E-01	3.9E-02	3.3E-03	2.9E-02	1.1E-01
Sr-85	3.4E-04	2.2E-05	2.4E-04	1.0E-03	2.7E-04	1.5E-05	1.6E-04	8.4E-04
Sr-89	6.6E-07	4.3E-08	4.5E-07	1.9E-06	5.0E-07	2.9E-08	3.3E-07	1.5E-06
Sr-90	6.2E-07	4.8E-08	4.7E-07	1.7E-06	4.7E-07	2.4E-08	3.2E-07	1.4E-06
Y-91	1.9E-06	1.2E-07	1.3E-06	5.3E-06	1.4E-06	6.8E-08	8.7E-07	4.1E-06
Mo-93	2.0E-04	7.8E-05	1.9E-04	3.6E-04	1.5E-04	4.9E-05	1.3E-04	3.3E-04
Nb-93m	1.1E-07	6.7E-09	8.2E-08	3.2E-07	8.7E-08	4.3E-09	6.0E-08	2.6E-07
Nb-94	6.5E-03	4.1E-04	5.0E-03	1.8E-02	4.9E-03	2.5E-04	3.4E-03	1.3E-02
Nb-95	1.8E-04	1.2E-05	1.3E-04	5.5E-04	1.4E-04	7.9E-06	8.8E-05	4.3E-04
Zr-95	4.8E-04	2.4E-05	3.3E-04	1.5E-03	3.6E-04	1.6E-05	2.3E-04	1.2E-03
Tc-99	4.1E-05	1.7E-05	3.8E-05	7.5E-05	3.1E-05	1.0E-05	2.6E-05	7.0E-05
Ru-103	4.3E-02	1.5E-02	4.0E-02	8.8E-02	3.3E-02	9.0E-03	2.7E-02	7.8E-02
Ru-106	1.6E-01	6.1E-02	1.5E-01	3.0E-01	1.2E-01	3.7E-02	1.0E-01	2.7E-01
Ag-108m	2.0E+00	7.5E-01	1.9E+00	3.8E+00	1.5E+00	4.2E-01	1.3E+00	3.5E+00
Cd-109	1.4E-06	9.2E-08	1.1E-06	3.9E-06	1.1E-06	5.3E-08	7.7E-07	2.9E-06
Ag-110m	1.9E+00	6.6E-01	1.7E+00	3.3E+00	1.4E+00	4.2E-01	1.2E+00	3.2E+00
Sb-124	2.7E-01	9.5E-02	2.6E-01	5.3E-01	2.1E-01	5.7E-02	1.7E-01	4.5E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	4.0E-01	1.5E-01	3.7E-01	7.5E-01	3.1E-01	9.3E-02	2.6E-01	6.9E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.4E-03	8.3E-05	1.0E-03	3.7E-03	1.1E-03	5.6E-05	6.6E-04	3.3E-03
Cs-134	5.3E-03	3.3E-04	3.9E-03	1.4E-02	4.0E-03	1.7E-04	2.9E-03	1.2E-02
Cs-137	2.5E-03	1.5E-04	1.9E-03	6.8E-03	1.9E-03	9.7E-05	1.3E-03	5.5E-03

Table F.13 Dose factors[a] for FE-METL-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	8.9E-05	3.8E-06	6.5E-05	2.6E-04	6.8E-05	2.8E-06	4.6E-05	2.1E-04
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	4.6E-03	2.7E-04	3.4E-03	1.2E-02	3.5E-03	1.6E-04	2.4E-03	1.0E-02
Eu-155	6.1E-05	4.3E-06	4.3E-05	1.7E-04	4.6E-05	2.4E-06	3.0E-05	1.7E-04
Re-186	1.2E-07	1.3E-10	8.7E-09	6.0E-07	9.3E-08	8.5E-11	6.5E-09	4.9E-07
Ir-192	9.4E-02	5.9E-03	7.7E-02	2.3E-01	7.2E-02	4.2E-03	5.1E-02	2.1E-01
Pb-210	8.9E-06	1.9E-06	7.2E-06	2.1E-05	6.8E-06	1.1E-06	5.3E-06	1.8E-05
Po-210	1.3E-08	9.2E-10	9.7E-09	3.5E-08	9.6E-09	4.7E-10	6.9E-09	2.9E-08
Bi-210	1.3E-08	4.5E-11	2.1E-09	6.5E-08	9.9E-09	3.0E-11	1.5E-09	4.8E-08
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	2.2E-05	1.8E-06	1.3E-05	7.6E-05	1.7E-05	1.1E-06	8.3E-06	5.4E-05
Ra-224	6.1E-07	6.2E-10	4.7E-08	3.8E-06	4.9E-07	4.3E-10	3.3E-08	2.6E-06
Ac-225	1.8E-06	5.2E-08	7.6E-07	7.3E-06	1.4E-06	3.8E-08	5.3E-07	5.2E-06
Ra-225	1.7E-07	2.0E-08	1.1E-07	5.6E-07	1.3E-07	1.1E-08	8.1E-08	4.1E-07
Ra-226	3.9E-02	6.9E-03	3.1E-02	1.0E-01	3.0E-02	4.7E-03	2.2E-02	8.4E-02
Ac-227	1.4E-03	8.0E-05	1.0E-03	3.7E-03	1.1E-03	4.6E-05	6.8E-04	3.2E-03
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	4.0E-03	2.1E-04	3.1E-03	1.1E-02	3.0E-03	1.6E-04	2.0E-03	9.5E-03
Ra-228	1.8E-02	3.3E-03	1.5E-02	4.4E-02	1.4E-02	1.9E-03	1.0E-02	3.6E-02
Th-229	9.5E-04	5.0E-05	6.8E-04	2.5E-03	7.1E-04	2.9E-05	4.8E-04	2.1E-03
Th-230	2.2E-06	1.5E-07	1.6E-06	6.1E-06	1.6E-06	9.1E-08	1.1E-06	4.9E-06
Pa-231	1.0E-04	6.9E-06	8.1E-05	2.9E-04	7.8E-05	4.5E-06	5.5E-05	2.3E-04
Th-231	4.7E-16	1.0E-27	1.1E-21	2.0E-15	4.2E-16	9.8E-28	9.2E-22	1.4E-15
Th-232	4.4E-04	2.2E-05	3.3E-04	1.3E-03	3.4E-04	1.6E-05	2.3E-04	1.1E-03
Pa-233	2.6E-05	1.5E-06	1.8E-05	8.0E-05	2.0E-05	1.0E-06	1.3E-05	6.1E-05
U-233	5.4E-08	3.1E-09	4.1E-08	1.5E-07	4.1E-08	2.0E-09	2.7E-08	1.3E-07
Th-234	1.0E-06	4.2E-08	6.9E-07	3.3E-06	8.1E-07	2.4E-08	4.8E-07	2.6E-06
U-234	9.4E-08	6.5E-09	7.0E-08	2.6E-07	7.0E-08	4.6E-09	5.1E-08	2.0E-07
U-235	4.5E-04	2.3E-05	3.4E-04	1.2E-03	3.4E-04	1.6E-05	2.4E-04	1.0E-03
Np-237	7.9E-04	4.5E-05	5.8E-04	2.1E-03	6.0E-04	3.1E-05	4.3E-04	1.8E-03
Pu-238	1.1E-07	6.8E-09	8.0E-08	3.0E-07	8.3E-08	4.6E-09	5.5E-08	2.5E-07
U-238	4.0E-05	2.2E-06	2.9E-05	1.2E-04	3.0E-05	1.5E-06	2.0E-05	9.2E-05
Pu-239	4.2E-08	2.2E-09	2.9E-08	1.1E-07	3.2E-08	1.5E-09	2.3E-08	9.8E-08
Pu-240	1.1E-07	6.5E-09	8.0E-08	3.0E-07	8.6E-08	3.7E-09	5.3E-08	2.6E-07
Pu-241	2.3E-08	1.3E-09	1.7E-08	6.6E-08	1.7E-08	9.3E-10	1.1E-08	5.4E-08
Am-241	1.0E-05	6.5E-07	7.7E-06	2.9E-05	7.6E-06	4.6E-07	5.1E-06	2.2E-05
Cm-242	7.1E-08	4.5E-09	5.5E-08	2.0E-07	5.4E-08	2.9E-09	3.7E-08	1.5E-07
Pu-242	1.4E-07	8.8E-09	1.1E-07	3.8E-07	7.1E-08	3.8E-09	4.6E-08	2.1E-07
Cm-244	9.4E-08	5.0E-09	7.0E-08	2.7E-07	1.1E-07	6.6E-09	7.5E-08	3.2E-07

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.14 Dose factors[a] for FE-METL-SMMASS-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.1E-06	2.6E-07	9.7E-07	2.4E-06	8.3E-07	1.6E-07	6.3E-07	2.1E-06
Na-22	1.3E-03	6.3E-05	9.1E-04	4.0E-03	9.9E-04	3.8E-05	6.4E-04	3.1E-03
P-32	3.6E-08	9.4E-10	1.3E-08	1.5E-07	2.7E-08	5.5E-10	8.6E-09	1.1E-07
S-35	2.2E-08	1.6E-09	1.5E-08	6.7E-08	1.7E-08	1.0E-09	9.7E-09	5.8E-08
Cl-36	6.0E-07	8.8E-08	4.9E-07	1.4E-06	4.6E-07	5.6E-08	3.4E-07	1.2E-06
K-40	1.1E-04	5.4E-06	7.0E-05	3.4E-04	8.1E-05	2.9E-06	4.9E-05	2.7E-04
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	5.3E-09	2.3E-10	3.2E-09	1.7E-08	4.0E-09	1.4E-10	2.4E-09	1.4E-08
Cr-51	1.1E-04	1.6E-05	7.6E-05	3.3E-04	8.0E-05	8.8E-06	5.2E-05	2.4E-04
Mn-54	4.2E-02	9.3E-03	3.6E-02	1.0E-01	3.2E-02	5.8E-03	2.5E-02	9.1E-02
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	6.3E-03	1.5E-03	5.4E-03	1.5E-02	4.9E-03	8.5E-04	3.6E-03	1.3E-02
Co-58	3.0E-02	6.5E-03	2.5E-02	6.8E-02	2.2E-02	3.7E-03	1.8E-02	5.7E-02
Fe-59	1.5E-02	2.6E-03	1.3E-02	3.7E-02	1.1E-02	1.6E-03	8.7E-03	3.1E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	4.9E-01	1.1E-01	4.1E-01	1.1E+00	3.7E-01	6.1E-02	2.9E-01	1.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.4E-03	4.1E-04	4.7E-03	1.8E-02	4.9E-03	2.9E-04	3.1E-03	1.4E-02
Cu-67	4.3E-10	4.9E-17	4.8E-13	2.6E-09	3.2E-10	3.1E-17	3.2E-13	1.9E-09
Se-75	7.6E-03	6.0E-04	5.3E-03	2.1E-02	5.9E-03	3.4E-04	3.8E-03	2.0E-02
Sr-85	4.6E-05	2.2E-06	2.9E-05	1.5E-04	3.5E-05	1.2E-06	2.0E-05	1.2E-04
Sr-89	8.2E-08	3.5E-09	5.1E-08	2.6E-07	6.3E-08	2.2E-09	3.6E-08	2.2E-07
Sr-90	1.1E-07	4.6E-09	7.2E-08	3.7E-07	8.9E-08	3.0E-09	4.9E-08	3.4E-07
Y-91	2.6E-07	1.0E-08	1.6E-07	8.2E-07	2.0E-07	8.0E-09	1.1E-07	6.5E-07
Mo-93	3.5E-05	7.8E-06	3.1E-05	8.2E-05	2.7E-05	4.2E-06	2.0E-05	7.4E-05
Nb-93m	1.9E-08	8.3E-10	1.2E-08	5.4E-08	1.4E-08	4.5E-10	9.1E-09	4.3E-08
Nb-94	1.2E-03	6.0E-05	8.3E-04	3.8E-03	9.5E-04	3.8E-05	5.1E-04	3.2E-03
Nb-95	2.2E-05	7.3E-07	1.3E-05	7.8E-05	1.7E-05	4.8E-07	8.7E-06	5.7E-05
Zr-95	6.3E-05	3.1E-06	4.2E-05	2.0E-04	4.8E-05	2.4E-06	2.8E-05	1.7E-04
Tc-99	7.4E-06	1.7E-06	6.5E-06	1.7E-05	5.6E-06	1.0E-06	4.3E-06	1.5E-05
Ru-103	5.2E-03	1.0E-03	3.9E-03	1.2E-02	3.9E-03	5.9E-04	2.9E-03	1.1E-02
Ru-106	2.8E-02	5.9E-03	2.4E-02	6.5E-02	2.2E-02	3.6E-03	1.6E-02	5.8E-02
Ag-108m	3.7E-01	9.2E-02	3.1E-01	8.5E-01	2.8E-01	5.4E-02	2.1E-01	7.8E-01
Cd-109	2.2E-07	1.1E-08	1.5E-07	7.0E-07	1.7E-07	8.2E-09	1.0E-07	5.9E-07
Ag-110m	3.1E-01	7.3E-02	2.6E-01	7.0E-01	2.4E-01	4.4E-02	1.8E-01	6.3E-01
Sb-124	3.7E-02	8.0E-03	3.0E-02	9.0E-02	2.8E-02	4.6E-03	2.1E-02	7.9E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.1E-02	1.7E-02	6.1E-02	1.6E-01	5.4E-02	9.9E-03	4.3E-02	1.4E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.4E-04	8.7E-06	1.6E-04	7.0E-04	1.9E-04	6.6E-06	1.1E-04	6.1E-04
Cs-134	9.1E-04	4.4E-05	6.3E-04	2.7E-03	6.9E-04	2.7E-05	4.4E-04	2.3E-03
Cs-137	4.7E-04	2.1E-05	3.0E-04	1.5E-03	3.5E-04	1.3E-05	2.0E-04	1.2E-03

Table F.14 Dose factors[a] for FE-METL-SMMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	8.5E-07	3.5E-08	5.3E-07	3.0E-06	6.6E-07	1.8E-08	3.8E-07	2.3E-06
Ce-144	1.5E-05	5.5E-07	9.6E-06	4.7E-05	1.2E-05	3.7E-07	6.4E-06	3.9E-05
Pm-147	9.5E-10	4.3E-11	6.3E-10	3.0E-09	7.3E-10	2.5E-11	4.4E-10	2.4E-09
Eu-152	7.6E-04	4.1E-05	4.5E-04	2.4E-03	5.8E-04	2.7E-05	3.2E-04	2.0E-03
Eu-154	8.2E-04	3.8E-05	5.4E-04	2.5E-03	6.2E-04	2.4E-05	3.6E-04	2.0E-03
Eu-155	9.8E-06	5.3E-07	6.4E-06	3.0E-05	7.6E-06	3.5E-07	4.6E-06	2.6E-05
Re-186	1.1E-09	1.6E-14	1.1E-11	5.7E-09	8.1E-10	1.0E-14	7.4E-12	5.0E-09
Ir-192	1.3E-02	7.2E-04	9.4E-03	4.2E-02	1.0E-02	4.5E-04	6.3E-03	3.3E-02
Pb-210	1.5E-06	2.1E-07	1.2E-06	4.1E-06	1.2E-06	1.2E-07	7.9E-07	3.1E-06
Po-210	2.1E-09	8.3E-11	1.3E-09	6.5E-09	1.6E-09	5.3E-11	8.6E-10	5.3E-09
Bi-210	2.1E-10	4.7E-14	7.6E-12	1.3E-09	1.6E-10	3.1E-14	5.7E-12	7.8E-10
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E-06	3.0E-08	4.0E-07	5.6E-06	9.4E-07	1.8E-08	3.2E-07	3.5E-06
Ra-224	5.8E-09	7.8E-14	5.5E-11	2.6E-08	4.3E-09	5.3E-14	3.8E-11	2.4E-08
Ac-225	8.4E-08	7.7E-10	2.1E-08	3.8E-07	6.5E-08	5.1E-10	1.6E-08	2.7E-07
Ra-225	1.1E-08	3.7E-10	4.3E-09	4.2E-08	8.0E-09	2.3E-10	3.0E-09	3.0E-08
Ra-226	7.2E-03	8.5E-04	5.6E-03	2.0E-02	5.5E-03	5.8E-04	3.9E-03	1.6E-02
Ac-227	2.3E-04	1.2E-05	1.6E-04	7.3E-04	1.7E-04	9.2E-06	1.1E-04	6.3E-04
Th-227	4.2E-07	9.1E-09	1.8E-07	1.6E-06	3.2E-07	7.6E-09	1.3E-07	1.4E-06
Th-228	7.5E-04	3.8E-05	4.9E-04	2.4E-03	5.6E-04	2.3E-05	3.5E-04	1.9E-03
Ra-228	3.4E-03	4.5E-04	2.4E-03	9.7E-03	2.7E-03	2.7E-04	1.7E-03	8.5E-03
Th-229	1.7E-04	1.0E-05	1.1E-04	5.1E-04	1.3E-04	5.7E-06	7.5E-05	4.2E-04
Th-230	4.1E-07	1.4E-08	2.5E-07	1.3E-06	3.3E-07	1.1E-08	1.7E-07	1.1E-06
Pa-231	2.0E-05	8.5E-07	1.3E-05	6.2E-05	1.5E-05	5.9E-07	8.9E-06	5.3E-05
Th-231	6.6E-21	3.2E-39	1.5E-29	2.2E-20	4.8E-21	2.2E-39	7.4E-30	1.4E-20
Th-232	8.1E-05	3.6E-06	5.5E-05	2.4E-04	6.1E-05	2.5E-06	3.8E-05	1.9E-04
Pa-233	2.5E-06	9.4E-08	1.3E-06	9.0E-06	1.8E-06	6.6E-08	9.2E-07	6.6E-06
U-233	9.0E-09	4.1E-10	6.0E-09	2.9E-08	6.9E-09	3.0E-10	4.2E-09	2.1E-08
Th-234	1.0E-07	2.2E-09	5.0E-08	3.8E-07	7.8E-08	1.9E-09	3.7E-08	3.3E-07
U-234	1.6E-08	8.4E-10	1.0E-08	4.6E-08	1.2E-08	5.9E-10	7.1E-09	3.8E-08
U-235	8.2E-05	3.2E-06	4.8E-05	2.7E-04	6.3E-05	2.5E-06	3.2E-05	2.1E-04
Np-237	1.4E-04	6.9E-06	8.6E-05	4.3E-04	1.1E-04	3.9E-06	6.1E-05	3.6E-04
Pu-238	1.9E-08	8.6E-10	1.2E-08	6.6E-08	1.5E-08	5.8E-10	8.0E-09	5.7E-08
U-238	7.1E-06	2.8E-07	4.7E-06	2.1E-05	5.3E-06	2.1E-07	3.4E-06	1.7E-05
Pu-239	6.7E-09	3.8E-10	4.9E-09	2.2E-08	5.0E-09	2.7E-10	3.3E-09	1.6E-08
Pu-240	1.9E-08	7.3E-10	1.2E-08	6.0E-08	1.5E-08	4.8E-10	8.6E-09	5.2E-08
Pu-241	4.1E-09	1.9E-10	2.4E-09	1.4E-08	3.1E-09	1.2E-10	1.8E-09	1.1E-08
Am-241	1.8E-06	9.8E-08	1.2E-06	5.6E-06	1.3E-06	6.1E-08	8.8E-07	4.2E-06
Cm-242	1.0E-08	4.4E-10	7.0E-09	3.2E-08	8.0E-09	3.1E-10	4.7E-09	2.6E-08
Pu-242	1.5E-08	8.7E-10	9.6E-09	5.2E-08	1.2E-08	5.1E-10	6.8E-09	4.0E-08
Cm-244	2.5E-08	1.1E-09	1.6E-08	7.2E-08	1.9E-08	6.9E-10	1.2E-08	6.4E-08

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.15 Dose factors[a] for FE-METL-SMOBJCT-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm^2)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.4E-04	2.3E-05	1.0E-04	3.6E-04	1.0E-04	1.4E-05	7.7E-05	2.9E-04
Na-22	1.3E-01	4.6E-03	7.9E-02	4.0E-01	9.5E-02	3.7E-03	5.3E-02	3.3E-01
P-32	4.6E-06	8.1E-08	1.5E-06	1.9E-05	3.5E-06	5.6E-08	1.0E-06	1.6E-05
S-35	2.9E-06	1.3E-07	1.7E-06	9.3E-06	2.2E-06	1.0E-07	1.3E-06	7.7E-06
Cl-36	7.7E-05	9.4E-06	5.3E-05	2.1E-04	5.9E-05	6.3E-06	3.9E-05	1.8E-04
K-40	9.8E-03	2.6E-04	6.2E-03	3.0E-02	7.4E-03	1.6E-04	4.4E-03	2.5E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	6.5E-07	2.1E-08	3.7E-07	2.2E-06	4.9E-07	1.5E-08	2.6E-07	1.7E-06
Cr-51	1.2E-02	1.4E-03	8.0E-03	3.6E-02	9.1E-03	8.1E-04	5.7E-03	3.1E-02
Mn-54	3.9E+00	5.5E-01	3.1E+00	9.9E+00	3.0E+00	3.6E-01	2.0E+00	8.2E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.2E+00	2.0E-01	9.6E-01	3.1E+00	9.3E-01	1.2E-01	6.9E-01	2.4E+00
Co-58	2.9E+00	4.6E-01	2.2E+00	7.3E+00	2.2E+00	2.8E-01	1.6E+00	6.1E+00
Fe-59	1.4E+00	1.9E-01	1.1E+00	3.8E+00	1.0E+00	1.0E-01	7.4E-01	3.2E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	4.4E+01	7.5E+00	3.4E+01	1.1E+02	3.3E+01	4.4E+00	2.5E+01	8.6E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.1E-01	2.9E-02	3.9E-01	1.8E+00	4.6E-01	1.6E-02	2.8E-01	1.6E+00
Cu-67	7.1E-08	8.2E-15	5.0E-11	4.3E-07	5.4E-08	6.1E-15	3.8E-11	2.8E-07
Se-75	9.8E-01	4.9E-02	6.6E-01	2.9E+00	7.3E-01	2.9E-02	4.7E-01	2.4E+00
Sr-85	4.6E-03	2.1E-04	2.7E-03	1.4E-02	3.4E-03	1.3E-04	2.0E-03	1.2E-02
Sr-89	1.1E-05	3.7E-07	6.0E-06	4.3E-05	8.3E-06	2.5E-07	4.2E-06	3.2E-05
Sr-90	1.4E-05	6.7E-07	8.1E-06	4.6E-05	1.1E-05	3.7E-07	5.4E-06	4.0E-05
Y-91	2.2E-05	8.6E-07	1.4E-05	7.1E-05	1.7E-05	4.8E-07	9.5E-06	6.1E-05
Mo-93	1.4E-02	2.5E-03	1.1E-02	3.7E-02	1.1E-02	1.4E-03	7.9E-03	3.1E-02
Nb-93m	7.6E-06	3.0E-07	4.6E-06	2.7E-05	5.6E-06	2.0E-07	3.1E-06	2.0E-05
Nb-94	1.1E-01	4.4E-03	6.8E-02	3.5E-01	8.4E-02	2.9E-03	4.9E-02	3.0E-01
Nb-95	1.9E-03	8.3E-05	1.0E-03	6.2E-03	1.4E-03	4.8E-05	7.6E-04	4.5E-03
Zr-95	6.3E-03	1.8E-04	3.7E-03	2.0E-02	4.8E-03	1.2E-04	2.6E-03	1.7E-02
Tc-99	9.4E-04	1.6E-04	7.1E-04	2.4E-03	7.1E-04	9.8E-05	5.3E-04	1.9E-03
Ru-103	5.4E-01	7.2E-02	4.1E-01	1.5E+00	4.0E-01	4.5E-02	2.7E-01	1.2E+00
Ru-106	2.8E+00	4.4E-01	2.2E+00	7.0E+00	2.1E+00	2.8E-01	1.6E+00	5.5E+00
Ag-108m	3.6E+01	6.1E+00	2.8E+01	9.1E+01	2.7E+01	3.7E+00	2.0E+01	7.3E+01
Cd-109	7.8E-05	2.6E-06	3.0E-05	2.7E-04	6.0E-05	1.8E-06	3.5E-05	2.0E-04
Ag-110m	2.9E+01	5.1E+00	2.3E+01	7.6E+01	2.2E+01	2.9E+00	1.6E+01	6.0E+01
Sb-124	3.5E+00	5.5E-01	2.6E+00	9.5E+00	2.6E+00	3.4E-01	1.8E+00	7.4E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.4E+00	1.3E+00	5.7E+00	1.9E+01	5.6E+00	7.5E-01	3.9E+00	1.6E+01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.7E-02	8.6E-04	1.7E-02	8.4E-02	2.1E-02	6.2E-04	1.1E-02	6.9E-02
Cs-134	9.4E-02	3.1E-03	5.1E-02	3.3E-01	7.0E-02	2.1E-03	3.8E-02	2.7E-01
Cs-137	4.3E-02	1.8E-03	2.7E-02	1.4E-01	3.1E-02	1.1E-03	1.8E-02	9.6E-02

Table F.15 Dose factors[a] for FE-METL-SMOBJCT-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.5E-04	4.7E-06	8.1E-05	5.5E-04	1.1E-04	3.0E-06	5.8E-05	4.0E-04
Ce-144	1.6E-03	7.4E-05	9.6E-04	5.2E-03	1.2E-03	5.6E-05	6.8E-04	3.9E-03
Pm-147	1.9E-07	8.9E-09	1.1E-07	6.5E-07	1.5E-07	5.7E-09	8.0E-08	5.2E-07
Eu-152	7.6E-02	2.8E-03	4.6E-02	2.6E-01	5.8E-02	1.7E-03	3.3E-02	2.0E-01
Eu-154	7.8E-02	3.9E-03	4.6E-02	2.7E-01	5.9E-02	2.7E-03	3.2E-02	1.9E-01
Eu-155	2.7E-03	1.0E-04	1.6E-03	9.0E-03	2.0E-03	6.2E-05	1.1E-03	6.7E-03
Re-186	2.4E-07	3.6E-12	1.9E-09	1.3E-06	1.8E-07	2.6E-12	1.3E-09	9.0E-07
Ir-192	1.4E+00	6.3E-02	9.1E-01	4.6E+00	1.1E+00	4.5E-02	6.5E-01	3.3E+00
Pb-210	5.2E-04	6.2E-05	3.6E-04	1.5E-03	3.9E-04	3.9E-05	2.4E-04	1.1E-03
Po-210	1.9E-07	7.2E-09	1.1E-07	6.2E-07	1.4E-07	3.7E-09	7.9E-08	4.8E-07
Bi-210	3.0E-08	9.0E-12	9.1E-10	1.5E-07	2.4E-08	4.9E-12	7.9E-10	1.2E-07
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.6E-04	3.1E-06	4.1E-05	6.6E-04	1.2E-04	1.9E-06	3.0E-05	5.3E-04
Ra-224	6.9E-07	7.8E-12	4.2E-09	3.6E-06	5.1E-07	6.2E-12	3.3E-09	2.7E-06
Ac-225	9.7E-06	7.2E-08	2.0E-06	4.1E-05	7.4E-06	4.6E-08	1.4E-06	3.7E-05
Ra-225	3.5E-06	1.4E-07	1.3E-06	1.4E-05	2.6E-06	8.0E-08	9.2E-07	1.1E-05
Ra-226	7.0E-01	7.0E-02	4.9E-01	2.2E+00	5.2E-01	4.1E-02	3.2E-01	1.6E+00
Ac-227	2.8E-02	9.6E-04	1.7E-02	9.6E-02	2.1E-02	6.9E-04	1.2E-02	7.2E-02
Th-227	5.2E-05	8.4E-07	2.2E-05	2.0E-04	4.0E-05	5.9E-07	1.6E-05	1.6E-04
Th-228	7.1E-02	2.3E-03	4.0E-02	2.4E-01	5.4E-02	1.5E-03	2.9E-02	1.9E-01
Ra-228	3.1E-01	3.5E-02	2.0E-01	1.1E+00	2.4E-01	2.2E-02	1.4E-01	7.9E-01
Th-229	2.0E-02	7.1E-04	1.3E-02	6.4E-02	1.5E-02	5.4E-04	8.8E-03	5.4E-02
Th-230	4.6E-05	2.2E-06	3.0E-05	1.5E-04	3.4E-05	1.3E-06	2.1E-05	1.2E-04
Pa-231	2.4E-03	8.8E-05	1.2E-03	8.8E-03	1.8E-03	5.8E-05	8.3E-04	6.6E-03
Th-231	1.9E-18	8.5E-37	1.3E-27	3.5E-18	1.6E-18	7.1E-37	7.9E-28	2.4E-18
Th-232	7.4E-03	3.6E-04	4.5E-03	2.5E-02	5.5E-03	2.5E-04	3.1E-03	1.8E-02
Pa-233	2.9E-04	9.4E-06	1.5E-04	1.1E-03	2.2E-04	6.0E-06	1.1E-04	8.4E-04
U-233	4.0E-06	1.5E-07	2.4E-06	1.3E-05	3.1E-06	9.5E-08	1.5E-06	1.1E-05
Th-234	1.3E-05	2.9E-07	5.6E-06	5.0E-05	9.9E-06	1.8E-07	3.8E-06	3.6E-05
U-234	6.2E-06	2.2E-07	3.8E-06	2.1E-05	4.7E-06	1.6E-07	2.7E-06	1.7E-05
U-235	1.3E-02	4.2E-04	7.0E-03	4.3E-02	9.4E-03	2.5E-04	4.8E-03	3.2E-02
Np-237	1.7E-02	7.4E-04	1.0E-02	5.9E-02	1.3E-02	4.6E-04	7.0E-03	4.5E-02
Pu-238	7.7E-06	2.5E-07	4.2E-06	2.7E-05	5.8E-06	1.8E-07	3.0E-06	2.1E-05
U-238	8.6E-04	3.5E-05	5.3E-04	3.0E-03	6.5E-04	1.9E-05	3.5E-04	2.3E-03
Pu-239	2.9E-06	1.3E-07	1.5E-06	9.2E-06	2.1E-06	9.0E-08	1.1E-06	7.5E-06
Pu-240	6.5E-06	2.9E-07	3.7E-06	2.2E-05	4.9E-06	1.8E-07	2.5E-06	1.7E-05
Pu-241	1.2E-06	5.3E-08	7.3E-07	3.9E-06	9.0E-07	2.6E-08	5.2E-07	3.0E-06
Am-241	6.0E-04	2.6E-05	3.6E-04	2.1E-03	4.4E-04	1.7E-05	2.5E-04	1.6E-03
Cm-242	4.1E-06	1.5E-07	2.4E-06	1.4E-05	3.1E-06	1.1E-07	1.7E-06	1.1E-05
Pu-242	5.7E-06	2.7E-07	3.5E-06	2.0E-05	4.3E-06	1.8E-07	2.5E-06	1.4E-05
Cm-244	9.7E-06	3.8E-07	5.4E-06	3.2E-05	7.3E-06	2.9E-07	3.6E-06	2.6E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.16 Dose factors[a] for FE-METL-VEHICLE-N

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.0E-04	1.8E-05	8.6E-05	2.5E-04	7.9E-05	1.2E-05	6.3E-05	2.0E-04
Na-22	1.4E-01	4.9E-03	8.8E-02	4.5E-01	1.1E-01	3.6E-03	6.1E-02	3.4E-01
P-32	1.0E-05	2.4E-07	4.6E-06	3.8E-05	7.8E-06	1.7E-07	3.2E-06	3.2E-05
S-35	2.6E-06	1.2E-07	1.9E-06	7.9E-06	2.0E-06	7.6E-08	1.2E-06	6.1E-06
Cl-36	5.8E-05	8.4E-06	4.6E-05	1.6E-04	4.4E-05	5.3E-06	3.2E-05	1.3E-04
K-40	1.2E-02	4.7E-04	7.6E-03	3.9E-02	8.8E-03	3.1E-04	5.0E-03	3.1E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	5.2E-07	2.1E-08	3.5E-07	1.6E-06	4.1E-07	1.4E-08	2.3E-07	1.3E-06
Cr-51	1.7E-02	2.8E-03	1.3E-02	4.8E-02	1.3E-02	1.9E-03	9.0E-03	3.8E-02
Mn-54	4.5E+00	7.2E-01	3.7E+00	1.1E+01	3.4E+00	4.9E-01	2.6E+00	8.9E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	6.1E-01	1.2E-01	4.9E-01	1.5E+00	4.6E-01	7.2E-02	3.5E-01	1.1E+00
Co-58	3.9E+00	7.2E-01	3.2E+00	9.6E+00	3.0E+00	4.3E-01	2.4E+00	7.7E+00
Fe-59	2.3E+00	4.2E-01	1.9E+00	5.8E+00	1.8E+00	2.6E-01	1.4E+00	4.2E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.3E+01	1.0E+01	4.4E+01	1.3E+02	4.1E+01	6.1E+00	3.1E+01	1.0E+02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	7.5E-01	3.7E-02	5.2E-01	2.3E+00	5.6E-01	2.4E-02	3.6E-01	1.7E+00
Cu-67	2.2E-06	9.8E-11	3.8E-08	1.5E-05	1.8E-06	7.7E-11	2.9E-08	1.0E-05
Se-75	8.2E-01	4.3E-02	5.4E-01	2.4E+00	6.4E-01	2.7E-02	3.6E-01	2.1E+00
Sr-85	6.0E-03	2.9E-04	3.6E-03	2.0E-02	4.4E-03	1.9E-04	2.4E-03	1.6E-02
Sr-89	1.1E-05	4.1E-07	6.3E-06	3.9E-05	8.3E-06	3.2E-07	4.5E-06	3.2E-05
Sr-90	1.0E-05	4.5E-07	6.4E-06	3.1E-05	7.4E-06	3.2E-07	4.7E-06	2.5E-05
Y-91	3.7E-05	1.5E-06	2.3E-05	1.2E-04	2.8E-05	9.3E-07	1.7E-05	9.0E-05
Mo-93	1.8E-03	3.2E-04	1.5E-03	4.3E-03	1.3E-03	2.0E-04	1.0E-03	3.5E-03
Nb-93m	9.8E-07	3.7E-08	6.3E-07	3.0E-06	7.4E-07	2.5E-08	4.5E-07	2.5E-06
Nb-94	1.3E-01	4.8E-03	7.9E-02	4.3E-01	9.4E-02	3.5E-03	5.6E-02	3.1E-01
Nb-95	3.5E-03	1.3E-04	2.1E-03	1.1E-02	2.7E-03	8.2E-05	1.4E-03	7.9E-03
Zr-95	9.0E-03	3.5E-04	4.9E-03	3.0E-02	6.7E-03	2.2E-04	3.8E-03	2.4E-02
Tc-99	7.0E-04	1.3E-04	5.9E-04	1.7E-03	5.3E-04	8.6E-05	4.0E-04	1.3E-03
Ru-103	7.7E-01	1.5E-01	6.0E-01	2.0E+00	5.9E-01	9.0E-02	4.5E-01	1.6E+00
Ru-106	3.0E+00	5.5E-01	2.6E+00	7.4E+00	2.3E+00	3.3E-01	1.8E+00	5.9E+00
Ag-108m	3.7E+01	6.9E+00	3.1E+01	9.4E+01	2.8E+01	4.3E+00	2.1E+01	7.1E+01
Cd-109	1.4E-05	3.5E-07	8.3E-06	4.9E-05	1.1E-05	1.8E-07	6.1E-06	3.3E-05
Ag-110m	3.4E+01	6.3E+00	2.9E+01	8.2E+01	2.6E+01	4.0E+00	2.1E+01	6.8E+01
Sb-124	5.2E+00	9.2E-01	4.3E+00	1.3E+01	4.0E+00	5.8E-01	3.2E+00	1.1E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.5E+00	1.4E+00	5.9E+00	1.8E+01	5.6E+00	8.2E-01	4.4E+00	1.5E+01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.3E-02	9.3E-04	1.4E-02	6.9E-02	1.8E-02	6.9E-04	9.1E-03	6.3E-02
Cs-134	1.0E-01	3.6E-03	6.4E-02	3.3E-01	7.8E-02	2.3E-03	4.3E-02	2.7E-01
Cs-137	4.8E-02	1.8E-03	3.1E-02	1.5E-01	3.6E-02	1.1E-03	2.0E-02	1.2E-01

Table F.16 Dose factors[a] for FE-METL-VEHICLE-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.2E-04	5.1E-06	7.7E-05	4.3E-04	9.4E-05	3.2E-06	4.9E-05	2.9E-04
Ce-144	1.5E-03	5.5E-05	1.0E-03	4.9E-03	1.2E-03	3.9E-05	6.9E-04	3.8E-03
Pm-147	8.9E-08	3.3E-09	5.2E-08	3.2E-07	6.8E-08	2.3E-09	3.7E-08	2.3E-07
Eu-152	7.9E-02	3.2E-03	4.9E-02	2.6E-01	6.1E-02	2.1E-03	3.4E-02	2.1E-01
Eu-154	8.8E-02	4.0E-03	5.8E-02	2.7E-01	6.5E-02	2.7E-03	4.0E-02	2.0E-01
Eu-155	8.5E-04	4.5E-05	5.1E-04	2.7E-03	6.5E-04	3.2E-05	3.4E-04	2.1E-03
Re-186	1.6E-06	1.4E-09	1.1E-07	7.9E-06	1.3E-06	9.5E-10	8.9E-08	6.0E-06
Ir-192	1.6E+00	1.0E-01	1.1E+00	4.9E+00	1.2E+00	6.5E-02	7.3E-01	3.7E+00
Pb-210	1.2E-04	1.4E-05	8.5E-05	3.3E-04	8.9E-05	1.0E-05	5.9E-05	2.5E-04
Po-210	2.5E-07	1.1E-08	1.5E-07	8.3E-07	1.9E-07	7.5E-09	1.0E-07	6.2E-07
Bi-210	2.1E-07	4.6E-10	3.0E-08	1.1E-06	1.7E-07	3.7E-10	1.9E-08	9.1E-07
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.8E-04	2.3E-05	1.7E-04	1.5E-03	3.0E-04	1.2E-05	1.3E-04	1.2E-03
Ra-224	1.1E-05	9.6E-09	8.3E-07	5.4E-05	8.9E-06	5.9E-09	6.3E-07	4.2E-05
Ac-225	3.1E-05	7.4E-07	1.2E-05	1.2E-04	2.4E-05	4.1E-07	8.5E-06	1.1E-04
Ra-225	2.0E-06	1.5E-07	1.0E-06	6.6E-06	1.5E-06	8.8E-08	7.2E-07	5.5E-06
Ra-226	7.6E-01	7.8E-02	5.2E-01	2.1E+00	5.9E-01	6.1E-02	3.6E-01	1.9E+00
Ac-227	2.3E-02	8.9E-04	1.4E-02	7.9E-02	1.8E-02	5.4E-04	9.9E-03	6.2E-02
Th-227	8.3E-05	2.6E-06	4.5E-05	2.7E-04	6.2E-05	1.6E-06	3.2E-05	1.9E-04
Th-228	8.0E-02	3.0E-03	5.0E-02	2.4E-01	6.0E-02	1.9E-03	3.7E-02	1.9E-01
Ra-228	3.4E-01	4.4E-02	2.4E-01	8.8E-01	2.5E-01	2.8E-02	1.6E-01	7.4E-01
Th-229	1.6E-02	5.9E-04	9.5E-03	5.4E-02	1.2E-02	3.5E-04	6.7E-03	4.4E-02
Th-230	4.1E-05	1.5E-06	2.6E-05	1.4E-04	3.2E-05	9.7E-07	1.8E-05	1.2E-04
Pa-231	1.8E-03	7.5E-05	1.1E-03	5.9E-03	1.3E-03	5.5E-05	8.0E-04	4.3E-03
Th-231	4.8E-15	1.6E-26	1.6E-20	2.1E-14	3.8E-15	1.3E-26	1.3E-20	1.7E-14
Th-232	8.4E-03	3.8E-04	5.3E-03	2.6E-02	6.4E-03	2.1E-04	3.7E-03	2.3E-02
Pa-233	4.1E-04	1.4E-05	2.3E-04	1.3E-03	3.1E-04	1.2E-05	1.7E-04	1.1E-03
U-233	4.7E-07	2.1E-08	2.9E-07	1.6E-06	3.6E-07	1.3E-08	2.1E-07	1.3E-06
Th-234	1.8E-05	7.8E-07	1.1E-05	6.8E-05	1.4E-05	4.7E-07	7.5E-06	5.2E-05
U-234	9.4E-07	3.3E-08	5.6E-07	3.0E-06	7.1E-07	2.1E-08	3.8E-07	2.5E-06
U-235	7.2E-03	2.5E-04	4.7E-03	2.2E-02	5.3E-03	1.6E-04	3.2E-03	1.8E-02
Np-237	1.3E-02	5.3E-04	7.7E-03	4.2E-02	9.7E-03	3.2E-04	5.5E-03	3.2E-02
Pu-238	8.9E-07	3.3E-08	5.8E-07	2.9E-06	6.7E-07	2.7E-08	4.1E-07	2.1E-06
U-238	7.1E-04	3.2E-05	4.2E-04	2.3E-03	5.4E-04	2.1E-05	3.0E-04	1.8E-03
Pu-239	3.7E-07	1.6E-08	2.6E-07	1.1E-06	2.8E-07	1.0E-08	1.8E-07	8.9E-07
Pu-240	8.0E-07	3.2E-08	4.9E-07	2.7E-06	6.0E-07	2.0E-08	3.6E-07	2.1E-06
Pu-241	3.0E-07	1.1E-08	1.9E-07	1.0E-06	2.3E-07	7.4E-09	1.2E-07	7.6E-07
Am-241	1.4E-04	4.8E-06	9.2E-05	4.6E-04	1.1E-04	3.6E-06	5.9E-05	3.3E-04
Cm-242	6.3E-07	2.4E-08	3.9E-07	1.9E-06	4.9E-07	1.6E-08	3.0E-07	1.7E-06
Pu-242	8.8E-07	3.4E-08	5.8E-07	2.7E-06	6.4E-07	1.8E-08	3.7E-07	2.1E-06
Cm-244	1.3E-06	4.5E-08	8.8E-07	3.9E-06	9.9E-07	3.2E-08	5.8E-07	3.2E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.17 Dose factors[a] for FE-METL-BLDGSTR-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	3.5E-05	1.1E-05	3.0E-05	7.6E-05	2.7E-05	6.1E-06	2.1E-05	6.7E-05
Na-22	3.4E-02	1.5E-03	2.3E-02	1.0E-01	2.7E-02	1.1E-03	1.6E-02	8.6E-02
P-32	3.5E-06	1.1E-07	1.6E-06	1.4E-05	2.6E-06	7.7E-08	1.1E-06	9.9E-06
S-35	8.9E-07	4.5E-08	6.1E-07	2.7E-06	6.7E-07	2.9E-08	4.2E-07	2.1E-06
Cl-36	1.9E-05	3.6E-06	1.6E-05	4.6E-05	1.5E-05	2.2E-06	1.1E-05	4.1E-05
K-40	2.7E-03	1.3E-04	1.7E-03	8.5E-03	2.0E-03	8.4E-05	1.3E-03	6.7E-03
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.9E-07	1.0E-08	1.2E-07	5.4E-07	1.4E-07	6.2E-09	8.3E-08	4.5E-07
Cr-51	5.0E-03	1.2E-03	4.0E-03	1.2E-02	3.8E-03	6.5E-04	2.7E-03	1.0E-02
Mn-54	1.1E+00	2.7E-01	9.3E-01	2.5E+00	8.1E-01	1.7E-01	6.4E-01	2.1E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.2E-01	9.9E-02	2.9E-01	6.8E-01	2.4E-01	5.9E-02	1.9E-01	5.9E-01
Co-58	9.3E-01	2.5E-01	7.9E-01	2.1E+00	7.1E-01	1.6E-01	5.4E-01	1.8E+00
Fe-59	5.3E-01	1.4E-01	4.4E-01	1.2E+00	4.0E-01	8.2E-02	3.0E-01	1.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.2E+01	3.5E+00	1.0E+01	2.7E+01	9.0E+00	1.9E+00	7.0E+00	2.3E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.7E-05	1.1E-06	1.3E-05	4.5E-05	1.3E-05	8.8E-07	8.8E-06	3.7E-05
Cu-67	9.0E-07	5.1E-11	1.4E-08	5.5E-06	6.6E-07	3.6E-11	1.1E-08	3.6E-06
Se-75	2.8E-01	1.4E-02	2.1E-01	7.7E-01	2.1E-01	1.1E-02	1.4E-01	6.3E-01
Sr-85	1.5E-03	8.7E-05	1.0E-03	4.1E-03	1.2E-03	6.2E-05	6.6E-04	4.1E-03
Sr-89	3.8E-06	1.7E-07	2.6E-06	1.2E-05	3.0E-06	1.0E-07	1.8E-06	1.0E-05
Sr-90	3.6E-06	1.9E-07	2.4E-06	1.1E-05	2.6E-06	1.2E-07	1.7E-06	8.7E-06
Y-91	8.4E-06	4.4E-07	5.6E-06	2.5E-05	6.3E-06	2.3E-07	4.1E-06	2.3E-05
Mo-93	2.5E-03	7.0E-04	2.2E-03	5.4E-03	1.9E-03	4.1E-04	1.5E-03	4.7E-03
Nb-93m	1.4E-06	6.9E-08	9.2E-07	4.2E-06	1.1E-06	3.8E-08	6.9E-07	4.0E-06
Nb-94	3.0E-02	1.5E-03	2.0E-02	8.8E-02	2.3E-02	9.8E-04	1.4E-02	7.4E-02
Nb-95	8.0E-04	4.5E-05	5.5E-04	2.6E-03	6.1E-04	2.5E-05	3.9E-04	2.0E-03
Zr-95	2.0E-03	9.4E-05	1.4E-03	6.0E-03	1.5E-03	8.3E-05	9.5E-04	5.3E-03
Tc-99	2.4E-04	6.8E-05	2.0E-04	5.4E-04	1.8E-04	3.9E-05	1.4E-04	4.5E-04
Ru-103	2.0E-01	5.3E-02	1.7E-01	4.3E-01	1.5E-01	3.0E-02	1.2E-01	4.1E-01
Ru-106	7.4E-01	2.0E-01	6.6E-01	1.6E+00	5.6E-01	1.2E-01	4.4E-01	1.3E+00
Ag-108m	9.0E+00	2.4E+00	7.9E+00	1.9E+01	6.8E+00	1.5E+00	5.6E+00	1.6E+01
Cd-109	2.3E-05	1.1E-06	1.6E-05	6.6E-05	1.7E-05	6.1E-07	1.1E-05	5.7E-05
Ag-110m	8.1E+00	2.5E+00	7.0E+00	1.8E+01	6.2E+00	1.5E+00	4.8E+00	1.6E+01
Sb-124	1.2E+00	3.5E-01	1.0E+00	2.6E+00	9.1E-01	2.0E-01	7.1E-01	2.3E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.8E+00	5.3E-01	1.6E+00	3.9E+00	1.4E+00	3.2E-01	1.1E+00	3.4E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	6.6E-03	3.1E-04	4.5E-03	1.9E-02	5.0E-03	2.3E-04	3.2E-03	1.7E-02
Cs-134	2.4E-02	1.0E-03	1.7E-02	6.6E-02	1.8E-02	6.0E-04	1.2E-02	6.2E-02
Cs-137	1.1E-02	5.2E-04	7.8E-03	3.4E-02	8.7E-03	3.5E-04	5.5E-03	2.7E-02

Table F.17 Dose factors[a] for FE-METL-BLDGSTR-N

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	6.0E-05	3.1E-06	3.8E-05	2.0E-04	4.6E-05	1.9E-06	2.5E-05	1.6E-04
Ce-144	4.5E-04	2.1E-05	3.0E-04	1.4E-03	3.5E-04	1.5E-05	2.1E-04	1.1E-03
Pm-147	5.2E-08	2.4E-09	3.7E-08	1.4E-07	4.0E-08	1.9E-09	2.6E-08	1.2E-07
Eu-152	2.0E-02	9.8E-04	1.3E-02	5.8E-02	1.5E-02	6.6E-04	9.2E-03	4.6E-02
Eu-154	2.1E-02	1.0E-03	1.5E-02	6.1E-02	1.6E-02	6.9E-04	1.0E-02	5.3E-02
Eu-155	7.4E-04	4.2E-05	5.2E-04	2.2E-03	5.5E-04	2.9E-05	3.5E-04	1.7E-03
Re-186	9.8E-07	1.1E-09	5.8E-08	5.7E-06	7.5E-07	6.6E-10	3.8E-08	3.7E-06
Ir-192	4.3E-01	2.8E-02	3.3E-01	1.1E+00	3.2E-01	1.5E-02	2.3E-01	9.7E-01
Pb-210	2.0E-04	3.6E-05	1.7E-04	5.0E-04	1.5E-04	2.2E-05	1.1E-04	3.9E-04
Po-210	5.8E-08	3.4E-09	3.8E-08	1.8E-07	4.4E-08	2.0E-09	2.8E-08	1.4E-07
Bi-210	7.4E-08	2.3E-10	9.0E-09	3.7E-07	5.7E-08	1.9E-10	6.7E-09	2.9E-07
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E-04	7.8E-06	6.0E-05	4.2E-04	8.9E-05	5.6E-06	4.2E-05	3.5E-04
Ra-224	2.7E-06	2.6E-09	1.9E-07	1.3E-05	1.9E-06	1.8E-09	1.5E-07	9.8E-06
Ac-225	8.8E-06	2.5E-07	3.6E-06	3.5E-05	6.7E-06	1.6E-07	2.5E-06	2.9E-05
Ra-225	3.6E-06	3.2E-07	2.0E-06	1.2E-05	2.8E-06	2.0E-07	1.5E-06	9.4E-06
Ra-226	1.8E-01	2.6E-02	1.4E-01	4.9E-01	1.4E-01	1.6E-02	9.5E-02	4.2E-01
Ac-227	7.1E-03	3.3E-04	4.9E-03	2.1E-02	5.5E-03	2.1E-04	3.3E-03	1.8E-02
Th-227	2.7E-05	1.1E-06	1.4E-05	9.2E-05	2.1E-05	6.6E-07	9.9E-06	7.4E-05
Th-228	1.9E-02	1.1E-03	1.3E-02	5.6E-02	1.4E-02	6.5E-04	9.2E-03	4.0E-02
Ra-228	8.2E-02	1.3E-02	6.2E-02	2.1E-01	6.2E-02	8.2E-03	4.3E-02	1.7E-01
Th-229	5.2E-03	2.8E-04	3.6E-03	1.5E-02	4.0E-03	1.7E-04	2.4E-03	1.3E-02
Th-230	1.3E-05	6.5E-07	8.2E-06	3.9E-05	9.7E-06	4.3E-07	6.2E-06	3.1E-05
Pa-231	5.2E-04	3.0E-05	3.6E-04	1.5E-03	4.0E-04	1.9E-05	2.5E-04	1.3E-03
Th-231	3.9E-15	1.9E-26	1.3E-20	2.0E-14	2.6E-15	1.4E-26	1.1E-20	1.5E-14
Th-232	2.0E-03	9.7E-05	1.3E-03	6.2E-03	1.5E-03	6.6E-05	9.4E-04	4.7E-03
Pa-233	1.3E-04	5.8E-06	8.3E-05	4.1E-04	9.9E-05	3.7E-06	5.7E-05	3.2E-04
U-233	6.6E-07	3.3E-08	4.5E-07	2.2E-06	5.0E-07	1.9E-08	3.0E-07	1.6E-06
Th-234	6.7E-06	2.9E-07	4.1E-06	2.2E-05	5.2E-06	1.9E-07	3.0E-06	1.7E-05
U-234	1.4E-06	7.2E-08	9.2E-07	4.3E-06	1.0E-06	6.0E-08	6.6E-07	3.2E-06
U-235	2.7E-03	1.4E-04	2.0E-03	8.6E-03	2.1E-03	9.8E-05	1.3E-03	7.2E-03
Np-237	4.1E-03	1.9E-04	2.9E-03	1.3E-02	3.1E-03	1.3E-04	1.9E-03	9.7E-03
Pu-238	1.3E-06	6.9E-08	9.0E-07	4.3E-06	1.0E-06	5.6E-08	6.2E-07	3.0E-06
U-238	2.5E-04	1.3E-05	1.8E-04	7.7E-04	1.9E-04	7.8E-06	1.3E-04	6.0E-04
Pu-239	5.3E-07	3.1E-08	3.8E-07	1.6E-06	4.0E-07	2.1E-08	2.4E-07	1.2E-06
Pu-240	1.1E-06	6.8E-08	8.3E-07	3.2E-06	8.5E-07	4.9E-08	6.5E-07	2.7E-06
Pu-241	4.6E-07	2.3E-08	3.0E-07	1.4E-06	3.6E-07	1.7E-08	2.2E-07	1.2E-06
Am-241	2.2E-04	1.3E-05	1.5E-04	7.2E-04	1.7E-04	9.0E-06	1.0E-04	5.8E-04
Cm-242	9.6E-07	5.1E-08	6.2E-07	2.8E-06	7.1E-07	3.6E-08	4.5E-07	2.5E-06
Pu-242	1.2E-06	6.3E-08	8.0E-07	3.6E-06	9.0E-07	4.9E-08	5.4E-07	3.1E-06
Cm-244	2.0E-06	9.7E-08	1.4E-06	5.6E-06	1.5E-06	6.7E-08	9.1E-07	4.9E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.18 Dose factors[a] for FE-SLAG-CONCBAS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.4E-09	1.5E-10	2.3E-09	2.0E-08	4.2E-09	8.0E-11	1.7E-09	1.6E-08
Na-22	2.7E+00	2.8E-01	1.5E+00	8.0E+00	2.0E+00	1.9E-01	1.1E+00	6.4E+00
P-32	2.7E-06	1.0E-07	1.3E-06	9.9E-06	2.0E-06	6.8E-08	9.9E-07	7.8E-06
S-35	1.6E-07	8.7E-09	8.0E-08	5.6E-07	1.2E-07	5.1E-09	5.8E-08	4.1E-07
Cl-36	3.0E-05	1.1E-06	1.5E-05	1.1E-04	2.2E-05	7.5E-07	1.1E-05	8.5E-05
K-40	1.1E-01	8.1E-03	6.1E-02	4.3E-01	8.5E-02	4.5E-03	4.2E-02	3.2E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.3E-06	2.6E-07	1.4E-06	7.2E-06	1.8E-06	1.6E-07	1.0E-06	5.8E-06
Cr-51	8.9E-04	2.7E-05	4.4E-04	3.3E-03	6.9E-04	1.8E-05	3.0E-04	2.4E-03
Mn-54	9.4E-01	1.1E-01	6.1E-01	3.1E+00	7.1E-01	6.7E-02	4.0E-01	2.5E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.8E-04	7.3E-06	8.6E-05	6.3E-04	1.4E-04	3.9E-06	6.0E-05	4.7E-04
Co-58	1.7E-03	7.3E-05	8.0E-04	6.1E-03	1.3E-03	4.2E-05	5.6E-04	5.0E-03
Fe-59	7.9E-03	6.1E-04	4.0E-03	2.9E-02	6.0E-03	3.6E-04	2.8E-03	2.0E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.1E-02	6.4E-04	9.7E-03	8.5E-02	1.6E-02	4.8E-04	7.0E-03	6.4E-02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.1E-03	7.4E-05	1.5E-03	1.1E-02	2.4E-03	5.6E-05	1.0E-03	8.8E-03
Cu-67	4.5E-09	6.6E-13	1.2E-10	2.2E-08	3.3E-09	3.8E-13	9.4E-11	1.9E-08
Se-75	1.2E-01	9.8E-03	6.7E-02	4.3E-01	9.1E-02	7.1E-03	4.9E-02	3.5E-01
Sr-85	2.4E-01	2.6E-02	1.3E-01	8.6E-01	1.8E-01	1.5E-02	1.0E-01	6.0E-01
Sr-89	5.4E-05	5.8E-06	3.2E-05	1.7E-04	4.0E-05	4.0E-06	2.3E-05	1.3E-04
Sr-90	4.5E-05	4.0E-06	2.8E-05	1.4E-04	3.4E-05	2.4E-06	2.2E-05	1.1E-04
Y-91	1.5E-03	1.8E-04	8.6E-04	4.6E-03	1.2E-03	1.1E-04	6.3E-04	3.9E-03
Mo-93	3.7E-07	9.1E-09	1.5E-07	1.5E-06	2.8E-07	7.5E-09	1.1E-07	1.2E-06
Nb-93m	1.7E-05	2.1E-06	1.1E-05	5.7E-05	1.3E-05	1.3E-06	7.4E-06	5.2E-05
Nb-94	4.4E+00	4.5E-01	2.7E+00	1.4E+01	3.3E+00	2.8E-01	2.0E+00	1.1E+01
Nb-95	1.5E-01	1.7E-02	8.9E-02	5.1E-01	1.2E-01	1.1E-02	6.2E-02	3.9E-01
Zr-95	3.5E-01	3.9E-02	2.2E-01	9.9E-01	2.7E-01	2.2E-02	1.5E-01	9.2E-01
Tc-99	3.4E-08	1.2E-09	1.4E-08	1.3E-07	2.6E-08	7.0E-10	1.0E-08	9.7E-08
Ru-103	3.7E-04	9.0E-06	1.7E-04	1.5E-03	2.9E-04	5.7E-06	1.2E-04	1.1E-03
Ru-106	7.2E-03	2.0E-04	3.4E-03	2.5E-02	5.5E-03	1.4E-04	2.4E-03	2.1E-02
Ag-108m	1.4E-02	4.0E-04	6.8E-03	5.7E-02	1.1E-02	3.0E-04	4.7E-03	3.9E-02
Cd-109	7.5E-06	6.2E-07	4.2E-06	2.6E-05	5.5E-06	3.7E-07	3.2E-06	2.0E-05
Ag-110m	1.4E-02	3.3E-04	7.3E-03	5.1E-02	1.0E-02	2.4E-04	4.7E-03	3.6E-02
Sb-124	7.9E-02	2.7E-03	3.6E-02	2.8E-01	5.8E-02	2.0E-03	2.5E-02	2.1E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.6E-02	4.0E-03	4.5E-02	3.2E-01	7.4E-02	2.5E-03	3.4E-02	2.7E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	8.7E-01	7.7E-02	4.9E-01	2.8E+00	6.9E-01	4.9E-02	3.4E-01	2.2E+00
Cs-134	9.8E-02	7.1E-03	5.2E-02	3.4E-01	7.5E-02	4.2E-03	3.8E-02	2.8E-01
Cs-137	4.3E-02	3.9E-03	2.5E-02	1.4E-01	3.3E-02	2.2E-03	1.7E-02	1.1E-01

Table F.18 Dose factors[a] for FE-SLAG-CONCBAS-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	4.4E-03	4.3E-04	2.6E-03	1.5E-02	3.4E-03	2.9E-04	1.7E-03	1.2E-02
Ce-144	5.4E-02	5.0E-03	3.3E-02	1.8E-01	4.3E-02	3.3E-03	2.1E-02	1.5E-01
Pm-147	6.3E-07	7.2E-08	4.1E-07	2.1E-06	4.8E-07	4.3E-08	2.8E-07	1.6E-06
Eu-152	3.1E+00	3.0E-01	1.8E+00	1.0E+01	2.4E+00	1.8E-01	1.2E+00	7.8E+00
Eu-154	3.1E+00	3.9E-01	2.0E+00	9.7E+00	2.3E+00	2.5E-01	1.4E+00	6.8E+00
Eu-155	2.1E-02	2.5E-03	1.4E-02	6.3E-02	1.6E-02	1.4E-03	9.2E-03	5.1E-02
Re-186	2.1E-08	6.9E-11	2.9E-09	9.7E-08	1.6E-08	4.2E-11	2.1E-09	6.8E-08
Ir-192	8.3E-03	6.7E-04	4.7E-03	2.9E-02	6.5E-03	4.2E-04	3.1E-03	2.5E-02
Pb-210	8.7E-06	7.0E-07	5.1E-06	3.1E-05	6.8E-06	4.2E-07	3.4E-06	2.5E-05
Po-210	2.0E-08	1.6E-09	1.1E-08	6.5E-08	1.5E-08	8.9E-10	7.7E-09	5.4E-08
Bi-210	7.6E-09	5.4E-11	1.6E-09	3.2E-08	5.8E-09	3.4E-11	1.1E-09	2.6E-08
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.8E-03	2.0E-04	2.0E-03	1.6E-02	2.9E-03	1.2E-04	1.4E-03	1.1E-02
Ra-224	2.2E-04	8.3E-07	3.8E-05	1.1E-03	1.7E-04	4.9E-07	2.6E-05	9.2E-04
Ac-225	2.1E-03	9.8E-05	9.9E-04	7.1E-03	1.5E-03	6.2E-05	7.6E-04	6.1E-03
Ra-225	1.0E-05	8.5E-07	6.0E-06	3.6E-05	7.9E-06	4.6E-07	4.4E-06	2.6E-05
Ra-226	4.4E+00	4.6E-01	2.6E+00	1.4E+01	3.3E+00	3.0E-01	1.8E+00	1.2E+01
Ac-227	8.0E-01	7.8E-02	4.9E-01	2.3E+00	6.1E-01	4.7E-02	3.5E-01	2.2E+00
Th-227	3.8E-03	3.1E-04	2.3E-03	1.2E-02	2.9E-03	2.0E-04	1.6E-03	9.8E-03
Th-228	2.9E+00	2.8E-01	1.8E+00	9.1E+00	2.2E+00	2.0E-01	1.3E+00	7.4E+00
Ra-228	2.3E+00	2.6E-01	1.3E+00	7.0E+00	1.7E+00	1.6E-01	9.2E-01	5.8E+00
Th-229	5.5E-01	5.6E-02	3.3E-01	1.9E+00	4.3E-01	3.7E-02	2.4E-01	1.6E+00
Th-230	1.4E-03	1.3E-04	8.4E-04	4.8E-03	1.1E-03	8.1E-05	6.2E-04	3.4E-03
Pa-231	6.0E-02	6.0E-03	3.6E-02	1.9E-01	4.6E-02	3.9E-03	2.7E-02	1.5E-01
Th-231	6.0E-12	1.1E-20	5.7E-16	3.1E-11	4.5E-12	7.5E-21	4.3E-16	2.1E-11
Th-232	3.1E-01	3.8E-02	1.8E-01	9.3E-01	2.4E-01	2.1E-02	1.3E-01	8.0E-01
Pa-233	1.8E-02	1.8E-03	1.1E-02	5.9E-02	1.4E-02	1.1E-03	7.5E-03	5.4E-02
U-233	8.0E-06	7.8E-07	4.7E-06	2.6E-05	6.0E-06	5.1E-07	3.2E-06	2.0E-05
Th-234	8.1E-04	8.0E-05	5.0E-04	2.6E-03	6.2E-04	5.1E-05	3.4E-04	2.2E-03
U-234	1.8E-05	1.8E-06	1.1E-05	5.7E-05	1.4E-05	1.2E-06	7.9E-06	4.7E-05
U-235	2.2E-01	2.3E-02	1.3E-01	8.0E-01	1.7E-01	1.4E-02	9.3E-02	5.8E-01
Np-237	4.2E-01	4.4E-02	2.6E-01	1.3E+00	3.2E-01	2.6E-02	1.9E-01	1.0E+00
Pu-238	1.6E-05	2.1E-06	1.0E-05	4.9E-05	1.2E-05	1.3E-06	7.4E-06	4.3E-05
U-238	2.3E-02	2.8E-03	1.4E-02	7.1E-02	1.8E-02	1.6E-03	1.0E-02	5.8E-02
Pu-239	6.4E-06	6.7E-07	3.8E-06	2.1E-05	4.9E-06	4.2E-07	2.7E-06	1.7E-05
Pu-240	1.4E-05	1.7E-06	8.9E-06	4.3E-05	1.1E-05	1.0E-06	6.1E-06	3.4E-05
Pu-241	6.7E-06	6.4E-07	4.3E-06	2.2E-05	5.2E-06	4.2E-07	2.9E-06	1.9E-05
Am-241	3.3E-03	3.6E-04	2.0E-03	9.7E-03	2.6E-03	1.9E-04	1.5E-03	8.3E-03
Cm-242	1.2E-05	1.3E-06	6.9E-06	4.0E-05	9.4E-06	8.1E-07	5.1E-06	3.3E-05
Pu-242	1.4E-05	1.6E-06	8.5E-06	4.8E-05	1.1E-05	9.4E-07	6.3E-06	3.7E-05
Cm-244	2.4E-05	2.6E-06	1.5E-05	7.7E-05	1.8E-05	1.5E-06	9.8E-06	6.4E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.19 Dose factors[a] for FE-SLAG-ROADBED-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.1E-07	6.2E-09	1.1E-07	7.7E-07	1.6E-07	4.1E-09	7.4E-08	6.2E-07
Na-22	2.7E+01	4.5E+00	1.8E+01	7.7E+01	2.0E+01	2.5E+00	1.3E+01	6.6E+01
P-32	2.6E-04	1.5E-05	1.4E-04	9.4E-04	2.1E-04	1.0E-05	9.8E-05	7.4E-04
S-35	6.7E-06	4.6E-07	3.5E-06	2.5E-05	5.1E-06	3.5E-07	2.5E-06	1.7E-05
Cl-36	2.6E-03	1.2E-04	1.6E-03	8.8E-03	2.0E-03	8.4E-05	1.1E-03	7.0E-03
K-40	1.2E+00	1.2E-01	6.8E-01	3.5E+00	9.1E-01	7.4E-02	5.1E-01	2.9E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.2E-04	1.9E-05	8.5E-05	3.1E-04	9.3E-05	1.1E-05	6.0E-05	2.7E-04
Cr-51	9.1E-03	3.2E-04	5.3E-03	3.1E-02	7.1E-03	2.1E-04	3.7E-03	2.6E-02
Mn-54	9.2E+00	1.5E+00	6.6E+00	2.6E+01	6.9E+00	7.7E-01	4.5E+00	2.1E+01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	4.4E-03	1.8E-04	2.3E-03	1.5E-02	3.3E-03	1.3E-04	1.7E-03	1.2E-02
Co-58	1.6E-02	6.4E-04	8.8E-03	5.3E-02	1.2E-02	4.7E-04	6.7E-03	4.3E-02
Fe-59	7.9E-02	8.3E-03	5.0E-02	2.7E-01	6.1E-02	5.6E-03	3.5E-02	1.9E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.2E-01	9.6E-03	1.1E-01	8.0E-01	1.7E-01	5.2E-03	7.6E-02	6.1E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.2E-02	9.8E-04	1.6E-02	1.1E-01	2.4E-02	8.7E-04	1.1E-02	9.0E-02
Cu-67	6.6E-08	1.8E-11	2.3E-09	3.0E-07	5.7E-08	1.2E-11	1.5E-09	2.0E-07
Se-75	1.5E+00	2.1E-01	9.5E-01	4.2E+00	1.1E+00	1.1E-01	7.0E-01	3.9E+00
Sr-85	2.3E+00	3.6E-01	1.5E+00	6.6E+00	1.7E+00	2.0E-01	1.0E+00	5.3E+00
Sr-89	4.8E-03	8.0E-04	3.3E-03	1.4E-02	3.7E-03	4.7E-04	2.3E-03	1.2E-02
Sr-90	3.0E-03	5.4E-04	2.1E-03	8.3E-03	2.3E-03	3.2E-04	1.4E-03	7.4E-03
Y-91	2.2E-02	3.0E-03	1.5E-02	6.1E-02	1.6E-02	2.1E-03	1.0E-02	5.0E-02
Mo-93	8.9E-06	3.1E-07	4.5E-06	3.3E-05	6.8E-06	2.0E-07	3.0E-06	2.4E-05
Nb-93m	4.3E-04	8.4E-05	3.1E-04	1.2E-03	3.3E-04	4.8E-05	2.2E-04	9.7E-04
Nb-94	4.2E+01	6.6E+00	3.0E+01	1.1E+02	3.3E+01	3.7E+00	2.1E+01	1.0E+02
Nb-95	1.5E+00	1.9E-01	9.8E-01	4.5E+00	1.1E+00	1.3E-01	7.0E-01	3.7E+00
Zr-95	3.3E+00	5.7E-01	2.2E+00	9.6E+00	2.6E+00	3.2E-01	1.5E+00	8.2E+00
Tc-99	1.9E-06	7.6E-08	9.9E-07	7.3E-06	1.5E-06	5.5E-08	6.6E-07	5.7E-06
Ru-103	3.5E-03	1.3E-04	1.7E-03	1.4E-02	2.7E-03	8.9E-05	1.2E-03	1.0E-02
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	1.4E-01	4.6E-03	7.7E-02	5.1E-01	1.1E-01	3.9E-03	5.6E-02	4.3E-01
Cd-109	1.3E-03	1.5E-04	8.1E-04	4.1E-03	9.5E-04	8.9E-05	5.9E-04	3.1E-03
Ag-110m	1.4E-01	4.9E-03	7.9E-02	4.7E-01	1.1E-01	3.2E-03	5.3E-02	3.9E-01
Sb-124	7.9E-01	4.3E-02	4.7E-01	2.7E+00	6.0E-01	2.5E-02	3.0E-01	2.3E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.4E-01	4.2E-02	5.2E-01	3.4E+00	7.0E-01	3.6E-02	3.4E-01	2.4E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	8.4E+00	1.4E+00	6.0E+00	2.4E+01	6.3E+00	8.3E-01	4.0E+00	1.8E+01
Cs-134	9.3E-01	1.1E-01	5.6E-01	2.8E+00	7.0E-01	7.2E-02	4.1E-01	2.3E+00
Cs-137	8.7E-05	1.1E-05	5.6E-05	2.7E-04	6.6E-05	6.6E-06	3.9E-05	2.1E-04

Table F.19 Dose factors[a] for FE-SLAG-ROADBED-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	8.4E-02	1.3E-02	5.7E-02	2.3E-01	6.3E-02	7.2E-03	4.0E-02	1.9E-01
Ce-144	1.9E-01	3.2E-02	1.3E-01	5.4E-01	1.5E-01	2.1E-02	9.0E-02	4.5E-01
Pm-147	1.9E-04	3.2E-05	1.3E-04	5.2E-04	1.4E-04	1.9E-05	9.1E-05	4.2E-04
Eu-152	3.0E+01	4.9E+00	2.1E+01	8.2E+01	2.3E+01	2.8E+00	1.4E+01	7.0E+01
Eu-154	3.3E+01	4.9E+00	2.3E+01	9.1E+01	2.5E+01	2.8E+00	1.6E+01	7.6E+01
Eu-155	7.5E-01	1.2E-01	5.2E-01	2.2E+00	5.7E-01	6.8E-02	3.7E-01	1.8E+00
Re-186	6.0E-07	2.9E-09	9.1E-08	2.6E-06	4.4E-07	2.0E-09	6.0E-08	2.2E-06
Ir-192	8.4E-02	8.7E-03	5.3E-02	2.4E-01	6.3E-02	5.7E-03	3.9E-02	1.9E-01
Pb-210	6.1E-04	6.9E-05	3.8E-04	1.9E-03	4.7E-04	4.9E-05	2.7E-04	1.7E-03
Po-210	2.4E-06	2.8E-07	1.5E-06	7.2E-06	1.8E-06	1.8E-07	1.1E-06	5.7E-06
Bi-210	6.1E-07	5.8E-09	1.5E-07	2.7E-06	4.7E-07	3.0E-09	1.0E-07	1.9E-06
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.6E-02	1.6E-03	9.6E-03	5.3E-02	1.2E-02	9.9E-04	6.6E-03	4.2E-02
Ra-224	1.6E-05	7.2E-08	2.5E-06	7.8E-05	1.2E-05	4.0E-08	1.7E-06	6.0E-05
Ac-225	1.2E-03	1.0E-04	6.0E-04	4.2E-03	8.9E-04	6.1E-05	4.3E-04	3.2E-03
Ra-225	5.8E-04	6.6E-05	3.7E-04	1.8E-03	4.4E-04	4.8E-05	2.5E-04	1.5E-03
Ra-226	4.9E+01	7.5E+00	3.5E+01	1.4E+02	3.7E+01	4.6E+00	2.6E+01	1.2E+02
Ac-227	8.5E+00	1.3E+00	6.2E+00	2.4E+01	6.4E+00	8.1E-01	4.1E+00	1.8E+01
Th-227	4.9E-02	6.2E-03	3.2E-02	1.4E-01	3.7E-02	3.8E-03	2.3E-02	1.2E-01
Th-228	3.5E+01	5.5E+00	2.4E+01	9.6E+01	2.6E+01	3.7E+00	1.7E+01	7.8E+01
Ra-228	2.5E+01	3.8E+00	1.7E+01	7.2E+01	1.9E+01	2.4E+00	1.1E+01	5.7E+01
Th-229	6.7E+00	1.1E+00	5.0E+00	1.8E+01	5.2E+00	6.3E-01	3.4E+00	1.7E+01
Th-230	2.0E-02	2.9E-03	1.5E-02	5.4E-02	1.6E-02	2.0E-03	9.8E-03	5.1E-02
Pa-231	8.4E-01	1.2E-01	6.2E-01	2.5E+00	6.4E-01	7.8E-02	4.2E-01	2.0E+00
Th-231	1.8E-10	7.6E-19	2.3E-14	1.3E-09	1.5E-10	5.6E-19	1.8E-14	9.0E-10
Th-232	3.2E+00	5.9E-01	2.3E+00	8.7E+00	2.4E+00	3.4E-01	1.6E+00	7.3E+00
Pa-233	2.0E-01	2.8E-02	1.3E-01	5.4E-01	1.5E-01	1.9E-02	9.8E-02	4.7E-01
U-233	6.1E-03	1.1E-03	4.0E-03	1.7E-02	4.6E-03	5.9E-04	3.1E-03	1.3E-02
Th-234	3.8E-03	4.7E-04	2.6E-03	1.1E-02	3.0E-03	3.1E-04	1.6E-03	9.9E-03
U-234	1.8E-03	3.0E-04	1.2E-03	5.0E-03	1.3E-03	1.6E-04	8.8E-04	4.1E-03
U-235	3.2E+00	5.3E-01	2.1E+00	8.8E+00	2.4E+00	3.6E-01	1.5E+00	7.1E+00
Np-237	4.8E+00	7.7E-01	3.5E+00	1.3E+01	3.7E+00	4.7E-01	2.4E+00	1.0E+01
Pu-238	6.5E-04	1.1E-04	4.7E-04	1.7E-03	5.0E-04	6.4E-05	3.3E-04	1.5E-03
U-238	6.1E-01	9.5E-02	4.0E-01	1.8E+00	4.5E-01	5.5E-02	2.9E-01	1.5E+00
Pu-239	1.3E-03	2.1E-04	8.9E-04	3.8E-03	9.7E-04	1.4E-04	6.1E-04	3.1E-03
Pu-240	6.5E-04	9.8E-05	4.8E-04	1.9E-03	5.0E-04	6.1E-05	3.1E-04	1.5E-03
Pu-241	4.0E-04	6.6E-05	2.9E-04	1.1E-03	3.0E-04	3.6E-05	2.0E-04	8.7E-04
Am-241	1.9E-01	3.3E-02	1.3E-01	5.2E-01	1.4E-01	2.0E-02	9.5E-02	4.6E-01
Cm-242	3.2E-04	5.4E-05	2.3E-04	8.8E-04	2.4E-04	3.3E-05	1.6E-04	7.5E-04
Pu-242	5.7E-04	9.5E-05	4.0E-04	1.6E-03	4.4E-04	5.1E-05	2.9E-04	1.3E-03
Cm-244	5.3E-04	9.3E-05	3.6E-04	1.4E-03	4.0E-04	5.3E-05	2.6E-04	1.2E-03

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.20 Dose factors[a] for FE-SCRP-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.2E-04	2.6E-04	4.2E-04	5.7E-04	3.1E-04	1.3E-04	2.9E-04	5.8E-04
Na-22	2.2E+02	1.4E+02	2.2E+02	3.0E+02	1.7E+02	7.1E+01	1.5E+02	3.0E+02
P-32	1.3E-01	8.1E-02	1.3E-01	1.8E-01	9.9E-02	4.2E-02	9.2E-02	1.8E-01
S-35	4.3E-04	2.7E-04	4.4E-04	5.9E-04	3.3E-04	1.4E-04	3.0E-04	5.9E-04
Cl-36	3.4E-02	2.1E-02	3.4E-02	4.7E-02	2.6E-02	1.1E-02	2.4E-02	4.7E-02
K-40	1.6E+01	1.0E+01	1.6E+01	2.2E+01	1.2E+01	5.2E+00	1.1E+01	2.2E+01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.5E-03	9.3E-04	1.5E-03	2.1E-03	1.1E-03	4.8E-04	1.1E-03	2.1E-03
Cr-51	2.5E+00	1.5E+00	2.5E+00	3.4E+00	1.9E+00	7.8E-01	1.7E+00	3.4E+00
Mn-54	8.5E+01	5.3E+01	8.6E+01	1.2E+02	6.4E+01	2.7E+01	6.0E+01	1.2E+02
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.8E+00	2.4E+00	3.8E+00	5.2E+00	2.9E+00	1.2E+00	2.7E+00	5.3E+00
Co-58	9.5E+01	5.8E+01	9.6E+01	1.3E+02	7.2E+01	3.0E+01	6.6E+01	1.3E+02
Fe-59	1.1E+02	7.0E+01	1.2E+02	1.6E+02	8.7E+01	3.6E+01	8.0E+01	1.6E+02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.5E+02	1.6E+02	2.6E+02	3.5E+02	1.9E+02	8.2E+01	1.8E+02	3.5E+02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.0E+01	3.7E+01	6.0E+01	8.2E+01	4.5E+01	1.9E+01	4.2E+01	8.2E+01
Cu-67	2.1E+00	1.0E+00	1.9E+00	3.6E+00	1.6E+00	5.6E-01	1.4E+00	3.1E+00
Se-75	2.5E+01	1.5E+01	2.5E+01	3.4E+01	1.9E+01	7.8E+00	1.7E+01	3.4E+01
Sr-85	4.7E+01	2.9E+01	4.7E+01	6.4E+01	3.6E+01	1.5E+01	3.3E+01	6.5E+01
Sr-89	1.2E-01	7.1E-02	1.2E-01	1.6E-01	8.8E-02	3.7E-02	8.1E-02	1.6E-01
Sr-90	1.3E-02	7.9E-03	1.3E-02	1.7E-02	9.6E-03	4.1E-03	8.9E-03	1.8E-02
Y-91	3.5E-01	2.1E-01	3.5E-01	4.7E-01	2.6E-01	1.1E-01	2.4E-01	4.7E-01
Mo-93	4.3E-04	2.7E-04	4.3E-04	5.9E-04	3.2E-04	1.4E-04	3.0E-04	5.9E-04
Nb-93m	7.2E-05	4.5E-05	7.2E-05	9.9E-05	5.4E-05	2.3E-05	5.0E-05	9.9E-05
Nb-94	1.6E+02	1.0E+02	1.6E+02	2.3E+02	1.2E+02	5.3E+01	1.1E+02	2.3E+02
Nb-95	7.2E+01	4.5E+01	7.3E+01	9.9E+01	5.5E+01	2.3E+01	5.1E+01	9.9E+01
Zr-95	7.2E+01	4.4E+01	7.2E+01	9.8E+01	5.4E+01	2.3E+01	5.0E+01	9.9E+01
Tc-99	2.8E-03	1.8E-03	2.8E-03	3.9E-03	2.1E-03	9.1E-04	2.0E-03	3.9E-03
Ru-103	4.6E+01	2.9E+01	4.7E+01	6.4E+01	3.5E+01	1.5E+01	3.2E+01	6.4E+01
Ru-106	2.1E+01	1.3E+01	2.1E+01	2.8E+01	1.6E+01	6.6E+00	1.4E+01	2.8E+01
Ag-108m	1.6E+02	1.0E+02	1.6E+02	2.2E+02	1.2E+02	5.2E+01	1.1E+02	2.2E+02
Cd-109	7.2E-03	4.5E-03	7.2E-03	9.9E-03	5.4E-03	2.3E-03	5.0E-03	9.9E-03
Ag-110m	2.8E+02	1.8E+02	2.8E+02	3.9E+02	2.1E+02	9.1E+01	2.0E+02	3.9E+02
Sb-124	1.8E+02	1.1E+02	1.8E+02	2.5E+02	1.4E+02	5.7E+01	1.3E+02	2.5E+02
I-125	6.5E-02	4.0E-02	6.6E-02	8.9E-02	4.9E-02	2.1E-02	4.6E-02	9.0E-02
Sb-125	4.1E+01	2.5E+01	4.1E+01	5.6E+01	3.1E+01	1.3E+01	2.9E+01	5.6E+01
I-129	5.1E-02	3.2E-02	5.1E-02	7.0E-02	3.9E-02	1.6E-02	3.6E-02	7.1E-02
I-131	2.5E+01	1.5E+01	2.5E+01	3.6E+01	1.9E+01	8.0E+00	1.7E+01	3.4E+01
Ba-133	2.8E+01	1.7E+01	2.8E+01	3.8E+01	2.1E+01	9.0E+00	2.0E+01	3.9E+01
Cs-134	1.6E+02	9.9E+01	1.6E+02	2.2E+02	1.2E+02	5.1E+01	1.1E+02	2.2E+02
Cs-137	6.2E+01	3.8E+01	6.2E+01	8.5E+01	4.7E+01	2.0E+01	4.3E+01	8.5E+01

Table F.20 Dose factors[a] for FE-SCRP-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.7E+00	1.7E+00	2.7E+00	3.7E+00	2.1E+00	8.6E-01	1.9E+00	3.7E+00
Ce-144	3.3E+00	2.0E+00	3.3E+00	4.5E+00	2.5E+00	1.1E+00	2.3E+00	4.5E+00
Pm-147	1.1E-04	6.5E-05	1.1E-04	1.4E-04	7.9E-05	3.4E-05	7.4E-05	1.5E-04
Eu-152	1.1E+02	6.9E+01	1.1E+02	1.5E+02	8.4E+01	3.6E+01	7.8E+01	1.5E+02
Eu-154	1.2E+02	7.5E+01	1.2E+02	1.7E+02	9.2E+01	3.9E+01	8.5E+01	1.7E+02
Eu-155	1.1E+00	6.6E-01	1.1E+00	1.5E+00	8.0E-01	3.4E-01	7.5E-01	1.5E+00
Re-186	2.5E-01	1.4E-01	2.4E-01	3.9E-01	1.9E-01	7.5E-02	1.7E-01	3.5E-01
Ir-192	7.1E+01	4.4E+01	7.1E+01	9.7E+01	5.4E+01	2.3E+01	5.0E+01	9.7E+01
Pb-210	1.6E-02	1.0E-02	1.6E-02	2.2E-02	1.2E-02	5.2E-03	1.1E-02	2.2E-02
Po-210	8.3E-04	5.1E-04	8.3E-04	1.1E-03	6.3E-04	2.7E-04	5.8E-04	1.1E-03
Bi-210	3.1E-02	1.8E-02	3.1E-02	4.7E-02	2.4E-02	9.7E-03	2.2E-02	4.4E-02
Rn-222	8.6E+01	4.8E+01	8.2E+01	1.3E+02	6.5E+01	2.6E+01	5.9E+01	1.2E+02
Ra-223	1.8E+01	1.1E+01	1.8E+01	2.5E+01	1.4E+01	5.7E+00	1.3E+01	2.5E+01
Ra-224	6.1E+01	3.4E+01	5.9E+01	9.7E+01	4.6E+01	1.8E+01	4.2E+01	8.8E+01
Ac-225	1.4E+01	8.8E+00	1.4E+01	2.0E+01	1.1E+01	4.5E+00	9.9E+00	1.9E+01
Ra-225	3.2E-02	2.0E-02	3.2E-02	4.4E-02	2.4E-02	1.0E-02	2.2E-02	4.3E-02
Ra-226	1.7E+02	1.1E+02	1.7E+02	2.4E+02	1.3E+02	5.6E+01	1.2E+02	2.4E+02
Ac-227	1.0E+01	6.4E+00	1.0E+01	1.4E+01	7.8E+00	3.3E+00	7.2E+00	1.4E+01
Th-227	5.9E+00	3.6E+00	5.9E+00	8.1E+00	4.4E+00	1.9E+00	4.1E+00	8.1E+00
Th-228	1.3E+02	7.9E+01	1.3E+02	1.7E+02	9.6E+01	4.1E+01	8.9E+01	1.8E+02
Ra-228	8.4E+01	5.2E+01	8.4E+01	1.2E+02	6.3E+01	2.7E+01	5.9E+01	1.2E+02
Th-229	7.9E+00	4.9E+00	7.9E+00	1.1E+01	5.9E+00	2.5E+00	5.5E+00	1.1E+01
Th-230	2.3E-03	1.4E-03	2.3E-03	3.2E-03	1.7E-03	7.4E-04	1.6E-03	3.2E-03
Pa-231	2.1E+00	1.3E+00	2.1E+00	2.8E+00	1.6E+00	6.6E-01	1.4E+00	2.8E+00
Th-231	1.5E-02	3.3E-03	1.1E-02	3.9E-02	1.1E-02	1.9E-03	7.7E-03	3.2E-02
Th-232	6.0E-01	3.7E-01	6.0E-01	8.2E-01	4.5E-01	1.9E-01	4.2E-01	8.2E-01
Pa-233	1.3E+01	8.1E+00	1.3E+01	1.8E+01	1.0E+01	4.2E+00	9.3E+00	1.8E+01
U-233	2.0E-05	1.3E-05	2.0E-05	2.8E-05	1.5E-05	6.5E-06	1.4E-05	2.8E-05
Th-234	7.3E-01	4.5E-01	7.4E-01	1.0E+00	5.5E-01	2.3E-01	5.1E-01	1.0E+00
U-234	3.7E-04	2.3E-04	3.7E-04	5.1E-04	2.8E-04	1.2E-04	2.6E-04	5.1E-04
U-235	8.2E+00	5.1E+00	8.2E+00	1.1E+01	6.2E+00	2.6E+00	5.7E+00	1.1E+01
Np-237	6.2E+00	3.9E+00	6.3E+00	8.6E+00	4.7E+00	2.0E+00	4.4E+00	8.6E+00
Pu-238	1.2E-04	7.3E-05	1.2E-04	1.6E-04	8.8E-05	3.8E-05	8.2E-05	1.6E-04
U-238	3.3E-01	2.0E-01	3.3E-01	4.5E-01	2.5E-01	1.1E-01	2.3E-01	4.5E-01
Pu-239	4.5E-05	2.8E-05	4.5E-05	6.1E-05	3.4E-05	1.4E-05	3.1E-05	6.2E-05
Pu-240	3.9E-04	2.4E-04	3.9E-04	5.3E-04	2.9E-04	1.2E-04	2.7E-04	5.3E-04
Pu-241	5.3E-05	3.3E-05	5.4E-05	7.4E-05	4.0E-05	1.7E-05	3.8E-05	7.4E-05
Am-241	1.5E-01	9.3E-02	1.5E-01	2.1E-01	1.1E-01	4.8E-02	1.0E-01	2.1E-01
Cm-242	1.7E-04	1.0E-04	1.7E-04	2.3E-04	1.3E-04	5.4E-05	1.2E-04	2.3E-04
Pu-242	2.0E-04	1.3E-04	2.0E-04	2.8E-04	1.5E-04	6.5E-05	1.4E-04	2.8E-04
Cm-244	1.5E-04	9.4E-05	1.5E-04	2.1E-04	1.1E-04	4.9E-05	1.1E-04	2.1E-04

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.21 Dose factors[a] for FE-SLAG-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	6.2E-07	1.8E-08	3.0E-07	2.0E-06	4.5E-07	1.2E-08	2.3E-07	1.7E-06
Na-22	4.5E+01	7.8E+00	3.2E+01	1.2E+02	3.4E+01	5.2E+00	2.4E+01	1.0E+02
P-32	5.9E-03	3.7E-04	3.2E-03	2.2E-02	4.4E-03	2.0E-04	2.2E-03	1.6E-02
S-35	5.7E-05	4.3E-06	3.3E-05	1.9E-04	4.2E-05	3.5E-06	2.3E-05	1.6E-04
Cl-36	3.5E-03	1.9E-04	2.0E-03	1.3E-02	2.5E-03	1.4E-04	1.4E-03	8.7E-03
K-40	1.8E+00	1.6E-01	1.1E+00	5.6E+00	1.3E+00	1.1E-01	7.4E-01	4.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	5.4E-04	9.0E-05	3.8E-04	1.4E-03	4.1E-04	5.6E-05	2.9E-04	1.3E-03
Cr-51	1.2E-01	5.2E-03	7.3E-02	3.9E-01	9.1E-02	3.9E-03	4.9E-02	3.1E-01
Mn-54	2.0E+01	3.5E+00	1.4E+01	5.5E+01	1.5E+01	2.0E+00	1.1E+01	4.2E+01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	4.7E-03	2.4E-04	2.5E-03	1.6E-02	3.6E-03	1.4E-04	1.7E-03	1.4E-02
Co-58	9.4E-02	4.4E-03	4.9E-02	3.2E-01	7.0E-02	2.5E-03	3.3E-02	2.4E-01
Fe-59	6.8E-01	8.9E-02	4.3E-01	2.1E+00	5.2E-01	5.0E-02	2.9E-01	1.8E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	3.4E-01	1.6E-02	1.7E-01	1.2E+00	2.5E-01	9.1E-03	1.3E-01	8.7E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	7.8E-02	2.4E-03	4.0E-02	2.7E-01	6.0E-02	2.0E-03	2.8E-02	2.2E-01
Cu-67	8.8E-06	1.3E-09	2.3E-07	5.4E-05	6.2E-06	9.3E-10	1.7E-07	3.0E-05
Se-75	4.1E+00	5.8E-01	2.8E+00	1.2E+01	3.0E+00	3.5E-01	1.9E+00	8.7E+00
Sr-85	1.4E+01	2.4E+00	9.8E+00	3.5E+01	1.0E+01	1.4E+00	6.9E+00	2.9E+01
Sr-89	3.1E-02	5.3E-03	2.2E-02	8.1E-02	2.3E-02	3.3E-03	1.4E-02	6.6E-02
Sr-90	5.1E-03	9.4E-04	3.7E-03	1.4E-02	3.9E-03	6.0E-04	2.5E-03	1.1E-02
Y-91	9.7E-02	1.7E-02	6.9E-02	2.5E-01	7.3E-02	1.1E-02	4.7E-02	2.3E-01
Mo-93	6.0E-07	2.6E-08	3.2E-07	2.1E-06	4.3E-07	1.6E-08	2.3E-07	1.6E-06
Nb-93m	2.9E-05	5.1E-06	2.1E-05	7.7E-05	2.2E-05	3.4E-06	1.5E-05	6.4E-05
Nb-94	6.7E+01	1.1E+01	4.9E+01	1.8E+02	5.0E+01	6.8E+00	3.4E+01	1.4E+02
Nb-95	1.6E+01	2.5E+00	1.1E+01	4.4E+01	1.2E+01	1.6E+00	8.4E+00	3.6E+01
Zr-95	2.1E+01	3.8E+00	1.5E+01	5.5E+01	1.6E+01	2.3E+00	1.1E+01	4.6E+01
Tc-99	3.9E-06	1.8E-07	2.1E-06	1.4E-05	2.9E-06	1.4E-07	1.3E-06	1.0E-05
Ru-103	3.6E-02	1.5E-03	2.1E-02	1.2E-01	2.7E-02	9.2E-04	1.4E-02	9.7E-02
Ru-106	2.7E-02	9.5E-04	1.6E-02	9.3E-02	2.2E-02	5.2E-04	1.0E-02	8.2E-02
Ag-108m	2.2E-01	7.2E-03	1.2E-01	8.0E-01	1.7E-01	4.6E-03	8.4E-02	6.4E-01
Cd-109	7.6E-05	1.0E-05	5.1E-05	2.3E-04	5.5E-05	6.4E-06	3.6E-05	1.7E-04
Ag-110m	3.5E-01	1.3E-02	2.0E-01	1.2E+00	2.6E-01	7.0E-03	1.4E-01	8.4E-01
Sb-124	5.1E+00	2.9E-01	3.0E+00	1.7E+01	4.0E+00	1.6E-01	2.1E+00	1.4E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.6E+00	8.1E-02	9.0E-01	5.4E+00	1.2E+00	5.1E-02	6.9E-01	4.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.1E+01	2.1E+00	8.1E+00	3.0E+01	8.4E+00	1.4E+00	5.6E+00	2.5E+01
Cs-134	1.7E+00	2.3E-01	1.1E+00	5.3E+00	1.3E+00	1.4E-01	8.2E-01	3.9E+00
Cs-137	6.7E-01	8.3E-02	4.4E-01	1.9E+00	5.0E-01	5.0E-02	3.2E-01	1.7E+00

Table F.21 Dose factors[a] for FE-SLAG-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	5.8E-01	9.4E-02	4.1E-01	1.6E+00	4.3E-01	5.7E-02	2.9E-01	1.2E+00
Ce-144	1.2E+00	2.2E-01	9.2E-01	3.2E+00	9.4E-01	1.4E-01	6.5E-01	3.0E+00
Pm-147	4.2E-05	7.5E-06	3.0E-05	1.1E-04	3.2E-05	4.7E-06	2.2E-05	9.2E-05
Eu-152	4.5E+01	7.9E+00	3.4E+01	1.2E+02	3.4E+01	4.8E+00	2.3E+01	1.0E+02
Eu-154	4.9E+01	8.8E+00	3.6E+01	1.3E+02	3.7E+01	5.2E+00	2.4E+01	1.1E+02
Eu-155	4.3E-01	7.5E-02	3.1E-01	1.2E+00	3.1E-01	4.8E-02	2.2E-01	9.1E-01
Re-186	2.9E-05	1.1E-07	3.9E-06	1.5E-04	2.2E-05	6.8E-08	2.8E-06	1.1E-04
Ir-192	4.5E-01	5.2E-02	2.9E-01	1.3E+00	3.5E-01	3.3E-02	2.1E-01	1.1E+00
Pb-210	1.5E-04	2.0E-05	9.5E-05	4.8E-04	1.2E-04	1.2E-05	6.9E-05	4.0E-04
Po-210	7.8E-06	9.4E-07	5.6E-06	2.3E-05	5.9E-06	6.3E-07	3.9E-06	1.8E-05
Bi-210	5.5E-05	3.1E-07	1.1E-05	2.7E-04	4.3E-05	2.4E-07	7.2E-06	2.3E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.3E+00	1.2E-01	7.5E-01	4.3E+00	9.9E-01	8.0E-02	5.5E-01	3.3E+00
Ra-224	2.8E-01	1.1E-03	4.4E-02	1.6E+00	2.1E-01	8.5E-04	3.2E-02	1.1E+00
Ac-225	8.6E-01	6.4E-02	4.4E-01	3.1E+00	6.3E-01	4.4E-02	3.3E-01	2.2E+00
Ra-225	3.2E-03	4.1E-04	2.1E-03	1.1E-02	2.4E-03	2.7E-04	1.5E-03	7.3E-03
Ra-226	7.1E+01	1.3E+01	5.1E+01	1.9E+02	5.3E+01	7.1E+00	3.6E+01	1.4E+02
Ac-227	4.2E+00	7.2E-01	3.0E+00	1.1E+01	3.1E+00	4.6E-01	2.2E+00	9.8E+00
Th-227	7.9E-01	1.0E-01	5.4E-01	2.3E+00	5.9E-01	7.2E-02	3.9E-01	2.0E+00
Th-228	5.0E+01	9.2E+00	3.6E+01	1.3E+02	3.8E+01	5.4E+00	2.6E+01	1.1E+02
Ra-228	3.3E+01	6.4E+00	2.5E+01	8.8E+01	2.6E+01	3.8E+00	1.7E+01	7.4E+01
Th-229	3.2E+00	5.4E-01	2.3E+00	8.0E+00	2.4E+00	3.5E-01	1.6E+00	7.5E+00
Th-230	9.3E-04	1.8E-04	6.5E-04	2.5E-03	7.0E-04	1.0E-04	4.5E-04	2.2E-03
Pa-231	8.4E-01	1.5E-01	6.1E-01	2.3E+00	6.3E-01	7.9E-02	4.4E-01	1.8E+00
Th-231	3.6E-08	5.3E-17	3.9E-12	2.4E-07	2.6E-08	4.7E-17	2.2E-12	1.5E-07
Th-232	2.5E-01	4.6E-02	1.7E-01	6.7E-01	1.9E-01	2.6E-02	1.2E-01	5.8E-01
Pa-233	2.5E+00	3.4E-01	1.7E+00	7.1E+00	1.8E+00	2.5E-01	1.2E+00	5.3E+00
U-233	8.2E-06	1.5E-06	6.1E-06	2.2E-05	6.3E-06	1.0E-06	4.1E-06	1.9E-05
Th-234	1.3E-01	2.0E-02	8.3E-02	3.8E-01	9.6E-02	1.3E-02	5.7E-02	3.1E-01
U-234	1.5E-04	2.8E-05	1.1E-04	3.8E-04	1.1E-04	1.6E-05	7.5E-05	3.2E-04
U-235	3.3E+00	5.7E-01	2.4E+00	8.6E+00	2.5E+00	3.7E-01	1.7E+00	7.3E+00
Np-237	2.6E+00	4.2E-01	1.9E+00	6.5E+00	1.9E+00	2.7E-01	1.3E+00	6.1E+00
Pu-238	4.8E-05	9.1E-06	3.6E-05	1.3E-04	3.6E-05	5.2E-06	2.5E-05	1.0E-04
U-238	1.3E-01	2.3E-02	9.7E-02	3.4E-01	9.8E-02	1.5E-02	6.8E-02	2.8E-01
Pu-239	1.8E-05	3.4E-06	1.3E-05	4.8E-05	1.4E-05	1.9E-06	9.4E-06	4.0E-05
Pu-240	1.6E-04	2.9E-05	1.2E-04	4.2E-04	1.2E-04	1.9E-05	7.7E-05	3.4E-04
Pu-241	2.2E-05	4.1E-06	1.6E-05	5.8E-05	1.6E-05	2.5E-06	1.1E-05	4.9E-05
Am-241	6.0E-02	1.1E-02	4.3E-02	1.6E-01	4.6E-02	7.3E-03	3.0E-02	1.3E-01
Cm-242	6.0E-05	1.1E-05	4.3E-05	1.6E-04	4.5E-05	6.1E-06	3.3E-05	1.3E-04
Pu-242	8.2E-05	1.6E-05	5.9E-05	2.2E-04	6.3E-05	8.8E-06	4.0E-05	2.0E-04
Cm-244	6.1E-05	1.1E-05	4.6E-05	1.6E-04	4.5E-05	7.1E-06	3.1E-05	1.3E-04

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.22 Dose factors[a] for FE-EAFD-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.8E-05	1.8E-06	1.2E-05	5.7E-05	1.4E-05	1.1E-06	8.1E-06	4.6E-05
Na-22	4.1E+02	7.3E+01	2.9E+02	1.1E+03	3.2E+02	4.6E+01	1.9E+02	9.2E+02
P-32	7.8E-02	5.3E-03	4.3E-02	2.9E-01	5.8E-02	3.7E-03	2.9E-02	2.1E-01
S-35	7.6E-04	6.5E-05	4.2E-04	2.5E-03	5.8E-04	4.3E-05	3.0E-04	2.2E-03
Cl-36	4.3E-02	5.0E-03	2.7E-02	1.3E-01	3.2E-02	3.1E-03	1.9E-02	1.0E-01
K-40	5.2E+01	9.2E+00	3.8E+01	1.4E+02	4.0E+01	5.7E+00	2.6E+01	1.2E+02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.1E-04	1.0E-05	7.3E-05	3.5E-04	8.8E-05	6.8E-06	4.9E-05	2.8E-04
Cr-51	3.7E-02	3.6E-03	2.3E-02	1.2E-01	2.8E-02	2.2E-03	1.6E-02	8.4E-02
Mn-54	5.6E+00	6.7E-01	3.4E+00	1.7E+01	4.2E+00	3.5E-01	2.5E+00	1.4E+01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.5E-01	1.5E-02	9.3E-02	4.6E-01	1.2E-01	1.0E-02	6.9E-02	3.9E-01
Co-58	3.1E+00	3.7E-01	2.0E+00	8.9E+00	2.3E+00	2.3E-01	1.4E+00	7.2E+00
Fe-59	3.1E+00	3.5E-01	2.0E+00	9.4E+00	2.4E+00	2.4E-01	1.4E+00	7.6E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.1E+01	1.1E+00	7.2E+00	3.1E+01	8.1E+00	8.2E-01	4.7E+00	2.5E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.1E+02	4.0E+01	1.5E+02	5.8E+02	1.6E+02	2.3E+01	1.0E+02	4.9E+02
Cu-67	3.9E-04	3.5E-07	2.6E-05	2.1E-03	2.9E-04	2.5E-07	1.9E-05	1.4E-03
Se-75	3.6E+01	1.5E+00	2.2E+01	1.2E+02	2.7E+01	1.0E+00	1.6E+01	9.3E+01
Sr-85	2.9E+00	2.8E-01	1.8E+00	8.9E+00	2.2E+00	1.7E-01	1.3E+00	7.1E+00
Sr-89	6.7E-03	6.3E-04	4.2E-03	2.0E-02	4.9E-03	4.4E-04	3.1E-03	1.5E-02
Sr-90	1.1E-03	9.0E-05	6.8E-04	3.1E-03	8.1E-04	6.1E-05	4.5E-04	2.7E-03
Y-91	2.2E-02	2.0E-03	1.3E-02	7.5E-02	1.6E-02	1.3E-03	9.1E-03	5.2E-02
Mo-93	1.9E-05	2.0E-06	1.2E-05	5.6E-05	1.4E-05	1.4E-06	8.7E-06	4.1E-05
Nb-93m	6.3E-06	5.5E-07	3.7E-06	2.2E-05	4.7E-06	3.6E-07	2.5E-06	1.5E-05
Nb-94	1.4E+01	1.2E+00	8.5E+00	4.8E+01	1.1E+01	8.3E-01	5.7E+00	4.0E+01
Nb-95	3.6E+00	3.1E-01	2.3E+00	1.1E+01	2.7E+00	2.1E-01	1.5E+00	9.0E+00
Zr-95	4.6E+00	4.8E-01	3.0E+00	1.5E+01	3.4E+00	2.8E-01	1.9E+00	1.2E+01
Tc-99	1.2E-04	1.4E-05	8.0E-05	3.5E-04	8.8E-05	9.6E-06	5.7E-05	2.9E-04
Ru-103	1.2E+00	1.4E-01	7.9E-01	3.8E+00	8.8E-01	8.6E-02	5.5E-01	2.8E+00
Ru-106	8.2E-01	9.7E-02	5.1E-01	2.6E+00	6.4E-01	6.3E-02	3.7E-01	2.1E+00
Ag-108m	7.0E+00	7.6E-01	4.5E+00	2.1E+01	5.2E+00	4.8E-01	3.4E+00	1.6E+01
Cd-109	2.9E-02	5.2E-03	2.0E-02	8.0E-02	2.2E-02	3.1E-03	1.4E-02	6.4E-02
Ag-110m	1.1E+01	1.1E+00	7.1E+00	3.3E+01	8.3E+00	7.1E-01	5.1E+00	2.5E+01
Sb-124	1.9E+00	6.6E-02	1.1E+00	6.1E+00	1.4E+00	4.8E-02	7.0E-01	4.8E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	5.7E-01	2.2E-02	3.2E-01	1.9E+00	4.5E-01	1.4E-02	2.2E-01	1.6E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.3E+00	2.2E-01	1.4E+00	7.2E+00	1.7E+00	1.7E-01	9.9E-01	5.8E+00
Cs-134	6.6E+02	1.1E+02	4.7E+02	1.7E+03	4.9E+02	7.2E+01	3.3E+02	1.3E+03
Cs-137	2.6E+02	4.8E+01	1.8E+02	6.8E+02	2.0E+02	2.8E+01	1.3E+02	5.9E+02

Table F.22 Dose factors[a] for FE-EAFD-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.3E-01	1.2E-02	7.5E-02	4.1E-01	9.6E-02	7.4E-03	5.5E-02	3.2E-01
Ce-144	2.7E-01	2.7E-02	1.5E-01	8.3E-01	2.0E-01	1.6E-02	1.1E-01	6.4E-01
Pm-147	9.2E-06	8.2E-07	5.4E-06	2.8E-05	7.0E-06	5.1E-07	3.8E-06	2.5E-05
Eu-152	9.2E+00	1.0E+00	5.9E+00	2.8E+01	6.9E+00	6.5E-01	3.9E+00	2.3E+01
Eu-154	9.9E+00	1.1E+00	6.0E+00	3.2E+01	7.5E+00	7.6E-01	4.4E+00	2.6E+01
Eu-155	8.9E-02	9.0E-03	5.4E-02	2.9E-01	6.6E-02	5.7E-03	3.9E-02	2.3E-01
Re-186	9.8E-03	4.9E-05	1.7E-03	4.6E-02	7.2E-03	3.4E-05	1.2E-03	3.4E-02
Ir-192	1.2E+02	6.3E+00	6.7E+01	4.0E+02	8.9E+01	3.7E+00	4.9E+01	3.4E+02
Pb-210	6.7E-02	1.1E-02	4.8E-02	1.8E-01	5.0E-02	7.0E-03	3.5E-02	1.4E-01
Po-210	3.0E-03	5.7E-04	2.1E-03	7.9E-03	2.2E-03	3.5E-04	1.6E-03	6.3E-03
Bi-210	3.6E-03	1.1E-04	1.5E-03	1.6E-02	2.7E-03	7.3E-05	1.0E-03	1.2E-02
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.3E-01	2.0E-02	1.7E-01	1.1E+00	2.4E-01	1.3E-02	1.2E-01	8.2E-01
Ra-224	8.8E-02	4.9E-04	1.5E-02	4.0E-01	6.7E-02	3.7E-04	1.0E-02	3.3E-01
Ac-225	2.1E-01	1.3E-02	1.1E-01	8.7E-01	1.5E-01	7.9E-03	7.4E-02	5.7E-01
Ra-225	8.2E-04	5.6E-05	4.3E-04	2.9E-03	5.8E-04	3.9E-05	2.9E-04	2.1E-03
Ra-226	1.5E+01	1.2E+00	8.8E+00	4.6E+01	1.1E+01	9.7E-01	6.2E+00	3.8E+01
Ac-227	8.9E-01	7.6E-02	5.2E-01	2.8E+00	6.8E-01	5.1E-02	3.6E-01	2.4E+00
Th-227	1.9E-01	1.5E-02	1.1E-01	7.1E-01	1.4E-01	9.3E-03	7.5E-02	5.1E-01
Th-228	1.1E+01	8.4E-01	6.4E+00	3.8E+01	8.3E+00	6.2E-01	4.5E+00	3.1E+01
Ra-228	7.2E+00	6.0E-01	4.3E+00	2.6E+01	5.5E+00	4.6E-01	2.9E+00	1.9E+01
Th-229	6.8E-01	6.1E-02	4.1E-01	2.3E+00	5.1E-01	3.8E-02	2.8E-01	1.7E+00
Th-230	2.0E-04	1.7E-05	1.2E-04	6.4E-04	1.5E-04	1.3E-05	8.1E-05	5.1E-04
Pa-231	1.7E-01	1.8E-02	1.1E-01	5.1E-01	1.3E-01	1.1E-02	7.5E-02	3.9E-01
Th-231	1.6E-08	5.8E-16	6.6E-12	8.8E-08	1.3E-08	4.5E-16	4.5E-12	6.9E-08
Th-232	5.1E-02	4.2E-03	3.2E-02	1.6E-01	3.9E-02	2.7E-03	2.2E-02	1.3E-01
Pa-233	5.6E-01	5.6E-02	3.6E-01	1.7E+00	4.1E-01	3.5E-02	2.4E-01	1.5E+00
U-233	1.8E-06	1.7E-07	1.1E-06	6.2E-06	1.3E-06	1.2E-07	7.1E-07	4.7E-06
Th-234	2.9E-02	2.4E-03	1.8E-02	1.0E-01	2.2E-02	1.5E-03	1.1E-02	7.5E-02
U-234	3.3E-05	2.8E-06	2.0E-05	1.1E-04	2.4E-05	1.9E-06	1.4E-05	8.2E-05
U-235	7.1E-01	6.3E-02	4.1E-01	2.5E+00	5.4E-01	4.0E-02	2.9E-01	1.9E+00
Np-237	5.2E-01	4.8E-02	3.3E-01	1.7E+00	4.0E-01	3.2E-02	2.2E-01	1.4E+00
Pu-238	9.8E-06	9.6E-07	5.8E-06	3.2E-05	7.2E-06	5.6E-07	4.2E-06	2.3E-05
U-238	2.9E-02	2.7E-03	1.7E-02	9.7E-02	2.2E-02	1.7E-03	1.2E-02	7.9E-02
Pu-239	3.8E-06	3.9E-07	2.3E-06	1.2E-05	2.8E-06	2.2E-07	1.6E-06	8.8E-06
Pu-240	3.3E-05	3.1E-06	2.0E-05	1.0E-04	2.5E-05	2.0E-06	1.5E-05	8.3E-05
Pu-241	4.5E-06	4.2E-07	2.6E-06	1.4E-05	3.4E-06	2.9E-07	1.9E-06	1.1E-05
Am-241	1.2E-02	1.2E-03	7.6E-03	4.0E-02	9.6E-03	7.0E-04	5.4E-03	3.1E-02
Cm-242	1.3E-05	1.2E-06	7.6E-06	4.2E-05	9.4E-06	8.4E-07	5.7E-06	3.1E-05
Pu-242	1.7E-05	1.5E-06	1.0E-05	5.5E-05	1.3E-05	9.7E-07	7.7E-06	4.4E-05
Cm-244	1.8E-05	1.1E-06	8.1E-06	4.3E-05	9.7E-06	7.4E-07	5.4E-06	3.3E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.23 Dose factors[a] for FE-METL-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.8E-05	5.5E-06	2.1E-05	6.9E-05	2.1E-05	3.4E-06	1.5E-05	5.4E-05
Na-22	5.0E-02	2.1E-03	2.6E-02	1.8E-01	3.8E-02	1.2E-03	1.9E-02	1.4E-01
P-32	6.3E-05	1.8E-06	3.0E-05	2.6E-04	4.7E-05	1.3E-06	2.1E-05	1.8E-04
S-35	2.3E-06	1.1E-07	1.3E-06	7.9E-06	1.8E-06	8.9E-08	9.3E-07	6.0E-06
Cl-36	1.6E-05	2.1E-06	1.0E-05	5.0E-05	1.2E-05	1.5E-06	7.1E-06	3.9E-05
K-40	4.0E-03	1.5E-04	2.1E-03	1.5E-02	3.0E-03	9.9E-05	1.5E-03	1.3E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.1E-07	1.2E-08	1.7E-07	1.2E-06	2.3E-07	8.1E-09	1.1E-07	9.3E-07
Cr-51	5.4E-02	9.7E-03	3.7E-02	1.6E-01	3.9E-02	5.3E-03	2.5E-02	1.1E-01
Mn-54	2.1E+00	3.5E-01	1.5E+00	5.7E+00	1.6E+00	2.1E-01	1.0E+00	4.7E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	2.4E-01	4.4E-02	1.6E-01	6.5E-01	1.8E-01	3.0E-02	1.2E-01	5.2E-01
Co-58	4.7E+00	8.5E-01	3.4E+00	1.2E+01	3.5E+00	5.1E-01	2.4E+00	9.7E+00
Fe-59	4.6E+00	8.1E-01	3.2E+00	1.3E+01	3.6E+00	5.0E-01	2.1E+00	1.1E+01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.8E+01	3.3E+00	1.3E+01	4.6E+01	1.3E+01	1.8E+00	9.1E+00	4.1E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.8E-01	2.0E-02	2.3E-01	1.2E+00	2.9E-01	1.2E-02	1.6E-01	9.5E-01
Cu-67	1.7E-04	3.8E-08	6.5E-06	9.4E-04	1.2E-04	2.8E-08	4.4E-06	7.2E-04
Se-75	5.6E-01	2.8E-02	3.3E-01	1.8E+00	4.1E-01	1.8E-02	2.4E-01	1.4E+00
Sr-85	7.7E-03	2.6E-04	4.1E-03	3.0E-02	5.7E-03	1.7E-04	3.0E-03	2.2E-02
Sr-89	1.7E-05	6.4E-07	8.8E-06	5.7E-05	1.3E-05	4.7E-07	6.4E-06	5.0E-05
Sr-90	3.0E-06	1.0E-07	1.6E-06	1.1E-05	2.2E-06	7.2E-08	1.2E-06	7.4E-06
Y-91	5.2E-05	3.2E-06	2.8E-05	1.9E-04	4.0E-05	2.0E-06	1.9E-05	1.4E-04
Mo-93	3.0E-05	5.5E-06	2.2E-05	8.2E-05	2.3E-05	3.5E-06	1.5E-05	6.3E-05
Nb-93m	1.7E-08	7.0E-10	9.3E-09	5.4E-08	1.3E-08	4.6E-10	6.3E-09	4.3E-08
Nb-94	3.8E-02	1.5E-03	2.3E-02	1.3E-01	2.9E-02	8.4E-04	1.6E-02	1.1E-01
Nb-95	8.7E-03	2.9E-04	4.9E-03	3.0E-02	6.5E-03	1.7E-04	3.2E-03	2.4E-02
Zr-95	1.2E-02	5.1E-04	6.1E-03	4.6E-02	9.2E-03	2.6E-04	4.5E-03	3.5E-02
Tc-99	2.0E-04	3.5E-05	1.4E-04	5.2E-04	1.5E-04	2.1E-05	1.0E-04	4.6E-04
Ru-103	1.8E+00	2.8E-01	1.3E+00	4.8E+00	1.3E+00	1.8E-01	8.8E-01	4.2E+00
Ru-106	1.3E+00	2.3E-01	1.0E+00	3.5E+00	1.0E+00	1.3E-01	7.2E-01	2.7E+00
Ag-108m	1.1E+01	2.0E+00	8.1E+00	2.9E+01	8.5E+00	1.3E+00	5.9E+00	2.6E+01
Cd-109	1.6E-06	7.1E-08	8.5E-07	5.6E-06	1.2E-06	5.0E-08	6.0E-07	4.4E-06
Ag-110m	1.8E+01	3.4E+00	1.3E+01	4.5E+01	1.3E+01	2.1E+00	9.2E+00	3.7E+01
Sb-124	7.9E+00	1.3E+00	5.5E+00	2.1E+01	6.0E+00	8.0E-01	3.9E+00	1.8E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.6E+00	4.8E-01	1.8E+00	7.0E+00	2.0E+00	2.8E-01	1.2E+00	6.1E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	6.6E-03	2.4E-04	3.5E-03	2.3E-02	5.0E-03	1.6E-04	2.4E-03	1.9E-02
Cs-134	3.5E-02	1.6E-03	2.0E-02	1.2E-01	2.6E-02	1.1E-03	1.5E-02	8.4E-02
Cs-137	1.4E-02	6.0E-04	8.2E-03	4.8E-02	1.1E-02	3.7E-04	5.5E-03	4.2E-02

Table F.23 Dose factors[a] for FE-METL-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5^{th}	50^{th}	95^{th}	Surficial dose factors (µSv/y per Bq/cm^2) Mean	5^{th}	50^{th}	95^{th}
Ce-141	3.1E-04	1.1E-05	1.6E-04	1.2E-03	2.4E-04	9.4E-06	1.1E-04	8.9E-04
Ce-144	7.2E-04	2.2E-05	4.0E-04	2.6E-03	5.4E-04	1.6E-05	2.8E-04	1.9E-03
Pm-147	2.5E-08	6.9E-10	1.2E-08	9.0E-08	1.9E-08	4.9E-10	9.1E-09	6.9E-08
Eu-152	2.6E-02	1.0E-03	1.5E-02	1.0E-01	2.0E-02	6.4E-04	9.7E-03	7.3E-02
Eu-154	2.9E-02	1.3E-03	1.5E-02	1.2E-01	2.1E-02	6.5E-04	1.1E-02	7.9E-02
Eu-155	2.5E-04	9.1E-06	1.3E-04	9.0E-04	1.9E-04	5.9E-06	9.0E-05	7.0E-04
Re-186	6.4E-05	1.3E-07	6.2E-06	3.3E-04	4.6E-05	8.1E-08	4.5E-06	2.4E-04
Ir-192	1.8E+00	8.2E-02	1.0E+00	5.9E+00	1.4E+00	5.2E-02	7.8E-01	4.6E+00
Pb-210	2.6E-05	3.0E-06	1.8E-05	7.8E-05	2.0E-05	1.8E-06	1.2E-05	6.7E-05
Po-210	1.6E-07	6.5E-09	9.3E-08	5.4E-07	1.2E-07	4.4E-09	6.1E-08	4.1E-07
Bi-210	6.1E-06	2.6E-08	1.1E-06	3.1E-05	4.1E-06	2.0E-08	7.3E-07	2.0E-05
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	3.9E-03	1.9E-04	1.7E-03	1.5E-02	2.8E-03	1.1E-04	1.3E-03	9.3E-03
Ra-224	5.6E-04	1.1E-06	6.0E-05	3.1E-03	3.8E-04	6.7E-07	3.8E-05	2.1E-03
Ac-225	3.8E-04	7.9E-06	1.5E-04	1.7E-03	2.8E-04	5.4E-06	1.0E-04	1.2E-03
Ra-225	9.7E-06	6.3E-07	5.1E-06	3.3E-05	7.1E-06	3.6E-07	3.5E-06	2.4E-05
Ra-226	2.6E-01	2.4E-02	1.6E-01	8.7E-01	1.9E-01	1.5E-02	1.1E-01	6.3E-01
Ac-227	2.5E-03	7.7E-05	1.4E-03	8.7E-03	1.8E-03	6.8E-05	9.1E-04	6.4E-03
Th-227	4.0E-04	1.3E-05	1.8E-04	1.6E-03	2.9E-04	6.4E-06	1.4E-04	1.2E-03
Th-228	2.9E-02	1.3E-03	1.5E-02	1.0E-01	2.3E-02	7.1E-04	1.1E-02	9.1E-02
Ra-228	1.2E-01	1.0E-02	7.8E-02	3.7E-01	9.2E-02	6.6E-03	5.2E-02	3.1E-01
Th-229	1.8E-03	7.6E-05	9.6E-04	6.2E-03	1.3E-03	5.6E-05	7.4E-04	4.6E-03
Th-230	5.5E-07	2.2E-08	2.8E-07	2.0E-06	4.1E-07	1.4E-08	1.9E-07	1.6E-06
Pa-231	4.7E-04	1.6E-05	2.7E-04	1.6E-03	3.5E-04	1.0E-05	1.9E-04	1.2E-03
Th-231	2.2E-12	3.7E-22	1.1E-16	8.1E-12	1.5E-12	3.3E-22	7.6E-17	5.3E-12
Th-232	1.4E-04	6.0E-06	7.3E-05	4.7E-04	1.1E-04	3.6E-06	5.1E-05	3.8E-04
Pa-233	1.3E-03	4.6E-05	6.6E-04	4.6E-03	9.4E-04	3.0E-05	5.1E-04	3.5E-03
U-233	4.9E-09	1.9E-10	2.8E-09	1.7E-08	3.6E-09	1.1E-10	1.8E-09	1.3E-08
Th-234	6.7E-05	2.4E-06	3.2E-05	2.5E-04	4.9E-05	1.6E-06	2.1E-05	2.0E-04
U-234	9.0E-08	3.2E-09	5.2E-08	3.5E-07	6.8E-08	2.2E-09	3.3E-08	2.7E-07
U-235	2.0E-03	7.0E-05	1.1E-03	7.5E-03	1.5E-03	4.9E-05	8.1E-04	5.1E-03
Np-237	1.5E-03	4.1E-05	8.1E-04	5.4E-03	1.1E-03	2.8E-05	5.4E-04	4.2E-03
Pu-238	2.8E-08	1.1E-09	1.4E-08	1.0E-07	2.1E-08	7.4E-10	1.1E-08	8.3E-08
U-238	7.7E-05	2.9E-06	4.6E-05	2.6E-04	5.8E-05	1.8E-06	3.2E-05	2.0E-04
Pu-239	1.0E-08	4.0E-10	5.4E-09	3.6E-08	7.9E-09	3.0E-10	3.8E-09	2.9E-08
Pu-240	9.1E-08	4.3E-09	4.9E-08	3.5E-07	6.8E-08	2.6E-09	3.4E-08	2.2E-07
Pu-241	1.3E-08	5.5E-10	6.8E-09	4.4E-08	9.1E-09	3.4E-10	4.8E-09	3.2E-08
Am-241	3.4E-05	1.3E-06	2.0E-05	1.2E-04	2.5E-05	9.2E-07	1.4E-05	8.4E-05
Cm-242	3.5E-08	1.2E-09	1.8E-08	1.3E-07	2.6E-08	8.6E-10	1.2E-08	9.1E-08
Pu-242	4.7E-08	2.2E-09	2.5E-08	1.7E-07	3.5E-08	1.5E-09	1.7E-08	1.3E-07
Cm-244	3.6E-08	1.4E-09	1.9E-08	1.3E-07	2.7E-08	8.5E-10	1.3E-08	1.0E-07

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm^2), multiply by 3.70 E-03

Table F.24 Dose factors[a] for FE-BOFD-DISPOSL-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.4E-07	2.1E-08	3.6E-07	1.7E-06	4.0E-07	1.3E-08	2.4E-07	1.4E-06
Na-22	3.5E-01	2.1E-02	3.0E-01	9.2E-01	2.7E-01	1.5E-02	2.0E-01	7.2E-01
P-32	8.0E-05	2.7E-06	4.6E-05	3.2E-04	6.0E-05	2.0E-06	3.1E-05	2.2E-04
S-35	1.3E-05	6.5E-07	8.2E-06	3.8E-05	9.7E-06	3.8E-07	6.0E-06	3.3E-05
Cl-36	1.1E-04	8.3E-06	8.8E-05	2.9E-04	8.6E-05	5.7E-06	6.0E-05	2.3E-04
K-40	4.5E-02	3.1E-03	3.8E-02	1.1E-01	3.4E-02	2.1E-03	2.5E-02	9.7E-02
Ca-41	8.9E-07	4.4E-08	5.5E-07	3.2E-06	6.8E-07	3.0E-08	3.8E-07	2.4E-06
Ca-45	2.5E-06	9.9E-08	1.6E-06	7.8E-06	1.9E-06	7.1E-08	1.1E-06	6.1E-06
Cr-51	2.6E-05	1.1E-06	1.7E-05	8.3E-05	1.9E-05	8.5E-07	1.2E-05	6.2E-05
Mn-54	4.5E-03	2.5E-04	3.0E-03	1.4E-02	3.5E-03	1.6E-04	2.1E-03	1.2E-02
Fe-55	2.6E-06	1.4E-07	1.9E-06	7.6E-06	2.0E-06	9.1E-08	1.3E-06	6.6E-06
Co-57	2.6E-04	1.4E-05	1.9E-04	7.5E-04	2.0E-04	1.1E-05	1.3E-04	6.3E-04
Co-58	2.4E-03	1.3E-04	1.7E-03	7.4E-03	1.8E-03	8.7E-05	1.1E-03	5.8E-03
Fe-59	2.5E-02	1.1E-03	1.6E-02	7.5E-02	1.9E-02	6.9E-04	1.2E-02	6.4E-02
Ni-59	1.3E-07	7.8E-09	1.1E-07	3.4E-07	1.0E-07	5.3E-09	7.4E-08	2.8E-07
Co-60	9.2E-03	4.2E-04	7.1E-03	2.5E-02	7.0E-03	3.2E-04	4.8E-03	2.1E-02
Ni-63	3.6E-07	1.5E-08	2.7E-07	9.7E-07	2.7E-07	1.2E-08	1.8E-07	8.1E-07
Zn-65	1.8E-01	9.1E-03	1.5E-01	4.4E-01	1.3E-01	6.9E-03	1.0E-01	3.6E-01
Cu-67	1.4E-07	1.9E-11	3.4E-09	6.6E-07	1.1E-07	1.1E-11	2.8E-09	4.5E-07
Se-75	3.7E-02	1.0E-03	2.4E-02	1.2E-01	2.9E-02	6.8E-04	1.6E-02	9.5E-02
Sr-85	2.3E-03	1.3E-04	1.4E-03	7.2E-03	1.8E-03	7.3E-05	8.7E-04	5.7E-03
Sr-89	1.3E-05	6.8E-07	9.0E-06	3.7E-05	9.5E-06	4.5E-07	6.3E-06	3.1E-05
Sr-90	3.0E-04	1.5E-05	2.1E-04	1.0E-03	2.3E-04	9.6E-06	1.5E-04	7.3E-04
Y-91	3.3E-05	1.8E-06	2.1E-05	1.0E-04	2.5E-05	1.0E-06	1.5E-05	7.6E-05
Mo-93	3.2E-06	1.8E-07	2.3E-06	8.9E-06	2.5E-06	1.1E-07	1.6E-06	7.7E-06
Nb-93m	5.6E-06	2.3E-07	3.5E-06	1.7E-05	4.2E-06	1.5E-07	2.5E-06	1.3E-05
Nb-94	1.1E-02	5.4E-04	7.7E-03	3.3E-02	8.7E-03	3.2E-04	5.1E-03	3.1E-02
Nb-95	2.5E-03	1.1E-04	1.6E-03	8.4E-03	1.9E-03	7.1E-05	1.2E-03	6.9E-03
Zr-95	3.5E-03	1.8E-04	2.2E-03	1.1E-02	2.6E-03	1.0E-04	1.5E-03	8.9E-03
Tc-99	1.2E-06	7.7E-08	9.2E-07	3.3E-06	8.8E-07	4.9E-08	6.3E-07	2.6E-06
Ru-103	8.0E-04	3.7E-05	5.5E-04	2.5E-03	6.0E-04	3.0E-05	4.0E-04	2.0E-03
Ru-106	4.7E-05	2.3E-06	3.6E-05	1.4E-04	3.6E-05	1.4E-06	2.3E-05	1.1E-04
Ag-108m	5.7E-03	3.2E-04	4.0E-03	1.6E-02	4.2E-03	2.1E-04	2.9E-03	1.3E-02
Cd-109	1.4E-03	1.1E-04	1.4E-03	3.2E-03	1.1E-03	7.5E-05	9.2E-04	2.9E-03
Ag-110m	8.9E-03	5.1E-04	6.5E-03	2.7E-02	6.8E-03	3.2E-04	4.5E-03	2.4E-02
Sb-124	1.5E-03	3.8E-05	7.2E-04	5.4E-03	1.1E-03	2.8E-05	5.0E-04	4.3E-03
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	4.4E-04	1.3E-05	2.5E-04	1.6E-03	3.2E-04	9.4E-06	1.7E-04	1.2E-03
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.3E-03	9.8E-05	1.5E-03	7.0E-03	1.8E-03	5.3E-05	1.0E-03	5.8E-03
Cs-134	5.3E-01	2.9E-02	4.2E-01	1.4E+00	4.0E-01	2.0E-02	3.2E-01	1.1E+00
Cs-137	1.5E-03	8.8E-05	1.3E-03	4.0E-03	1.1E-03	6.1E-05	9.1E-04	3.1E-03

Table F.24 Dose factors[a] for FE-BOFD-DISPOSL-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.7E-04	7.0E-06	1.1E-04	5.5E-04	1.3E-04	4.5E-06	7.3E-05	4.3E-04
Ce-144	1.5E-04	6.8E-06	1.0E-04	4.1E-04	1.1E-04	4.5E-06	7.0E-05	3.6E-04
Pm-147	7.5E-06	2.8E-07	4.9E-06	2.1E-05	5.8E-06	2.0E-07	3.3E-06	1.9E-05
Eu-152	8.5E-03	3.7E-04	5.3E-03	2.6E-02	6.7E-03	2.3E-04	3.5E-03	2.4E-02
Eu-154	9.2E-03	3.6E-04	6.0E-03	3.0E-02	7.1E-03	2.2E-04	3.9E-03	2.3E-02
Eu-155	2.2E-04	8.8E-06	1.6E-04	6.7E-04	1.7E-04	6.0E-06	1.0E-04	5.1E-04
Re-186	8.3E-06	1.2E-08	8.2E-07	3.5E-05	6.4E-06	8.1E-09	5.3E-07	2.8E-05
Ir-192	9.0E-02	2.7E-03	5.9E-02	2.7E-01	6.8E-02	1.8E-03	4.0E-02	2.1E-01
Pb-210	2.4E-01	1.9E-02	2.2E-01	5.8E-01	1.8E-01	1.2E-02	1.4E-01	4.9E-01
Po-210	1.0E-01	6.8E-03	8.9E-02	2.3E-01	7.4E-02	5.0E-03	5.8E-02	2.1E-01
Bi-210	1.8E-05	1.8E-07	3.5E-06	8.9E-05	1.4E-05	1.0E-07	2.5E-06	6.5E-05
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	2.8E-04	8.3E-06	1.6E-04	1.0E-03	2.1E-04	4.4E-06	1.1E-04	7.9E-04
Ra-224	2.6E-06	4.4E-09	1.9E-07	1.4E-05	1.9E-06	3.2E-09	1.5E-07	9.7E-06
Ac-225	1.3E-04	2.8E-06	6.3E-05	5.3E-04	9.8E-05	2.0E-06	4.3E-05	3.6E-04
Ra-225	2.9E-04	7.2E-06	1.7E-04	9.6E-04	2.2E-04	4.9E-06	1.2E-04	7.7E-04
Ra-226	1.6E-02	6.7E-04	1.0E-02	4.7E-02	1.2E-02	4.8E-04	7.1E-03	4.0E-02
Ac-227	2.5E-01	1.0E-02	1.6E-01	8.6E-01	1.9E-01	5.6E-03	1.1E-01	6.6E-01
Th-227	9.0E-04	4.0E-05	5.4E-04	3.1E-03	6.9E-04	2.3E-05	3.5E-04	2.4E-03
Th-228	7.1E-02	3.4E-03	4.6E-02	2.1E-01	5.3E-02	2.3E-03	3.3E-02	1.7E-01
Ra-228	9.6E-03	4.6E-04	7.1E-03	2.8E-02	7.2E-03	3.4E-04	4.9E-03	2.1E-02
Th-229	3.2E-01	1.3E-02	2.1E-01	1.0E+00	2.4E-01	8.8E-03	1.3E-01	9.1E-01
Th-230	4.7E-02	2.0E-03	2.9E-02	1.5E-01	3.5E-02	1.5E-03	2.1E-02	1.1E-01
Pa-231	1.6E-01	6.7E-03	1.1E-01	4.9E-01	1.2E-01	4.2E-03	7.7E-02	3.8E-01
Th-231	4.1E-12	7.6E-22	1.3E-16	1.7E-11	3.0E-12	5.4E-22	7.9E-17	1.5E-11
Th-232	2.1E-01	9.6E-03	1.3E-01	6.8E-01	1.6E-01	5.5E-03	8.7E-02	5.6E-01
Pa-233	4.4E-04	2.0E-05	2.7E-04	1.4E-03	3.4E-04	1.3E-05	1.8E-04	1.2E-03
U-233	2.4E-02	1.1E-03	1.4E-02	8.1E-02	1.9E-02	6.5E-04	1.0E-02	6.3E-02
Th-234	1.4E-05	5.2E-07	8.7E-06	4.4E-05	1.1E-05	3.7E-07	6.1E-06	3.6E-05
U-234	2.4E-02	1.1E-03	1.5E-02	7.9E-02	1.9E-02	7.4E-04	1.1E-02	6.3E-02
U-235	2.2E-02	1.2E-03	1.5E-02	7.1E-02	1.6E-02	7.5E-04	1.0E-02	5.3E-02
Np-237	1.0E-01	4.4E-03	6.6E-02	3.1E-01	7.6E-02	2.7E-03	4.7E-02	2.6E-01
Pu-238	5.1E-02	2.0E-03	3.3E-02	1.6E-01	3.8E-02	1.5E-03	2.2E-02	1.2E-01
U-238	2.2E-02	1.0E-03	1.4E-02	7.0E-02	1.7E-02	6.7E-04	9.5E-03	5.6E-02
Pu-239	5.6E-02	2.9E-03	3.5E-02	1.7E-01	4.4E-02	1.6E-03	2.5E-02	1.5E-01
Pu-240	5.5E-02	2.3E-03	3.8E-02	1.7E-01	4.1E-02	1.5E-03	2.6E-02	1.3E-01
Pu-241	9.2E-04	3.8E-05	5.5E-04	2.8E-03	7.0E-04	2.7E-05	3.6E-04	2.4E-03
Am-241	8.6E-02	3.6E-03	5.4E-02	2.7E-01	6.6E-02	2.1E-03	3.6E-02	2.2E-01
Cm-242	2.7E-03	1.0E-04	1.8E-03	9.1E-03	2.0E-03	6.9E-05	1.2E-03	7.3E-03
Pu-242	5.5E-02	2.2E-03	3.4E-02	1.7E-01	4.2E-02	1.4E-03	2.3E-02	1.4E-01
Cm-244	4.6E-02	2.2E-03	3.0E-02	1.5E-01	3.5E-02	1.4E-03	1.9E-02	1.3E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.25 Dose factors[a] for FE-SLAG-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.2E-08	9.8E-10	2.1E-08	2.1E-07	4.0E-08	6.4E-10	1.4E-08	1.6E-07
Na-22	1.0E-01	1.3E-02	6.7E-02	3.0E-01	7.9E-02	7.9E-03	5.0E-02	2.6E-01
P-32	2.1E-05	1.3E-06	1.1E-05	7.6E-05	1.6E-05	7.5E-07	7.1E-06	6.0E-05
S-35	1.6E-06	1.1E-07	8.9E-07	5.1E-06	1.3E-06	6.3E-08	6.7E-07	4.3E-06
Cl-36	1.8E-05	1.0E-06	1.1E-05	5.8E-05	1.3E-05	7.6E-07	7.8E-06	4.8E-05
K-40	4.2E-03	3.4E-04	2.2E-03	1.5E-02	3.2E-03	2.3E-04	1.7E-03	1.2E-02
Ca-41	9.3E-06	1.0E-06	6.2E-06	2.9E-05	7.0E-06	6.6E-07	4.3E-06	2.3E-05
Ca-45	2.3E-05	3.2E-06	1.5E-05	7.0E-05	1.8E-05	2.1E-06	1.1E-05	5.9E-05
Cr-51	2.9E-04	7.7E-06	1.4E-04	1.1E-03	2.2E-04	6.6E-06	9.9E-05	7.7E-04
Mn-54	4.4E-02	6.8E-03	2.9E-02	1.3E-01	3.3E-02	3.9E-03	2.2E-02	9.6E-02
Fe-55	1.2E-07	9.3E-09	6.8E-08	3.8E-07	8.7E-08	6.6E-09	5.1E-08	2.8E-07
Co-57	2.3E-05	8.0E-07	1.1E-05	7.9E-05	1.7E-05	4.4E-07	8.1E-06	6.0E-05
Co-58	2.0E-04	8.5E-06	1.1E-04	6.8E-04	1.6E-04	4.2E-06	7.5E-05	4.9E-04
Fe-59	1.6E-03	1.5E-04	8.8E-04	5.3E-03	1.2E-03	1.0E-04	6.3E-04	4.4E-03
Ni-59	7.7E-09	2.5E-10	3.7E-09	3.2E-08	5.8E-09	1.6E-10	2.7E-09	2.3E-08
Co-60	8.0E-04	2.7E-05	4.0E-04	2.9E-03	6.2E-04	2.0E-05	2.6E-04	2.6E-03
Ni-63	2.1E-08	6.5E-10	9.2E-09	7.5E-08	1.6E-08	4.7E-10	6.9E-09	6.4E-08
Zn-65	1.7E-04	4.9E-06	8.7E-05	6.6E-04	1.3E-04	3.3E-06	6.0E-05	5.0E-04
Cu-67	2.1E-08	3.4E-12	8.9E-10	1.1E-07	1.6E-08	2.6E-12	6.1E-10	8.3E-08
Se-75	1.2E-02	1.5E-03	7.4E-03	3.7E-02	9.0E-03	9.3E-04	5.3E-03	3.0E-02
Sr-85	3.0E-02	4.0E-03	2.0E-02	9.4E-02	2.3E-02	2.5E-03	1.4E-02	7.9E-02
Sr-89	1.4E-04	2.3E-05	1.0E-04	3.9E-04	1.1E-04	1.4E-05	6.7E-05	3.1E-04
Sr-90	2.1E-03	3.2E-04	1.4E-03	6.2E-03	1.6E-03	2.0E-04	9.7E-04	4.8E-03
Y-91	3.8E-04	6.0E-05	2.6E-04	1.1E-03	2.8E-04	3.8E-05	1.8E-04	8.5E-04
Mo-93	1.5E-07	5.3E-09	7.0E-08	5.3E-07	1.1E-07	3.0E-09	5.2E-08	3.8E-07
Nb-93m	3.0E-05	4.0E-06	2.1E-05	9.3E-05	2.3E-05	2.5E-06	1.4E-05	7.0E-05
Nb-94	1.4E-01	2.1E-02	1.0E-01	3.9E-01	1.1E-01	1.2E-02	6.9E-02	3.2E-01
Nb-95	3.5E-02	4.4E-03	2.3E-02	1.0E-01	2.7E-02	2.7E-03	1.6E-02	7.9E-02
Zr-95	4.4E-02	7.1E-03	3.1E-02	1.3E-01	3.3E-02	4.2E-03	2.2E-02	9.7E-02
Tc-99	6.3E-08	2.5E-09	3.4E-08	2.2E-07	4.7E-08	1.4E-09	2.4E-08	1.8E-07
Ru-103	7.6E-05	2.2E-06	3.7E-05	3.0E-04	6.2E-05	1.3E-06	2.5E-05	2.5E-04
Ru-106	1.9E-06	5.9E-08	9.4E-07	7.1E-06	1.5E-06	3.9E-08	6.1E-07	5.7E-06
Ag-108m	4.7E-04	1.3E-05	2.5E-04	1.7E-03	3.5E-04	9.5E-06	1.7E-04	1.3E-03
Cd-109	8.9E-06	9.6E-07	5.6E-06	2.7E-05	6.9E-06	6.2E-07	3.9E-06	2.2E-05
Ag-110m	7.6E-04	1.8E-05	4.1E-04	2.9E-03	5.7E-04	1.4E-05	2.7E-04	2.1E-03
Sb-124	1.1E-02	5.4E-04	6.1E-03	3.7E-02	8.4E-03	3.4E-04	4.5E-03	3.1E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.6E-03	1.6E-04	1.9E-03	1.3E-02	2.7E-03	1.1E-04	1.4E-03	9.9E-03
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.8E-02	4.1E-03	2.0E-02	8.0E-02	2.2E-02	2.5E-03	1.4E-02	6.4E-02
Cs-134	3.6E-03	4.0E-04	2.2E-03	1.1E-02	2.8E-03	2.3E-04	1.4E-03	1.0E-02
Cs-137	9.6E-06	8.6E-07	5.8E-06	3.2E-05	7.4E-06	5.3E-07	3.8E-06	2.5E-05

Table F.25 Dose factors[a] for FE-SLAG-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.3E-03	2.9E-04	1.5E-03	6.7E-03	1.8E-03	1.8E-04	1.1E-03	6.1E-03
Ce-144	1.4E-03	2.2E-04	1.0E-03	3.9E-03	1.1E-03	1.3E-04	7.3E-04	3.0E-03
Pm-147	4.1E-05	6.1E-06	2.7E-05	1.2E-04	3.2E-05	3.9E-06	2.0E-05	1.0E-04
Eu-152	1.0E-01	1.5E-02	6.9E-02	3.1E-01	7.9E-02	8.6E-03	4.7E-02	2.4E-01
Eu-154	1.1E-01	1.6E-02	7.8E-02	3.3E-01	8.8E-02	9.2E-03	5.6E-02	2.8E-01
Eu-155	2.7E-03	3.5E-04	1.8E-03	8.0E-03	2.1E-03	2.1E-04	1.3E-03	6.1E-03
Re-186	1.3E-07	6.0E-10	1.9E-08	6.4E-07	1.0E-07	3.7E-10	1.4E-08	5.1E-07
Ir-192	1.0E-03	9.1E-05	6.3E-04	3.5E-03	8.0E-04	5.0E-05	4.7E-04	2.6E-03
Pb-210	1.1E-03	9.3E-05	6.5E-04	3.7E-03	8.5E-04	5.7E-05	4.3E-04	2.9E-03
Po-210	4.4E-04	4.9E-05	2.7E-04	1.4E-03	3.3E-04	2.8E-05	1.9E-04	1.0E-03
Bi-210	5.1E-07	5.7E-09	1.2E-07	1.8E-06	4.0E-07	3.0E-09	8.9E-08	1.7E-06
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	2.6E-03	2.8E-04	1.6E-03	8.8E-03	2.0E-03	1.7E-04	1.1E-03	6.9E-03
Ra-224	2.8E-05	1.2E-07	4.8E-06	1.2E-04	2.2E-05	7.6E-08	3.2E-06	1.0E-04
Ac-225	9.8E-04	6.4E-05	4.5E-04	3.4E-03	7.4E-04	4.1E-05	3.2E-04	2.8E-03
Ra-225	1.9E-03	2.1E-04	1.2E-03	6.6E-03	1.5E-03	1.2E-04	8.3E-04	4.3E-03
Ra-226	1.8E-01	2.8E-02	1.2E-01	5.3E-01	1.4E-01	1.7E-02	8.3E-02	4.2E-01
Ac-227	1.2E+00	1.6E-01	8.2E-01	3.7E+00	9.3E-01	1.0E-01	5.7E-01	3.0E+00
Th-227	6.3E-03	6.5E-04	4.2E-03	1.8E-02	4.8E-03	4.0E-04	3.1E-03	1.5E-02
Th-228	4.4E-01	6.7E-02	3.0E-01	1.4E+00	3.3E-01	4.9E-02	2.0E-01	1.1E+00
Ra-228	1.1E-01	1.5E-02	7.4E-02	3.2E-01	8.2E-02	9.5E-03	5.4E-02	2.6E-01
Th-229	1.5E+00	2.1E-01	9.9E-01	4.5E+00	1.1E+00	1.4E-01	7.1E-01	3.5E+00
Th-230	2.3E-01	2.8E-02	1.5E-01	7.0E-01	1.8E-01	1.8E-02	1.1E-01	6.2E-01
Pa-231	8.0E-01	1.1E-01	5.5E-01	2.4E+00	6.0E-01	6.7E-02	4.0E-01	1.9E+00
Th-231	1.4E-10	5.2E-19	2.2E-14	7.3E-10	1.1E-10	3.0E-19	1.9E-14	6.0E-10
Th-232	1.0E+00	1.4E-01	6.3E-01	3.1E+00	7.5E-01	9.9E-02	4.5E-01	2.4E+00
Pa-233	6.1E-03	7.2E-04	4.1E-03	1.9E-02	4.6E-03	4.6E-04	2.9E-03	1.4E-02
U-233	1.2E-01	1.3E-02	7.5E-02	3.6E-01	9.1E-02	8.4E-03	5.4E-02	2.9E-01
Th-234	1.8E-04	2.4E-05	1.2E-04	5.4E-04	1.4E-04	1.6E-05	8.0E-05	4.7E-04
U-234	1.2E-01	1.3E-02	8.1E-02	3.8E-01	9.1E-02	8.2E-03	5.2E-02	3.0E-01
U-235	1.2E-01	1.6E-02	7.9E-02	3.7E-01	9.0E-02	1.1E-02	5.4E-02	3.1E-01
Np-237	5.2E-01	6.6E-02	3.4E-01	1.6E+00	3.8E-01	4.0E-02	2.4E-01	1.2E+00
Pu-238	2.6E-01	3.1E-02	1.6E-01	8.4E-01	1.9E-01	2.0E-02	1.1E-01	6.2E-01
U-238	1.1E-01	1.2E-02	6.8E-02	3.3E-01	8.0E-02	8.5E-03	4.7E-02	2.8E-01
Pu-239	2.8E-01	3.3E-02	1.7E-01	8.9E-01	2.1E-01	2.3E-02	1.1E-01	6.5E-01
Pu-240	2.7E-01	3.2E-02	1.7E-01	8.1E-01	2.1E-01	2.1E-02	1.2E-01	6.5E-01
Pu-241	4.4E-03	4.9E-04	2.6E-03	1.3E-02	3.3E-03	3.2E-04	2.0E-03	1.0E-02
Am-241	4.1E-01	5.2E-02	2.7E-01	1.3E+00	3.1E-01	3.3E-02	1.9E-01	9.8E-01
Cm-242	1.4E-02	1.6E-03	8.1E-03	4.2E-02	1.0E-02	1.1E-03	6.1E-03	3.2E-02
Pu-242	2.6E-01	2.6E-02	1.8E-01	8.1E-01	2.0E-01	1.6E-02	1.3E-01	6.3E-01
Cm-244	2.2E-01	2.8E-02	1.5E-01	6.6E-01	1.7E-01	1.8E-02	1.1E-01	5.4E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.26 Dose factors[a] for FE-SCRP-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.8E-06	6.5E-07	1.6E-06	3.4E-06	1.3E-06	3.7E-07	1.1E-06	3.2E-06
Na-22	1,8E+00	6.5E-01	1.6E+00	3.5E+00	1.3E+00	3.8E-01	1.1E+00	3.2E+00
P-32	9.2E-04	3.3E-04	8.2E-04	1.9E-03	7.0E-04	2.0E-04	5.4E-04	1.7E-03
S-35	1.8E-06	6.6E-07	1.6E-06	3.5E-06	1.4E-06	3.9E-07	1.1E-06	3.2E-06
Cl-36	3.1E-04	1.1E-04	2.8E-04	6.1E-04	2.4E-04	6.6E-05	2.0E-04	5.7E-04
K-40	1.4E-01	5.0E-02	1.2E-01	2.6E-01	1.0E-01	2.9E-02	8.8E-02	2.5E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	7.8E-06	2.9E-06	7.0E-06	1.5E-05	5.9E-06	1.7E-06	5.0E-06	1.4E-05
Cr-51	1.7E-02	6.6E-03	1.6E-02	3.5E-02	1.3E-02	3.7E-03	1.1E-02	3.2E-02
Mn-54	6.6E-01	2.4E-01	5.9E-01	1.3E+00	5.0E-01	1.4E-01	4.2E-01	1.2E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	6.4E-02	2.3E-02	5.7E-02	1.3E-01	4.8E-02	1.4E-02	4.1E-02	1.2E-01
Co-58	7.0E-01	2.6E-01	6.2E-01	1.4E+00	5.3E-01	1.5E-01	4.4E-01	1.3E+00
Fe-59	8.4E-01	3.2E-01	7.5E-01	1.7E+00	6.4E-01	1.8E-01	5.2E-01	1.5E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.1E+00	7.8E-01	1.9E+00	4.1E+00	1.6E+00	4.5E-01	1.4E+00	3.8E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	4.7E-01	1.7E-01	4.2E-01	9.2E-01	3.6E-01	1.0E-01	3.0E-01	8.5E-01
Cu-67	5.1E-03	6.5E-04	3.0E-03	1.7E-02	3.9E-03	4.3E-04	2.1E-03	1.3E-02
Se-75	2.4E-01	9.0E-02	2.2E-01	4.8E-01	1.8E-01	5.3E-02	1.5E-01	4.4E-01
Sr-85	3.5E-01	1.3E-01	3.1E-01	6.8E-01	2.6E-01	7.4E-02	2.2E-01	6.2E-01
Sr-89	1.0E-03	3.8E-04	9.1E-04	2.0E-03	7.8E-04	2.2E-04	6.4E-04	1.8E-03
Sr-90	9.2E-05	3.4E-05	8.3E-05	1.8E-04	7.0E-05	2.0E-05	5.9E-05	1.7E-04
Y-91	3.7E-03	1.4E-03	3.3E-03	7.3E-03	2.8E-03	8.0E-04	2.3E-03	6.7E-03
Mo-93	7.7E-05	2.8E-05	7.0E-05	1.5E-04	5.9E-05	1.6E-05	5.0E-05	1.4E-04
Nb-93m	1.4E-05	5.0E-06	1.2E-05	2.6E-05	1.0E-05	2.9E-06	8.7E-06	2.5E-05
Nb-94	1.3E+00	4.6E-01	1.1E+00	2.5E+00	9.6E-01	2.7E-01	8.1E-01	2.3E+00
Nb-95	4.9E-01	1.9E-01	4.4E-01	9.8E-01	3.8E-01	1.1E-01	3.0E-01	8.9E-01
Zr-95	5.3E-01	1.9E-01	4.7E-01	1.0E+00	4.0E-01	1.1E-01	3.3E-01	9.4E-01
Tc-99	1.6E-05	6.0E-06	1.5E-05	3.2E-05	1.2E-05	3.5E-06	1.1E-05	3.0E-05
Ru-103	3.0E-01	1.1E-01	2.7E-01	5.9E-01	2.3E-01	6.4E-02	1.8E-01	5.3E-01
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	1.3E+00	4.6E-01	1.1E+00	2.5E+00	9.6E-01	2.7E-01	8.1E-01	2.3E+00
Cd-109	1.9E-03	7.0E-04	1.7E-03	3.7E-03	1.4E-03	4.0E-04	1.2E-03	3.4E-03
Ag-110m	2.2E+00	8.0E-01	2.0E+00	4.3E+00	1.7E+00	4.7E-01	1.4E+00	3.9E+00
Sb-124	1.3E+00	5.0E-01	1.2E+00	2.6E+00	1.0E+00	2.9E-01	8.4E-01	2.4E+00
I-125	1.9E-03	7.1E-04	1.7E-03	3.7E-03	1.4E-03	4.1E-04	1.2E-03	3.4E-03
Sb-125	3.2E-01	1.2E-01	2.9E-01	6.2E-01	2.4E-01	6.8E-02	2.0E-01	5.7E-01
I-129	1.7E-03	6.2E-04	1.5E-03	3.3E-03	1.3E-03	3.6E-04	1.1E-03	3.1E-03
I-131	1.1E-01	3.9E-02	9.7E-02	2.5E-01	8.7E-02	2.3E-02	6.5E-02	2.3E-01
Ba-133	2.6E-01	9.5E-02	2.3E-01	5.0E-01	2.0E-01	5.5E-02	1.7E-01	4.7E-01
Cs-134	1.2E+00	4.5E-01	1.1E+00	2.4E+00	9.3E-01	2.6E-01	7.9E-01	2.2E+00
Cs-137	9.8E-05	3.6E-05	8.9E-05	1.9E-04	7.4E-05	2.1E-05	6.3E-05	1.8E-04

Table F.26 Dose factors[a] for FE-SCRP-DISPOSL-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.3E-02	1.3E-02	2.9E-02	6.6E-02	2.5E-02	7.0E-03	2.0E-02	6.0E-02
Ce-144	9.1E-03	3.4E-03	8.2E-03	1.8E-02	6.9E-03	2.0E-03	5.8E-03	1.7E-02
Pm-147	6.5E-06	2.4E-06	5.9E-06	1.3E-05	4.9E-06	1.4E-06	4.2E-06	1.2E-05
Eu-152	9.2E-01	3.4E-01	8.3E-01	1.8E+00	6.9E-01	1.9E-01	5.9E-01	1.7E+00
Eu-154	1.0E+00	3.7E-01	9.1E-01	2.0E+00	7.6E-01	2.1E-01	6.4E-01	1.8E+00
Eu-155	2.4E-02	8.7E-03	2.1E-02	4.6E-02	1.8E-02	5.0E-03	1.5E-02	4.3E-02
Re-186	1.6E-03	3.4E-04	1.2E-03	4.6E-03	1.2E-03	2.1E-04	8.0E-04	3.5E-03
Ir-192	5.4E-01	2.0E-01	4.9E-01	1.1E+00	4.1E-01	1.2E-01	3.4E-01	9.7E-01
Pb-210	8.0E-04	2.9E-04	7.2E-04	1.6E-03	6.1E-04	1.7E-04	5.1E-04	1.4E-03
Po-210	6.5E-06	2.4E-06	5.8E-06	1.3E-05	4.9E-06	1.4E-06	4.1E-06	1.2E-05
Bi-210	1.1E-04	3.1E-05	9.1E-05	2.9E-04	8.6E-05	1.9E-05	6.1E-05	2.4E-04
Rn-222	4.9E-05	1.1E-05	3.6E-05	1.4E-04	3.8E-05	6.6E-06	2.5E-05	1.1E-04
Ra-223	4.1E-02	1.5E-02	3.7E-02	8.5E-02	3.1E-02	9.0E-03	2.4E-02	7.7E-02
Ra-224	9.9E-04	2.1E-04	7.2E-04	2.9E-03	7.6E-04	1.3E-04	4.9E-04	2.2E-03
Ac-225	4.0E-03	1.4E-03	3.5E-03	8.4E-03	3.0E-03	8.4E-04	2.3E-03	7.6E-03
Ra-225	8.7E-04	3.2E-04	7.8E-04	1.8E-03	6.6E-04	1.9E-04	5.2E-04	1.6E-03
Ra-226	1.5E+00	5.4E-01	1.3E+00	2.8E+00	1.1E+00	3.1E-01	9.4E-01	2.6E+00
Ac-227	9.2E-02	3.4E-02	8.3E-02	1.8E-01	7.0E-02	2.0E-02	5.9E-02	1.7E-01
Th-227	4.6E-02	1.7E-02	4.1E-02	9.0E-02	3.5E-02	1.0E-02	2.8E-02	8.3E-02
Th-228	1.3E+00	4.7E-01	1.2E+00	2.5E+00	9.8E-01	2.8E-01	8.3E-01	2.3E+00
Ra-228	7.8E-01	2.9E-01	7.0E-01	1.5E+00	5.9E-01	1.7E-01	5.0E-01	1.4E+00
Th-229	9.2E-02	3.4E-02	8.4E-02	1.8E-01	7.0E-02	2.0E-02	5.9E-02	1.7E-01
Th-230	1.6E-04	5.8E-05	1.4E-04	3.1E-04	1.2E-04	3.4E-05	1.0E-04	2.9E-04
Pa-231	2.5E-02	9.1E-03	2.3E-02	4.8E-02	1.9E-02	5.3E-03	1.6E-02	4.5E-02
Th-231	1.8E-05	1.1E-07	3.0E-06	9.8E-05	1.4E-05	6.8E-08	2.2E-06	6.9E-05
Th-232	5.6E-03	2.0E-03	5.0E-03	1.1E-02	4.2E-03	1.2E-03	3.6E-03	1.0E-02
Pa-233	1.0E-01	3.8E-02	9.1E-02	2.0E-01	7.7E-02	2.1E-02	6.3E-02	1.9E-01
U-233	1.8E-04	6.7E-05	1.7E-04	3.6E-04	1.4E-04	3.9E-05	1.2E-04	3.3E-04
Th-234	2.3E-03	8.6E-04	2.1E-03	4.6E-03	1.8E-03	5.0E-04	1.4E-03	4.2E-03
U-234	5.3E-05	1.9E-05	4.7E-05	1.0E-04	4.0E-05	1.1E-05	3.4E-05	9.5E-05
U-235	9.4E-02	3.5E-02	8.5E-02	1.8E-01	7.2E-02	2.0E-02	6.1E-02	1.7E-01
Np-237	6.4E-02	2.3E-02	5.7E-02	1.2E-01	4.8E-02	1.3E-02	4.1E-02	1.1E-01
Pu-238	2.0E-05	7.3E-06	1.8E-05	3.9E-05	1.5E-05	4.2E-06	1.3E-05	3.6E-05
U-238	6.0E-03	2.2E-03	5.4E-03	1.2E-02	4.5E-03	1.3E-03	3.8E-03	1.1E-02
Pu-239	3.9E-05	1.4E-05	3.5E-05	7.5E-05	2.9E-05	8.2E-06	2.5E-05	7.0E-05
Pu-240	1.9E-05	7.0E-06	1.7E-05	3.7E-05	1.5E-05	4.1E-06	1.2E-05	3.5E-05
Pu-241	1.3E-06	4.9E-07	1.2E-06	2.6E-06	1.0E-06	2.9E-07	8.6E-07	2.4E-06
Am-241	5.7E-03	2.1E-03	5.2E-03	1.1E-02	4.3E-03	1.2E-03	3.7E-03	1.0E-02
Cm-242	2.1E-05	7.9E-06	1.9E-05	4.2E-05	1.6E-05	4.6E-06	1.4E-05	3.9E-05
Pu-242	1.7E-05	6.1E-06	1.5E-05	3.3E-05	1.3E-05	3.6E-06	1.1E-05	3.0E-05
Cm-244	1.6E-05	6.0E-06	1.5E-05	3.2E-05	1.2E-05	3.5E-06	1.1E-05	3.0E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table F.27 Dose factors[a] for FE-EAFD-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.8E-10	1.8E-11	1.1E-10	5.8E-10	1.4E-10	1.2E-11	6.8E-11	4.8E-10
Na-22	3.4E-03	4.5E-04	2.2E-03	9.7E-03	2.5E-03	3.0E-04	1.6E-03	7.9E-03
P-32	6.8E-07	4.0E-08	3.1E-07	2.4E-06	4.8E-07	2.7E-08	2.4E-07	1.9E-06
S-35	7.4E-09	4.6E-10	4.4E-09	2.6E-08	5.6E-09	3.2E-10	3.0E-09	1.9E-08
Cl-36	4.4E-07	3.8E-08	2.8E-07	1.4E-06	3.2E-07	2.5E-08	1.9E-07	1.1E-06
K-40	3.9E-04	5.0E-05	2.5E-04	1.2E-03	2.9E-04	3.2E-05	1.8E-04	9.7E-04
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.2E-09	8.2E-11	6.2E-10	4.0E-09	8.7E-10	5.1E-11	4.7E-10	2.8E-09
Cr-51	3.2E-07	2.8E-08	1.8E-07	1.1E-06	2.4E-07	1.7E-08	1.4E-07	7.8E-07
Mn-54	4.7E-05	3.4E-06	2.7E-05	1.5E-04	3.5E-05	2.3E-06	1.8E-05	1.1E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.8E-06	1.5E-07	1.2E-06	5.8E-06	1.4E-06	1.1E-07	7.7E-07	4.6E-06
Co-58	2.5E-05	2.4E-06	1.5E-05	8.0E-05	1.9E-05	1.4E-06	1.1E-05	7.0E-05
Fe-59	2.2E-05	2.1E-06	1.4E-05	7.2E-05	1.6E-05	1.4E-06	1.0E-05	5.5E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	8.7E-05	7.1E-06	5.0E-05	2.9E-04	6.5E-05	4.8E-06	3.5E-05	2.3E-04
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.6E-03	2.1E-04	1.1E-03	5.1E-03	1.2E-03	1.4E-04	7.7E-04	3.5E-03
Cu-67	2.1E-09	8.9E-13	1.1E-10	1.2E-08	1.5E-09	6.7E-13	7.2E-11	7.5E-09
Se-75	3.9E-04	1.4E-05	2.0E-04	1.4E-03	3.0E-04	9.9E-06	1.5E-04	1.0E-03
Sr-85	2.6E-05	1.9E-06	1.5E-05	8.5E-05	1.8E-05	1.2E-06	1.0E-05	6.3E-05
Sr-89	6.5E-08	4.4E-09	3.8E-08	2.1E-07	4.8E-08	2.8E-09	2.8E-08	1.5E-07
Sr-90	1.1E-08	8.8E-10	6.6E-09	3.5E-08	8.2E-09	5.8E-10	4.6E-09	2.6E-08
Y-91	1.6E-07	1.3E-08	8.4E-08	5.5E-07	1.2E-07	8.2E-09	5.9E-08	4.5E-07
Mo-93	6.0E-09	5.9E-10	3.7E-09	1.9E-08	4.5E-09	3.0E-10	2.7E-09	1.6E-08
Nb-93m	1.9E-09	1.5E-10	1.2E-09	6.3E-09	1.4E-09	1.1E-10	8.1E-10	5.1E-09
Nb-94	1.1E-04	1.0E-05	6.5E-05	3.5E-04	8.2E-05	6.6E-06	4.5E-05	2.7E-04
Nb-95	2.7E-05	2.4E-06	1.6E-05	9.6E-05	2.0E-05	1.6E-06	1.0E-05	7.0E-05
Zr-95	3.7E-05	2.6E-06	2.1E-05	1.1E-04	2.8E-05	1.7E-06	1.4E-05	9.6E-05
Tc-99	1.2E-09	1.2E-10	7.7E-10	4.0E-09	9.2E-10	6.9E-11	5.2E-10	3.3E-09
Ru-103	9.9E-06	9.1E-07	6.2E-06	3.2E-05	7.3E-06	5.1E-07	4.2E-06	2.7E-05
Ru-106	7.0E-06	6.0E-07	4.3E-06	2.2E-05	5.2E-06	3.8E-07	3.1E-06	1.7E-05
Ag-108m	6.1E-05	5.3E-06	3.3E-05	2.1E-04	4.5E-05	3.5E-06	2.4E-05	1.6E-04
Cd-109	1.6E-06	2.1E-07	1.1E-06	4.7E-06	1.2E-06	1.3E-07	7.5E-07	3.9E-06
Ag-110m	9.1E-05	7.4E-06	5.4E-05	2.9E-04	6.7E-05	5.0E-06	3.8E-05	2.2E-04
Sb-124	1.4E-05	5.0E-07	6.3E-06	5.3E-05	1.1E-05	2.8E-07	4.5E-06	3.8E-05
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	5.1E-06	1.6E-07	2.5E-06	1.8E-05	4.0E-06	1.0E-07	1.7E-06	1.5E-05
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.5E-05	1.8E-06	1.4E-05	8.5E-05	1.8E-05	1.4E-06	1.0E-05	6.1E-05
Cs-134	5.4E-03	7.7E-04	3.6E-03	1.6E-02	4.1E-03	4.8E-04	2.5E-03	1.2E-02
Cs-137	2.2E-03	2.9E-04	1.5E-03	7.1E-03	1.7E-03	1.8E-04	1.0E-03	5.3E-03

Table F.27 Dose factors[a] for FE-EAFD-DISPOSL-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.4E-06	9.9E-08	8.5E-07	5.0E-06	1.1E-06	6.2E-08	5.9E-07	3.8E-06
Ce-144	2.3E-06	1.8E-07	1.3E-06	8.1E-06	1.7E-06	1.2E-07	9.1E-07	5.7E-06
Pm-147	1.2E-10	1.1E-11	7.0E-11	4.1E-10	8.9E-11	7.1E-12	4.6E-11	3.1E-10
Eu-152	7.6E-05	5.4E-06	4.0E-05	2.7E-04	5.7E-05	3.7E-06	3.2E-05	1.8E-04
Eu-154	8.5E-05	6.1E-06	4.8E-05	2.9E-04	6.4E-05	4.2E-06	3.3E-05	2.3E-04
Eu-155	1.2E-06	8.4E-08	6.8E-07	4.5E-06	9.3E-07	5.0E-08	4.5E-07	3.1E-06
Re-186	7.1E-08	2.2E-10	1.0E-08	3.3E-07	4.8E-08	1.4E-10	6.8E-09	2.5E-07
Ir-192	1.1E-03	5.1E-05	5.8E-04	3.9E-03	7.8E-04	2.8E-05	3.9E-04	3.0E-03
Pb-210	1.1E-06	1.5E-07	7.5E-07	3.4E-06	8.2E-07	1.0E-07	5.1E-07	2.7E-06
Po-210	2.5E-08	3.1E-09	1.7E-08	7.3E-08	1.8E-08	1.9E-09	1.3E-08	5.2E-08
Bi-210	2.7E-08	4.1E-10	7.7E-09	1.2E-07	1.8E-08	2.7E-10	5.6E-09	8.2E-08
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	2.4E-06	1.2E-07	1.2E-06	8.4E-06	1.8E-06	9.0E-08	7.8E-07	6.1E-06
Ra-224	3.7E-07	1.4E-09	5.1E-08	1.9E-06	2.4E-07	8.3E-10	3.3E-08	1.1E-06
Ac-225	1.5E-06	6.4E-08	6.4E-07	5.9E-06	1.1E-06	3.4E-08	5.0E-07	3.9E-06
Ra-225	1.3E-08	6.6E-10	7.0E-09	4.3E-08	9.7E-09	4.5E-10	4.9E-09	3.5E-08
Ra-226	1.1E-04	7.8E-06	6.6E-05	3.7E-04	8.2E-05	5.9E-06	4.8E-05	2.7E-04
Ac-227	8.4E-06	7.0E-07	4.8E-06	2.7E-05	6.3E-06	4.2E-07	3.2E-06	2.4E-05
Th-227	1.7E-06	1.1E-07	9.2E-07	5.9E-06	1.3E-06	6.6E-08	6.4E-07	4.9E-06
Th-228	8.0E-05	5.9E-06	4.8E-05	2.8E-04	6.1E-05	3.3E-06	3.5E-05	2.2E-04
Ra-228	5.6E-05	4.0E-06	3.4E-05	1.8E-04	4.2E-05	2.6E-06	2.5E-05	1.5E-04
Th-229	6.5E-06	4.6E-07	3.7E-06	2.2E-05	4.9E-06	3.0E-07	2.4E-06	1.8E-05
Th-230	3.7E-09	2.9E-10	2.2E-09	1.2E-08	2.8E-09	1.8E-10	1.6E-09	1.0E-08
Pa-231	1.8E-06	1.3E-07	1.2E-06	5.8E-06	1.3E-06	8.8E-08	7.7E-07	4.4E-06
Th-231	5.9E-14	2.0E-22	5.9E-18	2.5E-13	3.5E-14	1.4E-22	5.2E-18	1.7E-13
Th-232	4.0E-07	3.3E-08	2.5E-07	1.2E-06	2.9E-07	1.9E-08	1.7E-07	9.8E-07
Pa-233	5.5E-06	4.2E-07	3.0E-06	1.7E-05	4.2E-06	2.6E-07	2.2E-06	1.3E-05
U-233	9.1E-10	8.4E-11	5.2E-10	3.2E-09	6.9E-10	4.7E-11	3.7E-10	2.5E-09
Th-234	2.5E-07	1.9E-08	1.4E-07	8.6E-07	1.8E-07	1.1E-08	9.7E-08	6.2E-07
U-234	1.6E-09	1.6E-10	9.2E-10	5.0E-09	1.2E-09	1.0E-10	6.2E-10	4.4E-09
U-235	7.5E-06	7.0E-07	4.1E-06	2.5E-05	5.7E-06	4.5E-07	2.8E-06	1.9E-05
Np-237	6.0E-06	4.6E-07	3.2E-06	2.1E-05	4.6E-06	2.8E-07	2.2E-06	1.8E-05
Pu-238	1.8E-09	1.2E-10	1.1E-09	6.1E-09	1.4E-09	8.3E-11	7.9E-10	5.2E-09
U-238	2.7E-07	2.5E-08	1.5E-07	1.0E-06	2.0E-07	1.7E-08	1.0E-07	6.4E-07
Pu-239	7.3E-10	4.9E-11	3.9E-10	2.4E-09	5.5E-10	3.3E-11	3.0E-10	1.9E-09
Pu-240	1.9E-09	1.3E-10	1.2E-09	5.8E-09	1.5E-09	8.5E-11	8.3E-10	5.3E-09
Pu-241	6.1E-11	4.2E-12	3.6E-11	2.0E-10	4.4E-11	2.9E-12	2.4E-11	1.6E-10
Am-241	1.8E-07	1.3E-08	9.3E-08	6.3E-07	1.3E-07	9.0E-09	7.3E-08	4.7E-07
Cm-242	2.4E-09	2.0E-10	1.5E-09	8.1E-09	1.9E-09	1.3E-10	9.7E-10	6.9E-09
Pu-242	1.6E-09	1.2E-10	9.0E-10	5.6E-09	1.2E-09	7.5E-11	6.6E-10	4.0E-09
Cm-244	2.5E-09	2.3E-10	1.5E-09	8.0E-09	1.8E-09	1.4E-10	1.0E-09	5.7E-09

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

APPENDIX G

DOSE FACTORS FOR COPPER RECYCLE SCENARIOS

CONTENTS

Tables

G DOSE FACTORS FOR COPPER RECYCLE SCENARIOS

This appendix presents tabulated values from the distribution of radionuclide-specific dose factors for all copper recycle exposure scenarios. Volumetric (mass) dose factors are based on volumetrically distributed residual radioactivity in cleared material. Surficial dose factors are calculated by multiplying the mass dose factors by a surface-to-mass ratio distribution appropriate for cleared copper. Both sets of dose factors are listed in SI units; the conversion factor to convert the dose factors to conventional units is listed in the footnote at the end of each table.

The tabulated values from the frequency distribution of each dose factor consists of the mean (arithmetic average) and three percentile values (5^{th}, 50^{th}, and 95^{th}). A 90% confidence interval for any dose factor is the range between the 5^{th} percentile value and the 95^{th} percentile value.

The shading in the tables in this appendix is only to facilitate reading the values in the tables.

Table G.1 Dose factors[a] for CU-SCRP-HANDLIN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	1.4E-05	4.6E-06	1.3E-05	2.7E-05	1.2E-05	3.3E-06	1.0E-05	2.5E-05
C-14	3.2E-04	5.8E-05	2.8E-04	7.9E-04	2.8E-04	4.1E-05	2.3E-04	6.6E-04
Na-22	3.8E+00	9.7E-01	3.2E+00	8.6E+00	3.3E+00	7.8E-01	2.7E+00	7.3E+00
P-32	3.5E-03	1.5E-03	3.3E-03	6.4E-03	3.0E-03	1.0E-03	2.8E-03	6.2E-03
S-35	2.3E-04	8.4E-05	2.1E-04	4.2E-04	2.0E-04	6.1E-05	1.7E-04	4.1E-04
Cl-36	2.4E-03	1.1E-03	2.3E-03	4.1E-03	2.1E-03	7.6E-04	1.9E-03	4.2E-03
K-40	3.0E-01	7.7E-02	2.5E-01	6.7E-01	2.6E-01	6.3E-02	2.2E-01	5.7E-01
Ca-41	2.8E-04	9.3E-05	2.6E-04	5.5E-04	2.4E-04	6.8E-05	2.1E-04	4.9E-04
Ca-45	9.2E-04	3.5E-04	8.7E-04	1.6E-03	7.8E-04	2.4E-04	7.1E-04	1.6E-03
Cr-51	3.9E-02	9.5E-03	3.2E-02	8.6E-02	3.3E-02	7.6E-03	2.7E-02	7.3E-02
Mn-54	1.5E+00	3.7E-01	1.2E+00	3.3E+00	1.3E+00	3.0E-01	1.1E+00	2.8E+00
Fe-55	1.8E-04	6.4E-05	1.7E-04	3.2E-04	1.5E-04	4.7E-05	1.4E-04	3.2E-04
Co-57	5.2E-02	1.3E-02	4.3E-02	1.2E-01	4.4E-02	1.1E-02	3.7E-02	9.8E-02
Co-58	1.7E+00	4.1E-01	1.4E+00	3.7E+00	1.4E+00	3.3E-01	1.2E+00	3.2E+00
Fe-59	2.1E+00	5.2E-01	1.8E+00	4.7E+00	1.8E+00	4.2E-01	1.5E+00	4.0E+00
Ni-59	9.1E-05	3.3E-05	8.4E-05	1.7E-04	7.8E-05	2.3E-05	6.9E-05	1.6E-04
Co-60	4.8E+00	1.2E+00	4.0E+00	1.1E+01	4.0E+00	9.7E-01	3.4E+00	9.0E+00
Ni-63	2.4E-04	8.7E-05	2.2E-04	4.3E-04	2.0E-04	6.0E-05	1.8E-04	4.2E-04
Zn-65	6.5E-01	1.7E-01	5.5E-01	1.5E+00	5.6E-01	1.3E-01	4.7E-01	1.2E+00
Cu-67	3.0E-02	6.7E-03	2.4E-02	7.6E-02	2.6E-02	5.0E-03	2.0E-02	6.6E-02
Se-75	3.9E-01	1.0E-01	3.3E-01	8.8E-01	3.4E-01	8.1E-02	2.8E-01	7.5E-01
Sr-85	8.4E-01	2.1E-01	7.0E-01	1.9E+00	7.1E-01	1.7E-01	6.0E-01	1.6E+00
Sr-89	5.8E-03	2.8E-03	5.6E-03	9.4E-03	4.9E-03	1.8E-03	4.6E-03	9.2E-03
Sr-90	1.1E-01	3.5E-02	9.7E-02	2.0E-01	9.1E-02	2.5E-02	7.8E-02	2.0E-01
Y-91	1.1E-02	4.9E-03	1.0E-02	1.9E-02	9.2E-03	3.3E-03	8.5E-03	1.7E-02
Mo-93	2.2E-03	6.8E-04	1.9E-03	4.3E-03	1.8E-03	5.0E-04	1.6E-03	4.0E-03
Nb-93m	2.0E-03	5.2E-04	1.8E-03	4.2E-03	1.7E-03	3.8E-04	1.4E-03	3.9E-03
Nb-94	2.9E+00	7.5E-01	2.4E+00	6.3E+00	2.4E+00	5.9E-01	2.1E+00	5.4E+00
Nb-95	1.2E+00	3.0E-01	1.0E+00	2.7E+00	1.0E+00	2.4E-01	8.7E-01	2.3E+00
Zr-95	1.2E+00	3.0E-01	1.0E+00	2.7E+00	1.0E+00	2.5E-01	8.6E-01	2.3E+00
Tc-99	8.1E-04	3.1E-04	7.4E-04	1.5E-03	6.9E-04	2.2E-04	6.1E-04	1.4E-03
Ru-103	7.4E-01	1.8E-01	6.2E-01	1.6E+00	6.3E-01	1.5E-01	5.2E-01	1.4E+00
Ru-106	3.8E-01	1.3E-01	3.3E-01	8.1E-01	3.3E-01	9.0E-02	2.8E-01	6.9E-01
Ag-108m	2.8E+00	7.2E-01	2.3E+00	6.2E+00	2.4E+00	5.8E-01	2.0E+00	5.3E+00
Cd-109	5.2E-03	2.0E-03	5.1E-03	9.1E-03	4.5E-03	1.5E-03	4.0E-03	9.0E-03
Ag-110m	4.9E+00	1.2E+00	4.1E+00	1.1E+01	4.1E+00	1.0E+00	3.5E+00	9.3E+00
Sb-124	3.2E+00	8.0E-01	2.7E+00	7.1E+00	2.7E+00	6.5E-01	2.3E+00	6.1E+00
I-125	8.4E-03	3.3E-03	7.7E-03	1.6E-02	7.2E-03	2.3E-03	6.3E-03	1.5E-02
Sb-125	6.5E-01	1.6E-01	5.4E-01	1.4E+00	5.5E-01	1.3E-01	4.7E-01	1.2E+00
I-129	5.4E-02	1.6E-02	4.8E-02	1.1E-01	4.6E-02	1.2E-02	3.9E-02	9.9E-02
I-131	3.9E-01	1.0E-01	3.2E-01	8.7E-01	3.3E-01	7.9E-02	2.7E-01	7.7E-01
Ba-133	4.3E-01	1.1E-01	3.6E-01	9.6E-01	3.7E-01	8.8E-02	3.1E-01	8.2E-01
Cs-134	2.7E+00	6.8E-01	2.2E+00	6.0E+00	2.3E+00	5.5E-01	1.9E+00	5.1E+00
Cs-137	1.1E+00	2.7E-01	8.8E-01	2.3E+00	8.9E-01	2.2E-01	7.5E-01	2.0E+00

Table G.1 Dose factors[a] for CU-SCRP-HANDLIN-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.7E-02	9.8E-03	3.1E-02	8.1E-02	3.1E-02	7.9E-03	2.6E-02	6.9E-02
Ce-144	9.3E-02	3.8E-02	8.5E-02	1.7E-01	7.9E-02	2.7E-02	7.2E-02	1.6E-01
Pm-147	2.7E-03	7.4E-04	2.4E-03	5.6E-03	2.3E-03	5.2E-04	1.9E-03	5.3E-03
Eu-152	1.9E+00	5.0E-01	1.6E+00	4.3E+00	1.6E+00	4.0E-01	1.4E+00	3.6E+00
Eu-154	2.2E+00	5.9E-01	1.9E+00	5.0E+00	1.9E+00	4.7E-01	1.6E+00	4.3E+00
Eu-155	1.5E-02	5.6E-03	1.3E-02	3.0E-02	1.3E-02	3.9E-03	1.1E-02	2.7E-02
Re-186	4.1E-03	1.2E-03	3.4E-03	9.3E-03	3.5E-03	8.8E-04	2.8E-03	8.3E-03
Ir-192	1.1E+00	2.7E-01	8.9E-01	2.4E+00	9.1E-01	2.2E-01	7.6E-01	2.0E+00
Pb-210	1.7E+00	6.1E-01	1.6E+00	3.1E+00	1.4E+00	4.5E-01	1.3E+00	3.0E+00
Po-210	8.3E-01	3.0E-01	7.6E-01	1.5E+00	7.1E-01	2.1E-01	6.3E-01	1.5E+00
Bi-210	8.4E-03	2.4E-03	7.5E-03	1.8E-02	7.2E-03	1.8E-03	6.2E-03	1.6E-02
Rn-222	1.6E+00	3.7E-01	1.3E+00	3.7E+00	1.3E+00	2.8E-01	1.1E+00	3.3E+00
Ra-223	7.6E-01	3.2E-01	7.2E-01	1.3E+00	6.5E-01	2.3E-01	6.0E-01	1.2E+00
Ra-224	1.1E+00	3.3E-01	8.8E-01	2.4E+00	9.0E-01	2.4E-01	7.3E-01	2.1E+00
Ac-225	6.4E-01	2.5E-01	5.9E-01	1.1E+00	5.5E-01	1.8E-01	5.0E-01	1.1E+00
Ra-225	4.7E-01	1.3E-01	4.2E-01	9.5E-01	4.0E-01	9.9E-02	3.4E-01	9.0E-01
Ra-226	3.9E+00	1.6E+00	3.5E+00	7.7E+00	3.3E+00	1.1E+00	3.0E+00	6.8E+00
Ac-227	8.6E+01	2.1E+01	7.7E+01	1.8E+02	7.4E+01	1.5E+01	6.2E+01	1.7E+02
Th-227	1.0E+00	3.0E-01	9.0E-01	2.1E+00	8.6E-01	2.1E-01	7.3E-01	1.9E+00
Th-228	2.4E+01	7.1E+00	2.1E+01	5.0E+01	2.1E+01	5.0E+00	1.7E+01	4.5E+01
Ra-228	2.5E+00	1.1E+00	2.3E+00	4.3E+00	2.1E+00	7.6E-01	2.0E+00	4.0E+00
Th-229	1.1E+02	2.6E+01	1.0E+02	2.4E+02	9.7E+01	1.9E+01	8.1E+01	2.2E+02
Th-230	1.7E+01	3.8E+00	1.5E+01	3.7E+01	1.5E+01	2.8E+00	1.2E+01	3.4E+01
Pa-231	5.7E+01	1.4E+01	5.1E+01	1.2E+02	4.9E+01	1.0E+01	4.1E+01	1.1E+02
Th-231	2.3E-04	3.2E-05	1.5E-04	7.0E-04	2.0E-04	2.5E-05	1.2E-04	6.3E-04
Th-232	7.5E+01	1.7E+01	6.7E+01	1.6E+02	6.4E+01	1.2E+01	5.4E+01	1.5E+02
Pa-233	2.3E-01	5.6E-02	1.9E-01	5.0E-01	1.9E-01	4.5E-02	1.6E-01	4.3E-01
U-233	8.8E+00	1.9E+00	7.9E+00	1.9E+01	7.5E+00	1.4E+00	6.3E+00	1.8E+01
Th-234	1.7E-02	7.1E-03	1.5E-02	3.3E-02	1.5E-02	4.9E-03	1.3E-02	3.0E-02
U-234	8.6E+00	1.9E+00	7.7E+00	1.9E+01	7.4E+00	1.4E+00	6.1E+00	1.7E+01
U-235	8.1E+00	1.9E+00	7.2E+00	1.7E+01	6.9E+00	1.4E+00	5.8E+00	1.6E+01
Np-237	3.6E+01	8.5E+00	3.2E+01	7.6E+01	3.1E+01	6.2E+00	2.6E+01	7.1E+01
Pu-238	1.9E+01	4.1E+00	1.7E+01	4.0E+01	1.6E+01	3.1E+00	1.3E+01	3.7E+01
U-238	7.7E+00	1.7E+00	6.9E+00	1.7E+01	6.6E+00	1.3E+00	5.5E+00	1.5E+01
Pu-239	2.0E+01	4.4E+00	1.8E+01	4.3E+01	1.7E+01	3.3E+00	1.4E+01	4.0E+01
Pu-240	2.0E+01	4.4E+00	1.8E+01	4.3E+01	1.7E+01	3.3E+00	1.4E+01	4.0E+01
Pu-241	3.2E-01	7.1E-02	2.9E-01	6.9E-01	2.8E-01	5.3E-02	2.3E-01	6.4E-01
Am-241	2.9E+01	6.9E+00	2.6E+01	6.2E+01	2.5E+01	5.0E+00	2.1E+01	5.8E+01
Cm-242	1.1E+00	2.6E-01	1.0E+00	2.4E+00	9.6E-01	1.9E-01	8.1E-01	2.2E+00
Pu-242	1.9E+01	4.2E+00	1.7E+01	4.1E+01	1.6E+01	3.1E+00	1.4E+01	3.8E+01
Cm-244	1.6E+01	3.8E+00	1.5E+01	3.5E+01	1.4E+01	2.8E+00	1.2E+01	3.3E+01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.2 Dose factors[a] for CU-REVD-BAGHOUS-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	2.9E-02	2.4E-03	1.9E-02	9.1E-02	2.5E-02	1.8E-03	1.6E-02	7.9E-02
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	1.9E-03	2.7E-04	1.4E-03	5.5E-03	1.7E-03	2.0E-04	1.1E-03	4.6E-03
K-40	2.2E-03	2.7E-04	1.5E-03	6.7E-03	1.9E-03	2.4E-04	1.2E-03	5.9E-03
Ca-41	1.2E-05	9.5E-07	7.3E-06	3.9E-05	1.0E-05	8.0E-07	6.0E-06	3.4E-05
Ca-45	2.7E-05	2.6E-06	1.7E-05	8.8E-05	2.3E-05	1.9E-06	1.3E-05	7.4E-05
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.4E-02	1.9E-03	1.6E-02	8.1E-02	2.1E-02	1.4E-03	1.3E-02	6.9E-02
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	2.2E-02	2.3E-03	1.4E-02	6.9E-02	1.9E-02	1.8E-03	1.2E-02	6.3E-02
Cs-137	8.5E-03	1.0E-03	5.4E-03	2.5E-02	7.3E-03	6.9E-04	4.6E-03	2.2E-02

Table G.2 Dose factors[a] for CU-REVD-BAGHOUS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.3 Dose factors[a] for CU-CNVD-BAGHOUS-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	1.5E-04	2.2E-05	9.7E-05	4.1E-04	1.2E-04	1.5E-05	7.9E-05	3.6E-04
Ca-45	3.7E-04	5.9E-05	2.5E-04	1.1E-03	3.1E-04	4.5E-05	2.1E-04	8.4E-04
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.9E-01	3.5E-02	2.5E-01	1.2E+00	3.4E-01	3.1E-02	2.2E-01	1.1E+00
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	2.0E+00	1.4E-01	1.4E+00	5.5E+00	1.7E+00	1.1E-01	1.1E+00	4.8E+00
Cs-137	6.0E-01	5.6E-02	3.7E-01	2.0E+00	5.2E-01	4.0E-02	3.1E-01	1.8E+00

Table G.3 Dose factors[a] for CU-CNVD-BAGHOUS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	2.3E-01	4.2E-02	1.7E-01	6.1E-01	1.9E-01	2.9E-02	1.3E-01	5.5E-01
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.4 Dose factors[a] for CU-REVM-HANDREF-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	5.0E-05	2.0E-06	2.4E-05	2.0E-04	3.8E-05	1.4E-06	1.7E-05	1.4E-04
Na-22	3.6E+00	1.7E-01	2.0E+00	1.2E+01	2.8E+00	1.2E-01	1.4E+00	1.0E+01
P-32	3.8E-03	1.8E-04	1.8E-03	1.5E-02	2.8E-03	1.0E-04	1.3E-03	1.1E-02
S-35	5.0E-04	2.1E-05	2.6E-04	1.9E-03	3.8E-04	1.4E-05	1.7E-04	1.5E-03
Cl-36	2.9E-03	2.2E-04	1.7E-03	9.5E-03	2.2E-03	1.5E-04	1.2E-03	7.7E-03
K-40	4.5E-01	3.7E-02	2.4E-01	1.5E+00	3.4E-01	2.1E-02	1.8E-01	1.1E+00
Ca-41	6.1E-05	2.6E-06	2.8E-05	2.4E-04	4.5E-05	1.7E-06	2.0E-05	1.8E-04
Ca-45	1.5E-04	4.3E-06	6.2E-05	5.7E-04	1.1E-04	3.2E-06	4.5E-05	4.5E-04
Cr-51	3.4E-04	1.7E-05	1.8E-04	1.3E-03	2.7E-04	9.8E-06	1.2E-04	1.0E-03
Mn-54	4.8E-02	2.3E-03	2.3E-02	1.8E-01	3.6E-02	1.4E-03	1.6E-02	1.3E-01
Fe-55	1.5E-05	6.4E-07	7.8E-06	5.2E-05	1.1E-05	4.7E-07	5.5E-06	3.6E-05
Co-57	2.2E-03	9.5E-05	1.1E-03	7.5E-03	1.7E-03	6.9E-05	7.8E-04	6.7E-03
Co-58	2.6E-02	1.2E-03	1.4E-02	1.0E-01	2.0E-02	8.2E-04	9.4E-03	7.1E-02
Fe-59	2.7E-02	1.1E-03	1.4E-02	8.4E-02	2.1E-02	7.6E-04	9.9E-03	6.9E-02
Ni-59	5.5E-06	2.8E-07	2.9E-06	2.1E-05	4.1E-06	1.9E-07	1.9E-06	1.6E-05
Co-60	9.3E-02	4.1E-03	4.6E-02	3.5E-01	7.4E-02	2.8E-03	3.1E-02	2.9E-01
Ni-63	1.6E-05	9.0E-07	8.4E-06	6.2E-05	1.2E-05	5.3E-07	5.5E-06	4.4E-05
Zn-65	1.2E+00	7.5E-02	5.9E-01	4.2E+00	9.0E-01	4.8E-02	4.1E-01	3.5E+00
Cu-67	6.9E-06	9.0E-09	5.3E-07	3.5E-05	5.7E-06	4.5E-09	4.0E-07	3.0E-05
Se-75	3.8E-01	1.2E-02	1.8E-01	1.6E+00	2.9E-01	8.0E-03	1.1E-01	1.2E+00
Sr-85	2.7E-02	1.1E-03	1.3E-02	9.6E-02	2.1E-02	6.6E-04	9.0E-03	7.8E-02
Sr-89	4.1E-04	2.6E-05	2.2E-04	1.5E-03	3.1E-04	1.6E-05	1.6E-04	1.1E-03
Sr-90	8.5E-03	4.0E-04	4.1E-03	3.0E-02	6.4E-03	3.1E-04	2.8E-03	2.7E-02
Y-91	5.4E-04	3.8E-05	3.1E-04	1.8E-03	1.8E-06	2.2E-05	2.1E-04	1.6E-03
Mo-93	9.9E-05	8.7E-06	6.0E-05	3.1E-04	4.1E-04	6.0E-06	4.1E-05	2.7E-04
Nb-93m	7.9E-05	5.2E-06	4.5E-05	2.9E-04	7.5E-05	3.3E-06	3.0E-05	2.1E-04
Nb-94	1.2E-01	4.8E-03	5.6E-02	4.1E-01	6.0E-05	3.0E-03	3.6E-02	3.3E-01
Nb-95	3.3E-02	1.2E-03	1.5E-02	1.3E-01	9.0E-02	8.7E-04	1.0E-02	1.0E-01
Zr-95	4.0E-02	1.7E-03	1.8E-02	1.6E-01	2.6E-02	1.0E-03	1.3E-02	1.1E-01
Tc-99	4.3E-05	2.6E-06	2.3E-05	1.7E-04	3.0E-02	1.5E-06	1.5E-05	1.2E-04
Ru-103	1.1E-02	5.7E-04	5.0E-03	4.1E-02	3.2E-05	3.7E-04	3.7E-03	3.6E-02
Ru-106	8.2E-03	4.6E-04	4.3E-03	2.9E-02	8.6E-03	3.3E-04	2.9E-03	2.2E-02
Ag-108m	5.9E-02	2.7E-03	3.1E-02	2.2E-01	6.3E-03	1.5E-03	2.1E-02	1.9E-01
Cd-109	4.5E-02	5.4E-03	2.8E-02	1.4E-01	4.5E-02	3.3E-03	1.9E-02	1.1E-01
Ag-110m	9.1E-02	4.6E-03	4.5E-02	3.2E-01	3.4E-02	3.1E-03	3.2E-02	2.7E-01
Sb-124	1.6E-02	2.8E-04	6.5E-03	6.2E-02	7.0E-02	1.9E-04	4.3E-03	4.6E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-02	0.0E+00	0.0E+00	0.0E+00
Sb-125	5.1E-03	9.2E-05	2.0E-03	1.8E-02	0.0E+00	6.6E-05	1.3E-03	1.5E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-03	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.2E-02	9.6E-04	1.1E-02	7.4E-02	0.0E+00	6.6E-04	7.2E-03	5.6E-02
Cs-134	5.5E+00	4.2E-01	3.0E+00	2.0E+01	1.7E-02	2.7E-01	2.2E+00	1.6E+01
Cs-137	2.2E+00	2.0E-01	1.1E+00	7.7E+00	4.3E+00	1.1E-01	8.3E-01	6.7E+00

Table G.4 Dose factors[a] for CU-REVM-HANDREF-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.0E-03	7.7E-05	9.2E-04	7.3E-03	1.7E+00	5.4E-05	6.6E-04	5.9E-03
Ce-144	4.4E-03	2.8E-04	2.2E-03	1.5E-02	1.5E-03	1.7E-04	1.6E-03	1.3E-02
Pm-147	9.3E-05	5.5E-06	4.8E-05	3.3E-04	3.3E-03	3.5E-06	3.5E-05	2.5E-04
Eu-152	7.9E-02	3.5E-03	3.8E-02	2.9E-01	6.8E-05	1.9E-03	2.8E-02	2.5E-01
Eu-154	8.4E-02	4.2E-03	4.3E-02	2.8E-01	6.3E-02	2.8E-03	3.1E-02	2.6E-01
Eu-155	2.3E-03	8.9E-05	1.1E-03	8.2E-03	6.5E-02	7.1E-05	7.7E-04	6.7E-03
Re-186	2.8E-04	2.0E-06	4.4E-05	1.3E-03	1.8E-03	1.2E-06	3.1E-05	1.0E-03
Ir-192	1.0E+00	2.7E-02	4.6E-01	4.0E+00	2.2E-04	1.6E-02	3.3E-01	3.0E+00
Pb-210	1.3E+01	7.8E-01	7.3E+00	4.8E+01	7.9E-01	5.0E-01	5.2E+00	3.6E+01
Po-210	4.4E+00	2.7E-01	2.4E+00	1.5E+01	9.9E+00	2.0E-01	1.7E+00	1.2E+01
Bi-210	7.6E-04	1.5E-05	2.5E-04	3.7E-03	3.3E+00	9.3E-06	1.7E-04	2.9E-03
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-04	0.0E+00	0.0E+00	0.0E+00
Ra-223	1.2E-02	5.8E-04	5.4E-03	5.2E-02	0.0E+00	3.5E-04	4.0E-03	3.9E-02
Ra-224	1.5E-03	1.1E-05	2.2E-04	6.9E-03	9.3E-03	7.1E-06	1.6E-04	5.3E-03
Ac-225	4.7E-03	2.3E-04	2.1E-03	1.7E-02	1.1E-03	1.3E-04	1.6E-03	1.4E-02
Ra-225	8.3E-03	4.0E-04	3.7E-03	3.1E-02	3.3E-03	2.7E-04	2.6E-03	2.4E-02
Ra-226	2.0E-01	1.3E-02	9.9E-02	6.9E-01	6.3E-03	8.7E-03	7.0E-02	5.3E-01
Ac-227	2.2E+00	1.4E-01	1.1E+00	8.3E+00	1.5E-01	9.2E-02	7.8E-01	6.8E+00
Th-227	9.5E-03	5.2E-04	4.8E-03	3.4E-02	1.7E+00	3.0E-04	3.6E-03	2.7E-02
Th-228	5.3E-01	3.0E-02	2.5E-01	1.8E+00	7.0E-03	1.9E-02	1.7E-01	1.6E+00
Ra-228	1.5E-01	9.1E-03	8.8E-02	5.4E-01	3.9E-01	6.3E-03	5.9E-02	4.0E-01
Th-229	2.2E+00	8.3E-02	1.1E+00	8.3E+00	1.2E-01	5.0E-02	7.7E-01	6.5E+00
Th-230	3.4E-01	1.3E-02	1.5E-01	1.4E+00	1.7E+00	8.9E-03	1.1E-01	8.9E-01
Pa-231	1.6E+00	8.6E-02	7.7E-01	5.2E+00	2.5E-01	5.4E-02	5.4E-01	4.3E+00
Th-231	2.1E-09	2.7E-16	1.6E-12	1.1E-08	1.1E+00	1.6E-16	1.2E-12	7.3E-09
Th-232	1.5E+00	5.9E-02	6.8E-01	5.7E+00	1.7E-09	3.7E-02	5.2E-01	4.5E+00
Pa-233	6.2E-03	2.5E-04	3.0E-03	2.2E-02	1.2E+00	1.7E-04	2.1E-03	1.9E-02
U-233	1.7E-01	4.3E-03	6.4E-02	5.9E-01	4.8E-03	3.1E-03	4.6E-02	4.7E-01
Th-234	7.0E-04	4.0E-05	3.5E-04	2.6E-03	1.3E-01	2.4E-05	2.6E-04	1.8E-03
U-234	1.6E-01	5.2E-03	6.4E-02	5.9E-01	5.2E-04	3.2E-03	4.7E-02	4.5E-01
U-235	1.6E-01	7.2E-03	6.6E-02	6.1E-01	1.2E-01	4.2E-03	4.6E-02	4.7E-01
Np-237	8.4E-01	3.8E-02	4.9E-01	2.5E+00	1.2E-01	2.8E-02	3.2E-01	1.9E+00
Pu-238	3.6E-01	8.5E-03	1.5E-01	1.4E+00	6.2E-01	6.4E-03	1.1E-01	1.1E+00
U-238	1.5E-01	3.3E-03	5.7E-02	6.1E-01	2.7E-01	2.5E-03	4.4E-02	4.2E-01
Pu-239	3.6E-01	1.4E-02	1.6E-01	1.4E+00	1.1E-01	7.8E-03	1.0E-01	1.1E+00
Pu-240	3.9E-01	1.2E-02	1.5E-01	1.4E+00	2.6E-01	8.4E-03	1.1E-01	1.2E+00
Pu-241	5.6E-03	1.8E-04	2.5E-03	2.1E-02	2.9E-01	9.8E-05	1.9E-03	1.8E-02
Am-241	6.6E-01	4.1E-02	3.8E-01	2.1E+00	4.3E-03	2.7E-02	2.6E-01	1.7E+00
Cm-242	2.2E-02	1.2E-03	1.2E-02	7.8E-02	5.2E-01	7.9E-04	7.8E-03	6.9E-02
Pu-242	3.7E-01	1.1E-02	1.5E-01	1.5E+00	1.7E-02	7.9E-03	1.0E-01	1.1E+00
Cm-244	3.7E-01	2.4E-02	1.9E-01	1.4E+00	2.7E-01	1.5E-02	1.8E-01	1.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.5 Dose factors[a] for CU-CNVM-HANDREF-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	2.7E-09	4.1E-11	1.1E-09	1.1E-08	2.4E-09	3.6E-11	9.1E-10	9.6E-09
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	4.4E-06	7.6E-08	1.8E-06	1.7E-05	3.8E-06	6.5E-08	1.5E-06	1.5E-05
S-35	1.7E-06	3.7E-08	8.7E-07	6.2E-06	1.4E-06	3.2E-08	7.4E-07	5.1E-06
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	9.4E-05	2.2E-05	7.0E-05	2.4E-04	7.9E-05	1.7E-05	5.7E-05	2.2E-04
Mn-54	6.3E-03	1.7E-03	4.8E-03	1.5E-02	5.3E-03	1.4E-03	3.9E-03	1.4E-02
Fe-55	1.0E-05	2.0E-06	8.0E-06	2.5E-05	8.6E-06	1.6E-06	6.4E-06	2.3E-05
Co-57	4.2E-04	1.1E-04	3.3E-04	9.7E-04	3.6E-04	9.3E-05	2.6E-04	9.5E-04
Co-58	5.3E-03	1.5E-03	4.3E-03	1.3E-02	4.4E-03	1.0E-03	3.5E-03	1.1E-02
Fe-59	4.7E-03	1.2E-03	3.6E-03	1.1E-02	3.9E-03	9.4E-04	3.0E-03	9.6E-03
Ni-59	4.4E-06	1.0E-06	3.5E-06	1.1E-05	3.7E-06	8.1E-07	2.8E-06	9.3E-06
Co-60	1.9E-02	5.2E-03	1.5E-02	4.2E-02	1.6E-02	4.0E-03	1.2E-02	3.8E-02
Ni-63	1.2E-05	2.9E-06	9.1E-06	2.7E-05	1.0E-05	2.0E-06	7.7E-06	2.6E-05
Zn-65	4.0E-03	1.2E-03	3.2E-03	9.9E-03	3.4E-03	8.8E-04	2.6E-03	8.2E-03
Cu-67	1.6E-06	1.5E-10	3.7E-08	8.0E-06	1.3E-06	1.3E-10	3.0E-08	6.9E-06
Se-75	4.8E-04	1.2E-05	3.0E-04	1.6E-03	4.1E-04	1.0E-05	2.3E-04	1.3E-03
Sr-85	6.9E-03	1.7E-03	5.5E-03	1.7E-02	5.9E-03	1.3E-03	4.4E-03	1.5E-02
Sr-89	2.9E-04	6.0E-05	2.4E-04	7.2E-04	2.5E-04	4.5E-05	2.0E-04	6.8E-04
Sr-90	1.1E-02	2.4E-03	8.4E-03	2.9E-02	9.2E-03	1.9E-03	6.6E-03	2.4E-02
Y-91	9.4E-05	2.4E-05	7.0E-05	2.3E-04	8.0E-05	1.6E-05	6.3E-05	2.1E-04
Mo-93	6.9E-05	1.9E-05	5.5E-05	1.6E-04	6.0E-05	1.4E-05	4.6E-05	1.5E-04
Nb-93m	5.8E-05	1.5E-05	4.6E-05	1.4E-04	5.1E-05	1.1E-05	3.8E-05	1.5E-04
Nb-94	1.4E-02	3.8E-03	1.2E-02	3.1E-02	1.2E-02	2.6E-03	9.6E-03	3.0E-02
Nb-95	2.8E-03	6.7E-04	2.2E-03	6.9E-03	2.3E-03	4.8E-04	1.8E-03	5.7E-03
Zr-95	3.4E-03	8.1E-04	2.6E-03	8.2E-03	2.8E-03	6.1E-04	2.1E-03	6.6E-03
Tc-99	2.9E-05	6.5E-06	2.4E-05	7.2E-05	2.5E-05	5.4E-06	2.0E-05	6.8E-05
Ru-103	1.8E-03	4.0E-04	1.3E-03	4.5E-03	1.5E-03	2.8E-04	1.1E-03	4.1E-03
Ru-106	2.3E-03	6.6E-04	1.8E-03	5.3E-03	2.0E-03	4.9E-04	1.5E-03	5.0E-03
Ag-108m	1.4E-01	3.9E-02	1.1E-01	3.2E-01	1.2E-01	3.0E-02	8.9E-02	2.9E-01
Cd-109	2.4E-04	6.0E-05	1.9E-04	5.9E-04	2.0E-04	4.4E-05	1.6E-04	5.1E-04
Ag-110m	1.9E-01	5.3E-02	1.6E-01	4.6E-01	1.6E-01	4.2E-02	1.3E-01	3.8E-01
Sb-124	8.7E-03	2.3E-03	7.1E-03	1.9E-02	7.4E-03	1.9E-03	5.6E-03	1.8E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.4E-03	8.5E-04	2.8E-03	8.1E-03	2.9E-03	6.5E-04	2.3E-03	6.9E-03
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	7.4E-03	1.8E-03	5.9E-03	1.8E-02	6.3E-03	1.4E-03	4.7E-03	1.6E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.5. Dose factors[a] for CU-CNVM-HANDREF-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.0E-04	2.2E-05	8.4E-05	2.4E-04	8.8E-05	1.8E-05	6.9E-05	2.1E-04
Ce-144	7.0E-04	1.8E-04	5.7E-04	1.6E-03	6.0E-04	1.5E-04	4.8E-04	1.6E-03
Pm-147	5.2E-05	1.3E-05	4.0E-05	1.3E-04	4.4E-05	1.0E-05	3.3E-05	1.2E-04
Eu-152	5.8E-03	1.5E-03	4.6E-03	1.4E-02	4.9E-03	1.2E-03	3.7E-03	1.3E-02
Eu-154	6.5E-03	1.8E-03	5.0E-03	1.6E-02	5.4E-03	1.3E-03	4.3E-03	1.4E-02
Eu-155	1.4E-04	4.3E-05	1.2E-04	3.4E-04	1.2E-04	3.1E-05	9.7E-05	3.1E-04
Re-186	2.1E-07	4.9E-10	2.1E-08	1.1E-06	1.8E-07	3.9E-10	1.7E-08	1.0E-06
Ir-192	4.4E-02	1.2E-02	3.5E-02	1.0E-01	3.6E-02	9.3E-03	3.0E-02	8.0E-02
Pb-210	9.3E-02	2.2E-02	7.4E-02	2.2E-01	8.0E-02	1.6E-02	6.3E-02	1.9E-01
Po-210	2.8E-02	6.5E-03	2.2E-02	6.8E-02	2.4E-02	4.8E-03	1.8E-02	6.2E-02
Bi-210	3.4E-06	4.1E-08	7.9E-07	1.6E-05	2.9E-06	3.3E-08	6.4E-07	1.3E-05
Rn-222	7.1E-08	4.6E-11	4.1E-09	4.0E-07	5.9E-08	3.9E-11	3.5E-09	3.2E-07
Ra-223	1.4E-03	1.5E-04	8.5E-04	4.4E-03	1.2E-03	1.1E-04	7.6E-04	4.1E-03
Ra-224	2.6E-05	5.7E-08	2.3E-06	1.3E-04	2.1E-05	4.4E-08	1.7E-06	9.7E-05
Ac-225	3.1E-06	1.9E-08	1.0E-06	1.2E-05	2.6E-06	1.6E-08	7.8E-07	1.1E-05
Ra-225	1.8E-03	2.8E-04	1.2E-03	5.6E-03	1.6E-03	2.0E-04	9.8E-04	5.1E-03
Ra-226	2.9E-02	8.4E-03	2.4E-02	6.8E-02	2.5E-02	6.2E-03	2.0E-02	6.1E-02
Ac-227	6.9E-03	1.1E-04	3.2E-03	2.5E-02	6.1E-03	8.8E-05	2.6E-03	2.0E-02
Th-227	2.2E-05	1.7E-07	7.5E-06	9.2E-05	1.8E-05	1.4E-07	6.0E-06	7.6E-05
Th-228	1.8E-03	1.7E-05	7.7E-04	7.6E-03	1.6E-03	1.4E-05	5.8E-04	6.4E-03
Ra-228	2.9E-02	8.3E-03	2.4E-02	6.5E-02	2.5E-02	5.9E-03	1.9E-02	5.9E-02
Th-229	9.6E-03	9.5E-05	3.7E-03	3.9E-02	8.4E-03	8.0E-05	3.1E-03	3.1E-02
Th-230	1.4E-03	1.7E-05	5.8E-04	5.8E-03	1.2E-03	1.3E-05	4.6E-04	4.8E-03
Pa-231	5.1E-03	7.0E-05	2.2E-03	2.0E-02	4.3E-03	6.7E-05	1.6E-03	1.6E-02
Th-231	2.5E-15	3.1E-26	2.1E-20	8.5E-15	2.0E-15	3.0E-26	1.3E-20	8.3E-15
Th-232	6.2E-03	9.9E-05	2.4E-03	2.5E-02	5.4E-03	6.4E-05	2.1E-03	2.1E-02
Pa-233	1.6E-06	1.9E-08	7.6E-07	5.5E-06	1.3E-06	1.2E-08	5.8E-07	4.7E-06
U-233	7.2E-04	7.1E-06	2.8E-04	3.0E-03	6.6E-04	5.5E-06	2.3E-04	2.6E-03
Th-234	2.9E-07	3.3E-09	1.1E-07	1.2E-06	2.5E-07	2.7E-09	9.7E-08	9.4E-07
U-234	6.8E-04	9.2E-06	3.0E-04	2.7E-03	5.7E-04	7.4E-06	2.4E-04	2.3E-03
U-235	6.8E-04	6.3E-06	2.9E-04	2.7E-03	5.9E-04	5.9E-06	2.2E-04	2.2E-03
Np-237	3.0E-03	4.3E-05	1.2E-03	1.2E-02	2.5E-03	3.5E-05	1.1E-03	1.0E-02
Pu-238	1.4E-03	2.4E-05	5.9E-04	5.5E-03	1.2E-03	1.9E-05	4.8E-04	4.8E-03
U-238	6.2E-04	8.0E-06	2.5E-04	2.7E-03	5.4E-04	6.3E-06	2.0E-04	2.4E-03
Pu-239	1.6E-03	2.5E-05	6.1E-04	6.8E-03	1.3E-03	1.9E-05	5.2E-04	5.6E-03
Pu-240	1.6E-03	2.8E-05	6.1E-04	5.6E-03	1.3E-03	2.1E-05	5.1E-04	4.6E-03
Pu-241	2.5E-05	4.4E-07	9.4E-06	1.0E-04	2.1E-05	3.1E-07	8.2E-06	8.3E-05
Am-241	2.5E-03	3.1E-05	1.0E-03	8.9E-03	2.2E-03	2.4E-05	8.4E-04	8.4E-03
Cm-242	8.1E-05	7.2E-07	3.2E-05	3.2E-04	6.9E-05	6.5E-07	2.6E-05	2.9E-04
Pu-242	1.6E-03	2.2E-05	6.1E-04	6.3E-03	1.4E-03	1.8E-05	4.5E-04	5.5E-03
Cm-244	1.5E-03	1.4E-05	5.7E-04	6.0E-03	1.3E-03	1.4E-05	4.6E-04	5.1E-03

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.6 Dose factors[a] for CU-ELRM-HANDREF-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm^2)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	4.5E-11	1.5E-13	1.4E-11	1.8E-10	3.8E-11	1.3E-13	1.2E-11	1.5E-10
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	3.9E-07	2.8E-09	9.4E-08	1.8E-06	3.4E-07	2.0E-09	8.1E-08	1.5E-06
S-35	2.5E-07	2.4E-09	8.4E-08	1.0E-06	2.0E-07	2.1E-09	6.6E-08	8.2E-07
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	2.3E-07	9.3E-09	1.2E-07	7.9E-07	2.0E-07	7.1E-09	1.0E-07	6.6E-07
Mn-54	2.1E-05	1.3E-06	1.3E-05	6.9E-05	1.8E-05	8.9E-07	1.1E-05	6.1E-05
Fe-55	3.4E-08	1.6E-09	2.2E-08	1.2E-07	2.8E-08	1.2E-09	1.8E-08	1.0E-07
Co-57	1.4E-06	7.1E-08	8.8E-07	4.7E-06	1.2E-06	4.7E-08	7.3E-07	3.9E-06
Co-58	1.6E-05	7.9E-07	9.8E-06	5.4E-05	1.3E-05	5.6E-07	8.3E-06	4.6E-05
Fe-59	1.3E-05	5.4E-07	7.5E-06	4.4E-05	1.1E-05	4.7E-07	6.2E-06	3.7E-05
Ni-59	1.5E-08	6.8E-10	9.1E-09	4.9E-08	1.3E-08	5.2E-10	7.6E-09	4.4E-08
Co-60	6.5E-05	3.2E-06	3.9E-05	2.1E-04	5.5E-05	2.4E-06	3.3E-05	1.7E-04
Ni-63	3.9E-08	2.0E-09	2.4E-08	1.2E-07	3.4E-08	1.3E-09	2.0E-08	1.1E-07
Zn-65	1.3E-05	7.0E-07	8.2E-06	4.4E-05	1.1E-05	5.1E-07	6.8E-06	3.7E-05
Cu-67	1.4E-07	4.9E-13	6.4E-10	8.6E-07	1.2E-07	4.4E-13	6.1E-10	6.5E-07
Se-75	7.0E-05	7.6E-07	2.8E-05	3.0E-04	6.0E-05	6.1E-07	2.5E-05	2.6E-04
Sr-85	2.1E-05	8.3E-07	1.2E-05	6.9E-05	1.8E-05	7.7E-07	1.0E-05	6.0E-05
Sr-89	8.4E-07	3.5E-08	4.5E-07	2.7E-06	7.3E-07	3.2E-08	3.7E-07	2.6E-06
Sr-90	3.7E-05	2.2E-06	2.2E-05	1.3E-04	3.2E-05	1.7E-06	1.7E-05	1.1E-04
Y-91	2.5E-07	1.2E-08	1.7E-07	7.6E-07	2.1E-07	8.5E-09	1.4E-07	6.3E-07
Mo-93	2.3E-07	9.8E-09	1.6E-07	6.8E-07	2.0E-07	8.8E-09	1.3E-07	6.2E-07
Nb-93m	1.9E-07	8.4E-09	1.2E-07	6.2E-07	1.6E-07	6.3E-09	1.0E-07	5.2E-07
Nb-94	4.7E-05	1.8E-06	3.1E-05	1.3E-04	4.0E-05	1.5E-06	2.5E-05	1.2E-04
Nb-95	7.0E-06	3.1E-07	4.5E-06	2.2E-05	5.9E-06	2.5E-07	3.7E-06	1.9E-05
Zr-95	9.9E-06	5.0E-07	6.2E-06	3.4E-05	8.4E-06	3.6E-07	5.0E-06	2.9E-05
Tc-99	9.8E-08	4.5E-09	6.1E-08	3.2E-07	8.6E-08	3.8E-09	5.2E-08	3.0E-07
Ru-103	4.5E-06	2.1E-07	2.8E-06	1.4E-05	3.8E-06	1.7E-07	2.3E-06	1.3E-05
Ru-106	7.6E-06	4.1E-07	5.0E-06	2.3E-05	6.6E-06	3.0E-07	4.3E-06	2.2E-05
Ag-108m	4.7E-04	2.2E-05	3.1E-04	1.4E-03	4.0E-04	1.9E-05	2.4E-04	1.3E-03
Cd-109	7.9E-07	4.5E-08	4.7E-07	2.7E-06	6.9E-07	3.6E-08	3.9E-07	2.3E-06
Ag-110m	6.4E-04	3.2E-05	4.3E-04	1.9E-03	5.5E-04	2.3E-05	3.5E-04	1.9E-03
Sb-124	2.5E-05	1.4E-06	1.5E-05	8.0E-05	2.2E-05	1.2E-06	1.3E-05	7.0E-05
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.2E-05	5.8E-07	7.3E-06	3.6E-05	1.0E-05	4.3E-07	6.1E-06	3.3E-05
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.4E-05	1.3E-06	1.5E-05	7.5E-05	2.0E-05	1.1E-06	1.3E-05	6.3E-05
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.6 Dose factors[a] for CU-ELRM-HANDREF-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.7E-07	1.2E-08	1.6E-07	9.2E-07	2.3E-07	9.3E-09	1.2E-07	7.5E-07
Ce-144	2.3E-06	1.2E-07	1.5E-06	7.4E-06	2.0E-06	8.7E-08	1.2E-06	6.5E-06
Pm-147	1.8E-07	8.2E-09	1.0E-07	5.7E-07	1.5E-07	6.5E-09	8.1E-08	5.0E-07
Eu-152	2.0E-05	9.3E-07	1.3E-05	5.8E-05	1.7E-05	9.2E-07	1.1E-05	5.8E-05
Eu-154	2.2E-05	1.0E-06	1.4E-05	7.1E-05	1.9E-05	7.6E-07	1.2E-05	5.9E-05
Eu-155	4.9E-07	2.8E-08	3.1E-07	1.6E-06	4.2E-07	2.3E-08	2.5E-07	1.3E-06
Re-186	1.2E-10	2.4E-14	3.1E-12	6.0E-10	1.0E-10	1.8E-14	2.3E-12	5.0E-10
Ir-192	1.3E-04	6.2E-06	8.2E-05	4.1E-04	1.1E-04	4.8E-06	6.6E-05	3.4E-04
Pb-210	3.2E-04	1.8E-05	1.9E-04	1.1E-03	2.8E-04	1.2E-05	1.5E-04	1.0E-03
Po-210	8.8E-05	3.7E-06	5.2E-05	3.2E-04	7.5E-05	2.8E-06	4.2E-05	2.5E-04
Bi-210	3.1E-09	3.7E-12	2.0E-10	1.4E-08	2.7E-09	2.8E-12	1.6E-10	1.1E-08
Rn-222	2.8E-10	8.8E-15	3.4E-12	1.2E-09	2.4E-10	6.4E-15	2.7E-12	9.6E-10
Ra-223	2.2E-06	4.4E-08	9.6E-07	7.4E-06	1.9E-06	3.8E-08	7.8E-07	6.8E-06
Ra-224	1.3E-08	1.3E-12	3.3E-10	7.0E-08	1.1E-08	1.1E-12	2.8E-10	6.1E-08
Ac-225	4.6E-09	1.1E-11	8.6E-10	2.0E-08	3.9E-09	9.6E-12	6.9E-10	1.6E-08
Ra-225	3.6E-06	7.8E-08	1.5E-06	1.4E-05	3.0E-06	6.0E-08	1.2E-06	1.0E-05
Ra-226	9.7E-05	4.6E-06	6.7E-05	3.1E-04	8.4E-05	3.9E-06	5.2E-05	2.6E-04
Ac-227	2.4E-05	1.4E-07	6.4E-06	9.9E-05	2.0E-05	9.6E-08	6.1E-06	8.3E-05
Th-227	3.6E-08	1.1E-10	9.8E-09	1.5E-07	3.1E-08	1.0E-10	8.1E-09	1.2E-07
Th-228	5.0E-06	2.9E-08	1.7E-06	2.2E-05	4.2E-06	2.4E-08	1.4E-06	1.8E-05
Ra-228	9.6E-05	4.9E-06	6.2E-05	3.0E-04	8.2E-05	3.9E-06	5.0E-05	2.6E-04
Th-229	2.6E-05	1.1E-07	9.4E-06	1.1E-04	2.2E-05	9.2E-08	7.5E-06	9.4E-05
Th-230	4.1E-06	1.9E-08	1.4E-06	1.9E-05	3.5E-06	1.7E-08	1.1E-06	1.3E-05
Pa-231	1.7E-05	9.3E-08	5.0E-06	7.0E-05	1.5E-05	6.4E-08	3.8E-06	5.9E-05
Th-231	5.8E-20	5.4E-35	2.0E-27	1.1E-19	4.0E-20	2.9E-35	1.4E-27	1.2E-19
Th-232	1.8E-05	1.0E-07	6.2E-06	7.8E-05	1.6E-05	7.0E-08	4.9E-06	6.8E-05
Pa-233	3.7E-09	2.0E-11	1.1E-09	1.5E-08	3.2E-09	1.6E-11	8.2E-10	1.3E-08
U-233	2.4E-06	1.3E-08	7.2E-07	1.1E-05	2.0E-06	1.1E-08	5.9E-07	9.3E-06
Th-234	5.7E-10	2.6E-12	1.8E-10	2.5E-09	4.8E-10	2.3E-12	1.6E-10	2.3E-09
U-234	2.2E-06	1.3E-08	7.5E-07	9.0E-06	1.8E-06	9.8E-09	5.4E-07	7.2E-06
U-235	2.0E-06	1.3E-08	6.0E-07	8.7E-06	1.8E-06	1.1E-08	5.0E-07	7.8E-06
Np-237	9.4E-06	5.6E-08	2.9E-06	4.2E-05	7.5E-06	5.2E-08	2.3E-06	3.5E-05
Pu-238	4.6E-06	2.9E-08	1.4E-06	2.1E-05	3.9E-06	2.4E-08	1.1E-06	1.5E-05
U-238	1.9E-06	1.0E-08	5.9E-07	8.8E-06	1.6E-06	8.9E-09	4.8E-07	7.1E-06
Pu-239	5.2E-06	2.9E-08	1.7E-06	2.3E-05	4.4E-06	2.2E-08	1.4E-06	2.1E-05
Pu-240	5.4E-06	3.1E-08	1.6E-06	2.3E-05	4.7E-06	2.3E-08	1.2E-06	2.2E-05
Pu-241	8.7E-08	5.3E-10	2.4E-08	3.9E-07	7.4E-08	4.5E-10	2.0E-08	3.1E-07
Am-241	7.9E-06	4.5E-08	2.5E-06	3.5E-05	7.1E-06	3.5E-08	1.9E-06	2.9E-05
Cm-242	2.4E-07	1.4E-09	7.2E-08	1.1E-06	2.0E-07	1.3E-09	5.5E-08	8.8E-07
Pu-242	4.8E-06	3.0E-08	1.6E-06	1.8E-05	4.1E-06	2.2E-08	1.2E-06	1.6E-05
Cm-244	4.5E-06	2.5E-08	1.3E-06	1.9E-05	3.8E-06	1.9E-08	1.0E-06	1.7E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.7 Dose factors[a] for CU-REVM-HANDMAN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	1.5E-07	5.7E-09	9.9E-08	5.0E-07	1.3E-07	3.6E-09	7.9E-08	4.2E-07
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	2.8E-05	1.4E-06	1.5E-05	1.1E-04	2.4E-05	1.2E-06	1.1E-05	9.8E-05
S-35	1.1E-05	7.4E-07	7.1E-06	3.0E-05	9.1E-06	5.0E-07	5.7E-06	2.9E-05
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	8.5E-04	1.8E-04	6.6E-04	2.1E-03	7.3E-04	1.5E-04	5.2E-04	2.0E-03
Mn-54	5.8E-02	1.5E-02	4.8E-02	1.3E-01	4.9E-02	1.2E-02	3.9E-02	1.2E-01
Fe-55	9.3E-05	2.1E-05	7.2E-05	2.2E-04	7.8E-05	1.7E-05	6.0E-05	1.9E-04
Co-57	3.9E-03	1.1E-03	3.3E-03	9.0E-03	3.3E-03	8.2E-04	2.5E-03	8.3E-03
Co-58	5.0E-02	1.2E-02	4.0E-02	1.2E-01	4.3E-02	9.7E-03	3.3E-02	1.0E-01
Fe-59	4.4E-02	1.1E-02	3.7E-02	1.0E-01	3.7E-02	8.3E-03	3.0E-02	9.1E-02
Ni-59	4.0E-05	1.0E-05	3.3E-05	9.4E-05	3.4E-05	7.8E-06	2.8E-05	8.7E-05
Co-60	1.7E-01	4.8E-02	1.4E-01	4.0E-01	1.5E-01	3.4E-02	1.2E-01	3.7E-01
Ni-63	1.1E-04	2.7E-05	8.8E-05	2.6E-04	9.2E-05	2.0E-05	7.3E-05	2.3E-04
Zn-65	3.8E-02	9.7E-03	3.1E-02	9.1E-02	3.2E-02	7.6E-03	2.5E-02	8.4E-02
Cu-67	1.4E-06	2.0E-10	3.4E-08	8.0E-06	1.2E-06	1.4E-10	3.0E-08	6.2E-06
Se-75	3.3E-03	1.7E-04	2.2E-03	1.0E-02	2.8E-03	1.3E-04	1.7E-03	9.2E-03
Sr-85	1.3E-02	3.2E-03	1.0E-02	3.3E-02	1.1E-02	2.4E-03	8.5E-03	3.0E-02
Sr-89	5.6E-04	1.3E-04	4.2E-04	1.4E-03	4.7E-04	9.5E-05	3.4E-04	1.3E-03
Sr-90	2.0E-02	5.1E-03	1.6E-02	5.1E-02	1.7E-02	3.6E-03	1.3E-02	4.6E-02
Y-91	3.4E-04	8.9E-05	2.8E-04	7.9E-04	2.9E-04	6.7E-05	2.3E-04	7.3E-04
Mo-93	6.5E-04	1.7E-04	5.3E-04	1.5E-03	5.6E-04	1.3E-04	4.3E-04	1.5E-03
Nb-93m	5.5E-04	1.3E-04	4.4E-04	1.3E-03	4.7E-04	1.0E-04	3.5E-04	1.3E-03
Nb-94	1.3E-01	3.4E-02	1.0E-01	2.9E-01	1.1E-01	2.7E-02	8.7E-02	2.8E-01
Nb-95	2.7E-02	5.9E-03	2.1E-02	6.8E-02	2.3E-02	4.6E-03	1.6E-02	6.2E-02
Zr-95	1.7E+00	7.8E-03	2.9E-02	6.0E+00	1.4E+00	6.6E-03	2.5E-02	5.1E+00
Tc-99	2.8E-04	6.4E-05	2.2E-04	6.8E-04	2.4E-04	5.3E-05	1.9E-04	5.6E-04
Ru-103	1.6E-02	4.0E-03	1.3E-02	3.7E-02	1.4E-02	2.7E-03	1.1E-02	3.4E-02
Ru-106	2.1E-02	6.5E-03	1.7E-02	4.6E-02	1.8E-02	4.6E-03	1.5E-02	4.2E-02
Ag-108m	1.3E-01	3.5E-02	1.1E-01	3.1E-01	1.2E-01	2.8E-02	8.6E-02	3.1E-01
Cd-109	2.3E-03	5.4E-04	1.7E-03	5.5E-03	1.9E-03	4.0E-04	1.4E-03	5.1E-03
Ag-110m	1.9E-01	5.3E-02	1.5E-01	4.2E-01	1.6E-01	4.1E-02	1.3E-01	3.9E-01
Sb-124	8.3E-02	2.0E-02	6.6E-02	2.0E-01	7.1E-02	1.7E-02	5.4E-02	1.8E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.2E-02	8.2E-03	2.6E-02	7.4E-02	2.7E-02	6.4E-03	2.1E-02	6.4E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.4E-02	3.3E-03	1.1E-02	3.4E-02	1.2E-02	2.6E-03	9.2E-03	3.2E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.7 Dose factors[a] for CU-REVM-HANDMAN-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.8E-04	1.0E-04	3.0E-04	9.5E-04	3.2E-04	7.8E-05	2.5E-04	8.0E-04
Ce-144	2.6E-03	7.8E-04	2.2E-03	6.2E-03	2.2E-03	5.7E-04	1.8E-03	5.6E-03
Pm-147	1.9E-04	4.9E-05	1.5E-04	4.6E-04	1.6E-04	3.8E-05	1.2E-04	4.1E-04
Eu-152	2.1E-02	5.6E-03	1.8E-02	5.0E-02	1.8E-02	4.2E-03	1.4E-02	4.6E-02
Eu-154	2.4E-02	6.5E-03	2.0E-02	5.6E-02	2.0E-02	4.9E-03	1.6E-02	5.0E-02
Eu-155	5.3E-04	1.6E-04	4.5E-04	1.2E-03	4.5E-04	1.2E-04	3.7E-04	1.1E-03
Re-186	2.0E-06	3.8E-09	2.4E-07	1.1E-05	1.7E-06	3.2E-09	1.8E-07	8.4E-06
Ir-192	4.3E-02	1.1E-02	3.4E-02	1.0E-01	3.6E-02	8.3E-03	2.8E-02	8.7E-02
Pb-210	8.7E-01	1.9E-01	7.0E-01	2.1E+00	7.5E-01	1.5E-01	5.8E-01	2.0E+00
Po-210	2.6E-01	6.2E-02	2.2E-01	6.0E-01	2.2E-01	4.4E-02	1.7E-01	5.5E-01
Bi-210	3.4E-05	3.4E-07	6.7E-06	1.5E-04	2.9E-05	3.0E-07	5.5E-06	1.2E-04
Rn-222	4.9E-06	6.0E-09	3.8E-07	2.9E-05	4.2E-06	5.5E-09	3.1E-07	2.5E-05
Ra-223	5.4E-03	5.9E-04	3.2E-03	1.7E-02	4.5E-03	5.4E-04	2.8E-03	1.3E-02
Ra-224	8.6E-05	2.1E-07	9.2E-06	5.0E-04	7.3E-05	1.9E-07	8.4E-06	4.0E-04
Ac-225	2.0E-04	4.0E-06	8.0E-05	7.6E-04	1.7E-04	3.2E-06	6.4E-05	6.8E-04
Ra-225	7.0E-03	9.3E-04	4.8E-03	2.2E-02	5.9E-03	6.5E-04	3.7E-03	1.9E-02
Ra-226	1.1E-01	3.1E-02	8.9E-02	2.4E-01	9.4E-02	2.3E-02	7.1E-02	2.3E-01
Ac-227	3.9E-01	1.8E-02	2.6E-01	1.2E+00	3.4E-01	1.4E-02	2.1E-01	1.1E+00
Th-227	1.0E-03	3.8E-05	5.3E-04	3.9E-03	8.9E-04	3.2E-05	4.5E-04	3.0E-03
Th-228	9.5E-02	5.2E-03	6.2E-02	3.3E-01	8.0E-02	3.9E-03	4.9E-02	2.4E-01
Ra-228	1.1E-01	2.8E-02	8.8E-02	2.6E-01	9.5E-02	2.1E-02	7.2E-02	2.3E-01
Th-229	5.2E-01	2.2E-02	3.0E-01	1.7E+00	4.4E-01	1.8E-02	2.5E-01	1.4E+00
Th-230	7.9E-02	3.4E-03	4.4E-02	2.5E-01	6.8E-02	2.4E-03	3.6E-02	2.3E-01
Pa-231	2.6E-01	1.1E-02	1.6E-01	9.3E-01	2.2E-01	8.8E-03	1.3E-01	7.3E-01
Th-231	1.8E-13	3.3E-24	1.3E-18	6.5E-13	1.6E-13	2.5E-24	1.2E-18	4.9E-13
Th-232	3.4E-01	1.6E-02	2.0E-01	1.2E+00	2.9E-01	1.5E-02	1.6E-01	1.1E+00
Pa-233	8.8E-05	3.7E-06	5.4E-05	2.8E-04	7.3E-05	3.3E-06	4.4E-05	2.3E-04
U-233	3.8E-02	1.5E-03	2.3E-02	1.3E-01	3.3E-02	1.3E-03	1.9E-02	1.1E-01
Th-234	1.6E-05	7.0E-07	9.4E-06	5.4E-05	1.3E-05	6.0E-07	7.5E-06	4.7E-05
U-234	3.6E-02	1.5E-03	2.3E-02	1.1E-01	3.1E-02	1.4E-03	1.9E-02	9.9E-02
U-235	3.4E-02	1.6E-03	2.1E-02	1.2E-01	2.8E-02	1.2E-03	1.6E-02	8.9E-02
Np-237	1.5E-01	6.2E-03	1.0E-01	4.4E-01	1.3E-01	4.4E-03	8.9E-02	3.7E-01
Pu-238	7.8E-02	3.7E-03	5.0E-02	2.6E-01	6.7E-02	2.7E-03	3.9E-02	2.5E-01
U-238	3.2E-02	1.9E-03	2.1E-02	1.0E-01	2.7E-02	1.4E-03	1.6E-02	9.4E-02
Pu-239	8.7E-02	3.5E-03	5.3E-02	2.8E-01	7.4E-02	3.2E-03	4.4E-02	2.4E-01
Pu-240	9.0E-02	4.0E-03	4.9E-02	2.9E-01	7.7E-02	3.0E-03	3.9E-02	2.5E-01
Pu-241	1.3E-03	7.6E-05	8.5E-04	4.1E-03	1.1E-03	5.3E-05	7.8E-04	3.7E-03
Am-241	1.4E-01	5.9E-03	8.6E-02	4.6E-01	1.2E-01	4.9E-03	6.9E-02	4.0E-01
Cm-242	4.3E-03	2.1E-04	2.6E-03	1.4E-02	3.6E-03	1.5E-04	2.2E-03	1.2E-02
Pu-242	7.9E-02	3.4E-03	4.8E-02	2.5E-01	6.9E-02	2.9E-03	3.9E-02	2.3E-01
Cm-244	7.5E-02	3.2E-03	4.2E-02	2.3E-01	6.4E-02	2.8E-03	3.6E-02	2.1E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.8 Dose factors[a] for CU-REVM-HANDDIS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	6.5E-07	1.9E-08	2.9E-07	2.6E-06	5.8E-07	1.2E-08	2.3E-07	2.3E-06
S-35	1.9E-08	9.9E-10	1.3E-08	5.3E-08	1.6E-08	7.8E-10	1.1E-08	4.6E-08
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	2.5E-04	4.2E-05	1.9E-04	6.9E-04	2.2E-04	3.1E-05	1.5E-04	5.9E-04
Mn-54	2.8E-02	6.5E-03	2.2E-02	6.6E-02	2.4E-02	5.5E-03	1.8E-02	6.2E-02
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.8E-03	4.8E-04	1.4E-03	4.4E-03	1.5E-03	3.4E-04	1.2E-03	4.1E-03
Co-58	2.0E-02	4.4E-03	1.6E-02	4.9E-02	1.7E-02	3.2E-03	1.3E-02	4.4E-02
Fe-59	1.6E-02	3.5E-03	1.2E-02	3.8E-02	1.3E-02	2.7E-03	9.9E-03	3.7E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	8.5E-02	2.4E-02	7.0E-02	2.0E-01	7.2E-02	1.7E-02	5.8E-02	1.7E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.7E-02	4.0E-03	1.4E-02	4.1E-02	1.4E-02	2.9E-03	1.2E-02	3.5E-02
Cu-67	2.1E-08	1.6E-14	5.4E-11	1.2E-07	1.8E-08	1.4E-14	4.6E-11	1.1E-07
Se-75	1.4E-03	8.8E-05	8.5E-04	4.3E-03	1.2E-03	6.3E-05	6.9E-04	3.8E-03
Sr-85	5.2E-03	1.2E-03	4.0E-03	1.3E-02	4.4E-03	8.1E-04	3.4E-03	1.1E-02
Sr-89	1.2E-05	2.6E-06	9.5E-06	3.1E-05	1.1E-05	1.8E-06	7.7E-06	2.9E-05
Sr-90	3.0E-06	7.0E-07	2.4E-06	7.3E-06	2.6E-06	5.1E-07	1.8E-06	7.1E-06
Y-91	1.5E-05	3.5E-06	1.2E-05	3.8E-05	1.3E-05	2.5E-06	9.7E-06	3.6E-05
Mo-93	6.3E-06	1.6E-06	5.1E-06	1.5E-05	5.4E-06	1.2E-06	4.3E-06	1.3E-05
Nb-93m	1.1E-06	2.9E-07	8.1E-07	2.5E-06	9.0E-07	2.2E-07	6.6E-07	2.3E-06
Nb-94	6.1E-02	1.5E-02	4.7E-02	1.5E-01	5.3E-02	1.1E-02	3.9E-02	1.3E-01
Nb-95	8.6E-03	1.8E-03	6.2E-03	2.2E-02	7.4E-03	1.4E-03	5.2E-03	2.1E-02
Zr-95	1.2E-02	2.7E-03	9.5E-03	3.1E-02	1.0E-02	2.2E-03	8.1E-03	2.7E-02
Tc-99	1.1E-06	3.0E-07	8.7E-07	2.9E-06	9.7E-07	2.1E-07	7.1E-07	2.5E-06
Ru-103	5.6E-03	1.2E-03	4.2E-03	1.4E-02	4.7E-03	8.3E-04	3.5E-03	1.3E-02
Ru-106	5.9E-03	1.3E-03	4.9E-03	1.4E-02	5.1E-03	1.0E-03	4.2E-03	1.2E-02
Ag-108m	6.3E-02	1.6E-02	5.1E-02	1.5E-01	5.4E-02	1.3E-02	4.1E-02	1.4E-01
Cd-109	1.6E-05	4.5E-06	1.3E-05	3.7E-05	1.4E-05	3.5E-06	1.1E-05	3.3E-05
Ag-110m	8.7E-02	2.3E-02	7.3E-02	2.1E-01	7.5E-02	1.7E-02	5.6E-02	1.9E-01
Sb-124	3.2E-02	7.2E-03	2.5E-02	7.9E-02	2.8E-02	5.4E-03	2.0E-02	7.4E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.5E-02	3.6E-03	1.2E-02	3.7E-02	1.3E-02	2.8E-03	1.0E-02	3.3E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	6.7E-03	1.7E-03	5.5E-03	1.7E-02	5.7E-03	1.3E-03	4.5E-03	1.3E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.8 Dose factors[a] for CU-REVM-HANDDIS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.1E-04	2.0E-05	8.1E-05	2.7E-04	9.3E-05	1.6E-05	6.5E-05	2.5E-04
Ce-144	2.9E-04	7.0E-05	2.4E-04	7.2E-04	2.5E-04	5.5E-05	1.9E-04	6.6E-04
Pm-147	1.6E-08	3.8E-09	1.2E-08	3.6E-08	1.4E-08	2.8E-09	1.0E-08	3.4E-08
Eu-152	1.0E-02	2.6E-03	7.9E-03	2.5E-02	8.7E-03	1.9E-03	6.8E-03	2.2E-02
Eu-154	1.1E-02	2.6E-03	8.9E-03	2.7E-02	9.7E-03	2.0E-03	7.1E-03	2.6E-02
Eu-155	1.6E-04	3.8E-05	1.2E-04	4.0E-04	1.4E-04	2.9E-05	9.9E-05	3.6E-04
Re-186	4.4E-08	3.7E-12	1.0E-09	2.6E-07	3.7E-08	3.5E-12	8.5E-10	2.0E-07
Ir-192	1.7E-02	3.9E-03	1.4E-02	4.2E-02	1.5E-02	2.9E-03	1.2E-02	3.9E-02
Pb-210	1.2E-05	2.9E-06	9.2E-06	2.8E-05	1.0E-05	2.3E-06	7.7E-06	2.5E-05
Po-210	2.0E-07	4.9E-08	1.6E-07	4.7E-07	1.8E-07	3.6E-08	1.3E-07	4.7E-07
Bi-210	2.7E-08	2.3E-11	2.4E-09	1.5E-07	2.3E-08	1.9E-11	1.9E-09	1.3E-07
Rn-222	2.0E-07	8.8E-12	3.6E-09	1.1E-06	1.7E-07	6.9E-12	2.8E-09	9.3E-07
Ra-223	7.9E-05	3.2E-06	3.7E-05	2.9E-04	6.8E-05	2.8E-06	3.1E-05	2.6E-04
Ra-224	1.7E-06	1.0E-10	4.2E-08	8.1E-06	1.4E-06	8.3E-11	3.4E-08	7.9E-06
Ac-225	2.6E-06	2.6E-08	7.1E-07	1.1E-05	2.2E-06	2.0E-08	5.9E-07	9.4E-06
Ra-225	5.8E-07	4.0E-08	3.0E-07	2.1E-06	4.9E-07	2.9E-08	2.6E-07	1.8E-06
Ra-226	1.5E-02	3.5E-03	1.3E-02	3.6E-02	1.3E-02	2.8E-03	9.9E-03	3.4E-02
Ac-227	7.8E-05	3.8E-06	4.9E-05	2.5E-04	6.7E-05	3.2E-06	3.8E-05	2.2E-04
Th-227	6.3E-06	1.9E-07	3.0E-06	2.4E-05	5.3E-06	1.8E-07	2.4E-06	1.9E-05
Th-228	7.5E-04	3.5E-05	4.4E-04	2.6E-03	6.5E-04	2.5E-05	3.9E-04	2.4E-03
Ra-228	7.6E-03	1.9E-03	5.8E-03	2.0E-02	6.4E-03	1.5E-03	4.9E-03	1.6E-02
Th-229	6.1E-05	2.8E-06	3.8E-05	2.0E-04	5.2E-05	2.3E-06	3.2E-05	1.7E-04
Th-230	3.4E-08	1.5E-09	2.2E-08	1.1E-07	2.9E-08	1.2E-09	1.7E-08	9.8E-08
Pa-231	1.6E-05	8.0E-07	1.0E-05	5.2E-05	1.4E-05	6.2E-07	8.6E-06	5.0E-05
Th-231	1.5E-17	5.2E-34	1.4E-25	4.9E-17	1.2E-17	5.0E-34	1.5E-25	3.8E-17
Th-232	3.8E-06	1.8E-07	2.5E-06	1.2E-05	3.3E-06	1.2E-07	2.0E-06	1.0E-05
Pa-233	2.4E-05	9.4E-07	1.4E-05	8.7E-05	2.1E-05	7.3E-07	1.1E-05	7.7E-05
U-233	8.4E-09	3.9E-10	5.4E-09	2.8E-08	7.1E-09	2.9E-10	4.4E-09	2.3E-08
Th-234	1.1E-06	4.1E-08	5.7E-07	3.6E-06	9.2E-07	3.0E-08	4.7E-07	3.4E-06
U-234	1.5E-08	6.3E-10	9.4E-09	5.2E-08	1.3E-08	5.4E-10	7.9E-09	4.0E-08
U-235	6.9E-05	4.1E-06	4.3E-05	1.9E-04	6.0E-05	3.2E-06	3.6E-05	1.9E-04
Np-237	5.2E-05	2.3E-06	3.5E-05	1.6E-04	4.4E-05	1.7E-06	2.8E-05	1.5E-04
Pu-238	1.7E-08	8.0E-10	1.1E-08	5.2E-08	1.5E-08	5.2E-10	8.8E-09	4.4E-08
U-238	2.4E-06	1.2E-07	1.6E-06	7.9E-06	2.1E-06	9.1E-08	1.3E-06	6.7E-06
Pu-239	6.5E-09	2.6E-10	4.0E-09	2.0E-08	5.6E-09	2.3E-10	3.5E-09	1.9E-08
Pu-240	1.7E-08	7.0E-10	1.1E-08	5.9E-08	1.5E-08	6.4E-10	8.5E-09	5.1E-08
Pu-241	5.4E-10	2.4E-11	3.3E-10	1.8E-09	4.6E-10	1.9E-11	2.7E-10	1.7E-09
Am-241	1.7E-06	6.2E-08	1.0E-06	5.6E-06	1.4E-06	4.6E-08	8.2E-07	4.9E-06
Cm-242	2.0E-08	1.0E-09	1.2E-08	6.4E-08	1.7E-08	7.8E-10	1.0E-08	6.0E-08
Pu-242	1.4E-08	7.0E-10	9.1E-09	4.2E-08	1.2E-08	5.5E-10	7.3E-09	3.8E-08
Cm-244	2.3E-08	1.3E-09	1.4E-08	6.6E-08	2.0E-08	1.0E-09	1.2E-08	6.5E-08

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.9 Dose factors[a] for CU-REVS-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.4E-04	2.5E-05	1.0E-04	4.2E-04	1.2E-04	1.8E-05	8.1E-05	3.6E-04
Na-22	4.0E+01	9.9E+00	3.2E+01	1.0E+02	3.4E+01	7.2E+00	2.5E+01	8.8E+01
P-32	1.1E-02	2.3E-03	7.8E-03	3.2E-02	9.8E-03	1.6E-03	6.5E-03	3.0E-02
S-35	7.8E-04	1.7E-04	6.1E-04	2.0E-03	6.6E-04	1.3E-04	5.0E-04	1.8E-03
Cl-36	7.8E-03	2.0E-03	6.1E-03	1.8E-02	6.7E-03	1.5E-03	5.2E-03	1.7E-02
K-40	3.2E+00	7.7E-01	2.6E+00	7.2E+00	2.7E+00	5.0E-01	2.2E+00	6.7E+00
Ca-41	2.0E-03	3.3E-04	1.5E-03	5.2E-03	1.7E-03	2.5E-04	1.2E-03	4.7E-03
Ca-45	5.1E-03	1.0E-03	3.8E-03	1.3E-02	4.3E-03	7.0E-04	3.1E-03	1.2E-02
Cr-51	2.7E-03	5.8E-04	2.0E-03	7.4E-03	2.3E-03	4.2E-04	1.7E-03	6.3E-03
Mn-54	1.5E-01	3.4E-02	1.2E-01	3.8E-01	1.3E-01	2.3E-02	9.4E-02	3.9E-01
Fe-55	1.1E-05	2.2E-06	8.0E-06	2.8E-05	9.0E-06	1.6E-06	6.6E-06	2.3E-05
Co-57	1.5E-02	3.4E-03	1.1E-02	3.6E-02	1.2E-02	2.5E-03	9.3E-03	3.4E-02
Co-58	1.4E-01	3.2E-02	1.1E-01	3.5E-01	1.2E-01	2.3E-02	8.8E-02	3.2E-01
Fe-59	1.5E-01	3.2E-02	1.2E-01	4.3E-01	1.3E-01	2.4E-02	1.0E-01	3.3E-01
Ni-59	4.7E-06	1.0E-06	3.7E-06	1.1E-05	4.0E-06	7.6E-07	3.0E-06	1.0E-05
Co-60	5.1E-01	1.1E-01	4.0E-01	1.3E+00	4.3E-01	8.0E-02	3.1E-01	1.1E+00
Ni-63	1.2E-05	2.7E-06	9.5E-06	3.0E-05	1.0E-05	2.0E-06	8.1E-06	2.5E-05
Zn-65	1.1E-01	2.0E-02	8.3E-02	2.8E-01	9.3E-02	1.6E-02	6.6E-02	2.5E-01
Cu-67	4.7E-05	1.1E-07	5.3E-06	2.5E-04	3.9E-05	9.3E-08	5.1E-06	1.9E-04
Se-75	4.5E+00	8.7E-01	3.5E+00	1.2E+01	3.9E+00	6.2E-01	2.9E+00	1.1E+01
Sr-85	3.5E+00	6.9E-01	2.6E+00	1.0E+01	3.0E+00	5.2E-01	2.1E+00	8.3E+00
Sr-89	1.6E-02	3.7E-03	1.3E-02	3.7E-02	1.4E-02	3.1E-03	1.1E-02	3.5E-02
Sr-90	2.3E-01	5.1E-02	1.7E-01	5.5E-01	1.9E-01	3.6E-02	1.4E-01	5.5E-01
Y-91	6.6E-02	1.6E-02	5.4E-02	1.6E-01	5.6E-02	1.2E-02	4.4E-02	1.4E-01
Mo-93	9.3E-05	2.3E-05	7.1E-05	2.3E-04	8.0E-05	1.7E-05	6.0E-05	2.0E-04
Nb-93m	6.6E-05	1.4E-05	5.3E-05	1.8E-04	5.6E-05	1.1E-05	4.1E-05	1.6E-04
Nb-94	3.0E-01	7.0E-02	2.4E-01	7.1E-01	2.6E-01	4.9E-02	2.0E-01	6.6E-01
Nb-95	8.8E-02	1.7E-02	6.3E-02	2.5E-01	7.5E-02	1.3E-02	5.2E-02	2.2E-01
Zr-95	1.0E-01	2.4E-02	7.9E-02	2.6E-01	8.8E-02	1.7E-02	6.5E-02	2.3E-01
Tc-99	3.9E-05	1.0E-05	3.0E-05	9.6E-05	3.4E-05	8.0E-06	2.5E-05	9.0E-05
Ru-103	5.2E-02	1.2E-02	4.0E-02	1.4E-01	4.4E-02	8.1E-03	3.3E-02	1.2E-01
Ru-106	1.2E-03	2.6E-04	9.5E-04	2.9E-03	1.0E-03	1.9E-04	7.7E-04	2.5E-03
Ag-108m	3.0E-01	6.9E-02	2.4E-01	7.3E-01	2.6E-01	4.8E-02	1.9E-01	7.0E-01
Cd-109	7.0E-04	1.8E-04	5.6E-04	1.5E-03	5.9E-04	1.4E-04	4.6E-04	1.5E-03
Ag-110m	4.9E-01	1.1E-01	3.8E-01	1.3E+00	4.2E-01	8.2E-02	3.2E-01	1.1E+00
Sb-124	2.6E-01	6.2E-02	2.0E-01	6.7E-01	2.3E-01	4.4E-02	1.7E-01	6.4E-01
I-125	6.1E-02	1.6E-02	5.0E-02	1.5E-01	5.2E-02	1.0E-02	3.9E-02	1.4E-01
Sb-125	7.5E-02	1.6E-02	6.1E-02	1.9E-01	6.4E-02	1.2E-02	4.8E-02	1.6E-01
I-129	3.5E-01	7.1E-02	2.5E-01	9.2E-01	3.0E-01	5.6E-02	2.2E-01	8.6E-01
I-131	5.6E-01	6.3E-02	3.5E-01	1.8E+00	4.8E-01	4.2E-02	3.0E-01	1.6E+00
Ba-133	3.1E+00	6.7E-01	2.4E+00	8.5E+00	2.7E+00	5.0E-01	1.9E+00	7.9E+00
Cs-134	2.8E+01	6.7E+00	2.2E+01	7.3E+01	2.5E+01	4.7E+00	1.8E+01	7.0E+01
Cs-137	7.3E-02	1.4E-02	5.3E-02	2.1E-01	6.3E-02	1.2E-02	4.5E-02	1.8E-01

Table G.9 Dose factors[a] for CU-REVS-HANDLIN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	4.1E-01	8.1E-02	3.2E-01	1.1E+00	3.5E-01	5.6E-02	2.6E-01	9.1E-01
Ce-144	2.2E-01	6.3E-02	1.8E-01	5.4E-01	1.9E-01	4.7E-02	1.5E-01	4.8E-01
Pm-147	6.8E-03	1.5E-03	5.2E-03	1.7E-02	5.8E-03	1.2E-03	4.2E-03	1.7E-02
Eu-152	1.6E+01	3.7E+00	1.3E+01	4.2E+01	1.4E+01	2.6E+00	1.1E+01	4.2E+01
Eu-154	1.8E+01	4.0E+00	1.3E+01	5.1E+01	1.5E+01	2.8E+00	1.1E+01	4.2E+01
Eu-155	4.3E-01	1.0E-01	3.3E-01	1.1E+00	3.7E-01	6.8E-02	2.7E-01	9.6E-01
Re-186	3.3E-05	5.1E-07	9.6E-06	1.6E-04	2.8E-05	4.0E-07	8.3E-06	1.4E-04
Ir-192	1.1E-01	2.3E-02	8.4E-02	2.9E-01	9.6E-02	1.7E-02	7.2E-02	2.6E-01
Pb-210	1.0E-01	1.9E-02	7.7E-02	2.6E-01	8.6E-02	1.4E-02	6.2E-02	2.5E-01
Po-210	3.6E-02	7.5E-03	2.8E-02	9.4E-02	3.1E-02	5.7E-03	2.3E-02	8.4E-02
Bi-210	1.9E-05	9.8E-07	8.1E-06	7.7E-05	1.6E-05	7.2E-07	6.7E-06	6.7E-05
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	2.1E-01	4.0E-02	1.5E-01	5.4E-01	1.8E-01	2.8E-02	1.2E-01	5.5E-01
Ra-224	3.4E-03	6.5E-05	1.1E-03	1.3E-02	2.8E-03	4.3E-05	9.3E-04	1.1E-02
Ac-225	2.9E-01	4.4E-02	1.9E-01	8.1E-01	2.5E-01	3.3E-02	1.6E-01	8.0E-01
Ra-225	1.4E-01	2.6E-02	1.0E-01	3.9E-01	1.2E-01	2.0E-02	8.3E-02	3.5E-01
Ra-226	9.5E+00	2.4E+00	7.4E+00	2.3E+01	8.2E+00	1.7E+00	5.9E+00	2.3E+01
Ac-227	2.6E+02	5.1E+01	2.0E+02	6.5E+02	2.3E+02	3.9E+01	1.7E+02	6.6E+02
Th-227	1.7E+00	3.4E-01	1.3E+00	4.0E+00	1.4E+00	2.7E-01	1.1E+00	3.7E+00
Th-228	9.3E+01	2.4E+01	7.4E+01	2.3E+02	8.0E+01	1.8E+01	6.1E+01	2.1E+02
Ra-228	5.7E+00	1.5E+00	4.2E+00	1.5E+01	4.8E+00	1.1E+00	3.6E+00	1.3E+01
Th-229	3.3E+02	6.2E+01	2.5E+02	9.3E+02	2.9E+02	5.2E+01	2.0E+02	8.1E+02
Th-230	5.0E+01	1.0E+01	3.6E+01	1.4E+02	4.3E+01	7.8E+00	2.9E+01	1.3E+02
Pa-231	1.8E+02	3.3E+01	1.4E+02	4.4E+02	1.6E+02	2.7E+01	1.1E+02	4.0E+02
Th-231	4.7E-07	1.1E-13	5.9E-10	2.7E-06	4.0E-07	7.3E-14	4.2E-10	2.2E-06
Th-232	2.2E+02	4.0E+01	1.6E+02	6.1E+02	1.9E+02	3.1E+01	1.4E+02	5.1E+02
Pa-233	1.5E+00	2.6E-01	1.2E+00	4.4E+00	1.3E+00	2.0E-01	9.9E-01	4.0E+00
U-233	2.5E+01	4.8E+00	2.0E+01	6.2E+01	2.1E+01	4.0E+00	1.6E+01	5.8E+01
Th-234	4.5E-02	1.0E-02	3.5E-02	1.2E-01	3.9E-02	7.8E-03	2.8E-02	1.1E-01
U-234	2.5E+01	4.3E+00	1.9E+01	6.6E+01	2.1E+01	3.4E+00	1.5E+01	6.1E+01
U-235	2.5E+01	5.7E+00	1.9E+01	6.2E+01	2.1E+01	4.1E+00	1.6E+01	6.1E+01
Np-237	1.1E+02	2.1E+01	8.3E+01	3.2E+02	9.4E+01	1.6E+01	6.6E+01	2.7E+02
Pu-238	5.5E+01	9.7E+00	4.1E+01	1.5E+02	4.8E+01	7.1E+00	3.4E+01	1.3E+02
U-238	2.3E+01	4.0E+00	1.6E+01	6.4E+01	2.0E+01	3.0E+00	1.4E+01	5.8E+01
Pu-239	5.8E+01	1.0E+01	4.4E+01	1.5E+02	5.0E+01	8.4E+00	3.6E+01	1.4E+02
Pu-240	5.7E+01	1.2E+01	4.2E+01	1.6E+02	4.9E+01	9.0E+00	3.6E+01	1.3E+02
Pu-241	9.4E-01	1.8E-01	7.0E-01	2.6E+00	8.1E-01	1.3E-01	5.7E-01	2.5E+00
Am-241	9.0E+01	1.8E+01	6.7E+01	2.4E+02	7.8E+01	1.4E+01	5.5E+01	2.1E+02
Cm-242	3.0E+00	6.3E-01	2.3E+00	7.6E+00	2.5E+00	5.0E-01	1.9E+00	6.9E+00
Pu-242	5.4E+01	9.7E+00	4.3E+01	1.2E+02	4.6E+01	8.0E+00	3.2E+01	1.2E+02
Cm-244	4.9E+01	9.8E+00	3.7E+01	1.3E+02	4.2E+01	7.4E+00	3.1E+01	1.1E+02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.10 Dose factors[a] for CU-CNVS-HANDLIN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	9.5E-04	4.0E-05	5.9E-04	3.3E-03	8.2E-04	3.1E-05	4.7E-04	3.0E-03
S-35	1.1E-04	6.0E-06	6.9E-05	3.2E-04	9.5E-05	5.3E-06	5.7E-05	3.2E-04
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.7E-01	3.5E-02	1.3E-01	4.7E-01	1.5E-01	2.6E-02	1.1E-01	3.9E-01
Mn-54	1.4E+01	3.1E+00	1.1E+01	3.6E+01	1.2E+01	2.2E+00	8.8E+00	3.0E+01
Fe-55	9.7E-04	1.9E-04	7.6E-04	2.5E-03	8.3E-04	1.5E-04	6.1E-04	2.2E-03
Co-57	1.3E+00	3.2E-01	9.9E-01	3.3E+00	1.1E+00	2.3E-01	8.1E-01	3.0E+00
Co-58	1.2E+01	2.7E+00	8.4E+00	3.1E+01	9.8E+00	1.9E+00	7.3E+00	2.7E+01
Fe-59	1.2E+01	2.6E+00	8.6E+00	3.0E+01	9.8E+00	2.0E+00	7.0E+00	2.7E+01
Ni-59	4.2E-04	1.0E-04	3.3E-04	9.8E-04	3.6E-04	8.2E-05	2.8E-04	9.0E-04
Co-60	4.6E+01	1.0E+01	3.7E+01	1.1E+02	4.0E+01	7.4E+00	3.0E+01	1.1E+02
Ni-63	1.1E-03	2.6E-04	8.8E-04	3.0E-03	9.7E-04	1.8E-04	7.5E-04	2.6E-03
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cu-67	3.9E-06	5.1E-10	9.6E-08	1.9E-05	3.3E-06	3.9E-10	8.2E-08	1.6E-05
Se-75	6.3E-01	4.7E-02	4.2E-01	1.9E+00	5.4E-01	3.9E-02	3.5E-01	1.7E+00
Sr-85	1.6E+00	3.3E-01	1.2E+00	4.0E+00	1.3E+00	2.4E-01	9.9E-01	3.7E+00
Sr-89	7.1E-03	1.9E-03	5.8E-03	1.6E-02	5.9E-03	1.3E-03	4.9E-03	1.4E-02
Sr-90	1.1E-01	2.9E-02	9.0E-02	2.9E-01	9.8E-02	2.0E-02	7.5E-02	2.5E-01
Y-91	1.5E-02	3.5E-03	1.2E-02	3.8E-02	1.3E-02	2.5E-03	9.4E-03	3.6E-02
Mo-93	8.4E-03	2.3E-03	6.7E-03	2.0E-02	7.1E-03	1.6E-03	5.7E-03	1.8E-02
Nb-93m	5.9E-03	1.5E-03	4.7E-03	1.4E-02	5.0E-03	1.1E-03	3.9E-03	1.3E-02
Nb-94	2.8E+01	6.7E+00	2.2E+01	6.9E+01	2.4E+01	5.3E+00	1.7E+01	6.2E+01
Nb-95	5.9E+00	1.2E+00	4.6E+00	1.4E+01	5.1E+00	8.1E-01	3.8E+00	1.3E+01
Zr-95	6.5E+00	1.4E+00	4.9E+00	1.8E+01	5.5E+00	1.1E+00	4.0E+00	1.5E+01
Tc-99	2.9E-03	7.0E-04	2.2E-03	7.0E-03	2.5E-03	4.7E-04	1.9E-03	6.4E-03
Ru-103	2.9E+00	5.6E-01	2.3E+00	7.2E+00	2.5E+00	4.4E-01	1.9E+00	7.1E+00
Ru-106	8.4E-02	1.9E-02	6.7E-02	2.0E-01	7.3E-02	1.5E-02	5.4E-02	2.0E-01
Ag-108m	2.2E-01	4.1E-02	1.6E-01	6.2E-01	1.9E-01	3.0E-02	1.3E-01	6.0E-01
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	3.5E-01	5.2E-02	2.5E-01	9.6E-01	3.0E-01	4.2E-02	2.1E-01	9.5E-01
Sb-124	2.0E+01	4.2E+00	1.7E+01	5.1E+01	1.7E+01	3.0E+00	1.4E+01	4.6E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	6.9E+00	1.6E+00	5.4E+00	1.6E+01	5.8E+00	1.2E+00	4.5E+00	1.4E+01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.6E+00	3.3E-01	1.3E+00	4.1E+00	1.4E+00	2.4E-01	1.0E+00	3.6E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.10 Dose factors[a] for CU-CNVS-HANDLIN-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	8.0E-02	1.6E-02	6.0E-02	2.1E-01	6.9E-02	1.1E-02	4.9E-02	1.9E-01
Ce-144	5.8E-02	1.4E-02	4.7E-02	1.4E-01	4.9E-02	1.0E-02	3.8E-02	1.3E-01
Pm-147	1.7E-03	3.9E-04	1.3E-03	4.2E-03	1.4E-03	2.8E-04	1.1E-03	3.5E-03
Eu-152	4.4E+00	9.2E-01	3.4E+00	1.1E+01	3.7E+00	7.1E-01	2.6E+00	9.7E+00
Eu-154	4.7E+00	1.1E+00	3.8E+00	1.2E+01	4.0E+00	7.8E-01	2.9E+00	1.1E+01
Eu-155	1.1E-01	2.3E-02	8.8E-02	2.8E-01	9.7E-02	1.8E-02	7.1E-02	2.7E-01
Re-186	3.5E-04	9.6E-07	4.6E-05	1.8E-03	2.9E-04	7.6E-07	3.8E-05	1.5E-03
Ir-192	7.1E-02	1.0E-02	5.4E-02	2.0E-01	6.1E-02	7.5E-03	4.2E-02	1.6E-01
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	3.9E-04	5.1E-06	9.4E-05	1.8E-03	3.3E-04	4.0E-06	7.9E-05	1.5E-03
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	7.6E-02	8.9E-03	4.5E-02	2.5E-01	6.5E-02	6.4E-03	3.8E-02	2.1E-01
Ra-224	4.4E-04	8.4E-07	4.6E-05	2.6E-03	3.8E-04	6.8E-07	4.2E-05	2.1E-03
Ac-225	2.1E-06	2.3E-08	6.2E-07	8.6E-06	1.9E-06	1.9E-08	5.4E-07	7.2E-06
Ra-225	5.9E-02	9.2E-03	3.8E-02	1.7E-01	5.0E-02	6.8E-03	3.1E-02	1.5E-01
Ra-226	7.6E+00	1.8E+00	6.1E+00	1.9E+01	6.6E+00	1.4E+00	4.7E+00	1.8E+01
Ac-227	4.3E-03	1.1E-04	1.9E-03	1.6E-02	3.7E-03	8.3E-05	1.5E-03	1.5E-02
Th-227	1.8E-02	7.3E-04	9.0E-03	5.7E-02	1.5E-02	5.9E-04	7.5E-03	5.2E-02
Th-228	1.7E+00	7.6E-02	1.0E+00	5.5E+00	1.4E+00	5.9E-02	8.4E-01	4.5E+00
Ra-228	4.5E+00	1.1E+00	3.5E+00	1.1E+01	3.9E+00	7.9E-01	3.0E+00	9.8E+00
Th-229	5.9E+00	2.9E-01	3.3E+00	2.0E+01	5.1E+00	1.9E-01	2.7E+00	1.7E+01
Th-230	8.9E-01	3.9E-02	4.9E-01	3.1E+00	7.9E-01	2.7E-02	3.9E-01	2.9E+00
Pa-231	3.0E+00	1.3E-01	1.8E+00	1.0E+01	2.7E+00	9.6E-02	1.5E+00	9.3E+00
Th-231	2.8E-11	6.8E-22	2.7E-16	1.3E-10	2.4E-11	5.2E-22	2.1E-16	1.2E-10
Th-232	3.9E+00	1.5E-01	2.3E+00	1.4E+01	3.5E+00	1.2E-01	1.8E+00	1.3E+01
Pa-233	1.9E-02	8.6E-04	1.1E-02	7.0E-02	1.7E-02	7.5E-04	8.8E-03	5.5E-02
U-233	4.1E-01	1.8E-02	2.6E-01	1.4E+00	3.5E-01	1.6E-02	2.0E-01	1.2E+00
Th-234	5.3E-04	2.4E-05	3.1E-04	1.8E-03	4.5E-04	2.0E-05	2.5E-04	1.5E-03
U-234	4.4E-01	1.8E-02	2.5E-01	1.5E+00	3.8E-01	1.3E-02	2.1E-01	1.3E+00
U-235	4.5E-01	2.1E-02	2.6E-01	1.4E+00	3.9E-01	1.7E-02	2.1E-01	1.4E+00
Np-237	1.9E+00	7.8E-02	1.1E+00	6.0E+00	1.6E+00	6.1E-02	9.1E-01	5.7E+00
Pu-238	9.1E-01	4.5E-02	5.6E-01	2.9E+00	7.6E-01	3.5E-02	4.7E-01	2.6E+00
U-238	4.0E-01	1.5E-02	2.1E-01	1.4E+00	3.5E-01	1.2E-02	1.8E-01	1.4E+00
Pu-239	9.9E-01	3.8E-02	5.9E-01	3.5E+00	8.6E-01	3.2E-02	4.9E-01	2.9E+00
Pu-240	1.0E+00	4.3E-02	6.1E-01	3.4E+00	8.6E-01	3.6E-02	4.9E-01	2.9E+00
Pu-241	1.6E-02	6.3E-04	9.3E-03	5.5E-02	1.4E-02	5.9E-04	7.5E-03	4.7E-02
Am-241	1.5E+00	6.2E-02	9.5E-01	5.0E+00	1.3E+00	4.9E-02	7.6E-01	4.3E+00
Cm-242	5.0E-02	2.2E-03	2.7E-02	1.9E-01	4.3E-02	1.8E-03	2.3E-02	1.8E-01
Pu-242	9.9E-01	3.9E-02	5.7E-01	3.5E+00	8.8E-01	3.0E-02	4.4E-01	3.1E+00
Cm-244	7.7E-01	2.6E-02	5.0E-01	2.3E+00	6.6E-01	2.5E-02	4.0E-01	2.2E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.11 Dose factors[a] for CU-ELRS-HANDLIN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	2.6E-04	4.6E-06	1.1E-04	1.1E-03	2.3E-04	3.8E-06	8.8E-05	9.6E-04
S-35	5.4E-05	1.1E-06	2.7E-05	1.8E-04	4.6E-05	8.7E-07	2.2E-05	1.7E-04
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	5.3E-02	8.9E-03	3.5E-02	1.5E-01	4.5E-02	6.7E-03	3.0E-02	1.3E-01
Mn-54	5.6E+00	1.2E+00	4.0E+00	1.4E+01	4.6E+00	9.3E-01	3.3E+00	1.3E+01
Fe-55	4.0E-04	7.3E-05	2.8E-04	1.0E-03	3.5E-04	5.5E-05	2.4E-04	9.8E-04
Co-57	5.3E-01	1.1E-01	4.0E-01	1.5E+00	4.5E-01	8.1E-02	3.2E-01	1.3E+00
Co-58	4.2E+00	7.9E-01	3.0E+00	1.1E+01	3.5E+00	5.9E-01	2.3E+00	1.0E+01
Fe-59	3.8E+00	7.6E-01	2.7E+00	1.1E+01	3.2E+00	5.7E-01	2.2E+00	9.6E+00
Ni-59	1.8E-04	3.5E-05	1.3E-04	4.6E-04	1.6E-04	2.6E-05	1.1E-04	4.5E-04
Co-60	1.9E+01	4.2E+00	1.4E+01	4.8E+01	1.6E+01	3.2E+00	1.2E+01	4.6E+01
Ni-63	4.7E-04	1.0E-04	3.5E-04	1.2E-03	4.0E-04	7.0E-05	2.8E-04	1.1E-03
Zn-65	3.7E+00	7.4E-01	2.9E+00	1.0E+01	3.1E+00	5.8E-01	2.3E+00	8.7E+00
Cu-67	4.4E-07	9.9E-13	1.3E-09	2.0E-06	4.0E-07	7.6E-13	1.1E-09	1.7E-06
Se-75	3.5E-01	8.5E-03	1.6E-01	1.4E+00	3.0E-01	6.1E-03	1.4E-01	1.1E+00
Sr-85	5.0E+00	9.7E-01	3.8E+00	1.3E+01	4.3E+00	6.8E-01	3.2E+00	1.2E+01
Sr-89	2.2E-02	5.3E-03	1.6E-02	5.9E-02	1.9E-02	3.7E-03	1.3E-02	5.1E-02
Sr-90	4.3E-01	1.0E-01	3.0E-01	1.2E+00	3.7E-01	7.2E-02	2.5E-01	1.1E+00
Y-91	1.6E-02	3.4E-03	1.2E-02	4.2E-02	1.3E-02	2.4E-03	9.2E-03	3.7E-02
Mo-93	3.5E-03	8.4E-04	2.6E-03	8.6E-03	3.0E-03	5.9E-04	2.3E-03	8.2E-03
Nb-93m	2.5E-03	5.1E-04	1.9E-03	6.3E-03	2.2E-03	3.9E-04	1.5E-03	5.6E-03
Nb-94	1.2E+01	2.4E+00	8.9E+00	3.4E+01	1.0E+01	1.9E+00	6.9E+00	2.9E+01
Nb-95	1.9E+00	3.2E-01	1.3E+00	5.3E+00	1.6E+00	2.4E-01	1.1E+00	4.9E+00
Zr-95	2.6E+00	4.7E-01	1.9E+00	7.3E+00	2.2E+00	3.5E-01	1.5E+00	6.3E+00
Tc-99	1.4E-03	2.9E-04	9.7E-04	3.7E-03	1.2E-03	2.2E-04	8.0E-04	3.5E-03
Ru-103	1.1E+00	1.7E-01	7.7E-01	2.8E+00	9.1E-01	1.1E-01	6.3E-01	2.5E+00
Ru-106	3.8E-02	8.6E-03	2.7E-02	1.1E-01	3.2E-02	6.0E-03	2.3E-02	8.9E-02
Ag-108m	1.2E+02	2.5E+01	8.2E+01	2.9E+02	9.9E+01	1.7E+01	6.9E+01	2.7E+02
Cd-109	2.6E-02	6.2E-03	2.0E-02	6.4E-02	2.2E-02	4.6E-03	1.6E-02	5.7E-02
Ag-110m	1.7E+02	3.9E+01	1.4E+02	4.2E+02	1.4E+02	2.9E+01	1.1E+02	3.6E+02
Sb-124	7.6E+00	1.5E+00	5.2E+00	2.1E+01	6.5E+00	1.1E+00	4.3E+00	1.8E+01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.9E+00	6.0E-01	2.1E+00	7.5E+00	2.4E+00	4.9E-01	1.7E+00	6.6E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0:0E+00
Ba-133	6.2E+00	1.2E+00	4.4E+00	1.7E+01	5.3E+00	9.5E-01	3.6E+00	1.5E+01
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.11 Dose factors[a] for CU-ELRS-HANDLIN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm^2)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	7.4E-02	1.1E-02	5.2E-02	2.1E-01	6.3E-02	9.1E-03	4.1E-02	1.8E-01
Ce-144	7.0E-02	1.6E-02	5.1E-02	1.8E-01	6.0E-02	1.2E-02	4.4E-02	1.6E-01
Pm-147	2.1E-03	4.3E-04	1.5E-03	5.9E-03	1.9E-03	3.1E-04	1.3E-03	5.5E-03
Eu-152	5.3E+00	1.1E+00	4.0E+00	1.4E+01	4.5E+00	8.4E-01	3.3E+00	1.2E+01
Eu-154	6.0E+00	1.2E+00	4.4E+00	1.7E+01	5.1E+00	9.3E-01	3.5E+00	1.6E+01
Eu-155	1.4E-01	2.7E-02	1.0E-01	3.5E-01	1.2E-01	2.1E-02	8.4E-02	3.3E-01
Re-186	3.3E-05	8.6E-09	1.1E-06	1.7E-04	3.1E-05	6.1E-09	9.1E-07	1.6E-04
Ir-192	3.2E+01	7.1E+00	2.3E+01	7.5E+01	2.8E+01	5.5E+00	1.8E+01	7.4E+01
Pb-210	3.8E+00	7.7E-01	2.8E+00	9.2E+00	3.3E+00	5.9E-01	2.3E+00	8.8E+00
Po-210	1.1E+00	2.0E-01	7.7E-01	2.6E+00	9.0E-01	1.5E-01	6.6E-01	2.5E+00
Bi-210	5.0E-05	8.6E-08	4.4E-06	2.8E-04	4.4E-05	7.8E-08	3.6E-06	2.6E-04
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	4.9E-02	3.0E-03	2.3E-02	1.7E-01	4.3E-02	2.4E-03	1.8E-02	1.6E-01
Ra-224	9.7E-05	2.2E-08	3.4E-06	5.8E-04	8.7E-05	1.8E-08	3.0E-06	4.9E-04
Ac-225	6.1E-05	2.4E-07	1.3E-05	2.8E-04	5.5E-05	2.1E-07	1.0E-05	2.1E-04
Ra-225	4.3E-02	3.4E-03	2.4E-02	1.4E-01	3.8E-02	2.9E-03	1.9E-02	1.4E-01
Ra-226	9.7E+00	2.2E+00	7.1E+00	2.5E+01	8.2E+00	1.7E+00	5.6E+00	2.3E+01
Ac-227	2.8E-01	3.8E-03	1.2E-01	1.2E+00	2.6E-01	3.0E-03	9.3E-02	1.1E+00
Th-227	6.6E-04	6.6E-06	2.5E-04	2.4E-03	5.7E-04	5.2E-06	2.1E-04	2.3E-03
Th-228	9.2E-02	1.4E-03	4.8E-02	3.2E-01	8.1E-02	1.1E-03	3.9E-02	2.8E-01
Ra-228	5.6E+00	1.2E+00	4.3E+00	1.6E+01	4.7E+00	9.6E-01	3.5E+00	1.3E+01
Th-229	3.5E-01	5.6E-03	1.6E-01	1.3E+00	3.0E-01	3.5E-03	1.2E-01	1.0E+00
Th-230	5.3E-02	5.6E-04	2.2E-02	1.9E-01	4.8E-02	4.1E-04	1.8E-02	1.7E-01
Pa-231	2.0E-01	2.3E-03	9.6E-02	8.4E-01	1.7E-01	1.7E-03	7.4E-02	7.2E-01
Th-231	1.3E-14	1.9E-29	5.5E-22	4.0E-14	1.2E-14	1.4E-29	4.8E-22	3.4E-14
Th-232	2.3E-01	3.1E-03	9.5E-02	9.0E-01	1.9E-01	2.5E-03	7.4E-02	7.1E-01
Pa-233	9.4E-04	9.8E-06	3.3E-04	3.7E-03	8.2E-04	6.9E-06	2.8E-04	3.5E-03
U-233	2.9E-02	2.8E-04	1.1E-02	1.2E-01	2.5E-02	1.9E-04	8.7E-03	1.0E-01
Th-234	2.2E-05	2.7E-07	8.7E-06	8.8E-05	1.9E-05	2.0E-07	7.3E-06	7.7E-05
U-234	2.7E-02	3.4E-04	1.1E-02	1.1E-01	2.4E-02	2.5E-04	9.5E-03	9.5E-02
U-235	2.7E-02	3.3E-04	1.2E-02	9.9E-02	2.4E-02	2.4E-04	9.7E-03	8.7E-02
Np-237	1.2E-01	1.5E-03	4.6E-02	4.8E-01	1.0E-01	1.1E-03	4.0E-02	3.8E-01
Pu-238	5.7E-02	7.2E-04	2.4E-02	2.6E-01	5.1E-02	5.8E-04	2.0E-02	2.2E-01
U-238	2.4E-02	2.5E-04	9.8E-03	9.4E-02	2.1E-02	2.1E-04	7.5E-03	7.9E-02
Pu-239	6.5E-02	6.2E-04	2.6E-02	2.4E-01	5.6E-02	5.4E-04	2.1E-02	2.1E-01
Pu-240	6.6E-02	8.2E-04	2.4E-02	2.5E-01	5.8E-02	6.8E-04	1.9E-02	2.4E-01
Pu-241	9.7E-04	1.1E-05	4.0E-04	3.6E-03	8.4E-04	7.1E-06	3.4E-04	3.0E-03
Am-241	9.9E-02	1.2E-03	4.2E-02	3.7E-01	8.7E-02	8.9E-04	3.2E-02	3.5E-01
Cm-242	2.7E-03	4.1E-05	1.2E-03	1.0E-02	2.4E-03	3.1E-05	9.2E-04	9.1E-03
Pu-242	5.5E-02	7.9E-04	2.4E-02	2.3E-01	4.8E-02	5.7E-04	1.9E-02	1.7E-01
Cm-244	5.8E-02	6.7E-04	2.0E-02	2.2E-01	5.1E-02	5.4E-04	1.7E-02	1.9E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm^2), multiply by 3.70 E-03

Table G.12 Dose factors[a] for CU-ATMO-REVERAT-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	5.6E-04	6.1E-05	4.1E-04	1.7E-03	4.8E-04	4.5E-05	3.3E-04	1.4E-03
C-14	1.6E-02	1.7E-03	1.1E-02	5.1E-02	1.4E-02	1.3E-03	8.4E-03	4.6E-02
Na-22	1.3E-04	4.2E-05	1.1E-04	2.9E-04	1.1E-04	3.0E-05	8.9E-05	2.8E-04
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	5.2E-02	4.6E-03	3.4E-02	1.6E-01	4.4E-02	4.5E-03	2.8E-02	1.3E-01
K-40	3.9E-05	1.2E-05	3.3E-05	8.3E-05	3.4E-05	9.2E-06	2.7E-05	7.9E-05
Ca-41	8.9E-08	2.4E-08	7.3E-08	2.0E-07	7.5E-08	1.8E-08	5.9E-08	1.9E-07
Ca-45	1.2E-07	3.4E-08	9.5E-08	2.8E-07	1.0E-07	2.6E-08	7.9E-08	2.6E-07
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	4.5E-05	1.4E-05	3.8E-05	9.7E-05	3.9E-05	1.0E-05	3.1E-05	8.9E-05
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	2.4E-02	2.2E-03	1.6E-02	7.7E-02	2.0E-02	1.7E-03	1.3E-02	5.9E-02
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	4.4E-01	4.4E-02	3.1E-01	1.3E+00	3.7E-01	4.0E-02	2.6E-01	1.1E+00
I-131	1.7E-03	1.2E-04	9.0E-04	6.0E-03	1.5E-03	8.7E-05	7.8E-04	5.0E-03
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	7.8E-05	2.4E-05	6.6E-05	1.7E-04	6.6E-05	1.8E-05	5.3E-05	1.5E-04
Cs-137	1.2E-04	3.8E-05	1.0E-04	2.6E-04	1.1E-04	2.8E-05	8.1E-05	2.5E-04

Table G.12 Dose factors[a] for CU-ATMO-REVERAT-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.13 Dose factors[a] for CU-ATMO-CONVERT-N

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	9.4E-06	2.9E-07	5.0E-06	3.3E-05	8.4E-06	2.0E-07	4.0E-06	2.8E-05
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.0E-03	2.5E-04	7.5E-04	2.5E-03	8.6E-04	1.8E-04	6.3E-04	2.2E-03
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	1.9E-04	5.4E-05	1.5E-04	4.5E-04	1.6E-04	3.7E-05	1.2E-04	4.1E-04
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.13 Dose factors[a] for CU-ATMO-CONVERT-N

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	5.0E-02	1.1E-02	3.4E-02	1.0E-01	4.3E-02	8.0E-03	2.8E-02	9.2E-02
Po-210	8.2E-03	2.0E-03	6.5E-03	2.1E-02	7.0E-03	1.6E-03	4.9E-03	1.8E-02
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.14 Dose factors[a] for CU-REVD-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	3.5E+00	1.1E+00	2.8E+00	7.6E+00	3.0E+00	7.7E-01	2.4E+00	6.9E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	2.7E-02	7.3E-03	2.2E-02	6.9E-02	2.3E-02	5.1E-03	1.8E-02	5.8E-02
K-40	2.7E-01	7.5E-02	2.1E-01	6.3E-01	2.3E-01	5.3E-02	1.8E-01	5.5E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.2E-05	6.2E-06	1.8E-05	4.9E-05	1.9E-05	4.4E-06	1.4E-05	4.8E-05
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	4.5E+00	1.2E+00	3.6E+00	1.0E+01	3.9E+00	8.6E-01	3.0E+00	9.7E+00
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	2.5E+00	7.2E-01	2.1E+00	5.6E+00	2.1E+00	5.6E-01	1.7E+00	5.0E+00
Cs-137	1.0E+00	2.8E-01	8.1E-01	2.3E+00	8.6E-01	2.1E-01	6.6E-01	2.1E+00

Table G.14 Dose factors[a] for CU-REVD-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.15 Dose factors[a] for CU-CNVD-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	7.8E+01	2.2E+01	6.4E+01	1.9E+02	6.7E+01	1.5E+01	5.0E+01	1.6E+02
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	1.0E-02	3.1E-03	8.0E-03	2.5E-02	8.9E-03	2.2E-03	6.7E-03	2.3E-02
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.15 Dose factors[a] for CU-CNVD-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	2.5E-02	7.0E-03	2.0E-02	5.8E-02	2.1E-02	4.9E-03	1.6E-02	5.4E-02
Po-210	8.0E-04	2.0E-04	6.3E-04	1.9E-03	6.9E-04	1.5E-04	5.1E-04	1.8E-03
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.16 Dose factors[a] for CU-SCRP-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.2E-04	2.6E-04	4.1E-04	5.8E-04	3.6E-04	1.8E-04	3.3E-04	6.1E-04
Na-22	2.2E+02	1.4E+02	2.2E+02	3.1E+02	1.9E+02	9.3E+01	1.8E+02	3.2E+02
P-32	1.3E-01	8.2E-02	1.3E-01	1.8E-01	1.1E-01	5.4E-02	1.0E-01	1.9E-01
S-35	4.3E-04	2.8E-04	4.3E-04	6.1E-04	3.7E-04	1.8E-04	3.4E-04	6.3E-04
Cl-36	3.4E-02	2.1E-02	3.4E-02	4.8E-02	2.9E-02	1.4E-02	2.7E-02	5.0E-02
K-40	1.6E+01	1.0E+01	1.6E+01	2.3E+01	1.4E+01	6.9E+00	1.3E+01	2.4E+01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.5E-03	9.6E-04	1.5E-03	2.1E-03	1.3E-03	6.4E-04	1.2E-03	2.2E-03
Cr-51	2.5E+00	1.6E+00	2.5E+00	3.4E+00	2.1E+00	1.0E+00	2.0E+00	3.5E+00
Mn-54	8.5E+01	5.4E+01	8.5E+01	1.2E+02	7.3E+01	3.6E+01	6.8E+01	1.3E+02
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.8E+00	2.4E+00	3.8E+00	5.3E+00	3.3E+00	1.6E+00	3.0E+00	5.6E+00
Co-58	9.5E+01	6.1E+01	9.5E+01	1.3E+02	8.1E+01	4.0E+01	7.5E+01	1.4E+02
Fe-59	1.1E+02	7.3E+01	1.2E+02	1.6E+02	9.8E+01	4.8E+01	9.1E+01	1.7E+02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.5E+02	1.6E+02	2.5E+02	3.6E+02	2.2E+02	1.1E+02	2.0E+02	3.8E+02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.0E+01	3.8E+01	6.0E+01	8.4E+01	5.1E+01	2.5E+01	4.7E+01	8.8E+01
Cu-67	2.1E+00	1.0E+00	1.9E+00	3.6E+00	1.8E+00	6.8E-01	1.6E+00	3.3E+00
Se-75	2.4E+01	1.6E+01	2.5E+01	3.4E+01	2.1E+01	1.0E+01	1.9E+01	3.6E+01
Sr-85	4.7E+01	3.0E+01	4.7E+01	6.6E+01	4.0E+01	2.0E+01	3.7E+01	6.9E+01
Sr-89	1.2E-01	7.4E-02	1.2E-01	1.6E-01	9.9E-02	4.9E-02	9.2E-02	1.7E-01
Sr-90	1.3E-02	8.0E-03	1.3E-02	1.8E-02	1.1E-02	5.4E-03	1.0E-02	1.9E-02
Y-91	3.5E-01	2.2E-01	3.5E-01	4.8E-01	3.0E-01	1.5E-01	2.7E-01	5.0E-01
Mo-93	4.3E-04	2.7E-04	4.3E-04	6.0E-04	3.6E-04	1.8E-04	3.4E-04	6.3E-04
Nb-93m	7.2E-05	4.5E-05	7.2E-05	1.0E-04	6.1E-05	3.0E-05	5.7E-05	1.1E-04
Nb-94	1.6E+02	1.0E+02	1.6E+02	2.3E+02	1.4E+02	6.9E+01	1.3E+02	2.4E+02
Nb-95	7.2E+01	4.6E+01	7.3E+01	1.0E+02	6.2E+01	3.0E+01	5.8E+01	1.0E+02
Zr-95	7.2E+01	4.6E+01	7.2E+01	1.0E+02	6.2E+01	3.0E+01	5.7E+01	1.1E+02
Tc-99	2.8E-03	1.8E-03	2.8E-03	3.9E-03	2.4E-03	1.2E-03	2.2E-03	4.2E-03
Ru-103	4.6E+01	2.9E+01	4.7E+01	6.5E+01	4.0E+01	1.9E+01	3.7E+01	6.7E+01
Ru-106	2.1E+01	1.3E+01	2.1E+01	2.9E+01	1.8E+01	8.7E+00	1.6E+01	3.0E+01
Ag-108m	1.6E+02	1.0E+02	1.6E+02	2.3E+02	1.4E+02	6.9E+01	1.3E+02	2.4E+02
Cd-109	7.2E-03	4.5E-03	7.2E-03	1.0E-02	6.1E-03	3.0E-03	5.7E-03	1.1E-02
Ag-110m	2.8E+02	1.8E+02	2.8E+02	4.0E+02	2.4E+02	1.2E+02	2.2E+02	4.2E+02
Sb-124	1.8E+02	1.2E+02	1.8E+02	2.5E+02	1.5E+02	7.6E+01	1.4E+02	2.6E+02
I-125	6.5E-02	4.2E-02	6.5E-02	9.1E-02	5.6E-02	2.7E-02	5.2E-02	9.5E-02
Sb-125	4.1E+01	2.6E+01	4.1E+01	5.7E+01	3.5E+01	1.7E+01	3.2E+01	6.0E+01
I-129	5.1E-02	3.2E-02	5.1E-02	7.1E-02	4.4E-02	2.2E-02	4.1E-02	7.5E-02
I-131	2.5E+01	1.5E+01	2.5E+01	3.6E+01	2.1E+01	1.0E+01	2.0E+01	3.6E+01
Ba-133	2.8E+01	1.8E+01	2.8E+01	3.9E+01	2.4E+01	1.2E+01	2.2E+01	4.1E+01
Cs-134	1.6E+02	1.0E+02	1.6E+02	2.2E+02	1.4E+02	6.8E+01	1.3E+02	2.4E+02
Cs-137	6.2E+01	3.9E+01	6.2E+01	8.6E+01	5.3E+01	2.6E+01	4.9E+01	9.1E+01

Table G.16 Dose factors[a] for CU-SCRP-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.7E+00	1.7E+00	2.7E+00	3.8E+00	2.3E+00	1.1E+00	2.2E+00	3.9E+00
Ce-144	3.3E+00	2.1E+00	3.3E+00	4.6E+00	2.8E+00	1.4E+00	2.6E+00	4.8E+00
Pm-147	1.1E-04	6.6E-05	1.0E-04	1.5E-04	9.0E-05	4.4E-05	8.4E-05	1.5E-04
Eu-152	1.1E+02	7.0E+01	1.1E+02	1.6E+02	9.5E+01	4.7E+01	8.9E+01	1.6E+02
Eu-154	1.2E+02	7.6E+01	1.2E+02	1.7E+02	1.0E+02	5.1E+01	9.7E+01	1.8E+02
Eu-155	1.1E+00	6.7E-01	1.1E+00	1.5E+00	9.1E-01	4.5E-01	8.5E-01	1.6E+00
Re-186	2.5E-01	1.3E-01	2.4E-01	3.9E-01	2.1E-01	9.0E-02	2.0E-01	3.6E-01
Ir-192	7.1E+01	4.5E+01	7.1E+01	9.9E+01	6.1E+01	3.0E+01	5.6E+01	1.0E+02
Pb-210	1.6E-02	1.0E-02	1.6E-02	2.2E-02	1.4E-02	6.8E-03	1.3E-02	2.4E-02
Po-210	8.3E-04	5.3E-04	8.3E-04	1.2E-03	7.1E-04	3.5E-04	6.6E-04	1.2E-03
Bi-210	3.1E-02	1.7E-02	3.0E-02	4.7E-02	2.7E-02	1.2E-02	2.5E-02	4.5E-02
Rn-222	8.6E+01	4.6E+01	8.2E+01	1.3E+02	7.3E+01	3.1E+01	6.9E+01	1.3E+02
Ra-223	1.8E+01	1.1E+01	1.8E+01	2.6E+01	1.5E+01	7.4E+00	1.5E+01	2.6E+01
Ra-224	6.1E+01	3.3E+01	5.8E+01	9.7E+01	5.2E+01	2.2E+01	4.9E+01	9.0E+01
Ac-225	1.4E+01	8.6E+00	1.4E+01	2.0E+01	1.2E+01	5.7E+00	1.1E+01	2.0E+01
Ra-225	3.2E-02	2.0E-02	3.1E-02	4.4E-02	2.7E-02	1.3E-02	2.5E-02	4.5E-02
Ra-226	1.7E+02	1.1E+02	1.7E+02	2.4E+02	1.5E+02	7.4E+01	1.4E+02	2.6E+02
Ac-227	1.0E+01	6.5E+00	1.0E+01	1.4E+01	8.8E+00	4.4E+00	8.2E+00	1.5E+01
Th-227	5.9E+00	3.7E+00	5.8E+00	8.2E+00	5.0E+00	2.4E+00	4.7E+00	8.4E+00
Th-228	1.3E+02	8.0E+01	1.3E+02	1.8E+02	1.1E+02	5.4E+01	1.0E+02	1.9E+02
Ra-228	8.4E+01	5.3E+01	8.4E+01	1.2E+02	7.2E+01	3.6E+01	6.7E+01	1.2E+02
Th-229	7.9E+00	5.0E+00	7.8E+00	1.1E+01	6.7E+00	3.3E+00	6.3E+00	1.2E+01
Th-230	2.3E-03	1.4E-03	2.3E-03	3.2E-03	2.0E-03	9.7E-04	1.8E-03	3.4E-03
Pa-231	2.1E+00	1.3E+00	2.0E+00	2.9E+00	1.8E+00	8.7E-01	1.6E+00	3.0E+00
Th-231	1.5E-02	3.3E-03	1.1E-02	3.8E-02	1.3E-02	2.3E-03	9.3E-03	3.5E-02
Th-232	6.0E-01	3.7E-01	5.9E-01	8.3E-01	5.1E-01	2.5E-01	4.7E-01	8.8E-01
Pa-233	1.3E+01	8.4E+00	1.3E+01	1.8E+01	1.1E+01	5.5E+00	1.1E+01	1.9E+01
U-233	2.0E-05	1.3E-05	2.0E-05	2.8E-05	1.7E-05	8.6E-06	1.6E-05	3.0E-05
Th-234	7.3E-01	4.6E-01	7.3E-01	1.0E+00	6.2E-01	3.0E-01	5.8E-01	1.0E+00
U-234	3.7E-04	2.3E-04	3.7E-04	5.2E-04	3.2E-04	1.6E-04	3.0E-04	5.5E-04
U-235	8.2E+00	5.1E+00	8.2E+00	1.1E+01	7.0E+00	3.5E+00	6.5E+00	1.2E+01
Np-237	6.2E+00	3.9E+00	6.2E+00	8.7E+00	5.3E+00	2.6E+00	5.0E+00	9.2E+00
Pu-238	1.2E-04	7.4E-05	1.2E-04	1.6E-04	1.0E-04	5.0E-05	9.3E-05	1.7E-04
U-238	3.3E-01	2.1E-01	3.3E-01	4.6E-01	2.8E-01	1.4E-01	2.6E-01	4.8E-01
Pu-239	4.5E-05	2.8E-05	4.5E-05	6.2E-05	3.8E-05	1.9E-05	3.6E-05	6.6E-05
Pu-240	3.9E-04	2.4E-04	3.9E-04	5.4E-04	3.3E-04	1.6E-04	3.1E-04	5.7E-04
Pu-241	5.3E-05	3.4E-05	5.3E-05	7.5E-05	4.6E-05	2.3E-05	4.3E-05	7.9E-05
Am-241	1.5E-01	9.4E-02	1.5E-01	2.1E-01	1.3E-01	6.3E-02	1.2E-01	2.2E-01
Cm-242	1.7E-04	1.1E-04	1.7E-04	2.4E-04	1.5E-04	7.2E-05	1.3E-04	2.5E-04
Pu-242	2.0E-04	1.3E-04	2.0E-04	2.8E-04	1.7E-04	8.5E-05	1.6E-04	3.0E-04
Cm-244	1.5E-04	9.5E-05	1.5E-04	2.1E-04	1.3E-04	6.4E-05	1.2E-04	2.2E-04

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.17 Dose factors[a] for CU-REVM-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	6.8E-05	3.3E-06	3.8E-05	2.4E-04	5.7E-05	3.0E-06	3.0E-05	2.0E-04
S-35	9.1E-07	6.6E-08	6.6E-07	2.5E-06	7.8E-07	4.8E-08	5.3E-07	2.2E-06
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.8E-02	4.7E-03	1.5E-02	4.3E-02	1.5E-02	3.4E-03	1.2E-02	4.1E-02
Mn-54	1.5E+00	4.8E-01	1.2E+00	3.1E+00	1.3E+00	3.4E-01	1.0E+00	3.1E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	6.5E-02	2.1E-02	5.5E-02	1.4E-01	5.5E-02	1.4E-02	4.4E-02	1.2E-01
Co-58	1.2E+00	3.9E-01	9.9E-01	2.8E+00	1.0E+00	2.7E-01	8.5E-01	2.5E+00
Fe-59	1.2E+00	3.6E-01	9.4E-01	2.7E+00	1.0E+00	2.6E-01	8.1E-01	2.5E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	4.7E+00	1.6E+00	3.9E+00	9.9E+00	4.0E+00	1.1E+00	3.3E+00	9.3E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	9.7E-01	3.1E-01	8.3E-01	2.1E+00	8.2E-01	2.3E-01	6.8E-01	1.9E+00
Cu-67	2.4E-05	3.0E-09	7.0E-07	1.4E-04	2.0E-05	2.3E-09	5.4E-07	1.2E-04
Se-75	5.8E-02	3.9E-03	4.0E-02	1.8E-01	5.1E-02	2.9E-03	3.3E-02	1.7E-01
Sr-85	3.0E-01	8.4E-02	2.4E-01	6.4E-01	2.5E-01	6.2E-02	2.1E-01	6.4E-01
Sr-89	6.6E-04	2.0E-04	5.2E-04	1.6E-03	5.7E-04	1.4E-04	4.3E-04	1.4E-03
Sr-90	1.2E-04	3.6E-05	1.0E-04	2.7E-04	1.1E-04	2.7E-05	8.2E-05	2.6E-04
Y-91	1.0E-03	3.0E-04	8.6E-04	2.4E-03	8.9E-04	2.2E-04	7.0E-04	2.2E-03
Mo-93	8.0E-06	2.7E-06	6.9E-06	1.7E-05	6.9E-06	2.1E-06	5.4E-06	1.7E-05
Nb-93m	1.4E-06	4.3E-07	1.1E-06	2.9E-06	1.2E-06	3.2E-07	9.0E-07	2.8E-06
Nb-94	3.1E+00	1.0E+00	2.5E+00	6.5E+00	2.6E+00	7.3E-01	2.1E+00	6.3E+00
Nb-95	6.4E-01	1.7E-01	5.2E-01	1.5E+00	5.5E-01	1.4E-01	4.2E-01	1.4E+00
Zr-95	7.8E-01	2.2E-01	6.3E-01	1.8E+00	6.7E-01	1.6E-01	5.3E-01	1.6E+00
Tc-99	4.6E-05	1.5E-05	3.7E-05	1.0E-04	3.9E-05	1.1E-05	3.0E-05	9.8E-05
Ru-103	3.8E-01	1.1E-01	3.1E-01	8.7E-01	3.3E-01	8.2E-02	2.6E-01	8.2E-01
Ru-106	3.1E-01	1.0E-01	2.7E-01	6.7E-01	2.6E-01	7.2E-02	2.2E-01	5.8E-01
Ag-108m	3.0E+00	1.0E+00	2.6E+00	6.5E+00	2.6E+00	7.0E-01	2.1E+00	6.2E+00
Cd-109	1.3E-04	4.0E-05	1.1E-04	2.7E-04	1.1E-04	2.9E-05	8.9E-05	2.5E-04
Ag-110m	4.8E+00	1.6E+00	3.9E+00	1.1E+01	4.1E+00	1.1E+00	3.3E+00	9.8E+00
Sb-124	2.2E+00	6.7E-01	1.8E+00	4.7E+00	1.9E+00	4.3E-01	1.5E+00	4.4E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	7.4E-01	2.5E-01	6.2E-01	1.6E+00	6.3E-01	1.7E-01	5.1E-01	1.5E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	2.6E-01	8.0E-02	2.3E-01	5.5E-01	2.2E-01	5.4E-02	1.8E-01	5.4E-01
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.17 Dose factors[a] for CU-REVM-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	5.7E-03	1.6E-03	4.6E-03	1.3E-02	4.9E-03	1.2E-03	3.7E-03	1.2E-02
Ce-144	1.4E-02	4.5E-03	1.2E-02	3.2E-02	1.2E-02	3.2E-03	9.8E-03	2.9E-02
Pm-147	4.9E-07	1.5E-07	4.2E-07	1.1E-06	4.2E-07	1.1E-07	3.5E-07	1.0E-06
Eu-152	5.3E-01	1.7E-01	4.4E-01	1.2E+00	4.6E-01	1.2E-01	3.6E-01	1.1E+00
Eu-154	5.7E-01	2.0E-01	4.6E-01	1.3E+00	4.9E-01	1.5E-01	3.7E-01	1.2E+00
Eu-155	5.1E-03	1.5E-03	4.1E-03	1.2E-02	4.3E-03	1.1E-03	3.5E-03	9.9E-03
Re-186	1.9E-05	5.1E-08	2.2E-06	9.9E-05	1.6E-05	3.8E-08	1.9E-06	8.3E-05
Ir-192	9.3E-01	2.8E-01	7.8E-01	2.1E+00	8.0E-01	2.1E-01	6.3E-01	2.0E+00
Pb-210	3.0E-04	9.9E-05	2.5E-04	6.4E-04	2.5E-04	7.1E-05	2.0E-04	5.7E-04
Po-210	1.1E-05	3.5E-06	9.6E-06	2.4E-05	9.5E-06	2.5E-06	7.6E-06	2.1E-05
Bi-210	7.7E-06	1.0E-07	1.9E-06	3.6E-05	6.6E-06	7.0E-08	1.6E-06	2.9E-05
Rn-222	1.3E-04	1.6E-07	1.0E-05	5.6E-04	1.1E-04	1.1E-07	8.1E-06	5.0E-04
Ra-223	1.0E-02	1.1E-03	6.4E-03	2.8E-02	8.7E-03	8.2E-04	5.3E-03	2.8E-02
Ra-224	1.1E-03	2.9E-06	1.1E-04	5.2E-03	9.2E-04	2.4E-06	1.0E-04	4.3E-03
Ac-225	3.9E-04	1.1E-05	1.8E-04	1.6E-03	3.5E-04	8.0E-06	1.5E-04	1.3E-03
Ra-225	2.8E-05	4.5E-06	1.9E-05	8.5E-05	2.5E-05	3.1E-06	1.7E-05	8.2E-05
Ra-226	8.3E-01	2.6E-01	6.9E-01	1.8E+00	7.1E-01	1.9E-01	5.5E-01	1.7E+00
Ac-227	3.3E-03	1.4E-04	2.3E-03	1.0E-02	2.9E-03	1.2E-04	1.9E-03	9.3E-03
Th-227	4.8E-04	2.1E-05	2.9E-04	1.6E-03	4.2E-04	1.4E-05	2.3E-04	1.5E-03
Th-228	4.0E-02	2.3E-03	2.7E-02	1.2E-01	3.4E-02	1.7E-03	2.2E-02	1.1E-01
Ra-228	4.0E-01	1.2E-01	3.5E-01	8.1E-01	3.4E-01	9.2E-02	2.8E-01	7.5E-01
Th-229	2.6E-03	1.3E-04	1.7E-03	8.2E-03	2.2E-03	1.1E-04	1.4E-03	7.0E-03
Th-230	7.6E-07	3.9E-08	5.0E-07	2.4E-06	6.6E-07	3.3E-08	3.9E-07	2.1E-06
Pa-231	6.5E-04	3.6E-05	4.3E-04	2.0E-03	5.6E-04	2.9E-05	3.4E-04	1.8E-03
Th-231	1.4E-12	1.5E-23	8.3E-18	4.4E-12	1.2E-12	1.4E-23	7.5E-18	3.7E-12
Th-232	1.9E-04	9.5E-06	1.4E-04	6.1E-04	1.6E-04	9.0E-06	1.1E-04	4.7E-04
Pa-233	1.6E-03	7.6E-05	9.7E-04	5.5E-03	1.4E-03	6.1E-05	8.1E-04	4.6E-03
U-233	6.4E-09	3.5E-10	4.4E-09	1.9E-08	5.4E-09	2.8E-10	3.5E-09	1.7E-08
Th-234	8.1E-05	3.8E-06	5.0E-05	2.6E-04	7.0E-05	3.2E-06	3.9E-05	2.5E-04
U-234	1.2E-07	5.9E-09	8.1E-08	3.5E-07	1.0E-07	4.7E-09	6.5E-08	3.2E-07
U-235	2.5E-03	1.2E-04	1.8E-03	7.3E-03	2.2E-03	9.8E-05	1.5E-03	6.5E-03
Np-237	2.0E-03	9.8E-05	1.4E-03	6.1E-03	1.7E-03	9.0E-05	1.1E-03	5.4E-03
Pu-238	3.7E-08	1.7E-09	2.5E-08	1.1E-07	3.2E-08	1.7E-09	2.0E-08	9.7E-08
U-238	1.0E-04	5.1E-06	7.1E-05	3.2E-04	8.7E-05	4.3E-06	5.7E-05	2.6E-04
Pu-239	1.4E-08	7.2E-10	9.5E-09	4.5E-08	1.2E-08	5.6E-10	7.6E-09	4.0E-08
Pu-240	1.2E-07	6.7E-09	8.5E-08	3.5E-07	1.0E-07	5.2E-09	6.9E-08	3.1E-07
Pu-241	1.7E-08	9.2E-10	1.2E-08	5.3E-08	1.4E-08	6.9E-10	9.3E-09	4.2E-08
Am-241	4.9E-05	2.3E-06	3.5E-05	1.5E-04	4.2E-05	1.7E-06	2.8E-05	1.3E-04
Cm-242	4.4E-08	2.8E-09	3.0E-08	1.3E-07	3.8E-08	2.6E-09	2.4E-08	1.2E-07
Pu-242	6.3E-08	3.4E-09	4.3E-08	1.9E-07	5.3E-08	2.5E-09	3.7E-08	1.6E-07
Cm-244	4.7E-08	3.1E-09	3.2E-08	1.4E-07	4.0E-08	2.5E-09	2.4E-08	1.3E-07

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.18 Dose factors[a] for CU-ELRM-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	4.5E-07	2.8E-09	1.2E-07	1.8E-06	3.9E-07	2.1E-09	9.7E-08	1.6E-06
S-35	1.9E-08	1.7E-10	8.0E-09	7.1E-08	1.6E-08	1.2E-10	6.4E-09	6.6E-08
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	3.4E-06	1.3E-07	1.8E-06	1.2E-05	2.9E-06	1.0E-07	1.6E-06	9.8E-06
Mn-54	5.1E-04	2.8E-05	3.3E-04	1.6E-03	4.4E-04	1.9E-05	2.6E-04	1.5E-03
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	2.2E-05	1.3E-06	1.4E-05	7.6E-05	1.9E-05	9.5E-07	1.1E-05	6.5E-05
Co-58	3.4E-04	1.8E-05	2.0E-04	1.1E-03	2.8E-04	1.2E-05	1.8E-04	9.4E-04
Fe-59	2.7E-04	1.6E-05	1.7E-04	8.3E-04	2.3E-04	1.2E-05	1.4E-04	7.6E-04
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.7E-03	9.2E-05	1.1E-03	5.6E-03	1.5E-03	7.3E-05	9.2E-04	4.9E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	3.2E-04	2.0E-05	2.2E-04	1.1E-03	2.8E-04	1.7E-05	1.8E-04	9.0E-04
Cu-67	2.8E-07	3.2E-14	2.0E-10	1.7E-06	2.3E-07	2.2E-14	1.8E-10	1.5E-06
Se-75	1.2E-03	1.2E-05	4.7E-04	4.8E-03	1.0E-03	8.8E-06	3.9E-04	4.4E-03
Sr-85	3.9E-04	2.4E-05	2.4E-04	1.3E-03	3.3E-04	1.9E-05	2.0E-04	1.2E-03
Sr-89	8.1E-07	3.6E-08	4.7E-07	2.9E-06	6.9E-07	2.6E-08	3.9E-07	2.4E-06
Sr-90	2.2E-07	1.2E-08	1.4E-07	7.2E-07	1.9E-07	9.1E-09	1.1E-07	6.4E-07
Y-91	6.6E-07	3.3E-08	4.3E-07	2.0E-06	5.5E-07	2.5E-08	3.5E-07	1.7E-06
Mo-93	2.9E-09	1.6E-10	2.0E-09	8.3E-09	2.5E-09	1.2E-10	1.5E-09	8.2E-09
Nb-93m	4.8E-10	2.3E-11	3.5E-10	1.4E-09	4.1E-10	2.1E-11	2.6E-10	1.3E-09
Nb-94	1.1E-03	5.2E-05	7.8E-04	3.2E-03	9.5E-04	4.1E-05	6.1E-04	2.9E-03
Nb-95	1.4E-04	4.4E-06	8.0E-05	3.8E-04	1.2E-04	3.6E-06	6.6E-05	3.7E-04
Zr-95	2.0E-04	1.0E-05	1.3E-04	7.0E-04	1.7E-04	7.3E-06	1.0E-04	5.6E-04
Tc-99	1.7E-08	9.2E-10	1.1E-08	5.5E-08	1.5E-08	6.8E-10	8.8E-09	4.8E-08
Ru-103	8.3E-05	3.4E-06	5.4E-05	2.6E-04	6.9E-05	2.7E-06	4.3E-05	2.2E-04
Ru-106	1.0E-04	6.1E-06	7.0E-05	2.9E-04	8.6E-05	5.0E-06	5.9E-05	2.5E-04
Ag-108m	1.1E-02	4.9E-04	7.5E-03	3.4E-02	9.2E-03	4.0E-04	6.3E-03	3.0E-02
Cd-109	4.4E-08	3.1E-09	3.0E-08	1.4E-07	3.8E-08	2.3E-09	2.2E-08	1.2E-07
Ag-110m	1.5E-02	7.8E-04	1.1E-02	4.6E-02	1.3E-02	6.5E-04	8.4E-03	4.0E-02
Sb-124	5.7E-04	3.0E-05	3.5E-04	1.9E-03	4.9E-04	2.2E-05	2.9E-04	1.6E-03
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.7E-04	1.6E-05	1.8E-04	8.2E-04	2.3E-04	1.3E-05	1.4E-04	7.1E-04
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	4.6E-04	2.7E-05	3.3E-04	1.3E-03	3.9E-04	1.8E-05	2.7E-04	1.2E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.18 Dose factors[a] for CU-ELRM-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.0E-06	1.3E-07	1.8E-06	9.8E-06	2.5E-06	9.7E-08	1.5E-06	9.2E-06
Ce-144	1.2E-05	6.3E-07	7.8E-06	4.0E-05	1.0E-05	5.8E-07	6.3E-06	3.5E-05
Pm-147	4.3E-10	2.3E-11	2.8E-10	1.3E-09	3.7E-10	1.6E-11	2.4E-10	1.1E-09
Eu-152	4.8E-04	2.5E-05	3.1E-04	1.5E-03	4.2E-04	1.9E-05	2.5E-04	1.5E-03
Eu-154	5.2E-04	2.7E-05	3.5E-04	1.7E-03	4.4E-04	2.0E-05	2.8E-04	1.5E-03
Eu-155	4.5E-06	2.5E-07	2.9E-06	1.4E-05	3.9E-06	1.7E-07	2.3E-06	1.2E-05
Re-186	2.2E-10	2.8E-15	2.3E-12	1.1E-09	2.0E-10	1.9E-15	2.1E-12	9.3E-10
Ir-192	2.4E-03	1.2E-04	1.6E-03	7.4E-03	2.1E-03	9.9E-05	1.3E-03	6.6E-03
Pb-210	1.1E-07	5.4E-09	7.4E-08	3.6E-07	9.3E-08	4.4E-09	6.1E-08	3.2E-07
Po-210	3.4E-09	1.7E-10	2.1E-09	1.0E-08	3.0E-09	1.3E-10	1.8E-09	9.2E-09
Bi-210	2.2E-10	4.3E-14	8.0E-12	1.3E-09	1.7E-10	3.9E-14	6.9E-12	9.9E-10
Rn-222	1.6E-09	5.5E-15	5.5E-12	7.7E-09	1.4E-09	4.3E-15	4.8E-12	6.5E-09
Ra-223	2.2E-06	2.9E-08	6.6E-07	8.4E-06	1.8E-06	2.3E-08	5.4E-07	7.2E-06
Ra-224	3.7E-08	3.0E-13	2.3E-10	2.0E-07	3.0E-08	2.4E-13	2.1E-10	1.4E-07
Ac-225	4.3E-09	6.6E-12	6.4E-10	2.2E-08	3.7E-09	4.6E-12	5.4E-10	1.8E-08
Ra-225	8.0E-09	1.3E-10	3.1E-09	3.5E-08	6.5E-09	1.0E-10	2.5E-09	2.8E-08
Ra-226	7.6E-04	3.6E-05	4.7E-04	2.5E-03	6.4E-04	3.3E-05	4.1E-04	2.0E-03
Ac-227	1.9E-07	9.8E-10	6.5E-08	7.7E-07	1.7E-07	8.3E-10	5.3E-08	7.2E-07
Th-227	1.1E-08	3.6E-11	2.7E-09	4.5E-08	8.9E-09	2.8E-11	2.1E-09	3.9E-08
Th-228	2.1E-06	1.2E-08	7.9E-07	8.2E-06	1.7E-06	1.0E-08	6.8E-07	7.0E-06
Ra-228	3.5E-04	1.8E-05	2.4E-04	1.1E-03	3.0E-04	1.6E-05	1.9E-04	1.1E-03
Th-229	1.3E-07	8.0E-10	5.3E-08	5.6E-07	1.2E-07	4.7E-10	4.1E-08	5.2E-07
Th-230	4.0E-11	1.9E-13	1.4E-11	1.8E-10	3.4E-11	1.8E-13	1.3E-11	1.5E-10
Pa-231	4.1E-08	2.4E-10	1.2E-08	1.7E-07	3.2E-08	2.2E-10	1.1E-08	1.4E-07
Th-231	1.0E-21	2.5E-40	8.6E-31	2.1E-21	8.8E-22	1.8E-40	7.4E-31	2.0E-21
Th-232	1.0E-08	5.3E-11	3.8E-09	4.2E-08	8.5E-09	5.2E-11	3.0E-09	3.4E-08
Pa-233	4.6E-08	3.2E-10	1.4E-08	2.3E-07	4.1E-08	2.7E-10	1.1E-08	1.9E-07
U-233	3.8E-13	2.7E-15	1.3E-13	1.7E-12	3.2E-13	2.1E-15	1.1E-13	1.4E-12
Th-234	2.0E-09	7.8E-12	5.9E-10	7.9E-09	1.7E-09	7.2E-12	5.2E-10	6.9E-09
U-234	6.9E-12	4.9E-14	2.4E-12	3.0E-11	5.9E-12	4.2E-14	1.9E-12	2.5E-11
U-235	1.5E-07	1.2E-09	5.3E-08	6.4E-07	1.3E-07	8.7E-10	4.4E-08	5.8E-07
Np-237	1.2E-07	8.5E-10	4.0E-08	4.9E-07	1.1E-07	6.5E-10	3.1E-08	4.0E-07
Pu-238	2.2E-12	1.4E-14	7.7E-13	9.2E-12	1.8E-12	1.1E-14	6.1E-13	7.3E-12
U-238	6.2E-09	4.3E-11	2.0E-09	2.6E-08	5.3E-09	3.5E-11	1.7E-09	2.2E-08
Pu-239	8.5E-13	5.9E-15	3.0E-13	3.4E-12	7.2E-13	3.9E-15	2.3E-13	2.8E-12
Pu-240	7.4E-12	4.8E-14	2.5E-12	2.9E-11	6.2E-12	3.9E-14	1.9E-12	2.5E-11
Pu-241	1.0E-12	6.3E-15	3.5E-13	4.3E-12	8.7E-13	5.9E-15	2.7E-13	3.4E-12
Am-241	2.7E-09	1.5E-11	9.8E-10	1.1E-08	2.3E-09	1.8E-11	8.4E-10	9.9E-09
Cm-242	2.5E-12	1.6E-14	7.6E-13	1.1E-11	2.2E-12	1.5E-14	6.5E-13	9.7E-12
Pu-242	3.7E-12	2.8E-14	1.4E-12	1.5E-11	3.3E-12	1.9E-14	1.1E-12	1.3E-11
Cm-244	3.1E-12	2.3E-14	9.2E-13	1.4E-11	2.6E-12	1.5E-14	7.4E-13	1.2E-11

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.19 Dose factors[a] for CU-SCRP-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	6.7E-06	2.4E-06	6.1E-06	1.3E-05	5.7E-06	1.7E-06	5.1E-06	1.2E-05
Na-22	6.8E+00	2.4E+00	6.2E+00	1.3E+01	5.8E+00	1.7E+00	5.1E+00	1.2E+01
P-32	3.5E-03	1.2E-03	3.1E-03	7.3E-03	3.0E-03	8.5E-04	2.5E-03	6.4E-03
S-35	6.8E-06	2.5E-06	6.2E-06	1.3E-05	5.8E-06	1.7E-06	5.1E-06	1.3E-05
Cl-36	1.2E-03	4.3E-04	1.1E-03	2.3E-03	1.0E-03	3.0E-04	9.0E-04	2.2E-03
K-40	5.2E-01	1.9E-01	4.7E-01	1.0E+00	4.4E-01	1.3E-01	3.9E-01	9.4E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.0E-05	1.1E-05	2.7E-05	5.9E-05	2.5E-05	7.4E-06	2.2E-05	5.4E-05
Cr-51	6.7E-02	2.4E-02	6.0E-02	1.3E-01	5.7E-02	1.6E-02	4.9E-02	1.2E-01
Mn-54	2.5E+00	9.0E-01	2.3E+00	4.9E+00	2.1E+00	6.2E-01	1.9E+00	4.6E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	2.4E-01	8.8E-02	2.2E-01	4.8E-01	2.1E-01	6.0E-02	1.8E-01	4.4E-01
Co-58	2.7E+00	9.6E-01	2.4E+00	5.3E+00	2.3E+00	6.7E-01	2.0E+00	4.9E+00
Fe-59	3.2E+00	1.1E+00	2.9E+00	6.4E+00	2.7E+00	8.2E-01	2.4E+00	5.9E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	8.1E+00	2.9E+00	7.3E+00	1.6E+01	6.9E+00	2.0E+00	6.1E+00	1.5E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.8E+00	6.5E-01	1.6E+00	3.5E+00	1.5E+00	4.4E-01	1.3E+00	3.3E+00
Cu-67	1.9E-02	2.5E-03	1.2E-02	6.4E-02	1.6E-02	1.7E-03	9.8E-03	5.2E-02
Se-75	9.3E-01	3.4E-01	8.4E-01	1.8E+00	7.9E-01	2.3E-01	7.0E-01	1.7E+00
Sr-85	1.3E+00	4.7E-01	1.2E+00	2.6E+00	1.1E+00	3.3E-01	9.9E-01	2.4E+00
Sr-89	3.9E-03	1.4E-03	3.5E-03	7.8E-03	3.3E-03	9.9E-04	2.9E-03	7.2E-03
Sr-90	3.5E-04	1.3E-04	3.2E-04	6.9E-04	3.0E-04	8.8E-05	2.6E-04	6.4E-04
Y-91	1.4E-02	5.1E-03	1.3E-02	2.8E-02	1.2E-02	3.6E-03	1.1E-02	2.6E-02
Mo-93	3.0E-04	1.1E-04	2.7E-04	5.8E-04	2.5E-04	7.4E-05	2.2E-04	5.4E-04
Nb-93m	5.2E-05	1.9E-05	4.7E-05	1.0E-04	4.4E-05	1.3E-05	3.9E-05	9.4E-05
Nb-94	4.8E+00	1.7E+00	4.4E+00	9.4E+00	4.1E+00	1.2E+00	3.6E+00	8.8E+00
Nb-95	1.9E+00	6.8E-01	1.7E+00	3.8E+00	1.6E+00	4.7E-01	1.4E+00	3.4E+00
Zr-95	2.0E+00	7.2E-01	1.8E+00	4.0E+00	1.7E+00	5.0E-01	1.5E+00	3.7E+00
Tc-99	6.3E-05	2.2E-05	5.7E-05	1.2E-04	5.3E-05	1.6E-05	4.7E-05	1.1E-04
Ru-103	1.1E+00	4.0E-01	1.0E+00	2.3E+00	9.6E-01	2.9E-01	8.4E-01	2.1E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	4.8E+00	1.7E+00	4.4E+00	9.4E+00	4.1E+00	1.2E+00	3.6E+00	8.7E+00
Cd-109	7.2E-03	2.6E-03	6.6E-03	1.4E-02	6.2E-03	1.8E-03	5.4E-03	1.3E-02
Ag-110m	8.3E+00	3.0E+00	7.6E+00	1.6E+01	7.1E+00	2.1E+00	6.2E+00	1.5E+01
Sb-124	5.2E+00	1.8E+00	4.6E+00	1.0E+01	4.4E+00	1.3E+00	3.8E+00	9.4E+00
I-125	7.3E-03	2.6E-03	6.6E-03	1.4E-02	6.2E-03	1.8E-03	5.4E-03	1.3E-02
Sb-125	1.2E+00	4.3E-01	1.1E+00	2.4E+00	1.0E+00	3.0E-01	9.1E-01	2.2E+00
I-129	6.5E-03	2.3E-03	5.9E-03	1.3E-02	5.5E-03	1.6E-03	4.9E-03	1.2E-02
I-131	4.4E-01	1.4E-01	3.7E-01	9.5E-01	3.7E-01	9.8E-02	3.0E-01	8.4E-01
Ba-133	9.9E-01	3.5E-01	9.0E-01	1.9E+00	8.4E-01	2.5E-01	7.4E-01	1.8E+00
Cs-134	4.7E+00	1.7E+00	4.3E+00	9.2E+00	4.0E+00	1.2E+00	3.5E+00	8.5E+00
Cs-137	3.8E-04	1.3E-04	3.4E-04	7.3E-04	3.2E-04	9.3E-05	2.8E-04	6.8E-04

Table G.19 Dose factors[a] for CU-SCRP-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.3E-01	4.5E-02	1.1E-01	2.5E-01	1.1E-01	3.1E-02	9.3E-02	2.3E-01
Ce-144	3.5E-02	1.3E-02	3.2E-02	6.8E-02	3.0E-02	8.6E-03	2.6E-02	6.3E-02
Pm-147	2.5E-05	8.9E-06	2.3E-05	4.8E-05	2.1E-05	6.2E-06	1.9E-05	4.5E-05
Eu-152	3.5E+00	1.3E+00	3.2E+00	6.8E+00	3.0E+00	8.7E-01	2.6E+00	6.3E+00
Eu-154	3.8E+00	1.4E+00	3.5E+00	7.5E+00	3.3E+00	9.5E-01	2.9E+00	6.9E+00
Eu-155	9.1E-02	3.2E-02	8.3E-02	1.8E-01	7.7E-02	2.3E-02	6.8E-02	1.6E-01
Re-186	6.1E-03	1.2E-03	4.5E-03	1.7E-02	5.2E-03	9.0E-04	3.6E-03	1.4E-02
Ir-192	2.1E+00	7.5E-01	1.9E+00	4.1E+00	1.8E+00	5.2E-01	1.6E+00	3.8E+00
Pb-210	3.1E-03	1.1E-03	2.8E-03	5.9E-03	2.6E-03	7.6E-04	2.3E-03	5.5E-03
Po-210	2.5E-05	9.0E-06	2.3E-05	4.9E-05	2.1E-05	6.1E-06	1.9E-05	4.5E-05
Bi-210	4.3E-04	1.1E-04	3.4E-04	1.0E-03	3.7E-04	8.0E-05	2.8E-04	9.4E-04
Rn-222	1.9E-04	3.9E-05	1.4E-04	5.1E-04	1.6E-04	2.8E-05	1.1E-04	4.4E-04
Ra-223	1.6E-01	5.4E-02	1.4E-01	3.3E-01	1.3E-01	3.7E-02	1.2E-01	2.9E-01
Ra-224	3.8E-03	7.5E-04	2.8E-03	1.0E-02	3.2E-03	5.6E-04	2.2E-03	8.9E-03
Ac-225	1.5E-02	5.1E-03	1.3E-02	3.2E-02	1.3E-02	3.6E-03	1.1E-02	2.9E-02
Ra-225	3.3E-03	1.2E-03	3.0E-03	6.9E-03	2.8E-03	8.1E-04	2.4E-03	6.1E-03
Ra-226	5.6E+00	2.0E+00	5.1E+00	1.1E+01	4.8E+00	1.4E+00	4.2E+00	1.0E+01
Ac-227	3.5E-01	1.3E-01	3.2E-01	6.8E-01	3.0E-01	8.8E-02	2.6E-01	6.4E-01
Th-227	1.7E-01	6.1E-02	1.6E-01	3.6E-01	1.5E-01	4.3E-02	1.3E-01	3.2E-01
Th-228	4.9E+00	1.8E+00	4.5E+00	9.6E+00	4.2E+00	1.2E+00	3.7E+00	8.9E+00
Ra-228	3.0E+00	1.1E+00	2.7E+00	5.8E+00	2.5E+00	7.4E-01	2.2E+00	5.4E+00
Th-229	3.5E-01	1.3E-01	3.2E-01	6.9E-01	3.0E-01	8.8E-02	2.7E-01	6.4E-01
Th-230	6.1E-04	2.2E-04	5.5E-04	1.2E-03	5.1E-04	1.5E-04	4.5E-04	1.1E-03
Pa-231	9.5E-02	3.4E-02	8.7E-02	1.9E-01	8.1E-02	2.4E-02	7.2E-02	1.7E-01
Th-231	6.8E-05	4.8E-07	1.2E-05	3.5E-04	5.7E-05	3.6E-07	1.0E-05	3.1E-04
Th-232	2.1E-02	7.6E-03	1.9E-02	4.2E-02	1.8E-02	5.3E-03	1.6E-02	3.9E-02
Pa-233	3.9E-01	1.4E-01	3.5E-01	7.8E-01	3.3E-01	9.6E-02	2.8E-01	7.0E-01
U-233	7.0E-04	2.5E-04	6.4E-04	1.4E-03	5.9E-04	1.7E-04	5.2E-04	1.3E-03
Th-234	8.8E-03	3.1E-03	8.0E-03	1.8E-02	7.5E-03	2.2E-03	6.4E-03	1.6E-02
U-234	2.0E-04	7.2E-05	1.8E-04	3.9E-04	1.7E-04	5.0E-05	1.5E-04	3.6E-04
U-235	3.6E-01	1.3E-01	3.3E-01	7.0E-01	3.1E-01	9.0E-02	2.7E-01	6.5E-01
Np-237	2.4E-01	8.7E-02	2.2E-01	4.7E-01	2.1E-01	6.1E-02	1.8E-01	4.4E-01
Pu-238	7.6E-05	2.7E-05	6.9E-05	1.5E-04	6.4E-05	1.9E-05	5.7E-05	1.4E-04
U-238	2.3E-02	8.2E-03	2.1E-02	4.4E-02	1.9E-02	5.7E-03	1.7E-02	4.1E-02
Pu-239	1.5E-04	5.3E-05	1.3E-04	2.9E-04	1.3E-04	3.7E-05	1.1E-04	2.7E-04
Pu-240	7.3E-05	2.6E-05	6.7E-05	1.4E-04	6.2E-05	1.8E-05	5.5E-05	1.3E-04
Pu-241	5.1E-06	1.8E-06	4.7E-06	1.0E-05	4.4E-06	1.3E-06	3.9E-06	9.3E-06
Am-241	2.2E-02	7.8E-03	2.0E-02	4.3E-02	1.9E-02	5.4E-03	1.6E-02	4.0E-02
Cm-242	8.2E-05	3.0E-05	7.4E-05	1.6E-04	6.9E-05	2.0E-05	6.1E-05	1.5E-04
Pu-242	6.4E-05	2.3E-05	5.8E-05	1.2E-04	5.4E-05	1.6E-05	4.8E-05	1.2E-04
Cm-244	6.3E-05	2.3E-05	5.7E-05	1.2E-04	5.4E-05	1.6E-05	4.7E-05	1.1E-04

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.20 Dose factors[a] for CU-ELRM-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	1.3E-08	2.7E-11	2.0E-09	6.6E-08	1.1E-08	2.1E-11	1.5E-09	5.4E-08
S-35	5.9E-09	5.4E-11	2.6E-09	2.4E-08	5.0E-09	4.3E-11	2.0E-09	1.9E-08
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	2.5E-07	8.5E-09	1.1E-07	9.5E-07	2.2E-07	6.5E-09	8.9E-08	9.2E-07
Mn-54	3.2E-04	1.9E-05	2.2E-04	9.1E-04	2.8E-04	1.7E-05	1.7E-04	9.1E-04
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.9E-05	1.0E-06	1.3E-05	5.6E-05	1.7E-05	7.4E-07	1.0E-05	5.1E-05
Co-58	7.0E-05	3.4E-06	4.3E-05	2.1E-04	6.1E-05	2.7E-06	3.6E-05	2.0E-04
Fe-59	2.9E-05	1.5E-06	1.8E-05	1.0E-04	2.5E-05	1.1E-06	1.5E-05	9.5E-05
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.5E-03	7.9E-05	1.0E-03	4.5E-03	1.3E-03	5.6E-05	8.1E-04	3.9E-03
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.7E-04	7.3E-06	1.2E-04	5.2E-04	1.5E-04	5.7E-06	9.3E-05	5.1E-04
Cu-67	6.8E-11	5.2E-21	1.0E-15	3.1E-10	5.7E-11	3.7E-21	7.3E-16	2.7E-10
Se-75	5.8E-04	7.1E-06	2.3E-04	2.4E-03	4.9E-04	5.3E-06	1.9E-04	2.0E-03
Sr-85	8.3E-05	4.3E-06	5.3E-05	2.7E-04	7.2E-05	2.9E-06	4.3E-05	2.4E-04
Sr-89	1.4E-07	5.2E-09	8.0E-08	4.5E-07	1.2E-07	4.9E-09	6.4E-08	4.2E-07
Sr-90	2.7E-07	1.1E-08	1.8E-07	8.2E-07	2.4E-07	9.6E-09	1.5E-07	8.2E-07
Y-91	1.1E-07	3.8E-09	6.7E-08	3.6E-07	9.4E-08	2.9E-09	5.6E-08	3.1E-07
Mo-93	1.1E-07	6.0E-09	7.7E-08	3.2E-07	9.6E-08	5.0E-09	6.1E-08	3.1E-07
Nb-93m	1.8E-08	1.1E-09	1.3E-08	5.4E-08	1.6E-08	9.1E-10	9.6E-09	5.0E-08
Nb-94	1.1E-03	5.0E-05	7.5E-04	3.2E-03	9.4E-04	5.0E-05	5.8E-04	3.0E-03
Nb-95	1.1E-05	3.4E-07	6.5E-06	4.4E-05	9.5E-06	2.9E-07	5.1E-06	3.3E-05
Zr-95	4.0E-05	1.8E-06	2.5E-05	1.2E-04	3.3E-05	1.3E-06	2.0E-05	1.1E-04
Tc-99	2.0E-08	1.0E-09	1.3E-08	6.2E-08	1.8E-08	8.7E-10	1.1E-08	5.7E-08
Ru-103	9.0E-06	3.7E-07	4.9E-06	3.1E-05	7.9E-06	2.8E-07	3.9E-06	2.7E-05
Ru-106	7.3E-05	4.2E-06	4.5E-05	2.3E-04	6.4E-05	3.0E-06	3.7E-05	2.0E-04
Ag-108m	1.1E-02	5.6E-04	7.8E-03	3.1E-02	9.3E-03	4.1E-04	6.6E-03	2.6E-02
Cd-109	2.1E-07	1.2E-08	1.4E-07	6.4E-07	1.9E-07	1.1E-08	1.1E-07	5.4E-07
Ag-110m	8.4E-03	5.5E-04	5.8E-03	2.6E-02	7.3E-03	4.0E-04	4.9E-03	2.1E-02
Sb-124	9.9E-05	3.7E-06	5.8E-05	3.5E-04	8.5E-05	2.7E-06	4.8E-05	3.0E-04
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.4E-04	1.1E-05	1.6E-04	7.6E-04	2.1E-04	8.1E-06	1.4E-04	7.2E-04
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	5.9E-04	2.9E-05	4.0E-04	1.7E-03	5.2E-04	2.3E-05	3.2E-04	1.8E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table G.20 Dose factors[a] for CU-ELRM-LGMASS-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.1E-07	1.1E-08	1.8E-07	1.0E-06	2.7E-07	7.4E-09	1.5E-07	9.6E-07
Ce-144	7.7E-06	3.9E-07	5.5E-06	2.2E-05	6.7E-06	2.9E-07	4.5E-06	2.0E-05
Pm-147	6.1E-10	2.9E-11	4.1E-10	1.9E-09	5.3E-10	2.2E-11	3.2E-10	1.6E-09
Eu-152	4.4E-04	2.2E-05	3.1E-04	1.4E-03	3.8E-04	1.5E-05	2.6E-04	1.3E-03
Eu-154	4.8E-04	2.4E-05	3.3E-04	1.5E-03	4.2E-04	1.8E-05	2.7E-04	1.4E-03
Eu-155	6.5E-06	3.2E-07	4.5E-06	2.0E-05	5.5E-06	2.0E-07	3.5E-06	1.8E-05
Re-186	3.0E-13	4.6E-20	1.6E-16	1.7E-12	2.7E-13	3.5E-20	1.5E-16	1.4E-12
Ir-192	6.5E-04	3.0E-05	4.2E-04	2.2E-03	5.7E-04	2.4E-05	3.2E-04	2.0E-03
Pb-210	1.1E-07	5.5E-09	7.0E-08	3.1E-07	9.3E-08	3.5E-09	5.7E-08	2.9E-07
Po-210	1.4E-09	6.2E-11	9.2E-10	4.4E-09	1.2E-09	4.5E-11	7.3E-10	3.9E-09
Bi-210	6.5E-13	3.7E-18	3.0E-15	3.5E-12	5.5E-13	2.9E-18	2.0E-15	4.1E-12
Rn-222	1.6E-12	3.5E-20	4.9E-16	7.4E-12	1.4E-12	3.3E-20	3.5E-16	6.5E-12
Ra-223	3.4E-08	1.7E-10	5.1E-09	1.6E-07	2.9E-08	1.3E-10	4.3E-09	1.3E-07
Ra-224	2.5E-11	2.2E-18	1.2E-14	1.2E-10	2.1E-11	1.3E-18	1.0E-14	9.8E-11
Ac-225	6.4E-11	2.0E-14	3.9E-12	2.8E-10	5.2E-11	1.7E-14	3.2E-12	2.5E-10
Ra-225	4.1E-10	3.8E-12	1.1E-10	2.0E-09	3.6E-10	3.3E-12	8.8E-11	1.7E-09
Ra-226	2.2E-06	1.1E-07	1.4E-06	6.5E-06	1.9E-06	1.0E-07	1.2E-06	5.9E-06
Ac-227	7.0E-11	2.7E-13	2.5E-11	3.2E-10	6.0E-11	2.1E-13	1.9E-11	2.5E-10
Th-227	5.0E-10	1.0E-12	8.1E-11	2.3E-09	4.4E-10	6.6E-13	6.6E-11	1.9E-09
Th-228	1.6E-09	6.2E-12	4.3E-10	6.7E-09	1.4E-09	5.5E-12	3.7E-10	6.3E-09
Ra-228	3.1E-04	1.9E-05	2.2E-04	9.6E-04	2.7E-04	1.6E-05	1.8E-04	8.0E-04
Th-229	7.1E-08	2.6E-10	2.2E-08	3.0E-07	6.4E-08	2.0E-10	1.8E-08	2.8E-07
Th-230	1.1E-10	5.5E-13	3.2E-11	5.0E-10	9.3E-11	4.1E-13	2.5E-11	4.5E-10
Pa-231	5.5E-08	2.7E-10	1.6E-08	2.2E-07	4.7E-08	2.0E-10	1.4E-08	2.1E-07
Th-231	1.0E-27	4.1E-54	1.6E-41	6.4E-28	1.1E-27	2.5E-54	1.0E-41	5.0E-28
Th-232	7.5E-11	3.1E-13	2.5E-11	3.0E-10	6.2E-11	2.2E-13	1.9E-11	2.6E-10
Pa-233	3.7E-09	1.3E-11	9.4E-10	1.7E-08	3.2E-09	9.2E-12	7.1E-10	1.7E-08
U-233	2.6E-11	1.6E-13	7.8E-12	1.2E-10	2.2E-11	1.7E-13	6.3E-12	9.5E-11
Th-234	1.4E-10	4.4E-13	3.0E-11	7.3E-10	1.3E-10	3.1E-13	2.5E-11	5.7E-10
U-234	4.6E-11	3.3E-13	1.4E-11	2.3E-10	3.9E-11	2.4E-13	1.2E-11	1.7E-10
U-235	2.1E-07	1.3E-09	7.2E-08	1.0E-06	1.8E-07	9.7E-10	5.6E-08	8.3E-07
Np-237	1.2E-08	7.7E-11	3.8E-09	4.8E-08	9.8E-09	5.2E-11	3.1E-09	3.9E-08
Pu-238	4.4E-11	4.0E-13	1.7E-11	1.7E-10	3.7E-11	3.2E-13	1.4E-11	1.5E-10
U-238	3.4E-11	2.0E-13	1.2E-11	1.4E-10	3.0E-11	1.7E-13	9.8E-12	1.3E-10
Pu-239	1.8E-11	1.4E-13	6.3E-12	6.9E-11	1.5E-11	9.2E-14	5.0E-12	6.0E-11
Pu-240	4.6E-11	3.4E-13	1.7E-11	1.8E-10	4.0E-11	2.1E-13	1.4E-11	1.7E-10
Pu-241	9.5E-13	6.4E-15	3.5E-13	4.1E-12	8.1E-13	5.4E-15	3.0E-13	3.7E-12
Am-241	4.5E-09	2.1E-11	1.8E-09	1.9E-08	4.0E-09	1.8E-11	1.3E-09	1.7E-08
Cm-242	2.7E-11	1.4E-13	8.6E-12	1.2E-10	2.3E-11	1.1E-13	6.7E-12	9.6E-11
Pu-242	3.9E-11	3.2E-13	1.5E-11	1.5E-10	3.4E-11	2.1E-13	1.3E-11	1.5E-10
Cm-244	6.8E-11	5.2E-13	2.4E-11	3.2E-10	5.8E-11	3.3E-13	1.9E-11	3.0E-10

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.21 Dose factors[a] for CU-ELRM-SMMASS-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	3.3E-07	2.0E-08	2.4E-07	9.9E-07	2.8E-07	1.5E-08	1.9E-07	8.7E-07
Na-22	1.2E-01	7.3E-03	8.0E-02	3.5E-01	1.0E-01	5.7E-03	6.3E-02	3.3E-01
P-32	2.2E-06	1.3E-07	1.2E-06	9.0E-06	1.9E-06	1.1E-07	8.9E-07	7.7E-06
S-35	4.3E-07	9.4E-08	3.6E-07	1.0E-06	3.7E-07	7.7E-08	2.9E-07	9.6E-07
Cl-36	1.8E-04	4.1E-05	1.5E-04	4.1E-04	1.5E-04	2.9E-05	1.3E-04	3.7E-04
K-40	6.5E-02	1.3E-02	5.3E-02	1.6E-01	5.6E-02	9.9E-03	4.4E-02	1.5E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.0E-06	6.2E-07	2.5E-06	7.4E-06	2.6E-06	4.8E-07	1.9E-06	6.7E-06
Cr-51	2.8E-04	4.1E-05	2.0E-04	7.4E-04	2.4E-04	3.1E-05	1.7E-04	6.6E-04
Mn-54	2.2E-01	4.6E-02	1.8E-01	5.1E-01	1.9E-01	3.6E-02	1.5E-01	4.7E-01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.2E-02	2.7E-03	9.9E-03	3.1E-02	1.1E-02	2.2E-03	7.9E-03	2.8E-02
Co-58	6.1E-02	1.2E-02	4.8E-02	1.6E-01	5.2E-02	9.7E-03	4.0E-02	1.4E-01
Fe-59	4.5E-03	1.9E-04	3.0E-03	1.4E-02	3.8E-03	1.6E-04	2.5E-03	1.2E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.1E-01	9.0E-02	4.2E-01	1.2E+00	4.3E-01	7.1E-02	3.3E-01	1.1E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.5E-02	1.3E-02	5.2E-02	1.6E-01	5.5E-02	1.1E-02	4.2E-02	1.4E-01
Cu-67	2.4E-10	2.7E-17	2.4E-13	1.4E-09	2.1E-10	2.0E-17	1.8E-13	1.1E-09
Se-75	9.7E-03	2.2E-03	7.8E-03	2.4E-02	8.2E-03	1.6E-03	6.6E-03	2.0E-02
Sr-85	2.8E-02	5.3E-03	2.2E-02	7.3E-02	2.3E-02	4.6E-03	1.7E-02	6.6E-02
Sr-89	4.8E-05	1.1E-05	3.7E-05	1.3E-04	4.1E-05	8.6E-06	3.0E-05	1.1E-04
Sr-90	6.5E-05	1.4E-05	5.5E-05	1.5E-04	5.5E-05	1.2E-05	4.5E-05	1.4E-04
Y-91	1.3E-04	2.4E-05	1.1E-04	3.4E-04	1.1E-04	2.2E-05	8.4E-05	2.8E-04
Mo-93	6.2E-05	1.3E-05	4.9E-05	1.5E-04	5.2E-05	9.6E-06	4.1E-05	1.4E-04
Nb-93m	9.6E-06	2.2E-06	8.4E-06	2.2E-05	8.3E-06	1.6E-06	6.6E-06	2.1E-05
Nb-94	7.2E-01	1.3E-01	5.9E-01	1.6E+00	6.1E-01	1.1E-01	4.8E-01	1.6E+00
Nb-95	1.3E-02	2.1E-03	9.8E-03	3.5E-02	1.1E-02	1.7E-03	8.2E-03	3.2E-02
Zr-95	3.8E-02	7.7E-03	3.0E-02	9.7E-02	3.2E-02	6.3E-03	2.5E-02	8.6E-02
Tc-99	1.5E-05	3.1E-06	1.2E-05	3.6E-05	1.3E-05	2.4E-06	1.0E-05	3.3E-05
Ru-103	1.0E-02	2.0E-03	7.6E-03	2.8E-02	8.8E-03	1.7E-03	5.9E-03	2.5E-02
Ru-106	2.9E-02	5.8E-03	2.5E-02	7.1E-02	2.5E-02	4.5E-03	2.0E-02	6.5E-02
Ag-108m	1.9E-01	3.9E-02	1.6E-01	4.2E-01	1.6E-01	3.5E-02	1.3E-01	3.8E-01
Cd-109	3.4E-05	6.9E-06	2.8E-05	8.3E-05	2.9E-05	5.4E-06	2.3E-05	7.1E-05
Ag-110m	1.6E-01	3.1E-02	1.3E-01	3.8E-01	1.4E-01	2.4E-02	1.0E-01	3.5E-01
Sb-124	2.1E-02	3.6E-03	1.6E-02	5.3E-02	1.8E-02	2.7E-03	1.3E-02	5.0E-02
I-125	1.9E-05	3.3E-06	1.4E-05	4.4E-05	1.6E-05	2.7E-06	1.2E-05	4.2E-05
Sb-125	4.1E-02	7.4E-03	3.3E-02	9.4E-02	3.4E-02	4.9E-03	2.7E-02	9.0E-02
I-129	4.1E-04	8.4E-05	3.6E-04	9.8E-04	3.5E-04	6.4E-05	2.8E-04	8.3E-04
I-131	3.4E-05	3.4E-07	7.9E-06	1.7E-04	2.9E-05	2.7E-07	6.6E-06	1.5E-04
Ba-133	1.4E-01	3.2E-02	1.1E-01	3.3E-01	1.2E-01	2.5E-02	9.8E-02	3.0E-01
Cs-134	4.9E-01	1.0E-01	4.1E-01	1.2E+00	4.2E-01	8.3E-02	3.3E-01	1.0E+00
Cs-137	2.7E-01	6.2E-02	2.2E-01	6.2E-01	2.3E-01	4.6E-02	1.9E-01	5.6E-01

Table G.21 Dose factors[a] for CU-ELRM-SMMASS-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	9.5E-06	3.2E-07	5.1E-06	3.3E-05	8.0E-06	2.2E-07	4.2E-06	2.9E-05
Ce-144	2.2E-03	5.0E-04	1.6E-03	5.4E-03	1.8E-03	3.7E-04	1.4E-03	4.8E-03
Pm-147	1.4E-07	2.9E-08	1.2E-07	3.5E-07	1.2E-07	2.2E-08	9.3E-08	3.1E-07
Eu-152	8.1E-03	3.7E-04	5.1E-03	2.7E-02	6.7E-03	2.4E-04	4.2E-03	2.1E-02
Eu-154	1.3E-01	2.7E-02	1.0E-01	3.1E-01	1.1E-01	2.1E-02	8.3E-02	2.7E-01
Eu-155	1.5E-03	3.2E-04	1.3E-03	3.6E-03	1.3E-03	2.6E-04	1.0E-03	3.4E-03
Re-186	7.9E-11	1.0E-15	7.0E-13	4.5E-10	6.6E-11	8.8E-16	5.3E-13	3.8E-10
Ir-192	9.0E-04	3.5E-05	5.4E-04	3.1E-03	7.6E-04	2.7E-05	4.4E-04	2.7E-03
Pb-210	2.2E-06	1.1E-07	1.4E-06	6.8E-06	1.9E-06	8.9E-08	1.1E-06	6.3E-06
Po-210	3.2E-07	6.6E-08	2.6E-07	7.4E-07	2.7E-07	5.0E-08	2.1E-07	6.3E-07
Bi-210	6.6E-11	1.4E-14	2.8E-12	3.0E-10	5.8E-11	9.8E-15	2.0E-12	3.0E-10
Rn-222	2.1E-08	3.0E-13	1.8E-10	1.2E-07	1.9E-08	2.5E-13	1.4E-10	1.1E-07
Ra-223	2.2E-06	2.5E-08	5.4E-07	9.9E-06	1.9E-06	2.1E-08	4.5E-07	9.4E-06
Ra-224	1.2E-08	1.1E-13	7.1E-11	5.7E-08	1.0E-08	7.6E-14	5.4E-11	4.7E-08
Ac-225	9.1E-07	8.0E-09	2.0E-07	3.8E-06	7.8E-07	6.6E-09	1.7E-07	3.2E-06
Ra-225	1.7E-08	3.0E-10	6.2E-09	6.9E-08	1.4E-08	2.3E-10	5.2E-09	5.8E-08
Ra-226	1.3E-02	4.6E-04	7.9E-03	4.2E-02	1.0E-02	3.9E-04	6.3E-03	3.4E-02
Ac-227	2.5E-03	9.7E-05	1.7E-03	7.8E-03	2.1E-03	8.1E-05	1.3E-03	6.5E-03
Th-227	4.1E-06	9.3E-08	2.1E-06	1.4E-05	3.4E-06	6.3E-08	1.7E-06	1.2E-05
Th-228	7.5E-03	3.3E-04	4.6E-03	2.3E-02	6.5E-03	2.8E-04	3.8E-03	2.2E-02
Ra-228	5.9E-03	2.4E-04	3.5E-03	1.9E-02	5.0E-03	2.2E-04	2.8E-03	1.6E-02
Th-229	1.7E-03	8.0E-05	1.1E-03	5.0E-03	1.4E-03	7.1E-05	8.9E-04	4.9E-03
Th-230	4.2E-06	2.0E-07	2.5E-06	1.6E-05	3.6E-06	1.6E-07	2.1E-06	1.2E-05
Pa-231	1.9E-04	9.4E-06	1.3E-04	5.7E-04	1.7E-04	7.8E-06	1.1E-04	5.2E-04
Th-231	9.6E-20	4.5E-38	1.1E-28	1.8E-19	7.8E-20	3.1E-38	7.9E-29	1.3E-19
Th-232	7.9E-04	4.1E-05	5.3E-04	2.5E-03	6.6E-04	3.1E-05	4.5E-04	1.9E-03
Pa-233	2.4E-05	1.0E-06	1.3E-05	8.6E-05	2.1E-05	8.5E-07	1.1E-05	7.4E-05
U-233	9.3E-08	3.7E-09	6.0E-08	2.8E-07	7.9E-08	3.1E-09	4.7E-08	2.6E-07
Th-234	1.0E-06	3.3E-08	5.2E-07	3.6E-06	8.4E-07	2.6E-08	4.3E-07	3.4E-06
U-234	1.6E-07	7.5E-09	1.0E-07	5.2E-07	1.4E-07	5.4E-09	8.5E-08	4.6E-07
U-235	7.4E-04	3.5E-05	5.2E-04	2.3E-03	6.2E-04	2.6E-05	4.2E-04	1.9E-03
Np-237	1.3E-02	7.4E-04	8.9E-03	3.7E-02	1.1E-02	5.6E-04	7.8E-03	3.1E-02
Pu-238	1.7E-06	9.7E-08	1.2E-06	4.9E-06	1.4E-06	7.5E-08	9.7E-07	4.5E-06
U-238	4.2E-03	9.0E-04	3.4E-03	9.8E-03	3.6E-03	6.9E-04	2.8E-03	9.0E-03
Pu-239	4.3E-06	9.1E-07	3.6E-06	1.0E-05	3.6E-06	7.5E-07	2.9E-06	9.0E-06
Pu-240	1.1E-05	2.6E-06	9.5E-06	2.7E-05	9.5E-06	1.8E-06	7.8E-06	2.4E-05
Pu-241	2.3E-06	5.1E-07	1.8E-06	5.5E-06	2.0E-06	3.8E-07	1.6E-06	5.1E-06
Am-241	1.1E-03	2.3E-04	9.3E-04	2.5E-03	9.2E-04	1.9E-04	7.5E-04	2.4E-03
Cm-242	6.4E-06	1.3E-06	5.4E-06	1.5E-05	5.4E-06	1.0E-06	4.1E-06	1.4E-05
Pu-242	9.1E-06	1.7E-06	7.6E-06	2.1E-05	7.7E-06	1.3E-06	6.2E-06	1.9E-05
Cm-244	1.5E-05	3.2E-06	1.2E-05	3.5E-05	1.2E-05	2.3E-06	9.9E-06	2.9E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.22 Dose factors[a] for CU-REVM-SMOBJCT-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.8E-05	9.7E-07	1.3E-05	5.2E-05	1.5E-05	7.5E-07	1.0E-05	4.8E-05
Na-22	5.2E+00	2.5E-01	3.2E+00	1.8E+01	4.3E+00	2.0E-01	2.7E+00	1.4E+01
P-32	1.3E-04	6.3E-06	5.5E-05	4.7E-04	1.0E-04	4.6E-06	4.6E-05	4.0E-04
S-35	2.5E-05	3.7E-06	1.9E-05	6.5E-05	2.1E-05	2.8E-06	1.6E-05	5.7E-05
Cl-36	1.0E-02	1.6E-03	8.4E-03	2.8E-02	8.8E-03	1.1E-03	6.7E-03	2.5E-02
K-40	2.6E+00	3.6E-01	2.1E+00	7.2E+00	2.2E+00	2.7E-01	1.7E+00	5.7E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.7E-04	2.6E-05	1.3E-04	4.4E-04	1.4E-04	2.0E-05	1.1E-04	3.6E-04
Cr-51	1.4E-02	1.4E-03	9.3E-03	4.1E-02	1.2E-02	1.2E-03	7.9E-03	3.4E-02
Mn-54	9.3E+00	1.5E+00	7.3E+00	2.5E+01	7.9E+00	1.0E+00	6.1E+00	2.1E+01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.1E+00	1.7E-01	8.4E-01	3.0E+00	9.3E-01	1.2E-01	6.6E-01	2.5E+00
Co-58	2.7E+00	4.1E-01	2.0E+00	6.8E+00	2.2E+00	3.2E-01	1.7E+00	6.2E+00
Fe-59	1.9E-01	8.4E-03	1.1E-01	6.1E-01	1.6E-01	6.0E-03	1.0E-01	5.3E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.0E+01	3.3E+00	1.5E+01	5.4E+01	1.7E+01	2.4E+00	1.2E+01	4.7E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.7E+00	3.7E-01	2.1E+00	7.2E+00	2.3E+00	3.1E-01	1.7E+00	6.4E+00
Cu-67	1.5E-08	1.9E-15	1.5E-11	9.8E-08	1.2E-08	1.5E-15	1.0E-11	7.6E-08
Se-75	5.6E-01	7.7E-02	4.4E-01	1.4E+00	4.6E-01	6.3E-02	3.5E-01	1.2E+00
Sr-85	1.3E+00	1.9E-01	9.5E-01	3.3E+00	1.0E+00	1.4E-01	7.5E-01	2.9E+00
Sr-89	2.8E-03	3.9E-04	2.1E-03	7.4E-03	2.4E-03	3.0E-04	1.7E-03	6.6E-03
Sr-90	3.8E-03	5.6E-04	2.9E-03	1.1E-02	3.2E-03	4.0E-04	2.4E-03	9.1E-03
Y-91	5.4E-03	8.2E-04	4.2E-03	1.5E-02	4.6E-03	6.3E-04	3.3E-03	1.3E-02
Mo-93	1.1E-02	1.6E-03	8.6E-03	3.1E-02	9.5E-03	1.2E-03	6.9E-03	2.6E-02
Nb-93m	1.8E-03	2.8E-04	1.4E-03	5.1E-03	1.5E-03	2.1E-04	1.2E-03	4.2E-03
Nb-94	3.0E+01	4.8E+00	2.4E+01	8.2E+01	2.6E+01	4.0E+00	1.9E+01	6.8E+01
Nb-95	5.4E-01	6.4E-02	3.8E-01	1.4E+00	4.5E-01	5.0E-02	3.2E-01	1.3E+00
Zr-95	1.7E+00	2.3E-01	1.2E+00	4.5E+00	1.4E+00	1.9E-01	1.1E+00	3.9E+00
Tc-99	8.4E-04	1.1E-04	6.8E-04	2.3E-03	7.1E-04	9.2E-05	5.5E-04	2.0E-03
Ru-103	4.8E-01	6.6E-02	3.6E-01	1.3E+00	4.0E-01	4.6E-02	2.9E-01	1.1E+00
Ru-106	1.3E+00	1.9E-01	1.0E+00	3.7E+00	1.1E+00	1.5E-01	8.0E-01	3.0E+00
Ag-108m	8.4E+00	1.3E+00	6.5E+00	2.4E+01	7.0E+00	9.8E-01	5.3E+00	1.8E+01
Cd-109	5.5E-03	8.1E-04	4.1E-03	1.5E-02	4.6E-03	6.2E-04	3.4E-03	1.2E-02
Ag-110m	6.8E+00	1.0E+00	5.2E+00	1.9E+01	5.7E+00	7.3E-01	4.2E+00	1.5E+01
Sb-124	8.5E-01	1.1E-01	6.8E-01	2.3E+00	7.1E-01	9.0E-02	5.6E-01	1.9E+00
I-125	3.0E-03	4.3E-04	2.4E-03	8.0E-03	2.5E-03	3.4E-04	2.0E-03	6.1E-03
Sb-125	1.9E+00	2.5E-01	1.5E+00	5.1E+00	1.6E+00	2.0E-01	1.2E+00	4.3E+00
I-129	6.6E-02	9.7E-03	5.2E-02	1.8E-01	5.6E-02	7.2E-03	4.3E-02	1.6E-01
I-131	1.6E-03	1.3E-05	3.4E-04	8.0E-03	1.3E-03	9.5E-06	2.7E-04	6.0E-03
Ba-133	7.3E+00	1.1E+00	5.9E+00	2.0E+01	6.1E+00	7.7E-01	4.7E+00	1.7E+01
Cs-134	2.1E+01	3.6E+00	1.6E+01	5.6E+01	1.7E+01	2.9E+00	1.3E+01	4.4E+01
Cs-137	1.2E+01	1.7E+00	9.5E+00	3.4E+01	1.0E+01	1.2E+00	7.6E+00	2.6E+01

Table G.22 Dose factors[a] for CU-REVM-SMOBJCT-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	6.9E-04	2.3E-05	3.6E-04	2.6E-03	5.8E-04	1.7E-05	3.0E-04	2.2E-03
Ce-144	1.1E-01	1.7E-02	8.3E-02	2.9E-01	9.1E-02	1.3E-02	6.9E-02	2.5E-01
Pm-147	1.4E-05	1.9E-06	1.0E-05	4.0E-05	1.1E-05	1.5E-06	8.1E-06	2.9E-05
Eu-152	3.3E-01	1.5E-02	1.9E-01	1.1E+00	2.8E-01	1.3E-02	1.6E-01	9.3E-01
Eu-154	5.6E+00	8.5E-01	4.2E+00	1.5E+01	4.7E+00	5.4E-01	3.4E+00	1.3E+01
Eu-155	1.8E-01	2.6E-02	1.4E-01	4.7E-01	1.5E-01	1.8E-02	1.2E-01	4.1E-01
Re-186	6.2E-09	9.2E-14	5.4E-11	2.9E-08	4.8E-09	9.2E-14	4.3E-11	2.2E-08
Ir-192	4.2E-02	1.4E-03	2.5E-02	1.5E-01	3.6E-02	1.1E-03	2.1E-02	1.2E-01
Pb-210	3.3E-04	1.4E-05	2.0E-04	1.1E-03	2.8E-04	1.1E-05	1.6E-04	8.8E-04
Po-210	1.3E-05	2.0E-06	1.0E-05	3.5E-05	1.1E-05	1.4E-06	8.4E-06	3.0E-05
Bi-210	2.8E-09	1.2E-12	1.1E-10	1.5E-08	2.3E-09	7.9E-13	9.6E-11	1.2E-08
Rn-222	8.3E-07	1.1E-11	7.8E-09	4.6E-06	6.6E-07	9.9E-12	6.7E-09	3.9E-06
Ra-223	9.7E-05	1.1E-06	2.9E-05	4.3E-04	7.9E-05	9.3E-07	2.4E-05	3.1E-04
Ra-224	3.5E-07	4.5E-12	2.5E-09	1.9E-06	2.9E-07	4.4E-12	1.9E-09	1.5E-06
Ac-225	4.3E-05	2.1E-07	9.9E-06	2.0E-04	3.4E-05	1.7E-07	7.9E-06	1.7E-04
Ra-225	2.6E-06	3.9E-08	9.0E-07	1.1E-05	2.1E-06	3.0E-08	7.3E-07	9.1E-06
Ra-226	5.2E-01	1.8E-02	2.9E-01	1.8E+00	4.4E-01	1.4E-02	2.6E-01	1.5E+00
Ac-227	1.3E-01	3.7E-03	8.2E-02	4.3E-01	1.1E-01	4.0E-03	6.4E-02	3.8E-01
Th-227	2.4E-04	5.3E-06	9.4E-05	9.5E-04	1.9E-04	4.1E-06	7.5E-05	6.6E-04
Th-228	3.2E-01	9.5E-03	1.7E-01	1.0E+00	2.7E-01	7.9E-03	1.5E-01	8.8E-01
Ra-228	2.6E-01	7.2E-03	1.5E-01	9.2E-01	2.2E-01	5.1E-03	1.2E-01	8.0E-01
Th-229	9.4E-02	3.5E-03	5.4E-02	3.3E-01	7.7E-02	2.9E-03	4.5E-02	2.6E-01
Th-230	2.2E-04	7.7E-06	1.3E-04	7.6E-04	1.9E-04	5.5E-06	9.8E-05	6.9E-04
Pa-231	1.0E-02	4.4E-04	6.0E-03	3.8E-02	8.9E-03	3.1E-04	4.9E-03	3.3E-02
Th-231	6.2E-18	5.4E-36	1.2E-26	1.5E-17	4.7E-18	4.6E-36	9.1E-27	9.5E-18
Th-232	3.6E-02	8.0E-04	1.9E-02	1.2E-01	3.0E-02	8.1E-04	1.5E-02	1.0E-01
Pa-233	1.3E-03	4.1E-05	6.8E-04	4.6E-03	1.1E-03	2.5E-05	5.5E-04	3.5E-03
U-233	1.8E-05	4.7E-07	1.1E-05	6.4E-05	1.5E-05	4.7E-07	8.8E-06	5.1E-05
Th-234	5.4E-05	1.1E-06	2.6E-05	2.1E-04	4.5E-05	8.8E-07	2.2E-05	1.7E-04
U-234	2.9E-05	7.5E-07	1.8E-05	9.9E-05	2.5E-05	6.4E-07	1.4E-05	8.7E-05
U-235	5.5E-02	1.8E-03	3.5E-02	1.7E-01	4.7E-02	1.3E-03	2.7E-02	1.6E-01
Np-237	6.8E-01	3.0E-02	4.7E-01	2.1E+00	5.7E-01	2.8E-02	3.9E-01	1.9E+00
Pu-238	2.9E-04	1.4E-05	2.0E-04	9.7E-04	2.5E-04	1.4E-05	1.6E-04	8.4E-04
U-238	2.4E-01	3.6E-02	1.8E-01	6.8E-01	2.0E-01	2.9E-02	1.5E-01	5.4E-01
Pu-239	7.6E-04	1.3E-04	5.7E-04	1.9E-03	6.4E-04	8.8E-05	4.6E-04	1.8E-03
Pu-240	1.7E-03	2.7E-04	1.3E-03	4.4E-03	1.4E-03	2.2E-04	1.1E-03	3.5E-03
Pu-241	3.3E-04	5.0E-05	2.5E-04	9.0E-04	2.8E-04	4.1E-05	2.1E-04	7.4E-04
Am-241	1.6E-01	2.1E-02	1.2E-01	4.6E-01	1.3E-01	1.5E-02	1.0E-01	3.3E-01
Cm-242	1.1E-03	1.7E-04	8.9E-04	2.9E-03	9.2E-04	1.4E-04	7.0E-04	2.4E-03
Pu-242	1.6E-03	2.3E-04	1.3E-03	4.2E-03	1.4E-03	1.7E-04	9.9E-04	3.7E-03
Cm-244	2.6E-03	3.9E-04	2.0E-03	7.0E-03	2.2E-03	2.8E-04	1.6E-03	5.9E-03

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table G.23 Dose factors[a] for CU-METL-PIPES-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	3.8E-08	1.4E-09	2.4E-08	1.4E-07	3.2E-08	1.2E-09	2.0E-08	1.2E-07
C-14	1.2E-05	4.8E-07	7.7E-06	3.9E-05	1.1E-05	3.4E-07	6.3E-06	3.3E-05
Na-22	5.6E-05	3.1E-06	3.1E-05	1.8E-04	4.7E-05	2.1E-06	2.8E-05	1.5E-04
P-32	8.6E-07	4.2E-08	4.0E-07	3.4E-06	7.4E-07	3.2E-08	3.3E-07	3.0E-06
S-35	3.0E-06	5.5E-07	2.3E-06	8.0E-06	2.6E-06	4.0E-07	1.9E-06	7.5E-06
Cl-36	1.1E-04	1.7E-05	8.6E-05	3.0E-04	9.4E-05	1.4E-05	7.1E-05	2.5E-04
K-40	6.6E-04	1.2E-04	5.4E-04	1.6E-03	5.7E-04	9.9E-05	4.3E-04	1.5E-03
Ca-41	4.7E-05	7.9E-06	3.7E-05	1.3E-04	4.0E-05	5.8E-06	3.1E-05	1.1E-04
Ca-45	4.3E-05	6.9E-06	3.4E-05	1.1E-04	3.7E-05	5.8E-06	2.8E-05	1.0E-04
Cr-51	1.1E-07	1.2E-08	7.3E-08	3.5E-07	9.7E-08	9.2E-09	6.0E-08	2.9E-07
Mn-54	6.0E-05	1.0E-05	4.4E-05	1.7E-04	5.1E-05	7.2E-06	3.6E-05	1.4E-04
Fe-55	1.8E-05	3.4E-06	1.4E-05	4.9E-05	1.6E-05	2.3E-06	1.2E-05	4.0E-05
Co-57	1.4E-05	2.6E-06	1.1E-05	3.8E-05	1.2E-05	1.7E-06	9.1E-06	3.1E-05
Co-58	1.5E-05	2.5E-06	1.2E-05	3.9E-05	1.3E-05	1.9E-06	9.5E-06	3.5E-05
Fe-59	2.2E-06	9.9E-08	1.4E-06	7.5E-06	1.9E-06	6.4E-08	1.1E-06	7.4E-06
Ni-59	7.6E-07	3.4E-08	5.2E-07	2.4E-06	6.5E-07	2.9E-08	4.4E-07	2.0E-06
Co-60	1.8E-04	3.0E-05	1.3E-04	4.6E-04	1.5E-04	2.3E-05	1.1E-04	4.0E-04
Ni-63	1.1E-05	1.8E-06	8.2E-06	2.6E-05	9.0E-06	1.5E-06	7.0E-06	2.3E-05
Zn-65	1.4E-04	2.4E-05	1.0E-04	3.7E-04	1.2E-04	1.9E-05	8.4E-05	3.2E-04
Cu-67	3.9E-13	3.7E-20	3.0E-16	2.1E-12	3.6E-13	3.3E-20	2.3E-16	1.5E-12
Se-75	2.5E-05	4.6E-06	1.9E-05	6.3E-05	2.1E-05	3.3E-06	1.5E-05	5.5E-05
Sr-85	8.6E-06	1.2E-06	6.4E-06	2.4E-05	7.4E-06	9.4E-07	5.2E-06	2.0E-05
Sr-89	2.6E-05	4.4E-06	1.8E-05	7.2E-05	2.2E-05	3.3E-06	1.5E-05	6.2E-05
Sr-90	5.1E-03	9.5E-04	3.9E-03	1.4E-02	4.3E-03	7.4E-04	3.3E-03	1.1E-02
Y-91	3.0E-05	4.2E-06	2.2E-05	7.9E-05	2.6E-05	3.3E-06	1.8E-05	7.3E-05
Mo-93	4.3E-05	6.5E-06	3.3E-05	1.1E-04	3.6E-05	4.9E-06	2.8E-05	1.0E-04
Nb-93m	1.6E-05	3.0E-06	1.2E-05	4.5E-05	1.4E-05	2.3E-06	9.7E-06	3.6E-05
Nb-94	2.6E-04	5.0E-05	2.0E-04	7.0E-04	2.2E-04	3.5E-05	1.7E-04	5.9E-04
Nb-95	3.4E-06	4.8E-07	2.4E-06	9.7E-06	2.9E-06	3.9E-07	2.0E-06	8.4E-06
Zr-95	3.9E-05	6.5E-06	2.9E-05	1.1E-04	3.3E-05	4.7E-06	2.3E-05	8.7E-05
Tc-99	5.4E-05	9.5E-06	4.1E-05	1.4E-04	4.6E-05	7.5E-06	3.3E-05	1.2E-04
Ru-103	5.1E-06	7.4E-07	3.6E-06	1.6E-05	4.4E-06	5.4E-07	3.0E-06	1.3E-05
Ru-106	3.2E-04	5.3E-05	2.5E-04	8.0E-04	2.7E-04	3.7E-05	2.0E-04	7.4E-04
Ag-108m	7.1E-05	1.2E-05	5.3E-05	1.9E-04	6.1E-05	1.0E-05	4.3E-05	1.8E-04
Cd-109	8.4E-05	1.7E-05	6.3E-05	2.2E-04	7.1E-05	1.1E-05	5.2E-05	1.8E-04
Ag-110m	5.3E-05	8.4E-06	3.9E-05	1.4E-04	4.5E-05	5.8E-06	3.3E-05	1.2E-04
Sb-124	1.0E-05	1.7E-06	7.3E-06	2.8E-05	8.6E-06	1.1E-06	5.9E-06	2.4E-05
I-125	3.8E-05	6.1E-06	2.9E-05	1.0E-04	3.2E-05	4.3E-06	2.4E-05	9.1E-05
Sb-125	2.2E-05	3.9E-06	1.7E-05	5.8E-05	1.9E-05	2.6E-06	1.4E-05	5.2E-05
I-129	8.9E-03	1.5E-03	6.9E-03	2.5E-02	7.6E-03	1.2E-03	5.6E-03	2.1E-02
I-131	4.6E-07	3.4E-09	8.1E-08	2.4E-06	4.1E-07	2.8E-09	6.7E-08	2.2E-06
Ba-133	1.2E-04	2.3E-05	8.9E-05	3.2E-04	1.0E-04	1.6E-05	7.3E-05	2.7E-04
Cs-134	1.9E-03	3.3E-04	1.4E-03	5.0E-03	1.6E-03	2.3E-04	1.2E-03	4.5E-03
Cs-137	1.8E-03	3.3E-04	1.3E-03	5.1E-03	1.5E-03	2.2E-04	1.2E-03	4.1E-03

Table G.23 Dose factors[a] for CU-METL-PIPES-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	6.0E-08	1.9E-09	2.9E-08	1.9E-07	5.1E-08	1.6E-09	2.2E-08	1.9E-07
Ce-144	1.1E-04	1.9E-05	8.4E-05	3.1E-04	9.4E-05	1.4E-05	6.5E-05	2.7E-04
Pm-147	8.3E-06	1.4E-06	6.0E-06	2.3E-05	7.0E-06	1.1E-06	5.1E-06	1.9E-05
Eu-152	4.0E-06	1.6E-07	2.4E-06	1.3E-05	3.5E-06	1.1E-07	1.8E-06	1.2E-05
Eu-154	8.4E-05	1.5E-05	6.5E-05	2.3E-04	7.2E-05	1.2E-05	5.3E-05	1.9E-04
Eu-155	1.3E-05	2.3E-06	9.8E-06	3.5E-05	1.1E-05	1.7E-06	8.3E-06	3.1E-05
Re-186	3.1E-12	4.3E-17	2.1E-14	1.3E-11	2.7E-12	3.0E-17	1.6E-14	1.4E-11
Ir-192	5.0E-07	2.3E-08	2.8E-07	1.5E-06	4.3E-07	1.7E-08	2.2E-07	1.4E-06
Pb-210	3.2E-03	1.6E-04	1.8E-03	9.9E-03	2.8E-03	1.2E-04	1.5E-03	1.0E-02
Po-210	5.8E-03	9.0E-04	4.4E-03	1.6E-02	4.9E-03	6.5E-04	3.6E-03	1.3E-02
Bi-210	5.5E-11	9.9E-15	1.6E-12	2.8E-10	4.9E-11	6.8E-15	1.4E-12	2.5E-10
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	4.7E-07	5.2E-09	1.1E-07	2.3E-06	4.0E-07	3.6E-09	8.6E-08	1.9E-06
Ra-224	2.1E-10	1.8E-15	1.5E-12	1.1E-09	1.8E-10	1.3E-15	1.3E-12	1.0E-09
Ac-225	4.7E-08	3.3E-10	7.9E-09	2.2E-07	4.2E-08	2.4E-10	6.8E-09	2.1E-07
Ra-225	7.3E-07	1.6E-08	2.6E-07	3.1E-06	6.3E-07	1.1E-08	2.1E-07	2.7E-06
Ra-226	8.2E-04	3.6E-05	4.7E-04	2.8E-03	7.1E-04	2.7E-05	3.9E-04	2.3E-03
Ac-227	8.5E-03	3.3E-04	5.0E-03	2.9E-02	7.2E-03	2.7E-04	3.9E-03	2.4E-02
Th-227	1.6E-07	3.5E-09	6.6E-08	6.7E-07	1.4E-07	2.6E-09	5.6E-08	6.0E-07
Th-228	3.7E-04	1.3E-05	2.2E-04	1.2E-03	3.1E-04	9.7E-06	1.8E-04	1.1E-03
Ra-228	8.4E-04	3.1E-05	4.9E-04	2.9E-03	7.2E-04	2.3E-05	3.9E-04	2.4E-03
Th-229	2.2E-03	8.3E-05	1.3E-03	7.4E-03	1.9E-03	5.0E-05	9.9E-04	6.2E-03
Th-230	3.5E-04	1.2E-05	2.1E-04	1.1E-03	3.0E-04	1.0E-05	1.6E-04	1.0E-03
Pa-231	6.6E-03	2.6E-04	4.0E-03	2.1E-02	5.6E-03	2.2E-04	3.3E-03	1.8E-02
Th-231	3.6E-21	9.7E-40	3.1E-30	6.2E-21	3.4E-21	7.7E-40	3.1E-30	5.2E-21
Th-232	1.7E-03	6.1E-05	1.0E-03	5.8E-03	1.5E-03	5.6E-05	7.9E-04	5.1E-03
Pa-233	4.3E-08	1.1E-09	2.2E-08	1.5E-07	3.7E-08	9.5E-10	1.8E-08	1.4E-07
U-233	1.6E-05	6.6E-07	9.8E-06	5.3E-05	1.4E-05	4.7E-07	7.8E-06	4.6E-05
Th-234	1.2E-07	3.5E-09	5.7E-08	4.5E-07	9.8E-08	2.6E-09	4.6E-08	4.0E-07
U-234	1.7E-05	5.6E-07	9.2E-06	5.5E-05	1.4E-05	4.8E-07	7.6E-06	5.3E-05
U-235	1.5E-05	6.9E-07	9.6E-06	5.2E-05	1.3E-05	6.0E-07	8.1E-06	4.0E-05
Np-237	2.6E-02	9.9E-04	1.6E-02	8.1E-02	2.2E-02	9.0E-04	1.3E-02	6.9E-02
Pu-238	2.7E-04	1.7E-05	1.7E-04	8.2E-04	2.3E-04	1.1E-05	1.4E-04	7.2E-04
U-238	8.6E-04	1.7E-04	6.7E-04	2.2E-03	7.3E-04	1.2E-04	5.5E-04	1.9E-03
Pu-239	1.9E-03	3.5E-04	1.5E-03	5.2E-03	1.6E-03	2.4E-04	1.2E-03	4.5E-03
Pu-240	1.9E-03	3.5E-04	1.5E-03	5.3E-03	1.6E-03	2.6E-04	1.2E-03	4.3E-03
Pu-241	2.7E-05	4.7E-06	2.0E-05	7.3E-05	2.3E-05	3.7E-06	1.8E-05	6.5E-05
Am-241	1.3E-01	2.3E-02	1.0E-01	3.4E-01	1.1E-01	1.9E-02	8.6E-02	2.8E-01
Cm-242	1.6E-03	2.9E-04	1.2E-03	4.3E-03	1.3E-03	2.2E-04	9.9E-04	3.7E-03
Pu-242	1.8E-03	3.2E-04	1.3E-03	4.9E-03	1.5E-03	2.4E-04	1.1E-03	4.2E-03
Cm-244	7.2E-02	1.3E-02	5.4E-02	2.0E-01	6.2E-02	9.7E-03	4.5E-02	1.7E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

APPENDIX H

DOSE FACTORS FOR ALUMINUM RECYCLE SCENARIOS

CONTENTS

Tables

H DOSE FACTORS FOR ALUMINUM RECYCLE SCENARIOS

This appendix presents tabulated values from the distribution of radionuclide-specific dose factors for all aluminum recycle exposure scenarios. Volumetric (mass) dose factors are based on volumetrically distributed residual radioactivity in cleared material. Surficial dose factors are calculated by multiplying the mass dose factors by a surface-to-mass ratio distribution appropriate for cleared aluminum. Both sets of dose factors are listed in SI units; the conversion factor to convert the dose factors to conventional units is listed in the footnote at the end of each table.

The tabulated values from the frequency distribution of each dose factor consists of the mean (arithmetic average) and three percentile values (5^{th}, 50^{th}, and 95^{th}). A 90% confidence interval for any dose factor is the range between the 5^{th} percentile value and the 95^{th} percentile value.

The shading in the tables in this appendix is only to facilitate reading the values in the tables.

Table H.1 Dose factors[a] for AL-SCRP-HANDLIN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	3.1E-07	9.5E-08	2.8E-07	6.6E-07	1.2E-06	2.2E-07	9.5E-07	3.3E-06
C-14	7.5E-06	1.3E-06	6.2E-06	1.8E-05	3.0E-05	3.6E-06	2.2E-05	8.5E-05
Na-22	9.3E-02	1.8E-02	7.8E-02	2.1E-01	3.8E-01	5.4E-02	2.8E-01	1.0E+00
P-32	8.4E-05	2.9E-05	7.8E-05	1.6E-04	3.4E-04	7.1E-05	2.8E-04	8.1E-04
S-35	4.8E-06	1.7E-06	4.3E-06	9.7E-06	1.9E-05	3.9E-06	1.6E-05	4.7E-05
Cl-36	5.3E-05	2.2E-05	5.0E-05	9.6E-05	2.1E-04	4.6E-05	1.9E-04	4.7E-04
K-40	7.3E-03	1.5E-03	6.1E-03	1.6E-02	3.0E-02	4.4E-03	2.2E-02	8.1E-02
Ca-41	6.2E-06	1.9E-06	5.6E-06	1.3E-05	2.5E-05	4.6E-06	2.0E-05	6.5E-05
Ca-45	2.0E-05	6.5E-06	1.8E-05	4.0E-05	8.1E-05	1.8E-05	6.5E-05	1.9E-04
Cr-51	9.4E-04	1.8E-04	7.8E-04	2.1E-03	3.8E-03	5.5E-04	2.7E-03	1.0E-02
Mn-54	3.6E-02	6.9E-03	3.0E-02	8.1E-02	1.5E-01	2.1E-02	1.1E-01	4.0E-01
Fe-55	3.9E-06	1.2E-06	3.5E-06	7.7E-06	1.6E-05	3.3E-06	1.2E-05	3.7E-05
Co-57	1.3E-03	2.4E-04	1.1E-03	2.8E-03	5.1E-03	7.4E-04	3.7E-03	1.4E-02
Co-58	4.0E-02	7.6E-03	3.4E-02	8.9E-02	1.6E-01	2.3E-02	1.2E-01	4.5E-01
Fe-59	5.1E-02	9.7E-03	4.3E-02	1.1E-01	2.1E-01	3.0E-02	1.5E-01	5.7E-01
Ni-59	1.9E-06	6.1E-07	1.7E-06	4.0E-06	7.8E-06	1.6E-06	6.3E-06	1.9E-05
Co-60	1.2E-01	2.2E-02	9.7E-02	2.6E-01	4.7E-01	6.6E-02	3.4E-01	1.3E+00
Ni-63	5.0E-06	1.6E-06	4.6E-06	1.0E-05	2.0E-05	4.1E-06	1.6E-05	5.0E-05
Zn-65	1.6E-02	3.1E-03	1.3E-02	3.6E-02	6.5E-02	9.3E-03	4.7E-02	1.8E-01
Cu-67	7.3E-04	1.3E-04	5.5E-04	1.8E-03	3.0E-03	3.6E-04	2.0E-03	9.3E-03
Se-75	9.6E-03	1.9E-03	8.0E-03	2.1E-02	3.9E-02	5.6E-03	2.8E-02	1.1E-01
Sr-85	2.0E-02	3.9E-03	1.7E-02	4.5E-02	8.3E-02	1.2E-02	6.0E-02	2.3E-01
Sr-89	1.3E-04	5.5E-05	1.2E-04	2.2E-04	5.2E-04	1.1E-04	4.6E-04	1.1E-03
Sr-90	2.2E-03	6.2E-04	1.9E-03	4.7E-03	8.9E-03	1.7E-03	7.0E-03	2.3E-02
Y-91	2.5E-04	9.7E-05	2.3E-04	4.4E-04	1.0E-03	2.2E-04	8.6E-04	2.3E-03
Mo-93	4.4E-05	1.3E-05	3.7E-05	9.4E-05	1.8E-04	3.4E-05	1.4E-04	4.6E-04
Nb-93m	4.0E-05	9.2E-06	3.3E-05	9.1E-05	1.6E-04	2.5E-05	1.2E-04	4.4E-04
Nb-94	6.9E-02	1.4E-02	5.8E-02	1.6E-01	2.8E-01	4.2E-02	2.0E-01	7.7E-01
Nb-95	3.0E-02	5.7E-03	2.5E-02	6.6E-02	1.2E-01	1.8E-02	8.7E-02	3.3E-01
Zr-95	2.9E-02	5.6E-03	2.5E-02	6.6E-02	1.2E-01	1.7E-02	8.7E-02	3.3E-01
Tc-99	1.7E-05	6.1E-06	1.5E-05	3.4E-05	6.9E-05	1.4E-05	5.6E-05	1.7E-04
Ru-103	1.8E-02	3.4E-03	1.5E-02	4.0E-02	7.3E-02	1.1E-02	5.3E-02	2.0E-01
Ru-106	9.2E-03	2.2E-03	7.7E-03	2.0E-02	3.7E-02	6.6E-03	2.8E-02	9.8E-02
Ag-108m	6.8E-02	1.4E-02	5.7E-02	1.5E-01	2.8E-01	4.1E-02	2.0E-01	7.6E-01
Cd-109	1.1E-04	4.0E-05	1.0E-04	2.2E-04	4.5E-04	1.0E-04	3.7E-04	1.1E-03
Ag-110m	1.2E-01	2.3E-02	9.9E-02	2.7E-01	4.8E-01	6.8E-02	3.5E-01	1.3E+00
Sb-124	7.8E-02	1.5E-02	6.5E-02	1.7E-01	3.2E-01	4.6E-02	2.3E-01	8.7E-01
I-125	1.9E-04	6.5E-05	1.7E-04	3.9E-04	7.8E-04	1.7E-04	6.2E-04	1.9E-03
Sb-125	1.6E-02	3.0E-03	1.3E-02	3.6E-02	6.4E-02	9.1E-03	4.7E-02	1.8E-01
I-129	1.2E-03	3.5E-04	1.1E-03	2.6E-03	4.9E-03	8.9E-04	3.8E-03	1.3E-02
I-131	9.4E-03	1.9E-03	7.8E-03	2.2E-02	3.8E-02	5.7E-03	2.7E-02	1.0E-01
Ba-133	1.0E-02	2.0E-03	8.7E-03	2.4E-02	4.2E-02	6.0E-03	3.1E-02	1.2E-01
Cs-134	6.5E-02	1.3E-02	5.4E-02	1.5E-01	2.6E-01	3.8E-02	1.9E-01	7.3E-01
Cs-137	2.6E-02	5.1E-03	2.1E-02	5.7E-02	1.0E-01	1.5E-02	7.6E-02	2.8E-01

Table H.1 Dose factors[a] for AL-SCRP-HANDLIN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	8.9E-04	1.9E-04	7.5E-04	2.0E-03	3.6E-03	5.7E-04	2.6E-03	9.8E-03
Ce-144	2.2E-03	7.7E-04	2.0E-03	4.2E-03	8.7E-03	1.9E-03	6.8E-03	2.1E-02
Pm-147	5.5E-05	1.2E-05	4.5E-05	1.2E-04	2.2E-04	3.6E-05	1.7E-04	5.9E-04
Eu-152	4.7E-02	9.3E-03	3.9E-02	1.1E-01	1.9E-01	2.8E-02	1.4E-01	5.2E-01
Eu-154	5.5E-02	1.1E-02	4.6E-02	1.2E-01	2.2E-01	3.3E-02	1.6E-01	6.1E-01
Eu-155	3.5E-04	1.1E-04	3.1E-04	7.2E-04	1.4E-03	2.8E-04	1.1E-03	3.7E-03
Re-186	9.9E-05	2.4E-05	8.0E-05	2.2E-04	4.0E-04	6.2E-05	2.8E-04	1.2E-03
Ir-192	2.6E-02	5.0E-03	2.2E-02	5.8E-02	1.1E-01	1.5E-02	7.7E-02	2.9E-01
Pb-210	3.7E-02	1.1E-02	3.3E-02	7.3E-02	1.5E-01	3.2E-02	1.2E-01	3.5E-01
Po-210	1.8E-02	5.6E-03	1.6E-02	3.6E-02	7.1E-02	1.4E-02	5.7E-02	1.7E-01
Bi-210	1.7E-04	5.2E-05	1.5E-04	3.9E-04	7.0E-04	1.2E-04	5.3E-04	1.8E-03
Rn-222	3.8E-02	7.2E-03	3.0E-02	8.9E-02	1.5E-01	2.1E-02	1.1E-01	4.6E-01
Ra-223	1.7E-02	6.6E-03	1.5E-02	3.0E-02	6.8E-02	1.4E-02	6.0E-02	1.6E-01
Ra-224	2.5E-02	6.7E-03	2.1E-02	5.7E-02	1.0E-01	1.6E-02	7.5E-02	2.9E-01
Ac-225	1.4E-02	5.1E-03	1.3E-02	2.7E-02	5.6E-02	1.1E-02	4.7E-02	1.3E-01
Ra-225	9.6E-03	2.4E-03	8.0E-03	2.0E-02	3.9E-02	6.8E-03	2.9E-02	1.0E-01
Ra-226	9.2E-02	2.9E-02	8.1E-02	1.9E-01	3.7E-01	7.5E-02	2.9E-01	9.6E-01
Ac-227	1.7E+00	3.6E-01	1.4E+00	4.0E+00	7.0E+00	1.0E+00	5.2E+00	1.9E+01
Th-227	2.1E-02	5.6E-03	1.7E-02	4.4E-02	8.3E-02	1.3E-02	6.3E-02	2.2E-01
Th-228	4.9E-01	1.3E-01	4.1E-01	1.1E+00	2.0E+00	3.3E-01	1.5E+00	5.2E+00
Ra-228	5.7E-02	2.2E-02	5.3E-02	1.0E-01	2.3E-01	4.9E-02	1.9E-01	5.4E-01
Th-229	2.3E+00	4.2E-01	1.9E+00	5.2E+00	9.2E+00	1.3E+00	6.7E+00	2.5E+01
Th-230	3.4E-01	6.3E-02	2.8E-01	7.9E-01	1.4E+00	1.9E-01	1.0E+00	3.8E+00
Pa-231	1.2E+00	2.4E-01	9.5E-01	2.6E+00	4.7E+00	6.8E-01	3.5E+00	1.3E+01
Th-231	5.7E-06	6.3E-07	3.3E-06	1.8E-05	2.4E-05	1.8E-06	1.3E-05	8.5E-05
Th-232	1.5E+00	2.8E-01	1.2E+00	3.5E+00	6.1E+00	8.4E-01	4.5E+00	1.7E+01
Pa-233	5.5E-03	1.1E-03	4.6E-03	1.2E-02	2.2E-02	3.3E-03	1.6E-02	6.1E-02
U-233	1.8E-01	3.2E-02	1.4E-01	4.1E-01	7.2E-01	9.5E-02	5.2E-01	2.0E+00
Th-234	4.0E-04	1.3E-04	3.6E-04	8.1E-04	1.6E-03	3.4E-04	1.3E-03	4.1E-03
U-234	1.7E-01	3.1E-02	1.4E-01	4.0E-01	7.0E-01	9.3E-02	5.1E-01	1.9E+00
U-235	1.6E-01	3.3E-02	1.3E-01	3.7E-01	6.6E-01	9.1E-02	4.8E-01	1.8E+00
Np-237	7.2E-01	1.5E-01	5.9E-01	1.7E+00	2.9E+00	4.2E-01	2.2E+00	8.0E+00
Pu-238	3.8E-01	6.8E-02	3.1E-01	8.7E-01	1.5E+00	2.0E-01	1.1E+00	4.2E+00
U-238	1.5E-01	2.8E-02	1.3E-01	3.6E-01	6.3E-01	8.3E-02	4.6E-01	1.7E+00
Pu-239	4.0E-01	7.3E-02	3.3E-01	9.3E-01	1.6E+00	2.2E-01	1.2E+00	4.5E+00
Pu-240	4.0E-01	7.3E-02	3.3E-01	9.3E-01	1.6E+00	2.2E-01	1.2E+00	4.5E+00
Pu-241	6.5E-03	1.2E-03	5.3E-03	1.5E-02	2.6E-02	3.5E-03	1.9E-02	7.2E-02
Am-241	5.9E-01	1.2E-01	4.9E-01	1.4E+00	2.4E+00	3.4E-01	1.8E+00	6.5E+00
Cm-242	2.3E-02	4.5E-03	1.9E-02	5.2E-02	9.1E-02	1.3E-02	6.7E-02	2.5E-01
Pu-242	3.8E-01	7.0E-02	3.1E-01	8.8E-01	1.5E+00	2.1E-01	1.1E+00	4.2E+00
Cm-244	3.3E-01	6.7E-02	2.7E-01	7.6E-01	1.3E+00	1.9E-01	9.9E-01	3.6E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.2 Dose factors[a] for AL-DUST-BAGHOUS-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	6.3E-04	4.2E-05	4.1E-04	1.9E-03	2.6E-03	1.5E-04	1.4E-03	9.0E-03
P-32	9.5E-06	3.5E-07	4.2E-06	3.2E-05	3.8E-05	1.0E-06	1.6E-05	1.5E-04
S-35	1.1E-06	2.3E-08	4.9E-07	4.2E-06	4.3E-06	7.2E-08	1.7E-06	1.7E-05
Cl-36	3.6E-05	3.6E-06	2.1E-05	1.1E-04	1.4E-04	1.1E-05	7.9E-05	4.5E-04
K-40	4.9E-05	4.1E-06	3.2E-05	1.6E-04	1.9E-04	1.2E-05	1.2E-04	6.2E-04
Ca-41	2.6E-07	1.4E-08	1.5E-07	8.2E-07	1.0E-06	4.6E-08	4.8E-07	3.8E-06
Ca-45	5.7E-07	3.4E-08	3.2E-07	2.0E-06	2.3E-06	1.1E-07	1.1E-06	8.7E-06
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	2.4E-04	1.7E-05	1.6E-04	7.5E-04	9.7E-04	4.5E-05	5.6E-04	3.5E-03
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	5.0E-04	4.1E-05	3.2E-04	1.6E-03	2.0E-03	1.3E-04	1.1E-03	6.8E-03
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	1.2E-03	3.4E-05	5.6E-04	4.2E-03	4.6E-03	1.1E-04	2.1E-03	1.6E-02
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	4.8E-04	4.0E-05	2.8E-04	1.5E-03	1.9E-03	1.1E-04	1.0E-03	7.4E-03
Cs-137	1.8E-04	1.5E-05	1.2E-04	5.7E-04	7.2E-04	4.9E-05	4.4E-04	2.3E-03

Table H.2 Dose factors[a] for AL-DUST-BAGHOUS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.3 Dose factors[a] for AL-METL-HANDREF-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	4.6E-09	1.5E-10	2.3E-09	1.6E-08	1.9E-08	4.6E-10	8.0E-09	7.6E-08
C-14	6.7E-06	7.9E-07	4.2E-06	2.1E-05	2.7E-05	1.9E-06	1.6E-05	9.5E-05
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	3.5E-05	6.8E-06	2.8E-05	9.1E-05	1.4E-04	2.0E-05	9.4E-05	4.1E-04
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	2.7E-06	4.6E-07	2.0E-06	7.3E-06	1.1E-05	1.2E-06	7.3E-06	3.1E-05
Co-57	1.2E-04	2.5E-05	8.9E-05	3.0E-04	4.8E-04	6.0E-05	3.3E-04	1.4E-03
Co-58	1.7E-03	3.5E-04	1.2E-03	4.4E-03	6.9E-03	8.1E-04	4.3E-03	2.0E-02
Fe-59	1.6E-03	3.2E-04	1.2E-03	4.4E-03	6.6E-03	7.7E-04	4.4E-03	2.1E-02
Ni-59	1.2E-06	2.4E-07	8.5E-07	3.2E-06	4.9E-06	6.3E-07	3.1E-06	1.5E-05
Co-60	5.2E-03	1.0E-03	4.0E-03	1.4E-02	2.1E-02	2.8E-03	1.4E-02	6.3E-02
Ni-63	3.2E-06	6.0E-07	2.3E-06	8.7E-06	1.3E-05	1.8E-06	8.6E-06	4.0E-05
Zn-65	1.2E-03	2.5E-04	8.4E-04	3.2E-03	4.6E-03	6.3E-04	3.0E-03	1.4E-02
Cu-67	4.5E-07	1.2E-09	5.4E-08	2.1E-06	1.9E-06	3.6E-09	1.7E-07	9.8E-06
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	4.5E-04	9.1E-05	3.2E-04	1.2E-03	1.8E-03	2.3E-04	1.2E-03	6.1E-03
Sr-89	1.9E-05	3.4E-06	1.4E-05	5.2E-05	7.9E-05	1.0E-05	5.2E-05	2.5E-04
Sr-90	5.7E-04	1.2E-04	4.2E-04	1.4E-03	2.3E-03	2.9E-04	1.5E-03	6.5E-03
Y-91	1.2E-05	2.5E-06	8.3E-06	3.2E-05	4.8E-05	6.1E-06	3.0E-05	1.6E-04
Mo-93	1.9E-05	3.7E-06	1.5E-05	4.6E-05	7.6E-05	9.1E-06	5.3E-05	2.3E-04
Nb-93m	1.6E-05	3.0E-06	1.1E-05	4.6E-05	6.5E-05	8.2E-06	4.3E-05	2.0E-04
Nb-94	3.8E-03	7.4E-04	2.8E-03	9.9E-03	1.5E-02	2.0E-03	1.1E-02	4.4E-02
Nb-95	1.0E-03	1.9E-04	7.5E-04	2.6E-03	4.0E-03	5.6E-04	2.7E-03	1.1E-02
Zr-95	6.4E-04	1.2E-04	4.8E-04	1.7E-03	2.5E-03	2.9E-04	1.7E-03	7.5E-03
Tc-99	8.1E-06	1.5E-06	6.0E-06	2.1E-05	3.3E-05	4.2E-06	2.0E-05	1.0E-04
Ru-103	6.1E-04	1.3E-04	4.5E-04	1.7E-03	2.5E-03	3.2E-04	1.6E-03	7.6E-03
Ru-106	6.4E-04	1.5E-04	4.7E-04	1.6E-03	2.5E-03	3.8E-04	1.7E-03	7.0E-03
Ag-108m	3.9E-03	8.0E-04	2.8E-03	1.1E-02	1.6E-02	2.0E-03	1.2E-02	4.4E-02
Cd-109	6.8E-05	1.2E-05	4.8E-05	1.7E-04	2.7E-04	2.7E-05	1.9E-04	8.0E-04
Ag-110m	5.8E-03	1.2E-03	4.1E-03	1.6E-02	2.3E-02	3.0E-03	1.6E-02	6.8E-02
Sb-124	2.9E-03	5.7E-04	2.1E-03	7.7E-03	1.2E-02	1.4E-03	7.5E-03	3.7E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.4E-04	1.9E-04	6.9E-04	2.4E-03	3.7E-03	5.2E-04	2.7E-03	1.1E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	4.0E-04	8.0E-05	3.1E-04	1.1E-03	1.6E-03	2.0E-04	1.1E-03	5.0E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.3 Dose factors[a] for AL-METL-HANDREF-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	1.5E-05	3.4E-06	1.1E-05	4.0E-05	6.2E-05	8.8E-06	3.8E-05	1.8E-04
Ce-144	7.9E-05	1.8E-05	5.9E-05	2.0E-04	3.2E-04	4.3E-05	2.2E-04	9.6E-04
Pm-147	5.6E-06	1.1E-06	3.9E-06	1.5E-05	2.2E-05	2.5E-06	1.5E-05	6.4E-05
Eu-152	6.3E-04	1.3E-04	4.7E-04	1.6E-03	2.6E-03	3.2E-04	1.7E-03	7.7E-03
Eu-154	7.1E-04	1.4E-04	5.4E-04	1.8E-03	2.8E-03	3.3E-04	2.0E-03	8.0E-03
Eu-155	1.6E-05	3.5E-06	1.2E-05	3.9E-05	6.4E-05	8.6E-06	4.2E-05	1.9E-04
Re-186	3.2E-07	5.5E-09	1.1E-07	1.4E-06	1.3E-06	1.7E-08	3.3E-07	5.5E-06
Ir-192	1.4E-03	2.8E-04	1.1E-03	3.9E-03	5.7E-03	8.1E-04	3.8E-03	1.7E-02
Pb-210	2.6E-02	4.7E-03	1.7E-02	6.8E-02	1.0E-01	1.4E-02	6.5E-02	3.3E-01
Po-210	8.4E-03	1.6E-03	5.8E-03	2.3E-02	3.4E-02	3.8E-03	2.1E-02	1.1E-01
Bi-210	4.3E-06	1.4E-07	1.6E-06	1.7E-05	1.8E-05	4.6E-07	5.3E-06	3.8E-05
Rn-222	8.6E-07	4.7E-09	1.7E-07	4.3E-06	3.4E-06	1.3E-08	5.8E-07	1.5E-05
Ra-223	1.3E-03	1.8E-04	8.5E-04	4.0E-03	5.4E-03	5.7E-04	3.1E-03	1.9E-02
Ra-224	6.4E-05	1.0E-06	1.9E-05	2.8E-04	2.7E-04	2.9E-06	6.8E-05	1.3E-03
Ac-225	7.4E-04	8.5E-05	4.8E-04	2.3E-03	2.9E-03	2.5E-04	1.7E-03	9.9E-03
Ra-225	1.4E-03	2.1E-04	1.0E-03	4.1E-03	5.7E-03	6.8E-04	3.4E-03	1.9E-02
Ra-226	1.3E-02	2.8E-03	9.7E-03	3.2E-02	5.0E-02	6.9E-03	3.6E-02	1.4E-01
Ac-227	6.6E-01	1.3E-01	4.9E-01	1.8E+00	2.7E+00	3.8E-01	1.7E+00	8.1E+00
Th-227	2.9E-03	4.8E-04	2.0E-03	7.6E-03	1.2E-02	1.3E-03	7.0E-03	3.6E-02
Th-228	1.7E-01	3.1E-02	1.2E-01	4.6E-01	6.7E-01	7.4E-02	4.2E-01	2.1E+00
Ra-228	1.3E-02	2.5E-03	9.4E-03	3.4E-02	4.9E-02	7.8E-03	3.5E-02	1.5E-01
Th-229	8.4E-01	1.6E-01	6.0E-01	2.3E+00	3.3E+00	4.8E-01	2.2E+00	1.0E+01
Th-230	1.3E-01	2.3E-02	9.3E-02	3.7E-01	5.2E-01	6.5E-02	3.2E-01	1.5E+00
Pa-231	4.6E-01	7.7E-02	3.2E-01	1.3E+00	1.8E+00	2.5E-01	1.1E+00	5.6E+00
Th-231	5.9E-11	8.5E-18	6.4E-14	3.4E-10	2.6E-10	3.2E-17	1.9E-13	1.0E-09
Th-232	5.7E-01	1.0E-01	4.0E-01	1.6E+00	2.3E+00	2.8E-01	1.5E+00	7.1E+00
Pa-233	2.1E-04	3.9E-05	1.6E-04	5.9E-04	8.6E-04	9.1E-05	5.8E-04	2.7E-03
U-233	6.6E-02	1.2E-02	4.9E-02	1.9E-01	2.6E-01	3.0E-02	1.8E-01	7.3E-01
Th-234	4.0E-05	7.5E-06	2.8E-05	1.1E-04	1.6E-04	1.9E-05	1.0E-04	5.0E-04
U-234	6.5E-02	1.1E-02	4.6E-02	1.7E-01	2.6E-01	3.0E-02	1.7E-01	7.8E-01
U-235	6.0E-02	1.1E-02	4.1E-02	1.8E-01	2.4E-01	3.1E-02	1.5E-01	7.8E-01
Np-237	2.7E-01	5.1E-02	2.0E-01	7.5E-01	1.1E+00	1.4E-01	7.2E-01	3.1E+00
Pu-238	1.4E-01	2.4E-02	1.0E-01	3.7E-01	5.5E-01	5.6E-02	3.6E-01	1.6E+00
U-238	5.7E-02	1.0E-02	4.0E-02	1.5E-01	2.3E-01	3.0E-02	1.4E-01	7.3E-01
Pu-239	1.5E-01	2.7E-02	1.0E-01	3.8E-01	6.0E-01	7.3E-02	3.8E-01	1.7E+00
Pu-240	1.5E-01	2.4E-02	1.1E-01	4.0E-01	5.9E-01	6.6E-02	4.1E-01	1.8E+00
Pu-241	2.3E-03	4.1E-04	1.9E-03	6.3E-03	9.5E-03	1.1E-03	6.2E-03	2.8E-02
Am-241	2.3E-01	4.4E-02	1.6E-01	6.0E-01	9.4E-01	1.1E-01	5.7E-01	2.8E+00
Cm-242	7.9E-03	1.4E-03	5.7E-03	2.4E-02	3.3E-02	3.7E-03	2.0E-02	1.2E-01
Pu-242	1.4E-01	2.6E-02	1.0E-01	3.8E-01	5.4E-01	7.8E-02	3.7E-01	1.5E+00
Cm-244	1.3E-01	2.4E-02	9.4E-02	3.7E-01	5.1E-01	6.9E-02	3.4E-01	1.5E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.4 Dose factors[a] for AL-METL-HANDMAN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	4.4E-09	1.5E-10	2.4E-09	1.7E-08	1.8E-08	5.4E-10	8.3E-09	7.5E-08
C-14	6.6E-06	7.3E-07	4.4E-06	2.0E-05	2.6E-05	2.1E-06	1.7E-05	7.8E-05
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	2.6E-05	3.9E-06	1.8E-05	7.1E-05	1.0E-04	1.1E-05	6.9E-05	2.9E-04
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	2.8E-06	4.1E-07	1.9E-06	7.6E-06	1.1E-05	1.4E-06	7.0E-06	3.2E-05
Co-57	1.2E-04	2.3E-05	8.7E-05	2.9E-04	4.8E-04	5.8E-05	2.9E-04	1.3E-03
Co-58	1.5E-03	2.8E-04	1.1E-03	4.0E-03	5.9E-03	7.2E-04	4.1E-03	1.7E-02
Fe-59	1.3E-03	2.5E-04	9.8E-04	3.5E-03	5.1E-03	7.5E-04	3.3E-03	1.6E-02
Ni-59	1.2E-06	2.3E-07	9.3E-07	3.1E-06	4.7E-06	6.1E-07	3.2E-06	1.2E-05
Co-60	5.1E-03	1.0E-03	4.0E-03	1.4E-02	2.0E-02	3.2E-03	1.5E-02	6.0E-02
Ni-63	3.2E-06	5.6E-07	2.3E-06	8.3E-06	1.3E-05	1.7E-06	8.1E-06	4.0E-05
Zn-65	1.1E-03	2.4E-04	8.3E-04	3.1E-03	4.4E-03	5.7E-04	3.1E-03	1.2E-02
Cu-67	4.8E-08	4.8E-12	8.7E-10	2.7E-07	1.8E-07	1.6E-11	3.0E-09	9.4E-07
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	3.9E-04	7.2E-05	2.7E-04	1.0E-03	1.6E-03	1.9E-04	1.0E-03	4.6E-03
Sr-89	1.6E-05	3.1E-06	1.2E-05	4.4E-05	6.4E-05	7.9E-06	4.1E-05	2.1E-04
Sr-90	5.6E-04	1.1E-04	4.3E-04	1.5E-03	2.2E-03	2.9E-04	1.5E-03	6.1E-03
Y-91	9.9E-06	1.9E-06	7.4E-06	2.5E-05	3.8E-05	5.6E-06	2.7E-05	1.1E-04
Mo-93	1.9E-05	4.2E-06	1.4E-05	4.8E-05	7.5E-05	1.0E-05	5.2E-05	2.2E-04
Nb-93m	1.6E-05	3.1E-06	1.2E-05	4.4E-05	6.3E-05	8.6E-06	4.3E-05	1.8E-04
Nb-94	3.8E-03	8.2E-04	2.9E-03	1.0E-02	1.5E-02	1.9E-03	1.1E-02	4.4E-02
Nb-95	7.7E-04	1.4E-04	5.4E-04	2.1E-03	3.0E-03	3.7E-04	1.9E-03	9.4E-03
Zr-95	5.5E-04	9.6E-05	3.9E-04	1.6E-03	2.2E-03	2.4E-04	1.4E-03	6.5E-03
Tc-99	8.1E-06	1.5E-06	5.6E-06	2.2E-05	3.3E-05	4.1E-06	2.2E-05	1.1E-04
Ru-103	4.7E-04	8.6E-05	3.5E-04	1.2E-03	1.8E-03	2.1E-04	1.3E-03	5.1E-03
Ru-106	6.3E-04	1.5E-04	4.8E-04	1.6E-03	2.4E-03	3.8E-04	1.8E-03	6.4E-03
Ag-108m	3.8E-03	9.0E-04	2.8E-03	9.3E-03	1.5E-02	2.4E-03	1.0E-02	4.6E-02
Cd-109	6.6E-05	1.2E-05	4.6E-05	1.8E-04	2.7E-04	3.0E-05	1.7E-04	8.7E-04
Ag-110m	5.6E-03	1.0E-03	4.1E-03	1.4E-02	2.3E-02	2.9E-03	1.5E-02	6.9E-02
Sb-124	2.4E-03	4.8E-04	1.7E-03	6.7E-03	9.5E-03	1.3E-03	6.7E-03	2.8E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.5E-04	1.9E-04	6.8E-04	2.5E-03	3.8E-03	4.7E-04	2.5E-03	1.2E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	4.0E-04	8.7E-05	3.0E-04	1.1E-03	1.6E-03	2.6E-04	1.0E-03	5.1E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.4 Dose factors[a] for AL-METL-HANDMAN-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.1E-05	2.1E-06	8.0E-06	3.4E-05	4.6E-05	6.0E-06	2.8E-05	1.5E-04
Ce-144	7.6E-05	1.7E-05	5.6E-05	2.0E-04	3.0E-04	4.6E-05	2.1E-04	9.4E-04
Pm-147	5.5E-06	1.2E-06	4.0E-06	1.6E-05	2.2E-05	3.2E-06	1.4E-05	6.9E-05
Eu-152	6.4E-04	1.3E-04	4.6E-04	1.7E-03	2.6E-03	3.5E-04	1.6E-03	8.5E-03
Eu-154	7.1E-04	1.4E-04	5.1E-04	1.9E-03	2.9E-03	3.5E-04	1.9E-03	8.6E-03
Eu-155	1.6E-05	3.2E-06	1.2E-05	3.9E-05	6.1E-05	8.5E-06	4.4E-05	1.7E-04
Re-186	5.7E-08	1.3E-10	6.2E-09	2.9E-07	2.2E-07	4.5E-10	2.3E-08	1.1E-06
Ir-192	1.3E-03	2.5E-04	9.6E-04	3.5E-03	5.1E-03	6.4E-04	3.4E-03	1.6E-02
Pb-210	2.6E-02	4.8E-03	1.7E-02	7.7E-02	1.0E-01	1.3E-02	6.5E-02	3.3E-01
Po-210	7.6E-03	1.5E-03	5.5E-03	2.0E-02	2.9E-02	4.3E-03	1.9E-02	8.7E-02
Bi-210	8.7E-07	9.8E-09	2.2E-07	3.6E-06	3.4E-06	3.3E-08	7.0E-07	1.3E-05
Rn-222	1.3E-07	1.2E-10	1.2E-08	5.3E-07	5.0E-07	3.4E-10	4.2E-08	2.5E-06
Ra-223	6.3E-04	5.8E-05	3.5E-04	2.1E-03	2.4E-03	1.9E-04	1.2E-03	8.6E-03
Ra-224	1.1E-05	1.9E-08	1.2E-06	5.4E-05	3.9E-05	5.8E-08	3.9E-06	2.0E-04
Ac-225	3.2E-04	2.5E-05	1.7E-04	1.2E-03	1.2E-03	6.7E-05	5.9E-04	4.4E-03
Ra-225	7.8E-04	9.2E-05	4.8E-04	2.7E-03	3.1E-03	2.7E-04	1.7E-03	1.2E-02
Ra-226	1.2E-02	2.6E-03	9.6E-03	3.0E-02	5.1E-02	6.9E-03	3.3E-02	1.5E-01
Ac-227	6.7E-01	1.4E-01	4.9E-01	1.7E+00	2.7E+00	3.1E-01	1.8E+00	8.0E+00
Th-227	1.7E-03	2.5E-04	1.2E-03	5.2E-03	6.8E-03	7.3E-04	4.2E-03	1.9E-02
Th-228	1.6E-01	3.0E-02	1.2E-01	4.4E-01	6.4E-01	7.8E-02	4.4E-01	1.9E+00
Ra-228	1.2E-02	2.5E-03	9.4E-03	3.2E-02	5.0E-02	6.6E-03	3.5E-02	1.5E-01
Th-229	8.4E-01	1.5E-01	6.2E-01	2.3E+00	3.3E+00	4.1E-01	2.2E+00	9.2E+00
Th-230	1.3E-01	2.4E-02	8.9E-02	3.4E-01	5.1E-01	5.9E-02	3.4E-01	1.5E+00
Pa-231	4.5E-01	8.9E-02	3.5E-01	1.2E+00	1.9E+00	2.2E-01	1.1E+00	5.8E+00
Th-231	2.1E-13	8.3E-24	2.5E-18	1.5E-12	8.6E-13	3.1E-23	8.6E-18	4.2E-12
Th-232	5.8E-01	1.0E-01	3.9E-01	1.6E+00	2.3E+00	2.5E-01	1.4E+00	7.2E+00
Pa-233	1.5E-04	2.6E-05	1.1E-04	4.5E-04	6.1E-04	7.6E-05	3.7E-04	1.9E-03
U-233	6.5E-02	1.2E-02	4.7E-02	1.7E-01	2.6E-01	3.2E-02	1.8E-01	7.9E-01
Th-234	2.7E-05	4.4E-06	1.8E-05	7.8E-05	1.0E-04	1.1E-05	6.6E-05	3.6E-04
U-234	6.5E-02	1.2E-02	4.5E-02	1.8E-01	2.7E-01	3.3E-02	1.5E-01	8.9E-01
U-235	6.1E-02	1.1E-02	4.0E-02	1.7E-01	2.5E-01	2.6E-02	1.5E-01	7.7E-01
Np-237	2.8E-01	5.1E-02	2.0E-01	7.3E-01	1.1E+00	1.3E-01	7.2E-01	3.4E+00
Pu-238	1.4E-01	2.6E-02	9.5E-02	3.9E-01	5.6E-01	6.0E-02	3.5E-01	1.8E+00
U-238	5.7E-02	1.1E-02	4.0E-02	1.6E-01	2.3E-01	3.0E-02	1.4E-01	7.6E-01
Pu-239	1.5E-01	2.6E-02	1.1E-01	4.4E-01	6.0E-01	7.5E-02	3.8E-01	1.9E+00
Pu-240	1.5E-01	2.7E-02	1.0E-01	4.5E-01	5.8E-01	7.6E-02	4.0E-01	1.7E+00
Pu-241	2.3E-03	4.6E-04	1.8E-03	6.1E-03	9.3E-03	1.1E-03	6.0E-03	3.0E-02
Am-241	2.2E-01	3.8E-02	1.6E-01	5.9E-01	8.8E-01	1.3E-01	5.9E-01	2.7E+00
Cm-242	7.2E-03	1.3E-03	5.2E-03	1.9E-02	2.9E-02	3.8E-03	1.8E-02	8.2E-02
Pu-242	1.4E-01	2.7E-02	9.8E-02	4.0E-01	5.7E-01	6.6E-02	3.7E-01	1.7E+00
Cm-244	1.3E-01	2.5E-02	9.0E-02	3.4E-01	5.0E-01	6.7E-02	3.1E-01	1.6E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.5 Dose factors[a] for AL-METL-HANDDIS-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.0E-08	1.9E-09	7.2E-09	2.6E-08	4.0E-08	4.3E-09	2.6E-08	1.2E-07
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.5E-05	2.3E-06	1.0E-05	4.8E-05	6.4E-05	6.1E-06	3.4E-05	2.3E-04
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.1E-04	2.2E-05	7.9E-05	2.8E-04	4.4E-04	5.7E-05	2.7E-04	1.3E-03
Co-58	1.2E-03	2.3E-04	8.2E-04	3.0E-03	4.8E-03	5.3E-04	3.1E-03	1.5E-02
Fe-59	9.5E-04	1.7E-04	6.6E-04	2.8E-03	3.9E-03	4.8E-04	2.2E-03	1.4E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.1E-03	9.2E-04	4.1E-03	1.3E-02	2.0E-02	2.4E-03	1.4E-02	5.8E-02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.0E-03	2.1E-04	7.0E-04	2.6E-03	4.0E-03	4.9E-04	2.6E-03	1.2E-02
Cu-67	1.5E-09	1.0E-15	2.1E-12	8.2E-09	5.5E-09	3.0E-15	9.6E-12	3.2E-08
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	3.0E-04	5.4E-05	2.2E-04	8.8E-04	1.2E-03	1.3E-04	8.1E-04	3.8E-03
Sr-89	7.0E-07	1.4E-07	5.1E-07	1.8E-06	2.9E-06	2.9E-07	2.0E-06	8.3E-06
Sr-90	1.7E-07	3.4E-08	1.3E-07	4.4E-07	6.9E-07	8.1E-08	4.8E-07	2.0E-06
Y-91	9.1E-07	1.6E-07	6.4E-07	2.5E-06	3.6E-06	4.7E-07	2.3E-06	1.1E-05
Mo-93	3.7E-07	7.2E-08	2.8E-07	1.0E-06	1.5E-06	2.1E-07	9.8E-07	4.9E-06
Nb-93m	6.3E-08	1.3E-08	4.4E-08	1.7E-07	2.5E-07	3.1E-08	1.7E-07	7.1E-07
Nb-94	3.6E-03	7.5E-04	2.7E-03	9.7E-03	1.5E-02	2.1E-03	9.1E-03	4.7E-02
Nb-95	5.3E-04	7.7E-05	3.6E-04	1.5E-03	2.2E-03	1.9E-04	1.3E-03	6.6E-03
Zr-95	4.3E-04	8.0E-05	3.0E-04	1.2E-03	1.7E-03	2.1E-04	1.1E-03	5.4E-03
Tc-99	6.8E-08	1.3E-08	5.0E-08	1.8E-07	2.8E-07	3.1E-08	1.8E-07	8.6E-07
Ru-103	3.2E-04	5.3E-05	2.3E-04	9.6E-04	1.3E-03	1.3E-04	8.1E-04	4.6E-03
Ru-106	3.5E-04	7.7E-05	2.5E-04	8.7E-04	1.4E-03	1.8E-04	9.1E-04	3.9E-03
Ag-108m	3.7E-03	7.7E-04	2.7E-03	9.7E-03	1.5E-02	1.8E-03	1.0E-02	4.4E-02
Cd-109	9.7E-07	1.9E-07	7.1E-07	2.6E-06	4.0E-06	5.1E-07	2.5E-06	1.2E-05
Ag-110m	5.1E-03	1.2E-03	3.8E-03	1.3E-02	2.0E-02	2.9E-03	1.4E-02	6.2E-02
Sb-124	1.9E-03	3.3E-04	1.4E-03	5.5E-03	7.5E-03	9.9E-04	4.9E-03	2.5E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.1E-04	1.9E-04	6.7E-04	2.3E-03	3.7E-03	5.2E-04	2.3E-03	1.1E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	4.0E-04	7.3E-05	2.9E-04	1.1E-03	1.7E-03	2.0E-04	1.0E-03	5.7E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.5 Dose factors[a] for AL-METL-HANDDIS-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	6.4E-06	1.1E-06	4.3E-06	1.9E-05	2.5E-05	2.9E-06	1.6E-05	7.8E-05
Ce-144	1.7E-05	3.1E-06	1.2E-05	4.6E-05	6.7E-05	8.5E-06	4.4E-05	2.0E-04
Pm-147	9.2E-10	1.8E-10	7.0E-10	2.5E-09	3.7E-09	5.2E-10	2.5E-09	1.1E-08
Eu-152	6.0E-04	1.1E-04	4.3E-04	1.6E-03	2.4E-03	2.8E-04	1.6E-03	7.1E-03
Eu-154	6.6E-04	1.3E-04	4.9E-04	1.8E-03	2.7E-03	3.0E-04	1.7E-03	8.6E-03
Eu-155	9.1E-06	1.8E-06	6.4E-06	2.5E-05	3.6E-05	4.6E-06	2.3E-05	1.2E-04
Re-186	2.7E-09	2.2E-13	5.2E-11	1.7E-08	1.0E-08	6.8E-13	2.0E-10	6.6E-08
Ir-192	1.0E-03	1.9E-04	7.4E-04	2.8E-03	4.1E-03	4.8E-04	2.7E-03	1.3E-02
Pb-210	7.1E-07	1.4E-07	5.2E-07	1.9E-06	2.9E-06	3.5E-07	1.8E-06	8.7E-06
Po-210	1.2E-08	2.3E-09	9.0E-09	3.1E-08	4.7E-08	6.0E-09	3.2E-08	1.3E-07
Bi-210	1.5E-09	1.6E-12	1.0E-10	7.7E-09	6.3E-09	5.1E-12	3.9E-10	3.0E-08
Rn-222	1.0E-08	5.8E-13	2.2E-10	6.1E-08	4.1E-08	2.1E-12	7.9E-10	2.9E-07
Ra-223	1.8E-05	8.1E-07	7.1E-06	7.6E-05	7.4E-05	2.5E-06	2.6E-05	3.0E-04
Ra-224	3.8E-07	2.1E-11	9.6E-09	1.8E-06	1.4E-06	6.7E-11	3.1E-08	8.0E-06
Ac-225	9.0E-06	2.7E-07	3.5E-06	3.5E-05	3.6E-05	6.6E-07	1.2E-05	1.5E-04
Ra-225	1.3E-07	9.4E-09	7.0E-08	4.9E-07	5.2E-07	2.7E-08	2.5E-07	2.1E-06
Ra-226	3.6E-03	7.2E-04	2.7E-03	9.5E-03	1.4E-02	2.0E-03	9.4E-03	3.9E-02
Ac-227	2.6E-04	5.7E-05	1.9E-04	6.7E-04	1.1E-03	1.4E-04	7.3E-04	3.2E-03
Th-227	2.1E-05	2.2E-06	1.2E-05	7.2E-05	8.5E-05	5.9E-06	4.6E-05	3.2E-04
Th-228	2.5E-03	5.3E-04	1.9E-03	6.7E-03	1.0E-02	1.5E-03	6.3E-03	3.5E-02
Ra-228	1.8E-03	3.4E-04	1.4E-03	4.7E-03	7.1E-03	9.7E-04	4.7E-03	2.0E-02
Th-229	2.1E-04	4.1E-05	1.5E-04	5.5E-04	8.4E-04	1.0E-04	5.1E-04	2.5E-03
Th-230	1.1E-07	2.3E-08	9.1E-08	2.8E-07	4.7E-07	5.6E-08	3.3E-07	1.4E-06
Pa-231	5.9E-05	1.2E-05	4.3E-05	1.6E-04	2.4E-04	2.8E-05	1.6E-04	7.7E-04
Th-231	7.5E-17	3.0E-33	6.9E-25	1.9E-16	2.4E-16	9.3E-33	2.7E-24	7.8E-16
Th-232	1.3E-05	2.6E-06	9.3E-06	3.5E-05	5.2E-05	6.6E-06	3.3E-05	1.7E-04
Pa-233	8.6E-05	1.3E-05	5.6E-05	2.7E-04	3.4E-04	3.5E-05	2.0E-04	1.2E-03
U-233	3.0E-08	5.8E-09	2.2E-08	7.7E-08	1.2E-07	1.4E-08	8.2E-08	3.3E-07
Th-234	3.8E-06	5.2E-07	2.3E-06	1.2E-05	1.5E-05	1.5E-06	8.5E-06	5.8E-05
U-234	5.3E-08	9.7E-09	3.7E-08	1.4E-07	2.1E-07	2.8E-08	1.4E-07	6.5E-07
U-235	2.4E-04	4.8E-05	1.8E-04	6.4E-04	9.5E-04	1.4E-04	6.6E-04	3.0E-03
Np-237	1.9E-04	3.8E-05	1.3E-04	4.8E-04	7.4E-04	1.0E-04	4.5E-04	2.3E-03
Pu-238	6.1E-08	1.2E-08	4.4E-08	1.6E-07	2.5E-07	3.2E-08	1.6E-07	7.8E-07
U-238	8.8E-06	1.7E-06	6.0E-06	2.3E-05	3.6E-05	4.2E-06	2.3E-05	1.1E-04
Pu-239	2.3E-08	4.9E-09	1.7E-08	6.1E-08	9.3E-08	1.2E-08	5.8E-08	2.7E-07
Pu-240	6.2E-08	1.2E-08	4.5E-08	1.7E-07	2.4E-07	3.6E-08	1.6E-07	7.5E-07
Pu-241	1.9E-09	3.4E-10	1.4E-09	5.0E-09	7.6E-09	9.7E-10	4.9E-09	2.1E-08
Am-241	5.7E-06	1.2E-06	4.2E-06	1.6E-05	2.3E-05	2.8E-06	1.4E-05	7.2E-05
Cm-242	7.0E-08	1.3E-08	5.4E-08	1.8E-07	2.9E-07	3.6E-08	1.9E-07	8.6E-07
Pu-242	5.0E-08	9.1E-09	4.0E-08	1.3E-07	2.0E-07	2.5E-08	1.5E-07	5.9E-07
Cm-244	8.2E-08	1.6E-08	6.1E-08	2.2E-07	3.4E-07	3.9E-08	2.2E-07	1.0E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.6 Dose factors[a] for AL-DROS-HANDLIN-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	7.7E-07	8.0E-08	4.7E-07	2.5E-06	3.0E-06	1.9E-07	1.7E-06	1.0E-05
Na-22	2.2E-01	3.1E-02	1.5E-01	6.4E-01	8.6E-01	9.5E-02	5.3E-01	2.6E+00
P-32	6.0E-05	9.0E-06	3.7E-05	1.8E-04	2.3E-04	2.4E-05	1.4E-04	7.9E-04
S-35	3.9E-06	6.8E-07	2.8E-06	1.0E-05	1.6E-05	1.8E-06	1.1E-05	4.9E-05
Cl-36	4.1E-05	6.7E-06	3.1E-05	1.1E-04	1.6E-04	1.8E-05	1.1E-04	5.2E-04
K-40	1.7E-02	2.6E-03	1.1E-02	5.1E-02	6.7E-02	7.4E-03	4.2E-02	2.0E-01
Ca-41	1.0E-05	1.2E-06	6.9E-06	2.9E-05	4.1E-05	3.4E-06	2.5E-05	1.3E-04
Ca-45	2.6E-05	3.6E-06	1.8E-05	7.2E-05	9.9E-05	1.1E-05	6.3E-05	2.9E-04
Cr-51	2.3E-05	9.1E-07	1.2E-05	7.9E-05	8.7E-05	3.3E-06	4.1E-05	3.2E-04
Mn-54	7.7E-02	1.4E-02	5.3E-02	2.2E-01	3.1E-01	3.7E-02	2.0E-01	1.0E+00
Fe-55	9.3E-08	2.8E-09	5.2E-08	3.5E-07	3.9E-07	7.8E-09	1.9E-07	1.4E-06
Co-57	1.4E-04	4.2E-06	6.9E-05	5.1E-04	5.4E-04	1.5E-05	2.4E-04	2.1E-03
Co-58	1.2E-03	3.6E-05	6.7E-04	4.4E-03	4.8E-03	1.1E-04	2.3E-03	1.8E-02
Fe-59	1.4E-03	4.6E-05	7.7E-04	5.5E-03	5.5E-03	1.4E-04	2.7E-03	1.9E-02
Ni-59	4.0E-08	1.4E-09	2.2E-08	1.4E-07	1.5E-07	4.5E-09	7.7E-08	5.9E-07
Co-60	4.5E-03	1.4E-04	2.4E-03	1.6E-02	1.8E-02	4.2E-04	8.1E-03	7.9E-02
Ni-63	1.1E-07	3.4E-09	5.1E-08	4.0E-07	4.3E-07	1.2E-08	2.0E-07	1.6E-06
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cu-67	3.8E-07	4.4E-10	3.1E-08	1.7E-06	1.6E-06	1.3E-09	1.0E-07	6.8E-06
Se-75	2.4E-02	3.5E-03	1.6E-02	6.7E-02	9.3E-02	9.4E-03	5.8E-02	3.0E-01
Sr-85	1.8E-02	2.6E-03	1.3E-02	4.6E-02	6.9E-02	7.1E-03	4.5E-02	2.0E-01
Sr-89	8.9E-05	1.3E-05	6.1E-05	2.5E-04	3.4E-04	4.4E-05	2.2E-04	1.1E-03
Sr-90	1.2E-03	1.8E-04	8.2E-04	3.5E-03	4.8E-03	4.9E-04	2.8E-03	1.6E-02
Y-91	3.5E-04	5.7E-05	2.6E-04	9.8E-04	1.4E-03	1.7E-04	8.7E-04	4.2E-03
Mo-93	7.8E-07	3.6E-08	4.0E-07	2.8E-06	3.2E-06	9.8E-08	1.5E-06	1.2E-05
Nb-93m	5.8E-07	1.9E-08	3.0E-07	2.3E-06	2.5E-06	5.8E-08	1.0E-06	9.9E-06
Nb-94	2.9E-03	1.0E-04	1.4E-03	9.6E-03	1.1E-02	3.2E-04	4.9E-03	4.2E-02
Nb-95	8.1E-04	2.4E-05	3.7E-04	3.0E-03	3.2E-03	8.3E-05	1.3E-03	1.3E-02
Zr-95	2.8E-02	3.9E-03	1.8E-02	8.7E-02	1.1E-01	1.1E-02	6.6E-02	3.6E-01
Tc-99	3.1E-06	1.6E-07	1.8E-06	1.1E-05	1.3E-05	5.5E-07	6.2E-06	4.8E-05
Ru-103	4.3E-03	1.9E-04	2.2E-03	1.6E-02	1.6E-02	6.4E-04	8.0E-03	5.9E-02
Ru-106	9.4E-05	4.8E-06	5.3E-05	3.1E-04	3.7E-04	1.3E-05	2.1E-04	1.3E-03
Ag-108m	2.7E-03	1.1E-04	1.4E-03	1.0E-02	1.1E-02	2.9E-04	4.7E-03	3.9E-02
Cd-109	6.2E-06	2.3E-07	3.3E-06	2.1E-05	2.4E-05	7.5E-07	1.1E-05	9.0E-05
Ag-110m	4.3E-03	1.6E-04	2.3E-03	1.5E-02	1.8E-02	5.0E-04	8.0E-03	7.2E-02
Sb-124	2.5E-03	7.8E-05	1.2E-03	9.2E-03	9.8E-03	2.0E-04	4.1E-03	4.1E-02
I-125	3.3E-04	5.3E-05	2.3E-04	9.5E-04	1.3E-03	1.5E-04	8.3E-04	3.7E-03
Sb-125	6.9E-04	1.9E-05	3.7E-04	2.4E-03	2.6E-03	6.4E-05	1.3E-03	9.7E-03
I-129	1.9E-03	2.7E-04	1.1E-03	5.6E-03	7.5E-03	6.1E-04	4.6E-03	2.5E-02
I-131	3.1E-03	2.6E-04	1.6E-03	1.0E-02	1.2E-02	6.9E-04	5.6E-03	4.0E-02
Ba-133	1.7E-02	2.4E-03	1.1E-02	5.5E-02	6.6E-02	6.3E-03	4.0E-02	2.1E-01
Cs-134	1.5E-01	2.1E-02	1.1E-01	4.6E-01	6.2E-01	6.8E-02	3.9E-01	1.8E+00
Cs-137	4.0E-04	4.4E-05	2.7E-04	1.1E-03	1.6E-03	1.2E-04	9.9E-04	5.2E-03

Table H.6 Dose factors[a] for AL-DROS-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.3E-03	3.0E-04	1.5E-03	7.1E-03	8.7E-03	7.8E-04	5.3E-03	2.9E-02
Ce-144	1.2E-03	2.2E-04	8.5E-04	3.3E-03	4.6E-03	6.2E-04	3.1E-03	1.4E-02
Pm-147	3.5E-05	4.9E-06	2.2E-05	1.0E-04	1.4E-04	1.4E-05	8.2E-05	4.8E-04
Eu-152	8.7E-02	1.3E-02	6.2E-02	2.5E-01	3.4E-01	4.0E-02	2.1E-01	1.1E+00
Eu-154	9.6E-02	1.5E-02	6.3E-02	2.9E-01	3.9E-01	4.3E-02	2.2E-01	1.3E+00
Eu-155	2.2E-03	3.6E-04	1.6E-03	6.2E-03	8.7E-03	9.6E-04	5.5E-03	2.6E-02
Re-186	2.8E-06	1.5E-08	4.9E-07	1.3E-05	1.1E-05	5.1E-08	1.7E-06	5.9E-05
Ir-192	9.7E-04	3.9E-05	5.1E-04	3.3E-03	4.0E-03	1.1E-04	1.8E-03	1.4E-02
Pb-210	8.6E-04	2.3E-05	4.9E-04	3.2E-03	3.5E-03	9.0E-05	1.7E-03	1.3E-02
Po-210	3.0E-03	1.2E-04	1.6E-03	1.1E-02	1.2E-02	4.2E-04	5.7E-03	4.3E-02
Bi-210	1.8E-07	1.8E-09	4.1E-08	7.4E-07	6.7E-07	4.9E-09	1.6E-07	3.2E-06
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	8.0E-05	2.5E-06	3.4E-05	3.2E-04	3.1E-04	7.3E-06	1.3E-04	1.2E-03
Ra-224	1.3E-06	5.1E-09	2.3E-07	6.2E-06	5.1E-06	1.8E-08	8.5E-07	2.6E-05
Ac-225	2.7E-05	7.4E-07	1.0E-05	1.1E-04	1.1E-04	2.2E-06	3.9E-05	4.6E-04
Ra-225	5.1E-05	1.5E-06	2.3E-05	1.7E-04	2.0E-04	3.9E-06	8.6E-05	7.6E-04
Ra-226	3.6E-03	1.4E-04	1.8E-03	1.2E-02	1.4E-02	4.2E-04	5.8E-03	5.5E-02
Ac-227	2.3E-02	7.2E-04	1.2E-02	8.4E-02	9.2E-02	1.8E-03	4.4E-02	3.7E-01
Th-227	1.5E-04	5.7E-06	7.6E-05	5.7E-04	5.7E-04	1.7E-05	2.8E-04	2.2E-03
Th-228	8.1E-03	3.8E-04	4.5E-03	2.8E-02	3.3E-02	1.1E-03	1.6E-02	1.1E-01
Ra-228	2.1E-03	7.3E-05	1.1E-03	7.4E-03	8.2E-03	2.4E-04	3.8E-03	2.9E-02
Th-229	2.9E-02	9.2E-04	1.6E-02	9.7E-02	1.2E-01	2.9E-03	5.6E-02	3.7E-01
Th-230	4.2E-03	1.7E-04	2.2E-03	1.5E-02	1.7E-02	5.6E-04	7.9E-03	6.6E-02
Pa-231	1.6E-02	4.8E-04	7.6E-03	5.2E-02	6.4E-02	1.4E-03	2.9E-02	2.5E-01
Th-231	3.6E-11	4.3E-18	2.1E-14	1.5E-10	1.2E-10	1.3E-17	7.8E-14	5.8E-10
Th-232	1.8E-02	7.2E-04	9.3E-03	6.7E-02	7.5E-02	1.8E-03	3.3E-02	2.8E-01
Pa-233	1.5E-04	4.1E-06	6.7E-05	5.6E-04	5.7E-04	1.3E-05	2.4E-04	2.1E-03
U-233	2.0E-03	7.7E-05	1.1E-03	7.0E-03	8.2E-03	2.5E-04	3.6E-03	3.2E-02
Th-234	4.0E-06	1.5E-07	2.1E-06	1.3E-05	1.6E-05	4.0E-07	7.2E-06	6.8E-05
U-234	2.0E-03	9.7E-05	1.1E-03	7.6E-03	8.0E-03	2.5E-04	3.7E-03	2.7E-02
U-235	2.2E-03	9.1E-05	1.1E-03	7.2E-03	8.4E-03	3.1E-04	4.1E-03	3.1E-02
Np-237	9.3E-03	3.2E-04	5.1E-03	3.4E-02	3.8E-02	9.5E-04	1.6E-02	1.6E-01
Pu-238	4.7E-03	1.7E-04	2.2E-03	1.7E-02	1.9E-02	6.2E-04	7.8E-03	7.7E-02
U-238	1.9E-03	7.2E-05	9.4E-04	7.3E-03	7.9E-03	2.3E-04	3.6E-03	3.2E-02
Pu-239	4.9E-03	2.0E-04	2.5E-03	1.6E-02	1.9E-02	6.2E-04	8.8E-03	6.8E-02
Pu-240	4.8E-03	1.7E-04	2.4E-03	1.7E-02	2.0E-02	6.2E-04	8.3E-03	7.4E-02
Pu-241	8.0E-05	2.6E-06	4.1E-05	2.8E-04	3.3E-04	8.9E-06	1.4E-04	1.2E-03
Am-241	7.2E-03	2.9E-04	4.0E-03	2.6E-02	3.0E-02	9.7E-04	1.3E-02	9.8E-02
Cm-242	2.5E-04	7.3E-06	1.3E-04	8.9E-04	1.0E-03	2.8E-05	4.5E-04	3.8E-03
Pu-242	4.9E-03	1.7E-04	2.2E-03	1.8E-02	2.0E-02	5.6E-04	7.6E-03	8.7E-02
Cm-244	4.3E-03	1.3E-04	2.3E-03	1.6E-02	1.6E-02	5.3E-04	7.7E-03	5.8E-02

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.7 Dose factors[a] for AL-ATMO-REFINER-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	1.8E-06	1.3E-07	9.4E-07	6.6E-06	6.8E-06	5.1E-07	3.1E-06	2.3E-05
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	3.1E-06	2.2E-07	1.6E-06	1.0E-05	1.2E-05	6.1E-07	5.6E-06	3.9E-05
P-32	8.1E-09	2.4E-10	3.2E-09	3.5E-08	3.1E-08	9.2E-10	1.1E-08	1.2E-07
S-35	7.8E-09	2.1E-10	3.9E-09	3.0E-08	2.9E-08	6.7E-10	1.4E-08	1.0E-07
Cl-36	1.7E-04	1.1E-05	8.8E-05	5.5E-04	6.4E-04	3.5E-05	3.1E-04	2.5E-03
K-40	8.7E-07	7.3E-08	4.5E-07	3.2E-06	3.3E-06	2.3E-07	1.7E-06	1.2E-05
Ca-41	1.3E-09	9.3E-11	7.3E-10	4.6E-09	5.1E-09	3.1E-10	2.4E-09	1.7E-08
Ca-45	1.9E-09	1.6E-10	1.1E-09	6.2E-09	7.2E-09	5.6E-10	4.0E-09	2.3E-08
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	3.8E-07	2.7E-08	2.0E-07	1.3E-06	1.5E-06	9.0E-08	7.0E-07	4.6E-06
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	9.9E-07	8.2E-08	5.3E-07	3.3E-06	3.9E-06	2.4E-07	1.9E-06	1.4E-05
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	9.7E-07	2.8E-08	4.2E-07	3.6E-06	3.8E-06	8.9E-08	1.5E-06	1.4E-05
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	8.1E-05	5.5E-06	3.6E-05	3.1E-04	3.0E-04	1.7E-05	1.3E-04	1.1E-03
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	1.6E-03	1.2E-04	7.9E-04	6.0E-03	6.0E-03	3.5E-04	3.1E-03	2.0E-02
I-131	6.6E-06	2.5E-07	2.4E-06	2.8E-05	2.5E-05	7.8E-07	8.4E-06	1.0E-04
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	1.7E-06	1.4E-07	1.0E-06	5.4E-06	6.7E-06	4.2E-07	3.4E-06	2.2E-05
Cs-137	2.3E-08	1.7E-09	1.2E-08	8.8E-08	8.8E-08	5.2E-09	4.3E-08	2.7E-07

Table H.7 Dose factors[a] for AL-ATMO-REFINER-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.8 Dose factors[a] for AL-DUST-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	7.8E-02	1.8E-02	5.6E-02	2.1E-01	3.2E-01	4.3E-02	2.2E-01	9.2E-01
P-32	2.0E-04	1.1E-05	1.1E-04	7.3E-04	8.1E-04	2.9E-05	4.0E-04	2.9E-03
S-35	1.9E-06	1.2E-07	1.2E-06	6.0E-06	7.5E-06	2.7E-07	4.3E-06	2.6E-05
Cl-36	6.0E-04	1.2E-04	4.6E-04	1.6E-03	2.4E-03	3.2E-04	1.6E-03	7.0E-03
K-40	5.8E-03	1.4E-03	4.4E-03	1.5E-02	2.3E-02	3.2E-03	1.7E-02	6.6E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	4.9E-07	1.1E-07	3.6E-07	1.3E-06	2.0E-06	2.8E-07	1.3E-06	6.3E-06
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	2.9E-02	6.3E-03	2.2E-02	7.1E-02	1.2E-01	1.5E-02	8.1E-02	3.2E-01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.0E-01	2.2E-02	7.6E-02	2.5E-01	4.0E-01	5.5E-02	2.6E-01	1.3E+00
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	1.1E-01	6.2E-03	7.1E-02	3.4E-01	4.7E-01	2.0E-02	2.7E-01	1.7E+00
Sr-85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-109	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	5.6E-02	1.2E-02	4.3E-02	1.4E-01	2.2E-01	3.2E-02	1.6E-01	6.3E-01
Cs-137	2.2E-02	5.1E-03	1.6E-02	5.7E-02	8.8E-02	1.5E-02	5.8E-02	2.8E-01

Table H.8 Dose factors[a] for AL-DUST-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.9 Dose factors[a] for AL-SCRP-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	8.3E-06	5.3E-06	8.3E-06	1.1E-05	3.4E-05	8.8E-06	3.1E-05	6.4E-05
Na-22	4.4E+00	2.8E+00	4.4E+00	6.0E+00	1.8E+01	4.7E+00	1.6E+01	3.4E+01
P-32	2.6E-03	1.7E-03	2.6E-03	3.6E-03	1.1E-02	2.9E-03	9.6E-03	2.0E-02
S-35	8.6E-06	5.5E-06	8.7E-06	1.2E-05	3.5E-05	9.2E-06	3.2E-05	6.6E-05
Cl-36	6.8E-04	4.4E-04	6.8E-04	9.4E-04	2.8E-03	7.3E-04	2.5E-03	5.2E-03
K-40	3.2E-01	2.1E-01	3.3E-01	4.5E-01	1.3E+00	3.5E-01	1.2E+00	2.5E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.0E-05	1.9E-05	3.0E-05	4.2E-05	1.2E-04	3.2E-05	1.1E-04	2.3E-04
Cr-51	4.9E-02	3.2E-02	4.9E-02	6.8E-02	2.0E-01	5.3E-02	1.8E-01	3.8E-01
Mn-54	1.7E+00	1.1E+00	1.7E+00	2.3E+00	6.9E+00	1.8E+00	6.3E+00	1.3E+01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	7.6E-02	4.9E-02	7.6E-02	1.0E-01	3.1E-01	8.1E-02	2.8E-01	5.8E-01
Co-58	1.9E+00	1.2E+00	1.9E+00	2.6E+00	7.7E+00	2.0E+00	7.0E+00	1.5E+01
Fe-59	2.3E+00	1.5E+00	2.3E+00	3.2E+00	9.3E+00	2.5E+00	8.5E+00	1.8E+01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.1E+00	3.3E+00	5.1E+00	7.0E+00	2.1E+01	5.4E+00	1.9E+01	3.9E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	1.2E+00	7.6E-01	1.2E+00	1.6E+00	4.8E+00	1.3E+00	4.5E+00	9.1E+00
Cu-67	4.1E-02	2.1E-02	3.8E-02	7.2E-02	1.7E-01	4.2E-02	1.4E-01	3.8E-01
Se-75	4.9E-01	3.1E-01	4.9E-01	6.8E-01	2.0E+00	5.2E-01	1.8E+00	3.8E+00
Sr-85	9.4E-01	6.0E-01	9.4E-01	1.3E+00	3.8E+00	1.0E+00	3.5E+00	7.2E+00
Sr-89	2.3E-03	1.5E-03	2.3E-03	3.2E-03	9.4E-03	2.5E-03	8.6E-03	1.8E-02
Sr-90	2.5E-04	1.6E-04	2.5E-04	3.5E-04	1.0E-03	2.7E-04	9.4E-04	1.9E-03
Y-91	6.9E-03	4.4E-03	6.9E-03	9.6E-03	2.8E-02	7.4E-03	2.6E-02	5.3E-02
Mo-93	8.5E-06	5.5E-06	8.5E-06	1.2E-05	3.4E-05	9.1E-06	3.2E-05	6.5E-05
Nb-93m	1.4E-06	9.2E-07	1.4E-06	2.0E-06	5.8E-06	1.5E-06	5.3E-06	1.1E-05
Nb-94	3.3E+00	2.1E+00	3.3E+00	4.5E+00	1.3E+01	3.5E+00	1.2E+01	2.5E+01
Nb-95	1.4E+00	9.3E-01	1.4E+00	2.0E+00	5.8E+00	1.6E+00	5.3E+00	1.1E+01
Zr-95	1.4E+00	9.2E-01	1.4E+00	2.0E+00	5.8E+00	1.5E+00	5.3E+00	1.1E+01
Tc-99	5.6E-05	3.6E-05	5.6E-05	7.7E-05	2.3E-04	6.0E-05	2.1E-04	4.3E-04
Ru-103	9.3E-01	5.9E-01	9.2E-01	1.3E+00	3.7E+00	1.0E+00	3.4E+00	7.1E+00
Ru-106	4.1E-01	2.6E-01	4.1E-01	5.7E-01	1.7E+00	4.4E-01	1.5E+00	3.2E+00
Ag-108m	3.2E+00	2.1E+00	3.2E+00	4.5E+00	1.3E+01	3.4E+00	1.2E+01	2.5E+01
Cd-109	1.4E-04	9.2E-05	1.4E-04	2.0E-04	5.8E-04	1.5E-04	5.4E-04	1.1E-03
Ag-110m	5.7E+00	3.6E+00	5.7E+00	7.8E+00	2.3E+01	6.0E+00	2.1E+01	4.3E+01
Sb-124	3.6E+00	2.3E+00	3.6E+00	5.0E+00	1.5E+01	3.9E+00	1.3E+01	2.8E+01
I-125	1.3E-03	8.3E-04	1.3E-03	1.8E-03	5.3E-03	1.4E-03	4.8E-03	1.0E-02
Sb-125	8.1E-01	5.2E-01	8.1E-01	1.1E+00	3.3E+00	8.7E-01	3.0E+00	6.2E+00
I-129	1.0E-03	6.6E-04	1.0E-03	1.4E-03	4.1E-03	1.1E-03	3.8E-03	7.8E-03
I-131	5.0E-01	3.2E-01	4.9E-01	7.2E-01	2.0E+00	5.6E-01	1.9E+00	4.0E+00
Ba-133	5.6E-01	3.6E-01	5.6E-01	7.7E-01	2.3E+00	5.9E-01	2.1E+00	4.3E+00
Cs-134	3.2E+00	2.1E+00	3.2E+00	4.4E+00	1.3E+01	3.4E+00	1.2E+01	2.4E+01
Cs-137	1.2E+00	7.9E-01	1.2E+00	1.7E+00	5.0E+00	1.3E+00	4.6E+00	9.5E+00

Table H.9 Dose factors[a] for AL-SCRP-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	5.4E-02	3.5E-02	5.4E-02	7.5E-02	2.2E-01	5.9E-02	2.0E-01	4.1E-01
Ce-144	6.6E-02	4.2E-02	6.6E-02	9.1E-02	2.7E-01	7.0E-02	2.5E-01	5.0E-01
Pm-147	2.1E-06	1.3E-06	2.1E-06	2.9E-06	8.5E-06	2.2E-06	7.8E-06	1.6E-05
Eu-152	2.2E+00	1.4E+00	2.2E+00	3.1E+00	9.0E+00	2.4E+00	8.3E+00	1.7E+01
Eu-154	2.4E+00	1.6E+00	2.4E+00	3.3E+00	9.8E+00	2.6E+00	9.1E+00	1.9E+01
Eu-155	2.1E-02	1.4E-02	2.1E-02	2.9E-02	8.6E-02	2.3E-02	7.9E-02	1.6E-01
Re-186	4.9E-03	2.9E-03	4.7E-03	8.0E-03	2.0E-02	5.5E-03	1.8E-02	4.2E-02
Ir-192	1.4E+00	9.1E-01	1.4E+00	2.0E+00	5.7E+00	1.5E+00	5.2E+00	1.1E+01
Pb-210	3.2E-04	2.1E-04	3.2E-04	4.4E-04	1.3E-03	3.4E-04	1.2E-03	2.5E-03
Po-210	1.7E-05	1.1E-05	1.7E-05	2.3E-05	6.7E-05	1.8E-05	6.2E-05	1.3E-04
Bi-210	6.2E-04	3.8E-04	6.0E-04	9.5E-04	2.5E-03	7.2E-04	2.3E-03	5.1E-03
Rn-222	1.7E+00	1.0E+00	1.6E+00	2.8E+00	6.9E+00	1.9E+00	6.3E+00	1.5E+01
Ra-223	3.6E-01	2.3E-01	3.6E-01	5.1E-01	1.5E+00	4.1E-01	1.3E+00	2.9E+00
Ra-224	1.2E+00	7.2E-01	1.2E+00	2.0E+00	4.9E+00	1.4E+00	4.5E+00	1.1E+01
Ac-225	2.8E-01	1.8E-01	2.8E-01	4.0E-01	1.1E+00	3.2E-01	1.0E+00	2.3E+00
Ra-225	6.3E-04	4.0E-04	6.3E-04	8.7E-04	2.5E-03	7.0E-04	2.3E-03	4.9E-03
Ra-226	3.5E+00	2.2E+00	3.5E+00	4.8E+00	1.4E+01	3.7E+00	1.3E+01	2.7E+01
Ac-227	2.1E-01	1.3E-01	2.1E-01	2.8E-01	8.3E-01	2.2E-01	7.7E-01	1.6E+00
Th-227	1.2E-01	7.6E-02	1.2E-01	1.6E-01	4.7E-01	1.3E-01	4.3E-01	9.1E-01
Th-228	2.5E+00	1.6E+00	2.5E+00	3.5E+00	1.0E+01	2.7E+00	9.5E+00	1.9E+01
Ra-228	1.7E+00	1.1E+00	1.7E+00	2.3E+00	6.8E+00	1.8E+00	6.3E+00	1.3E+01
Th-229	1.6E-01	1.0E-01	1.6E-01	2.2E-01	6.4E-01	1.7E-01	5.9E-01	1.2E+00
Th-230	4.6E-05	2.9E-05	4.6E-05	6.3E-05	1.9E-04	4.9E-05	1.7E-04	3.5E-04
Pa-231	4.1E-02	2.6E-02	4.1E-02	5.6E-02	1.7E-01	4.4E-02	1.5E-01	3.1E-01
Th-231	3.0E-04	6.6E-05	2.2E-04	7.7E-04	1.2E-03	1.8E-04	7.4E-04	4.0E-03
Th-232	1.2E-02	7.6E-03	1.2E-02	1.6E-02	4.8E-02	1.3E-02	4.4E-02	9.1E-02
Pa-233	2.6E-01	1.7E-01	2.6E-01	3.6E-01	1.1E+00	2.8E-01	9.8E-01	2.0E+00
U-233	4.0E-07	2.6E-07	4.1E-07	5.6E-07	1.6E-06	4.3E-07	1.5E-06	3.1E-06
Th-234	1.5E-02	9.5E-03	1.5E-02	2.0E-02	5.9E-02	1.6E-02	5.4E-02	1.1E-01
U-234	7.4E-06	4.8E-06	7.4E-06	1.0E-05	3.0E-05	7.9E-06	2.8E-05	5.7E-05
U-235	1.6E-01	1.0E-01	1.6E-01	2.2E-01	6.6E-01	1.7E-01	6.1E-01	1.3E+00
Np-237	1.2E-01	8.0E-02	1.2E-01	1.7E-01	5.0E-01	1.3E-01	4.7E-01	9.6E-01
Pu-238	2.3E-06	1.5E-06	2.3E-06	3.2E-06	9.4E-06	2.5E-06	8.7E-06	1.8E-05
U-238	6.5E-03	4.2E-03	6.6E-03	9.0E-03	2.6E-02	7.0E-03	2.4E-02	5.0E-02
Pu-239	8.9E-07	5.7E-07	8.9E-07	1.2E-06	3.6E-06	9.5E-07	3.3E-06	6.8E-06
Pu-240	7.7E-06	5.0E-06	7.7E-06	1.1E-05	3.1E-05	8.2E-06	2.9E-05	5.9E-05
Pu-241	1.1E-06	6.9E-07	1.1E-06	1.5E-06	4.3E-06	1.1E-06	4.0E-06	8.2E-06
Am-241	3.0E-03	1.9E-03	3.0E-03	4.1E-03	1.2E-02	3.2E-03	1.1E-02	2.3E-02
Cm-242	3.4E-06	2.2E-06	3.4E-06	4.7E-06	1.4E-05	3.6E-06	1.3E-05	2.6E-05
Pu-242	4.0E-06	2.6E-06	4.0E-06	5.5E-06	1.6E-05	4.3E-06	1.5E-05	3.1E-05
Cm-244	3.0E-06	1.9E-06	3.0E-06	4.2E-06	1.2E-05	3.2E-06	1.1E-05	2.3E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.10 Dose factors[a] for AL-METL-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	2.0E-07	4.7E-08	1.6E-07	4.9E-07	8.1E-07	1.1E-07	5.7E-07	2.3E-06
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	5.2E-04	1.1E-04	3.9E-04	1.4E-03	2.1E-03	3.0E-04	1.4E-03	5.9E-03
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	1.9E-03	4.5E-04	1.5E-03	4.8E-03	7.5E-03	1.0E-03	5.5E-03	2.2E-02
Co-58	3.5E-02	8.6E-03	2.8E-02	8.6E-02	1.4E-01	1.7E-02	9.5E-02	4.2E-01
Fe-59	3.5E-02	7.6E-03	2.8E-02	8.6E-02	1.4E-01	1.8E-02	9.7E-02	3.8E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.4E-01	3.4E-02	1.1E-01	3.5E-01	5.7E-01	7.7E-02	3.8E-01	1.6E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.8E-02	6.3E-03	2.3E-02	7.0E-02	1.1E-01	1.7E-02	8.0E-02	3.1E-01
Cu-67	8.5E-07	6.1E-11	2.2E-08	4.8E-06	3.7E-06	1.5E-10	6.6E-08	2.0E-05
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	8.6E-03	1.9E-03	6.7E-03	2.1E-02	3.4E-02	5.2E-03	2.4E-02	9.7E-02
Sr-89	1.9E-05	4.4E-06	1.4E-05	5.2E-05	7.7E-05	1.2E-05	5.1E-05	2.3E-04
Sr-90	3.6E-06	8.3E-07	2.7E-06	9.2E-06	1.4E-05	2.0E-06	9.9E-06	4.2E-05
Y-91	3.0E-05	7.1E-06	2.4E-05	7.9E-05	1.2E-04	1.9E-05	8.5E-05	3.6E-04
Mo-93	2.3E-07	6.2E-08	1.8E-07	5.6E-07	9.4E-07	1.7E-07	6.2E-07	2.7E-06
Nb-93m	3.9E-08	9.1E-09	3.2E-08	9.3E-08	1.6E-07	2.2E-08	1.1E-07	4.2E-07
Nb-94	9.0E-02	2.2E-02	6.8E-02	2.2E-01	3.6E-01	5.0E-02	2.5E-01	1.0E+00
Nb-95	1.9E-02	4.2E-03	1.4E-02	4.9E-02	7.7E-02	9.0E-03	5.4E-02	2.3E-01
Zr-95	1.3E-02	2.8E-03	1.0E-02	3.4E-02	5.4E-02	6.7E-03	3.5E-02	1.6E-01
Tc-99	1.4E-06	3.2E-07	1.0E-06	3.3E-06	5.4E-06	7.2E-07	3.8E-06	1.5E-05
Ru-103	1.1E-02	2.3E-03	8.1E-03	2.9E-02	4.6E-02	6.1E-03	3.1E-02	1.4E-01
Ru-106	9.0E-03	2.1E-03	7.0E-03	2.2E-02	3.7E-02	5.2E-03	2.5E-02	1.0E-01
Ag-108m	9.0E-02	2.1E-02	7.0E-02	2.3E-01	3.6E-01	5.2E-02	2.4E-01	1.0E+00
Cd-109	3.7E-06	9.4E-07	3.0E-06	8.7E-06	1.5E-05	2.2E-06	1.0E-05	4.0E-05
Ag-110m	1.4E-01	3.4E-02	1.0E-01	3.5E-01	5.6E-01	9.4E-02	3.9E-01	1.6E+00
Sb-124	6.3E-02	1.5E-02	4.9E-02	1.5E-01	2.6E-01	3.1E-02	1.8E-01	7.1E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	2.2E-02	5.5E-03	1.7E-02	5.2E-02	8.9E-02	1.2E-02	6.3E-02	2.8E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	7.8E-03	1.8E-03	6.0E-03	1.9E-02	3.2E-02	3.9E-03	2.2E-02	9.2E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.10 Dose factors[a] for AL-METL-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.7E-04	3.2E-05	1.3E-04	4.3E-04	6.8E-04	7.9E-05	4.5E-04	2.0E-03
Ce-144	4.2E-04	9.7E-05	3.2E-04	1.1E-03	1.7E-03	2.2E-04	1.2E-03	4.9E-03
Pm-147	1.4E-08	3.5E-09	1.1E-08	3.6E-08	5.7E-08	8.2E-09	4.0E-08	1.7E-07
Eu-152	1.6E-02	3.7E-03	1.2E-02	4.0E-02	6.3E-02	9.2E-03	4.2E-02	1.9E-01
Eu-154	1.7E-02	3.8E-03	1.3E-02	4.2E-02	6.9E-02	1.0E-02	4.6E-02	2.0E-01
Eu-156	1.5E-04	3.4E-05	1.1E-04	3.7E-04	5.9E-04	8.9E-05	4.0E-04	1.7E-03
Re-186	5.9E-07	1.1E-09	5.4E-08	3.0E-06	2.4E-06	3.5E-09	1.9E-07	1.1E-05
Ir-192	2.7E-02	7.0E-03	2.1E-02	6.6E-02	1.0E-01	1.9E-02	7.3E-02	3.0E-01
Pb-210	8.8E-06	2.2E-06	6.9E-06	2.1E-05	3.5E-05	5.2E-06	2.6E-05	1.0E-04
Po-210	3.3E-07	7.4E-08	2.4E-07	8.3E-07	1.3E-06	1.9E-07	8.7E-07	3.9E-06
Bi-210	2.3E-07	2.5E-09	5.1E-08	1.2E-06	9.4E-07	8.1E-09	1.8E-07	4.5E-06
Rn-222	4.9E-06	3.2E-09	2.7E-07	2.9E-05	2.0E-05	8.7E-09	9.5E-07	1.1E-04
Ra-223	1.2E-03	1.1E-04	7.2E-04	3.7E-03	5.0E-03	3.1E-04	2.4E-03	2.1E-02
Ra-224	1.4E-04	2.5E-07	1.2E-05	7.9E-04	6.3E-04	6.1E-07	4.7E-05	3.0E-03
Ac-225	6.7E-04	5.7E-05	3.9E-04	2.2E-03	2.8E-03	1.7E-04	1.3E-03	9.5E-03
Ra-225	3.2E-06	4.4E-07	2.1E-06	9.7E-06	1.3E-05	1.1E-06	7.0E-06	4.4E-05
Ra-226	9.6E-02	2.3E-02	7.7E-02	2.4E-01	3.9E-01	5.9E-02	2.6E-01	1.1E+00
Ac-227	5.7E-03	1.3E-03	4.6E-03	1.4E-02	2.3E-02	3.0E-03	1.6E-02	7.0E-02
Th-227	8.4E-04	1.4E-04	5.6E-04	2.6E-03	3.4E-03	3.6E-04	2.0E-03	1.1E-02
Th-228	6.8E-02	1.6E-02	5.1E-02	1.6E-01	2.6E-01	4.3E-02	1.9E-01	7.2E-01
Ra-228	4.6E-02	1.1E-02	3.5E-02	1.1E-01	1.9E-01	2.6E-02	1.3E-01	5.6E-01
Th-229	4.3E-03	1.0E-03	3.4E-03	1.1E-02	1.7E-02	2.7E-03	1.2E-02	4.6E-02
Th-230	1.3E-06	3.0E-07	1.0E-06	2.9E-06	5.0E-06	8.6E-07	3.4E-06	1.4E-05
Pa-231	1.1E-03	2.8E-04	8.8E-04	2.8E-03	4.6E-03	7.2E-04	3.0E-03	1.3E-02
Th-231	2.2E-12	4.1E-23	2.5E-17	1.2E-11	9.3E-12	1.5E-22	9.9E-17	3.9E-11
Th-232	3.3E-04	8.0E-05	2.5E-04	8.2E-04	1.3E-03	2.0E-04	9.2E-04	3.6E-03
Pa-233	2.9E-03	5.1E-04	2.0E-03	8.1E-03	1.2E-02	1.4E-03	7.4E-03	3.7E-02
U-233	1.1E-08	2.7E-09	8.6E-09	2.7E-08	4.5E-08	6.7E-09	3.0E-08	1.2E-07
Th-234	1.3E-04	2.6E-05	9.6E-05	3.9E-04	5.7E-04	6.4E-05	3.6E-04	1.8E-03
U-234	2.0E-07	4.7E-08	1.6E-07	4.8E-07	8.2E-07	1.1E-07	5.7E-07	2.3E-06
U-235	4.5E-03	1.1E-03	3.5E-03	1.1E-02	1.8E-02	2.6E-03	1.3E-02	5.5E-02
Np-237	3.4E-03	8.5E-04	2.7E-03	8.0E-03	1.4E-02	2.1E-03	9.3E-03	3.8E-02
Pu-238	6.4E-08	1.6E-08	5.0E-08	1.5E-07	2.6E-07	3.6E-08	1.8E-07	7.3E-07
U-238	1.8E-04	4.4E-05	1.4E-04	4.4E-04	7.3E-04	1.1E-04	5.0E-04	2.2E-03
Pu-239	2.4E-08	6.1E-09	2.0E-08	5.7E-08	9.6E-08	1.6E-08	7.0E-08	2.6E-07
Pu-240	2.1E-07	5.2E-08	1.7E-07	5.2E-07	8.6E-07	1.1E-07	6.2E-07	2.4E-06
Pu-241	2.9E-08	6.9E-09	2.3E-08	7.1E-08	1.2E-07	1.7E-08	8.0E-08	3.3E-07
Am-241	8.2E-05	2.0E-05	6.4E-05	2.0E-04	3.3E-04	4.9E-05	2.3E-04	9.2E-04
Cm-242	7.9E-08	1.9E-08	6.2E-08	2.0E-07	3.2E-07	4.7E-08	2.1E-07	9.5E-07
Pu-242	1.1E-07	2.7E-08	8.5E-08	2.7E-07	4.6E-07	6.6E-08	3.2E-07	1.4E-06
Cm-244	8.4E-08	2.0E-08	6.4E-08	2.1E-07	3.3E-07	4.8E-08	2.2E-07	1.0E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.11 Dose factors[a] for AL-DROS-TRANSPO-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	3.5E-08	6.3E-09	2.5E-08	9.2E-08	1.4E-07	1.8E-08	9.0E-08	3.9E-07
Na-22	3.5E-01	7.0E-02	2.5E-01	9.1E-01	1.4E+00	1.7E-01	9.6E-01	4.0E+00
P-32	3.3E-05	3.7E-06	1.9E-05	1.0E-04	1.3E-04	9.8E-06	6.9E-05	4.6E-04
S-35	4.5E-07	8.4E-08	3.2E-07	1.2E-06	1.8E-06	2.3E-07	1.2E-06	5.0E-06
Cl-36	2.8E-05	4.9E-06	2.0E-05	7.6E-05	1.2E-04	1.3E-05	7.5E-05	3.3E-04
K-40	2.7E-02	4.9E-03	1.8E-02	7.4E-02	1.1E-01	1.2E-02	7.0E-02	3.3E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.1E-06	3.7E-07	1.5E-06	5.7E-06	8.4E-06	1.1E-06	5.4E-06	2.5E-05
Cr-51	2.5E-05	1.2E-06	1.4E-05	8.8E-05	1.0E-04	3.0E-06	5.3E-05	4.0E-04
Mn-54	1.3E-01	2.5E-02	9.2E-02	3.4E-01	5.1E-01	6.0E-02	3.4E-01	1.5E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	9.7E-05	3.3E-06	5.5E-05	3.0E-04	3.9E-04	1.1E-05	1.9E-04	1.4E-03
Co-58	1.8E-03	6.3E-05	1.0E-03	6.1E-03	7.0E-03	1.9E-04	3.8E-03	2.5E-02
Fe-59	1.8E-03	6.8E-05	9.9E-04	6.5E-03	7.4E-03	2.0E-04	3.3E-03	2.7E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	7.1E-03	2.4E-04	4.1E-03	2.4E-02	2.8E-02	8.2E-04	1.4E-02	9.9E-02
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cu-67	4.0E-08	1.8E-12	5.3E-10	1.8E-07	1.5E-07	8.0E-12	1.8E-09	7.7E-07
Se-75	2.8E-02	5.2E-03	2.0E-02	7.6E-02	1.1E-01	1.4E-02	7.6E-02	3.5E-01
Sr-85	2.6E-02	4.6E-03	1.9E-02	7.1E-02	1.1E-01	1.2E-02	6.7E-02	3.4E-01
Sr-89	5.7E-05	1.0E-05	4.1E-05	1.6E-04	2.3E-04	2.7E-05	1.5E-04	8.2E-04
Sr-90	1.1E-05	2.0E-06	7.9E-06	2.9E-05	4.3E-05	5.5E-06	2.8E-05	1.3E-04
Y-91	2.7E-04	4.9E-05	1.9E-04	7.8E-04	1.1E-03	1.2E-04	7.4E-04	3.3E-03
Mo-93	1.2E-08	5.3E-10	6.7E-09	4.1E-08	4.6E-08	1.8E-09	2.2E-08	1.7E-07
Nb-93m	2.0E-09	9.1E-11	1.0E-09	7.4E-09	8.1E-09	3.0E-10	3.9E-09	3.0E-08
Nb-94	4.7E-03	2.0E-04	2.6E-03	1.7E-02	1.9E-02	5.5E-04	8.8E-03	7.0E-02
Nb-95	9.6E-04	3.7E-05	4.9E-04	3.3E-03	3.7E-03	1.1E-04	1.8E-03	1.3E-02
Zr-95	3.9E-02	7.9E-03	2.9E-02	1.0E-01	1.6E-01	1.8E-02	9.9E-02	4.7E-01
Tc-99	6.8E-07	4.4E-08	4.2E-07	2.2E-06	2.8E-06	1.4E-07	1.4E-06	1.0E-05
Ru-103	5.9E-03	3.4E-04	3.7E-03	2.0E-02	2.4E-02	8.4E-04	1.2E-02	9.3E-02
Ru-106	4.9E-03	2.6E-04	2.9E-03	1.6E-02	1.9E-02	9.2E-04	1.1E-02	6.6E-02
Ag-108m	4.6E-03	1.8E-04	2.5E-03	1.6E-02	1.8E-02	6.2E-04	8.9E-03	7.0E-02
Cd-109	1.9E-07	8.2E-09	1.0E-07	6.5E-07	8.2E-07	2.6E-08	3.4E-07	3.3E-06
Ag-110m	7.1E-03	2.9E-04	3.9E-03	2.5E-02	2.9E-02	8.8E-04	1.3E-02	1.1E-01
Sb-124	3.3E-03	1.3E-04	1.8E-03	1.2E-02	1.4E-02	3.4E-04	6.3E-03	5.4E-02
I-125	5.5E-05	9.8E-06	4.0E-05	1.4E-04	2.2E-04	2.8E-05	1.5E-04	6.5E-04
Sb-125	1.1E-03	4.6E-05	6.3E-04	4.1E-03	4.7E-03	1.2E-04	2.3E-03	1.7E-02
I-129	6.8E-05	1.3E-05	4.8E-05	1.8E-04	2.8E-04	3.5E-05	1.8E-04	8.3E-04
I-131	1.8E-03	8.1E-05	7.6E-04	6.9E-03	7.4E-03	2.5E-04	2.5E-03	3.3E-02
Ba-133	2.3E-02	4.1E-03	1.7E-02	5.8E-02	9.2E-02	1.3E-02	6.0E-02	2.7E-01
Cs-134	2.5E-01	4.6E-02	1.8E-01	6.8E-01	1.0E+00	1.1E-01	6.9E-01	3.2E+00
Cs-137	1.0E-01	2.0E-02	7.1E-02	2.6E-01	4.0E-01	5.2E-02	2.6E-01	1.2E+00

Table H.11 Dose factors[a] for AL-DROS-TRANSPO-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.5E-03	2.6E-04	1.0E-03	4.2E-03	6.0E-03	7.7E-04	3.8E-03	1.9E-02
Ce-144	3.7E-03	8.0E-04	2.8E-03	9.8E-03	1.5E-02	1.8E-03	9.8E-03	4.3E-02
Pm-147	1.3E-07	2.4E-08	9.3E-08	3.5E-07	5.0E-07	6.5E-08	3.2E-07	1.5E-06
Eu-152	1.4E-01	2.6E-02	1.0E-01	3.6E-01	5.5E-01	7.5E-02	3.5E-01	1.7E+00
Eu-154	1.5E-01	2.9E-02	1.1E-01	3.8E-01	6.1E-01	7.1E-02	3.8E-01	1.8E+00
Eu-155	1.3E-03	2.5E-04	9.8E-04	3.4E-03	5.2E-03	6.6E-04	3.5E-03	1.6E-02
Re-186	3.0E-07	2.7E-10	2.1E-08	1.8E-06	1.2E-06	8.4E-10	7.8E-08	7.4E-06
Ir-192	1.4E-03	5.8E-05	8.0E-04	4.5E-03	5.4E-03	1.7E-04	2.8E-03	2.0E-02
Pb-210	4.4E-07	1.8E-08	2.5E-07	1.5E-06	1.8E-06	6.1E-08	8.7E-07	6.8E-06
Po-210	1.7E-07	9.2E-09	1.1E-07	5.3E-07	6.9E-07	2.3E-08	4.1E-07	2.4E-06
Bi-210	1.2E-08	3.5E-11	1.6E-09	5.9E-08	5.1E-08	1.2E-10	5.9E-09	2.5E-07
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	6.2E-05	1.9E-06	2.3E-05	2.4E-04	2.6E-04	5.9E-06	8.0E-05	1.1E-03
Ra-224	7.7E-06	5.3E-09	4.4E-07	4.3E-05	3.3E-05	1.5E-08	1.5E-06	1.4E-04
Ac-225	3.2E-05	7.2E-07	1.4E-05	1.3E-04	1.3E-04	2.4E-06	4.7E-05	6.0E-04
Ra-225	1.8E-07	4.9E-09	7.0E-08	7.2E-07	7.3E-07	1.3E-08	2.5E-07	3.6E-06
Ra-226	5.1E-03	2.0E-04	2.6E-03	1.7E-02	2.1E-02	6.3E-04	9.6E-03	8.1E-02
Ac-227	2.8E-04	1.3E-05	1.6E-04	9.9E-04	1.1E-03	3.6E-05	5.7E-04	4.1E-03
Th-227	4.3E-05	1.5E-06	2.1E-05	1.4E-04	1.7E-04	4.4E-06	7.5E-05	6.3E-04
Th-228	3.3E-03	1.6E-04	2.0E-03	1.2E-02	1.3E-02	4.3E-04	6.9E-03	4.6E-02
Ra-228	2.5E-03	1.0E-04	1.3E-03	8.5E-03	9.7E-03	3.1E-04	4.6E-03	3.6E-02
Th-229	2.2E-04	1.0E-05	1.2E-04	8.0E-04	8.4E-04	3.4E-05	4.0E-04	3.1E-03
Th-230	6.4E-08	2.9E-09	3.6E-08	2.2E-07	2.5E-07	9.6E-09	1.2E-07	8.7E-07
Pa-231	6.1E-05	2.1E-06	3.3E-05	2.1E-04	2.5E-04	8.0E-06	1.1E-04	9.6E-04
Th-231	7.1E-14	1.1E-24	5.4E-19	3.1E-13	3.0E-13	5.7E-24	2.6E-18	1.3E-12
Th-232	1.7E-05	7.6E-07	9.0E-06	5.7E-05	6.5E-05	2.3E-06	3.2E-05	2.4E-04
Pa-233	1.5E-04	4.0E-06	7.1E-05	5.5E-04	6.3E-04	1.3E-05	2.5E-04	2.6E-03
U-233	5.6E-10	2.6E-11	3.2E-10	2.2E-09	2.2E-09	9.2E-11	1.1E-09	7.7E-09
Th-234	7.0E-06	2.6E-07	3.3E-06	2.5E-05	2.9E-05	9.1E-07	1.1E-05	1.1E-04
U-234	1.0E-08	5.2E-10	5.7E-09	3.4E-08	4.1E-08	1.5E-09	2.1E-08	1.5E-07
U-235	2.2E-04	1.1E-05	1.3E-04	7.6E-04	9.3E-04	2.7E-05	4.7E-04	3.7E-03
Np-237	1.7E-04	5.2E-06	1.0E-04	5.7E-04	7.1E-04	1.9E-05	3.6E-04	2.8E-03
Pu-238	3.3E-09	1.5E-10	1.7E-09	1.2E-08	1.3E-08	4.1E-10	6.2E-09	4.2E-08
U-238	8.8E-06	4.4E-07	5.0E-06	3.2E-05	3.5E-05	1.5E-06	1.8E-05	1.2E-04
Pu-239	1.2E-09	5.0E-11	6.9E-10	4.2E-09	5.2E-09	1.6E-10	2.3E-09	2.1E-08
Pu-240	1.1E-08	4.9E-10	6.0E-09	4.1E-08	4.4E-08	1.6E-09	2.0E-08	1.8E-07
Pu-241	1.5E-09	6.2E-11	8.0E-10	5.1E-09	5.7E-09	1.9E-10	2.8E-09	2.1E-08
Am-241	4.0E-06	1.7E-07	2.2E-06	1.2E-05	1.6E-05	5.4E-07	8.2E-06	6.0E-05
Cm-242	4.0E-09	1.2E-10	2.3E-09	1.3E-08	1.6E-08	4.6E-10	7.9E-09	5.9E-08
Pu-242	5.6E-09	2.5E-10	3.0E-09	1.8E-08	2.3E-08	7.2E-10	1.1E-08	8.4E-08
Cm-244	4.1E-09	1.4E-10	2.5E-09	1.3E-08	1.7E-08	5.2E-10	8.4E-09	6.5E-08

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.12 Dose factors[a] for AL-SCRP-DISPOSL-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.1E-07	2.4E-08	1.0E-07	2.3E-07	4.4E-07	5.5E-08	3.5E-07	1.1E-06
Na-22	1.1E-01	2.4E-02	1.0E-01	2.3E-01	4.4E-01	5.6E-02	3.6E-01	1.1E+00
P-32	5.7E-05	1.2E-05	5.2E-05	1.1E-04	2.3E-04	2.9E-05	1.9E-04	6.1E-04
S-35	1.1E-07	2.5E-08	1.0E-07	2.3E-07	4.5E-07	5.7E-08	3.6E-07	1.1E-06
Cl-36	2.0E-05	4.3E-06	1.8E-05	4.1E-05	7.8E-05	9.8E-06	6.3E-05	2.0E-04
K-40	8.5E-03	1.9E-03	8.0E-03	1.8E-02	3.4E-02	4.3E-03	2.7E-02	8.7E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	4.9E-07	1.1E-07	4.6E-07	1.0E-06	2.0E-06	2.5E-07	1.6E-06	5.0E-06
Cr-51	1.1E-03	2.3E-04	1.0E-03	2.2E-03	4.4E-03	5.6E-04	3.5E-03	1.1E-02
Mn-54	4.1E-02	9.0E-03	3.9E-02	8.7E-02	1.6E-01	2.1E-02	1.3E-01	4.2E-01
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	4.0E-03	8.8E-04	3.7E-03	8.4E-03	1.6E-02	2.0E-03	1.3E-02	4.1E-02
Co-58	4.4E-02	9.6E-03	4.1E-02	9.1E-02	1.8E-01	2.3E-02	1.4E-01	4.5E-01
Fe-59	5.3E-02	1.1E-02	4.9E-02	1.1E-01	2.1E-01	2.7E-02	1.7E-01	5.4E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.3E-01	2.9E-02	1.2E-01	2.8E-01	5.3E-01	6.6E-02	4.2E-01	1.4E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.9E-02	6.5E-03	2.8E-02	6.2E-02	1.2E-01	1.5E-02	9.5E-02	3.0E-01
Cu-67	3.1E-04	2.7E-05	1.9E-04	9.7E-04	1.3E-03	7.9E-05	7.3E-04	4.3E-03
Se-75	1.5E-02	3.3E-03	1.4E-02	3.2E-02	6.1E-02	7.7E-03	4.9E-02	1.6E-01
Sr-85	2.2E-02	4.7E-03	2.0E-02	4.5E-02	8.7E-02	1.1E-02	6.9E-02	2.2E-01
Sr-89	6.4E-05	1.4E-05	6.0E-05	1.3E-04	2.6E-04	3.3E-05	2.1E-04	6.5E-04
Sr-90	5.8E-06	1.3E-06	5.4E-06	1.2E-05	2.3E-05	2.9E-06	1.8E-05	5.9E-05
Y-91	2.3E-04	5.1E-05	2.2E-04	4.8E-04	9.3E-04	1.2E-04	7.5E-04	2.4E-03
Mo-93	4.8E-06	1.1E-06	4.5E-06	1.0E-05	1.9E-05	2.4E-06	1.5E-05	5.0E-05
Nb-93m	8.5E-07	1.8E-07	8.0E-07	1.8E-06	3.4E-06	4.3E-07	2.7E-06	8.7E-06
Nb-94	7.9E-02	1.7E-02	7.4E-02	1.7E-01	3.2E-01	4.0E-02	2.5E-01	8.1E-01
Nb-95	3.1E-02	6.7E-03	2.9E-02	6.4E-02	1.2E-01	1.6E-02	1.0E-01	3.2E-01
Zr-95	3.3E-02	7.1E-03	3.1E-02	6.8E-02	1.3E-01	1.7E-02	1.1E-01	3.3E-01
Tc-99	1.0E-06	2.2E-07	9.6E-07	2.2E-06	4.1E-06	5.2E-07	3.3E-06	1.1E-05
Ru-103	1.9E-02	4.0E-03	1.7E-02	3.9E-02	7.4E-02	9.6E-03	6.0E-02	1.9E-01
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	7.9E-02	1.7E-02	7.4E-02	1.7E-01	3.2E-01	4.0E-02	2.5E-01	8.1E-01
Cd-109	1.2E-04	2.6E-05	1.1E-04	2.5E-04	4.7E-04	5.9E-05	3.8E-04	1.2E-03
Ag-110m	1.4E-01	3.0E-02	1.3E-01	2.9E-01	5.5E-01	6.8E-02	4.4E-01	1.4E+00
Sb-124	8.4E-02	1.8E-02	7.9E-02	1.7E-01	3.4E-01	4.3E-02	2.7E-01	8.6E-01
I-125	1.2E-04	2.6E-05	1.1E-04	2.5E-04	4.8E-04	6.1E-05	3.8E-04	1.2E-03
Sb-125	2.0E-02	4.3E-03	1.9E-02	4.2E-02	7.9E-02	1.0E-02	6.4E-02	2.0E-01
I-129	1.1E-04	2.3E-05	9.9E-05	2.2E-04	4.2E-04	5.3E-05	3.4E-04	1.1E-03
I-131	7.1E-03	1.3E-03	6.2E-03	1.5E-02	2.9E-02	3.6E-03	2.3E-02	7.8E-02
Ba-133	1.6E-02	3.5E-03	1.5E-02	3.4E-02	6.5E-02	8.1E-03	5.2E-02	1.7E-01
Cs-134	7.7E-02	1.7E-02	7.2E-02	1.6E-01	3.1E-01	3.8E-02	2.5E-01	7.9E-01
Cs-137	6.2E-06	1.3E-06	5.7E-06	1.3E-05	2.5E-05	3.1E-06	2.0E-05	6.3E-05

Table H.12 Dose factors[a] for AL-SCRP-DISPOSL-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.1E-03	4.4E-04	1.9E-03	4.3E-03	8.2E-03	1.1E-03	6.7E-03	2.1E-02
Ce-144	5.7E-04	1.3E-04	5.4E-04	1.2E-03	2.3E-03	2.9E-04	1.8E-03	5.9E-03
Pm-147	4.1E-07	8.9E-08	3.8E-07	8.6E-07	1.6E-06	2.0E-07	1.3E-06	4.2E-06
Eu-152	5.7E-02	1.2E-02	5.4E-02	1.2E-01	2.3E-01	2.9E-02	1.8E-01	5.9E-01
Eu-154	6.3E-02	1.4E-02	5.9E-02	1.3E-01	2.5E-01	3.1E-02	2.0E-01	6.4E-01
Eu-155	1.5E-03	3.2E-04	1.4E-03	3.1E-03	5.9E-03	7.5E-04	4.8E-03	1.5E-02
Re-186	9.9E-05	1.4E-05	7.3E-05	2.7E-04	4.0E-04	4.0E-05	2.7E-04	1.2E-03
Ir-192	3.4E-02	7.4E-03	3.2E-02	7.1E-02	1.4E-01	1.8E-02	1.1E-01	3.5E-01
Pb-210	5.0E-05	1.1E-05	4.7E-05	1.1E-04	2.0E-04	2.5E-05	1.6E-04	5.1E-04
Po-210	4.1E-07	8.9E-08	3.8E-07	8.4E-07	1.6E-06	2.0E-07	1.3E-06	4.2E-06
Bi-210	7.0E-06	1.1E-06	5.7E-06	1.7E-05	2.8E-05	3.2E-06	2.1E-05	8.3E-05
Rn-222	3.0E-06	4.4E-07	2.2E-06	8.1E-06	1.2E-05	1.2E-06	8.4E-06	3.8E-05
Ra-223	2.6E-03	5.1E-04	2.3E-03	5.2E-03	1.0E-02	1.3E-03	8.4E-03	2.8E-02
Ra-224	6.1E-05	8.4E-06	4.5E-05	1.7E-04	2.5E-04	2.4E-05	1.7E-04	7.8E-04
Ac-225	2.5E-04	4.9E-05	2.2E-04	5.1E-04	1.0E-03	1.3E-04	8.1E-04	2.7E-03
Ra-225	5.4E-05	1.1E-05	4.9E-05	1.1E-04	2.2E-04	2.8E-05	1.8E-04	5.8E-04
Ra-226	9.2E-02	2.0E-02	8.6E-02	1.9E-01	3.7E-01	4.6E-02	2.9E-01	9.4E-01
Ac-227	5.8E-03	1.3E-03	5.4E-03	1.2E-02	2.3E-02	2.9E-03	1.8E-02	5.9E-02
Th-227	2.9E-03	6.1E-04	2.6E-03	5.7E-03	1.1E-02	1.5E-03	9.4E-03	3.0E-02
Th-228	8.1E-02	1.8E-02	7.6E-02	1.7E-01	3.2E-01	4.0E-02	2.6E-01	8.3E-01
Ra-228	4.9E-02	1.1E-02	4.6E-02	1.0E-01	1.9E-01	2.4E-02	1.6E-01	5.0E-01
Th-229	5.8E-03	1.3E-03	5.4E-03	1.2E-02	2.3E-02	2.9E-03	1.9E-02	5.9E-02
Th-230	9.9E-06	2.2E-06	9.3E-06	2.1E-05	4.0E-05	5.0E-06	3.2E-05	1.0E-04
Pa-231	1.6E-03	3.4E-04	1.5E-03	3.3E-03	6.2E-03	7.8E-04	5.0E-03	1.6E-02
Th-231	1.1E-06	5.2E-09	2.0E-07	5.3E-06	4.5E-06	1.6E-08	7.6E-07	2.1E-05
Th-232	3.5E-04	7.6E-05	3.3E-04	7.4E-04	1.4E-03	1.8E-04	1.1E-03	3.6E-03
Pa-233	6.3E-03	1.4E-03	5.9E-03	1.3E-02	2.5E-02	3.3E-03	2.0E-02	6.6E-02
U-233	1.1E-05	2.5E						
06	1.1E-05	2.4E-05	4.6E-05	5.7E-06	3.7E-05	1.2E-04		
Th-234	1.4E-04	3.1E-05	1.3E-04	3.0E-04	5.8E-04	7.4E-05	4.7E-04	1.5E-03
U-234	3.3E-06	7.1E-07	3.1E-06	6.9E-06	1.3E-05	1.7E-06	1.1E-05	3.4E-05
U-235	5.9E-03	1.3E-03	5.5E-03	1.2E-02	2.4E-02	3.0E-03	1.9E-02	6.1E-02
Np-237	4.0E-03	8.6E-04	3.7E-03	8.4E-03	1.6E-02	2.0E-03	1.3E-02	4.1E-02
Pu-238	1.2E-06	2.7E-07	1.2E-06	2.6E-06	5.0E-06	6.2E-07	4.0E-06	1.3E-05
U-238	3.7E-04	8.1E-05	3.5E-04	7.9E-04	1.5E-03	1.9E-04	1.2E-03	3.8E-03
Pu-239	2.4E-06	5.3E-07	2.3E-06	5.1E-06	9.7E-06	1.2E-06	7.7E-06	2.5E-05
Pu-240	1.2E-06	2.6E-07	1.1E-06	2.5E-06	4.8E-06	6.0E-07	3.8E-06	1.2E-05
Pu-241	8.4E-08	1.8E-08	7.9E-08	1.8E-07	3.4E-07	4.2E-08	2.7E-07	8.6E-07
Am-241	3.6E-04	7.8E-05	3.3E-04	7.6E-04	1.4E-03	1.8E-04	1.1E-03	3.7E-03
Cm-242	1.3E-06	2.9E-07	1.3E-06	2.8E-06	5.3E-06	6.7E-07	4.3E-06	1.4E-05
Pu-242	1.0E-06	2.3E-07	9.8E-07	2.2E-06	4.2E-06	5.3E-07	3.4E-06	1.1E-05
Cm-244	1.0E-06	2.2E-07	9.6E-07	2.2E-06	4.1E-06	5.2E-07	3.3E-06	1.1E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.13 Dose factors[a] for AL-METL-LGMASS-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.2E-07	1.4E-07	3.7E-07	8.3E-07	1.7E-06	3.7E-07	1.3E-06	3.9E-06
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.1E-04	2.8E-05	9.1E-05	2.5E-04	4.3E-04	9.8E-05	3.1E-04	1.1E-03
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.1E-03	1.0E-03	2.7E-03	6.2E-03	1.2E-02	2.5E-03	1.0E-02	3.0E-02
Co-58	1.7E-02	4.9E-03	1.5E-02	3.4E-02	6.6E-02	1.4E-02	5.4E-02	1.7E-01
Fe-59	9.2E-03	3.0E-03	8.1E-03	1.9E-02	3.6E-02	7.6E-03	2.8E-02	8.4E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.1E-01	7.1E-02	1.8E-01	4.0E-01	8.1E-01	1.7E-01	6.9E-01	2.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.8E-02	9.2E-03	2.5E-02	5.4E-02	1.1E-01	2.3E-02	8.6E-02	2.7E-01
Cu-67	1.2E-08	6.3E-13	2.4E-10	6.7E-08	4.6E-08	2.4E-12	7.3E-10	2.3E-07
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	4.0E-03	1.2E-03	3.5E-03	8.5E-03	1.6E-02	3.0E-03	1.3E-02	4.1E-02
Sr-89	7.7E-06	2.1E-06	6.7E-06	1.6E-05	3.1E-05	5.4E-06	2.5E-05	8.0E-05
Sr-90	7.4E-06	2.2E-06	6.5E-06	1.6E-05	2.9E-05	6.2E-06	2.4E-05	7.2E-05
Y-91	1.1E-05	3.6E-06	9.3E-06	2.3E-05	4.3E-05	9.3E-06	3.6E-05	1.0E-04
Mo-93	1.6E-05	5.3E-06	1.4E-05	3.2E-05	6.4E-05	1.3E-05	5.1E-05	1.6E-04
Nb-93m	2.6E-06	9.2E-07	2.3E-06	4.9E-06	1.0E-05	2.1E-06	8.1E-06	2.6E-05
Nb-94	1.5E-01	5.2E-02	1.3E-01	3.1E-01	6.1E-01	1.1E-01	5.2E-01	1.4E+00
Nb-95	4.3E-03	1.2E-03	3.6E-03	9.5E-03	1.7E-02	3.2E-03	1.3E-02	4.2E-02
Zr-95	5.5E-03	1.6E-03	4.6E-03	1.2E-02	2.2E-02	4.5E-03	1.7E-02	5.9E-02
Tc-99	2.9E-06	8.9E-07	2.5E-06	6.0E-06	1.1E-05	2.3E-06	9.1E-06	2.7E-05
Ru-103	3.0E-03	8.1E-04	2.5E-03	6.8E-03	1.2E-02	2.3E-03	9.1E-03	3.0E-02
Ru-106	1.1E-02	3.6E-03	9.5E-03	2.3E-02	4.4E-02	9.3E-03	3.5E-02	1.0E-01
Ag-108m	1.6E-01	5.5E-02	1.4E-01	3.2E-01	6.3E-01	1.4E-01	5.1E-01	1.5E+00
Cd-109	3.3E-05	1.1E-05	2.9E-05	6.6E-05	1.3E-04	2.8E-05	1.0E-04	3.2E-04
Ag-110m	1.5E-01	4.8E-02	1.3E-01	2.8E-01	5.8E-01	1.2E-01	4.6E-01	1.4E+00
Sb-124	2.3E-02	7.1E-03	2.0E-02	4.9E-02	9.3E-02	1.9E-02	7.3E-02	2.3E-01
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.5E-02	1.1E-02	3.0E-02	7.0E-02	1.4E-01	2.8E-02	1.1E-01	3.4E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.6E-02	5.5E-03	1.4E-02	3.2E-02	6.4E-02	1.4E-02	5.1E-02	1.5E-01
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.13 Dose factors[a] for AL-METL-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	5.2E-05	1.4E-05	4.3E-05	1.2E-04	2.1E-04	3.6E-05	1.6E-04	5.6E-04
Ce-144	5.0E-04	1.7E-04	4.4E-04	1.1E-03	2.0E-03	4.5E-04	1.5E-03	4.8E-03
Pm-147	3.5E-08	1.1E-08	3.1E-08	7.0E-08	1.4E-07	2.7E-08	1.2E-07	3.4E-07
Eu-152	2.5E-02	8.2E-03	2.2E-02	5.2E-02	1.0E-01	2.0E-02	8.2E-02	2.6E-01
Eu-154	2.7E-02	9.1E-03	2.4E-02	5.5E-02	1.1E-01	2.3E-02	8.3E-02	2.7E-01
Eu-155	3.7E-04	1.1E-04	3.4E-04	7.4E-04	1.4E-03	2.8E-04	1.2E-03	3.4E-03
Re-186	1.5E-08	2.8E-11	1.7E-09	7.3E-08	5.6E-08	8.4E-11	6.3E-09	3.0E-07
Ir-192	1.4E-02	4.7E-03	1.3E-02	2.9E-02	5.7E-02	1.3E-02	4.5E-02	1.4E-01
Pb-210	2.9E-05	1.0E-05	2.6E-05	6.0E-05	1.2E-04	2.5E-05	9.6E-05	2.8E-04
Po-210	2.6E-07	8.6E-08	2.3E-07	5.4E-07	1.0E-06	1.9E-07	8.0E-07	2.4E-06
Bi-210	7.4E-09	7.4E-11	1.6E-09	3.5E-08	2.8E-08	2.5E-10	6.2E-09	1.2E-07
Rn-222	7.0E-08	6.7E-11	4.1E-09	4.1E-07	2.8E-07	2.0E-10	1.5E-08	1.3E-06
Ra-223	9.1E-05	1.0E-05	5.1E-05	2.9E-04	3.5E-04	3.1E-05	1.9E-04	1.2E-03
Ra-224	2.4E-06	2.9E-09	2.0E-07	1.1E-05	8.9E-06	9.8E-09	7.6E-07	4.2E-05
Ac-225	4.3E-05	4.0E-06	2.4E-05	1.4E-04	1.6E-04	1.4E-05	8.2E-05	5.0E-04
Ra-225	6.6E-07	1.2E-07	4.6E-07	1.9E-06	2.6E-06	3.1E-07	1.7E-06	8.0E-06
Ra-226	1.5E-01	5.2E-02	1.4E-01	3.0E-01	6.0E-01	1.3E-01	4.8E-01	1.5E+00
Ac-227	3.1E-02	1.0E-02	2.9E-02	6.1E-02	1.2E-01	2.8E-02	1.0E-01	3.0E-01
Th-227	1.2E-04	2.8E-05	9.4E-05	2.9E-04	4.7E-04	8.0E-05	3.2E-04	1.3E-03
Th-228	9.2E-02	3.4E-02	8.2E-02	1.9E-01	3.7E-01	7.7E-02	2.9E-01	9.1E-01
Ra-228	7.1E-02	2.3E-02	6.5E-02	1.4E-01	2.9E-01	5.7E-02	2.3E-01	7.4E-01
Th-229	2.1E-02	7.6E-03	1.9E-02	4.4E-02	8.6E-02	1.8E-02	6.9E-02	2.1E-01
Th-230	5.1E-05	1.7E-05	4.5E-05	1.0E-04	2.0E-04	4.8E-05	1.6E-04	5.0E-04
Pa-231	2.5E-03	7.7E-04	2.3E-03	4.9E-03	9.9E-03	2.0E-03	7.6E-03	2.4E-02
Th-231	8.7E-15	4.8E-26	4.7E-20	4.7E-14	3.1E-14	1.3E-25	1.8E-19	1.2E-13
Th-232	1.0E-02	3.1E-03	8.7E-03	2.2E-02	4.0E-02	7.6E-03	3.2E-02	1.0E-01
Pa-233	6.2E-04	1.5E-04	4.9E-04	1.5E-03	2.4E-03	4.6E-04	1.9E-03	6.2E-03
U-233	1.2E-06	4.7E-07	1.1E-06	2.6E-06	4.9E-06	1.0E-06	4.0E-06	1.1E-05
Th-234	2.5E-05	5.8E-06	1.9E-05	6.4E-05	9.9E-05	1.8E-05	6.9E-05	2.8E-04
U-234	2.2E-06	7.5E-07	1.9E-06	4.4E-06	8.7E-06	1.8E-06	7.1E-06	2.0E-05
U-235	1.0E-02	3.1E-03	9.4E-03	2.2E-02	4.2E-02	8.5E-03	3.2E-02	1.0E-01
Np-237	1.9E-02	6.2E-03	1.7E-02	3.8E-02	7.4E-02	1.6E-02	6.3E-02	1.7E-01
Pu-238	2.5E-06	7.8E-07	2.3E-06	4.9E-06	1.0E-05	2.0E-06	8.2E-06	2.4E-05
U-238	9.1E-04	3.0E-04	8.1E-04	1.8E-03	3.6E-03	8.1E-04	2.8E-03	8.6E-03
Pu-239	9.7E-07	3.2E-07	8.6E-07	2.0E-06	3.8E-06	8.3E-07	3.1E-06	1.0E-05
Pu-240	2.6E-06	9.3E-07	2.3E-06	5.3E-06	1.0E-05	2.1E-06	8.5E-06	2.5E-05
Pu-241	5.2E-07	1.7E-07	4.5E-07	1.1E-06	2.1E-06	4.5E-07	1.7E-06	4.8E-06
Am-241	2.4E-04	8.1E-05	2.1E-04	4.8E-04	9.5E-04	2.1E-04	7.8E-04	2.4E-03
Cm-242	1.6E-06	5.5E-07	1.5E-06	3.5E-06	6.5E-06	1.5E-06	5.4E-06	1.5E-05
Pu-242	2.1E-06	7.1E-07	1.8E-06	4.4E-06	8.7E-06	1.6E-06	7.0E-06	2.2E-05
Cm-244	3.4E-06	1.1E-06	3.1E-06	6.4E-06	1.3E-05	3.0E-06	1.1E-05	3.3E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.14 Dose factors[a] for AL-METL-SMMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.1E-07	2.7E-08	8.9E-08	2.7E-07	4.5E-07	6.6E-08	3.1E-07	1.2E-06
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.7E-05	2.3E-06	1.1E-05	5.0E-05	6.7E-05	5.8E-06	4.2E-05	2.2E-04
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	7.4E-04	1.7E-04	6.3E-04	1.8E-03	2.9E-03	4.0E-04	2.2E-03	8.0E-03
Co-58	3.6E-03	6.4E-04	2.8E-03	9.1E-03	1.5E-02	1.8E-03	1.0E-02	4.0E-02
Fe-59	1.8E-03	3.1E-04	1.3E-03	5.1E-03	7.2E-03	9.1E-04	4.8E-03	2.1E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.6E-02	1.3E-02	4.6E-02	1.4E-01	2.3E-01	3.2E-02	1.7E-01	5.9E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	7.2E-03	1.6E-03	5.8E-03	1.7E-02	2.9E-02	4.0E-03	2.1E-02	7.8E-02
Cu-67	7.1E-11	6.7E-18	4.0E-14	3.4E-10	2.7E-10	2.6E-17	1.2E-13	1.2E-09
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	8.3E-04	1.6E-04	6.1E-04	2.2E-03	3.4E-03	4.7E-04	2.2E-03	1.0E-02
Sr-89	1.5E-06	2.6E-07	1.1E-06	4.0E-06	5.9E-06	6.9E-07	4.1E-06	1.8E-05
Sr-90	2.0E-06	4.2E-07	1.5E-06	5.0E-06	7.8E-06	9.5E-07	5.7E-06	2.1E-05
Y-91	2.3E-06	3.9E-07	1.8E-06	6.1E-06	9.2E-06	1.1E-06	6.3E-06	2.7E-05
Mo-93	4.1E-06	8.4E-07	3.4E-06	9.9E-06	1.6E-05	2.2E-06	1.2E-05	4.9E-05
Nb-93m	6.6E-07	1.3E-07	5.4E-07	1.7E-06	2.7E-06	3.4E-07	1.9E-06	7.2E-06
Nb-94	4.2E-02	8.5E-03	3.4E-02	1.0E-01	1.7E-01	2.3E-02	1.3E-01	5.2E-01
Nb-95	7.3E-04	1.3E-04	5.4E-04	2.1E-03	2.9E-03	3.1E-04	1.9E-03	8.0E-03
Zr-95	1.2E-03	2.0E-04	9.2E-04	3.1E-03	4.7E-03	5.8E-04	3.2E-03	1.3E-02
Tc-99	7.6E-07	1.6E-07	6.0E-07	1.9E-06	3.1E-06	4.4E-07	2.2E-06	9.1E-06
Ru-103	5.3E-04	9.0E-05	3.9E-04	1.4E-03	2.2E-03	2.6E-04	1.4E-03	7.2E-03
Ru-106	2.9E-03	6.4E-04	2.3E-03	7.4E-03	1.2E-02	1.6E-03	8.4E-03	3.3E-02
Ag-108m	4.4E-02	9.3E-03	3.4E-02	1.2E-01	1.8E-01	2.5E-02	1.3E-01	5.1E-01
Cd-109	7.5E-06	1.6E-06	6.2E-06	1.8E-05	3.0E-05	4.1E-06	2.2E-05	8.6E-05
Ag-110m	3.7E-02	7.2E-03	3.0E-02	9.0E-02	1.5E-01	2.0E-02	1.1E-01	4.1E-01
Sb-124	4.8E-03	9.9E-04	3.7E-03	1.2E-02	1.9E-02	2.5E-03	1.3E-02	5.7E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	9.3E-03	1.9E-03	7.2E-03	2.4E-02	3.7E-02	4.9E-03	2.6E-02	1.1E-01
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	4.2E-03	8.3E-04	3.5E-03	1.1E-02	1.7E-02	2.4E-03	1.2E-02	5.0E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.14 Dose factors[a] for AL-METL-SMMASS-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	8.0E-06	1.0E-06	5.4E-06	2.2E-05	3.2E-05	3.2E-06	2.0E-05	9.5E-05
Ce-144	1.3E-04	2.9E-05	1.0E-04	3.0E-04	5.1E-04	6.7E-05	3.7E-04	1.5E-03
Pm-147	8.4E-09	2.0E-09	6.5E-09	2.1E-08	3.4E-08	4.5E-09	2.5E-08	9.8E-08
Eu-152	7.0E-03	1.3E-03	5.2E-03	1.8E-02	2.8E-02	3.8E-03	2.0E-02	8.5E-02
Eu-154	7.5E-03	1.5E-03	5.9E-03	1.8E-02	3.0E-02	3.8E-03	2.2E-02	8.3E-02
Eu-155	9.0E-05	1.8E-05	7.1E-05	2.3E-04	3.6E-04	4.5E-05	2.7E-04	1.0E-03
Re-186	2.3E-10	6.0E-15	2.7E-12	1.2E-09	9.2E-10	2.0E-14	8.5E-12	4.7E-09
Ir-192	3.1E-03	6.4E-04	2.4E-03	7.9E-03	1.2E-02	1.6E-03	9.0E-03	3.3E-02
Pb-210	7.6E-06	1.5E-06	5.9E-06	2.0E-05	3.0E-05	4.3E-06	2.2E-05	8.8E-05
Po-210	6.4E-08	1.3E-08	4.6E-08	1.6E-07	2.6E-07	3.5E-08	1.7E-07	7.7E-07
Bi-210	2.1E-10	9.8E-14	1.0E-11	9.8E-10	8.1E-10	2.8E-13	3.6E-11	3.7E-09
Rn-222	1.3E-09	1.9E-14	8.3E-12	6.8E-09	4.6E-09	5.9E-14	3.3E-11	2.4E-08
Ra-223	7.2E-06	2.3E-07	2.7E-06	3.0E-05	2.9E-05	6.9E-07	9.2E-06	1.1E-04
Ra-224	3.9E-08	6.4E-13	3.8E-10	2.2E-07	1.5E-07	2.1E-12	1.2E-09	8.8E-07
Ac-225	3.1E-06	6.5E-08	9.9E-07	1.3E-05	1.3E-05	2.1E-07	3.5E-06	6.0E-05
Ra-225	6.0E-08	3.9E-09	2.7E-08	2.3E-07	2.4E-07	1.1E-08	1.0E-07	9.0E-07
Ra-226	4.2E-02	9.2E-03	3.4E-02	1.1E-01	1.7E-01	2.2E-02	1.2E-01	4.7E-01
Ac-227	8.3E-03	1.7E-03	6.9E-03	1.9E-02	3.3E-02	4.7E-03	2.5E-02	9.0E-02
Th-227	1.4E-05	1.3E-06	8.5E-06	4.5E-05	5.5E-05	4.0E-06	3.0E-05	1.9E-04
Th-228	2.6E-02	5.1E-03	2.0E-02	6.4E-02	1.0E-01	1.4E-02	7.6E-02	3.1E-01
Ra-228	2.0E-02	4.4E-03	1.5E-02	5.0E-02	8.1E-02	1.1E-02	5.5E-02	2.5E-01
Th-229	6.0E-03	1.3E-03	4.5E-03	1.5E-02	2.4E-02	3.3E-03	1.6E-02	6.8E-02
Th-230	1.4E-05	2.9E-06	1.1E-05	3.2E-05	5.6E-05	7.3E-06	3.9E-05	1.6E-04
Pa-231	6.8E-04	1.5E-04	5.3E-04	1.7E-03	2.7E-03	4.0E-04	1.9E-03	7.5E-03
Th-231	3.7E-19	2.2E-37	7.9E-28	6.6E-19	1.4E-18	7.8E-37	1.4E-27	3.0E-18
Th-232	2.8E-03	6.3E-04	2.2E-03	6.3E-03	1.1E-02	1.6E-03	7.8E-03	3.1E-02
Pa-233	8.9E-05	1.2E-05	5.7E-05	2.5E-04	3.5E-04	3.6E-05	2.2E-04	1.1E-03
U-233	3.3E-07	6.1E-08	2.6E-07	8.3E-07	1.3E-06	1.8E-07	9.4E-07	3.9E-06
Th-234	3.5E-06	4.1E-07	2.2E-06	1.1E-05	1.4E-05	1.2E-06	8.0E-06	5.0E-05
U-234	5.5E-07	1.3E-07	4.4E-07	1.3E-06	2.2E-06	3.0E-07	1.6E-06	5.9E-06
U-235	2.8E-03	5.8E-04	2.2E-03	7.3E-03	1.1E-02	1.6E-03	7.9E-03	3.4E-02
Np-237	4.7E-03	1.0E-03	3.7E-03	1.1E-02	1.9E-02	2.3E-03	1.4E-02	5.3E-02
Pu-238	6.4E-07	1.4E-07	5.1E-07	1.6E-06	2.6E-06	3.6E-07	2.0E-06	6.8E-06
U-238	2.4E-04	5.7E-05	1.9E-04	6.0E-04	9.8E-04	1.3E-04	6.9E-04	2.9E-03
Pu-239	2.5E-07	5.3E-08	2.0E-07	6.4E-07	1.0E-06	1.5E-07	7.5E-07	2.9E-06
Pu-240	6.5E-07	1.4E-07	5.2E-07	1.6E-06	2.6E-06	3.5E-07	1.9E-06	7.9E-06
Pu-241	1.4E-07	3.0E-08	1.1E-07	3.4E-07	5.5E-07	8.4E-08	3.9E-07	1.5E-06
Am-241	6.5E-05	1.4E-05	5.1E-05	1.6E-04	2.6E-04	3.4E-05	1.9E-04	7.5E-04
Cm-242	3.7E-07	8.0E-08	3.0E-07	9.3E-07	1.5E-06	2.2E-07	1.1E-06	4.1E-06
Pu-242	5.3E-07	1.2E-07	4.2E-07	1.3E-06	2.1E-06	3.2E-07	1.5E-06	6.1E-06
Cm-244	8.5E-07	1.6E-07	7.1E-07	2.1E-06	3.4E-06	4.6E-07	2.4E-06	9.4E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.15 Dose factors[a] for AL-METL-SMOBJCT-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.6E-06	7.1E-07	3.4E-06	1.2E-05	1.8E-05	1.8E-06	1.2E-05	5.7E-05
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	5.8E-04	7.0E-05	3.9E-04	1.6E-03	2.3E-03	1.9E-04	1.3E-03	7.6E-03
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	4.8E-02	7.1E-03	3.5E-02	1.3E-01	1.9E-01	2.0E-02	1.3E-01	6.0E-01
Co-58	1.1E-01	1.5E-02	7.7E-02	3.1E-01	4.4E-01	4.7E-02	2.8E-01	1.3E+00
Fe-59	5.0E-02	7.7E-03	3.6E-02	1.4E-01	2.0E-01	2.2E-02	1.4E-01	6.3E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.7E+00	2.4E-01	1.3E+00	4.7E+00	6.7E+00	7.2E-01	4.5E+00	2.0E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.2E-01	3.3E-02	1.6E-01	5.8E-01	8.6E-01	1.0E-01	5.7E-01	2.4E+00
Cu-67	2.5E-09	2.7E-16	2.7E-12	1.2E-08	1.0E-08	9.6E-16	8.3E-12	4.7E-08
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	2.7E-02	3.8E-03	2.0E-02	7.6E-02	1.1E-01	1.1E-02	7.2E-02	3.6E-01
Sr-89	6.0E-05	7.7E-06	4.3E-05	1.7E-04	2.3E-04	2.4E-05	1.5E-04	7.2E-04
Sr-90	8.0E-05	1.2E-05	5.8E-05	2.2E-04	3.1E-04	3.7E-05	2.3E-04	9.0E-04
Y-91	6.6E-05	8.9E-06	5.1E-05	1.9E-04	2.6E-04	2.9E-05	1.7E-04	8.5E-04
Mo-93	5.5E-04	8.4E-05	4.1E-04	1.6E-03	2.2E-03	2.4E-04	1.4E-03	6.4E-03
Nb-93m	8.7E-05	1.5E-05	6.5E-05	2.4E-04	3.4E-04	3.7E-05	2.3E-04	1.1E-03
Nb-94	1.3E+00	1.8E-01	1.0E+00	3.5E+00	5.2E+00	5.3E-01	3.5E+00	1.5E+01
Nb-95	2.3E-02	2.9E-03	1.5E-02	6.9E-02	9.0E-02	8.9E-03	5.3E-02	2.9E-01
Zr-95	3.5E-02	5.3E-03	2.5E-02	1.0E-01	1.4E-01	1.6E-02	8.7E-02	4.4E-01
Tc-99	3.1E-05	4.6E-06	2.3E-05	8.7E-05	1.2E-04	1.3E-05	8.3E-05	4.1E-04
Ru-103	1.8E-02	2.5E-03	1.2E-02	5.2E-02	7.0E-02	6.3E-03	4.2E-02	2.3E-01
Ru-106	9.4E-02	1.3E-02	7.2E-02	2.6E-01	3.8E-01	3.5E-02	2.5E-01	1.2E+00
Ag-108m	1.4E+00	2.1E-01	9.8E-01	3.6E+00	5.6E+00	5.7E-01	3.5E+00	1.7E+01
Cd-109	8.8E-04	1.4E-04	6.7E-04	2.4E-03	3.5E-03	4.3E-04	2.4E-03	1.0E-02
Ag-110m	1.1E+00	1.7E-01	8.8E-01	2.7E+00	4.4E+00	4.6E-01	3.0E+00	1.3E+01
Sb-124	1.4E-01	2.0E-02	1.0E-01	3.7E-01	5.6E-01	5.5E-02	3.6E-01	1.7E+00
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.1E-01	5.2E-02	2.3E-01	7.8E-01	1.2E+00	1.4E-01	7.9E-01	3.4E+00
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.6E-01	2.4E-02	1.2E-01	4.1E-01	6.2E-01	6.7E-02	4.0E-01	1.7E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.15 Dose factors[a] for AL-METL-SMOBJCT-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm^2)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	4.2E-04	5.4E-05	2.9E-04	1.3E-03	1.7E-03	1.5E-04	9.8E-04	5.8E-03
Ce-144	4.7E-03	6.7E-04	3.3E-03	1.3E-02	1.9E-02	1.7E-03	1.2E-02	6.0E-02
Pm-147	5.5E-07	8.6E-08	4.2E-07	1.4E-06	2.2E-06	2.3E-07	1.5E-06	6.3E-06
Eu-152	2.2E-01	3.2E-02	1.6E-01	6.4E-01	8.6E-01	8.8E-02	5.5E-01	2.5E+00
Eu-154	2.3E-01	3.5E-02	1.6E-01	7.3E-01	9.4E-01	9.1E-02	6.1E-01	2.9E+00
Eu-155	7.5E-03	1.1E-03	5.2E-03	2.0E-02	2.9E-02	3.2E-03	2.0E-02	8.7E-02
Re-186	1.2E-08	3.7E-13	1.8E-10	6.2E-08	4.9E-08	1.3E-12	6.9E-10	2.8E-07
Ir-192	1.1E-01	1.6E-02	7.7E-02	2.9E-01	4.3E-01	4.3E-02	2.8E-01	1.4E+00
Pb-210	8.7E-04	1.3E-04	6.4E-04	2.4E-03	3.4E-03	3.6E-04	2.2E-03	1.1E-02
Po-210	1.9E-06	2.8E-07	1.3E-06	5.0E-06	7.3E-06	9.5E-07	4.9E-06	2.4E-05
Bi-210	7.2E-09	3.5E-12	4.3E-10	3.1E-08	3.0E-08	1.3E-11	1.6E-09	1.4E-07
Rn-222	2.4E-08	5.5E-13	4.0E-10	1.5E-07	1.0E-07	1.5E-12	1.3E-09	5.2E-07
Ra-223	2.5E-04	7.0E-06	9.6E-05	1.0E-03	1.0E-03	2.4E-05	3.4E-04	4.4E-03
Ra-224	9.8E-07	2.1E-11	1.2E-08	5.0E-06	4.0E-06	6.5E-11	4.0E-08	2.0E-05
Ac-225	1.0E-04	2.4E-06	3.2E-05	4.2E-04	4.3E-04	7.0E-06	1.1E-04	1.8E-03
Ra-225	6.4E-06	3.5E-07	3.1E-06	2.2E-05	2.6E-05	9.7E-07	1.1E-05	1.0E-04
Ra-226	1.3E+00	1.9E-01	1.0E+00	3.5E+00	5.2E+00	5.0E-01	3.4E+00	1.7E+01
Ac-227	3.4E-01	4.9E-02	2.3E-01	9.0E-01	1.3E+00	1.3E-01	8.6E-01	4.0E+00
Th-227	5.6E-04	4.5E-05	3.0E-04	1.8E-03	2.2E-03	1.4E-04	1.1E-03	8.6E-03
Th-228	7.9E-01	1.1E-01	5.5E-01	2.1E+00	3.1E+00	3.4E-01	2.1E+00	8.8E+00
Ra-228	6.0E-01	9.4E-02	4.3E-01	1.6E+00	2.3E+00	2.8E-01	1.5E+00	6.9E+00
Th-229	2.3E-01	3.1E-02	1.6E-01	6.3E-01	9.1E-01	1.0E-01	6.1E-01	2.7E+00
Th-230	5.3E-04	8.5E-05	4.0E-04	1.5E-03	2.1E-03	2.3E-04	1.4E-03	6.4E-03
Pa-231	2.5E-02	4.2E-03	1.8E-02	6.9E-02	1.0E-01	1.1E-02	6.6E-02	2.9E-01
Th-231	2.4E-17	1.4E-35	4.1E-26	3.8E-17	9.8E-17	6.4E-35	1.6E-25	2.1E-16
Th-232	8.5E-02	1.3E-02	6.3E-02	2.3E-01	3.3E-01	3.7E-02	2.2E-01	9.5E-01
Pa-233	3.3E-03	4.1E-04	2.1E-03	1.1E-02	1.3E-02	1.2E-03	7.7E-03	4.5E-02
U-233	4.4E-05	5.8E-06	3.2E-05	1.2E-04	1.7E-04	1.7E-05	1.1E-04	5.3E-04
Th-234	1.4E-04	1.4E-05	8.5E-05	4.4E-04	5.4E-04	4.5E-05	3.0E-04	1.9E-03
U-234	7.0E-05	1.2E-05	5.3E-05	1.9E-04	2.8E-04	3.1E-05	1.9E-04	8.5E-04
U-235	1.3E-01	2.3E-02	9.6E-02	3.8E-01	5.3E-01	6.0E-02	3.5E-01	1.6E+00
Np-237	1.9E-01	3.1E-02	1.4E-01	5.1E-01	7.7E-01	9.2E-02	4.8E-01	2.2E+00
Pu-238	8.6E-05	1.1E-05	6.2E-05	2.3E-04	3.4E-04	3.5E-05	2.3E-04	1.2E-03
U-238	1.0E-02	1.6E-03	7.3E-03	2.5E-02	4.0E-02	4.1E-03	2.7E-02	1.2E-01
Pu-239	3.2E-05	4.5E-06	2.5E-05	8.1E-05	1.3E-04	1.3E-05	8.8E-05	3.7E-04
Pu-240	7.0E-05	1.1E-05	5.3E-05	1.9E-04	2.8E-04	3.1E-05	1.9E-04	8.4E-04
Pu-241	1.4E-05	2.3E-06	1.0E-05	3.8E-05	5.5E-05	6.3E-06	3.6E-05	1.5E-04
Am-241	6.7E-03	1.1E-03	5.0E-03	1.8E-02	2.6E-02	2.9E-03	1.9E-02	7.9E-02
Cm-242	4.7E-05	7.4E-06	3.5E-05	1.3E-04	1.9E-04	2.1E-05	1.2E-04	5.5E-04
Pu-242	6.7E-05	1.0E-05	5.0E-05	1.8E-04	2.7E-04	3.0E-05	1.7E-04	7.8E-04
Cm-244	1.1E-04	1.8E-05	7.9E-05	2.7E-04	4.2E-04	4.8E-05	2.7E-04	1.1E-03

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm^2), multiply by 3.70 E-03

Table H.16 Dose factors[a] for AL-METL-ENGINE-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	3.7E-08	1.0E-08	3.2E-08	7.8E-08	1.5E-07	2.8E-08	1.2E-07	3.7E-07
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	5.3E-06	1.1E-06	4.0E-06	1.4E-05	2.1E-05	3.0E-06	1.4E-05	5.8E-05
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	2.4E-04	8.3E-05	2.1E-04	4.8E-04	9.7E-04	2.0E-04	7.7E-04	2.4E-03
Co-58	1.1E-03	3.5E-04	9.7E-04	2.3E-03	4.5E-03	9.0E-04	3.7E-03	1.1E-02
Fe-59	5.7E-04	1.6E-04	4.6E-04	1.3E-03	2.2E-03	3.5E-04	1.7E-03	5.9E-03
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.8E-02	5.9E-03	1.7E-02	3.7E-02	7.3E-02	1.4E-02	6.0E-02	1.8E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.3E-03	8.4E-04	2.1E-03	4.7E-03	9.1E-03	1.9E-03	7.6E-03	2.1E-02
Cu-67	1.8E-11	2.4E-18	1.8E-14	1.2E-10	6.9E-11	8.3E-18	5.4E-14	3.7E-10
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	2.6E-04	7.5E-05	2.3E-04	5.3E-04	1.1E-03	1.8E-04	8.3E-04	2.8E-03
Sr-89	4.8E-07	1.3E-07	3.9E-07	1.1E-06	1.9E-06	2.8E-07	1.5E-06	4.6E-06
Sr-90	6.3E-07	2.0E-07	5.4E-07	1.3E-06	2.5E-06	5.1E-07	2.0E-06	6.1E-06
Y-91	7.4E-07	2.0E-07	6.3E-07	1.6E-06	2.9E-06	5.4E-07	2.2E-06	7.3E-06
Mo-93	1.3E-06	4.2E-07	1.2E-06	2.7E-06	5.3E-06	1.1E-06	4.3E-06	1.3E-05
Nb-93m	2.1E-07	7.0E-08	1.9E-07	4.4E-07	8.6E-07	1.7E-07	6.9E-07	2.2E-06
Nb-94	1.4E-02	4.1E-03	1.2E-02	2.9E-02	5.5E-02	1.0E-02	4.3E-02	1.4E-01
Nb-95	2.4E-04	5.7E-05	2.0E-04	5.8E-04	9.6E-04	1.5E-04	7.3E-04	2.5E-03
Zr-95	3.7E-04	1.1E-04	3.2E-04	7.5E-04	1.5E-03	2.8E-04	1.2E-03	3.6E-03
Tc-99	2.5E-07	7.0E-08	2.2E-07	5.1E-07	9.9E-07	2.0E-07	7.7E-07	2.5E-06
Ru-103	1.7E-04	4.3E-05	1.4E-04	4.2E-04	6.8E-04	1.0E-04	5.1E-04	1.8E-03
Ru-106	9.3E-04	3.1E-04	8.2E-04	1.9E-03	3.7E-03	7.4E-04	3.0E-03	8.7E-03
Ag-108m	1.4E-02	4.5E-03	1.3E-02	2.8E-02	5.7E-02	1.1E-02	4.6E-02	1.3E-01
Cd-109	2.5E-06	7.5E-07	2.2E-06	5.4E-06	9.8E-06	1.9E-06	8.1E-06	2.4E-05
Ag-110m	1.2E-02	3.6E-03	1.1E-02	2.4E-02	4.7E-02	8.3E-03	3.9E-02	1.1E-01
Sb-124	1.5E-03	4.4E-04	1.3E-03	3.2E-03	6.1E-03	1.1E-03	5.0E-03	1.5E-02
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	3.0E-03	8.6E-04	2.7E-03	5.9E-03	1.2E-02	2.4E-03	9.9E-03	3.0E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	1.4E-03	4.3E-04	1.1E-03	2.9E-03	5.4E-03	1.2E-03	4.3E-03	1.4E-02
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.16 Dose factors[a] for AL-METL-ENGINE-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.5E-06	5.7E-07	1.9E-06	5.7E-06	9.7E-06	1.5E-06	7.3E-06	2.6E-05
Ce-144	4.1E-05	1.3E-05	3.7E-05	8.6E-05	1.6E-04	3.2E-05	1.3E-04	4.1E-04
Pm-147	2.7E-09	8.5E-10	2.4E-09	5.6E-09	1.1E-08	2.1E-09	8.5E-09	2.6E-08
Eu-152	2.2E-03	6.9E-04	1.9E-03	4.3E-03	8.9E-03	1.7E-03	7.1E-03	2.1E-02
Eu-154	2.4E-03	7.5E-04	2.1E-03	5.1E-03	9.5E-03	2.0E-03	7.5E-03	2.4E-02
Eu-155	2.9E-05	8.5E-06	2.6E-05	6.2E-05	1.1E-04	2.0E-05	9.1E-05	2.7E-04
Re-186	7.0E-11	2.2E-15	1.3E-12	4.3E-10	2.6E-10	8.4E-15	3.9E-12	1.5E-09
Ir-192	9.9E-04	3.1E-04	8.6E-04	2.2E-03	3.9E-03	7.2E-04	3.3E-03	9.6E-03
Pb-210	2.5E-06	7.2E-07	2.2E-06	5.0E-06	9.8E-06	1.9E-06	8.2E-06	2.4E-05
Po-210	2.0E-08	5.9E-09	1.8E-08	4.3E-08	8.1E-08	1.6E-08	6.5E-08	2.0E-07
Bi-210	6.6E-11	3.9E-14	4.1E-12	4.3E-10	2.5E-10	1.4E-13	1.2E-11	1.4E-09
Rn-222	3.1E-10	8.3E-15	4.3E-12	1.6E-09	1.2E-09	2.9E-14	1.4E-11	6.3E-09
Ra-223	2.3E-06	1.1E-07	9.8E-07	9.0E-06	8.9E-06	3.2E-07	3.4E-06	3.5E-05
Ra-224	1.1E-08	2.4E-13	1.3E-10	7.0E-08	4.2E-08	8.6E-13	4.9E-10	2.5E-07
Ac-225	1.0E-06	3.0E-08	3.7E-07	4.2E-06	3.9E-06	9.0E-08	1.3E-06	1.6E-05
Ra-225	1.9E-08	1.6E-09	1.0E-08	6.7E-08	7.2E-08	4.3E-09	3.7E-08	2.5E-07
Ra-226	1.4E-02	4.5E-03	1.2E-02	2.7E-02	5.5E-02	1.0E-02	4.4E-02	1.4E-01
Ac-227	2.7E-03	8.9E-04	2.4E-03	5.7E-03	1.1E-02	2.1E-03	8.9E-03	2.7E-02
Th-227	4.5E-06	5.8E-07	2.9E-06	1.5E-05	1.8E-05	1.6E-06	1.1E-05	6.1E-05
Th-228	8.3E-03	2.8E-03	7.3E-03	1.7E-02	3.3E-02	6.8E-03	2.6E-02	8.2E-02
Ra-228	6.4E-03	2.0E-03	5.7E-03	1.4E-02	2.5E-02	4.8E-03	2.1E-02	6.0E-02
Th-229	1.9E-03	6.7E-04	1.6E-03	3.9E-03	7.5E-03	1.6E-03	6.2E-03	2.0E-02
Th-230	4.5E-06	1.5E-06	4.0E-06	8.8E-06	1.8E-05	3.9E-06	1.4E-05	4.5E-05
Pa-231	2.2E-04	7.4E-05	2.0E-04	4.1E-04	8.8E-04	1.6E-04	7.3E-04	2.1E-03
Th-231	8.0E-20	8.8E-38	1.8E-28	3.4E-19	3.1E-19	3.0E-37	5.3E-28	1.2E-18
Th-232	9.0E-04	3.0E-04	8.0E-04	1.8E-03	3.6E-03	8.2E-04	2.9E-03	8.5E-03
Pa-233	2.8E-05	5.4E-06	2.1E-05	7.2E-05	1.1E-04	1.6E-05	8.2E-05	3.1E-04
U-233	1.0E-07	3.2E-08	9.2E-08	2.1E-07	4.2E-07	8.1E-08	3.6E-07	9.6E-07
Th-234	1.1E-06	1.9E-07	8.2E-07	2.9E-06	4.3E-06	5.3E-07	3.0E-06	1.2E-05
U-234	1.8E-07	5.8E-08	1.6E-07	3.5E-07	7.2E-07	1.5E-07	5.9E-07	1.8E-06
U-235	8.9E-04	2.9E-04	7.7E-04	1.9E-03	3.6E-03	7.2E-04	3.0E-03	8.6E-03
Np-237	1.5E-03	5.3E-04	1.4E-03	3.1E-03	6.0E-03	1.3E-03	5.0E-03	1.4E-02
Pu-238	2.1E-07	6.5E-08	1.8E-07	4.3E-07	8.4E-07	1.7E-07	6.7E-07	2.1E-06
U-238	7.9E-05	2.5E-05	7.0E-05	1.6E-04	3.2E-04	7.4E-05	2.5E-04	8.2E-04
Pu-239	8.0E-08	2.5E-08	7.3E-08	1.6E-07	3.2E-07	6.5E-08	2.8E-07	7.7E-07
Pu-240	2.1E-07	6.8E-08	1.9E-07	4.3E-07	8.4E-07	1.7E-07	6.9E-07	2.0E-06
Pu-241	4.4E-08	1.5E-08	3.9E-08	8.7E-08	1.7E-07	3.7E-08	1.4E-07	4.3E-07
Am-241	2.1E-05	6.4E-06	1.8E-05	4.1E-05	8.2E-05	1.7E-05	6.8E-05	2.0E-04
Cm-242	1.2E-07	3.9E-08	1.1E-07	2.4E-07	4.7E-07	9.0E-08	3.9E-07	1.1E-06
Pu-242	1.7E-07	5.4E-08	1.6E-07	3.6E-07	7.0E-07	1.3E-07	5.6E-07	1.7E-06
Cm-244	2.7E-07	8.4E-08	2.4E-07	5.6E-07	1.1E-06	2.1E-07	9.0E-07	2.8E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table H.17 Dose factors[a] for AL-METL-COOKWAR-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	1.4E-07	7.4E-09	9.5E-08	4.3E-07	5.5E-07	2.1E-08	3.3E-07	1.9E-06
C-14	2.6E-04	5.2E-05	2.1E-04	5.8E-04	1.0E-03	1.5E-04	7.5E-04	2.7E-03
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	1.9E-06	3.6E-07	1.4E-06	4.8E-06	7.6E-06	9.5E-07	5.2E-06	2.2E-05
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	7.3E-05	1.6E-05	6.3E-05	1.6E-04	2.9E-04	4.4E-05	2.2E-04	7.9E-04
Co-57	1.3E-04	4.2E-05	1.1E-04	2.6E-04	5.0E-04	1.1E-04	3.9E-04	1.3E-03
Co-58	3.8E-04	1.1E-04	3.1E-04	8.5E-04	1.6E-03	2.7E-04	1.1E-03	4.2E-03
Fe-59	2.2E-04	5.7E-05	1.8E-04	5.1E-04	8.7E-04	1.4E-04	7.0E-04	2.3E-03
Ni-59	2.9E-05	6.2E-06	2.4E-05	6.7E-05	1.2E-04	1.8E-05	9.0E-05	3.1E-04
Co-60	6.6E-03	1.9E-03	5.7E-03	1.5E-02	2.7E-02	5.1E-03	2.0E-02	7.4E-02
Ni-63	8.2E-05	1.8E-05	7.0E-05	1.9E-04	3.2E-04	5.3E-05	2.5E-04	8.1E-04
Zn-65	1.7E-03	5.2E-04	1.5E-03	3.6E-03	6.6E-03	1.4E-03	5.1E-03	1.6E-02
Cu-67	1.0E-11	1.1E-18	9.2E-15	6.7E-11	3.4E-11	4.2E-18	3.7E-14	2.3E-10
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-85	9.4E-05	2.5E-05	7.5E-05	2.2E-04	3.7E-04	6.3E-05	2.7E-04	9.5E-04
Sr-89	5.2E-05	8.9E-06	4.2E-05	1.3E-04	2.0E-04	2.4E-05	1.4E-04	5.9E-04
Sr-90	1.0E-02	1.9E-03	8.8E-03	2.4E-02	4.0E-02	5.7E-03	2.8E-02	1.2E-01
Y-91	3.4E-05	5.7E-06	2.7E-05	8.3E-05	1.3E-04	1.9E-05	9.6E-05	3.5E-04
Mo-93	1.9E-04	4.4E-05	1.6E-04	4.4E-04	7.6E-04	1.1E-04	5.7E-04	2.2E-03
Nb-93m	7.1E-05	1.6E-05	6.0E-05	1.8E-04	2.8E-04	4.2E-05	2.2E-04	7.6E-04
Nb-94	4.8E-03	1.4E-03	4.2E-03	1.0E-02	1.9E-02	4.0E-03	1.4E-02	5.0E-02
Nb-95	8.1E-05	1.7E-05	5.9E-05	2.2E-04	3.2E-04	4.7E-05	2.3E-04	9.0E-04
Zr-95	1.8E-04	4.7E-05	1.5E-04	4.0E-04	7.2E-04	1.4E-04	5.4E-04	1.9E-03
Tc-99	1.8E-04	4.1E-05	1.4E-04	4.5E-04	7.2E-04	1.2E-04	5.0E-04	1.9E-03
Ru-103	6.5E-05	1.6E-05	5.3E-05	1.7E-04	2.6E-04	4.6E-05	1.8E-04	7.3E-04
Ru-106	2.4E-03	6.3E-04	2.0E-03	5.4E-03	9.5E-03	1.7E-03	7.0E-03	2.6E-02
Ag-108m	5.1E-03	1.6E-03	4.3E-03	1.2E-02	2.1E-02	3.8E-03	1.5E-02	5.6E-02
Cd-109	1.3E-03	2.8E-04	1.1E-03	2.8E-03	5.1E-03	8.3E-04	3.9E-03	1.4E-02
Ag-110m	4.1E-03	1.3E-03	3.5E-03	8.7E-03	1.6E-02	3.3E-03	1.3E-02	4.3E-02
Sb-124	5.9E-04	1.7E-04	4.9E-04	1.3E-03	2.4E-03	4.3E-04	1.8E-03	6.6E-03
I-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	1.2E-03	3.4E-04	1.0E-03	2.6E-03	4.7E-03	9.8E-04	3.6E-03	1.2E-02
I-129	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	6.2E-04	1.8E-04	5.4E-04	1.3E-03	2.5E-03	5.4E-04	1.8E-03	6.3E-03
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table H.17 Dose factors[a] for AL-METL-COOKWAR-N

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.9E-06	7.9E-07	2.9E-06	9.6E-06	1.5E-05	2.0E-06	1.1E-05	3.9E-05
Ce-144	4.3E-04	8.1E-05	3.6E-04	1.0E-03	1.7E-03	2.5E-04	1.3E-03	4.6E-03
Pm-147	3.1E-05	6.4E-06	2.6E-05	7.4E-05	1.3E-04	1.8E-05	9.0E-05	3.4E-04
Eu-152	8.6E-04	2.7E-04	7.0E-04	1.9E-03	3.4E-03	7.1E-04	2.5E-03	8.4E-03
Eu-154	1.0E-03	2.9E-04	8.8E-04	2.1E-03	4.1E-03	7.4E-04	3.1E-03	1.1E-02
Eu-155	5.8E-05	1.5E-05	4.8E-05	1.4E-04	2.3E-04	4.2E-05	1.7E-04	6.1E-04
Re-186	5.1E-10	1.6E-14	6.4E-12	3.4E-09	1.8E-09	5.1E-14	2.5E-11	7.9E-09
Ir-192	3.9E-04	1.2E-04	3.3E-04	8.2E-04	1.6E-03	3.3E-04	1.3E-03	3.9E-03
Pb-210	7.5E-01	1.7E-01	5.9E-01	1.8E+00	3.0E+00	4.5E-01	2.2E+00	8.1E+00
Po-210	7.4E-02	1.6E-02	6.2E-02	1.6E-01	2.9E-01	4.3E-02	2.2E-01	7.8E-01
Bi-210	1.1E-08	4.4E-12	5.8E-10	6.2E-08	3.9E-08	1.5E-11	2.1E-09	2.1E-07
Rn-222	1.0E-10	1.9E-15	9.6E-13	5.4E-10	4.1E-10	7.0E-15	3.4E-12	1.9E-09
Ra-223	1.1E-04	3.6E-06	4.2E-05	4.6E-04	4.0E-04	1.2E-05	1.4E-04	1.5E-03
Ra-224	5.3E-08	1.2E-12	6.8E-10	3.1E-07	1.8E-07	3.7E-12	2.3E-09	9.5E-07
Ac-225	1.0E-05	2.0E-07	3.1E-06	4.3E-05	3.9E-05	7.0E-07	1.3E-05	1.5E-04
Ra-225	1.7E-04	9.9E-06	9.0E-05	6.0E-04	6.3E-04	3.1E-05	3.0E-04	2.2E-03
Ra-226	1.9E-01	4.1E-02	1.6E-01	4.4E-01	7.6E-01	1.2E-01	5.8E-01	2.0E+00
Ac-227	1.9E+00	4.4E-01	1.7E+00	4.2E+00	7.6E+00	9.8E-01	5.8E+00	1.9E+01
Th-227	3.7E-05	3.4E-06	2.3E-05	1.2E-04	1.4E-04	1.0E-05	8.6E-05	4.3E-04
Th-228	8.6E-02	2.1E-02	7.0E-02	2.1E-01	3.4E-01	5.6E-02	2.6E-01	9.1E-01
Ra-228	1.9E-01	3.9E-02	1.6E-01	4.1E-01	7.4E-01	1.1E-01	5.6E-01	1.9E+00
Th-229	5.0E-01	1.1E-01	4.3E-01	1.2E+00	2.0E+00	3.0E-01	1.5E+00	5.5E+00
Th-230	7.8E-02	1.7E-02	6.6E-02	1.8E-01	3.1E-01	4.8E-02	2.4E-01	8.2E-01
Pa-231	1.5E+00	3.0E-01	1.3E+00	3.7E+00	5.9E+00	9.1E-01	4.3E+00	1.5E+01
Th-231	8.3E-19	4.1E-37	1.3E-27	3.3E-18	2.6E-18	1.4E-36	3.4E-27	1.1E-17
Th-232	3.9E-01	7.7E-02	3.2E-01	9.1E-01	1.5E+00	2.2E-01	1.2E+00	4.2E+00
Pa-233	1.8E-05	3.3E-06	1.4E-05	4.4E-05	7.0E-05	9.3E-06	5.2E-05	2.0E-04
U-233	3.7E-03	7.6E-04	3.2E-03	8.4E-03	1.5E-02	2.2E-03	1.2E-02	4.1E-02
Th-234	2.7E-05	3.7E-06	1.8E-05	7.8E-05	1.0E-04	1.1E-05	6.9E-05	3.2E-04
U-234	3.7E-03	8.0E-04	3.0E-03	9.3E-03	1.5E-02	2.1E-03	1.1E-02	4.0E-02
U-235	4.0E-03	9.0E-04	3.4E-03	8.9E-03	1.6E-02	2.6E-03	1.2E-02	3.9E-02
Np-237	6.2E-01	1.4E-01	5.4E-01	1.4E+00	2.5E+00	3.5E-01	1.9E+00	6.8E+00
Pu-238	7.0E-03	1.5E-03	5.8E-03	1.6E-02	2.8E-02	3.9E-03	2.0E-02	8.1E-02
U-238	3.4E-03	6.6E-04	2.8E-03	7.7E-03	1.3E-02	2.1E-03	1.0E-02	3.5E-02
Pu-239	7.3E-03	1.6E-03	6.2E-03	1.8E-02	2.9E-02	4.2E-03	2.2E-02	7.9E-02
Pu-240	7.3E-03	1.5E-03	6.3E-03	1.6E-02	2.9E-02	4.5E-03	2.2E-02	7.6E-02
Pu-241	1.1E-04	2.1E-05	8.8E-05	2.5E-04	4.2E-04	5.7E-05	3.2E-04	1.1E-03
Am-241	5.2E-01	1.1E-01	4.2E-01	1.3E+00	2.1E+00	3.1E-01	1.6E+00	5.8E+00
Cm-242	6.1E-03	1.3E-03	5.0E-03	1.4E-02	2.4E-02	3.7E-03	1.8E-02	6.6E-02
Pu-242	7.0E-03	1.5E-03	5.8E-03	1.6E-02	2.7E-02	4.4E-03	2.1E-02	6.9E-02
Cm-244	2.8E-01	5.6E-02	2.3E-01	6.8E-01	1.1E+00	1.6E-01	8.3E-01	2.9E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

APPENDIX I

DOSE FACTORS FOR CONCRETE RECYCLE SCENARIOS

CONTENTS

Tables

I DOSE FACTORS FOR CONCRETE RECYCLE SCENARIOS

This appendix presents tabulated values from the distribution of radionuclide-specific dose factors for all concrete recycle exposure scenarios. Volumetric (mass) dose factors are based on volumetrically distributed residual radioactivity in cleared material. Surficial dose factors are calculated by multiplying the mass dose factors by a surface-to-mass ratio distribution appropriate for cleared concrete. Both sets of dose factors are listed in SI units; the conversion factor to convert the dose factors to conventional units is listed in the footnote at the end of each table.

The tabulated values from the frequency distribution of each dose factor consists of the mean (arithmetic average) and three percentile values (5^{th}, 50^{th}, and 95^{th}). A 90% confidence interval for any dose factor is the range between the 5^{th} percentile value and the 95^{th} percentile value.

The shading in the tables in this appendix is only to facilitate reading the values in the tables.

Table I.1 Dose factors[a] for CN-SCRP-HANDLIN-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	3.2E-04	8.9E-05	2.9E-04	6.4E-04	7.4E-06	1.5E-06	6.0E-06	1.9E-05
C-14	9.3E-03	2.1E-03	8.3E-03	2.0E-02	2.2E-04	3.5E-05	1.8E-04	5.8E-04
Na-22	1.1E+02	3.7E+01	1.0E+02	2.1E+02	2.6E+00	6.0E-01	2.3E+00	5.8E+00
P-32	9.7E-02	4.3E-02	9.3E-02	1.6E-01	2.3E-03	6.1E-04	2.1E-03	4.7E-03
S-35	3.5E-03	1.5E-03	3.3E-03	6.2E-03	8.2E-05	2.2E-05	7.2E-05	1.8E-04
Cl-36	4.2E-02	2.2E-02	4.1E-02	6.8E-02	9.9E-04	3.0E-04	9.2E-04	2.0E-03
K-40	8.8E+00	2.9E+00	8.0E+00	1.7E+01	2.0E-01	4.7E-02	1.8E-01	4.5E-01
Ca-41	6.3E-03	1.8E-03	5.8E-03	1.3E-02	1.5E-04	2.9E-05	1.2E-04	3.8E-04
Ca-45	1.8E-02	6.4E-03	1.7E-02	3.4E-02	4.2E-04	9.5E-05	3.6E-04	1.0E-03
Cr-51	1.1E+00	3.7E-01	1.0E+00	2.2E+00	2.6E-02	5.9E-03	2.3E-02	6.0E-02
Mn-54	4.3E+01	1.4E+01	3.9E+01	8.3E+01	1.0E+00	2.3E-01	8.9E-01	2.2E+00
Fe-55	3.4E-03	1.1E-03	3.2E-03	6.5E-03	8.0E-05	1.7E-05	6.7E-05	1.9E-04
Co-57	1.5E+00	5.0E-01	1.4E+00	2.9E+00	3.5E-02	8.0E-03	3.1E-02	7.8E-02
Co-58	4.8E+01	1.6E+01	4.4E+01	9.3E+01	1.1E+00	2.5E-01	9.9E-01	2.5E+00
Fe-59	6.1E+01	2.0E+01	5.6E+01	1.2E+02	1.4E+00	3.2E-01	1.3E+00	3.2E+00
Ni-59	1.5E-03	5.4E-04	1.3E-03	2.6E-03	3.4E-05	8.1E-06	2.9E-05	7.7E-05
Co-60	1.4E+02	4.6E+01	1.3E+02	2.6E+02	3.2E+00	7.4E-01	2.8E+00	7.2E+00
Ni-63	3.9E-03	1.4E-03	3.6E-03	7.1E-03	9.1E-05	2.2E-05	7.7E-05	2.1E-04
Zn-65	1.9E+01	6.3E+00	1.7E+01	3.6E+01	4.4E-01	1.0E-01	3.9E-01	9.9E-01
Cu-67	8.7E-01	2.5E-01	7.7E-01	1.9E+00	2.0E-02	4.0E-03	1.7E-02	4.9E-02
Se-75	1.1E+01	3.8E+00	1.0E+01	2.2E+01	2.7E-01	6.1E-02	2.4E-01	6.0E-01
Sr-85	2.4E+01	8.1E+00	2.2E+01	4.7E+01	5.7E-01	1.3E-01	5.0E-01	1.3E+00
Sr-89	1.2E-01	5.7E-02	1.1E-01	1.9E-01	2.7E-03	7.8E-04	2.6E-03	5.3E-03
Sr-90	1.4E+00	5.5E-01	1.3E+00	2.5E+00	3.3E-02	8.9E-03	2.8E-02	7.1E-02
Y-91	2.5E-01	1.2E-01	2.4E-01	4.3E-01	5.9E-03	1.7E-03	5.5E-03	1.2E-02
Mo-93	2.6E-02	1.2E-02	2.4E-02	4.8E-02	6.1E-04	1.8E-04	5.5E-04	1.2E-03
Nb-93m	2.0E-02	7.8E-03	1.8E-02	4.2E-02	4.7E-04	1.3E-04	4.0E-04	1.1E-03
Nb-94	8.3E+01	2.7E+01	7.5E+01	1.6E+02	1.9E+00	4.4E-01	1.7E+00	4.3E+00
Nb-95	3.6E+01	1.2E+01	3.2E+01	6.9E+01	8.3E-01	1.9E-01	7.3E-01	1.9E+00
Zr-95	3.5E+01	1.2E+01	3.2E+01	6.9E+01	8.2E-01	1.9E-01	7.3E-01	1.9E+00
Tc-99	1.3E-02	5.6E-03	1.2E-02	2.2E-02	3.0E-04	8.1E-05	2.6E-04	6.4E-04
Ru-103	2.2E+01	7.2E+00	2.0E+01	4.2E+01	5.0E-01	1.1E-01	4.4E-01	1.1E+00
Ru-106	1.1E+01	3.7E+00	9.6E+00	2.0E+01	2.5E-01	5.7E-02	2.2E-01	5.4E-01
Ag-108m	8.1E+01	2.7E+01	7.4E+01	1.6E+02	1.9E+00	4.3E-01	1.7E+00	4.2E+00
Cd-109	9.3E-02	3.9E-02	8.9E-02	1.6E-01	2.2E-03	5.5E-04	1.9E-03	4.8E-03
Ag-110m	1.4E+02	4.7E+01	1.3E+02	2.7E+02	3.3E+00	7.6E-01	2.9E+00	7.4E+00
Sb-124	9.3E+01	3.1E+01	8.5E+01	1.8E+02	2.2E+00	4.9E-01	1.9E+00	4.9E+00
I-125	2.1E-01	8.2E-02	2.0E-01	4.0E-01	5.0E-03	1.1E-03	4.3E-03	1.2E-02
Sb-125	1.9E+01	6.2E+00	1.7E+01	3.6E+01	4.4E-01	1.0E-01	3.9E-01	9.9E-01
I-129	1.3E+00	3.7E-01	1.2E+00	2.7E+00	3.1E-02	6.0E-03	2.6E-02	8.0E-02
I-131	1.1E+01	3.8E+00	1.0E+01	2.2E+01	2.6E-01	6.0E-02	2.3E-01	6.0E-01
Ba-133	1.3E+01	4.1E+00	1.1E+01	2.4E+01	2.9E-01	6.7E-02	2.6E-01	6.5E-01
Cs-134	7.8E+01	2.6E+01	7.1E+01	1.5E+02	1.8E+00	4.2E-01	1.6E+00	4.1E+00
Cs-137	3.1E+01	1.0E+01	2.8E+01	5.8E+01	7.1E-01	1.6E-01	6.3E-01	1.6E+00

Table I.1 Dose factors[a] for CN-SCRP-HANDLIN-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5^{th}	50^{th}	95^{th}	Mean	5^{th}	50^{th}	95^{th}
Ce-141	1.1E+00	3.6E-01	9.6E-01	2.0E+00	2.5E-02	5.7E-03	2.2E-02	5.6E-02
Ce-144	2.2E+00	9.1E-01	2.1E+00	4.0E+00	5.2E-02	1.3E-02	4.6E-02	1.1E-01
Pm-147	2.8E-02	1.1E-02	2.5E-02	5.7E-02	6.5E-04	1.7E-04	5.7E-04	1.5E-03
Eu-152	5.6E+01	1.8E+01	5.1E+01	1.1E+02	1.3E+00	3.0E-01	1.1E+00	2.9E+00
Eu-154	6.5E+01	2.2E+01	5.9E+01	1.2E+02	1.5E+00	3.5E-01	1.3E+00	3.4E+00
Eu-155	3.9E-01	1.4E-01	3.6E-01	7.2E-01	9.0E-03	2.2E-03	8.0E-03	1.9E-02
Re-186	1.2E-01	4.1E-02	1.1E-01	2.3E-01	2.7E-03	6.0E-04	2.4E-03	6.2E-03
Ir-192	3.1E+01	1.0E+01	2.8E+01	6.0E+01	7.2E-01	1.6E-01	6.4E-01	1.6E+00
Pb-210	3.1E+01	1.1E+01	2.9E+01	5.9E+01	7.4E-01	1.6E-01	6.2E-01	1.7E+00
Po-210	1.3E+01	4.9E+00	1.2E+01	2.4E+01	3.1E-01	7.4E-02	2.6E-01	6.9E-01
Bi-210	9.9E-02	4.3E-02	9.0E-02	1.9E-01	2.3E-03	6.6E-04	2.0E-03	5.2E-03
Rn-222	4.5E+01	1.4E+01	4.0E+01	9.2E+01	1.1E+00	2.1E-01	9.1E-01	2.5E+00
Ra-223	1.4E+01	6.9E+00	1.4E+01	2.3E+01	3.3E-01	9.5E-02	3.1E-01	6.5E-01
Ra-224	2.9E+01	9.7E+00	2.6E+01	5.7E+01	6.7E-01	1.5E-01	5.8E-01	1.5E+00
Ac-225	1.1E+01	4.9E+00	1.0E+01	1.8E+01	2.5E-01	7.1E-02	2.3E-01	5.1E-01
Ra-225	5.2E+00	2.0E+00	4.8E+00	1.0E+01	1.2E-01	3.3E-02	1.1E-01	2.7E-01
Ra-226	1.0E+02	4.1E+01	9.4E+01	1.9E+02	2.4E+00	6.2E-01	2.1E+00	5.1E+00
Ac-227	8.4E+02	3.0E+02	7.4E+02	1.8E+03	2.0E+01	4.8E+00	1.6E+01	4.6E+01
Th-227	1.1E+01	4.8E+00	1.0E+01	2.1E+01	2.6E-01	7.2E-02	2.3E-01	5.8E-01
Th-228	2.6E+02	1.1E+02	2.3E+02	5.2E+02	6.1E+00	1.7E+00	5.4E+00	1.3E+01
Ra-228	5.7E+01	2.7E+01	5.3E+01	1.0E+02	1.3E+00	3.6E-01	1.2E+00	2.7E+00
Th-229	1.0E+03	3.4E+02	9.2E+02	2.3E+03	2.5E+01	5.8E+00	2.0E+01	6.0E+01
Th-230	1.6E+02	5.1E+01	1.4E+02	3.4E+02	3.7E+00	8.6E-01	3.1E+00	9.1E+00
Pa-231	5.6E+02	2.0E+02	4.9E+02	1.2E+03	1.3E+01	3.2E+00	1.1E+01	3.1E+01
Th-231	6.7E-03	1.1E-03	4.7E-03	2.0E-02	1.6E-04	1.7E-05	9.6E-05	5.1E-04
Th-232	7.0E+02	2.3E+02	6.1E+02	1.5E+03	1.6E+01	3.8E+00	1.4E+01	4.0E+01
Pa-233	6.6E+00	2.2E+00	6.0E+00	1.3E+01	1.5E-01	3.4E-02	1.3E-01	3.5E-01
U-233	8.1E+01	2.5E+01	7.1E+01	1.8E+02	1.9E+00	4.3E-01	1.6E+00	4.7E+00
Th-234	4.6E-01	2.0E-01	4.2E-01	8.2E-01	1.1E-02	2.8E-03	9.7E-03	2.2E-02
U-234	7.9E+01	2.5E+01	6.9E+01	1.7E+02	1.8E+00	4.2E-01	1.5E+00	4.6E+00
U-235	7.7E+01	2.6E+01	6.7E+01	1.6E+02	1.8E+00	4.5E-01	1.5E+00	4.3E+00
Np-237	3.4E+02	1.2E+02	3.0E+02	7.3E+02	8.1E+00	2.0E+00	6.7E+00	1.9E+01
Pu-238	1.7E+02	5.4E+01	1.5E+02	3.8E+02	4.0E+00	9.2E-01	3.3E+00	1.0E+01
U-238	7.1E+01	2.2E+01	6.2E+01	1.5E+02	1.7E+00	3.8E-01	1.4E+00	4.1E+00
Pu-239	1.8E+02	5.8E+01	1.6E+02	4.0E+02	4.3E+00	9.8E-01	3.6E+00	1.1E+01
Pu-240	1.8E+02	5.8E+01	1.6E+02	4.0E+02	4.3E+00	9.8E-01	3.6E+00	1.1E+01
Pu-241	3.0E+00	9.3E-01	2.6E+00	6.5E+00	6.9E-02	1.6E-02	5.8E-02	1.7E-01
Am-241	2.8E+02	9.9E+01	2.5E+02	6.0E+02	6.6E+00	1.6E+00	5.5E+00	1.6E+01
Cm-242	1.1E+01	3.6E+00	9.3E+00	2.3E+01	2.5E-01	5.9E-02	2.1E-01	6.0E-01
Pu-242	1.7E+02	5.5E+01	1.5E+02	3.8E+02	4.1E+00	9.3E-01	3.4E+00	1.0E+01
Cm-244	1.6E+02	5.5E+01	1.4E+02	3.4E+02	3.7E+00	8.8E-01	3.1E+00	8.8E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.2 Dose factors[a] for CN-SCRP-TRANSPO-W

	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	4.2E-04	2.7E-04	4.1E-04	5.8E-04	9.8E-06	3.4E-06	9.4E-06	1.9E-05
Na-22	2.2E+02	1.4E+02	2.2E+02	3.0E+02	5.2E+00	1.8E+00	5.0E+00	1.0E+01
P-32	1.4E-01	8.6E-02	1.4E-01	1.9E-01	3.2E-03	1.1E-03	3.1E-03	6.1E-03
S-35	4.4E-04	2.8E-04	4.3E-04	6.0E-04	1.0E-05	3.6E-06	9.8E-06	2.0E-05
Cl-36	3.4E-02	2.2E-02	3.4E-02	4.7E-02	8.0E-04	2.8E-04	7.7E-04	1.5E-03
K-40	1.6E+01	1.1E+01	1.6E+01	2.2E+01	3.8E-01	1.3E-01	3.7E-01	7.3E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	1.5E-03	9.8E-04	1.5E-03	2.1E-03	3.6E-05	1.3E-05	3.4E-05	6.9E-05
Cr-51	2.5E+00	1.6E+00	2.5E+00	3.5E+00	6.0E-02	2.1E-02	5.7E-02	1.1E-01
Mn-54	8.5E+01	5.6E+01	8.4E+01	1.2E+02	2.0E+00	7.0E-01	1.9E+00	3.9E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.8E+00	2.5E+00	3.8E+00	5.3E+00	9.0E-02	3.2E-02	8.6E-02	1.7E-01
Co-58	9.6E+01	6.2E+01	9.5E+01	1.3E+02	2.3E+00	7.9E-01	2.1E+00	4.4E+00
Fe-59	1.2E+02	7.4E+01	1.2E+02	1.6E+02	2.7E+00	9.6E-01	2.6E+00	5.3E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	2.5E+02	1.7E+02	2.5E+02	3.5E+02	6.0E+00	2.1E+00	5.7E+00	1.2E+01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	6.0E+01	3.9E+01	5.9E+01	8.3E+01	1.4E+00	5.0E-01	1.3E+00	2.7E+00
Cu-67	2.9E+00	1.1E+00	2.5E+00	5.6E+00	6.8E-02	1.6E-02	5.7E-02	1.6E-01
Se-75	2.5E+01	1.6E+01	2.4E+01	3.4E+01	5.8E-01	2.0E-01	5.5E-01	1.1E+00
Sr-85	4.7E+01	3.0E+01	4.7E+01	6.6E+01	1.1E+00	3.9E-01	1.1E+00	2.2E+00
Sr-89	1.2E-01	7.5E-02	1.2E-01	1.6E-01	2.8E-03	9.7E-04	2.6E-03	5.3E-03
Sr-90	1.3E-02	8.2E-03	1.3E-02	1.8E-02	3.0E-04	1.0E-04	2.9E-04	5.7E-04
Y-91	3.5E-01	2.2E-01	3.5E-01	4.8E-01	8.2E-03	2.9E-03	7.8E-03	1.6E-02
Mo-93	4.3E-04	2.8E-04	4.2E-04	5.9E-04	1.0E-05	3.5E-06	9.6E-06	1.9E-05
Nb-93m	7.2E-05	4.7E-05	7.1E-05	9.9E-05	1.7E-06	5.9E-07	1.6E-06	3.2E-06
Nb-94	1.6E+02	1.1E+02	1.6E+02	2.3E+02	3.9E+00	1.3E+00	3.7E+00	7.4E+00
Nb-95	7.4E+01	4.7E+01	7.3E+01	1.0E+02	1.7E+00	6.0E-01	1.7E+00	3.4E+00
Zr-95	7.3E+01	4.7E+01	7.2E+01	1.0E+02	1.7E+00	6.0E-01	1.6E+00	3.3E+00
Tc-99	2.8E-03	1.8E-03	2.8E-03	3.9E-03	6.6E-05	2.3E-05	6.4E-05	1.3E-04
Ru-103	4.7E+01	3.0E+01	4.7E+01	6.6E+01	1.1E+00	3.9E-01	1.1E+00	2.2E+00
Ru-106	2.1E+01	1.3E+01	2.0E+01	2.9E+01	4.9E-01	1.7E-01	4.7E-01	9.4E-01
Ag-108m	1.6E+02	1.1E+02	1.6E+02	2.2E+02	3.8E+00	1.3E+00	3.7E+00	7.3E+00
Cd-109	7.2E-03	4.7E-03	7.1E-03	9.9E-03	1.7E-04	5.9E-05	1.6E-04	3.3E-04
Ag-110m	2.8E+02	1.8E+02	2.8E+02	3.9E+02	6.7E+00	2.3E+00	6.4E+00	1.3E+01
Sb-124	1.8E+02	1.2E+02	1.8E+02	2.5E+02	4.3E+00	1.5E+00	4.1E+00	8.3E+00
I-125	6.6E-02	4.2E-02	6.5E-02	9.1E-02	1.6E-03	5.4E-04	1.5E-03	3.0E-03
Sb-125	4.1E+01	2.6E+01	4.0E+01	5.6E+01	9.6E-01	3.3E-01	9.2E-01	1.8E+00
I-129	5.1E-02	3.3E-02	5.0E-02	7.1E-02	1.2E-03	4.2E-04	1.1E-03	2.3E-03
I-131	2.8E+01	1.6E+01	2.7E+01	4.0E+01	6.5E-01	2.1E-01	6.1E-01	1.3E+00
Ba-133	2.8E+01	1.8E+01	2.8E+01	3.9E+01	6.6E-01	2.3E-01	6.3E-01	1.3E+00
Cs-134	1.6E+02	1.0E+02	1.6E+02	2.2E+02	3.8E+00	1.3E+00	3.6E+00	7.2E+00
Cs-137	6.2E+01	4.0E+01	6.1E+01	8.5E+01	1.5E+00	5.1E-01	1.4E+00	2.8E+00

Table I.2 Dose factors[a] for CN-SCRP-TRANSPO-W

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	2.8E+00	1.8E+00	2.7E+00	3.9E+00	6.6E-02	2.3E-02	6.3E-02	1.3E-01
Ce-144	3.3E+00	2.1E+00	3.3E+00	4.6E+00	7.8E-02	2.7E-02	7.4E-02	1.5E-01
Pm-147	1.1E-04	6.8E-05	1.0E-04	1.5E-04	2.5E-06	8.6E-07	2.4E-06	4.7E-06
Eu-152	1.1E+02	7.2E+01	1.1E+02	1.5E+02	2.6E+00	9.1E-01	2.5E+00	5.0E+00
Eu-154	1.2E+02	7.9E+01	1.2E+02	1.7E+02	2.9E+00	1.0E+00	2.7E+00	5.5E+00
Eu-155	1.1E+00	6.9E-01	1.1E+00	1.5E+00	2.5E-02	8.7E-03	2.4E-02	4.8E-02
Re-186	3.1E-01	1.4E-01	2.8E-01	5.2E-01	7.2E-03	2.0E-03	6.4E-03	1.5E-02
Ir-192	7.2E+01	4.6E+01	7.1E+01	9.9E+01	1.7E+00	5.9E-01	1.6E+00	3.3E+00
Pb-210	1.6E-02	1.0E-02	1.6E-02	2.2E-02	3.8E-04	1.3E-04	3.6E-04	7.2E-04
Po-210	8.3E-04	5.4E-04	8.3E-04	1.1E-03	2.0E-05	6.9E-06	1.9E-05	3.8E-05
Bi-210	3.6E-02	1.9E-02	3.5E-02	5.7E-02	8.6E-04	2.6E-04	8.0E-04	1.7E-03
Rn-222	1.1E+02	5.0E+01	9.7E+01	1.8E+02	2.5E+00	6.8E-01	2.2E+00	5.3E+00
Ra-223	1.9E+01	1.2E+01	1.9E+01	2.8E+01	4.5E-01	1.5E-01	4.3E-01	8.7E-01
Ra-224	7.6E+01	3.6E+01	7.0E+01	1.3E+02	1.8E+00	4.9E-01	1.6E+00	3.8E+00
Ac-225	1.5E+01	9.1E+00	1.5E+01	2.2E+01	3.6E-01	1.2E-01	3.4E-01	6.9E-01
Ra-225	3.3E-02	2.1E-02	3.3E-02	4.7E-02	7.8E-04	2.7E-04	7.4E-04	1.5E-03
Ra-226	1.7E+02	1.1E+02	1.7E+02	2.4E+02	4.1E+00	1.4E+00	3.9E+00	7.8E+00
Ac-227	1.0E+01	6.7E+00	1.0E+01	1.4E+01	2.4E-01	8.5E-02	2.3E-01	4.7E-01
Th-227	6.1E+00	3.8E+00	6.0E+00	8.6E+00	1.4E-01	4.9E-02	1.4E-01	2.7E-01
Th-228	1.3E+02	8.3E+01	1.3E+02	1.8E+02	3.0E+00	1.0E+00	2.9E+00	5.8E+00
Ra-228	8.4E+01	5.5E+01	8.3E+01	1.2E+02	2.0E+00	6.9E-01	1.9E+00	3.8E+00
Th-229	7.9E+00	5.1E+00	7.8E+00	1.1E+01	1.9E-01	6.5E-02	1.8E-01	3.5E-01
Th-230	2.3E-03	1.5E-03	2.3E-03	3.2E-03	5.4E-05	1.9E-05	5.2E-05	1.0E-04
Pa-231	2.0E+00	1.3E+00	2.0E+00	2.8E+00	4.8E-02	1.7E-02	4.6E-02	9.2E-02
Th-231	3.9E-02	3.5E-03	2.1E-02	1.3E-01	9.2E-04	5.8E-05	4.7E-04	3.5E-03
Th-232	5.9E-01	3.9E-01	5.9E-01	8.2E-01	1.4E-02	4.9E-03	1.3E-02	2.7E-02
Pa-233	1.4E+01	8.6E+00	1.3E+01	1.9E+01	3.2E-01	1.1E-01	3.1E-01	6.1E-01
U-233	2.0E-05	1.3E-05	2.0E-05	2.8E-05	4.8E-07	1.7E-07	4.6E-07	9.1E-07
Th-234	7.5E-01	4.7E-01	7.4E-01	1.0E+00	1.8E-02	6.1E-03	1.7E-02	3.4E-02
U-234	3.7E-04	2.4E-04	3.7E-04	5.1E-04	8.7E-06	3.0E-06	8.3E-06	1.7E-05
U-235	8.2E+00	5.3E+00	8.1E+00	1.1E+01	1.9E-01	6.7E-02	1.8E-01	3.7E-01
Np-237	6.2E+00	4.1E+00	6.2E+00	8.6E+00	1.5E-01	5.1E-02	1.4E-01	2.8E-01
Pu-238	1.2E-04	7.6E-05	1.2E-04	1.6E-04	2.8E-06	9.6E-07	2.6E-06	5.3E-06
U-238	3.3E-01	2.1E-01	3.2E-01	4.5E-01	7.7E-03	2.7E-03	7.4E-03	1.5E-02
Pu-239	4.5E-05	2.9E-05	4.4E-05	6.2E-05	1.1E-06	3.7E-07	1.0E-06	2.0E-06
Pu-240	3.9E-04	2.5E-04	3.8E-04	5.3E-04	9.1E-06	3.2E-06	8.7E-06	1.7E-05
Pu-241	5.3E-05	3.5E-05	5.3E-05	7.4E-05	1.3E-06	4.4E-07	1.2E-06	2.4E-06
Am-241	1.5E-01	9.7E-02	1.5E-01	2.1E-01	3.5E-03	1.2E-03	3.4E-03	6.7E-03
Cm-242	1.7E-04	1.1E-04	1.7E-04	2.4E-04	4.0E-06	1.4E-06	3.8E-06	7.8E-06
Pu-242	2.0E-04	1.3E-04	2.0E-04	2.8E-04	4.7E-06	1.7E-06	4.5E-06	9.1E-06
Cm-244	1.5E-04	9.8E-05	1.5E-04	2.1E-04	3.6E-06	1.2E-06	3.4E-06	6.8E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.3 Dose factors[a] for CN-SCRP-DISPOSL-W

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	6.4E-05	2.0E-05	6.2E-05	1.2E-04	1.5E-06	3.2E-07	1.3E-06	3.6E-06
C-14	1.9E-03	4.2E-04	1.8E-03	3.6E-03	4.5E-05	7.8E-06	3.5E-05	1.1E-04
Na-22	2.8E+01	1.2E+01	2.7E+01	5.0E+01	6.7E-01	1.7E-01	5.8E-01	1.4E+00
P-32	2.7E-02	1.4E-02	2.7E-02	4.3E-02	6.4E-04	1.9E-04	5.7E-04	1.3E-03
S-35	7.1E-04	3.1E-04	6.9E-04	1.2E-03	1.7E-05	4.5E-06	1.4E-05	3.6E-05
Cl-36	1.0E-02	5.8E-03	1.0E-02	1.5E-02	2.4E-04	7.6E-05	2.2E-04	4.8E-04
K-40	2.2E+00	9.1E-01	2.1E+00	3.8E+00	5.1E-02	1.3E-02	4.5E-02	1.1E-01
Ca-41	1.3E-03	4.1E-04	1.2E-03	2.3E-03	3.1E-05	6.4E-06	2.5E-05	7.3E-05
Ca-45	3.7E-03	1.4E-03	3.5E-03	6.4E-03	8.7E-05	2.1E-05	7.5E-05	1.9E-04
Cr-51	3.3E-01	1.4E-01	3.1E-01	5.7E-01	7.7E-03	2.0E-03	6.7E-03	1.7E-02
Mn-54	1.1E+01	4.4E+00	1.0E+01	1.9E+01	2.5E-01	6.4E-02	2.2E-01	5.4E-01
Fe-55	7.0E-04	2.6E-04	6.6E-04	1.2E-03	1.7E-05	3.8E-06	1.4E-05	3.7E-05
Co-57	1.0E+00	4.3E-01	9.8E-01	1.8E+00	2.4E-02	6.2E-03	2.1E-02	5.2E-02
Co-58	1.2E+01	5.0E+00	1.1E+01	2.1E+01	2.8E-01	7.1E-02	2.4E-01	6.1E-01
Fe-59	1.5E+01	6.3E+00	1.4E+01	2.6E+01	3.5E-01	8.9E-02	3.1E-01	7.7E-01
Ni-59	3.0E-04	1.2E-04	2.9E-04	5.2E-04	7.1E-06	1.8E-06	6.1E-06	1.6E-05
Co-60	3.3E+01	1.4E+01	3.2E+01	5.9E+01	7.9E-01	2.0E-01	6.9E-01	1.7E+00
Ni-63	7.9E-04	3.2E-04	7.7E-04	1.4E-03	1.9E-05	4.8E-06	1.6E-05	4.1E-05
Zn-65	7.6E+00	3.2E+00	7.3E+00	1.3E+01	1.8E-01	4.6E-02	1.6E-01	3.9E-01
Cu-67	3.9E-01	1.4E-01	3.4E-01	7.7E-01	9.1E-03	2.3E-03	7.5E-03	2.1E-02
Se-75	4.0E+00	1.7E+00	3.8E+00	7.1E+00	9.5E-02	2.4E-02	8.3E-02	2.0E-01
Sr-85	5.9E+00	2.5E+00	5.6E+00	1.0E+01	1.4E-01	3.5E-02	1.2E-01	3.0E-01
Sr-89	3.0E-02	1.7E-02	3.0E-02	4.7E-02	7.2E-04	2.1E-04	6.5E-04	1.4E-03
Sr-90	2.9E-01	1.2E-01	2.7E-01	4.9E-01	6.8E-03	1.8E-03	5.9E-03	1.5E-02
Y-91	7.8E-02	3.9E-02	7.6E-02	1.3E-01	1.8E-03	5.1E-04	1.6E-03	3.8E-03
Mo-93	5.9E-03	3.1E-03	5.6E-03	9.8E-03	1.4E-04	4.1E-05	1.2E-04	2.7E-04
Nb-93m	4.3E-03	1.9E-03	3.8E-03	7.9E-03	1.0E-04	2.5E-05	8.5E-05	2.2E-04
Nb-94	2.0E+01	8.4E+00	1.9E+01	3.6E+01	4.7E-01	1.2E-01	4.2E-01	1.0E+00
Nb-95	8.9E+00	3.8E+00	8.5E+00	1.6E+01	2.1E-01	5.4E-02	1.8E-01	4.6E-01
Zr-95	8.9E+00	3.8E+00	8.6E+00	1.6E+01	2.1E-01	5.4E-02	1.8E-01	4.6E-01
Tc-99	2.6E-03	1.2E-03	2.5E-03	4.2E-03	6.1E-05	1.7E-05	5.3E-05	1.3E-04
Ru-103	5.3E+00	2.2E+00	5.0E+00	9.3E+00	1.2E-01	3.2E-02	1.1E-01	2.7E-01
Ru-106	8.2E-02	3.6E-02	7.7E-02	1.5E-01	1.9E-03	5.0E-04	1.6E-03	4.1E-03
Ag-108m	2.0E+01	8.4E+00	1.9E+01	3.5E+01	4.7E-01	1.2E-01	4.1E-01	1.0E+00
Cd-109	4.7E-02	2.6E-02	4.6E-02	7.4E-02	1.1E-03	3.3E-04	1.0E-03	2.2E-03
Ag-110m	3.5E+01	1.5E+01	3.4E+01	6.2E+01	8.3E-01	2.1E-01	7.3E-01	1.8E+00
Sb-124	2.3E+01	9.8E+00	2.2E+01	4.1E+01	5.5E-01	1.4E-01	4.8E-01	1.2E+00
I-125	6.8E-02	3.4E-02	6.8E-02	1.1E-01	1.6E-03	4.8E-04	1.4E-03	3.3E-03
Sb-125	5.0E+00	2.1E+00	4.8E+00	8.9E+00	1.2E-01	3.0E-02	1.0E-01	2.6E-01
I-129	2.9E-01	1.0E-01	2.8E-01	5.2E-01	6.9E-03	1.6E-03	5.9E-03	1.6E-02
I-131	3.2E+00	1.4E+00	3.1E+00	5.7E+00	7.6E-02	2.0E-02	6.5E-02	1.7E-01
Ba-133	4.1E+00	1.7E+00	3.9E+00	7.3E+00	9.7E-02	2.5E-02	8.5E-02	2.1E-01
Cs-134	2.0E+01	8.2E+00	1.9E+01	3.5E+01	4.6E-01	1.2E-01	4.1E-01	1.0E+00
Cs-137	5.0E-02	1.5E-02	4.8E-02	9.1E-02	1.2E-03	2.4E-04	9.9E-04	2.8E-03

Table I.3 Dose factors[a] for CN-SCRP-DISPOSL-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	6.0E-01	2.6E-01	5.8E-01	1.1E+00	1.4E-02	3.7E-03	1.2E-02	3.1E-02
Ce-144	2.1E-01	1.1E-01	2.1E-01	3.2E-01	5.0E-03	1.5E-03	4.5E-03	1.0E-02
Pm-147	5.8E-03	2.5E-03	5.3E-03	1.1E-02	1.4E-04	3.5E-05	1.2E-04	3.0E-04
Eu-152	1.4E+01	6.1E+00	1.4E+01	2.6E+01	3.4E-01	8.8E-02	3.0E-01	7.5E-01
Eu-154	1.6E+01	6.7E+00	1.5E+01	2.8E+01	3.8E-01	9.6E-02	3.3E-01	8.2E-01
Eu-155	3.8E-01	1.7E-01	3.7E-01	6.7E-01	9.0E-03	2.3E-03	7.9E-03	2.0E-02
Re-186	8.0E-02	3.2E-02	7.4E-02	1.5E-01	1.9E-03	4.8E-04	1.6E-03	4.4E-03
Ir-192	9.2E+00	3.9E+00	8.8E+00	1.6E+01	2.2E-01	5.5E-02	1.9E-01	4.7E-01
Pb-210	6.4E+00	2.4E+00	6.2E+00	1.1E+01	1.5E-01	3.6E-02	1.3E-01	3.4E-01
Po-210	2.7E+00	1.1E+00	2.6E+00	4.6E+00	6.3E-02	1.7E-02	5.4E-02	1.4E-01
Bi-210	2.1E-02	1.1E-02	2.0E-02	3.6E-02	5.0E-04	1.5E-04	4.4E-04	1.1E-03
Rn-222	2.4E-03	9.4E-04	2.2E-03	4.4E-03	5.6E-05	1.4E-05	4.7E-05	1.3E-04
Ra-223	2.2E+00	1.2E+00	2.1E+00	3.3E+00	5.2E-02	1.6E-02	4.7E-02	1.0E-01
Ra-224	3.9E-01	1.8E-01	3.7E-01	6.5E-01	9.1E-03	2.7E-03	8.0E-03	2.0E-02
Ac-225	9.3E-01	4.2E-01	8.3E-01	1.7E+00	2.2E-02	5.7E-03	1.9E-02	4.7E-02
Ra-225	1.1E+00	4.8E-01	1.0E+00	1.9E+00	2.6E-02	6.7E-03	2.2E-02	5.5E-02
Ra-226	2.5E+01	1.2E+01	2.4E+01	4.3E+01	6.0E-01	1.6E-01	5.3E-01	1.3E+00
Ac-227	1.7E+02	6.9E+01	1.5E+02	3.3E+02	4.1E+00	9.9E-01	3.4E+00	9.1E+00
Th-227	2.7E+00	1.4E+00	2.5E+00	4.4E+00	6.3E-02	1.9E-02	5.6E-02	1.3E-01
Th-228	6.3E+01	3.2E+01	5.9E+01	1.0E+02	1.5E+00	4.2E-01	1.3E+00	3.1E+00
Ra-228	1.5E+01	7.6E+00	1.5E+01	2.5E+01	3.6E-01	9.9E-02	3.2E-01	7.5E-01
Th-229	2.2E+02	7.9E+01	1.9E+02	4.3E+02	5.1E+00	1.1E+00	4.2E+00	1.2E+01
Th-230	3.3E+01	1.2E+01	2.8E+01	6.5E+01	7.7E-01	1.7E-01	6.4E-01	1.8E+00
Pa-231	1.1E+02	4.5E+01	1.0E+02	2.2E+02	2.7E+00	6.6E-01	2.2E+00	6.1E+00
Th-231	7.1E-03	1.4E-03	4.9E-03	2.0E-02	1.6E-04	2.7E-05	1.0E-04	5.3E-04
Th-232	1.4E+02	5.3E+01	1.2E+02	2.9E+02	3.4E+00	7.6E-01	2.8E+00	7.9E+00
Pa-233	1.9E+00	8.1E-01	1.8E+00	3.4E+00	4.5E-02	1.2E-02	3.9E-02	9.9E-02
U-233	1.7E+01	5.9E+00	1.4E+01	3.3E+01	3.9E-01	8.6E-02	3.2E-01	9.2E-01
Th-234	5.9E-02	3.0E-02	5.8E-02	9.5E-02	1.4E-03	4.0E-04	1.2E-03	2.8E-03
U-234	1.6E+01	5.7E+00	1.4E+01	3.3E+01	3.8E-01	8.4E-02	3.2E-01	9.0E-01
U-235	1.7E+01	6.7E+00	1.4E+01	3.1E+01	3.9E-01	9.4E-02	3.3E-01	8.7E-01
Np-237	7.1E+01	2.8E+01	6.2E+01	1.4E+02	1.7E+00	4.0E-01	1.4E+00	3.8E+00
Pu-238	3.5E+01	1.2E+01	3.0E+01	7.1E+01	8.3E-01	1.8E-01	6.9E-01	2.0E+00
U-238	1.5E+01	5.2E+00	1.3E+01	2.9E+01	3.4E-01	7.6E-02	2.9E-01	8.1E-01
Pu-239	3.8E+01	1.3E+01	3.2E+01	7.6E+01	8.9E-01	2.0E-01	7.4E-01	2.1E+00
Pu-240	3.8E+01	1.3E+01	3.2E+01	7.6E+01	8.9E-01	2.0E-01	7.4E-01	2.1E+00
Pu-241	6.1E-01	2.1E-01	5.2E-01	1.2E+00	1.4E-02	3.1E-03	1.2E-02	3.4E-02
Am-241	5.8E+01	2.2E+01	5.0E+01	1.1E+02	1.4E+00	3.2E-01	1.1E+00	3.1E+00
Cm-242	2.2E+00	8.3E-01	1.9E+00	4.3E+00	5.1E-02	1.2E-02	4.3E-02	1.2E-01
Pu-242	3.6E+01	1.3E+01	3.1E+01	7.2E+01	8.5E-01	1.9E-01	7.0E-01	2.0E+00
Cm-244	3.2E+01	1.2E+01	2.8E+01	6.3E+01	7.6E-01	1.8E-01	6.3E-01	1.7E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.4 Dose factors[a] for CN-SCRP-ROADBED-W

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	2.1E-04	4.6E-05	1.8E-04	4.8E-04	4.9E-06	8.8E-07	3.5E-06	1.3E-05
C-14	6.3E-03	1.1E-03	5.2E-03	1.5E-02	1.5E-04	2.1E-05	1.0E-04	4.1E-04
Na-22	1.8E+02	4.0E+01	1.7E+02	3.7E+02	4.3E+00	7.2E-01	3.4E+00	1.1E+01
P-32	1.1E-01	3.3E-02	1.0E-01	2.3E-01	2.6E-03	5.5E-04	2.0E-03	6.5E-03
S-35	2.3E-03	8.4E-04	2.1E-03	4.3E-03	5.3E-05	1.4E-05	4.4E-05	1.2E-04
Cl-36	5.0E-02	1.9E-02	4.7E-02	8.9E-02	1.2E-03	3.2E-04	9.8E-04	2.6E-03
K-40	1.4E+01	3.1E+00	1.3E+01	2.9E+01	3.3E-01	5.6E-02	2.6E-01	8.4E-01
Ca-41	4.2E-03	9.4E-04	3.6E-03	9.6E-03	9.8E-05	1.8E-05	7.0E-05	2.6E-04
Ca-45	1.2E-02	3.7E-03	1.1E-02	2.5E-02	2.8E-04	6.6E-05	2.2E-04	7.0E-04
Cr-51	1.8E+00	3.8E-01	1.6E+00	3.8E+00	4.2E-02	6.8E-03	3.3E-02	1.1E-01
Mn-54	6.8E+01	1.5E+01	6.1E+01	1.4E+02	1.6E+00	2.7E-01	1.2E+00	4.0E+00
Fe-55	2.3E-03	6.3E-04	2.1E-03	4.9E-03	5.3E-05	1.1E-05	3.9E-05	1.4E-04
Co-57	6.6E+00	1.4E+00	5.9E+00	1.3E+01	1.5E-01	2.6E-02	1.2E-01	3.9E-01
Co-58	7.2E+01	1.6E+01	6.5E+01	1.5E+02	1.7E+00	2.8E-01	1.3E+00	4.3E+00
Fe-59	8.7E+01	1.9E+01	7.9E+01	1.8E+02	2.0E+00	3.3E-01	1.6E+00	5.2E+00
Ni-59	9.7E-04	3.1E-04	8.9E-04	1.9E-03	2.3E-05	5.4E-06	1.8E-05	5.3E-05
Co-60	2.2E+02	4.8E+01	2.0E+02	4.5E+02	5.1E+00	8.6E-01	4.0E+00	1.3E+01
Ni-63	2.6E-03	8.2E-04	2.4E-03	5.2E-03	6.0E-05	1.4E-05	4.7E-05	1.4E-04
Zn-65	4.8E+01	1.1E+01	4.4E+01	9.9E+01	1.1E+00	1.9E-01	8.9E-01	2.9E+00
Cu-67	5.5E-01	4.3E-02	2.9E-01	1.9E+00	1.3E-02	8.4E-04	6.3E-03	4.6E-02
Se-75	2.5E+01	5.5E+00	2.3E+01	5.2E+01	5.9E-01	9.8E-02	4.6E-01	1.5E+00
Sr-85	3.6E+01	7.9E+00	3.2E+01	7.5E+01	8.4E-01	1.4E-01	6.5E-01	2.1E+00
Sr-89	1.4E-01	5.3E-02	1.3E-01	2.7E-01	3.3E-03	8.4E-04	2.7E-03	7.6E-03
Sr-90	9.3E-01	3.2E-01	8.5E-01	1.8E+00	2.2E-02	5.4E-03	1.8E-02	5.0E-02
Y-91	4.3E-01	1.2E-01	3.9E-01	8.7E-01	1.0E-02	2.1E-03	7.8E-03	2.5E-02
Mo-93	2.3E-02	9.5E-03	2.2E-02	4.0E-02	5.4E-04	1.5E-04	4.7E-04	1.2E-03
Nb-93m	1.4E-02	4.8E-03	1.2E-02	3.0E-02	3.4E-04	8.2E-05	2.8E-04	8.9E-04
Nb-94	1.3E+02	2.9E+01	1.2E+02	2.7E+02	3.1E+00	5.2E-01	2.4E+00	7.8E+00
Nb-95	5.1E+01	1.1E+01	4.7E+01	1.1E+02	1.2E+00	1.9E-01	9.3E-01	3.1E+00
Zr-95	5.4E+01	1.2E+01	4.9E+01	1.1E+02	1.3E+00	2.1E-01	9.9E-01	3.2E+00
Tc-99	9.2E-03	3.7E-03	8.6E-03	1.7E-02	2.1E-04	6.0E-05	1.9E-04	4.6E-04
Ru-103	3.1E+01	6.7E+00	2.8E+01	6.5E+01	7.2E-01	1.2E-01	5.6E-01	1.8E+00
Ru-106	2.6E-01	8.8E-02	2.4E-01	5.2E-01	6.1E-03	1.5E-03	5.0E-03	1.5E-02
Ag-108m	1.3E+02	2.9E+01	1.2E+02	2.7E+02	3.0E+00	5.1E-01	2.4E+00	7.7E+00
Cd-109	2.5E-01	8.8E-02	2.3E-01	4.7E-01	5.8E-03	1.4E-03	4.6E-03	1.4E-02
Ag-110m	2.2E+02	4.9E+01	2.0E+02	4.6E+02	5.3E+00	8.8E-01	4.1E+00	1.3E+01
Sb-124	1.4E+02	3.1E+01	1.3E+02	2.9E+02	3.3E+00	5.4E-01	2.5E+00	8.3E+00
I-125	3.0E-01	1.1E-01	2.9E-01	5.8E-01	7.1E-03	1.9E-03	6.0E-03	1.6E-02
Sb-125	3.3E+01	7.2E+00	3.0E+01	6.7E+01	7.7E-01	1.3E-01	6.0E-01	1.9E+00
I-129	1.0E+00	3.2E-01	8.8E-01	2.2E+00	2.4E-02	5.6E-03	1.8E-02	6.1E-02
I-131	1.2E+01	2.3E+00	1.0E+01	2.8E+01	2.8E-01	4.3E-02	2.0E-01	7.7E-01
Ba-133	2.7E+01	5.9E+00	2.4E+01	5.5E+01	6.2E-01	1.0E-01	4.9E-01	1.6E+00
Cs-134	1.3E+02	2.8E+01	1.2E+02	2.6E+02	3.0E+00	5.0E-01	2.3E+00	7.5E+00
Cs-137	1.7E-01	4.1E-02	1.4E-01	3.8E-01	3.9E-03	7.8E-04	2.9E-03	1.0E-02

Table I.4 Dose factors[a] for CN-SCRP-ROADBED-W

Radionuclide	Mass dose factors (µSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (µSv/y per Bq/cm²) Mean	5th	50th	95th
Ce-141	3.4E+00	7.5E-01	3.1E+00	7.1E+00	8.0E-02	1.3E-02	6.2E-02	2.1E-01
Ce-144	1.1E+00	3.8E-01	1.0E+00	2.2E+00	2.7E-02	6.3E-03	2.2E-02	6.3E-02
Pm-147	1.9E-02	6.2E-03	1.6E-02	4.0E-02	4.4E-04	1.0E-04	3.6E-04	1.2E-03
Eu-152	9.4E+01	2.1E+01	8.6E+01	1.9E+02	2.2E+00	3.7E-01	1.7E+00	5.6E+00
Eu-154	1.0E+02	2.3E+01	9.4E+01	2.1E+02	2.4E+00	4.1E-01	1.9E+00	6.1E+00
Eu-155	2.5E+00	5.6E-01	2.3E+00	5.0E+00	5.8E-02	9.9E-03	4.5E-02	1.5E-01
Re-186	1.7E-01	2.2E-02	1.2E-01	5.0E-01	4.0E-03	4.3E-04	2.4E-03	1.4E-02
Ir-192	5.6E+01	1.2E+01	5.1E+01	1.2E+02	1.3E+00	2.2E-01	1.0E+00	3.4E+00
Pb-210	2.1E+01	6.1E+00	1.9E+01	4.4E+01	4.9E-01	1.1E-01	3.7E-01	1.2E+00
Po-210	8.4E+00	2.7E+00	7.8E+00	1.7E+01	2.0E-01	4.8E-02	1.6E-01	4.6E-01
Bi-210	3.5E-02	8.6E-03	2.9E-02	7.7E-02	8.1E-04	1.6E-04	6.2E-04	1.9E-03
Rn-222	5.2E-03	6.6E-04	3.6E-03	1.5E-02	1.2E-04	1.3E-05	7.3E-05	4.1E-04
Ra-223	6.9E+00	2.5E+00	6.3E+00	1.3E+01	1.6E-01	4.0E-02	1.3E-01	3.7E-01
Ra-224	4.5E-01	9.4E-02	3.3E-01	1.1E+00	1.0E-02	1.7E-03	7.2E-03	2.8E-02
Ac-225	2.1E+00	6.0E-01	1.8E+00	4.4E+00	4.9E-02	1.1E-02	3.9E-02	1.2E-01
Ra-225	2.6E+00	8.2E-01	2.3E+00	5.4E+00	6.1E-02	1.4E-02	5.0E-02	1.5E-01
Ra-226	1.6E+02	4.1E+01	1.4E+02	3.2E+02	3.7E+00	7.0E-01	2.9E+00	9.1E+00
Ac-227	5.5E+02	1.6E+02	4.6E+02	1.2E+03	1.3E+01	2.7E+00	9.9E+00	3.7E+01
Th-227	9.0E+00	3.0E+00	8.4E+00	1.7E+01	2.1E-01	5.4E-02	1.8E-01	4.9E-01
Th-228	2.7E+02	9.7E+01	2.5E+02	4.9E+02	6.3E+00	1.6E+00	5.2E+00	1.4E+01
Ra-228	8.9E+01	2.7E+01	8.1E+01	1.8E+02	2.1E+00	4.4E-01	1.6E+00	5.0E+00
Th-229	7.0E+02	1.7E+02	5.7E+02	1.6E+03	1.6E+01	3.1E+00	1.2E+01	4.7E+01
Th-230	1.0E+02	2.5E+01	8.6E+01	2.4E+02	2.4E+00	4.5E-01	1.8E+00	7.1E+00
Pa-231	3.7E+02	1.1E+02	3.1E+02	8.1E+02	8.7E+00	1.8E+00	6.6E+00	2.5E+01
Th-231	2.0E-03	8.3E-06	2.9E-04	1.0E-02	4.6E-05	1.7E-07	6.1E-06	2.5E-04
Th-232	4.6E+02	1.1E+02	3.8E+02	1.0E+03	1.1E+01	2.0E+00	8.0E+00	3.1E+01
Pa-233	1.0E+01	2.2E+00	9.6E+00	2.2E+01	2.4E-01	4.0E-02	1.9E-01	6.4E-01
U-233	5.3E+01	1.2E+01	4.4E+01	1.2E+02	1.2E+00	2.2E-01	9.0E-01	3.7E+00
Th-234	2.8E-01	8.2E-02	2.5E-01	5.6E-01	6.5E-03	1.3E-03	5.1E-03	1.6E-02
U-234	5.2E+01	1.2E+01	4.3E+01	1.2E+02	1.2E+00	2.1E-01	8.8E-01	3.6E+00
U-235	5.8E+01	1.8E+01	4.9E+01	1.2E+02	1.4E+00	3.0E-01	1.1E+00	3.7E+00
Np-237	2.3E+02	6.6E+01	1.9E+02	5.1E+02	5.4E+00	1.1E+00	4.1E+00	1.5E+01
Pu-238	1.1E+02	2.6E+01	9.3E+01	2.6E+02	2.6E+00	4.6E-01	1.9E+00	7.8E+00
U-238	4.7E+01	1.1E+01	3.9E+01	1.1E+02	1.1E+00	2.0E-01	8.1E-01	3.2E+00
Pu-239	1.2E+02	2.7E+01	9.9E+01	2.8E+02	2.8E+00	4.9E-01	2.0E+00	8.4E+00
Pu-240	1.2E+02	2.7E+01	9.9E+01	2.8E+02	2.8E+00	4.9E-01	2.0E+00	8.4E+00
Pu-241	1.9E+00	4.4E-01	1.6E+00	4.5E+00	4.5E-02	7.8E-03	3.3E-02	1.3E-01
Am-241	1.8E+02	5.0E+01	1.6E+02	4.1E+02	4.3E+00	8.5E-01	3.3E+00	1.3E+01
Cm-242	6.8E+00	1.8E+00	5.7E+00	1.5E+01	1.6E-01	3.1E-02	1.2E-01	4.6E-01
Pu-242	1.1E+02	2.6E+01	9.4E+01	2.7E+02	2.7E+00	4.6E-01	1.9E+00	7.9E+00
Cm-244	1.0E+02	2.7E+01	8.6E+01	2.3E+02	2.4E+00	4.7E-01	1.8E+00	7.0E+00

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.5 Dose factors[a] for CN-SCRP-ROADBED-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.4E-04	7.0E-05	1.4E-04	2.3E-04	3.3E-06	1.1E-06	3.1E-06	6.8E-06
Na-22	1.2E+02	6.3E+01	1.2E+02	2.0E+02	2.9E+00	9.3E-01	2.7E+00	6.0E+00
P-32	4.1E-03	2.0E-03	4.0E-03	6.7E-03	9.8E-05	2.8E-05	8.6E-05	2.1E-04
S-35	4.7E-05	2.3E-05	4.5E-05	7.4E-05	1.1E-06	3.4E-07	1.0E-06	2.3E-06
Cl-36	2.5E-02	1.3E-02	2.4E-02	4.0E-02	5.9E-04	1.9E-04	5.4E-04	1.2E-03
K-40	1.1E+01	5.5E+00	1.1E+01	1.7E+01	2.6E-01	8.2E-02	2.4E-01	5.2E-01
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	3.2E-04	1.6E-04	3.1E-04	5.0E-04	7.5E-06	2.3E-06	6.9E-06	1.5E-05
Cr-51	1.5E-01	7.7E-02	1.5E-01	2.5E-01	3.6E-03	1.0E-03	3.2E-03	7.4E-03
Mn-54	3.6E+01	1.8E+01	3.5E+01	5.7E+01	8.5E-01	2.7E-01	7.8E-01	1.7E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	3.3E+00	1.7E+00	3.2E+00	5.3E+00	7.8E-02	2.5E-02	7.2E-02	1.6E-01
Co-58	1.5E+01	7.7E+00	1.5E+01	2.4E+01	3.6E-01	1.1E-01	3.3E-01	7.4E-01
Fe-59	1.2E+01	6.2E+00	1.1E+01	1.9E+01	2.8E-01	8.4E-02	2.5E-01	5.7E-01
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	1.6E+02	7.9E+01	1.5E+02	2.5E+02	3.7E+00	1.2E+00	3.4E+00	7.6E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	2.3E+01	1.2E+01	2.3E+01	3.7E+01	5.5E-01	1.7E-01	5.1E-01	1.1E+00
Cu-67	4.2E-03	6.3E-04	2.9E-03	1.2E-02	9.8E-05	9.9E-06	5.6E-05	3.2E-04
Se-75	8.1E+00	4.1E+00	7.8E+00	1.3E+01	1.9E-01	5.9E-02	1.8E-01	3.9E-01
Sr-85	7.0E+00	3.5E+00	6.7E+00	1.1E+01	1.6E-01	5.0E-02	1.5E-01	3.4E-01
Sr-89	1.6E-02	8.4E-03	1.6E-02	2.6E-02	3.8E-04	1.2E-04	3.5E-04	7.8E-04
Sr-90	7.3E-03	3.6E-03	7.0E-03	1.2E-02	1.7E-04	5.5E-05	1.6E-04	3.5E-04
Y-91	6.8E-02	3.5E-02	6.6E-02	1.1E-01	1.6E-03	4.9E-04	1.5E-03	3.3E-03
Mo-93	6.2E-03	3.1E-03	6.0E-03	9.9E-03	1.5E-04	4.6E-05	1.3E-04	3.0E-04
Nb-93m	1.1E-03	5.3E-04	1.0E-03	1.7E-03	2.5E-05	8.0E-06	2.3E-05	5.1E-05
Nb-94	1.0E+02	5.1E+01	9.8E+01	1.6E+02	2.4E+00	7.6E-01	2.2E+00	4.9E+00
Nb-95	5.5E+00	2.8E+00	5.3E+00	8.7E+00	1.3E-01	3.8E-02	1.2E-01	2.6E-01
Zr-95	1.0E+01	5.3E+00	1.0E+01	1.7E+01	2.5E-01	7.5E-02	2.2E-01	5.1E-01
Tc-99	1.3E-03	6.6E-04	1.3E-03	2.1E-03	3.1E-05	9.9E-06	2.9E-05	6.3E-05
Ru-103	3.7E+00	1.9E+00	3.6E+00	5.8E+00	8.7E-02	2.6E-02	7.8E-02	1.8E-01
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	1.0E+02	5.0E+01	9.7E+01	1.6E+02	2.4E+00	7.6E-01	2.2E+00	4.8E+00
Cd-109	1.2E-01	5.9E-02	1.1E-01	1.9E-01	2.7E-03	8.7E-04	2.5E-03	5.6E-03
Ag-110m	1.1E+02	5.5E+01	1.1E+02	1.7E+02	2.6E+00	8.1E-01	2.4E+00	5.3E+00
Sb-124	2.5E+01	1.3E+01	2.4E+01	4.0E+01	6.0E-01	1.8E-01	5.4E-01	1.2E+00
I-125	3.6E-02	1.8E-02	3.5E-02	5.7E-02	8.4E-04	2.6E-04	7.7E-04	1.7E-03
Sb-125	2.3E+01	1.1E+01	2.2E+01	3.6E+01	5.3E-01	1.7E-01	4.9E-01	1.1E+00
I-129	1.4E-01	6.8E-02	1.3E-01	2.2E-01	3.2E-03	1.0E-03	2.9E-03	6.5E-03
I-131	2.9E-01	1.3E-01	2.7E-01	5.1E-01	6.8E-03	1.7E-03	5.9E-03	1.5E-02
Ba-133	2.0E+01	1.0E+01	1.9E+01	3.2E+01	4.7E-01	1.5E-01	4.4E-01	9.7E-01
Cs-134	8.4E+01	4.2E+01	8.1E+01	1.3E+02	2.0E+00	6.2E-01	1.8E+00	4.0E+00
Cs-137	7.8E-03	3.9E-03	7.5E-03	1.2E-02	1.8E-04	5.8E-05	1.7E-04	3.7E-04

Table I.5 Dose factors[a] for CN-SCRP-ROADBED-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	3.4E-01	1.7E-01	3.3E-01	5.4E-01	8.0E-03	2.3E-03	7.2E-03	1.6E-02
Ce-144	4.8E-01	2.4E-01	4.7E-01	7.7E-01	1.1E-02	3.6E-03	1.1E-02	2.3E-02
Pm-147	4.6E-04	2.3E-04	4.4E-04	7.3E-04	1.1E-05	3.4E-06	9.9E-06	2.2E-05
Eu-152	7.1E+01	3.6E+01	6.9E+01	1.1E+02	1.7E+00	5.4E-01	1.6E+00	3.4E+00
Eu-154	7.7E+01	3.9E+01	7.5E+01	1.2E+02	1.8E+00	5.8E-01	1.7E+00	3.7E+00
Eu-155	1.8E+00	8.9E-01	1.7E+00	2.8E+00	4.2E-02	1.3E-02	3.9E-02	8.5E-02
Re-186	1.9E-03	5.2E-04	1.6E-03	4.5E-03	4.5E-05	7.9E-06	3.2E-05	1.2E-04
Ir-192	1.2E+01	6.2E+00	1.2E+01	2.0E+01	2.9E-01	8.9E-02	2.6E-01	6.0E-01
Pb-210	6.3E-02	3.1E-02	6.1E-02	1.0E-01	1.5E-03	4.7E-04	1.4E-03	3.0E-03
Po-210	2.4E-04	1.2E-04	2.3E-04	3.8E-04	5.6E-06	1.7E-06	5.1E-06	1.1E-05
Bi-210	1.8E-04	6.2E-05	1.6E-04	3.7E-04	4.2E-06	8.8E-07	3.4E-06	1.0E-05
Rn-222	5.9E-05	1.6E-05	4.9E-05	1.4E-04	1.4E-06	2.5E-07	1.0E-06	3.8E-06
Ra-223	1.5E-01	6.9E-02	1.4E-01	2.5E-01	3.5E-03	1.0E-03	3.1E-03	7.8E-03
Ra-224	1.1E-03	3.0E-04	9.4E-04	2.7E-03	2.7E-05	4.6E-06	1.9E-05	7.5E-05
Ac-225	1.3E-02	5.8E-03	1.2E-02	2.1E-02	3.0E-04	8.1E-05	2.6E-04	6.5E-04
Ra-225	4.1E-03	2.0E-03	4.0E-03	6.6E-03	9.6E-05	2.8E-05	8.5E-05	2.1E-04
Ra-226	1.2E+02	5.9E+01	1.1E+02	1.9E+02	2.8E+00	8.8E-01	2.5E+00	5.6E+00
Ac-227	2.1E+01	1.0E+01	2.0E+01	3.3E+01	4.8E-01	1.5E-01	4.5E-01	9.9E-01
Th-227	2.7E-01	1.3E-01	2.6E-01	4.4E-01	6.4E-03	1.8E-03	5.7E-03	1.3E-02
Th-228	8.7E+01	4.4E+01	8.4E+01	1.4E+02	2.0E+00	6.5E-01	1.9E+00	4.2E+00
Ra-228	5.9E+01	2.9E+01	5.7E+01	9.4E+01	1.4E+00	4.4E-01	1.3E+00	2.8E+00
Th-229	1.6E+01	8.2E+00	1.6E+01	2.6E+01	3.9E-01	1.2E-01	3.6E-01	7.9E-01
Th-230	4.8E-02	2.4E-02	4.6E-02	7.6E-02	1.1E-03	3.6E-04	1.0E-03	2.3E-03
Pa-231	2.0E+00	1.0E+00	1.9E+00	3.2E+00	4.7E-02	1.5E-02	4.3E-02	9.6E-02
Th-231	6.1E-06	4.1E-08	1.1E-06	3.1E-05	1.4E-07	7.4E-10	2.2E-08	6.9E-07
Th-232	7.7E+00	3.9E+00	7.5E+00	1.2E+01	1.8E-01	5.8E-02	1.7E-01	3.7E-01
Pa-233	8.6E-01	4.3E-01	8.4E-01	1.4E+00	2.0E-02	5.9E-03	1.8E-02	4.2E-02
U-233	1.5E-02	7.3E-03	1.4E-02	2.3E-02	3.4E-04	1.1E-04	3.2E-04	7.1E-04
Th-234	1.8E-02	8.7E-03	1.7E-02	2.8E-02	4.1E-04	1.2E-04	3.7E-04	8.6E-04
U-234	4.2E-03	2.1E-03	4.1E-03	6.7E-03	9.9E-05	3.2E-05	9.1E-05	2.0E-04
U-235	7.6E+00	3.8E+00	7.3E+00	1.2E+01	1.8E-01	5.7E-02	1.6E-01	3.6E-01
Np-237	1.2E+01	5.8E+00	1.1E+01	1.8E+01	2.7E-01	8.6E-02	2.5E-01	5.5E-01
Pu-238	1.6E-03	7.9E-04	1.5E-03	2.5E-03	3.7E-05	1.2E-05	3.4E-05	7.6E-05
U-238	1.4E+00	7.2E-01	1.4E+00	2.3E+00	3.4E-02	1.1E-02	3.1E-02	6.9E-02
Pu-239	3.1E-03	1.5E-03	3.0E-03	4.9E-03	7.3E-05	2.3E-05	6.7E-05	1.5E-04
Pu-240	1.5E-03	7.7E-04	1.5E-03	2.5E-03	3.6E-05	1.2E-05	3.3E-05	7.4E-05
Pu-241	9.5E-04	4.8E-04	9.2E-04	1.5E-03	2.2E-05	7.1E-06	2.1E-05	4.6E-05
Am-241	4.6E-01	2.3E-01	4.4E-01	7.3E-01	1.1E-02	3.4E-03	9.9E-03	2.2E-02
Cm-242	8.7E-04	4.4E-04	8.4E-04	1.4E-03	2.0E-05	6.4E-06	1.9E-05	4.2E-05
Pu-242	1.3E-03	6.7E-04	1.3E-03	2.1E-03	3.2E-05	1.0E-05	2.9E-05	6.5E-05
Cm-244	1.3E-03	6.5E-04	1.2E-03	2.1E-03	3.0E-05	9.7E-06	2.8E-05	6.2E-05

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.6 Dose factors[a] for CN-SCRP-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g) Mean	5th	50th	95th	Surficial dose factors (μSv/y per Bq/cm²) Mean	5th	50th	95th
H-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	1.3E-05	6.8E-06	1.2E-05	2.1E-05	3.0E-07	9.7E-08	2.8E-07	6.3E-07
Na-22	4.8E+00	2.5E+00	4.6E+00	7.8E+00	1.1E-01	3.6E-02	1.0E-01	2.3E-01
P-32	1.7E-04	8.4E-05	1.5E-04	2.8E-04	3.9E-06	1.2E-06	3.5E-06	8.5E-06
S-35	4.2E-06	2.1E-06	3.9E-06	6.7E-06	9.8E-08	3.1E-08	8.9E-08	2.1E-07
Cl-36	1.1E-03	5.6E-04	1.0E-03	1.7E-03	2.5E-05	7.9E-06	2.3E-05	5.2E-05
K-40	3.6E-01	1.9E-01	3.4E-01	5.9E-01	8.5E-03	2.7E-03	7.7E-03	1.8E-02
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	2.3E-05	1.2E-05	2.2E-05	3.8E-05	5.5E-07	1.7E-07	5.0E-07	1.2E-06
Cr-51	6.8E-03	3.5E-03	6.4E-03	1.1E-02	1.6E-04	5.1E-05	1.4E-04	3.5E-04
Mn-54	1.4E+00	7.5E-01	1.4E+00	2.3E+00	3.4E-02	1.1E-02	3.1E-02	7.1E-02
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-57	9.1E-02	4.7E-02	8.6E-02	1.5E-01	2.1E-03	6.7E-04	1.9E-03	4.5E-03
Co-58	6.2E-01	3.2E-01	5.9E-01	1.0E+00	1.5E-02	4.5E-03	1.3E-02	3.1E-02
Fe-59	4.2E-01	2.2E-01	4.0E-01	6.8E-01	9.9E-03	3.1E-03	8.9E-03	2.2E-02
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	5.6E+00	2.9E+00	5.3E+00	9.1E+00	1.3E-01	4.2E-02	1.2E-01	2.7E-01
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	8.5E-01	4.4E-01	8.1E-01	1.4E+00	2.0E-02	6.3E-03	1.8E-02	4.2E-02
Cu-67	1.5E-04	2.2E-05	9.9E-05	4.2E-04	3.5E-06	3.4E-07	2.2E-06	1.1E-05
Se-75	3.2E-01	1.7E-01	3.1E-01	5.3E-01	7.6E-03	2.4E-03	7.0E-03	1.6E-02
Sr-85	3.0E-01	1.6E-01	2.9E-01	4.9E-01	7.2E-03	2.2E-03	6.4E-03	1.5E-02
Sr-89	6.5E-04	3.4E-04	6.2E-04	1.0E-03	1.5E-05	4.8E-06	1.4E-05	3.3E-05
Sr-90	3.9E-04	2.0E-04	3.7E-04	6.4E-04	9.2E-06	2.9E-06	8.3E-06	1.9E-05
Y-91	1.7E-03	8.9E-04	1.7E-03	2.8E-03	4.1E-05	1.3E-05	3.7E-05	8.8E-05
Mo-93	4.3E-04	2.2E-04	4.1E-04	7.0E-04	1.0E-05	3.2E-06	9.1E-06	2.1E-05
Nb-93m	7.0E-05	3.7E-05	6.7E-05	1.1E-04	1.6E-06	5.2E-07	1.5E-06	3.4E-06
Nb-94	4.1E+00	2.1E+00	3.9E+00	6.7E+00	9.6E-02	3.0E-02	8.7E-02	2.0E-01
Nb-95	2.2E-01	1.1E-01	2.1E-01	3.6E-01	5.3E-03	1.7E-03	4.7E-03	1.2E-02
Zr-95	4.2E-01	2.1E-01	4.0E-01	6.8E-01	9.9E-03	3.1E-03	8.9E-03	2.1E-02
Tc-99	8.8E-05	4.6E-05	8.4E-05	1.4E-04	2.1E-06	6.6E-07	1.9E-06	4.3E-06
Ru-103	1.7E-01	8.6E-02	1.6E-01	2.7E-01	3.9E-03	1.2E-03	3.5E-03	8.7E-03
Ru-106	3.7E-01	1.9E-01	3.5E-01	6.0E-01	8.7E-03	2.7E-03	7.8E-03	1.8E-02
Ag-108m	4.3E+00	2.2E+00	4.1E+00	6.9E+00	1.0E-01	3.2E-02	9.1E-02	2.1E-01
Cd-109	9.3E-04	4.8E-04	8.8E-04	1.5E-03	2.2E-05	6.9E-06	2.0E-05	4.6E-05
Ag-110m	4.3E+00	2.2E+00	4.1E+00	7.1E+00	1.0E-01	3.2E-02	9.2E-02	2.1E-01
Sb-124	9.4E-01	4.8E-01	8.8E-01	1.5E+00	2.2E-02	6.8E-03	2.0E-02	4.7E-02
I-125	1.0E-03	5.2E-04	9.6E-04	1.6E-03	2.4E-05	7.4E-06	2.1E-05	5.1E-05
Sb-125	9.5E-01	5.0E-01	9.1E-01	1.6E+00	2.2E-02	7.1E-03	2.0E-02	4.7E-02
I-129	3.2E-03	1.7E-03	3.0E-03	5.2E-03	7.5E-05	2.4E-05	6.8E-05	1.6E-04
I-131	1.3E-02	5.6E-03	1.2E-02	2.4E-02	3.0E-04	7.5E-05	2.6E-04	6.6E-04
Ba-133	8.6E-01	4.5E-01	8.2E-01	1.4E+00	2.0E-02	6.4E-03	1.8E-02	4.2E-02
Cs-134	3.4E+00	1.8E+00	3.3E+00	5.6E+00	8.1E-02	2.6E-02	7.3E-02	1.7E-01
Cs-137	1.6E+00	8.2E-01	1.5E+00	2.6E+00	3.7E-02	1.2E-02	3.3E-02	7.7E-02

Table I.6 Dose factors[a] for CN-SCRP-LGMASS-N

Radionuclide	Mass dose factors (μSv/y per Bq/g)				Surficial dose factors (μSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	1.1E-02	5.7E-03	1.1E-02	1.8E-02	2.6E-04	8.3E-05	2.3E-04	5.8E-04
Ce-144	5.8E-02	3.0E-02	5.5E-02	9.4E-02	1.4E-03	4.3E-04	1.2E-03	2.8E-03
Pm-147	3.8E-06	2.0E-06	3.6E-06	6.2E-06	8.9E-08	2.8E-08	8.0E-08	1.9E-07
Eu-152	2.6E+00	1.4E+00	2.5E+00	4.3E+00	6.2E-02	2.0E-02	5.6E-02	1.3E-01
Eu-154	2.9E+00	1.5E+00	2.7E+00	4.7E+00	6.7E-02	2.1E-02	6.1E-02	1.4E-01
Eu-155	3.9E-02	2.0E-02	3.7E-02	6.3E-02	9.1E-04	2.9E-04	8.2E-04	1.9E-03
Re-186	4.7E-05	1.2E-05	3.7E-05	1.1E-04	1.1E-06	1.8E-07	8.0E-07	2.8E-06
Ir-192	5.4E-01	2.7E-01	5.1E-01	8.6E-01	1.3E-02	3.9E-03	1.1E-02	2.7E-02
Pb-210	3.9E-04	2.1E-04	3.7E-04	6.4E-04	9.2E-06	2.9E-06	8.4E-06	1.9E-05
Po-210	9.5E-06	4.9E-06	9.0E-06	1.5E-05	2.2E-07	7.0E-08	2.0E-07	4.7E-07
Bi-210	8.0E-06	2.7E-06	6.8E-06	1.7E-05	1.9E-07	3.8E-08	1.5E-07	4.4E-07
Rn-222	9.9E-03	2.6E-03	7.8E-03	2.4E-02	2.3E-04	3.7E-05	1.7E-04	5.9E-04
Ra-223	1.5E-02	7.4E-03	1.4E-02	2.7E-02	3.6E-04	9.8E-05	3.1E-04	7.8E-04
Ra-224	6.7E-03	1.7E-03	5.1E-03	1.6E-02	1.6E-04	2.4E-05	1.1E-04	4.1E-04
Ac-225	9.3E-03	4.4E-03	8.5E-03	1.7E-02	2.2E-04	5.8E-05	1.9E-04	4.8E-04
Ra-225	8.0E-05	4.0E-05	7.4E-05	1.3E-04	1.9E-06	5.5E-07	1.7E-06	4.0E-06
Ra-226	4.1E+00	2.1E+00	3.9E+00	6.7E+00	9.6E-02	3.0E-02	8.7E-02	2.0E-01
Ac-227	8.5E-01	4.4E-01	8.1E-01	1.4E+00	2.0E-02	6.3E-03	1.8E-02	4.1E-02
Th-227	1.1E-02	5.6E-03	1.0E-02	1.8E-02	2.6E-04	7.6E-05	2.3E-04	5.5E-04
Th-228	2.6E+00	1.3E+00	2.4E+00	4.2E+00	6.0E-02	1.9E-02	5.4E-02	1.3E-01
Ra-228	1.9E+00	1.0E+00	1.8E+00	3.2E+00	4.5E-02	1.4E-02	4.1E-02	9.4E-02
Th-229	5.7E-01	3.0E-01	5.5E-01	9.4E-01	1.3E-02	4.3E-03	1.2E-02	2.8E-02
Th-230	1.4E-03	7.1E-04	1.3E-03	2.2E-03	3.2E-05	1.0E-05	2.9E-05	6.6E-05
Pa-231	6.7E-02	3.5E-02	6.3E-02	1.1E-01	1.6E-03	5.0E-04	1.4E-03	3.3E-03
Th-231	1.2E-07	8.0E-10	2.2E-08	5.7E-07	2.8E-09	1.5E-11	5.3E-10	1.5E-08
Th-232	2.7E-01	1.4E-01	2.5E-01	4.4E-01	6.3E-03	2.0E-03	5.7E-03	1.3E-02
Pa-233	3.9E-02	2.0E-02	3.7E-02	6.4E-02	9.1E-04	2.9E-04	8.1E-04	2.0E-03
U-233	3.4E-05	1.8E-05	3.2E-05	5.5E-05	7.9E-07	2.5E-07	7.1E-07	1.6E-06
Th-234	1.7E-03	8.7E-04	1.6E-03	2.8E-03	4.0E-05	1.2E-05	3.6E-05	8.7E-05
U-234	5.9E-05	3.1E-05	5.6E-05	9.7E-05	1.4E-06	4.4E-07	1.3E-06	2.9E-06
U-235	2.8E-01	1.4E-01	2.6E-01	4.5E-01	6.5E-03	2.1E-03	5.9E-03	1.4E-02
Np-237	5.0E-01	2.6E-01	4.7E-01	8.1E-01	1.2E-02	3.7E-03	1.1E-02	2.4E-02
Pu-238	6.8E-05	3.5E-05	6.5E-05	1.1E-04	1.6E-06	5.1E-07	1.4E-06	3.3E-06
U-238	2.4E-02	1.3E-02	2.3E-02	4.0E-02	5.7E-04	1.8E-04	5.2E-04	1.2E-03
Pu-239	2.6E-05	1.4E-05	2.5E-05	4.2E-05	6.1E-07	1.9E-07	5.5E-07	1.3E-06
Pu-240	7.0E-05	3.7E-05	6.7E-05	1.1E-04	1.6E-06	5.2E-07	1.5E-06	3.4E-06
Pu-241	1.4E-05	7.3E-06	1.3E-05	2.3E-05	3.3E-07	1.0E-07	3.0E-07	6.8E-07
Am-241	6.4E-03	3.3E-03	6.1E-03	1.0E-02	1.5E-04	4.7E-05	1.4E-04	3.1E-04
Cm-242	5.1E-05	2.7E-05	4.9E-05	8.3E-05	1.2E-06	3.8E-07	1.1E-06	2.6E-06
Pu-242	5.7E-05	3.0E-05	5.5E-05	9.4E-05	1.3E-06	4.3E-07	1.2E-06	2.8E-06
Cm-244	9.1E-05	4.8E-05	8.7E-05	1.5E-04	2.1E-06	6.8E-07	1.9E-06	4.5E-06

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

Table I.7 Dose factors[a, b] for CN-SCRP-LANDFIL-N

Radionuclide	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
	Mean	5th	50th	95th	Mean	5th	50th	95th
H-3	8.8E-03	9.9E-06	5.0E-04	3.9E-02	1.9E-04	1.9E-07	1.1E-05	7.9E-04
C-14	1.6E+01	2.7E-02	1.1E+00	5.7E+01	3.7E-01	6.4E-04	2.4E-02	1.2E+00
Na-22	1.9E-05	2.9E-16	6.8E-11	2.7E-05	5.3E-07	5.1E-18	1.4E-12	6.7E-07
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	4.5E-68	1.1E-184	1.0E-128	1.3E-71	8.9E-70	2.3E-186	2.7E-130	1.2E-73
Cl-36	1.6E+02	1.0E+00	1.9E+01	5.4E+02	3.2E+00	1.8E-02	3.9E-01	1.2E+01
K-40	4.7E+01	1.9E-01	5.7E+00	2.2E+02	1.1E+00	4.0E-03	1.3E-01	5.5E+00
Ca-41	4.8E+00	1.4E-02	4.6E-01	1.9E+01	1.2E-01	3.2E-04	9.7E-03	4.7E-01
Ca-45	5.9E-36	3.6E-98	1.2E-68	6.9E-38	1.8E-37	8.5E-100	4.3E-70	1.1E-39
Cr-51	6.8E-204	0.0E+00	0.0E+00	4.0E-219	1.1E-205	0.0E+00	0.0E+00	1.2E-220
Mn-54	1.2E-18	8.2E-51	5.9E-35	4.5E-19	3.2E-20	2.6E-52	1.2E-36	6.9E-21
Fe-55	1.2E-09	6.1E-20	7.4E-15	1.3E-09	3.4E-11	1.4E-21	1.6E-16	2.8E-11
Co-57	1.6E-22	1.3E-59	2.0E-41	4.2E-23	4.2E-24	3.6E-61	3.6E-43	7.3E-25
Co-58	3.4E-80	1.9E-224	5.8E-155	2.3E-84	1.0E-81	3.2E-226	1.5E-156	7.7E-86
Fe-59	1.2E-126	0.0E+00	1.6E-246	8.4E-135	3.2E-128	0.0E+00	5.9E-248	1.4E-136
Ni-59	7.4E-03	1.8E-05	8.1E-04	3.0E-02	1.8E-04	3.9E-07	1.6E-05	6.9E-04
Co-60	5.3E-02	4.5E-08	6.5E-05	1.3E-01	1.4E-03	1.0E-09	1.6E-06	2.8E-03
Ni-63	1.0E-02	2.7E-05	1.0E-03	3.8E-02	2.4E-04	5.4E-07	2.2E-05	9.0E-04
Zn-65	5.5E-24	2.5E-65	5.3E-45	1.0E-24	1.4E-25	8.6E-67	7.0E-47	2.0E-26
Cu-67	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	3.4E-48	9.0E-133	7.8E-92	3.8E-50	9.3E-50	1.8E-134	1.8E-93	9.8E-52
Sr-85	1.7E-87	6.9E-245	2.4E-169	2.8E-92	4.4E-89	1.1E-246	2.3E-171	7.5E-94
Sr-89	2.4E-112	0.0E+00	3.3E-219	1.0E-120	5.3E-114	0.0E+00	8.7E-221	2.9E-122
Sr-90	2.2E+00	3.0E-03	1.3E-01	7.6E+00	5.5E-02	5.5E-05	2.6E-03	1.6E-01
Y-91	7.5E-97	3.5E-272	1.8E-188	1.8E-103	9.4E-99	4.5E-274	4.7E-190	3.2E-105
Mo-93	3.8E+01	9.9E-02	3.5E+00	1.6E+02	8.5E-01	2.3E-03	6.7E-02	3.3E+00
Nb-93m	6.3E-04	2.7E-07	1.5E-05	2.0E-03	1.5E-05	5.5E-09	3.2E-07	4.5E-05
Nb-94	2.9E+02	4.4E-01	2.1E+01	1.1E+03	7.3E+00	8.4E-03	4.6E-01	2.5E+01
Nb-95	7.3E-160	0.0E+00	0.0E+00	5.0E-171	1.7E-161	0.0E+00	0.0E+00	1.4E-172
Zr-95	1.1E-88	1.6E-248	1.6E-171	1.5E-93	3.2E-90	4.6E-250	4.9E-173	4.1E-95
Tc-99	1.2E+02	8.8E-01	1.8E+01	4.6E+02	2.6E+00	1.9E-02	4.1E-01	9.5E+00
Ru-103	1.2E-143	0.0E+00	1.2E-279	2.8E-153	3.1E-145	0.0E+00	4.5E-281	7.1E-155
Ru-106	5.9E-18	4.5E-45	6.7E-32	2.2E-18	1.5E-19	1.2E-46	9.8E-34	4.2E-20
Ag-108m	1.7E+02	2.3E-01	1.2E+01	7.4E+02	4.3E+00	5.0E-03	2.5E-01	1.4E+01
Cd-109	1.2E-14	7.0E-36	2.0E-25	7.9E-15	3.2E-16	2.2E-37	3.5E-27	1.8E-16
Ag-110m	9.2E-23	4.6E-63	2.9E-43	1.8E-23	2.4E-24	1.3E-64	4.1E-45	3.6E-25
Sb-124	8.5E-94	7.5E-264	6.2E-182	3.8E-99	2.5E-95	2.2E-265	2.2E-183	1.0E-100
I-125	2.1E-93	6.5E-264	1.2E-182	3.1E-100	3.1E-95	2.2E-265	3.2E-184	8.9E-102
Sb-125	8.5E-06	5.3E-16	6.1E-11	1.4E-05	2.3E-07	9.3E-18	1.3E-12	3.1E-07
I-129	2.4E+03	1.5E+01	2.6E+02	8.4E+03	5.1E+01	2.9E-01	5.3E+00	2.0E+02
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-133	3.8E-01	6.2E-05	7.1E-03	1.3E+00	9.5E-03	1.3E-06	1.4E-04	3.1E-02
Cs-134	2.9E-07	1.6E-20	7.1E-14	4.1E-07	7.8E-09	4.6E-22	1.2E-15	6.9E-09
Cs-137	4.9E+00	1.0E-02	3.7E-01	1.7E+01	9.8E-02	2.5E-04	8.2E-03	3.8E-01

Table I.7 Dose factors[a, b] for CN-SCRP-LANDFIL-N

	Mass dose factors (µSv/y per Bq/g)				Surficial dose factors (µSv/y per Bq/cm²)			
Radionuclide	Mean	5th	50th	95th	Mean	5th	50th	95th
Ce-141	4.1E-174	0.0E+00	0.0E+00	1.6E-186	8.5E-176	0.0E+00	0.0E+00	4.7E-188
Ce-144	2.9E-22	9.7E-58	2.3E-40	6.7E-23	7.5E-24	3.3E-59	4.5E-42	1.3E-24
Pm-147	2.0E-09	2.1E-12	8.9E-11	7.5E-09	4.7E-11	3.7E-14	1.9E-12	1.8E-10
Eu-152	3.2E+00	1.1E-03	8.8E-02	1.2E+01	7.8E-02	2.3E-05	1.8E-03	2.6E-01
Eu-154	6.0E-01	3.5E-05	6.3E-03	1.8E+00	1.5E-02	7.7E-07	1.3E-04	4.1E-02
Eu-155	3.6E-04	1.5E-10	3.0E-07	8.4E-04	9.4E-06	3.5E-12	7.6E-09	1.9E-05
Re-186	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192	6.8E-77	8.1E-215	2.1E-148	7.7E-81	2.0E-78	1.1E-216	5.4E-150	2.6E-82
Pb-210	8.1E+00	7.4E-03	3.5E-01	2.5E+01	1.9E-01	1.4E-04	7.6E-03	5.4E-01
Po-210	2.7E-42	1.0E-115	3.6E-80	8.3E-44	7.6E-44	2.4E-117	6.0E-82	2.2E-45
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rn-222	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	5.3E+02	1.2E+00	5.0E+01	2.1E+03	1.3E+01	2.4E-02	1.0E+00	5.0E+01
Ac-227	8.8E+01	6.7E-02	3.5E+00	2.7E+02	2.1E+00	1.3E-03	7.5E-02	6.9E+00
Th-227	4.8E-299	0.0E+00	0.0E+00	0.0E+00	5.3E-301	0.0E+00	0.0E+00	0.0E+00
Th-228	1.3E-07	3.9E-22	6.2E-15	1.1E-07	3.6E-09	1.1E-23	1.2E-16	2.4E-09
Ra-228	1.3E-01	3.5E-07	2.7E-04	2.5E-01	3.3E-03	8.1E-09	5.6E-06	6.3E-03
Th-229	1.4E+03	1.8E+00	1.0E+02	4.3E+03	3.3E+01	3.8E-02	2.1E+00	1.2E+02
Th-230	2.2E+02	2.9E-01	1.6E+01	6.9E+02	5.3E+00	6.3E-03	3.4E-01	1.9E+01
Pa-231	2.1E+03	3.4E+00	1.8E+02	6.7E+03	5.0E+01	7.6E-02	3.7E+00	1.9E+02
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	1.3E+03	1.9E+00	1.1E+02	4.6E+03	3.2E+01	4.1E-02	2.3E+00	1.2E+02
Pa-233	2.7E-208	0.0E+00	0.0E+00	5.0E-224	4.3E-210	0.0E+00	0.0E+00	1.4E-225
U-233	1.7E+02	6.8E-01	1.7E+01	6.0E+02	3.8E+00	1.3E-02	3.4E-01	1.3E+01
Th-234	1.9E-234	0.0E+00	0.0E+00	1.2E-252	2.6E-236	0.0E+00	0.0E+00	3.4E-254
U-234	1.7E+02	4.0E-01	1.6E+01	6.5E+02	3.8E+00	9.7E-03	3.5E-01	1.4E+01
U-235	1.4E+02	5.1E-01	1.8E+01	6.1E+02	3.2E+00	1.2E-02	4.0E-01	1.3E+01
Np-237	7.1E+04	9.0E+01	4.0E+03	2.2E+05	1.4E+03	1.6E+00	8.3E+01	5.0E+03
Pu-238	1.0E+02	1.2E-01	6.2E+00	3.3E+02	2.4E+00	2.7E-03	1.5E-01	8.4E+00
U-238	1.3E+02	4.0E-01	1.5E+01	5.7E+02	3.1E+00	8.9E-03	3.4E-01	1.1E+01
Pu-239	2.2E+02	2.8E-01	1.6E+01	7.1E+02	5.4E+00	6.9E-03	3.4E-01	2.0E+01
Pu-240	2.2E+02	2.7E-01	1.5E+01	7.1E+02	5.4E+00	7.2E-03	3.4E-01	2.0E+01
Pu-241	1.7E+01	2.1E-02	8.9E-01	7.2E+01	4.0E-01	3.4E-04	1.8E-02	1.6E+00
Am-241	3.3E+02	4.2E-01	2.3E+01	1.1E+03	8.0E+00	1.1E-02	5.1E-01	3.1E+01
Cm-242	5.0E-01	4.3E-04	2.1E-02	1.8E+00	1.2E-02	7.1E-06	4.9E-04	4.4E-02
Pu-242	2.1E+02	2.7E-01	1.5E+01	6.8E+02	5.1E+00	6.2E-03	3.3E-01	1.9E+01
Cm-244	9.6E+00	4.8E-03	3.0E-01	3.0E+01	2.3E-01	1.1E-04	6.7E-03	6.6E-01

a. To convert these values to conventional units (mrem/y per pCi/g or mrem/y per pCi/cm²), multiply by 3.70 E-03

b. Some of the dose factors in this table are extremely small (essentially zero). The numbers have been listed as they were calculated in the scenario spreadsheet.

APPENDIX J

ILLUSTRATIVE SPECIFIC APPLICATIONS OF GENERAL METHODS

CONTENTS

Tables

J Illustrative Specific Applications of Generic Methods

This appendix contains calculations that illustrate how to apply the methods and results in this report to specific cases. The two sets of independent calculations included here address (1) a specific licensed facility that has material with residual radioactivity that is proposed hypothetically to be sold to the general public, and (2) a hypothetical situation involving a residential setting on a closed landfill that contains cleared material.

In the first case, the licensed material is a slag-like material that has value to the steel industry as a steel conditioner. The scenarios used in the general reuse/recycle analysis were used—with appropriate parameter changes—to evaluate the disposition of this material. The proposed disposition was evaluated (i.e., sale of the material to the steel industry), as well as other dispositions such as direct disposal, and other common uses of slag-like material.

Evaluation of residential scenarios was included here as the second case because it represents a possible, but very unlikely, exposure scenario that could arise following the clearance of material. Because it is conceptually possible and is a traditional scenario for low-level waste facilities, it is relevant to the overall reuse/recycle analysis as an indication of what the magnitude of a residential dose might be, given such a situation.

J.1 Analysis of the Release of Epic Pest Slag

This section describes an analysis of the potential release of material from a licensed facility. Although the analyses are very similar, this situation is not representative of the clearance of material discussed in Volume 1.

J.1.1 Background

A licensed facility has proposed to sell material that contains low levels of radionuclides to buyers that are not licensed by the NRC. This material—Epic Pest Slag (EPS)—could to be sold to the steel industry for use as an additive in steelmaking. Epic Pest Slag is a derivative of existing material in one of two slag piles at the licensed facility that contains various slag material produced during several past mineral processing operations at the facility.

This appendix section contains a discussion of an analysis of the potential impacts of the release of EPS. The potential impacts consist of estimated radionuclide concentrations in various materials, and calculated doses and dose factors for individuals that may come into contact with—or close proximity to—EPS or refinery products following introduction of EPS into a steel refinery.

Following a brief description of the characteristics and use of EPS, an EPS material flow model is described in Sections J.2, J.3, and J.4. This model consists of the equations and parameter values used to calculate radionuclide concentrations in refinery products. Section J.5 contains a description of the dose calculations, including tables of input and results. The tables contain values used in the calculational models, and calculated doses and dose factors for the various scenarios evaluated.

J.1.1.1 Characteristics of Epic Pest Slag

As tabulated in Table J.1, the Epic Slag Pile at the licensed facility contains slags resulting from the production of various ferroalloys (ferrovanadium, ferrocolumbium, ferrotitanium, ferroboron, F-Product, S-Product, and G-Product). The licensed facility has proposed that the 3,634 metric tons (4,006 tons) of ferrocolumbium slag in the Epic Slag Pile be removed and the remaining combination of slags be sold as EPS. Following removal of ferrocolumbium slag, the major chemical constituents of EPS would be Al_2O_3 (app. 44 wt%), CaO (app. 24 wt%), and MgO (app. 12 wt%), as well as smaller quantities of SiO_2, TiO_2, FeO, and other oxides. The Epic Slag Pile also contains soil that has been added to the pile at various times in the past, therefore EPS would also contain soil (app. 2 wt %). The overall source content (weight percent of source material radionuclides) of EPS is about 0.01%, as shown in Table J.2. The estimated bulk density of EPS is 2.0 g/cm^3 (1.7 tons/yd^3).

Table J.1 Constituents in Epic Slag Pile and Epic Pest Slag (EPS)

Material	Epic Slag Pile (metric tons)	Epic Pest Slag (metric tons)		
		(metric tons)	% of slag	% of total material
G-Product	19,449	19,449	40.2	39.4
Ferrovanadium slag	15,584	15,584	32.2	31.6
F-Product slag	6,797	6,797	14.1	13.8
Ferrocolumbium slag	3,634	0	0.0	0.0
Ferrotitanium slag	3,561	3,561	7.4	7.2
S-Product	2,852	2,852	5.9	5.8
Ferroboron slag	77	77	0.2	0.2
Miscellaneous slag	32	32	0.1	0.1
Total slag	51,986	48,352	100.0	n/a
Soil	998	998	n/a	2.0
Total material	52,984	49,350	n/a	100.0

n/a = not applicable

Table J.2 Radionuclide content of Epic Pest Slag (EPS) (C_I)

Radionuclide	Mean Concentration in EPS (Bq/g)	(pCi/g)
U-238	4.18E-01	1.13E+01
Th-234	3.74E-01	1.01E+01
Pa-234m	4.22E-01	1.14E+01
U-234	4.33E-01	1.17E+01
Th-230	3.81E+01	1.03E+03
Ra-226	7.77E-01	2.10E+01
Rn-222	7.77E-01	2.10E+01
Po-218	7.77E-01	2.10E+01
Pb-214	7.88E-01	2.13E+01
Bi-214	7.73E-01	2.09E+01
Po-214	7.73E-01	2.09E+01
Pb-210	1.27E+00	3.44E+01
Bi-210	3.44E-01	9.30E+00
Po-210	2.44E-01	6.60E+00
U-235	8.55E-02	2.31E+00
Th-231	8.55E-02	2.31E+00
Pa-231	1.08E+00	2.92E+01
Ac-227	6.25E-01	1.69E+01
Th-227	6.25E-01	1.69E+01
Ra-223	1.17E+00	3.16E+01
Rn-219	1.17E+00	3.16E+01
Po-215	1.17E+00	3.16E+01
Pb-211	1.17E+00	3.16E+01
Bi-211	1.17E+00	3.16E+01
Tl-207	1.17E+00	3.16E+01
Th-232	3.56E-01	9.63E+00
Ra-228	1.55E-01	4.20E+00
Ac-228	1.55E-01	4.20E+00
Th-228	1.27E-01	3.44E+00
Ra-224	1.68E+00	4.54E+01
Rn-220	1.68E+00	4.54E+01
Po-216	1.68E+00	4.54E+01
Pb-212	1.92E-01	5.18E+00
Bi-212	1.50E-01	4.05E+00
Po-212	9.62E-02	2.60E+00
Tl-208	5.40E-02	1.46E+00

J.1.1.2 Use of Epic Pest Slag

The chemical characteristics of EPS would result in it serving the same general functions in steel production as ferrovanadium slag. Ferrovanadium slag is one type of addition agent used in the steel industry. It can be used either as a steel conditioner or as a "synthetic" slag. Because ferrovanadium is easily oxidized it is normally added to the steelmaking process in the ladle (Lankford et al. 1985). This type of addition agent is used for desulfurization or as an insulator for molten metal in the ladle.

Shipments of EPS from the licensed facility could be sent either directly to a steel refinery or to a slag blender. EPS would likely be blended with other synthetic slag or lime at a slag blender or at a steel refinery. When the EPS is added to the ladle it would mix with a small amount of furnace slag carried over to the ladle with the molten steel, as well as any other additives that were added to the ladle, such as calcium and lime (Stewart 1998). According to Medina (1998), Waters (1998), and Stewart (1998) none of the addition agent remains with the molten metal (i.e., it is removed with the ladle slag). When the ladle slag (i.e., EPS, furnace slag, other additives) is removed from the ladle it is mixed with other furnace slag removed from the furnace, and typically stockpiled in a slag pile where it is allowed to cool.

About 96% of all steel slag in the U.S. is used for either road bases, fill or asphaltic aggregate (Kalyoncu 1997). Therefore, refinery slag would most likely be sent to a slag processor, where it would be minimally processed (removal of metals by physical separation), and sold for typical slag uses (road bases, etc.), as described in Volume 1 of this report

The source material radionuclides in EPS (Table J.2) would likely remain in slag after introduction of EPS to the refining process. These radionuclides are not expected to partition to refined steel or other byproducts of steel refining during use of EPS in steelmaking. This is based on the assumption that EPS would be added to the ladle (not the furnace), plus the partitioning data in Volume 1 of this report. Therefore, the only process that would change the concentration of radionuclides is dilution with other material at various steps in the use of EPS in steelmaking.

J.1.2 Equations Used to Model Mixing

The following equations are used to calculate the concentrations in various end products assuming an initial concentration in EPS (C_1). Because each scenario is time dependent, no correction for decay is calculated here. Decay is applied to each scenario individually.

The concentration in EPS as delivered to the slag blender or refinery is represented by Equation 1. This equation takes into account the mixing that occurs with the addition of other material shipped with EPS from the licensed facility.

$$C_2 = C_1 * \left(\frac{M_{EPS}}{M_{EPS} + M_{SA}} \right) \qquad 1$$

Equation 2 was used to calculate the concentration in EPS following blending. The concentration in EPS, as delivered to the slag blender or refinery, is mixed with other additives, such as lime, during blending.

$$C_3 = C_2 * \left(\frac{M_{EPS} + M_{SA}}{M_{EPS} + M_{SA} + M_{ADD}} \right) \quad 2$$

The mass of EPS used in the ladle per charge is represented by Equation 3.

$$M_{ladle} = M_m * M_{ss} * \left(\frac{1\ ton}{9.072E{+}5g} \right) \quad 3$$

The total mass of non-molten metal in the ladle includes the EPS blended slag, the furnace slag carried over with the metal, and other additives such as calcium. Equation 4 was used to calculate this total mass.

$$M_{TL} = M_{ladle} + M_{SL} + M_{f,add} \quad 4$$

Equation 5 was used to calculate the concentration in the slag removed from the ladle. This equation takes into account the mixing that occurs in the ladle by the addition of furnace slag carried over with the metal and other additives to the EPS blended slag.

$$C_4 = C_3 * \left(\frac{M_{ladle}}{M_{TL}} \right) \quad 5$$

The total mass of slag produced at the refinery per charge, represented by Equation 6, is the sum of the slag removed from the furnace and the slag removed from the ladle.

$$M_{TS} = M_{TL} + M_S \quad 6$$

Equation 7 was used to calculate the concentration in the slag pile at the refinery. The slag pile consists of the furnace slag and the ladle slag, collectively referred to as "end slag."

$$C_5 = C_4 * \left(\frac{M_{TL}}{M_{TS}} \right) \quad 7$$

where:

C_1 = concentration in EPS (pCi/g)
C_2 = concentration in EPS as delivered to slag blender or refinery (pCi/g)
C_3 = concentration in blended EPS (pCi/g)
C_4 = concentration in slag removed from the ladle (pCi/g)
C_5 = concentration in slag stored at the refinery (pCi/g)
M_{ladle} = mass of blended EPS used in the ladle per charge (g/charge)
M_{TL} = total mass of non-molten metal in the ladle (i.e., slag and EPS) per charge (g/charge)
M_{TS} = total mass of slag produced at the refinery per charge (g/charge)

and

M_{EPS} = mass of EPS shipped from the licensed facility (g)
M_{SA} = mass of other material shipped with EPS from the licensed facility (g)
M_{ADD} = mass of additives mixed with EPS during blending (g)
M_m = mass of molten steel in ladle per charge (g/charge)
M_{SS} = mass of blended EPS per ton of molten metal (g EPS/ton steel)
M_{SL} = mass of furnace slag carried over with the molten metal in the ladle per charge (g/charge)
$M_{f,add}$ = mass of other additives in the ladle per charge (g/charge)
M_S = mass of refinery slag removed from the furnace per charge (g/charge)

J.1.3 Parameter Values for Dilution Calculations

This section describes the values used for parameters in the modeling of EPS use in a steel refinery. As described above, the radionuclides in EPS would remain in slag materials throughout the refining and use steps, so the parameters used in modeling the flow of EPS are largely masses of various materials at various steps in the process. These masses are used to estimate dilution of radionuclide concentrations in various slag materials. Parameter values used as input to the material flow model are summarized in Table J.3 and are discussed below.

The mass of EPS shipped from the licensed facility is taken to be the total amount of EPS available to be shipped from the facility, 51,576[1] metric tons (56,852 tons). No mixing is assumed because it is not likely that the EPS would be mixed prior to sale. Based on discussions with a steel industry metallurgist (Lilley 1998), EPS would likely be blended with lime at a ratio of about 50% EPS and 50% lime. This blending could take place at either a slag blender or the refinery. However, it is not likely that EPS would be blended at both locations. Therefore, a value of 51,576 metric tons (56,852 tons) is used for the mass of additives mixed with EPS during blending (M_{ADD}). The mass of molten steel in the ladle per charge (M_m) and the mass of refinery slag removed from the furnace per charge (M_S) are 79.3 metric tons (87.4 tons) and 13.2 metric tons (14.6 tons) respectively. These values are based on information presented in Volume 1 of this report.

[1] An EPS mass of 51,576 t is used to model the flow of radionuclides during use of EPS in a steel refinery. However, a mass of 49,350 t was used to approximate some uncertainties that can arise in practice.

Table J.3 Input parameter values for the EPS material flow model

Parameter	Parameter values[a]	Rationale for values
mass of EPS shipped from the licensed facility (g)—M_{EPS}	5.16E+10 FIXED	Set to equal the amount available at the licensed facility.
mass (g) of other material shipped with EPS from the licensed facility (g)—M_{SA}	0.0 FIXED	Assumed that the licensedG facility will not mix EPS prior to shipping, based on available documentation. No data to base a distribution on.
mass (g) of additives mixed with EPS during blending (g)—M_{ADD}	2.58E+10 [5.16E+10] 1.03E+11 UNIFORM	There is variability within the steel industry for this value, depending on the facility and type of metal end product desired. Therefore a uniform distribution is assumed (all values within the distribution are equally likely). The minimum and maximum values are ± 50% of the deterministic value, based on information from steel industry contacts.
mass of molten steel in ladle per charge (g/charge)—M_m	7.93E+07[b]	The output distribution for M_m from the EAF steel scrap material flow spreadsheet will be used. Parameter values for M_m in the EPS material flow model will be selected by sampling from the EAF steel scrap material flow uncertainty distribution.
mass of EPS per ton of molten metal (g/ton metal)—M_{SS}	0.0 [2.72E+03] 4.54E+03 UNIFORM	There is variability within the steel industry for this value, depending on the facility and type of metal end product desired. Therefore a uniform distribution is assumed (all values within the distribution are equally likely). A minimum value of 0.0 was chosen because it is very possible that a charge would be run without the addition of the blended EPS. The maximum value was chosen based on information from industry contacts.
mass of slag carried over with the molten metal in the ladle per charge (g/charge)—M_{SL}	2.27E+05 [6.80E+05] 1.36E+06 TRI	There is variability within the steel industry for this value, depending on the type of facility. During the tapping of the furnace, refinery personnel generally try to minimize the amount of furnace slag carried over to the ladle, however a small amount always carries over to the ladle. A triangular distribution was chosen because it is more likely that a lower-end value (obtained from industry contacts) would occur. The minimum and maximum values were also obtained from steel industry contacts, (see Section J.1.3).
mass of other additives in ladle per charge (g/charge)—$M_{\ell,add}$	0.0 [9.81E+05] 9.81E+05 UNIFORM	There is variability within the steel industry for this value, depending on the facility and type of metal end product desired. Therefore a uniform distribution is assumed (all values within the distribution are equally likely). A minimum value of 0.0 was chosen because it is very possible that a charge would be run without the addition of other additives. The maximum value was chosen based on information from industry contacts (see Section J.1.3).
mass of refinery slag removed from the furnace per charge (g/charge)—M_S	1.32E+07[b]	The output distribution for M_S from the EAF steel scrap material flow spreadsheet will be used. Parameter values for M_m in the EPS material flow model will be selected by sampling from the EAF steel scrap material flow uncertainty distribution.

a "Fixed" indicates that no uncertainty is associated with this parameter value in the model. For multiple values listed, values are: minimum, [most likely], maximum values for triangular distributions (TRI); and minimum, [deterministic], maximum values for uniform distributions (UNIFORM)

b. Input distribution for these parameters consists of the output distribution from the EAF material flow workbook used for the steel recycle analysis in SAIC (1997)

The mass of EPS used relative to the mass of molten metal in the ladle is based on information from steel industry contacts. Stewart (1998) states that between 227 and 363 kg (500 and 800 lbs) of synthetic slag mix (75% vanadium slag and 25% calcium), is added for every 150 metric tons (165 tons) of molten steel. This equates to an average value of about 1.5 kg of EPS per metric ton of molten steel (3 pounds of EPS per ton of molten steel). Medina (1998) states that slag is added to the ladle at the rate of approximately 5 kg/t steel (10 lb/ton steel), while Waters (1998) states that the rate of addition is about 2 kg of slag per metric ton of steel (4 lbs of slag per ton of steel). The average of these values, 2.8 kg/t (5.7 lb/ton), is used for the mass of EPS added to the ladle (M_{SS}).

The mass of slag carried over with the molten metal in the ladle per charge was determined in a similar way. Medina (1998) states that about 227 kg (500 lbs) of furnace slag is carried over to the ladle after each charge. Stewart (1998) states that between 907 and 1361 kg (2000 - 3000 lbs) of furnace slag is carried over to the ladle each charge (average value of 1134 kg [2500 lbs]). The mean of these two values is 680 kg (1500 lbs), and this value is used for the value of M_{SL} in this analysis.

Other additives can also be added to the ladle; this is accounted for in the flow model with the parameter $M_{f,add}$. Stewart (1998) indicates that an average of 74 kg (163 lb) of calcium is added per charge (in the synthetic slag mix mentioned above) in addition to another 907 kg (2,000 lbs) of lime added to each charge, for a total of 981 kg (2,163 lbs) of other additives added to the ladle for each furnace charge.

J.1.4 Results of EPS Material Flow Analysis

Calculated radionuclide concentrations in refinery end slag (C_5) are tabulated in Table J.4. The 5th percentile and 95th percentile values indicate the range of possible concentrations in end slag from a steel refinery using EPS as an additive. The mean values from the distribution are the most appropriate values to be used as point estimates for concentration. The mean value for each radionuclide is higher than the median (50th percentile) value, indicating that the output distribution from the uncertainly analysis is skewed to the right. Models of this type commonly produce frequency distributions that are best characterized as log-normal. The mean values from the output distribution are 0.8% of the initial radionuclide concentrations in EPS.

There are 16 radionuclides[1] in EPS that were not explicitly included in the original development of the set of radionuclides for this analysis, as described in Volume 1. These radionuclides were not explicitly added to the EPS analysis. Therefore, the listing of radionuclide concentrations in end slag in Table J.4 lists concentrations only for the 19 radionuclides that are explicitly part of the analysis. Some of these radionuclides would result in little or no dose impact (e.g., Po-212), and many of the remainder have been included implicitly in the analysis as progeny (see Section J.1.5.2 and Tables J.8 through J.21).

[1] The radionuclides not explicitly included are Tl-207, Tl-208, Pb-211, Pb-212, Pb-214, Bi-211, Bi-212, Bi-214, Po-212, Po-214, Po-215, Po-216, Po-218, Rn-219, Ac-228, and Pa-234m.

Table J.4 EPS material flow model results—radionuclide concentrations in end slag

Radionuclide	Mean (Bq/g) (pCi/g)	5th (Bq/g) (pCi/g)	50th (Bq/g) (pCi/g)	95th (Bq/g) (pCi/g)
Pb-210	9.83E-03	7.31E-04	6.86E-03	2.74E-02
	2.66E-01	*1.97E-02*	*1.86E-01*	*7.42E-01*
Po-210	1.86E-03	1.40E-04	1.32E-03	5.62E-03
	5.10E-02	*3.79E-03*	*3.56E-02*	*1.42E-01*
Bi-210	2.66E-03	1.98E-04	1.86E-03	7.42E-03
	7.19E-02	*5.34E-03*	*5.02E-02*	*2.00E-01*
Rn-222	6.00E-03	4.46E-04	4.19E-03	1.68E-02
	1.62E-01	*1.21E-02*	*1.13E-01*	*4.53E-01*
Ra-223	9.03E-03	6.71E-04	6.31E-03	2.52E-02
	2.44E-01	*1.81E-02*	*1.70E-01*	*6.81E-01*
Ra-224	1.30E-02	9.64E-04	9.06E-03	3.62E-02
	3.51E-01	*2.61E-02*	*2.45E-01*	*9.79E-01*
Ra-226	6.00E-03	4.46E-04	4.19E-03	1.68E-02
	1.62E-01	*1.21E-02*	*1.13E-01*	*4.53E-01*
Ac-227	4.83E-03	3.59E-04	3.37E-03	1.35E-02
	1.31E-01	*9.70E-03*	*9.11E-02*	*3.64E-01*
Th-227	4.83E-03	3.59E-04	3.37E-03	1.35E-02
	1.31E-01	*9.70E-03*	*9.11E-02*	*3.64E-01*
Th-228	9.83E-04	7.31E-05	6.86E-04	2.74E-03
	2.66E-02	*1.97E-03*	*1.86E-02*	*7.42E-02*
Ra-228	1.20E-03	8.92E-05	8.38E-04	3.35E-03
	3.25E-02	*2.41E-03*	*2.27E-02*	*9.05E-02*
Th-230	2.94E-01	2.19E-02	2.06E-01	8.22E-01
	7.96E+00	*5.91E-01*	*5.56E+00*	*2.22E+01*
Pa-231	8.35E-03	6.20E-04	5.83E-03	2.33E-02
	2.26E-01	*1.68E-02*	*1.57E-01*	*6.30E-01*
Th-231	6.60E-04	4.91E-05	4.61E-04	1.84E-03
	1.78E-02	*1.33E-03*	*1.25E-02*	*4.98E-02*
Th-232	2.75E-03	2.05E-04	1.92E-03	7.68E-03
	7.44E-02	*5.53E-03*	*5.19E-02*	*2.08E-01*
Th-234	2.89E-03	2.15E-04	2.02E-03	8.06E-03
	7.80E-02	*5.80E-03*	*5.45E-02*	*2.18E-01*
U-234	3.34E-03	2.49E-04	2.33E-03	9.33E-03
	9.04E-02	*6.72E-03*	*6.31E-02*	*2.52E-01*
U-235	6.60E-04	4.91E-05	4.61E-04	1.84E-03
	1.78E-02	*1.33E-03*	*1.25E-02*	*4.98E-02*
U-238	3.23E-03	2.40E-04	2.26E-03	9.01E-03
	8.73E-02	*6.49E-03*	*6.09E-02*	*2.44E-01*

J.1.5 Dose Evaluation

Exposure scenarios were analyzed for the use of EPS and refinery end slag in the slag scenarios developed and described in Volume 1 of this report. For each of these scenarios, total effective dose equivalents (TEDE) were calculated for two cases: one using parameter values appropriate for EPS, and the second using parameter values appropriate for end slag. The scenarios are briefly described in Section J.1.5.1, parameter values are discussed in Section J.1.5.2, and results are discussed in Sections J.1.5.3 and J.1.5.4.

J.1.5.1 Scenarios Evaluated

The slag scenarios evaluated are briefly described here. The generic term "slag" is used in the title of each scenario, and as described above, both end slag and EPS were evaluated for each scenario.

"Handling slag at a refinery"

This work-related slag-handling scenario was used to evaluate the potential dose to an average individual in the group consisting of workers at steel refineries or slag blenders whose primary job is using heavy earthmoving equipment to move, load, and unload slag. The slag is stored in a pile outdoors adjacent to the refinery. The worker is exposed to contamination in refinery slag via the external, inhalation, and secondary ingestion pathways.

"Use of slag in basement construction"

This scenario was used to evaluate the potential dose to an average individual in the group of individuals that spend a large fraction of the day in a single room or building with a concrete basement constructed using slag as aggregate in the concrete. This could be a residential or work-related situation, and includes individuals that work at home (including housewives). Excluded from critical group consideration are groups of individuals that spend excessive amounts of time in a single room or building, such as invalids ("shut-ins"). These individuals were excluded primarily because they represent a small fraction of the adult U.S. population. For those individuals that work at home, the most likely situation is that they would spend the nighttime hours in a different room or basement than where the daytime hours were spent, but this may represent a maximum case. The individual is exposed to external radiation form the slag in the basement foundation.

"Use of slag in a roadbed"

This scenario was used to evaluate the potential to an average individual in the group of individuals that spend a fraction of the year driving on roads constructed with slag in the roadbed. The roadbed is constructed using unmixed slag, which is applied and compacted. The individual is exposed to external radiation from the slag in the roadbed.

"Road construction activities using slag"

This scenario was used to evaluate the potential dose to an average individual in the group of workers whose primary job is working on road construction projects using slag as aggregate material. The worker is exposed to contamination in slag via the external, inhalation, and secondary ingestion pathways.

"Transport of slag"

This scenario was used to evaluate the potential dose to an average individual in the group of workers whose primary job is driving a truck hauling slag to or from a steel refinery. The driver is exposed only to external radiation form the slag in the back of the truck.

"Processing slag for aggregate"

This scenario was used to evaluate the potential dose to an average individual in the group of workers at steel refineries whose primary job includes working in areas where slag is processed for use as aggregate or as roadbed. The worker is exposed to contamination in refinery slag via the external, inhalation, and secondary ingestion pathways.

"Disposal of slag at a landfill"

This scenario was used to evaluate the potential dose to an average individual in the group of workers at landfills whose primary job is using heavy equipment to move, load, and unload waste, some of which includes refinery slag. The worker is exposed to contamination from slag via the external, inhalation, and secondary ingestion pathways.

J.1.5.2 Parameter Values

Table J.5 contains the values used for all parameters except radionuclide concentrations (these values are in Table J.2 and Table J.4, for EPS and end slag, respectively). The parameter values for these scenarios are described in Volume 1 of this report. Tables J.6 and J.7 contain external geometry factor values and internal dose conversion factors, respectively, used in the EPS analysis. These tables – as well as the tables of results – list values for only 7 radionuclides. The reason for this is that the effects of many of the progeny radionuclides that are listed as constituents of EPS are already included implicitly in this analysis with the parent radionuclides listed in Tables J.6, J.7, and all results tables. To avoid double-counting, these progeny for these scenarios are described in Volume 1 of this report. Tables J.6 and J.7 contain external geometry factor values and internal dose conversion factors, respectively, used in the EPS radionuclides were not included explicitly in the dose estimates, only implicitly as progeny. The footnotes in the tables of results (e.g., Table J.8), list the progeny radionuclides whose dose effects are included with each parent radionuclide.

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report.

EPS: All parameter values are identical to those used in the end slag handling scenario with the following exceptions. The time-of-scenario value is set to Zero on the assumption that EPS would be sold directly to a refinery or blender. The large pile geometry factor has been used (instead of the FGR #12 infinite depth geometry) to reflect the amount of EPS likely to be at a single facility.

Table J.5 Parameter values for scenario evaluations[1]

	Time of scenario (days after release)	External Geometry Factor used[2]	Duration (hrs/yr)	Mass loading (mg/m^3)	Respirable fraction (unitless)	Breathing rate (m^{3}h)	Secondary ingestion rate (mg/hr)
Handling slag at a refinery							
End slag	14.5 [29] 43.5 UNIFORM	FGR #12 x SF SF=0.3 [0.5] 0.7 TRI	500 [1000] 1500 Uniform	1.3[3.9]7.4 TRI	.23[.33].42	0.6[1.2]3.0	2.1[10]30 TRI
EPS	0 Fixed	Large Pile UF=0.07[0.5]1.0 TRI					
Use of slag in basement construction							
End slag	18[36]54 UNIFORM	Inside Sphere UF=0.07[0.2]0.8 TRI	1400[2800] 4200 UNIFORM	n/a	n/a	n/a	n/a
EPS	3[7]11 UNIFORM						
Use of slag in a roadbed							
End slag	18[36]54 UNIFORM	FGR#12	250[500]750 UNIFORM	n/a	n/a	n/a	n/a
EPS	3[7]11 UNIFORM						
Road construction activities using slag							
End slag	18[36]54 UNIFORM	FGR#12 UF=0.3[0.5]1.0 TRI	120[500]750 UNIFORM	1.3[3.9]7.4 TRI	.23[.33].42 TRI	0.6[1.2]3.0 TRI	2.1[10]30 TRI
EPS	3[7]11 UNIFORM						
Transport of slag							
End slag	17[34]51 UNIFORM	Driver UF=0.5[1.0]1.05 TRI	500[1000] 1250 UNIFORM	n/a	n/a	n/a	n/a
EPS	0 FIXED						
Processing slag for aggregate							
End slag	16[32]48 UNIFORM	Large Pile UF=0.5[1.0]1.05 TRI	500[1000] 1500 UNIFORM	1.3[3.9]7.4 TRI	.23[.33].42 TRI	0.6[1.2]3.0 TRI	2.1[10]30 TRI
EPS	0 FIXED						
Disposal of slag at a landfill							
End slag	18[36]54 UNIFORM	FGR#12xSF SF=0.3[0.5]0.7 TRI	180[360]540 UNIFORM	1.3[3.9]7.4 TRI	.23[33].42 TRI	0.6[1.2]3.0 TRI	2.1[10]30 TRI
EPS	0 FIXED		500[1000] 1500 UNIFORM				

1."Fixed" indicates that no uncertainty is associated with this parameter value in the model. Where multiple values are listed: minimum, [most likely], maximum values for triangular distributions (TRI); and minimum, [deterministic], maximum values for uniform distributions (UNIFORM)
2. FGR#12=Federal Guidance Report #12, soil infinite depth; SF=Shielding Factor; UF=Uncertainty Factor; Large Pile, Inside Sphere, and Driver geometry factors are described in SAIC (1997).

Table J.6 Geometry factors used

	FGR#12-Infinite Depth (mrem/hr per pCi/m³)	Large Pile (mrem/hr per pCi/g)	Inside Sphere (mrem/hr per pCi/g)	Driver (mrem/hr per pCi/g)
Ra-226	7.98E-01	2.82E-04	1.62E-03	8.24E-04
Th-230	8.62E-14	1.71E-09	2.20E-08	1.09E-08
Pa-231	9.99E-11	2.78E-05	1.96E-04	9.47E-05
Th-232	1.20E-09	2.97E-04	2.09E-03	9.69E-04
U-234	2.86E-14	1.14E-10	6.75E-09	1.79E09
U-235	5.40E-11	1.02E-05	8.05E-05	3.95E-05
U-238	8.12E-12	1.33E-06	8.58E-06	3.88E-06

Table J.7 Internal dose conversion factors used (mrem/pCi)

	Inhalation	Ingestion
Ra-226	2.25E-02	5.69E-03
Th-230	2.62E-01	5.48E-04
Pa-231	4.89E+00	1.94E-02
Th-232	1.49E+00	4.90E-03
U-234	1.32E-01	2.61E-05
U-235	1.23E-01	2.80E-05
U-238	1.18E-01	3.74E-05

"Handling slag at a refinery"

"Use of slag in basement construction"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1.

EPS: All parameter values are identical to those used in the end slag basement construction scenario with the following exceptions. The time-of-scenario value reflects direct transfer to a processing facility and immediate use after processing. No delay for passage through a steel refinery is included. This treatment is consistent with that for processing refinery slag and recycling concrete.

"Use of slag in roadbed"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report.

EPS: All parameter values are identical to those used in the end slag roadbed scenario with the following exceptions. The time-of-scenario value reflects direct transfer to a processing facility and immediate use after processing. No delay for passage through a steel refinery is included. This treatment is consistent with that for processing refinery slag and recycling concrete.

"Road construction activities using slag"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report.

EPS: All parameter values are identical to those used in the end slag road construction scenario with the following exceptions. The time-of-scenario value reflects direct transfer to a processing facility and immediate use after processing. No delay for passage through a steel refinery is included. This treatment is consistent with that for processing refinery slag and recycling concrete.

"Transport of slag"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report.

EPS: All parameter values are identical to those used in the end slag transport scenario.

"Processing slag for aggregate"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report.

EPS: All parameter values are identical to those used in the end slag processing scenario with the following exceptions. The time-of-scenario value is set to zero on the assumption that EPS would be sold directly to a processing facility.

"Disposal of slag at a landfill"

End Slag: Parameter values are identical to those used in the corresponding steel slag scenario in Volume 1 of this report. Changes from SAIC (1997) are as follows: uncertainty in the time-of-scenario has been including; a shielding factor (SF) has been included with the GF to account for shielding by earthmoving equipment during slag handling; occupational exposure time has been reduced to account for time not in the presence of slag; a uniform distribution has been adopted for occupational exposure time to reflect industry variation and quality of available data.

EPS: All parameter values are identical to those used in the end slag disposal scenario with the following exceptions. The time-of-scenario value is set to zero on the assumption that EPS would be shipped directly to a landfill. Worker exposure time is larger than for end slag disposal because it is reasonable to assume that Shieldalloy would dispose of the EPS as quickly as possible (i.e., within a year); this would result in a greater level of disposal activity for a single year.

J.1.5.3 Results of Dose Evaluation

Doses and dose factors (normalized to a unit concentration) were calculated for both radionuclide concentrations in EPS and in end slag. The calculated mean doses represent estimates of the doses to an average individual in the exposed population for each scenario, resulting from the use of EPS (Tables J.8–J.14) and end slag (Tables J.15–J.21) in the various "slag" scenarios. Tables J.8–J.21 show representative values from the uncertainty analysis for EPS in each scenario. The 5th percentile and 95th percentile values define the range of the confidence interval for possible doses for an individual in the exposed group in each scenario. The mean (arithmetic average) dose from the distribution is used as the point estimate dose for each scenario, because the output distribution represents variability among calculated doses in a defined population (Hoffman 1997). The mean and median (50th percentile) doses for each radionuclide are sometimes very close to one another, however the mean dose is typically higher than the median dose, indicating that the output distribution from the uncertainty analysis is positively skewed (more occurences at the low end than at the high end).

The calculated mean *dose factors* are the mean doses normalized to a unit concentration in the initial material—i.e., the calculated mean radionuclide dose divided by the initial radionuclide concentration in EPS. Although other values from the distributions are not displayed in Tables J.8–J.21, the dose factors exhibit similar distributional characteristics as the calculated doses.

J.1.5.4 Discussion of Dose Evaluation Results

Several conclusions can be drawn from an examination of the calculated doses. Most obvious is the significant magnitude and range of some of the calculated doses. The handling scenarios (e.g., "Handling slag at a refinery") all describe similar activities, and they result in mean total calculated doses that are approximately 1 rem/y. Even the low-end values of the dose range for these scenarios (i.e., the 5th percentile) exceed the current NRC dose limit for members of the public of 100 mrem/yr in a calendar year. This means, based on the results of this analysis, that it is very likely that the dose limit would be exceeded for individuals in these types of exposure scenarios. The primary exposure pathway in the handling scenarios is inhalation of resuspended material, which typically contributes 95% of the total calculated dose. Also, the range of the calculated doses for these scenarios shows that they are highly uncertain, ranging over roughly an order of magnitude. Both the magnitude and the range of calculated doses for the scenarios that do not involve handling slag material are much smaller (e.g., "Use of EPS/End slag in basement

J.8 Results for "Handling EPS at a refinery"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	5.0E+01	9.2E+01	1.5E+02	9.4E+01	1.2E+02
	5.0E+00	9.2E+00	1.5E+01	9.4E+00	4.5E-01
Th-230	2.0E+03	5.3E+03	1.3E+04	5.9E+03	1.6E+02
	2.0E+02	5.3E+02	1.3E+03	5.9E+02	5.8E-01
Pa-231	1.1E+03	2.9E+03	6.7E+03	3.2E+03	3.0E+03
	1.1E+02	2.9E+02	6.7E+02	3.2E+02	1.1E+01
Th-232	1.4E+02	3.2E+02	6.9E+02	3.5E+02	9.8E+02
	1.4E+01	3.2E+01	6.9E+01	3.5E+01	3.6E+00
U-234	1.1E+01	3.0E+01	7.2E+01	3.4E+01	7.8E+01
	1.1E+00	3.0E+00	7.2E+00	3.4E+00	2.9E-01
U-235	2.3E+00	5.8E+00	1.3E+01	6.5E+00	7.6E+01
	2.3E-01	5.8E-01	1.3E+00	6.5E-01	2.8E-01
U-238	9.7E+00	2.6E+01	6.2E+01	2.9E+01	7.0E+01
	9.7E-01	2.6E+00	6.2E+00	2.9E+00	2.6E-01
Total				9.7E+03	
				9.7E+02	

J.9 Results for "Processing EPS for slag"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	5.0E+01	8.8E+01	1.5E+02	9.4E+01	1.2E+02
	5.0E+00	8.8E+00	1.5E+01	9.4E+00	4.5E-01
Th-230	1.9E+03	5.2E+03	1.2E+04	6.0E+03	1.6E+02
	1.9E+02	5.2E+02	1.2E+03	6.0E+02	5.8E-01
Pa-231	1.1E+03	2.8E+03	6.5E+03	3.2E+03	3.0E+03
	1.1E+02	2.8E+02	6.5E+02	3.2E+02	1.1E+01
Th-232	1.4E+02	3.1E+02	6.7E+02	3.5E+02	9.9E+02
	1.4E+01	3.1E+01	6.7E+01	3.5E+01	3.7E+00
U-234	1.1E+01	2.9E+01	6.8E+01	3.4E+01	7.9E+01
	1.1E+00	2.9E+00	6.8E+00	3.4E+00	2.9E-01
U-235	2.3E+00	5.6E+00	1.3E+01	6.5E+00	7.6E+01
	2.3E-01	5.6E-01	1.3E+00	6.5E-01	2.8E-01
U-238	9.5E+00	2.6E+01	5.9E+01	3.0E+01	7.1E+01
	9.5E-01	2.6E+00	5.9E+00	3.0E+00	2.6E-01
Total				9.7E+03	
				9.7E+02	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210.

- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227.
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.10 Results for "Road construction activities using EPS"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**4.3E+01**	**1.2E+02**	**2.3E+02**	**1.2E+02**	**1.6E+02**
	4.3E+00	1.2E+01	2.3E+01	1.2E+01	5.9E-01
Th-230	**7.8E+02**	**3.1E+03**	**9.3E+03**	**4.0E+03**	**1.0E+02**
	7.8E+01	3.1E+02	9.3E+02	4.0E+02	3.8E-01
Pa-231	**4.6E+02**	**1.7E+03**	**5.0E+03**	**2.1E+03**	**2.0E+03**
	4.6E+01	1.7E+02	5.0E+02	2.1E+02	7.3E+00
Th-232	**1.0E+02**	**2.6E+02**	**5.6E+02**	**2.9E+02**	**8.0E+02**
	1.0E+01	2.6E+01	5.6E+01	2.9E+01	3.0E+00
U-234	**4.2E+00**	**1.8E+01**	**5.3E+01**	**2.3E+01**	**5.2E+01**
	4.2E-01	1.8E+00	5.3E+00	2.3E+00	1.9E-01
U-235	**1.5E+00**	**4.2E+00**	**1.0E+01**	**4.9E+00**	**5.8E+01**
	1.5E-01	4.2E-01	1.0E+00	4.9E-01	2.1E-01
U-238	**4.0E+00**	**1.6E+01**	**4.6E+01**	**2.0E+01**	**4.8E+01**
	4.0E-01	1.6E+00	4.6E+00	2.0E+00	1.8E-01
Total				6.6E+03	
				6.6E+02	

J.11 Results for "Disposal of EPS at a landfill"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**5.7E+01**	**1.0E+02**	**1.7E+02**	**1.1E+02**	**1.4E+02**
	5.7E+00	*1.0E+01*	*1.7E+01*	*1.1E+01*	*5.1E-01*
Th-230	**1.9E+03**	**5.3E+03**	**1.3E+04**	**6.0E+03**	**1.6E+02**
	1.9E+02	*5.3E+02*	*1.3E+03*	*6.0E+02*	*5.8E-01*
Pa-231	**1.0E+03**	**2.9E+03**	**6.8E+03**	**3.2E+03**	**3.0E+03**
	1.0E+02	*2.9E+02*	*6.8E+02*	*3.2E+02*	*1.1E+01*
Th-232	**1.6E+02**	**3.4E+02**	**7.5E+02**	**3.8E+02**	**1.1E+03**
	1.6E+01	*3.4E+01*	*7.5E+01*	*3.8E+01*	*3.9E+00*
U-234	**1.0E+01**	**3.0E+01**	**7.3E+01**	**3.4E+01**	**7.9E+01**
	1.0E+00	*3.0E+00*	*7.3E+00*	*3.4E+00*	2.9E-01
U-235	**2.5E+00**	**6.2E+00**	**1.4E+01**	**6.8E+00**	***8.0E+01***
	2.5E-01	*6.2E-01*	*1.4E+00*	*6.8E-01*	*3.0E-01*
U-238	**9.5E+00**	**2.6E+01**	**6.4E+01**	**3.0E+01**	**7.1E+01**
	9.5E-01	*2.6E+00*	*6.4E+00*	*3.0E+00*	*2.6E-01*
Total				9.8E+03	
				9.8E+02	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210.

- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227.
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.12 Results for "Use of EPS in a roadbed"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	4.9E+01	9.7E+01	1.6E+02	9.8E+01	1.3E+02
	4.9E+00	9.7E+00	1.6E+01	9.8E+00	4.7E-01
Th-230	2.6E-01	5.1E-01	8.3E-01	5.2E-01	1.4E-02
	2.6E-02	5.1E-02	8.3E-02	5.2E-02	5.1E-05
Pa-231	8.5E+00	1.7E+01	2.7E+01	1.7E+01	1.6E+01
	8.5E-01	1.7E+00	2.7E+00	1.7E+00	5.9E-02
Th-232	3.4E+01	6.7E+01	1.1E+02	6.8E+01	1.9E+02
	3.4E+00	6.7E+00	1.1E+01	6.8E+00	7.1E-01
U-234	9.8E-04	1.9E-03	3.2E-03	2.0E-03	4.5E-03
	9.8E-05	1.9E-04	3.2E-04	2.0E-04	1.7E-05
U-235	3.7E-01	7.2E-01	1.2E+00	7.3E-01	8.6E+00
	3.7E-02	7.2E-02	1.2E-01	7.3E-02	3.2E-02
U-238	2.7E-01	5.3E-01	8.6E-01	5.4E-01	1.3E+00
	2.7E-02	5.3E-02	8.6E-02	5.4E-02	4.8E-03
Total				1.9E+02	
				1.9E+01	

J.13 Results for "Use of EPS in basement construction"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	1.6E+00	5.9E+00	1.7E+01	7.1E+00	9.2E+00
	1.6E-01	5.9E-01	1.7E+00	7.1E-01	3.4E-02
Th-230	1.1E-03	3.9E-03	1.1E-02	4.7E-03	1.2E-04
	1.1E-04	3.9E-04	1.1E-03	4.7E-04	4.6E-07
Pa-231	2.7E-01	9.9E-01	2.8E+00	1.2E+00	1.1E+00
	2.7E-02	9.9E-02	2.8E-01	1.2E-01	4.1E-03
Th-232	9.4E-01	3.5E+00	1.0E+01	4.2E+00	1.2E+01
	9.4E-02	3.5E-01	1.0E+00	4.2E-01	4.4E-02
U-234	3.7E-06	1.4E-05	3.9E-05	1.7E-05	3.8E-05
	3.7E-07	1.4E-06	3.9E-06	1.7E-06	1.4E-07
U-235	8.7E-03	3.2E-02	9.2E-02	3.9E-02	4.6E-01
	8.7E-04	3.2E-03	9.2E-03	3.9E-03	1.7E-03
U-238	4.5E-03	1.7E-02	4.8E-02	2.0E-02	4.9E-02
	4.5E-04	1.7E-03	4.8E-03	2.0E-03	1.8E-04
Total				1.3E+01	
				1.3E+00	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210

- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb- 212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.14 Results for "Transport of EPS"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**7.5E+01**	**1.3E+02**	**1.9E+02**	**1.3E+02**	**1.7E+02**
	7.5E+00	1.3E+01	1.9E+01	1.3E+01	6.1E-01
Th-230	**4.8E-02**	**8.2E-02**	**1.3E-01**	**8.3E-02**	**2.2E-03**
	4.8E-03	8.2E-03	1.3E-02	8.3E-03	8.1E-06
Pa-231	**1.2E+01**	**2.0E+01**	**3.1E+01**	**2.1E+01**	**1.9E+01**
	1.2E+00	2.0E+00	3.1E+00	2.1E+00	7.0E-02
Th-232	**4.0E+01**	**6.8E+01**	**1.0E+02**	**6.9E+01**	**1.9E+02**
	4.0E+00	6.8E+00	1.0E+01	6.9E+00	7.2E-01
U-234	**8.9E-05**	**1.5E-04**	**2.3E-04**	**1.5E-04**	**3.5E-04**
	8.9E-06	1.5E-05	2.3E-05	1.5E-05	1.3E-06
U-235	**3.9E-01**	**6.6E-01**	**1.0E+00**	**6.8E-01**	**7.9E+00**
	3.9E-02	6.6E-02	1.0E-01	6.8E-02	2.9E-02
U-238	**1.9E-01**	**3.2E-01**	**4.9E-01**	**3.3E-01**	**7.8E-01**
	1.9E-02	3.2E-02	4.9E-02	3.3E-02	2.9E-03
Total				2.2E+02	
				2.2E+01	

J.15 Results for "Handling end slag at a refinery"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**4.7E-02**	**5.7E-01**	**2.5E+00**	**8.4E-01**	**1.1E+00**
	4.7E-03	5.7E-02	2.5E-01	8.4E-02	4.0E-03
Th-230	**2.0E+00**	**2.7E+01**	**1.7E+02**	**4.7E+01**	**1.2E+00**
	2.0E-01	2.7E+00	1.7E+01	4.7E+00	4.6E-03
Pa-231	**1.3E+00**	**1.5E+01**	**8.7E+01**	**2.5E+01**	**2.3E+01**
	1.3E-01	1.5E+00	8.7E+00	2.5E+00	8.6E-02
Th-232	**2.0E-01**	**1.8E+00**	**9.7E+00**	**2.9E+00**	**8.2E+00**
	2.0E-02	1.8E-01	9.7E-01	2.9E-01	3.0E-02
U-234	**1.6E-02**	**1.5E-01**	**8.8E-01**	**2.6E-01**	**6.0E-01**
	1.6E-03	1.5E-02	8.8E-02	2.6E-02	2.2E-03
U-235	**3.0E-03**	**3.2E-02**	**1.6E-01**	**5.1E-02**	**6.0E-01**
	3.0E-04	3.2E-03	1.6E-02	5.1E-03	2.2E-03
U-238	**1.0E-02**	**1.4E-01**	**8.3E-01**	**2.4E-01**	**5.6E-01**
	1.0E-03	1.4E-02	8.3E-02	2.4E-02	2.1E-03
Total				7.6E+01	
				7.6E+00	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210.

- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227.
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.16 Results for "Processing end slag for aggregate"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**4.2E-02**	**4.7E-01**	**2.2E+00**	**7.2E-01**	**9.2E-01**
	4.2E-03	4.7E-02	2.2E-01	7.2E-02	3.4E-03
Th-230	**2.3E+00**	**2.7E+01**	**1.5E+02**	**4.4E+01**	**1.1E+00**
	2.3E-01	2.7E+00	1.5E+01	4.4E+00	4.2E-03
Pa-231	**1.3E+00**	**1.5E+01**	**7.5E+01**	**2.5E+01**	**2.3E+01**
	1.3E-01	1.5E+00	7.5E+00	2.5E+00	8.4E-02
Th-232	**1.4E-01**	**1.6E+00**	**8.4E+00**	**2.7E+00**	**7.5E+00**
	1.4E-02	1.6E-01	8.4E-01	2.7E-01	2.8E-02
U-234	**9.9E-03**	**1.6E-01**	**7.4E-01**	**2.6E-01**	**5.9E-01**
	9.9E-04	1.6E-02	7.4E-02	2.6E-02	2.2E-03
U-235	**2.3E-03**	**2.9E-02**	**1.6E-01**	**5.1E-02**	**6.0E-01**
	2.3E-04	2.9E-03	1.6E-02	5.1E-03	2.2E-03
U-238	**1.1E-02**	**1.3E-01**	**7.4E-01**	**2.3E-01**	**5.4E-01**
	1.1E-03	1.3E-02	7.4E-02	2.3E-02	2.0E-03
Total				7.2E+01	
				7.2E+00	

J.17 Results for "Road construction activities using end slag"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**4.7E-02**	**5.8E-01**	**3.1E+00**	**9.5E-01**	**1.2E+00**
	4.7E-03	5.8E-02	3.1E-01	9.5E-02	4.5E-03
Th-230	**1.2E+00**	**1.6E+01**	**1.0E+02**	**3.0E+01**	**7.8E-01**
	1.2E-01	1.6E+00	1.0E+01	3.0E+00	2.9E-03
Pa-231	**5.8E-01**	**8.8E+00**	**5.9E+01**	**1.7E+01**	**1.5E+01**
	5.8E-02	8.8E-01	5.9E+00	1.7E+00	5.7E-02
Th-232	**1.2E-01**	**1.3E+00**	**7.0E+00**	**2.1E+00**	**6.0E+00**
	1.2E-02	1.3E-01	7.0E-01	2.1E-01	2.2E-02
U-234	**5.5E-03**	**9.7E-02**	**6.9E-01**	**1.8E-01**	**4.1E-01**
	5.5E-04	9.7E-03	6.9E-02	1.8E-02	1.5E-03
U-235	**1.9E-03**	**2.3E-02**	**1.2E-01**	**3.8E-02**	**4.4E-01**
	1.9E-04	2.3E-03	1.2E-02	3.8E-03	1.6E-03
U-238	**5.3E-03**	**8.3E-02**	**5.9E-01**	**1.5E-01**	**3.7E-01**
	5.3E-04	8.3E-03	5.9E-02	1.5E-02	1.4E-03
Total				5.0E+01	
				5.0E+00	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210
- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227.
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb- 212, Bi-212, and Tl-208
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.18 Results for "Disposal of end slag at a landfill"

Radionuclide	Doses (TEDE) 5th (μSv/y) (mrem/y)	50th (μSv/y) (mrem/y)	95th (μSv/y) (mrem/y)	Mean (μSv/y) (mrem/y)	Dose Factors (μSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	1.9E-02	1.8E-01	9.8E-01	3.0E-01	3.9E-01
	1.9E-03	1.8E-02	9.8E-02	3.0E-02	1.4E-03
Th-230	7.8E-01	1.0E+01	5.3E+01	1.7E+01	4.3E-01
	7.8E-02	1.0E+00	5.3E+00	1.7E+00	1.6E-03
Pa-231	4.8E-01	5.1E+00	2.6E+01	8.9E+00	8.3E+00
	4.8E-02	5.1E-01	2.6E+00	8.9E-01	3.1E-02
Th-232	6.9E-02	6.2E-01	3.5E+00	1.0E+00	2.9E+00
	6.9E-03	6.2E-02	3.5E-01	1.0E-01	1.1E-02
U-234	5.2E-03	5.8E-02	3.1E-01	9.5E-02	2.2E-01
	5.2E-04	5.8E-03	3.1E-02	9.5E-03	8.1E-04
U-235	1.1E-03	1.1E-02	6.1E-02	1.9E-02	2.2E-01
	1.1E-04	1.1E-03	6.1E-03	1.9E-03	8.2E-04
U-238	4.4E-03	4.9E-02	2.4E-01	8.0E-02	1.9E-01
	4.4E-04	4.9E-03	2.4E-02	8.0E-03	7.0E-04
Total				2.7E+01	
				2.7E+00	

J.19 Results for "Use of end slag in a roadbed"

Radionuclide	Doses (TEDE) 5th (μSv/y) (mrem/y)	50th (μSv/y) (mrem/y)	95th (μSv/y) (mrem/y)	Mean (μSv/y) (mrem/y)	Dose Factors (μSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	5.0E-02	5.0E-01	2.3E+00	7.6E-01	9.8E-01
	5.0E-03	5.0E-02	2.3E-01	7.6E-02	3.6E-03
Th-230	2.5E-04	2.8E-03	1.3E-02	4.0E-03	1.1E-04
	2.5E-05	2.8E-04	1.3E-03	4.0E-04	3.9E-07
Pa-231	7.9E-03	8.4E-02	4.2E-01	1.3E-01	1.2E-01
	7.9E-04	8.4E-03	4.2E-02	1.3E-02	4.5E-04
Th-232	3.4E-02	3.3E-01	1.7E+00	5.3E-01	1.5E+00
	3.4E-03	3.3E-02	1.7E-01	5.3E-02	5.5E-03
U-234	9.2E-07	9.5E-06	4.8E-05	1.5E-05	3.5E-05
	9.2E-08	9.5E-07	4.8E-06	1.5E-06	1.3E-07
U-235	4.1E-04	3.6E-03	1.8E-02	5.5E-03	6.4E-02
	4.1E-05	3.6E-04	1.8E-03	5.5E-04	2.4E-04
U-238	2.9E-04	2.5E-03	1.3E-02	4.2E-03	1.0E-02
	2.9E-05	2.5E-04	1.3E-03	4.2E-04	3.7E-05
Total				1.4E+00	
				1.4E-01	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210.
- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227.
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

J.20 Results for "Use of end slag in basement construction"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**2.4E-03**	**2.9E-02**	**2.1E-01**	**5.4E-02**	**7.0E-02**
	2.4E-04	2.9E-03	2.1E-02	5.4E-03	2.6E-04
Th-230	**2.0E-06**	**1.8E-05**	**1.4E-04**	**3.6E-05**	**9.5E-07**
	2.0E-07	1.8E-06	1.4E-05	3.6E-06	3.5E-09
Pa-231	**3.7E-04**	**4.8E-03**	**3.1E-02**	**9.4E-03**	**8.7E-03**
	3.7E-05	4.8E-04	3.1E-03	9.4E-04	3.2E-05
Th-232	**1.6E-03**	**1.7E-02**	**1.0E-01**	**3.1E-02**	**8.7E-02**
	1.6E-04	1.7E-03	1.0E-02	3.1E-03	3.2E-04
U-234	**5.3E-09**	**7.3E-08**	**4.7E-07**	**1.3E-07**	**3.1E-07**
	5.3E-10	7.3E-09	4.7E-08	1.3E-08	1.1E-09
U-235	**1.2E-05**	**1.5E-04**	**1.1E-03**	**3.0E-04**	**3.5E-03**
	1.2E-06	1.5E-05	1.1E-04	3.0E-05	q.3E-05
U-238	**5.3E-06**	**8.0E-05**	**5.4E-04**	**1.6E-04**	**3.8E-04**
	5.3E-07	8.0E-06	5.4E-05	1.6E-05	1.4E-06
Total				9.5E-02	
				9.5E-03	

J.21 Results for "Transport of end slag"

Radionuclide	Doses (TEDE) 5th (µSv/y) (mrem/y)	50th (µSv/y) (mrem/y)	95th (µSv/y) (mrem/y)	Mean (µSv/y) (mrem/y)	Dose Factors (µSv/y per Bg/g) (mrem/yr per pCi/g)
Ra-226	**6.3E-02**	**6.5E-01**	**3.1E+00**	**1.0E+00**	**1.3E+00**
	6.3E-03	6.5E-02	3.1E-01	1.0E-01	4.8E-03
Th-230	**4.0E-05**	**4.3E-04**	**2.1E-03**	**6.5E-04**	**1.7E-05**
	4.0E-06	4.3E-05	2.1E-04	6.5E-05	6.3E-08
Pa-231	**1.0E-02**	**1.1E-01**	**4.8E-01**	**1.6E-01**	**1.5E-01**
	1.0E-03	1.1E-02	4.8E-02	1.6E-02	5.4E-04
Th-232	**3.4E-02**	**3.5E-01**	**1.6E+00**	**5.3E-01**	**1.5E+00**
	3.4E-03	3.5E-02	1.6E-01	5.3E-02	5.5E-03
U-234	**7.1E-08**	**7.3E-07**	**3.9E-06**	**1.2E-06**	**2.8E-06**
	7.1E-09	7.3E-08	3.9E-07	1.2E-07	1.0E-08
U-235	**3.5E-04**	**3.1E-03**	**1.6E-02**	**5.4E-03**	**6.3E-02**
	3.5E-05	3.1E-04	1.6E-03	5.4E-04	2.3E-04
U-238	**1.5E-04**	**1.7E-03**	**7.6E-03**	**2.5E-03**	**6.0E-03**
	1.5E-05	1.7E-04	7.6E-04	2.5E-04	2.2E-05
Total				1.7E+00	
				1.7E-01	

NOTES: Ra-226 values include equilibrium dose contributions from Rn-222, Pb-214, Bi-214, Pb-210, Bi-210, and Po-210.

- Pa-231 values include equilibrium dose contributions from Ac-227, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, and Th-227
- Th-232 values include equilibrium dose contributions from Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb- 212, Bi-212, and Tl-208.
- U-235 values include equilibrium dose contributions from Th-231.
- U-238 values include equilibrium dose contributions from Th-234 and Pa-234m.

construction"). The calculated doses for these "non-handling" scenarios are lower is that they involve only the external exposure pathway.

Also, calculated doses for most scenarios are dominated by a single radionuclide (plus progeny). The calculated doses for the scenarios involving handling slag material, e.g., "Handling s`lag at a refinery," are dominated by the inhalation of Th-230. This radionuclide contributes over 50% of the total mean calculated dose for the handling scenarios. In the non-handling scenarios (e.g., "Use of EPS/End slag in basement construction"), Ra-226 and progeny contribute at least 50% of the calculated doses, all via the external exposure pathway.

Finally, and as expected, the scenarios involving the direct use of EPS result in much higher calculated doses than the corresponding end slag scenarios. This is because the end slag concentrations are much lower then EPS (approximately 1% of the concentrations in EPS), and most other scenario parameters are the same for EPS and end slag.

J.2 Landfill resident scenarios

Historically, scenarios assessing the potential dose to individuals residing on land above a closed landfill have been analyzed as a bounding or upper-limit case. As an illustrative reference for comparison, this scenario was examined for a closed landfill that contains cleared material or byproducts of refining cleared material. These hypothetical scenarios were judged too improbable to include in the determination of critical groups. Although closed landfills are used for commercial uses (e.g., golf courses and airports) (Rathje 1991)they are not typically used for residences.

A set of landfill resident scenarios was evaluated for clearance of steel in order to give an indication of what potential doses might occur. A description of the modeling of this scenario is contained in Section 4 of the main report. The scenario includes a factor that accounts for the estimated fraction of a landfill that might be comprised of cleared material (or byproducts of refining)—see Section 4 for a discussion of this factor. The scenarios also include an assumption of food ingestion by the resident. Similar to the refinery atmospheric release scenarios, this exposure pathway is comprised of ingestion of vegetables, and ingestion of drinking water. These ingestion pathways are in addition to external, and inhalation pathways.

Dose factors were calculated for a set of four landfill resident scenarios to account for the following steel scrap and byproducts of refining: scrap steel; steel refinery slag; electric arc furnace baghouse dust; and basic oxygen furnace baghouse dust.

The highest dose factors calculated for each radionuclide in these scenarios are tabulated in Table J.22 and J.23. Dose factors for 31 radionuclides were zero in all landfill resident scenarios; these are excluded from the tables. The 31 radionuclides all have short radioactive half-lives, which accounts for the zero doses for the landfill scenarios. Dose factors for several more radionuclides listed in Table J.22 and J.23 are essentially zero. The non-zero mean dose factors range from a high of 8.9E+03 µSv/y per Bg/g (33 mrem/y per pCi/g) for Np-237 down to much less than 0.1 µSv/y per Bg/g (4E-04 mrem/y per pCi/g).

Table J.22 Highest landfill resident mass dose factors for steel recycle

	(µSv/y per Bq/g)				(mrem/y per pCi/g)				
	mean	5th	50th	95th	mean	5th	50th	95th	Scenario
H-3	1.6E-03	1.1E-05	2.7E-04	6.1E-03	6.0E-06	3.9E-08	9.9E-07	2.2E-05	FE-SCRP-LANDFIL-N
C-14	3.6E+00	1.0E-01	1.0E+00	1.4E+01	1.3E-02	3.8E-04	3.7E-03	5.4E-02	FE-SCRP-LANDFIL-N
Na-22	7.6E-07	6.0E-18	1.8E-12	6.8E-07	2.8E-09	2.2E-20	6.8E-15	2.5E-09	FE-BOFD-LANDFIL-N
Cl-36	1.8E+01	7.0E-01	7.4E+00	7.3E+01	6.7E-02	2.6E-03	2.7E-02	2.7E-01	FE-SCRP-LANDFIL-N
K-40	1.0E+01	3.9E-01	4.3E+00	3.7E+01	3.8E-02	1.5E-03	1.6E-02	1.4E-01	FE-SCRP-LANDFIL-N
Ca-41	1.5E+00	4.1E-02	5.2E-01	6.4E+00	5.6E-03	1.5E-04	1.9E-03	2.4E-02	FE-SCRP-LANDFIL-N
Mn-54	1.3E-19	1.6E-51	1.5E-35	3.7E-20	4.7E-22	5.7E-54	5.6E-38	1.4E-22	FE-SCRP-LANDFIL-N
Fe-55	8.6E-10	5.3E-19	4.0E-14	3.5E-09	3.2E-12	1.9E-21	1.5E-16	1.3E-11	FE-SCRP-LANDFIL-N
Co-57	2.1E-23	1.5E-60	8.1E-42	5.5E-24	7.9E-26	5.5E-63	3.0E-44	2.0E-26	FE-SCRP-LANDFIL-N
Ni-59	7.3E-03	1.8E-04	2.4E-03	2.8E-02	2.7E-05	6.7E-07	8.8E-06	1.0E-04	FE-SCRP-LANDFIL-N
Co-60	1.7E-03	1.5E-08	8.6E-06	6.3E-03	6.3E-06	5.5E-11	3.2E-08	2.3E-05	FE-SCRP-LANDFIL-N
Ni-63	8.8E-03	2.7E-04	3.1E-03	3.5E-02	3.3E-05	9.9E-07	1.1E-05	1.3E-04	FE-SCRP-LANDFIL-N
Zn-65	2.8E-24	3.9E-66	2.2E-46	4.5E-26	1.0E-26	1.4E-68	8.2E-49	1.7E-28	FE-BOFD-LANDFIL-N
Sr-90	3.5E-01	1.4E-02	1.4E-01	1.4E+00	1.3E-03	5.3E-05	5.1E-04	5.2E-03	FE-SCRP-LANDFIL-N
Mo-93	4.0E+00	1.2E-01	1.7E+00	1.7E+01	1.5E-02	4.4E-04	6.2E-03	6.4E-02	FE-SCRP-LANDFIL-N
Nb-93m	8.3E-05	1.4E-06	2.5E-05	3.5E-04	3.1E-07	5.3E-09	9.2E-08	1.3E-06	FE-SCRP-LANDFIL-N
Nb-94	1.7E+01	9.6E-02	2.6E+00	8.4E+01	6.3E-02	3.6E-04	9.8E-03	3.1E-01	FE-SCRP-LANDFIL-N
Tc-99	1.4E+01	1.3E+00	6.6E+00	5.6E+01	5.1E-02	4.8E-03	2.4E-02	2.1E-01	FE-SCRP-LANDFIL-N
Ru-106	1.8E-18	7.6E-45	7.7E-32	2.3E-18	6.7E-21	2.8E-47	2.9E-34	8.5E-21	FE-SCRP-LANDFIL-N
Ag-108m	9.5E+00	5.5E-02	1.5E+00	5.0E+01	3.5E-02	2.0E-04	5.5E-03	1.8E-01	FE-SCRP-LANDFIL-N
Cd-109	7.0E-15	1.7E-35	6.6E-25	1.6E-14	2.6E-17	6.4E-38	2.4E-27	6.0E-17	FE-SCRP-LANDFIL-N
Ag-110m	1.3E-23	4.0E-64	9.7E-44	1.5E-24	4.9E-26	1.5E-66	3.6E-46	5.6E-27	FE-SCRP-LANDFIL-N
Sb-125	2.7E-07	7.2E-17	8.9E-12	7.3E-07	1.0E-09	2.7E-19	3.3E-14	2.7E-09	FE-SCRP-LANDFIL-N
I-129	4.4E+02	3.1E+01	1.8E+02	1.6E+03	1.6E+00	1.2E-01	6.8E-01	5.9E+00	FE-SCRP-LANDFIL-N
Ba-133	1.5E-02	2.7E-05	1.1E-03	7.2E-02	5.5E-05	9.8E-08	4.0E-06	2.7E-04	FE-SCRP-LANDFIL-N
Cs-134	2.4E-08	1.6E-21	7.4E-15	3.1E-08	8.9E-11	5.9E-24	2.7E-17	1.1E-10	FE-BOFD-LANDFIL-N
Cs-137	2.3E+00	7.1E-02	8.7E-01	9.9E+00	8.6E-03	2.6E-04	3.2E-03	3.7E-02	FE-SCRP-LANDFIL-N
Ce-144	6.4E-23	1.9E-59	5.8E-42	5.7E-24	2.4E-25	6.9E-62	2.2E-44	2.1E-26	FE-SLAG-LANDFIL-N
Pm-147	2.7E-10	8.1E-12	6.5E-11	1.1E-09	1.0E-12	3.0E-14	2.4E-13	4.0E-12	FE-SCRP-LANDFIL-N
Eu-152	1.3E-01	5.5E-06	1.7E-03	2.0E-01	4.7E-04	2.0E-08	6.4E-06	7.5E-04	FE-SLAG-LANDFIL-N
Eu-154	3.0E-02	2.6E-07	1.4E-04	4.8E-02	1.1E-04	9.5E-10	5.1E-07	1.8E-04	FE-SLAG-LANDFIL-N
Eu-155	1.3E-05	1.4E-12	4.9E-09	1.6E-05	4.9E-08	5.0E-15	1.8E-11	5.8E-08	FE-SLAG-LANDFIL-N
Pb-210	2.9E+00	6.5E-02	8.6E-01	1.2E+01	1.1E-02	2.4E-04	3.2E-03	4.3E-02	FE-SCRP-LANDFIL-N
Ra-226	2.6E+02	1.1E+01	9.9E+01	1.1E+03	9.5E-01	3.9E-02	3.7E-01	3.9E+00	FE-SCRP-LANDFIL-N
Ac-227	9.0E+00	2.8E-01	2.9E+00	4.4E+01	3.3E-02	1.0E-03	1.1E-02	1.6E-01	FE-SCRP-LANDFIL-N
Th-228	6.3E-09	9.1E-24	1.1E-16	3.9E-09	2.3E-11	3.4E-26	3.9E-19	1.5E-11	FE-SLAG-LANDFIL-N
Ra-228	8.1E-03	3.6E-09	6.1E-06	8.8E-03	3.0E-05	1.3E-11	2.2E-08	3.2E-05	FE-SLAG-LANDFIL-N
Th-229	1.3E+02	1.4E+00	2.4E+01	4.8E+02	4.7E-01	5.3E-03	8.8E-02	1.8E+00	FE-SCRP-LANDFIL-N
Th-230	2.0E+01	2.8E-01	4.1E+00	9.0E+01	7.6E-02	1.0E-03	1.5E-02	3.3E-01	FE-SCRP-LANDFIL-N
Pa-231	5.5E+02	1.8E+01	1.9E+02	2.4E+03	2.0E+00	6.6E-02	6.9E-01	8.9E+00	FE-SCRP-LANDFIL-N
Th-232	1.1E+02	1.3E+00	2.4E+01	4.6E+02	4.1E-01	4.9E-03	8.9E-02	1.7E+00	FE-SCRP-LANDFIL-N
U-233	3.2E+01	8.8E-01	1.1E+01	1.3E+02	1.2E-01	3.3E-03	4.1E-02	4.8E-01	FE-SCRP-LANDFIL-N
U-234	3.2E+01	8.8E-01	1.0E+01	1.2E+02	1.2E-01	3.3E-03	3.8E-02	4.5E-01	FE-SCRP-LANDFIL-N
U-235	3.1E+01	1.0E+00	1.2E+01	1.1E+02	1.2E-01	3.7E-03	4.4E-02	4.0E-01	FE-SCRP-LANDFIL-N
Np-237	8.9E+03	2.3E+02	3.1E+03	3.7E+04	3.3E+01	8.5E-01	1.1E+01	1.4E+02	FE-SCRP-LANDFIL-N
Pu-238	7.9E+00	1.1E-01	1.4E+00	3.6E+01	2.9E-02	3.9E-04	5.2E-03	1.3E-01	FE-SCRP-LANDFIL-N
U-238	2.8E+01	6.9E-01	9.8E+00	1.1E+02	1.1E-01	2.6E-03	3.6E-02	4.2E-01	FE-SCRP-LANDFIL-N
Pu-239	2.0E+01	2.5E-01	3.3E+00	7.6E+01	7.3E-02	9.1E-04	1.2E-02	2.8E-01	FE-SCRP-LANDFIL-N
Pu-240	1.9E+01	2.0E-01	3.5E+00	7.6E+01	7.1E-02	7.6E-04	1.3E-02	2.8E-01	FE-SCRP-LANDFIL-N
Pu-241	5.9E+00	1.5E-01	1.7E+00	2.6E+01	2.2E-02	5.7E-04	6.2E-03	9.6E-02	FE-SCRP-LANDFIL-N
Am-241	4.0E+01	1.8E+00	1.4E+01	1.5E+02	1.5E-01	6.6E-03	5.1E-02	5.6E-01	FE-SCRP-LANDFIL-N
Cm-242	4.6E-02	2.1E-04	4.1E-03	1.9E-01	1.7E-04	7.7E-07	1.5E-05	7.2E-04	FE-SCRP-LANDFIL-N
Pu-242	1.8E+01	2.0E-01	3.2E+00	7.2E+01	6.8E-02	7.3E-04	1.2E-02	2.7E-01	FE-SCRP-LANDFIL-N
Cm-244	5.1E-01	6.8E-03	9.3E-02	2.1E+00	1.9E-03	2.5E-05	3.4E-04	7.7E-03	FE-SCRP-LANDFIL-N

Table J.23 Highest landfill resident surficial dose factors for steel recycle

	(μSv/y per Bq/cm²)				(mrem/y per pCi/cm²)				
	Mean	5th	50th	95th	Mean	5th	50th	95th	Scenario
H-3	1.2E-03	8.2E-06	2.0E-04	4.5E-03	4.6E-06	3.0E-08	7.3E-07	1.7E-05	FE-SCRP-LANDFIL-N
C-14	2.6E+00	8.2E-06	2.0E-04	4.5E-03	9.6E-03	3.0E-08	7.3E-07	1.7E-05	FE-SCRP-LANDFIL-N
Na-22	5.4E-07	4.1E-18	1.6E-12	4.8E-07	2.0E-09	1.5E-20	5.9E-15	1.8E-09	FE-BOFD-LANDFIL-N
Cl-36	1.3E+01	4.8E-01	5.0E+00	5.2E+01	5.0E-02	1.8E-03	1.8E-02	1.9E-01	FE-SCRP-LANDFIL-N
K-40	7.3E+00	3.0E-01	2.9E+00	2.8E+01	2.7E-02	1.1E-03	1.1E-02	1.0E-01	FE-SCRP-LANDFIL-N
Ca-41	1.1E+00	2.9E-02	3.4E-01	4.0E+00	4.1E-03	1.1E-04	1.2E-03	1.5E-02	FE-SCRP-LANDFIL-N
Mn-54	1.1E-19	1.7E-52	6.6E-37	4.2E-21	3.9E-22	6.2E-55	2.4E-39	1.6E-23	FE-SLAG-LANDFIL-N
Fe-55	7.0E-10	2.9E-19	3.2E-14	2.5E-09	2.6E-12	1.1E-21	1.2E-16	9.4E-12	FE-SCRP-LANDFIL-N
Co-57	1.3E-23	1.3E-60	4.1E-42	3.7E-24	4.8E-26	4.8E-63	1.5E-44	1.4E-26	FE-SCRP-LANDFIL-N
Ni-59	5.4E-03	1.3E-04	1.7E-03	2.4E-02	2.0E-05	4.9E-07	6.1E-06	8.9E-05	FE-SCRP-LANDFIL-N
Co-60	1.5E-03	1.1E-08	6.7E-06	5.7E-03	5.4E-06	4.1E-11	2.5E-08	2.1E-05	FE-SCRP-LANDFIL-N
Ni-63	6.4E-03	1.7E-04	2.1E-03	2.7E-02	2.4E-05	6.1E-07	7 9E-06	1.0E-04	FE-SCRP-LANDFIL-N
Zn-65	2.0E-24	2.6E-66	2.5E-46	2.7E-26	7.6E-27	9.6E-69	9.2E-49	9.9E-29	FE-BOFD-LANDFIL-N
Sr-90	2.6E-01	1.0E-02	1.0E-01	1.0E+00	9.7E-04	3.8E-05	3.7E-04	3.9E-03	FE-SCRP-LANDFIL-N
Mo-93	3.0E+00	1.1E-01	1.2E+00	1.3E+01	1.1E-02	4.0E-04	4.4E-03	5.0E-02	FE-SCRP-LANDFIL-N
Nb-93m	6.2E-05	8.7E-07	1.7E-05	2.7E-04	2.3E-07	3.2E-09	6.2E-08	1.0E-06	FE-SCRP-LANDFIL-N
Nb-94	1.2E+01	7.7E-02	1.7E+00	6 4E+01	4.4E-02	2.8E-04	6.4E-03	2.4E-01	FE-SCRP-LANDFIL-N
Tc-99	1.0E+01	9.3E-01	4.7E+00	3.5E+01	3.7E-02	3.4E-03	1.7E-02	1.3E-01	FE-SCRP-LANDFIL-N
Ru-106	1.2E-18	5.6E-45	6.9E-32	1.6E-18	4 3E-21	2.1E-47	2.6E-34	5.9E-21	FE-SCRP-LANDFIL-N
Ag-108m	6.8E+00	4.1E-02	9.8E-01	3.4E+01	2.5E-02	1.5E-04	3.6E-03	1.2E-01	FE-SCRP-LANDFIL-N
Cd-109	5.1E-15	1.3E-35	3.9E-25	1.1E-14	1.9E-17	4.9E-38	1.4E-27	4.1E-17	FE-SCRP-LANDFIL-N
Ag-110m	7.9E-24	3.1E-64	4.3E-44	1.2E-24	2.9E-26	1.2E-66	1.6E-46	4.6E-27	FE-SCRP-LANDFIL-N
Sb-125	2.2E-07	5.2E-17	6.5E-12	5.7E-07	8.0E-10	1.9E-19	2.4E-14	2.1E-09	FE-SCRP-LANDFIL-N
I-129	3.2E+02	2.0E+01	1.3E+02	1.3E+03	1.2E+00	7.3E-02	4.6E-01	4.7E+00	FE-SCRP-LANDFIL-N
Ba-133	1.2E-02	1.6E-05	8.2E-04	5.5E-02	4.6E-05	5.9E-08	3.0E-06	2.0E-04	FE-SCRP-LANDFIL-N
Cs-134	1.7E-08	1.0E-21	4.6E-15	1.5E-08	6.4E-11	3.8E-24	1.7E-17	5.5E-11	FE-BOFD-LANDFIL-N
Cs-137	1.8E+00	4.7E-02	6.3E-01	7.6E+00	6.6E-03	1.7E-04	2.3E-03	2.8E-02	FE-SCRP-LANDFIL-N
Ce-144	4.8E-23	1.3E-59	3.8E-42	3.2E-24	1.8E-25	5.0E-62	1.4E-44	1.2E-26	FE-SLAG-LANDFIL-N
Pm-147	2.1E-10	5.4E-12	4.9E-11	7.8E-10	7.6E-13	2.0E-14	1.8E-13	2.9E-12	FE-SCRP-LANDFIL-N
Eu-152	1.2E-01	3.2E-06	1.2E-03	1.7E-01	4.6E-04	1.2E-08	4.5E-06	6.4E-04	FE-SLAG-LANDFIL-N
Eu-154	3.2E-02	1.6E-07	8.7E-05	4.6E-02	1.2E-04	6.1E-10	3.2E-07	1.7E-04	FE-SLAG-LANDFIL-N
Eu-155	1.2E-05	1.1E-12	3.2E-09	1.1E-05	4.5E-08	4.0E-15	1.2E-11	4.2E-08	FE-SLAG-LANDFIL-N
Pb-210	2.1E+00	5.1E-02	6.0E-01	9.8E+00	7.8E-03	1.9E-04	2.2E-03	3.6E-02	FE-SCRP-LANDFIL-N
Ra-226	1.9E+02	8.2E+00	7.0E+01	8.5E+02	6.9E-01	3.0E-02	2.6E-01	3.1E+00	FE-SCRP-LANDFIL-N
Ac-227	6.8E+00	1.9E-01	2.0E+00	2.8E+01	2.5E-02	7.1E-04	7.6E-03	1.0E-01	FE-SCRP-LANDFIL-N
Th-228	6.3E-09	4.6E-24	6.9E-17	2.2E-09	2.3E-11	1.7E-26	2.6E-19	8.1E-12	FE-SLAG-LANDFIL-N
Ra-228	7.4E-03	2.8E-09	4.3E-06	7.1E-03	2.8E-05	1.0E-11	1.6E-08	2.6E-05	FE-SLAG-LANDFIL-N
Th-229	9.0E+01	1.3E+00	1.7E+01	4.1E+02	3.3E-01	4.9E-03	6.4E-02	1.5E+00	FE-SCRP-LANDFIL-N
Th-230	1.5E+01	2.2E-01	3.0E+00	7.3E+01	5.4E-02	8.1E-04	1.1E-02	2.7E-01	FE-SCRP-LANDFIL-N
Pa-231	4.2E+02	1.2E+01	1.4E+02	1.8E+03	1.5E+00	4.3E-02	5.0E-01	6.6E+00	FE-SCRP-LANDFIL-N
Th-232	7.9E+01	1.0E+00	1.6E+01	3.8E+02	2.9E-01	3.8E-03	5.9E-02	1.4E+00	FE-SCRP-LANDFIL-N
U-233	2.3E+01	6.2E-01	7.9E+00	9.6E+01	8.6E-02	2.3E-03	2.9E-02	3.5E-01	FE-SCRP-LANDFIL-N
U-234	2.4E+01	5.6E-01	7.4E+00	9.1E+01	8.9E-02	2.1E-03	2.8E-02	3.4E-01	FE-SCRP-LANDFIL-N
U-235	2.2E+01	6.5E-01	8.3E+00	9.0E+01	8.3E-02	2.4E-03	3.1E-02	3.3E-01	FE-SCRP-LANDFIL-N
Np-237	6.6E+03	1.6E+02	2.3E+03	2.5E+04	2.4E+01	5.8E-01	8.7E+00	9.1E+01	FE-SCRP-LANDFIL-N
Pu-238	5.8E+00	7.0E-02	1.0E+00	2.8E+01	2.1E-02	2.6E-04	3.8E-03	1.0E-01	FE-SCRP-LANDFIL-N
U-238	2.1E+01	4.8E-01	6.8E+00	8.4E+01	7.7E-02	1.8E-03	2.5E-02	3.1E-01	FE-SCRP-LANDFIL-N
Pu-239	1.4E+01	1.4E-01	2.3E+00	6.5E+01	5.3E-02	5.2E-04	8.5E-03	2.4E-01	FE-SCRP-LANDFIL-N
Pu-240	1.4E+01	1.5E-01	2.5E+00	6.9E+01	5.1E-02	5.6E-04	9.3E-03	2.6E-01	FE-SCRP-LANDFIL-N
Pu-241	4.3E+00	1.2E-01	1.2E+00	1.9E+01	1.6E-02	4.3E-04	4.6E-03	7.0E-02	FE-SCRP-LANDFIL-N
Am-241	2.9E+01	1.2E+00	9.4E+00	1.3E+02	1.1E-01	4.4E-03	3.5E-02	4.7E-01	FE-SCRP-LANDFIL-N
Cm-242	3.5E-02	1.5E-04	3.2E-03	1.5E-01	1.3E-04	5.7E-07	1.2E-05	5.4E-04	FE-SCRP-LANDFIL-N
Pu-242	1.3E+01	1.4E-01	2.3E+00	6.0E+01	4.9E-02	5.2E-04	8.6E-03	2.2E-01	FE-SCRP-LANDFIL-N
Cm-244	3.9E-01	4.9E-03	6.1E-02	1.9E+00	1.5E-03	1.8E-05	2.3E-04	7.0E-03	FE-SCRP-LANDFIL-N

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11. ABSTRACT *(200 words or less)*

This report documents the technical basis for the Nuclear Regulatory Commission to use in developing regulatory standards for clearing equipment and materials with residual radioactivity from nuclear facilities. In addition to equipment reuse, the analysis identifies material flow models, based on U.S. industry practices, for recycle of steel, copper, aluminum, and concrete. Using information from the material flow models, likely potential exposure scenarios were realistically modeled for the recycle of these materials. Scenarios for copper, aluminum, and concrete were based on the steel scenarios, but were modified to reflect differences in each industry, and additional exposure scenarios unique to each material were included. The modeling includes all significant exposure pathways, and scenarios include handling and processing, storage, transportation, product use, and disposal. The results of the analyses are expressed in both mass and surficial units. Using Monte Carlo techniques, distributions of radionuclide concentrations were estimated in the material flow model, and concentrations at selected points in the process were used as inputs to the dose assessment model for each scenario. Probability distributions for dose factors (along with the mean, median, 5th and 95th percentile values) were estimated for each radionuclide and each scenario. For each material (e.g. steel), a critical group was identified for each radionuclide, which represents the scenario with the highest mean dose factor. Volume 2 contains the appendices with details of the analysis and tabulations of dose assessments for clearance that are described, summarized and published in Volume 1.

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