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RADIATION PROTECTION

ICRP PUBLICATION 72

Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 5. Compilation of Ingestion and Inhalation Dose Coefficients

ADOPTED BY THIS COMMISSION IN SEPTEMBER 1993

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ANNEXE A. DOSE COEFFICIENTS FOR INGESTION AND INHALATION OF RADIONUCLIDES AND EFFECTIVE DOSE RATES FOR EXPOSURE TO INERT GASES

Table A.1. Ingestion dose coefficients, $e(1)$, to age 70 y (Sv Bq^{-1})

Nuclide	Physical half-life	$e(1)$		e_1	$e(1)$				
		ily	3 months		ily	1 Year	1 Year	10 Years	15 Years
Hydrogen^a									
Tritium	12.3 y	1.000	6.0E-12	1.000	4.0E-11	3.3E-11	2.3E-11	1.8E-11	1.8E-11
Water	12.3 y	1.000	1.2E-10	1.000	1.2E-10	7.3E-11	5.7E-11	4.2E-11	4.2E-11
Deuterium									
De-1	32.3 d	0.070	1.0E-10	0.005	1.0E-10	7.7E-11	5.0E-11	3.0E-11	2.0E-11
De-10	1.40E+04 y	0.020	1.4E-09	0.005	9.0E-09	6.7E-09	2.0E-09	1.0E-09	1.0E-09
Carbon^a									
C-11	20.4 d	1.000	2.0E-10	1.000	1.0E-10	1.0E-11	6.7E-11	3.0E-11	2.0E-11
C-14	5.73E+03 y	1.000	1.0E-09	1.000	1.0E-09	9.0E-10	5.0E-10	3.0E-10	3.0E-10
Fluorine									
F-18	1.83 h	1.000	8.2E-10	1.000	3.0E-10	1.0E-10	5.0E-11	2.0E-11	1.0E-11
Sodium									
Na-22	2.60 y	1.000	2.1E-09	1.000	1.0E-09	8.0E-09	5.0E-09	3.0E-09	2.0E-09
Na-24	15.0 h	1.000	3.0E-09	1.000	3.0E-09	1.0E-09	7.0E-10	5.0E-10	4.0E-10
Argon^a									
Ar-39	269 y	1.000	1.7E-09	0.500	1.0E-09	7.0E-09	4.0E-09	2.0E-09	2.0E-09
Chlorine^a									
Cl-36	3.08E+05 y	0.020	1.0E-09	0.010	2.0E-09	1.0E-09	1.0E-09	4.0E-09	3.0E-09
Sulfur^a									
S-35	87.5 d	0.020	1.0E-09	0.010	1.0E-09	5.0E-10	3.0E-10	1.0E-10	1.0E-10
S-36	4.90E+03 y	0.020	7.0E-09	0.010	6.0E-09	3.0E-09	1.0E-09	7.0E-10	6.0E-10
Phosphorus									
P-32	14.3 d	1.000	3.7E-09	0.004	1.0E-09	8.0E-09	5.0E-09	3.0E-09	2.0E-09
P-33	25.4 d	1.000	3.7E-09	0.000	1.0E-09	8.0E-09	5.0E-09	3.0E-09	2.0E-09
Selenium^a									
Se-75	17.0 d	1.000	5.0E-09	1.000	8.0E-10	6.0E-10	2.0E-10	1.0E-10	1.0E-10
Se-76 (radioactive)	17.0 d	1.000	7.0E-09	1.000	8.0E-09	2.0E-09	1.0E-09	5.0E-10	7.0E-10

^a Dose coefficients for radionuclides of this element are based on age-specific biokinetic data.

AGE-DEPENDENT DOSES FROM INTAKE OF RADIONUCLIDES

Table A.1.-(continued)

Radionuclide	Physical Half-life	\dot{D}_1		\dot{D}_2		\dot{D}_3		Adult
		city	3 months	city	1 Year	5 Years	10 Years	15 Years
Th-230	7.70E+04 y	0.005	4.12E-06	5.2E-04	6.1E-01	3.1E-07	2.4E-01	1.7E-07
Th-232	1.40E+10 y	0.005	3.9E-11	5.0E-11	2.5E-09	1.2E-09	7.0E-10	4.2E-10
Th-234	24.1 d	0.005	4.1E-06	5.0E-04	6.1E-01	3.1E-07	2.4E-01	1.7E-07
Protactinium								
Pa-231	3.27E+04 y	0.005	5.0E-05	5.0E-04	1.2E-09	9.0E-10	5.0E-10	4.5E-11
Pa-233	22.3 h	0.005	1.2E-06	1.3E-04	6.0E-01	1.0E-09	9.0E-10	1.0E-10
Pa-235	17.4 d	0.005	2.0E-06	5.0E-04	5.7E-09	3.1E-09	1.0E-09	9.3E-10
Pa-237	3.7E+04 y	0.005	3.3E-05	5.0E-04	1.3E-09	1.2E-09	9.2E-10	7.2E-10
Pa-239	15.1 d	0.005	6.2E-06	5.0E-04	4.2E-01	2.2E-09	1.0E-09	1.3E-10
Pa-241	21.0 d	0.005	9.7E-06	5.0E-04	1.2E-09	3.2E-09	1.0E-09	1.3E-10
Pa-243	1.30 h	0.005	5.0E-06	5.0E-04	1.2E-09	1.2E-09	6.0E-10	5.3E-10
Uranium								
U-238	20.0 d	1.000	1.9E-07	0.000	3.0E-07	1.5E-07	3.0E-07	4.0E-08
U-235	4.7E+09 y	0.005	3.1E-09	3.2E-11	2.2E-09	3.0E-09	3.5E-10	2.0E-10
U-232	72.0 y	0.005	2.9E-06	2.2E-11	0.2E-01	5.0E-07	3.7E-07	3.3E-07
U-233	1.59E+05 y	0.000	3.0E-07	0.000	1.1E-07	9.2E-09	7.0E-09	5.1E-09
U-234	2.44E+05 y	0.000	3.7E-07	0.000	1.2E-07	0.0E-09	7.0E-09	4.9E-09
U-236	2.00E+06 y	0.000	3.2E-07	0.000	1.3E-07	0.0E-09	7.0E-09	4.9E-09
U-238	2.34E+04 y	0.000	3.9E-07	0.000	1.3E-07	0.0E-09	7.0E-09	4.9E-09
U-239	0.75 d	0.000	0.3E-09	0.000	5.0E-09	2.0E-09	5.0E-10	1.0E-10
U-240	4.47E+04 y	0.000	3.6E-07	0.000	1.2E-07	0.0E-09	7.0E-09	4.9E-09
U-242	0.70E+04 y	0.000	3.0E-10	1.000	1.0E-10	9.2E-11	3.9E-11	2.7E-11
U-244	1.1E+06 y	0.005	1.2E-06	0.000	7.1E-09	4.1E-09	2.0E-09	1.0E-09
Neptunium								
Np-237	0.21E+06 y	1.000	0.7E-13	1.2E-04	5.2E-11	2.7E-13	1.7E-11	3.2E-12
Np-239	0.000	0.000	2.7E-11	5.0E-04	1.3E-11	0.0E-12	0.0E-12	1.2E-11
Np-240	4.0E+06 y	0.005	6.2E-09	5.0E-04	4.0E-09	2.0E-09	1.0E-09	0.3E-10
Np-241	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11
Np-242	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11
Np-243	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11
Np-244	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11
Np-245	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11
Np-246	1.3E+06 y	0.005	7.1E-10	5.0E-04	4.0E-10	1.2E-10	0.0E-11	0.3E-11

a Dose coefficients for this element are based on age-specific biokinetic data

AGE-DEPENDENT DOSES FROM INTAKE OF RADIONUCLIDES

Table A.1.-(continued)

Radionuclide	Physical Half-life	\dot{D}_1		\dot{D}_2		\dot{D}_3		Adult
		city	3 months	city	1 Year	5 Years	10 Years	15 Years
Mo-99	22.5 h	0.005	2.3E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Mo-237	2.10E+06 y	0.005	2.0E-06	5.0E-04	2.3E-07	1.0E-07	1.3E-07	1.3E-07
Mo-239	2.1E+06 y	0.005	9.0E-09	5.0E-04	6.7E-10	3.2E-09	1.7E-09	9.1E-10
Mo-240	1.0E+06 y	0.005	1.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Mo-241	1.0E+06 y	0.005	1.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Technetium								
Tc-99m	6.00 h	0.005	2.1E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Tc-99	1.42E+06 y	0.005	2.7E-12	5.0E-04	1.3E-12	5.0E-12	2.7E-12	2.7E-12
Tc-98	2.0E+06 y	0.005	2.1E-09	5.0E-04	2.3E-07	1.0E-07	1.3E-07	1.3E-07
Tc-97	4.5E+06 y	0.005	1.1E-09	5.0E-04	6.7E-10	3.2E-09	1.7E-09	9.1E-10
Tc-96	0.7E+06 y	0.005	1.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Tc-95	2.1E+06 y	0.005	1.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Tc-94	5.5E+03 y	0.005	4.7E-09	5.0E-04	4.7E-07	2.3E-07	2.3E-07	2.3E-07
Tc-93	14.4 y	0.005	5.0E-09	5.0E-04	5.7E-09	3.0E-09	1.5E-09	4.0E-09
Tc-92	3.7E+06 y	0.005	0.2E-09	5.0E-04	4.0E-01	3.2E-01	2.3E-01	1.3E-01
Tc-91	4.9E+06 y	0.005	1.2E-09	5.0E-04	6.7E-10	3.2E-09	1.7E-09	9.1E-10
Tc-90	0.7E+06 y	0.005	1.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Tc-89	10.5 h	0.005	0.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Tc-88	10.5 h	0.005	0.0E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Antimony								
Sb-127	1.2E+06 y	0.005	1.7E-10	5.0E-04	1.2E-10	6.7E-11	4.0E-11	1.0E-11
Sb-125	1.4E+06 y	0.005	2.0E-10	5.0E-04	1.3E-10	6.7E-11	4.0E-11	1.0E-11
Sb-123	11.5 h	0.005	7.0E-09	5.0E-04	7.7E-09	4.0E-09	2.0E-09	1.0E-09
Sb-122	2.1E+06 y	0.005	1.2E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Sb-121	6.3E+02 y	0.005	1.2E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Sb-120	14.0 h	0.005	5.0E-09	5.0E-04	4.7E-07	2.3E-07	2.3E-07	2.3E-07
Sb-119	1.3E+06 y	0.005	1.2E-09	5.0E-04	1.2E-09	6.7E-10	4.0E-10	1.0E-10
Sb-118	7.3E+03 y	0.005	3.0E-09	5.0E-04	5.7E-07	3.0E-07	1.5E-07	4.0E-07
Sb-117	10.5 h	0.005	4.0E-09	5.0E-04	4.7E-07	2.3E-07	2.3E-07	2.3E-07
Sb-116	0.13E+06 y	0.005	3.7E-10	5.0E-04	4.7E-07	2.3E-07	2.3E-07	2.3E-07

a Dose coefficients for this element are based on age-specific biokinetic data

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Table A.2. Inhalation dose coefficients, $e(v)$, to age 70 y (Sv Bq⁻¹)

Nuclide	Physical Half-life	Type	vty	e(i)		e(i)				
				3 Months	1 y	1 Year	5 Years	10 Years	15 Years	Adult
Hydrogen										
Tritium compounds	12.3 y	F	1.000	2.0E-11	1.000	2.0E-11	1.1E-11	8.2E-12	5.9E-12	6.2E-12
		M	0.200	3.4E-10	0.100	2.1E-10	1.0E-10	8.2E-11	5.9E-11	6.2E-11
		S	0.220	1.2E-09	0.010	1.0E-09	6.3E-10	3.0E-10	2.0E-10	2.0E-10
Deuterium										
D-1	53.3 d	M	0.020	2.0E-10	0.005	2.2E-10	1.2E-10	9.3E-11	6.2E-11	6.0E-11
		S	0.020	2.0E-10	0.005	2.2E-10	1.2E-10	9.3E-11	6.2E-11	6.0E-11
		S	0.020	2.0E-10	0.005	2.2E-10	1.2E-10	9.3E-11	6.2E-11	6.0E-11
D-2	1.00E+06 y	M	0.030	1.1E-09	0.005	1.0E-09	2.0E-09	1.1E-09	5.9E-10	5.9E-10
		S	0.030	3.7E-09	0.005	3.2E-09	6.1E-09	4.2E-09	2.7E-09	2.5E-09
		S	0.030	3.7E-09	0.005	3.2E-09	6.1E-09	4.2E-09	2.7E-09	2.5E-09
Carbon										
C-12	0.140 y	F	1.000	1.0E-11	1.000	1.0E-11	1.2E-11	1.0E-11	1.1E-11	1.1E-11
		M	0.200	1.0E-10	0.100	1.1E-10	1.3E-10	1.0E-10	1.1E-10	1.1E-10
		S	0.200	1.0E-10	0.100	1.1E-10	1.3E-10	1.0E-10	1.1E-10	1.1E-10
C-14	5,730E+03 y	F	1.000	0.1E-10	1.000	1.1E-10	1.0E-10	1.0E-10	1.0E-10	1.0E-10
		M	0.200	0.1E-09	0.100	1.1E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
		S	0.020	1.0E-09	0.010	1.1E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
Fluorine										
F-18	1.83 h	F	1.000	2.0E-10	1.000	1.0E-10	9.2E-11	5.0E-11	3.0E-11	2.0E-11
		M	1.200	4.1E-10	1.000	2.0E-10	1.8E-10	9.2E-11	5.0E-11	3.0E-11
		S	1.000	4.1E-10	1.000	2.0E-10	1.8E-10	9.2E-11	5.0E-11	3.0E-11
Sodium										
Na-22	2.60 y	F	1.200	1.7E-09	1.000	7.2E-09	3.0E-09	2.4E-09	1.3E-09	1.3E-09
		M	1.000	2.0E-09	1.000	1.0E-09	8.0E-10	5.7E-10	3.7E-10	2.7E-10
		S	1.000	2.0E-09	1.000	1.0E-09	8.0E-10	5.7E-10	3.7E-10	2.7E-10
Na-24	15.0 h	F	1.000	2.0E-09	1.000	1.0E-09	8.0E-10	5.7E-10	3.7E-10	2.7E-10
		M	1.000	2.0E-09	1.000	1.0E-09	8.0E-10	5.7E-10	3.7E-10	2.7E-10
		S	1.000	2.0E-09	1.000	1.0E-09	8.0E-10	5.7E-10	3.7E-10	2.7E-10
Magnesium										
Mg-28	20.9 h	F	1.000	3.2E-09	0.300	4.7E-09	2.2E-09	1.2E-09	7.2E-10	6.0E-10
		M	1.000	3.2E-09	0.300	4.7E-09	2.2E-09	1.2E-09	7.2E-10	6.0E-10
		S	1.000	3.2E-09	0.300	4.7E-09	2.2E-09	1.2E-09	7.2E-10	6.0E-10
Aluminum										
Al-26	1.10E+05 y	F	0.020	0.1E-09	0.010	4.7E-09	3.2E-09	2.0E-09	1.3E-09	1.1E-09
		M	0.020	0.1E-09	0.010	4.7E-09	3.2E-09	2.0E-09	1.3E-09	1.1E-09
		S	0.020	0.1E-09	0.010	4.7E-09	3.2E-09	2.0E-09	1.3E-09	1.1E-09
Helium										
He-3	2.02 h	F	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
		M	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
		S	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
He-4	4.00E+02 y	F	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
		M	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
		S	0.020	1.0E-10	0.010	2.3E-10	8.0E-11	5.0E-11	3.0E-11	2.0E-11
Phosphorus										
P-32	14.3 d	F	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10
		M	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10
		S	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10
P-33	25.4 d	F	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10
		M	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10
		S	1.000	1.2E-09	0.300	1.2E-09	1.2E-09	1.0E-09	5.0E-10	5.0E-10

a. Dose coefficients for radionuclides of this element are based on age-specific biokinetic data

AGE-DEPENDENT DOSES FROM INTAKE OF RADIONUCLIDES

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Table A.2. (continued)

Nuclide	Physical Half-life	Type	e(i)		e(i)					
			1 y	3 Months	1 y	1 Year	5 Years	10 Years	15 Years	Adult
Sulfur ^a										
S-35 (Inorganic)	87.4 d	F	1.000	1.5E-10	0.000	3.9E-10	1.0E-10	3.2E-10	6.0E-11	5.7E-11
		M	0.200	3.9E-09	0.100	4.5E-09	2.0E-09	2.0E-09	1.0E-09	1.0E-09
		S	0.020	1.2E-09	0.010	4.5E-09	2.0E-09	2.0E-09	1.0E-09	1.0E-09
Chlorine										
Cl-36	3.08E+05 y	F	1.000	3.9E-09	1.000	2.4E-09	1.2E-09	1.1E-10	1.0E-10	3.5E-10
		M	1.000	3.1E-09	1.000	2.4E-09	2.5E-09	1.0E-09	1.0E-09	7.9E-09
		S	1.000	3.1E-09	1.000	2.4E-09	2.5E-09	1.0E-09	1.0E-09	7.9E-09
Cl-38	3.72E+01 h	F	1.000	2.7E-10	1.000	1.9E-10	8.0E-11	5.1E-11	3.0E-11	2.5E-11
		M	1.000	4.7E-10	1.000	3.0E-10	1.4E-10	8.5E-11	5.0E-11	4.5E-11
		S	1.000	4.7E-10	1.000	3.0E-10	1.4E-10	8.5E-11	5.0E-11	4.5E-11
Cl-39	5.52E+01 h	F	1.000	2.7E-10	1.000	1.9E-10	8.0E-11	5.1E-11	3.0E-11	2.5E-11
		M	1.000	4.7E-10	1.000	3.0E-10	1.4E-10	8.5E-11	5.0E-11	4.5E-11
		S	1.000	4.7E-10	1.000	3.0E-10	1.4E-10	8.5E-11	5.0E-11	4.5E-11
Potassium										
K-40	1.20E+09 y	F	1.000	2.0E-09	1.000	1.7E-09	1.5E-09	4.5E-09	2.9E-09	2.1E-09
		M	1.000	1.0E-09	1.000	1.0E-09	4.5E-10	2.0E-10	1.3E-10	1.2E-10
		S	1.000	1.0E-09	1.000	1.0E-09	4.5E-10	2.0E-10	1.3E-10	1.2E-10
K-41	22.6 h	F	1.000	1.3E-09	1.000	9.7E-10	4.7E-10	2.9E-10	1.7E-10	1.4E-10
		M	1.000	2.7E-10	1.000	1.7E-10	8.0E-11	4.0E-11	2.0E-11	2.0E-11
		S	1.000	2.7E-10	1.000	1.7E-10	8.0E-11	4.0E-11	2.0E-11	2.0E-11
K-42	3.69 h	F	1.000	2.2E-10	1.000	1.0E-10	6.9E-11	4.0E-11	2.0E-11	2.0E-11
		M	1.000	1.0E-10	1.000	1.0E-10	4.0E-11	2.0E-11	1.0E-11	1.0E-11
		S	1.000	1.0E-10	1.000	1.0E-10	4.0E-11	2.0E-11	1.0E-11	1.0E-11
K-43	3.33 h	F	1.000	1.0E-10	1.000	1.0E-10	4.0E-11	2.0E-11	1.0E-11	1.0E-11
		M	1.000	1.0E-10	1.000	1.0E-10	4.0E-11	2.0E-11	1.0E-11	1.0E-11
		S	1.000	1.0E-10	1.000	1.0E-10	4.0E-11	2.0E-11	1.0E-11	1.0E-11
Selenium										
Se-83	3.0E+01 h	F	0.001	9.3E-10	1.0E-04	6.7E-10	3.0E-10	2.0E-10	1.0E-10	1.1E-10
		M	0.001	1.0E-09	1.0E-04	1.7E-09	8.0E-10	5.0E-10	2.0E-10	2.0E-10
		S	0.001	1.1E-09	1.0E-04	2.4E-09	1.2E-09	7.0E-10	3.0E-10	3.0E-10
Se-84	3.0E+01 h	F	0.001	1.1E-09	1.0E-04	6.7E-10	3.0E-10	2.0E-10	1.0E-10	1.1E-10
		M	0.001	1.0E-09	1.0E-04	1.7E-09	8.0E-10	5.0E-10	2.0E-10	2.0E-10
		S	0.001	1.1E-09	1.0E-04	2.4E-09	1.2E-09	7.0E-10	3.0E-10	3.0E-10
Se-86	3.3E+01 h	F	0.001	6.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
		M	0.001	6.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
		S	0.001	6.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
Se-87	1.52 d	F	0.001	7.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
		M	0.001	7.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
		S	0.001	7.0E-09	1.0E-04	2.0E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09
Se-89	6.96E+01 h	F	0.001	3.9E-10	1.0E-04	2.4E-10	1.1E-10	7.2E-11	4.0E-11	4.0E-11
		M	0.001	3.9E-10	1.0E-04	2.4E-10	1.1E-10	7.2E-11	4.0E-11	4.0E-11
		S	0.001	3.9E-10	1.0E-04	2.4E-10	1.1E-10	7.2E-11	4.0E-11	4.0E-11
Tellurium										
Te-131	67.3 y	F	0.020	3.1E-07	0.010	2.0E-07	1.0E-07	3.0E-08	6.0E-08	6.1E-08
		M	0.020	3.1E-07	0.010	2.0E-07	1.0E-07	3.0E-08	6.0E-08	6.1E-08
		S	0.020	3.1E-07	0.010	2.0E-07	1.0E-07	3.0E-08	6.0E-08	6.1E-08

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AGE-DEPENDENT DOSES FROM INTAKE OF RADIONUCLIDES

Table A.2—(continued)

Radionuclide	Physical half-life	Type	\dot{D}_1		\dot{D}_2		\dot{D}_3				Adult
			Cl/y	3 Months	Cl/y	1 Year	5 Years	10 Years	15 Years		
Technetium											
Tc-224	0.515 h	T	0.005	1.45-01	5.04-04	1.05-07	4.95-09	1.05-09	2.52-09	2.25-08	
		M	0.005	3.04-01	5.04-04	2.15-07	1.15-07	0.35-08	1.65-09	0.52-08	
		S	0.005	3.15-01	5.04-04	2.25-07	1.25-07	0.45-08	1.75-09	0.62-08	
Tc-227	18.7 d	T	0.005	0.45-05	5.04-04	5.25-05	2.75-06	1.05-06	1.05-06	4.75-07	
		M	0.005	3.25-05	5.04-04	2.50-05	1.15-05	1.15-05	1.15-05	0.50-06	
		S	0.005	3.35-05	5.04-04	3.00-05	1.25-05	1.05-05	1.35-05	1.00-06	
Tc-228	1.91 y	T	0.005	1.05-04	5.04-04	1.35-04	0.35-05	5.25-05	3.05-05	2.25-05	
		M	0.005	1.25-04	5.04-04	1.15-04	0.15-05	4.45-05	3.05-05	3.25-05	
		S	0.005	1.55-04	5.04-04	1.35-04	0.25-05	5.35-05	4.15-05	4.05-05	
Tc-229	1.34E+03 y	T	0.005	3.05-04	5.04-04	5.15-04	3.95-04	2.95-04	2.05-04	2.05-04	
		M	0.005	2.35-04	5.04-04	5.15-04	3.45-04	1.25-04	1.25-04	1.25-04	
		S	0.005	2.15-04	5.04-04	1.95-04	1.25-04	0.75-05	0.75-05	0.75-05	
Tc-230	1.30E+04 y	T	0.005	2.15-04	5.04-04	2.05-04	1.95-04	1.15-04	0.95-05	1.05-04	
		M	0.005	7.75-05	5.04-04	7.05-05	5.55-05	4.35-05	4.25-05	4.25-05	
		S	0.005	4.05-05	5.04-04	3.55-05	2.65-05	1.05-05	1.35-05	1.45-05	
Tc-231	1.06 d	T	0.005	1.15-09	5.04-04	7.25-10	2.65-10	3.45-10	3.25-11	7.05-07	
		M	0.005	2.25-09	5.04-04	1.65-09	0.65-10	4.05-10	3.05-10	3.15-10	
		S	0.005	2.05-09	5.04-04	1.75-09	7.05-10	3.15-10	4.15-10	3.25-10	
Tc-232	1.40E+10 y	T	0.005	2.25-04	5.04-04	3.25-04	0.95-04	3.25-04	3.25-04	1.25-04	
		M	0.005	0.35-05	5.04-04	0.15-05	0.15-05	0.15-05	0.15-05	0.15-05	
		S	0.005	0.45-05	5.04-04	0.05-05	0.15-05	0.15-05	0.15-05	0.15-05	
Tc-234	24.1 d	T	0.005	4.05-04	5.04-04	2.55-04	1.15-04	6.15-05	2.05-05	2.05-05	
		M	0.005	3.95-04	5.04-04	7.05-05	1.55-04	1.05-04	7.95-05	6.05-05	
		S	0.005	4.15-04	5.04-04	1.15-04	1.75-04	1.15-04	9.15-05	7.15-05	
Protactinium											
Pa-221	3.83 h	T	0.005	3.05-01	5.04-04	2.05-07	1.45-07	1.05-07	5.05-09	7.05-07	
		M	0.005	3.05-01	5.04-04	2.05-07	1.45-07	1.15-07	5.15-09	0.05-08	
		S	0.005	3.05-01	5.04-04	2.15-07	1.55-07	1.25-07	5.25-09	7.55-07	
Pa-228	22.8 h	T	0.005	2.45-01	5.04-04	2.15-07	1.25-07	0.05-08	7.75-09	6.05-08	
		M	0.005	2.95-01	5.04-04	2.15-07	1.55-07	1.15-07	8.15-09	7.55-07	
		S	0.005	2.45-01	5.04-04	2.15-07	1.25-07	0.05-08	7.75-09	6.05-08	
Pa-230	17.4 d	T	0.005	2.05-05	5.04-04	1.05-05	1.15-06	0.35-06	7.05-07	6.25-07	
		M	0.005	2.05-05	5.04-04	1.05-05	1.15-06	0.35-06	7.05-07	6.25-07	
		S	0.005	2.05-05	5.04-04	1.05-05	1.15-06	0.35-06	7.05-07	6.25-07	
Pa-231	3.77E+04 y	T	0.005	2.25-04	5.04-04	2.25-04	1.25-04	1.25-04	1.25-04	1.25-04	
		M	0.005	2.25-04	5.04-04	2.25-04	1.25-04	1.25-04	1.25-04	1.25-04	
		S	0.005	2.25-04	5.04-04	2.25-04	1.25-04	1.25-04	1.25-04	1.25-04	
Pa-232	1.31 d	T	0.005	1.05-09	5.04-04	1.05-09	1.05-09	1.05-09	1.05-09	1.05-09	
		M	0.005	1.05-09	5.04-04	1.05-09	1.05-09	1.05-09	1.05-09	1.05-09	
		S	0.005	1.05-09	5.04-04	1.05-09	1.05-09	1.05-09	1.05-09	1.05-09	
Pa-233	27.0 d	T	0.005	1.55-09	5.04-04	1.15-09	0.55-09	0.75-09	4.15-09	3.75-09	
		M	0.005	1.75-09	5.04-04	1.35-09	0.75-09	0.95-09	4.35-09	3.95-09	
		S	0.005	1.55-09	5.04-04	1.15-09	0.55-09	0.75-09	4.15-09	3.75-09	
Pa-234	6.70 h	T	0.005	2.05-09	5.04-04	2.05-09	1.05-09	0.05-10	4.15-10	3.95-10	
		M	0.005	2.05-09	5.04-04	2.05-09	1.05-09	0.05-10	4.15-10	3.95-10	
		S	0.005	2.05-09	5.04-04	2.05-09	1.05-09	0.05-10	4.15-10	3.95-10	
Praseodymium											
Pr-230	24.8 d	T	0.005	3.25-05	0.020	1.95-04	7.25-07	5.05-07	4.75-07	3.05-07	
		M	0.005	4.95-05	0.020	3.75-05	2.45-05	1.05-05	1.75-05	1.35-05	
		S	0.020	5.05-05	0.002	6.05-05	2.05-05	2.15-05	2.05-05	1.05-05	
Pr-231	4.79 d	T	0.005	0.95-10	0.020	6.25-10	3.15-10	1.45-10	1.05-10	0.75-10	
		M	0.005	0.95-10	0.020	1.75-09	0.45-10	0.55-10	4.05-10	3.05-10	
		S	0.020	2.05-09	0.002	1.95-09	0.05-10	0.15-10	4.05-10	4.05-10	

* Dose coefficients for this element are based on age-specific biokinetic data

AGE-DEPENDENT DOSES FROM INTAKE OF RADIONUCLIDES

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Table A.2—(continued)

Radionuclide	Physical half-life	Type	\dot{D}_1		\dot{D}_2		\dot{D}_{11}					Adult
			Cl/y	3 Months	1/y	1 Year	5 Years	10 Years	15 Years			
Neptunium												
Np-232	72.0 y	T	0.005	1.05-03	0.020	1.95-05	0.95-04	1.05-04	7.35-04	4.05-04		
		M	0.005	3.05-03	0.020	2.15-05	1.05-04	1.15-04	1.05-04	7.05-04		
		S	0.020	1.05-04	0.002	5.35-05	0.05-05	0.35-05	1.05-05	1.75-05		
Np-233	1.50E+04 y	T	0.005	2.75-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		M	0.005	2.75-04	0.020	1.15-04	0.05-05	0.05-05	0.05-05	0.05-05		
		S	0.020	2.05-05	0.002	3.05-05	1.35-05	1.35-05	1.35-05	0.05-05		
Np-234	2.40E+05 y	T	0.005	2.15-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		M	0.005	2.15-04	0.020	1.15-04	0.05-05	0.05-05	0.05-05	0.05-05		
		S	0.020	2.15-04	0.002	2.75-05	1.35-05	1.35-05	1.35-05	0.05-05		
Np-235	1.00E+06 y	T	0.005	2.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		M	0.005	2.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		S	0.020	3.05-05	0.002	2.05-05	1.35-05	1.35-05	1.35-05	0.05-05		
Np-236	2.34E+07 y	T	0.005	2.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		M	0.005	2.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		S	0.020	3.05-05	0.002	2.05-05	1.35-05	1.35-05	1.35-05	0.05-05		
Np-237	6.73 d	T	0.005	1.05-09	0.020	1.05-09	0.05-09	0.05-09	0.05-09	0.05-09		
		M	0.005	1.05-09	0.020	1.05-09	0.05-09	0.05-09	0.05-09	0.05-09		
		S	0.020	0.75-09	0.002	4.75-09	3.75-09	3.75-09	3.75-09	1.75-09		
Np-238	1.47E+09 y	T	0.005	1.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		M	0.005	1.05-04	0.020	1.05-04	0.05-05	0.05-05	0.05-05	0.05-05		
		S	0.020	2.05-05	0.002	2.05-05	1.35-05	1.35-05	1.35-05	0.05-05		
Np-239	0.392 h	T	0.005	1.05-10	0.020	4.05-11	2.05-11	1.05-11	1.25-11	1.05-11		
		M	0.005	1.05-10	0.020	1.25-10	0.05-11	0.05-11	2.25-11	2.25-11		
		S	0.020	1.95-10	0.002	1.05-10	0.05-11	0.05-11	2.25-11	2.25-11		
Np-240	14.1 h	T	0.005	2.45-09	0.020	1.05-09	0.05-09	0.05-09	0.05-09	0.05-09		
		M	0.005	4.45-09	0.020	3.15-09	1.75-09	1.15-09	0.35-10	0.35-10		
		S	0.020	4.95-09	0.002	3.35-09	1.05-09	1.15-09	0.75-09	0.75-09		
Neptunium												
Np-241	0.245 h	T	0.005	2.05-10	0.020	6.15-11	3.05-11	1.15-11	1.35-11	1.25-11		
		M	0.005	2.05-10	0.020	6.15-11	3.05-11	1.15-11	1.35-11	1.25-11		
		S	0.005	1.25-10	0.020	1.05-10	0.05-11	0.05-11	2.25-11	2.25-11		
Np-242	0.063 h	T	0.005	1.25-11	0.005	0.75-12	4.25-12	2.85-12	1.45-12	1.15-12		
		M	0.005	1.25-11	0.005	1.15-11	5.85-12	4.05-12	2.05-12	1.75-12		
		S	0.005	1.25-11	0.005	2.75-11	5.75-12	4.05-12	2.05-12	1.75-12		
Np-243	0.00 d	T	0.005	2.05-09	0.020	2.25-09	1.15-09	7.25-10	4.35-10	3.35-10		
		M	0.005	3.05-09	0.020	3.15-09	1.65-09	1.05-09	6.25-10	3.55-10		
		S	0.005	3.05-09	0.020	3.15-09	1.65-09	1.05-09	6.25-10	3.55-10		
Np-245	1.08 y	T	0.005	0.75-09	0.020	3.35-09	1.75-09	1.15-10	7.55-12	6.35-10		
		M	0.005	2.05-09	0.020	3.35-09	1.75-09	1.15-10	7.55-12	6.35-10		
		S	0.005	2.05-09	0.020	3.35-09	1.75-09	1.15-10	7.55-12	6.35-10		
Np-246	1.10E+05 y	T	0.005	0.95-04	0.020	1.15-04	7.25-04	7.05-04	7.05-04	0.05-05		
		M	0.005	2.05-04	0.020	1.15-04	7.25-04	7.05-04	7.05-04	0.05-05		
		S	0.005	1.05-04	0.020	1.05-04	1.35-04	1.05-04	1.05-04	0.05-05		
Np-248	27.5 h	T	0.005	2.05-09	0.020	2.05-09	1.35-09	1.35-09	0.05-09	0.05-09		
		M	0.005	2.05-09	0.020	2.05-09	1.35-09	1.35-09	0.05-09	0.05-09		
		S	0.005	1.05-09	0.020	1.35-09	0.65-09	0.75-09	0.05-09	0.05-09		
Np-249	2.14E+04 y	T	0.005	0.95-05	0.020	0.35-05	0.05-05	0.05-05	4.75-05	0.05-05		
		M	0.005	4.15-05	0.020	0.35-05	0.05-05	0.05-05	4.75-05	0.05-05		
		S	0.005	3.75-05	0.020	0.35-05	0.05-05	0.05-05	4.75-05	0.05-05		

Table A.2.—(continued)

Nucleide	Physical Half-Life	Type	$t_{1/2}$		$\sigma(\text{e})$		$\sigma(\text{b})$				
			1 Yr	3 Months	1 Yr	1 Year	5 Years	10 Years	15 Years	Adult	
Pu-238	2.12 d	F	0.005	0.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.004	7.30-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	0.000	0.10-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-239	2.34 d	F	0.005	2.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	5.70-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	0.005	5.00-00	1.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-240	1.00 h	F	0.005	2.00-10	0.00-00	2.00-10	1.00-10	7.70-11	4.70-11	6.00-11	
		M	0.005	3.30-10	0.00-00	4.00-10	2.30-10	1.00-10	1.00-10	0.00-11	
		S	0.005	0.50-10	0.00-00	0.00-10	2.30-10	1.00-10	1.10-10	0.00-11	
Plutonium											
Pu-234	0.00 h	F	0.005	3.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	7.70-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.70-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-235	0.427 h	F	0.005	1.00-11	1.00-00	1.00-12	3.00-12	2.00-12	1.10-12	1.00-12	
		M	0.005	2.00-11	1.00-00	1.00-12	3.00-12	2.00-12	1.10-12	1.00-12	
		S	1.00-04	1.30-11	1.00-00	1.00-12	3.00-12	2.00-12	1.10-12	1.00-12	
Pu-236	2.05 y	F	0.005	1.00-04	0.00-00	0.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	2.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	2.10-00	1.00-00	1.00-00	1.00-00	1.00-00	1.00-00	1.00-00	
Pu-241	(0.3) d	F	0.005	2.20-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	1.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		S	1.00-04	2.00-00	1.00-00	1.00-00	1.00-00	1.00-00	1.00-00	1.00-00	
Pu-242	0.77 y	F	0.005	2.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	7.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.20-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-230	2.4100 d	F	0.005	2.10-04	0.00-00	0.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.20-00	1.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-243	14.1 y	F	0.045	2.20-06	0.00-00	2.00-06	2.00-06	2.00-06	2.00-06	2.00-06	
		M	0.005	9.10-07	0.00-00	1.70-07	0.00-07	0.00-07	0.00-07	0.00-07	
		S	1.00-04	2.20-07	1.00-00	2.20-07	2.00-07	1.70-07	1.70-07	1.70-07	
Pu-242	3.74000 y	F	0.005	2.00-04	0.00-00	1.00-04	1.00-04	1.20-04	1.10-04	1.20-04	
		M	0.005	2.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.00-00	1.00-00	0.00-00	2.20-00	1.70-00	1.00-00	1.00-00	
Pu-243	1.65 h	F	0.005	2.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	3.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.00-00	1.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-244	8.24000 y	F	0.005	2.00-04	0.00-00	1.00-04	1.00-04	1.20-04	1.10-04	1.20-04	
		M	0.005	2.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.00-00	1.00-00	0.00-00	2.20-00	1.70-00	1.00-00	1.00-00	
Pu-245	10.5 h	F	0.005	1.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	3.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.00-00	1.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
Pu-246	10.8 d	F	0.005	2.00-00	0.00-00	1.00-00	4.00-00	3.70-00	1.70-00	3.30-00	
		M	0.005	3.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	0.00-00	
		S	1.00-04	0.00-00	1.00-00	0.00-00	2.20-00	1.70-00	1.00-00	1.00-00	

a. Poor coefficients for this element are based on age-specific biotinoid data

Table A.2.—(continued)

Isotope	Physical half-life	Type	λ_1		λ_2		λ_3				
			λ_1	2 Months	λ_2	1 Year	5 Years	10 Years	15 Years	Adult	
Am-241											
Am-241	1.22 h	F	0.005	0.00-11	0.00-04	7.36-11	3.90-11	2.28-11	1.30-11	1.15-11	
		M	0.009	1.70-10	5.00-04	1.20-10	6.20-11	6.10-11	3.00-11	2.80-11	
		S	0.003	1.70-10	5.00-04	1.30-10	6.00-11	6.30-11	3.20-11	2.90-11	
Am-240	1.63 h	F	0.005	3.30-10	3.00-04	3.00-10	2.50-10	2.00-10	1.00-10	1.00-10	
		M	0.005	3.10-10	3.00-04	2.00-10	1.30-10	0.40-11	0.00-11	0.00-11	
		S	0.005	2.10-10	3.00-04	2.20-10	1.30-10	0.70-11	0.10-11	0.40-11	
Am-239	12.1 h	F	0.005	0.10-10	0.00-04	5.00-10	2.00-10	1.00-10	0.10-11	1.00-11	
		M	0.006	1.50-09	0.00-04	1.10-10	0.50-10	3.70-10	2.70-10	2.00-10	
		S	0.005	1.00-09	0.00-04	1.10-11	0.50-10	0.00-10	2.20-10	2.00-10	
Am-241	2.12 d	F	0.005	2.00-09	0.00-04	1.70-09	0.00-10	3.50-10	3.00-10	2.00-10	
		M	0.005	2.00-09	0.00-04	1.70-09	1.70-10	3.70-10	3.00-10	2.00-10	
		S	0.006	3.00-09	0.00-04	2.30-09	1.20-09	3.70-10	3.50-10	2.00-10	
Am-241	4.770-02 y	F	0.005	3.00-04	0.00-04	1.00-04	3.20-04	1.00-04	0.70-05	0.00-05	
		M	0.005	7.30-05	0.00-04	1.00-04	3.20-04	1.00-04	0.00-05	1.70-05	
		S	0.005	4.00-05	0.00-04	6.00-05	2.70-05	1.10-05	1.70-05	1.70-05	
Am-242	16.0 h	F	0.005	5.10-09	0.00-04	7.10-09	3.50-09	2.10-09	1.00-09	1.10-09	
		M	0.002	7.00-09	0.00-04	0.00-09	3.00-09	2.00-09	1.10-09	1.70-09	
		S	0.006	0.00-09	0.00-04	6.70-09	3.00-09	2.70-09	2.00-09	1.00-09	
Am-242m	1.520-02 y	F	0.005	1.00-04	0.00-04	1.50-04	1.10-04	0.10-05	2.10-05	0.00-05	
		M	0.005	3.20-05	0.00-04	5.00-05	0.10-05	3.40-05	3.20-05	1.70-05	
		S	0.005	1.50-05	0.00-04	2.00-05	1.70-05	1.10-05	3.20-05	1.20-05	
Am-243	7.300-01 y	F	0.005	1.00-04	0.00-04	1.70-04	1.20-04	1.00-04	0.10-05	0.00-05	
		M	0.003	7.00-05	0.00-04	6.00-05	0.00-05	0.00-05	0.00-05	1.40-05	
		S	0.006	4.00-05	0.00-04	3.00-05	2.00-05	1.00-05	1.00-05	1.50-05	
Am-244	10.1 h	F	0.005	1.00-09	0.00-04	0.10-09	0.00-09	0.00-09	0.00-09	1.70-09	
		M	0.005	0.00-09	0.00-04	5.00-09	3.00-09	2.00-09	2.00-09	2.00-09	
		S	0.003	0.10-09	0.00-04	0.00-09	1.00-09	1.00-09	1.00-09	1.00-09	
Am-244m	0.433 h	F	0.005	0.00-10	0.00-04	0.00-10	2.10-10	1.00-10	1.00-10	1.00-10	
		M	0.005	1.30-10	0.00-04	2.10-10	1.30-10	0.70-11	0.30-11	0.00-11	
		S	0.005	1.00-10	0.00-04	2.20-10	1.20-10	0.70-11	0.50-11	0.70-11	
Am-245	1.90 h	F	0.005	2.10-10	0.00-04	3.00-10	0.70-11	0.00-11	2.10-11	2.10-11	
		M	0.005	5.70-10	0.00-04	2.00-10	1.30-10	0.70-11	0.40-11	0.50-11	
		S	0.005	4.10-10	0.00-04	2.90-10	1.30-10	0.70-11	0.60-11	0.60-11	
Am-246	0.650 h	F	0.005	3.00-10	0.00-04	2.00-10	0.30-11	0.10-11	3.00-11	3.30-11	
		M	0.005	5.00-10	0.00-04	1.10-10	0.70-11	0.40-11	0.20-11	0.20-11	
		S	0.005	4.00-10	0.00-04	1.00-10	1.70-10	1.20-10	0.40-11	0.80-11	
Am-246m	0.017 h	F	0.005	1.00-10	0.00-04	0.00-11	4.70-11	2.00-11	1.00-11	1.40-11	
		M	0.005	1.00-10	0.00-04	1.20-10	6.10-11	4.00-11	2.00-11	2.00-11	
		S	0.005	2.00-10	0.00-04	1.10-10	6.00-11	4.10-11	2.70-11	2.90-11	
Berk-246											
Berk-246	2.40 h	F	0.005	7.70-09	5.00-04	5.00-09	2.00-09	1.00-09	0.30-10	1.00-10	
		M	0.005	2.10-09	0.00-04	1.20-09	7.00-10	5.00-10	0.00-10	0.50-10	
		S	0.005	2.20-09	0.00-04	1.00-09	6.00-09	6.00-09	0.10-10	4.00-09	
Berk-246	27.0 d	F	0.005	0.30-05	0.00-04	6.30-05	3.20-05	2.00-05	1.50-06	1.10-06	
		M	0.005	1.20-05	0.00-04	0.30-05	5.00-05	4.20-05	1.00-06	2.20-06	
		S	0.003	1.20-05	0.00-04	0.30-05	6.00-05	6.00-05	0.70-06	3.50-06	

* Base coefficients for this element are based on non-specific microscopic data

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LES Hearing Exhibits

LES Exh. #	Witness/ Panel	Description
81	Deconversion	NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (Mar. 2002), Chapter 10 ("Decommissioning")
82	Deconversion	NUREG-1757, "Consolidated NMSS Decommissioning Guidance" (Sept. 2003), Volume 3 ("Financial Assurance, Recordkeeping, and Timeliness"), pp. iii, 4-1 to 4-11, A-25 to A-30
83	Deconversion	National Enrichment Facility Safety Analysis Report, Chapter 10 ("Decommissioning") (most current revision).
84	Deconversion	NEF #05-001, "Subject: Response to NRC Request for Additional Information Regarding Depleted Uranium Hexafluoride Disposition Costs (Jan. 7, 2005), Cover Letter & Attach. 1 (pp. 1-3, 6) only. [LES-05306 to LES-05311; LES-05314] [ADAMS Access. No. ML050130145]
85	Deconversion	Letter from Paul M. Golan (U.S. Department of Energy) to Rod Krich (Louisiana Energy Services, L.P.) ("LES") (Mar. 1, 2005) [LES-05476 to -05477] [ADAMS Access. No. ML050960429 (Attach. 4)]
86	Deconversion	E. Meek, D. Gallway, D. Gray, & G. Westerbeck, <i>An Analysis of DOE's Cost to Dispose of DUF₆</i> , Report DE523T1, prepared for DOE by LMI Government Consulting) (Dec. 2004) [LES-PRO-01275 to LES-PRO-01297] [PROPRIETARY]

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LES Hearing Exhibits

LES Exh. #	Witness/ Panel	Description
87	Deconversion	NEF #05-030, "Subject: Response to NRC Request for Additional Information on Depleted Uranium Disposition Costs and Application for Withholding Information from Public Disclosure" (Aug. 12, 2005) [LES-06006 to LES-06009], with Enclosure "Louisiana Energy Services, L.P. Response to the NRC Request for Additional Information on U.S. Department of Energy Depleted Uranium Disposition Cost Estimate" [LES-PRO-01299 to LES-PRO-01313] [PROPRIETARY]
88	Deconversion	"Memorandum of Understanding Between Louisiana Energy Services, L.P. and AREVA Enterprises, Inc." (Jan. 21, 2005) [LES-PRO-00750 to -00754] [PROPRIETARY]
89	Deconversion	Letter from Chris Chater (Urenco Limited) to Brigitte LeMotais (COGEMA) (May 10, 2004) [LES-PRO-00628 to LES-PRO-00630] [PROPRIETARY]
90	Deconversion	Letter from Brigitte LeMotais (COGEMA) to Chris Chater (Urenco Limited) (June 21, 2004) [LES-PRO-00605 to -00621] [PROPRIETARY]
91	Deconversion	Urenco Business Study (Aug. 26, 2004) [LES-PRO-00631 to -00646] [PROPRIETARY]
92	Deconversion	"Estimated Costs for Deconversion of DUF ₆ Using a Private Facility" (undated) [LES-05301 to -05302]
93	Deconversion	Untitled summary regarding preparation of LES commercial cost estimate, prepared for a meeting with NRC Staff at LES offices in Washington, D.C. (Apr. 19, 2005) [LES-06005]
94	Deconversion	Urenco meeting notes for July 7, 2004 meeting, prepared by Paul J C Harding (Urenco Capenhurst Limited) (July 14, 2005) [LES-PRO-00622 to -00627] [PROPRIETARY]

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LES Hearing Exhibits

LES Exh. #	Witness/ Panel	Description
95	Deconversion	Urenco telephone summary notes, prepared by Chris Chater (Urenco Limited) (Aug. 16, 2004) [LES-PRO-00593 to -00594] [PROPRIETARY]
96	Deconversion	NEF #05-016, "Subject: Clarifying Information Related to Depleted UF ₆ Disposition Costs and Request for License Condition," Cover Letter & Enclosure only (<i>i.e.</i> , attachments identified in this list as separate exhibits) (Mar. 29, 2005) [LES-05462 to -05466] [ADAMS Access. No. ML050960429]
97	Deconversion	E-mail from Rod Krich (LES) to James Curtiss (Winston & Strawn LLP) (Nov. 21, 2004), with Attachment, "CaF ₂ Disposal Option, prepared by George Harper, Framatome-ANP (Nov. 19, 2004) [LES-05297 to - 05300] [ADAMS Access. No. ML050960429 (Attach. 1)]
98	Transportation Cost	E-mail from Rod Fisk (Transportation Logistics International, Inc) to Rod Krich (LES) (Dec. 2, 2004) [LES-PRO-00776] [PROPRIETARY]
99	Transportation Cost	E-mail from Rod Fisk (Transportation Logistics International, Inc) to Rod Krich (LES) (Mar. 23, 2005) [LES-05474] [ADAMS Access. No. ML050960429] (Attach. 3)]
100	Transportation Cost	Excerpts from official company website of Transportation Logistics International, Inc., printed from http://www.tliusa.com
101	Disposal	10 C.F.R. Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" (2005)

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LES Hearing Exhibits

LES Exh. #	Witness/ Panel	Description
102	Disposal	"Activity Concentrations of Materials Placed in WIPP Through September 2002 and Comparison to the Activity Concentration of Depleted Uranium," prepared by Thomas E. Potter (Sept. 2005) [LES-06013 to LES-06015]
103	Disposal	Letter from Al Rafati (Envirocare of Utah, LLC) to E. James Ferland (LES) (February 3, 2005) [LES-05319] [ADAMS Access. No. ML050960429] (Attach. 2)]
104	Disposal	Memorandum from Matthew Blevins (NRC) to Scott Flanders (NRC), "Subject: Telephone Summary Regarding Depleted Uranium Disposal" ,with attached Telephone Summary (Apr. 6, 2005) [ADAMS Access. No. ML050770583]
105	Disposal	Memorandum of Agreement Between Louisiana Energy Services, L.P. and Waste Control Specialists, LLC" (Jan. 14, 2005) [LES-PRO-00779 to LES-PRO-00783] [PROPRIETARY]
106	Disposal	Handwritten notes of telephone conversation between Leo Lessard (Framatome-ANP) and J. Harrison (Envirocare) (Dec. 30, 2002) [LES-02075]
107	Disposal	NEF#04-052, "Subject: Response to NRC Request for Additional Information Regarding Decommissioning Funding Plan," Cover Letter & pp. 1,2 & 5 (Dec. 10, 2004) [ADAMS Access. No. ML043560369]
108	Disposal	Excerpt from the Department of Energy's website on DUF ₆ Management, printed from http://web.ead.anl.gov/uranium/faq/mgmt/faq27.cfm

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LES Hearing Exhibits

LES Exh. #	Witness/ Panel	Description
109	Disposal	Section 4.13 of the NEF Environmental Report, "Waste Management Impacts" (most current revision) (nonproprietary)
110	Transportation Cost	10-6-05 Letter to Rod Krich from Rod Fisk, TLI, re cost figures PROPRIETARY
111	Disposal	2-27-87 Federal Register Notice, 52 FR 5992, 10 CFR Part 60, Advanced notice of proposed rulemaking
112	Disposal	NUREG-0945, Vol. 1, Final Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste," Nov. 1982
113	Disposal	DOE Response to Comments, re disposal (Depleted UF ₆ Final PEIS, p. 3-171)
114	Disposal	DOE Response to Comments, re disposal (Depleted UF ₆ Final PEIS, p. 3-142)
115	Deconversion	10-14-05 Letter to Paul Schneider from John Smets re relative costs of HF Disposition Options
116	Disposal	Excerpts from ICRP Publication 72, "Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 5 Compilation of Ingestion and Inhalation Dose Coefficients," <i>Annals of the ICRP</i> , 1996

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October 2005 Evidentiary Hearing on Contested Issues**

LES Hearing Exhibits

**PREVIOUSLY ADMITTED LES EXHIBITS UPON WHICH LES INTENDS TO RELY IN THE OCTOBER 2005
EVIDENTIARY HEARING ON DEPLETED URANIUM DISPOSITIONING ISSUES**

Party Exh. #	Witness/ Panel	Description
16	Deconversion & Disposal	"Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio Site" (DOE/EIS-0360), Vol. 1
17	Deconversion & Disposal	"Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site" (DOE/EIS-0359), Vol. 1
18	Deconversion & Disposal	"Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride" (DOE/EIS-0269), Vols. 1 and 2
76	Deconversion	Slide, AREVA-COGEMA, "Defluorination of Depleted UF ₆ – The W defluorination facility" (Sept. 26, 2004)
77	Deconversion	Letter from V. Autry, Director of Division of Waste Management, Bureau of Land and Waste Management, South Carolina Department of Health and Environmental Control, to L. Garner, Regulatory Affairs Coordinator, Starmet CMI (Apr. 1, 1999)
78	Deconversion	Letter from V. Autry, Director of Division of Waste Management, Bureau of Land and Waste Management, South Carolina Department of Health and Environmental Control, to L. Garner, Regulatory Affairs Coordinator, Starmet CMI (June 17, 1999)