Verification Study of the Preliminary Remediation Goals for Radionuclides (PRG) Electronic Calculator

Verifcation Study Record

April 24, 2015 - September 30, 2015

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G. Timothy Jannik (Savannah River National Laboratory)

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Wm. Thomas Pentecost (Colorado Department of Public Health and Environment (Retired)

- Review
- Curriculum Vitae
- Conflict of Interest Certification

Verification Study Charge for:

U.S. Environmental Protection Agency (EPA), "Preliminary Remediation Goals for Radionuclides" (PRG) electronic calculator

Background:

EMS, under contract EP-W-13-016 with EPA's Office of Solid Waste and Emergency Response, has been requested to obtain an external, independent verification study of the "Preliminary Remediation Goals for Radionuclides" (PRG) electronic calculator.

This calculator provides information on establishing PRGs for radionuclides at CERCLA sites with radioactive contamination. The PRG electronic calculator presents standardized exposure parameters and equations that should generally be used for calculating radionuclide PRGs for residential, commercial/industrial, and agricultural land use exposures, tap water and fish ingestion exposures, and migration of radionuclides through the unsaturated zone.

Charge:

According to EPA's Guidance on the Development, Evaluation, and Application of Environmental Models (2009), *verification* refers to activities designed to confirm that the mathematical framework embodied in the module is correct and that the computer code for a module is operating according to its intended design so that the results obtained compare favorably with those obtained using known analytical solutions or numerical solutions from simulators based on similar or identical mathematical frameworks.

The purpose of this verification study is to ascertain that the computer code has no inherent numerical problems with obtaining a solution and that the code performs according to design specifications. In addition, the study will ensure that the equations are programmed correctly and that sources of error, such as rounding, are minimal. We are enlisting two subject matter experts for this verification study. Your comments and recommendations will be used to revise the calculator so that the final version will reflect sound technical information and guidance.

As an independent tester of the PRG electronic calculator, we ask you to examine the numerical technique in the computer code for consistency with the conceptual model and governing equations.

When your verification study is complete, e-mail your comments to EMS's Project Manager (Jennifer Rando, jennifer.rando@emsus.com) on or before September 30, 2015. Please submit your comments in Microsoft Word and reference each comment to a specific step in the calculator and equation (http://epa-prgs.ornl.gov/radionuclides/equations.html). For specific comments or text edits on the user's guide, you may copy and paste text into Microsoft Word and indicate edits or comments using track changes or the comments feature. *Please do not hand write your comments.*

How to Use the Calculator:

The PRG calculator is available at http://epa-prgs.ornl.gov/radionuclides/, and the User's Guide is available at http://epa-prgs.ornl.gov/radionuclides/prg_guide.html. To summarize,

Step 1 Select an exposure scenario. The PRG calculator has nine exposure scenarios:

1. Resident
2. Composite Worker
3. Outdoor Worker
4. Indoor Worker
5. Construction Worker - Standard Unpaved Road Vehicle Traffic (Site-specific only)Farmer
6. Construction Worker - Wind Erosion and Other Construction Activities (Site-specific only)
7. Recreator
8. Farmer
9. Soil to Groundwater

Some of these exposure scenarios have multiple media choices; other scenarios will only involve one media so a choice will not appear.

Step 2 Select either "Generic" (in which case the runs use a pre-determined set of default input parameters) or "Site-Specific" (in which case the user can change some of the input parameters).

Step 3 Select if you want to get estimates of the cancer risk posed by radionuclides at your site, in addition to the target risk-based concentrations that will be provided as PRGs.

Step 4 Choose to have your results in either picocuries per gram, which are the units usually used in the United States, or in bequerels per gram which most of the rest of the world uses.

Step 5 Select one or more radionuclides for which you want to develop PRGs. Some of the radionuclides and radioactive decay chain products are designated with the suffix "+D" to indicate that cancer risk estimates for these radionuclides include the contributions from their short-lived decay products, assuming secular equilibrium.

The decay chain for +D radionuclide ends in 100 years.

The equations used in the calculator are listed at http://epa-prgs.ornl.gov/radionuclides/equations.html. There are approximately 167 equations used in the calculator.

G. Timothy Jannik
Savannah River National Laboratory

SAVANNAH RIVER NATIONAL LABORATORY
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

SRNL-STI-2015-00443

August 28, 2015

To: Jennifer Rando, Environmental Management Support, Inc.

From: Tim Jannik, SRNL
Brooke Stagich, SRNL

Verification of EPA's "Preliminary Remediation Goals for Radionuclides" (PRG) electronic Calculator

Introduction

The U.S. Environmental Protection Agency (EPA) requested an external, independent verification study of their updated "Preliminary Remediation Goals for Radionuclides" (PRG) electronic calculator. The calculator provides PRGs for radionuclides that are used as a screening tool at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) sites. These risk-based PRGs establish concentration limits under specific exposure scenarios. The purpose of this verification study is to determine that the calculator has no inherit numerical problems with obtaining solutions as well as to ensure that the equations are programmed correctly. There are 167 equations used in the calculator. To verify the calculator, all equations for each of seven receptor types (resident, construction worker, outdoor and indoor worker, recreator, farmer, and composite worker) were hand calculated using the default parameters. The same four radionuclides (Am-241, Co-60, H-3, and Pu-238) were used for each calculation for consistency throughout.

Results

1) The only problem found in the equations was in the Farmer direct consumption of agricultural products back calculated to soil and water – combined calculation. There is a decay factor that is included in each of the intercept equations (Equation 1); however, it is not included in the results calculated by the PRG calculator. The results from calculations performed by hand were approximately 110% different from the PRG results when the decay factor was included (Table 1). Since the slope results were almost exact to the PRG results; this left only the PRG factor and decay

factor as the possible problems. These were the only factors that were not included in the slope calculations as well as not being specific value parameters. After checking the PRG factor, these values were correct as shown by the results from the Farmer direct consumption of agricultural products (Table 2). Therefore, the factor that was causing the problem in the calculation was the decay factor. When the decay factor was removed from the hand calculations, the recalculated results showed a difference of ≤ 1% when compared to the current PRG results (Table 3).

2) For the air pathway, the hierarchal default slope factor for H-3 is the particle form with an "S" absorption type. It is cumbersome to change this to the much more common vapor form (tritum oxide). To make the PRG Calculator more user friendly, it is suggested that the isotope list include the more common forms of radionuclides instead of defaulting to highest slope factor form.

Conclusions

After performing all the calculations for Am-241, Co-60, H-3, and Pu-238, EPA's PRG electronic calculator appears to be mathematically correct in all scenarios and pathways, except for the Farmer direct consumption – combined calculation.

Equation 1: The intercept equation for consumption of fruits and vegetables with a decay factor included.

$$\text{INTERCEPT}=\frac{\text{PRG}_{\text{f-prod-rad-ing}}\ (\text{pCi/g})}{\left(\text{R}_{\text{upv}}+\text{R}_{\text{es}}\right)}\ \text{x}\left(\frac{\text{t}_{\text{f}}\ (\text{yr})\ \text{x}\ \lambda\ \left(\frac{1}{\text{yr}}\right)}{(1\text{-e}^{-\lambda \text{t}_{\text{f}}})}\right)$$

Table 1: The results from hand calculations using Co-60 compared to the PRG results when the decay factor was included in the hand calculations.

Co-60				
		Calculated	PRG	% Differ.
F&V	Slope	-2.33E+01	-2.32E+01	0.4%
	Intercept	1.50E-01	4.35E-02	110.1%
Fish	Slope	-4.80E-01	-4.80E-01	0.0%
	Intercept	5.01E-01	1.46E-01	109.7%
Beef	Slope	-1.54E+01	-1.54E+01	0.0%
	Intercept	4.67E+01	1.37E+01	109.3%
Milk	Slope	-1.93E+01	-1.93E+01	0.0%
	Intercept	4.97E+01	1.45E+01	109.7%
Swine	Slope	-7.19E+00	-7.19E+00	0.0%
	Intercept	4.02E+01	1.18E+01	109.2%
Poultry	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	1.63E+00	4.76E-01	109.6%
Egg	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	9.58E+01	2.80E+01	109.5%

Table 2: The results from the hand calculations using Co-60 compared to the PRG results from the Farmer direct consumption calculations.

Co-60			
	Calculated	PRG	% Differ.
F & V	1.18E-02	1.16E-02	1.7%
Poultry	3.41E-02	3.40E-02	0.3%
Eggs	6.82E-02	6.82E-02	0.0%
Beef	2.02E-02	2.02E-02	0.0%
Milk	7.43E-03	7.42E-03	0.1%
Swine	3.73E-02	3.73E-02	0.0%
Fish	2.32E-02	2.32E-02	0.0%

Table 3: The results from hand calculations using Co-60 compared to the PRG results when the decay factor was not included in the hand calculations.

Co-60				
		Calculated	PRG	% Differ.
F&V	Slope	-2.33E+01	-2.32E+01	0.4%
	Intercept	4.40E-02	4.35E-02	1.1%
Fish	Slope	-4.80E-01	-4.80E-01	0.0%
	Intercept	1.47E-01	1.46E-01	0.7%
Beef	Slope	-1.54E+01	-1.54E+01	0.0%
	Intercept	1.37E+01	1.37E+01	0.0%
Milk	Slope	-1.93E+01	-1.93E+01	0.0%
	Intercept	1.46E+01	1.45E+01	0.7%
Swine	Slope	-7.19E+00	-7.19E+00	0.0%
	Intercept	1.18E+01	1.18E+01	0.0%
Poultry	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	4.76E-01	4.76E-01	0.0%
Egg	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	2.81E+01	2.80E+01	0.4%

Variables	Defaults
TR	1.00E-06
t(w)	25
EF(w)	250
ED(w)	25
IRS(w)	100
ET(w)	8
IRA(w)	60
PEF	1.36E+09
Q/C(wind)	93.774
V	0.5
U(m)	4.69
U(t)	11.32
F(x)	0.194
A	16.2302
A(s)	0.5
B	18.7762
C	216.108

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(s)	SF(i)	SF(ext-sv)	SF(sub)	GSF(o)	ACF(ext-sv)
Am-241	M	4.32E+02	1.60E-03	3.93E-02	9.10E-11	0.00E+00	2.77E-08	5.81E-11	1.00E+00	1.00E+00
Co-60	M	5.27E+00	1.31E-01	9.63E-01	7.33E-12	1.80E-01	1.24E-05	1.13E-08	1.00E+00	1.00E+00
H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	2m^2	0.00E+00	0.00E+00	1.00E+00	1.00E+00
Pu-238	M	8.77E+01	7.90E-03	1.79E-01	1.17E-10	2.80E-01	6.92E-11	2.56E-13	1.00E+00	1.00E+00

Composite Worker Soil

	Ingestion	Inhalation	External	Total
Am-241	4.01E-08	4.01E-08	4.01E-08	1.00E+00
	2.24E-09	0.00E+00	6.22E-09	#DIV/0!
	1.79E+01	**#DIV/0!**	**6.45E+00**	**#DIV/0!**
Co-60	3.29E-06	3.29E-06	3.29E-06	1.00E+00
	4.41E-09	1.59E-02	6.81E-05	4.87E+03
	7.45E+02	**2.06E-04**	**4.83E-02**	**2.05E-04**
H-3		1.41E-06		1.00E+00
		#VALUE!		#VALUE!
		#VALUE!		**#VALUE!**
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.00E+00
	1.31E-08	4.62E-03	7.08E-11	2.34E+04
	1.51E+01	**4.28E-05**	**2.79E+03**	**4.28E-05**

		Calculated	PRG	% Differ.
Am-241	Ingestion	1.79E+01	1.79E+01	0.0%
	Inhalation	2.94E+02	2.94E+02	0.0%
	External	6.45E+00	6.46E+00	-0.2%
	Total	4.67E+00	4.67E+00	0.0%
Co-60	Ingestion	7.45E+02	7.46E+02	-0.1%
	Inhalation	3.68E+05	3.69E+05	-0.3%
	External	4.83E-02	4.83E-02	0.0%
	Total	4.82E-02	4.83E-02	-0.2%
H-3	Ingestion			
	Inhalation	2.99E-01	2.99E-01	0.0%
	External			
	Total	2.99E-01	2.99E-01	0.0%
Pu-238	Ingestion	1.51E+01	1.51E+01	0.0%
	Inhalation	2.30E+02	2.30E+02	0.0%
	External	2.79E+03	2.79E+03	0.0%
	Total	1.41E+01	1.41E+01	0.0%

Composite Worker Air

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	4.01E-08	4.01E-08	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	0.00E+00	1.30E-11	#DIV/0!	0.00E+00	3.32E-10	#DIV/0!
	#DIV/0!	**3.08E+03**	**#DIV/0!**	**#DIV/0!**	**3.02E+03**	**#DIV/0!**
Co-60	3.29E-06	3.29E-06	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	2.17E+04	6.21E-08	6.59E+09	2.25E+04	6.45E-08	2.25E+10
	1.52E-10	**5.29E+01**	**1.52E-10**	**4.44E-11**	**1.55E+01**	**4.44E-11**
H-3	1.41E-06		1.00E+00	1.00E-06		1.00E+00
	#VALUE!		#VALUE!	#VALUE!		#VALUE!
	#VALUE!		**#VALUE!**	**#VALUE!**		**#VALUE!**
Pu-238	1.98E-07	1.98E-07	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	6.27E+03	2.62E-13	3.18E+10	3.50E+04	1.46E-12	3.50E+10
	3.15E-11	**7.54E+05**	**3.15E-11**	**2.86E-11**	**6.84E+05**	**2.86E-11**

		Calculated	PRG	% Differ.
Am-241	Inhalation	2.16E-04	2.16E-04	0.0%
	External	3.08E+03	3.08E+03	0.0%
	Total	2.16E-04	2.16E-04	0.0%
	Inhalation	2.12E-04	2.12E-04	0.0%
	External	3.02E+03	3.02E+03	0.0%
	Total	2.12E-04	2.12E-04	0.0%
Co-60	Inhalation	2.70E-01	2.71E-01	-0.4%
	External	5.29E+01	5.32E+01	-0.6%
	Total	2.69E-01	2.70E-01	-0.4%
	Inhalation	7.92E-02	7.95E-02	-0.4%
	External	1.55E+01	1.56E+01	-0.6%
	Total	7.88E-02	7.91E-02	-0.4%
H-3	Inhalation	1.76E+01	1.76E+01	0.0%
	External			
	Total	1.76E+01	1.76E+01	0.0%
	Inhalation	9.45E+00	9.44E+00	0.1%
	External			
	Total	9.45E+00	9.44E+00	0.1%
Pu-238	Inhalation	1.69E-04	1.69E-04	0.0%
	External	7.54E+05	7.55E+05	-0.1%
	Total	1.69E-04	1.69E-04	0.0%
	Inhalation	1.53E-04	1.53E-04	0.0%
	External	6.84E+05	6.85E+05	-0.1%
	Total	1.53E-04	1.53E-04	0.0%

Inhalation (with half-life decay)

"PR" "G" _"w–air–inh–decay" " " ("pCi" /"m" ^"3")"=" ⊦"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")
/(("1–" "e" ^("–λ" "t" _"w"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"w" " " ("250 day" /"yr")" x E" "D" _"w" " " ("25 yr")"x E" "T" _"w" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"w" "
" (("60 " "m" ^"3")/"day"))

Total (with half-life decay)

"PR" "G" _"w–air–tot–decay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"w–air–inh–decay") "+"
"1" /("PR" "G" _"w–air–sub–decay") " ")

External (with half-life decay)

"PR" "G" _"w–air–sub–decay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")

Ingestion of soil

"PR" "G" _"w–soil–ing" ("pCi" /"g")"=" ("TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr"))/(("1–" "e" ^("–λ" "t" _"w"))" x S" "F" _"s" ("risk" /"pCi")" x E" "F" _"w" " " ("250 day" /"yr")" x E" "D" _"w" " " ("25 yr") " x IR" "S" _"w" " " ("100 mg" /"day")" x " ("g" /"1000 mg")" ")

Inhalation of particulates emitted from soil

"PR" "G" _"w–soil–inh" ("pCi" ⁄"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"w"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"w" " " ("250 day" /"yr")" x E" "D" _"w" " " ("25 yr")" x E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"w" " " (("60 " "m" ^"3")/"day")" x " ("1" /"PEF" ("m" ^"3" /"kg"))" x " ("1000g" /"kg")) " "

External exposure to ionizing radiation

"PRGw–soil–ext " ("pCi" ⁄"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"w"))" x S" "F" _"ext–sv" " " (("risk" /"yr")/├"pCi" /"g" ┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext –sv" ┤┤)

Total

"PR" "G" _"w–soil–tot" " " ("pCi" ⁄"g")"=" "1" /("1" /("PR" "G" _"w–soil–ing"))"+" ("1" /("PR" "G" _

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind" " " (("g" /("m" ^"2" "–s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1–V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")
"Q" /"C" _"wind" "=A x" "exp" [("ln" "A" _"s" " " ("acre")"–B")^"2" /"C"]

Inhalation (without half-life decay)

"PR" "G" _"w–air–inh–nodecay" " " ("pCi" /"m" ^"3")"=" ⊦"TR"⊣/("S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"w" " " ("250 day" /"yr")"
x E" "D" _"w" " " ("25 yr")"x E" "T" _"w" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"w" " " (("60 " "m" ^"3")/"day"))

External (without half-life decay)

"PR" "G" _"w–air–sub–nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR"┤/("S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _
"w" " " ("250 day" /"yr")" x " (├"1 yr"┤/"365 days")" x E" "D" _"w" " " ("25 yr")" x E" "T" _"w" "
" ("8 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"w–air–tot–nodecay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"w–air–inh–nodecay") "+"
"1" /("PR" "G" _"w–air–sub–nodecay") " ")

Variables	Defaults
TR	1.00E-06
t(w)	25
EF(w)	250
EW(w)	50
DW(w)	5
ED(w)	25
ET(w)	8

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(ext-sv)	SF(ext-1cm)	SF(ext-5cm)	SF(ext-15cm)	SF(ext-gp)	GSF(o)@0cm
Am-241	M	4.32E+02	1.60E-03	3.93E-02	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.87E-08	1.00E+00
Co-60	M	5.27E+00	1.31E-01	9.63E-01	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.19E-06	1.00E+00
H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
Pu-238	M	8.77E+01	7.90E-03	1.79E-01	6.92E-11	4.81E-11	6.30E-11	6.87E-11	3.68E-10	1.00E+00

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.08E-01	9.46E-02	9.50E-02	9.69E-02	8.44E-02
Co-60	9.83E-02	4.26E-02	6.55E-02	8.49E-02	2.83E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	1.79E-01	1.53E-01	1.60E-01	1.71E-01	1.03E-01
	Cover Layer Thickness = 0cm ; Area = 1m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	6.71E-10	2.93E-10	5.50E-10	6.02E-10	3.54E-10
	5.97E+01	**1.37E+02**	**7.29E+01**	**6.66E+01**	**1.13E+02**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	6.70E-06	5.29E-07	2.34E-06	4.85E-06	3.41E-07
	4.91E-01	**6.21E+00**	**1.41E+00**	**6.78E-01**	**9.65E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	1.27E-11	7.53E-12	1.03E-11	1.20E-11	3.88E-11
	1.56E+04	**2.62E+04**	**1.92E+04**	**1.64E+04**	**5.09E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	5.97E+01	6.00E+01	-0.5%
	1 cm	1.37E+02	1.37E+02	0.0%
	5 cm	7.29E+01	7.30E+01	-0.1%
	15 cm	6.66E+01	6.66E+01	0.0%
	Dust	1.13E+02	1.13E+02	0.0%
Co-60	Infinite Depth	4.91E-01	4.92E-01	-0.2%
	1 cm	6.21E+00	6.21E+00	0.0%
	5 cm	1.41E+00	1.41E+00	0.0%
	15 cm	6.78E-01	6.77E-01	0.1%
	Dust	9.65E+00	9.67E+00	-0.2%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	1.56E+04	1.56E+04	0.0%
	1 cm	2.62E+04	2.62E+04	0.0%
	5 cm	1.92E+04	1.92E+04	0.0%
	15 cm	1.64E+04	1.65E+04	-0.6%
	Dust	5.09E+03	5.09E+03	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.94E-01	1.67E-01	1.67E-01	1.64E-01	1.50E-01
Co-60	1.77E-01	7.98E-02	1.22E-01	1.59E-01	5.21E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	2.84E-01	2.70E-01	2.83E-01	2.83E-01	1.84E-01
	Cover Layer Thickness = 0cm ; Area = 2m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	1.21E-09	5.17E-10	9.67E-10	1.02E-09	6.29E-10
	3.33E+01	**7.76E+01**	**4.15E+01**	**3.93E+01**	**6.37E+01**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	1.21E-05	9.91E-07	4.35E-06	9.09E-06	6.27E-07
	2.73E-01	**3.32E+00**	**7.56E-01**	**3.62E-01**	**5.24E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	2.01E-11	1.33E-11	1.82E-11	1.99E-11	6.93E-11
	9.82E+03	**1.49E+04**	**1.08E+04**	**9.93E+03**	**2.85E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	3.33E+01	3.33E+01	0.0%
	1 cm	7.76E+01	7.77E+01	-0.1%
	5 cm	4.15E+01	4.16E+01	-0.2%
	15 cm	3.93E+01	3.94E+01	-0.3%
	Dust	6.37E+01	6.36E+01	0.2%
Co-60	Infinite Depth	2.73E-01	2.73E-01	0.0%
	1 cm	3.32E+00	3.32E+00	0.0%
	5 cm	7.56E-01	7.57E-01	-0.1%
	15 cm	3.62E-01	3.62E-01	0.0%
	Dust	5.24E+00	5.25E+00	-0.2%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	9.82E+03	9.83E+03	-0.1%
	1 cm	1.49E+04	1.49E+04	0.0%
	5 cm	1.08E+04	1.08E+04	0.0%
	15 cm	9.93E+03	9.94E+03	-0.1%
	Dust	2.85E+03	2.85E+03	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	3.20E-01	2.97E-01	2.90E-01	2.85E-01	2.71E-01
Co-60	3.33E-01	1.48E-01	2.22E-01	2.88E-01	9.86E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	5.92E-01	4.72E-01	5.02E-01	5.18E-01	3.31E-01
	Cover Layer Thickness = 0cm ; Area = 5m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	1.99E-09	9.20E-10	1.68E-09	1.77E-09	1.14E-09
	2.02E+01	**4.36E+01**	**2.39E+01**	**2.26E+01**	**3.53E+01**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	2.27E-05	1.84E-06	7.92E-06	1.65E-05	1.19E-06
	1.45E-01	**1.79E+00**	**4.15E-01**	**2.00E-01**	**2.77E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	4.19E-11	2.32E-11	3.24E-11	3.64E-11	1.25E-10
	4.71E+03	**8.50E+03**	**6.10E+03**	**5.43E+03**	**1.59E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	2.02E+01	2.02E+01	0.0%
	1 cm	4.36E+01	4.37E+01	-0.2%
	5 cm	2.39E+01	2.39E+01	0.0%
	15 cm	2.26E+01	2.27E+01	-0.4%
	Dust	3.53E+01	3.53E+01	0.0%
Co-60	Infinite Depth	1.45E-01	1.45E-01	0.0%
	1 cm	1.79E+00	1.79E+00	0.0%
	5 cm	4.15E-01	4.16E-01	-0.2%
	15 cm	2.00E-01	1.99E-01	0.5%
	Dust	2.77E+00	2.78E+00	-0.4%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	4.71E+03	4.72E+03	-0.2%
	1 cm	8.50E+03	8.52E+03	-0.2%
	5 cm	6.10E+03	6.10E+03	0.0%
	15 cm	5.43E+03	5.43E+03	0.0%
	Dust	1.59E+03	1.59E+03	0.0%

Direct External Exposure to contamination at infinite depth

"PRGw−soil−sv " ("pCi" /"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"w"))" x S" "F" _"ext−sv" " " (("risk" /"yr")/├"pCi" /"g"┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext−sv" ┤┤)

Direct External Exposure to contamination at 1 cm

"PRGw−soil−1cm " ("pCi" ∕"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"w"))" x S" "F" _"ext−1cm" " " (("risk" ∕"yr")/├"pCi" ∕"g"┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −1cm"┤┤)

Direct External Exposure to contamination at 5cm

"PRGw−soil−5cm " ("pCi" ∕"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"w"))" x S" "F" _"ext−5cm" " " (("risk" ∕"yr")/├"pCi" ∕"g"┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −5cm"┤┤)

Direct External Exposure to contamination at 15cm

"PRGw−soil−15cm " ("pCi" ∕"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"w"))" x S" "F" _"ext−15cm" " " (("risk" ∕"yr")/├"pCi" ∕"g"┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −15cm"┤┤)

Direct External Exposure to contamination dust

"PRGw−soil−gp " ("pCi" ∕"g")"=" ├"TR x " "t" _"w" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"w"))" x S" "F" _"ext−gp" " " (("risk" ∕"yr")/├"pCi" ∕"g"┤)" x E" "F" _"w" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"w" " " ("25 yr")" x " ├├"E" "T" _"w" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −gp"┤┤)

External Exposure								
	Type	Ground Plan	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elemental	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Ground Plane, Area Correction Factor																
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume, Area Correction Factor																
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Variables	Defaults
TR	1.00E-06
t(cw)	1
EF(cw)	250
EW(cw)	50
DW(cw)	5
ED(cw)	1
IRS(cw)	330
ET(cw)	8
IRA(cw)	60
PEF(sc)	2026670.7
PEF'(sc)	7844640.1
Q/C(sr)	23.01785
F(D)	0.1858372
A(R)	274.21393
T	7200000
s	8.5
W	12.142857
M(dry)	0.2
p	250
ΣVKT	393.575
A	12.9351
A(s)	0.5
B	5.7383
C	71.7711
L(R)	147.58077
W(R)	20
# of cars	20
tons/car	10
# of trucks	15
tons/truck	15
total vehicles	35
distance	0.04498
t(c)	8400
Q/C(sa)	14.314067
<J'(T)>	9.819E-06
A	2.4538
A(c)	0.5
B	17.566
C	189.0426
Mpc(wind)	8803.9135
V	0
U(m)	4.69
U(t)	11.32
F(x)	0.194
A(surf)	2023.43
ED	1
M(excav)	368.75106
M(m-excav)	12
ρ(soil)	1.68
A(excav)	50
d(excav)	18
N(A-dump)	2
M(doz)	721.52119
s(doz)	6.9
M(m-doz)	7.9
ΣVKT(doz)	24.282
S(doz)	11.4
M(grade)	7068.7427
S(grade)	11.4
ΣVKT(grade)	16.188
M(till)	126083.83
s(till)	18
A(c-till)	25
N(A-till)	2
A(c-grade)	15
B(g)	15
N(A-grade)	4
A(c-doz)	10
N(A-doz)	6
B(d)	10

Site-Specific
Calculated & Site-Specific

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(s)	SF(i)	SF(ext-sv)	GSF(o)	ACF(ext-sv)
Am-241	M	4.32E+02	1.60E-03	1.60E-03	9.10E-11	3.77E-08	2.77E-08	1.00E+00	1.08E-01
Co-60	M	5.27E+00	1.31E-01	1.23E-01	7.33E-12	1.01E-10	1.24E-05	1.00E+00	9.83E-02
H-3	M	1.23E+01	5.63E-02	5.48E-02	0.00E+00	8.47E-13	0.00E+00	1.00E+00	9.00E-01
Pu-238	M	8.77E+01	7.90E-03	7.87E-03	1.17E-10	5.22E-08	6.92E-11	1.00E+00	1.79E-01

Exposure to Unpaved Roads					Exposure to Other than Unpaved Roads				
	Ingestion	Inhalation	External	Total		Ingestion	Inhalation	External	Total
Am-241	1.60E-09	1.60E-09	1.60E-09	1.00E+00	Am-241	1.60E-09	1.60E-09	1.60E-09	1.00E+00
	1.20E-11	1.49E-10	1.09E-12	1.01E-01		1.20E-11	3.85E-11	1.09E-12	3.22E-02
	1.33E+02	**1.08E+01**	**1.47E+03**	**9.89E+00**		**1.33E+02**	**4.16E+01**	**1.47E+03**	**3.11E+01**
Co-60	1.31E-07	1.31E-07	1.31E-07	1.00E+00	Co-60	1.31E-07	1.31E-07	1.31E-07	1.00E+00
	7.45E-11	3.07E-11	3.43E-08	2.62E-01		7.45E-11	7.93E-12	3.43E-08	2.61E-01
	1.76E+03	**4.28E+03**	**3.83E+00**	**3.82E+00**		**1.76E+03**	**1.66E+04**	**3.83E+00**	**3.83E+00**
H-3		5.63E-08		1.00E+00	H-3		5.63E-08		1.00E+00
		1.36E-08		2.42E-01			1.36E-08		2.42E-01
		4.13E+00		**4.13E+00**			**4.13E+00**		**4.13E+00**
Pu-238	7.90E-09	7.90E-09	7.90E-09	1.00E+00	Pu-238	7.90E-09	7.90E-09	7.90E-09	1.00E+00
	7.60E-11	1.01E-09	2.23E-14	1.38E-01		7.60E-11	2.62E-10	2.23E-14	4.28E-02
	1.04E+02	**7.80E+00**	**3.55E+05**	**7.25E+00**		**1.04E+02**	**3.02E+01**	**3.55E+05**	**2.34E+01**
		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	Ingestion	1.33E+02	1.33E+02	0.0%	Am-241	Ingestion	1.33E+02	1.33E+02	0.0%
	Inhalation	1.08E+01	1.07E+01	0.9%		Inhalation	4.16E+01	4.16E+01	0.0%
	External	1.47E+03	1.47E+03	0.0%		External	1.47E+03	1.47E+03	0.0%
	Total	9.89E+00	9.88E+00	0.1%		Total	3.11E+01	3.10E+01	0.3%
Co-60	Ingestion	1.76E+03	1.77E+03	-0.6%	Co-60	Ingestion	1.76E+03	1.77E+03	-0.6%
	Inhalation	4.28E+03	4.30E+03	-0.5%		Inhalation	1.66E+04	1.66E+04	0.0%
	External	3.83E+00	3.84E+00	-0.3%		External	3.83E+00	3.84E+00	-0.3%
	Total	3.82E+00	3.83E+00	-0.3%		Total	3.83E+00	3.83E+00	0.0%
H-3	Ingestion				H-3	Ingestion			
	Inhalation	4.13E+00	4.13E+00	0.0%		Inhalation	4.13E+00	4.13E+00	0.0%
	External					External			
	Total	4.13E+00	4.13E+00	0.0%		Total	4.13E+00	4.13E+00	0.0%
Pu-238	Ingestion	1.04E+02	1.04E+02	0.0%	Pu-238	Ingestion	1.04E+02	1.04E+02	0.0%
	Inhalation	7.80E+00	7.80E+00	0.0%		Inhalation	3.02E+01	3.02E+01	0.0%
	External	3.55E+05	3.56E+05	-0.3%		External	3.55E+05	3.53E+05	0.6%
	Total	7.25E+00	7.26E+00	-0.1%		Total	2.34E+01	2.34E+01	0.0%

Incidental ingestion of soil (unpaved roads)

"PR" "G" _"cw-soil-ing" " " ("pCi" /"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"cw"))" x S" "F" _" s" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _" cw" " " ("1 yr")" x IR" "S" _"cw" " " ("330 mg" /"day")" x " ("g" /"1000 mg"))

Inhalation of particulates emitted from soil (unpaved roads)

"PR" "G" _"cw−soil−inh" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1 −" "e" ^("−λ" "t" _"cw"))" x S" "F" _ "i" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _"cw" " " ("1 yr")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"cw" " " (("60 " "m" ^"3")/"day") " x " ("1" /("PE" "F" _"sc" " " ("m" ^"3" /"kg")))" x " (├ "1000 g" ┤ /"kg"))

External exposure to ionizing radiation (unpaved roads)

"PR" "G" _"cw−soil−ext" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1 −" "e" ^("−λ" "t" _"cw"))" x S" " F" _"ext−sv" " " ("risk/yr" /"pCi/g")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" / "week")" x " ("1 yr" /"365 days")" x E" "D" _"cw" " " ("1 yr")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"o" " " ("1.0")" x AC" "F" _"ext−sv")

Total (unpaved roads)

"PR" "G" _"cw−soil−tot" " " ("pCi" ⁄"g")"=" "1" /(├ "1" /("PR" "G" _"cw−soil−ing")┤ "+" "1" /("PR" "G" _"cw−soil−inh"

Incidental ingestion of soil (other than unpaved roads)

"PR" "G" _"cw-soil-ing-sa" " " ("pCi" /"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"cw"))" x S" "F" _"s" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _"cw" " " ("1 yr")" x IR" "S" _"cw" " " ("330 mg" /"day")" x " ("g" /"1000 mg"))

Inhalation of particulates emitted from soil (other than unpaved roads)

"PR" "G" _"cw−soil−inh−sa" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1 −" "e" ^("−λ" "t" _"cw"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _"cw" " " ("1 yr")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"cw" " " (("60 " "m" ^"3")/"day")" x " ("1" /("PE" 〖"F"′ 〗_"sc" " " ("m" ^"3" /"kg")))" x " (├ "1000 g" ┤ /"kg"))

External exposure to ionizing radiation (other than unpaved roads)

"PR" "G" _"cw−soil−ext−sa" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"cw" " x λ " ("1" /"yr"))/(("1 −" "e" ^("−λ" "t" _"cw"))" x S" "F" _"ext−sv" " " ("risk/yr" /"pCi/g")" x E" "F" _"cw" " " ("E" "W" _"cw" "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x " ("1 yr" /"365 days")" x E" "D" _"cw" " " ("1 yr")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"o" " " ("1.0")" x AC" "F" _"ext −sv")

Total (other than unpaved roads)

"PR" "G" _"cw−soil−tot−sa" " " ("pCi" ⁄"g")"=" "1" /(├ "1" /("PR" "G" _"cw−soil−ing−sa")┤ "+" "1" /("PR" "G" _"cw−soil−inh−sa") "+" "1" /("PR" "G" _"cw−soil−ext−sa"))

Particulate Emission Factor - Other Than Unpaved Roads

"PE" 〖"F"′ 〗_"sc" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"sa" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))" x" "1" /"F" _"D" " x " ├ 1/(<J_T^′>(g /(m^2−s)))┤

"Q" /"C" _"sa" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))"=A x" "exp" [("ln" "A" _"c" " " ("acre")"-B")^"2" /"C"]

"<" "J" _"T" ^"′" ">" ("g" /("m" ^"2" "-s"))"=" ("M" _"wind" ^"pc" " " ("g")"+" "M" _"excav" " " ("g")"+" "M" _"doz" " " ("g")"+" "M" _"grade" " " ("g")"+" "M" _"till" " " ("g"))/("A" _"surf" " " ("m" ^"2")" x T(s)")

"M" _"wind" ^"pc" " " ("g")"=0.036 x " ("1-V")" x " (("U" _"m" ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F" ("x")" x " "A" _"surf" " " ("m" ^"2")" x ED " ("yr")" x 8760" ("hr" /"yr")

"M" _"excav" " " ("g")"=0.35 x 0.0016 x" (("U" _"m" " " ("m" /"s"))/"2.2")^"1.3" /(("M" _"m-excav" " " ("%"))/"2")^"1.4" " x " "ρ" _"soil" " " ("Mg" /"m" ^"3")" x " "A" _"excav" " " ("m" ^"2")" x " "d" _"excav" " " ("m")" x " "N" _"A-dump" " x 1000 " ("g" /"kg")

"M" _"doz" ("g")"=0.75 x" ("0.45 x " ("s" _"doz" ("%"))^"1.5")/("M" _"m-doz" " " ("%"))^"1.4" " x " ("ΣVK" "T" _"doz" " (km)")/("S" _"doz" " " ("km" /"hr")) " x 1000 " ("g" /"kg")

"M" _"grade" " " ("g")"=0.60 x 0.0056 x " "S" _"grade" " " ("km" /"hr")^"2" " x ΣVK" "T" _"grade" " " ("km")" x 1000 " ("g" /"kg")

"M" _"till" " " ("g")"=1.1 x " "s" _"till" " " ("%")^"0.6" " x " "A" _"c-till" " " ("acres")" x 4047 " ("m" ^"2" /"acre")" x " 〖"10" 〗^"-4" " " ("ha" /"m" ^"2")" x 1000 " ("g" /"kg")" x " "N" _"A-till"

"ΣVK" "T" _"grade" " " ("km")"=" "A" _"c-grade" " " ("acres")" x 4047 " ("m" ^"2" /"acre")" x" "1" /("B" _"g" " (m)") " x" "1" /"1000 " ("m" /"km") " x " "N" _"A-grade"

"ΣVK" "T" _"doz" " " ("km")"=" "A" _"c-doz" " " ("acres")" x 4047 " ("m" ^"2" /"acre")" x" "1" /("B" _"g" " (m)") " x" "1" /"1000 " ("m" /"km") " x " "N" _"A-doz"

"T " ("7200000 s")"=E" "D" _"cw" " " ("1 yr")" x E" "F" _"cw" " " ("250 days" /"year")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("3600 s" /"hr")

"F" _"D" " " ("0.18584")"=0.1852+" ("5.3537" /"t" _"c")"+" ("-" "9.6318" /("t" _"c" ^"2"))

"t" _"c" " " ("8400 hr")"=E" "D" _"cw" " " ("1 yr")" x E" "W" _"cw" " " ("50 wks" /"year")" x " ("7 days" /"week")" x " ("24 hrs" /"day")

Particulate Emission Factor - Unpaved Roads

"PE" "F" _"sc" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"sr" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))" x" "1" /"F" _"D" " x " [("T" ("s")" x " "A" _"R" " " ("m" ^"2"))/(("2.6 x " ("s" /"12")^"0.8" "x " ("W" ("tons")/"3")^"0.4")/("M" _"dry" /"0.2")^"0.3" " x " (("365 " ("days" /"year")" -p " ("days" /"year")))/"365 " ("days" /"year") " x 281.9 x ΣVKT " ("km"))]

"Q" /"C" _"sr" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))"=A x" "exp" [("ln" "A" _"s" " " ("acre")"-B")^"2" /"C"]

"A" _"R" " " ("m" ^"2")"=" "L" _"R" " " ("ft")" x " "W" _"R" " " ("20 ft")" x 0.092903 " ("m" ^"2" /("f" "t" ^"2"))

"W " ("tons")"=" (("number of cars x" "tons" /"car" "+number of trucks x" "tons" /"truck"))/"total vehicles"

"ΣVKT " ("km")"=total vehicles x distance " ("km" /"day")" x E" "W" _"cw" " " ("weeks" /"year")" x D" "W" _"cw" " " ("days" /"week")

"T " ("7200000 s")"=E" "D" _"cw" " " ("1 yr")" x E" "F" _"cw" " " ("250 days" /"year")" x E" "T" _"cw" " " ("8 hrs" /"day")" x " ("3600 s" /"hr")

"F" _"D" " " ("0.18584")"=0.1852+" ("5.3537" /"t" _"c")"+" ("-" "9.6318" /("t" _"c" ^"2"))

"t" _"c" " " ("8400 hr")"=E" "D" _"cw" " " ("1 yr")" x E" "W" _"cw" " " ("50 wks" /"year")" x " ("7 days" /"week")" x " ("24 hrs" /"day")

Variables	Defaults	
TR	1.00E-06	
t(cw)	1	
EF(cw)	250	
EW(cw)	50	
DW(cw)	5	
ED(cw)	1	
ET(cw)	8	
IRA(cw)	60	

Legend
Site-Specific
Calculated & Site-Specific

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(sub)	SF(i)	GSF(o)
Am-241	M	4.32E+02	1.60E-03	1.60E-03	5.81E-11	3.77E-08	1.00E+00
Co-60	M	5.27E+00	1.31E-01	1.23E-01	1.13E-08	1.01E-10	1.00E+00
H-3	M	1.23E+01	5.63E-02	5.48E-02	0.00E+00	8.47E-13	1.00E+00
Pu-238	M	8.77E+01	7.90E-03	7.87E-03	2.56E-13	5.22E-08	1.00E+00

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	1.60E-09	1.60E-09	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	3.02E-07	2.13E-14	1.88E+02	1.89E-04	1.33E-11	1.89E+02
	5.31E-03	**7.54E+04**	**5.31E-03**	**5.31E-03**	**7.54E+04**	**5.31E-03**
Co-60	1.31E-07	1.31E-07	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	6.22E-08	3.18E-10	4.76E-01	5.05E-07	2.58E-09	5.08E-01
	2.11E+00	**4.14E+02**	**2.10E+00**	**1.98E+00**	**3.88E+02**	**1.97E+00**
H-3	5.63E-08		1.00E+00	1.00E-06		1.00E+00
	2.32E-10		4.12E-03	4.24E-09		4.24E-03
	2.43E+02		**2.43E+02**	**2.36E+02**		**2.36E+02**
Pu-238	7.90E-09	7.90E-09	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	2.05E-06	4.60E-16	2.60E+02	2.61E-04	5.84E-14	2.61E+02
	3.85E-03	**1.72E+07**	**3.85E-03**	**3.83E-03**	**1.71E+07**	**3.83E-03**

		Calculated	PRG	% Differ.
Am-241	Inhalation	5.31E-03	5.30E-03	0.2%
	External	7.54E+04	7.55E+04	-0.1%
	Total	5.31E-03	5.30E-03	0.2%
	Inhalation	5.31E-03	5.30E-03	0.2%
	External	7.54E+04	7.55E+04	-0.1%
	Total	5.31E-03	5.30E-03	0.2%
Co-60	Inhalation	2.11E+00	2.12E+00	-0.5%
	External	4.14E+02	4.16E+02	-0.5%
	Total	2.10E+00	2.11E+00	-0.5%
	Inhalation	1.98E+00	1.99E+00	-0.5%
	External	3.88E+02	3.90E+02	-0.5%
	Total	1.97E+00	1.98E+00	-0.5%
H-3	Inhalation	2.43E+02	2.43E+02	0.0%
	External			
	Total	2.43E+02	2.43E+02	0.0%
	Inhalation	2.36E+02	2.36E+02	0.0%
	External			
	Total	2.36E+02	2.36E+02	0.0%
Pu-238	Inhalation	3.85E-03	3.85E-03	0.0%
	External	1.72E+07	1.72E+07	0.0%
	Total	3.85E-03	3.85E-03	0.0%
	Inhalation	3.83E-03	3.83E-03	0.0%
	External	1.71E+07	1.71E+07	0.0%
	Total	3.83E-03	3.83E-03	0.0%

Inhalation (with half-life decay)

"PR" "G" _"cw–air–inh–decay" " " ("pCi" /"m" ^"3")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"cw"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" " " "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _"cw" " " ("1 yr")"x E" "T" _"cw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"cw" " " (("60 " "m" ^"3")/"day"))

External exposure to ionizing radiation (with half-life decay)

"PR" "G" _"cw–air–sub–decay" " " ("pCi" /"m" ^"3")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"cw"))" x S" "F" _"sub" " " ("risk/yr" /("pCi/" "m" ^"3" " "))" x E" "F" _"cw" " " ("E" "W" _"cw" " " "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x " ("1 yr" /"365 days")" x E" "D" _"cw" " " ("1 yr")"x E" "T" _"cw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x GS" "F" _"a" " " ("1.0"))

Total (with half - life decay)

"PR" "G" _"cw–air–tot–decay" " " ("pCi" /"m" ^"3")"=" "1" /("1" /("PR" "G" _"cw–air–inh–decay") "+" "1" /("PR" "G" _"cw–air–sub–decay"))

Inhalation (without half-life decay)

"PR" "G" _"cw-air-inh-nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR" ┤/("S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"cw" " " ("E" "W" _"cw" " " "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x E" "D" _"cw" " " ("1 yr")"x E" "T" _"cw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"cw" " " (("60 " "m" ^"3")/"day"))

External exposure to ionizing radiation (without half-life decay)

"PR" "G" _"cw-air-sub-nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR" ┤/("S" "F" _"sub" " " ("risk/yr" /("pCi/" "m" ^"3" " "))" x E" "F" _"cw" " " ("E" "W" _"cw" " " "50 weeks" /"yr" " x D" "W" _"cw" "5 days" /"week")" x " ("1 yr" /"365 days")" x E" "D" _"cw" " " ("1 yr")"x E" "T" _"cw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x GS" "F" _"a" " " ("1.0"))

Total (without half - life decay)

"PR" "G" _"cw-air-tot-nodecay" " " ("pCi" /"m" ^"3")"=" "1" /("1" /("PR" "G" _"cw-air-inh-nodecay") "+" "1" /("PR" "G" _"cw-air-sub-nodecay"))

Variables	Defaults
TR	1.00E-06
t(cw)	1
EF(cw)	250
EW(cw)	50
DW(cw)	5
ED(cw)	1
ET(cw)	8

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(ext-sv)	SF(ext-1cm)	SF(ext-5cm)	SF(ext-15cm)	SF(ext-gp)	GSF(o)@0cm
Am-241	M	4.32E+02	1.60E-03	1.60E-03	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.87E-08	1.00E+00
Co-60	M	5.27E+00	1.31E-01	1.23E-01	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.19E-06	1.00E+00
H-3	M	1.23E+01	5.63E-02	5.48E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
Pu-238	M	8.77E+01	7.90E-03	7.87E-03	6.92E-11	4.81E-11	6.30E-11	6.87E-11	3.68E-10	1.00E+00

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.08E-01	9.46E-02	9.50E-02	9.69E-02	8.44E-02
Co-60	9.83E-02	4.26E-02	6.55E-02	8.49E-02	2.83E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	1.79E-01	1.53E-01	1.60E-01	1.71E-01	1.03E-01

	Cover Layer Thickness = 0cm ; Area = 1m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09
	1.09E-12	4.78E-13	8.97E-13	9.82E-13	5.78E-13
	1.47E+03	**3.36E+03**	**1.79E+03**	**1.63E+03**	**2.78E+03**
Co-60	1.31E-07	1.31E-07	1.31E-07	1.31E-07	1.31E-07
	3.43E-08	2.71E-09	1.20E-08	2.48E-08	1.74E-09
	3.83E+00	**4.86E+01**	**1.10E+01**	**5.29E+00**	**7.54E+01**
H-3	[redacted]				
Pu-238	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09
	2.23E-14	1.32E-14	1.81E-14	2.11E-14	6.81E-14
	3.55E+05	**5.98E+05**	**4.36E+05**	**3.74E+05**	**1.16E+05**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	1.47E+03	1.47E+03	0.0%
	1 cm	3.36E+03	3.37E+03	-0.3%
	5 cm	1.79E+03	1.79E+03	0.0%
	15 cm	1.63E+03	1.63E+03	0.0%
	Dust	2.78E+03	2.78E+03	0.0%
Co-60	Infinite Depth	3.83E+00	3.84E+00	-0.3%
	1 cm	4.86E+01	4.85E+01	0.2%
	5 cm	1.10E+01	1.10E+01	0.0%
	15 cm	5.29E+00	5.29E+00	0.0%
	Dust	7.54E+01	7.56E+01	-0.3%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	3.55E+05	3.56E+05	-0.3%
	1 cm	5.98E+05	5.97E+05	0.2%
	5 cm	4.36E+05	4.37E+05	-0.2%
	15 cm	3.74E+05	3.75E+05	-0.3%
	Dust	1.16E+05	1.16E+05	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.94E-01	1.67E-01	1.67E-01	1.64E-01	1.50E-01
Co-60	1.77E-01	7.98E-02	1.22E-01	1.59E-01	5.21E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	2.84E-01	2.70E-01	2.83E-01	2.83E-01	1.84E-01

	Cover Layer Thickness = 0cm ; Area = 2m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09
	1.97E-12	8.43E-13	1.58E-12	1.66E-12	1.03E-12
	8.16E+02	**1.90E+03**	**1.02E+03**	**9.65E+02**	**1.56E+03**
Co-60	1.31E-07	1.31E-07	1.31E-07	1.31E-07	1.31E-07
	6.17E-08	5.07E-09	2.23E-08	4.65E-08	3.21E-09
	2.13E+00	**2.59E+01**	**5.90E+00**	**2.83E+00**	**4.10E+01**
H-3	[redacted]				
Pu-238	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09
	3.53E-14	2.33E-14	3.20E-14	3.49E-14	1.22E-13
	2.24E+05	**3.39E+05**	**2.47E+05**	**2.26E+05**	**6.49E+04**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	8.16E+02	8.16E+02	0.0%
	1 cm	1.90E+03	1.91E+03	-0.5%
	5 cm	1.02E+03	1.02E+03	0.0%
	15 cm	9.65E+02	9.66E+02	-0.1%
	Dust	1.56E+03	1.56E+03	0.0%
Co-60	Infinite Depth	2.13E+00	2.13E+00	0.0%
	1 cm	2.59E+01	2.59E+01	0.0%
	5 cm	5.90E+00	5.92E+00	-0.3%
	15 cm	2.83E+00	2.83E+00	0.0%
	Dust	4.10E+01	4.11E+01	-0.2%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	2.24E+05	2.24E+05	0.0%
	1 cm	3.39E+05	3.40E+05	-0.3%
	5 cm	2.47E+05	2.47E+05	0.0%
	15 cm	2.26E+05	2.26E+05	0.0%
	Dust	6.49E+04	6.49E+04	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	3.20E-01	2.97E-01	2.90E-01	2.85E-01	2.71E-01
Co-60	3.33E-01	1.48E-01	2.22E-01	2.88E-01	9.86E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	5.92E-01	4.72E-01	5.02E-01	5.18E-01	3.31E-01

	Cover Layer Thickness = 0cm ; Area = 5m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09
	3.24E-12	1.50E-12	2.74E-12	2.89E-12	1.85E-12
	4.95E+02	**1.07E+03**	**5.86E+02**	**5.55E+02**	**8.65E+02**
Co-60	1.31E-07	1.31E-07	1.31E-07	1.31E-07	1.31E-07
	1.16E-07	9.41E-09	4.05E-08	8.43E-08	6.07E-09
	1.13E+00	**1.40E+01**	**3.24E+00**	**1.56E+00**	**2.16E+01**
H-3	[redacted]				
Pu-238	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09
	7.36E-14	4.08E-14	5.68E-14	6.39E-14	2.19E-13
	1.07E+05	**1.94E+05**	**1.39E+05**	**1.24E+05**	**3.61E+04**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	4.95E+02	4.96E+02	-0.2%
	1 cm	1.07E+03	1.07E+03	0.0%
	5 cm	5.86E+02	5.87E+02	-0.2%
	15 cm	5.55E+02	5.56E+02	-0.2%
	Dust	8.65E+02	8.66E+02	-0.1%
Co-60	Infinite Depth	1.13E+00	1.13E+00	0.0%
	1 cm	1.40E+01	1.40E+01	0.0%
	5 cm	3.24E+00	3.25E+00	-0.3%
	15 cm	1.56E+00	1.56E+00	0.0%
	Dust	2.16E+01	2.17E+01	-0.5%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	1.07E+05	1.07E+05	0.0%
	1 cm	1.94E+05	1.94E+05	0.0%
	5 cm	1.39E+05	1.39E+05	0.0%
	15 cm	1.24E+05	1.24E+05	0.0%
	Dust	3.61E+04	3.61E+04	0.0%

Direct External Exposure to contamination at infinite depth

"PRGcw−soil−sv " ("pCi" ⁄"g")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^ ("−λ" "t" _"cw"))" x S" "F" _"ext−sv" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"cw" " " ("E" "W" _"cw"   "50 weeks" /"yr" " x D" "W" _"cw"   "5 days" /"week")" x " ("1yr" /"365 days")" x E" "D" _"cw" " " ("25 yr")" x " ├ ├"E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −sv"┤┤)

Direct External Exposure to contamination at 1 cm

"PRGcw−soil−1cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"cw"))" x S" "F" _"ext−1cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"cw"   " " ("E" "W" _"cw"   "50 weeks" /"yr" " x D" "W" _"cw"   "5 days" /"week")" x " ("1yr" /"365 days")" x E" "D" _"cw" " " ("25 yr")" x " ├ ├"E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −1cm"┤┤)

Direct External Exposure to contamination at 5cm

"PRGcw−soil−5cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"cw"))" x S" "F" _"ext−5cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"cw" " " ("E" "W" _"cw"   "50 weeks" /"yr" " x D" "W" _"cw"   "5 days" /"week")" x " ("1yr" /"365 days")" x E" "D" _"cw" " " ("25 yr")" x " ├ ├"E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −5cm"┤┤)

Direct External Exposure to contamination at 15cm

"PRGcw−soil−15cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"cw"))" x S" "F" _"ext−15cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"cw" " " ("E" "W" _"cw"   "50 weeks" /"yr" " x D" "W" _"cw"   "5 days" /"week")" x " ("1yr" /"365 days")" x E" "D" _"cw" " " ("25 yr")" x " ├ ├"E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −15cm"┤┤)

Direct External Exposure to contamination dust

"PRGcw−soil−gp " ("pCi" ⁄"g")"=" ├"TR x " "t" _"cw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"cw"))" x S" "F" _"ext−gp" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"cw" " " ("E" "W" _"cw"   "50 weeks" /"yr" " x D" "W" _"cw"   "5 days" /"week")" x " ("1yr" /"365 days")" x E" "D" _"cw" " " ("25 yr")" x " ├ ├"E" "T" _"cw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −gp"┤┤)

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	;(elementa	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ground Plane, Area Correction Factor																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Variables	Defaults
TR	1.00E-06
IFF(f-adj)	2262400
IFV(f-adj)	1589350
EF(f-c)	350
ED(f-c)	6
IRF(f-c)	68.1
EF(f-a)	350
ED(f-a)	34
IRF(f-a)	178.1
IRV(f-c)	41.7
IRV(f-a)	126.2
CPF(f)	1
IFP(f-adj)	1316910
IRP(f-c)	23.6
IRP(f-a)	106.5
CF(po)	1
IFE(f-adj)	657265
IRE(f-c)	10.95
IRE(f-a)	53.3
CF(egg)	1
IFB(f-adj)	2222640
IRB(f-c)	40.1
IRB(f-a)	179.7
CF(beef)	1
IFD(f-adj)	6036590
IRD(f-c)	349.5
IRD(f-a)	445.6
CF(dairy)	1
IFSW(f-adj)	1202670
IRSW(f-c)	18.5
IRSW(f-a)	97.8
CF(sw)	1
IFFI(f-adj)	1932420
IRFI(f-c)	32.8
IRFI(f-a)	156.6
CF(fish)	1

	Type	Halflife (y)	λ	SF(f)
Am-241	M	4.32E+02	1.60E-03	1.34E-10
Co-60	M	5.27E+00	1.31E-01	2.23E-11
H-3	M	1.23E+01	5.63E-02	1.44E-13
H-3	V	1.23E+01	5.63E-02	6.51E-14
Pu-238	M	8.77E+01	7.90E-03	1.69E-10

		Fruits & Vegetables	Poultry	Eggs	Beef	Milk	Swine	Fish
Am-241	M	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
		5.11E-04	1.76E-04	8.81E-05	2.98E-04	8.09E-04	1.61E-04	2.59E-04
		1.96E-03	**5.67E-03**	**1.14E-02**	**3.36E-03**	**1.24E-03**	**6.21E-03**	**3.86E-03**
Co-60	M	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
		8.50E-05	2.94E-05	1.47E-05	4.96E-05	1.35E-04	2.68E-05	4.31E-05
		1.18E-02	**3.41E-02**	**6.82E-02**	**2.02E-02**	**7.43E-03**	**3.73E-02**	**2.32E-02**
H-3	M	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
		5.49E-07	1.90E-07	9.46E-08	3.20E-07	8.69E-07	1.73E-07	2.78E-07
		1.82E+00	**5.27E+00**	**1.06E+01**	**3.12E+00**	**1.15E+00**	**5.77E+00**	**3.59E+00**
H-3	V	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
		2.48E-07	8.57E-08	4.28E-08	1.45E-07	3.93E-07	7.83E-08	1.26E-07
		4.03E+00	**1.17E+01**	**2.34E+01**	**6.91E+00**	**2.54E+00**	**1.28E+01**	**7.95E+00**
Pu-238	M	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
		6.44E-04	2.23E-04	1.11E-04	3.76E-04	1.02E-03	2.03E-04	3.27E-04
		1.55E-03	**4.49E-03**	**9.00E-03**	**2.66E-03**	**9.80E-04**	**4.92E-03**	**3.06E-03**

		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	F & V	1.96E-03	1.94E-03	1.0%	H-3	F & V	1.82E+00	1.80E+00	1.1%
	Poultry	5.67E-03	5.69E-03	-0.4%		Poultry	5.27E+00	5.27E+00	0.0%
	Eggs	1.14E-02	1.14E-02	0.0%		Eggs	1.06E+01	1.06E+01	0.0%
	Beef	3.36E-03	3.37E-03	-0.3%		Beef	3.12E+00	3.12E+00	0.0%
	Milk	1.24E-03	1.24E-03	0.0%		Milk	1.15E+00	1.15E+00	0.0%
	Swine	6.21E-03	6.23E-03	-0.3%		Swine	5.77E+00	5.77E+00	0.0%
	Fish	3.86E-03	3.87E-03	-0.3%		Fish	3.59E+00	3.59E+00	0.0%
Co-60	F & V	1.18E-02	1.16E-02	1.7%	Pu-238	F & V	1.55E-03	1.53E-03	1.3%
	Poultry	3.41E-02	3.40E-02	0.3%		Poultry	4.49E-03	4.48E-03	0.2%
	Eggs	6.82E-02	6.82E-02	0.0%		Eggs	9.00E-03	8.98E-03	0.2%
	Beef	2.02E-02	2.02E-02	0.0%		Beef	2.66E-03	2.65E-03	0.4%
	Milk	7.43E-03	7.42E-03	0.1%		Milk	9.80E-04	9.78E-04	0.2%
	Swine	3.73E-02	3.73E-02	0.0%		Swine	4.92E-03	4.91E-03	0.2%
	Fish	2.32E-02	2.32E-02	0.0%		Fish	3.06E-03	3.05E-03	0.3%

Consumption of fruits and vegetables

"PR" "G" _"f–prod–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ("IF" "F" _"f –adj" " " ("2,262,400 g")"+IF" "V" _"f–adj" " " ("1,589,350 g"))" x CP" "F" _"f" " " ("1.0"))

"IF" "F" _"f–adj" " " ("2,262,400 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "F" _"f–c" " " ("68.1 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "F" _"f–a" " " ("178.1 g" /"day"))

"IF" "F" _"f–adj" " " ("1,589,350 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "V" _"f–c" " " ("41.7 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "V" _"f–a" " " ("126.2 g" /"day"))

Consumption of poultry

"PR" "G" _"f–po–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" "P" _"f–adj" " " ("1,136,910 g")┤"x C" "F" _"po" " " ("1.0"))

"IF" "P" _"f–adj" " " ("1,136,910 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "P" _"f–c" " " ("23.6 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "P" _"f–a" " " ("106.5 g" /"day"))

Consumption of eggs

"PR" "G" _"f–egg–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" "E" _"f–adj" " " ("657,265 g")┤"x C" "F" _"egg" " " ("1.0"))

"IF" "E" _"f–adj" " " ("657,265 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "E" _"f–c" " " ("10.95 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "E" _"f–a" " " ("53.3 g" /"day"))

Consumption of beef

"PR" "G" _"f–beef–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" "B" _"f–adj" " " ("2,222,640 g")┤"x C" "F" _"beef" " " ("1.0"))

"IF" "B" _"f–adj" " " ("2,222,640 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "B" _"f–c" " " ("40.1 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "B" _"f–a" " " ("179.7 g" /"day"))

Consumption of milk

"PR" "G" _"f–dairy–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" "D" _"f–adj" " " ("6,036,590 g")┤"x C" "F" _"dairy" " " ("1.0"))

"IF" "D" _"f–adj" " " ("6,036,590 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" "D" _"f–c" " " ("349.5 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" "D" _"f–a" " " ("445.6 g" /"day"))

Consumption of swine

"PR" "G" _"f–sw–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" 〖"SW" 〗_"f–adj" " " ("1,202,670 g")┤"x C" "F" _"sw" " " ("1.0"))

"IF" 〖"SW" 〗_"f–adj" " " ("1,202,670 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" 〖"SW" 〗_"f–c" " " ("18.5 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" 〖"SW" 〗_"f–a" " " ("97.8 g" /"day"))

Consumption of fish

"PR" "G" _"f–fish–ing" " " ("pCi" ⁄"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")" x " ├"IF" 〖"FI" 〗_"f–adj" " " ("1,932,420 g")┤"x C" "F" _"fish" " " ("1.0"))

"IF" 〖"FI" 〗_"f–adj" " " ("1,932,420 g")"=" ("E" "F" _"f–c" " " ("350 day" /"yr")" x E" "D" _"f–c" " " ("6 yr")" x IR" 〖"FI" 〗_"f–c" " " ("32.8 g" /"day"))"+" ("E" "F" _"f–a" " " ("350 day" /"yr")" x E" "D" _"f–a" " " ("34 yr")" x IR" 〖"FI" 〗_"f–a" " " ("156.6 g" /"day"))

Variables	Defaults
TR	1.00E-06
IFW(f-adj)	31388
EF(f-c)	350
ED(f-c)	6
IRW(f-c)	0.78
EF(f-a)	350
ED(f-a)	34
IRW(f-a)	2.5
IFA(f-adj)	259000
ET(f-c)	24
IRA(f-c)	10
ET(f-a)	24
IRA(f-a)	20
K	0.5
DFA(f-adj)	9583
EV(f-c)	1
t(f-c-event)	0.54
EV(f-a)	1
t(f-a-event)	0.71
I(r)	3.62
F	0.25
t(b)	10950
P	240
MLF	0.26
I(f)	0.42
T	1
t(v)	60
Y(v)	2
Q(w-po)	0.4
Q(w-po)	0.4
Q(w-beef)	53
ρ(m)	0.970873786
Q(w-dairy)	92
Q(w-sw)	11.4
λ(HL)	0.000027

	Ingestion of Tapwater	Inhalation	Immersion	Fruits & Veg.	Eggs	Poultry	Fish	Beef	Milk	Swine	Total Tap	Total
Am-241	1.00E-06		1.00E-06	Am-241	Ingestion	3.08E-01	H-3	6.28E+02	-1.59E-03	0.00E+00	1.00E+00	1.00E+00
	0.00E+00		0.00E+00	#DIV/0!	1.22E-04	-2.61E-06	#VALUE!	3.33E+01	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!		#DIV/0!	#VALUE!	#VALUE!	-1.18E+05	#VALUE!	1.88E+01	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	1.00E-06		1.00E-06	0.00E+00	Inhalation	0.00E+00	0.00E+00	9.12E+00	1.10E-03	0.00E+00	1.00E+00	1.00E+00
	0.00E+00		0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#VALUE!	4.83E-01	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!		#DIV/0!	#DIV/0!	#VALUE!	#DIV/0!	#VALUE!	1.89E+01	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
H-3	1.00E-06	1.00E-06		0.00E+00			0.00E+00	0.00E+00	0.00E+00		1.00E+00	1.00E+00
	0.00E+00	0.00E+00		#DIV/0!			#VALUE!	0.00E+00	0.00E+00		#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!		#DIV/0!			#VALUE!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!
Pu-238	1.00E-06		1.00E-06	0.00E+00	Lambda B	3.14E-05	0.00E+00	1.81E-04	0.00E+00	0.00E+00	1.00E+00	1.00E+00
	0.00E+00		0.00E+00	#DIV/0!	1.26E-08	0.00E+00	#VALUE!	9.59E-06	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!		#DIV/0!	#DIV/0!	#VALUE!	#DIV/0!	#VALUE!	1.89E+01	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	Irr(rup)	Irr(res)	Irr(dep)
Am-241	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
H-3	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
Pu-238	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!

		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	Ingestion	3.06E-01	3.08E-01	-0.7%	H-3	Ingestion	6.28E+02	6.29E+02	-0.2%
	Inhalation					Inhalation	9.12E+00	9.11E+00	0.1%
	Immersion	6.93E+06	6.93E+06	0.0%		Immersion			
	Lambda i	4.39E-06	4.39E-06	0.0%		Lambda i	1.54E-04	1.54E-04	0.0%
	Lambda B	3.14E-05	3.14E-05	0.0%		Lambda B	1.81E-04	1.81E-04	0.0%
	Lambda E	4.95E-02	4.95E-02	0.0%		Lambda E	4.93E-02	4.95E-02	-0.4%
	Irr(rup)	6.67E-04	6.69E-04	-0.3%		Irr(rup)	8.61E+01	8.62E+01	-0.1%
	Irr(res)	9.08E+00	9.08E+00	0.0%		Irr(res)	4.66E+00	4.67E+00	-0.2%
	Irr(dep)	3.64E+00	3.64E+00	0.0%		Irr(dep)	3.65E+00	3.64E+00	0.3%
	F & V	1.54E-01	1.53E-01	0.7%		F & V	4.27E+01	4.22E+01	1.2%
	Poultry	2.36E+03	2.37E+03	-0.4%		Poultry			
	Eggs	9.46E+03	9.49E+03	-0.3%		Eggs			
	Beef	1.27E+02	1.27E+02	0.0%		Beef	1.09E+04	1.09E+04	0.0%
	Milk	3.30E+04	3.31E+04	-0.3%		Milk	2.85E+03	2.85E+03	0.0%
	Swine	3.20E+03	3.21E+03	-0.3%		Swine			
	Fish	1.61E-02	1.61E-02	0.0%		Fish	7.95E+03	7.95E+03	0.0%
	Total Tap	1.02E-01	1.02E-01	0.0%		Total Tap	7.42E+00	7.41E+00	0.1%
	Total	1.39E-02	1.39E-02	0.0%		Total	7.39E+00	7.38E+00	0.1%
Co-60	Ingestion	2.02E+00	2.02E+00	0.0%	Pu-238	Ingestion	2.43E-01	2.43E-01	0.0%
	Inhalation					Inhalation			
	Immersion	3.75E+04	3.75E+04	0.0%		Immersion	1.54E+09	1.54E+09	0.0%
	Lambda i	3.60E-04	3.60E-04	0.0%		Lambda i	2.16E-05	2.16E-05	0.0%
	Lambda B	3.87E-04	3.87E-04	0.0%		Lambda B	4.86E-05	4.86E-05	0.0%
	Lambda E	4.91E-02	4.95E-02	-0.8%		Lambda E	4.95E-02	4.95E-02	0.0%
	Irr(rup)	7.10E-02	7.10E-02	0.0%		Irr(rup)	2.65E-04	2.65E-04	0.0%
	Irr(res)	2.50E+00	2.50E+00	0.0%		Irr(res)	8.32E+00	8.32E+00	0.0%
	Irr(dep)	3.66E+00	3.64E+00	0.5%		Irr(dep)	3.64E+00	3.64E+00	0.0%
	F & V	1.89E+00	1.87E+00	1.1%		F & V	1.30E-01	1.28E-01	1.6%
	Poultry	8.78E+01	8.77E+01	0.1%		Poultry	3.74E+03	3.73E+03	0.3%
	Eggs	5.17E+03	5.17E+03	0.0%		Eggs	1.88E+04	1.87E+04	0.5%
	Beef	8.85E+02	8.85E+02	0.0%		Beef	4.57E+04	4.55E+04	0.4%
	Milk	7.56E+02	7.56E+02	0.0%		Milk	1.10E+03	1.09E+03	0.9%
	Swine	1.64E+03	1.63E+03	0.6%		Swine	5.39E+03	5.38E+03	0.2%
	Fish	3.05E-01	3.05E-01	0.0%		Fish	1.46E-04	1.45E-04	0.7%
	Total Tap	9.75E-01	9.72E-01	0.3%		Total Tap	8.46E-02	8.38E-02	1.0%
	Total	2.32E-01	2.31E-01	0.4%		Total	1.46E-04	1.45E-04	0.7%

	Type	Halflife (y)	λ	SF(w)	SF(i)	SF(imm)	Bv(wet)	Halflife (d)	λ(i)	λ(B)	-exp(-λ(B)t(b	λ(E)	-exp(-λ(E)t(v	PRG(f-prod-ing)	PRG(f-egg-ing	TF(egg)	PRG(f-po-ing)	TF(po)	PRG(f-fish-ing	BCF	PRG(f-beef-ing)	TF(beef)	PRG(f-dairy-ing	TF(dairy)	PRG(f-sw-ing	TF(sw)
Am-241	M	4.32E+02	1.60E-03	#REF!	#REF!	0.00E+00	1.91E-05	1.58E+05	-4.39E-06	3.14E-05	2.91E-01	4.95E-02	9.49E-01	0.00E+00	0.00E+00	3.00E-03	0.00E+00	6.00E-03	0.00E+00	2.40E+02	0.00E+00	5.00E-04	0.00E+00	4.20E-07	0.00E+00	1.70E-04
Co-60	M	5.27E+00	1.31E-01	#REF!	#REF!	0.00E+00	7.40E-03	1.92E+03	-3.60E-04	3.87E-04	9.86E-01	4.91E-02	9.48E-01	0.00E+00	0.00E+00	3.30E-02	0.00E+00	9.70E-01	0.00E+00	7.60E+01	0.00E+00	4.30E-04	0.00E+00	1.10E-04	0.00E+00	2.00E-03
H-3	M	1.23E+01	5.63E-02	#REF!			4.80E+00	4.49E+03	-1.54E-04	1.81E-04	8.63E-01	4.93E-02	9.48E-01	0.00E+00	0.00E+00		0.00E+00		0.00E+00	1.00E+00	0.00E+00	1.20E-02	0.00E+00	1.00E-02	0.00E+00	
H-3	V	1.23E+01	5.63E-02	#REF!	#REF!		4.80E+00	4.49E+03	-1.54E-04	1.81E-04	8.63E-01	4.93E-02	9.48E-01	0.00E+00	0.00E+00		0.00E+00		0.00E+00	1.00E+00	0.00E+00	1.20E-02	0.00E+00	1.00E-02	0.00E+00	
Pu-238	M	8.77E+01	7.90E-03	#REF!	5.22E-08	4.90E-01	8.27E-06	3.20E+04	-2.16E-05	4.86E-05	4.13E-01	4.95E-02	9.49E-01	0.00E+00	0.00E+00	1.20E-03	0.00E+00	3.00E-03	0.00E+00	2.10E+04	0.00E+00	1.10E-06	0.00E+00	1.00E-05	0.00E+00	8.00E-05

Ingestion of Tapwater

"PR" "G" _"water−f−ing" " " ("pCi" /"L")"=" "TR" /("S" "F" _"w" " " ("risk" /"pCi")" x IF" "W" _"f−adj" " " ("31,388 L"))"IF" "W" _"f−adj" " " ("31,388 L")"=" ("E" "F" _"f−c" " " ("350 day" /"yr")" x E" "D" _"f−c" " " ("6 yr")" x IR" "W" _"f−c" " " ("0.78 L" /"day"))"+" ("E" "F" _"f−a" " " ("350 day" /"yr")" x E" "D" _"f−a" " " ("34 yr")" x IR" "W" _"f−a" " " ("2.5 L" /"day"))

Inhalation (Only calculated for C-14, H-3, Ra-224, Ra-226, and Ra-226+D)

"PR" "G" _"water−f−inh" " " ("pCi" /"L")"=" "TR" /("S" "F" _"i" " " ("risk" /"pCi")" x IF" "A" _"f−adj" " " ("259,000 " "m" ^"3")" x K " ("0.5 L" /"m" ^"3"))"IF" "A" _"f−adj" " " ("259,000 " "m" ^"3")"=" ("E" "F" _"f−c" " " ("350 day" /"yr")" x E" "D" _"f−c" " " ("6 yr")" x E" "T" _"f−c" " " ("24 hrs" /"day")" x " (├ "1 day" ┤ /"24 hrs")" x IR" "A" _"f−c" " " (("10 " "m" ^"3")/"day"))"+ " ("E" "F" _"f−a" " " ("350 day" /"yr")" x E" "D" _"f−a" " " ("34 yr")" x E" "T" _"f−a" " " ("24 hrs" /"day")" x " ((("1 day"))/"24 hrs")" x IR" "A" _"f−a" " " (("20 " "m" ^"3")/"day"))

Immersion

"PR" "G" _"water−f−imm" " " ("pCi" /"L")"=" "TR" /("S" "F" _"imm" " " (("risk" /"yr")/("pCi" /"L"))" x " ("1 yr" /"8760 hr")" x DF" "A" _"f−adj" " " ("9583 hr"))"DF" "A" _"f−adj" " " ("9583 hr")"=" ("E" "F" _"f−c" " " ("350 day" /"yr")" x E" "D" _"f−c" " " ("6 yr")" x E" "V" _"f−c" " " ("1 event" /"day")" x " "t" _"f−c−event" " " ("0.54 hr" /"event"))"+" ("E" "F" _"f−a" " " ("350 day" /"yr")" x E" "D" _"f−a" " " ("34 yr")" x E" "V" _"f−a" " " ("1 event" /"day")" x " "t" _"f−a−event" " " ("0.71 hr" /"event"))" "

Total Tapwater

"PR" "G" _"water−f−tot" " " ("pCi" ⁄"L")"=" "1" /("1" /("PR" "G" _"water−f−ing") "+" "1" /("PR" "G" _"water−f−inh") "+" "1" /("PR" "G" _"water−f−imm") "+" "1" /("PR" "G" _"water−f−prod−ing"))

Consumption of fruits and vegetables

"PR" "G" _"water−f−prod−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−prod−ing" " " ("pCi" /"g"))/" " ├ " " ("1 kg" /"1000 g")"x " ("Ir" "r" _"rup" ("L" /"kg")"+Ir" "r" _"res" ("L" /"kg")"+Ir" "r" _"dep" ("L" /"kg"))┤ " ""Ir" "r" _"rup" " " ("L" /"kg")"=" ("Ir x F x B" "v" _"wet" " x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")])/("P x " "λ" _"B") " ; Ir" "r" _"res" " " ("L" /"kg")"=" "Ir x F x MLF x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")]/("P x " "λ" _"B") " ; Ir" "r" _"res" " " ("L" /"kg")"=" ("Ir x F x " "I" _"f" " x T x " ["1−" "e" ^("−" "λ" _"E" " x " "t" _"v")])/("Y" _"v" " x " "λ" _"E") " "

Consumption of eggs

"PR" "G" _"water−f−egg−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−egg−ing" " " ("pCi" /"g"))/("T" "F" _"egg" " " ("day" /"kg")" x " "Q" _"w−po" ("0.4 L" /"day")"x" ("1 kg" /"1000 g")) " "

Consumption poultry

"PR" "G" _"water−f−po−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−po−ing" " " ("pCi" /"g"))/("T" "F" _"po" " " ("day" /"kg")" x " "Q" _"w−po" ("0.4 L" /"day")"x" ("1 kg" /"1000 g")) " "

Consumption of fish

"PR" "G" _"water−f−fish−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−fish−ing" " " ("pCi" /"g"))/" " ├ "BCF " ("L" /"kg")┤ "x" ("1 kg" /"1000 g") " "

Consumption of beef

"PR" "G" _"water−f−beef−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−beef−ing" " " ("pCi" /"g"))/("T" "F" _"beef" " " ("day" /"kg")" x " "Q" _"w−beef" ("53 L" /"day")"x" ("1 kg" /"1000 g")) " "

Consumption of milk

"PR" "G" _"water−f−dairy−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−dairy−ing" " " ("pCi" /"g"))/("T" "F" _"dairy" " " ("day" /"kg")" x " "ρ" _"m" " " ("1.03 kg" /"1 L milk")^"−1" "x " "Q" _"w−dairy" ("92 L" /"day")"x" ("1 kg" /"1000 g")) " "

Consumption of swine

"PR" "G" _"water−f−sw−ing" " " ("pCi" /"g")"=" ("PR" "G" _"f−sw−ing" " " ("pCi" /"g"))/("T" "F" _"sw" " " ("day" /"kg")" x " "Q" _"w−sw" ("11.4 L" /"day")"x" ("1 kg" /"1000 g")) " "

Total

"PR" "G" _"water−f−tot" " " ("pCi" ⁄"L")"=" "1" /("1" /("PR" "G" _"water−f−ing") "+" "1" /("PR" "G" _"water−f−inh") "+" "1" /("PR" "G" _"water−f−imm") "+" "1" /("PR" "G" _"water−f−prod−ing")+"1" /("PR" "G" _"water−f−egg−ing") "+" "1" /("PR" "G" _"water−f−po−ing") "+" "1" /("PR" "G" _"water−f−fish−ing") "+" "1" /("PR" "G" _"water−f−beef−ing") "+" "1" /("PR" "G" _"water−f−dairy−ing") "+" "1" /("PR" "G" _"water−f−sw−ing"))

Variables	Defaults
TR	1.00E-06
t(f)	40
IFS(f-adj)	1610000
EF(f-c)	350
ED(f-c)	6
IRS(f-c)	200
EF(f-a)	350
ED(f-a)	34
IRS(f-a)	100
IFA(f-adj)	259000
ET(f-c)	24
IRA(f-c)	10
ET(f-a)	24
IRA(f-a)	20
PEF	1.36E+09
EF(f)	350
ED(f)	40
ET(fo)	12.168
ET(fi)	10.008
R(upv)	Bv(wet)
R(es)	MLF
MLF	0.25
MLF	0.26
Q(p-po)	0.2
f(p-po)	1
f(s-po)	1
Q(s-po)	0.022
R(upp)	Bv(dry)
Q(p-beef)	11.77
f(p-beef)	1
f(s-beef)	1
Q(s-beef)	0.39
ρ(m)	1.03
Q(p-dairy)	16.9
f(p-dairy)	1
f(s-dairy)	1
Q(s-dairy)	0.41
Q(p-sw)	4.7
f(p-sw)	1
f(s-sw)	1
Q(s-sw)	0.37
Q/C(wind)	93.774
V	0.5
U(m)	4.69
U(t)	11.32
F(x)	0.194
A	16.2302
A(s)	0.5
B	18.7762
C	216.108

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(s)	SF(i)	SF(ext-sv)	GSF(o)	GSF(i)	ACF(ext-sv)	Bv(dry)	Bv(wet)	Kd
Am-241	M	4.32E+02	1.60E-03	6.22E-02	1.84E-10	3.77E-08	2.77E-08	1.00E+00	4.00E-01	1.00E+00	2.20E-05	1.91E-05	4.00E+00
Co-60	M	5.27E+00	1.31E-01	9.95E-01	3.81E-11	1.01E-10	1.24E-05	1.00E+00	4.00E-01	1.00E+00	8.50E-03	7.40E-03	4.80E+02
H-3	M	1.23E+01	5.63E-02	8.95E-01		8.47E-13		1.00E+00	4.00E-01	9.00E-01	2.40E+01	4.80E+00	0.00E+00
H-3	V	1.23E+01	5.63E-02	8.95E-01		8.47E-13		1.00E+00	4.00E-01	9.00E-01	2.40E+01	4.80E+00	0.00E+00
Pu-238	M	8.77E+01	7.90E-03	2.71E-01	2.25E-10	5.22E-08	6.92E-11	1.00E+00	4.00E-01	1.00E+00	9.50E-06	8.27E-06	5.00E+00

	PRG(f-prod-ing)	PRG(f-egg-ing)	TF(egg)	PRG(f-po-ing)	TF(po)	PRG(f-fish-ing)	BCF	PRG(f-beef-ing)	TF(beef)	PRG(f-dairy-ing)	TF(dairy)	PRG(f-sw-ing)	TF(sw)
Am-241	1.96E-03	1.14E-02	3.00E-03	5.67E-03	6.00E-03	3.86E-03	2.40E+02	3.36E-03	5.00E-04	1.24E-03	4.20E-07	6.21E-03	1.70E-04
Co-60	1.18E-02	6.82E-02	3.30E-02	3.41E-02	9.70E-01	2.32E-02	7.60E+01	2.02E-02	4.30E-04	7.43E-03	1.10E-04	3.73E-02	2.00E-03
H-3 (M)	1.82E+00	1.06E+01		5.27E+00		3.59E+00	1.00E+00	3.12E+00	1.20E-02	1.15E+00	1.00E-02	5.77E+00	
H-3 (V)	4.03E+00	2.34E+01		1.17E+01		7.95E+00	1.00E+00	6.91E+00	1.20E-02	2.54E+00	1.00E-02	1.28E+01	
Pu-238	1.55E-03	9.00E-03	1.20E-03	4.49E-03	3.00E-03	3.06E-03	2.10E+04	2.66E-03	1.10E-06	9.80E-04	1.00E-05	4.92E-03	8.00E-05

	Ingestion	Inhalation	Exposure	Fruits & Veg.	Fish	Beef	Milk	Swine	Poultry	Eggs	Total
Am-241	6.42E-08	6.42E-08	6.42E-08	1.96E-03	1.54E-02	3.36E-03	1.24E-03	6.21E-03	5.67E-03	1.14E-02	1.00E+00
	1.84E-08	4.46E-10	4.45E-08	2.60E-01	2.40E+02	1.67E-03	1.89E-06	2.63E-04	4.32E-04	2.16E-04	1.52E+04
	3.49E+00	**1.44E+02**	**1.44E+00**	**7.77E-03**	**6.65E-05**	**2.08E+00**	**6.75E+02**	**2.44E+01**	**1.35E+01**	**5.43E+01**	**6.59E-05**
Co-60	5.26E-06	5.26E-06	5.26E-06	1.18E-02	1.11E+01	2.02E-02	7.43E-03	3.73E-02	3.41E-02	6.82E-02	1.00E+00
	6.10E-08	1.91E-11	3.19E-04	2.67E-01	7.60E+01	1.48E-03	5.10E-04	3.17E-03	7.15E-02	2.43E-03	6.67E+01
	8.62E+01	**2.75E+05**	**1.65E-02**	**2.33E-01**	**7.75E-01**	**7.23E+01**	**7.70E+01**	**6.22E+01**	**2.52E+00**	**1.48E+02**	**1.50E-02**
H-3		2.25E-06		1.82E+00		3.12E+00	1.15E+00				1.00E+00
		1.15E-05		5.06E+00		3.43E+00	3.98E+00				7.60E+00
		1.95E-01		**9.07E-01**		**2.29E+00**	**7.27E-01**				**1.32E-01**
Pu-238	3.16E-07	3.16E-07	3.16E-07	1.55E-03	1.53E-02	2.66E-03	9.80E-04	4.92E-03	4.49E-03	9.00E-03	1.00E+00
	9.82E-08	2.70E-09	4.85E-10	2.60E-01	2.10E+04	3.67E-06	4.50E-05	1.24E-04	2.16E-04	8.64E-05	1.18E+06
	3.22E+00	**1.17E+02**	**6.52E+02**	**6.96E-03**	**8.50E-07**	**8.47E+02**	**2.54E+01**	**4.64E+01**	**2.43E+01**	**1.22E+02**	**8.50E-07**

		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	Ingestion	3.49E+00	3.48E+00	0.3%	H-3	Ingestion			
	Inhalation	1.44E+02	1.44E+02	0.0%		Inhalation	1.95E-01	1.95E-01	0.0%
	Exposure	1.44E+00	1.44E+00	0.0%		Exposure			
	F & V	7.77E-03	7.72E-03	0.6%		F & V	9.07E-01	8.96E-01	1.2%
	Fish	6.65E-05	6.67E-05	-0.3%		Fish			
	Beef	2.08E+00	2.09E+00	-0.5%		Beef	2.29E+00	2.29E+00	0.0%
	Milk	6.75E+02	6.77E+02	-0.3%		Milk	7.27E-01	7.26E-01	0.1%
	Swine	2.44E+01	2.45E+01	-0.4%		Swine			
	Poultry	1.35E+01	1.36E+01	-0.7%		Poultry			
	Eggs	5.43E+01	5.44E+01	-0.2%		Eggs			
	Total	6.59E-05	6.61E-05	-0.3%		Total	1.32E-01	1.24E-01	6.3%
Co-60	Ingestion	8.62E+01	8.62E+01	0.0%	Pu-238	Ingestion	3.22E+00	3.23E+00	-0.3%
	Inhalation	2.75E+05	2.76E+05	-0.4%		Inhalation	1.17E+02	1.17E+02	0.0%
	Exposure	1.65E-02	1.65E-02	0.0%		Exposure	6.53E+02	6.53E+02	0.0%
	F & V	2.33E-01	2.30E-01	1.3%		F & V	6.96E-03	6.87E-03	1.3%
	Fish	7.75E-01	7.74E-01	0.1%		Fish	8.50E-07	8.48E-07	0.2%
	Beef	7.23E+01	7.22E+01	0.1%		Beef	8.47E+02	8.45E+02	0.2%
	Milk	7.70E+01	7.69E+01	0.1%		Milk	2.54E+01	2.53E+01	0.4%
	Swine	6.22E+01	6.21E+01	0.2%		Swine	4.64E+01	4.63E+01	0.2%
	Poultry	2.52E+00	2.52E+00	0.0%		Poultry	2.43E+01	2.42E+01	0.4%
	Eggs	1.48E+02	1.48E+02	0.0%		Eggs	1.22E+02	1.21E+02	0.8%
	Total	1.50E-02	1.50E-02	0.0%		Total	8.50E-07	8.48E-07	0.2%

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1-V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")

"Q" /"C" _"wind" "=A x" "exp" [("ln" "A" _"s" " " ("acre")"-B")^"2" /"C"]

Incidental ingestion of soil

"PR" "G" _"f-soil-ing" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"f" " " ("years")" x λ " ("1" /"years"))/(("1 -" "e" ^("-λ" "t" _"f"))" x S" "F" _"s" " " ("risk" /"pG")"x IF" "S" _"f-adj" " " ("1,610,000 mg")" x " ("g" /"1000 mg"))" IF" "S" _"f-adj" " " ("1,610,000 mg")"=" (("E" "F" _"f-c" " " (("350" "day")/"yr")" x E" "D" _"f-c" " " ("6 yr")" x IR" "S" _"f-c" " " ("200 mg" /"day"))"+" ("E" "F" _"f-a" " " ("350 day" /"yr")" x E" "D" _"f-a" " " ("34 yr")" x IR" "S" _"f-a" " " ("100 mg" /"day")))

Inhalation of particulates emitted from soil

"PR" "G" _"f-soil-inh" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"f" " " ("years")" x λ " ("1" /"years"))/(("1 -" "e" ^("-λ" "t" _"f"))" x S" "F" _"i" " " ("risk" /"pG")"x IF" "A" _"f-adj" " " (〖"259,000 m" 〗^"3")" x " ("1" /"PEF " ("m" ^"3" /"kg"))" x " ("1000 g" /"kg"))

"IF" "A" _"f-adj" " " (〖"259,000 m" 〗^"3")"=" (("E" "F" _"f-c" " " (("350" "day")/"yr")" x E" "D" _"f-c" " " ("6 yr")" x E" "T" _"f-c" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")"x IR" "A" _"f-c" " " (("10 " "m" ^"3")/"day"))"+" ("E" "F" _"f-a" " " ("350 day" /"yr")" x E" "D" _"f-a" " " ("34 yr")" x E" "T" _"f-a" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")"x IR" "A" _"f-a" " " (("20 " "m" ^"3")/"day")))

External exposure to ionizing radiation

"PR" "G" _"f-soil-ext" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"f" " " ("years")" x λ " ("1" /"years"))/(("1 -" "e" ^("-λ" "t" _"f"))" x S" "F" _"ext-sv" " " ("risk⁄yr" /"pCi/g")"x E" "F" _"f" " " ("350 days" /"year")" x " ("1 yr" /"365 days")" x E" "D" _"f" " " ("40 yrs")" x " [("E" "T" _"f-o" " " ("12.168 hr" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0"))"+" ("E" "T" _"f-i" " " ("10.008 hr" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4"))]" x AC" "F" _"ext -sv")

Consumption of fruits and vegetables

"PR" "G" _"soil-f-prod-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-prod-ing" " " ("pCi" ⁄"g"))/" " ├ " " ("R" _"upv" "+" "R" _"es")┤ " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))

"R" _"upv" "=B" "v" _"wet" " " "R" _"es" "=MLF (0.26)"

Consumption of eggs

"PR" "G" _"soil-f-egg-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-egg-ing" " " ("pCi" ⁄"g"))/("T" "F" _"egg" " " ("day" /"kg")" x " [("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))

"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption poultry

"PR" "G" _"soil-f-po-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-po-ing" " " ("pCi" ⁄"g"))/("T" "F" _"po" " " ("day" /"kg")" x " [("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))

"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of fish

"PR" "G" _"soil-f-fish-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-fish-ing" " " ("pCi" ⁄"g")" x " "K" _"d" " " ("L" /"kg"))/" " ├ "BCF " ("L" /"kg")┤ " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))

Consumption of beef

"PR" "G" _"soil-f-beef-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-beef-ing" " " ("pCi" ⁄"g"))/("T" "F" _"beef" " " ("day" /"kg")" x " [("Q" _"p-beef" " " ("11.77 kg" /"day")" x " "f" _"p-beef" " " ("1")" x " "f" _"s-beef" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-beef" " " ("0.39 kg" /"day")"x " "f" _"p-beef" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of milk

"PR" "G" _"soil-f-dairy-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-dairy-ing" " " ("pCi" ⁄"g"))/("T" "F" _"dairy" " " ("day" /"kg")" x " "ρ" _"m" " " ("1.03 kg" /"1 L milk")^"-1" "x " [("Q" _"p-dairy" " " ("16.9 kg" /"day")" x " "f" _"p-dairy" " " ("1")" x " "f" _"s-dairy" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-dairy" " " ("0.41 kg" /"day")"x " "f" _"p-dairy" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of swine

"PR" "G" _"soil-f-sw-ing" " " ("pCi" ⁄"g")"=" ("PR" "G" _"f-sw-ing" " " ("pCi" ⁄"g"))/("T" "F" _"sw" " " ("day" /"kg")" x " [("Q" _"p-sw" " " ("4.7 kg" /"day")" x " "f" _"p-sw" " " ("1")" x " "f" _"s-sw" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-sw" " " ("0.37 kg" /"day")"x " "f" _"p-sw" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Variables	Defaults
TR	1.00E-06
t(f)	40
IFA(r-adj)	259000
EF(f-c)	350
ED(f-c)	6
ET(f-c)	24
IRA(f-c)	10
EF(f-a)	350
ED(f-a)	34
ET(f-a)	24
IRA(f-a)	20
EF(f)	350
ED(f)	40
ET(f)	24

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(i)	SF(sub)	GSF(a)
Am-241	M	4.32E+02	1.60E-03	6.22E-02	3.77E-08	5.81E-11	1.00E+00
Co-60	M	5.27E+00	1.31E-01	9.95E-01	1.01E-10	1.13E-08	1.00E+00
H-3	M	1.23E+01	5.63E-02	8.95E-01	8.47E-13	0.00E+00	1.00E+00
H-3	V	1.23E+01	5.63E-02	8.95E-01		0.00E+00	1.00E+00
Pu-238	M	8.77E+01	7.90E-03	2.71E-01	5.22E-08	2.56E-13	1.00E+00

Farmer Air

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	6.42E-08	6.42E-08	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	6.07E-04	1.39E-10	9.46E+03	9.76E-03	2.23E-09	9.76E+03
	1.06E-04	**4.63E+02**	**1.06E-04**	**1.02E-04**	**4.49E+02**	**1.02E-04**
Co-60	5.26E-06	5.26E-06	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	2.60E-05	4.31E-07	5.03E+00	2.62E-05	4.33E-07	2.66E+01
	2.02E-01	**1.22E+01**	**1.99E-01**	**3.82E-02**	**2.31E+00**	**3.76E-02**
H-3	2.25E-06		1.00E+00	1.00E-06		1.00E+00
	1.96E-07		8.71E-02	2.19E-07		2.19E-01
	1.15E+01		**1.15E+01**	**4.56E+00**		**4.56E+00**
Pu-238	3.16E-07	3.16E-07	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	3.66E-03	2.66E-12	1.16E+04	1.35E-02	9.82E-12	1.35E+04
	8.63E-05	**1.19E+05**	**8.63E-05**	**7.40E-05**	**1.02E+05**	**7.40E-05**

		Calculated	PRG	% Differ.
Am-241	Inhalation	1.06E-04	1.06E-04	0.0%
	External	4.63E+02	4.64E+02	-0.2%
	Total	1.06E-04	1.06E-04	0.0%
	Inhalation	1.02E-04	1.02E-04	0.0%
	External	4.49E+02	4.49E+02	0.0%
	Total	1.02E-04	1.02E-04	0.0%
Co-60	Inhalation	2.02E-01	2.03E-01	-0.5%
	External	1.22E+01	1.23E+01	-0.8%
	Total	1.99E-01	2.00E-01	-0.5%
	Inhalation	3.82E-02	3.84E-02	-0.5%
	External	2.31E+00	2.32E+00	-0.4%
	Total	3.76E-02	3.77E-02	-0.3%
H-3	Inhalation	1.15E+01	1.15E+01	0.0%
	External			
	Total	1.15E+01	1.15E+01	0.0%
	Inhalation	4.56E+00	4.56E+00	0.0%
	External			
	Total	4.56E+00	4.56E+00	0.0%
Pu-238	Inhalation	8.63E-05	8.63E-05	0.0%
	External	1.19E+05	1.19E+05	0.0%
	Total	8.63E-05	8.63E-05	0.0%
	Inhalation	7.40E-05	7.40E-05	0.0%
	External	1.02E+05	1.02E+05	0.0%
	Total	7.40E-05	7.40E-05	0.0%

Inhalation (with half-life decay)

"PR" "G" _"f−air−inh−decay" " " ("pCi" /"m" ^"3")"=" ⊦"TR x " "t" _"f" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"f"))" x SFi " ("risk" /"pCi")" x IF" "A" _"f−adj" " " ("161,000 " "m" ^"3"))"IF" "A" _"f−adj" " " ("161,000 " "m" ^"3")"=" ("E" "F" _"f−c" " " ("350 day" /"yr")" x E" "D" _"f−c" " " ("6 yr")" x E" "T" _"f−c" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"f−c" " " (("10 " "m" ^"3")/"day"))"+" (⟦"EF" ⟧_"f−a" " " ("350 day" /"yr")" x " ⟦"ED" ⟧_"f−a" " " ("34 yr")" x " ⟦"ET" ⟧_"f−a" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x " ⟦"IRA" ⟧_"f−a" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (with half-life decay)

"PR" "G" _"f−air−sub−decay" " " ("pCi" /"m" ^"3")"=" ⊦"TR x " "t" _"f" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"f"))" x S" "F" _"sub" " " (("risk" /"yr")/("pCi" /"m" ^"3"))" x E" "F" _"f" " " ("350 day" /"yr")" x " (⊦"1 yr" ⊣ /"365 days")" x E" "D" _"f" " " ("40 yr")" x E" "T" _"f" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (with half-life decay)

"PR" "G" _"f−air−tot−decay" " " ("pCi" /"m" ^"3")"=" "1" /("1" /("PR" "G" _"f−air−inh−decay") "+" "1" /("PR" "G" _"f−air−sub−decay") " ")

Inhalation (without half-life decay)

"PR" "G" _"f−air−inh−nodecay" " " ("pCi" /"m" ^"3")"=" ⊦"TR" ⊣ /("SFi " ("risk" /"pCi")" x IF" "A" _"f−adj" " " ("259,000 " "m" ^"3"))"IF" "A" _"f−adj" " " ("259,000 " "m" ^"3")"=" ("E" "F" _"f−c" " " ("350 day" /"yr")" x E" "D" _"f−c" " " ("6 yr")" x E" "T" _"f−c" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"f−c" " " (("10 " "m" ^"3")/"day"))"+" (⟦"EF" ⟧_"f−a" " " ("350 day" /"yr")" x " ⟦"ED" ⟧_"f−a" " " ("34 yr")" x " ⟦"ET" ⟧_"f−a" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x " ⟦"IRA" ⟧_"f−a" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (without half-life decay)

"PR" "G" _"f−air−sub−nodecay" " " ("pCi" /"m" ^"3")"=" ⊦"TR" ⊣ /("S" "F" _"sub" " " (("risk" /"yr")/("pCi" /"m" ^"3"))" x E" "F" _"f" " " ("350 day" /"yr")" x " (⊦"1 yr" ⊣ /"365 days")" x E" "D" _"f" " " ("40 yr")" x E" "T" _"f" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"f−air−tot−nodecay" " " ("pCi" /"m" ^"3")"=" "1" /("1" /("PR" "G" _"f−air−inh−nodecay") "+" "1" /("PR" "G" _"f−air−sub−nodecay") " ")

Variables	Defaults	
TR	1.00E-06	
t(f)	25	
IFS(f-adj)	1610000	
EF(f-c)	350	
ED(f-c)	6	
IRS(f-c)	200	
EF(f-a)	350	
ED(f-a)	34	
IRS(f-a)	100	
IFA(f-adj)	259000	
ET(f-c)	24	
IRA(f-c)	10	
ET(f-a)	24	
IRA(f-a)	20	
PEF	1.36E+09	
EF(f)	350	
ED(f)	40	
ET(fo)	12.168	
ET(fi)	10.008	
R(upv)	Bv(wet)	
R(es)	MLF	
MLF	0.26	
MLF	0.25	
Q(p-po)	0.2	
f(p-po)	1	
f(s-po)	1	
Q(s-po)	0.022	
R(upp)	Bv(dry)	
Q(p-beef)	11.77	
f(p-beef)	1	16.9
f(s-beef)	1	
Q(s-beef)	0.39	
ρ(m)	1.03	0.41
Q(p-dairy)	16.9	
f(p-dairy)	1	
f(s-dairy)	1	
Q(s-dairy)	0.41	
Q(p-sw)	4.7	
f(p-sw)	1	
f(s-sw)	1	
Q(s-sw)	0.37	
Q/C(wind)	93.774	
V	0.5	
U(m)	4.69	
U(t)	11.32	
F(x)	0.194	
A	16.2302	
A(s)	0.5	
B	18.7762	
C	216.108	
I(r)	3.62	
F	0.25	
t(b)	10950	
P	240	
MLF	0.26	
I(f)	0.42	
T	1	
t(v)	60	
Y(v)	2	
Q(w-po)	0.4	
Q(w-po)	0.4	
Q(w-beef)	53	
ρ(m)	0.970874	
Q(w-dairy)	92	
Q(w-sw)	11.4	

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(w)	SF(i)	SF(imm)	Bv(wet)	Bv(dry)	Kd	PRG(f-prod-ing)	Irr(rup)	Irr(res)	Irr(dep)
Am-241	M	4.32E+02	1.60E-03	3.93E-02	1.04E-10	3.77E-08	1.32E-13	1.91E-05	2.20E-05	4.00E+00	1.96E-03	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	M	5.27E+00	1.31E-01	9.63E-01	1.58E-11	1.01E-10	2.44E-11	7.40E-03	8.50E-03	4.80E+02	1.18E-02	#DIV/0!	#DIV/0!	#DIV/0!
H-3	M	1.13E+01	6.13E-02	7.84E-01	1.12E-13	8.47E-13	0.00E+00	4.80E+00	2.40E+01	0.00E+00	1.82E+00	0.00E+00	0.00E+00	0.00E+00
H-3	V	1.13E+01	6.13E-02	7.84E-01	5.07E-14	8.47E-13	0.00E+00	4.80E+00	2.40E+01	0.00E+00	4.03E+00	#DIV/0!	#DIV/0!	#DIV/0!
Pu-238	M	8.77E+01	7.90E-03	1.79E-01	1.31E-10	5.22E-08	5.96E-16	8.27E-06	9.50E-06	5.00E+00	1.55E-03	#DIV/0!	#DIV/0!	#DIV/0!

	Type	PRG(f-egg-ing)	TF(egg)	PRG(f-po-ing)	TF(po)	PRG(f-fish-ing)	BCF	PRG(f-beef-ing)	TF(beef)	PRG(f-dairy-ing)	TF(dairy)	PRG(f-sw-ing)	TF(sw)
Am-241	M	1.14E-02	3.00E-03	5.67E-03	6.00E-03	3.86E-03	2.40E+02	3.36E-03	5.00E-04	1.24E-03	4.20E-07	6.21E-03	1.70E-04
Co-60	M	6.82E-02	3.30E-02	3.41E-02	9.70E-01	2.32E-02	7.60E+01	2.02E-02	4.30E-04	7.43E-03	1.10E-04	3.73E-02	2.00E-03
H-3	M	1.06E+01		5.27E+00		3.59E+00	1.00E+00	3.12E+00	1.20E-02	1.15E+00	1.00E-02	5.77E+00	
H-3	V	2.34E+01		1.17E+01		7.95E+00	1.00E+00	6.91E+00	1.20E-02	2.54E+00	1.00E-02	1.28E+01	
Pu-238	M	9.00E-03	1.20E-03	4.49E-03	3.00E-03	3.06E-03	2.10E+04	2.66E-03	1.10E-06	9.80E-04	1.00E-05	4.92E-03	8.00E-05

	Fruits & Vegetables		Fish		Beef		Milk		Swine		Poultry		Egg	
	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept
Am-241	#DIV/0!	1.96E-03	-4.00E+00	1.54E-02	-5.30E+01	3.36E-03	-9.20E+01	1.24E-03	-1.14E+01	6.21E-03	-4.00E-01	5.67E-03	-4.00E-01	1.14E-02
	2.60E-01	2.60E-01	1000	2.40E+02	3.33E+00	1.67E-03	4.64E+00	1.89E-06	1.55E+00	2.63E-04	7.20E-02	4.32E-04	7.20E-02	2.16E-04
	#DIV/0!	**7.53E-03**	**-4.00E-03**	**6.44E-05**	**-1.59E+01**	**2.01E+00**	**-1.98E+01**	**6.54E+02**	**-7.38E+00**	**2.36E+01**	**-5.56E+00**	**1.31E+01**	**-5.56E+00**	**5.26E+01**
Co-60	#DIV/0!	1.18E-02	-4.80E+02	1.11E+01	-5.30E+01	2.02E-02	-9.20E+01	7.43E-03	-1.14E+01	3.73E-02	-4.00E-01	3.41E-02	-4.00E-01	6.82E-02
	2.67E-01	2.67E-01	1000	7.60E+01	3.43E+00	1.48E-03	4.78E+00	5.10E-04	1.58E+00	3.17E-03	7.37E-02	7.15E-02	7.37E-02	2.43E-03
	#DIV/0!	**4.40E-02**	**-4.80E-01**	**1.47E-01**	**-1.54E+01**	**1.37E+01**	**-1.93E+01**	**1.46E+01**	**-7.19E+00**	**1.18E+01**	**-5.43E+00**	**4.76E-01**	**-5.43E+00**	**2.81E+01**
H-3	#DIV/0!	4.03E+00			-5.30E+01	6.91E+00	-9.20E+01	2.54E+00	-1.14E+01		-4.00E-01		-4.00E-01	
	5.06E+00	5.06E+00			2.86E+02	3.43E+00	4.10E+02	3.98E+00	1.14E+02		4.87E+00		4.87E+00	
	#DIV/0!	**7.96E-01**			**-1.85E-01**	**2.02E+00**	**-2.24E-01**	**6.39E-01**	**-9.97E-02**		**-8.21E-02**		**-8.21E-02**	
Pu-238	#DIV/0!	1.55E-03	-5.00E+00	1.53E-02	-5.30E+01	2.66E-03	-9.20E+01	9.80E-04	-1.14E+01	4.92E-03	-4.00E-01	4.49E-03	-4.00E-01	9.00E-03
	2.60E-01	2.60E-01	1000	2.10E+04	3.33E+00	3.67E-06	4.64E+00	4.50E-05	1.55E+00	1.24E-04	7.20E-02	2.16E-04	7.20E-02	8.64E-05
	#DIV/0!	**5.97E-03**	**-5.00E-03**	**7.29E-07**	**-1.59E+01**	**7.26E+02**	**-1.98E+01**	**2.18E+01**	**-7.38E+00**	**3.98E+01**	**-5.56E+00**	**2.08E+01**	**-5.56E+00**	**1.04E+02**

Am-241		Calculated	PRG	% Differ.	Co-60		Calculated	PRG	% Differ.
F&V	Slope	-4.90E+01	-4.89E+01	0.2%	F&V	Slope	-2.33E+01	-2.32E+01	0.4%
	Intercept	7.53E-03	7.48E-03	0.7%		Intercept	4.40E-02	4.35E-02	1.1%
Fish	Slope	-4.00E-03	-4.00E-03	0.0%	Fish	Slope	-4.80E-01	-4.80E-01	0.0%
	Intercept	6.44E-05	6.46E-05	-0.3%		Intercept	1.47E-01	1.46E-01	0.7%
Beef	Slope	-1.59E+01	-1.59E+01	0.0%	Beef	Slope	-1.54E+01	-1.54E+01	0.0%
	Intercept	2.01E+00	2.02E+00	-0.5%		Intercept	1.37E+01	1.37E+01	0.0%
Milk	Slope	-1.98E+01	-1.98E+01	0.0%	Milk	Slope	-1.93E+01	-1.93E+01	0.0%
	Intercept	6.54E+02	6.56E+02	-0.3%		Intercept	1.46E+01	1.45E+01	0.7%
Swine	Slope	-7.38E+00	-7.38E+00	0.0%	Swine	Slope	-7.19E+00	-7.19E+00	0.0%
	Intercept	2.36E+01	2.37E+01	-0.4%		Intercept	1.18E+01	1.18E+01	0.0%
Poultry	Slope	-5.56E+00	-5.56E+00	0.0%	Poultry	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	1.31E+01	1.32E+01	-0.8%		Intercept	4.76E-01	4.76E-01	0.0%
Egg	Slope	-5.56E+00	-5.56E+00	0.0%	Egg	Slope	-5.43E+00	-5.43E+00	0.0%
	Intercept	5.26E+01	5.27E+01	-0.2%		Intercept	2.81E+01	2.80E+01	0.4%

H-3		Calculated	PRG	% Differ.	Pu-238		Calculated	PRG	% Differ.
F&V	Slope	-1.87E+01	-1.87E+01	0.0%	F&V	Slope	-4.60E+01	-4.60E+01	0.0%
	Intercept	7.96E-01	7.88E-01	1.0%		Intercept	5.97E-03	5.89E-03	1.3%
Fish	Slope				Fish	Slope	-5.00E-03	-5.00E-03	0.0%
	Intercept					Intercept	7.29E-07	7.27E-07	0.3%
Beef	Slope	-1.85E-01	-1.85E-01	0.0%	Beef	Slope	-1.59E+01	-1.59E+01	0.0%
	Intercept	2.02E+00	2.01E+00	0.5%		Intercept	7.26E+02	7.24E+02	0.3%
Milk	Slope	-2.24E-01	-2.24E-01	0.0%	Milk	Slope	-1.98E+01	-1.98E+01	0.0%
	Intercept	6.39E-01	6.39E-01	0.0%		Intercept	2.18E+01	2.17E+01	0.5%
Swine	Slope	-9.97E-02	-9.97E-02	0.0%	Swine	Slope	-7.38E+00	-7.38E+00	0.0%
	Intercept					Intercept	3.98E+01	3.97E+01	0.3%
Poultry	Slope	-8.21E-02	-8.21E-02	0.0%	Poultry	Slope	-5.56E+00	-5.56E+00	0.0%
	Intercept					Intercept	2.08E+01	2.07E+01	0.5%
Egg	Slope	-8.21E-02	-8.21E-02	0.0%	Egg	Slope	-5.56E+00	-5.56E+00	0.0%
	Intercept					Intercept	1.04E+02	1.04E+02	0.0%

Consumption of fruits and vegetables

"PR" "G" _"sw-f-prod-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f−prod−rad−ing" " " ("pCi" ⁄"g"))/" " ├ " " ("R" _"upv" "+" "R" _"es")┤ " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1−" "e" ^("−λ" "t" _"f")))) "SLOPE=" "-" ("Ir" "r" _"rup" ("L" /"kg")"+Ir" "r" _"res" ("L" /"kg")"+Ir" "r" _"dep" ("L" /"kg"))/" " ├ " " ("R" _"upv" "+" "R" _"es")┤
"Ir" "r" _"rup" " " ("L" /"kg")"=" ("Ir x F x B" "v" _"wet" " x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")])/("P x " "λ" _"B") " ; Ir" "r" _"res" " " ("L" /"kg")"=" "Ir x F x MLF x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")]/("P x " "λ" _"B") " ; Ir" "r" _"res" " " ("L" /"kg")"=" ("Ir x F x " "I" _"f" " x T x " ["1−" "e" ^("−" "λ" _"E" " x " "t" _"v")])/("Y" _"v" " x " "λ" _"E") " "; 〖" R" 〗_"upv" "=B" "v" _"wet" " " "R" _"es" "=MLF (0.26)"

Consumption of eggs

"PR" "G" _"sw-f-egg-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-egg-rad−ing" " " ("pCi" ⁄"g"))/("T" "F" _"egg" " " ("day" /"kg")" x " [("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f")))) "SLOPE=" ("-" "Q" _"w-po" ("0.4 L" /"day"))/("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+ " ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1")) " ""R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of poultry

"PR" "G" _"sw-f-po-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-po-rad-ing" " " ("pCi" ⁄"g"))/("T" "F" _"po" " " ("day" /"kg")" x " [("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"SLOPE=" ("-" "Q" _"w-po" ("0.4 L" /"day"))/("Q" _"p-po" " " ("0.2 kg" /"day")" x " "f" _"p-po" " " ("1")" x " "f" _"s-po" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+ " ("Q" _"s-po" " " ("0.022 kg" /"day")"x " "f" _"p-po" " " ("1")) " ""R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of fish

"PR" "G" _"sw-f-fish-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-fish-rad-ing" " " ("pCi" ⁄"g")" x " "K" _"d" " " ("L" /"kg"))/" " ├ "BCF " ("L" /"kg")┤ " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"SLOPE=" ("-" "K" _"d" " " ("L" /"kg"))/" " ├ "1000" ┤ " "

Consumption of beef

"PR" "G" _"sw-f-beef-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-beef-rad-ing" " " ("pCi" ⁄"g"))/("T" "F" _"beef" " " ("day" /"kg")" x " [("Q" _"p-beef" " " ("11.77 kg" /"day")" x " "f" _"p-beef" " " ("1")" x " "f" _"s-beef" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-beef" " " ("0.39 kg" /"day")"x " "f" _"p-beef" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"SLOPE=" ("-" "Q" _"w-beef" ("53 L" /"day"))/("Q" _"p-beef" " " ("11.77 kg" /"day")" x " "f" _"p-beef" " " ("1")" x " "f" _"s-beef" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+ " ("Q" _"s-beef" " " ("0.39 kg" /"day")"x " "f" _"p-beef" " " ("1")) " ""R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of milk

"PR" "G" _"sw-f-dairy-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-dairy-rad-ing" " " ("pCi" ⁄"g"))/("T" "F" _"dairy" " " ("day" /"kg")" x " "ρ" _"m" " " ("1.03 kg" /"1 L milk")^"-1" "x " [("Q" _"p-dairy" " " ("16.9 kg" /"day")" x " "f" _"p-dairy" " " ("1")" x " "f" _"s-dairy" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-dairy" " " ("0.41 kg" /"day")"x " "f" _"p-dairy" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"f"))))"SLOPE=" ("-" "Q" _"w-dairy" ("92 L" /"day"))/("Q" _"p-dairy" " " ("16.9 kg" /"day")" x " "f" _"p-dairy" " " ("1")" x " "f" _"s-dairy" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+ " ("Q" _"s-dairy" " " ("0.41 kg" /"day")"x " "f" _"p-dairy" " " ("1")) " ""R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of swine

"PR" "G" _"sw-f-sw-rad-ing" "="
"INTERCEPT=" ("PR" "G" _"f-sw-rad-ing" " " ("pCi" ⁄"g"))/("T" "F" _"sw" " " ("day" /"kg")" x " [("Q" _"p-sw" " " ("4.7 kg" /"day")" x " "f" _"p-sw" " " ("1")" x " "f" _"s-sw" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-sw" " " ("0.37 kg" /"day")"x " "f" _"p-sw" " " ("1"))]) " x " (("t" _"f" " " ("yr")" x λ " ("1" /"yr"))/(("1-

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elemental)	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ground Plane, Area Correction Factor																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Variables	Defaults
C(w)	MCL or PRG*DAF
t	26
θ(w)	0.3
ρ(b)	1.5
DAF	1
DAF	13.751432
K	10
i	2
d	0.5738144
I	0.18
L	5
d(a)	3
ED(gw)	70
d(s)	1.5

	Halflife (y)	λ	1-exp(-λt(cw))	K(d)	PRG	MCL	PRG	MCL
Am-241	4.32E+02	1.60E-03	4.09E-02	4.00E+00	3.35E-01	1.50E+01	4.61E+00	2.06E+02
Co-60	5.27E+00	1.31E-01	9.67E-01	4.80E+02	2.61E+00	1.00E+02	3.59E+01	1.38E+03
H-3	1.23E+01	5.63E-02	7.69E-01	0.00E+00	1.37E+01	2.00E+04	1.89E+02	2.75E+05
Pu-238	8.77E+01	7.90E-03	1.86E-01	5.00E+00	2.70E-01	1.50E+01	3.71E+00	2.06E+02

Partitioning

	PRG based	MCL based
Am-241	1.44E-03	6.43E-02
Co-60	4.43E+00	1.70E+02
H-3	5.22E-03	7.62E+00
Pu-238	1.55E-03	8.63E-02

		Calculated	PRG	% Differ.
Am-241	PRG Based	1.44E-03	1.44E-03	0.0%
	MCL Based	6.43E-02	6.43E-02	0.0%
Co-60	PRG Based	4.43E+00	4.43E+00	0.0%
	MCL Based	1.70E+02	1.70E+02	0.0%
H-3	PRG Based	5.22E-03	5.23E-03	-0.2%
	MCL Based	7.62E+00	7.61E+00	0.1%
Pu-238	PRG Based	1.55E-03	1.55E-03	0.0%
	MCL Based	8.63E-02	8.63E-02	0.0%

Mass Loading

	PRG based	MCL based
Am-241	2.42E-03	1.08E-01
	9.19E-02	9.19E-02
	2.63E-02	**1.18E+00**
Co-60	1.55E+00	5.94E+01
	2.18E+00	2.18E+00
	7.10E-01	**2.73E+01**
H-3	3.48E+00	5.08E+03
	1.73E+00	1.73E+00
	2.01E+00	**2.93E+03**
Pu-238	9.61E-03	5.33E-01
	4.18E-01	4.18E-01
	2.30E-02	**1.28E+00**

		Calculated	PRG	% Differ.
Am-241	PRG Based	2.63E-02	2.63E-02	0.0%
	MCL Based	1.18E+00	1.18E+00	0.0%
Co-60	PRG Based	7.10E-01	7.10E-01	0.0%
	MCL Based	2.73E+01	2.72E+01	0.4%
H-3	PRG Based	2.01E+00	2.01E+00	0.0%
	MCL Based	2.93E+03	2.93E+03	0.0%
Pu-238	PRG Based	2.30E-02	2.30E-02	0.0%
	MCL Based	1.28E+00	1.28E+00	0.0%

Partitioning

"SSL " ("pCi" /"g")"=" "C" _"w" " " ("pCi" /"L")" x " 〖"10" 〗^"-3" " " ("kg" /"g")" x (" "K" _"d" " " ("L" /"kg")"+" ("θ" _"w" " " ("L" _"water" /"L" _"soil"))/("ρ" _"b" " " ("kg" /"L")) " x" "t x λ" /(("1-" "e" ^"-λt"))

"C" _"w" "=MCL or " ("PRG x DAF")

Mass Loading

"SSL " ("pCi" /"g")"=" ("C" _"w" " " ("pCi" /"L")" x I " ("m" /"yr")" x E" "D" _"gw" " " ("70 yr")" x " 〖"10" 〗^"-3" " " ("kg" /"g")" x t x λ")/("ρ" _"b" " " ("kg" /"L")" x " "d" _"s" " " ("m")" x " ("1-" "e" ^"-λt"))

"C" _"w" "=MCL or " ("PRG x DAF")

Dilution Attenuation Factor

"DAF=1+" ("K " ("m" /"yr")" x i " ("m" /"m")" x d " ("m")/"I " ("m" /"yr")" x L" ("m"))

Mixing Zone Depth

"d" ("m")"=" ("0.0112 x L " ("m")^"2")^"0.5" "+" "d" _"a" " " ("m")" x " {"1-" "e" ^["-L " ("m")" x I " ("m" /"yr")/("K " ("m" /"yr")" x i " ("m" /"m")" x " "d" _"a" " " ("m"))] }

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elementa	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Soil Volume																
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Ground Plane, Area Correction Factor																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elementa	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Ground Plane, Area Correction Factor																
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume																
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Variables	Defaults
TR	1.00E-06
t(iw)	25
EF(iw)	250
ED(iw)	25
IRS(iw)	50
ET(iw)	8
IRA(iw)	60
PEF	1.36E+09
GSF(i)	0.4
GSF(a)	1
Q/C(wind)	93.77358
V	0.5
U(m)	4.69
U(t)	11.32
F(x)	0.194
A	16.2302
A(s)	0.5
B	18.7762
C	216.108

	Type	Halflife (y)	λ	1-exp(-λt(iw))	SF(s)	SF(i)	SF(ext-sv)	ACF(ext-sv)	SF(sub)
Am-241	M	4.32E+02	1.60E-03	3.93E-02	9.10E-11	0.00E+00	2.77E-08	1.00E+00	5.81E-11
Co-60	M	5.27E+00	1.31E-01	9.63E-01	7.33E-12	1.00E+00	1.24E-05	1.00E+00	1.13E-08
H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	0.00E+00	0.00E+00	9.00E-01	0.00E+00
Pu-238	M	8.77E+01	7.90E-03	1.79E-01	1.17E-10	1.00E+00	6.92E-11	1.00E+00	2.56E-13

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind"   " " (("g" /("m" ^"2" "−s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1−V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")

"Q" /"C" _"wind"   "=A x" "exp" [("ln" "A" _"s" " " ("acre")"−B")^"2" /"C"]

Soil				
	Ingestion	Inhalation	External	Total
Am-241	4.01E-08	4.01E-08	4.01E-08	1.00E+00
	1.12E-09	0.00E+00	2.49E-09	#DIV/0!
	3.59E+01	#DIV/0!	1.61E+01	#DIV/0!
Co-60	3.29E-06	3.29E-06	3.29E-06	1.00E+00
	2.21E-09	8.85E-02	2.73E-05	2.69E+04
	1.49E+03	3.71E-05	1.21E-01	3.71E-05
H-3		1.41E-06		1.00E+00
		0.00E+00		#DIV/0!
		#DIV/0!		#DIV/0!
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.00E+00
	6.55E-09	1.65E-02	2.83E-11	8.34E+04
	3.01E+01	1.20E-05	6.98E+03	1.20E-05

Soil				
		Calculated	PRG	% Differ.
Am-241	Ingestion	3.59E+01	3.59E+01	0.0%
	Inhalation	2.94E+02	2.94E+02	0.0%
	External	1.61E+01	1.61E+01	0.0%
	Total	1.07E+01	1.07E+01	0.0%
Co-60	Ingestion	1.49E+03	1.49E+03	0.0%
	Inhalation	3.68E+05	3.69E+05	-0.3%
	External	1.21E-01	1.21E-01	0.0%
	Total	1.21E-01	1.21E-01	0.0%
H-3	Ingestion			
	Inhalation	2.99E-01	2.99E-01	0.0%
	External			
	Total	2.99E-01	2.99E-01	0.0%
Pu-238	Ingestion	3.01E+01	3.03E+01	-0.7%
	Inhalation	2.30E+02	2.30E+02	0.0%
	External	6.98E+03	6.98E+03	0.0%
	Total	2.65E+01	2.66E+01	-0.4%

Air						
	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	#REF!	#REF!	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Co-60	#REF!	#REF!	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
H-3	0.00E+00		1.00E+00	1.00E-06		1.00E+00
	#VALUE!		#VALUE!	#VALUE!		#VALUE!
	#VALUE!		#VALUE!	#VALUE!		#VALUE!
Pu-238	#VALUE!	#VALUE!	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#VALUE!	#VALUE!	#VALUE!	2.01E+02	0.00E+00	#DIV/0!
	#VALUE!	#VALUE!	#VALUE!	4.99E-09	#DIV/0!	#DIV/0!

Air				
		Calculated	PRG	% Differ.
Am-241	Inhalation	2.16E-04	2.16E-04	0.0%
	External	3.08E+03	3.08E+03	0.0%
	Total	2.16E-04	2.16E-04	0.0%
	Inhalation	2.12E-04	2.12E-04	0.0%
	External	3.02E+03	3.02E+03	0.0%
	Total	2.12E-04	2.12E-04	0.0%
Co-60	Inhalation	2.70E-01	2.71E-01	-0.4%
	External	5.29E+01	5.32E+01	-0.6%
	Total	2.69E-01	2.70E-01	-0.4%
	Inhalation	7.92E-02	7.95E-02	-0.4%
	External	1.55E+01	1.56E+01	-0.6%
	Total	7.88E-02	7.91E-02	-0.4%
H-3	Inhalation	1.76E+01	1.76E+01	0.0%
	External			
	Total	1.76E+01	1.76E+01	0.0%
	Inhalation	9.45E+00	9.44E+00	0.1%
	External			
	Total	9.45E+00	9.44E+00	0.1%
Pu-238	Inhalation	1.69E-04	1.69E-04	0.0%
	External	7.54E+05	7.55E+05	-0.1%
	Total	1.69E-04	1.69E-04	0.0%
	Inhalation	1.53E-04	1.53E-04	0.0%
	External	6.84E+05	6.85E+05	-0.1%
	Total	1.53E-04	1.53E-04	0.0%

Ingestion of soil

"PR" "G" _"iw−soil−ing" ("pCi" /"g")"=" ("TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr"))/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"s" ("risk" /"pCi")" x E" "F" _"iw" " " ("250 day" /"yr")" x E" "D" _"iw" " " ("25 yr")" x IR" "S" _"iw" " " ("50 mg" /"day")" x " ("g" /"1000 mg")" ")

Inhalation of particulates emitted from soil

"PR" "G" _"iw−soil−inh" ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"iw" " " ("250 day" /"yr")" x E" "D" _"iw" " " ("25 yr")" x E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"iw" " " (("60 " "m" ^"3")/"day")" x " ("1" /"PEF" ("m" ^"3" /"kg"))" x " ("1000g" /"kg"))   " "

External exposure to ionizing radiation

"PRGiw−soil−ext " ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−sv" " " (("risk" ⁄"yr")/├"pCi" ⁄"g" ┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext−sv" ┤┤)

Total

"PR" "G" _"iw−soil−tot" " " ("pCi" ⁄"g")"=" "1" /("1" /("PR" "G" _"iw−soil−ing"))"+" ("1" /("PR" "G" _"iw−soil−inh"))"+" ("1" /("PR" "G" _"iw−soil−ext"))

Inhalation (with half-life decay)

"PR" "G" _"iw−air−inh−decay" " " ("pCi" /"m" ^"3")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"iw" " " ("250 day" /"yr")" x E" "D" _"iw" " " ("25 yr")"x E" "T" _"iw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"iw" " " (("60 " "m" ^"3")/"day"))

External (with half-life decay)

"PR" "G" _"iw−air−sub−decay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _"iw" " " ("250 day" /"yr")" x " (├"1 yr" ┤/"365 days")" x E" "D" _"iw" " " ("25 yr")" x E" "T" _"iw" " " ("8 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (with half-life decay)

"PR" "G" _"iw−air−tot−decay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"iw−air−inh−decay") "+" "1" /("PR" "G" _"iw−air−sub−decay") " ")

Inhalation (without half-life decay)

"PR" "G" _"iw−air−inh−nodecay" " " ("pCi" /"m" ^"3")"=" ├"TR" ┤/("S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"iw" " " ("250 day" /"yr")" x E" "D" _"iw" " " ("25 yr")"x E" "T" _"iw" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"iw" " " (("60 " "m" ^"3")/"day"))

External (without half-life decay)

"PR" "G" _"iw−air−sub−nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR" ┤/("S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _"iw" " " ("250 day" /"yr")" x " (├"1 yr" ┤/"365 days")" x E" "D" _"iw" " " ("25 yr")" x E" "T" _"iw" " " ("8 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"iw−air−tot−nodecay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"iw−air−inh−nodecay") "+" "1" /("PR" "G" _"iw−air−sub−nodecay") " ")

Variables	Defaults
TR	1.00E-06
t(ow)	25
EF(ow)	225
ED(ow)	25
IRS(ow)	100
ET(ow)	8
IRA(ow)	60
PEF	1.36E+09
GSF(o)	1
GSF(a)	1
Q/C(wind)	93.77358
V	0.5
U(m)	4.69
U(t)	11.32
F(x)	0.194
A	16.2302
A(s)	0.5
B	18.7762
C	216.108

	Type	Halflife (y)	λ	1-exp(-λt(iw))	SF(s)	SF(i)	SF(ext-sv)	ACF(ext-sv)	SF(sub)
Am-241	M	4.32E+02	1.60E-03	3.93E-02	9.10E-11	0.00E+00	2.77E-08	1.00E+00	5.81E-11
Co-60	M	5.27E+00	1.31E-01	9.63E-01	7.33E-12	1.00E+00	1.24E-05	1.00E+00	1.13E-08
H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	0.00E+00	0.00E+00	9.00E-01	0.00E+00
Pu-238	M	8.77E+01	7.90E-03	1.79E-01	1.17E-10	1.00E+00	6.92E-11	1.00E+00	2.56E-13

Soil				
	Ingestion	Inhalation	External	Total
Am-241	4.01E-08	4.01E-08	4.01E-08	1.00E+00
	2.01E-09	0.00E+00	5.59E-09	#DIV/0!
	1.99E+01	#DIV/0!	7.17E+00	#DIV/0!
Co-60	3.29E-06	3.29E-06	3.29E-06	1.00E+00
	3.97E-09	7.97E-02	6.13E-05	2.43E+04
	8.28E+02	4.13E-05	5.36E-02	4.12E-05
H-3		1.41E-06		1.00E+00
		0.00E+00		#DIV/0!
		#DIV/0!		#DIV/0!
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.00E+00
	1.18E-08	1.48E-02	6.37E-11	7.51E+04
	1.67E+01	1.33E-05	3.10E+03	1.33E-05

Soil				
		Calculated	PRG	% Differ.
Am-241	Ingestion	1.99E+01	1.99E+01	0.0%
	Inhalation	3.27E+02	3.27E+02	0.0%
	External	7.17E+00	7.18E+00	-0.1%
	Total	5.19E+00	5.19E+00	0.0%
Co-60	Ingestion	8.28E+02	8.29E+02	-0.1%
	Inhalation	4.09E+05	4.10E+05	-0.2%
	External	5.36E-02	5.37E-02	-0.2%
	Total	5.36E-02	5.37E-02	-0.2%
H-3	Ingestion			
	Inhalation	3.33E-01	3.32E-01	0.3%
	External			
	Total	3.33E-01	3.32E-01	0.3%
Pu-238	Ingestion	1.67E+01	1.68E+01	-0.6%
	Inhalation	2.55E+02	2.55E+02	0.0%
	External	3.10E+03	3.10E+03	0.0%
	Total	1.56E+01	1.57E+01	-0.6%

Air						
	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	#REF!	#REF!	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Co-60	#REF!	#REF!	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
H-3	#REF!		1.00E+00	1.00E-06		1.00E+00
	#REF!		#REF!	#REF!		#REF!
	#REF!		#REF!	#REF!		#REF!
Pu-238	0.00E+00	0.00E+00	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

Air				
		Calculated	PRG	% Differ.
Am-241	Inhalation	2.41E-04	2.40E-04	0.4%
	External	3.42E+03	3.42E+03	0.0%
	Total	2.41E-04	2.40E-04	0.4%
	Inhalation	2.36E-04	2.36E-04	0.0%
	External	3.35E+03	3.35E+03	0.0%
	Total	2.36E-04	2.36E-04	0.0%
Co-60	Inhalation	3.01E-01	3.02E-01	-0.3%
	External	5.88E+01	5.91E+01	-0.5%
	Total	2.99E-01	3.00E-01	-0.3%
	Inhalation	8.80E-02	8.83E-02	-0.3%
	External	1.72E+01	1.73E+01	-0.6%
	Total	8.76E-02	8.79E-02	-0.3%
H-3	Inhalation	1.96E+01	1.95E+01	0.5%
	External			
	Total	1.96E+01	1.95E+01	0.5%
	Inhalation	1.05E+01	1.05E+01	0.0%
	External			
	Total	1.05E+01	1.05E+01	0.0%
Pu-238	Inhalation	1.88E-04	1.88E-04	0.0%
	External	8.38E+05	8.39E+05	-0.1%
	Total	1.88E-04	1.88E-04	0.0%
	Inhalation	1.70E-04	1.70E-04	0.0%
	External	7.60E+05	7.61E+05	-0.1%
	Total	1.70E-04	1.70E-04	0.0%

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind" " " (("g" /("m" ^"2" "–s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1–V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")

"Q" /"C" _"wind" "=A x" "exp" [("ln" "A" _"s" " " ("acre")"–B")^"2" /"C"]

Ingestion of soil

"PR" "G" _"ow–soil–ing" ("pCi" /"g")"=" ("TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr"))/(("1–" "e" ^("–λ" "t" _"ow"))" x S" "F" _"s" ("risk" /"pCi")" x E" "F" _"ow" " " ("225 day" /"yr")" x E" "D" _"ow" " " ("25 yr")" x IR" "S" _"ow" " " ("100 mg" /"day")" x " ("g" /"1000 mg")" ")

Inhalation of particulates emitted from soil

"PR" "G" _"ow–soil–inh" ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"ow"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"ow" " " ("225 day" /"yr")" x E" "D" _"ow" " " ("25 yr")" x E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"ow" " " (("60 " "m" ^"3")/"day")" x " ("1" /"PEF" ("m" ^"3" /"kg"))" x " ("1000g" /"kg")) " "

External exposure to ionizing radiation

"PRGo–soil–ext " ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"ow"))" x S" "F" _"ext–sv" " " (("risk" ⁄"yr")/├"pCi" ⁄"g" ┤)" x E" "F" _"ow" " " ("225 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext–sv" ┤┤)

Total

"PR" "G" _"ow–soil–tot" " " ("pCi" ⁄"g")"=" "1" /("1" /("PR" "G" _"ow–soil–ing"))"+" ("1" /("PR" "G" _"ow–soil–inh"))"+" ("1" /("PR" "G" _"ow–soil–ext"))

Inhalation (with half-life decay)

"PR" "G" _"ow–air–inh–decay" " " ("pCi" /"m" ^"3")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"ow"))" x S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"ow" " " ("250 day" /"yr")" x E" "D" _"ow" " " ("25 yr")"x E" "T" _"ow" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"ow" " " (("60 " "m" ^"3")/"day"))

External (with half-life decay)

"PR" "G" _"ow–air–sub–decay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1–" "e" ^("–λ" "t" _"ow"))" x S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _"ow" " " ("250 day" /"yr")" x " (├"1 yr" ┤/"365 days")" x E" "D" _"ow" " " ("25 yr")" x E" "T" _"ow" " " ("8 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (with half-life decay)

"PR" "G" _"ow–air–tot–decay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"ow–air–inh–decay") "+" "1" /("PR" "G" _"ow–air–sub–decay") " ")

Inhalation (without half-life decay)

"PR" "G" _"ow–air–inh–nodecay" " " ("pCi" /"m" ^"3")"=" ├"TR" ┤/("S" "F" _"i" " " ("risk" /"pCi")" x E" "F" _"ow" " " ("250 day" /"yr")" x E" "D" _"ow" " " ("25 yr")"x E" "T" _"ow" " " ("8 hr" /"day")" x " ("1 day" /"24 hours")" x IR" "A" _"ow" " " (("60 " "m" ^"3")/"day"))

External (without half-life decay)

"PR" "G" _"ow–air–sub–nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR" ┤/("S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _"ow" " " ("250 day" /"yr")" x " (├"1 yr" ┤/"365 days")" x E" "D" _"ow" " " ("25 yr")" x E" "T" _"ow" " " ("8 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"ow–air–tot–nodecay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"ow–air–inh–nodecay") "+" "1" /("PR" "G" _"ow–air–sub–nodecay") " ")

Variables	Defaults		Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(ext-sv)	SF(ext-1cm)	SF(ext-5cm)	SF(ext-15cm)	SF(ext-gp)	GSF(o)@0cm
TR	1.00E-06	Am-241	M	4.32E+02	1.60E-03	3.93E-02	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.87E-08	4.00E-01
t(iw)	25	Co-60	M	5.27E+00	1.31E-01	9.63E-01	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.19E-06	4.00E-01
EF(iw)	250	H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-01
ED(iw)	25	Pu-238	M	8.77E+01	7.90E-03	1.79E-01	6.92E-11	4.81E-11	6.30E-11	6.87E-11	3.68E-10	4.00E-01
ET(iw)	8											

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.08E-01	9.46E-02	9.50E-02	9.69E-02	8.44E-02
Co-60	9.83E-02	4.26E-02	6.55E-02	8.49E-02	2.83E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	1.79E-01	1.53E-01	1.60E-01	1.71E-01	1.03E-01
	Cover Layer Thickness = 0cm ; Area = 1m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	2.68E-10	1.17E-10	2.20E-10	2.41E-10	1.42E-10
	1.49E+02	**3.42E+02**	**1.82E+02**	**1.66E+02**	**2.83E+02**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	2.68E-06	2.12E-07	9.34E-07	1.94E-06	1.36E-07
	1.23E+00	**1.55E+01**	**3.52E+00**	**1.69E+00**	**2.41E+01**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	5.07E-12	3.01E-12	4.13E-12	4.81E-12	1.55E-11
	3.90E+04	**6.56E+04**	**4.79E+04**	**4.11E+04**	**1.27E+04**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	1.49E+02	1.50E+02	-0.7%
	1 cm	3.42E+02	3.44E+02	-0.6%
	5 cm	1.82E+02	1.82E+02	0.0%
	15 cm	1.66E+02	1.67E+02	-0.6%
	Dust	2.83E+02	2.83E+02	0.0%
Co-60	Infinite Depth	1.23E+00	1.23E+00	0.0%
	1 cm	1.55E+01	1.55E+01	0.0%
	5 cm	3.52E+00	3.52E+00	0.0%
	15 cm	1.69E+00	1.69E+00	0.0%
	Dust	2.41E+01	2.42E+01	-0.4%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	3.90E+04	3.91E+04	-0.3%
	1 cm	6.56E+04	6.55E+04	0.2%
	5 cm	4.79E+04	4.80E+04	-0.2%
	15 cm	4.11E+04	4.12E+04	-0.2%
	Dust	1.27E+04	1.27E+04	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.94E-01	1.67E-01	1.67E-01	1.64E-01	1.50E-01
Co-60	1.77E-01	7.98E-02	1.22E-01	1.59E-01	5.21E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	2.84E-01	2.70E-01	2.83E-01	2.83E-01	1.84E-01
	Cover Layer Thickness = 0cm ; Area = 2m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	4.82E-10	2.07E-10	3.87E-10	4.08E-10	2.52E-10
	8.32E+01	**1.94E+02**	**1.04E+02**	**9.84E+01**	**1.59E+02**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	4.82E-06	3.96E-07	1.74E-06	3.63E-06	2.51E-07
	6.82E-01	**8.29E+00**	**1.89E+00**	**9.05E-01**	**1.31E+01**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	8.04E-12	5.32E-12	7.30E-12	7.96E-12	2.77E-11
	2.46E+04	**3.72E+04**	**2.71E+04**	**2.48E+04**	**7.13E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	8.32E+01	8.32E+01	0.0%
	1 cm	1.94E+02	1.94E+02	0.0%
	5 cm	1.04E+02	1.04E+02	0.0%
	15 cm	9.84E+01	9.85E+01	-0.1%
	Dust	1.59E+02	1.59E+02	0.0%
Co-60	Infinite Depth	6.82E-01	6.83E-01	-0.1%
	1 cm	8.29E+00	8.29E+00	0.0%
	5 cm	1.89E+00	1.89E+00	0.0%
	15 cm	9.05E-01	9.04E-01	0.1%
	Dust	1.31E+01	1.31E+01	0.0%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	2.46E+04	2.46E+04	0.0%
	1 cm	3.72E+04	3.73E+04	-0.3%
	5 cm	2.71E+04	2.71E+04	0.0%
	15 cm	2.48E+04	2.49E+04	-0.4%
	Dust	7.13E+03	7.13E+03	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	3.20E-01	2.97E-01	2.90E-01	2.85E-01	2.71E-01
Co-60	3.33E-01	1.48E-01	2.22E-01	2.88E-01	9.86E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	5.92E-01	4.72E-01	5.02E-01	5.18E-01	3.31E-01
	Cover Layer Thickness = 0cm ; Area = 5m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	7.96E-10	3.68E-10	6.72E-10	7.09E-10	4.55E-10
	5.04E+01	**1.09E+02**	**5.97E+01**	**5.66E+01**	**8.82E+01**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	9.08E-06	7.35E-07	3.17E-06	6.58E-06	4.75E-07
	3.62E-01	**4.47E+00**	**1.04E+00**	**4.99E-01**	**6.93E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	1.68E-11	9.29E-12	1.29E-11	1.46E-11	4.99E-11
	1.18E+04	**2.13E+04**	**1.53E+04**	**1.36E+04**	**3.96E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	5.04E+01	5.05E+01	-0.2%
	1 cm	1.09E+02	1.09E+02	0.0%
	5 cm	5.97E+01	5.99E+01	-0.3%
	15 cm	5.66E+01	5.67E+01	-0.2%
	Dust	8.82E+01	8.83E+01	-0.1%
Co-60	Infinite Depth	3.62E-01	3.62E-01	0.0%
	1 cm	4.47E+00	4.48E+00	-0.2%
	5 cm	1.04E+00	1.04E+00	0.0%
	15 cm	4.99E-01	4.98E-01	0.2%
	Dust	6.93E+00	6.95E+00	-0.3%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	1.18E+04	1.18E+04	0.0%
	1 cm	2.13E+04	2.13E+04	0.0%
	5 cm	1.53E+04	1.53E+04	0.0%
	15 cm	1.36E+04	1.36E+04	0.0%
	Dust	3.96E+03	3.96E+03	0.0%

Direct External Exposure to contamination at infinite depth

"PRGiw−soil−sv " ("pCi" /"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−sv" " " (("risk" /"yr")/├"pCi" /"g"┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext−sv" ┤┤)

Direct External Exposure to contamination at 1 cm

"PRGiw−soil−1cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−1cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext −1cm"┤┤)

Direct External Exposure to contamination at 5cm

"PRGiw−soil−5cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−5cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext −5cm"┤┤)

Direct External Exposure to contamination at 15cm

"PRGiw−soil−15cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−15cm" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext −15cm"┤┤)

Direct External Exposure to contamination dust

"PRGiw−soil−gp " ("pCi" ⁄"g")"=" ├"TR x " "t" _"iw" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"iw"))" x S" "F" _"ext−gp" " " (("risk" ⁄"yr")/├"pCi" ⁄"g"┤)" x E" "F" _"iw" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"iw" " " ("25 yr")" x " ├├"E" "T" _"iw" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4") "x AC" "F" _"ext −gp"┤┤)

Variables	Defaults		Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(ext-sv)	SF(ext-1cm)	SF(ext-5cm)	SF(ext-15cm)	SF(ext-gp)	GSF(o)@0cm
TR	1.00E-06	Am-241	M	4.32E+02	1.60E-03	3.93E-02	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.87E-08	1.00E+00
t(ow)	25	Co-60	M	5.27E+00	1.31E-01	9.63E-01	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.19E-06	1.00E+00
EF(ow)	225	H-3	M	1.23E+01	5.63E-02	7.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
ED(ow)	25	Pu-238	M	8.77E+01	7.90E-03	1.79E-01	6.92E-11	4.81E-11	6.30E-11	6.87E-11	3.68E-10	1.00E+00
ET(ow)	8											

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.08E-01	9.46E-02	9.50E-02	9.69E-02	8.44E-02
Co-60	9.83E-02	4.26E-02	6.55E-02	8.49E-02	2.83E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	1.79E-01	1.53E-01	1.60E-01	1.71E-01	1.03E-01

	Cover Layer Thickness = 0cm ; Area = 1m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	6.04E-10	2.64E-10	4.95E-10	5.42E-10	3.19E-10
	6.64E+01	**1.52E+02**	**8.10E+01**	**7.40E+01**	**1.26E+02**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	6.03E-06	4.76E-07	2.10E-06	4.37E-06	3.06E-07
	5.45E-01	**6.91E+00**	**1.56E+00**	**7.53E-01**	**1.07E+01**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	1.14E-11	6.78E-12	9.28E-12	1.08E-11	3.49E-11
	1.73E+04	**2.92E+04**	**2.13E+04**	**1.83E+04**	**5.66E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	6.64E+01	6.66E+01	-0.3%
	1 cm	1.52E+02	1.53E+02	-0.7%
	5 cm	8.10E+01	8.11E+01	-0.1%
	15 cm	7.40E+01	7.40E+01	0.0%
	Dust	1.26E+02	1.26E+02	0.0%
Co-60	Infinite Depth	5.45E-01	5.46E-01	-0.2%
	1 cm	6.91E+00	6.90E+00	0.1%
	5 cm	1.56E+00	1.56E+00	0.0%
	15 cm	7.53E-01	7.52E-01	0.1%
	Dust	1.07E+01	1.07E+01	0.0%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	1.73E+04	1.74E+04	-0.6%
	1 cm	2.92E+04	2.91E+04	0.3%
	5 cm	2.13E+04	2.13E+04	0.0%
	15 cm	1.83E+04	1.83E+04	0.0%
	Dust	5.66E+03	5.65E+03	0.2%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.94E-01	1.67E-01	1.67E-01	1.64E-01	1.50E-01
Co-60	1.77E-01	7.98E-02	1.22E-01	1.59E-01	5.21E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	2.84E-01	2.70E-01	2.83E-01	2.83E-01	1.84E-01

	Cover Layer Thickness = 0cm ; Area = 2m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	1.09E-09	4.65E-10	8.70E-10	9.17E-10	5.66E-10
	3.70E+01	**8.62E+01**	**4.61E+01**	**4.37E+01**	**7.08E+01**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	1.09E-05	8.92E-07	3.92E-06	8.18E-06	5.64E-07
	3.03E-01	**3.69E+00**	**8.40E-01**	**4.02E-01**	**5.83E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	1.81E-11	1.20E-11	1.64E-11	1.79E-11	6.24E-11
	1.09E+04	**1.65E+04**	**1.20E+04**	**1.10E+04**	**3.17E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	3.70E+01	3.70E+01	0.0%
	1 cm	8.62E+01	8.64E+01	-0.2%
	5 cm	4.61E+01	4.62E+01	-0.2%
	15 cm	4.37E+01	4.38E+01	-0.2%
	Dust	7.08E+01	7.07E+01	0.1%
Co-60	Infinite Depth	3.03E-01	3.04E-01	-0.3%
	1 cm	3.69E+00	3.69E+00	0.0%
	5 cm	8.40E-01	8.42E-01	-0.2%
	15 cm	4.02E-01	4.02E-01	0.0%
	Dust	5.83E+00	5.84E+00	-0.2%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	1.09E+04	1.09E+04	0.0%
	1 cm	1.65E+04	1.66E+04	-0.6%
	5 cm	1.20E+04	1.20E+04	0.0%
	15 cm	1.10E+04	1.10E+04	0.0%
	Dust	3.17E+03	3.17E+03	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	3.20E-01	2.97E-01	2.90E-01	2.85E-01	2.71E-01
Co-60	3.33E-01	1.48E-01	2.22E-01	2.88E-01	9.86E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	5.92E-01	4.72E-01	5.02E-01	5.18E-01	3.31E-01

	Cover Layer Thickness = 0cm ; Area = 5m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	4.01E-08	4.01E-08	4.01E-08	4.01E-08	4.01E-08
	1.79E-09	8.28E-10	1.51E-09	1.59E-09	1.02E-09
	2.24E+01	**4.85E+01**	**2.65E+01**	**2.52E+01**	**3.92E+01**
Co-60	3.29E-06	3.29E-06	3.29E-06	3.29E-06	3.29E-06
	2.04E-05	1.65E-06	7.12E-06	1.48E-05	1.07E-06
	1.61E-01	**1.99E+00**	**4.61E-01**	**2.22E-01**	**3.08E+00**
H-3	[redacted]				
Pu-238	1.98E-07	1.98E-07	1.98E-07	1.98E-07	1.98E-07
	3.77E-11	2.09E-11	2.91E-11	3.28E-11	1.12E-10
	5.24E+03	**9.45E+03**	**6.78E+03**	**6.03E+03**	**1.76E+03**

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	2.24E+01	2.25E+01	-0.4%
	1 cm	4.85E+01	4.86E+01	-0.2%
	5 cm	2.65E+01	2.66E+01	-0.4%
	15 cm	2.52E+01	2.52E+01	0.0%
	Dust	3.92E+01	3.92E+01	0.0%
Co-60	Infinite Depth	1.61E-01	1.61E-01	0.0%
	1 cm	1.99E+00	1.99E+00	0.0%
	5 cm	4.61E-01	4.62E-01	-0.2%
	15 cm	2.22E-01	2.21E-01	0.5%
	Dust	3.08E+00	3.09E+00	-0.3%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	5.24E+03	5.24E+03	0.0%
	1 cm	9.45E+03	9.47E+03	-0.2%
	5 cm	6.78E+03	6.78E+03	0.0%
	15 cm	6.03E+03	6.04E+03	-0.2%
	Dust	1.76E+03	1.76E+03	0.0%

Direct External Exposure to contamination at infinite depth

"PRGow−soil−sv " ("pCi" /"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"ow"))" x S" "F" _"ext−sv" " " (("risk" /"yr")/├ "pCi" /"g" ┤)" x E" "F" _"ow" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├ ├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext−sv" ┤┤)

Direct External Exposure to contamination at 1 cm

"PRGow−soil−1cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"ow"))" x S" "F" _"ext−1cm" " " (("risk" ⁄"yr")/├ "pCi" ⁄"g" ┤)" x E" "F" _"ow" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├ ├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −1cm"┤┤)

Direct External Exposure to contamination at 5cm

"PRGow−soil−5cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"ow"))" x S" "F" _"ext−5cm" " " (("risk" ⁄"yr")/├ "pCi" ⁄"g" ┤)" x E" "F" _"ow" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├ ├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −5cm"┤┤)

Direct External Exposure to contamination at 15cm

"PRGow−soil−15cm " ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"ow"))" x S" "F" _"ext−15cm" " " (("risk" ⁄"yr")/├ "pCi" ⁄"g" ┤)" x E" "F" _"ow" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├ ├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −15cm"┤┤)

Direct External Exposure to contamination dust

"PRGow−soil−gp " ("pCi" ⁄"g")"=" ├"TR x " "t" _"ow" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"ow"))" x S" "F" _"ext−gp" " " (("risk" ⁄"yr")/├ "pCi" ⁄"g" ┤)" x E" "F" _"ow" " " ("250 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"ow" " " ("25 yr")" x " ├ ├"E" "T" _"ow" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext −gp"┤┤)

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elementa	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Ground Plane, Area Correction Factor																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

Variables	Defaults
TR	1.00E-06
t(rec)	19
IFS(rec-adj)	575000
EF(recsc)	250
ED(recsc)	4
IRS(recsc)	200
EF(recsa)	250
ED(recsa)	15
IRS(recsa)	100
IFA(rec-adj)	42500
ET(recsc)	12
IRA(recsc)	10
ET(recsa)	12
IRA(recsa)	20
PEF	1.36E+09
Q/C(wind)	93.774
V	0.5
U(m)	4.69
U(t)	11.32
F(x)	0.194
A	16.2302
A(s)	0.5
B	18.7762
C	216.108
EF(rec)	19
ED(rec)	250
ET(rec)	12

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(s)	SF(i)	SF(ext-sv)	SF(sub)	GSF(o)	ACF(ext-sv)
Am-241	M	4.32E+02	1.60E-03	3.00E-02	1.84E-10	#REF!	2.77E-08	5.81E-11	1.00E+00	1.08E-01
Co-60	M	5.27E+00	1.31E-01	9.18E-01	3.81E-11	#REF!	1.24E-05	1.13E-08	1.00E+00	9.83E-02
H-3	M	1.23E+01	5.63E-02	6.57E-01	0.00E+00	#REF!	0.00E+00	0.00E+00	1.00E+00	9.00E-01
Pu-238	M	8.77E+01	7.90E-03	1.39E-01	2.25E-10	#REF!	6.92E-11	2.56E-13	1.00E+00	1.79E-01

Composite Worker Soil

	Ingestion	Inhalation	External	Total
Am-241	3.05E-08	3.05E-08	3.05E-08	1.00E+00
	3.18E-09	#REF!	5.84E-10	#REF!
	9.60E+00	**#REF!**	**5.22E+01**	**#REF!**
Co-60	2.50E-06	2.50E-06	2.50E-06	1.00E+00
	2.01E-08	#REF!	7.28E-06	#REF!
	1.24E+02	**#REF!**	**3.43E-01**	**#REF!**
H-3		1.07E-06		1.00E+00
		#REF!		#REF!
		#REF!		**#REF!**
Pu-238	1.50E-07	1.50E-07	1.50E-07	1.00E+00
	1.80E-08	#REF!	1.12E-11	#REF!
	8.32E+00	**#REF!**	**1.34E+04**	**#REF!**

		Calculated	PRG	% Differ.
Am-241	Ingestion	9.60E+00	9.58E+00	0.2%
	Inhalation	8.61E+02	8.60E+02	0.1%
	External	5.22E+01	5.24E+01	-0.4%
	Total	8.03E+00	8.02E+00	0.1%
Co-60	Ingestion	1.24E+02	1.24E+02	0.0%
	Inhalation	8.62E+05	8.65E+05	-0.3%
	External	3.43E-01	3.44E-01	-0.3%
	Total	3.42E-01	3.43E-01	-0.3%
H-3	Ingestion			
	Inhalation	7.69E-01	7.68E-01	0.1%
	External			
	Total	7.69E-01	7.68E-01	0.1%
Pu-238	Ingestion	8.32E+00	8.34E+00	-0.2%
	Inhalation	6.60E+02	6.60E+02	0.0%
	External	1.34E+04	1.34E+04	0.0%
	Total	8.22E+00	8.23E+00	-0.1%

Composite Worker Air

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	3.05E-08	3.05E-08	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	1.13E-11	#REF!	#REF!	3.78E-10	#REF!
	#REF!	**2.69E+03**	**#REF!**	**#REF!**	**2.65E+03**	**#REF!**
Co-60	2.50E-06	2.50E-06	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	6.75E-08	#REF!	#REF!	7.35E-08	#REF!
	#REF!	**3.70E+01**	**#REF!**	**#REF!**	**1.36E+01**	**#REF!**
H-3	1.07E-06		1.00E+00	1.00E-06		1.00E+00
	#REF!		#REF!	#REF!		#REF!
	#REF!		**#REF!**	**#REF!**		**#REF!**
Pu-238	1.50E-07	1.50E-07	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	#REF!	2.32E-13	#REF!	#REF!	1.67E-12	#REF!
	#REF!	**6.47E+05**	**#REF!**	**#REF!**	**6.00E+05**	**#REF!**

		Calculated	PRG	% Differ.
Am-241	Inhalation	6.34E-04	6.33E-04	0.2%
	External	2.69E+03	2.69E+03	0.0%
	Total	6.34E-04	6.33E-04	0.2%
	Inhalation	6.24E-04	6.23E-04	0.2%
	External	2.65E+03	2.65E+03	0.0%
	Total	6.24E-04	6.23E-04	0.2%
Co-60	Inhalation	6.34E-01	6.36E-01	-0.3%
	External	3.70E+01	3.72E+01	-0.5%
	Total	6.24E-01	6.26E-01	-0.3%
	Inhalation	2.33E-01	2.34E-01	-0.4%
	External	1.36E+01	1.37E+01	-0.7%
	Total	2.29E-01	2.30E-01	-0.4%
H-3	Inhalation	4.53E+01	4.52E+01	0.2%
	External			
	Total	4.53E+01	4.52E+01	0.2%
	Inhalation	2.78E+01	2.78E+01	0.0%
	External			
	Total	2.78E+01	2.78E+01	0.0%
Pu-238	Inhalation	4.85E-04	4.86E-04	-0.2%
	External	6.47E+05	6.47E+05	0.0%
	Total	4.85E-04	4.86E-04	-0.2%
	Inhalation	4.51E-04	4.51E-04	0.0%
	External	6.00E+05	6.01E+05	-0.2%
	Total	4.51E-04	4.51E-04	0.0%

Inhalation (without half-life decay)

"PR" "G" _"rec−air−inh−nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR"┤/("S" "F" _"i" " " ("risk" /"pCi")" x IF" "A" _"rec−adj" " " ("m" ^"3"))"IF" "A" _"rec−adj" " " ("m" ^"3")"=" ("E" "F" _"recsc" " " ("day" /"yr")" x E" "D" _"recsc" " " ("yr")" x E" "T" _"recsc" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"recsc" " " (("10 " "m" ^"3")/"day"))"+" ("E" "F" _"recsa" " " ("day" /"yr")" x E" "D" _"recsa" " " ("yr")" x E" "T" _"recsa" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x " 〖"IRA" 〗_"recsa" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (without half-life decay)

"PR" "G" _"rec−air−sub−nodecay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR"┤/("S" "F" _"sub" " " (("risk" ⁄"yr")/("pCi" ⁄"m" ^"3"))" x E" "F" _"rec" " " ("day" /"yr")" x " (├"1 yr"┤/"365 days")" x E" "D" _"rec" " " ("yr")" x E" "T" _"rec" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"rec−air−tot−nodecay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"rec−air−inh−nodecay") "+" "1" /("PR" "G" _"rec−air−sub−nodecay") " ")

Inhalation (with half-life decay)

"PR" "G" _"rec−air−inh−decay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR x " "t" _"rec" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"r"))" x S" "F" _"i" " " ("risk" /"pCi")" x IF" "A" _"rec−adj" " " ("m" ^"3"))
"IF" "A" _"rec−adj" " " ("m" ^"3")"=" ("E" "F" _"recsc" " " ("day" /"yr")" x E" "D" _"recsc" " " ("yr")" x E" "T" _"recsc" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"recsc" " " (("10 " "m" ^"3")/"day"))"+" ("E" "F" _"recsa" " " ("day" /"yr")" x E" "D" _"recsa" " " ("yr")" x E" "T" _"recsa" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x " 〖"IRA" 〗_"recsa" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (with half-life decay)

"PR" "G" _"rec−air−sub−decay" " " ("pCi" ⁄"m" ^"3")"=" ├"TR x " "t" _"rec" " " ("yr")" x λ " ("1" /"yr")┤/(("1−" "e" ^("−λ" "t" _"rec"))" x S" "F" _"sub" " " (("risk" /"yr")/("pCi" /"m" ^"3"))" x E" "F" _"rec" " " ("day" /"yr")" x " (├"1 yr"┤/"365 days")" x E" "D" _"rec" " " ("yr")" x E" "T" _"rec" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (with half-life decay)

"PR" "G" _"rec−air−tot−decay" " " ("pCi" ⁄"m" ^"3")"=" "1" /("1" /("PR" "G" _"rec−air−inh−decay") "+" "1" /("PR" "G" _"rec−air−sub−decay") " ")

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind" " " (("g" /("m" ^"2" "-s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1-V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")
"Q" /"C" _"wind" "=A x" "exp" [("ln" "A" _"s" " " ("acre")"-B")^"2" /"C"]

Incidental ingestion of soil

"PR" "G" _"rec-sol-ing" " " ("pCi" /"g")"=" ("TR x " "t" _"rec" " " ("years")" x λ " ("1" /"years"))/(("1-" "e" ^("-λ" "t" _"rec"))" x S" "F" _"s" " " ("risk" /"pCi")"x IF" "S" _"rec-adj" " " ("mg")" x " ("g" /"1000 mg"))
"IF" "S" _"rec-adj" " " ("mg")"=" (("E" "F" _"recsc" " " ("days" /"yr")" x E" "D" _"recsc" " " ("yr")" x IR" "S" _"recsc" " " ("200 mg" /"day"))"+" ("E" "F" _"recsa" " " ("days" /"yr")" x E" "D" _"recsa" " " ("yr")" x IR" "S" _"recsa" " " ("100 mg" /"day")))

Inhalation of particulates emitted from soil

"PR" "G" _"rec-sol-inh" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"rec" " " ("years")" x λ " ("1" /"years"))/(("1-" "e" ^("-λ" "t" _"rec"))" x S" "F" _"i" " " ("risk" /"pCi")"x IF" "A" _"rec-adj" " " ("m" ^"3")" x " ("1" /"PEF " ("m" ^"3" /"kg"))" x " ("1000 g" /"kg"))
"IF" "A" _"rec-adj" " " ("m" ^"3")"=" (("E" "F" _"recsc" " " ("days" /"yr")" x E" "D" _"recsc" " " ("yr")" x E" "T" _"recsc" " " ("hr" /"day")" x " ("1 day" /"24 hrs")"x IR" "A" _"recsc" " " (("10 " "m" ^"3")/"day"))"+" ("E" "F" _"recsa" " " ("days" /"yr")" x E" "D" _"recsa" " " ("yr")" x E" "T" _"recsa" " " ("hr" /"day")" x " ("1 day" /"24 hrs")"x IR" "A" _"recsa" " " (("20 " "m" ^"3")/"day")))

External exposure to ionizing radiation

"PR" "G" _"rec-sol-ext" " " ("pCi" ⁄"g")"=" ("TR x " "t" _"rec" " " ("years")" x λ " ("1" /"years"))/(("1-" "e" ^("-λ" "t" _"rec"))" x S" "F" _"ext-sv" " " ("risk/yr" /"pCi/g")"x E" "F" _"rec" " " ("days" /"year")" x " ("1 yr" /"365 days")" x E" "D" _"rec" " " ("yrs")" x E" "T" _"rec" " " ("hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"o" " " ("1.0")" x AC" "F" _"ext-sv")

Total

"PR" "G" _"rec-sol-tot" " " ("pCi" /"g")"=" "1" /("1" /("PR" "G" _"rec-sol-ing") "+" "1" /("PR" "G" _"rec-sol-inh") "+" "1" /("PR" "G" _"rec-sol-ext"))

Variables	Defaults
TR	1.00E-06
t(rec)	19
EF(rec)	250
ED(rec)	19
IRGL(rec)	60
Q(p-fowl)	0.4
f(p-fowl)	3
f(s-fowl)	2
R(upp)	Bv(dry)
R(es)	MLF
Q(s-fowl)	0.054
MLF	0.25
Q(w-fowl)	2
IRGF(rec)	40
Q(p-game)	14.5
f(p-game)	5
f(s-game)	6
Q(s-game)	0.78
Q(w-game)	55

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(f)	TF(fowl)	TF(game)	Bv(dry)
Am-241	M	4.32E+02	1.60E-03	3.00E-02	1.34E-10	6.00E-03	5.00E-04	2.20E-05
Co-60	M	5.27E+00	1.31E-01	9.18E-01	2.23E-11	9.70E-01	4.30E-04	8.50E-03
H-3	M	1.23E+01	5.63E-02	6.57E-01	1.44E-13	-	1.20E-02	2.40E+01
Pu-238	M	8.77E+01	7.90E-03	1.39E-01	1.69E-10	3.00E-03	1.10E-06	9.50E-06

BC = Back-Calculated

	Consumption of Fowl		
	Direct	BC to Soil	BC to Water
Am-241	1.00E-06	3.93E-02	3.93E-02
	2.55E-05	4.57E-03	1.20E-05
	3.93E-02	**8.72E+00**	**3.27E+03**
Co-60	1.00E-06	2.36E-01	2.36E-01
	4.24E-06	7.59E-01	1.94E-03
	2.36E-01	**8.47E-01**	**1.22E+02**
H-3	1.00E-06	[redacted]	
	2.74E-08		
	3.65E+01		
Pu-238	1.00E-06	3.11E-02	3.11E-02
	3.21E-05	2.29E-03	6.00E-06
	3.11E-02	**1.47E+01**	**5.19E+03**

	Consumption of Land Game		
	Direct	BC to Soil	BC to Water
Am-241	1.00E-06	2.62E-02	2.62E-02
	3.82E-05	5.63E-02	2.75E-05
	2.62E-02	**4.72E-01**	**9.52E+02**
Co-60	1.00E-06	1.57E-01	1.57E-01
	6.36E-06	5.00E-02	2.37E-05
	1.57E-01	**8.56E+00**	**6.65E+03**
H-3	1.00E-06	2.44E+01	2.44E+01
	4.10E-08	1.27E+02	6.60E-04
	2.44E+01	**3.13E-01**	**3.69E+04**
Pu-238	1.00E-06	2.08E-02	2.08E-02
	4.82E-05	1.24E-04	6.05E-08
	2.08E-02	**1.80E+02**	**3.43E+05**

		Calculated	PRG	% Differ.
Am-241	Direct	3.93E-02	3.94E-02	-0.3%
	BC to Soil	8.72E+00	8.75E+00	-0.3%
	BC to Water	3.27E+03	3.28E+03	-0.3%
Co-60	Direct	2.36E-01	2.36E-01	0.0%
	BC to Soil	8.47E-01	8.46E-01	0.1%
	BC to Water	1.22E+02	1.22E+02	0.0%
H-3	Direct	3.65E+01	3.65E+01	0.0%
	BC to Soil	[redacted]		
	BC to Water			
Pu-238	Direct	3.11E-02	3.11E-02	0.0%
	BC to Soil	1.47E+01	1.46E+01	0.7%
	BC to Water	5.19E+03	5.18E+03	0.2%

		Calculated	PRG	% Differ.
Am-241	Direct	2.62E-02	2.63E-02	-0.4%
	BC to Soil	4.72E-01	4.73E-01	-0.2%
	BC to Water	9.52E+02	9.55E+02	-0.3%
Co-60	Direct	1.57E-01	1.57E-01	0.0%
	BC to Soil	8.56E+00	8.56E+00	0.0%
	BC to Water	6.65E+03	6.65E+03	0.0%
H-3	Direct	2.44E+01	2.44E+01	0.0%
	BC to Soil	3.13E-01	3.13E-01	0.0%
	BC to Water	3.69E+04	3.69E+04	0.0%
Pu-238	Direct	2.08E-02	2.07E-02	0.5%
	BC to Soil	1.80E+02	1.80E+02	0.0%
	BC to Water	3.43E+05	3.42E+05	0.3%

Consumption of game - direct

"PR" "G" _"rec-game-ing" " " ("pCi" /"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")"x E" "F" _"rec" " " ("days" /"yr")" x E" "D" _"rec" " " ("yrs")" x IRG" "L" _"rec" " " ("g" /"day"))

Consumption of game - back-calculated to soil

"PR" "G" _"soil-rec-game-ing" " " ("pCi" /"g")"=" ("PR" "G" _"rec-game-ing" " " ("pCi" /"g"))/("T" "F" _"game" " " ("day" /"kg")" x " [("Q" _"p-game" " " ("kg" /"day")" x " "f" _"p-game" " " ("1")" x " "f" _"s-game" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-game" " " ("kg" /"day")"x " "f" _"p-game" " " ("1"))]) " x " (("t" _"r" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"r"))))

"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of game - back-calculated to water

"PR" "G" _"water-rec-game-ing" " " ("pCi" /"L")"=" ("PR" "G" _"rec-game-ing" " " ("pCi" /"g"))/("T" "F" _"game" " " ("day" /"kg")" x " "Q" _"w-game" " " ("L" /"day")" x " ("1 kg" /"1000 g"))

Consumption of fowl - direct

"PR" "G" _"rec-fowl-ing" " " ("pCi" /"g")"=" "TR" /("S" "F" _"f" " " ("risk" /"pCi")"x E" "F" _"rec" " " ("days" /"yr")" x E" "D" _"rec" " " ("yrs")" x IRG" "F" _"rec" " " ("g" /"day"))

Consumption of fowl - back-calculated to soil

"PR" "G" _"soil-rec-fowl-ing" " " ("pCi" /"g")"=" ("PR" "G" _"rec-fowl-ing" " " ("pCi" /"g"))/("T" "F" _"fowl" " " ("day" /"kg")" x " [("Q" _"p-fowl" " " ("kg" /"day")" x " "f" _"p-fowl" " " ("1")" x " "f" _"s-fowl" " " ("1")" x " ("R" _"upp" "+" "R" _"es"))"+" ("Q" _"s-fowl" " " ("kg" /"day")"x " "f" _"p-fowl" " " ("1"))]) " x " (("t" _"r" " " ("yr")" x λ " ("1" /"yr"))/(("1-" "e" ^("-λ" "t" _"r"))))

"R" _"upp" "=B" "v" _"dry" " " "R" _"es" "=MLF (0.25)"

Consumption of fowl - back-calculated to water

"PR" "G" _"water-rec-fowl-ing" " " ("pCi" /"L")"=" ("PR" "G" _"rec-fowl-ing" " " ("pCi" /"g"))/("T" "F" _"fowl" " " ("day" /"kg")" x " "Q" _"w-fowl" " " ("L" /"day")" x " ("1 kg" /"1000 g"))

Variables	Defaults
TR	1.00E-06
IFW(rec-adj)	6300
EF(recw-c)	250
ED(recw-c)	4
ET(recw-c)	12
EV(recw-c)	3
IRW(recw-c)	0.05
EF(recw-a)	250
ED(recw-a)	15
ET(recw-a)	12
EV(recw-a)	2
IRW(recw-a)	0.05
DFA(rec-adj)	126000

	Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(w)	SF(imm)
Am-241	M	4.32E+02	1.60E-03	1.00E+00	1.04E-10	1.32E-13
Co-60	M	5.27E+00	1.31E-01	1.00E+00	1.58E-11	2.44E-11
H-3	V	1.23E+01	5.63E-02	1.00E+00	5.07E-14	0.00E+00
Pu-238	M	8.77E+01	7.90E-03	1.00E+00	1.31E-10	5.96E-16

	Ingestion	Immersion	Total
Am-241	1.00E-06	1.00E-06	1.00E+00
	6.55E-07	1.90E-12	6.55E-01
	1.53E+00	**5.27E+05**	**1.53E+00**
Co-60	1.00E-06	1.00E-06	1.00E+00
	9.95E-08	3.51E-10	9.99E-02
	1.00E+01	**2.85E+03**	**1.00E+01**
H-3	1.00E-06		1.00E+00
	3.19E-10		3.19E-04
	3.13E+03		**3.13E+03**
Pu-238	1.00E-06	1.00E-06	1.00E+00
	8.25E-07	8.57E-15	8.25E-01
	1.21E+00	**1.17E+08**	**1.21E+00**

		Calculated	PRG	% Differ.
Am-241	Ingestion	1.53E+00	1.53E+00	0.0%
	Immersion	5.27E+05	5.27E+05	0.0%
	Total	1.53E+00	1.53E+00	0.0%
Co-60	Ingestion	1.00E+01	1.01E+01	-1.0%
	Immersion	2.85E+03	2.85E+03	0.0%
	Total	1.00E+01	1.00E+01	0.0%
H-3	Ingestion	3.13E+03	3.13E+03	0.0%
	Immersion			
	Total	3.13E+03	3.13E+03	0.0%
Pu-238	Ingestion	1.21E+00	1.21E+00	0.0%
	Immersion	1.17E+08	1.17E+08	0.0%
	Total	1.21E+00	1.21E+00	0.0%

Ingestion of Tapwater

"PR" "G" _"rec−water−ing" " " ("pCi" ⁄"L")"=" "TR" /("S" "F" _"w" " " ("risk" /"pCi")" x IF" "W" _"rec −adj" " " ("L"))"IF" "W" _"rec−adj" " " ("L")"=" ("E" "F" _"recw−c" " " ("day" /"yr")" x E" "D" _"recw −c" " " ("yr")" x E" "T" _"recw-c" " " ("hr" /"event")" x E" "V" _"recw-c" " " ("events" /"day")" x IR" "W" _"recw−c" " " ("0.05 L" /"hr"))"+" ("E" "F" _"recw−a" " " ("day" /"yr")" x E" "D" _"recw−a" " " ("yr")" x E" "T" _"recw−a" " " ("hr" /"event")" x E" "V" _"recw−a" " " ("events" /"day")" x IR" "W" _"recw −a" " " ("0.05 L" /"hr"))

Immersion

"PR" "G" _"rec−water−imm" " " ("pCi" ⁄"L")"=" "TR" /("S" "F" _"imm" " " (("risk" /"yr")/("pCi" /"L"))" x " ("1 yr" /"8760 hr")" x DF" "A" _"rec −adj" " " ("hr"))"DF" "A" _"rec−adj" " " ("hr")"=" ("E" "F" _"recw−c" " " ("day" /"yr")" x E" "D" _"recw−c" " " ("yr")" x E" "V" _"recw−c" " " ("events" /"day")" x E" "T" _"recw−c" " " ("hr" /"event")" ")"+" ("E" "F" _"recw−a" " " ("day" /"yr")" x E" "D" _"recw−a" " " ("yr")" x E" "V" _"recw−a" " " ("events" /"day")" x E" "T" _"recw−a" " " ("hr" /"event"))" "

Total

"PR" "G" _"rec−water−tot" " " ("pCi" ⁄"L")"=" "1" /("1" /("PR" "G" _"rec−water−ing") "+" "1" /("PR" "G" _"rec−water−imm"))

Variables	Defaults		Type	Halflife (y)	λ	1-exp(-λt(cw))	SF(ext-sv)	SF(ext-1cm)	SF(ext-5cm)	SF(ext-15cm)	SF(ext-gp)	GSF(o)@0cm
TR	1.00E-06	Am-241	M	4.32E+02	1.60E-03	3.00E-02	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.87E-08	1.00E+00
t(rec)	19	Co-60	M	5.27E+00	1.31E-01	9.18E-01	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.19E-06	1.00E+00
EF(rec)	250	H-3	M	1.23E+01	5.63E-02	6.57E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
ED(rec)	19	Pu-238	M	8.77E+01	7.90E-03	1.39E-01	6.92E-11	4.81E-11	6.30E-11	6.87E-11	3.68E-10	1.00E+00
ET(rec)	12											

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.08E-01	9.46E-02	9.50E-02	9.69E-02	8.44E-02
Co-60	9.83E-02	4.26E-02	6.55E-02	8.49E-02	2.83E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	1.79E-01	1.53E-01	1.60E-01	1.71E-01	1.03E-01

	Cover Layer Thickness = 0cm ; Area = 1m^2				
	Infinite Dep	1 cm	5 cm	15 cm	Dust
Am-241	3.05E-08	3.05E-08	3.05E-08	3.05E-08	3.05E-08
	5.84E-10	2.55E-10	4.79E-10	5.24E-10	3.08E-10
	#######	1.20E+02	6.37E+01	5.81E+01	9.89E+01
Co-60	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06
	7.28E-06	5.75E-07	2.54E-06	5.27E-06	3.70E-07
	3.43E-01	4.35E+00	9.84E-01	4.74E-01	6.75E+00
H-3	[redacted]				
Pu-238	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07
	1.12E-11	6.68E-12	9.14E-12	1.07E-11	3.44E-11
	#######	2.25E+04	1.64E+04	1.41E+04	4.37E+03

		Calculated	PRG	% Differ.
Am-241	finite Dep	5.22E+01	5.24E+01	-0.4%
	1 cm	1.20E+02	1.20E+02	0.0%
	5 cm	6.37E+01	6.37E+01	0.0%
	15 cm	5.81E+01	5.82E+01	-0.2%
	Dust	9.89E+01	9.90E+01	-0.1%
Co-60	finite Dep	3.43E-01	3.44E-01	-0.3%
	1 cm	4.35E+00	4.34E+00	0.2%
	5 cm	9.84E-01	9.84E-01	0.0%
	15 cm	4.74E-01	4.73E-01	0.2%
	Dust	6.75E+00	6.76E+00	-0.1%
H-3	finite Dep	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	finite Dep	1.34E+04	1.34E+04	0.0%
	1 cm	2.25E+04	2.25E+04	0.0%
	5 cm	1.64E+04	1.64E+04	0.0%
	15 cm	1.41E+04	1.41E+04	0.0%
	Dust	4.37E+03	4.36E+03	0.2%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	1.94E-01	1.67E-01	1.67E-01	1.64E-01	1.50E-01
Co-60	1.77E-01	7.98E-02	1.22E-01	1.59E-01	5.21E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	2.84E-01	2.70E-01	2.83E-01	2.83E-01	1.84E-01

	Cover Layer Thickness = 0cm ; Area = 2m^2				
	Infinite Depth	1 cm	5 cm	15 cm	Dust
Am-241	3.05E-08	3.05E-08	3.05E-08	3.05E-08	3.05E-08
	1.05E-09	4.50E-10	8.42E-10	8.87E-10	5.48E-10
	2.90E+01	6.77E+01	3.62E+01	3.43E+01	5.56E+01
Co-60	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06
	1.31E-05	1.08E-06	4.73E-06	9.88E-06	6.81E-07
	1.91E-01	2.32E+00	5.28E-01	2.53E-01	3.67E+00
H-3	[redacted]				
Pu-238	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07
	1.78E-11	1.18E-11	1.62E-11	1.76E-11	6.14E-11
	8.42E+03	1.27E+04	9.28E+03	8.51E+03	2.44E+03

		Calculated	PRG	% Differ.
Am-241	Infinite Depth	2.90E+01	2.91E+01	-0.3%
	1 cm	6.77E+01	6.79E+01	-0.3%
	5 cm	3.62E+01	3.63E+01	-0.3%
	15 cm	3.43E+01	3.44E+01	-0.3%
	Dust	5.56E+01	5.56E+01	0.0%
Co-60	Infinite Depth	1.91E-01	1.91E-01	0.0%
	1 cm	2.32E+00	2.32E+00	0.0%
	5 cm	5.28E-01	5.30E-01	-0.4%
	15 cm	2.53E-01	2.53E-01	0.0%
	Dust	3.67E+00	3.67E+00	0.0%
H-3	Infinite Depth	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	Infinite Depth	8.42E+03	8.43E+03	-0.1%
	1 cm	1.27E+04	1.28E+04	-0.8%
	5 cm	9.28E+03	9.30E+03	-0.2%
	15 cm	8.51E+03	8.52E+03	-0.1%
	Dust	2.44E+03	2.44E+03	0.0%

	ACF(ext-sv)	ACF(ext-1cm)	ACF(ext-5cm)	ACF(ext-15cm)	ACF(ext-gp)
Am-241	3.20E-01	2.97E-01	2.90E-01	2.85E-01	2.71E-01
Co-60	3.33E-01	1.48E-01	2.22E-01	2.88E-01	9.86E-02
H-3	9.00E-01	9.00E-01	9.00E-01	9.00E-01	9.00E-01
Pu-238	5.92E-01	4.72E-01	5.02E-01	5.18E-01	3.31E-01

	Cover Layer Thickness = 0cm ; Area = 5m^2				
	Infinite Dep	1 cm	5 cm	15 cm	Dust
Am-241	3.05E-08	3.05E-08	3.05E-08	3.05E-08	3.05E-08
	1.73E-09	8.01E-10	1.46E-09	1.54E-09	9.90E-10
	#######	3.81E+01	2.09E+01	1.98E+01	3.08E+01
Co-60	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06
	2.47E-05	2.00E-06	8.60E-06	1.79E-05	1.29E-06
	1.01E-01	1.25E+00	2.90E-01	1.40E-01	1.94E+00
H-3	[redacted]				
Pu-238	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07
	3.72E-11	2.06E-11	2.87E-11	3.23E-11	1.10E-10
	#######	7.29E+03	5.23E+03	4.65E+03	1.36E+03

		Calculated	PRG	% Differ.
Am-241	finite Dep	1.76E+01	1.76E+01	0.0%
	1 cm	3.81E+01	3.82E+01	-0.3%
	5 cm	2.09E+01	2.09E+01	0.0%
	15 cm	1.98E+01	1.98E+01	0.0%
	Dust	3.08E+01	3.08E+01	0.0%
Co-60	finite Dep	1.01E-01	1.01E-01	0.0%
	1 cm	1.25E+00	1.25E+00	0.0%
	5 cm	2.90E-01	2.91E-01	-0.3%
	15 cm	1.40E-01	1.39E-01	0.7%
	Dust	1.94E+00	1.94E+00	0.0%
H-3	finite Dep	[redacted]		
	1 cm			
	5 cm			
	15 cm			
	Dust			
Pu-238	finite Dep	4.04E+03	4.04E+03	0.0%
	1 cm	7.29E+03	7.31E+03	-0.3%
	5 cm	5.23E+03	5.23E+03	0.0%
	15 cm	4.65E+03	4.66E+03	-0.2%
	Dust	1.36E+03	1.36E+03	0.0%

Direct External Exposure to contamination at infinite depth

"PRGrec−soil−sv " ("pCi" /"g")"=" ⊦"TR x " "t" _"rec" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"rec"))" x S" "F" _"ext−sv" " " (("risk" /"yr")/ ⊦"pCi" /"g" ⊣)" x E" "F" _"rec" " " ("days" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"rec" " " ("yr")" x " ⊦ ⊦"E" "T" _"rec" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext−sv" ⊣⊣)

Direct External Exposure to contamination at 1 cm

"PRGrec−soil−1cm " ("pCi" /"g")"=" ⊦"TR x " "t" _"rec" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"rec"))" x S" "F" _"ext−1cm" " " (("risk" /"yr")/ ⊦ "pCi" /"g" ⊣)" x E" "F" _"rec" " " ("days" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"rec" " " ("yr")" x " ⊦ ⊦"E" "T" _"rec" " " ("8 hrs" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"o" " " ("1.0") "x AC" "F" _"ext−1cm" ⊣⊣)

Direct External Exposure to contamination at 5cm

"PRGrec−soil−5cm " ("pCi" /"g")"=" ⊦"TR x " "t" _"rec" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"rec"))" x S" "F" _"ext−5cm" " " (("risk" /"yr")/ ⊦

Variables	Defaults
TR	1.00E-06
t(r)	26
IFS(r-adj)	1120000
EF(r-c)	350
ED(r-c)	6
IRS(c)	200
EF(r-a)	350
ED(r-a)	20
IRS(a)	100
IFA(r-adj)	161000
PEF	1.36E+09
ET(r-c)	24
IRA(c)	10
ET(r-a)	24
IRA(a)	20
EF(r)	350
ED(r)	26
ET(r-o)	1.752
GSF(o)	1
ET(r-i)	16.416
GSF(i)	0.4
ACF(ext-sv)	
MLF	0.26
R(upv)	Bv(wet)
R(es)	MLF
IFF(r-adj)	1389710
IFV(r-adj)	970970
CPF(r)	0.25
IRF(r-c)	68.1
IRF(r-a)	178.1
IRV(r-c)	41.7
IRV(r-a)	126.2
U(m)	4.69
A(s)	0.5
U(t)	11.32
V	0.5
A	16.230
B	18.776
C	216.108
F(x)	0.194
Q/C(wind)	93.774
A(VF)	11.911
B(VF)	18.439
C(VF)	209.785

	Ingestion	Inhalation	External	Consump		Total
Am-241	0.00E+00	0.00E+00	0.00E+00	1.00E-06	#DIV/0!	1.00E+00
	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	0.00E+00	0.00E+00	0.00E+00	1.00E-06	#DIV/0!	1.00E+00
	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
H-3		0.00E+00		1.00E-06	#DIV/0!	1.00E+00
		#DIV/0!		0.00E+00	#DIV/0!	#DIV/0!
		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!
Pu-238	0.00E+00	0.00E+00	0.00E+00	1.00E-06	#DIV/0!	1.00E+00
	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	Type	Halflife (y)	λ	1-exp(-λt(r))	SF(s)	SF(i)	Q/C	PEF	SF(ext-sv)	ACF(ext-sv)	Bv(wet)	SF(f)
Am-241	M	4.32E+02	1.60E-03	4.09E-02	0.00E+00	0.00E+00	93.774	1.36E+09	#REF!	1.00E+00	1.91E-05	0.00E+00
Co-60	M	5.27E+00	1.31E-01	9.67E-01	1cm	1.12E-13	93.774	1.36E+09	#REF!	1.00E+00	7.40E-03	Soil Volume
H-3	M	1.23E+01	5.63E-02	7.69E-01		0.00E+00	68.184	1.70E+01		9.00E-01	4.80E+00	1.24E-05
Pu-238	M	8.77E+01	7.90E-03	1.86E-01	0.00E+00	3.54E-08	93.774	1.36E+09	#REF!	1.00E+00	8.27E-06	0.00E+00

		Calculated	PRG	% Differ.
Am-241	Ingestion	4.95E+00	4.95E+00	0.0%
	Inhalation	2.29E+02	2.28E+02	0.4%
	External	4.27E+00	4.27E+00	0.0%
	Consump.	4.97E-02	4.98E-02	-0.2%
	Total	4.86E-02	4.87E-02	-0.2%
Co-60	Ingestion	8.28E+01	8.28E+01	0.0%
	Inhalation	2.95E+05	2.96E+05	-0.3%
	External	3.30E-02	3.30E-02	0.0%
	Consump.	1.00E+00	1.00E+00	0.0%
	Total	3.19E-02	3.20E-02	-0.3%
H-3	Ingestion			
	Inhalation	2.38E-01	2.37E-01	0.4%
	External			
	Consump.	4.43E+00	4.43E+00	0.0%
	Total	2.25E-01	2.25E-01	0.0%
Pu-238	Ingestion	4.39E+00	4.40E+00	-0.2%
	Inhalation	1.79E+02	1.79E+02	0.0%
	External	1.85E+03	1.85E+03	0.0%
	Consump.	4.27E-02	4.25E-02	0.5%
	Total	4.22E-02	4.21E-02	0.2%

Incidental ingestion of soil

"PRG$_{res-soil-ing}$" ("pCi" /"g")"=" ⊦"TR x tr " ("yr")" x λ " ("1" /"yr")⊣ /("1−" "e" ^"−λtr")" x SFs " ("risk" /"pCi")" x IFSr$_{-adj}$" ("1,120,00 mg")" x " ("g" /"1000 mg")

"IFS$_{r-adj}$" ("1,120,000 mg")"=" ("EF$_{r-c}$" ("350 day" /"yr")" x EDr$_{-c}$ " ("6 yr")" x IRSc " ("200 mg" /"day")" ")"+" ("EF$_{r-a}$" ("350 day" /"yr")" x EDr$_{-a}$ " ("20 yr")" x IRSa " ("100 mg" /"day"))

Inhalation of particulates emitted from soil

"PRG$_{res-soil-ing}$" ("pCi" ⁄"g")"=" ⊦"TR x tr " ("yr")" x λ " ("1" /"yr")⊣ /("1−" "e" ^"−λtr")" x SFi " ("risk" /"pCi")" x IFAr$_{-adj}$" ("161,00 m3")" x " ("1" /"PEF" ("m" ^"3" /"kg"))" x " ("1000g" /"kg")

"IFA$_{r-adj}$" ("161,000 " "m" ^"3")"=" ("EF$_{r-c}$ " ("350 day" /"yr")" x EDr$_{-c}$ " ("6 yr")" x ETr$_{-c}$ " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IRAc " (("10 " "m" ^"3")/"day"))"+" ("EF$_{r-a}$ " ("350 day" /"yr")" x EDr$_{-a}$ " ("20 yr")" x ETr$_{-a}$ " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IRAa " (("20" 〚" m" 〛^"3")/"day"))" "

External exposure to ionizing

"PRGres−soil−ext " ("pCi" ⁄"g")"=" ⊦"TR x " "t" _"r" " " ("yr")" x λ " ("1" /"yr")⊣ /(("1−" "e" ^("−λ" "t" _"r"))" x S" "F" _"ext−sv" " " (("risk" /"yr")/⊦"pCi" /"g" ⊣)" x E" "F" _"r" " " ("350 day" /"yr")" x " ("1yr" /"365 days")" x E" "D" _"r" " " ("26 yr")" x " [("E" "T" _"r −o" " " ("1.752 hr" /"day")" x " ("1 day" /"24 hr")" x GS""F" _"o" " " ("1.0"))"+" ("E" "T" _"r−i" " " ("16.416 hr" /"day")" x " ("1 day" /"24 hr")" x GS" "F" _"i" " " ("0.4"))]" x AC" "F" _"ext−sv")

Consumption of fruits and vegetables

"PR" "G" _"res−prod−ing" " " ("pCi" ⁄"g")"=" "TR" /("SFf " ("risk" /"pCi")" x " ("IF" "F" _"r −adj" " " ("1,389,710 g")"+IF" "V" _"r−adj" " " ("970,970 g"))" x CP" "F" _"r" " " ("0.25"))

"IF" "F" _"r−adj" " " ("1,389,710 g")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x IR" "F" _"r−c" " " ("68.1 g" /"day"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x IR" "F" _"r−a" " " ("178.1 g" /"day"))

"IF" "F" _"r−adj" " " ("970,970 g")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x IR" "V" _"r−c" " " ("41.7 g" /"day"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x IR" "V" _"r−a" " " ("126.2 g" /"day"))

Consumption of Fruits and Vegetables back-calculated to soil

"PR" "G" _"res−soil−prod−ing" ("pCi" ⁄"g")"=" ("PR" "G" _"res−prod−ing" " " ("pCi" /"g"))/(("R" _"upv" "+" "R" _"es"))" x " (("t" _"r" " " ("yr")" x λ " ("1" /"yr"))/(("1 −" "e" ^("−λ" "t" _"r"))))

"R" _"upv" "=B" "v" _"wet" " ;" 〚" R" 〛_"es" "=MLF " ("0.26")

Total

"PR" "G" _"res−soil−tot" " " ("pCi" ⁄"g")"=" "1" /("1" /("PR" "G" _"res−soil−ing"))"+" ("1" /("PR" "G" _"res−soil−inh"))"+" ("1" /("PR" "G" _"res−soil−ext"))"+" ("1" /("PR" "G" _"res−soil−prod−ing"))

Particulate Emission Factor - Wind

"PE" "F" _"w" " " (("m" _"air" ^"3")/("k" "g" _"soil"))"=" "Q" /"C" _"wind" " " (("g" /("m" ^"2" "−s"))/("kg" /"m" ^"3"))" x " "3600 " ("s" /"hour")/("0.036 x " ("1−V")"x " (("U" _"m" " " ("m" /"s"))/("U" _"t" " " ("m" /"s")))^"3" " x F(x)")

"Q" /"C" _"wind" "=A x" "exp" 〖("ln" "A" _"s" " " ("acre")"−B")^"2" /"C"]

Variables	Defaults
TR	1.00E-06
t(r)	26
EF(r-c)	350
ED(r-c)	6
EF(r-a)	350
ED(r-a)	20
IFA(r-adj)	161000
ET(r-c)	24
IRA(c)	10
ET(r-a)	24
IRA(a)	20
EF(r)	350
ED(r)	26
GSF(a)	1
ET(r)	24

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	0.00E+00	0.00E+00	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	0.00E+00	0.00E+00	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
H-3	0.00E+00		1.00E+00	1.00E-06		1.00E+00
	0.00E+00		#DIV/0!	0.00E+00		#DIV/0!
	#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!
Pu-238	0.00E+00	0.00E+00	1.00E+00	1.00E-06	1.00E-06	1.00E+00
	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	Type	Halflife (y)	λ	1-exp(-λt(r))	SF(i)	SF(sub)
Am-241	M	4.32E+02	1.60E-03	4.09E-02	0.00E+00	#REF!
Co-60	M	5.27E+00	1.31E-01	9.67E-01	0.00E+00	#REF!
H-3	M	1.23E+01	5.63E-02	7.69E-01	0.00E+00	
Pu-238	M	8.77E+01	7.90E-03	1.86E-01	0.00E+00	0.00E+00

		Calculated	PRG	% Differ.
Am-241	Inhalation	1.68E-04	1.68E-04	0.0%
	External	7.05E+02	7.06E+02	-0.1%
	Total	1.68E-04	1.68E-04	0.0%
	Inhalation	1.65E-04	1.65E-04	0.0%
	External	6.90E+02	6.91E+02	-0.1%
	Total	1.65E-04	1.65E-04	0.0%
Co-60	Inhalation	2.17E-01	2.18E-01	-0.5%
	External	1.25E+01	1.26E+01	-0.8%
	Total	2.14E-01	2.14E-01	0.0%
	Inhalation	6.15E-02	6.17E-02	-0.3%
	External	3.55E+00	3.57E+00	-0.6%
	Total	6.04E-02	6.07E-02	-0.5%
H-3	Inhalation	1.40E+01	1.40E+01	0.0%
	External			
	Total	1.40E+01	1.40E+01	0.0%
	Inhalation	7.33E+00	7.33E+00	0.0%
	External			
	Total	7.33E+00	7.33E+00	0.0%
Pu-238	Inhalation	1.32E-04	1.32E-04	0.0%
	External	1.73E+05	1.74E+05	-0.6%
	Total	1.32E-04	1.32E-04	0.0%
	Inhalation	1.19E-04	1.19E-04	0.0%
	External	1.57E+05	1.57E+05	0.0%
	Total	1.19E-04	1.19E-04	0.0%

Inhalation (with half-life decay)

"PR" "G" _"res−air−inh−decay" " " ("pCi" /"m" ^"3")"=" ├ "TR x " "t" _"r" " " ("yr")" x λ " ("1" /"yr")┤ /(("1−" "e" ^("−λ" "t" _"r"))" x SFi " ("risk" /"pCi")" x IF" "A" _"r−adj" " " ("161,000 " "m" ^"3"))

"IF" "A" _"r−adj" " " ("161,000 " "m" ^"3")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x E" "T" _"r−c" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"r−c" " " (("10 " "m" ^"3")/"day"))"+" (⟦"EF" ⟧_"r−a" " " ("350 day" /"yr")" x " ⟦"ED" ⟧_"r−a" " " ("20 yr")" x " ⟦"ET" ⟧_"r−a" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x " ⟦"IRA" ⟧_"r−a" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (with half-life decay)

"PR" "G" _"res−air−sub−decay" " " ("pCi" ∕"m" ^"3")"=" ├ "TR x " "t" _"r" " " ("yr")" x λ " ("1" /"yr")┤ /(("1−" "e" ^("−λ" "t" _"r"))" x S" "F" _"sub" " " (("risk" /"yr")/("pCi" /"m" ^"3"))" x E" "F" _"r" " " ("350 day" /"yr")" x " (├ "1 yr" ┤ /"365 days")" x E" "D" _"r" " " ("26 yr")" x E" "T" _"r" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (with half-life decay)

"PR" "G" _"res−air−tot−decay" " " ("pCi" ∕"m" ^"3")"=" "1" /("1" /("PR" "G" _"res−air−inh−decay") "+" "1" /("PR" "G" _"res−air−sub−decay") " ")

Inhalation (without half-life decay)

"PR" "G" _"res−air−inh−nodecay" " " ("pCi" /"m" ^"3")"=" ├ "TR" ┤ /("SFi " ("risk" /"pCi")" x IF" "A" _"r−adj" " " ("161,000 " "m" ^"3"))

"IF" "A" _"r−adj" " " ("161,000 " "m" ^"3")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x E" "T" _"r−c" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x IR" "A" _"r−c" " " (("10 " "m" ^"3")/"day"))"+" (⟦"EF" ⟧_"r−a" " " ("350 day" /"yr")" x " ⟦"ED" ⟧_"r−a" " " ("20 yr")" x " ⟦"ET" ⟧_"r−a" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x " ⟦"IRA" ⟧_"r−a" " " (("20 " "m" ^"3")/"day"))

External exposure to ionizing radiation (without half-life decay)

"PR" "G" _"res−air−sub−nodecay" " " ("pCi" ∕"m" ^"3")"=" ├ "TR" ┤ /("S" "F" _"sub" " " (("risk" /"yr")/("pCi" /"m" ^"3"))" x E" "F" _"r" " " ("350 day" /"yr")" x " (├ "1 yr" ┤ /"365 days")" x E" "D" _"r" " " ("26 yr")" x E" "T" _"r" " " ("24 hr" /"day")" x " ("1 day" /"24 hrs")" x GS" "F" _"a" " " ("1.0"))

Total (without half-life decay)

"PR" "G" _"res−air−tot−nodecay" " " ("pCi" ∕"m" ^"3")"=" "1" /("1" /("PR" "G" _"res−air−inh−nodecay") "+" "1" /("PR" "G" _"res−air−sub−nodecay") " ")

Variables	Defaults
TR	1.00E-06
t(r)	26
IFW(r-adj)	19138
EF(r-c)	350
ED(r-c)	6
IRW(c)	0.78
EF(r-a)	350
ED(r-a)	20
IRW(a)	2.5
IFA(r-adj)	161000
DFA(r-adj)	6104
ET(r-c)	24
IRA(c)	10
ET(r-a)	24
IRA(a)	20
EF(r)	350
ED(r)	26
ET(r-o)	1.752
GSF(o)	1
ET(r-i)	16.416
GSF(i)	0.4
MLF	0.26
R(upv)	Bv(wet)
R(es)	MLF
IFF(r-adj)	1389710
IFV(r-adj)	970970
CPF(r)	0.25
IRF(r-c)	68.1
IRF(r-a)	178.1
IRV(r-c)	41.7
IRV(r-a)	126.2
EV(r-c)	1
EV(r-a)	1
F	0.25
I(f)	0.42
I(r)	3.62
K	0.5
λ(HL)	0.000027
P	240
T	1
t(a-event)	0.71
t(b)	10950
t(c-event)	0.54
t(v)	60
t(w)	14
Y(v)	2
IRF(a)	54
CF(fish)	1

	Ingestion of Tapwater	Inhalation	Immersion	Fruits & Veg.	Total
Am-241	1.00E-06		1.00E-06	#DIV/0!	1.00E+00
	0.00E+00		#VALUE!	#VALUE!	#DIV/0!
	#DIV/0!		#VALUE!	#DIV/0!	#DIV/0!
Co-60	1.00E-06		1.00E-06	7.09E-10	1.00E+00
	0.00E+00		#VALUE!	#VALUE!	#DIV/0!
	#DIV/0!		#VALUE!	#VALUE!	#DIV/0!
H-3	1.00E-06	1.00E-06		#DIV/0!	1.00E+00
	0.00E+00	0.00E+00		#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!
Pu-238	1.00E-06		1.00E-06	#DIV/0!	1.00E+00
	#VALUE!		#VALUE!	#VALUE!	#VALUE!
	#VALUE!		#VALUE!	#DIV/0!	#VALUE!

	Fish
Am-241	1.00E-06
	#REF!
	#REF!
Co-60	1.00E-06
	#REF!
	#REF!
H-3	1.00E-06
	0.00E+00
	#DIV/0!
Pu-238	1.00E-06
	0.00E+00
	#DIV/0!

	Irr(rup)	Irr(res)	Irr(dep)
Am-241	#VALUE!	#VALUE!	1.38E+00
	0.00E+00	0.00E+00	7.28E+00
	#VALUE!	#VALUE!	1.90E-01
Co-60	#VALUE!	#VALUE!	3.18E-01
	0.00E+00	0.00E+00	1.68E+00
	#VALUE!	#VALUE!	1.90E-01
H-3	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
Pu-238	#VALUE!	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#VALUE!	#DIV/0!	#DIV/0!

		Calculated	PRG	% Differ.
Am-241	Fish	1.52E-02	1.52E-02	0.0%
Co-60	Fish	9.13E-02	9.12E-02	0.1%
H-3	Fish	1.41E+01	1.41E+01	0.0%
Pu-238	Fish	1.20E-02	1.20E-02	0.0%

		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	Ingestion	5.02E-01	5.04E-01	-0.4%	H-3	Ingestion	1.03E+03	1.03E+03	0.0%
	Inhalation					Inhalation	1.47E+01	1.47E+01	0.0%
	Immersion	1.09E+07	1.09E+07	0.0%		Immersion			
	Lambda i	4.39E-06	4.36E-06	0.7%		Lambda i	1.54E-04	1.54E-04	0.0%
	Lambda B	3.14E-05	3.14E-05	0.0%		Lambda B	1.81E-04	1.81E-04	0.0%
	Lambda E	4.95E-02	4.95E-02	0.0%		Lambda E	4.93E-02	4.95E-02	-0.4%
	Irr(rup)	6.67E-04	6.69E-04	-0.3%		Irr(rup)	8.61E+01	8.62E+01	-0.1%
	Irr(res)	9.08E+00	9.08E+00	0.0%		Irr(res)	4.66E+00	4.67E+00	-0.2%
	Irr(dep)	3.64E+00	3.64E+00	0.0%		Irr(dep)	3.65E+00	3.64E+00	0.3%
	F & V	9.93E-01	9.97E-01	-0.4%		F & V	2.76E+02	2.75E+02	0.4%
	Total	3.34E-01	3.31E-01	0.9%		Total	1.37E+01	1.37E+01	0.0%
Co-60	Ingestion	3.31E+00	3.32E+00	-0.3%	Pu-238	Ingestion	3.99E-01	3.98E-01	0.3%
	Inhalation					Inhalation			
	Immersion	5.88E+04	5.88E+04	0.0%		Immersion	2.41E+09	2.41E+09	0.0%
	Lambda i	3.60E-04	3.60E-04	0.0%		Lambda i	2.16E-05	2.16E-05	0.0%
	Lambda B	3.87E-04	3.87E-04	0.0%		Lambda B	4.86E-05	4.86E-05	0.0%
	Lambda E	4.91E-02	4.95E-02	-0.8%		Lambda E	4.95E-02	4.95E-02	0.0%
	Irr(rup)	7.10E-02	7.10E-02	0.0%		Irr(rup)	2.65E-04	2.65E-04	0.0%
	Irr(res)	2.50E+00	2.50E+00	0.0%		Irr(res)	8.32E+00	8.32E+00	0.0%
	Irr(dep)	3.66E+00	3.64E+00	0.5%		Irr(dep)	3.64E+00	3.64E+00	0.0%
	F & V	1.22E+01	1.22E+01	0.0%		F & V	8.38E-01	8.36E-01	0.2%
	Total	2.60E+00	2.61E+00	-0.4%		Total	2.70E-01	2.70E-01	0.0%

	Type	Halflife (y)	λ	1-exp(-λt(r)	SF(w)	SF(i)	SF(imm)	Bv(wet)	Halflife (d)	λ(i)	λ(B)	1-exp(-λ(B)t(b)	λ(E)	-exp(-λ(E)t(v	SF(f)
Am-241	M	4.32E+02	1.60E-03	4.09E-02	#REF!	#REF!	0.00E+00	1.91E-05	1.58E+05	-4.39E-06	3.14E-05	2.91E-01	4.95E-02	9.49E-01	#REF!
Co-60	M	5.27E+00	1.31E-01	9.67E-01	#REF!	#REF!	0.00E+00	7.40E-03	1.92E+03	-3.60E-04	3.87E-04	9.86E-01	4.91E-02	9.48E-01	#REF!
H-3	M	1.23E+01	5.63E-02	7.69E-01	#REF!	#REF!	1.04E-10	4.80E+00	4.49E+03	-1.54E-04	1.81E-04	8.63E-01	4.93E-02	9.48E-01	#REF!
H-3	V	1.23E+01	5.63E-02	7.69E-01	#REF!	#REF!	SF(w)	4.80E+00	4.49E+03	-1.54E-04	1.81E-04	8.63E-01	4.93E-02	9.48E-01	#REF!
Pu-238	M	8.77E+01	7.90E-03	1.86E-01	#REF!	#REF!	1.58E-11	8.27E-06	3.20E+04	-2.16E-05	4.86E-05	4.13E-01	4.95E-02	9.49E-01	#REF!

Ingestion of Tapwater

"PR" "G" _"water−ing" " " ("pCi" /"L")"=" "TR" /("S" "F" _"w" " " ("risk" /"pCi")" x IF" "W" _"res−adj" " " ("19,138 L"))"IF" "W" _"res−adj" " " ("19,138 L")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x IR" "W" _"r−c" " " ("0.78 L" /"day"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x IR" "W" _"r−a" " " ("2.5 L" /"day"))

Inhalation (Only calculated for C-14, H-3, Ra-224, Ra-226, and Ra-226+D)

"PR" "G" _"water−inh" " " ("pCi" ⁄"L")"=" "TR" /("S" "F" _"i" " " ("risk" /"pCi")" x IF" "A" _"res −adj" " " ("161,000 " "m" ^"3")" x K " ("0.5 L" /"m" ^"3"))"IF" "A" _"res−adj" " " ("161,000 " "m" ^"3")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x E" "T" _"r−c" " " ("24 hrs" /"day")" x " (├ "1 day" ┤ /"24 hrs")" x IR" "A" _"r−c" " " (("10 " "m" ^"3")/"day"))"+ " ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x E" "T" _"r−a" " " ("24 hrs" /"day")" x " ((("1 day"))/"24 hrs")" x IR" "A" _"r −a" " " (("20 " "m" ^"3")/"day"))

Immersion

"PR" "G" _"water−imm" " " ("pCi" ⁄"L")"=" "TR" /("S" "F" _"imm" " " (("risk" /"yr")/("pCi" /"L"))" x " ("1 yr" /"8760 hr")" x DF" "A" _"r −adj" " " ("6104 hr"))"DF" "A" _"r−adj" " " ("6104 hr")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x E" "V" _"r−c" " " ("1 event" /"day")" x " "t" _"r−c−event" " " ("0.54 hr" /"event"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x E" "V" _"r−a" " " ("1 event" /"day")" x " "t" _"r−a−event" " " ("0.71 hr" /"event"))" "

Consumption of fruits and vegetables

"PR" "G" _"res−prod−ing" " " ("pCi" ⁄"g")"=" "TR" /(⟦"SF" ⟧_"f" ("risk" /"pCi")" x " ("IF" "F" _"r−adj" " " ("1,389,710 g")"+IF" "V" _"r−adj" " " ("970,970 g"))" x CP" "F" _"r" " " ("0.25"))"IF" "F" _"r−adj" " " ("1,389,710 g")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x IR" "F" _"r−c" " " ("68.1 g" /"day"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x IR" "F" _"r−a" " " ("178.1 g" /"day"))"IF" "F" _"r−adj" " " ("970,970 g")"=" ("E" "F" _"r−c" " " ("350 day" /"yr")" x E" "D" _"r−c" " " ("6 yr")" x IR" "V" _"r−c" " " ("41.7 g" /"day"))"+" ("E" "F" _"r−a" " " ("350 day" /"yr")" x E" "D" _"r−a" " " ("20 yr")" x IR" "V" _"r−a" " " ("126.2 g" /"day"))

Consumption of fruits and vegetables back-calculated to water

"PR" "G" _"water−prod" ("pCi" ⁄"L")"=" (("PR" "G" _"res−prod−ing" " " ("pCi" /"g")))/("1 kg" /"1000 g")"x " ("Ir" "r" _"rup" ("L" /"kg")"+Ir" "r" _"res" ("L" /"kg")"+Ir" "r" _"dep" ("L" /"kg")) "Ir" "r" _"rup" " " ("L" /"kg")"=" ("Ir x F x B" "v" _"wet" " x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")])/("P x " "λ" _"B") ; "Ir" "r" _"res" " " ("L" /"kg")"=" "Ir x F x MLF x " ["1−" "e" ^("−" "λ" _"B" " x " "t" _"b")]/("P x " "λ" _"B") ; "Ir" "r" _"res" " " ("L" /"kg")"=" ("Ir x F x " "I" _"f" " x T x " ["1−" "e" ^("−" "λ" _"E" " x " "t" _"v")])/("Y" _"v" " x " "λ" _"E")

Total

"PR" "G" _"water-tot" " " ("pCi" ⁄"L")"=" "1" /("1" /("PR" "G" _"water−ing") "+" "1" /("PR" "G" _"water−inh") "+" "1" /("PR" "G" _"water−imm") "+" "1" /("PR" "G" _"water−prod"))

Consumption of fish

"PR" "G" _"res−fsh−ing" " " ("pCi" /"g")"=" "TR" /("S" "F" _"fish" " " ("risk" /"pCi")"x E" "F" _"r" " " ("350 day" /"yr")"x E" "D" _"r" " " ("26 yr")"x IR" "F" _"a" " " ("54 g" /"day")"x C" "F" _"fish" " (1)")

Variables	Substitutes
TR	1.00E-03
t(r)	40
IFS(r-adj)	1350000
EF(r-c)	300
ED(r-c)	10
IRS(c)	180
EF(r-a)	300
ED(r-a)	30
IRS(a)	90
IFA(r-adj)	195000
PEF	6.18E+08
ET(r-c)	14
IRA(c)	15
ET(r-a)	18
IRA(a)	25
EF(r)	300
ED(r)	40
ET(r-o)	2.354
GSF(o)	at 10cm
ET(r-i)	14.752
GSF(i)	0.6
ACF(ext-sv)	at 1m(2)
MLF	0.38
R(upv)	Bv(wet)
R(es)	MLF
IFF(r-adj)	1890000
IFV(r-adj)	1350000
CPF(r)	0.3
IRF(r-c)	75
IRF(r-a)	185
IRV(r-c)	48
IRV(r-a)	134
U(m)	5.75
A(s)	10
U(t)	12.5
V	0.8
A	14.835
B	17.926
C	204.152
F(x)	0.408
Q/C(wind)	49.038

	Ingestion	Inhalation	External	Consump		Total
Am-241	6.42E-05	6.42E-05	6.42E-05	1.00E-03	2.02E+01	1.00E+00
	1.54E-08	7.40E-10	2.26E-09	1.30E-04	1.03E+00	4.82E-02
	4.16E+03	8.67E+04	2.84E+04	7.68E+00	2.09E+01	2.07E+01
Co-60	5.26E-03	5.26E-03	5.26E-03	1.00E-03	1.19E+02	1.00E+00
	5.12E-08	3.17E-11	1.60E-05	2.17E-05	5.29E+00	4.63E-03
	1.03E+05	1.66E+08	3.29E+02	4.61E+01	6.30E+02	2.16E+02
H-3		2.25E-03		1.00E-03	1.38E+03	1.00E+00
		8.70E-06		1.40E-07	2.52E+00	4.15E-03
		2.59E+02		7.14E+03	3.47E+03	2.41E+02
Pu-238	3.16E-04	3.16E-04	3.16E-04	1.00E-03	1.60E+01	1.00E+00
	8.23E-08	4.47E-09	4.07E-11	1.64E-04	1.17E+00	5.38E-02
	3.84E+03	7.08E+04	7.76E+06	6.09E+00	1.87E+01	1.86E+01

		Calculated	PRG	% Differ.
Am-241	Ingestion	4.16E+03	4.16E+03	0.0%
	Inhalation	8.67E+04	8.67E+04	0.0%
	External	2.84E+04	2.85E+04	-0.4%
	Consump.	2.09E+01	2.09E+01	0.0%
	Total	2.07E+01	2.07E+01	0.0%
Co-60	Ingestion	1.03E+05	1.02E+05	1.0%
	Inhalation	1.66E+08	1.65E+08	0.6%
	External	3.29E+02	3.28E+02	0.3%
	Consump.	6.30E+02	6.27E+02	0.5%
	Total	2.16E+02	2.15E+02	0.5%
H-3	Ingestion			
	Inhalation	2.59E+02	2.59E+02	0.0%
	External			
	Consump.	3.47E+03	3.47E+03	0.0%
	Total	2.41E+02	2.41E+02	0.0%
Pu-238	Ingestion	3.84E+03	3.84E+03	0.0%
	Inhalation	7.08E+04	7.08E+04	0.0%
	External	7.76E+06	7.79E+06	-0.4%
	Consump.	1.87E+01	1.87E+01	0.0%
	Total	1.86E+01	1.86E+01	0.0%

	Type	Halflife (y)	λ	1-exp(-λt(r))	SF(s)	SF(i)	Q/C	PEF	SF(ext-sv)	GSF @ 10cm	ACF(ext-sv)	Bv(wet)	SF(f)
Am-241	M	4.32E+02	1.60E-03	6.22E-02	1.84E-10	3.77E-08	49.038	6.18E+08	2.77E-08	9.60E-03	1.08E-01	1.91E-05	1.34E-10
Co-60	M	5.27E+00	1.31E-01	9.95E-01	3.81E-11	1.01E-10	49.038	6.18E+08	1.24E-05	3.24E-01	9.83E-02	7.40E-03	2.23E-11
H-3	M	1.23E+01	5.63E-02	8.95E-01		8.47E-13		1.70E+01			9.00E-01	4.80E+00	1.44E-13
Pu-238	M	8.77E+01	7.90E-03	2.71E-01	2.25E-10	5.22E-08	49.038	6.18E+08	6.92E-11	8.72E-04	1.79E-01	8.27E-06	1.69E-10

Variables	Substitutes
TR	2.00E-06
t(r)	74
EF(r-c)	280
ED(r-c)	24
EF(r-a)	360
ED(r-a)	50
IFA(r-adj)	873540
ET(r-c)	18
IRA(c)	26
ET(r-a)	22
IRA(a)	45
EF(r)	334
ED(r)	74
GSF(a)	3
ET(r)	21

	With Halflife Decay			Without Halflife Decay		
	Inhalation	External	Total	Inhalation	External	Total
Am-241	2.37E-07	2.37E-07	1.00E+00	2.00E-06	2.00E-06	1.00E+00
	3.69E-03	1.14E-09	1.55E+04	3.29E-02	1.02E-08	1.65E+04
	6.44E-05	2.08E+02	6.44E-05	6.07E-05	1.96E+02	6.07E-05
Co-60	1.95E-05	1.95E-05	1.00E+00	2.00E-06	2.00E-06	1.00E+00
	8.82E-05	1.98E-06	4.63E+00	8.82E-05	1.98E-06	4.51E+01
	2.21E-01	9.83E+00	2.16E-01	2.27E-02	1.01E+00	2.22E-02
H-3	8.34E-06		1.00E+00	2.00E-06		1.00E+00
	7.28E-07		8.74E-02	7.40E-07		3.70E-01
	1.14E+01		1.14E+01	2.70E+00		2.70E+00
Pu-238	1.17E-06	1.17E-06	1.00E+00	2.00E-06	2.00E-06	1.00E+00
	2.02E-02	1.99E-11	1.73E+04	4.56E-02	4.49E-11	2.28E+04
	5.79E-05	5.89E+04	5.79E-05	4.39E-05	4.46E+04	4.39E-05

		Calculated	PRG	% Differ.
Am-241	Inhalation	6.44E-05	6.44E-05	0.0%
	External	2.08E+02	2.09E+02	-0.5%
	Total	6.44E-05	6.44E-05	0.0%
	Inhalation	6.07E-05	6.07E-05	0.0%
	External	1.96E+02	1.97E+02	-0.5%
	Total	6.07E-05	6.07E-05	0.0%
Co-60	Inhalation	2.21E-01	2.20E-01	0.5%
	External	9.83E+00	9.88E+00	-0.5%
	Total	2.16E-01	2.15E-01	0.5%
	Inhalation	2.27E-02	2.27E-02	0.0%
	External	1.01E+00	1.02E+00	-1.0%
	Total	2.22E-02	2.22E-02	0.0%
H-3	Inhalation	1.14E+01	1.14E+01	0.0%
	External			
	Total	1.14E+01	1.14E+01	0.0%
	Inhalation	2.70E+00	2.70E+00	0.0%
	External			
	Total	2.70E+00	2.70E+00	0.0%
Pu-238	Inhalation	5.79E-05	5.79E-05	0.0%
	External	5.89E+04	5.89E+04	0.0%
	Total	5.79E-05	5.79E-05	0.0%
	Inhalation	4.39E-05	4.39E-05	0.0%
	External	4.46E+04	4.46E+04	0.0%
	Total	4.39E-05	4.39E-05	0.0%

	Type	Halflife (y)	λ	1-exp(-λt(r))	SF(i)	SF(sub)
Am-241	M	4.32E+02	1.60E-03	1.12E-01	3.77E-08	5.81E-11
Co-60	M	5.27E+00	1.31E-01	1.00E+00	1.01E-10	1.13E-08
H-3	M	1.23E+01	5.63E-02	9.85E-01	8.47E-13	
Pu-238	M	8.77E+01	7.90E-03	4.43E-01	5.22E-08	2.56E-13

Variables	Substitutes
TR	2.00E-03
t(r)	49
IFW(r-adj)	37166
EF(r-c)	120
ED(r-c)	12
IRW(c)	1.4
EF(r-a)	250
ED(r-a)	37
IRW(a)	3.8
IFA(r-adj)	274111.7
DFA(r-adj)	51434
ET(r-c)	12
IRA(c)	6
ET(r-a)	20
IRA(a)	35
EF(r)	218
ED(r)	49
ET(r-o)	
GSF(o)	
ET(r-i)	
GSF(i)	
MLF	0.45
R(upv)	Bv(wet)
R(es)	MLF
IFF(r-adj)	2122010
IFV(r-adj)	1433800
CPF(r)	0.38
IRF(r-c)	54
IRF(r-a)	221
IRV(r-c)	45
IRV(r-a)	148
EV(r-c)	3
EV(r-a)	2
F	0.4
I(f)	0.56
I(r)	5.48
K	1.2
Lambda HL	0.000065
P	285
T	3
t(a-event)	2.5
t(b)	12000
t(c-event)	1.2
t(v)	75
t(w)	18
Y(v)	5
IRF(a)	65
CF(fish)	1

	Ingestion of Tapwater	Inhalation	Immersion	Fruits & Veg.	Total
Am-241	2.00E-03		2.00E-03	#DIV/0!	1.00E+00
	0.00E+00		0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!
Co-60	2.00E-03		2.00E-03	#DIV/0!	1.00E+00
	0.00E+00		0.00E+00	#DIV/0!	#DIV/0!
	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!
H-3	2.00E-03	2.00E-03		#DIV/0!	1.00E+00
	#REF!	#REF!		#REF!	#REF!
	#REF!	#REF!		#DIV/0!	#REF!
Pu-238	2.00E-03		2.00E-03	#DIV/0!	1.00E+00
	#REF!		#REF!	#REF!	#REF!
	#REF!		#REF!	#DIV/0!	#REF!

	Irr(rup)	Irr(res)	Irr(dep)
Am-241	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
Co-60	0.00E+00	0.00E+00	0.00E+00
	0.00E+00	0.00E+00	0.00E+00
	#DIV/0!	#DIV/0!	#DIV/0!
H-3	#REF!	#REF!	0.00E+00
	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!
Pu-238	#REF!	#REF!	0.00E+00
	#REF!	#REF!	#REF!
	#REF!	#REF!	#REF!

	Fish
Am-241	2.00E-03
	0.00E+00
	#DIV/0!
Co-60	2.00E-03
	0.00E+00
	#DIV/0!
H-3	2.00E-03
	0.00E+00
	#DIV/0!
Pu-238	2.00E-03
	0.00E+00
	#DIV/0!

		Calculated	PRG	% Differ.			Calculated	PRG	% Differ.
Am-241	Ingestion	5.17E+02	5.17E+02	0.0%	H-3	Ingestion	1.06E+06	1.06E+06	0.0%
	Inhalation					Inhalation	7.18E+03	7.18E+03	0.0%
	Immersion	2.58E+09	2.58E+09	0.0%		Immersion			
	Lambda i	4.39E-06	4.39E-06	0.0%		Lambda i	1.54E-04	1.54E-04	0.0%
	Lambda B	6.94E-05	6.94E-05	0.0%		Lambda B	2.19E-04	2.19E-04	0.0%
	Lambda E	3.85E-02	3.85E-02	0.0%		Lambda E	3.83E-02	3.85E-02	-0.5%
	Irr(rup)	1.20E-03	1.20E-03	0.0%		Irr(rup)	1.56E+02	1.56E+02	0.0%
	Irr(res)	2.82E+01	2.82E+01	0.0%		Irr(res)	1.46E+01	1.47E+01	-0.7%
	Irr(dep)	1.81E+01	1.81E+01	0.0%		Irr(dep)	1.81E+01	1.81E+01	0.0%
	F & V	2.39E+02	2.39E+02	0.0%		F & V	1.20E+05	1.20E+05	0.0%
	Total	1.63E+02	1.63E+02	0.0%		Total	6.73E+03	6.73E+03	0.0%
Co-60	Ingestion	3.41E+03	3.41E+03	0.0%	Pu-238	Ingestion	4.11E+02	4.11E+02	0.0%
	Inhalation					Inhalation			
	Immersion	1.40E+07	1.40E+07	0.0%		Immersion	5.72E+11	5.72E+11	0.0%
	Lambda i	3.60E-04	3.61E-04	-0.3%		Lambda i	2.16E-05	2.17E-05	-0.5%
	Lambda B	4.25E-04	4.26E-04	-0.2%		Lambda B	8.66E-05	8.67E-05	-0.1%
	Lambda E	3.81E-02	3.85E-02	-1.0%		Lambda E	3.85E-02	3.85E-02	0.0%
	Irr(rup)	1.33E-01	1.33E-01	0.0%		Irr(rup)	4.75E-04	4.75E-04	0.0%
	Irr(res)	8.09E+00	8.08E+00	0.1%		Irr(res)	2.58E+01	2.58E+01	0.0%
	Irr(dep)	1.82E+01	1.81E+01	0.6%		Irr(dep)	1.81E+01	1.81E+01	0.0%
	F & V	2.51E+03	2.53E+03	-0.8%		F & V	2.00E+02	2.00E+02	0.0%
	Total	1.45E+03	1.45E+03	0.0%		Total	1.34E+02	1.34E+02	0.0%

		Calculated	PRG	% Differ.
Am-241	Fish	2.15E+01	2.15E+01	0.0%
Co-60	Fish	1.29E+02	1.29E+02	0.0%
H-3	Fish	2.00E+04	2.00E+04	0.0%
Pu-238	Fish	1.70E+01	1.70E+01	0.0%

	Type	Halflife (y)	λ	1-exp(-λt(r))	SF(w)	SF(i)	SF(imm)	Bv(wet)	Halflife (d)	λ(i)	λ(B)	-exp(-λ(B)t(b	λ(E)	-exp(-λ(E)t(v	SF(f)
Am-241	M	4.32E+02	1.60E-03	7.56E-02	#REF!	#REF!	1.01E-10	1.91E-05	1.58E+05	-4.39E-06	6.94E-05	5.65E-01	3.85E-02	9.44E-01	#REF!
Co-60	M	5.27E+00	1.31E-01	9.98E-01	#REF!	#REF!	1.95E-14	7.40E-03	1.92E+03	-3.60E-04	4.25E-04	9.94E-01	3.81E-02	9.43E-01	#REF!
H-3	M	1.23E+01	5.63E-02	9.37E-01	#REF!	#REF!	8.47E-13	4.80E+00	4.49E+03	-1.54E-04	2.19E-04	9.28E-01	3.83E-02	9.44E-01	#REF!
H-3	V	1.23E+01	5.63E-02	9.37E-01	#REF!	#REF!	1.99E-13	4.80E+00	4.49E+03	-1.54E-04	2.19E-04	9.28E-01	3.83E-02	9.44E-01	#REF!
Pu-238	M	8.77E+01	7.90E-03	3.21E-01	#REF!	#REF!	5.62E-14	8.27E-06	3.20E+04	-2.16E-05	8.66E-05	6.46E-01	3.85E-02	9.44E-01	#REF!

External Exposure								
	Type	Ground Plane	Soil Volume	1cm	5cm	15cm	SF(imm)	SF(sub)
Am-241	M	1.87E-08	2.77E-08	1.38E-08	2.58E-08	2.77E-08	1.32E-13	5.81E-11
Co-60	M	2.19E-06	1.24E-05	2.26E-06	6.49E-06	1.04E-05	2.44E-11	1.13E-08
H-3	V	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	M	3.68E-10	6.92E-11	4.81E-11	6.30E-11	6.87E-11	5.96E-16	2.56E-13

Ingestion					
	Type	SF(w)	SF(f)	SF(s)	Soil Worker
Am-241	M	1.04E-10	1.34E-10	1.84E-10	9.10E-11
Co-60	M	1.58E-11	2.23E-11	3.81E-11	7.33E-12
H-3	V	5.07E-14	6.51E-14	8.99E-14	4.51E-14
H-3	M	1.12E-13	1.44E-13	0.00E+00	0.00E+00
Pu-238	M	1.31E-10	1.69E-10	2.25E-10	1.17E-10

Inhalation		
	Form	SF(i)
Am-241	F	3.77E-08
Am-241	M	2.81E-08
Am-241	S	3.54E-08
Co-60	F	1.71E-11
Co-60	M	3.59E-11
Co-60	S	1.01E-10
H-3	F	1.95E-14
H-3	M	1.99E-13
H-3	S	8.47E-13
H-3	V	5.62E-14
H-3	G(elemental)	5.62E-18
H-3	G(organic)	1.28E-13
Pu-238	F	5.22E-08
Pu-238	M	3.36E-08
Pu-238	S	3.55E-08

Ground Plane, Area Correction Factor																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	8.40E-02	1.50E-01	2.70E-01	3.90E-01	5.10E-01	6.50E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.30E-01	9.50E-01	9.80E-01	9.90E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	2.80E-02	5.20E-02	9.80E-02	1.50E-01	2.10E-01	2.90E-01	3.70E-01	4.40E-01	5.40E-01	5.90E-01	6.60E-01	7.40E-01	8.10E-01	8.70E-01	9.10E-01	9.70E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.00E-01	1.80E-01	3.30E-01	4.70E-01	6.10E-01	7.80E-01	8.70E-01	9.40E-01	9.90E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Soil Volume																	
	1m^2	2m^2	5m^2	10m^2	20m^2	50m^2	100m^2	200m^2	500m^2	1000m^2	2000m^2	5000m^2	10000m^2	20000m^2	50000m^2	100000m^2	Infinite
Am-241	1.00E-01	1.90E-01	3.20E-01	4.80E-01	5.50E-01	6.60E-01	6.90E-01	7.50E-01	7.40E-01	8.20E-01	8.70E-01	9.10E-01	1.10E+00	9.50E-01	9.90E-01	1.00E+00	1.00E+00
Co-60	9.80E-02	1.80E-01	3.30E-01	4.90E-01	5.90E-01	7.00E-01	7.40E-01	7.60E-01	7.10E-01	9.30E-01	8.50E-01	8.80E-01	9.20E-01	9.40E-01	1.00E+00	9.50E-01	1.00E+00
H-3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Pu-238	1.80E-01	2.80E-01	5.90E-01	8.20E-01	8.60E-01	9.80E-01	1.00E+00	9.40E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	1.10E+00	1.10E+00	9.90E-01	1.00E+00	1.00E+00

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Position: Principal Technical Advisor

Education/Qualification:

- Bachelors of Science, 1977: Villanova University, Mechanical Engineering
- Masters of Science, 1988: Georgia Institute of Technology, Health Physics

Relevant Experience:

Tim Jannik is a Principal Technical Advisor at the Savannah River National Laboratory (SRNL). He has over 35 years of experience in the nuclear industry, 26 of which have been at the Savannah River Site. Mr. Jannik is the technical lead of the Environmental Dosimetry Group at SRNL and he specializes in 1) environmental dosimetry and radioecology, 2) effluent monitoring and environmental surveillance, and 3) human health risk analyses.

Employment and Professional History:

1995 to present, ***Savannah River National Laboratory***
Savannah River Nuclear Solutions/WSRC

Principal Technical Advisor

- Technical Lead of the SRNL Environmental Dosimetry Group
- Savannah River Site (SRS) subject matter expert for human health risk and environmental dose assessments
- Technical Advisor for the Environmental Monitoring Section

1989-1995, ***Westinghouse Savannah River Company***

Principal Engineer/Scientist

- Subject matter expert for Environmental Monitoring (1991-1995)
- Effluent Monitoring System Engineer for Reactors (1990-1991)
- Start-up Engineer for Defense Waste Processing Facility (1989-1990)

1977-1989, **Project/Construction Engineer**

- Georgia Power Company (Plant Vogtle) (1984-1989)
- Newburg/Marble Hill (1983-1984)
- Bechtel Power Corporation (1982-1983)
- Tennessee Valley Authority (1979-1982)

- Martin Marietta Corporation (1978-1979)
- Rutgers University (Research Assistant) (1977-1978)

Technical Accomplishments:

60+ Technical Reports, Publications, and Presentations
Peer Reviewer for Health Physics Journal

Professional Affiliations:

Health Physics Society (HPS), Member since 1992

Awards and Honors:

Pi Tau Sigma (Mechanical Engineering Honor Society)
1998 Westinghouse Savannah River Company Vice-President's Award
2003 and 2004 Savannah River National Laboratory Directors Award

Other:

Active DOE 'Q' Clearance

Selected Publications:

1. E.B. Farfan and **G.T. Jannik,** (editors), *Radiation Monitoring and Radioecology Research in the Chernobyl Exclusion Zone – 25 Years After the Accident,* Special Issue of the Health Physics Journal, ISSN 0017-9078, Vol. 101, No. 4, October 2011.
2. **G.T. Jannik**, M.H. Paller, and P.D. Fledderman, *Effective Dosimetric Half-Life of Cs-137 Soil Contamination,* Published in the Proceedings of the 2008 ANS Annual Meeting, 2008.
3. M.H. Paller, **G.T. Jannik**, and P.D. Fledderman *Changes in Cs-137 Concentrations in Soil and Vegetation on the Floodplain of the Savannah River Over a 30 Year Period,* Journal of Environmental Radioactivity, ISSN 0265-931X, Vol. 99. No. 8, pp 1302-1310, 2008.
4. P.D. Fledderman, **G.T. Jannik**, and M.H. Paller, *An Overview of Cs-137 Contamination in a Southeastern Swamp Environment,* Operational Health Physics-The Radiation Safety Journal, Vol. 93, Sup. 3, 2007.
5. M.H. Paller, **G.T. Jannik**, and L.D. Wike, *Concentration Ratios for Small Mammals Collected from the Exposed Sediments of a Cs-137 Contaminated Reservoir,* Journal of Environmental Radioactivity, ISSN 0265-931X, Vol. 90. No. 3, pp 224-235, 2006.
6. **G.T. Jannik**, P.L. Lee, T.O. Oliver, J.L. Roach, Jr., and A.A. Simpkins. *Risk-Based Radionuclide Derived Concentration Guideline Levels for an Industrial Worker Exposed to Concrete-Slab End States at the Savannah River Site."* Proceedings of the 2005 ANS Topical Meeting on Decommissioning, Decontamination, and Reutilization. "The Transition to Closure and Legacy Management." ANS Order No. 700315, ISBN 0-89448-689-6, La Grange Park, IL, August, 2005.

7. **G.T. Jannik** and P.D. Fledderman, *Risk-Based Radioactive Liquid Effluent Monitoring Requirements at the U.S. Department of Energy's Savannah River Site,* Operational Health Physics-The Radiation Safety Journal, Vol. 82, Supplement 1, February 2002.
8. **G.T. Jannik**, *Critical Radionuclide/Critical Pathway Analysis for the U.S. Department of Energy's Savannah River Site,* Risk Analysis-An International Journal, Vol. 19, No. 3, 1999.
9. W.H. Carlton, C.E. Murphy, **G.T. Jannik**, and A.A. Simpkins *Radiostrontium in the Savannah River Site Environment,* Health Physics-The Radiation Safety Journal, Vol. 77, Number 6, December 1999.

Conflict of Interest Certification

Verification Study: U.S. Environmental Protection Agency (EPA), "Preliminary Remediation Goals (PRG) for Radionuclides Electronic Calculator"

A conflict of interest or lack of impartiality exists when the proposed reviewer personally (or the reviewer's immediate family), or his or her employer, has financial interests that may be affected by the results of verification study; or may provide an verification study may be impaired due to other factors. When the Reviewer knows that a reasonable person with knowledge of the facts may question the reviewer's impartiality or financial involvement, an apparent lack of impartiality or conflict of interest exists.

The following questions, if answered affirmatively, represent potential or apparent lack of impartiality (*any affirmative answers should be explained on the back of this form or in an attachment*):

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- Have you served on previous advisory panels, committees, or subcommittees that have addressed the topic under consideration? ☒ No ☐ Yes
- Have you made any public statements (written or oral) on the issue? ☒ No ☐ Yes
- Have you made any public statements that would indicate to an observer that you have taken a position on the issue under consideration? ☒ No ☐ Yes
- Do you, your family, or your employer have any financial interest(s) in the matter or topic under review, or could someone with access to relevant facts reasonably conclude that you (or your family or employer) stand to benefit from a particular outcome of this verification study? ☒ No ☐ Yes

With regard to real or apparent conflicts of interest or questions of impartiality, the following provisions shall apply for the duration of this verification study:

(a) Reviewer warrants, to the best of his/her knowledge and belief, that there are no relevant facts or circumstances that could give rise to an actual, apparent, or potential organizational or personal conflict of interest, or that Reviewer has disclosed all such relevant information to EMS or to EPA.

(b) Reviewer agrees that if an actual, apparent, or potential personal or organizational conflict of interest is identified during performance of this verification study, he/she immediately will make a full disclosure in writing to EMS. This disclosure shall include a description of actions that Reviewer (or his/her employer) has taken or proposes to take after consultation with EMS to avoid, mitigate, or neutralize the actual, apparent, or potential organizational conflict of interest. Reviewer shall continue performance until notified by EMS of any contrary action to be taken.

[signature] 6/2/15

Signature Date

☐ Check here if any explanation is attached

G.T. JANNIK

Printed Name

SRNL

Affiliation/Organization

Wm. Thomas Pentecost
Colorado Department of Public Health and Environment (Retired)

Independent Verification Study

EPA, “Preliminary Remediation Goals for Radionuclides” (PRG) electronic calculator

29 September 2015

This study was conducted to perform an independent evaluation of the PRG calculator to ascertain if the calculator is operating according to its intended design and to verify that the results obtained compare favorably with those obtained using similar or identical mathematical frameworks. The study examined model inputs, the equations used in calculating the PRGs, and the performance of the model. Time limitations for this study prevented an exhaustive evaluation of every equation, input parameter, and modeling assumption. The findings of study are provided and grouped into the following areas: Inputs; Equations and Calculations; Model Inconsistencies; and Conclusions

Inputs

Many of the key default input parameters for establishing the various exposure scenarios (for example: the soil ingestion rate for a resident child; the adult respiration rate for a site worker; the exposure duration for a resident farmer; etc.) are consistent with the “conservative” modeling assumptions typically used by federal and state agencies when setting site specific clean-up standards for residual radioactive material contamination.

Some input parameters have a control placed upon the absolute range of possible inputs that the user can enter under user specified conditions. For example: See the input parameter $EF_{far\text{-}a}$ (exposure frequency – farmer adult) under the Resident Farmer exposure scenario when modeling exposures from the inhalation of airborne radioactive materials. The default value for this parameter is 350 days/year. If the modeler were to enter an inappropriate value such as 385 days/year the model provides an error message stating, “ Days per year cannot exceed 365 nor be less than 0. Please reenter.” Clicking on the error message box resets the parameter to the default value. The model user is then free to use the default value or enter an appropriate site specific value.

Other input parameters do not have similar controls placed on the range of input values. For example: See the input parameter $IRA_{far\text{-}a}$ (inhalation rate – farmer adult) under the Resident Farmer exposure scenario when modeling exposures from the inhalation of airborne radioactive materials. The default value for the adult farmer's inhalation rate is 20 m^3/day. If the modeler were to enter an inappropriate value (either by typographical error or by design) such as an inhalation rate of 48 m^3/day or 2 m^3/day, the model provides no error message. The model then calculates corresponding PRGs based upon the nonsensical inputs.

Examples of input parameters without "input controls / limits" can be found throughout the various exposure scenarios, and include many parameters that can have a substantial impact upon the resulting PRGs. The following are a few examples of input parameters without input controls/limits:

$ED_{res\text{-}a}$ (exposure duration - resident adult) years

$IRS_{res\text{-}c}$ (soil intake rate - resident child) mg/day

ED_w (exposure duration - composite worker) yr

IRA_w (inhalation rate - composite worker) m^3/day

U_m (mean annual wind speed) m/s

I_r (irrigation rate) L/m^2-day

$Q_{p\text{-}dairy}$ (dairy fodder intake rate) kg/day

$f_{p\text{-}poultry}$ (animal on-site fraction) unitless

Equations and Calculations

Several of the PRG calculations performed by the model were verified by independently calculating the PRG using the equations provided in the PRG Guide and default input values. In each case, the results of the independent calculations when rounded to the same number of significant figures were identical to the PRG model results.

Numerous model runs were made within exposure scenarios for Resident, Composite Worker, Outdoor Worker, Indoor Worker, and Farmer. A "baseline PRG" calculation for each scenario using all default values for inputs was first obtained. The model was then repeatedly used use to generate a new set of

PRGs by varying a single exposure parameter within that scenario (such as soil intake rate, exposure duration, inhalation rate, etc.) and the results compared to the "baseline PRG". The model consistently produced a result that accurately reflected the change in the individual exposure parameter.

Model Inconsistencies

The model presents two separate lines of input for the some radionuclides. It is completely unclear why there are two lines for some and not others. It is also unclear how the model is using the two lines of input values.

Example PRG Calculator run:
PRG Calculator: Resident Scenario, exposure media Soil, user provided isotope information,
No risk output, units in pCi, Isotopes selected I-129 and I 131, retrieve;

The model produces a table with two rows of input data for both I-129 and I-131. Many of the slope factors are missing in one of the lines for each of the two isotopes.

Under this scenario, the model requires the user to select a value for Slab Area and Cover Thickness. Enter 100,000 m^2 for slab area and 0 cm for cover thickness. All other default values are used. Retrieve.

The model produces a table of Resident PRGs for Soil listing two lines of model results for each of the two radionuclides. Different results are provided for the same radionuclide (a blank or a value) in the columns pertaining to Area Correction Factor, Gamma Shielding Factor, and External Exposure PRG. The Total PRG values are identical in the two rows for I-129 but different in the two rows for I-131.

Double line entries have been noted for other radionuclides including: H-3, I-123, I-121, I-123, I-124, I-125, I-126, I-128, I-130, Ni-56, Ni-57, Ni-59, Ni-63, Ni-65, Ni-66, S-35, S-38, Te-133, Te-133m, and Te-134.

Conculsion

In Section 2.2.1 of the PRG User's Guide a lengthy discussion is provided about the selection of individual isotopes and isotopes that are listed with a '+D' designation. The section also makes reference to a table of the 100 year progeny ingrowth for the isotopes used in the slope factors. An individual attempting to use the PRG Calculator does not have a ready reference when selecting an isotope with a '+D' designation to see precisely which of the decay products is being including in the calculations when making that selection.

It is recommended that the model identify the decay products that are included in the analysis (and assumed to be in secular equilibrium) whenever an isotope with a '+D' designation is selected. This could be in a separate box to the right of the box for "selected" individual Isotopes on the input screen. It is absolutely critical to get the proper radionuclide mix into the PRG Calculator.

Potential users of the PRG calculator will likely include State or Federal Regulators; Site managers; concerned citizens; and possibly persons seeking to disrupt the cleanup process. Each has a limited skill set with regards to the use this type of modeling tool. Constraints need to be placed upon all input parameters that can be modified by an individual user such as the 0 to 365 day range constraints for $EF_{far\text{-}a}$ (exposure frequency – farmer adult) as discussed above. At a minimum, the constraints must limit the range of inputs to the range of possible values. However, I recommend more restrictive constraints for some key input parameters. A good deal of thought and effort went into the selection of the default inputs values to make the PRG results conservative in nature. Appropriate constraints would allow flexibility in the modeling while preserving the conservative nature of the PRG results. For example: a range limit on the child soil ingestion rate could be set at +/- 20% of the default value of 200 mg/day. When such constraints are imposed, the PRG User's Guide should have a more in depth discussion of the default value as is provided regarding child soil ingestion in Section 4.1.1 Resident Soil.

For any given exposure scenario some input parameters will have a larger impact upon the calculated PRGs than other parameters. It would be extremely valuable to have a means of performing a sensitivity analysis on various input parameters. Knowing which parameters for a given exposure scenario were having the largest impact on the calculations of the PRGs would allow the modeler to focus efforts to ensure the accuracy of the site specific input values for those parameters.

Section 4.10.6 of the PRG User's Guide pertains to a gamma shielding factor. This section is particularly well written. It provides essential information pertaining to the parameter and its use in the modeling. It also provides two specific default gamma shielding factors for indoor exposure (GSFi is established at 0.4 (60% shielding) and for exposure to ionizing radiation in air (GSFa is established at 1 (0% shielding).

It is recommended that additional informative sections be added to the PRG User's Guide to describe, in similar detail, many of the more critical default input parameters and the basis for the selection of default input values.

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I am currently a retired Health Physicist and am available to provide technical assistance for short term projects.

Employment History:

1976 - 1982 U.S. Air Force, Nuclear Weapons Mechanic, E5, Honorably Discharged

1982 - 1989 United Postal Service, worked the midnight shift on the loading dock sorting packages to support my family while attending Indiana University.

1989 - 2008 Colorado Department of Public Health and Environment: Health Physicist (EPS III)

- Performed technical analysis of potential radiation hazards, worker training, and health physics operating procedures to determine the adequacy of license applications for industrial and medical uses of radioactive materials.
- Inspected licensed facilities to determine compliance with State regulations and license conditions.
- Investigated occurrences of lost and/or found radioactive sources. Preformed contamination surveys, and evaluated the adequacy of facility shielding.
- Prepared written correspondence, license documents, inspections reports and other significant documentation for the Department of Health.
- Developed emergency response plans and procedures for the Colorado Department of Health and participated in numerous emergency drills and exercises at the Stata EOC pertaining to potential releases from Rocky Flats.
- Performed RESRAD modeling to evaluate proposed residual contamination levels associated with the decommissioning of licensed facilities using unsealed radioactive materials and for Rock Flats.
- Performed extensive modeling and sensitivity analysis on input parameters for use of the RESRAD modeling code. Participated in a multi-agency (DOE, EPA, State Health and Rocky Flats) assessment of potential doses to members of the public for various decommissioning scenarios at Rocky Flats.

Training and Education:

Indiana University: Bachelors in Mathematics

Oak Ridge Associated University: Courses in Applied Health Physics, Medical Use of Radioactive Materials, Health Physics Engineering, and Handling of Radiation Accidents.

Argonne National Laboratories: Multiple workshops pertaining to RESRAD and RESRAD-Build

U.S. Nuclear Regulatory: Numerous courses pertaining to the licensure, inspection and decommissioning of facilities using radioactive materials.

Conflict of Interest Certification

Verfication Study: U.S. Environmental Protection Agency (EPA), "Preliminary Remediation Goals (PRG) for Radionuclides Electronic Calculator"

A conflict of interest or lack of impartiality exists when the proposed reviewer personally (or the reviewer's immediate family), or his or her employer, has financial interests that may be affected by the results of verification study; or may provide an verification study may be impaired due to other factors. When the Reviewer knows that a reasonable person with knowledge of the facts may question the reviewer's impartiality or financial involvement, an apparent lack of impartiality or conflict of interest exists.

The following questions, if answered affirmatively, represent potential or apparent lack of impartiality (*any affirmative answers should be explained on the back of this form or in an attachment*):

- Did you contribute to the development of the document under review, or were you consulted during its development, or did you offer comments or suggestions to any drafts or versions of the document during its development? ☒ No ☐ Yes
- Do you know of any reason that you might be unable to provide impartial advice on the matter under consideration in this verification study, or any reason that your impartiality in the matter might be questioned? ☒ No ☐ Yes
- Have you had any previous involvement with the review document(s) under consideration? ☒ No ☐ Yes
- Have you served on previous advisory panels, committees, or subcommittees that have addressed the topic under consideration? ☒ No ☐ Yes
- Have you made any public statements (written or oral) on the issue? ☒ No ☐ Yes
- Have you made any public statements that would indicate to an observer that you have taken a position on the issue under consideration? ☒ No ☐ Yes
- Do you, your family, or your employer have any financial interest(s) in the matter or topic under review, or could someone with access to relevant facts reasonably conclude that you (or your family or employer) stand to benefit from a particular outcome of this verification study? ☒ No ☐ Yes

With regard to real or apparent conflicts of interest or questions of impartiality, the following provisions shall apply for the duration of this verification study:

(a) Reviewer warrants, to the best of his/her knowledge and belief, that there are no relevant facts or circumstances that could give rise to an actual, apparent, or potential organizational or personal conflict of interest, or that Reviewer has disclosed all such relevant information to EMS or to EPA.

(b) Reviewer agrees that if an actual, apparent, or potential personal or organizational conflict of interest is identified during performance of this verification study, he/she immediately will make a full disclosure in writing to EMS. This disclosure shall include a description of actions that Reviewer (or his/her employer) has taken or proposes to take after consultation with EMS to avoid, mitigate, or neutralize the actual, apparent, or potential organizational conflict of interest. Reviewer shall continue performance until notified by EMS of any contrary action to be taken.

Wm Thomas Pentecost 31 July 2015

Signature Date

☐ Check here if any explanation is attached

Wm Thomas Pentecost

Printed Name

Retired Health Physist

Affiliation/Organization