GPU NUCLEAR

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February 4, 2002
E910-02-005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Gentlemen,

Subject: Saxton Nuclear Experimental Corporation (SNEC)
Operating License No., DPR-4
Docket No. 50-146
Supplemental Response to RAI #2 Questions

Attached to this letter is GPU Nuclear's supplemental response to the NRC Request for Additional Information (RAI2), dated November 8, 2000, concerning the License Termination Plan (LTP) for the Saxton Nuclear Experimental Corporation (SNEC) facility. GPU Nuclear letter E910-01-012, dated June 20, 2001 provided responses to several of these questions. From this letter, question resolution and further action items were specified pertaining to RESRAD modeling, K_d development, use of buried debris/refill materials and river sediment characterization.

The purpose of this letter is to provide supplemental responses, based on recent empirical study, for the remaining questions (4-9).

If you have any questions, please contact Mr. James Byrne at (717) 948-8461.

Sincerely,

G. A. Kuehn Jr.
Program Director, SNEC Facility

Attachment

cc: NRC Project Manager
NRC Project Scientist, Region 1

A001

Response to SNEC RAI2
(Questions 4-9)

Note: Previous responses to Questions 1-3 & 10 are unchanged. Reference GPU Letter #E910-01-012 to NRC dated 6/29/01.

QUESTION 4:

Resident Farmer Assumptions and Justifications used to Demonstrate Compliance-
Please describe the assumptions and provide justifications for the parameters used in the RESRAD calculation of the site-specific DCGLs for contaminated soil. Specifically, provide justification for the parameters listed in the attached Table 1. Guidance on sources of information for providing acceptable justification for parameters used in dose assessments can be found in the "Draft Technical Basis Document to the Standard Review Plan for Decommissioning," which is located at http://www.nrc.gov/NMSS/DWM/DECOM/dosemodel.htm.

[LTP References: Appendix 6.1; Section 6.2.2; Haley & Aldrich Letter, March 31, 1999, appended to chapter 6.]

RESPONSE:

This response replaces our response to question 4 previously provided by GPU Nuclear Letter E910-01-012 dated June 20, 2001.

Two models have been developed covering surface and sub-surface open land areas for the Resident Farmer scenario. Both models were developed using the RESRAD Version 6.1 deterministic and probabilistic codes. GPU Nuclear developed the surface model while URS Corporation developed a sub-surface model, incorporating many of the same input parameters used in the surface model. Appendix 2 provides the URS report, which discusses the sub-surface model and calculation of the sub-surface DCGLs.

Table 1 provides input parameters used by GPU Nuclear to derive site-specific DCGLs. These parameters were used as input into the RESRAD 6.1 deterministic and probablistic codes for modeling dose from radioactivity in the surface unit at the SNEC facility. R016 parameters associated with distribution coefficients (K_d) have been developed through empirical testing by Argonne National Lab (ANL) on media samples obtained from the SNEC Facility. Results of these K_d analyses are listed in Table 3. Other supporting information and justification for Table input parameters are as follows:

> Section I provides the geology and hydrogeology information for the SNEC site. Section II provides a list of RESRAD input parameters and the classification and justification for each parameter. Section III provides a list of 22 input parameters (Table 3) that have the greatest influence in the dose calculation sensitivity analyses. The degree of sensitivity from each these input parameters could vary depending on the type of isotope selected. Therefore, the Table 3 list is not ranked by importance.

DCGL results were compared between the two models. Minimum value DCGLs were combined into a single list based on minimum dose limit and pathway criteria. Table 2 provides a list of these DCGL values. Also see GPU Nuclear's response to Question 8 of this RAI.

Table 1

RESRAD INPUTS

RESRAD INPUT VALUES FOR PROBALISTIC ANALYSIS						
Menu	Class	PARAMETERS	Basic RESRAD Input	Range of Values Evaluated Min.	Range of Values Evaluated Max.	Assigned Distribution
C14	P	**Thickness of Soil Evasion Layer of C-14 in Soil (m)**	0.3	0.2	0.6	Triangular
N/A	P	Contaminated Zone Effective Porosity	Not Used by RESRAD	N/A	N/A	N/A
RO11	P	Area of Contaminated Zone (m^2)	10000	N/A	N/A	Not Included in Probalistic Analysis
RO11	NRC	Basic Radiation Dose Limit (mrem/y) (NRC)	25	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Length Parallel to Aquifer Flow (m)	112.8	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	**Thickness of Contaminated Zone 1 (m)**	1	0.5	1.5	Uniform
RO11	P	Time Since Placement of Materials (yr)	0	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	1	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	3	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	10	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	30	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	150	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	350	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	1000	N/A	N/A	Not Included in Probalistic Analysis
RO11	P	Times for Calculations (yr)	10000	N/A	N/A	Not Included in Probalistic Analysis
RO13	P	Average Annual Wind Speed (m/sec)	4.07	3.13	4.83	Not Included in Probalistic Analysis
RO13	P	Contaiminated Zone Field Capacity	0.136	0.079	0.192	Not Included in Probalistic Analysis
RO13	P	Contaminated Zone b Parameter	5.6	4.07	7.12	Not Included in Probalistic Analysis
RO13	P	**Contaminated Zone Erosion Rate (m/yr)**	0.000345	0.00009	0.0006	Loguniform
RO13	P	**Contaminated Zone Hydraulic Conductivity (m/yr)**	32.3	0.362	25400	Loguniform
RO13	P	**Contaminated Zone Total Porosity**	0.46	0.35	0.56	Uniform
RO13	P	Cover Depth (m)	0	N/A	N/A	N/A
RO13	P, B	Cover Depth Erosion Rate (m/yr)	Not Used by RESRAD	N/A	N/A	N/A
RO13	P	**Density of Contaminated Zone (g/cc)**	1.6	1.28	1.92	Uniform
RO13	P	Density of Cover Material (g/cc)	Not Used	N/A	N/A	N/A
RO13	P	**Evapotranspiration Coefficient (m/yr)**	0.59	0.5	0.67	Uniform
RO13	P	**Humidity in Air (Default Value Used) (g/m^3)**	8	Default Value	Default Value	Truncated Lognormal-N
RO13	B	**Irrigation (m/yr) (Default Value Used)**	0.2	0.1	0.4	Uniform
RO13	B	Irrigation Mode (Overhead)	Overhead	N/A	N/A	N/A
RO13	P	**Precipitation (m/y)**	0.936	0.688	1.327	Uniform
RO13	P	**Runoff Coefficient**	0.35	0.3	0.4	Uniform
RO13	P	**Watershed Area for Nearby Stream or Pond (m^2)**	5.00E+06	2.500E+06	7.500E+06	Uniform
RO14	P	**Density of Saturated Zone (g/cc)**	1.6	1.28	1.92	Uniform
RO14	P	Model: Non-dispersion (ND) or Mass-Balance (MB)	Non-Dispersion	N/A	N/A	N/A
RO14	P	**Saturated Zone b Parameter**	Not Used by RESRAD	N/A	N/A	N/A
RO14	P	**Saturated Zone Effective Porosity**	0.028	0.005	0.05	Loguniform
RO14	P	**Saturated Zone Hydraulic Conductivity (m/yr)**	67.91	15.59	909.53	Uniform
RO14	P	**Saturated Zone Hydraulic Gradient**	0.02	0.013	0.03	Uniform
RO14	P	**Saturated Zone Total Porosity**	0.36	0.31	0.41	Uniform
RO14	P	Water Table Drop Rate (m/yr)	0	N/A	N/A	N/A
RO14	P	**Well Pump Intake Depth (m)**	30	10	50	Uniform
RO14	B, P	Well Pumping Rate (m^3/yr)	286.2	207.3	365	Not Included in Probalistic Analysis
RO14	P	Saturated Zone Field Capacity	0.136	0.079	0.192	Not Included in Probalistic Analysis
RO15	P	**Density of Unsaturated Zone 1 (g/cc)**	1.6	1.28	1.92	Uniform
RO15	P	**Effective Porosity of Unsaturated Zone 1**	0.41	0.28	0.54	Uniform
RO15	P	**Hydraulic Conductivity of Unsaturated Zone 1 (m/yr)**	32.3	0.362	25400	Loguniform
RO15	P	Number of Unsaturated Zone Strata	1	N/A	N/A	N/A

RO15	P	Thickness of Unsaturated Zone 1 (m)	0.25	0	0.5	Uniform
RO15	P	Total porosity of Unsaturated Zone 1	0.46	0.35	0.56	Uniform
RO15	P	Unsaturated Zone 1 b Parameter	5.6	4.05	7.12	Not Included in Probalistic Analysis
RO15	P	Unsaturated Zone Field Capacity	0.136	0.079	0.192	Not Included in Probalistic Analysis
RO17	P	External Gamma Shielding Factor	0.7	0.044	1	Bounded Lognormal-N
RO17	P	Indoor Dust Filtration Factor	0.4	0.15	0.95	Uniform
RO17	M, B	Indoor Time Fraction	0.5	0	1	Continuous Linear
RO17	M, B	Inhalation Rate (m^3/yr)	8400	4380	13100	Triangular
RO17	P	Mass Loading for Inhalation (g/m^3)	0.0001	0	0.0001	Continuous Linear
RO18	B, P	Contaminated Fraction of Aquatic Food	0.5	0	1	Triangular
RO18	B, P	Contaminated Fraction of Drinking Water	1	N/A	N/A	Not Included in Probalistic Analysis
RO18	B, P	Contaminated Fraction of Household Water	Not Used	N/A	N/A	N/A
RO18	B, P	Contaminated Fraction of Irrigation Water	0.75	0.5	1	Uniform
RO18	B, P	Contaminated Fraction of Livestock Water	0.75	0.5	1	Uniform
RO18	B, P	Contaminated Fraction of Plant Food	1	N/A	N/A	Not Included in Probalistic Analysis
RO18	B, P	Contaminated Fraction of Meat	1	N/A	N/A	Not Included in Probalistic Analysis
RO18	B, P	Contaminated Fraction of Milk	1	N/A	N/A	Not Included in Probalistic Analysis
RO18	M, B	Drinking Water Intake (L/yr)	478.5	478.5	730	Uniform
RO18	M, B	Fish Consumption (kg/yr)	20.6	20.6	21	Uniform
RO18	M, B	Fruit, Vegetable, and Grain Consumption (kg/yr)	112	112	520	Uniform
RO18	M, B	Leafy Vegetable Consumption (kg/yr)	21.4	21.4	64	Uniform
RO18	M, B	Meat and Poultry Consumption (kg/yr)	67	67	110	Uniform
RO18	M, B	Milk Consumption	233	233	310	Uniform
RO18	M, B	Other Seafood Consumption (kg/yr)	0.9	0.9	5	Uniform
RO18	M, B	Soil Ingestion Rate (g/yr)	18.3	18.3	36.5	Uniform
RO19	P	Depth of Roots (m)	0.9	0.3	4	Uniform
RO19	P	Depth of Soil Mixing Layer (m)	0.15	0	0.6	Triangular
RO19B	P	Weathering Removal Constant of all Vegetation	20	5.1	84	Triangular
RO19B	P	Wet Crop Yield for Fodder (kg/m^2)	1.1	0.55	2.2	Not Included in Probalistic Analysis
RO19B	P	Wet Crop Yield for Leafy (kg/m^2)	1.5	0.75	3	Uniform
RO19B	P	Wet Crop Yield for Non-Leafy (kg/m^2)	0.7	Default Value	Default Value	Truncated Lognormal-N
RO19B	P	Wet Foliar Inception Fraction of Leafy Vegetables	0.25	0.06	0.95	Triangular

RG 1.109 Values

From EPRI Report No. TR-112874

		Distribution Coefficient for Americium & Curium	Value Used	ANL Min.	ANL Max.	Distribution Type
R16	P	1. Contaminated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
		Distribution Coefficient for Carbon	Value Used (ANL)	GPU Min.	GPU Max.	Distribution Type
R16	P	1. Contaminated Zone (cm^3/g)	1	0	5	Uniform
R16	P	2. Unsaturated Zone (cm^3/g)	1	0	5	Uniform
R16	P	3. Saturated Zone (cm^3/g)	1	0	5	Uniform
		Distribution Coefficient for Cobalt	Value Used	ANL Min.	ANL Max.	Distribution Type
R16	P	1. Contaminated Zone (cm^3/g)	200	200	1000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	200	200	1000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	200	200	1000	Not Included in Probalistic Analysis
		Distribution Coefficient for Cesium	Value Used	ANL Min.	ANL Max.	Distribution Type
R16	P	1. Contaminated Zone (cm^3/g)	2131	2131	28341	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	2131	2131	28341	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	2131	2131	28341	Not Included in Probalistic Analysis

		Distribution Coefficient for Europium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	1000	1000	5000	Not Included in Probalistic Analysis
		Distribution Coefficient for Iron	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	10000	10000	50000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	10000	10000	50000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	10000	10000	50000	Not Included in Probalistic Analysis
		Distribution Coefficient for Hydrogen	*Value Used (ANL)*	*GPU Min.*	*GPU Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	1	0	5	Uniform
R16	P	2. Unsaturated Zone (cm^3/g)	1	0	5	Uniform
R16	P	3. Saturated Zone (cm^3/g)	1	0	5	Uniform
		Distribution Coefficient for Niobium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	80	80	600	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	80	80	600	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	80	80	600	Not Included in Probalistic Analysis
		Distribution Coefficient for Nickel	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	1300	1300	10000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	1300	1300	10000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	1300	1300	10000	Not Included in Probalistic Analysis
		Distribution Coefficient for Plutonium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	160	160	600	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	160	160	600	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	160	160	600	Not Included in Probalistic Analysis
		Distribution Coefficient for Antimony	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	153	153	5200	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	153	153	5200	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	153	153	5200	Not Included in Probalistic Analysis
		Distribution Coefficient for Strontium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	11	11	475	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	11	11	475	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	11	11	475	Not Included in Probalistic Analysis
		Distribution Coefficient for Technetium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	1.3	1.3	54	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	1.3	1.3	54	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	1.3	1.3	54	Not Included in Probalistic Analysis
		Distribution Coefficient for Uranium	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	16	16	5200	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	16	16	5200	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	16	16	5200	Not Included in Probalistic Analysis
		Distribution Coefficient for Lead	*Value Used*	*ANL Min.*	*ANL Max.*	*Distribution Type*
R16	P	1. Contaminated Zone (cm^3/g)	9700	9700	160000	Not Included in Probalistic Analysis
R16	P	2. Unsaturated Zone (cm^3/g)	9700	9700	160000	Not Included in Probalistic Analysis
R16	P	3. Saturated Zone (cm^3/g)	9700	9700	160000	Not Included in Probalistic Analysis

NOTE: Additional RAI Information Requested But Not Shown In Above Table

D34	P	**Food Transfer Factors:**	*Values Used*	*Distribution Type*
		Plant/soil concentration ratios, dimensionless	RESRAD 6.1 Defaults	LOGNORMAL - N
		Beef/livestock-intake ratios, (pCi/kg/(pCi/d)	RESRAD 6.1 Defaults	LOGNORMAL - N
		Milk/livestock-intake ratios, (pCi/L)/(pCi/d)	RESRAD 6.1 Defaults	LOGNORMAL - N

D5	P	**Bioaccumulation factors, fresh water, L/kg:**		
		Fish	RESRAD 6.1 Defaults	LOGNORMAL - N
		Crustacea and mollusks	RESRAD 6.1 Defaults	Not Included in Probalistic Analysis

Table 2

SNEC Open Land DCGLs

	SURFACE (Upper ~1 Meter) SNEC RESRAD 6.1 Probabilistic DCGL's (pCi/g)				SUBSURFACE (Below ~1 Meter) SNEC RESRAD 6.1 Probabilistic DCGL's (pCi/g)		
	25 mrem/y Limit	*Peak Dose Year(s)*	*4 mrem/y DW Path*	*Peak Dose Year(s)*	*Based on DCGL 25 mrem/y, All Pathway Standard*	*Based on DCGL 4 mrem/y, Drinking-Water Path*	**MINIMUM SITE DCGLs**
Am-241	21.4	0	196	758.6 - 1000	**18**	45	**18**
C-14	**27**	0	1038	1 - 3	89	31	**27**
Cm-243	**25**	0	1949	525	120	970	**25**
Cm-244	**39**	0	868	525	180	560	**39**
Co-60	**3.9**	0	9.44E+05	13.18 - 19.05	21	4.1E+04	**3.9**
Cs-134	**5.1**	0	3.01E+09	3 - 9.12	29	5.6E+15 (> SA Limit)	**5.1**
Cs-137	**8.7**	0	1.93E+07	83.2	51	9.4E+05	**8.7**
Eu-152	**10.8**	0	1.24E+08	35 - 57.54	54	3.9E+06	**10.8**
Eu-154	**10**	0	2.10E+08	27.54 - 39.81	50	9.8E+06	**10**
Eu-155	**415**	0	4.80E+09	19.05 - 27.54	2100	7.7E+08	**415**
Fe-55	**2.3E+04**	0	8.23E+13	13.18 - 39.81	1.7E+05	7.6E+22 (> SA Limit)	**2.3E+04**
H-3	2730	0	1461	2.089	8600	**1400**	**1400**
Nb-94	**7.6**	0	529	251	38	370	**7.6**
Ni-59	**3216**	0	4.74E+05	2291 - 3311	1.7.E+04	2.1E+05	**3216**
Ni-63	**1175**	0	3.48E+07	251.2 - 300	6300	2.5E+06	**1175**
Pu-238	24.1	0	21.5	174	42	**6.7**	**6.7**
Pu-239	9.2	363.1	2.2	525	9.4	**1.5**	**1.5**
Pu-240	9.5	363.1	2.3	5.25E+02	9.7	**1.6**	**1.6**
Pu-241	**1021**	27.54 - 35	3889	758.6 - 1000	3400	1100	**1021**
Pu-242	9.6	363.1	2.3	525	9.7	**1.6**	**1.6**
Sb-125	33.6	0	1.15E+07	6.31 - 9.12	100	**16**	**16**
Sr-90	**1.3**	0	6.7	27.5	7	4.2	**1.3**
Tc-99	**11.4**	0	46.6	4.4	54	33	**11.4**
U-234	12.6	39.81 - 57.54	2.7	5.75E+01	12	**1.9**	**1.9**
U-235	12	39.81 - 57.54	2.8	57.5	12	**1.9**	**1.9**
U-238	13	39.81 - 57.54	2.9	5.75E+01	12	**2**	**2**

NOTE: Bolded values represent the lowest calculated value (25 mrem/y TEDE limit Vs the 4 mrem/y drinking water path).

Shaded radionuclides are drinking water dose contributors. (Shaded: Am-241, C-14, Cm-243, Cm-244, H-3, Nb-94, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Tc-99, U-234, U-235, U-238)

Table 3

	SNEC SAMPLES ASSAYED FOR Kd VALUES AT ANL									
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8		
Location	River (composite) Sediment Sample	SSGS SE Sump	South of Warehouse by Old Access Road	CV Area	CV Area, Near Switchyard	CV Area	CV Area	CV Area		
Material Type	Sediment	Construction Debris	Fly Ash & Cinders	Back-Fill Materials	Fill Soil	Clay Material	Weathered Bedrock	Unweathered Bedrock (crushed)		
Reference Grid No. & Coordinates	Bank Above Bridge & Off Tip Of Island	AV-133	AJ-131, 21' N by 2 W	AZ-129, 14' W by 10' N	BA-129, 1' N	BA-129, 1' N by 2 W	AZ-128, 13' N	AZ-129, 15' N by 1 to 18' E		
Depth (Grade=811' El)	0' - 1' Below Sediment Surface	~787' El	~811'	~795'	~810.8'	~809.12'	~800'	~800'	Lowest Value	Highest Value
Elements										
H	~1	~1	~1	~1	~1	~1	~1	~1	1	1
C	~1	~1	~1	~1	~1	~1	~1	~1	1	1
Ni	10000	10000	4000	10000	10000	10000	1300	1500	1300	10000
Zr, Nb	600	80	500	500	500	500	500	500	80	600
Tc	8.1	54	54	8.6	1.4	1.6	1.3	1.3	1.3	54
U	37	16	5200	17	34	106	5200	226	16	5200
Pu	600	160	600	400	400	400	600	400	160	600
Ce, Eu	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Co	1000	1000	200	1000	1000	1000	1000	1000	200	1000
Cs	2340	2433	2131	14149	13618	2864	9746	28341	2131	28341
Fe	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Am, Cm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Sr	60	25	475	28	11	24	114	60	11	475
Sb	1100	153	5200	2070	1100	1800	5000	1900	153	5200
Pb	46000	1.60E+05	58000	81000	31000	98000	9700	26000	9700	160000

Section I – SNEC Geology/Hydrogeology Background Information

Since 1981, subsurface investigations have been conducted through installation of monitor wells. In 1981, a subsurface investigation was conducted to evaluate geologic and hydrogeologic conditions at the Facility. Since 1981, numerous wells were installed, generally to further define the hydrogeologic conditions. Below is a summary of each investigation.

The first investigation was conducted in 1981 by Groundwater Technology, Inc. The investigation consisted of reviewing information obtained from the Pennsylvania State Geologist and the United States Geological Survey (Water Resource Branch), and conducting geologic reconnaissance of the area to provide the initial geologic interpretation for the Facility. In addition, test borings were drilled near the CV and the RWDF to characterize the soils, bedrock and depth to groundwater. The results of this investigation were summarized in a 1981 report entitled "Preliminary Hydrological Investigation, Saxton Nuclear Station, Saxton, Pennsylvania". Results of this investigation were as follows:

- There are three distinct subsurface materials: fill, a boulder layer with silty clay matrix and bedrock (occurring in this order from ground surface when present).
- The material with the highest permeability is at the boulder layer/bedrock interface, based on field permeability testing. Packer tests were conducted in boreholes drilled at the site and soil laboratory mechanical tests were performed on construction fill materials. Packer test results ranged from 10^{-5} to 10^{-3} cm/sec and some boreholes had no flow. Soil testing results of fill based on mechanical (sieve) analysis for a silty red sand fill and a sample of flyash both with very high fine grained contents suggested very low permeability probably ranging between 10^{-8} to 10^{-6} cm/sec.
- Based on the composition of the matrix of the boulder layer, it appears to act as a barrier to the flow of groundwater between the construction fill and the bedrock.
- Preliminary hydraulic gradient of 0.017 to 0.019 (a slope of 10 to 15 feet over a distance of 600-800 feet) from the Site to the river based on groundwater level observations in test borings.
- The combination of hydraulic gradient, bedrock permeability, and bedrock structure (bedding and fracture patterns) indicates that the groundwater has a potential to flow from the Site to the river.

In 1992, GEO Engineering installed monitor wells near the CV and the RWDF. Eight monitoring wells (GEO-1 though GEO-8) were installed in the suspected upgradient and downgradient flow direction for the CV. The wells were screened (and sanded) across the top bedrock and boulder layer contact (overburden/bedrock interface). This zone was previously identified in the 1981 as an area of relatively higher permeability compared to its immediate surroundings. The results of this investigation were included in a 1992 report entitled, Phase I Report of Findings-Groundwater Investigation Saxton Nuclear Experimental Station, Saxton, Pennsylvania, by GEO Engineering. Other information from this investigation includes:

- At the overburden/bedrock interface, groundwater flow direction from the Facility is toward the west/northwest and the river (Raystown Branch of Juniata River). A relative elevation survey of eight monitor wells was conducted. Water level information from these eight wells was used to produce computer-generated groundwater elevation contour maps.
- The results of the investigation indicated that groundwater movement in bedrock is controlled by fractures trending to the northwest and to the northeast (bedding planes and a fracture set).
- Two additional wells were proposed in bedrock adjacent to the CV.

In 1994, GEO Engineering installed three monitor wells at the Site. Two additional monitor wells (MW-1 and MW-2) were installed near the CV. The two additional monitor wells were installed west and northwest of the CV at an angle, approximately 25°, to facilitate the interception of groundwater flowing in fractured bedrock. The wells, completed as gas-actuated monitor wells, 54' in length, were installed to the depth similar to the CV (approximately 50' below ground surface). A third monitor well, a 50-foot monitor well (GEO-9), was installed in bedrock making it possible to obtain water level elevation data from the bedrock unit. As part of this field activity, monitoring wells GEO-1 to GEO-8 were retrofitted with gas actuated samplers. The results of this investigation were reported in GEO Engineering's, Summary of Field Work, 1994.

In 1998, a total of three additional wells were added to the monitoring array. Two bedrock monitor wells (MW-3 and MW-4) with gas actuated devices were installed adjacent to the RWDF (to the depth of the sump) to investigate the potential presence of tritium in groundwater. In addition, GEO-10 was installed at the overburden/bedrock interface downgradient of GEO-5 to evaluate trace amounts of tritium detected in the groundwater at GEO-5. Haley and Aldrich described details of this investigation in a 1998 Summary of Field Work.

In December 2000, additional monitor wells were installed at the Site and slug testing was performed to evaluate hydraulic conductivity of the materials. Seven monitor wells were installed to characterize groundwater flow in the area beyond the Facility. The seven wells consisted of three nests of an overburden/bedrock interface and bedrock well (OW-3/3R, OW-4/4R, and OW-5/5R) and one additional overburden well (OW-6). The monitor wells in the overburden are screened at the overburden/bedrock interface. The bedrock wells extend to 50 feet below ground surface. The well installations occurred between December 11 and 21, 2000. The investigation confirmed the presence of the types of subsurface materials reported in earlier investigations. Slug tests (falling head tests) were conducted on the monitor wells.

In May 2001, one additional monitor well nest and two observation points were installed in the area of the Facility. The monitor well nest, OW-7 and OW-7R, consists of a well installed in the overburden/bedrock interface and a well installed in bedrock. The cluster was installed to the east of the discharge tunnel, between the Facility and the river. The two observation points (OP-3 and OP-4) were installed in the backfill on the eastern side of the discharge tunnel. The purpose of the wells was to obtain additional groundwater elevation data and provide an additional groundwater monitoring points for the detection of tritium, if present, in groundwater. Results of groundwater elevation data and addition hydrology information was previously submitted to the NRC in GPU Nuclear letter E910-02-003, dated January 24, 2002.

Subsurface Materials

There is approximately 7 to 18 feet of overburden material overlying bedrock (a fractured siltstone). The overburden materials generally consist of fill overlying a natural boulder layer with silt and clay filling the interstitial spaces. Groundwater occurs in both the overburden/bedrock interface and the fractured bedrock. A detail description of each unit follows and Figure 1 shows a generalized cross section of these materials.

<u>FILL</u> The material near the ground surface is referred to as fill. The material generally consists of sand, silt and gravel or ash and cinders (initial Site investigation by Groundwater/Technology, Inc. in 1981). In most areas adjacent to the area modified during the construction of the CV this material has been observed to be 1.5 to 4 feet thick. The fill material is generally unsaturated. However, local water level information indicates for a period of one to two months in the spring water levels come up into the fill.

<u>BOULDER LAYER</u> A boulder layer apparently was formed as a result of the river's depositional processes. Most of the boulders are rounded and are very hard quartzite (virtually no porosity). The void space between the boulders contains a dense mixture of sand, silt and clay. Based on these characteristics, this material has low bulk permeability and consequently acts as a hydraulic barrier to flow between the fill and the siltstone bedrock. Although water level information indicates most of this layer is saturated, it does not undergo appreciable groundwater flow (when present).

<u>SHALE AND SANDSTONE BEDROCK</u> The bedrock locally underlying the boulder layer is identified as the marine beds of upper Devonian age in the Paleozoic era (Pennsylvania Geologic Survey, Fourth Series, 1960). These rocks are described as gray to olive brown shales, graywackes and sandstone. The top of the bedrock surface is weathered and fractured (Groundwater Technology, Inc. 1981). Also, the bedrock surface apparently decreases in elevation from the Facility to the northwest. This surface apparently decreases in elevation to the north and the south.

Section II - Descriptions and Justifications for RESRAD Input Parameters

Per NUREG-1727, Appendix C, "Technical Basis for Dose Modeling Evaluation" the following responses include the RESRAD menu code, parameter description, how the parameter is used in the dose model, the classification of the parameter (e.g. behavioral, metabolic, or physical) and the basis for its selection.

> **Note:** Unless a RESRAD default value is specified, the range of the following values is used as the boundary conditions for all RESRAD probabilistic input. Any single value stated is used as the deterministic input.

R013 Cover depth (m) – Physical Parameter
Cover will not be placed over the area for which the modeling applies, and therefore, the cover depth was input as 0.0 meters.

R013 Density of cover material (g/cm^3) – Physical Parameter
Since the above-described parameter (cover depth) is input as 0.0, density of the cover material is not applicable and therefore not input into the RESRAD model.

R013 Cover depth erosion rate (m/yr) – Physical Parameter
Since the above-described parameter (cover depth) is input as 0.0, density of the cover material is not applicable and therefore not input into the RESRAD model.

R013 Density of contaminated zone (g/cm^3) – Physical Parameter
For the surface model, a contaminated zone is located between approximately 0 and 1.0 meter, as shown on Figure 1. Based on subsurface investigations as described in Section I, the geologic stratigraphy at this depth is described as mixed soils, sandy or silty clay to well graded sand and gravel with rock fragments. Based on the May 1982 Department of Navy Naval Facilities Engineering Command (NAVFAC) DM-7.1 Manual, dry weight density for this type of material is in the range of 80 to 120 lb./ft^3 (or 1.28 to 1.92 g/cm^3). The range for dry weight as opposed to wet, or submerged weight was used, as the depth of soil contamination is unsaturated. The value input into the RESRAD model was 1.60 g/cm^3, the average of the above-stated range.

R013 Contaminated zone erosion rate (m/yr) – Physical Parameter
Based on the Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil (C. Yu, C. Loureiro, J. -J. Cheng, L.G. Jones, Y.Y Wang, Y.P Chia, and E. Faillace, Environmental Assessment Division Argonne National Laboratory - www.ead.anl.gov) and assuming future use scenario as row-crop agriculture with an approximate 2% slope, the range of $6x10^{-4}$ to $9x10^{-5}$ m/yr was used. The value input into the RESRAD model was $3.45x10^{-4}$ m/yr, the average of the above-stated range.

R013 Contaminated zone total porosity – Physical Parameter
Based on subsurface investigations as described in Section I, the geologic stratigraphy of the contaminated zone is described as mixed soils, sandy or silty clay to well graded sand and gravel with rock fragments. Referencing Maidment, Handbook of Hydrology (pp. 5.14), 1993, these soil types correspond to total porosity ranges of between 0.35 and 0.56. Total porosity is defined as the part of rock or soil volume, which is void space. The value input into the RESRAD model was 0.46, the average of the above-stated range.

R013 Contaminated zone effective porosity – Physical Parameter
The effective porosity range for the site was based on the soil types. Referencing Maidment, Handbook of Hydrology (pp. 5.14), 1993 expressed the effective porosity range of 0.28 to 0.54 based on the soil types found at the site. Effective porosity is defined as the percentage of inter-connected void space, and is applied to characterize soil. The recommended value is 0.41, the average of the above-stated range. This value is not used by RESRAD 6.0.

R013 Contaminated zone hydraulic conductivity (m/yr) – Physical Parameter
Hydraulic conductivity values are based on field permeability testing, soil characterization, empirical relationships, published values and the experience of our expert consultant. Packer tests (rock pressure tests) were performed during the 1981 Preliminary Hydrogeologic Investigation in order to estimate the apparent permeability of the bedrock below the site. The packer test involves pumping water under pressure into selected sections of an open borehole isolated using pneumatic packers. Packer tests indicated hydraulic conductivity of the bedrock to range between $1x10^{-3}$ cm/s to negligible flow.

In addition to packer testing for the 1981 report, sieve analyses were conducted on samples of the silty sand fill and ash fill. Initial estimates of hydraulic conductivity suggested a high of $1x10^{-6}$ cm/s for the fill.

Based on recent analyses for the purpose of the RESRAD modeling, data from the grain size distributions of the fill collected from the 1981 investigation were entered into several empirical relationships in order to refine the estimates of hydraulic conductivity. These empirical relationships relate median effective grain diameter (typically, the grain diameter which represents the 10% finer by weight on a grain size distribution) as well as other properties including sorting and porosity to hydraulic conductivity. The empirical relationships used have been shown to correspond well with field measured hydraulic conductivity (Vukovic, Milan and Soro, Andjelko, Determination of Hydraulic Conductivity of Porous Media from Grain-Size Composition, 1992).

The following presents one of the empirical equations as taken from Vukovic, Milan and Soro, Andjelko, Determination of Hydraulic Conductivity of Porous Media from Grain-Size Composition, 1992:

Slichter:

$$K = g/v * C_s * n^{3.287} * d_{10}^2$$

Where:
K = hydraulic conductivity (cm/sec)
g = acceleration due to gravity: 980 cm/sec^2
v = kinematic viscosity of water [at 20 deg C]: 1.125x10^{-2}
C_s = constant: 1.0x10^{-2}
n = porosity
d_{10} = effective grain diameter

Hydraulic conductivity values for the fill generated through the empirical relationships using grain size data were somewhat higher than the estimates initially suggested in the 1981 Preliminary Hydrogeologic Investigation report. Specifically, the original report suggested hydraulic conductivity values ranging from 1x10^{-6} to 1x10^{-5} to cm/s (0.315 to 3.15 m/yr). However, recent evaluations of grain size data (soil samples S-1, S-2 from the 1981 Ground/Water Technology investigation and TB-1, similar to TB-3 from the Haley & Aldrich geotechnical investigation 1999) suggest hydraulic conductivity values ranging from 1x10^{-6} to 8x10^{-2} cm/s (3.62 x 10^{-1} to 2.54 x 10^{4} to m/yr), which is the range used in the RESRAD modeling. The recommended value input into the RESRAD model is 32.3 m/yr (1 x 10^{-4} cm/sec), the geometric mean of the above-stated range.

In addition to methods described above, hydraulic conductivity was qualitatively assessed given the experience of our expert consultant and based on their visual observation during installation of the soil borings and soil sample characterization. The values given above also correspond with published values for silts, sandy silts, and clayey sands (Applied Hydrogeology, Fetter, C.W., 1988).

R013 Contaminated zone b parameter – Physical Parameter

As described in the Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil (C. Yu, C. Loureiro, J. -J. Cheng, L.G. Jones, Y.Y Wang, Y.P Chia, and E. Faillace, Environmental Assessment Division Argonne National Laboratory - www.ead.anl.gov) the soil-specific exponential b parameter is an empirical and dimensionless parameter that is used to evaluate the saturation ratio (or the volumetric water saturation) of the soil. Published data based on laboratory testing indicate ranges of the exponential b parameter to be between 4.05 and 7.12. The RESRAD input for this parameter was based on the values corresponding from sand to loam in Table 13.1 of the Data Collection Handbook. The recommended value for the RESRAD model is 5.6, the average of the above-stated range.

R013 Average annual wind speed (m/sec) – Physical Parameter

The input values for this parameter were based on data provided from the National Climatic Data Center (1999 Annual Summary Local Climatological Data for Pittsburgh, Pennsylvania). The RESRAD input reflects the minimum monthly mean wind speed (3.13 m/sec or 7.0 mph) and maximum monthly mean wind speed (4.83 m/sec or 10.8 mph) over a 42 year span. The value input into the RESRAD model is the annual mean wind speed based on 42 years of data of 4.07 m/sec (9.1 mph).

R013 Humidity in air (g/m^3) – Physical Parameter

This default value of 8.0 g/m^3 was used in the RESRAD model.

R013 Evapotranspiration coefficient – Physical Parameter

The value range for this input parameter was based primarily on guidance in the Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil, and was estimated through an iterative solution with other parameter values including precipitation, irrigation and runoff coefficient. The range was based on a runoff coefficient (C_r) range of 0.3 to 0.4; a precipitation range (P_r) of 0.688 to 1.327 m/yr; and an irrigation value (IR_r) of 0.2 (refer to individual parameter justifications, as described below). Using these values, an evapotranspiration rate (ET_r) was estimated (this value is not used implicitly in RESRAD, but is an intermediate step in calculating the evapotranspiration coefficient).

Based on the Evaporation Atlas of the United States (NOAA, 1982), evaporation is estimated to be approximately half of the total (annual) precipitation for the Saxton, PA area. Given this, the evapotranspiration coefficient was estimated as follows:

$$C_e = \frac{ET_r}{(1-C_r)*P_r + IR_r}$$

Calculated Range of C_e = 0.50 to 0.67 m/yr

The value input into the RESRAD model was 0.59, the average of the above-stated range.

R013 Precipitation (m/yr) – Physical Parameter
The input values for this parameter were based on data provided from the National Weather Service (1999 Annual Summary Local Climatological Data for Pittsburgh, Pennsylvania). The RESRAD input range reflects the 30 year minimum (0.688 m/yr or 27.09 inches/yr) and maximum (1.327 m/y or 52.24 inches/yr) annual precipitation amounts. The value input into the RESRAD model was 0.936 m/yr (36.85 inches/yr) which is the 30 year annual precipitation average.

R013 Irrigation (m/yr) – Physical Parameter
Based on the agricultural use scenario, the default value for irrigation (0.2 m/yr) was input into the RESRAD model.

R013 Irrigation mode – Physical Parameter
It was assumed that the irrigation would be distributed overhead.

R013 Runoff coefficient – Physical Parameter
The input values for this parameter were based on data provided from two sources: U.S. Geological Survey Hydrologic Investigation Atlas HA-710 – Average Annual Runoff in the United States, 1951-1980, and Table 10.1 of the Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil. The RESRAD input range represents coefficient values corresponding to an agricultural environment comprised of flat to rolling land (slopes of 0.3 to 6.1 m/mi). The corresponding range for runoff coefficient is 0.3 to 0.4. The value input into the RESRAD model was 0.35, the average of the above-stated range.

R013 Watershed area for nearby stream or pond (m^2) – Physical Parameter
Based on the topographic quadrangles for Saxton, PA and Hopewell, PA, the watershed area surrounding the facility was estimated as the total area of land bounded by the Juniata River and surrounding topographic high areas. The value input into the RESRAD model was $5x10^6$ m^2.

R014 Density of saturated zone (g/cm^3) – Physical Parameter
The saturated zone begins at between 0.7 and 2.3 meters below ground surface. Based on subsurface investigations as described in Section I, the geologic stratigraphy at this depth, and below, is described as mixed soils and bedrock. Based on the May 1982 Department of Navy Naval Facilities Engineering Command (NAVFAC) DM-7.1 Manual, density for this type of material is in the range of 80 to 120 lb./ft^3 (or 1.28 to 1.92 g/cm^3). The range for wet weight was used as this pertains to saturated soil/rock. The value input into the RESRAD model was 1.60 g/cm^3, the average of the above-stated range.

R014 Saturated zone total porosity – Physical Parameter
Based on subsurface investigations as described in Section I, the geologic stratigraphy of the saturated zone is described as mixed soils and bedrock. As denoted in Figure 1, units B, B/C and C are considered saturated and only units B/C and C subject to any appreciable flow of groundwater. Further, based on the thicker saturated thickness of unit C in relationship to unit B/C and other pertinent information we recommended combining the interface and bedrock units (B/C and C) and using values for the siltstone bedrock for the RESRAD inputs.

Referencing Domenico and Schwartz, Physical and Chemical Hydrogeology (1990, p. 29) the siltstone bedrock's total porosity ranges between 0.31 and 0.41. Total porosity in bedrock is related to fracture porosity, which for this rock type, provides the majority of the void space. The recommended value input into the RESRAD model is 0.36, the average of the above-stated range.

R014 Saturated zone effective porosity – Physical Parameter
The effective porosity range is based on bedrock. Referencing Domenico and Schwartz, Physical and Chemical Hydrogeology (1990, p.29) expressed the effective porosity range of 0.005 to 0.05 based on shale bedrock. The recommended input into the RESRAD model is 0.028, the average of the above stated range.

R014 Saturated zone hydraulic conductivity (m/yr) – Physical Parameter
The hydraulic conductivity for the bedrock based on testing of bedrock wells OW-3R, OW-4R, OW-5R and OW-7R is 67.91 m/yr, the geometric mean of these four test results, (value reported in Haley & Aldrich's August 2001 report) in the saturated zone. The recommended input into the RESRAD model is 67.91 m/yr. Results of groundwater hydraulic conductivity in bedrock (saturated zone) was previously submitted to the NRC in GPU Nuclear letter E910-02-003, dated January 24, 2002.

R014 Saturated zone hydraulic gradient – Physical Parameter
The hydraulic gradient in the bedrock based on water level information recorded on January 11, 2001 ranges between 0.02 and 0.03 (gradient between the tunnel and the river and the site to the discharge tunnel respectively). A review of water level information on June 13, 2001 indicated a decrease in the hydraulic gradient from the tunnel to the river (0.013) while the value from the site to the tunnel remained the same as that calculated for the January water level information. The recommended value input into the RESRAD model is 0.02, the average of the lower value of the tunnel to the river and the value of the site to the tunnel.

R014 Saturated zone b parameter – Physical Parameter
Refer to the discussion of the zone b parameter for the contaminated zone, presented above. The recommended value input in the RESRAD model is 5.6.

R014 Water table drop rate (m/yr) – Physical Parameter
Annual variation of the groundwater elevation at the SNEC facility is approximately 0.5 meters in the fill deposits and approximately 1.6 meters in the bedrock unit. This information is based on water level measurements collected over the period March 1999 to April 2001 by GPU Nuclear personnel. Although seasonal variation is up to approximately 1.6 meters, and possibly could be higher, a decline in long term groundwater elevations is expected to be significantly less, if any, since water table conditions are moderated by the strong hydrogeologic influence of the Juniata River, including existing river elevation controls. In addition, there is no unusually high consumptive use of groundwater locally. Based on this, a value of 0 m was input into the RESRAD model.

R014 Well pump intake depth (m below water table) – Physical Parameter
Based on recommended well pump intake depths (Driscoll, Fletcher, Groundwater and Wells, Second Edition, 1986) and the subsurface conditions as described in Section I, the range for the well pump intake depth was input as 10 to 50 meters below the water table. Actual pump intake depths may vary based on the actual depth of the well, in addition to actual well yield and usage requirements. The value input into the RESRAD model was 30 m, the average of the above-stated range.

R014 Model: nondispersion (ND) or Mass-balance (MB) – Physical Parameter
Guidelines from Appendix C – Rev 0 of the NMSS Decommissioning SRP indicate that the nondispersion approach should be acceptable when the area of contamination is known to be larger than the assumed capture area of a hypothetical well. The guidance provides a calculation to estimate the capture area of a hypothetical well, however the calculation assumes a flat water table, which, based on subsurface investigations decried in Section I, is not the case at the SNEC facility. The gradient based on data from monitoring wells collected as part of the 18 November 1992 report entitled Phase I Report of Findings - Groundwater Investigation, ranges from 0.02 to 0.04. Given static hydraulic gradient, hydraulic conductivity, and saturated thickness of the geologic strata, potential capture zone of a hypothetical well can be estimated as follows:

— **Downgradient flow boundary (null point):*

$$X_l = Q/(2\pi * K * b * i) \qquad X_l = 286.2/(2\pi * 67.91 * 50 * 0.02) \qquad X_l = 0.67m$$

— **Transverse boundary (width of capture):*

$$Y_l = Q/(K * b * i) \qquad Y_l = 286.2/(67.91 * 50 * 0.02) \qquad Y_l = 4.21m$$

Where,

Q = average pumping rate of RESRAD input range (m^3/yr)
K = average hydraulic conductivity of RESRAD input range (m/yr)
b = saturated thickness of the aquifer (m)
i = average hydraulic gradient of RESRAD input range (m/m)

- Equation taken from Wellhead Protection Strategies, US Geological Society, 1991.
- Since the transverse boundary is equivalent to a linear distance (width of capture zone), to extrapolate to a total capture area, the transverse boundary is multiplied times pi.

$$A_c = Y_l * \pi \qquad A_c = 13.23 m^2$$

Based on information provided by GPU Nuclear, the area of contamination ranges from 182.4 to 1,161 m^2. Based on the above equations, an estimate of capture zone for a hypothetical well at the SNEC facility is approximately 13.23 m^2. Thus, the area of the contamination is greater than the capture area of a hypothetical well, and therefore the non-dispersion mode was applied for the RESRAD modeling.

R014 Well pumping rate (m^3/yr) – Physical Parameter
Based on data collected in the American Water Works Association Research Foundation's Residential End Use Study, 1998, the typical usage volume for a single domestic well varies from approximately 207.3 m^3/yr to 365 m^3/yr. The value input into the RESRAD model was 286.2 m^3/yr, the average of the above-stated range.

R015 Number of unsaturated zone strata – Physical Parameter
As noted earlier, the contaminated zone is present to 1.0 m below ground surface for the modeled area (Figure 1). The saturated zone begins at approximately 1.5 m below ground surface, and given the seasonal variation of the water table, the unsaturated zone exists (and varies) from 1 to 1.5 m below ground surface. During a period of one to two months in the spring water levels may be higher than throughout most of the hydrologic year resulting in a period of transient saturation. Therefore, 1 was input for the number of unsaturated zone strata.

R015 Unsaturated zone 1, thickness (m) – Physical Parameter
As noted above, the unsaturated zone exists (and varies) from 1 to 1.5 m below ground surface. Therefore, the unsaturated zone thickness ranges from 0 to 0.5 m (see Figure 1). The value input into the RESRAD model was 0.25 m, the average of the above-stated range.

R015 Unsaturated zone 1, soil density (g/cm^3) – Physical Parameter
Based on subsurface investigations as described in Section I, the geologic stratigraphy at this depth is described as mixed soils, sandy or silty clay to well graded sand and gravel with rock fragments. Based on the May 1982 Department of Navy Naval Facilities Engineering Command (NAVFAC) DM-7.1 Manual, dry weight density for this type of material is in the range of 80 to 120 lb./ft^3 (or 1.28 to 1.92 g/cm^3). The range for dry weight as opposed to wet, or submerged weight, was used as the depth of soil contamination is unsaturated. The value input into the RESRAD model was 1.60 g/cm^3, the average of the above-stated range.

R015 Unsaturated zone 1, total porosity – Physical Parameter
The total porosity range for the site in the unsaturated zone is based in three soil types (fill materials). Specifically, soil samples S-1 and S-2 from the 1981 Ground/Water Technology investigation and TB-1, similar to TB-3 from the Haley & Aldrich geotechnical investigation 1999 were selected. Referencing Maidment, Handbook of Hydrology (pp. 5.14), 1993, the on-site soil types correspond to a range in total porosity between 0.35 and 0.56. Total porosity is defined as the part of the soil volume that is void space. The recommended value input into the RESRAD model is 0.46, the average of the above-stated range.

R015 Unsaturated zone 1, effective porosity – Physical Parameter
The effective porosity range for the site was based on the soil types. Referencing Maidment, Handbook of Hydrology (pp. 5.14), 1993, the range of 0.28 to 0.54 for effective porosity is the recommended as the appropriate parameter input based on the soil types found at the site. The recommended value input into the RESRAD model is 0.41, the average of the above-stated range.

R015 Unsaturated zone 1, soil-specific b parameter – Physical Parameter
Refer to the discussion of the zone b parameter for the contaminated zone, presented above. The recommended value input into the RESRAD model is 5.6.

R015 Unsaturated zone 1, hydraulic conductivity (m/yr) – Physical Parameter
Refer to the discussion of hydraulic conductivity for the contaminated zone, presented above. As the geologic profile does not change significantly with regard to hydraulic conductivity, the input range for the contaminated zone hydraulic

conductivity was used again as the range for the unsaturated zone hydraulic conductivity. The recommended value input into the RESRAD model is 32.3 m/yr (1 x 10^{-4} cm/sec), the geometric mean of three site soil types.

RO11 Contaminated Zone Thickness (m) – Physical Parameter
The contaminated zone is considered to be the upper 1-meter throughout the modeled area. The value input into the RESRAD model was therefore 1 meter.

RO14 Field Capacity – Physical Parameter
Field capacity, a value included in the RESRAD 6.1 code, refers to specific retention as it applies to unsaturated soil. Based on published values for field capacity for soil materials classified as similar to on-site soil (Brady, The Nature & Property of Soils, 1974) field capacity ranges from 0.079 to 0.192. The recommended value input into the RESRAD model is 0.136, the average of the minimum and maximum estimated values.

D-34 Food Transfer Factors – Physical Parameter
In RESRAD, radionuclide transfer to animal products (milk and meat) is through ingestion of fodder, soil and water. The food/soil concentration ratios for meat and milk are estimated by radionuclide transfer factors from fodder, soil, or water to meat or milk, daily intake, fodder/soil concentration ratio, and livestock water/soil ratio. These data determine the conservatism of dose estimation.

There are 3 types of food transfer factors used in the code. They are used to compute environmental transport factors for plant, meat, and milk pathways for each stable element of interest. These include:

(1) Plant/soil concentration ratios, dimensionless;
(2) Beef/livestock-intake ratios, (pCi/kg)/(pCi/d); and
(3) Milk/livestock-intake ratios, (pCi/L)/(pCi/d).

The plant/soil ratio is the transfer factor for root uptake. It is the ratio of radionuclide concentration in the edible portions of the plant at harvest time to the dry soil radionuclide concentration. It is assumed the same transfer factor can be used for leafy and non-leafy vegetables.

The beef/livestock-intake factor is the ratio of radionuclide concentration in beef to the daily intake of the same radionuclide in livestock feed, water or soil.

The milk/livestock-intake ratio is the ratio of radionuclide concentration in milk to the daily intake of the same radionuclide in livestock feed, water or soil. This is also a physical parameter in the code.

In DandD, the animal products include beef, poultry, milk and eggs. The fodder for animals are divided as forage, stored grain and stored hay. RESRAD default values were used as best guess estimates for the resident farmer scenario and for purposes of simplicity. In many cases there was a direct correlation (same value) or within an order of magnitude between DandD and RESRAD, with RESRAD being more conservative when considering most predominant nuclides on the site (e.g. cesium and cobalt).

The RESRAD default transfer factors were used within a probabilistic analysis.

D-5 Bioaccumulation Factors, fresh water – Physical Parameter
The bioaccumulation factors are used to calculate environmental transport factors for the aquatic pathway. This factor is the ratio of radionuclide concentration in the aquatic food to the concentration of the same radionuclide in freshwater. The two factors presented per element are for fish and crustacea and mollusks. DandD, with respect to aquatic food, only considers fish. The units of measure are (pCi/kg)/(pCi/L) or L/kg. The bioaccumulation factor is a physical parameter in the code.

Like the food transfer factors bioaccumulation values were compared with DandD values (Reference EPRI Report TR-112874, Table B-5, November, 1999). Since sport fishing is a popular sport along the Juniata River and Raystown Lake the bioaccumulation in fish is more of a concern. The default factors used by the RESRAD code are comparable to DandD values for the predominant radionuclides on the site and therefore, were used in the analysis.

The RESRAD default bioaccumulation factors were used within a probabilistic analysis.

R016 Distribution coefficients for all isotopes (K_d) – Physical Parameter

Contaminated zone
Unsaturated zone
Saturated zone
Leach Rate (/yr)
Solubility Constant

The distribution coefficient, K_d, is a value that refers to the ratio of mass or activity of a radionuclide present in the solid phase to the mass or activity present in solution. This is a physical parameter in the code and the units are in cm^3/gram. Radionuclide adsorption is influenced by many attributes of the geologic environment. The K_d value for different elements is quite variable, depending strongly on material/soil type, the pH, and E^h of the media, and the presence of other ions. The soil and fill material on-site is very diversified. GPU Nuclear contracted with Argonne (ANL) to provide K_d measurements for the Saxton Nuclear Experimental Corporation Facility (SNEC). A list of radionuclides of concern was provided to ANL along with various soil and construction debris samples and site groundwater. In nearly all cases, Argonne provided the data experimentally for the listed radionuclides using either radioactive or stable elements (and stand-ins) to establish relevant site K_d values. The K_d values for certain nuclides (^3H and ^{14}C) were estimated because of the uncertainty in the chemical form that these radionuclides would exhibit in this particular environmental condition. In the latter case, the K_d values (e.g. tritium oxide) are generally very low (conservative). Results of ANL's analyses are listed in Table 3. The most conservative K_d values (Used in Table 1) were selected and applied to all materials found on the SNEC site, and therefore no probabilistic analysis was performed for site radionuclides, except for H-3 and C-14. GPU Nuclear established a minimum/maximum K_d range of 0 to 5 in the probabilistic run.

RO18 Diet Parameters

Diet Parameter	Dimension	Parameter Classification
Fruits, vegetables & grain consumption	Kg/yr	Metabolic, behavioral
Leafy vegetable consumption	Kg/yr	Metabolic, behavioral
Milk consumption	L/yr	Metabolic, behavioral
Meat & poultry consumption	Kg/yr	Metabolic, behavioral
Fish consumption	Kg/yr	Metabolic, behavioral
Other seafood consumption	Kg/yr	Metabolic, behavioral
Soil ingestion	G/yr	Metabolic, behavioral
Drinking water intake	L/yr	Metabolic, behavioral

The RESRAD user input values for the above diet parameters were taken from DandD default values. The classification of animal food and human diets (including plant foods, animal products and aquatic food) in the two codes is different. RESRAD classifies plants in the human diet as two types: non-leafy vegetables (fruit, non-vegetable, and grain) and leafy vegetable, and divides animal products into two types: milk and meat/poultry, and two types of aquatic food: fish and crustacea/mollusks. DandD classifies plants as four different types: leafy vegetable, roots, fruits and grains, and divides animal products into four different types: beef, poultry, eggs and milk. Aquatic food in DandD is only one type: fish.

The DandD diet parameters were modified to fit the RESRAD input fields (Reference EPRI Report TR 112874, Table B-2). For example since RESRAD does not have an input field for fruits (52.8 kg/yr), roots (44.6 kg/yr) and grain (14.4 kg/yr) these parameter values were added (112 kg/yr) and input into the appropriate RESRAD field, i.e. 'Fruits, vegetables and grain consumption.' The same is true for meat and poultry. DandD meat consumption defaults for beef (39.8 kg/yr); eggs (1.9 kg/yr) and poultry (25.3 kg/yr) were added (67 kg/yr) and inputted as 67 kg/yr into the 'Meat and poultry consumption' RESRAD field.

RO18 Contamination Fractions – Physical/Behavioral

All the contamination fraction areas listed in this table are classified as physical and behavioral.

Contamination Fraction of	Input Value	Description
Drinking water	1.0	100% of the drinking water intake is from onsite. No probabilistic analysis is performed.
Household water	Not used	This parameter used to calculate radon exposure. Not part of SNEC dose model.
Livestock water	.75	Specifies fraction of contamination intake for livestock for meat and milk pathways. 75% of all livestock water is assumed taken from on-site sources. Probabilistic input ranges from 0.5 to 1.
Irrigation water	.75	Specifies fraction of contaminated intake for plant, meat and milk pathways. 75 % of all irrigation water is assumed taken from on-site sources. Probabilistic input ranges from 0.5 to 1.
Aquatic food	0.5	Specifies the fraction of intake for the fish pathway. In this case 50% of the fish intake is assumed from on-site sources (a RESRAD default value). Probabilistic input ranges from 0 to 1.
Plant food	1	In this case 100% of the plant food intake is assumed from on-site sources. No probabilistic analysis performed.
Meat	1	In this case 100% of the meat intake is assumed from on-site sources. No probabilistic analysis performed.
Milk	1	In this case 100% of the milk intake is assumed from on-site sources. No probabilistic analysis performed.

The intake fractions listed in the above table provide conservative, yet reasonable certainty for intake rates for the resident farmer scenario.

R19B Wet weight crop yields – Physical

Non-leafy
Leafy
Fodder

Dimensions are in kg/m^2. These three RESRAD user input parameters are classified as physical. They represent the mass (net weight) of the edible portion of the plant food produced from per unit land area and are expressed in terms of kg/m^2. The default values are 1.5 kg/m^2 for leafy vegetables, o.7 kg/m^2 for non-leafy vegetables and 1.1 kg/m^2 for fodder. These defaults are considered conservative due to the fact that the soil on the SNEC site is not conducive for producing high crop yields. These input parameters are used for estimating contaminant concentration in plant foods. Reference Appendix D, Equation D-10 in the RESRAD Users Manual.

Section III Sensitivity Analyses

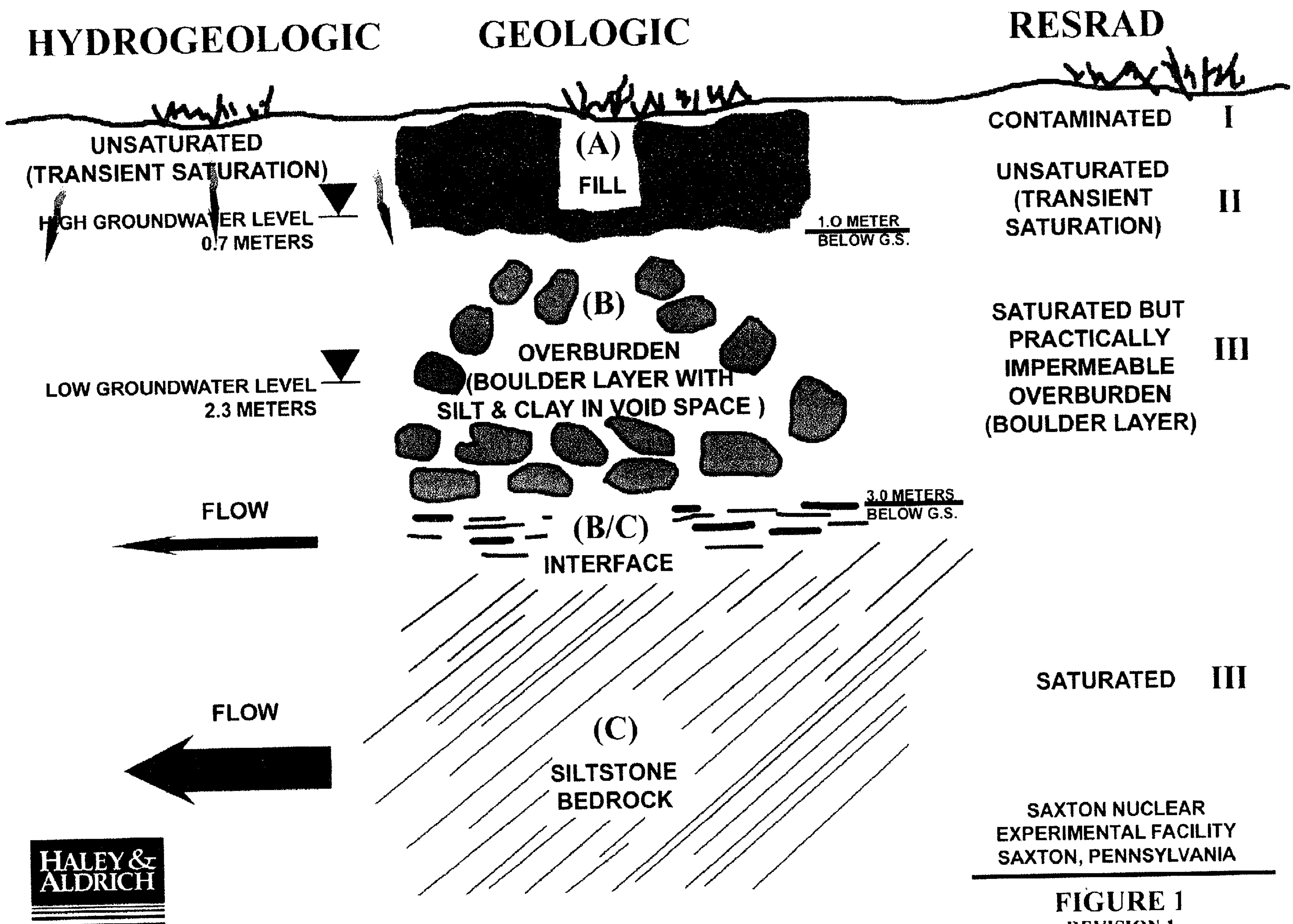
Twenty-two (22) RESRAD input parameters have been identified that have the biggest impact on dose. These were identified through a series of sensitivity analysis runs using RESRAD 6.1. Radiation dose from a specific radionuclide is dependent upon its type of radiation, energy, chemical form, half life and exposure pathway. The 22 input parameters have different dose impact sensitivities for different radionuclides. Therefore, Table 3 lists those parameters that have the biggest influence on dose calculations but in no particular order as far as rank.

Table 4

Sensitivity Table

Thickness of Contaminated Zone
Indoor Time Fraction
Contaminated Zone Erosion Rate
Run Off Coefficient
External Gamma Shielding Factor
Watershed Area for Nearby Stream or Pond
Fruit, Vegetable, and Grain Consumption
Contaminated Fraction of Plant Food
Evapotranspiration Coefficient
Well Pump Intake Depth
Thickness of Unsaturated Zone
Food Transfer Factors
Bioaccumulation Factors
Contaminated Zone Kd
Saturated Zone Kd
Unsaturated Zone Kd
External Gamma Shielding Factor
Livestock Fodder Intake for Meat
Contaminated Fraction of Plant Food
Contaminated Fraction of Meat
Depth of Roots
Leafy Vegetable Consumption

SKETCH OF UNDERGROUND MATERIALS



SAXTON NUCLEAR
EXPERIMENTAL FACILITY
SAXTON, PENNSYLVANIA

FIGURE 1
REVISION 1

QUESTION 5:

Criteria for Distinguishing Between "Contaminated" and "Uncontaminated Debris" – The LTP does not specifically identify what DCGLs or criteria will be used to distinguish between contaminated and uncontaminated debris. Considering that some of the debris will be used as fill material, please specifically identify the DCGLs, or criteria that will be used for distinguishing between contaminated and uncontaminated debris. In addition, provide an appropriate basis for the selected DCGLs. It should be noted that DCGLs developed for contaminated soil may not be acceptable for contaminated debris (e.g., concrete). Therefore, an appropriate basis needs to be provided for use of these DCGLs for other contaminated media.

[LTP References: Section 6.2.2; Decommissioning Cost Update, SNEF, document G01-1308-002, Rev 0, Selection 3.2.1 which is appended to LTP Chapter 7.]

RESPONSE:

Eight different types of media (including soils, re-fill materials and construction debris) have been assayed by Argonne National Laboratory (ANL) to determine their individual K_d values. The results of these analyses were reported in Table 3. The most conservative K_d values were selected and used as input parameters in the respective site surface and subsurface dose models. The modeling efforts have considered all K_ds for the different types of site materials including re-fill materials.

a) Dose modeling efforts have been completed to determine DCGLs for surface and subsurface areas. **Refer to GPU Nuclear's answer to RAI2 question 4 and Table 2 included in this submittal**. Based on dose modeling and K_d assayed results, one set of conservative and generic DCGL values have been developed for both the surface and subsurface models. These DCGL values include all soil, related debris, and refill materials found on site. Re-depositing slightly contaminated building debris, re-fill materials or soils in the saturated zone have been addressed in the subsurface dose model. All materials will meet established DCGL values for the respective region (surface and subsurface). Any surface soil or debris material released using $DCGL_{EMC}$ values based on site Area Factors will not be used as re-fill materials without further evaluation and permission from applicable regulatory agencies.

b) A sampling program will be implemented to monitor and control residual contamination levels in re-fill materials. The sampling program will be statistically based and be applied through the implementation of fully reviewed SNEC site procedures and/or work instructions. At least 5% of all samples collected would be analyzed for transuranic and HTD radionuclides as described in the SNEC LTP.

QUESTION 6:

Gross Activity DCGLs - Please develop gross activity DCGLs for surface contamination. If these DCGLs cannot be provided at this time, explain when and how gross activity DCGLs will be provided. If you do not plan to use gross activity DCGLs, explain in more detail.

[LTP References: Sections 5.2.3.2.3 and 5.2.3.2.4]

RESPONSE:

Gross activity DCGL values will be developed by applying the methodology described in the MARSSIM manual on page 4-9, equation 4-4 (or an equivalent form). The methodology used will consider all relevant emissions exhibiting threshold energies capable of entering the detector volume and causing a detectable pulse. In-growth of daughter radionuclides will also be considered as appropriate. Calculations documenting the appropriate gross activity DCGL value(s) for a selected area will be available for review at the SNEC site, prior to the start of Final Status Survey (FSS) work.

QUESTION 7:

Stream Sediment as a Potential Exposure Pathway - Please either: (a) describe remediation plans for sediment in the stream bed and demonstrate that radionuclide concentrations in stream sediments do not exceed background; or (b) include stream sediment, aquatic species, man as an exposure pathway in the derivation of DCGLs.

[LTP References: Table 2-19; Section 6.2.2.2, 6.2.2.6; App. 6.1 Section 4]

RESPONSE:

Historical wastewater discharges from the SNEC facility may have contributed to radiological contamination of the Juniata River. Work has been performed to characterize the nature and extent of possible radiological contamination by sampling sediments from likely areas where deposition may have occurred. Historical aerial photography, topographic mapping, and field reconnaissance activities were used to identify appropriate sample locations. **(Information related to this study was previously submitted to the NRC in GPU Nuclear letter E910-02-002, dated January 11, 2002.)** Table 5 lists the locations where samples were obtained. A total of 52 samples were obtained at 26 sampling locations. Sampling locations covered areas of interest such as upstream background areas, near field river sites, SNEC discharge tunnel out-fall, SNEC weir line out-fall and spray pond area.

Samples were analyzed for gamma emitters (specifically Cs-137 & Co-60). In addition, 5% of the samples were analyzed for applicable transuranic (TRU) alpha emitters and hard to detect (HTD) radionuclides that are representative of site liquid discharges. Tables 6 & 7 list the results of these analyses. Table 6 results indicate Cs-137 and Co-60 concentrations below or at background for all areas except the weir out-fall. Cs-137 concentrations directly under (Weir Site #1) and in front of (Weir Site #6) where the weir pipe was located indicated an average of 1.7 pCi/g. A small 25 m^2 area is estimated to be impacted and has been modeled to determine the recreation dose impact from the applicable pathways (fish, drinking water and direct) to man. Dose calculations are well below 25 mrem/yr. There were no TRU or HTD radionuclides (See Table 7) detected above background except naturally occurring uranium. Based on these results there is no remediation planned for this area.

Appendix 1 contains the RESRAD 6.1 input parameters and subsequent dose calculation for the recreation scenario and the 25 m^2 impacted area described above. The recreation scenario involves fishing (fish ingestion), swimming (drinking water ingestion) and direct (gamma dose from sediment in streambed). Recreation time is based on 67 hrs/yr per Reg. Guide 1.109. Since no other radionuclides were detected in the sediment only the dose from Cs-137 was calculated. The dose-to-source ratio was calculated to be 1.347E-3 mrem/yr per pCi/g for the fish-drinking water-direct dose pathways. In this case the dose range is calculated to be 2.3E-3 to 3.4E-3 mrem/yr based on the average and peak streambed sediment concentrations of 1.7 and 2.55 pCi/g respectively.

Table 5
Sediment Sampling Locations

Site Identification	Sample Identification	Latitude	Longitude	Sample Date	Sample Time	Sample Type
Weir 1	SXSD1472	40° 13' 42.539"	78° 14' 33.429"	10/10/01	855	Scoop
Weir 1	SXSD1473	40° 13' 42.539"	78° 14' 33.429"	10/10/01	900	Scoop
Weir 2	SXSD1474	40° 13' 43.417"	78° 14' 30.996"	10/10/01	1205	Scoop
Weir 2	SXSD1475	40° 13' 43.417"	78° 14' 30.996"	10/10/01	1215	Scoop
Weir 3	SXSD1476	40° 13' 43.491"	78° 14' 31.384"	10/10/01	1226	Scoop
Weir 3	SXSD1477	40° 13' 43.491"	78° 14' 31.384"	10/10/01	1232	Scoop
Weir 4	SXSD1478	40° 13' 43.676"	78° 14' 32.104"	10/10/01	1240	Scoop
Weir 4	SXSD1479	40° 13' 43.676"	78° 14' 32.104"	10/10/01	1245	Scoop
Weir 5	SXSD1480	40° 13' 42.832"	78° 14' 32.382"	10/10/01	1415	Suction
Weir 5	SXSD1481	40° 13' 42.832"	78° 14' 32.382"	10/10/01	1420	Suction
Weir 6	SXSD1545	40° 13' 42.597"	78° 14' 33.435"	10/18/01	817	Suction
Weir 6	SXSD1546	40° 13' 42.597"	78° 14' 33.435"	10/18/01	823	Suction
Discharge Tunnel 1	SXSD1482	40° 13' 43.548"	78° 14' 34.806"	10/10/01	1502	Scoop
Discharge Tunnel 1	SXSD1483	40° 13' 43.548"	78° 14' 34.806"	10/10/01	1508	Scoop
Discharge Tunnel 2	SXSD1484	40° 13' 43.561"	78° 14' 35.097"	10/10/01	1525	Scoop
Discharge Tunnel 2	SXSD1485	40° 13' 43.561"	78° 14' 35.097"	10/10/01	1535	Scoop
Discharge Tunnel 3	SXSD1486	40° 13' 42.284"	78° 14' 34.657"	10/10/01	1515	Ponar
Discharge Tunnel 3	SXSD1487	40° 13' 42.284"	78° 14' 34.657"	10/10/01	1530	Ponar
Discharge Tunnel 4	SXSD1488	40° 13' 42.440"	78° 14' 36.302"	10/10/01	1555	Ponar
Discharge Tunnel 4	SXSD1489	40° 13' 42.440"	78° 14' 36.302"	10/10/01	1605	Ponar
Discharge Tunnel 5	SXSD1490	40° 13' 42.116"	78° 14' 36.419"	10/10/01	1612	Scoop
Discharge Tunnel 5	SXSD1491	40° 13' 42.116"	78° 14' 36.419"	10/10/01	1615	Scoop
Spray Pond Lagoon	SXSD1498	40° 13' 27.614"	78° 14' 40.116"	10/11/01	1130	Core
Spray Pond Lagoon	SXSD1499	40° 13' 27.614"	78° 14' 40.116"	10/11/01	1155	Core
Spray Pond Bog	SXSD1500	40° 13' 28.015"	78° 14' 39.220"	10/11/01	1240	Ponar
Spray Pond Bog	SXSD1501	40° 13' 28.015"	78° 14' 39.220"	10/11/01	1242	Ponar
Site 1	SXSD1502	40° 13' 20.197"	78° 14' 35.441"	10/11/01	1310	Scoop
Site 1	SXSD1503	40° 13' 20.197"	78° 14' 35.441"	10/11/01	1313	Scoop
Site 2	SXSD1496	40° 13' 30.559"	78° 14' 43.783"	10/11/01	1018	Scoop
Site 2	SXSD1497	40° 13' 30.559"	78° 14' 43.783"	10/11/01	1022	Scoop
Site 3	SXSD1494	40° 13' 32.130"	78° 14' 45.129"	10/11/01	1007	Ponar
Site 3	SXSX1495	40° 13' 32.130"	78° 14' 45.129"	10/11/01	1010	Ponar
Site 4	SXSD1492	40° 13' 36.644"	78° 14' 46.519"	10/11/01	947	Scoop
Site 4	SXSD1493	40° 13' 36.644"	78° 14' 46.519"	10/11/01	954	Scoop
Site 5	Deleted due to redundancy with discharge tunnel sampling.					
Site 6	SXSD1506	40° 13' 56.499"	78° 13' 53.996"	10/15/01	1415	Core
Site 6	SXSD1507	40° 13' 56.499"	78° 13' 53.996"	10/15/01	1430	Core
Site 7	SXSD1508	40° 13' 59.081"	78° 13' 48.768"	10/15/01	1510	Core
Site 7	SXSD1509	40° 13' 59.081"	78° 13' 48.768"	10/15/01	1532	Core
Site 8	SXSD1535	40° 14' 01.520"	78° 13' 39.818"	10/16/01	946	Core
Site 8	SXSD1536	40° 14' 01.520"	78° 13' 39.818"	10/16/01	1014	Core
Site 9	SXSD1504	40° 13' 57.580"	78° 13' 24.309"	10/16/01	1200	Core
Site 9	SXSD1505	40° 13' 57.580"	78° 13' 24.309"	10/16/01	1216	Core
Site 10	SXSD1470	40° 14' 16.367"	78° 13' 15.900"	10/9/01	1530	Core
Site 10	SXSD1471	40° 14' 16.367"	78° 13' 15.900"	10/9/01	1600	Core
Site 11	SXSD1547	40° 14' 54.757"	78° 13' 49.096"	10/18/01	1116	Core
Site 11	SXSD1548	40° 14' 54.757"	78° 13' 49.096"	10/18/01	1200	Core
BKG - 1	SXSD1537	40° 09' 25.063"	78° 15' 22.185"	10/17/01	940	Core
BKG - 1	SXSD1538	40° 09' 25.063"	78° 15' 22.185"	10/17/01	955	Core
BKG - 2	SXSD1539	40° 12' 12.494"	78° 15' 46.467"	10/17/01	1300	Ponar
BKG - 2	SXSD1540	40° 12' 12.494"	78° 15' 46.467"	10/17/01	1315	Ponar
BKG - 3	SXSD1543	40° 11' 47.708"	78° 15' 04.959"	10/17/01	1355	Ponar
BKG - 3	SXSD1544	40° 11' 47.708"	78° 15' 04.959"	10/17/01	1405	Ponar

Table 6
Juniata River Sediment Gamma Spec Results

SAMPLE ID	HpGe ID #	SAMPLE DATE	TIME	DESCRIPTION/LOCATION	Cs-137 (pCi/g)	Co-60 (pCi/g)
*** 1472**	3-9330	10/10/01	855	**WEIR SITE #1**	**2.55**	< 0.08
1473	2-9329	10/10/01	900	WEIR SITE #1	**1.07**	< 0.06
1474	3-9327	10/10/01	1205	WEIR SITE #2	< 0.07	< 0.07
1475	2-9326	10/10/01	1215	WEIR SITE #2	**0.05**	< 0.055
1476	1-9325	10/10/01	1226	WEIR SITE #3	< 0.039	< 0.05
1477	1-9338	10/10/01	1232	WEIR SITE #3	< 0.06	< 0.05
1478	2-9339	10/10/01	1337	WEIR SITE #4	< 0.06	< 0.05
1479	1-9328	10/10/01	1245	WEIR SITE #4	< 0.05	< 0.04
1480	1-9344	10/10/01	1415	WEIR SITE #5	**0.15**	< 0.04
1481	1-9345	10/10/01	1420	WEIR SITE #5	**0.08**	< 0.04
1545	1-9412	10/18/01	817	WEIR SITE #6	**1.8**	< 0.05
1546	2-9413	10/18/01	823	WEIR SITE #6	**1.2**	< 0.07
1482	2-9346	10/10/01	1502	DISCHARGE TUNNEL #1	**0.07**	< 0.06
1483	2-9354	10/10/01	1508	DISCHARGE TUNNEL #1	< 0.07	< 0.07
1484	3-9352	10/10/01	1525	DISCHARGE TUNNEL #2	< 0.09	< 0.07
1485	2-9366	10/10/01	1535	DISCHARGE TUNNEL #2	< 0.04	< 0.07
1486	3-9356	10/10/01	1515	DISCHARGE TUNNEL #3	< 0.05	< 0.06
1487	2-9348	10/10/01	1530	DISCHARGE TUNNEL #3	< 0.045	< 0.06
1488	1-9371	10/10/01	1555	DISCHARGE TUNNEL #4	< 0.05	< 0.04
1489	2-9372	10/10/01	1605	DISCHARGE TUNNEL #4	< 0.06	< 0.06
1490	3-9349	10/10/01	1612	DISCHARGE TUNNEL #5	< 0.06	< 0.06
1491	2-9351	10/10/01	1615	DISCHARGE TUNNEL #5	< 0.06	< 0.06
1498	1-9369	10/11/01	1130	SPRAY POND LAGOON	< 0.06	< 0.05
1499	2-9364	10/11/01	1155	SPRAY POND LAGOON	< 0.06	< 0.07
1500	1-9367	10/11/01	1240	SPRAY POND BOG	< 0.06	< 0.06
1501	1-9363	10/11/01	1242	SPRAY POND BOG	< 0.14	< 0.12
1502	1-9365	10/11/01	1310	RIVER SITE #1	< 0.04	< 0.05
1503	1-9361	10/11/01	1313	RIVER SITE #1	< 0.05	< 0.05
1496	3-9358	10/11/01	1018	RIVER SITE #2	< 0.05	< 0.08
1497	3-9362	10/11/01	1022	RIVER SITE #2	< 0.1	< 0.1
1494	3-9360	10/11/01	1007	RIVER SITE #3	< 0.1	< 0.09
1495	2-9357	10/11/01	1010	RIVER SITE #3	< 0.1	< 0.09
1492	2-9370	10/11/01	947	RIVER SITE #4	< 0.08	< 0.07
1493	1-9347	10/11/01	954	RIVER SITE #4	< 0.047	< 0.057
1506	1-9397	10/15/01	1415	RIVER SITE #6	**0.07**	< 0.04
1507	2-9399	10/15/01	1430	RIVER SITE #6	< 0.053	< 0.055
1508	1-9390	10/15/01	1510	RIVER SITE #7	< 0.05	< 0.04
1508-B	2-9403	10/15/01	1510	RIVER SITE #7	< 0.06	< 0.05
1509	2-9391	10/15/01	1532	RIVER SITE #7	< 0.06	< 0.06
1509-B	1-9402	10/15/01	1532	RIVER SITE #7	< 0.04	< 0.03
1535	2-9386	10/16/01	946	RIVER SITE #8	**0.09**	< 0.06
1536	1-9387	10/16/01	1014	RIVER SITE #8	**0.11**	< 0.05
*** 1504**	1-9392	10/15/01	1200	**RIVER SITE #9**	**0.16**	< 0.04
1505	2-9393	10/15/01	1216	RIVER SITE #9	< 0.06	< 0.06
1470	1-9333	10/9/01	1530	RIVER SITE #10	**0.13**	< 0.037
1471	2-9334	10/9/01	1600	RIVER SITE #10	< 0.044	< 0.04
1547	1-9420	10/18/01	1116	RIVER SITE #11	< 0.03	< 0.04
1548	2-9416	10/18/01	1200	RIVER SITE #11	< 0.049	< 0.063
*** 1537**	2-9419	10/17/01	940	**BKG #1 RIDDLESBURG**	**0.08**	< 0.07
1538	2-9421	10/17/01	955	BKG #1 RIDDLESBURG	< 0.07	< 0.07
1539	2-9423	10/17/01	1300	BKG #2 WARRIORS PATH	**0.07**	< 0.06
1540	1-9418	10/17/01	1315	BKG #2 WARRIORS PATH	**0.09**	< 0.05
1543	1-9422	10/17/01	1355	BKG #3 WARRIORS PATH	**0.01**	< 0.04
1544	1-9414	10/17/01	1405	BKG #3 WARRIORS PATH	< 0.04	< 0.05

Areas with a < symbol are less than MDA.
* TRU analyses performed on these samples (Ref. BWXT Report #0110089).

Table 7
Juniata River Sediment TRU/HTD Results

Results (pCi/g)						
Isotope		Weir #1		River Site #9		Bkg #1 (Riddlesburg)
H-3	<	1.02E+01	<	1.01E+01	<	9.62E+00
C-14	<	4.58E+00	<	4.82E+00	<	4.94E+00
Fe-55	<	1.19E+00	<	3.21E-01	<	1.61E-01
Ni-59	<	5.20E+00	<	1.34E+01	<	5.74E+00
Ni-63	<	7.46E+00	<	6.94E+00	<	7.98E+00
Sr-90	<	1.40E-02	<	1.00E-02	<	1.00E-02
Tc-99	<	5.56E-01	<	2.05E+00	<	1.25E+00
I-129	<	1.35E+00	<	1.46E+00	<	1.27E+00
Np-237	<	3.41E-03	<	5.45E-03	<	1.03E-02
Pu-242	<	3.41E-03	<	4.35E-03	<	3.56E-03
Pu-239/240	<	3.41E-03	<	3.12E-03	<	3.56E-03
Pu-238	<	3.41E-03	<	3.48E-03	<	3.56E-03
Pu-241	<	9.60E-01	<	1.06E+00	<	1.15E+00
Am-243	<	5.13E-03	<	2.83E-03	<	3.50E-03
Am-241	<	4.89E-03	<	2.83E-03	<	3.50E-03
Cm-244	<	3.70E-03	<	3.16E-03	<	3.50E-03
Cm-242	<	5.72E-03	<	3.02E-03	<	3.72E-03
U-234		4.30E-01		5.29E-01		7.70E-01
U-235		2.30E-02		1.24E-02		1.81E-02
U-238		3.11E-01		4.12E-01		4.95E-01
Co-60		2.00E-02	<	2.74E-02	<	1.37E-02
Nb-94	<	1.08E-02	<	2.36E-02	<	1.13E-02
Sb-125	<	3.83E-02	<	5.90E-02	<	3.11E-02
Cs-134	<	1.57E-02	<	3.86E-02	<	2.04E-02
Cs-137		2.87E+00		1.54E-01		6.62E-02
Ce-144	<	8.78E-02	<	1.32E-01	<	8.73E-02
Eu-152	<	6.24E-02	<	1.39E-01	<	6.86E-02
Eu-154	<	4.20E-02	<	9.41E-02	<	4.66E-02
Eu-155	<	4.69E-02	<	6.98E-02	<	3.26E-02

Shaded areas denote positive results.
Areas with a < symbol are less than MDA.
Reference BWXT Report # 0110089, November 13, 2001

QUESTION 8:

Resident Farmer Source Term Configuration- Please revise the LTP to clarify if the configuration of contaminated material proposed for the resident farmer dose analysis takes into account any radioactive material that will be associated with buried debris and if contaminated material will be buried in the saturated zone. If contaminated material will be buried in the saturated zone, information must be provided on the effect this would have on soil DCGLs.
[LTP References: Table 2-19; Section 6.2.2]

RESPONSE:

Soil, refill and debris materials have been analyzed by ANL to determine the respective K_d values (See Table 3). DCGLs for the subsurface model (saturated zone) have been developed for GPU Nuclear by URS Corporation using conservative K_d values that were determined by ANL. Appendix 2 provides the URS report on calculation of the SNEC sub-surface DCGLs. The results of these subsurface DCGLs are listed in Table 8 for the respective configurations. Surface DCGL values have also been developed by GPU Nuclear. The RESRAD input parameters used by both models were similar. Conservative K_ds were selected from all the media (soil, refill and debris materials) test results and applied to both the surface and subsurface models. Results from the dose calculations showed DCGL values for gamma emitters were more conservative in the surface model while most of the alpha emitters, C-14 and H-3 values were more conservative in the subsurface model. The shaded radionuclides listed in Table 8, minimum site subsurface DCGL column, have been combined with the surface model DCGLs to form a single list of DCGLs to be used at SNEC. This new DCGL list is represented in Table 2. For the resident farmer scenario the use of these conservative DCGLs takes into account any radioactive material that will be associated with buried debris in the saturated zone. These DCGL values results will be incorporated into the next LTP revision.

Table 8

Subsurface DCGL Results

	BEDROCK LAYER below CV, Steam Plant, and Spray Pond		OVERBURDEN LAYER near CV, near Steam Plant, and below Spray Pond	MINIMUM SITE SUBSURFACE DCGL
NUCLIDES OF CONCERN	DCGL based on 25 mrem/yr all-pathway standard	DCGL based on 4 mrem/yr drinking-water standard	DCGL based on 25 mrem/yr all-pathway standard	
Am-241	2.8E+02	4.5E+01	1.8E+01	1.8E+01
C-14	1.9E+02	3.1E+01	8.9E+01	3.1E+01
Cm-243	6.1E+03	9.7E+02	1.2E+02	1.2E+02
Cm-244	3.5E+03	5.6E+02	1.8E+02	1.8E+02
Co-60	2.5E+05	4.1E+04	2.1E+01	2.1E+01
Cs-134	3.5E+16	5.6E+15	2.9E+01	2.9E+01
Cs-137	5.9E+06	9.4E+05	5.1E+01	5.1E+01
Eu-152	2.5E+07	3.9E+06	5.4E+01	5.4E+01
Eu-154	6.1E+07	9.8E+06	5.0E+01	5.0E+01
Eu-155	4.8E+09	7.7E+08	2.1E+03	2.1E+03
Fe-55	7.6E+22 *	7.6E+22 *	1.7E+05	1.7E+05
H-3	8.6E+03	1.4E+03	8.9E+03	1.4E+03
Nb-94	2.3E+03	3.7E+02	3.8E+01	3.8E+01
Ni-59	1.3E+06	2.1E+05	1.7E+04	1.7E+04
Ni-63	1.6E+07	2.5E+06	6.3E+03	6.3E+03
Pu-238	4.2E+01	6.7E+00	1.1E+02	6.7E+00
Pu-239	9.4E+00	1.5E+00	1.0E+02	1.5E+00
Pu-240	9.7E+00	1.6E+00	1.0E+02	1.6E+00
Pu-241	7.0E+03	1.1E+03	3.4E+03	1.1E+03
Pu-242	9.7E+00	1.6E+00	1.1E+02	1.6E+00
Sb-125	1.0E+02	1.6E+01	1.5E+02	1.6E+01
Sr-90	2.6E+01	4.2E+00	7.0E+00	4.2E+00
Tc-99	2.1E+02	3.3E+01	5.4E+01	3.3E+01
U-234	1.2E+01	1.9E+00	4.6E+02	1.9E+00
U-235	1.2E+01	1.9E+00	2.5E+02	1.9E+00
U-238	1.2E+02	2.0E+00	1.4E+03	2.0E+00

* Nuclide Specific Activity Limit

[shaded] Shaded minimum DCGL values combined with site surface model DCGL list.

QUESTION 9:

Water Resources- Surface Water and Sediments - Please provide additional information (i.e. sample data from outfall sediments) regarding the potential presence of alpha emitters at historic outfalls.

[LTP References: Chapter 8 of the LTP-- See section 5.5 pp. 5-3 through 5-5 of the "SNEC Facility Decommissioning Env Report, Rev 1, Feb 2000." Also, Chapter 5.0 of the LTP, section 5.2.1. Alpha emitters are also indirectly referenced in LTP when (TRU) nuclides are listed in Table 2-1, pg. 2-24; mentioned in section 5.2.1; pg. 5-2; Table 5-1, pg. 5-6; and Table 5-4, pg. 5-19. Furthermore sections 2.2.4.5, Groundwater, through Section 2.3.1, Summary of Soil Results, focus the discussion of gamma emitting radionuclides. However, the TRU nuclides are not discussed. Finally, section 5.5.3.6, Hard-to-detect Radionuclides, discusses gamma detection but does not discuss either alpha or beta detection.

RESPONSE:

Reference GPU's response to RAI2, question 7 and Tables 5, 6 & 7 included in this submittal. Analyses for alpha emitting radionuclides were conducted on samples taken from the Juniata river at three locations, i.e. approximately 6 miles upstream (Bkg #1 Riddlesburg) from SNEC, the weir discharge out-fall (Weir Site #1) and a sediment bed (Site #9) approximately 1.4 miles downstream from the site. There were no alpha emitting radionuclides detected in any of the samples except naturally occurring uranium (Table 7).

Table 5 lists the locations of the two historical outfalls, i.e. the Discharge Tunnel and the Weir site, from which riverbed and shoreline sediment samples were obtained. Twenty-two (22) samples were taken from these two outfall areas and screened for radioactivity above background (Table 6). The presence of Cs-137 activity was used as an indicator to determine if additional analyses for alpha emitters should be conducted. Upstream and downstream samples were also evaluated.

All samples taken in the vicinity of the Discharge Tunnel outfall were less or equal to 0.07 pCi/g Cs-137, well below typical background concentrations. Therefore, analyses for alpha emitters were not performed.

The Weir site, which is approximately 300 feet downstream of the Discharge Tunnel, had a sample, which indicated the presence of elevated Cs-137 activity. This sediment sample had the highest Cs-137 concentration (2.55 pCi/g) and was analyzed for alpha emitters.

Another location (Site 9 near field), downstream of the Weir site, was selected to have its sample analyzed for alpha emitters for two reasons.

1.) It was located in the vicinity of a recessed area along the right bank of the Juniata River. It was determined that such a recessed area could have been an important depositional feature during the operational period of the SNEC facility. After probing the substrate in this area a significant core sample of soft sediment deposit was obtained.
2.) Cs-137 concentration in this sample was 0.16 pCi/g, the highest concentration of all near field river samples.

Appendix 1

RESRAD 6.1 Calculation for Juniata River Recreation Dose

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose/Source Ratio = 1.347E-3 $\frac{mrem/yr}{pCi/s}$

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.500E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	3.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	5.640E+00	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m) - Water	3.000E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.000E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	3.000E-04	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.600E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.360E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.230E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.600E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	1.000E-04	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	0.000E+00	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E-05	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	0.000E+00	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E-04	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.600E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.800E-02	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.360E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	6.791E+01	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.600E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E-05	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	0.000E+00	2.500E+02	---	UW
R015	Number of unsaturated zone strata	0	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	2.131E+03	1.000E+03	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	2.131E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.776E-09	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration (yr)	1.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site) 67 hrs/yr	7.650E-03	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD SHAPE(
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD SHAPE(
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD SHAPE(1
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD SHAPE(1
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(1
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	2.060E+01	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	0.000E+00	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr) (Prorated to 67 hrs/yr)	5.000E+00	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	1.000E+00	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	1	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions

Area:	25.00 square meters
Thickness:	0.30 meters
Cover Depth:	0.30 meters

Initial Soil Concentrations, pCi/g

Cs-137	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.347E-03	1.316E-03	1.257E-03	1.069E-03	6.734E-04	1.336E-04	1.315E-06	1.244E-13
M(t):	5.387E-05	5.264E-05	5.026E-05	4.276E-05	2.693E-05	5.344E-06	5.261E-08	4.977E-15

Maximum TDOSE(t): 1.347E-03 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.347E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.347E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.347E-03
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.347E-03

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.316E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.316E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.316E-03
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.316E-03

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.257E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.257E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-03
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-03

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.069E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.069E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.069E-03
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.069E-03

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	6.734E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	6.734E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.734E-04
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.734E-04

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.336E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.336E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.336E-04
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.336E-04

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.315E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.315E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.315E-06
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.315E-06

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	1.244E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	1.244E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-13
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-13

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.347E-03	1.316E-03	1.257E-03	1.069E-03	6.734E-04	1.336E-04	1.315E-06	1.244E-13

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	1.856E+04	1.900E+04	1.990E+04	2.339E+04	3.713E+04	1.871E+05	1.901E+07	*8.701E+13

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.000E+00	0.000E+00	1.347E-03	1.856E+04	1.347E-03	1.856E+04

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.347E-03	1.316E-03	1.257E-03	1.069E-03	6.734E-04	1.336E-04	1.315E-06	1.244E-13

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.000E+00	9.772E-01	9.330E-01	7.937E-01	5.000E-01	9.921E-02	9.766E-04	9.240E-11

BRF(i) is the branch fraction of the parent nuclide.

RESCALC.EXE execution time = 258.70 seconds

Appendix 2

Calculation of Sub-Surface DCGLs for the Saxton Nuclear Experimental Corporation Site.

RAE-42613-003-5030-2
DRAFT FINAL

CALCULATION OF SUB-SURFACE DCGLs FOR THE SAXTON NUCLEAR EXPERIMENTAL CORPORATION SITE

Prepared for

GPU Nuclear, Inc.
Route 441 South
Middletown, PA 17057-0480

January 29, 2002

ROGERS & ASSOCIATES ENGINEERING BRANCH
URS CORPORATION
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1. INTRODUCTION

The Saxton Nuclear Experimental Corporation (SNEC) operated a 23.5-megawatt thermal pressurized water research and training reactor from 1962 to 1972 at its facility near Saxton, PA. As is shown in Figure 1-1, the reactor was located adjacent to a steam-turbine electric generating station that operated from 1924 to 1972. Since the reactor shutdown, GPU Nuclear, Inc. (GPU) has assisted SNEC in removing and disposing of the reactor fuel and internal parts and in characterizing and decontaminating large portions of the site. In preparing to terminate the Nuclear Regulatory Commission (NRC) license for the site, GPU determined Derived Concentration Guideline Levels (DCGLs) for the top meter of site soil that correspond to the 25 mrem/year total radiation dose limit prescribed by NRC for site cleanup and the 4 mrem/year dose limit for drinking water. GPU contracted with URS Corporation (URS) to develop and apply a conceptual model and methodology to determine DCGLs for the sub-surface zone below the top meter of soil at the site and for the top 0.3 m of sediments in a region of the Juniata River near the water discharge tunnel.

1.1 CONTAMINANT HISTORY

Radioactive materials are considered to have been on the SNEC Site from the time the site was licensed in 1962 by NRC to possess such materials and fuel the reactor. The operational history of the site indicates that the area (approximately 60 m x 75 m) around the reactor Containment Vessel (CV) included a Control and Auxiliary Building, a Radioactive Waste Disposal Facility, an underground pipe tunnel, a drum storage bunker, and a refueling water storage tank (GPU, 2000a,b). These facilities were decontaminated in 1987 – 1989 and all but

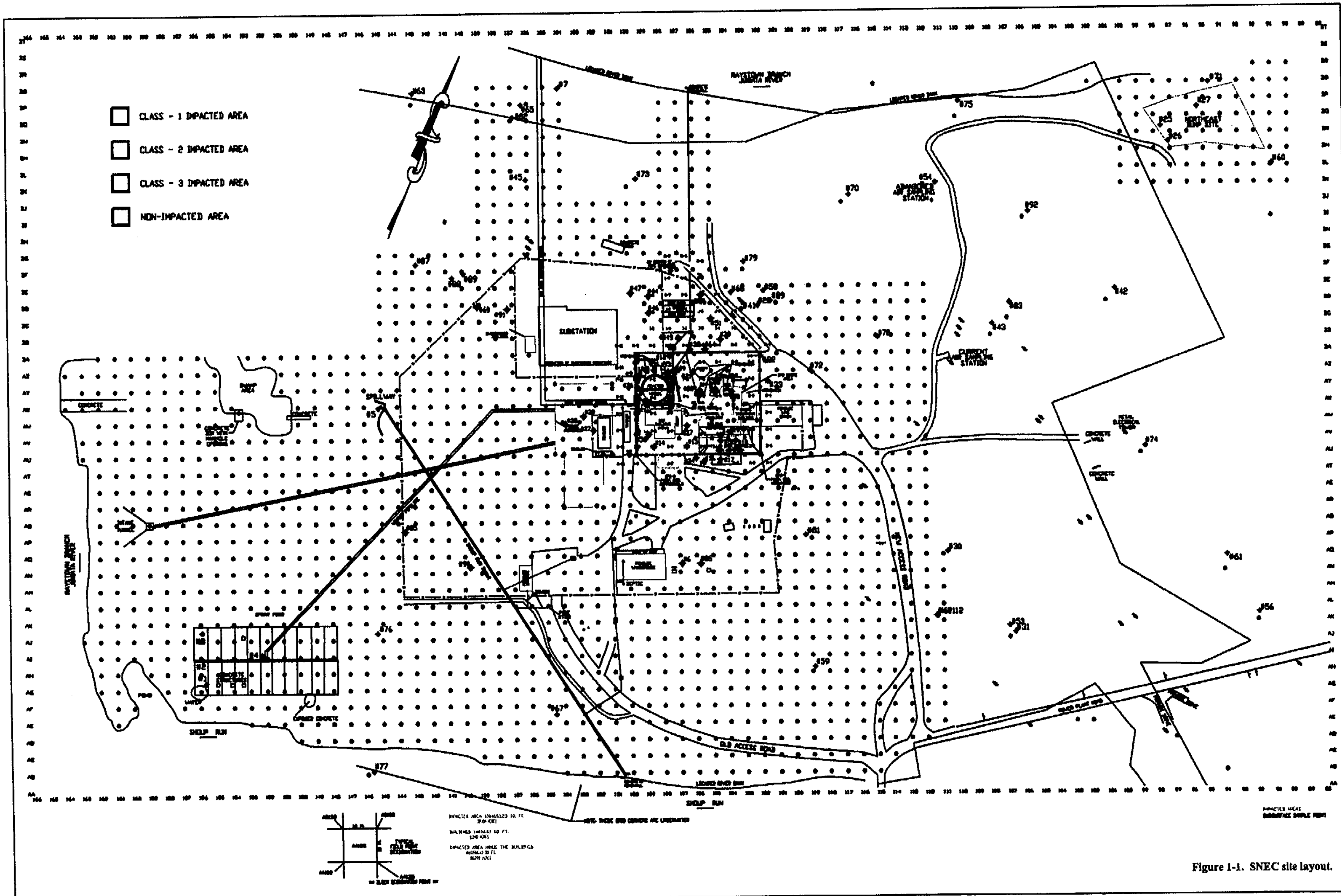

Figure 1-1. SNEC site layout.

the CV were demolished in 1992 after acceptance of a final release survey by NRC (NRC, 1992). The soils removed around the CV and structures were replaced with clean backfill soil. Although there is no evidence of leakage from the CV itself, the contamination removed from the areas surrounding the outside of the CV suggests the occurrence of surface spills and leaks from buried piping and tunnels.

The Steam Plant features underground concrete intake and discharge tunnels to cycle cooling water from the nearby Raystown Branch of the Juniata River (River). Since the reactor steam contained low levels of radioactivity, further contamination occurred when the steam was utilized in the generating station. When reactor steam was utilized in the station, low levels of radioactivity were cycled through the plant discharge tunnel. There is also a possibility that radioactive contamination occurred in the intake tunnel from warm discharge water that was recycled through the intake tunnel to avoid ice buildups during cold winter periods. Although radioactivity levels in the discharge tunnel were low enough to satisfy the radiation regulations then in effect, some radioactivity tended to accumulate in some Steam Plant structures, tunnel sediments, and surrounding soils near concrete cracks and joint leaks.

A Spray Pond was operated approximately 260 m southwest of the CV to cool water from the steam plant during summer months before release to the River. The pond consisted of arrays of pipes and spray nozzles covering a 40 m x 90 m area of surface soil. The radioactivity in the heated water could have been released and accumulated in the soils in the spray pond vicinity. Some building rubble from demolition of the Steam Plant also was disposed in the former Spray Pond area.

The River water rapidly dilutes any traces of radioactivity released from the Steam Plant discharge tunnel, the spray pond effluent, and any ground-water effluents. However, it may be possible for low levels of radioactivity to accumulate in river sediments. The River flows 3 to 4

miles north where it empties into Raystown lake, which was formed in 1973 by damming the River. The River is used extensively for recreation and fishing.

The primary radionuclides identified in analyses of steam plant sediments and soils in the CV vicinity are H-3, Sr-90, Co-60, Cs-137, and Am-241. Additional radionuclides have also been observed in one or more site samples or have been hypothesized to occur in contaminated materials, as listed in Table 1-1. All of these radionuclides will be analyzed for estimating river-sediment and site-subsurface DCGLs.

1.2 OBJECTIVE AND SCOPE

This draft report presents the DCGLs developed by URS for the SNEC Site materials deeper than one meter and the near-surface River sediments adjacent to the SNEC Site. Included in this report is a summary of the input parameters chosen to represent the SNEC Site hydrology and meteorology. URS developed these analysis inputs from reviews of historical and current technical reports furnished by GPU and in consultation with GPU personnel and their hydrologic consultant. The DCGLs are designed to satisfy the 25 mrem/year total dose limit and 4 mrem/year drinking water dose limit for members of the general public that could receive the maximum radiation exposures from the SNEC Site and adjacent section of the River and their environments. Additionally, the use of a single set of radionuclide DCGLs for all Site decontamination efforts is explored.

Table 1-1

Radionuclides observed in site samples.

H-3	Sr-90	Eu-152	Pu-238	Cm-243
C-14	Nb-94	Eu-154	Pu-239	Cm-244
Fe-55	Tc-99	Eu-155	Pu-240	
Ni-59	Sb-125	U-234	Pu-241	
Co-60	Cs-134	U-235	Pu-242	
Ni-63	Cs-137	U-238	Am-241	

2. CONCEPTUAL MODEL

The conceptual models of the Site and River are based upon available site characteristics. These characteristics have been observed through hydrologic well logging activities, and in-situ and laboratory analyses of site soils and river sediments. These characteristics are used to identify four representative areas of concern. Conceptual models for these four areas are summarized below and documented in further detail by URS (URS, 2001).

2.1 SITE HYDROGEOLOGY

Well logs show the near-surface hydrogeology to be a consistent pattern of three distinct layers of materials, (A) Fill, (B) Overburden, and (C) Bedrock (illustrated in Figure 2-1). Previous geotechnical and hydrologic investigations provided to URS by GPU identify the characteristics of these materials (H&A, 2001).

The Fill layer near the CV, Steam Plant, and Spray Ponds has been observed to be 0.46 to 1.22 meters thick. It is represented for modeling purposes to be about 1 meter thick with a range from about 0.4 to 2 meters over the larger site area. The Fill generally consists of well-graded silty and clayey fine to coarse sand with fine to medium gravel. In some areas, it also contains a well-graded mixture of ash and cinders from the former Steam Plant. In remediated areas near the CV and Steam Plant, clean backfill from an off-site source comprises the top meter. The Fill is estimated to have a total porosity of 0.46 (range from 0.35 to 0.56), an effective porosity of 0.41 (range from 0.28 to 0.54), a field capacity of 0.136 (range from 0.079 to 0.192), and a hydraulic conductivity of 32.3 meters/year. Although generally unsaturated, higher water levels during significant rainfall events cause periods of transient saturation. Because of the relative

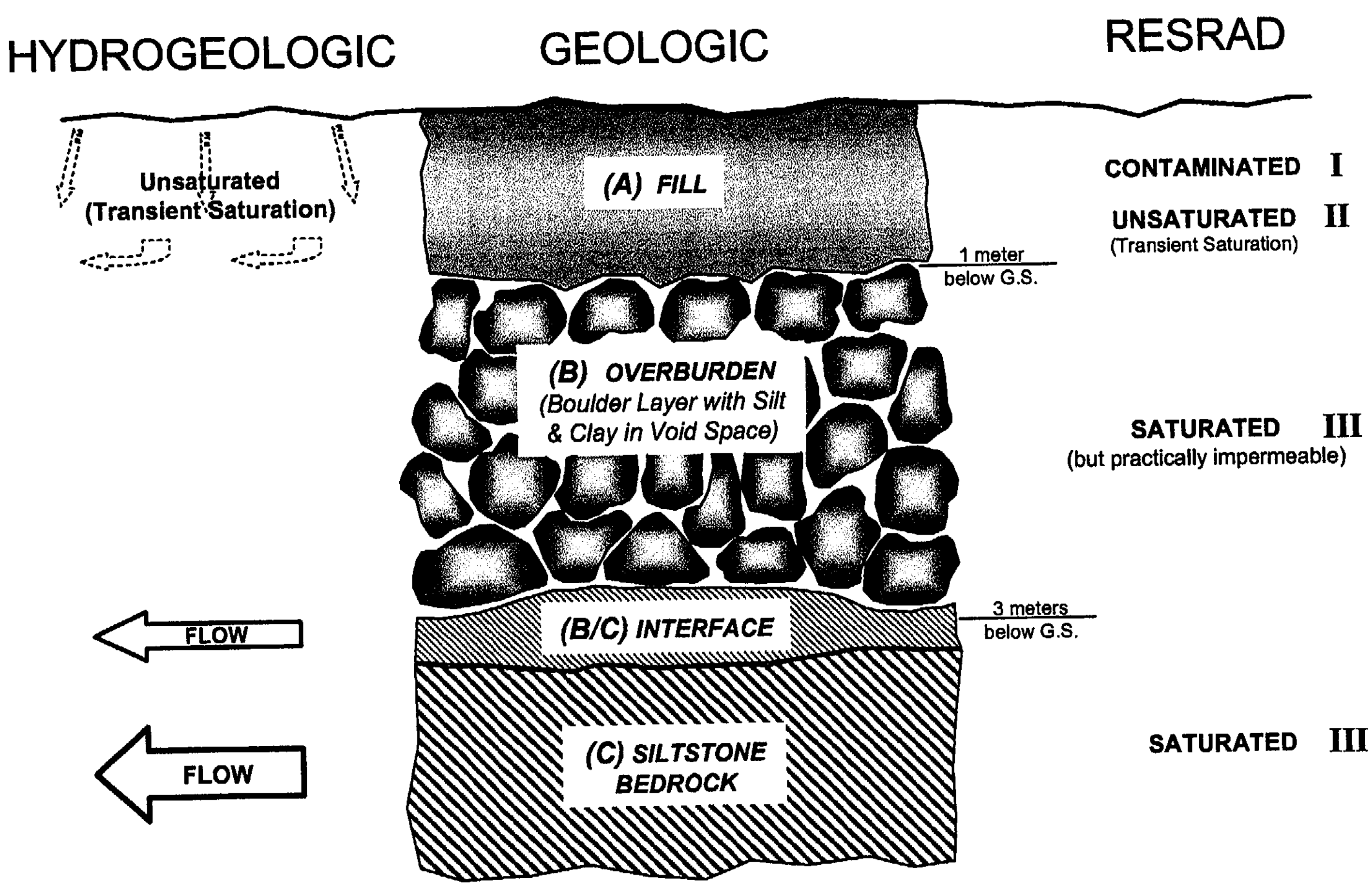

Figure 2-1. Conceptual representation of the hydrogeology at the SNEC site.

impermeability of the Overburden layer below the Fill soil, any water movement in the Fill is considered to be generally horizontal (down-gradient toward the River).

The Overburden or boulder layer thickness is observed to range from less than 1 meter to about 3 meters and is represented for modeling purposes by about 2 meters. The Overburden features rounded boulders interspersed with a dense mixture of sand, silt and clay. The boulders consist of hard quartzite with negligible porosity. The Overburden behaves like glacial till, with a low permeability on the order of 10^{-7} cm/s (0.032 m/y). Its bulk or total porosity is estimated at 0.10 to 0.15. Hydraulic gradients in the Overburden range from 0.02 to 0.03 based on gradients between the Site, tunnel, and river. The Overburden acts as a hydraulic barrier to flow between the Fill and Bedrock in undisturbed areas.

The Bedrock consists of fractured and weathered siltstone that begins at depths of 2.1 to 5.5 meters below the surface and is believed to extend to depths of more than several dozen meters. Saturated groundwater flow in the Bedrock generally occurs along bedding planes and within its fractures. The total porosity of the Bedrock ranges from 0.21 to 0.41 and the effective porosity is measured at approximately 0.0275. Hydraulic gradients in the Bedrock range from 0.013 to 0.03 based on gradients between the Site, tunnel, and river. The hydraulic conductivity of the Bedrock for fracture flow is estimated to be 67.9 meters/year.

The site hydrology is dominated by westward flow toward the River in both the Fill and the Bedrock. Intermittent water in the fill layer, including infiltrating water, is bounded on the bottom by the low-permeability Overburden, which isolates the water from the Bedrock in undisturbed areas. The Bedrock features saturated water flow in the B/C interface and in Bedrock fractures and bedding planes. Although the Bedrock water flow probably extends throughout the deeper parts of the Bedrock, the regional gradient promotes relatively horizontal flow in the top 20 meters that drains to the River. The Bedrock is intersected by the CV, which extends

approximately 15 m beneath the surface, and by the basement of the Steam Plant, which extends approximately 7.5 m beneath the surface. Utility tunnels near the CV also extend into the Bedrock, as do the plugged intake and drainage tunnels that connect the Steam Plant basement to the River. The disturbances of the Overburden layer in constructing the CV, Steam Plant, and concrete tunnels cause high-permeability zones at their interfaces with the Overburden that hydraulically connect the Fill and Bedrock.

2.2 AREAS OF CONCERN

Four areas of concern were selected to represent the parts of the SNEC Site that have the greatest potential to cause present or future radiation exposure to members of the public. These areas are illustrated in Figure 2-2. They include the CV area, the Steam Plant area, the Spray Pond area, and the Juniata River. These areas were chosen to represent the site because of their potential for elevated radionuclide concentrations or their association with radiation exposure pathways.

2.2.1 CV Area

The CV Area is defined to include the area of the CV and the former auxiliary and waste management operations. This area is of concern because it was the original source of most man-made radioactivity at the site and because it contains backfill that hydraulically connects the Fill layer and the Bedrock. Although the reactor core, most internal structures and auxiliary facilities, and surrounding contaminated soils have been removed and disposed, potential residual contamination of soils and ground water that originated in this area may still remain.

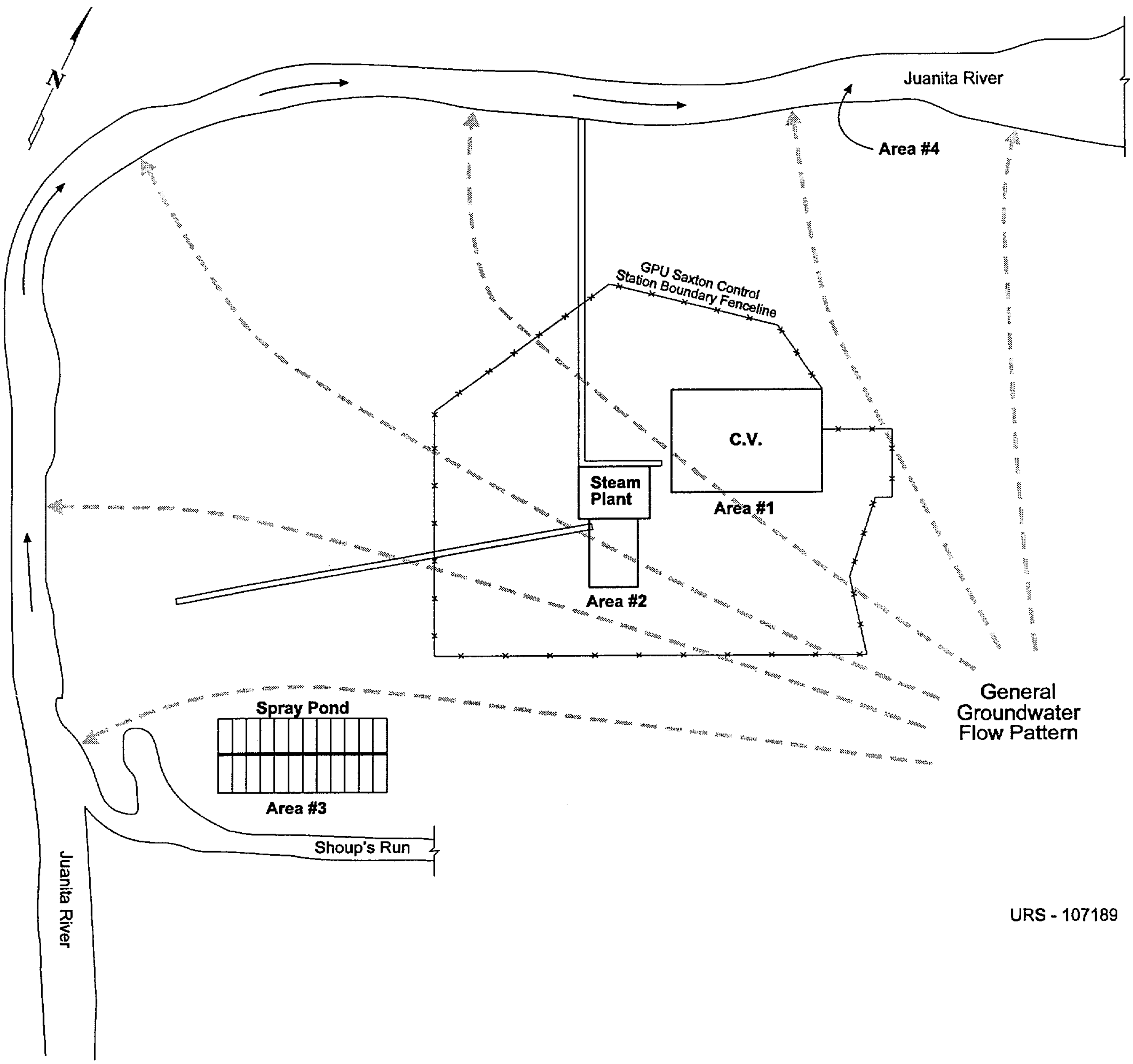

Figure 2-2. Areas of concern at the SNEC site.

It is therefore considered the area with greatest potential for elevated levels of residual radioactivity. The potential hydraulic connections along CV and tunnel interfaces with native materials could allow migration of any contaminants into the Fill layer, the Bedrock, or both.

2.2.2 Steam Plant Area

The Steam Plant Area is defined to include the existing basement of the Steam Plant and the underground intake and discharge tunnels that connect the former plant basement to the River. This area was selected because it received reactor steam, it was a conduit for discharging reactor secondary cooling water, it is hydraulically connected with the CV Area, it contains sediments and sumps with trace Cs-137 and other contaminants, and it contains channels that hydraulically connect the Fill-layer and the Bedrock. The Steam Plant basement was filled with demolition rubble from the former Steam Plant building. Although presently removed for surveys and sampling, one closure option calls for replacing the rubble into the basement and covering it. Potential residual contamination of soils, debris, and ground water may remain in this area or may occur from seepage through plugged tunnels from the CV Area.

The intake and discharge tunnels that connect the Steam Plant to the River affect migration of water and potential contaminants from other parts of the site. The tunnels generally feature a permeable zone along their exterior boundaries owing to less-compact backfill and removal of clays from the Overburden cobbles during tunnel construction. The intake tunnel (1.8 m x 2.4 m) is sufficiently large to intersect the Fill and Overburden layers in some areas and the Overburden-Bedrock interface in others. The intake tunnel hydraulically connects the Fill-layer and Bedrock over its entire length. The discharge tunnel has similar size and acts as a permeable path that intercepts Fill-layer water from the CV Area and diverts it to the River via the permeable zone along its exterior. The discharge tunnel hydraulically connects the Fill and Bedrock layers along approximately half its length near the Steam Plant and remains in the Fill

and Overburden layers in areas closer to the River. The tunnels can therefore conduct contaminants from the permeable basement of the Steam Plant into the Fill layer, the Bedrock, or both.

2.2.3 Spray Pond Area

The Spray Pond area is defined to include the approximate 40 m x 90 m footprint of the former Spray Pond. It was selected because it seasonally received cooling water from the Steam Plant and it was later covered with building rubble from the Steam Plant. The original surface soils remain in the Spray Pond area beneath building rubble. However, the steel pipe connecting the Spray Pond to the Steam Plant has been excavated, surveyed, and removed. While the Spray Pond was built on the surface of the Fill soil layer and was originally hydraulically isolated from the Bedrock by the overburden layer, recent and planned decontamination activities may create hydrologic transport channels through the Overburden allowing any contamination to seep into the saturated Bedrock layer.

2.2.4 Juniata River

A 3- to 4-mile segment of the Juniata River is defined to extend from the South of the SNEC site to the beginning of Raystown Lake. This area was selected because it receives water and any associated contaminants from the discharge tunnel, the Fill layer, the Bedrock, and runoff (if any) from the SNEC site. Although a longer segment of the River could have been affected prior to damming the River in 1973, analyses of potential contamination in the segment leading to the Raystown Lake will conservatively capture the highest potential concentrations.

2.3 RADIATION EXPOSURE SCENARIOS AND TRANSPORT PATHWAYS

Exposures to members of the critical population group are postulated to occur to a hypothetical individual (the Receptor) who is subject to all potential exposure pathways. His exposures from the first three areas of concern involve similar exposure scenarios because all three result from radionuclides buried in sub-surface soils (Overburden, and/or Bedrock) in locations where he could conceivably build a house and reside. Exposures from the fourth area of concern are treated separately because they utilize a scenario related to the radioactivity that occurs in the River sediments. In this case the scenarios involve use of the water for fishing and recreation. The pathways for radiation exposure are illustrated in Figure 2-3.

2.3.1 Residential Scenario in the CV, Steam Plant, and Spray Pond Areas

The Receptor is considered to reside in a home in or near any of the first three areas of concern. The most conservative parameters are selected from each of the areas of concern to identify a site-wide residential scenario which results in the highest exposure. This site-wide exposure is then used to determine nuclide-specific DCGLs for each subsurface layer. In the scenario, the Receptor is exposed to residual radioactivity in several ways that include (a) excavating and spreading contaminated Overburden material during home construction and yard leveling; (b) consuming drinking water from a Bedrock well; (c) consuming fruits and vegetables grown onsite with irrigation water from the transient flow within the Fill-soil layer; and (d) consuming beef and milk from cattle raised onsite using the same irrigation water. The shallow water table and the boulders in the Overburden layer discourage construction of a basement for the on-site residence. However, excavation and spreading of Fill material from beneath the top meter and into the upper Overburden layer could occur in leveling sloped areas for a home site.

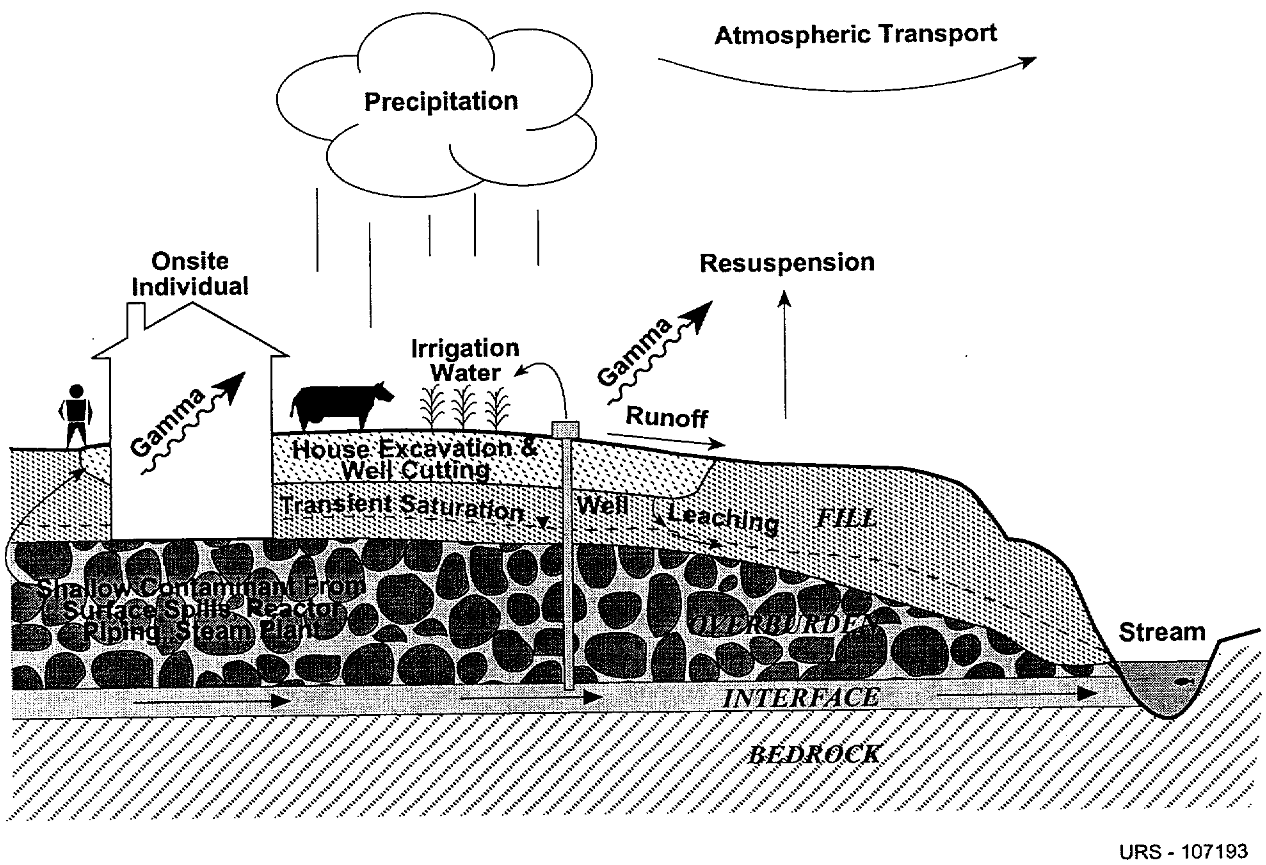

Figure 2-3. Radiation exposure pathways.

The potential radiation exposure pathways associated with the on-site residential scenarios are analyzed to estimate radiation doses. Gamma radiation exposures occur in the yard and through the house floor from radionuclides mixed into surface soils from excavation (pathway a) and well cuttings (pathway b). Exposures from inhaling contaminated dust occur during site grading (pathway a) and well excavation (pathway b) as well as from garden tillage and wind resuspension of contaminated soils (pathways a, b, c, and d). Exposures from ingesting contaminated soil occur from soil entrained on vegetables (pathway c) and unwashed hands (pathways a, b, c, and d). Exposures from ingesting contaminated drinking water occur from transport in the Bedrock (pathway b). Exposures from ingesting contaminated fruits and vegetables occur via their uptake from contaminated surface soil (pathways a and b) and contaminated irrigation water (pathway c). Exposures from ingesting contaminated beef and milk occur from cattle fed with contaminated crops and water (pathways a, b, and d).

2.3.2 Recreation Scenario for the Juniata River

The Receptor spends his recreation time fishing, swimming and boating in the Juniata River. The potential radiation exposure pathways associated with these activities are similar to those identified for his home construction and food provision. Gamma radiation exposures occur while fishing, boating and swimming. Exposures from inadvertently ingesting contaminated water occur while swimming. Exposures from ingesting contaminated fish occur via their absorption of water-borne contaminants from the River and their consumption of contaminants absorbed on algae and bottom sediments.

3. CALCULATION MODELS

Three main tools are used to determine the subsurface DCGLs for the Site Bedrock, Site Overburden soils, and the River sediments: (a) the RESRAD dose assessment model for sites contaminated with RESidual RADioactive materials, (b) spreadsheet calculations of contaminant flow, adsorption, and retardation (supported by the @Risk Probabilistic Risk Analysis Model), and (c) the MicroShield® external exposure and shielding model.

RESRAD 6.1 was developed and adapted from earlier versions for use with the NRC Standard Review Plan (NRC, 2000) for decommissioning and as a tool for demonstrating compliance with the license termination rule in a risk-informed manner. Version 6.1 also computes probabilistic estimates of radiation dose distributions that result from various distributions of input parameters. RESRAD is used to evaluate the sensitivity of input parameters and identify parameters whose most-probable values and distributions require site-specific measurements or detailed justification. It is also used to compute radiation dose distributions from unit concentrations of radionuclides.

Nuclide-specific DCGLs are then determined by ratios of the 25 mrem/year maximum to the peak of the mean dose versus time curve computed by RESRAD 6.1 and spreadsheet calculations. Additional DCGLs are also calculated from ratios of 4 mrem/year to the peak dose calculated for the drinking water pathway. Radiation doses calculated by RESRAD are defined as the effective dose equivalent (EDE) from external gamma radiation plus the committed effective dose equivalent (CEDE) from internal radiation. Their sum is the total effective dose equivalent (TEDE).

Spreadsheet calculations supported by other calculation models are used for situations where the RESRAD code cannot suitably represent the radiation exposure pathways being modeled. For example, radionuclide transport and retention in river waters and sediments are represented by fundamental equations of flow and adsorptive retardation (URS, 2001). Gamma radiation dose assessments for the boating, fishing and swimming scenarios are computed from the radionuclide concentrations using the MicroShield® code (Grove, 1996). Probabilistic assessment of the input parameter distributions within the spreadsheet calculations and MicroShield® model are performed using the @RISK Probabilistic Analysis Model (Palisade, 2000).

3.1 CALCULATIONS WITH RESRAD 6.1

As is illustrated in Figure 3-1, RESRAD's basic transport model assumes three main transport zones: contaminated, unsaturated, and saturated. RESRAD's model assumes water infiltrates into the contaminated zone and leaches radionuclides out of the waste, transporting the contaminated groundwater vertically down through the unsaturated zone and then horizontally through the saturated zone to a well.

RESRAD's representation of horizontal flow within the saturated zone assumes Darcian flow through a homogeneous, saturated, porous medium. Because the SNEC Site is highly heterogeneous, including the transient Fill and Bedrock water pathways, two basic RESRAD data sets are used in the analysis to address these layers separately.

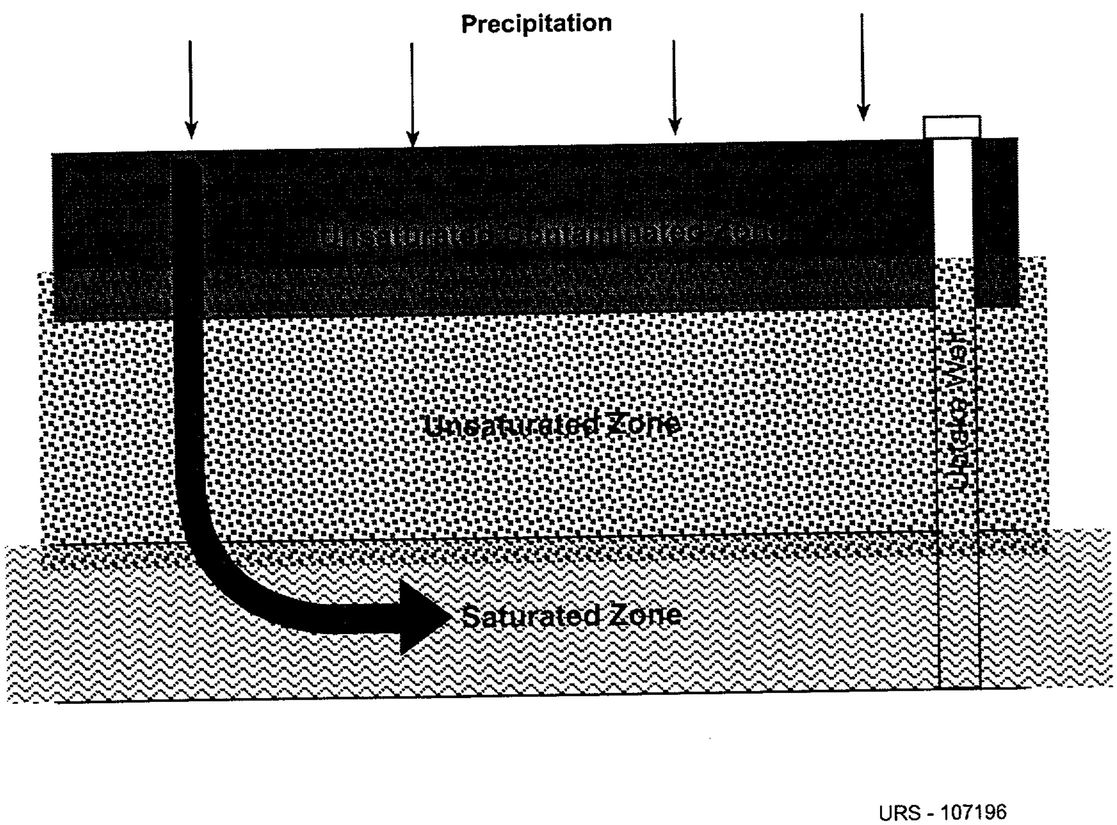

Figure 3-1. RESRAD's water transport model.

RESRAD calculates radiation doses for a chronically exposed individual, focusing on radioactive contaminants in soil and their transport in air, water, and biological media to a single receptor. It considers nine exposure pathways: direct gamma exposure, inhalation of particulates and radon, and ingestion of plant foods, meat, milk, aquatic foods, water, and soil. Radiation doses, health risks, soil guidelines, and media concentrations are calculated for specified time intervals. The source is adjusted over time to account for radioactive decay and in-growth, leaching, erosion, and mixing.

3.1.1 Overburden Layer

RESRAD assesses exposures from the Overburden layer at the Site by assuming that contamination is brought to the surface from well drill cuttings and excavation into the Overburden layer for a house foundation and yard leveling. It also considers that water in the Fill layer irrigates crops. Because RESRAD cannot directly represent transient horizontal flow, the irrigation is represented by a shallow well within the fill layer. Exposures from ingesting contaminated meat, milk, and vegetation; inhaling dust, and direct gamma radiation exposure are evaluated. The application of RESRAD for exposures from the Overburden layer is illustrated in Figure 3-2. Consistent with RESRAD terminology, the waste is assumed to be brought to the surface, spread, and mixed as a result of house construction, site grading, and well excavation will represent the waste zone. The region below the surface mixing zone, but above the water table is represented as the unsaturated zone (vertical transport region). RESRAD represents horizontal transport during the transient flow periods by defining a water table in the lower part of the Fill layer.

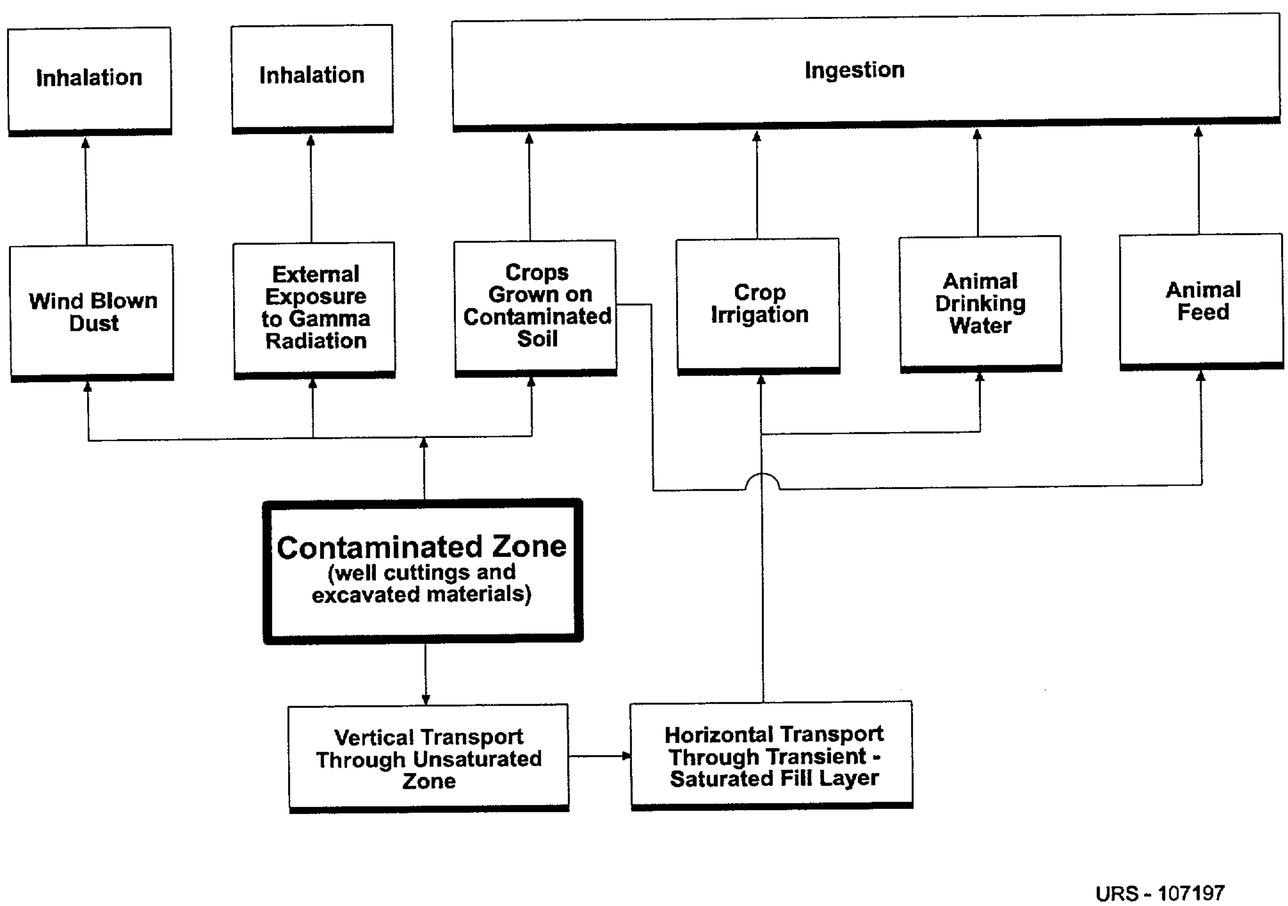

Figure 3-2. RESRAD representation of the overburden layer at the CV, and steam plant, and spray pond areas.

The input parameters and their sources for assessment of exposures related to the Overburden layer are summarized in Table 3-1. Site-specific values are used, whenever available. When not available, RESRAD default values are used in the analysis. Initial source concentrations of 0.2 pCi/g represent surface concentrations resulting from house construction and site excavation. During these activities, it is assumed that a thin layer of contaminated Overburden material is brought to the surface and then mixed with the top 15 cm of topsoil. It is estimated that this surface tillage results in a dilution factor of 1/5. Furthermore, the lowest of all distribution coefficients measured on site materials are used to conservatively represent transient contaminant migration within the Fill layer soil.

3.1.2 Bedrock Layer

The second RESRAD application evaluates ingestion of drinking water from a well drilled into the Bedrock. Potential waste residing near the base of the CV, Steam Plant, or transported downward from the Spray Pond Fill is modeled by RESRAD as being directly above the water-saturated bedrock. As is illustrated in Figure 3-3, this zone of contamination is represented within RESRAD by assigning the vertical-transport vadose zone a negligible thickness and rapid transport properties (making the contamination immediately available to the groundwater).

The input parameters and their sources for assessment of exposures related to the Bedrock layer are summarized in Table 3-2. Site-specific values are used, whenever available. When not available, RESRAD default values are used in the analysis. As with the Overburden analysis, the lowest of all distribution coefficients measured on site materials are used to conservatively represent rapid contaminant migration within the Bedrock (minimizing dilution and retardation-related decay).

Table 3-1

Site-Wide Overburden Exposure Scenario Input Parameter

PARAMETER DESCRIPTION		VALUE	SOURCE
Dose conversion factors for inhalation, mrem/pCi:	Ac-227+D	6.72E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Am-241	4.44E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Am-243+D	4.40E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	C-14	2.09E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cm-243	3.07E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cm-244	2.48E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Co-60	2.19E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cs-134	4.63E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cs-137+D	3.19E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-152	2.21E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-154	2.86E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-155	4.14E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Fe-55	2.69E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Gd-152	2.43E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	H-3	6.40E-08	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Nb-94	4.14E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ni-59	2.70E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ni-63	6.29E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Np-237+D	5.40E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pa-231	1.28E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pb-210+D	1.38E-02	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Po-210	9.40E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-238	3.92E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-239	4.29E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-240	4.29E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-241+D	8.25E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-242	4.11E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ra-226+D	8.60E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ra-228+D	5.08E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Sb-125	1.22E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Sr-90+D	1.31E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Tc-99	8.33E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Te-125m	7.29E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-228+D	3.45E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-229+D	2.16E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-230	3.26E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-232	1.64E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-233	1.35E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-234	1.32E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-235+D	1.23E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-236	1.25E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-238+D	1.18E-01	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Dose conversion factors for ingestion, mrem/pCi:	Ac-227+D	1.48E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-241	3.64E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-243+D	3.63E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	C-14	2.09E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-243	2.51E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-244	2.02E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Co-60	2.69E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-134	7.33E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-137+D	5.00E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-152	6.48E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-154	9.55E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-155	1.53E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Fe-55	6.07E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Gd-152	1.61E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	H-3	6.40E-08	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Nb-94	7.14E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-59	2.10E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-63	5.77E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Np-237+D	4.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pa-231	1.06E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pb-210+D	5.37E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Po-210	1.90E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-238	3.20E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-239	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-240	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-241+D	6.85E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-242	3.36E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-226+D	1.33E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-228+D	1.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sb-125	2.81E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sr-90+D	1.53E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Tc-99	1.46E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Te-125m	3.67E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-228+D	8.08E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-229+D	4.03E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-230	5.48E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-232	2.73E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-233	2.89E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-234	2.83E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-235+D	2.67E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-236	2.69E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-238+D	2.69E-04	RESRAD Default
Ac-227+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		2.00E-05	RESRAD Default
Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		2.00E-05	RESRAD Default
Am-241 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		5.00E-05	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Am-243+D , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-05	RESRAD Default
Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
C-14 , plant/soil concentration ratio, dimensionless	5.50E+00	RESRAD Default
C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.10E-02	RESRAD Default
C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.20E-02	RESRAD Default
Cm-243 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-05	RESRAD Default
Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Cm-244 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-05	RESRAD Default
Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Co-60 , plant/soil concentration ratio, dimensionless	8.00E-02	RESRAD Default
Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-02	RESRAD Default
Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-03	RESRAD Default
Cs-134 , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Cs-134 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-02	RESRAD Default
Cs-134 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.00E-03	RESRAD Default
Cs-137+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-02	RESRAD Default
Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.00E-03	RESRAD Default
Eu-152 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Eu-154 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Eu-155 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Fe-55 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Fe-55 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-02	RESRAD Default
Fe-55 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.00E-04	RESRAD Default
Gd-152 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
H-3 , plant/soil concentration ratio, dimensionless	4.80E+00	RESRAD Default
H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.20E-02	RESRAD Default
H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-02	RESRAD Default
Nb-94 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-07	RESRAD Default
Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Ni-59 , plant/soil concentration ratio, dimensionless	5.00E-02	RESRAD Default
Ni-59 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Ni-59 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-02	RESRAD Default
Ni-63 , plant/soil concentration ratio, dimensionless	5.00E-02	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-02	RESRAD Default
Np-237+D , plant/soil concentration ratio, dimensionless	2.00E-02	RESRAD Default
Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-06	RESRAD Default
Pa-231 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-06	RESRAD Default
Pb-210+D , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.00E-04	RESRAD Default
Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.00E-04	RESRAD Default
Po-210 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Po-210 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Po-210 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.40E-04	RESRAD Default
Pu-238 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-239 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-240 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-241+D , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-242 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-242 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-242 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Ra-226+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Ra-228+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Sb-125 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Sb-125 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Sb-125 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-04	RESRAD Default
Sr-90+D , plant/soil concentration ratio, dimensionless	3.00E-01	RESRAD Default
Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.00E-03	RESRAD Default
Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-03	RESRAD Default
Tc-99 , plant/soil concentration ratio, dimensionless	5.00E+00	RESRAD Default
Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Te-125m , plant/soil concentration ratio, dimensionless	6.00E-01	RESRAD Default
Te-125m , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	7.00E-03	RESRAD Default
Te-125m , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-04	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Th-228+D , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-229+D , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-230 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-232 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
U-233 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-234 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-235+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-236 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-238+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ac-227+D , fish	1.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Ac-227+D ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-241 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Am-241 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-243+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Am-243+D ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	C-14 , fish	5.00E+04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	C-14 ,	9.10E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-243 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Cm-243 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-244 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Cm-244 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Co-60 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Co-60 ,	2.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-134 , fish	2.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Cs-134 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-137+D , fish	2.00E+03	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Cs-137+D ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-152 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Eu-152 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-154 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Eu-154 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-155 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Eu-155 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Fe-55 , fish	2.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Fe-55 ,	3.20E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Gd-152 , fish	2.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Gd-152 ,	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	H-3 , fish	1.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	H-3 , crustacea	1.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Nb-94 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Nb-94 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-59 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Ni-59 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-63 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Ni-63 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Np-237+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Np-237+D ,	4.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pa-231 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pa-231 ,	1.10E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pb-210+D , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pb-210+D ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Po-210 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Po-210 ,	2.00E+04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-238 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pu-238 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-239 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pu-239 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-240 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pu-240 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-241+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pu-241+D ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-242 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Pu-242 ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-226+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-226+D ,	2.50E+02	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
crustacea and mollusks			
Bioaccumulation factors, fresh water, L/kg:	Ra-228+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Ra-228+D ,	2.50E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sb-125 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Sb-125 ,	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sr-90+D , fish	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Sr-90+D ,	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Tc-99 , fish	2.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Tc-99 ,	5.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Te-125m , fish	4.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Te-125m ,	7.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-228+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Th-228+D ,	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-229+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Th-229+D ,	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-230 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Th-230 ,	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-232 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	Th-232 ,	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-233 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	U-233 ,	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-234 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	U-234 ,	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-235+D , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	U-235+D ,	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-236 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	U-236 ,	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-238+D , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: crustacea and mollusks	U-238+D ,	6.00E+01	RESRAD Default
Area of contaminated zone (m^2)		1.00E+04	RESRAD Default
Thickness of contaminated zone (m)		1.50E-01	Assumed
Length parallel to aquifer flow (m)		1.13E+02	GPU e-mail 1/11/02
Basic radiation dose limit (mrem/yr)		2.50E+01	RESRAD Default
Time since placement of material (yr)		0.00E+00	RESRAD Default
Initial principal radionuclide (pCi/g): Am-241		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): C-14		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Cm-243		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Cm-244		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Co-60		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Cs-134		2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Cs-137		2.00E-01	Assumed

Table 3-1
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Initial principal radionuclide (pCi/g): Eu-152	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Eu-154	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Eu-155	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Fe-55	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): H-3	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Nb-94	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Ni-59	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Ni-63	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Pu-238	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Pu-239	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Pu-240	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Pu-241	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Pu-242	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Sb-125	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Sr-90	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): Tc-99	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): U-234	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): U-235	2.00E-01	Assumed
Initial principal radionuclide (pCi/g): U-238	2.00E-01	Assumed
Cover depth (m)	0.00E+00	RESRAD Default
Density of cover material (g/cm^3)	not used	
Cover depth erosion rate (m/yr)	not used	
Density of contaminated zone (g/cm^3)	1.60E+00	GPU e-mail 1/11/02
Contaminated zone erosion rate (m/yr)	3.45E-04	GPU e-mail 1/11/02
Contaminated zone total porosity	4.60E-01	GPU e-mail 1/11/02
Contaminated zone field capacity	1.36E-01	GPU e-mail 1/11/02
Contaminated zone hydraulic conductivity (m/yr)	3.23E+01	GPU e-mail 1/11/02
Contaminated zone b parameter	5.60E+00	GPU e-mail 1/11/02
Average annual wind speed (m/sec)	4.07E+00	GPU e-mail 1/11/02
Humidity in air (g/m^3)	8.00E+00	RESRAD Default
Evapotranspiration coefficient	5.90E-01	GPU e-mail 1/11/02
Precipitation (m/yr)	9.36E-01	GPU e-mail 1/11/02
Irrigation (m/yr)	2.00E-01	RESRAD Default
Irrigation mode	overhead	RESRAD Default
Runoff coefficient	3.50E-01	GPU e-mail 1/11/02
Watershed area for nearby stream or pond (m^2)	5.00E+06	GPU e-mail 1/11/02
Accuracy for water/soil computations	1.00E-03	RESRAD Default
Density of saturated zone (g/cm^3)	1.60E+00	GPU e-mail 1/11/02
Saturated zone total porosity	4.60E-01	GPU e-mail 1/11/02
Saturated zone effective porosity	4.60E-01	GPU e-mail 1/11/02
Saturated zone field capacity	1.36E-01	GPU e-mail 1/11/02
Saturated zone hydraulic conductivity (m/yr)	1.10E+01	GPU e-mail 1/11/02
Saturated zone hydraulic gradient	2.00E-03	GPU e-mail 1/11/02
Saturated zone b parameter	not used	GPU e-mail 1/11/02
Water table drop rate (m/yr)	0.00E+00	GPU e-mail 1/11/02
Well pump intake depth (m below water table)	1.00E-05	GPU e-mail 1/11/02
Model: Nondispersion (ND) or Mass-Balance (MB)	ND	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Well pumping rate (m^3/yr)		2.86E+02	GPU e-mail 1/11/02
Number of unsaturated zone strata		1	RESRAD Default
Unsat. zone 1, thickness (m)		1.00E-02	GPU e-mail 1/11/02
Unsat. zone 1, soil density (g/cm^3)		1.60E+00	GPU e-mail 1/11/02
Unsat. zone 1, total porosity		4.60E-01	GPU e-mail 1/11/02
Unsat. zone 1, effective porosity		4.60E-01	GPU e-mail 1/11/02
Unsat. zone 1, field capacity		1.36E-01	GPU e-mail 1/11/02
Unsat. zone 1, soil-specific b parameter		5.60E+00	GPU e-mail 1/11/02
Unsat. zone 1, hydraulic conductivity (m/yr)		3.23E+01	GPU e-mail 1/11/02
Distribution coefficients for C-14	Contaminated zone (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for C-14	Unsaturated zone 1 (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for C-14	Saturated zone (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for C-14	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for C-14	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cm-243	Contaminated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-243	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-243	Saturated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-243	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cm-243	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cm-244	Contaminated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-244	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-244	Saturated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Cm-244	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cm-244	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Co-60	Contaminated zone (cm^3/g)	2.00E+02	GPU e-mail 1/11/02
Distribution coefficients for Co-60	Unsaturated zone 1 (cm^3/g)	2.00E+02	GPU e-mail 1/11/02
Distribution coefficients for Co-60	Saturated zone (cm^3/g)	2.00E+02	GPU e-mail 1/11/02
Distribution coefficients for Co-60	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Co-60	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cs-134	Contaminated zone (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-134	Unsaturated zone 1 (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-134	Saturated zone (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-134	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cs-134	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cs-137	Contaminated zone (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-137	Unsaturated zone 1 (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-137	Saturated zone (cm^3/g)	2.13E+03	GPU e-mail 1/11/02
Distribution coefficients for Cs-137	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cs-137	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-152	Contaminated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-152	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-152	Saturated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-152	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-152	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-154	Contaminated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-154	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-154	Saturated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for Eu-154	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-154	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-155	Contaminated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-155	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-155	Saturated zone (cm^3/g)	1.00E+03	GPU e-mail 1/11/02
Distribution coefficients for Eu-155	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-155	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Fe-55	Contaminated zone (cm^3/g)	1.00E+04	GPU e-mail 1/11/02
Distribution coefficients for Fe-55	Unsaturated zone 1 (cm^3/g)	1.00E+04	GPU e-mail 1/11/02
Distribution coefficients for Fe-55	Saturated zone (cm^3/g)	1.00E+04	GPU e-mail 1/11/02
Distribution coefficients for Fe-55	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Fe-55	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for H-3	Contaminated zone (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for H-3	Unsaturated zone 1 (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for H-3	Saturated zone (cm^3/g)	1.00E+00	GPU e-mail 1/11/02
Distribution coefficients for H-3	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for H-3	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Nb-94	Contaminated zone (cm^3/g)	8.00E+01	GPU e-mail 1/11/02
Distribution coefficients for Nb-94	Unsaturated zone 1 (cm^3/g)	8.00E+01	GPU e-mail 1/11/02
Distribution coefficients for Nb-94	Saturated zone (cm^3/g)	8.00E+01	GPU e-mail 1/11/02
Distribution coefficients for Nb-94	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Nb-94	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Ni-59	Contaminated zone (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-59	Unsaturated zone 1 (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-59	Saturated zone (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-59	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Ni-59	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Ni-63	Contaminated zone (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-63	Unsaturated zone 1 (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-63	Saturated zone (cm^3/g)	1.30E+03	GPU e-mail 1/11/02
Distribution coefficients for Ni-63	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Ni-63	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-238	Contaminated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-238	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-238	Saturated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-238	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-238	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-239	Contaminated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-239	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-239	Saturated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-239	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-239	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-240	Contaminated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-240	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-240	Saturated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-240	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-240	Solubility constant	0.00E+00	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for Pu-241	Contaminated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-241	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-241	Saturated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-241	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-241	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-242	Contaminated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-242	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-242	Saturated zone (cm^3/g)	1.60E+02	GPU e-mail 1/11/02
Distribution coefficients for Pu-242	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-242	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Sb-125	Contaminated zone (cm^3/g)	1.53E+02	GPU e-mail 1/11/02
Distribution coefficients for Sb-125	Unsaturated zone 1 (cm^3/g)	1.53E+02	GPU e-mail 1/11/02
Distribution coefficients for Sb-125	Saturated zone (cm^3/g)	1.53E+02	GPU e-mail 1/11/02
Distribution coefficients for Sb-125	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Sb-125	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Tc-99	Contaminated zone (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Unsaturated zone 1 (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Saturated zone (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Tc-99	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-234	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-234	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-235	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-235	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-238	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-238	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ac-227	Contaminated zone (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Unsaturated zone 1 (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Saturated zone (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ac-227	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-241	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-241	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-241	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-241	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-241	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-243	Contaminated zone	1.00E+03	GPU E-MAIL 1/11/02

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
(cm^3/g)			
Distribution coefficients for daughter Am-243	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-243	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Unsaturated zone 1 (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Saturated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Unsaturated zone 1 (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Saturated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pa-231	Contaminated zone (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Unsaturated zone 1 (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Saturated zone (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pa-231	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pb-210	Contaminated zone (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Unsaturated zone 1 (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Saturated zone (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pb-210	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Po-210	Contaminated zone (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Unsaturated zone 1 (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Saturated zone (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Po-210	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-226	Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Unsaturated zone 1 (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Saturated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-226	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-228	Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Unsaturated zone 1 (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Saturated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-228	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Contaminated zone	0.00E+00	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
(cm³/g)			
Distribution coefficients for daughter Te-125m	Unsaturated zone 1 (cm³/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Saturated zone (cm³/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-228	Contaminated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Unsaturated zone 1 (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Saturated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-228	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-229	Contaminated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Unsaturated zone 1 (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Saturated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-229	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-230	Contaminated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Unsaturated zone 1 (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Saturated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-230	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-232	Contaminated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Unsaturated zone 1 (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Saturated zone (cm³/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-232	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-233	Contaminated zone (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Unsaturated zone 1 (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Saturated zone (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-233	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-236	Contaminated zone (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Unsaturated zone 1 (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Saturated zone (cm³/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-236	Solubility constant	0.00E+00	RESRAD Default
Inhalation rate (m³/yr)		8.40E+03	RESRAD Default
Mass loading for inhalation (g/m³)		1.00E-04	RESRAD Default
Exposure duration		3.00E+01	RESRAD Default
Shielding factor, inhalation		4.00E-01	RESRAD Default
Shielding factor, external gamma		7.00E-01	RESRAD Default
Fraction of time spent indoors		5.00E-01	RESRAD Default
Fraction of time spent outdoors (on site)		2.50E-01	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Shape factor flag, external gamma	1.00E+00	RESRAD Default
Fruits, vegetables and grain consumption (kg/yr)	1.12E+02	GPU E-MAIL 1/11/02
Leafy vegetable consumption (kg/yr)	2.14E+01	GPU E-MAIL 1/11/02
Milk consumption (L/yr)	2.33E+02	GPU E-MAIL 1/11/02
Meat and poultry consumption (kg/yr)	6.70E+01	GPU E-MAIL 1/11/02
Fish consumption (kg/yr)	not used	
Other seafood consumption (kg/yr)	not used	
Soil ingestion rate (g/yr)	1.83E+01	GPU E-MAIL 1/11/02
Drinking water intake (L/yr)	not used	
Contamination fraction of drinking water	not used	
Contamination fraction of household water	not used	
Contamination fraction of livestock water	1.00E+00	RESRAD Default
Contamination fraction of irrigation water	1.00E+00	RESRAD Default
Contamination fraction of aquatic food	not used	
Contamination fraction of plant food	1.00E+00	GPU E-MAIL 1/11/02
Contamination fraction of meat	1.00E+00	GPU E-MAIL 1/11/02
Contamination fraction of milk	1.00E+00	GPU E-MAIL 1/11/02
Livestock fodder intake for meat (kg/day)	6.80E+01	RESRAD Default
Livestock fodder intake for milk (kg/day)	5.50E+01	RESRAD Default
Livestock water intake for meat (L/day)	5.00E+01	RESRAD Default
Livestock water intake for milk (L/day)	1.60E+02	RESRAD Default
Livestock soil intake (kg/day)	5.00E-01	RESRAD Default
Mass loading for foliar deposition (g/m^3)	1.00E-04	RESRAD Default
Depth of soil mixing layer (m)	1.50E-01	RESRAD Default
Depth of roots (m)	9.00E-01	RESRAD Default
Drinking water fraction from ground water	not used	
Household water fraction from ground water	not used	
Livestock water fraction from ground water	1.00E+00	RESRAD Default
Irrigation fraction from ground water	1.00E+00	RESRAD Default
Wet weight crop yield for Non-Leafy (kg/m^2)	7.00E-01	RESRAD Default
Wet weight crop yield for Leafy (kg/m^2)	1.50E+00	RESRAD Default
Wet weight crop yield for Fodder (kg/m^2)	1.10E+00	RESRAD Default
Growing Season for Non-Leafy (years)	1.70E-01	RESRAD Default
Growing Season for Leafy (years)	2.50E-01	RESRAD Default
Growing Season for Fodder (years)	8.00E-02	RESRAD Default
Translocation Factor for Non-Leafy	1.00E-01	RESRAD Default
Translocation Factor for Leafy	1.00E+00	RESRAD Default
Translocation Factor for Fodder	1.00E+00	RESRAD Default
Dry Foliar Interception Fraction for Non-Leafy	2.50E-01	RESRAD Default
Dry Foliar Interception Fraction for Leafy	2.50E-01	RESRAD Default
Dry Foliar Interception Fraction for Fodder	2.50E-01	RESRAD Default
Wet Foliar Interception Fraction for Non-Leafy	2.50E-01	RESRAD Default
Wet Foliar Interception Fraction for Leafy	2.50E-01	RESRAD Default
Wet Foliar Interception Fraction for Fodder	2.50E-01	RESRAD Default
Weathering Removal Constant for Vegetation	2.00E+01	RESRAD Default
C-12 concentration in water (g/cm^3)	2.00E-05	RESRAD Default
C-12 concentration in contaminated soil (g/g)	3.00E-02	RESRAD Default

Table 3-1
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Fraction of vegetation carbon from soil		2.00E-02	RESRAD Default
Fraction of vegetation carbon from air		9.80E-01	RESRAD Default
C-14 evasion layer thickness in soil (m)		3.00E-01	RESRAD Default
C-14 evasion flux rate from soil (1/sec)		7.00E-07	RESRAD Default
C-12 evasion flux rate from soil (1/sec)		1.00E-10	RESRAD Default
Fraction of grain in beef cattle feed		8.00E-01	RESRAD Default
Fraction of grain in milk cow feed		2.00E-01	RESRAD Default
DCF correction factor for gaseous forms of C14		8.89E+01	RESRAD Default
Storage times of contaminated foodstuffs (days): vegetables, and grain	Fruits, non-leafy	1.40E+01	RESRAD Default
Storage times of contaminated foodstuffs (days):	Leafy vegetables	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Milk	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Meat and poultry	2.00E+01	RESRAD Default
Storage times of contaminated foodstuffs (days):	Fish	7.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days): mollusks	Crustacea and	7.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Well water	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Surface water	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Livestock fodder	4.50E+01	RESRAD Default

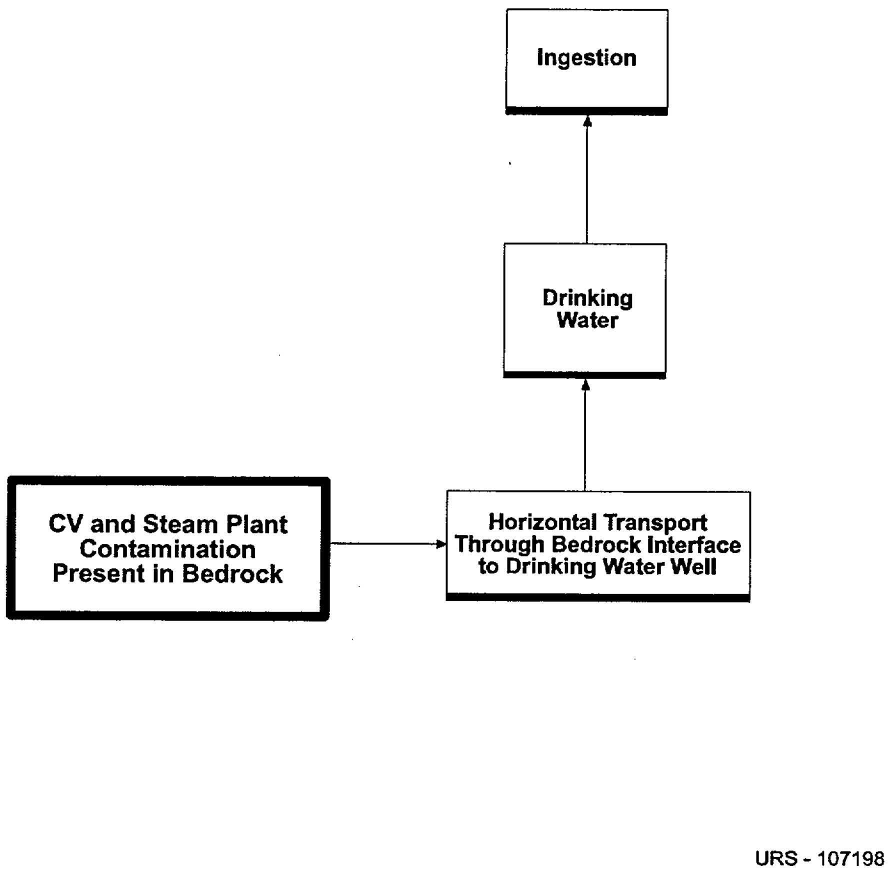

Figure 3-3. RESRAD representation of Bedrock below the CV, and steam plant, and spray pond areas.

Table 3-2

Site-Wide Bedrock Exposure Scenario Input Parameter

PARAMETER DESCRIPTION		VALUE	SOURCE
Dose conversion factors for inhalation, mrem/pCi:	Ac-227+D	6.72E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Am-241	4.44E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Am-243+D	4.40E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	C-14	2.09E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cm-243	3.07E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cm-244	2.48E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Co-60	2.19E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cs-134	4.63E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Cs-137+D	3.19E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-152	2.21E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-154	2.86E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Eu-155	4.14E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Fe-55	2.69E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Gd-152	2.43E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	H-3	6.40E-08	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Nb-94	4.14E-04	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ni-59	2.70E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ni-63	6.29E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Np-237+D	5.40E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pa-231	1.28E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pb-210+D	1.38E-02	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Po-210	9.40E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-238	3.92E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-239	4.29E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-240	4.29E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-241+D	8.25E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Pu-242	4.11E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ra-226+D	8.60E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Ra-228+D	5.08E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Sb-125	1.22E-05	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Sr-90+D	1.31E-03	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Tc-99	8.33E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Te-125m	7.29E-06	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-228+D	3.45E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-229+D	2.16E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-230	3.26E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	Th-232	1.64E+00	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-233	1.35E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-234	1.32E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-235+D	1.23E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-236	1.25E-01	RESRAD Default
Dose conversion factors for inhalation, mrem/pCi:	U-238+D	1.18E-01	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Dose conversion factors for ingestion, mrem/pCi:	Ac-227+D	1.48E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-241	3.64E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-243+D	3.63E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	C-14	2.09E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-243	2.51E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-244	2.02E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Co-60	2.69E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-134	7.33E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-137+D	5.00E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-152	6.48E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-154	9.55E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-155	1.53E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Fe-55	6.07E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Gd-152	1.61E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	H-3	6.40E-08	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Nb-94	7.14E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-59	2.10E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-63	5.77E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Np-237+D	4.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pa-231	1.06E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pb-210+D	5.37E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Po-210	1.90E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-238	3.20E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-239	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-240	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-241+D	6.85E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-242	3.36E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-226+D	1.33E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-228+D	1.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sb-125	2.81E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sr-90+D	1.53E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Tc-99	1.46E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Te-125m	3.67E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-228+D	8.08E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-229+D	4.03E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-230	5.48E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-232	2.73E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-233	2.89E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-234	2.83E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-235+D	2.67E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-236	2.69E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-238+D	2.69E-04	RESRAD Default
Ac-227+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		2.00E-05	RESRAD Default
Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		2.00E-05	RESRAD Default
Am-241 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		5.00E-05	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Am-243+D , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-05	RESRAD Default
Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
C-14 , plant/soil concentration ratio, dimensionless	5.50E+00	RESRAD Default
C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.10E-02	RESRAD Default
C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.20E-02	RESRAD Default
Cm-243 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-05	RESRAD Default
Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Cm-244 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-05	RESRAD Default
Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Co-60 , plant/soil concentration ratio, dimensionless	8.00E-02	RESRAD Default
Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-02	RESRAD Default
Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-03	RESRAD Default
Cs-134 , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Cs-134 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-02	RESRAD Default
Cs-134 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.00E-03	RESRAD Default
Cs-137+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-02	RESRAD Default
Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.00E-03	RESRAD Default
Eu-152 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Eu-154 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Eu-155 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
Fe-55 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Fe-55 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-02	RESRAD Default
Fe-55 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.00E-04	RESRAD Default
Gd-152 , plant/soil concentration ratio, dimensionless	2.50E-03	RESRAD Default
Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.00E-03	RESRAD Default
Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-05	RESRAD Default
H-3 , plant/soil concentration ratio, dimensionless	4.80E+00	RESRAD Default
H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.20E-02	RESRAD Default
H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-02	RESRAD Default
Nb-94 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.00E-07	RESRAD Default
Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-06	RESRAD Default
Ni-59 , plant/soil concentration ratio, dimensionless	5.00E-02	RESRAD Default
Ni-59 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Ni-59 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-02	RESRAD Default
Ni-63 , plant/soil concentration ratio, dimensionless	5.00E-02	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-02	RESRAD Default
Np-237+D , plant/soil concentration ratio, dimensionless	2.00E-02	RESRAD Default
Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-06	RESRAD Default
Pa-231 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-06	RESRAD Default
Pb-210+D , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.00E-04	RESRAD Default
Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.00E-04	RESRAD Default
Po-210 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Po-210 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.00E-03	RESRAD Default
Po-210 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.40E-04	RESRAD Default
Pu-238 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-239 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-240 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-241+D , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Pu-242 , plant/soil concentration ratio, dimensionless	1.00E-03	RESRAD Default
Pu-242 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Pu-242 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-06	RESRAD Default
Ra-226+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Ra-228+D , plant/soil concentration ratio, dimensionless	4.00E-02	RESRAD Default
Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Sb-125 , plant/soil concentration ratio, dimensionless	1.00E-02	RESRAD Default
Sb-125 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-03	RESRAD Default
Sb-125 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-04	RESRAD Default
Sr-90+D , plant/soil concentration ratio, dimensionless	3.00E-01	RESRAD Default
Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.00E-03	RESRAD Default
Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.00E-03	RESRAD Default
Tc-99 , plant/soil concentration ratio, dimensionless	5.00E+00	RESRAD Default
Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.00E-04	RESRAD Default
Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.00E-03	RESRAD Default
Te-125m , plant/soil concentration ratio, dimensionless	6.00E-01	RESRAD Default
Te-125m , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	7.00E-03	RESRAD Default
Te-125m , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.00E-04	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Th-228+D , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-229+D , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-230 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
Th-232 , plant/soil concentration ratio, dimensionless		1.00E-03	RESRAD Default
Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.00E-04	RESRAD Default
Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.00E-06	RESRAD Default
U-233 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-234 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-235+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-236 , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
U-238+D , plant/soil concentration ratio, dimensionless		2.50E-03	RESRAD Default
U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.40E-04	RESRAD Default
U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.00E-04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ac-227+D , fish	1.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Ac-227+D , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-241 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Am-241 , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-243+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Am-243+D , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	C-14 , fish	5.00E+04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	C-14 , crustacea and	9.10E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-243 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Cm-243 , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-244 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Cm-244 , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Co-60 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Co-60 , crustacea and	2.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-134 , fish	2.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Cs-134 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-137+D , fish	2.00E+03	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Bioaccumulation factors, fresh water, L/kg: and mollusks	Cs-137+D , crustacea	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-152 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Eu-152 , crustacea and	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-154 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Eu-154 , crustacea and	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-155 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Eu-155 , crustacea and	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Fe-55 , fish	2.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Fe-55 , crustacea and	3.20E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Gd-152 , fish	2.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Gd-152 , crustacea	1.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	H-3 , fish	1.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	H-3 , crustacea and	1.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Nb-94 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Nb-94 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-59 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Ni-59 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-63 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Ni-63 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Np-237+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Np-237+D , crustacea	4.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pa-231 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Pa-231 , crustacea and	1.10E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pb-210+D , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Pb-210+D , crustacea	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Po-210 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Po-210 , crustacea and	2.00E+04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-238 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Pu-238 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-239 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Pu-239 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-240 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Pu-240 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-241+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Pu-241+D , crustacea	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-242 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Pu-242 , crustacea and	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-226+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-226+D , crustacea	2.50E+02	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
and mollusks			
Bioaccumulation factors, fresh water, L/kg:	Ra-228+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Ra-228+D , crustacea	2.50E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sb-125 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Sb-125 , crustacea and	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sr-90+D , fish	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Sr-90+D , crustacea	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Tc-99 , fish	2.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Tc-99 , crustacea and	5.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Te-125m , fish	4.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Te-125m , crustacea	7.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-228+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Th-228+D , crustacea	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-229+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	Th-229+D , crustacea	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-230 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Th-230 , crustacea and	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-232 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	Th-232 , crustacea and	5.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-233 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	U-233 , crustacea and	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-234 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	U-234 , crustacea and	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-235+D , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	U-235+D , crustacea	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-236 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: mollusks	U-236 , crustacea and	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-238+D , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg: and mollusks	U-238+D , crustacea	6.00E+01	RESRAD Default
Area of contaminated zone (m**2)		1.00E+04	RESRAD Default
Thickness of contaminated zone (m)		2.00E+00	RESRAD Default
Length parallel to aquifer flow (m)		1.13E+02	GPU E-MAIL 1/11/02
Basic radiation dose limit (mrem/yr)		2.50E+01	RESRAD Default
Time since placement of material (yr)		0.00E+00	RESRAD Default
Initial principal radionuclide (pCi/g): Am-241		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): C-14		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cm-243		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cm-244		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Co-60		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cs-134		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cs-137		1.00E+00	Assumed

Table 3-2
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Initial principal radionuclide (pCi/g): Eu-152	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Eu-154	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Eu-155	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Fe-55	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): H-3	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Nb-94	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Ni-59	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Ni-63	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-238	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-239	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-240	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-241	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-242	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Sb-125	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Sr-90	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Tc-99	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-234	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-235	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-238	1.00E+00	Assumed
Cover depth (m)	5.00E+00	GPU E-MAIL 1/11/02
Density of cover material (g/cm3)	1.60E+00	GPU E-MAIL 1/11/02
Cover depth erosion rate (m/yr)	0.000345	GPU E-MAIL 1/11/02
Density of contaminated zone (g/cm3)	1.60E+00	GPU E-MAIL 1/11/02
Contaminated zone erosion rate (m/yr)	3.45E-04	GPU E-MAIL 1/11/02
Contaminated zone total porosity	3.60E-01	GPU E-MAIL 1/11/02
Contaminated zone field capacity	1.36E-01	GPU E-MAIL 1/11/02
Contaminated zone hydraulic conductivity (m/yr)	6.79E+01	GPU E-MAIL 1/11/02
Contaminated zone b parameter	5.60E+00	GPU E-MAIL 1/11/02
Average annual wind speed (m/sec)	4.07E+00	GPU E-MAIL 1/11/02
Humidity in air (g/m^3)	not used	GPU E-MAIL 1/11/02
Evapotranspiration coefficient	5.90E-01	GPU E-MAIL 1/11/02
Precipitation (m/yr)	9.36E-01	GPU E-MAIL 1/11/02
Irrigation (m/yr)	2.00E-01	RESRAD Default
Irrigation mode	overhead	RESRAD Default
Runoff coefficient	3.50E-01	GPU E-MAIL 1/11/02
Watershed area for nearby stream or pond (m^2)	5.00E+06	GPU E-MAIL 1/11/02
Accuracy for water/soil computations	1.00E-03	RESRAD Default
Density of saturated zone (g/cm^3)	1.60E+00	GPU E-MAIL 1/11/02
Saturated zone total porosity	3.60E-01	GPU E-MAIL 1/11/02
Saturated zone effective porosity	2.80E-02	GPU E-MAIL 1/11/02
Saturated zone field capacity	1.36E-01	GPU E-MAIL 1/11/02
Saturated zone hydraulic conductivity (m/yr)	6.79E+01	GPU E-MAIL 1/11/02
Saturated zone hydraulic gradient	2.00E-02	RESRAD Default
Saturated zone b parameter	not used	GPU E-MAIL 1/11/02
Water table drop rate (m/yr)	0.00E+00	GPU E-MAIL 1/11/02
Well pump intake depth (m below water table)	3.00E+01	GPU E-MAIL 1/11/02
Model: Nondispersion (ND) or Mass-Balance (MB)	ND	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Well pumping rate (m^3/yr)		not used	GPU E-MAIL 1/11/02
Number of unsaturated zone strata		1	RESRAD Default
Unsat. zone 1, thickness (m)		1.00E-02	GPU E-MAIL 1/11/02
Unsat. zone 1, soil density (g/cm^3)		1.60E+00	GPU E-MAIL 1/11/02
Unsat. zone 1, total porosity		4.60E-01	GPU E-MAIL 1/11/02
Unsat. zone 1, effective porosity		3.50E-01	GPU E-MAIL 1/11/02
Unsat. zone 1, field capacity		2.00E-01	RESRAD Default
Unsat. zone 1, soil-specific b parameter		5.60E+00	GPU E-MAIL 1/11/02
Unsat. zone 1, hydraulic conductivity (m/yr)		6.79E+01	GPU E-MAIL 1/11/02
Distribution coefficients for C-14	Contaminated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for C-14	Unsaturated zone 1 (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for C-14	Saturated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for C-14	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for C-14	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cm-243	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-243	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-243	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-243	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cm-243	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cm-244	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-244	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-244	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-244	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cm-244	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Co-60	Contaminated zone (cm^3/g)	2.00E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Co-60	Unsaturated zone 1 (cm^3/g)	2.00E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Co-60	Saturated zone (cm^3/g)	2.00E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Co-60	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Co-60	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cs-134	Contaminated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-134	Unsaturated zone 1 (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-134	Saturated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-134	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cs-134	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Cs-137	Contaminated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-137	Unsaturated zone 1 (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-137	Saturated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-137	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Cs-137	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-152	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-152	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-152	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-152	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-152	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-154	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-154	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-154	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for Eu-154	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-154	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Eu-155	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-155	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-155	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-155	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Eu-155	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Fe-55	Contaminated zone (cm^3/g)	1.00E+04	GPU E-MAIL 1/11/02
Distribution coefficients for Fe-55	Unsaturated zone 1 (cm^3/g)	1.00E+04	GPU E-MAIL 1/11/02
Distribution coefficients for Fe-55	Saturated zone (cm^3/g)	1.00E+04	GPU E-MAIL 1/11/02
Distribution coefficients for Fe-55	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Fe-55	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for H-3	Contaminated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for H-3	Unsaturated zone 1 (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for H-3	Saturated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for H-3	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for H-3	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Nb-94	Contaminated zone (cm^3/g)	8.00E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Nb-94	Unsaturated zone 1 (cm^3/g)	8.00E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Nb-94	Saturated zone (cm^3/g)	8.00E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Nb-94	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Nb-94	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Ni-59	Contaminated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-59	Unsaturated zone 1 (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-59	Saturated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-59	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Ni-59	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Ni-63	Contaminated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-63	Unsaturated zone 1 (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-63	Saturated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-63	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Ni-63	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-238	Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-238	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-238	Saturated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-238	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-238	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-239	Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-239	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-239	Saturated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-239	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-239	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-240	Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-240	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-240	Saturated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-240	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-240	Solubility constant	0.00E+00	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for Pu-241	Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-241	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-241	Saturated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-241	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-241	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Pu-242	Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-242	Unsaturated zone 1 (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-242	Saturated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-242	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Pu-242	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Sb-125	Contaminated zone (cm^3/g)	1.53E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Sb-125	Unsaturated zone 1 (cm^3/g)	1.53E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Sb-125	Saturated zone (cm^3/g)	1.53E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Sb-125	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Sb-125	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Sr-90	Contaminated zone (cm^3/g)	1.10E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Sr-90	Unsaturated zone 1 (cm^3/g)	1.10E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Sr-90	Saturated zone (cm^3/g)	1.10E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Sr-90	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Sr-90	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for Tc-99	Contaminated zone (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Unsaturated zone 1 (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Saturated zone (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for Tc-99	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-234	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-234	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-234	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-235	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-235	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for U-238	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for U-238	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ac-227	Contaminated zone (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Unsaturated zone 1 (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Saturated zone (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Ac-227	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ac-227	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-241	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-241	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for daughter Am-241	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-241	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-241	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-243	Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243	Unsaturated zone 1 (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243	Saturated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Am-243	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Unsaturated zone 1 (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Saturated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Gd-152	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Unsaturated zone 1 (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Saturated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pa-231	Contaminated zone (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Unsaturated zone 1 (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Saturated zone (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pa-231	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pa-231	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pb-210	Contaminated zone (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Unsaturated zone 1 (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Saturated zone (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Pb-210	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Pb-210	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Po-210	Contaminated zone (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Unsaturated zone 1 (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Saturated zone (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Po-210	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Po-210	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-226	Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Unsaturated zone 1 (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Saturated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-226	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-228	Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Unsaturated zone 1 (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Saturated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Ra-228	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Contaminated zone (cm^3/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Unsaturated zone 1 (cm^3/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Saturated zone (cm^3/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Te-125m	Leach rate (/yr)	0.00E+00	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Distribution coefficients for daughter Te-125m	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-228	Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Unsaturated zone 1 (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Saturated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-228	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-228	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-229	Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Unsaturated zone 1 (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Saturated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-229	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-230	Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Unsaturated zone 1 (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Saturated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-230	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-232	Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Unsaturated zone 1 (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Saturated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-232	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-233	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-233	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-233	Solubility constant	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-236	Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Unsaturated zone 1 (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Saturated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236	Leach rate (/yr)	0.00E+00	RESRAD Default
Distribution coefficients for daughter U-236	Solubility constant	0.00E+00	RESRAD Default
Inhalation rate (m^3/yr)		not used	
Mass loading for inhalation (g/m^3)		not used	
Exposure duration		3.00E+01	RESRAD Default
Shielding factor, inhalation		not used	
Shielding factor, external gamma		not used	
Fraction of time spent indoors		not used	
Fraction of time spent outdoors (on site)		not used	
Shape factor flag, external gamma		not used	
Fruits, vegetables and grain consumption (kg/yr)		not used	
Leafy vegetable consumption (kg/yr)		not used	
Milk consumption (L/yr)		not used	
Meat and poultry consumption (kg/yr)		not used	
Fish consumption (kg/yr)		not used	
Other seafood consumption (kg/yr)		not used	
Soil ingestion rate (g/yr)		not used	
Drinking water intake (L/yr)		479	Reg. Guide 1.109

Table 3-2
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Contamination fraction of drinking water	1	RESRAD Default
Contamination fraction of household water	not used	
Contamination fraction of livestock water	not used	
Contamination fraction of irrigation water	not used	
Contamination fraction of aquatic food	not used	
Contamination fraction of plant food	not used	
Contamination fraction of meat	not used	
Contamination fraction of milk	not used	
Livestock fodder intake for meat (kg/day)	not used	
Livestock fodder intake for milk (kg/day)	not used	
Livestock water intake for meat (L/day)	not used	
Livestock water intake for milk (L/day)	not used	
Livestock soil intake (kg/day)	not used	
Mass loading for foliar deposition (g/m^3)	not used	
Depth of soil mixing layer (m)	not used	
Depth of roots (m)	not used	
Drinking water fraction from ground water	1	RESRAD Default
Household water fraction from ground water	not used	
Livestock water fraction from ground water	not used	
Irrigation fraction from ground water	not used	
Wet weight crop yield for Non-Leafy (kg/m^2)	not used	
Wet weight crop yield for Leafy (kg/m^2)	not used	
Wet weight crop yield for Fodder (kg/m^2)	not used	
Growing Season for Non-Leafy (years)	not used	
Growing Season for Leafy (years)	not used	
Growing Season for Fodder (years)	not used	
Translocation Factor for Non-Leafy	not used	
Translocation Factor for Leafy	not used	
Translocation Factor for Fodder	not used	
Dry Foliar Interception Fraction for Non-Leafy	not used	
Dry Foliar Interception Fraction for Leafy	not used	
Dry Foliar Interception Fraction for Fodder	not used	
Wet Foliar Interception Fraction for Non-Leafy	not used	
Wet Foliar Interception Fraction for Leafy	not used	
Wet Foliar Interception Fraction for Fodder	not used	
Weathering Removal Constant for Vegetation	not used	
C-12 concentration in water (g/cm^3)	2.00E-05	RESRAD Default
C-12 concentration in contaminated soil (g/g)	3.00E-02	RESRAD Default
Fraction of vegetation carbon from soil	2.00E-02	RESRAD Default
Fraction of vegetation carbon from air	9.80E-01	RESRAD Default
C-14 evasion layer thickness in soil (m)	3.00E-01	RESRAD Default
C-14 evasion flux rate from soil (1/sec)	7.00E-07	RESRAD Default
C-12 evasion flux rate from soil (1/sec)	1.00E-10	RESRAD Default
Fraction of grain in beef cattle feed	8.00E-01	RESRAD Default
Fraction of grain in milk cow feed	2.00E-01	RESRAD Default
DCF correction factor for gaseous forms of C14	8.89E+01	RESRAD Default
Storage times of contaminated foodstuffs (days): Fruits, non-leafy vegetables, and grain	1.40E+01	RESRAD Default

Table 3-2
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Storage times of contaminated foodstuffs (days):	Leafy vegetables	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Milk	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Meat and poultry	2.00E+01	RESRAD Default
Storage times of contaminated foodstuffs (days):	Fish	7.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Crustacea and mollusks	7.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Well water	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Surface water	1.00E+00	RESRAD Default
Storage times of contaminated foodstuffs (days):	Livestock fodder	4.50E+01	RESRAD Default

3.2 SPREADSHEET-BASED CALCULATIONS WITH MicroShield®

@Risk-supported spreadsheet calculations based on equations listed in Appendix B are used to estimate the distributions of contaminant, sediment, and river flow properties for the Recreation scenario. Distributions of radionuclide concentrations in the River are projected. Sediment concentrations are used by MicroShield® to generate external gamma radiation exposure doses from fishing, swimming, and boating in these waters. These dose distributions are combined with spreadsheet-produced fish and water ingestion dose distributions from the equations in Appendix B to determine a cumulative TEDE to the receptor.

The input parameters and their sources for assessment of exposures related to contamination in the River sediments are summarized in Table 3-3. Site-specific values are used, whenever available. When not available, RESRAD and Microshield® default values are used in the analysis. The lowest of all distribution coefficients measured on site materials are used to conservatively represent contaminant migration from the sediments into the River.

Table 3-3

Recreation / Sediment Exposure Scenario Input Parameters

PARAMETER DESCRIPTION		VALUE	SOURCE
Dose conversion factors for ingestion, mrem/pCi:	Ac-227+D	1.48E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-241	3.64E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Am-243+D	3.63E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	C-14	2.09E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-243	2.51E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cm-244	2.02E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Co-60	2.69E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-134	7.33E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Cs-137+D	5.00E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-152	6.48E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-154	9.55E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Eu-155	1.53E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Fe-55	6.07E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Gd-152	1.61E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	H-3	6.40E-08	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Nb-94	7.14E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-59	2.10E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ni-63	5.77E-07	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Np-237+D	4.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pa-231	1.06E-02	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pb-210+D	5.37E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Po-210	1.90E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-238	3.20E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-239	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-240	3.54E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-241+D	6.85E-05	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Pu-242	3.36E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-226+D	1.33E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Ra-228+D	1.44E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sb-125	2.81E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Sr-90+D	1.53E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Tc-99	1.46E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Te-125m	3.67E-06	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-228+D	8.08E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-229+D	4.03E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-230	5.48E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	Th-232	2.73E-03	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-233	2.89E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-234	2.83E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-235+D	2.67E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-236	2.69E-04	RESRAD Default
Dose conversion factors for ingestion, mrem/pCi:	U-238+D	2.69E-04	RESRAD Default

Table 3-3
(continued)

PARAMETER DESCRIPTION		VALUE	SOURCE
Bioaccumulation factors, fresh water, L/kg:	Ac-227+D , fish	1.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-241 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Am-243+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	C-14 , fish	5.00E+04	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-243 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cm-244 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Co-60 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-134 , fish	2.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Cs-137+D , fish	2.00E+03	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-152 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-154 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Eu-155 , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Fe-55 , fish	2.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Gd-152 , fish	2.50E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	H-3 , fish	1.00E+00	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Nb-94 , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-59 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ni-63 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Np-237+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pa-231 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pb-210+D , fish	3.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Po-210 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-238 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-239 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-240 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-241+D , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Pu-242 , fish	3.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-226+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Ra-228+D , fish	5.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sb-125 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Sr-90+D , fish	6.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Tc-99 , fish	2.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Te-125m , fish	4.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-228+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-229+D , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-230 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	Th-232 , fish	1.00E+02	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-233 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-234 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-235+D , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-236 , fish	1.00E+01	RESRAD Default
Bioaccumulation factors, fresh water, L/kg:	U-238+D , fish	1.00E+01	RESRAD Default
Area of contaminated zone (m^2)		2.50E+01	RESRAD Default
Thickness of contaminated zone (m)		3.05E-01	GPU E-MAIL 1/11/02
Time since placement of material (yr)		0.00E+00	RESRAD Default
Initial principal radionuclide (pCi/g): Am-241		1.00E+00	Assumed
Initial principal radionuclide (pCi/g): C-14		1.00E+00	Assumed

Table 3-3
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Initial principal radionuclide (pCi/g): Cm-243	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cm-244	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Co-60	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cs-134	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Cs-137	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Eu-152	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Eu-154	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Eu-155	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Fe-55	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): H-3	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Nb-94	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Ni-59	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Ni-63	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-238	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-239	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-240	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-241	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Pu-242	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Sb-125	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Sr-90	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): Tc-99	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-234	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-235	1.00E+00	Assumed
Initial principal radionuclide (pCi/g): U-238	1.00E+00	Assumed
Cover depth (m)	0.00E+00	RESRAD Default
Contaminated zone total porosity	4.60E-01	GPU E-MAIL 1/11/02
Distribution coefficients for C-14 Contaminated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-243 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cm-244 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Co-60 Contaminated zone (cm^3/g)	2.00E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-134 Contaminated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Cs-137 Contaminated zone (cm^3/g)	2.13E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-152 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-154 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Eu-155 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Fe-55 Contaminated zone (cm^3/g)	1.00E+04	GPU E-MAIL 1/11/02
Distribution coefficients for H-3 Contaminated zone (cm^3/g)	1.00E+00	GPU E-MAIL 1/11/02
Distribution coefficients for Nb-94 Contaminated zone (cm^3/g)	8.00E+01	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-59 Contaminated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Ni-63 Contaminated zone (cm^3/g)	1.30E+03	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-238 Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-239 Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-240 Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-241 Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Pu-242 Contaminated zone (cm^3/g)	1.60E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Sb-125 Contaminated zone (cm^3/g)	1.53E+02	GPU E-MAIL 1/11/02
Distribution coefficients for Tc-99 Contaminated zone (cm^3/g)	1.30E+00	GPU E-MAIL 1/11/02

Table 3-3
(continued)

PARAMETER DESCRIPTION	VALUE	SOURCE
Distribution coefficients for U-234 Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-235 Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for U-238 Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Ac-227 Contaminated zone (cm^3/g)	2.00E+01	RESRAD Default
Distribution coefficients for daughter Am-241 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Am-243 Contaminated zone (cm^3/g)	1.00E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Gd-152 Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Np-237 Contaminated zone (cm^3/g)	-1.00E+00	RESRAD Default
Distribution coefficients for daughter Pa-231 Contaminated zone (cm^3/g)	5.00E+01	RESRAD Default
Distribution coefficients for daughter Pb-210 Contaminated zone (cm^3/g)	9.70E+03	GPU E-MAIL 1/11/02
Distribution coefficients for daughter Po-210 Contaminated zone (cm^3/g)	1.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-226 Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Ra-228 Contaminated zone (cm^3/g)	7.00E+01	RESRAD Default
Distribution coefficients for daughter Te-125m Contaminated zone (cm^3/g)	0.00E+00	RESRAD Default
Distribution coefficients for daughter Th-228 Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-229 Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-230 Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter Th-232 Contaminated zone (cm^3/g)	6.00E+04	RESRAD Default
Distribution coefficients for daughter U-233 Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Distribution coefficients for daughter U-236 Contaminated zone (cm^3/g)	1.60E+01	GPU E-MAIL 1/11/02
Fraction of time spent outdoors (on site)	6.70E+00	REG Guide 1.109
Fish consumption (kg/yr)	2.06E+01	RESRAD Default
Inadvertent water intake (L/yr)	5.00E+00	Assumed
Sediment Density (g/cm^3)	1.44E+00	GPU E-MAIL 1/11/02
Sediment Porosity	4.60E-01	GPU E-MAIL 1/11/02
Water Depth (m)	3.05E-01	GPU E-MAIL 1/11/02

4. ANALYSIS METHODS AND RESULTS

Radiation doses are determined for exposures to contaminants in the Overburden soils, Bedrock, and River sediments. The sensitivity of these projected doses to the various distributions and uncertainties of the input parameters are determined for the analysis and development of the DCGLs through the use of the sensitivity features of the RESRAD and @Risk models. The Microshield® and spreadsheet models are deterministic but utilize the @Risk model to generate their dose probability distributions from repeated Microshield® and spreadsheet calculations. The parameters to which the analysis results are most sensitive are identified. The magnitude of uncertainty in the DCGLs is estimated, using the probabilistic features of RESRAD version 6.1 and @Risk. The mean values from the resulting distributions of nuclide-specific doses are used to estimate DCGLs for each material type.

4.1 OVERBURDEN LAYER

The input parameters in Table 3-1 are employed to evaluate baseline doses for each radionuclide resulting from exposure to Overburden materials. The RESRAD calculations of these doses are presented in Appendix A. As listed in Table 4-1, site-specific distributions (GPU, 2002) are used to identify those input parameters to which the analysis results are most sensitive.

Table 4-1

Input Parameter Distributions

PARAMETERS	RANGE OF VALUES EVALUATED MIN.	MAX.	ASSIGNED DISTRIBUTION
Thickness of Soil Evasion Layer of C-14 in Soil (m) *(This is the maximum soil thickness layer through which C-14 can escape to the air by conversion to CO2. C-14 below this depth is assumed trapped in the soil.)*	0.2	0.6	Triangular
Thickness of Contaminated Zone 1 (m)	0.5	1.5	Uniform
Contaminated Zone Erosion Rate (m/yr)	0.00009	0.0006	Loguniform
Contaminated Zone Hydraulic Conductivity (m/yr)	0.362	25400	Loguniform
Contaminated Zone Total Porosity	0.35	0.56	Uniform
Density of Contaminated Zone (g/cm^3)	1.28	1.92	Uniform
Evapotranspiration Coefficient (m/yr)	0.5	0.67	Uniform
Humidity in Air (Default Value Used) (g/m^3)	Default Value	Default Value	Truncated Lognormal-N
Irrigation (m/yr) (Default Value Used)	0.1	0.4	Uniform
Precipitation (m/y)	0.688	1.327	Uniform
Runoff Coefficient	0.3	0.4	Uniform
Watershed Area for Nearby Stream or Pond (m^2)	2.500E+06	7.500E+06	Uniform
Density of Saturated Zone (g/cm^3)	1.28	1.92	Uniform
Saturated Zone Effective Porosity	0.005	0.05	Loguniform
Saturated Zone Hydraulic Conductivity (m/yr)	15.59	909.53	Uniform
Saturated Zone Hydraulic Gradient	0.013	0.03	Uniform
Saturated Zone Total Porosity	0.31	0.41	Uniform
Well Pump Intake Depth (m)	10	50	Uniform
Density of Unsaturated Zone 1 (g/cm^3)	1.28	1.92	Uniform
Effective Porosity of Unsaturated Zone 1	0.28	0.54	Uniform
Hydraulic Conductivity of Unsaturated Zone 1 (m/yr)	0.362	25400	Loguniform
Thickness of Unsaturated Zone 1 (m)	0	0.5	Uniform
Total porosity of Unsaturated Zone 1	0.35	0.56	Uniform
External Gamma Shielding Factor	0.044	1	Bounded Lognormal-N
Indoor Dust Filtration Factor	0.15	0.95	Uniform
Indoor Time Fraction	0	1	Continuous Linear
Inhalation Rate (m^3/yr)	4380	13100	Triangular
Mass Loading for Inhalation (g/m^3)	0	0.0001	Continuous Linear
Contaminated Fraction of Aquatic Food	0	1	Triangular
Contaminated Fraction of Irrigation Water	0.5	1	Uniform
Contaminated Fraction of Livestock Water	0.5	1	Uniform
Drinking Water Intake (L/yr)	478.5	730	Uniform
Fish Consumption (kg/yr)	20.6	21	Uniform
Fruit, Vegetable, and Grain Consumption (kg/yr)	112	520	Uniform
Leafy Vegetable Consumption (kg/yr)	21.4	64	Uniform
Meat and Poultry Consumption (kg/yr)	67	110	Uniform
Milk Consumption	233	310	Uniform

Table 4-1

Input Parameter Distributions

PARAMETERS	RANGE OF VALUES EVALUATED MIN.	MAX.	ASSIGNED DISTRIBUTION
Other Seafood Consumption (kg/yr)	0.9	5	Uniform
Soil Ingestion Rate (g/yr)	18.2625	36.5	Uniform
Depth of Roots (m)	0.3	4	Uniform
Depth of Soil Mixing Layer (m)	0	0.6	Triangular
Weathering Removal Constant of all Vegetation	5.1	84	Triangular
Wet Crop Yield for Leafy (kg/m^2)	0.75	3	Uniform
Wet Crop Yield for Non-Leafy (kg/m^2)	Default Value	Default Value	Truncated Lognormal-N
Wet Foliar Inception Fraction of Leafy Vegetables	0.06	0.95	Triangular
Distribution Coefficient for Carbon	*GPU Min.*	*GPU Max.*	*Distribution Type*
1. Contaminated Zone (cm^3/g)	0	5	Uniform
2. Unsaturated Zone (cm^3/g)	0	5	Uniform
3. Saturated Zone (cm^3/g)	0	5	Uniform
Distribution Coefficient for Hydrogen	*GPU Min.*	*GPU Max.*	*Distribution Type*
1. Contaminated Zone (cm^3/g)	0	5	Uniform
2. Unsaturated Zone (cm^3/g)	0	5	Uniform
3. Saturated Zone (cm^3/g)	0	5	Uniform

As is given in Table 4-2, the Overburden DCGLs are dependent upon variations in a variety of parameters. DCGLs for those nuclides which tend to concentrate in fruit and vegetation, (e.g., Eu-152, Eu-154, Fe-55, H-3, Pu-238, Pu-241, Pu-242, and the Uranium isotopes), are most sensitive to the amount of fruit, vegetation, and grain consumed by the receptor. Similarly, the Sb-125 DCGL is most sensitive to the amount of meat and poultry consumed by the receptor. Finally, the C-14, Cs-134, Cs-137, and Eu-152 DCGL are most sensitive to the thickness of the contamination layer on the ground surface.

Since ingestion of contaminated drinking water is not considered for the pore water in the Overburden, only the NRC 25 mrem/yr dose limit is used to compute DCGLs for the minimum, maximum, mean doses (reported in Table 4-3). While DCGL distribution shapes are nuclide specific, the widest distributions are estaimated for the Tritium and Nickel isotopes. Conversely, narrow distributions are computed for Americium, Cobolt, and Strontium isotopes.

The mean DCGLs range from 7 pCi/g for Sr-90 to 170,000 pCi/g for Fe-55, with 9 radionuclides at or below 50 pCi/g. DCGLs for 6 nuclides are above 1,000 pCi/g (Eu-155, Fe-55, H-3, Ni-59, Ni-63, and Pu-241). DCGLs for Fe-55 and Ni-59 are the only 2 above 10,000 pCi/g.

Table 4-2

Sensitivity of Overburden DCGLs to Input Parameter Distributions

	MOST SENSITIVE INPUT PARAMETERS		
	1st	2nd	3rd
Am-241	Density of contaminated zone	Wet weight crop yield of leafy vegetables	Wet weight crop yield of fruit, grain and non-leafy vegetables
C-14	Thickness of contaminated zone	Fruit, vegetable, and grain consumption	Density of contaminated zone
Cm-243	Indoor time fraction	Thickness of contaminated zone	External gamma shielding factor
Cm-244	Indoor time fraction	Thickness of contaminated zone	Inhalation rate
Co-60	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
Cs-134	Thickness of contaminated zone	Fruit, vegetable, and grain consumption	Density of contaminated zone
Cs-137	Thickness of contaminated zone	Meat and poultry consumption	Density of contaminated zone
Eu-152	Thickness of contaminated zone	Density of contaminated zone	Milk consumption
Eu-154	Indoor time fraction	Thickness of contaminated zone	Soil ingestion
Eu-155	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
Fe-55	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
H-3	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
Nb-94	Saturated zone hydraulic conductivity	Irrigation	Watershed area for nearby stream or pond
Ni-59	Saturated zone hydraulic conductivity	Thickness of contaminated zone	Irrigation
Ni-63	Saturated zone hydraulic conductivity	Thickness of contaminated zone	Milk consumption
Pu-238	Fruit, vegetable, and grain consumption	Thickness of contaminated zone	Indoor time fraction
Pu-239	Indoor time fraction	External gamma shielding factor	Fruit, vegetable, and grain consumption
Pu-240	Mass loading for inhalation	Indoor time fraction	Indoor dust filtration factor
Pu-241	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
Pu-242	Fruit, vegetable, and grain consumption	Thickness of contaminated zone	Leafy vegetable consumption
Sb-125	Meat and poultry consumption	Thickness of contaminated zone	Contaminated zone hydraulic conductivity
Sr-90	Milk consumption	Thickness of contaminated zone	Wet weight crop yield of fruit, grain and non-leafy vegetables
Tc-99	Indoor time fraction	Soil ingestion	Saturated zone hydraulic conductivity
U-234	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
U-235	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone
U-238	Fruit, vegetable, and grain consumption	Indoor time fraction	Thickness of contaminated zone

Table 4-3

Distributions Of Overburden DCGLs From Input Parameter Distributions (pCi/g)

NUCLIDES OF CONCERN	MEAN DCGL	MAXIMUM DCGL	MINIMUM DCGL	DCGL STANDARD DEVIATION
Am-241	1.8E+01	2.5E+02	6.4E+00	2.3E+01
C-14	8.9E+01	3.4E+02	4.3E+01	1.9E+02
Cm-243	1.2E+02	2.3E+02	7.6E+01	4.2E+02
Cm-244	1.8E+02	4.0E+02	1.1E+02	5.3E+02
Co-60	2.1E+01	3.0E+01	1.0E+01	6.5E+01
Cs-134	2.9E+01	4.3E+01	1.7E+01	1.2E+02
Cs-137	5.1E+01	7.8E+01	3.5E+01	2.6E+02
Eu-152	5.4E+01	7.8E+01	2.4E+01	1.4E+02
Eu-154	5.0E+01	7.2E+01	2.2E+01	1.3E+02
Eu-155	2.1E+03	3.0E+03	9.5E+02	5.6E+03
Fe-55	1.7E+05	2.3E+05	1.3E+05	1.3E+06
H-3	8.9E+03	2.0E+04	5.2E+03	2.7E+04
Nb-94	3.8E+01	5.5E+01	1.7E+01	1.0E+02
Ni-59	1.7E+04	3.0E+04	1.2E+04	8.3E+04
Ni-63	6.3E+03	1.1E+04	4.4E+03	3.0E+04
Pu-238	1.1E+02	2.4E+02	6.8E+01	3.3E+02
Pu-239	1.0E+02	2.2E+02	6.1E+01	3.0E+02
Pu-240	1.0E+02	2.2E+02	6.1E+01	3.0E+02
Pu-241	3.4E+03	7.4E+03	2.0E+03	9.8E+03
Pu-242	1.1E+02	2.3E+02	6.4E+01	3.2E+02
Sb-125	1.5E+02	2.2E+02	7.5E+01	4.5E+02
Sr-90	7.0E+00	1.4E+01	4.2E+00	2.3E+01
Tc-99	5.4E+01	1.3E+02	3.1E+01	1.5E+02
U-234	4.6E+02	9.1E+02	2.8E+02	1.5E+03
U-235	2.5E+02	4.0E+02	1.6E+02	1.1E+03
U-238	4.2E+02	7.6E+02	2.7E+02	1.6E+03

4.2 BEDROCK LAYER

The input parameters in Table 3-2 are employed to evaluate baseline doses for each radionuclide resulting from exposure to Bedrock materials. The RESRAD calculations of these doses are presented in Appendix A. The distributions, as listed previously in Table 4-1, are site-specific distributions. When appropriate, the listed distributions are applied in analysis of both the Overburden Layer and Bedrock Layer. These distributions are used to identify those input parameters to which the analysis results are most sensitive.

The parameters to which the radiation doses are most sensitive are listed in Table 4-4. Sensitivity analyses show that the Bedrock DCGLs are generally most sensitive to the saturated hydraulic conductivity of the Bedrock, the Bedrock hydraulic gradient, and then the Bedrock effective porosity. DCGLs for C-14 also show sensitivity to the Bedrock distribution coefficient.

Since ingestion of contaminated drinking water is the only pathway considered for the pore water in the Bedrock, both the EPA's 4 mrem/yr drinking water limit (reported in Table 4-5) and the NRC 25 mrem/year cumulative (reported in Table 4-6) dose limits are then used to compute DCGLs for the minimum, maximum, mean doses. While DCGL distribution shapes are nuclide specific, the widest distributions are estimated for the Cm-243, Ni-63, and the Europium isotopes. Conversely, narrow distributions are computed for Plutonium, Strontium, and Uranium isotopes. Since no appreciable dose is estimated from the ingestion of Fe-55-contaminated groundwater, no corresponding DCGL distribution is given.

Table 4-4

Sensitivity of Bedrock DCGLs to Input Parameter Distributions

	MOST SENSITIVE INPUT PARAMETERS		
	1st	**2nd**	**3rd**
Am-241	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
C-14	Saturated zone hydraulic conductivity	Kd of C-14 in Contaminated Zone	Saturated zone effective porosity
Cm-243	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Cm-244	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Co-60	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Cs-134	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Cs-137	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Eu-152	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Eu-154	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Eu-155	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Fe-55	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
H-3	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Nb-94	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Ni-59	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Ni-63	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Pu-238	Saturated zone hydraulic conductivity	Saturated zone effective porosity	Saturated zone hydraulic gradient
Pu-239	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Pu-240	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Pu-241	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Pu-242	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Sb-125	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Sr-90	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
Tc-99	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
U-234	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
U-235	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity
U-238	Saturated zone hydraulic conductivity	Saturated zone hydraulic gradient	Saturated zone effective porosity

Table 4-5

Distributions Of Bedrock 4 mrem/yr DCGLs From Input Parameter Distributions (pCi/g)

NUCLIDES OF CONCERN	MEAN DCGL	MAXIMUM DCGL	MINIMUM DCGL	DCGL STANDARD DEVIATION
Am-241	4.5E+01	2.1E+02	1.1E+01	6.1E+01
C-14	3.1E+01	3.0E+02	3.4E+00	2.6E+01
Cm-243	9.7E+02	4.8E+03	2.9E+02	1.5E+03
Cm-244	5.6E+02	2.3E+03	1.3E+02	6.6E+02
Co-60	4.1E+04	2.2E+05	9.9E+03	5.0E+04
Cs-134	5.6E+15	8.7E+20	3.5E+14	2.2E+15
Cs-137	9.4E+05	6.8E+06	2.0E+05	1.0E+06
Eu-152	3.9E+06	2.9E+07	8.4E+05	4.3E+06
Eu-154	9.8E+06	1.0E+08	1.8E+06	9.8E+06
Eu-155	7.7E+08	1.8E+10	1.2E+08	6.4E+08
Fe-55	7.6E+22 *	7.6E+22 *	7.6E+22 *	- -
H-3	1.4E+03	1.1E+04	3.0E+02	1.4E+03
Nb-94	3.7E+02	1.6E+03	8.3E+01	4.1E+02
Ni-59	2.1E+05	8.9E+05	4.7E+04	2.4E+05
Ni-63	2.5E+06	1.3E+07	6.6E+05	3.2E+06
Pu-238	6.7E+00	3.0E+01	1.6E+00	9.1E+00
Pu-239	1.5E+00	6.5E+00	3.4E-01	1.7E+00
Pu-240	1.6E+00	6.5E+00	3.5E-01	1.8E+00
Pu-241	1.1E+03	5.0E+03	2.7E+02	1.5E+03
Pu-242	1.6E+00	6.8E+00	3.5E-01	1.7E+00
Sb-125	1.6E+01	5.1E+01	3.8E+00	2.3E+01
Sr-90	4.2E+00	1.2E+01	8.5E-01	5.4E+00
Tc-99	3.3E+01	1.5E+02	7.4E+00	3.7E+01
U-234	1.9E+00	8.2E+00	4.2E-01	2.1E+00
U-235	1.9E+00	8.7E+00	4.3E-01	2.1E+00
U-238	2.0E+00	8.6E+00	4.4E-01	2.2E+00

* Nuclide Specific Activity Limit

Table 4-6

Distributions Of Bedrock 25 mrem/yr DCGLs From Input Parameter Distributions (pCi/g)

NUCLIDES OF CONCERN	MEAN DCGL		MAXIMUM DCGL		MINIMUM DCGL		DCGL STANDARD DEVIATION
Am-241	2.8E+02		1.3E+03		7.1E+01		3.8E+02
C-14	1.9E+02		1.9E+03		2.1E+01		1.6E+02
Cm-243	6.1E+03		3.0E+04		1.8E+03		9.1E+03
Cm-244	3.5E+03		1.5E+04		8.0E+02		4.1E+03
Co-60	2.5E+05		1.4E+06		6.2E+04		3.1E+05
Cs-134	3.5E+16		5.4E+21		2.2E+15		1.3E+16
Cs-137	5.9E+06		4.2E+07		1.3E+06		6.5E+06
Eu-152	2.5E+07		1.8E+08		5.3E+06		2.7E+07
Eu-154	6.1E+07		6.3E+08		1.2E+07		6.1E+07
Eu-155	4.8E+09		1.1E+11		7.2E+08		4.0E+09
Fe-55	7.6E+22	*	7.6E+22	*	7.6E+22	*	- -
H-3	8.6E+03		7.0E+04		1.9E+03		8.8E+03
Nb-94	2.3E+03		1.0E+04		5.2E+02		2.6E+03
Ni-59	1.3E+06		5.6E+06		2.9E+05		1.5E+06
Ni-63	1.6E+07		8.0E+07		4.1E+06		2.0E+07
Pu-238	4.2E+01		1.9E+02		1.0E+01		5.7E+01
Pu-239	9.4E+00		4.1E+01		2.1E+00		1.0E+01
Pu-240	9.7E+00		4.1E+01		2.2E+00		1.1E+01
Pu-241	7.0E+03		3.1E+04		1.7E+03		9.5E+03
Pu-242	9.7E+00		4.3E+01		2.2E+00		1.1E+01
Sb-125	1.0E+02		3.2E+02		2.4E+01		1.5E+02
Sr-90	2.6E+01		7.8E+01		5.3E+00		3.3E+01
Tc-99	2.1E+02		9.1E+02		4.6E+01		2.3E+02
U-234	1.2E+01		5.1E+01		2.6E+00		1.3E+01
U-235	1.2E+01		5.4E+01		2.7E+00		1.3E+01
U-238	1.2E+01		5.4E+01		2.8E+00		1.4E+01

* Nuclide Specific Activity Limit

Mean values from the calculated distributions of nuclide-specific doses are used to calculate DCGLs for the Bedrock layer. For those nuclides considered, the 4 mrem-yr DCGL values range from 1.5 pCi/g for Pu-239 to 7.6×10^{22} pCi/g for Fe-55 (maximum activity limit for Fe-55). Similarly, the 25 mrem-yr DCGL values range from 9.4 pCi/g for Pu-239 to the same maximum activity limit for Fe-55. Bedrock DCGLs (4 mrem/yr) for 17 of the 26 nuclides are below 2,000 pCi/g, with only 6 above 150,000 pCi/g When based on the 25 mrem/yr dose limit, 11 of the 26 nuclides are below 2,000 pCi/g, with 9 above 150,000 pCi/g

4.3 RECREATION / RIVER SEDIMENT

The input parameters in Table 3-3 are employed to evaluate baseline doses for each radionuclide resulting from exposure to river sediment materials. The spreadsheet calculations of these doses are presented in Appendix A. The sensitivity of these river sediment doses to the various distributions and uncertainties of the input parameters is estimated using the sensitivity features of the @Risk assessment model. The distributions, as listed in Table 4-1, include site-specific and default distributions. These distributions are used to identify those input parameters to which the analysis results are most sensitive.

The parameters to which the radiation doses are most sensitive are listed in Table 4-7. For major gamma-emitting nuclides, the computed DCGL is most sensitive to exposure time. Similarly, for those nuclides with a tendency to concentrate in fish flesh, the computed DCGL is most sensitive to the amount of fish consumed by the receptor.

Table 4-7

Sensitivity of Recreation / Sediment DCGLs to Input Parameter Distributions

	MOST SENSITIVE INPUT PARAMETERS		
	1st	2nd	3rd
Am-241	Time Spent Swimming	Fish Consumption	Sediment Density
C-14	Sediment Density	Sediment Hydraulic Conductivity	Contaminant Depth
Cm-243	Time Spent Swimming	Fish Consumption	Sediment Density
Cm-244	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Co-60	Time Spent Swimming	Fish Consumption	Sediment Density
Cs-134	Time Spent Swimming	Fish Consumption	Sediment Density
Cs-137	Time Spent Swimming	Fish Consumption	Sediment Density
Eu-152	Time Spent Swimming	Fish Consumption	Sediment Density
Eu-154	Time Spent Swimming	Fish Consumption	Sediment Density
Eu-155	Time Spent Swimming	Fish Consumption	Sediment Density
Fe-55	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
H-3	Sediment Density	Sediment Hydraulic Conductivity	Contaminant Depth
Nb-94	Time Spent Swimming	Fish Consumption	Sediment Density
Ni-59	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Ni-63	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Pu-238	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Pu-239	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Pu-240	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Pu-241	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Pu-242	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Sb-125	Time Spent Swimming	Fish Consumption	Sediment Density
Sr-90	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
Tc-99	Fish Consumption	Sediment Density	Sediment Hydraulic Conductivity
U-234	Sediment Density	Fish Consumption	Sediment Hydraulic Conductivity
U-235	Time Spent Swimming	Sediment Density	Fish Consumption
U-238	Sediment Density	Fish Consumption	Sediment Hydraulic Conductivity

The NRC 25 mrem/year cumulative (reported in Table 4-8) dose limits are used to compute DCGLs for the minimum, maximum, mean doses. Mean values from the calculated distributions of nuclide-specific doses are used to calculate DCGLs for the river sediment. For those nuclides considered, the DCGL values range from 1,800 pCi/g for Co-60 to 4.5×10^{11} pCi/g for Fe-55. Recreation DCGLs for only 9 of the 26 nuclides are below 100,000 pCi/g, with 9 above 10,000,000 pCi/g.

Table 4-8

Distributions Of Sediment / Recreation DCGLs From Input Parameter Distributions (pCi/g)

NUCLIDES OF CONCERN	MEAN DCGL	MAXIMUM DCGL	MINIMUM DCGL	DCGL STANDARD DEVIATION
Am-241	5.3E+06	9.3E+06	2.6E+06	1.8E+07
C-14	5.3E+04	2.0E+05	4.5E+03	5.2E+04
Cm-243	1.2E+05	2.2E+05	6.0E+04	3.8E+05
Cm-244	8.9E+07	3.4E+08	7.7E+06	8.9E+07
Co-60	1.8E+03	3.4E+03	9.0E+02	5.7E+03
Cs-134	4.0E+03	7.4E+03	2.0E+03	1.3E+04
Cs-137	1.1E+04	2.1E+04	5.8E+03	3.7E+04
Eu-152	4.7E+03	8.9E+03	2.4E+03	1.5E+04
Eu-154	3.7E+03	7.0E+03	1.9E+03	1.2E+04
Eu-155	6.4E+05	1.2E+06	3.2E+05	2.0E+06
Fe-55	4.5E+11	1.7E+12	3.8E+10	4.5E+11
H-3	6.9E+10	2.5E+11	6.2E+09	7.1E+10
Nb-94	3.7E+03	6.9E+03	1.9E+03	1.2E+04
Ni-59	3.4E+11	1.3E+12	2.9E+10	3.4E+11
Ni-63	1.2E+11	4.7E+11	1.1E+10	1.2E+11
Pu-238	9.1E+06	3.4E+07	7.7E+05	9.0E+06
Pu-239	8.1E+06	3.0E+07	7.0E+05	8.2E+06
Pu-240	8.2E+06	3.1E+07	7.0E+05	8.2E+06
Pu-241	4.3E+08	1.6E+09	3.6E+07	4.2E+08
Pu-242	8.7E+06	3.3E+07	7.4E+05	8.6E+06
Sb-125	1.8E+04	3.3E+04	8.9E+03	5.7E+04
Sr-90	6.6E+06	2.5E+07	5.6E+05	6.5E+06
Tc-99	2.4E+08	9.1E+08	2.1E+07	2.4E+08
U-234	2.8E+07	9.7E+07	2.6E+06	3.0E+07
U-235	9.8E+04	1.8E+05	5.0E+04	3.2E+05
U-238	3.1E+07	1.1E+08	2.7E+06	3.2E+07

5. SITE-WIDE DCGL SUMMARY

As is summarized in Chapter 4, this report contains two sets of nuclide-specific DCGLs for site subsurface materials (e.g., Overburden and Bedrock). In addition to these DCGLs calculated by URS, GPU has also estimated similar DCGLs for the top meter of Fill soil (GPU, 2000). The URS and GPU DCGLs have been calculated to serve as concentration limits for the respective soil layer decontamination activities. In addition to estimation of these DCGLs, GPU has requested that URS examine the conservatisms and implications of developing a single set of nuclide-specific DCGLs applicable site-wide to all soil materials (not including recreational use of River).

Table 5-1 summarizes the DCGLs for each material layer, noting the lowest (most conservative). The ratio of the lowest radionuclide DCGL to the DCGL for each soil layer is summarized in Table 5-2. As is reflected, the restrictive subsurface DCGLs occur from both drinking contaminated water from the Bedrock and from non-drinking water exposure to the Overburden (each at 13 nuclides of 26). As is also reflected in Table 5-2, applying the minimum DCGL for all subsurface layers results in a cleanup criterion at least 75% lower than mandated.

Table 5-1

Site-Wide DCGL Summary (pCi/g)

NUCLIDES OF CONCERN	BEDROCK LAYER below CV, Steam Plant, and Spray Pond: DCGL based on 25 mrem/yr all-pathway standard	BEDROCK LAYER below CV, Steam Plant, and Spray Pond: DCGL based on 4 mrem/yr drinking-water standard	OVERBURDEN LAYER near CV, near Steam Plant, and below Spray Pond: DCGL based on 25 mrem/yr all-pathway standard	MINIMUM SITE SUBSURFACE DCGL	RIVER SEDIMENTS FROM RECREATION SCENARIO: DCGL based on 25 mrem/yr all-pathway standard
Am-241	2.8E+02	4.5E+01	1.8E+01	1.80E+01	5.3E+06
C-14	1.9E+02	3.1E+01	8.9E+01	3.10E+01	5.3E+04
Cm-243	6.1E+03	9.7E+02	1.2E+02	1.20E+02	1.2E+05
Cm-244	3.5E+03	5.6E+02	1.8E+02	1.80E+02	8.9E+07
Co-60	2.5E+05	4.1E+04	2.1E+01	2.10E+01	1.8E+03
Cs-134	3.5E+16	5.6E+15	2.9E+01	2.90E+01	4.0E+03
Cs-137	5.9E+06	9.4E+05	5.1E+01	5.10E+01	1.1E+04
Eu-152	2.5E+07	3.9E+06	5.4E+01	5.40E+01	4.7E+03
Eu-154	6.1E+07	9.8E+06	5.0E+01	5.00E+01	3.7E+03
Eu-155	4.8E+09	7.7E+08	2.1E+03	2.10E+03	6.4E+05
Fe-55	7.6E+22 *	7.6E+22 *	1.7E+05	1.70E+05	4.5E+11
H-3	8.6E+03	1.4E+03	8.9E+03	1.40E+03	6.9E+10
Nb-94	2.3E+03	3.7E+02	3.8E+01	3.80E+01	3.7E+03
Ni-59	1.3E+06	2.1E+05	1.7E+04	1.70E+04	3.4E+11
Ni-63	1.6E+07	2.5E+06	6.3E+03	6.30E+03	1.2E+11
Pu-238	4.2E+01	6.7E+00	1.1E+02	6.70E+00	9.1E+06
Pu-239	9.4E+00	1.5E+00	1.0E+02	1.50E+00	8.1E+06
Pu-240	9.7E+00	1.6E+00	1.0E+02	1.60E+00	8.2E+06
Pu-241	7.0E+03	1.1E+03	3.4E+03	1.10E+03	4.3E+08
Pu-242	9.7E+00	1.6E+00	1.1E+02	1.60E+00	8.7E+06
Sb-125	1.0E+02	1.6E+01	1.5E+02	1.60E+01	1.8E+04
Sr-90	2.6E+01	4.2E+00	7.0E+00	4.20E+00	6.6E+06
Tc-99	2.1E+02	3.3E+01	5.4E+01	3.30E+01	2.4E+08
U-234	1.2E+01	1.9E+00	4.6E+02	1.90E+00	2.8E+07
U-235	1.2E+01	1.9E+00	2.5E+02	1.90E+00	9.8E+04
U-238	1.2E+01	2.0E+00	1.4E+03	2.00E+00	3.1E+07

* Nuclide Specific Activity Limit

Table 5-2

Ratio of Minimum Subsurface and Specific Soil Layer DCGL

	BEDROCK LAYER		OVERBURDEN LAYER
	25 mrem/yr	4 mrem/yr	25 mrem/yr
Am-241	0.06	0.40	1.00
C-14	0.16	1.00	0.35
Cm-243	0.02	0.12	1.00
Cm-244	0.05	0.32	1.00
Co-60	0.00	0.00	1.00
Cs-134	0.00	0.00	1.00
Cs-137	0.00	0.00	1.00
Eu-152	0.00	0.00	1.00
Eu-154	0.00	0.00	1.00
Eu-155	0.00	0.00	1.00
Fe-55	0.00	0.00	1.00
H-3	0.16	1.00	0.16
Nb-94	0.02	0.10	1.00
Ni-59	0.01	0.08	1.00
Ni-63	0.00	0.00	1.00
Pu-238	0.16	1.00	0.06
Pu-239	0.16	1.00	0.02
Pu-240	0.16	1.00	0.02
Pu-241	0.16	1.00	0.32
Pu-242	0.16	1.00	0.01
Sb-125	0.16	1.00	0.11
Sr-90	0.16	1.00	0.60
Tc-99	0.16	1.00	0.61
U-234	0.16	1.00	0.00
U-235	0.16	1.00	0.01
U-238	0.17	1.00	0.00

6. SUMMARY AND CONCLUSIONS

In preparing to terminate the NRC license for the site, GPU determined DCGLs for the top meter of the SNEC site soil that correspond to the 25 mrem/year radiation dose limit prescribed by NRC for site cleanup. This report documents a conceptual model and methodology developed by URS to determine DCGLs for the sub-surface zone below the top meter of soil.

Three areas of concern are considered for estimating radiation doses for a resident / farmer scenario: the CV, the Steam Plant, and the Spray Pond Areas. A fourth area, the River Sediments, is also considered for estimating radiation doses for a recreation scenario. DCGLs are calculated from the radiation doses.

The site hydrology is dominated by a shallow Fill layer and a deeper Bedrock region, separated by a relatively impermeable Overburden layer. The Fill and Bedrock both drain westward toward the River. Disturbed areas (or planned disturbed areas) of the Overburden at the perimeters of the CV, Steam Plant, tunnels, and Spray Ponds hydraulically connect the Fill and Bedrock and enhance drainage from the Site.

Radiation exposure pathways associated with the resident / farmer scenario are analyzed to estimate radiation doses. Gamma radiation exposures occur in the yard and through the house floor from radionuclides mixed into surface soils from excavation and well cuttings. Exposures from inhaling contaminated dust occur during site grading, well excavation, garden tillage, and wind resuspension. Exposures from ingesting contaminated soil occur from soil entrained on vegetables and unwashed hands. Exposures from ingesting contaminated drinking water occur from transport in the Bedrock. Exposures from ingesting contaminated fruits and vegetables occur via their uptake from contaminated surface soil and contaminated irrigation water.

Exposures from meat and milk occur from contaminants in animal feed and water. Gamma radiation exposures occur in recreation while fishing, boating, and swimming. Additional recreation exposures also occur from ingesting contaminated water while swimming and from consuming fish from the River.

RESRAD Version 6.1, @Risk, and spreadsheet calculations are used to estimate and combine the exposure distributions for the critical times. RESRAD Version 6.1 computes probabilistic estimates of radiation dose distributions that result from various distributions of input parameters. Probabilistic assessment of the input parameter distributions within the spreadsheet calculations and Microshield® model are performed using @Risk.

In order to account for plans of using heterogeneous Site materials for backfill and remediation, the lowest nuclide distribution coefficients are used in the analysis. This minimizes transport retardation and decay of contaminants, before they reach the point of exposure. This modeling conservatism allows single assessments of the Bedrock and Overburden layers to be conservatively applied site-wide. The first application of RESRAD represents the Fill layer and associated surface exposures. The second evaluates ingestion of drinking water from a well drilled into the Bedrock.

NRC's site cleanup criterion of 25 mrem/year and the EPA 4 mrem/year drinking water criterion are used to determine the DCGLs for each nuclide in each subsurface material layer, based on the temporal peaks of the mean doses. As are listed in Table 6-1, the most limiting DCGLs are conservatively proposed as site-wide DCGLs for the materials deeper than one meter.

Table 6-1

Site-Wide DCGLs (pCi/g)

NUCLIDES OF CONCERN	MINIMUM SITE SUBSURFACE DCGL
Am-241	1.80E+01
C-14	3.10E+01
Cm-243	1.20E+02
Cm-244	1.80E+02
Co-60	2.10E+01
Cs-134	2.90E+01
Cs-137	5.10E+01
Eu-152	5.40E+01
Eu-154	5.00E+01
Eu-155	2.10E+03
Fe-55	1.70E+05
H-3	1.40E+03
Nb-94	3.80E+01
Ni-59	1.70E+04
Ni-63	6.30E+03
Pu-238	6.70E+00
Pu-239	1.50E+00
Pu-240	1.60E+00
Pu-241	1.10E+03
Pu-242	1.60E+00
Sb-125	1.60E+01
Sr-90	4.20E+00
Tc-99	3.30E+01
U-234	1.90E+00
U-235	1.90E+00
U-238	2.00E+00

The ratio of the lowest radionuclide DCGL to the DCGL for each soil layer reveals that the most restrictive subsurface DCGLs generally occur from drinking contaminated water from the Bedrock, with slightly more than one-third from the non-drinking water pathways within the Overburden layer. Applying the minimum DCGLs for all subsurface layers conservatively results in cleanup criteria at least 75% lower than would be mandated by material-specific DCGLs.

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APPENDIX A

BASELINE RESRAD SUMMARY REPORTS

Appendix A

This appendix contains the RESRAD and spreadsheet calculated dose distributions that are used to determine the DCGLs for the Overburden layer, Bedrock, and River sediments. The Overburden RESRAD uncertainty output file (90 pages) is labeled as Shallow Water. Conversely, the Bedrock RESRAD uncertainty summary output file (131 pages) is labeled as Deep Water. The spreadsheet report of recreational doses (2 pages) is labeled River Sediments.

APPENDIX B

RIVER SEDIMENT / RECREATION ASSESSMENT MODEL

Appendix B

Spreadsheet calculations are used to calculate radiation doses from recreational uses of the Juniata River. The recreation scenario describes the doses to a receptor from Juniata River water that could have become contaminated by radionuclides from riverbed sediment near the SNEC Site. Recreational doses could result from ingesting contaminated water while swimming, ingesting contaminated fish, and gamma radiation exposures while fishing, boating, and swimming.

While unit radionuclide sediment concentrations are used by Microshield® to estimate external gamma radiation exposures from recreation activities, spreadsheet analysis is used to conservatively project corresponding River water concentrations for other exposure pathways. Standard K_d contaminant partitioning is assumed between the sediments and the river water:

$$C_R = \frac{C_s D_s P d}{\rho k_D V_R} \qquad \text{(B-1)}$$

where:

C_R	=	River water concentration (pCi/cm^3)
C_s	=	Sediment concentration (pCi/g)
D_s	=	Contaminant depth in sediment (m)
P	=	Saturated hydraulic conductivity in sediment (m/yr)
d	=	Contaminant zone length parallel to river flow (m)
ρ	=	Sediment density (g/cm^3)
k_D	=	Sediment distribution coefficient (mL/g)
V_R	=	River water flow rate above contaminant region (m^3/yr)

The annual-average contaminant concentrations in the Juniata River calculated from eqn. (B-1) are then used to estimate ingestion exposures as:

$$D_{ing} = C_R \, U_d \, t_s \, DF_{w,ing} + C_R \, f_s \, U_f \, DF_{nw,ing} \, , \qquad \text{(B-2)}$$

where

D_{ing}	=	ingestion dose from recreational exposure (mrem/yr),
U_d	=	amount of river water ingested per hour swimming (m^3/hr),
t_s	=	annual time spent swimming (hr/yr),
$DF_{w,ing}$	=	dose conversion factor for drinking water ingestion (mrem/pCi),
f_s	=	river-to-fish transfer factor (pCi/kg fish flesh per pCi/m^3 river water),
U_f	=	amount of fish ingested (kg/yr), and
$DF_{nw,ing}$	=	dose conversion factor for non-drinking water ingestion (mrem/pCi).

Doses from equation (B-2) are then added to th ose estimated by Microshield® to derive a cumulative TEDE to the receptor.

@RISK Summary Report

General Information

Workbook Name	preliminary dcgls.xls
Number of Simulations	1
Number of Iterations	500
Number of Inputs	60
Number of Outputs	26
Sampling Type	Latin Hypercube
Simulation Start Time	1/24/02 13:37:01
Simulation Stop Time	1/24/02 13:37:07
Simulation Duration	0:00:06
Random Seed	2142329504

Output and Input Summary Statistics

Output Name	Output Cell	Simulation#	Minimum	Maximum	Mean	Std Dev
Am-241 / Recreational Dose (	**Q10**	**1**	2.67454E-06	9.60737E-06	5.70625E-06	1.40444E-06
C-14 / Recreational Dose (mr	**Q11**	**1**	0.000124622	0.005594246	0.000748672	0.000479568
Cm-243 / Recreational Dose (	**Q12**	**1**	0.000113273	0.000418187	0.00024652	6.5829E-05
Cm-244 / Recreational Dose (	**Q13**	**1**	7.45498E-08	3.26508E-06	4.40651E-07	2.79804E-07
Co-60 / Recreational Dose (m	**Q14**	**1**	0.007453886	0.027737597	0.016325627	0.004369216
2000 / Recreational Dose (mr	**Q15**	**1**	0.003371126	0.012542492	0.007382442	0.001975658
2000 / Recreational Dose (mr	**Q16**	**1**	0.001167294	0.004341972	0.00255578	0.000683922
Eu-152 / Recreational Dose (	**Q17**	**1**	0.002817542	0.01048537	0.006171339	0.00165166
Eu-154 / Recreational Dose (	**Q18**	**1**	0.003576531	0.013309917	0.007833773	0.002096584
Eu-155 / Recreational Dose (	**Q19**	**1**	2.08929E-05	7.77487E-05	4.57607E-05	1.2247E-05
Fe-55 / Recreational Dose (m	**Q20**	**1**	1.44999E-11	6.50456E-10	8.70809E-11	5.5763E-11
H-3 / Recreational Dose (mre	**Q21**	**1**	9.99527E-11	4.0193E-09	5.70686E-10	3.51063E-10
Nb-94 / Recreational Dose (m	**Q22**	**1**	0.003613271	0.013445478	0.007913695	0.002117922
Ni-59 / Recreational Dose (m	**Q23**	**1**	1.93238E-11	8.66265E-10	1.16014E-10	7.42683E-11
Ni-63 / Recreational Dose (m	**Q24**	**1**	5.30945E-11	2.38017E-09	3.18762E-10	2.04061E-10
Pu-238 / Recreational Dose (	**Q25**	**1**	7.25066E-07	3.23085E-05	4.33777E-06	2.7704E-06
Pu-239 / Recreational Dose (	**Q26**	**1**	8.34678E-07	3.57887E-05	4.86132E-06	3.06463E-06
Pu-240 / Recreational Dose (	**Q27**	**1**	8.01853E-07	3.57409E-05	4.79818E-06	3.06475E-06
Pu-241 / Recreational Dose (	**Q28**	**1**	1.54748E-08	6.91536E-07	9.27667E-08	5.93041E-08
Pu-242 / Recreational Dose (	**Q29**	**1**	7.61347E-07	3.39239E-05	4.55472E-06	2.90892E-06
Sb-125 / Recreational Dose (	**Q30**	**1**	0.000751731	0.002797459	0.0016465	0.000440656
Sr-90 / Recreational Dose (m	**Q31**	**1**	1.00037E-06	4.48049E-05	6.00331E-06	3.84159E-06
Tc-99 / Recreational Dose (m	**Q32**	**1**	2.74236E-08	1.21317E-06	1.63318E-07	1.0403E-07
U-234 / Recreational Dose (m	**Q33**	**1**	2.56599E-07	9.6897E-06	1.37347E-06	8.26791E-07
U-235 / Recreational Dose (m	**Q34**	**1**	0.000137118	0.000502729	0.000296769	7.90933E-05
U-238 / Recreational Dose (m	**Q35**	**1**	2.18618E-07	9.17348E-06	1.25688E-06	7.85815E-07

@RISK Summary Report

Input Name	Input Cell	Simulation#	Minimum	Maximum	Mean	Std Dev
Sediment Dens	R1	1	0.767018557	2.846728563	1.680073078	0.44961121
Time Spent Swimming	O2	1	35.68852234	132.8136139	78.16963374	20.92086232
Contaminant area	R3	1	13.37181854	48.92655182	29.16716039	7.798221686
Inadvertant Water Ingestion	O4	1	2.606226444	9.922127724	5.833782024	1.562080063
c depth	R4	1	0.5363397	1.960565805	1.166696506	0.312073835
Fish Consumption	O5	1	11.01837444	40.21708298	24.03227496	6.426617895
Sed Hyd Cond	R6	1	15.55209255	58.9565506	35.0005914	9.365016959
Sediment Porosity	O7	1	0.241728216	0.895702422	0.536690579	0.143551509
Am-241 / Radius	D10	1	1.063210011	19.4027977	10.1659135	3.891124678
Am-241 / Shield Thickness	E10	1	1.351988435	19.84364128	10.16610168	3.89051489
C-14 / Radius	D11	1	1.543136716	19.52194595	10.16664958	3.889240437
C-14 / Shield Thickness	E11	1	1.453692317	19.5528965	10.1667678	3.888822288
Cm-243 / Radius	D12	1	1.540035367	19.54506493	10.16628186	3.887589875
Cm-243 / Shield Thickness	E12	1	1.308828831	19.57574081	10.16752193	3.89040258
Cm-244 / Radius	D13	1	1.451560259	19.4690876	10.16716026	3.888842694
Cm-244 / Shield Thickness	E13	1	1.289750934	19.7043457	10.16596969	3.888111644
Co-60 / Radius	D14	1	1.28590405	19.62527084	10.1662221	3.888607147
Co-60 / Shield Thickness	E14	1	1.352310896	19.38691139	10.16702496	3.887424349
Cs-134 / Radius	D15	1	1.116308093	19.74580193	10.1659413	3.893541806
Cs-134 / Shield Thickness	E15	1	1.420199871	19.49202538	10.16628534	3.889223239
Cs-137 / Radius	D16	1	1.197746038	19.57085037	10.16587543	3.888383448
Cs-137 / Shield Thickness	E16	1	1.320047498	19.53767586	10.16632837	3.889369032
Eu-152 / Radius	D17	1	1.115970135	19.73445511	10.16695246	3.891708798
Eu-152 / Shield Thickness	E17	1	1.36682272	19.48674011	10.16611378	3.889120661
Eu-154 / Radius	D18	1	1.373938441	19.81484604	10.1668969	3.89008157
Eu-154 / Shield Thickness	E18	1	1.201307535	19.54681969	10.16530874	3.890203846
Eu-155 / Radius	D19	1	1.492244601	19.8091526	10.16730655	3.891454828
Eu-155 / Shield Thickness	E19	1	1.520665646	19.77777481	10.16704266	3.889748558
Fe-55 / Radius	D20	1	1.339036703	19.70482826	10.16748082	3.889864007
Fe-55 / Shield Thickness	E20	1	1.217291594	19.54592896	10.16566129	3.889266321
H-3 / Radius	D21	1	1.142447114	19.88214874	10.16744157	3.893050598
H-3 / Shield Thickness	E21	1	1.519182801	19.65573502	10.16728825	3.890372999
Nb-94 / Radius	D22	1	1.350493193	19.44784355	10.16615128	3.887989798
Nb-94 / Shield Thickness	E22	1	1.196291924	19.49619865	10.16633154	3.890140886
Ni-59 / Radius	D23	1	1.134813666	19.38105202	10.16564996	3.890779809
Ni-59 / Shield Thickness	E23	1	1.451789856	19.89495277	10.16824523	3.891238238
Ni-63 / Radius	D24	1	1.332678437	19.37257004	10.16506604	3.888930975
Ni-63 / Shield Thickness	E24	1	1.52816081	19.56227684	10.16720962	3.890040324
Pu-238 / Radius	D25	1	1.181279302	19.41424751	10.16641967	3.888945167
Pu-238 / Shield Thickness	E25	1	1.428100348	19.73237991	10.16646634	3.891934764
Pu-239 / Radius	D26	1	1.081758738	19.59211731	10.1666722	3.891456062
Pu-239 / Shield Thickness	E26	1	1.421127796	19.61336899	10.16692775	3.889329472
Pu-240 / Radius	D27	1	1.35945034	19.39332581	10.16519735	3.890939467
Pu-240 / Shield Thickness	E27	1	1.560510516	19.6340847	10.16740585	3.887087018
Pu-241 / Radius	D28	1	1.557526708	19.54165459	10.1663711	3.888267837
Pu-241 / Shield Thickness	E28	1	1.099675298	19.38020706	10.1656423	3.890665056
Pu-242 / Radius	D29	1	1.239548564	19.69764519	10.166857	3.891697419
Pu-242 / Shield Thickness	E29	1	1.450811863	19.65544128	10.16595986	3.888884198
Sb-125 / Radius	D30	1	1.345744491	19.44150543	10.16636652	3.888746288
Sb-125 / Shield Thickness	E30	1	1.217978001	19.81005859	10.16785744	3.893227062
Sr-90 / Radius	D31	1	1.471344709	19.78667641	10.16792623	3.889763838
Sr-90 / Shield Thickness	E31	1	1.322262883	19.94240189	10.1667375	3.891397309
Tc-99 / Radius	D32	1	1.514995098	19.58579636	10.1664565	3.89033084
Tc-99 / Shield Thickness	E32	1	1.472812414	19.55085373	10.16740208	3.88790378
U-234 / Radius	D33	1	1.27129209	19.88454437	10.1658659	3.89066128
U-234 / Shield Thickness	E33	1	1.432187915	19.62651062	10.16657109	3.888962781
U-235 / Radius	D34	1	1.451202631	19.43480682	10.1662204	3.8897228
U-235 / Shield Thickness	E34	1	1.366495252	19.44992638	10.16635353	3.889025129
U-238 / Radius	D35	1	1.567361593	19.58576775	10.16737036	3.88691975
U-238 / Shield Thickness	E35	1	1.192869067	19.39091873	10.16626266	3.887951998