AUG 4 1992

MEMORANDUM FOR: John Hickey, Chief
Fuel Cycle Safety Branch
Division of Industrial
and Medical Nuclear Safety, IMNS

FROM: John H. Austin, Chief
Decommissioning and Regulatory
Issues Branch
Division of Low-Level Waste Management
and Decommissioning, NMSS

SUBJECT: GROUNDWATER DOSE ASSESSMENT FOR DISPOSAL OF CONTAMINATED CALCIUM SULFATE IN THE GSX HAZARDOUS WASTE LANDFILL, PINEWOOD, SOUTH CAROLINA

As requested, I am providing a copy of our evaluation of the potential doses via the groundwater pathway to the public from the disposal of $CaSO_4$ waste contaminated with small quantities of low-enriched uranium in the GSX hazardous waste landfill, Pinewood, South Carolina. This assessment was performed by the Regulatory Issues Section to estimate the annual dose to the maximum reasonably-exposed individual via the groundwater pathway.

On July 20, 1992, the Regulatory Issues Section staff contacted the South Carolina Department of Health and Environmental Control (DHEC) staff members Ken Taylor, Robert Ede, and Willie Morgan to collect site specific information on the general and hydrological characteristics of the GSX landfill. Additional information was received by the NRC staff from DHEC on August 3, 1992. The producer of the $CaSO_4$, GE Wilmington, was also contacted to collect information on the waste characteristics by Ed Flack, of your staff. We used the information in the RESRAD dose assessment code to estimate potential doses associated with the groundwater pathway. Conservative assumptions were employed and a detailed explanation of these assumptions is contained in the attached report.

The peak doses produced from this assessment indicate that the potential releases from the disposal of the contaminated $CaSO_4$ in the GSX landfill are sufficiently low to ensure protection of the public health and safety. Even

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under conservative conditions, the resulting annual dose to an off-site resident through the groundwater pathway is less than 1 mrem/yr. A more realistic exposure scenario would be expected to yield lower doses.

If you have any further questions, please contact Heather Astwood on 504-3466.

/S/ By Michael Weber for

John H. Austin, Chief
Decommissioning and Regulatory
Issues Branch
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and Decommissioning, NMSS

Enclosure: As Stated

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SUBJECT ABSTRACT: GROUNDWATER DOSE ASSESSMENT FOR DISPOSAL OF CONTAMINATED CALCIUM SULFATE IN THE GSX HAZARDOUS WASTE LANDFILL, PINEWOOD, SOUTH CAROLINA

OFC	LLDR HA	LLDR MW*	LLDR MW for			
NAME	HAstwood	MWeber	JAustin			
DATE	8/3/92	8/4/92	8/04/92			

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Groundwater Dose Assessment for Disposal of Contaminated Calcium Sulfate in the GSX Hazardous Waste Landfill, Pinewood, South Carolina

Prepared by
Division of Low-Level Waste Management and Decommissioning
U.S. Nuclear Regulatory Commission
August 3, 1992

1. Introduction

In 1985, the Nuclear Regulatory Commission (NRC) approved a license amendment request from General Electric (GE) located in Wilmington, North Carolina. This amendment allows GE to dispose of industrial waste containing small amounts of low enriched uranium at the GSX Hazardous Waste Landfill in Pinewood, South Carolina. The amendment was made to the Exemptions and Special Authorization section of the Special Nuclear Material (SNM) license 1907 with the addition of section 1.8.5.2.

GE is allowed under the license condition to dispose of waste containing small quantities of low enriched uranium in accordance with Option 2 of the 1981 Branch Technical Position, "Disposal or Onsite Storage of Thorium or Uranium Waste from Past Operations"[1] with a maximum concentration of 250 pCi/g (insoluble) or 100 pCi/g (soluble).

Since 1986, GE has been disposing of calcium fluoride with an average concentration of 30 pCi/g of uranium in the Pinewood facility in compliance with the condition. On June 22, 1992, GE informed the NRC of plans to dispose of calcium sulfate ($CaSO_4$) waste material in the Pinewood Hazardous Waste disposal facility under the same condition[2].

Although $CaSO_4$ is covered in the 1985 condition (e.g., the condition does not limit the waste type other than total specific activity of U), NRC performed a reevaluation of the potential doses produced from the disposal of this waste. This assessment evaluates the potential doses via the groundwater pathway to individual members of the public resulting from the disposal of $CaSO_4$ containing low-enriched uranium in the Pinewood facility.

2. Calcium Sulfate Waste

Calcium sulfate is produced as a byproduct from the recovery of uranium from on-site lagoon sludge at the Wilmington site. GE states that the uranium content in the $CaSO_4$ meets the limits in the license condition. The average concentration of uranium in the waste is 50 pCi/g with a maximum of 250 pCi/g uranium. The uranium is enriched to 4% uranium-235. This enrichment is equivalent to stating that approximately 95.97% of the uranium will be U-238, 4% will be U-235, and 0.03% will be U-234[4]. GE plans to send approximately 280 cubic meters of $CaSO_4$ to Pinewood over a two-year period.

3. Pinewood Landfill

The Pinewood facility is located in Pinewood, South Carolina and is operated by the GSX Corporation. NRC staff members contacted the South Carolina Department of Health and Environmental Control (DHEC) to assemble information on the GSX site necessary to support the evaluation of potential groundwater dose. Additional information was received by the NRC staff from DHEC on August 3, 1992. GSX plans to bury a majority of the waste in cell 3A. This is a lined cell, which has a volume of approximately 360,000 cubic meters (289 acre feet). The cell, as measured on the site map supplied by DHEC, is approximately 57,600 m^2 (620,000 ft^2) with an average depth of 6 m (20 ft) and a maximum depth of 23 m (75 ft).

Over the two years GE will be sending waste to the landfill, GSX will continue to place other forms of solid waste in the cell. This will effectively dilute the $CaSO_4$ waste with the total volume of waste in the cell. The activity of the $CaSO_4$ waste was assumed to be at a maximum of 250 pCi/g. DHEC reported to the NRC staff that approximately 800 tons (7.26×10^5 Kg assuming a density of 2.602 g/cm^3 for $CaSO_4$) of $CaSO_4$ was going to be disposed of at the landfill. This is equivalent to a total inventory of 0.18 curies of uranium.

Considering that the inhalation and ingestion pathways are the principal pathways for potential exposures, this activity was then assumed to be diluted with the total volume of waste in the cell, thereby reducing the activity in the cell to 0.31 pCi/g. This is considered to be a conservative value since the actual average uranium concentration in the waste, was reported by GE to be approximately 50 pCi/g for the $CaSO_4$. Using this value, the average concentration over the volume of the cell would be 0.06 pCi/g.

The $CaSO_4$ will be disposed of in a moist sludge form and placed into three separate synthetic bags (polyester, polypropylene, and polyvinyl-chloride) before being tied to wooden pallets to be placed into the cell. The cell will be constructed as depicted in Figure 1.

4. Groundwater Model

To assess potential doses to a member of the public who might install a well near the landfill and extract groundwater, NRC staff modeled leaching and subsequent transport of the uranium from cell 3A into the groundwater. The RESRAD code version 4.1, which was developed by Argonne National Laboratory, was used to estimate the maximum annual dose which could be received by a member of the general public. A description of the code and its methodology can be found in ANL/ES-160[3].

RESRAD assumes an intruder-family farm scenario to estimate dose (Figure 2). In this scenario, an intruder builds a residence directly on top of the contaminated area and drills a well into the groundwater below and at the down gradient edge of the contaminated zone. The water obtained from this well is then assumed to be used in all water uses (e.g., drinking, bathing, cooking, irrigation of crops and watering farm animals). The code also simulates other pathways not associated with the groundwater, such as direct radiation, ingestion of soils and contaminated foods, and inhalation of dust and radon.

However, this assessment only evaluated potential doses via the groundwater pathway. Estimated doses via the other pathways are bounded by the technical basis for the 1981 BTP (e.g., approximately 20 mrem/yr EDE from inhalation of optimally respirable insoluble high enriched uranium).

To estimate a dose to the maximum reasonably exposed individual, conservative assumptions were used in the RESRAD calculations. The waste being considered in this evaluation is low-enriched uranium, which contains U-238, U-235, and U-234. The specific activity of U-234 is the highest of the three isotopes of uranium. Therefore, to be conservative, the entire inventory of uranium was assumed to be U-234.

The dose calculations were made assuming the inventory in the cell leached into the groundwater at rates proportional to the distribution coefficient values of 50, 35, and 25 cm^3/g for uranium in the waste, unsaturated zone and saturated zone respectively. Distribution coefficients for uranium in clay soils are typically two orders of magnitude higher (e.g., less leaching into water) than those for sandy soils[5]. A conservative value for sandy soils is approximately 35 cm^3/g. Therefore, 25 cm^3/g was chosen as a conservative value in the sandy saturated zone. A slightly higher value was then chosen for the unsaturated sandy/clay zone, and an even higher value for the clay surrounding the waste. These are very conservative values in clay soils and the actual coefficients in the waste and unsaturated zones are probably much higher. In addition, the calculations were made assuming there was no liner in the cell and the waste was covered with one meter of soil with no synthetic barriers, and no erosion of the contaminated zone.

A list of the site specific parameters collected from DHEC by phone which were used in the RESRAD code are contained in Table 1. All site specific data obtained from DHEC were incorporated into the RESRAD calculations. Other values which were incorporated into the RESRAD analysis were taken from the default values contained in RESRAD. These default values represent average soil conditions and were considered to adequately represent the conditions at this site. Many conservative assumptions were made in the analysis which should bound any effect in the dose produced from variations in the default values. Appendix A contains the output from the RESRAD code and shows the site specific hydrological data, and the default values used in the model.

5. Results

Using the RESRAD code and the assumptions described above, estimated potential doses to a member of the public who uses groundwater obtained from directly beneath the contaminated cell are on the order of 0.18 mrem/yr EDE using the distribution coefficients mentioned above and an initial concentration of 0.06 pCi/g. Larger doses, on the order of 0.96 mrem/yr EDE, were estimated using a an initial concentration of 0.31 pCi/g. These results are illustrated in Figures 3 and 4.

6. Discussion

The potential doses from disposal of the $CaSO_4$ waste are low. For comparison, the proposed EPA drinking water standard for uranium is 30 pCi/liter (56 FR

33050; July 18, 1991). This standard equates to a dose of about 6 mrem/yr EDE. Therefore, using reasonable distribution coefficient estimates and the maximum diluted concentration of uranium in the waste, disposal of the waste would result in contamination ten times less than the proposed EPA standard. Even for the conservative analysis performed by the NRC staff, disposal of the waste would not pose a significant risk to members of the public from the disposal of this waste in the GSX landfill.

Actual doses would be expected to be considerably less than estimated in this assessment. This was a very conservative analysis and probably overestimated the doses that might actually occur at this site. One of the most conservative assumptions made in this analysis was the location of the intruder well. In actuality, an intruder would probably build along the boundary of the site. There are institutional controls placed on the site, which should be somewhat effective in preventing the public from having access to the site over the next several decades. If, however, these controls fail, an individual drilling a well into a hazardous waste landfill would most likely realize that this was a burial site and discontinue drilling. The concentrations of uranium in a well off-site would be further decreased due to dispersion and retardation that would occur between the cell and the well. Therefore, potential doses to people off-site would be much less than those calculated here.

The distribution coefficients used in this analysis also contribute to the conservatism of the estimated dose. Clay soils generally have high coefficients and, therefore, highly retard uranium transport in groundwater. In this assessment very little credit for the clay in the soils was taken. The soils were assumed to be predominately sandy. Therefore, the mobility of the uranium was probably overestimated in this analysis.

The analysis also did not incorporate any synthetic barriers in the cover, and assumed no liner in the cell. Although the liner cannot be assumed to remain intact indefinitely, there will realistically be some retardation of the uranium by the liners. Even in the event of a failure by the synthetic barriers, the cover should remain somewhat effective in reducing the amount of precipitation passing through the waste, and will thereby reduce the mobilization of the uranium. The liners will also inhibit the release of the nuclides into the ground, to some extent, even if they are not completely intact. Since no credit was given for either type of barrier in the analysis, the estimated doses are also overestimated.

Taking into account all of the conservative assumptions incorporated in this assessment, the dose to the general public in this area would most likely be much lower than the doses in this analysis. Therefore, disposal of the contaminated $CaSO_4$ waste in the GSX landfill will not pose a significant risk to the public via potential leaching and transport of uranium in groundwater.

REFERENCES

1. U.S. Nuclear Regulatory Commission, Uranium Fuel Licensing Branch Technical Position, "Disposal or Onsite Storage of Thorium or Uranium Waste from Past Operations," Federal Register (46 FR 52061), October 23, 1981.

2. Memo to file dated June 22, 1992, from Ed Flack. Subject: "Disposal of Industrial Waste Products Containing Uranium".

3. "A Manual for Implementing Residual Radioactive Material Guidelines", Argonne National Laboratory, June 1989; ANL/ES-160, DOE/CH/8901.

4. Letter to file dated July 31, 1991, from Ed Flack. "Cascade Gradients - U-234, U-236 versus U-235 for June 30, 1991".

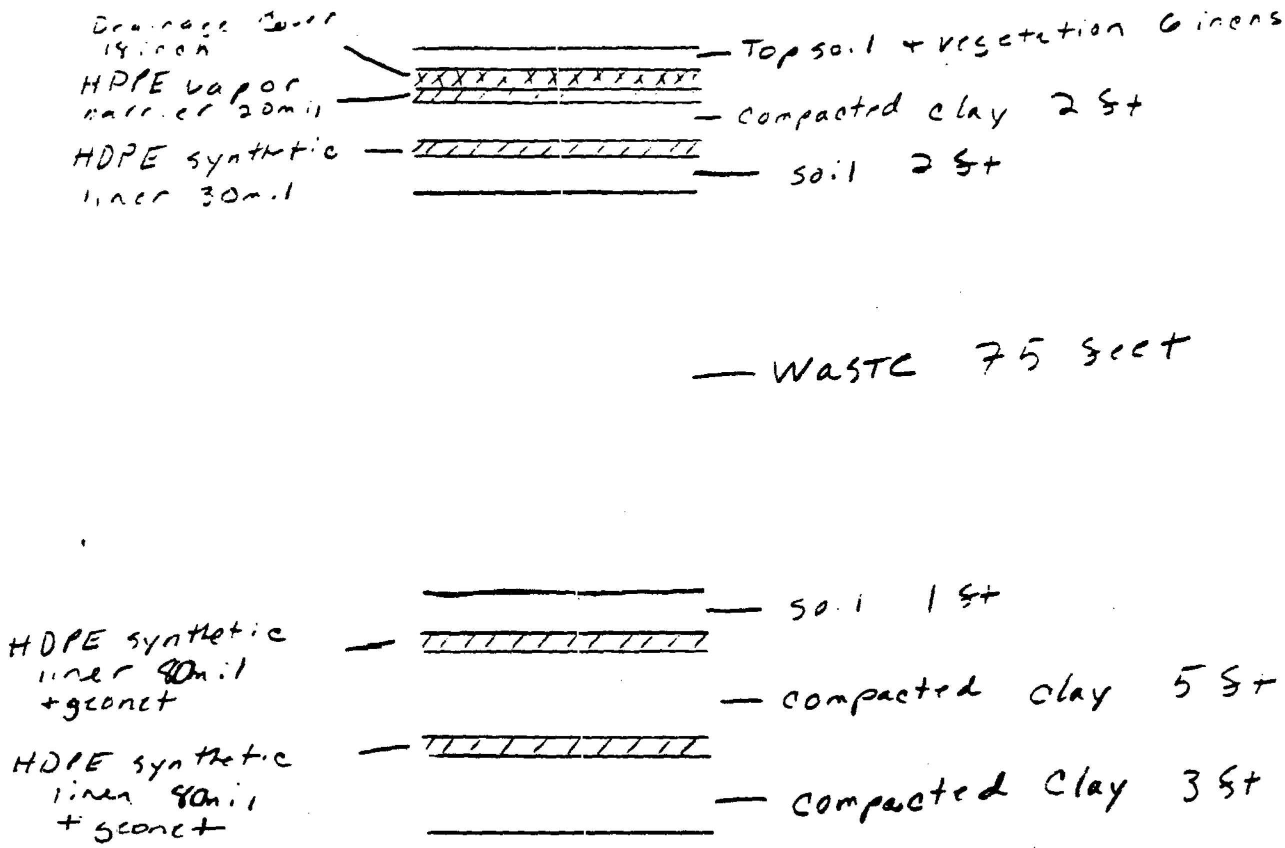
5. Sheppard, M. and D. Thibault, "Default Soil Solid/Liquid Partition Coefficients, K_ds, for Four Major Soil Types: A Compendium" Health Physics Vol. 59 No. 4, pp 471-482, 1991.

Table 1. A list of the information received by phone from DHEC July 20, 1992

Volume of cell 3A	approx. 289-300 acre feet
Depth of cell 3A	maximum of 75 feet
Cell liner from bottom up	10 feet claystone 3 feet compacted clay 80 mil synthetic liner (HDPE) and geonet 5 feet compacted clay 80 mil synthetic liner (HDPE) and geonet 1 foot soil Drainage above each layer
Cell cover from bottom up	2 feet soil 30 mil synthetic liner (HDPE) 2 feet compacted clay 20 mil vapor barrier 18 inch drainage cover 6 inch topsoil and vegetation
Permeability of clay stone	10^{-7} to 10^{-8} cm/sec
Permeability of clay layers	10^{-7} cm/sec
Effective porosity	approx. 15-25%
Hydraulic gradient	approx. 0.0035 SW
Annual precipitation	approx. 42 inches
Distance from bottom of cell to the next saturated unit	10 feet minimum
Distance from cell to next cell	approx. 500-800 feet
Distance from cell to lake	approx. 2500 feet
Distance from cell to buffer zone	approx. 1000 feet

Appendix A

Figure 1. Construction of cell 3A



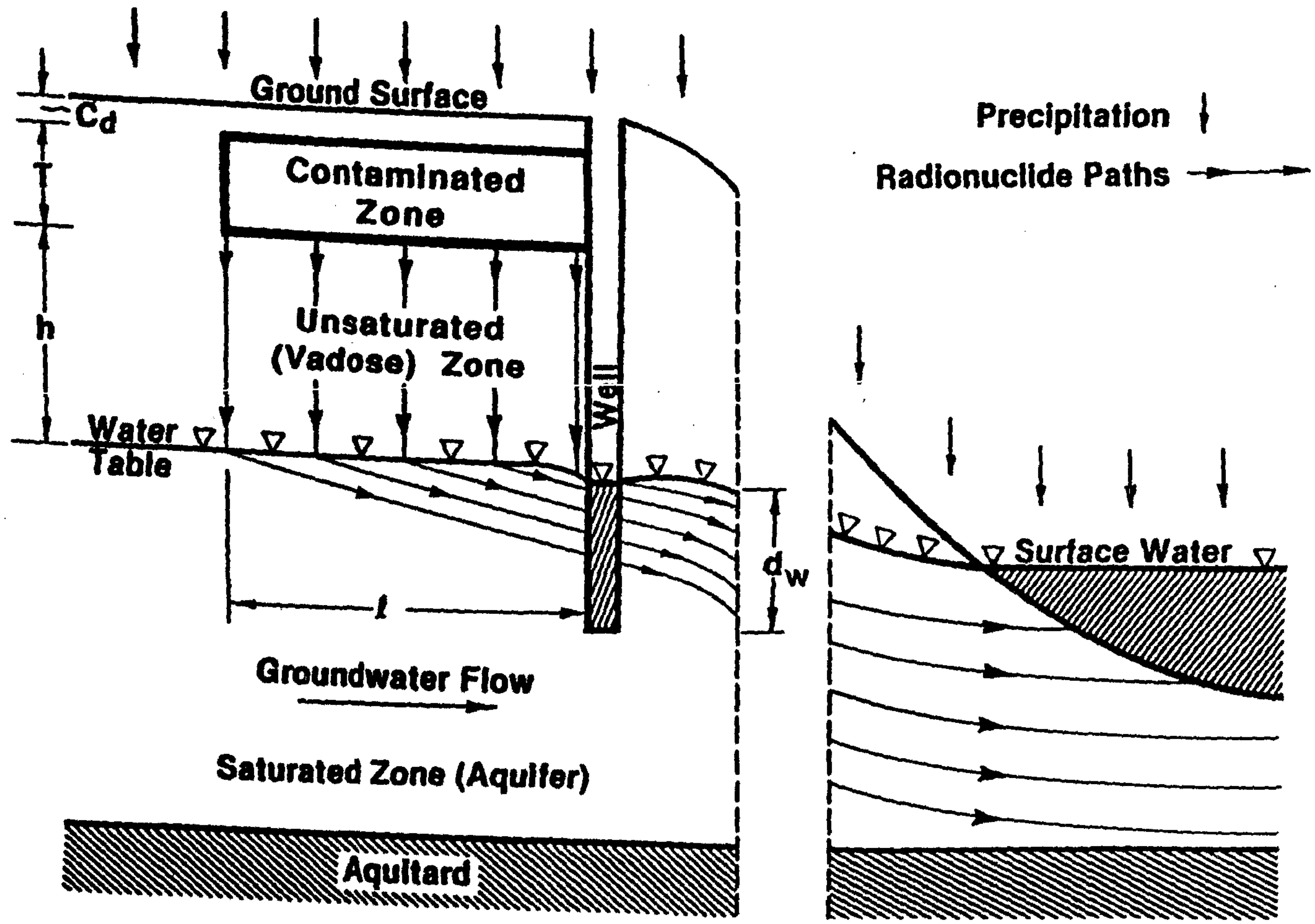


FIGURE 2. **Schematic Representation of the Water Pathway Segments**

DOSE: Water Dependent Pathways, U-234

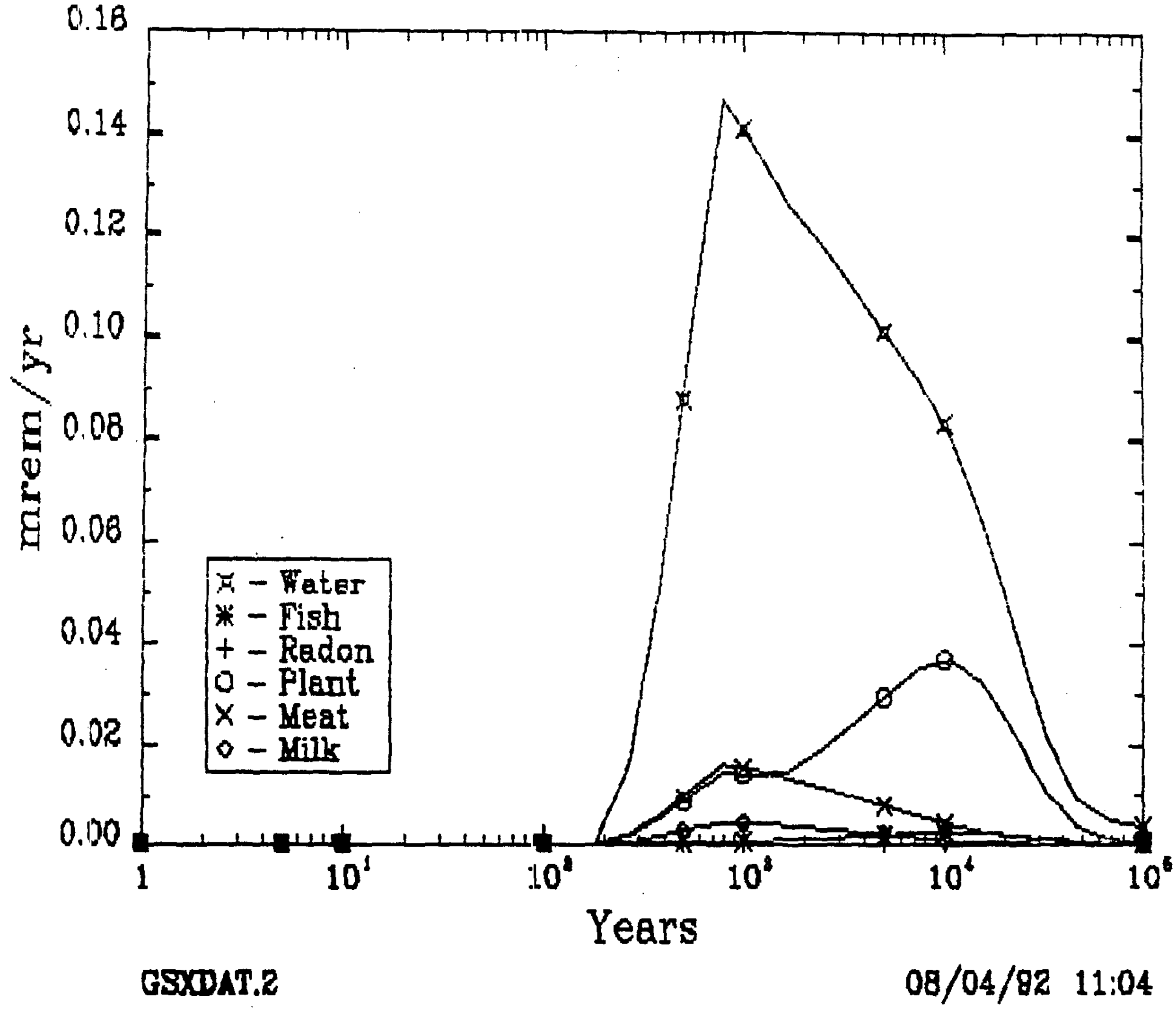


Figure 3. Estimated dose assessment using a concentration of 0.06 pCi/g. Maximum dose of 0.18 mrem/yr at 716 years.

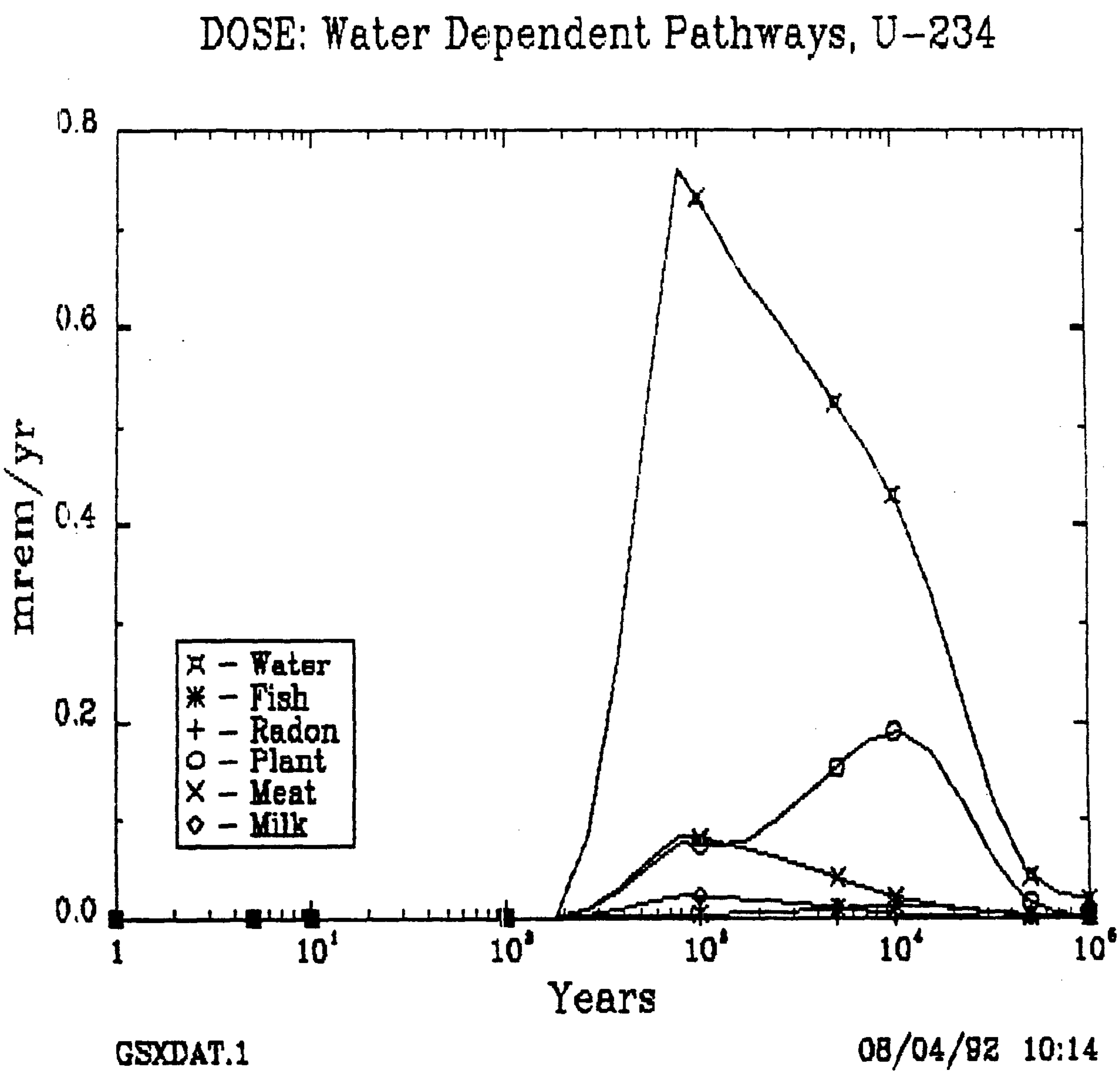


Figure 4. Estimated dose assessment using a concentration of 0.31 pCi/g. Maximum dose of 0.96 mrem/yr at 716 years.

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) 57,600 *	~~1.552E+04~~	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.300E+01	1.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m) 240 *	~~1.248E+02~~	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	1.000E+02	---	BRLD
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E-01	1.000E+00	---	T(2)
R011	Times for calculations (yr)	5.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+02	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+03	3.000E+02	---	T(7)
R011	Times for calculations (yr)	5.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+04	3.000E+03	---	T(9)
R011	Times for calculations (yr)	1.000E+05	1.000E+04	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-234	6.000E-02	0.000E+00	---	S(4)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W(4)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.600E+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	1.600E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity .031 *	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	~~3.400E-01~~	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Evapotranspiration coefficient	6.000E-01	6.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.600E+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 hydraulic conductivity (m/yr) 3 *	~~3.200E-02~~	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.500E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	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	Individual's use of groundwater (m**3/yr)	1.500E+02	1.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	3.000E+00	4.000E+00	---	H(1)

R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.600E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(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)	.031* ~~1.000E+02~~	1.000E+02	---	HCUZ(1)

* Adjustments to input values due to additional information received from DHEC on Aug. 3, 1992.

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCACTC(4)
R016	Unsaturated zone 1 (cm**3/g)	3.500E+01	5.000E+01	---	DCACTU(4,1)
R016	Saturated zone (cm**3/g)	2.500E+01	5.000E+01	---	DCACTS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.163E-04	RLEACH(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCACTC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCACTU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCACTS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	RLEACH(1)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCACTC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCACTU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCACTS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	RLEACH(2)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	1.000E+03	6.000E+04	---	DCACTC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	6.000E+04	---	DCACTU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+03	6.000E+04	---	DCACTS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.087E-05	RLEACH(3)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
R017	Occupancy factor, inhalation	not used	4.500E-01	---	FO3
R017	Occupancy and shielding factor, external gamma	not used	6.000E-01	---	FO1
R017	Shape factor, external gamma	not used	1.000E+00	---	FS1
R017	Fractions of annular areas within AREA:				
R017	Outer annular radius (m) = $\sqrt{(1/\pi)}$	not used	1.000E+00	---	FRACA(1)
R017	Outer annular radius (m) = $\sqrt{(10/\pi)}$	not used	1.000E+00	---	FRACA(2)
R017	Outer annular radius (m) = $\sqrt{(20/\pi)}$	not used	1.000E+00	---	FRACA(3)
R017	Outer annular radius (m) = $\sqrt{(50/\pi)}$	not used	1.000E+00	---	FRACA(4)
R017	Outer annular radius (m) = $\sqrt{(100/\pi)}$	not used	1.000E+00	---	FRACA(5)
R017	Outer annular radius (m) = $\sqrt{(200/\pi)}$	not used	1.000E+00	---	FRACA(6)
R017	Outer annular radius (m) = $\sqrt{(500/\pi)}$	not used	1.000E+00	---	FRACA(7)
R017	Outer annular radius (m) = $\sqrt{(1000/\pi)}$	not used	1.000E+00	---	FRACA(8)
R017	Outer annular radius (m) = $\sqrt{(5000/\pi)}$	not used	1.000E+00	---	FRACA(9)
R017	Outer annular radius (m) = $\sqrt{(1.E+04/\pi)}$	not used	1.000E+00	---	FRACA(10)
R017	Outer annular radius (m) = $\sqrt{(1.E+05/\pi)}$	not used	0.000E+00	---	FRACA(11)
R017	Outer annular radius (m) = $\sqrt{(1.E+06/\pi)}$	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
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)	not used	3.650E+01	---	SOIL

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) 57,600 *	~~1.559E+04~~	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.300E+01	1.000E+00	---	THICKO
R011	Length parallel to aquifer flow (m) 240 *	~~1.248E+02~~	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	1.000E+02	---	BRLD
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E-01	1.000E+00	---	T(2)
R011	Times for calculations (yr)	5.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+02	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+03	3.000E+02	---	T(7)
R011	Times for calculations (yr)	5.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+04	3.000E+03	---	T(9)
R011	Times for calculations (yr)	1.000E+05	1.000E+04	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-234	3.100E-01	0.000E+00	---	S(4)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W(4)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVERO
R013	Density of cover material (g/cm**3)	not used	1.600E+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	1.600E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr) .031 *	~~3.400E-01~~	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Evapotranspiration coefficient	6.000E-01	6.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.600E+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 hydraulic conductivity (m/yr) 3.0 *	~~3.200E-02~~	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	3.500E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	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	Individual's use of groundwater (m**3/yr)	1.500E+02	1.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	3.000E+00	4.000E+00	---	H(1)

R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.600E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(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) .031	* 1.000E+02	1.000E+02	---	HCUZ(1)

* Adjustments to input values due to additional information received from DHEC on Aug. 3, 1992.

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCACTC(4)
R016	Unsaturated zone 1 (cm**3/g)	3.500E+01	5.000E+01	---	DCACTU(4,1)
R016	Saturated zone (cm**3/g)	2.500E+01	5.000E+01	---	DCACTS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.163E-04	RLEACH(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCACTC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCACTU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCACTS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	RLEACH(1)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCACTC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCACTU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCACTS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	RLEACH(2)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	1.000E+03	6.000E+04	---	DCACTC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	6.000E+04	---	DCACTU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+03	6.000E+04	---	DCACTS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.087E-05	RLEACH(3)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
R017	Occupancy factor, inhalation	not used	4.500E-01	---	FO3
R017	Occupancy and shielding factor, external gamma	not used	6.000E-01	---	FO1
R017	Shape factor, external gamma	not used	1.000E+00	---	FS1
R017	Fractions of annular areas within AREA:				
R017	Outer annular radius (m) = √(1/π)	not used	1.000E+00	---	FRACA(1)
R017	Outer annular radius (m) = √(10/π)	not used	1.000E+00	---	FRACA(2)
R017	Outer annular radius (m) = √(20/π)	not used	1.000E+00	---	FRACA(3)
R017	Outer annular radius (m) = √(50/π)	not used	1.000E+00	---	FRACA(4)
R017	Outer annular radius (m) = √(100/π)	not used	1.000E+00	---	FRACA(5)
R017	Outer annular radius (m) = √(200/π)	not used	1.000E+00	---	FRACA(6)
R017	Outer annular radius (m) = √(500/π)	not used	1.000E+00	---	FRACA(7)
R017	Outer annular radius (m) = √(1000/π)	not used	1.000E+00	---	FRACA(8)
R017	Outer annular radius (m) = √(5000/π)	not used	1.000E+00	---	FRACA(9)
R017	Outer annular radius (m) = √(1.E+04/π)	not used	1.000E+00	---	FRACA(10)
R017	Outer annular radius (m) = √(1.E+05/π)	not used	0.000E+00	---	FRACA(11)
R017	Outer annular radius (m) = √(1.E+06/π)	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
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)	not used	3.650E+01	---	SOIL