

Appendix E

RESRAD

Input Parameter Summary Table

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Scenario Res. Gardener Industrial Worker					
Applicable Pathways					
	External Gamma		X	X	
	Inhalation		X	X	
	Plant Ingestion		X		
	Meat Ingestion				
	Milk Ingestion				
	Aquatic Foods				
	Drinking Water				
	Soil Ingestion		X	X	
	Radon				
RESRAD Menu	Parameter	Default	Residential Gardener (Blairsville Resident Gardener.RAD)	Industrial Worker (Blairsville Industrial Worker.RAD)	Parameter Justification (R# = See footnote for reference number)
Contaminated Zone	Area of contaminated zone (m ²)	10,000	12,100	12,100	R7, Figure 1
	Thickness of contaminated zone (meters)	2.00	0.1524	0.1524	Approximate average thickness = 6 inches = 0.1524 meters.
	Length parallel to aquifer flow (m)	100	110	not used	The square root of the contaminated zone area was used.
Soil Concentrations	Basic radiation dose limit (mrem/yr)	25	25	25	NRC guideline of 25 mrem/yr
	Time since placement of material (yr)	0	0	0	R3 explains that when radiological surveys are used to derive soil guideline information such as soil/water distribution coefficients, soil radionuclide concentrations and so forth, the elapsed time of waste placement is considered zero.
Calculation Times	Times for calculations (yr)	1	1	1	Default
	Times for calculations (yr)	3	3	3	Default
	Times for calculations (yr)	10	10	10	Default
	Times for calculations (yr)	30	30	30	Default
	Times for calculations (yr)	100	100	100	Default
	Times for calculations (yr)	300	300	300	Default
	Times for calculations (yr)	1,000	1,000	1,000	Default
Soil Concentrations	Initial principal radionuclides (pCi/g): U-234	0.00	0.75	0.75	See "Contaminant Concentration" section in text of this report. The radionuclide distribution is characteristic of a 3% U-235 enrichment. A 3% enrichment was assumed based upon isotopic analyses performed on FZBA soil samples collected during the final status survey as summarized in the R7.
	Initial principal radionuclides (pCi/g): U-235	0.00	0.04	0.04	See "Contaminant Concentration" section in text of this report. The radionuclide distribution is characteristic of a 3% U-235 enrichment. A 3% enrichment was assumed based upon isotopic analyses performed on FZBA soil samples collected during the final status survey as summarized in the R7.
	Initial principal radionuclides (pCi/g): U-238	0.00	0.21	0.21	See "Contaminant Concentration" section in text of this report. The radionuclide distribution is characteristic of a 3% U-235 enrichment. A 3% enrichment was assumed based upon isotopic analyses performed on FZBA soil samples collected during the final status survey as summarized in the R7.
Cover/Hydrology	Cover depth (m)	0.00	0.3048	0.3048	Approximate thickness = 1 foot = 0.3048 m.
	Density of cover material (g/cm ³)	1.50	1.44	1.44	The value of 1.44 was selected from Table 2.1 of R3 for a sandy loam based on soil descriptions contained in R6, Figures 3, and 8.
	Cover erosion rate (m/yr)	0.001	0.001	0.001	Default

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	Density of contaminated zone (g/cm ³)	1.50	1.44	1.44	The value of 1.44 was selected from Table 2.1 of R3 for a sandy loam based on soil descriptions contained in R6, Figures 3, and 8.
	Contaminated zone erosion rate (m/yr)	0.001	0.001	0.001	Default
	Contaminated zone total porosity	0.40	0.40	0.40	Default
	Contaminated zone field capacity	0.20	0.20	0.20	Default
	Contaminated zone hydraulic conductivity (m/yr)	10	10	10	Default
	Contaminated zone b parameter	5.3	5.3	5.3	Default
	Average annual wind speed (m/sec)	2	2	2	Default
	Humidity in air (g/cm ³)	8	not used	not used	NA - This parameter is only used when Tritium (H-3) is a principal radionuclide.
	Evapotranspiration coefficient	0.50	0.50	0.50	Default
	Precipitation (m/yr)	1.00	1.016	1.016	NOAA precipitation rates for PA = 40 in/yr = 1.016 m/yr,
	Irrigation (m/yr)	0.20	0.20	0.20	Default
	Irrigation mode	overhead	overhead	overhead	Default
	Runoff coefficient	0.20	0.20	0.20	Default
	Watershed area for nearby stream or pond (m ²)	1,000,000	119,000	not used	The value of 119,000 m ² was determined from topographic maps of the facility.
	Accuracy for water/soil computations	0.001	0.001	not used	Default
Saturated Zone	Density of saturated zone (g/cm ³)	1.50	2.40	not used	The value of 2.4 was selected from Table 2.1 of R3. The majority of the SZ is bedrock.
	Saturated zone total porosity	0.40	0.40	not used	Default
	Saturated zone effective porosity	0.20	0.20	not used	Default
	Saturated zone field capacity	0.20	0.20	not used	Default
	Saturated zone hydraulic conductivity (m/yr)	100	100	not used	Default
	Saturated zone hydraulic gradient	0.02	0.02	not used	Default
	Saturated zone b parameter	5.3	5.3	not used	Default
	Water table drop rate (m/yr)	0.001	0.001	not used	Default
	Well pump intake depth (m below water table)	10	10	not used	Default. This also approximates the depth to groundwater per R6.
	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	not used	Non-dispersion option was selected since area > 1,000 m ² .
	Well pumping rate (m ³ /yr)	250	19,900	not used	According to R6, the unconsolidated deposits underlying the site may be capable of groundwater yields up to 10 gpm. This is approximately 19,900 m ³ /year.
Unsaturated Zone	Number of unsaturated zone strata	1	1	not used	There is one unsaturated zone.
	Unsat. zone 1, thickness (m)	4.00	2.59	not used	A thickness of 8.5 feet x .305 m/ft = 2.59 meters was determined by assuming an approximate ground surface elevation of 995, an approximate groundwater surface elevation of 985, a cover thickness of 1 foot, and contaminated zone thickness of 0.5 feet. Refer to R6 Figures 3, 8, and 10
	Unsat. zone 1, soil density (g/cm ³)	1.50	1.44	not used	The value of 1.44 was selected from Table 2.1 of R3 for a sandy loam based on soil descriptions contained in R6, Figures 3, and 8.
	Unsat. zone 1, total porosity	0.40	0.40	not used	Default
	Unsat. zone 1, effective porosity	0.20	0.20	not used	Default
	Unsat. zone 1, field capacity	0.20	0.20	not used	Default
	Unsat. zone 1, soil-specific b parameter	5.30	5.30	not used	Default
	Unsat. zone 1, hydraulic conductivity (m/yr)	10	10	not used	Default
Soil Concentrations - Transport	Distribution coefficients for U-234				
	Contaminated zone (cm ³ /g)	50	50	50	Default
	Unsaturated zone (cm ³ /g)	50	50	50	Default
	Saturated zone (cm ³ /g)	50	50	50	Default

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	Leach rate (/yr)	0	0	0	Calculated by model
	Solubility constant	0	0	0	Supplied by model
	Distribution coefficients for U-235				
	Contaminated zone (cm ³ /g)	50	50	50	Default
	Unsaturated zone (cm ³ /g)	50	50	50	Default
	Saturated zone (cm ³ /g)	50	50	50	Default
	Leach rate (/yr)	0	0	0	Calculated by model
	Solubility constant	0	0	0	Supplied by model
	Distribution coefficients for U-238				
	Contaminated zone (cm ³ /g)	50	50	50	Default
	Unsaturated zone (cm ³ /g)	50	50	50	Default
	Saturated zone (cm ³ /g)	50	50	50	Default
	Leach rate (/yr)	0	0	0	Calculated by model
	Solubility constant	0	0	0	Supplied by model
Occupancy	Inhalation rate (m ³ /yr)	8,400	12,264	12,264	The value of 12,264 m ³ /yr (1.4 m ³ /hr) was taken from R5 Page 5-19 as a typical adult male breathing rate. This value is more conservative than the value suggested in R3 Section 43 for the reasonable worst-case inhalation rate where activity patterns are not known (11,000 m ³ /yr).
	Mass loading for inhalation (g/m ³)	0.0001	0.0001	0.0001	Default. A value of 0.0001 was obtained from R2 Table 6.23, outdoor air dust loading factor. This value is applicable when the inhalation pathway is turned on.
	Exposure duration (year)	30	30	30	USEPA standard default exposure factors for residential scenarios.
	Indoor Dust Filtration Factor (Shielding Factor, Inhalation)	0.4	0.5	0.5	The value of 0.5 is the ratio of the indoor air dust loading factor (5.0E-5) to the outdoor air dust loading factor (1.0E-4). See R2, Table 6.23.
	Shielding factor, external gamma	0.70	0.5512	0.5512	A value of 0.5512 was selected from R4 Table 2. This is more conservative than the value indicated in R2 (0.33) and the values in R5 Table 6.16 which are less than 0.5512 for most gamma energies and shielding material types.
	Fraction of time spent indoors (on site)	0.50	0.55	0.17	According to R2 Table 6.23 the resident farmer spends 200 days/yr inside. The fraction of time spent indoors is 200/365 = 0.55. This value was used for the resident gardener scenario. For the Industrial scenario, the indoor fraction was obtained from R1 Table 2.3.
	Fraction of time spent outdoors (on site)	0.25	0.21	0.06	According to R2 Table 6.23 the resident farmer spends 70.83 days/yr outside and another 4.17 days/yr gardening for a total of 75 days outside. The fraction of time spent outdoors is 75/365 = 0.21. This value was used for the resident gardener scenario. For the Industrial scenario, the outdoor fraction was obtained from R1 Table 2.3.
	Shape of Contaminated Zone	Circular	Circular	Circular	NA
Ingestion, Dietary	Fruits, vegetables and grain consumption (kg/yr)	160	160	not used	Default
	Leafy vegetable consumption (kg/yr)	14	14	not used	Default
	Milk consumption (L/yr)	92	not used	not used	NA
	Meat and poultry consumption (kg/yr)	63	not used	not used	NA

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	Fish consumption (kg/yr)	5.4	not used	not used	NA
	Other seafood consumption (kg/yr)	0.9	not used	not used	NA
	Soil ingestion rate (g/yr)	36.50	18.25	18.25	Mean of distribution From R5 Section 6.2.5.4
	Drinking water intake (L/yr)	510.00	not used	not used	NA
	Contamination fraction of drinking water	1	not used	not used	NA
	Contamination fraction of household water	1	not used	not used	NA
	Contamination fraction of livestock water	1	not used	not used	NA
	Contamination fraction of irrigation water	1	1	not used	Default, 100%, This is the most conservative value.
	Contamination fraction of aquatic food	0.5	not used	not used	NA
	Contamination fraction of plant food	-1	0.1	not used	R1 Table 2.3
	Contamination fraction of meat	-1	not used	not used	NA
	Contamination fraction of milk	-1	not used	not used	NA
Ingestion, Non-Dietary	Livestock fodder intake for meat (kg/day)	68	not used	not used	NA
	Livestock fodder intake for milk (kg/day)	55	not used	not used	NA
	Livestock water intake for meat (L/day)	50	not used	not used	NA
	Livestock water intake for milk (L/day)	160	not used	not used	NA
	Livestock soil intake (kg/day)	0.5	not used	not used	NA
	Mass loading for foliar deposition (g/m ²)	0.0001	0.0001	not used	Default. The value of 0.0001 was obtained from R2 Table 6.23, outdoor air dust loading factor.
	Depth of soil mixing layer (m)	0.15	0.15	0.15	Default. The value of 0.15 was obtained from R2 Table 6.23, thickness of surface-soil layer.
	Depth of roots (m)	0.9	0.9	not used	R3 Section 37 indicates that most of the plant roots from which nutrients are obtained usually extend to less than 1m below the surface. Therefore the RESRAD default value of 0.9 m was used.
	Drinking water fraction from ground water	1	not used	not used	NA
	Household water fraction from ground water	1	not used	not used	NA
	Livestock water fraction from ground water	1	not used	not used	NA
	Irrigation fraction from ground water	1	1	not used	Irrigation water (onsite) is assumed to originate as groundwater, therefore, this parameter is set to 1.0 in the residential scenarios. This is the maximum and most conservative value for this parameter.
Ingestion, Non-Dietary - Plant Factors	Wet weight crop yield for Non-Leafy (kg/m ²)	0.7	0.7	not used	Default
	Wet weight crop yield for Leafy (kg/m ²)	1.5	1.5	not used	Default
	Wet weight crop yield for Fodder (kg/m ²)	1.1	not used	not used	NA
	Growing Season for Non-Leafy (years)	0.17	0.17	not used	Default
	Growing Season for Leafy (years)	0.25	0.25	not used	Default
	Growing Season for Fodder (years)	0.08	not used	not used	NA
	Translocation Factor for Non-Leafy	0.1	0.1	not used	Default
	Translocation Factor for Leafy	1	1	not used	Default
	Translocation Factor for Fodder	1	not used	not used	NA
	Dry Foliar Interception Fraction for Non-Leafy	0.25	0.25	not used	Default
	Dry Foliar Interception Fraction for Leafy	0.25	0.25	not used	Default
	Dry Foliar Interception Fraction for Fodder	0.25	not used	not used	NA
	Wet Foliar Interception Fraction for Non-Leafy	0.25	0.25	not used	Default
	Wet Foliar Interception Fraction for Leafy	0.25	0.25	not used	Default
	Wet Foliar Interception Fraction for Fodder	0.25	not used	not used	NA
	Weathering Removal Constant for Vegetation	20	20	not used	Default

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Storage Times	Storage times of contaminated foodstuffs (days):				These parameters are affected by the consumption rates listed above. For example, if a consumption rate is set to zero the corresponding storage time is irrelevant.
	Fruits, non-leafy vegetables, and grain	14	14	not used	Default value and R2, Section 6.5.3, Table 6.11 & Table 6.23 holding time value for other vegetables or fruit or grain.
	Leafy vegetables	1	1	not used	Default value and R2, Section 6.5.3, Table 6.11 & Table 6.23 holding time value for leafy vegetables.
	Milk	1	not used	not used	NA
	Meat and poultry	20	not used	not used	NA
	Fish	7	not used	not used	NA
	Crustacea and mollusks	7	not used	not used	NA
	Well water	1	1	not used	Default
	Surface water	1	1	not used	Default
	Livestock fodder	45	not used	not used	NA
Radon	Thickness of building foundation (m)	0.15	not used	not used	NA
	Bulk density of building foundation (g/cm ³)	2.4	not used	not used	NA
	Total porosity of the cover material	0.4	not used	not used	NA
	Total porosity of the building foundation	0.1	not used	not used	NA
	Volumetric water content of the cover material	0.05	not used	not used	NA
	Volumetric water content of the foundation	0.03	not used	not used	NA
	Diffusion coefficient for radon gas (m/sec):		not used	not used	NA
	in cover material	2.E-06	not used	not used	NA
	in foundation material	3.E-07	not used	not used	NA
	in contaminated zone soil	2.E-06	not used	not used	NA
	Radon vertical dimension of mixing (m)	2	not used	not used	NA
	Average building air exchange rate (1/hr)	0.5	not used	not used	NA
	Height of the building (room) (m)	2.5	not used	not used	NA
	Building interior area factor	0	not used	not used	NA
	Building depth below ground surface (m)	-1	not used	not used	NA
	Emanating power of Rn-222 gas	0.25	not used	not used	NA
	Emanating power of Rn-220 gas	0.15	not used	not used	NA

R1 = User's Manual for RESRAD Version 6.0, July 2001

R2 = Residual Radioactive Contamination From Decommissioning, NUREG/CR-5512-Volume I, June 1994

R3 = Data Collection Handbook to Support Modeling Impacts of Radioactive Material In Soil, Argonne National Laboratory, April 1993

R4 = Preliminary Guidelines for Evaluating Dose Assessments in Support of Decommissioning, Handout, Nuclear Regulatory Commission Workshop, March 18 and 19, 1999.

R5 = Residual Radioactive Contamination From Decommissioning, NUREG/CR-5512-Volume 3, October 1999

R6 = Data Summary Report, Site Investigation, Specialty Metals Plant, Blairsville, PA, Project No. 93-132, Cummings Riter Consultants, Inc., May 1995

R7 = Draft Final Status Survey Report, Former Zircaloy Burn Area, Westinghouse Specialty Metals Plant, Blairsville, PA, B.Koh & Associates, Inc., December 15, 2001

NA = Not applicable to the current model because the pathway utilizing the parameter was turned off.