GRAFTech
GrafTech International Ltd.

UCAR CARBON COMPANY INC., *a GrafTech International Ltd. company*
CORPORATE HS&EP DEPARTMENT

12900 Snow Road • Parma, Ohio 44130

(216) 676-2175
Facsimile (216) 676-2697

Juanita Bursley
Corporate Manager, Environmental Protection

U.S. Nuclear Regulatory Commission
Attention: Mr. Ken L. Kalman
Mail Stop T7-F27
Washington, D.C. 20555-0001

May 13, 2005

RE: UCAR Carbon Company Inc.
Request for Approval of Proposed Procedures
in Accordance with 10 CFR 20.2002

Dear Mr. Kalman:

UCAR Carbon Company Inc. (UCAR) proposes to transfer fifteen (15) intermodal containers of solid low-level radiological waste from the voluntary decommissioning of its Lawrenceburg, TN site to the Waste Control Specialists (WCS) facility near Andrews, Texas for final disposal. The purpose of this letter is to submit a formal request to NRC for its approval of proposed procedures for alternative disposal of the above debris in accordance with the provisions of 10 CFR 20.2002, and provide NRC sufficient documentation to demonstrate that UCAR's proposal poses negligible risk to the public.

A description of the waste materials proposed for disposal at WCS is provided in Attachment 1. UCAR has also included radiological assessments of these materials and determined that the potential dose to members of the public as a consequence of the proposed transportation, handling and waste disposal will be substantially less than a few (e.g., five (5)) millirem per year. Furthermore, using RESRAD to calculate the projected effect of the proposed disposal activity on future members of the public at the disposal site through 1,000 years post-closure, the expected dose is less than 0.7 millirem per year, well below the one millirem negligible dose equivalent established in NCRP-91.

UCAR hereby requests expedited review and approval of this request to support our voluntary remedial activities at the Lawrenceburg site. At this time, UCAR has concluded its planned remedial activities and submitted its FSSRs to NRC, which demonstrate the release criteria have been met. However, UCAR has not yet received the results from NRC's confirmatory survey conducted in February 2005. While UCAR does not anticipate conducting any additional decommissioning activities, UCAR does reserve the right to modify this proposal to include a small amount of additional low-level wastes.

If you should have any questions regarding this submittal, or need additional information, please contact my office at (216) 676-2175.

Sincerely,

Juanita M. Bursley

Juanita M. Bursley
UCAR Carbon Company Inc.

JT34

Attachment

DISTRIBUTION

U.S. Nuclear Regulatory Commission

U.S. Nuclear Regulatory Commission
Attention: Mr. Daniel M. Gillen*
Mail Stop T7-F27
Washington, D.C. 20555-0001

U.S. Nuclear Regulatory Commission, Region 1
Attention: Ms. Marie Miller (1)
Chief Decommissioning Laboratory Branch
475 Allendale Road
King of Prussia, PA 19406-1415

U.S. Nuclear Regulatory Commission
Attention: Mr. Duane Schmidt*
Mail Stop T7-F27
Washington, D.C. 20555-0001

U.S. Nuclear Regulatory Commission
Attention: Ms. Kimberly Gruss*
Mail Stop T7-E18
Washington, D.C. 20555-0001

U.S. Nuclear Regulatory Commission
Attention: Mr. Ken L. Kalman (2)
Mail Stop T7-E18
Washington, D.C. 20555-0001

U.S. Nuclear Regulatory Commission
Attention: Mr. Christepher McKenney (2)
Mail Stop T7-F27
Washington, D.C. 20555-0001

U.S. Nuclear Regulatory Commission
Attention: Ms. Brooke G. Smith*
Mail Stop O15-D21
Washington, D.C. 20555-0001

Tennessee Department of Environment and Conservation

Mr. Lawrence E. Nanney, Director*
State of Tennessee
Department of Environment and Conservation
Division of Radiological Health
Third Floor, L&C Annex
401 Church Street
Nashville, TN 37243-1523

Mr. J. C. Graves, Licensing & Registration (1)
State of Tennessee
Department of Environment and Conservation
Division of Radiological Health
Third Floor, L&C Annex
401 Church Street
Nashville, TN 37243-1532

Law Offices of Anthony J. Thompson, P.C.

Mr. Anthony J. Thompson*
Law Offices of Anthony J. Thompson, P.C.
1225 Nineteenth St., NW, Second Floor
Suite 200
Washington, D.C. 20036

Nuclear Fuel Services, Inc.

Mr. Gary L. Hazlewood*
Nuclear Fuel Services, Inc.
1205 Banner Hill Road
Erwin, TN 37650

GrafTech International Ltd.

Ms. Karen Narwold*
Vice-President, General Counsel, Human Resources & Secretary
1521 Concord Pike
Suite 301
Brandywine West Building
Wilmington, DE 19803

Mr. Scott Mason*
President, Advanced Carbon Systems
UCAR Carbon Company Inc.
12900 Snow Road
Parma, OH 44130

Mr. Jeff Bryant*
Process Manager
UCAR Carbon Company Inc.
791 Santa Fe Pike
Columbia, TN 38401

Ms. Beverly Paley*
Health, Safety & Environmental Coordinator
UCAR Carbon Company Inc.
Highway 43 South
Lawrenceburg, TN 38464

*Cover Letter Only
(#) Number of Copies

5/13/05

Attachment 1
UCAR Carbon Company Inc.
Request for Approval of Proposed Procedures
in Accordance with 10 CFR 20.2002

1. INTRODUCTION

This request for approval of proposed disposal procedures in accordance with the provisions of 10 CFR 20.2002 allows UCAR Carbon Company Inc. (UCAR) to dispose of demolition debris from voluntary cleanup activities at the Lawrenceburg, TN, site at the WCS Facility, located one (1) mile north of State Highway 176, 250' west of the Texas-New Mexico border, and 30 miles west of Andrews, TX. This attachment documents an assessment of the radiological impacts of the proposed disposal. The main conclusion is that potential radiation doses to the members of the public would not exceed a few (e.g., five (5)) millirem per year from the proposed disposal. The following conservative calculations show that potential doses to members of the public after closure of the site and to workers involved in the transportation to and placement of the UCAR waste at the WCS facility would receive a small fraction of this limit.

2. RADIOLOGICAL CHARACTERIZATION

The fifteen (15) intermodal containers have been sampled for analytical analyses, as well as radiologically characterized using in situ gamma spectrometry techniques. The results of the in situ gamma characterization are presented in Table 2-1.

Table 2-1: Isotopic Concentrations

Intermodal ID Number	^{235}U Concentration (pCi/g)	Total U Concentration (pCi/g)
MHFU 1748	19	845
MHFU 1864	16	715
MHFU 1579	24	1,045
MHFU 2219	38	1,668
MHFU 1581	23	1,012
MHFU 1367	26	1,146
MHFU 1415	21	926
MHFU 2222	16	724
MHFU 1576	20	867
MHFU 1815	21	911
MHFU 2164	28	1,210
MHFU 2259	45	1,958
MHFU 1901	25	1,115
MHFU 1997	32	1,421
MHFU 2123	15	671
Average	25	1,082

3. TRANSPORT WORKER DOSE ASSESSMENT

The Transportation Scenario Maximally Exposed Individual (MEI) dose equivalent will not exceed a few (e.g., five (5)) mrem. Evaluations of both internal and external dose hazards to the transportation worker are discussed below.

Each intermodal will be strong-tight and will be verified to be in compliance with DOT external loose surface contamination limits prior to shipment. Therefore, there are no internal dose hazards associated with the Transportation Scenario.

The intermodal with the greatest radiological content was used to calculate external penetrating gamma dose rates. The geometry modeled bounds any variations in the actual intermodals that may be used. For external dose calculations, the remainder of the total Uranium value (i.e., after subtracting the ^{235}U value) was assumed to be ^{238}U since this assumption bounds the presence of ^{234}U. These calculations are included as Attachment 1A. The following dose receptor points were modeled.

- a worse case, on-contact (i.e., one inch (1")) receptor point adjacent to the center of the side of the intermodal;
- a representative one (1) meter receptor point adjacent to the center of the side of the intermodal; and
- a theoretical "driver" receptor point two (2) meters from the center of the front of the intermodal.

The resultant dose rates to each of these receptor points are 6.672 E-3 mR/hour, 4.529 E-3 mR/hour, and 1.534 E-3 mR/hour, respectively. Therefore, a worker would need to spend in excess of 749 hours, 1,103 hours, and 3,259 hours, respectively, at these points to exceed a dose equivalent of five (5) mrem per year. It is qualitatively judged to be non-credible that the Transportation Scenario Maximum Exposed Individual (MEI) (e.g., transportation worker, or any other member of public interacting with the transportation activity) would exceed these occupancy times during the shipment of the fifteen (15) intermodals.

While any given conveyance, or point on the conveyance, may exhibit external dose rates in excess of the levels calculated, the average dose rate to which the MEI is exposed over the course of the shipment is expected to be below the value calculated. Therefore, Transportation Scenario MEI dose equivalent will not exceed a few (e.g., five (5)) mrem.

4. DISPOSAL FACILITY WORKER DOSE ASSESSMENT

The Disposal Site –During Material Placement Scenario MEI dose equivalent will not exceed a few (e.g., five (5)) mrem. Evaluations of both internal and external dose hazards to the transportation worker are discussed below.

The facility has previously conducted disposal activities involving materials similar to those described herein, except that they were contaminated with source material, which has been exempted under 10CFR40. These source material isotopes (i.e., ^{238}U and ^{232}Th) were present in similar concentrations, and have similar Derived Air Concentration (DAC) and Annual Limit on Intake (ALI) values as the isotopes described herein. No measurable internal dose exposures have resulted from these activities. Therefore, operating experience indicates that there would be no internal dose hazards associated with the disposal activities described herein.

The intermodal with the greatest radiological content was used to calculate external penetrating gamma dose rates. For external dose calculations, the remainder of the total Uranium value (i.e., after subtracting the ^{235}U value) was assumed to be ^{238}U since this assumption bounds the presence of ^{234}U. These highest values were used to calculate penetrating gamma dose rates to the worker in the vicinity of the placed material prior to it being covered. The geometry modeled assumes a dose receptor point centered 18" above a representative slab of material (i.e., after placement) and bounds any after placement scenario. This calculation is included as Attachment 1B.

The resultant dose rate to the receptor point is 1.132 E-2 mR per hour. Therefore, a worker would need to spend in excess of 441 hours at this point after the placement of the fifteen (15) intermodals, and prior to the material being covered, to exceed a dose equivalent of five (5) mrem per year. It is qualitatively judged to be non-credible that the Disposal Site –During Material Placement Scenario MEI (e.g., disposal activity worker, or any other member of public interacting with the disposal activity) would exceed this occupancy time.

5. RESIDENT/FARMER DOSE ASSESSMENT

The RESRAD computer code was used to calculate the projected effect of the proposed disposal activity on future residents at the disposal site. The fifteen intermodals were modeled after placement, such that the resultant calculated dose equivalent to the maximum exposed individual (Resident Farmer) could be evaluated. A comprehensive report describing the methodology, input parameter selection, and calculation results is included as Attachment 1C. It can be seen that the expected dose to a member of the public post closure is less than 0.7 mrem/yr.

6. CONCLUSION

Based on the above assessment, it can be concluded that the calculated potential dose to members of the public (workers involved in the transportation to and placement of the waste and after closure of the site) as a consequence of the proposed waste disposal from the UCAR voluntary cleanup of the Lawrenceburg, TN, site at the WCS Facility will be an insignificant fraction of the 25 millirem per year limit. Therefore, UCAR concludes that the proposed request for approval in accordance with 10 CFR 20.2002 will not have a significant impact on the workers, public, or the environment and that it is, therefore, acceptable.

Attachment 1
UCAR Carbon Company Inc.
Request for Approval of Proposed Procedures
in Accordance with 10 CFR 20.2002

Attachment 1A

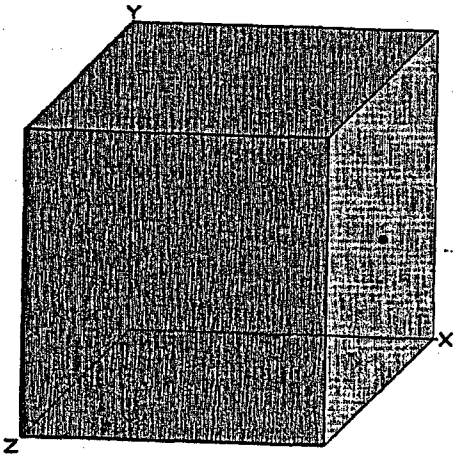
Transportation Dose Assessment Calculations

MicroShield v5.01 (5.01-00091)
Lockheed Martin Energy Systems

Page : 1
DOS File: UCAROC.MS5
Run Date: May 11, 2005
Run Time: 7:17:32 AM
Duration: 00:00:50

File Ref: UCAR
Date: 5/11/05
By: ZZ
Checked: MJS

Case Title: Transport - Side OC
Description: UCAR Transport - Side Dose Receptor On Contact
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	304.8 cm	10 ft 0.0 in
Width	609.6 cm	20 ft 0.0 in
Height	304.8 cm	10 ft 0.0 in

Dose Points

	X	Y	Z
# 1	307.6575 cm	152.4 cm	304.8 cm
	10 ft 1.1 in	5 ft 0.0 in	10 ft 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.46e+06 in³	Concrete	1
Shield 1	.125 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ac-227	9.1253e-014	3.3764e-003	1.6113e-015	5.9617e-011
Bi-210	5.3095e-018	1.9645e-007	9.3752e-020	3.4688e-015
Bi-211	3.6821e-016	1.3624e-005	6.5016e-018	2.4056e-013
Bi-214	2.1347e-017	7.8984e-007	3.7693e-019	1.3946e-014
Fr-223	1.2457e-015	4.6091e-005	2.1996e-017	8.1384e-013
Pa-231	5.2038e-010	1.9254e+001	9.1885e-012	3.3998e-007
Pa-234	2.1454e-005	7.9380e+005	3.7882e-007	1.4016e-002
Pa-234m	1.4508e-002	5.3681e+008	2.5618e-004	9.4787e+000
Pb-210	3.5126e-017	1.2997e-006	6.2023e-019	2.2949e-014
Pb-211	3.6866e-016	1.3640e-005	6.5095e-018	2.4085e-013
Pb-214	3.7444e-017	1.3854e-006	6.6116e-019	2.4463e-014
Po-210	9.3581e-018	3.4625e-007	1.6524e-019	6.1139e-015
Po-211	1.0055e-018	3.7205e-008	1.7755e-020	6.5694e-016
Po-214	2.7718e-017	1.0256e-006	4.8943e-019	1.8109e-014
Po-215	3.8011e-016	1.4064e-005	6.7117e-018	2.4833e-013
Po-218	2.4365e-017	9.0149e-007	4.3022e-019	1.5918e-014
Ra-223	3.8033e-016	1.4072e-005	6.7157e-018	2.4848e-013
Ra-226	1.4308e-017	5.2938e-007	2.5263e-019	9.3475e-015
Rn-219	3.7992e-016	1.4057e-005	6.7084e-018	2.4821e-013
Rn-222	1.3372e-017	4.9476e-007	2.3611e-019	8.7361e-015
Th-227	4.4947e-015	1.6630e-004	7.9364e-017	2.9365e-012
Th-230	2.5715e-017	9.5145e-007	4.5405e-019	1.6800e-014
Th-231	2.4506e-003	9.0673e+007	4.3271e-005	1.6010e+000
Th-234	1.4512e-002	5.3693e+008	2.5624e-004	9.4807e+000
Tl-207	3.6573e-016	1.3532e-005	6.4579e-018	2.3894e-013

Page : 2
DOS File: UCAROC.MS5
Run Date: May 11, 2005
Run Time: 7:17:32 AM
Duration: 00:00:50

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
U-234	2.8813e-010	1.0661e+001	5.0877e-012	1.8824e-007
U-235	2.5485e-003	9.4295e+007	4.5000e-005	1.6650e+000
U-238	1.0834e-001	4.0086e+009	1.9130e-003	7.0781e+001

Buildup
The material reference is : Source

Integration Parameters

X Direction	30
Y Direction	30
Z Direction	30

Results

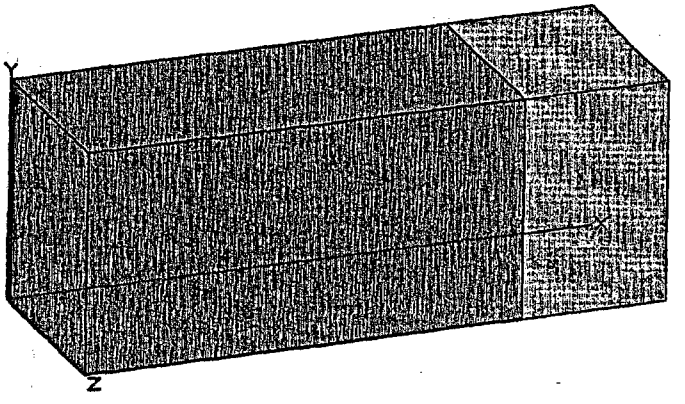
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.706e+05	2.715e-79	5.819e-29	2.329e-80	4.991e-30
0.02	6.739e-02	1.118e-44	3.618e-35	3.874e-46	1.253e-36
0.03	1.329e+07	1.497e-13	2.813e-13	1.484e-15	2.788e-15
0.04	9.716e+02	1.038e-11	2.789e-11	4.589e-14	1.233e-13
0.05	5.266e-02	1.111e-13	4.006e-13	2.961e-16	1.067e-15
0.06	2.481e+07	6.924e-04	3.030e-03	1.375e-06	6.019e-06
0.08	1.150e+07	3.654e-03	1.869e-02	5.782e-06	2.957e-05
0.1	4.269e+07	4.167e-02	2.192e-01	6.375e-05	3.354e-04
0.15	1.493e+07	5.030e-02	2.455e-01	8.283e-05	4.042e-04
0.2	5.836e+07	3.576e-01	1.607e+00	6.311e-04	2.836e-03
0.3	5.765e+04	7.183e-04	2.813e-03	1.363e-06	5.335e-06
0.4	4.874e+04	9.744e-04	3.430e-03	1.899e-06	6.683e-06
0.5	7.239e+04	2.080e-03	6.728e-03	4.082e-06	1.321e-05
0.6	2.958e+05	1.143e-02	3.441e-02	2.230e-05	6.717e-05
0.8	1.731e+06	1.070e-01	2.897e-01	2.036e-04	5.510e-04
1.0	5.658e+06	5.054e-01	1.266e+00	9.317e-04	2.333e-03
1.5	1.111e+05	1.947e-02	4.275e-02	3.276e-05	7.192e-05
2.0	1.433e+04	4.031e-03	8.195e-03	6.234e-06	1.267e-05
TOTALS:	1.737e+08	1.105e+00	3.747e+00	1.989e-03	6.672e-03

MicroShield v5.01 (5.01-00091)
Lockheed Martin Energy Systems

Page : 1
DOS File: UCARDRV.MS5
Run Date: May 11, 2005
Run Time: 7:20:29 AM
Duration: 00:00:51

File Ref: UCAR
Date: 5/11/05
By: ZZ
Checked: MJS

Case Title: Transport - Driver
Description: UCAR Transport - Driver @ 2 M
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	609.6 cm	20 ft 0.0 in
Width	304.8 cm	10 ft 0.0 in
Height	304.8 cm	10 ft 0.0 in

Dose Points

	X	Y	Z
# 1	815.975 cm	152.4 cm	152.4 cm
	26 ft 9.3 in	5 ft 0.0 in	5 ft 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.46e+06 in³	Concrete	1
Shield 1	.125 in	Iron	7.86
Shield 2	80.0 in	Air	0.00122
Shield 3	.125 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ac-227	9.1253e-014	3.3764e-003	1.6113e-015	5.9617e-011
Bi-210	5.3095e-018	1.9645e-007	9.3752e-020	3.4688e-015
Bi-211	3.6821e-016	1.3624e-005	6.5016e-018	2.4056e-013
Bi-214	2.1347e-017	7.8984e-007	3.7693e-019	1.3946e-014
Fr-223	1.2457e-015	4.6091e-005	2.1996e-017	8.1384e-013
Pa-231	5.2038e-010	1.9254e+001	9.1885e-012	3.3998e-007
Pa-234	2.1454e-005	7.9380e+005	3.7882e-007	1.4016e-002
Pa-234m	1.4508e-002	5.3681e+008	2.5618e-004	9.4787e+000
Pb-210	3.5126e-017	1.2997e-006	6.2023e-019	2.2949e-014
Pb-211	3.6866e-016	1.3640e-005	6.5095e-018	2.4085e-013
Pb-214	3.7444e-017	1.3854e-006	6.6116e-019	2.4463e-014
Po-210	9.3581e-018	3.4625e-007	1.6524e-019	6.1139e-015
Po-211	1.0055e-018	3.7205e-008	1.7755e-020	6.5694e-016
Po-214	2.7718e-017	1.0256e-006	4.8943e-019	1.8109e-014
Po-215	3.8011e-016	1.4064e-005	6.7117e-018	2.4833e-013
Po-218	2.4365e-017	9.0149e-007	4.3022e-019	1.5918e-014
Ra-223	3.8033e-016	1.4072e-005	6.7157e-018	2.4848e-013
Ra-226	1.4308e-017	5.2938e-007	2.5263e-019	9.3475e-015
Rn-219	3.7992e-016	1.4057e-005	6.7084e-018	2.4821e-013
Rn-222	1.3372e-017	4.9476e-007	2.3611e-019	8.7361e-015
Th-227	4.4947e-015	1.6630e-004	7.9364e-017	2.9365e-012
Th-230	2.5715e-017	9.5145e-007	4.5405e-019	1.6800e-014
Th-231	2.4506e-003	9.0673e+007	4.3271e-005	1.6010e+000

DOS File: UCARDRV.MS5
Run Date: May 11, 2005
Run Time: 7:20:29 AM
Duration: 00:00:51

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Th-234	1.4512e-002	5.3693e+008	2.5624e-004	9.4807e+000
Tl-207	3.6573e-016	1.3532e-005	6.4579e-018	2.3894e-013
U-234	2.8813e-010	1.0661e+001	5.0877e-012	1.8824e-007
U-235	2.5485e-003	9.4295e+007	4.5000e-005	1.6650e+000
U-238	1.0834e-001	4.0086e+009	1.9130e-003	7.0781e+001

Buildup
The material reference is : Source

Integration Parameters

X Direction	30
Y Direction	30
Z Direction	30

Results

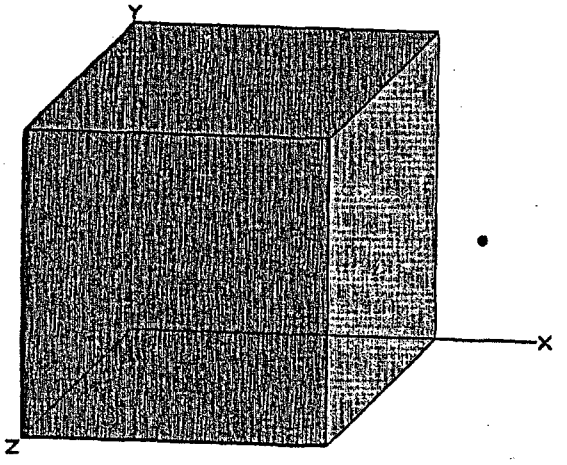
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.706e+05	3.269e-133	1.029e-29	2.804e-134	8.826e-31
0.02	6.739e-02	1.434e-69	6.398e-36	4.969e-71	2.216e-37
0.03	1.329e+07	4.229e-22	8.565e-22	4.191e-24	8.488e-24
0.04	9.716e+02	8.477e-16	2.739e-15	3.749e-18	1.212e-17
0.05	5.266e-02	4.969e-16	2.352e-15	1.324e-18	6.267e-18
0.06	2.481e+07	1.890e-05	1.138e-04	3.753e-08	2.259e-07
0.08	1.150e+07	3.936e-04	2.690e-03	6.228e-07	4.257e-06
0.1	4.269e+07	6.872e-03	4.520e-02	1.051e-05	6.915e-05
0.15	1.493e+07	1.075e-02	5.872e-02	1.770e-05	9.670e-05
0.2	5.836e+07	8.052e-02	3.848e-01	1.421e-04	6.792e-04
0.3	5.765e+04	1.662e-04	6.634e-04	3.152e-07	1.258e-06
0.4	4.874e+04	2.271e-04	7.989e-04	4.424e-07	1.557e-06
0.5	7.239e+04	4.857e-04	1.553e-03	9.533e-07	3.047e-06
0.6	2.958e+05	2.668e-03	7.874e-03	5.208e-06	1.537e-05
0.8	1.731e+06	2.492e-02	6.536e-02	4.739e-05	1.243e-04
1.0	5.658e+06	1.171e-01	2.822e-01	2.158e-04	5.201e-04
1.5	1.111e+05	4.445e-03	9.300e-03	7.478e-06	1.565e-05
2.0	1.433e+04	9.069e-04	1.750e-03	1.402e-06	2.706e-06
TOTALS:	1.737e+08	2.495e-01	8.610e-01	4.500e-04	1.534e-03

MicroShield v5.01 (5.01-00091)
Lockheed Martin Energy Systems

Page : 1
DOS File: UCAR1M.MS5
Run Date: May 11, 2005
Run Time: 1:03:25 PM
Duration: 00:00:48

File Ref: UCAR
Date: 5/11/5
By: ZZ
Checked: MJS

Case Title: Transport - Side 1M
Description: UCAR Transport - Side Dose Receptor at one (1) meter
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	304.8 cm	10 ft 0.0 in
Width	609.6 cm	20 ft 0.0 in
Height	304.8 cm	10 ft 0.0 in

Dose Points

	X	Y	Z
# 1	406.7175 cm	152.4 cm	304.8 cm
	13 ft 4.1 in	5 ft 0.0 in	10 ft 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.46e+06 in³	Concrete	1
Shield 1	.125 in	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ac-227	9.1253e-014	3.3764e-003	1.6113e-015	5.9617e-011
Bi-210	5.3095e-018	1.9645e-007	9.3752e-020	3.4688e-015
Bi-211	3.6821e-016	1.3624e-005	6.5016e-018	2.4056e-013
Bi-214	2.1347e-017	7.8984e-007	3.7693e-019	1.3946e-014
Fr-223	1.2457e-015	4.6091e-005	2.1996e-017	8.1384e-013
Pa-231	5.2038e-010	1.9254e+001	9.1885e-012	3.3998e-007
Pa-234	2.1454e-005	7.9380e+005	3.7882e-007	1.4016e-002
Pa-234m	1.4508e-002	5.3681e+008	2.5618e-004	9.4787e+000
Pb-210	3.5126e-017	1.2997e-006	6.2023e-019	2.2949e-014
Pb-211	3.6866e-016	1.3640e-005	6.5095e-018	2.4085e-013
Pb-214	3.7444e-017	1.3854e-006	6.6116e-019	2.4463e-014
Po-210	9.3581e-018	3.4625e-007	1.6524e-019	6.1139e-015
Po-211	1.0055e-018	3.7205e-008	1.7755e-020	6.5694e-016
Po-214	2.7718e-017	1.0256e-006	4.8943e-019	1.8109e-014
Po-215	3.8011e-016	1.4064e-005	6.7117e-018	2.4833e-013
Po-218	2.4365e-017	9.0149e-007	4.3022e-019	1.5918e-014
Ra-223	3.8033e-016	1.4072e-005	6.7157e-018	2.4848e-013
Ra-226	1.4308e-017	5.2938e-007	2.5263e-019	9.3475e-015
Rn-219	3.7992e-016	1.4057e-005	6.7084e-018	2.4821e-013
Rn-222	1.3372e-017	4.9476e-007	2.3611e-019	8.7361e-015
Th-227	4.4947e-015	1.6630e-004	7.9364e-017	2.9365e-012
Th-230	2.5715e-017	9.5145e-007	4.5405e-019	1.6800e-014
Th-231	2.4506e-003	9.0673e+007	4.3271e-005	1.6010e+000
Th-234	1.4512e-002	5.3693e+008	2.5624e-004	9.4807e+000
Tl-207	3.6573e-016	1.3532e-005	6.4579e-018	2.3894e-013

DOS File: UCAR1M.MS5
Run Date: May 11, 2005
Run Time: 1:03:25 PM
Duration: 00:00:48

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
U-234	2.8813e-010	1.0661e+001	5.0877e-012	1.8824e-007
U-235	2.5485e-003	9.4295e+007	4.5000e-005	1.6650e+000
U-238	1.0834e-001	4.0086e+009	1.9130e-003	7.0781e+001

Buildup
The material reference is : Source

Integration Parameters

X Direction	30
Y Direction	30
Z Direction	30

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.706e+05	2.488e-70	2.479e-29	2.134e-71	2.126e-30
0.02	6.739e-02	1.775e-41	1.541e-35	6.147e-43	5.339e-37
0.03	1.329e+07	3.460e-13	6.386e-13	3.429e-15	6.329e-15
0.04	9.716e+02	9.460e-12	2.516e-11	4.184e-14	1.113e-13
0.05	5.266e-02	9.479e-14	3.434e-13	2.525e-16	9.148e-16
0.06	2.481e+07	6.082e-04	2.702e-03	1.208e-06	5.366e-06
0.08	1.150e+07	3.231e-03	1.650e-02	5.112e-06	2.610e-05
0.1	4.269e+07	3.558e-02	1.816e-01	5.443e-05	2.778e-04
0.15	1.493e+07	3.986e-02	1.814e-01	6.564e-05	2.988e-04
0.2	5.836e+07	2.730e-01	1.129e+00	4.819e-04	1.993e-03
0.3	5.765e+04	5.297e-04	1.897e-03	1.005e-06	3.598e-06
0.4	4.874e+04	7.046e-04	2.267e-03	1.373e-06	4.418e-06
0.5	7.239e+04	1.483e-03	4.392e-03	2.910e-06	8.622e-06
0.6	2.958e+05	8.051e-03	2.224e-02	1.572e-05	4.341e-05
0.8	1.731e+06	7.399e-02	1.843e-01	1.407e-04	3.506e-04
1.0	5.658e+06	3.440e-01	7.952e-01	6.342e-04	1.466e-03
1.5	1.111e+05	1.286e-02	2.620e-02	2.164e-05	4.409e-05
2.0	1.433e+04	2.607e-03	4.937e-03	4.031e-06	7.635e-06
TOTALS:	1.737e+08	7.966e-01	2.553e+00	1.430e-03	4.529e-03

Attachment 1
UCAR Carbon Company Inc.
Request for Approval of Proposed Procedures
in Accordance with 10 CFR 20.2002

Attachment 1B

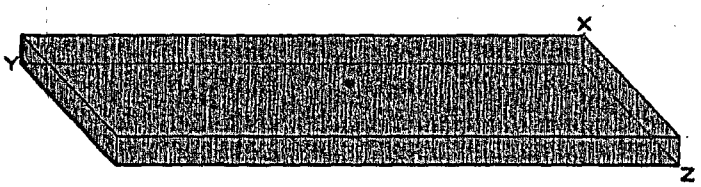
Placement Dose Assessment Calculations

MicroShield v5.01 (5.01-00091)
Lockheed Martin Energy Systems

Page : 1
DOS File: UCARWCS.MS5
Run Date: May 10, 2005
Run Time: 2:51:33 PM
Duration: 00:00:57

File Ref: UCAR
Date: 5/10/05
By: ZZ
Checked: MJS

Case Title: UCAR - WCS
Description: UCAR material in WCS cell
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	609.6 cm	20 ft 0.0 in
Width	1.2e+4 cm	400 ft
Height	1.2e+4 cm	400 ft

Dose Points

	X	Y	Z
# 1	655.32 cm	6096 cm	6096 cm
	21 ft 6.0 in	200 ft	200 ft

Shields

Shield Name	Dimension	Material	Density
Source	5.53e+09 in³	Concrete	1.5
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ac-227	2.1901e-010	8.1032e+000	2.4169e-015	8.9426e-011
Bi-210	1.2743e-014	4.7149e-004	1.4063e-019	5.2032e-015
Bi-211	8.8370e-013	3.2697e-002	9.7523e-018	3.6084e-013
Bi-214	5.1233e-014	1.8956e-003	5.6540e-019	2.0920e-014
Fr-223	2.9897e-012	1.1062e-001	3.2994e-017	1.2208e-012
Pa-231	1.2489e-006	4.6210e+004	1.3783e-011	5.0996e-007
Pa-234	5.1490e-002	1.9051e+009	5.6823e-007	2.1025e-002
Pa-234m	3.4820e+001	1.2883e+012	3.8427e-004	1.4218e+001
Pb-210	8.4303e-014	3.1192e-003	9.3035e-019	3.4423e-014
Pb-211	8.8477e-013	3.2737e-002	9.7642e-018	3.6128e-013
Pb-214	8.9865e-014	3.3250e-003	9.9173e-019	3.6694e-014
Po-210	2.2460e-014	8.3100e-004	2.4786e-019	9.1708e-015
Po-211	2.4133e-015	8.9291e-005	2.6633e-020	9.8540e-016
Po-214	6.6524e-014	2.4614e-003	7.3415e-019	2.7163e-014
Po-215	9.1226e-013	3.3754e-002	1.0068e-017	3.7250e-013
Po-218	5.8475e-014	2.1636e-003	6.4532e-019	2.3877e-014
Ra-223	9.1280e-013	3.3774e-002	1.0074e-017	3.7272e-013
Ra-226	3.4338e-014	1.2705e-003	3.7895e-019	1.4021e-014
Rn-219	9.1181e-013	3.3737e-002	1.0063e-017	3.7232e-013
Rn-222	3.2092e-014	1.1874e-003	3.5417e-019	1.3104e-014
Th-227	1.0787e-011	3.9913e-001	1.1905e-016	4.4047e-012
Th-230	6.1715e-014	2.2835e-003	6.8108e-019	2.5200e-014
Th-231	5.8815e+000	2.1761e+011	6.4907e-005	2.4016e+000
Th-234	3.4828e+001	1.2886e+012	3.8435e-004	1.4221e+001
Tl-207	8.7776e-013	3.2477e-002	9.6868e-018	3.5841e-013
U-234	6.9152e-007	2.5586e+004	7.6315e-012	2.8237e-007

DOS File: UCARWCS.MS5
Run Date: May 10, 2005
Run Time: 2:51:33 PM
Duration: 00:00:57

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
U-235	6.1164e+000	2.2631e+011	6.7500e-005	2.4975e+000
U-238	2.6002e+002	9.6206e+012	2.8695e-003	1.0617e+002

Buildup
The material reference is : Source

Integration Parameters

X Direction	30
Y Direction	30
Z Direction	30

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.093e+08	3.043e-12	3.330e-12	2.610e-13	2.856e-13
0.02	1.617e+02	2.748e-14	3.202e-14	9.519e-16	1.109e-15
0.03	3.188e+10	1.283e-03	1.711e-03	1.271e-05	1.696e-05
0.04	2.332e+06	4.579e-07	7.148e-07	2.025e-09	3.162e-09
0.05	1.264e+02	5.572e-11	1.012e-10	1.484e-13	2.696e-13
0.06	5.955e+10	4.448e-02	9.895e-02	8.834e-05	1.965e-04
0.08	2.760e+10	3.968e-02	1.084e-01	6.278e-05	1.716e-04
0.1	1.025e+11	2.208e-01	6.720e-01	3.379e-04	1.028e-03
0.15	3.583e+10	1.441e-01	4.699e-01	2.373e-04	7.738e-04
0.2	1.401e+11	8.488e-01	2.718e+00	1.498e-03	4.797e-03
0.3	1.384e+08	1.484e-03	4.393e-03	2.815e-06	8.333e-06
0.4	1.170e+08	1.888e-03	5.188e-03	3.679e-06	1.011e-05
0.5	1.737e+08	3.866e-03	9.991e-03	7.588e-06	1.961e-05
0.6	7.099e+08	2.059e-02	5.041e-02	4.018e-05	9.839e-05
0.8	4.155e+09	1.840e-01	4.157e-01	3.501e-04	7.906e-04
1.0	1.358e+10	8.395e-01	1.787e+00	1.548e-03	3.294e-03
1.5	2.666e+08	3.049e-02	5.860e-02	5.129e-05	9.859e-05
2.0	3.440e+07	6.088e-03	1.102e-02	9.414e-06	1.705e-05
TOTALS:	4.170e+11	2.387e+00	6.411e+00	4.250e-03	1.132e-02

Attachment 1
UCAR Carbon Company Inc.
Request for Approval of Proposed Procedures
in Accordance with 10 CFR 20.2002

Attachment 1C

RESRAD Dose Assessment

Assessment of the Radiological Effects on Future Residents from the Alternative Disposal of the Solid Waste from the UCAR Site at the Waste Control Specialists Hazardous Waste Landfill

Prepared by:

Mark McHugh, CHP
WESKEM, LLC
for
IMPACt Services, Inc.

May 2005

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

TABLE OF CONTENTS

		Page
1.0	Purpose	1
2.0	Background	1
3.0	Methodology	2
3.1	Isotopic Concentrations	2
3.2	The Model	3
4.0	Results	4
5.0	Conclusion	4
6.0	Appendices	4

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

1.0 Purpose

This assessment calculates the radiological effect to the future resident farmer at the Waste Control Specialists Hazardous Waste Landfill from the alternative disposal of wastes containing residual radioactive material contamination. These wastes consist of fifteen (15) intermodal containers of soil, rubble, and debris, which are contaminated with residual enriched Uranium contamination. The wastes are resultant from voluntary remediation activities that are being conducted at the UCAR site in Lawrenceburg, TN.

2.0 Background

WCS operates a hazardous waste landfill under a permit issued by the State of Texas. The facility has a successful history of disposal of wastes contaminated with residual radioactive materials contaminated with source material (i.e., ^{238}U and ^{232}Th) that has been exempted under 10CFR40. The input parameters used herein have been used previously by WCS staff to evaluate the radiological effects of disposal of this exempt source material to the resident farmer as an Average Member of the Critical Group (AMCG) who might live upon the disposal facility at some time after facility closure up to 1,000 years in the future.

The U.S. NRC has previously terminated the Special Nuclear Materials (SNM) license under which the residual contamination occurred at the UCAR site. Subsequent radiological characterization activities have indicated additional residual radioactive material contamination at the site. UCAR has agreed to conduct voluntary remediation activities to reduce the amount of residual radioactivity at the site. While the remediation activities are being conducted under the authorization of a Tennessee radioactive materials license, the residual contamination itself is not possessed under any active radioactive materials license (i.e., the original possession license having been previously terminated). Therefore, the subject residual radioactivity is not licensed radioactive material.

UCAR is seeking U.S. NRC approval for alternative disposal of these wastes in accordance with 10CFR20.2002, as well as the associated approval for WCS to possess and perform on-site disposal of these wastes without a radioactive material possession license. The analysis contained herein, demonstrates that the radiation dose equivalent resultant from this alternative disposal activity is less than the one millirem (1 mrem) negligible dose equivalent established in NCRP-91.

3.0 Methodology

3.1 Isotopic Concentrations

The dose assessment was performed using the RESRAD 6.22 computer code. Except where specifically noted, the RESRAD default parameters were used as input parameters. The fifteen (15) intermodal containers have been sampled for analytical analyses, as well as radiologically characterized using in situ gamma spectrometry techniques. The results of the in situ gamma characterization are presented in Table 3-1.

Table 3-1: Isotopic Concentrations

Intermodal ID Number	^{235}U Concentration (pCi/g)	Total U Concentration (pCi/g)
MHFU 1748	19	845
MHFU 1864	16	715
MHFU 1579	24	1,045
MHFU 2219	38	1,668
MHFU 1581	23	1,012
MHFU 1367	26	1,146
MHFU 1415	21	926
MHFU 2222	16	724
MHFU 1576	20	867
MHFU 1815	21	911
MHFU 2164	28	1,210
MHFU 2259	45	1,958
MHFU 1901	25	1,115
MHFU 1997	32	1,421
MHFU 2123	15	671
Average	25	1,082

The resultant isotopic concentrations were averaged, resulting in 25 pCi/g of ^{235}U and 1,082 pCi/g Total Uranium. Analytical results from samples taken indicate a wide range of Uranium enrichments throughout the waste. The combined total of the average ^{234}U and ^{238}U concentrations were calculated by subtracting the ^{235}U concentration from the total Uranium concentration, resulting in 1,057 pCi/g. Since the ratio of ^{234}U to ^{238}U varies with enrichment, the RESRAD model was run with each of the two (2) isotopes optimized to determine the more conservative isotope. The results indicated a higher AMCG dose equivalent assuming a ^{234}U concentration of 1,057 pCi/g and no ^{238}U. Therefore, the material isotopic concentrations were conservatively estimated as 25 pCi/g of ^{235}U and 1,057 pCi/g of ^{234}U. No down-blending was credited in the model for addition of non-radiological waste disposal in the landfill concurrent with disposal of the subject waste (i.e., resulting in further reduction of isotopic concentrations).

3.2 The Model

The RESRAD computer code is utilized to calculate doses, risks, and guidance values for residual concentrations of radionuclides in material. The code was designed by the Department of Energy (DOE) to demonstrate compliance with DOE Order 5400.5.

The radiation dose, as determined by RESRAD, is the Total Effective Dose Equivalent (TEDE) from the sum of external radiation plus the Committed Effective Dose Equivalent (CEDE) from internally deposited radionuclides. The critical population group is a relatively small, homogeneous group that is representative of those individuals in the population expected to receive the largest dose. The exposure scenario represents the reasonable maximally exposed resident farmer, who resides, works, grows crops, and raises livestock on site.

Because this scenario is based on "prudently conservative" assumptions that tend to overestimate potential doses, use of this scenario results in estimated doses that will be greater than exposure to future residents. The highest dose per year for each isotope was used to determine the potential effects of that isotope Copies of the graphic outputs for TEDE for each isotope are included in Appendix A.

RESRAD input parameters for the subject calculation and their bases are provided in Appendices B and C, respectively, and include calculations using site specific material characteristics, as determined from the site hydro-geological report. Otherwise, RESRAD default parameters were used. No institutional control period was credited (i.e., the model was evaluated from the time of cap emplacement to 1,000 years thereafter).

4.0 Results

The dose equivalent to the AMCG occurs at the 1,000 year point, primarily due to Radon diffusion from the in-growth of the Uranium Series ^{226}Ra daughter. The resultant dose equivalent to the AMCG is less than 0.7 mrem per year. Results are shown on the graphical output included as Appendix A and the RESRAD Summary Report included as Appendix B.

5.0 Conclusion

This assessment demonstrates that the dose equivalent to any future AMCG Resident Farmer living and working in the area around the subject disposal cell will be less than the NCRP-91 negligible dose of one (1) mrem.

6.0 Appendices

Appendix A: RESRAD Graphic Output for Resident Farmer Disposal Scenario

Appendix B: RESRAD Report of Input Parameters and Resultant TEDE for Resident Farmer Disposal Scenario

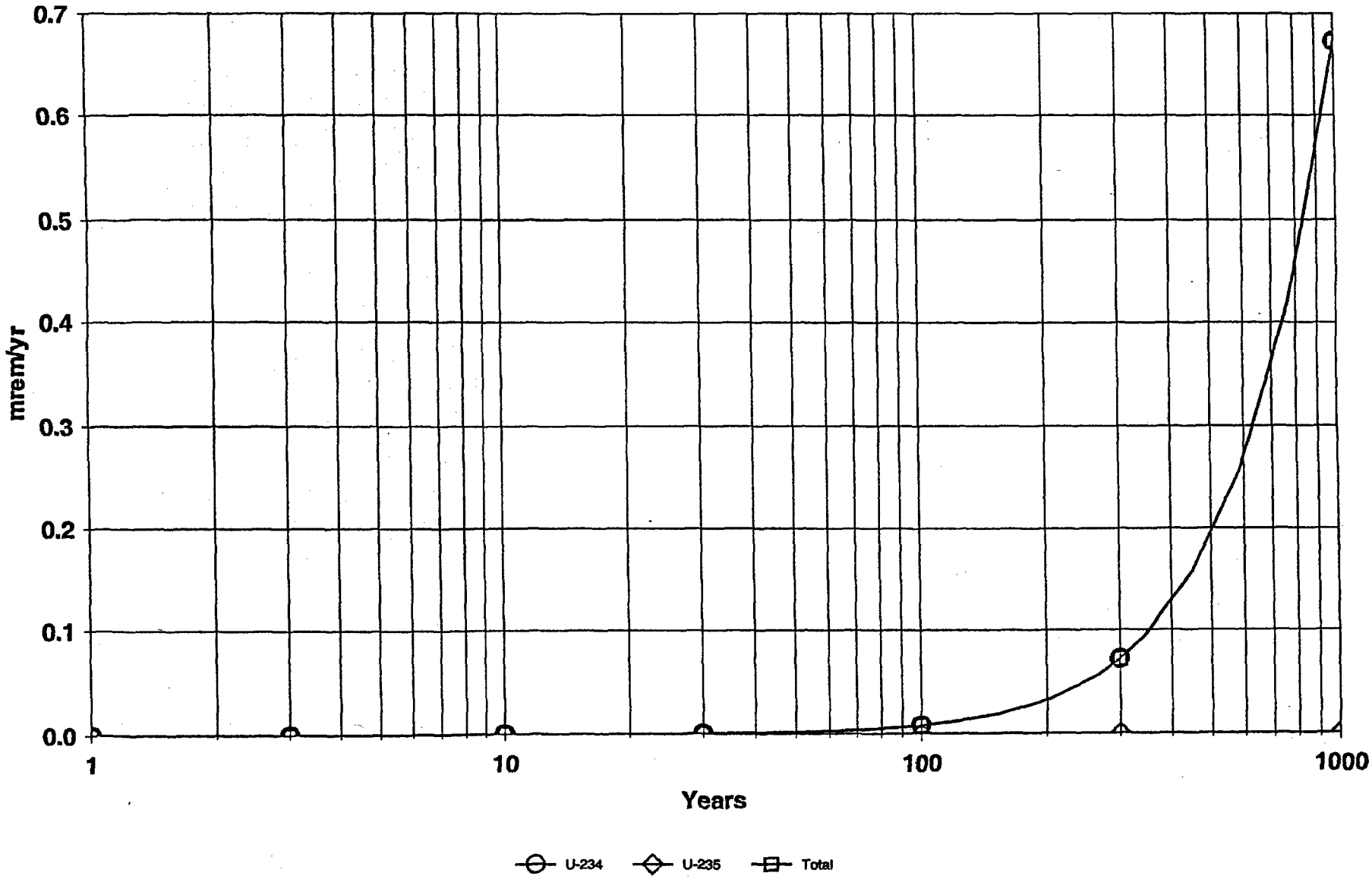
Appendix C: Technical Bases for RESRAD Input Parameters

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

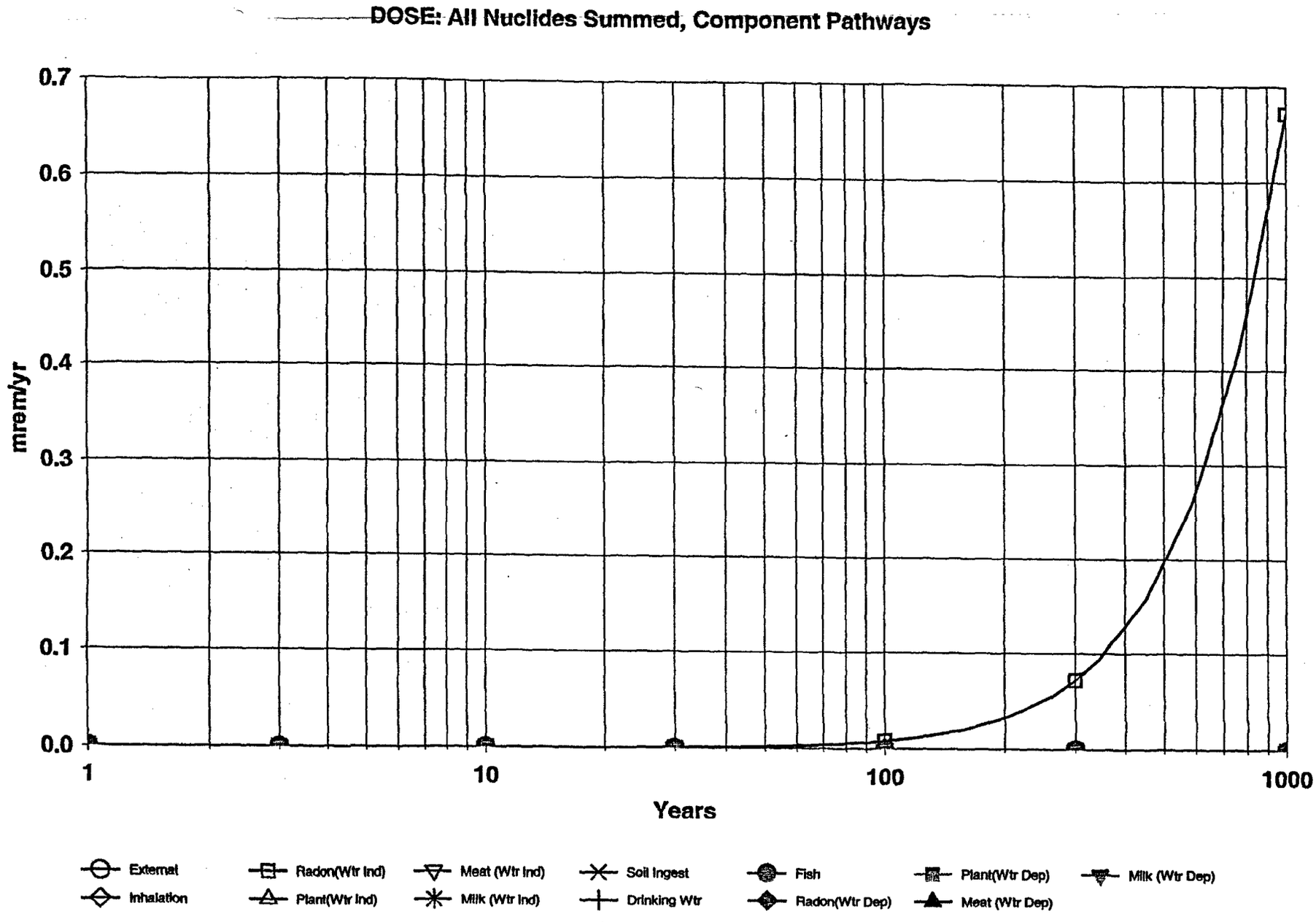
APPENDIX A

RESRAD Graphic Output for Resident Farmer Scenario

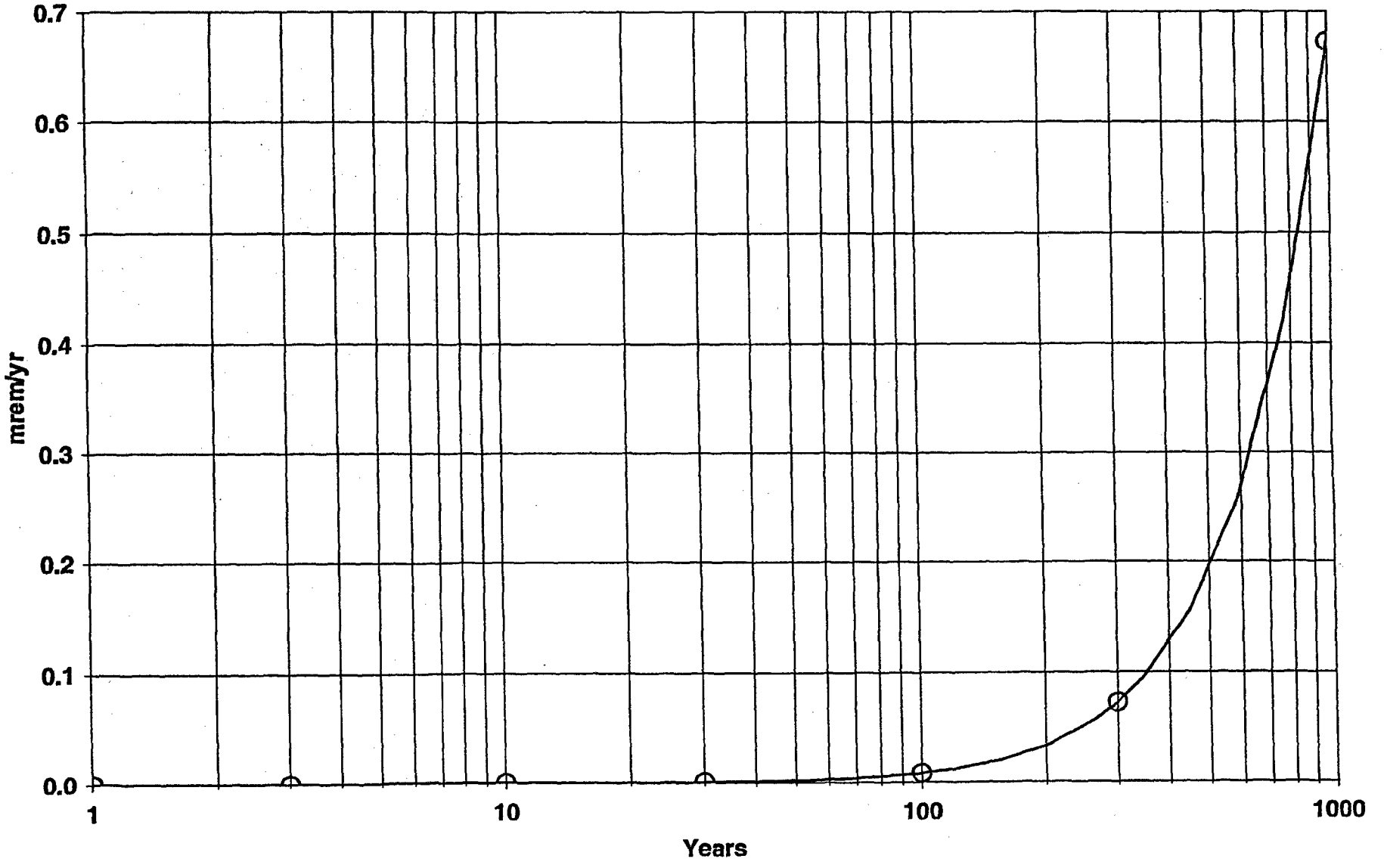
DOSE: All Nuclides Summed, All Pathways Summed



UCAR to WCS.RAD 05/09/2005 16:08 Includes All Pathways

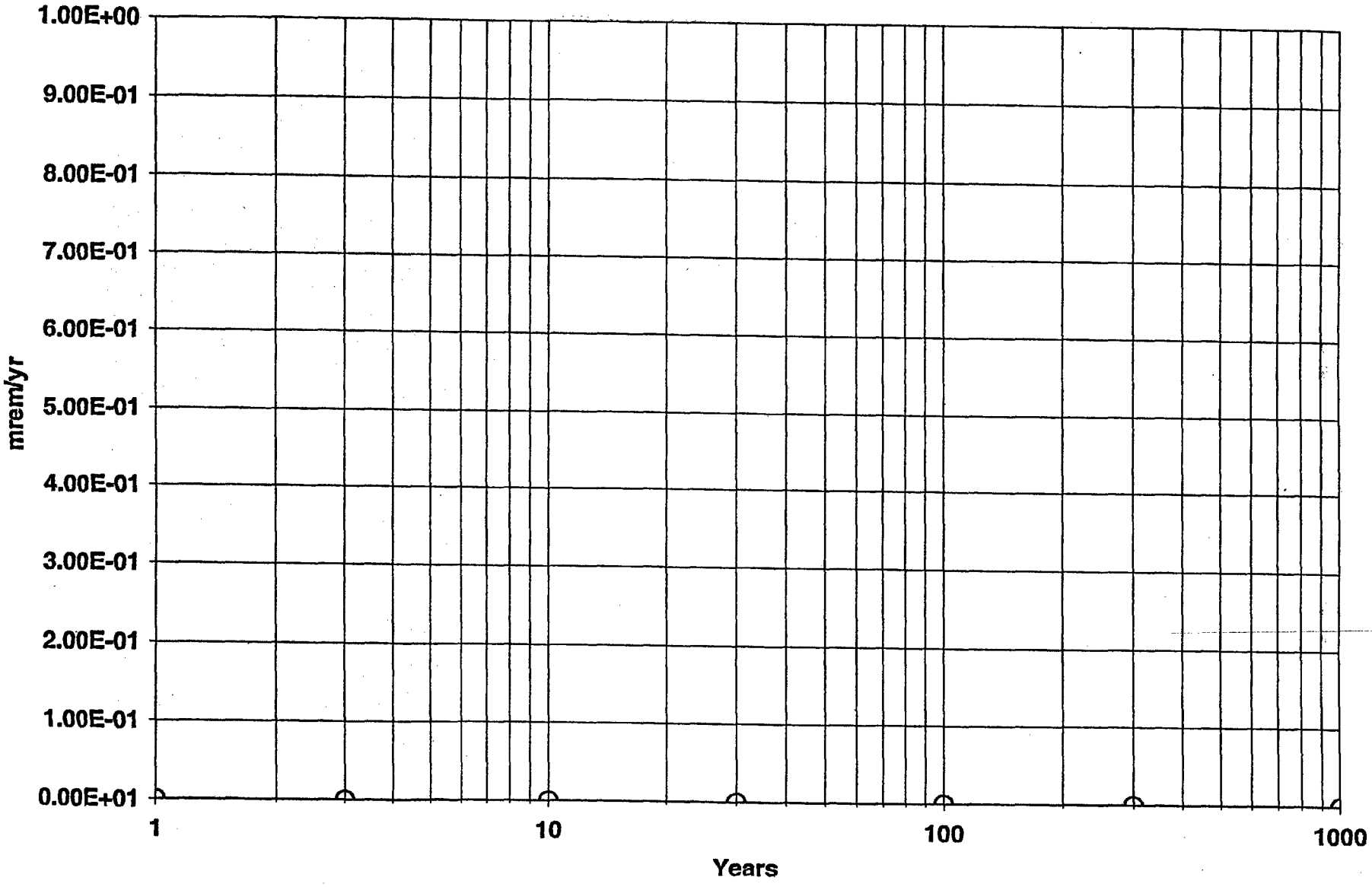

DOSE: All Nuclides Summed, Component Pathways
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
mrem/yr
1
10
100
1000
Years
External
Inhalation
Radon(Wtr Ind)
Plant(Wtr Ind)
Meat (Wtr Ind)
Milk (Wtr Ind)
Soil Ingest
Drinking Wtr
Fish
Radon(Wtr Dep)
Plant(Wtr Dep)
Meat (Wtr Dep)
Milk (Wtr Dep)
UCAR to WCS.RAD 05/09/2005 16:08

DOSE: U-234, All Pathways Summed



UCAR to WCS.RAD 05/09/2005 16:08 Includes All Pathways

DOSE: U-235, All Pathways Summed



UCAR to WCS.RAD 05/09/2005 16:08 Includes All Pathways

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

APPENDIX B

RESRAD Report of Input Parameters and Resultant TEDE for Resident Farmer Disposal Scenario

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary 4
Summary of Pathway Selections 9
Contaminated Zone and Total Dose Summary 10
Total Dose Components
Time = 0.000E+00 11
Time = 1.000E+00 12
Time = 3.000E+00 13
Time = 1.000E+01 14
Time = 3.000E+01 15
Time = 1.000E+02 16
Time = 3.000E+02 17
Time = 1.000E+03 18
Dose/Source Ratios Summed Over All Pathways 19
Single Radionuclide Soil Guidelines 19
Dose Per Nuclide Summed Over All Pathways 20
Soil Concentration Per Nuclide 20

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 1995 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	1.380E-02	1.380E-02	DCF2(3)
B-1	Po-210	9.400E-03	9.400E-03	DCF2(4)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(5)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(8)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	5.370E-03	5.370E-03	DCF3(3)
D-1	Po-210	1.900E-03	1.900E-03	DCF3(4)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(5)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(8)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Po-210 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Po-210 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(4,2)
D-34	Po-210 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.400E-04	3.400E-04	RTF(4,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 1995 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Po-210 , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Po-210 , crustacea and mollusks	2.000E+04	2.000E+04	BIOFAC(4,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)

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)	4.600E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.653E+00	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	5.000E+00	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): U-234	1.057E+03	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-235	2.500E+01	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	5.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	2.350E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.830E-06	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	8.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	3.550E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	5.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	3.000E+02	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.350E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	6.000E-02	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E-03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.006E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.006E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.987E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.006E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.005E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Po-210				
R016	Contaminated zone (cm**3/g)	1.000E+01	1.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+01	1.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	1.000E+01	1.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.883E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.434E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.678E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	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(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
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)	1.600E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.230E-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.230E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.230E-02	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	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

Site-Specific Parameter Summary (continued)

enu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
TOR	Storage times of contaminated foodstuffs (days):				
TOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
TOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
TOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
TOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
TOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
TOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
TOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
TOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
TOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	1.500E-01	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	4.000E-01	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	5.000E-02	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	2.000E-06	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	5.000E-01	5.000E-01	---	REXG
R021	Height of the building (room) (m)	2.500E+00	2.500E+00	---	HRM
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	-1.000E+00	-1.000E+00	code computed (time dependent)	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	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)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	active
Find peak pathway doses	active

Contaminated Zone Dimensions	
Area:	46.00 square meters
Thickness:	5.00 meters
Cover Depth:	5.00 meters

Initial Soil Concentrations, pCi/g	
U-234	1.057E+03
U-235	2.500E+01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 5.000E+00 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):	2.887E-07	2.020E-06	1.067E-05	9.530E-05	7.994E-04	8.522E-03	7.236E-02	6.722E-01
M(t):	5.773E-08	4.040E-07	2.135E-06	1.906E-05	1.599E-04	1.704E-03	1.447E-02	1.344E-01

Maximum TDOSE(t): 6.722E-01 mrem/yr at t = 1.000E+03 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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	2.887E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	2.887E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	2.887E-07	1.000(
U-235	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	0.000E+00	0.000(
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	2.887E-07	1.000(

*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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
J-234	0.000E+00	0.0000	0.000E+00	0.0000	2.020E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
J-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	2.020E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
-234	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	2.020E-06	1.000(
-235	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	0.000E+00	0.000(
otal	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	2.020E-06	1.000(

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	1.067E-05	1.000(
U-235	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	0.000E+00	0.000(
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	1.067E-05	1.000(

*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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	9.530E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	9.530E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	9.530E-05	1.000(
U-235	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	0.000E+00	0.000(
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	9.530E-05	1.000(

*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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	7.994E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	7.994E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	7.994E-04	1.000(
U-235	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	0.000E+00	0.000(
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	7.994E-04	1.000(

*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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	8.522E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	8.522E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	8.522E-03	1.000(
U-235	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	0.000E+00	0.000(
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	8.522E-03	1.000(

*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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	7.236E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
U-235	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	0.000E+00	0.000(
Total	0.000E+00	0.0000	0.000E+00	0.0000	7.236E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	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	7.236E-02	1.000(
U-235	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	0.000E+00	0.000(
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	7.236E-02	1.000(

*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)

:adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
luclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
I-234	0.000E+00	0.0000	0.000E+00	0.0000	6.722E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(
I-235	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	0.000E+00	0.000(
'otal	0.000E+00	0.0000	0.000E+00	0.0000	6.722E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000(

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

:adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
luclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
I-234	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	6.722E-01	1.000(
I-235	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	0.000E+00	0.000(
'otal	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	6.722E-01	1.000(

*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
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	2.731E-10	1.911E-09	1.010E-08	9.017E-08	7.563E-07	8.063E-06	6.845E-05	6.360E-04
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Po-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	∑DSR(j)		2.731E-10	1.911E-09	1.010E-08	9.017E-08	7.563E-07	8.063E-06	6.845E-05	6.360E-04
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*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 ≤ 30 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 5.000E+00 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
U-234	*6.245E+09	2.616E+09	4.952E+08	5.545E+07	6.611E+06	6.201E+05	7.304E+04	7.862E+03
U-235	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06

*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 = 1.000E+03 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
U-234	1.057E+03	1.000E+03	6.360E-04	7.862E+03	6.360E-04	7.862E+03
U-235	2.500E+01	0.000E+00	0.000E+00	*2.160E+06	0.000E+00	*2.160E+06

*At specific activity limit

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
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	2.887E-07	2.020E-06	1.067E-05	9.530E-05	7.994E-04	8.522E-03	7.236E-02	6.722E-01
Pb-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Po-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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
U-234	U-234	1.000E+00	1.057E+03	1.057E+03	1.056E+03	1.055E+03	1.051E+03	1.036E+03	9.944E+02	8.624E+02
Th-230	U-234	1.000E+00	0.000E+00	9.514E-03	2.854E-02	9.505E-02	2.845E-01	9.415E-01	2.765E+00	8.569E+00
Ra-226	U-234	1.000E+00	0.000E+00	2.060E-06	1.853E-05	2.056E-04	1.840E-03	2.008E-02	1.715E-01	1.595E+00
Pb-210	U-234	1.000E+00	0.000E+00	2.118E-08	5.630E-07	1.975E-05	4.606E-04	1.116E-02	1.392E-01	1.503E+00
Po-210	U-234	1.000E+00	0.000E+00	7.004E-09	3.478E-07	1.690E-05	4.377E-04	1.100E-02	1.386E-01	1.500E+00
U-235	U-235	1.000E+00	2.500E+01	2.499E+01	2.498E+01	2.495E+01	2.485E+01	2.450E+01	2.354E+01	2.046E+01
Pa-231	U-235	1.000E+00	0.000E+00	5.288E-04	1.586E-03	5.278E-03	1.577E-02	5.179E-02	1.489E-01	4.283E-01
Ac-227	U-235	1.000E+00	0.000E+00	8.329E-06	7.335E-05	7.570E-04	5.597E-03	3.599E-02	1.323E-01	4.112E-01

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

RESCALC.EXE execution time = 2.27 seconds

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

APPENDIX C

Technical Bases for RESRAD Input Parameters

General

Appendix C contains a list of all input parameters used to model the disposal of the fifteen intermodals of remediation waste from the UCAR site decommissioning waste at the WCS landfill. The first three (3) parameters are directly related to the waste volume (i.e., contaminated zone parameters). The next nine (9) input parameters have been previously reviewed by the U.S. Nuclear Regulatory Commission (NRC) in assessments for disposition of source material at the WCS landfill (e.g., the Lake City Army Ammunition Plant source material disposition). The last is the distribution coefficient (K_d) for the isotopes of concern for the unsaturated zone soil type (i.e., clay). All other values not specifically addressed herein are the recommended values selected by the developers of RESRAD (i.e., RESRAD default values) and are discussed in the RESRAD manual.

Assessment of the Radiological Effects on Future Residents
from the Alternative Disposal of the Solid Waste from the UCAR Site
at the Waste Control Specialists Hazardous Waste Landfill

Parameters Specific to WCS.

1) Area of contaminated zone:

   46 square meters - Estimated by the disposal facility for disposal of the anticipated volume of waste material (i.e., fifteen (15) 20 cubic yard intermodals at a five (5) meter thickness, as specified below).

2) Thickness of contaminated zone:

   5 meters - Estimated by the disposal facility for designated disposal cell.

3) Length parallel to aquifer flow:

   7.653 meters - the diameter of the circular area associated with the disposal volume.

4) Cover depth:

   5.0 meters - designated cover depth for the disposal cell.

5) Density of cover material:

   2.35 grams per cubic centimeter - the density of the compacted red bed clay used for cover material.

6) Cover erosion rate:

   1.830E-6 meters per year - erosion rate for landfill area.

7) Evapotranspiration coefficient:

   0.80 - Evapotranspiration factor for landfill.

8) Precipitation

   0.355 meters per year - annual rainfall for landfill area.

9) Runoff coefficient

   0.50 - applicable factor for landfill area.

10) Unsaturated zone thickness:

300 meters - distance between the contaminated zone (i.e., landfill material) and saturated zone (i.e., water table).

11) Unsaturated zone soil density

2.35 grams per cubic centimeter - the density of the compacted red bed clay.

12) Unsaturated zone effective porosity

0.06 - effective porosity of the compacted red bed clay.

13) Distribution coefficients (K_d)

The K_d values used for the Unsaturated Zone (i.e., red bed clay) were taken from the "Clay" column of Table 32.1, "Summary of Geometric Mean K_d Values (cm^3/g) for each Element by Soil Type," from Page 110 the RESRAD support manual [Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil, C. Yu et al, Argonne National Laboratory, April 1993] for the elements listed therein. Otherwise, RESRAD default values were used.