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DOSE COEFFICIENTS FOR RADIONUCLIDES PRODUCED  
IN HIGH ENERGY PROTON ACCELERATOR FACILITIES:  
COEFFICIENTS FOR RADIONUCLIDES  
NOT LISTED IN ICRP PUBLICATIONS

May 2002

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**Dose Coefficients for Radionuclides Produced in High Energy  
Proton Accelerator Facilities:**  
**Coefficients for Radionuclides not Listed in ICRP Publications**

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Effective dose coefficients, the committed effective dose per unit intake, by inhalation and ingestion have been calculated for 304 nuclides, including (1) 230 nuclides with half-lives  $\geq$  10 min and their daughters that are not listed in ICRP Publications and (2) 74 nuclides with half-lives  $< 10$  min that are produced in a spallation target. Effective dose coefficients for inhalation of soluble or reactive gases have been calculated for 21 nuclides, and effective dose rates for inert gases have been calculated for 9 nuclides.

Dose calculation was carried out using a general-purpose nuclear decay database DECDC developed at JAERI and a decay data library newly compiled from the ENSDF for the nuclides abundantly produced in a spallation target. The dose coefficients were calculated with the computer code DOCAP based on the respiratory tract model and biokinetic model of ICRP. The effective dose rates were calculated by considering both external irradiation from the surrounding cloud and irradiation of the lungs from the gas within them. The calculated results are presented as tables, which are the same forms as those in ICRP Publs. 68 and 72. The complete listings of the dose coefficients are arranged on a CD-ROM, DoseCD, as indexed tables for inhalation of 10 particle sizes, ingestion and injection into blood for workers and members of the public.

The dose coefficients calculated in the present study as well as those published in a series of ICRP Publications will be sufficient to calculate internal doses for a variety of radionuclides produced in high energy proton accelerator facilities.

**Keywords:** Radionuclide, High Energy Proton Accelerator, Internal Exposure,  
Dose Coefficient, Inhalation, Ingestion, Injection, Submersion,  
Effective Dose Rate

高エネルギー陽子加速器施設で生成される放射性核種  
に対する内部被ばく線量係数:  
ICRP Publication に収録されていない核種の係数

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半減期 10 分以上の核種及びそれらの娘核種の中で ICRP Publication に収録されていない 230 核種、また、核破碎中性子ターゲット中に生成される半減期 10 分未満の 74 核種の合計 304 核種に対して、単位摂取量あたりの預託実効線量(線量係数)を計算した。また、21 核種の可溶性及び反応性ガスの吸入に対する線量係数、さらに、9 核種の不活性ガスに対する単位濃度あたりの実効線量率を計算した。

線量計算には、原研において既に整備されている DECDC、また、核破碎ターゲット中に大量に生成される核種に対して、評価済核構造データファイル(ENSDF)から新たに編集した崩壊データライブラリを用いた。線量係数の計算は、ICRP の呼吸気道モデル及び体内動態モデルに基づいた内部被ばく線量係数計算コード DOCAP を用いて行った。実効線量率は、放射性雲からの外部照射及び肺中のガスによる肺の照射を考慮して計算した。計算した線量係数等は、ICRP Publ. 68 及び 72 と同一形式の表にまとめた。更に、核種ごとに、作業者及び公衆の各年齢群について、10 種類の粒径に対する吸入摂取、経口摂取、血液注入に対して計算した線量係数等の表を CD-ROM “DoseCD” に収録し、容易に検索・閲覧できるように整備した。

本研究により計算された線量係数等を、ICRP により既に整備されている線量係数等と併せることにより、大強度陽子加速器施設において生成される多様な核種に対する内部被ばく線量評価に対応することが可能となった。

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# 1 Introduction

High intensity proton accelerators have been developed for the production of intense and pulsed neutron beams for basic scientific research and the development of transmutation technology of long-lived transuranic nuclides.<sup>1-3)</sup> At these facilities, accelerator components, targets, shielding materials, air and cooling water are exposed to primary and secondary high energy particles during the accelerator operation, and various kinds of radionuclides are produced by a variety of nuclear reactions. These radionuclides become potential sources of internal and external exposures for workers and members of the public. Therefore, radiation protection against the induced radionuclides is one of the key issues for radiation safety in the development of high intensity proton accelerator facilities.

Effective dose coefficients  $e(\tau)^*$ , the committed effective dose per unit acute intake, are used for evaluating radiation doses by intake of radionuclides. The coefficients are also used for calculating the derived air concentrations, which are useful guides for judging the significance of air monitoring data and for the design of the ventilation system of the facility. The International Commission on Radiological Protection (ICRP) has calculated the dose coefficients for about 800 radionuclides for workers<sup>4)</sup> and members of the public.<sup>5-9)</sup> These dose coefficients have been adequate for the dose assessment of radionuclides that are important in medical, environmental, and occupational exposures. It has been found, however, that significant quantities of radionuclides whose dose coefficients are not given by ICRP Publications are produced in high energy proton accelerators.<sup>10,11)</sup> It is therefore necessary to enhance the database of the dose coefficients for such "exotic" radionuclides in order to ensure the radiation safety assessment in high intensity proton accelerator facilities.

This report presents the dose coefficients for intake of the radionuclides by workers and members of the public, which are not covered by a series of ICRP Publications. The dose coefficients are calculated using the latest dosimetry model of ICRP and nuclear decay data for inhalation of 10 particle sizes, ingestion and injection into blood. The calculated results are presented as tables, which are the same forms as those in ICRP Publs. 68 and 72. The complete listings of the dose coefficients are also arranged on a CD-ROM as indexed tables.

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\* $\tau$  is the time period in years over which the dose is calculated. The integration time is 50 years for adults, and  $(70 - t_0)$  years for children, where  $t_0$  is age.

## 2 Methods

### 2.1 Selection of Nuclides

Figure 1 shows the flow of the calculations of dose coefficients and effective dose rates in the present study. The dose coefficients were calculated for the following two categories:

- (1) the radionuclides with half-lives  $\geq 10$  min and their daughter nuclides that are not listed in a series of ICRP Publications,<sup>4,9)</sup> and
- (2) the radionuclides with half-lives  $< 10$  min that are abundantly produced in spallation neutron targets.

The nuclides in category (1) are selected for correspondence with the half-life criteria of ICRP Publications.<sup>4,9)</sup> Although their half-lives are short, the dose coefficients for category (2) are important for safety assessment in the design of spallation target systems, because large quantities of the nuclides are produced by the irradiation with intense proton beams. The radionuclides of category (2) were then chosen from the analysis of the spallation products in the target system.

Takada *et al.* developed the NMTC/JAERI97<sup>12)</sup>-DCHAIN-SP<sup>13)</sup> code system that can analyze spallation products generated under various irradiation conditions by high energy protons. The spallation products induced in a cylindrical mercury target, 20 cm in diameter and 90 cm in length, irradiated by 1.5 GeV protons with 1 mA for 30 days were analyzed using the code system.<sup>11)</sup> Of the induced radionuclides at the end of the irradiation, the nuclides with activity over 0.01 % of the total activity ( $2.5 \times 10^{16}$  Bq) and half-lives between 10 min and 1 min were chosen. The nuclides with short half-lives of less than 1 min would not be significant in dose assessment, because the target system is placed in a containment building to ensure safety from potential hazards due to the release of the spallation products into the workplace and the environment.

Tables 1 and 2 list the nuclides selected for the present calculation. The numbers of sources of the nuclear decay data, ① and ②, correspond to categories (1) and (2), respectively. Table 1 presents the nuclides, of which the dose coefficients for inhalation and ingestion of particulates were calculated, and the number of nuclides is 304. Of the nuclides in Table 1, the dose coefficients for soluble or reactive gases were calculated for 21 nuclides of the following 5 elements: sulphur, ruthenium, tellurium, iodine and mercury. The effective dose rates were calculated for inert gases of 9 nuclides given in Table 2.

About 700 radionuclides, which are corresponding to 70 % of the induced nuclides in the mercury target, are covered by the nuclides in Tables 1 and 2 as well as those presented in ICRP Publications.<sup>4,9)</sup> The remaining 300 nuclides are of short-lived (half-lives  $< 1$  min) and/or limited activity, so that these will be insignificant in dose assessment.

## 2.2 Compilation of Nuclear Decay Data Library

Two nuclear decay data libraries compiled at Japan Atomic Energy Research Institute (JAERI) were used for the dose calculations. One is DECDC<sup>15-17)</sup> developed and released in 2001<sup>†</sup>, and the other is a decay data library<sup>14)</sup> newly compiled for the selected nuclides of category (2) in subsection 2.1. Both decay data libraries were compiled using decay data sets from the Evaluated Nuclear Structure Data File (ENSDF).<sup>18)</sup>

DECDC is a general-purpose nuclear decay database for dosimetry calculation. DECDC contains the decay data for (a) 817 radionuclides that are listed in ICRP Publ. 38<sup>22)</sup> and 6 additional isomers and (b) 162 radionuclides with half-lives  $\geq 10$  min that are not listed in Publ. 38 and their 28 daughters. The decay data from DECDC were used for calculation of the dose coefficients that are not listed in a series of ICRP Publications as well as calculation of the dose contribution due to the build-up of decay products.

The decay data library for category (2) were compiled by the following procedures. The decay data sets from the ENSDF, the latest version in September, 2001, were obtained from the National Nuclear Data Center (NNDC) of Brookhaven National Laboratory (BNL) and were used for the data compilation. To provide uniform and concise presentation, the half-lives, decay modes and branching fractions, spin and parity values, excitation energies of the isomers, and total decay energies (Q values) were examined and updated by referring to NUBASE,<sup>19)</sup> the database for the nuclear and decay properties of nuclides. The half-lives, branching fractions, excitation energies, and Q values were updated when these values differed by more than 1% from those of NUBASE, and the spin and parity values were revised if any differences were found. For the revised decay data sets, the values of  $\log ft$  for the  $\beta$  decay were recalculated using the ENSDF utility program LOGFT.<sup>20)</sup> The  $\log ft$  values are used to determine the most probable forbiddenness of the transition, if spin or parity information is lacking for parent or daughter nuclear level.

After the review of the basic nuclear properties, the decay data sets were processed by the computer code EDISTR<sup>21)</sup> to calculate the energies and intensities of the nuclear and atomic radiations associated with the nuclear transformation. The energy spectra of  $\beta$  particles and bremsstrahlung in air were also computed by EDISTR for calculating the effective dose rates for inert gases in subsection 2.4. The decay data were assembled using two formats, ICRP Publ. 38<sup>22)</sup> and NUCDECAY<sup>23)</sup> formats, which are widely used in dosimetry calculation. Further details of the procedures and compiled data are described elsewhere.<sup>14)</sup>

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<sup>†</sup>Electronic copies of the data files (70 MB in total) are available by requesting NEA-1644 from the Nuclear Energy Agency Data Bank of Organization for Economic Co-operation and Development, and DLC-213 from the Radiation Safety Information Computational Center of Oak Ridge National Laboratory.

## 2.3 Calculation of Dose Coefficients for Inhalation, Ingestion and Injection

Dose coefficients for inhalation and ingestion of particulates and for injection into blood were calculated with the computer code DOCAP (DOse Coefficient Assessment Program).<sup>24)</sup> DOCAP calculates dose coefficients using the tissue and radiation weighting factors recommended in ICRP Publ. 60,<sup>25)</sup> the human respiratory tract model of Publ. 66,<sup>26)</sup> and the biokinetic models of Publs. 56,<sup>5)</sup> 67,<sup>6)</sup> 69<sup>7)</sup> and 71.<sup>8)</sup> Age-dependent specific effective energies (SEE) are calculated using SEECAL,<sup>27)</sup> developed at Oak Ridge National Laboratory. The dose coefficients for injection were calculated assuming the activity is injected directly into blood. The dose coefficients will be useful to estimate doses for intake from a wound.

The decay data in DOCAP are stored in 3 files, IDX, RAD and BET files, which have the same data formats as NUCDECAY.<sup>23)</sup> The IDX file contains nuclide names, decay modes, branching fractions, and addresses of the data in the RAD and BET files. The RAD file lists data on the intensity and energy of each radiation emitted from the nuclide, and the BET file contains the  $\beta$  particle spectra data for the  $\beta$  emitters. A preprocessor program was developed to prepare the IDX, RAD and BET files for DOCAP from the decay data libraries described in subsection 2.2.

The calculations were carried out for inhalation dose coefficients for 10 particle sizes (0.001, 0.003, 0.01, 0.03, 0.1, 0.3, 1, 3, 5 and 10  $\mu\text{m}$  AMAD (Activity Median Aerodynamic Diameter)) as well as ingestion and injection coefficients for both workers and members of the public. Particle parameters, such as the geometric standard deviation of particle size distribution, density and shape factor, were standard ones used in ICRP Publications.<sup>4,6-8)</sup>

## 2.4 Calculation of Effective Dose Rates for Inert Gases

Effective dose rates of inert gases were calculated by considering external irradiation from submersion in the cloud and irradiation of the lungs from the gas within them. Since absorption of gases in the lungs is, by definition, negligible,<sup>4)</sup> doses from absorbed gas in the lungs were not considered. The radionuclides of nitrogen and oxygen in Table 2 were assumed to be inert gases.

Effective dose rates from submersion in the cloud were calculated by the method described in Publ. 30<sup>28)</sup> and Federal Guidance Report (FGR) No. 12.<sup>29)</sup> In a semi-infinite source region with a uniform concentration  $C(t)$  ( $\text{Bq m}^{-3}$ ) of a radionuclide at time  $t$ , the effective dose rate,  $e_{\text{sub}}$  ( $\text{Sv d}^{-1}/\text{Bq m}^{-3}$ ), is given by

$$e_{\text{sub}} = \sum_T w_T h_T \int C(t) dt , \quad (1)$$

where  $w_T$  is the tissue weighting factor recommended in Publ. 60,<sup>25)</sup> and  $h_T$  is the equivalent

dose rate in tissue  $T$  ( $\text{Sv d}^{-1}/\text{Bq m}^{-3}$ ).

The equivalent dose rate in tissue  $T$ ,  $h_T$ , can be expressed as

$$h_T = \sum_{j=e^\pm, \gamma} \left[ \sum_i y_j(E_i) h_{T,j}(E_i) + \int_0^\infty y_j(E) h_{T,j}(E) dE \right], \quad (2)$$

where  $y_j(E_i)$  is the yield of discrete radiations of type  $j$  and energy  $E_i$ , and  $y_j(E)$  denotes the yield of continuous radiations per nuclear transformation with energy between  $E$  and  $E + dE$ . The notation  $e^\pm$  in the  $j$  denotes all electrons including  $\beta^\pm$  particles, internal conversion electrons and Auger electrons, and the  $\gamma$  denotes all photons including  $\gamma$  rays, X rays and bremsstrahlung.

The values of  $e_{\text{sub}}$  based on  $h_T$  for an isotropic exposure mode were calculated for 12 monoenergetic photon sources ranging from 0.01 to 5 MeV and presented in Table II.4 of FGR No. 12, as shown in Figure 2. The values of  $h_T$  for skin ( $h_{\text{skin}}$ ), which should be considered in  $\beta$  particle and electron exposures, were also calculated for monoenergetic electron sources and presented in Figure II.25 of FGR No. 12, as shown in Figure 3. By using the data from Figure 2, the  $e_{\text{sub}}$  due to  $\gamma$  rays and X rays from a radionuclide and external bremsstrahlung was calculated from their energies and intensities. In addition, the  $h_{\text{skin}}$  by  $\beta$  particles, internal conversion electrons and Auger electrons was calculated using the data from Figure 3 and added using the  $w_T$  for skin, 0.01, to the  $e_{\text{sub}}$ .

Equivalent dose rates to the lungs from the gas within them were calculated by assuming that the airways are uniformly filled with gas at the ambient concentration.<sup>30)</sup> The calculation was carried out using the computer program LUDEP<sup>31)</sup> according to the procedures described in Appendix B of reference 30. The decay data of the ICRP Publ.38's format were used in the calculation by LUDEP.

### 3 Results

The calculated effective dose coefficients are presented in Tables 3 – 8, which are the same forms as those in ICRP Publs.68<sup>4)</sup> and 72.<sup>9)</sup> Table 3 gives the dose coefficients for intakes of radionuclides by workers. The dose coefficients for inhalation of 1  $\mu\text{m}$  and 5  $\mu\text{m}$  particulates and ingestion are presented along with the  $f_1$  values and absorption types. Tables 4 and 5 give age-dependent dose coefficients of ingestion and inhalation for members of the public, respectively. Tables 6 and 7 list the dose coefficients for inhalation of soluble or reactive gases by workers and members of the public, respectively. Table 8 gives the effective dose rates for insoluble and non-reactive gases.

Particle size dependent dose coefficients for workers and members of the public are compiled

in DoseCD.pdf<sup>†</sup> in the attached CD-ROM, DoseCD. The first part of DoseCD.pdf is a list of nuclides contained in the CD-ROM. Following the nuclide list, the dose coefficients are arranged as indexed tables in order of the list for inhalation and ingestion of particulates, and injection into blood. It is possible to access the tables of the respective nuclides by clicking on the nuclide name in the nuclide table. Within a given nuclide, the table of dose coefficients are stored in order of workers and members of the public. The dose coefficients for 10 particle sizes are given in each age class. The tables present committed equivalent and effective doses per unit intake, which are similar forms with those in the ICRP CD-ROM of dose coefficients.<sup>32)</sup>

## 4 Summary

Effective dose coefficients by inhalation and ingestion have been calculated for 304 nuclides, including (1) 230 nuclides with half-lives  $\geq 10$  min and their daughters that are not listed in ICRP Publications and (2) 74 nuclides with half-lives  $< 10$  min that are produced in a spallation target. Effective dose coefficients for inhalation of soluble or reactive gases have been calculated for 21 nuclides, and effective dose rates for inert gases have been calculated for 9 nuclides. The calculated results are presented as tables, which are the same forms as those in ICRP Publs. 68 and 72. The complete listings of the dose coefficients are arranged on a CD-ROM, DoseCD, as indexed tables.

The dose coefficients calculated in the present study as well as those published in a series of ICRP Publications will be sufficient to calculate internal doses for a variety of radionuclides produced in high energy proton accelerator facilities.

## Acknowledgement

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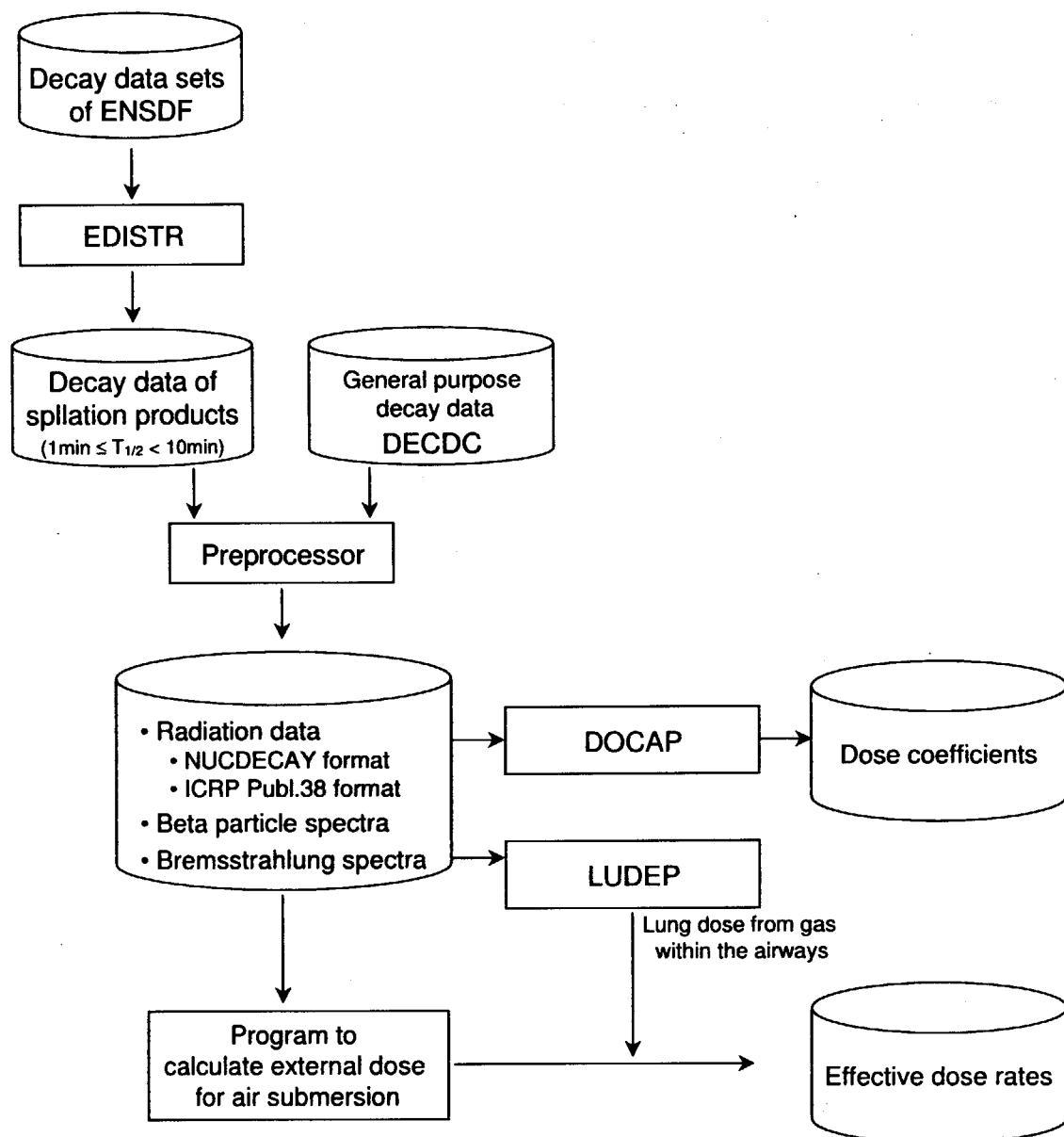
<sup>†</sup>Adobe Acrobat Reader<sup>TM</sup> will be needed to view and print DoseCD.pdf.

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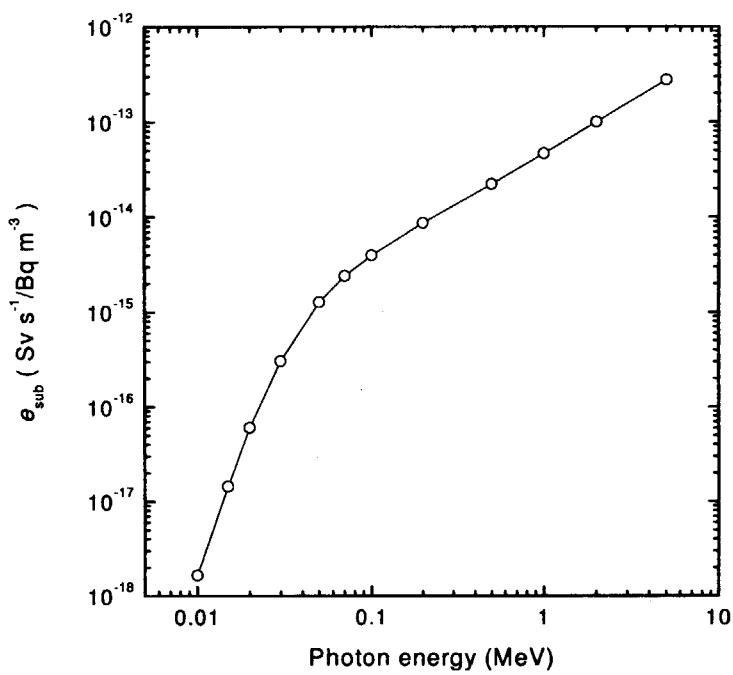
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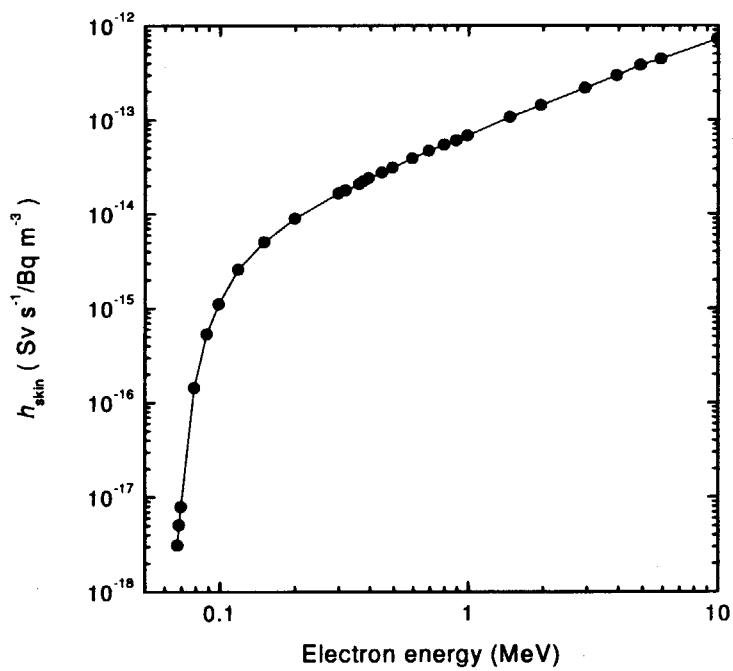
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**Figure 1** Flow of the calculations of dose coefficients and effective dose rates



**Figure 2** Effective dose rate as a function of photon energy (from reference 29).



**Figure 3** Skin dose rate as a function of electron energy (from reference 29).

**Table 1 Radionuclides included in dose coefficient database**  
**Ingestion and inhalation of particulates**

Atomic Number	Nuclide	Physical Half-life <sup>a</sup>	Source of the Nuclear Decay Data <sup>b</sup>	Atomic Number	Nuclide	Physical Half-life <sup>a</sup>	Source of the Nuclear Decay Data <sup>b</sup>
12	Mg-27	9.462 m	①	41	Nb-92m	10.15 d	①
13	Al-28	2.2414 m	①	41	Nb-94m	6.26 m	①
13	Al-29	6.56 m	①	42	Mo-91	15.49 m	①
15	P-30	2.498 m	①	42	Mo-102	11.3 m	①
16	S-37	5.05 m	①	43	Tc-102m	4.35 m	②
16	S-38	170.3 m	①	44	Ru-95	1.643 h	①
17	Cl-34m	32.00 m	①	45	Rh-97	30.7 m	①
17	Cl-40	1.35 m	①	45	Rh-97m	46.2 m	①
19	K-38	7.636 m	①	45	Rh-98	8.7 m	①
20	Ca-49	8.718 m	①	45	Rh-100m	4.6 m	②
22	Ti-51	5.76 m	②	46	Pd-98	17.7 m	①
23	V-50	1.5E+17 y	①	46	Pd-99	21.4 m	①
23	V-52	3.743 m	①	46	Pd-109m	4.69 m	②
23	V-53	1.61 m	①	46	Pd-111	23.4 m	①
24	Cr-55	3.497 m	①	46	Pd-112	21.03 h	①
24	Cr-56	5.94 m	②	47	Ag-101	11.1 m	①
25	Mn-57	1.42333 m	①	47	Ag-105m	7.23 m	①
25	Mn-58m	1.08666 m	②	47	Ag-108	2.37 m	①
26	Fe-53	8.51 m	①	47	Ag-111m	1.08 m	①
27	Co-62	1.50 m	①	47	Ag-113	5.37 h	①
29	Cu-62	9.74 m	①	47	Ag-113m	1.145 m	②
29	Cu-66	5.088 m	①	48	Cd-105	55.5 m	①
33	As-68	2.52666 m	①	48	Cd-111m	48.54 m	①
33	As-79	9.01 m	①	48	Cd-113m	14.1 y	①
34	Se-71	4.74 m	①	48	Cd-118	50.3 m	①
34	Se-72	8.40 d	①	49	In-107	32.4 m	①
34	Se-79m	3.92 m	①	49	In-108	58.0 m	①
35	Br-77m	4.28 m	①	49	In-108m	39.6 m	①
35	Br-78	6.46 m	②	49	In-109m	1.34 m	①
35	Br-82m	6.13 m	②	49	In-111m	7.7 m	①
35	Br-84m	6.0 m	①	49	In-112m	20.56 m	①
37	Rb-77	3.77 m	①	49	In-114	1.19833 m	①
37	Rb-78	17.66 m	①	49	In-118m	4.364 m	②
37	Rb-82	1.273 m	①	49	In-119	2.4 m	①
37	Rb-84m	20.26 m	①	50	Sn-108	10.30 m	①
37	Rb-86m	1.017 m	②	50	Sn-109	18.0 m	①
37	Rb-90	2.63333 m	①	50	Sn-113m	21.4 m	①
37	Rb-90m	4.3 m	①	50	Sn-125m	9.52 m	①
39	Y-83	7.08 m	②	51	Sb-114	3.49 m	②
39	Y-83m	2.85 m	②	51	Sb-118	3.6 m	①
39	Y-84m	40 m	①	51	Sb-122m	4.191 m	②
39	Y-85	2.68 h	①	51	Sb-124m	1.55 m	①
39	Y-85m	4.86 h	①	52	Te-117	62 m	①
39	Y-87m	13.37 h	①	52	Te-118	6.00 d	①
40	Zr-85	7.86 m	①	52	Te-119	16.03 h	①
40	Zr-87	1.68 h	①	52	Te-119m	4.70 d	①
40	Zr-89m	4.18 m	①	53	I-118	13.7 m	①
41	Nb-88m	7.8 m	②	53	I-119	19.1 m	①
41	Nb-91	6.8E+2 y	①	53	I-122	3.63 m	①
41	Nb-91m	60.86 d	①	55	Cs-126	1.64 m	①
41	Nb-92	3.47E+7 y	①	55	Cs-128	3.62 m	①

Table 1 - (continued)

Atomic Number	Nuclide	Physical Half-life*	Source of the Nuclear Decay Data <sup>b</sup>	Atomic Number	Nuclide	Physical Half-life*	Source of the Nuclear Decay Data <sup>b</sup>
55	Cs-130m	3.46 m	②	65	Tb-152	17.5 h	①
55	Cs-139	9.27 m	①	65	Tb-152m	4.2 m	②
56	Ba-124	11.0 m	①	65	Tb-162	7.60 m	②
56	Ba-127	12.7 m	①	65	Tb-163	19.5 m	①
56	Ba-129	2.23 h	①	65	Tb-164	3.0 m	②
56	Ba-129m	2.16 h	①	65	Tb-165	2.11 m	②
56	Ba-137m	2.552 m	①	66	Dy-149	4.20 m	②
57	La-129	11.6 m	①	66	Dy-150	7.17 m	②
57	La-130	8.7 m	①	66	Dy-151	17.9 m	①
57	La-132m	24.3 m	①	66	Dy-152	2.38 h	①
57	La-133	3.912 h	①	66	Dy-153	6.4 h	①
57	La-134	6.45 m	①	66	Dy-154	3.0E+6 y	①
57	La-136	9.87 m	②	66	Dy-165m	1.257 m	②
58	Ce-130	22.9 m	①	66	Dy-167	6.20 m	②
58	Ce-131	10.2 m	②	66	Dy-168	8.7 m	②
58	Ce-131m	5.0 m	①	67	Ho-152	2.69666 m	②
58	Ce-132	3.51 h	①	67	Ho-153	2.02 m	②
58	Ce-133	97 m	①	67	Ho-153m	9.3 m	②
58	Ce-133m	4.9 h	①	67	Ho-154	11.76 m	①
58	Ce-146	13.52 m	①	67	Ho-154m	3.10 m	②
59	Pr-134	17 m	①	67	Ho-156	56 m	①
59	Pr-134m	11 m	①	67	Ho-158	11.3 m	①
59	Pr-135	24 m	①	67	Ho-160	25.6 m	①
59	Pr-138	1.45 m	①	67	Ho-163	4570 y	①
59	Pr-140	3.39 m	①	67	Ho-168	2.99 m	②
59	Pr-144m	7.2 m	①	67	Ho-168m	2.2 m	②
59	Pr-146	24.15 m	①	67	Ho-170	2.76 m	②
60	Nd-135	12.4 m	①	68	Er-155	5.3 m	②
60	Nd-137	38.5 m	①	68	Er-156	19.5 m	①
60	Nd-140	3.37 d	①	68	Er-159	36 m	①
60	Nd-141m	1.03333 m	①	68	Er-163	75.0 m	①
60	Nd-144	2.29E+15 y	①	69	Tm-159	9.13 m	②
60	Nd-152	11.4 m	①	69	Tm-163	1.810 h	①
61	Pm-138	3.24 m	②	69	Tm-164	2.0 m	①
61	Pm-139	4.15 m	②	69	Tm-165	30.06 h	①
61	Pm-140m	5.95 m	②	69	Tm-168	93.1 d	①
61	Pm-152	4.12 m	①	70	Yb-163	11.05 m	①
62	Sm-140	14.82 m	①	70	Yb-164	75.8 m	①
62	Sm-143	8.83 m	②	70	Yb-165	9.9 m	①
62	Sm-143m	1.1 m	②	71	Lu-164	3.14 m	②
62	Sm-148	7E+15 y	①	71	Lu-165	10.74 m	①
63	Eu-143	2.59 m	②	71	Lu-166	2.65 m	②
63	Eu-152n	96 m	①	71	Lu-166m	1.41 m	②
63	Eu-154m	46.0 m	①	71	Lu-167	51.5 m	①
63	Eu-159	18.1 m	①	71	Lu-168m	6.7 m	②
64	Gd-145m	1.41666 m	②	71	Lu-169m	2.66666 m	②
64	Gd-150	1.79E+6 y	①	71	Lu-171m	1.31666 m	②
65	Tb-147m	1.87 m	②	71	Lu-172m	3.7 m	①
65	Tb-148	60 m	①	72	Hf-167	2.05 m	②
65	Tb-148m	2.20 m	②	72	Hf-169	3.24 m	①
65	Tb-149m	4.16 m	②	72	Hf-174	2.0E+15 y	①
65	Tb-150m	5.8 m	②	73	Ta-170	6.76 m	②

Table 1 - (continued)

Atomic Number	Nuclide	Physical Half-life <sup>a</sup>	Source of the Nuclear Decay Data <sup>b</sup>	Atomic Number	Nuclide	Physical Half-life <sup>a</sup>	Source of the Nuclear Decay Data <sup>b</sup>
73	Ta-178	9.31 m	①	81	Tl-209	2.161 m	①
74	W-179m	6.40 m	①	81	Tl-210	1.30 m	①
74	W-185m	1.597 m	①	82	Pb-194	12.0 m	①
74	W-190	30.0 m	①	82	Pb-196	37 m	①
75	Re-179	19.5 m	①	82	Pb-197	8 m	①
75	Re-180	2.44 m	①	82	Pb-197m	43 m	①
75	Re-183	70.0 d	①	82	Pb-204m	67.2 m	①
75	Re-190	3.1 m	①	83	Bi-197	9.33 m	②
76	Os-177	2.8 m	②	83	Bi-204	11.22 h	①
76	Os-179	6.5 m	②	83	Bi-208	3.68E+5 y	①
76	Os-183	13.0 h	①	83	Bi-211	2.14 m	①
76	Os-183m	9.9 h	①	83	Bi-215	7.6 m	①
76	Os-186	2.0E+15 y	①	84	Po-204	3.53 h	①
76	Os-190m	9.9 m	①	84	Po-206	8.8 d	①
76	Os-196	34.9 m	①	84	Po-208	2.898 y	①
77	Ir-179	1.31666 m	②	84	Po-209	102 y	①
77	Ir-180	1.5 m	②	84	Po-218	3.10 m	①
77	Ir-181	4.90 m	②	85	At-205	26.2 m	①
77	Ir-183	58 m	①	85	At-208	1.63 h	①
77	Ir-196m	1.40 h	①	85	At-209	5.41 h	①
78	Pt-183	6.5 m	②	85	At-210	8.1 h	①
78	Pt-184	17.3 m	①	87	Fr-212	20.0 m	①
78	Pt-187	2.35 h	①	87	Fr-221	4.9 m	①
78	Pt-190	6.5E+11 y	①	88	Ra-230	93 m	①
78	Pt-202	44 h	①	89	Ac-223	2.10 m	①
79	Au-186	10.7 m	①	89	Ac-229	62.7 m	①
79	Au-187	8.4 m	②	89	Ac-230	2.03333 m	①
79	Au-188	8.84 m	②	90	Th-233	22.3 m	①
79	Au-189m	4.59 m	②	91	Pa-229	1.50 d	①
79	Au-190	42.8 m	①	91	Pa-234m	1.17 m	①
79	Au-191	3.18 h	①	91	Pa-236	9.1 m	①
79	Au-192	4.94 h	①	92	U-228	9.1 m	①
79	Au-196	6.183 d	①	93	Np-231	48.8 m	①
79	Au-196m	9.6 h	①	93	Np-240m	7.22 m	①
80	Hg-187	2.2 m	②	93	Np-241	13.9 m	①
80	Hg-187m	2.4 m	②	94	Pu-232	34.1 m	①
80	Hg-188	3.25 m	②	95	Am-247	23.0 m	①
80	Hg-190	20.0 m	①	96	Cm-239	2.9 h	①
80	Hg-191m	50.8 m	①	97	Bk-244	4.35 h	①
80	Hg-192	4.85h	①	97	Bk-248m	23.7 h	①
80	Hg-205	5.2 m	②	97	Bk-251	55.6 m	①
80	Hg-206	8.15 m	②	98	Cf-247	3.11 h	①
81	Tl-190	2.6 m	②	98	Cf-255	85 m	①
81	Tl-190m	3.7 m	②	98	Cf-256	12.3 m	①
81	Tl-196	1.84 h	①	99	Es-249	102.2 m	①
81	Tl-206	4.199 m	①	99	Es-255	39.8 d	①
81	Tl-206m	3.74 m	②	99	Es-256	25.4 m	①
81	Tl-207	4.77 m	①	100	Fm-251	5.30 h	①
81	Tl-208	3.053 m	①	100	Fm-256	157.6 m	①

<sup>a</sup> m:minute, h:hour, d:day, y:year.<sup>b</sup> ①:DECDC (J. Nucl. Sci. Technol. 38, 689-696 (2001).), ②:JAERI-Data/Code, in preparation

**Table 2 Radionuclides included in dose coefficient database**  
**Inert gases**

Atomic Number	Nuclide	Physical Half-life <sup>a</sup>	Source of the Nuclear Decay Data <sup>b</sup>
7	N-13	9.965 m	①
8	O-14	1.17677 m	①
8	O-15	2.03733 m	①
18	Ar-42	32.9 y	①
18	Ar-44	11.87 m	①
36	Kr-75	4.29 m	①
36	Kr-89	3.15 m	①
54	Xe-127m	1.15333 m	①
54	Xe-137	3.818 m	①

<sup>a</sup> m:minute, y:year<sup>b</sup> ①:DECDC (J. Nucl. Sci. Technol. 38, 689-696 (2001).)

**Table 3 Effective dose coefficients for workers**  
**Ingestion and inhalation of particulates**

Nuclide	$t_{1/2}$	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )					
		Type	Inhalation, $e_{\text{inh}}(50)$			Ingestion	
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$	$f_1$	$e_{\text{ing}}(50)$
<b>Magnesium</b>							
Mg-27	9.462 m	F	0.5	7.7E-12	1.3E-11	0.5	2.1E-11
		M	0.5	1.1E-11	1.8E-11		
<b>Aluminium</b>							
Al-28	2.2414 m	F	0.01	3.2E-12	5.3E-12	0.01	9.9E-12
		M	0.01	3.6E-12	6.0E-12		
Al-29	6.56 m	F	0.01	6.9E-12	1.2E-11	0.01	2.1E-11
		M	0.01	9.1E-12	1.5E-11		
<b>Phosphorus</b>							
P-30	2.498 m	F	0.8	3.4E-12	5.5E-12	0.8	1.2E-11
		M	0.8	3.9E-12	6.3E-12		
		S	0.8	3.9E-12	6.4E-12		
<b>Sulphur</b>							
S-37 (inorganic)	5.05 m	F	0.8	6.4E-12	1.1E-11	0.8	1.6E-11
		M	0.8	7.9E-12	1.4E-11	0.1	1.6E-11
S-37 (organic)	5.05 m	See Table 6 for inhalation doses				1	1.5E-11
S-38 (inorganic)	170.3 m	F	0.8	1.4E-10	2.4E-10	0.8	4.3E-10
		M	0.8	2.5E-10	3.6E-10	0.1	6.4E-10
S-38 (organic)	170.3 m	See Table 6 for inhalation doses				1	2.7E-10
<b>Chlorine</b>							
Cl-34m	32.00 m	F	1	2.9E-11	5.1E-11	1	1.0E-10
		M	1	4.6E-11	7.5E-11		
Cl-40	1.35 m	F	1	2.6E-12	4.4E-12	1	8.5E-12
		M	1	2.8E-12	4.8E-12		
<b>Potassium</b>							
K-38	7.636 m	F	1	1.0E-11	1.8E-11	1	3.3E-11
<b>Calcium</b>							
Ca-49	8.718 m	M	0.3	1.8E-11	3.0E-11	0.3	3.9E-11
<b>Titanium</b>							
Ti-51	5.76 m	F	0.01	5.1E-12	8.5E-12	0.01	1.5E-11
		M	0.01	6.8E-12	1.1E-11		
		S	0.01	6.9E-12	1.1E-11		
<b>Vanadium</b>							
V-50	1.5E+17 y	F	0.01	8.4E-08	9.9E-08	0.01	4.2E-09
		M	0.01	3.5E-08	2.5E-08		
V-52	3.743 m	F	0.01	4.6E-12	7.7E-12	0.01	1.4E-11
		M	0.01	5.6E-12	9.3E-12		

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{ing}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
V-53	1.61 m	F	0.01	$2.1\text{E-12}$	$3.5\text{E-12}$		0.01	$5.7\text{E-12}$		
Chromium	Cr-55	M	0.01	$2.3\text{E-12}$	$3.9\text{E-12}$					
		F	0.1	$3.4\text{E-12}$	$5.6\text{E-12}$		0.1	$1.2\text{E-11}$		
		M	0.1	$4.2\text{E-12}$	$6.8\text{E-12}$		0.01	$1.2\text{E-11}$		
Manganese	Cr-56	S	0.1	$4.3\text{E-12}$	$6.9\text{E-12}$					
		F	0.1	$7.3\text{E-12}$	$1.3\text{E-11}$		0.1	$2.1\text{E-11}$		
		M	0.1	$1.1\text{E-11}$	$1.8\text{E-11}$		0.01	$2.1\text{E-11}$		
Iron	Mn-57	S	0.1	$1.1\text{E-11}$	$1.8\text{E-11}$					
		F	0.1	$1.6\text{E-12}$	$2.7\text{E-12}$		0.1	$5.1\text{E-12}$		
		M	0.1	$1.8\text{E-12}$	$3.0\text{E-12}$					
Cobalt	Mn-58m	F	0.1	$1.9\text{E-12}$	$3.2\text{E-12}$		0.1	$7.0\text{E-12}$		
		M	0.1	$2.1\text{E-12}$	$3.4\text{E-12}$					
Copper	Fe-53	M	0.1	$8.6\text{E-12}$	$1.4\text{E-11}$		0.1	$3.0\text{E-11}$		
		F	0.1	$1.2\text{E-11}$	$1.9\text{E-11}$					
		M	0.1							
Arsenic	Co-62	S	0.05	$2.5\text{E-12}$	$4.1\text{E-12}$		0.1	$8.6\text{E-12}$		
		M	0.1	$2.5\text{E-12}$	$4.2\text{E-12}$		0.05	$8.6\text{E-12}$		
		F	0.5	$9.5\text{E-12}$	$1.6\text{E-11}$		0.5	$3.7\text{E-11}$		
Selenium	Cu-62	M	0.5	$1.3\text{E-11}$	$2.2\text{E-11}$					
		S	0.5	$1.4\text{E-11}$	$2.3\text{E-11}$					
		F	0.5	$4.6\text{E-12}$	$7.5\text{E-12}$		0.5	$1.6\text{E-11}$		
Bromine	Cu-66	M	0.5	$6.0\text{E-12}$	$9.8\text{E-12}$					
		S	0.5	$6.2\text{E-12}$	$1.0\text{E-11}$					
		F	0.5							
As-68	Se-71	M	0.5	$5.9\text{E-12}$	$9.6\text{E-12}$		0.5	$1.9\text{E-11}$		
		F	0.8	$6.4\text{E-12}$	$1.1\text{E-11}$		0.8	$2.3\text{E-11}$		
As-79	Se-72	M	0.8	$8.2\text{E-12}$	$1.3\text{E-11}$		0.05	$2.3\text{E-11}$		
		F	0.8	$2.0\text{E-09}$	$2.8\text{E-09}$		0.8	$5.1\text{E-09}$		
Se-79m	Se-72	M	0.8	$3.6\text{E-09}$	$3.9\text{E-09}$		0.05	$2.6\text{E-09}$		
		F	0.8	$1.9\text{E-12}$	$3.2\text{E-12}$		0.8	$1.0\text{E-12}$		
Br-77m	Se-79m	M	0.8	$2.4\text{E-12}$	$4.0\text{E-12}$		0.05	$1.0\text{E-12}$		
		F	1	$2.6\text{E-12}$	$4.3\text{E-12}$		1	$1.3\text{E-12}$		
Br-78	Se-79m	M	1	$3.3\text{E-12}$	$5.5\text{E-12}$					
		F	1	$6.4\text{E-12}$	$1.1\text{E-11}$		1	$2.1\text{E-11}$		
		M	1	$8.4\text{E-12}$	$1.4\text{E-11}$					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{ing}}(50)$	
			Inhalation, $e_{\text{inh}}(50)$			Ingestion			
				$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$				
<b>Br-82m</b>	6.13 m	F	1	1.5E-12	2.4E-12		1	2.8E-12	
		M	1	2.3E-12	3.3E-12				
<b>Br-84m</b>	6.0 m	F	1	7.9E-12	1.4E-11		1	2.1E-11	
		M	1	1.0E-11	1.7E-11				
<b>Rubidium</b>									
Rb-77	3.77 m	F	1	6.9E-12	1.1E-11		1	2.6E-11	
Rb-78	17.66 m	F	1	2.1E-11	3.7E-11		1	7.0E-11	
Rb-82	1.273 m	F	1	1.8E-12	2.9E-12		1	6.3E-12	
Rb-84m	20.26 m	F	1	5.1E-12	8.9E-12		1	7.1E-12	
Rb-86m	1.017 m	F	1	1.9E-13	3.3E-13		1	3.3E-13	
Rb-90	2.63333 m	F	1	4.2E-12	6.8E-12		1	1.8E-11	
Rb-90m	4.3 m	F	1	6.9E-12	6.9E-12		1	2.3E-11	
<b>Yttrium</b>									
Y-83	7.08 m	M	0.0001	1.2E-11	1.9E-11		0.0001	3.2E-11	
		S	0.0001	1.2E-11	2.0E-11				
Y-83m	2.85 m	M	0.0001	5.2E-12	8.4E-12		0.0001	1.4E-11	
		S	0.0001	5.3E-12	8.6E-12				
Y-84m	40 m	M	0.0001	6.0E-11	1.0E-10		0.0001	1.2E-10	
		S	0.0001	6.2E-11	1.0E-10				
Y-85	2.68 h	M	0.0001	9.5E-11	1.5E-10		0.0001	1.9E-10	
		S	0.0001	9.9E-11	1.6E-10				
Y-85m	4.86 h	M	0.0001	1.7E-10	2.6E-10		0.0001	3.8E-10	
		S	0.0001	1.8E-10	2.7E-10				
Y-87m	13.37 h	M	0.0001	1.4E-10	1.9E-10		0.0001	2.2E-10	
		S	0.0001	1.4E-10	2.0E-10				
<b>Zirconium</b>									
Zr-85	7.86 m	F	0.002	1.1E-11	1.9E-11		0.002	4.3E-11	
		M	0.002	1.6E-11	2.6E-11				
		S	0.002	1.7E-11	2.7E-11				
Zr-87	1.68 h	F	0.002	4.7E-11	8.3E-11		0.002	2.0E-10	
		M	0.002	9.0E-11	1.4E-10				
		S	0.002	9.5E-11	1.4E-10				
Zr-89m	4.18 m	F	0.002	1.0E-12	1.8E-12		0.002	1.9E-12	
		M	0.002	1.3E-12	2.2E-12				
		S	0.002	1.3E-12	2.2E-12				
<b>Niobium</b>									
Nb-88m	7.8 m	M	0.01	1.7E-11	2.8E-11		0.01	4.2E-11	
		S	0.01	1.7E-11	2.8E-11				

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				
			Inhalation, $e_{\text{inh}}(50)$			Ingestion	
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$	$f_1$	$e_{\text{ing}}(50)$
Nb-91	6.8E+2 y	M	0.01	2.8E-10	1.9E-10	0.01	4.6E-11
		S	0.01	1.7E-09	1.0E-09		
Nb-91m	60.86 d	M	0.01	3.2E-09	2.8E-09	0.01	4.1E-10
		S	0.01	3.9E-09	3.4E-09		
Nb-92	3.47E+7 y	M	0.01	5.0E-09	3.4E-09	0.01	1.0E-09
		S	0.01	2.5E-08	1.5E-08		
Nb-92m	10.15 d	M	0.01	4.3E-10	5.4E-10	0.01	5.0E-10
		S	0.01	4.4E-10	5.4E-10		
Nb-94m	6.26 m	M	0.01	3.3E-13	4.7E-13	0.01	7.1E-13
		S	0.01	3.4E-13	4.8E-13		
<b>Molybdenum</b>							
Mo-91	15.49 m	F	0.8	1.4E-11	2.3E-11	0.8	6.0E-11
		S	0.05	2.2E-11	3.5E-11	0.05	6.1E-11
Mo-102	11.3 m	F	0.8	1.6E-11	2.7E-11	0.8	6.9E-11
		S	0.05	2.6E-11	4.2E-11	0.05	6.9E-11
<b>Technetium</b>							
Tc-102m	4.35 m	F	0.8	5.9E-12	1.0E-11	0.8	1.4E-11
		M	0.8	7.1E-12	1.2E-11		
<b>Ruthenium</b>							
Ru-95	1.643 h	F	0.05	2.8E-11	5.3E-11	0.05	6.3E-11
		M	0.05	3.8E-11	6.6E-11		
		S	0.05	3.9E-11	6.7E-11		
<b>Rhodium</b>							
Rh-97	30.7 m	F	0.05	1.6E-11	2.8E-11	0.05	4.9E-11
		M	0.05	2.4E-11	4.0E-11		
		S	0.05	2.5E-11	4.2E-11		
Rh-97m	46.2 m	F	0.05	2.0E-11	3.7E-11	0.05	4.8E-11
		M	0.05	2.8E-11	4.9E-11		
		S	0.05	2.9E-11	5.0E-11		
Rh-98	8.7 m	F	0.05	9.9E-12	1.7E-11	0.05	3.7E-11
		M	0.05	1.3E-11	2.2E-11		
		S	0.05	1.4E-11	2.3E-11		
Rh-100m	4.6 m	F	0.05	2.0E-12	3.3E-12	0.05	3.7E-12
		M	0.05	2.5E-12	4.0E-12		
		S	0.05	2.6E-12	4.1E-12		
<b>Palladium</b>							
Pd-98	17.7 m	F	0.005	1.7E-11	3.0E-11	0.005	6.3E-11
		M	0.005	2.8E-11	4.6E-11		
		S	0.005	2.9E-11	4.7E-11		
Pd-99	21.4 m	F	0.005	1.3E-11	2.3E-11	0.005	3.6E-11
		M	0.005	2.0E-11	3.3E-11		
		S	0.005	2.0E-11	3.4E-11		

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				
			Inhalation, $e_{\text{inh}}(50)$			Ingestion	
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$	$f_1$	$e_{\text{ing}}(50)$
Pd-109m	4.69 m	F	0.005	2.8E-12	4.9E-12	0.005	4.5E-12
		M	0.005	4.8E-12	7.4E-12		
		S	0.005	5.0E-12	7.7E-12		
Pd-111	23.4 m	F	0.005	1.3E-11	2.1E-11	0.005	5.0E-11
		M	0.005	2.5E-11	3.7E-11		
		S	0.005	2.7E-11	3.9E-11		
Pd-112	21.03 h	F	0.005	5.2E-10	8.2E-10	0.005	2.6E-09
		M	0.005	1.1E-09	1.4E-09		
		S	0.005	1.1E-09	1.5E-09		
<b>Silver</b>							
Ag-101	11.1 m	F	0.05	1.0E-11	1.8E-11	0.05	3.2E-11
		M	0.05	1.4E-11	2.4E-11		
		S	0.05	1.5E-11	2.4E-11		
Ag-105m	7.23 m	F	0.05	1.2E-13	1.7E-13	0.05	5.8E-13
		M	0.05	1.6E-13	1.8E-13		
		S	0.05	1.7E-13	1.9E-13		
Ag-108	2.37 m	F	0.05	2.2E-12	3.7E-12	0.05	4.6E-12
		M	0.05	2.6E-12	4.4E-12		
		S	0.05	2.6E-12	4.4E-12		
Ag-111m	1.08 m	F	0.05	1.5E-13	1.9E-13	0.05	3.3E-13
		M	0.05	2.7E-13	2.9E-13		
		S	0.05	2.8E-13	3.1E-13		
Ag-113	5.37 h	F	0.05	6.8E-11	1.2E-10	0.05	4.1E-10
		M	0.05	1.6E-10	2.3E-10		
		S	0.05	1.7E-10	2.5E-10		
Ag-113m	1.145 m	F	0.05	1.2E-10	1.2E-12	0.05	4.1E-10
		M	0.05	2.3E-10	1.5E-12		
		S	0.05	2.5E-10	1.6E-12		
<b>Cadmium</b>							
Cd-105	55.5 m	F	0.05	1.7E-11	3.0E-11	0.05	4.4E-11
		M	0.05	2.4E-11	4.1E-11		
		S	0.05	2.5E-11	4.2E-11		
Cd-111m	48.54 m	F	0.05	1.1E-11	1.9E-11	0.05	1.4E-11
		M	0.05	2.2E-11	3.6E-11		
		S	0.05	2.4E-11	3.8E-11		
Cd-113m	14.1 y	F	0.05	1.1E-07	1.3E-07	0.05	2.3E-08
		M	0.05	5.0E-08	4.1E-08		
		S	0.05	2.9E-08	2.3E-08		
Cd-118	50.3 m	F	0.05	3.7E-11	6.2E-11	0.05	1.9E-10
		M	0.05	7.6E-11	1.2E-10		
		S	0.05	8.1E-11	1.2E-10		

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{ing}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
				$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
<b>Indium</b>										
In-107	32.4 m	F	0.02	1.5E-11	2.7E-11		0.02	4.1E-11		
		M	0.02	2.5E-11	4.1E-11					
In-108	58.0 m	F	0.02	4.0E-11	7.5E-11		0.02	8.3E-11		
		M	0.02	5.2E-11	9.2E-11					
In-108m	39.6 m	F	0.02	2.6E-11	4.7E-11		0.02	8.5E-11		
		M	0.02	3.9E-11	6.5E-11					
In-109m	1.34 m	F	0.02	4.4E-13	8.0E-13		0.02	7.8E-13		
		M	0.02	5.2E-13	9.0E-13					
In-111m	7.7 m	F	0.02	1.6E-12	2.9E-12		0.02	3.2E-12		
		M	0.02	2.2E-12	3.7E-12					
In-112m	20.56 m	F	0.02	1.1E-11	2.0E-11		0.02	1.7E-11		
		M	0.02	2.2E-11	3.6E-11					
In-114	1.19833 m	F	0.02	1.3E-12	2.2E-12		0.02	3.0E-12		
		M	0.02	1.4E-12	2.4E-12					
In-118m	4.364 m	F	0.02	6.0E-12	1.0E-11		0.02	1.3E-11		
		M	0.02	7.2E-12	1.3E-11					
In-119	2.4 m	F	0.02	2.7E-12	4.5E-12		0.02	5.5E-12		
		M	0.02	3.1E-12	5.2E-12					
<b>Tin</b>										
Sn-108	10.30 m	F	0.02	8.2E-12	1.5E-11		0.02	2.3E-11		
		M	0.02	1.2E-11	2.0E-11					
Sn-109	18.0 m	F	0.02	9.8E-12	1.8E-11		0.02	1.9E-11		
		M	0.02	1.2E-11	2.2E-11					
Sn-113m	21.4 m	F	0.02	2.0E-12	3.0E-12		0.02	3.3E-12		
		M	0.02	4.0E-12	5.3E-12					
Sn-125m	9.52 m	F	0.02	7.2E-12	1.2E-11		0.02	2.2E-11		
		M	0.02	1.0E-11	1.7E-11					
<b>Antimony</b>										
Sb-114	3.49 m	F	0.1	4.8E-12	8.2E-12		0.1	1.5E-11		
		M	0.01	5.7E-12	9.5E-12					
Sb-118	3.6 m	F	0.1	3.3E-12	5.4E-12		0.1	1.1E-11		
		M	0.01	3.9E-12	6.5E-12					
Sb-122m	4.191 m	F	0.1	1.1E-12	1.6E-12		0.1	3.2E-12		
		M	0.01	2.0E-12	2.5E-12					
Sb-124m	1.55 m	F	0.1	5.7E-13	9.9E-13		0.1	8.5E-13		
		M	0.01	6.8E-13	1.1E-12					
<b>Tellurium</b>										
Te-117	62 m	F	0.3	2.2E-11	4.0E-11		0.3	5.4E-11		
		M	0.3	3.3E-11	5.5E-11					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
				$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
Te-118	6.00 d	F	0.3	$8.9\text{E}-10$	$1.4\text{E}-09$	0.3	$3.0\text{E}-09$			
		M	0.3	$2.2\text{E}-09$	$2.3\text{E}-09$					
Te-119	16.03 h	F	0.3	$8.2\text{E}-11$	$1.5\text{E}-10$	0.3	$1.8\text{E}-10$			
		M	0.3	$1.0\text{E}-10$	$1.8\text{E}-10$					
Te-119m	4.70 d	F	0.3	$3.6\text{E}-10$	$6.0\text{E}-10$	0.3	$7.3\text{E}-10$			
		M	0.3	$5.3\text{E}-10$	$7.3\text{E}-10$					
<b>Iodine</b>										
I-118	13.7 m	F	1	$6.0\text{E}-11$	$8.9\text{E}-11$	1	$2.0\text{E}-10$			
I-119	19.1 m	F	1	$1.6\text{E}-11$	$2.6\text{E}-11$	1	$4.6\text{E}-11$			
I-122	3.63 m	F	1	$3.7\text{E}-12$	$6.2\text{E}-12$	1	$1.4\text{E}-11$			
<b>Caesium</b>										
Cs-126	1.64 m	F	1	$2.0\text{E}-12$	$3.3\text{E}-12$	1	$7.6\text{E}-12$			
Cs-128	3.62 m	F	1	$3.2\text{E}-12$	$5.4\text{E}-12$	1	$1.1\text{E}-11$			
Cs-130m	3.46 m	F	1	$1.7\text{E}-12$	$2.8\text{E}-12$	1	$4.1\text{E}-12$			
Cs-139	9.27 m	F	1	$1.1\text{E}-11$	$1.8\text{E}-11$	1	$5.2\text{E}-11$			
<b>Barium</b>										
Ba-124	11.0 m	F	0.1	$1.7\text{E}-11$	$2.8\text{E}-11$	0.1	$6.9\text{E}-11$			
Ba-127	12.7 m	F	0.1	$8.4\text{E}-12$	$1.4\text{E}-11$	0.1	$2.5\text{E}-11$			
Ba-129	2.23 h	F	0.1	$2.1\text{E}-11$	$3.6\text{E}-11$	0.1	$5.2\text{E}-11$			
Ba-129m	2.16 h	F	0.1	$4.2\text{E}-11$	$7.6\text{E}-11$	0.1	$7.8\text{E}-11$			
Ba-137m	2.552 m	F	0.1	$5.8\text{E}-13$	$1.0\text{E}-12$	0.1	$1.0\text{E}-12$			
<b>Lanthanum</b>										
La-129	11.6 m	F	0.0005	$8.6\text{E}-12$	$1.5\text{E}-11$	0.0005	$2.7\text{E}-11$			
		M	0.0005	$1.3\text{E}-11$	$2.1\text{E}-11$					
La-130	8.7 m	F	0.0005	$9.3\text{E}-12$	$1.6\text{E}-11$	0.0005	$3.3\text{E}-11$			
		M	0.0005	$1.2\text{E}-11$	$2.1\text{E}-11$					
La-132m	24.3 m	F	0.0005	$1.3\text{E}-11$	$2.3\text{E}-11$	0.0005	$3.8\text{E}-11$			
		M	0.0005	$2.1\text{E}-11$	$3.4\text{E}-11$					
La-133	3.912 h	F	0.0005	$1.5\text{E}-11$	$2.7\text{E}-11$	0.0005	$4.6\text{E}-11$			
		M	0.0005	$2.4\text{E}-11$	$3.7\text{E}-11$					
La-134	6.45 m	F	0.0005	$4.5\text{E}-12$	$7.6\text{E}-12$	0.0005	$1.6\text{E}-11$			
		M	0.0005	$5.9\text{E}-12$	$9.8\text{E}-12$					
La-136	9.87 m	F	0.0005	$3.2\text{E}-12$	$5.6\text{E}-12$	0.0005	$9.6\text{E}-12$			
		M	0.0005	$4.6\text{E}-12$	$7.6\text{E}-12$					
<b>Cerium</b>										
Ce-130	22.9 m	M	0.0005	$3.6\text{E}-11$	$5.8\text{E}-11$	0.0005	$7.2\text{E}-11$			
		S	0.0005	$3.7\text{E}-11$	$6.1\text{E}-11$					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
Ce-131	10.2 m	M	0.0005	1.4E-11	2.4E-11		0.0005	2.8E-11		
		S	0.0005	1.5E-11	2.4E-11					
Ce-131m	5.0 m	M	0.0005	7.7E-12	1.3E-11		0.0005	1.8E-11		
		S	0.0005	7.9E-12	1.3E-11					
Ce-132	3.51 h	M	0.0005	1.4E-10	2.3E-10		0.0005	3.4E-10		
		S	0.0005	1.5E-10	2.3E-10					
Ce-133	97 m	M	0.0005	5.1E-11	7.6E-11		0.0005	9.1E-11		
		S	0.0005	5.3E-11	7.9E-11					
Ce-133m	4.9 h	M	0.0005	1.3E-10	2.1E-10		0.0005	2.3E-10		
		S	0.0005	1.3E-10	2.2E-10					
Ce-146	13.52 m	M	0.0005	2.6E-11	4.2E-11		0.0005	4.7E-11		
		S	0.0005	2.7E-11	4.4E-11					
<b>Praseodymium</b>										
Pr-134	17 m	M	0.0005	3.1E-11	4.8E-11		0.0005	8.1E-11		
		S	0.0005	3.2E-11	5.0E-11					
Pr-134m	11 m	M	0.0005	2.1E-11	3.3E-11		0.0005	4.6E-11		
		S	0.0005	2.1E-11	3.4E-11					
Pr-135	24 m	M	0.0005	2.1E-11	3.5E-11		0.0005	4.6E-11		
		S	0.0005	2.2E-11	3.6E-11					
Pr-138	1.45 m	M	0.0005	1.7E-12	2.8E-12		0.0005	5.8E-12		
		S	0.0005	1.8E-12	2.9E-12					
Pr-140	3.39 m	M	0.0005	2.5E-12	4.2E-12		0.0005	6.4E-12		
		S	0.0005	2.6E-12	4.3E-12					
Pr-144m	7.2 m	M	0.0005	7.5E-12	1.1E-11		0.0005	2.0E-11		
		S	0.0005	7.9E-12	1.2E-11					
Pr-146	24.15 m	M	0.0005	3.0E-11	4.8E-11		0.0005	7.8E-11		
		S	0.0005	3.1E-11	4.9E-11					
<b>Neodymium</b>										
Nd-135	12.4 m	M	0.0005	2.7E-11	4.4E-11		0.0005	6.0E-11		
		S	0.0005	2.8E-11	4.5E-11					
Nd-137	38.5 m	M	0.0005	3.0E-11	4.8E-11		0.0005	5.9E-11		
		S	0.0005	3.1E-11	5.0E-11					
Nd-140	3.37 d	M	0.0005	1.1E-09	1.3E-09		0.0005	2.0E-09		
		S	0.0005	1.1E-09	1.3E-09					
Nd-141m	1.03333 m	M	0.0005	3.1E-13	5.5E-13		0.0005	5.1E-13		
		S	0.0005	3.1E-13	5.6E-13					
Nd-144	2.29E+15 y	M	0.0005	7.4E-06	5.0E-06		0.0005	4.1E-08		
		S	0.0005	3.2E-06	1.6E-06					
Nd-152	11.4 m	M	0.0005	2.4E-11	3.9E-11		0.0005	4.9E-11		
		S	0.0005	2.5E-11	4.0E-11					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				
			Inhalation, $e_{\text{inh}}(50)$			Ingestion	
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$	$f_1$	$e_{\text{ing}}(50)$
<b>Promethium</b>							
Pm-138	3.24 m	M	0.0005	7.9E-12	1.3E-11	0.0005	2.3E-11
		S	0.0005	8.1E-12	1.3E-11		
Pm-139	4.15 m	M	0.0005	6.2E-12	1.0E-11	0.0005	1.8E-11
		S	0.0005	6.4E-12	1.0E-11		
Pm-140m	5.95 m	M	0.0005	1.1E-11	1.8E-11	0.0005	2.6E-11
		S	0.0005	1.1E-11	1.8E-11		
Pm-152	4.12 m	M	0.0005	5.9E-12	9.7E-12	0.0005	1.7E-11
		S	0.0005	6.1E-12	9.9E-12		
<b>Samarium</b>							
Sm-140	14.82 m	M	0.0005	3.3E-11	5.2E-11	0.0005	9.8E-11
Sm-143	8.83 m	M	0.0005	5.6E-12	9.2E-12	0.0005	1.4E-11
Sm-143m	1.1 m	M	0.0005	9.9E-13	1.7E-12	0.0005	2.2E-12
Sm-148	7E+15 y	M	0.0005	7.7E-06	5.2E-06	0.0005	4.3E-08
<b>Europium</b>							
Eu-143	2.59 m	M	0.0005	5.0E-12	8.1E-12	0.0005	1.6E-11
Eu-152n	96 m	M	0.0005	8.4E-12	1.1E-11	0.0005	1.4E-11
Eu-154m	46.0 m	M	0.0005	4.3E-12	5.8E-12	0.0005	9.1E-12
Eu-159	18.1 m	M	0.0005	2.4E-11	3.6E-11	0.0005	4.9E-11
<b>Gadolinium</b>							
Gd-145m	1.41666 m	F	0.0005	1.3E-12	2.2E-12	0.0005	3.2E-12
		M	0.0005	1.6E-12	2.7E-12		
Gd-150	1.79E+6 y	F	0.0005	2.4E-05	2.8E-05	0.0005	5.2E-08
		M	0.0005	9.8E-06	6.6E-06		
<b>Terbium</b>							
Tb-147m	1.87 m	M	0.0005	1.8E-12	3.1E-12	0.0005	3.5E-12
Tb-148	60 m	M	0.0005	7.1E-11	1.0E-10	0.0005	1.3E-10
Tb-148m	2.20 m	M	0.0005	3.1E-12	4.8E-12	0.0005	4.5E-12
Tb-149m	4.16 m	M	0.0005	3.1E-12	5.2E-12	0.0005	4.9E-12
Tb-150m	5.8 m	M	0.0005	4.7E-12	8.5E-12	0.0005	7.1E-12
Tb-152	17.5 h	M	0.0005	3.1E-10	5.0E-10	0.0005	7.1E-10
Tb-152m	4.2 m	M	0.0005	5.9E-12	1.0E-11	0.0005	5.3E-12
Tb-162	7.60 m	M	0.0005	1.0E-11	1.7E-11	0.0005	1.4E-11
Tb-163	19.5 m	M	0.0005	1.8E-11	2.9E-11	0.0005	2.2E-11
Tb-164	3.0 m	M	0.0005	6.1E-12	1.0E-11	0.0005	9.3E-12
Tb-165	2.11 m	M	0.0005	5.4E-12	8.9E-12	0.0005	8.7E-12

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				Ingestion		
			Inhalation, $e_{\text{inh}}(50)$						
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$	$f_1$	$e_{\text{ing}}(50)$		
<b>Dysprosium</b>									
Dy-149	4.20 m	M	0.0005	$6.3\text{E}-11$	$4.8\text{E}-11$	0.0005	$6.9\text{E}-12$		
Dy-150	7.17 m	M	0.0005	$3.2\text{E}-10$	$2.5\text{E}-10$	0.0005	$1.2\text{E}-11$		
Dy-151	17.9 m	M	0.0005	$1.2\text{E}-10$	$9.3\text{E}-11$	0.0005	$2.0\text{E}-11$		
Dy-152	2.38 h	M	0.0005	$6.0\text{E}-11$	$8.8\text{E}-11$	0.0005	$1.1\text{E}-10$		
Dy-153	6.4 h	M	0.0005	$1.3\text{E}-10$	$1.8\text{E}-10$	0.0005	$1.9\text{E}-10$		
Dy-154	$3.0\text{E}+6$ y	M	0.0005	$1.1\text{E}-05$	$7.1\text{E}-06$	0.0005	$5.6\text{E}-08$		
Dy-165m	1.257 m	M	0.0005	$1.8\text{E}-12$	$2.9\text{E}-12$	0.0005	$1.3\text{E}-12$		
Dy-167	6.20 m	M	0.0005	$1.1\text{E}-11$	$1.8\text{E}-11$	0.0005	$1.7\text{E}-11$		
Dy-168	8.7 m	M	0.0005	$2.3\text{E}-11$	$3.8\text{E}-11$	0.0005	$3.3\text{E}-11$		
<b>Holmium</b>									
Ho-152	2.69666 m	M	0.0005	$4.5\text{E}-11$	$3.7\text{E}-11$	0.0005	$9.6\text{E}-12$		
Ho-153	2.02 m	M	0.0005	$2.8\text{E}-12$	$4.4\text{E}-12$	0.0005	$5.3\text{E}-12$		
Ho-153m	9.3 m	M	0.0005	$1.6\text{E}-11$	$2.4\text{E}-11$	0.0005	$2.5\text{E}-11$		
Ho-154	11.76 m	M	0.0005	$1.6\text{E}-11$	$2.7\text{E}-11$	0.0005	$4.1\text{E}-11$		
Ho-154m	3.10 m	M	0.0005	$4.8\text{E}-12$	$8.3\text{E}-12$	0.0005	$9.0\text{E}-12$		
Ho-156	56 m	M	0.0005	$8.3\text{E}-12$	$9.1\text{E}-11$	0.0005	$9.0\text{E}-12$		
Ho-158	11.3 m	M	0.0005	$8.2\text{E}-12$	$1.4\text{E}-11$	0.0005	$8.9\text{E}-12$		
Ho-160	25.6 m	M	0.0005	$1.4\text{E}-11$	$2.4\text{E}-11$	0.0005	$1.7\text{E}-11$		
Ho-163	4570 y	M	0.0005	$2.4\text{E}-10$	$1.7\text{E}-10$	0.0005	$6.8\text{E}-12$		
Ho-168	2.99 m	M	0.0005	$4.5\text{E}-12$	$7.6\text{E}-12$	0.0005	$8.4\text{E}-12$		
Ho-168m	2.2 m	M	0.0005	$3.3\text{E}-12$	$5.4\text{E}-12$	0.0005	$6.2\text{E}-12$		
Ho-170	2.76 m	M	0.0005	$5.4\text{E}-12$	$9.2\text{E}-12$	0.0005	$8.7\text{E}-12$		
<b>Erbium</b>									
Er-155	5.3 m	M	0.0005	$7.4\text{E}-12$	$1.2\text{E}-11$	0.0005	$1.4\text{E}-11$		
Er-156	19.5 m	M	0.0005	$2.0\text{E}-11$	$3.0\text{E}-11$	0.0005	$3.8\text{E}-11$		
Er-159	36 m	M	0.0005	$1.8\text{E}-11$	$3.0\text{E}-11$	0.0005	$2.4\text{E}-11$		
Er-163	75.0 m	M	0.0005	$1.3\text{E}-12$	$2.2\text{E}-12$	0.0005	$2.7\text{E}-12$		
<b>Thulium</b>									
Tm-159	9.13 m	M	0.0005	$1.1\text{E}-11$	$1.8\text{E}-11$	0.0005	$2.1\text{E}-11$		
Tm-163	1.810 h	M	0.0005	$3.8\text{E}-11$	$6.3\text{E}-11$	0.0005	$5.6\text{E}-11$		
Tm-164	2.0 m	M	0.0005	$1.7\text{E}-12$	$2.8\text{E}-12$	0.0005	$4.1\text{E}-12$		
Tm-165	30.06 h	M	0.0005	$2.2\text{E}-10$	$3.1\text{E}-10$	0.0005	$3.6\text{E}-10$		

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}$ (50)			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
Tm-168	93.1 d	M	0.0005	4.3E-09	3.5E-09		0.0005	1.0E-09		
Ytterbium	Yb-163	M	0.0005	8.5E-12	1.4E-11		0.0005	1.6E-11		
		S	0.0005	8.8E-12	1.5E-11					
Yb-164	75.8 m	M	0.0005	4.2E-11	6.5E-11		0.0005	9.1E-11		
		S	0.0005	4.4E-11	6.7E-11					
Yb-165	9.9 m	M	0.0005	4.9E-12	7.3E-12		0.0005	7.5E-12		
		S	0.0005	5.1E-12	7.6E-12					
Lutetium	Lu-164	M	0.0005	7.3E-12	1.2E-11		0.0005	2.1E-11		
		S	0.0005	7.5E-12	1.2E-11					
Lu-165	10.74 m	M	0.0005	1.4E-11	2.2E-11		0.0005	2.3E-11		
		S	0.0005	1.5E-11	2.3E-11					
Lu-166	2.65 m	M	0.0005	5.1E-12	8.6E-12		0.0005	6.8E-12		
		S	0.0005	5.2E-12	8.8E-12					
Lu-166m	1.41 m	M	0.0005	2.6E-12	4.3E-12		0.0005	4.5E-12		
		S	0.0005	2.7E-12	4.4E-12					
Lu-167	51.5 m	M	0.0005	3.8E-11	5.7E-11		0.0005	5.0E-11		
		S	0.0005	4.0E-11	6.0E-11					
Lu-168m	6.7 m	M	0.0005	7.3E-12	7.3E-12		0.0005	9.1E-12		
		S	0.0005	7.5E-12	7.5E-12					
Lu-169m	2.66666 m	M	0.0005	5.7E-13	7.6E-13		0.0005	9.6E-13		
		S	0.0005	6.1E-13	7.9E-13					
Lu-171m	1.31666 m	M	0.0005	3.7E-13	4.5E-13		0.0005	3.8E-13		
		S	0.0005	3.8E-13	4.6E-13					
Lu-172m	3.7 m	M	0.0005	7.1E-13	7.8E-13		0.0005	9.8E-13		
		S	0.0005	7.6E-13	8.2E-13					
Hafnium	Hf-167	F	0.002	2.0E-12	3.4E-12		0.002	5.5E-12		
		M	0.002	2.8E-12	4.5E-12					
Hf-169	3.24 m	F	0.002	1.4E-12	2.3E-12		0.002	2.9E-12		
		M	0.002	1.8E-12	2.8E-12					
Hf-174	2.0E+15 y	F	0.002	3.0E-05	3.6E-05		0.002	2.5E-07		
		M	0.002	1.2E-05	8.2E-06					
Tantalum	Ta-170	M	0.001	1.4E-11	2.2E-11		0.001	3.6E-11		
		S	0.001	1.5E-11	2.3E-11					
Ta-178	9.31 m	M	0.001	1.7E-12	2.7E-12		0.001	1.5E-12		
		S	0.001	1.7E-12	2.8E-12					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}$ (50)			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
<b>Tungsten</b>										
W-179m	6.40 m	F	0.3	5.1E-12	9.0E-12		0.3	3.9E-12		
							0.01	3.9E-12		
W-185m	1.597 m	F	0.3	1.9E-12	3.1E-12		0.3	9.3E-13		
							0.01	9.3E-13		
W-190	30.0 m	F	0.3	3.8E-11	6.6E-11		0.3	8.5E-11		
							0.01	8.6E-11		
<b>Rhenium</b>										
Re-179	19.5 m	F	0.8	8.8E-12	1.5E-11		0.8	1.6E-11		
		M	0.8	1.3E-11	2.1E-11					
Re-180	2.44 m	F	0.8	2.1E-12	3.6E-12		0.8	2.4E-12		
		M	0.8	2.4E-12	4.1E-12					
Re-183	70.0 d	F	0.8	3.8E-10	5.4E-10		0.8	9.5E-10		
		M	0.8	2.6E-09	2.3E-09					
Re-190	3.1 m	F	0.8	4.6E-12	7.9E-12		0.8	8.0E-12		
		M	0.8	5.4E-12	9.3E-12					
<b>Osmium</b>										
Os-177	2.8 m	F	0.01	3.5E-12	5.9E-12		0.01	1.0E-11		
		M	0.01	4.9E-12	7.9E-12					
		S	0.01	5.1E-12	8.1E-12					
Os-179	6.5 m	F	0.01	1.4E-11	2.2E-11		0.01	6.4E-11		
		M	0.01	1.9E-11	2.9E-11					
		S	0.01	1.9E-11	3.0E-11					
Os-183	13.0 h	F	0.01	8.2E-11	1.4E-10		0.01	2.3E-10		
		M	0.01	1.7E-10	2.4E-10					
		S	0.01	1.9E-10	2.5E-10					
Os-183m	9.9 h	F	0.01	8.6E-11	1.5E-10		0.01	2.1E-10		
		M	0.01	1.4E-10	2.2E-10					
		S	0.01	1.5E-10	2.2E-10					
Os-186	2.0E+15 y	F	0.01	7.2E-07	8.5E-07		0.01	3.2E-08		
		M	0.01	1.1E-06	6.8E-07					
		S	0.01	3.8E-06	2.3E-06					
Os-190m	9.9 m	F	0.01	5.6E-12	1.0E-11		0.01	8.4E-12		
		M	0.01	7.3E-12	1.3E-11					
		S	0.01	7.5E-12	1.3E-11					
Os-196	34.9 m	F	0.01	2.9E-11	4.9E-11		0.01	1.2E-10		
		M	0.01	5.5E-11	8.7E-11					
		S	0.01	5.8E-11	9.1E-11					
<b>Iridium</b>										
Ir-179	1.31666 m	F	0.01	4.1E-12	6.7E-12		0.01	1.7E-11		
		M	0.01	5.3E-12	8.4E-12					
		S	0.01	5.4E-12	8.6E-12					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
Ir-180	1.5 m	F	0.01	2.0E-12	3.5E-12		0.01	2.5E-12		
		M	0.01	2.6E-12	4.4E-12					
		S	0.01	2.6E-12	4.5E-12					
Ir-181	4.90 m	F	0.01	4.7E-12	8.0E-12		0.01	1.2E-11		
		M	0.01	6.7E-12	1.1E-11					
		S	0.01	6.9E-12	1.1E-11					
Ir-183	58 m	F	0.01	2.3E-11	4.2E-11		0.01	5.5E-11		
		M	0.01	3.9E-11	6.2E-11					
		S	0.01	4.1E-11	6.4E-11					
Ir-196m	1.40 h	F	0.01	5.4E-11	9.7E-11		0.01	1.3E-10		
		M	0.01	9.5E-11	1.5E-10					
		S	0.01	9.9E-11	1.6E-10					
<b>Platinum</b>										
Pt-183	6.5 m	F	0.01	7.6E-12	1.3E-11		0.01	1.8E-11		
Pt-184	17.3 m	F	0.01	1.5E-11	2.6E-11		0.01	3.0E-11		
Pt-187	2.35 h	F	0.01	3.3E-11	6.0E-11		0.01	8.8E-11		
Pt-190	6.5E+11 y	F	0.01	1.1E-07	1.3E-07		0.01	6.8E-09		
Pt-202	44 h	F	0.01	8.6E-10	1.4E-09		0.01	4.5E-09		
<b>Gold</b>										
Au-186	10.7 m	F	0.1	1.4E-11	2.5E-11		0.1	4.6E-11		
		M	0.1	2.1E-11	3.4E-11					
		S	0.1	2.2E-11	3.5E-11					
Au-187	8.4 m	F	0.1	4.8E-12	8.6E-12		0.1	1.1E-11		
		M	0.1	7.8E-12	1.2E-11					
		S	0.1	8.1E-12	1.3E-11					
Au-188	8.84 m	F	0.1	6.8E-12	1.2E-11		0.1	2.1E-11		
		M	0.1	9.8E-12	1.6E-11					
		S	0.1	1.0E-11	1.6E-11					
Au-189m	4.59 m	F	0.1	2.6E-12	4.5E-12		0.1	3.6E-12		
		M	0.1	3.9E-12	6.2E-12					
		S	0.1	4.0E-12	6.4E-12					
Au-190	42.8 m	F	0.1	1.9E-11	3.4E-11		0.1	4.7E-11		
		M	0.1	2.6E-11	4.5E-11					
		S	0.1	2.7E-11	4.6E-11					
Au-191	3.18 h	F	0.1	2.9E-11	5.4E-11		0.1	7.7E-11		
		M	0.1	6.4E-11	9.2E-11					
		S	0.1	6.9E-11	9.7E-11					
Au-192	4.94 h	F	0.1	7.2E-11	1.4E-10		0.1	1.8E-10		
		M	0.1	9.8E-11	1.7E-10					
		S	0.1	1.0E-10	1.7E-10					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
Au-196	6.183 d	F	0.1	$1.5\text{E-}10$	$2.7\text{E-}10$	0.1	$5.3\text{E-}10$			
		M	0.1	$6.0\text{E-}10$	$6.7\text{E-}10$					
		S	0.1	$6.7\text{E-}10$	$7.3\text{E-}10$					
Au-196m	9.6 h	F	0.1	$1.2\text{E-}10$	$2.1\text{E-}10$	0.1	$4.1\text{E-}10$			
		M	0.1	$4.2\text{E-}10$	$5.7\text{E-}10$					
		S	0.1	$4.6\text{E-}10$	$6.1\text{E-}10$					
<b>Mercury</b>										
Hg-187 (inorganic)	2.2 m	F	0.02	$3.8\text{E-}12$	$6.4\text{E-}12$	0.02	$7.2\text{E-}12$			
		M	0.02	$4.5\text{E-}12$	$7.6\text{E-}12$					
Hg-187 (organic)	2.2 m	F	0.4	$3.8\text{E-}12$	$6.4\text{E-}12$	1 0.4	$7.1\text{E-}12$ $7.2\text{E-}12$			
		M	0.4	$4.2\text{E-}10$	$5.7\text{E-}10$					
Hg-187m (inorganic)	2.4 m	F	0.02	$4.3\text{E-}12$	$7.4\text{E-}12$	0.02	$7.3\text{E-}12$			
		M	0.02	$5.2\text{E-}12$	$8.8\text{E-}12$					
Hg-187m (organic)	2.4 m	F	0.4	$4.3\text{E-}12$	$7.4\text{E-}12$	1 0.4	$7.3\text{E-}12$ $7.3\text{E-}12$			
		M	0.4	$4.3\text{E-}12$	$7.4\text{E-}12$					
Hg-188 (inorganic)	3.25 m	F	0.02	$3.1\text{E-}12$	$5.2\text{E-}12$	0.02	$8.2\text{E-}12$			
		M	0.02	$4.4\text{E-}12$	$7.1\text{E-}12$					
Hg-188 (organic)	3.25 m	F	0.4	$3.1\text{E-}12$	$5.3\text{E-}12$	1 0.4	$8.4\text{E-}12$ $8.4\text{E-}12$			
		M	0.4	$3.1\text{E-}12$	$5.3\text{E-}12$					
Hg-190 (inorganic)	20.0 m	F	0.02	$9.9\text{E-}12$	$1.8\text{E-}11$	0.02	$2.5\text{E-}11$			
		M	0.02	$1.5\text{E-}11$	$2.5\text{E-}11$					
Hg-190 (organic)	20.0 m	F	0.4	$9.8\text{E-}12$	$1.8\text{E-}11$	1 0.4	$1.8\text{E-}11$ $2.4\text{E-}11$			
		M	0.4	$9.8\text{E-}12$	$1.8\text{E-}11$					
Hg-191m (inorganic)	50.8 m	F	0.02	$2.4\text{E-}11$	$4.5\text{E-}11$	0.02	$5.5\text{E-}11$			
		M	0.02	$4.3\text{E-}11$	$6.8\text{E-}11$					
Hg-191m (organic)	50.8 m	F	0.4	$2.4\text{E-}11$	$4.4\text{E-}11$	1 0.4	$3.4\text{E-}11$ $5.0\text{E-}11$			
		M	0.4	$2.4\text{E-}11$	$4.4\text{E-}11$					
Hg-192 (inorganic)	4.85h	F	0.02	$8.0\text{E-}11$	$1.5\text{E-}10$	0.02	$2.3\text{E-}10$			
		M	0.02	$1.3\text{E-}10$	$2.1\text{E-}10$					
Hg-192 (organic)	4.85h	F	0.4	$7.3\text{E-}11$	$1.4\text{E-}10$	1 0.4	$7.2\text{E-}11$ $1.8\text{E-}10$			
		M	0.4	$7.3\text{E-}11$	$1.4\text{E-}10$					
Hg-205 (inorganic)	5.2 m	F	0.02	$3.9\text{E-}12$	$6.6\text{E-}12$	0.02	$8.3\text{E-}12$			
		M	0.02	$5.2\text{E-}12$	$8.7\text{E-}12$					
Hg-205 (organic)	5.2 m	F	0.4	$3.9\text{E-}12$	$6.7\text{E-}12$	1 0.4	$8.4\text{E-}12$ $8.3\text{E-}12$			
		M	0.4	$3.9\text{E-}12$	$6.7\text{E-}12$					
Hg-206 (inorganic)	8.15 m	F	0.02	$9.4\text{E-}12$	$1.6\text{E-}11$	0.02	$2.1\text{E-}11$			
		M	0.02	$1.5\text{E-}11$	$2.4\text{E-}11$					
Hg-206 (organic)	8.15 m	F	0.4	$9.5\text{E-}12$	$1.6\text{E-}11$	1 0.4	$2.1\text{E-}11$ $2.1\text{E-}11$			
		M	0.4	$9.5\text{E-}12$	$1.6\text{E-}11$					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
				$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
<b>Thallium</b>										
Tl-190	2.6 m	F	1	4.0E-12	6.7E-12		1	1.5E-11		
Tl-190m	3.7 m	F	1	5.3E-12	9.3E-12		1	1.4E-11		
Tl-196	1.84 h	F	1	3.1E-11	5.7E-11		1	5.4E-11		
Tl-206	4.199 m	F	1	3.4E-12	5.7E-12		1	6.9E-12		
Tl-206m	3.74 m	F	1	6.5E-12	6.5E-12		1	1.1E-11		
Tl-207	4.77 m	F	1	3.6E-12	6.1E-12		1	7.1E-12		
Tl-208	3.053 m	F	1	4.8E-12	8.4E-12		1	8.6E-12		
Tl-209	2.161 m	F	1	3.4E-12	5.8E-12		1	6.4E-12		
Tl-210	1.30 m	F	1	2.8E-12	4.8E-12		1	6.5E-12		
<b>Lead</b>										
Pb-194	12.0 m	F	0.2	8.6E-12	1.5E-11		0.2	2.0E-11		
Pb-196	37 m	F	0.2	1.7E-11	3.1E-11		0.2	2.8E-11		
Pb-197	8 m	F	0.2	3.7E-12	6.8E-12		0.2	6.6E-12		
Pb-197m	43 m	F	0.2	2.6E-11	4.6E-11		0.2	4.5E-11		
Pb-204m	67.2 m	F	0.2	2.3E-11	4.4E-11		0.2	5.0E-11		
<b>Bismuth</b>										
Bi-197	9.33 m	F	0.05	1.0E-11	1.8E-11		0.05	2.4E-11		
		M	0.05	1.5E-11	2.5E-11					
Bi-204	11.22 h	F	0.05	2.7E-10	4.8E-10		0.05	6.1E-10		
		M	0.05	3.5E-10	5.8E-10					
Bi-208	3.68E+5 y	F	0.05	5.9E-10	9.6E-10		0.05	1.2E-09		
		M	0.05	4.4E-09	2.9E-09					
Bi-211	2.14 m	F	0.05	1.0E-09	1.5E-09		0.05	1.2E-11		
		M	0.05	1.2E-09	1.8E-09					
Bi-215	7.6 m	F	0.05	4.8E-09	7.6E-09		0.05	8.0E-11		
		M	0.05	8.6E-09	1.3E-08					
<b>Polonium</b>										
Po-204	3.53 h	F	0.1	1.4E-10	1.4E-10		0.1	3.1E-10		
		M	0.1	3.8E-10	3.8E-10					
Po-206	8.8 d	F	0.1	8.3E-09	1.0E-08		0.1	4.6E-09		
		M	0.1	5.2E-08	3.9E-08					
Po-208	2.898 y	F	0.1	7.6E-07	9.1E-07		0.1	3.1E-07		
		M	0.1	3.5E-06	2.6E-06					
Po-209	102 y	F	0.1	7.6E-07	9.1E-07		0.1	3.0E-07		
		M	0.1	3.4E-06	2.5E-06					

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$
			Inhalation, $e_{\text{inh}}$ (50)			Ingestion		
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$			
Po-218	3.10 m	F	0.1	$9.6\text{E-}10$	$1.3\text{E-}09$		0.1	$2.8\text{E-}11$
		M	0.1	$2.2\text{E-}09$	$2.9\text{E-}09$			
<b>Astatine</b>								
At-205	26.2 m	F	1	$2.2\text{E-}10$	$2.9\text{E-}10$		1	$7.7\text{E-}11$
		M	1	$6.2\text{E-}10$	$6.7\text{E-}10$			
At-208	1.63 h	F	1	$7.1\text{E-}11$	$1.2\text{E-}10$		1	$9.4\text{E-}11$
		M	1	$3.8\text{E-}10$	$3.7\text{E-}10$			
At-209	5.41 h	F	1	$8.9\text{E-}10$	$1.3\text{E-}09$		1	$1.9\text{E-}09$
		M	1	$2.8\text{E-}09$	$2.7\text{E-}09$			
At-210	8.1 h	F	1	$3.7\text{E-}09$	$5.1\text{E-}09$		1	$9.8\text{E-}09$
		M	1	$9.8\text{E-}09$	$9.6\text{E-}09$			
<b>Francium</b>								
Fr-212	20.0 m	F	1	$2.1\text{E-}09$	$2.8\text{E-}09$		1	$7.1\text{E-}10$
Fr-221	4.9 m	F	1	$5.1\text{E-}09$	$7.7\text{E-}09$		1	$1.7\text{E-}10$
<b>Radium</b>								
Ra-230	93 m	M	0.2	$1.1\text{E-}10$	$1.7\text{E-}10$		0.2	$1.9\text{E-}10$
<b>Actinium</b>								
Ac-223	2.10 m	F	0.0005	$6.0\text{E-}09$	$9.5\text{E-}09$		0.0005	$4.1\text{E-}11$
		M	0.0005	$7.1\text{E-}09$	$1.1\text{E-}08$			
		S	0.0005	$7.2\text{E-}09$	$1.1\text{E-}08$			
Ac-229	62.7 m	F	0.0005	$2.6\text{E-}11$	$3.8\text{E-}11$		0.0005	$4.4\text{E-}11$
		M	0.0005	$3.6\text{E-}11$	$5.3\text{E-}11$			
		S	0.0005	$3.5\text{E-}11$	$5.4\text{E-}11$			
Ac-230	2.03333 m	F	0.0005	$2.4\text{E-}12$	$4.0\text{E-}12$		0.0005	$5.7\text{E-}12$
		M	0.0005	$2.7\text{E-}12$	$4.5\text{E-}12$			
		S	0.0005	$2.7\text{E-}12$	$4.6\text{E-}12$			
<b>Thorium</b>								
Th-233	22.3 m	M	0.0005	$1.8\text{E-}11$	$2.7\text{E-}11$		0.0005	$2.2\text{E-}11$
		S	0.0002	$1.9\text{E-}11$	$2.9\text{E-}11$		0.0002	$2.2\text{E-}11$
<b>Protactinium</b>								
Pa-229	1.50 d	M	0.0005	$5.9\text{E-}09$	$4.8\text{E-}09$		0.0005	$2.2\text{E-}10$
		S	0.0005	$6.7\text{E-}09$	$5.5\text{E-}09$			
Pa-234m	1.17 m	M	0.0005	$1.4\text{E-}12$	$2.4\text{E-}12$		0.0005	$3.1\text{E-}12$
		S	0.0005	$1.4\text{E-}12$	$2.4\text{E-}12$			
Pa-236	9.1 m	M	0.0005	$1.2\text{E-}11$	$2.0\text{E-}11$		0.0005	$2.3\text{E-}11$
		S	0.0005	$1.3\text{E-}11$	$2.1\text{E-}11$			
<b>Uranium</b>								
U-228	9.1 m	F	0.02	$2.4\text{E-}08$	$3.8\text{E-}08$		0.02	$1.9\text{E-}10$
		M	0.02	$3.7\text{E-}08$	$5.7\text{E-}08$		0.002	$1.9\text{E-}10$
		S	0.002	$3.8\text{E-}08$	$5.9\text{E-}08$			

Table 3-(continued)

Nuclide	$t_{1/2}$	Type	Effective dose coefficients ( $\text{Sv Bq}^{-1}$ )				$f_1$	$e_{\text{inh}}(50)$		
			Inhalation, $e_{\text{inh}}(50)$			Ingestion				
			$f_1$	$1\mu\text{mAMAD}$	$5\mu\text{mAMAD}$					
<b>Neptunium</b>										
Np-231	48.8 m	M	0.0005	1.6E-09	1.7E-09		0.0005	2.9E-11		
Np-240m	7.22 m	M	0.0005	1.7E-09	1.3E-11		0.0005	2.9E-11		
Np-241	13.9 m	M	0.0005	1.4E-11	2.2E-11		0.0005	1.8E-11		
<b>Plutonium</b>										
Pu-232	34.1 m	M	0.0005	1.8E-08	2.4E-08		0.0005	2.9E-10		
		S	0.00001	1.9E-08	2.5E-08		0.00001	2.8E-10		
							0.0001	1.3E-10		
<b>Americium</b>										
Am-247	23.0 m	M	0.0005	2.7E-11	4.4E-11		0.0005	3.1E-11		
<b>Curium</b>										
Cm-239	2.9 h	M	0.0005	6.4E-11	8.8E-11		0.0005	8.2E-11		
<b>Berkelium</b>										
Bk-244	4.35 h	M	0.0005	1.0E-09	1.0E-09		0.0005	6.9E-10		
Bk-248m	23.7 h	M	0.0005	1.5E-08	1.2E-08		0.0005	3.3E-09		
Bk-251	55.6 m	M	0.0005	4.3E-11	6.4E-11		0.0005	4.4E-11		
<b>Californium</b>										
Cf-247	3.11 h	M	0.0005	4.2E-11	4.9E-11		0.0005	2.9E-11		
Cf-255	85 m	M	0.0005	5.4E-09	4.5E-09		0.0005	4.0E-11		
Cf-256	12.3 m	M	0.0005	2.1E-06	4.0E-06		0.0005	3.3E-09		
<b>Einsteinium</b>										
Es-249	102.2 m	M	0.0005	2.2E-10	2.7E-10		0.0005	2.2E-11		
Es-255	39.8 d	M	0.0005	3.6E-06	2.9E-06		0.0005	6.0E-09		
Es-256	25.4 m	M	0.0005	2.1E-07	3.4E-07		0.0005	4.1E-09		
<b>Fermium</b>										
Fm-251	5.30 h	M	0.0005	1.7E-09	1.8E-09		0.0005	7.2E-11		
Fm-256	157.6 m	M	0.0005	3.9E-06	7.0E-06		0.0005	2.6E-08		

**Table 4 Effective dose coefficients for members of the public**  
**Ingestion dose coefficients,  $e(\tau)$ , to age 70 y (Sv Bq<sup>-1</sup>)**

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Magnesium</b>									
Mg-27	9.462 m	1	3.0E-10	0.5	1.4E-10	6.7E-11	3.9E-11	2.7E-11	2.1E-11
<b>Aluminium</b>									
Al-28	2.2414 m	0.02	1.5E-10	0.01	6.5E-11	3.2E-11	1.8E-11	1.3E-11	9.9E-12
Al-29	6.56 m	0.02	3.1E-10	0.01	1.4E-10	6.8E-11	3.9E-11	2.7E-11	2.1E-11
<b>Phosphorus</b>									
P-30	2.498 m	1	1.8E-10	0.8	8.1E-11	4.0E-11	2.3E-11	1.6E-11	1.2E-11
<b>Sulphur</b>									
S-37 (inorganic)	5.05 m	1	2.1E-10	1	9.8E-11	4.9E-11	2.8E-11	2.0E-11	1.5E-11
S-37 (organic)	5.05 m	1	2.1E-10	1	9.8E-11	4.9E-11	2.8E-11	2.0E-11	1.5E-11
S-38 (inorganic)	170.3 m	1	3.8E-09	1	1.9E-09	9.9E-10	6.2E-10	4.3E-10	3.4E-10
S-38 (organic)	170.3 m	1	3.6E-09	1	1.7E-09	8.6E-10	5.0E-10	3.3E-10	2.7E-10
<b>Chlorine</b>									
Cl-34m	32.00 m	1	1.5E-09	1	6.7E-10	3.3E-10	1.9E-10	1.3E-10	1.0E-10
Cl-40	1.35 m	1	1.2E-10	1	5.5E-11	2.7E-11	1.6E-11	1.1E-11	8.5E-12
<b>Potassium</b>									
K-38	7.636 m	1	4.6E-10	1	2.1E-10	1.0E-10	6.0E-11	4.2E-11	3.3E-11
<b>Calcium</b>									
Ca-49	8.718 m	0.6	5.4E-10	0.3	2.5E-10	1.3E-10	7.3E-11	4.9E-11	3.9E-11
<b>Titanium</b>									
Ti-51	5.76 m	0.02	2.3E-10	0.01	1.0E-10	5.1E-11	2.9E-11	2.0E-11	1.5E-11
<b>Vanadium</b>									
V-50	1.5E+17 y	0.02	1.7E-08	0.01	9.0E-09	6.7E-09	5.4E-09	4.6E-09	4.2E-09
V-52	3.743 m	0.02	2.0E-10	0.01	9.1E-11	4.5E-11	2.6E-11	1.8E-11	1.4E-11
V-53	1.61 m	0.02	8.5E-11	0.01	3.8E-11	1.9E-11	1.1E-11	7.3E-12	5.7E-12
<b>Chromium</b>									
Cr-55	3.497 m	0.2	1.9E-10	0.1	8.2E-11	3.9E-11	2.2E-11	1.5E-11	1.2E-11
		0.02	1.9E-10	0.01	8.2E-11	3.9E-11	2.2E-11	1.5E-11	1.2E-11
Cr-56	5.94 m	0.2	2.9E-10	0.1	1.4E-10	7.0E-11	4.1E-11	2.6E-11	2.1E-11
		0.02	3.0E-10	0.01	1.4E-10	7.1E-11	4.1E-11	2.7E-11	2.1E-11
<b>Manganese</b>									
Mn-57	1.42333 m	0.2	8.0E-11	0.1	3.5E-11	1.7E-11	9.6E-12	6.5E-12	5.1E-12
Mn-58m	1.08666 m	0.2	1.0E-10	0.1	4.6E-11	2.2E-11	1.3E-11	8.9E-12	7.0E-12
<b>Iron</b>									
Fe-53	8.51 m	0.6	4.3E-10	0.1	2.0E-10	9.6E-11	5.5E-11	3.8E-11	3.0E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Cobalt</b>									
Co-62	1.50 m	0.6	1.3E-10	0.1	5.7E-11	2.8E-11	1.6E-11	1.1E-11	8.6E-12
<b>Copper</b>									
Cu-62	9.74 m	1	5.6E-10	0.5	2.5E-10	1.2E-10	7.0E-11	4.8E-11	3.7E-11
Cu-66	5.088 m	1	2.6E-10	0.5	1.1E-10	5.5E-11	3.1E-11	2.1E-11	1.6E-11
<b>Arsenic</b>									
As-68	2.52666 m	1	2.7E-10	0.5	1.2E-10	6.0E-11	3.5E-11	2.4E-11	1.9E-11
As-79	9.01 m	1	3.7E-10	0.5	1.6E-10	7.9E-11	4.5E-11	3.0E-11	2.4E-11
<b>Selenium</b>									
Se-71	4.74 m	1	3.3E-10	0.8	1.5E-10	7.4E-11	4.3E-11	2.9E-11	2.3E-11
Se-72	8.40 d	1	7.7E-08	0.8	4.4E-08	2.8E-08	2.1E-08	7.0E-09	5.1E-09
Se-79m	3.92 m	1	1.6E-11	0.8	6.9E-12	3.3E-12	1.9E-12	1.3E-12	1.0E-12
<b>Bromine</b>									
Br-77m	4.28 m	1	1.9E-11	1	8.5E-12	4.2E-12	2.4E-12	1.6E-12	1.3E-12
Br-78	6.46 m	1	3.2E-10	1	1.4E-10	6.9E-11	4.0E-11	2.7E-11	2.1E-11
Br-82m	6.13 m	1	3.2E-11	1	1.6E-11	8.5E-12	5.1E-12	3.5E-12	2.8E-12
Br-84m	6.0 m	1	2.8E-10	1	1.3E-10	6.4E-11	3.8E-11	2.6E-11	2.1E-11
<b>Rubidium</b>									
Rb-77	3.77 m	1	3.8E-10	1	1.7E-10	8.3E-11	4.8E-11	3.3E-11	2.6E-11
Rb-78	17.66 m	1	9.6E-10	1	4.4E-10	2.2E-10	1.3E-10	8.9E-11	7.0E-11
Rb-82	1.273 m	1	9.5E-11	1	4.2E-11	2.1E-11	1.2E-11	8.1E-12	6.3E-12
Rb-84m	20.26 m	1	8.3E-11	1	4.1E-11	2.1E-11	1.3E-11	8.8E-12	7.1E-12
Rb-86m	1.017 m	1	3.1E-12	1	1.7E-12	9.3E-13	5.9E-13	4.1E-13	3.3E-13
Rb-90	2.63333 m	1	2.7E-10	1	1.2E-10	5.9E-11	3.4E-11	2.3E-11	1.8E-11
Rb-90m	4.3 m	1	3.2E-10	1	1.5E-10	7.3E-11	4.2E-11	2.9E-11	2.3E-11
<b>Yttrium</b>									
Y-83	7.08 m	0.001	4.7E-10	1E-04	2.1E-10	1.1E-10	6.1E-11	4.1E-11	3.2E-11
Y-83m	2.85 m	0.001	2.0E-10	1E-04	9.0E-11	4.4E-11	2.5E-11	1.7E-11	1.4E-11
Y-84m	40 m	0.001	1.5E-09	1E-04	7.4E-10	3.8E-10	2.3E-10	1.6E-10	1.2E-10
Y-85	2.68 h	0.001	2.3E-09	1E-04	1.2E-09	6.3E-10	3.8E-10	2.4E-10	1.9E-10
Y-85m	4.86 h	0.001	4.7E-09	1E-04	2.5E-09	1.3E-09	7.9E-10	4.8E-10	3.8E-10
Y-87m	13.37 h	0.001	2.4E-09	1E-04	1.4E-09	7.3E-10	4.6E-10	2.8E-10	2.2E-10
<b>Zirconium</b>									
Zr-85	7.86 m	0.02	6.1E-10	0.01	2.9E-10	1.4E-10	8.2E-11	5.5E-11	4.3E-11
Zr-87	1.68 h	0.02	2.6E-09	0.01	1.3E-09	6.6E-10	3.9E-10	2.5E-10	2.0E-10
Zr-89m	4.18 m	0.02	1.9E-11	0.01	1.0E-11	5.5E-12	3.5E-12	2.4E-12	1.9E-12

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	≥1y	1 Years	5 Years	10 Years	15 Years	Adult
<b>Niobium</b>									
Nb-88m	7.8 m	0.02	5.8E-10	0.01	2.7E-10	1.3E-10	7.8E-11	5.4E-11	4.2E-11
Nb-91	6.8E+2 y	0.02	7.1E-10	0.01	3.6E-10	1.8E-10	1.0E-10	5.9E-11	4.6E-11
Nb-91m	60.86 d	0.02	5.8E-09	0.01	3.0E-09	1.5E-09	9.0E-10	5.1E-10	4.1E-10
Nb-92	3.47E+7 y	0.02	7.9E-09	0.01	4.7E-09	2.8E-09	1.9E-09	1.3E-09	1.0E-09
Nb-92m	10.15 d	0.02	3.8E-09	0.01	2.4E-09	1.4E-09	9.5E-10	6.3E-10	5.0E-10
Nb-94m	6.26 m	0.02	1.1E-11	0.01	4.9E-12	2.4E-12	1.3E-12	9.1E-13	7.1E-13
<b>Molybdenum</b>									
Mo-91	15.49 m	1	9.0E-10	1	4.0E-10	2.0E-10	1.1E-10	7.7E-11	6.0E-11
Mo-102	11.3 m	1	1.1E-09	1	4.8E-10	2.3E-10	1.3E-10	8.9E-11	6.9E-11
<b>Technetium</b>									
Tc-102m	4.35 m	1	1.9E-10	0.5	8.8E-11	4.4E-11	2.6E-11	1.8E-11	1.4E-11
<b>Ruthenium</b>									
Ru-95	1.643 h	0.1	5.5E-10	0.05	3.2E-10	1.8E-10	1.2E-10	7.8E-11	6.3E-11
<b>Rhodium</b>									
Rh-97	30.7 m	0.1	6.3E-10	0.05	3.0E-10	1.5E-10	9.1E-11	6.2E-11	4.9E-11
Rh-97m	46.2 m	0.1	5.1E-10	0.05	2.7E-10	1.4E-10	9.0E-11	6.1E-11	4.8E-11
Rh-98	8.7 m	0.1	5.3E-10	0.05	2.4E-10	1.2E-10	6.9E-11	4.7E-11	3.7E-11
Rh-100m	4.6 m	0.1	3.8E-11	0.05	2.1E-11	1.1E-11	7.1E-12	4.7E-12	3.7E-12
<b>Palladium</b>									
Pd-98	17.7 m	0.05	8.7E-10	0.005	4.1E-10	2.0E-10	1.2E-10	8.0E-11	6.3E-11
Pd-99	21.4 m	0.05	4.5E-10	0.005	2.2E-10	1.1E-10	6.6E-11	4.5E-11	3.6E-11
Pd-109m	4.69 m	0.05	6.2E-11	0.005	3.2E-11	1.6E-11	9.5E-12	5.7E-12	4.5E-12
Pd-111	23.4 m	0.05	7.7E-10	0.005	3.5E-10	1.7E-10	9.6E-11	6.4E-11	5.0E-11
Pd-112	21.03 h	0.05	3.4E-08	0.005	1.9E-08	9.5E-09	5.7E-09	3.2E-09	2.6E-09
<b>Silver</b>									
Ag-101	11.1 m	0.1	4.5E-10	0.05	2.1E-10	1.0E-10	6.0E-11	4.1E-11	3.2E-11
Ag-105m	7.23 m	0.1	8.8E-12	0.05	3.9E-12	1.9E-12	1.1E-12	7.5E-13	5.8E-13
Ag-108	2.37 m	0.1	7.2E-11	0.05	3.2E-11	1.5E-11	8.6E-12	5.9E-12	4.6E-12
Ag-111m	1.08 m	0.1	4.9E-12	0.05	2.3E-12	1.1E-12	6.6E-13	4.2E-13	3.3E-13
Ag-113	5.37 h	0.1	5.6E-09	0.05	3.0E-09	1.5E-09	8.8E-10	5.1E-10	4.1E-10
Ag-113m	1.145 m	0.1	2.7E-11	0.05	1.3E-11	6.4E-12	3.7E-12	2.4E-12	1.9E-12
<b>Cadmium</b>									
Cd-105	55.5 m	0.1	5.1E-10	0.05	2.6E-10	1.3E-10	8.3E-11	5.5E-11	4.4E-11
Cd-111m	48.54 m	0.1	1.8E-10	0.05	8.9E-11	4.5E-11	2.7E-11	1.8E-11	1.4E-11
Cd-113m	14.1 y	0.1	1.2E-07	0.05	5.6E-08	3.8E-08	2.9E-08	2.4E-08	2.3E-08

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	≥1y	1 Years	5 Years	10 Years	15 Years	Adult
Cd-118	50.3 m	0.1	2.9E-09	0.05	1.4E-09	6.7E-10	3.8E-10	2.5E-10	1.9E-10
<b>Indium</b>									
In-107	32.4 m	0.04	5.1E-10	0.02	2.6E-10	1.3E-10	7.9E-11	5.2E-11	4.1E-11
In-108	58.0 m	0.04	7.3E-10	0.02	4.1E-10	2.3E-10	1.5E-10	1.0E-10	8.3E-11
In-108m	39.6 m	0.04	1.1E-09	0.02	5.2E-10	2.7E-10	1.6E-10	1.1E-10	8.5E-11
In-109m	1.34 m	0.04	7.6E-12	0.02	4.1E-12	2.2E-12	1.4E-12	9.8E-13	7.8E-13
In-111m	7.7 m	0.04	3.7E-11	0.02	1.8E-11	9.6E-12	5.9E-12	4.1E-12	3.2E-12
In-112m	20.56 m	0.04	2.5E-10	0.02	1.2E-10	5.8E-11	3.3E-11	2.2E-11	1.7E-11
In-114	1.19833 m	0.04	4.7E-11	0.02	2.1E-11	1.0E-11	5.6E-12	3.8E-12	3.0E-12
In-118m	4.364 m	0.04	1.6E-10	0.02	7.6E-11	3.9E-11	2.3E-11	1.6E-11	1.3E-11
In-119	2.4 m	0.04	8.1E-11	0.02	3.6E-11	1.8E-11	1.0E-11	7.0E-12	5.5E-12
<b>Tin</b>									
Sn-108	10.30 m	0.04	2.8E-10	0.02	1.4E-10	7.2E-11	4.4E-11	2.9E-11	2.3E-11
Sn-109	18.0 m	0.04	1.7E-10	0.02	9.5E-11	5.3E-11	3.5E-11	2.4E-11	1.9E-11
Sn-113m	21.4 m	0.04	5.0E-11	0.02	2.3E-11	1.1E-11	6.3E-12	4.2E-12	3.3E-12
Sn-125m	9.52 m	0.04	3.4E-10	0.02	1.5E-10	7.3E-11	4.1E-11	2.8E-11	2.2E-11
<b>Antimony</b>									
Sb-114	3.49 m	0.2	2.2E-10	0.1	9.8E-11	4.9E-11	2.8E-11	2.0E-11	1.5E-11
Sb-118	3.6 m	0.2	1.6E-10	0.1	7.1E-11	3.5E-11	2.0E-11	1.4E-11	1.1E-11
Sb-122m	4.191 m	0.2	4.2E-11	0.1	2.2E-11	1.1E-11	6.5E-12	4.0E-12	3.2E-12
Sb-124m	1.55 m	0.2	1.1E-11	0.1	5.1E-12	2.6E-12	1.5E-12	1.1E-12	8.5E-13
<b>Tellurium</b>									
Te-117	62 m	0.6	5.5E-10	0.3	3.1E-10	1.6E-10	1.0E-10	6.8E-11	5.4E-11
Te-118	6.00 d	0.6	3.5E-08	0.3	2.2E-08	1.1E-08	6.6E-09	3.9E-09	3.0E-09
Te-119	16.03 h	0.6	1.2E-09	0.3	9.3E-10	5.3E-10	3.5E-10	2.2E-10	1.8E-10
Te-119m	4.70 d	0.6	5.1E-09	0.3	3.6E-09	2.1E-09	1.4E-09	9.1E-10	7.3E-10
<b>Iodine</b>									
I-118	13.7 m	1	2.4E-09	1	1.6E-09	8.6E-10	4.4E-10	2.9E-10	2.0E-10
I-119	19.1 m	1	5.8E-10	1	3.2E-10	1.7E-10	9.0E-11	6.1E-11	4.6E-11
I-122	3.63 m	1	2.0E-10	1	9.0E-11	4.4E-11	2.5E-11	1.7E-11	1.4E-11
<b>Caesium</b>									
Cs-126	1.64 m	1	1.1E-10	1	5.0E-11	2.5E-11	1.4E-11	9.7E-12	7.6E-12
Cs-128	3.62 m	1	1.6E-10	1	7.1E-11	3.5E-11	2.0E-11	1.4E-11	1.1E-11
Cs-130m	3.46 m	1	5.9E-11	1	2.7E-11	1.3E-11	7.7E-12	5.2E-12	4.1E-12
Cs-139	9.27 m	1	8.0E-10	1	3.6E-10	1.7E-10	9.7E-11	6.6E-11	5.2E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Barium</b>									
Ba-124	11.0 m	0.6	1.0E-09	0.2	4.6E-10	2.3E-10	1.3E-10	8.8E-11	6.9E-11
Ba-127	12.7 m	0.6	3.4E-10	0.2	1.6E-10	8.0E-11	4.6E-11	3.2E-11	2.5E-11
Ba-129	2.23 h	0.6	5.0E-10	0.2	3.1E-10	1.6E-10	9.7E-11	6.1E-11	5.1E-11
Ba-129m	2.16 h	0.6	5.1E-10	0.2	3.6E-10	2.1E-10	1.4E-10	9.0E-11	7.6E-11
Ba-137m	2.552 m	0.6	1.2E-11	0.2	5.7E-12	3.0E-12	1.8E-12	1.3E-12	1.0E-12
<b>Lanthanum</b>									
La-129	11.6 m	0.005	3.7E-10	5E-04	1.7E-10	8.6E-11	5.1E-11	3.4E-11	2.7E-11
La-130	8.7 m	0.005	4.6E-10	5E-04	2.1E-10	1.0E-10	6.0E-11	4.1E-11	3.3E-11
La-132m	24.3 m	0.005	4.4E-10	5E-04	2.3E-10	1.2E-10	7.5E-11	4.7E-11	3.8E-11
La-133	3.912 h	0.005	5.6E-10	5E-04	3.0E-10	1.6E-10	9.4E-11	5.8E-11	4.6E-11
La-134	6.45 m	0.005	2.3E-10	5E-04	1.1E-10	5.1E-11	3.0E-11	2.0E-11	1.6E-11
La-136	9.87 m	0.005	1.4E-10	5E-04	6.2E-11	3.1E-11	1.8E-11	1.2E-11	9.6E-12
<b>Cerium</b>									
Ce-130	22.9 m	0.005	9.6E-10	5E-04	4.5E-10	2.3E-10	1.4E-10	9.1E-11	7.2E-11
Ce-131	10.2 m	0.005	3.7E-10	5E-04	1.7E-10	8.7E-11	5.2E-11	3.5E-11	2.8E-11
Ce-131m	5.0 m	0.005	2.5E-10	5E-04	1.1E-10	5.7E-11	3.3E-11	2.2E-11	1.8E-11
Ce-132	3.51 h	0.005	3.8E-09	5E-04	2.2E-09	1.1E-09	7.0E-10	4.2E-10	3.4E-10
Ce-133	97 m	0.005	1.2E-09	5E-04	6.0E-10	3.1E-10	1.8E-10	1.1E-10	9.1E-11
Ce-133m	4.9 h	0.005	2.1E-09	5E-04	1.2E-09	6.9E-10	4.4E-10	2.8E-10	2.3E-10
Ce-146	13.52 m	0.005	6.8E-10	5E-04	3.2E-10	1.6E-10	9.0E-11	6.0E-11	4.7E-11
<b>Praseodymium</b>									
Pr-134	17 m	0.005	1.1E-09	5E-04	5.4E-10	2.7E-10	1.5E-10	1.0E-10	8.1E-11
Pr-134m	11 m	0.005	6.1E-10	5E-04	2.9E-10	1.5E-10	8.7E-11	5.9E-11	4.6E-11
Pr-135	24 m	0.005	6.2E-10	5E-04	2.9E-10	1.5E-10	8.7E-11	5.9E-11	4.6E-11
Pr-138	1.45 m	0.005	8.8E-11	5E-04	3.9E-11	1.9E-11	1.1E-11	7.5E-12	5.8E-12
Pr-140	3.39 m	0.005	9.5E-11	5E-04	4.3E-11	2.1E-11	1.2E-11	8.2E-12	6.4E-12
Pr-144m	7.2 m	0.005	3.1E-10	5E-04	1.4E-10	6.6E-11	3.8E-11	2.5E-11	2.0E-11
Pr-146	24.15 m	0.005	1.2E-09	5E-04	5.3E-10	2.6E-10	1.5E-10	1.0E-10	7.8E-11
<b>Neodymium</b>									
Nd-135	12.4 m	0.005	8.3E-10	5E-04	3.9E-10	1.9E-10	1.1E-10	7.6E-11	6.0E-11
Nd-137	38.5 m	0.005	7.4E-10	5E-04	3.7E-10	1.9E-10	1.1E-10	7.4E-11	5.9E-11
Nd-140	3.37 d	0.005	2.6E-08	5E-04	1.4E-08	7.2E-09	4.3E-09	2.5E-09	2.0E-09
Nd-141m	1.03333 m	0.005	5.6E-12	5E-04	2.8E-12	1.5E-12	9.1E-13	6.4E-13	5.1E-13
Nd-144	2.29E+15y	0.005	1.2E-06	5E-04	1.1E-07	7.3E-08	5.1E-08	4.3E-08	4.1E-08

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Nd-152	11.4 m	0.005	7.4E-10	5E-04	3.3E-10	1.6E-10	9.1E-11	6.2E-11	4.9E-11
<b>Promethium</b>									
Pm-138	3.24 m	0.005	3.1E-10	5E-04	1.5E-10	7.5E-11	4.4E-11	2.9E-11	2.3E-11
Pm-139	4.15 m	0.005	2.6E-10	5E-04	1.2E-10	5.7E-11	3.3E-11	2.2E-11	1.8E-11
Pm-140m	5.95 m	0.005	3.4E-10	5E-04	1.6E-10	8.1E-11	4.8E-11	3.3E-11	2.6E-11
Pm-152	4.12 m	0.005	2.6E-10	5E-04	1.2E-10	5.6E-11	3.2E-11	2.2E-11	1.7E-11
<b>Samarium</b>									
Sm-140	14.82 m	0.005	1.4E-09	5E-04	6.6E-10	3.2E-10	1.9E-10	1.3E-10	9.8E-11
Sm-143	8.83 m	0.005	2.0E-10	5E-04	9.1E-11	4.5E-11	2.6E-11	1.8E-11	1.4E-11
Sm-143m	1.1 m	0.005	3.0E-11	5E-04	1.4E-11	6.9E-12	4.0E-12	2.8E-12	2.2E-12
Sm-148	7E+15 y	0.005	1.2E-06	5E-04	1.1E-07	7.6E-08	5.3E-08	4.5E-08	4.3E-08
<b>Europium</b>									
Eu-143	2.59 m	0.005	2.4E-10	5E-04	1.1E-10	5.2E-11	3.0E-11	2.0E-11	1.6E-11
Eu-152n	96 m	0.005	1.8E-10	5E-04	9.2E-11	4.6E-11	2.8E-11	1.7E-11	1.4E-11
Eu-154m	46.0 m	0.005	1.3E-10	5E-04	6.1E-11	3.0E-11	1.8E-11	1.2E-11	9.1E-12
Eu-159	18.1 m	0.005	7.4E-10	5E-04	3.4E-10	1.7E-10	9.6E-11	6.3E-11	4.9E-11
<b>Gadolinium</b>									
Gd-145m	1.41666 m	0.005	3.9E-11	5E-04	1.9E-11	9.6E-12	5.8E-12	4.0E-12	3.2E-12
Gd-150	1.79E+6 y	0.005	1.5E-06	5E-04	1.4E-07	9.3E-08	6.5E-08	5.5E-08	5.2E-08
<b>Terbium</b>									
Tb-147m	1.87 m	0.005	4.2E-11	5E-04	2.0E-11	1.1E-11	6.4E-12	4.4E-12	3.5E-12
Tb-148	60 m	0.005	1.7E-09	5E-04	8.2E-10	4.2E-10	2.5E-10	1.6E-10	1.3E-10
Tb-148m	2.20 m	0.005	5.1E-11	5E-04	2.5E-11	1.3E-11	8.0E-12	5.7E-12	4.5E-12
Tb-149m	4.16 m	0.005	5.8E-11	5E-04	2.8E-11	1.5E-11	8.8E-12	6.2E-12	4.9E-12
Tb-150m	5.8 m	0.005	6.8E-11	5E-04	3.5E-11	1.9E-11	1.2E-11	8.9E-12	7.1E-12
Tb-152	17.5 h	0.005	7.6E-09	5E-04	4.4E-09	2.3E-09	1.4E-09	8.8E-10	7.1E-10
Tb-152m	4.2 m	0.005	6.2E-11	5E-04	3.2E-11	1.7E-11	1.0E-11	6.7E-12	5.3E-12
Tb-162	7.60 m	0.005	2.0E-10	5E-04	9.2E-11	4.5E-11	2.6E-11	1.8E-11	1.4E-11
Tb-163	19.5 m	0.005	3.0E-10	5E-04	1.4E-10	6.9E-11	4.0E-11	2.8E-11	2.2E-11
Tb-164	3.0 m	0.005	1.3E-10	5E-04	5.8E-11	2.9E-11	1.7E-11	1.2E-11	9.3E-12
Tb-165	2.11 m	0.005	1.3E-10	5E-04	5.9E-11	2.9E-11	1.6E-11	1.1E-11	8.7E-12
<b>Dysprosium</b>									
Dy-149	4.20 m	0.005	7.4E-11	5E-04	3.9E-11	2.1E-11	1.3E-11	8.7E-12	6.9E-12
Dy-150	7.17 m	0.005	1.6E-10	5E-04	7.9E-11	4.0E-11	2.4E-11	1.6E-11	1.2E-11
Dy-151	17.9 m	0.005	2.1E-10	5E-04	1.1E-10	5.9E-11	3.7E-11	2.5E-11	2.0E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Dy-152	2.38 h	0.005	1.1E-09	5E-04	6.6E-10	3.5E-10	2.2E-10	1.4E-10	1.1E-10
Dy-153	6.4 h	0.005	1.9E-09	5E-04	1.1E-09	5.8E-10	3.7E-10	2.3E-10	1.9E-10
Dy-154	3.0E+6 y	0.005	1.6E-06	5E-04	1.6E-07	1.0E-07	7.0E-08	5.8E-08	5.6E-08
Dy-165m	1.257 m	0.005	2.0E-11	5E-04	9.6E-12	4.7E-12	2.7E-12	1.7E-12	1.3E-12
Dy-167	6.20 m	0.005	2.5E-10	5E-04	1.1E-10	5.6E-11	3.3E-11	2.2E-11	1.7E-11
Dy-168	8.7 m	0.005	4.9E-10	5E-04	2.2E-10	1.1E-10	6.2E-11	4.3E-11	3.3E-11
<b>Holmium</b>									
Ho-152	2.69666 m	0.005	1.4E-10	5E-04	6.2E-11	3.1E-11	1.8E-11	1.2E-11	9.6E-12
Ho-153	2.02 m	0.005	7.2E-11	5E-04	3.4E-11	1.7E-11	9.9E-12	6.7E-12	5.3E-12
Ho-153m	9.3 m	0.005	3.4E-10	5E-04	1.6E-10	8.0E-11	4.7E-11	3.2E-11	2.5E-11
Ho-154	11.76 m	0.005	5.9E-10	5E-04	2.7E-10	1.3E-10	7.7E-11	5.3E-11	4.1E-11
Ho-154m	3.10 m	0.005	1.2E-10	5E-04	5.5E-11	2.8E-11	1.6E-11	1.1E-11	9.0E-12
Ho-156	56 m	0.005	1.4E-09	5E-04	6.9E-10	3.5E-10	2.1E-10	1.4E-10	1.1E-10
Ho-158	11.3 m	0.005	8.4E-11	5E-04	4.4E-11	2.4E-11	1.5E-11	1.1E-11	8.9E-12
Ho-160	25.6 m	0.005	1.5E-10	5E-04	8.4E-11	4.7E-11	3.0E-11	2.1E-11	1.7E-11
Ho-163	4570 y	0.005	1.3E-10	5E-04	4.6E-11	2.3E-11	1.4E-11	8.2E-12	6.8E-12
Ho-168	2.99 m	0.005	1.2E-10	5E-04	5.5E-11	2.7E-11	1.6E-11	1.1E-11	8.4E-12
Ho-168m	2.2 m	0.005	9.2E-11	5E-04	4.1E-11	2.0E-11	1.2E-11	8.0E-12	6.2E-12
Ho-170	2.76 m	0.005	1.2E-10	5E-04	5.5E-11	2.7E-11	1.6E-11	1.1E-11	8.7E-12
<b>Erbium</b>									
Er-155	5.3 m	0.005	1.8E-10	5E-04	8.6E-11	4.3E-11	2.6E-11	1.7E-11	1.4E-11
Er-156	19.5 m	0.005	4.9E-10	5E-04	2.4E-10	1.2E-10	7.4E-11	4.7E-11	3.8E-11
Er-159	36 m	0.005	2.4E-10	5E-04	1.3E-10	7.0E-11	4.4E-11	3.0E-11	2.4E-11
Er-163	75.0 m	0.005	2.9E-11	5E-04	1.6E-11	8.4E-12	5.2E-12	3.4E-12	2.7E-12
<b>Thulium</b>									
Tm-159	9.13 m	0.005	2.7E-10	5E-04	1.3E-10	6.5E-11	3.9E-11	2.6E-11	2.1E-11
Tm-163	1.810 h	0.005	5.0E-10	5E-04	2.9E-10	1.6E-10	1.0E-10	6.9E-11	5.6E-11
Tm-164	2.0 m	0.005	5.9E-11	5E-04	2.7E-11	1.3E-11	7.5E-12	5.2E-12	4.1E-12
Tm-165	30.06 h	0.005	3.5E-09	5E-04	2.1E-09	1.1E-09	7.2E-10	4.5E-10	3.6E-10
Tm-168	93.1 d	0.005	9.9E-09	5E-04	5.7E-09	3.2E-09	2.1E-09	1.3E-09	1.0E-09
<b>Ytterbium</b>									
Yb-163	11.05 m	0.005	1.8E-10	5E-04	9.1E-11	4.7E-11	2.9E-11	2.0E-11	1.6E-11
Yb-164	75.8 m	0.005	1.2E-09	5E-04	6.1E-10	3.0E-10	1.8E-10	1.2E-10	9.1E-11
Yb-165	9.9 m	0.005	9.5E-11	5E-04	4.6E-11	2.4E-11	1.4E-11	9.5E-12	7.5E-12

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	≥1y	1 Years	5 Years	10 Years	15 Years	Adult
<b>Lutetium</b>									
Lu-164	3.14 m	0.005	3.1E-10	5E-04	1.4E-10	7.0E-11	4.0E-11	2.7E-11	2.1E-11
Lu-165	10.74 m	0.005	3.0E-10	5E-04	1.4E-10	7.1E-11	4.2E-11	2.9E-11	2.3E-11
Lu-166	2.65 m	0.005	8.4E-11	5E-04	4.0E-11	2.1E-11	1.2E-11	8.6E-12	6.8E-12
Lu-166m	1.41 m	0.005	5.9E-11	5E-04	2.7E-11	1.4E-11	8.2E-12	5.7E-12	4.5E-12
Lu-167	51.5 m	0.005	5.4E-10	5E-04	2.8E-10	1.5E-10	9.4E-11	6.3E-11	5.0E-11
Lu-168m	6.7 m	0.005	1.0E-10	5E-04	4.9E-11	2.6E-11	1.6E-11	1.1E-11	9.1E-12
Lu-169m	2.66666 m	0.005	1.0E-11	5E-04	5.5E-12	2.9E-12	1.9E-12	1.2E-12	9.6E-13
Lu-171m	1.31666 m	0.005	5.5E-12	5E-04	2.5E-12	1.2E-12	7.2E-13	4.8E-13	3.8E-13
Lu-172m	3.7 m	0.005	1.2E-11	5E-04	6.0E-12	3.1E-12	1.9E-12	1.2E-12	9.8E-13
<b>Hafnium</b>									
Hf-167	2.05 m	0.02	7.3E-11	0.002	3.4E-11	1.7E-11	1.0E-11	7.0E-12	5.5E-12
Hf-169	3.24 m	0.02	3.3E-11	0.002	1.7E-11	8.7E-12	5.3E-12	3.7E-12	2.9E-12
Hf-174	2.0E+15 y	0.02	6.1E-06	0.002	5.5E-07	4.0E-07	3.0E-07	2.7E-07	2.5E-07
<b>Tantalum</b>									
Ta-170	6.76 m	0.01	5.2E-10	0.001	2.4E-10	1.2E-10	6.8E-11	4.6E-11	3.6E-11
Ta-178	9.31 m	0.01	1.9E-11	0.001	8.9E-12	4.5E-12	2.7E-12	1.9E-12	1.5E-12
<b>Tungsten</b>									
W-179m	6.40 m	0.6	5.7E-11	0.3	2.6E-11	1.3E-11	7.2E-12	4.9E-12	3.9E-12
W-185m	1.597 m	0.6	1.4E-11	0.3	6.4E-12	3.1E-12	1.7E-12	1.2E-12	9.3E-13
W-190	30.0 m	0.6	1.2E-09	0.3	5.6E-10	2.8E-10	1.6E-10	1.1E-10	8.5E-11
<b>Rhenium</b>									
Re-179	19.5 m	1	2.1E-10	0.8	9.7E-11	5.0E-11	3.0E-11	2.1E-11	1.6E-11
Re-180	2.44 m	1	2.9E-11	0.8	1.4E-11	7.1E-12	4.3E-12	3.0E-12	2.4E-12
Re-183	70.0 d	1	1.4E-08	0.8	6.6E-09	3.3E-09	1.9E-09	1.2E-09	9.5E-10
Re-190	3.1 m	1	1.1E-10	0.8	5.1E-11	2.5E-11	1.5E-11	1.0E-11	8.0E-12
<b>Osmium</b>									
Os-177	2.8 m	0.02	1.4E-10	0.01	6.6E-11	3.3E-11	1.9E-11	1.3E-11	1.0E-11
Os-179	6.5 m	0.02	9.6E-10	0.01	4.3E-10	2.1E-10	1.2E-10	8.2E-11	6.4E-11
Os-183	13.0 h	0.02	2.3E-09	0.01	1.3E-09	7.2E-10	4.6E-10	2.9E-10	2.3E-10
Os-183m	9.9 h	0.02	1.8E-09	0.01	1.1E-09	6.2E-10	4.1E-10	2.6E-10	2.1E-10
Os-186	2.0E+15 y	0.02	5.0E-07	0.01	1.9E-07	9.9E-08	6.1E-08	3.9E-08	3.2E-08
Os-190m	9.9 m	0.02	8.5E-11	0.01	4.3E-11	2.3E-11	1.5E-11	1.0E-11	8.4E-12
Os-196	34.9 m	0.02	1.7E-09	0.01	8.0E-10	3.9E-10	2.2E-10	1.5E-10	1.2E-10
<b>Iridium</b>									
Ir-179	1.31666 m	0.02	2.5E-10	0.01	1.1E-10	5.4E-11	3.1E-11	2.1E-11	1.7E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Ir-180	1.5 m	0.02	3.0E-11	0.01	1.4E-11	7.5E-12	4.5E-12	3.2E-12	2.5E-12
Ir-181	4.90 m	0.02	1.5E-10	0.01	7.1E-11	3.7E-11	2.2E-11	1.5E-11	1.2E-11
Ir-183	58 m	0.02	5.5E-10	0.01	3.0E-10	1.6E-10	1.0E-10	6.8E-11	5.5E-11
Ir-196m	1.40 h	0.02	1.4E-09	0.01	7.4E-10	3.9E-10	2.4E-10	1.6E-10	1.3E-10
<b>Platinum</b>									
Pt-183	6.5 m	0.02	2.4E-10	0.01	1.1E-10	5.8E-11	3.5E-11	2.3E-11	1.8E-11
Pt-184	17.3 m	0.02	3.4E-10	0.01	1.8E-10	9.4E-11	5.8E-11	3.8E-11	3.0E-11
Pt-187	2.35 h	0.02	9.8E-10	0.01	5.4E-10	2.8E-10	1.8E-10	1.1E-10	8.8E-11
Pt-190	6.5E+11 y	0.02	1.1E-07	0.01	4.3E-08	2.2E-08	1.4E-08	8.4E-09	6.8E-09
Pt-202	44 h	0.02	6.1E-08	0.01	3.3E-08	1.6E-08	9.8E-09	5.5E-09	4.5E-09
<b>Gold</b>									
Au-186	10.7 m	0.2	6.1E-10	0.1	2.9E-10	1.5E-10	8.6E-11	5.8E-11	4.6E-11
Au-187	8.4 m	0.2	1.2E-10	0.1	6.4E-11	3.4E-11	2.1E-11	1.4E-11	1.1E-11
Au-188	8.84 m	0.2	2.8E-10	0.1	1.3E-10	6.5E-11	3.8E-11	2.6E-11	2.1E-11
Au-189m	4.59 m	0.2	4.5E-11	0.1	2.2E-11	1.1E-11	6.8E-12	4.5E-12	3.6E-12
Au-190	42.8 m	0.2	5.1E-10	0.1	2.7E-10	1.4E-10	8.8E-11	5.9E-11	4.7E-11
Au-191	3.18 h	0.2	7.8E-10	0.1	4.5E-10	2.4E-10	1.5E-10	9.6E-11	7.7E-11
Au-192	4.94 h	0.2	1.5E-09	0.1	9.2E-10	5.1E-10	3.4E-10	2.2E-10	1.8E-10
Au-196	6.183 d	0.2	5.4E-09	0.1	3.4E-09	1.8E-09	1.1E-09	6.7E-10	5.3E-10
Au-196m	9.6 h	0.2	5.0E-09	0.1	2.9E-09	1.4E-09	8.7E-10	5.1E-10	4.1E-10
<b>Mercury</b>									
Hg-187 (inorganic)	2.2 m	0.04	1.0E-10	0.02	4.6E-11	2.3E-11	1.3E-11	9.1E-12	7.2E-12
Hg-187 (organic)	2.2 m	1	1.0E-10	1	4.6E-11	2.3E-11	1.3E-11	9.1E-12	7.1E-12
Hg-187m (inorganic)	0.8	1.0E-10	0.4	4.6E-11	2.3E-11	1.3E-11	9.1E-12	7.2E-12	
Hg-187m (organic)	2.4 m	0.04	1.0E-10	0.02	4.6E-11	2.3E-11	1.3E-11	9.3E-12	7.3E-12
Hg-187m (organic)	0.8	1.0E-10	0.4	4.6E-11	2.3E-11	1.3E-11	9.3E-12	7.3E-12	
Hg-188 (inorganic)	2.4 m	0.04	1.1E-10	0.02	5.1E-11	2.6E-11	1.5E-11	1.0E-11	8.2E-12
Hg-188 (organic)	3.25 m	1	1.1E-10	1	5.2E-11	2.6E-11	1.5E-11	1.1E-11	8.4E-12
Hg-188 (organic)	0.8	1.1E-10	0.4	5.2E-11	2.6E-11	1.5E-11	1.1E-11	8.4E-12	
Hg-189 (inorganic)	20.0 m	0.04	2.7E-10	0.02	1.4E-10	7.5E-11	4.7E-11	3.1E-11	2.5E-11
Hg-190 (organic)	20.0 m	1	2.1E-10	1	1.0E-10	5.4E-11	3.3E-11	2.3E-11	1.8E-11
Hg-190 (organic)	0.8	2.4E-10	0.4	1.4E-10	7.2E-11	4.5E-11	3.0E-11	2.4E-11	

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Hg-191m (inorganic)	50.8 m	0.04	5.6E-10	0.02	3.1E-10	1.7E-10	1.1E-10	6.9E-11	5.5E-11
Hg-191m (organic)	50.8 m	1 0.8	3.5E-10 4.2E-10	1 0.4	1.8E-10 2.8E-10	9.7E-11 1.5E-10	6.0E-11 9.4E-11	4.2E-11 6.2E-11	3.4E-11 5.0E-11
Hg-192 (inorganic)	4.85h	0.04	2.1E-09	0.02	1.3E-09	7.0E-10	4.6E-10	2.9E-10	2.3E-10
Hg-192 (organic)	4.85h	1 0.8	6.4E-10 9.7E-10	1 0.4	3.6E-10 9.6E-10	2.0E-10 5.3E-10	1.3E-10 3.4E-10	8.6E-11 2.2E-10	7.2E-11 1.8E-10
Hg-205 (inorganic)	5.2 m	0.04	1.3E-10	0.02	5.8E-11	2.8E-11	1.6E-11	1.1E-11	8.3E-12
Hg-205 (organic)	5.2 m	1 0.8	1.3E-10 1.3E-10	1 0.4	5.8E-11 5.8E-11	2.8E-11 2.8E-11	1.6E-11 1.6E-11	1.1E-11 1.1E-11	8.4E-12 8.3E-12
Hg-206 (inorganic)	8.15 m	0.04	3.3E-10	0.02	1.5E-10	7.0E-11	4.0E-11	2.7E-11	2.1E-11
Hg-206 (organic)	8.15 m	1 0.8	3.3E-10 3.3E-10	1 0.4	1.5E-10 1.5E-10	7.1E-11 7.0E-11	4.0E-11 4.0E-11	2.7E-11 2.7E-11	2.1E-11 2.1E-11
<b>Thallium</b>									
TI-190	2.6 m	1	2.1E-10	1	9.7E-11	4.8E-11	2.8E-11	1.9E-11	1.5E-11
TI-190m	3.7 m	1	1.8E-10	1	8.2E-11	4.2E-11	2.5E-11	1.7E-11	1.4E-11
TI-196	1.84 h	1	5.7E-10	1	2.9E-10	1.5E-10	9.5E-11	6.6E-11	5.4E-11
TI-206	4.199 m	1	1.1E-10	1	4.7E-11	2.3E-11	1.3E-11	8.8E-12	6.9E-12
TI-206m	3.74 m	1	1.4E-10	1	6.7E-11	3.4E-11	2.0E-11	1.4E-11	1.1E-11
TI-207	4.77 m	1	1.1E-10	1	4.9E-11	2.4E-11	1.3E-11	9.1E-12	7.1E-12
TI-208	3.053 m	1	1.1E-10	1	5.2E-11	2.6E-11	1.5E-11	1.1E-11	8.6E-12
TI-209	2.161 m	1	8.8E-11	1	4.0E-11	2.0E-11	1.2E-11	8.2E-12	6.4E-12
TI-210	1.30 m	1	9.2E-11	1	4.1E-11	2.0E-11	1.2E-11	8.2E-12	6.5E-12
<b>Lead</b>									
Pb-194	12.0 m	0.6	2.6E-10	0.2	1.2E-10	6.2E-11	3.7E-11	2.5E-11	2.0E-11
Pb-196	37 m	0.6	2.9E-10	0.2	1.5E-10	8.1E-11	5.0E-11	3.4E-11	2.8E-11
Pb-197	8 m	0.6	6.5E-11	0.2	3.4E-11	1.8E-11	1.2E-11	8.2E-12	6.6E-12
Pb-197m	43 m	0.6	4.9E-10	0.2	2.6E-10	1.4E-10	8.3E-11	5.6E-11	4.5E-11
Pb-204m	67.2 m	0.6	4.1E-10	0.2	2.4E-10	1.3E-10	8.7E-11	6.0E-11	5.0E-11
<b>Bismuth</b>									
Bi-197	9.33 m	0.1	2.8E-10	0.05	1.4E-10	7.1E-11	4.3E-11	3.0E-11	2.4E-11
Bi-204	11.22 h	0.1	4.8E-09	0.05	3.1E-09	1.8E-09	1.2E-09	7.7E-10	6.1E-10
Bi-208	3.68E+5 y	0.1	8.2E-09	0.05	5.5E-09	3.2E-09	2.2E-09	1.4E-09	1.2E-09
Bi-211	2.14 m	0.1	1.9E-10	0.05	8.3E-11	4.0E-11	2.3E-11	1.5E-11	1.2E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	≥1y	1 Years	5 Years	10 Years	15 Years	Adult
Bi-215	7.6 m	0.1	1.3E-09	0.05	5.6E-10	2.7E-10	1.5E-10	1.0E-10	8.0E-11
<b>Polonium</b>									
Po-204	3.53 h	1	1.8E-09	0.5	1.4E-09	7.5E-10	4.8E-10	3.1E-10	2.5E-10
Po-206	8.8 d	1	4.1E-07	0.5	1.1E-07	5.8E-08	3.5E-08	2.1E-08	1.7E-08
Po-208	2.898 y	1	3.7E-05	0.5	1.1E-05	5.4E-06	3.2E-06	2.0E-06	1.5E-06
Po-209	102 y	1	3.6E-05	0.5	1.1E-05	5.4E-06	3.2E-06	2.0E-06	1.5E-06
Po-218	3.10 m	1	1.3E-09	0.5	2.5E-10	1.2E-10	7.2E-11	4.6E-11	3.7E-11
<b>Astatine</b>									
At-205	26.2 m	1	9.2E-10	1	4.6E-10	2.4E-10	1.4E-10	9.6E-11	7.7E-11
At-208	1.63 h	1	9.8E-10	1	5.3E-10	2.8E-10	1.7E-10	1.2E-10	9.4E-11
At-209	5.41 h	1	7.5E-09	1	5.1E-09	3.2E-09	2.4E-09	2.1E-09	1.9E-09
At-210	8.1 h	1	9.2E-08	1	6.2E-08	3.2E-08	1.9E-08	1.2E-08	9.8E-09
<b>Francium</b>									
Fr-212	20.0 m	1	6.1E-09	1	3.8E-09	2.0E-09	1.2E-09	8.1E-10	7.1E-10
Fr-221	4.9 m	1	2.4E-09	1	1.2E-09	5.8E-10	3.4E-10	2.1E-10	1.7E-10
<b>Radium</b>									
Ra-230	93 m	0.6	2.5E-09	0.2	1.3E-09	6.5E-10	3.7E-10	2.3E-10	1.9E-10
<b>Actinium</b>									
Ac-223	2.10 m	0.005	6.4E-10	5E-04	2.8E-10	1.4E-10	7.7E-11	5.3E-11	4.1E-11
Ac-229	62.7 m	0.005	6.1E-10	5E-04	2.9E-10	1.5E-10	8.5E-11	5.5E-11	4.4E-11
Ac-230	2.03333 m	0.005	8.6E-11	5E-04	3.8E-11	1.9E-11	1.1E-11	7.3E-12	5.7E-12
<b>Thorium</b>									
Th-233	22.3 m	0.005	3.4E-10	5E-04	1.5E-10	7.4E-11	4.2E-11	2.8E-11	2.2E-11
<b>Protactinium</b>									
Pa-229	1.50 d	0.005	2.0E-09	5E-04	1.1E-09	6.2E-10	4.0E-10	2.7E-10	2.2E-10
Pa-234m	1.17 m	0.005	4.9E-11	5E-04	2.1E-11	1.0E-11	5.8E-12	4.0E-12	3.1E-12
Pa-236	9.1 m	0.005	3.4E-10	5E-04	1.5E-10	7.5E-11	4.3E-11	2.9E-11	2.3E-11
<b>Uranium</b>									
U-228	9.1 m	0.04	2.9E-09	0.02	1.3E-09	6.3E-10	3.5E-10	2.4E-10	1.9E-10
<b>Neptunium</b>									
Np-231	48.8 m	0.005	4.0E-10	5E-04	1.9E-10	9.6E-11	5.6E-11	3.7E-11	2.9E-11
Np-240m	7.22 m	0.005	2.2E-10	5E-04	9.9E-11	4.8E-11	2.8E-11	1.9E-11	1.5E-11
Np-241	13.9 m	0.005	2.5E-10	5E-04	1.1E-10	5.5E-11	3.2E-11	2.2E-11	1.8E-11
<b>Plutonium</b>									
Pu-232	34.1 m	0.005	2.4E-09	5E-04	1.2E-09	6.8E-10	4.5E-10	3.4E-10	2.9E-10
<b>Americium</b>									
Am-247	23.0 m	0.005	4.7E-10	5E-04	2.1E-10	1.0E-10	5.9E-11	3.9E-11	3.1E-11

Table 4-(continued)

Nuclide	Physical Half-life	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
		<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Curium</b>									
Cm-239	2.9 h 0.005		1.0E-09	5E-04	5.3E-10	2.7E-10	1.7E-10	1.0E-10	8.2E-11
<b>Berkelium</b>									
Bk-244	4.35 h 0.005		4.0E-09	5E-04	2.6E-09	1.6E-09	1.1E-09	7.9E-10	6.9E-10
Bk-248m	23.7 h 0.005		2.3E-08	5E-04	1.5E-08	8.6E-09	5.5E-09	3.8E-09	3.3E-09
Bk-251	55.6 m 0.005		5.8E-10	5E-04	2.8E-10	1.4E-10	8.1E-11	5.5E-11	4.4E-11
<b>Californium</b>									
Cf-247	3.11 h 0.005		2.8E-10	5E-04	1.5E-10	8.3E-11	5.3E-11	3.5E-11	2.9E-11
Cf-255	85 m 0.005		9.2E-10	5E-04	2.9E-10	1.5E-10	8.5E-11	5.1E-11	4.0E-11
Cf-256	12.3 m 0.005		2.7E-08	5E-04	1.3E-08	7.2E-09	4.8E-09	3.8E-09	3.3E-09
<b>Einsteinium</b>									
Es-249	102.2 m 0.005		2.4E-10	5E-04	1.3E-10	6.8E-11	4.2E-11	2.8E-11	2.2E-11
Es-255	39.8 d 0.005		3.0E-07	5E-04	4.5E-08	2.4E-08	1.5E-08	7.5E-09	6.0E-09
Es-256	25.4 m 0.005		2.8E-08	5E-04	1.5E-08	8.7E-09	6.1E-09	4.5E-09	4.1E-09
<b>Fermium</b>									
Fm-251	5.30 h 0.005		9.0E-10	5E-04	4.8E-10	2.5E-10	1.5E-10	9.1E-11	7.2E-11
Fm-256	157.6 m 0.005		1.8E-07	5E-04	9.8E-08	5.6E-08	3.9E-08	2.9E-08	2.6E-08

**Table 5 Effective dose coefficients for members of the public**  
**Inhalation dose coefficients,  $e(\tau)$ , to age 70 y (Sv Bq<sup>-1</sup>)**

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Magnesium</b>										
Mg-27	9.462 m	F	1	8.1E-11	0.5	4.7E-11	2.1E-11	1.4E-11	8.4E-12	7.2E-12
		M	1	1.1E-10	0.5	6.4E-11	2.9E-11	1.9E-11	1.2E-11	1.0E-11
<b>Aluminium</b>										
Al-28	2.2414 m	F	0.02	3.1E-11	0.01	1.9E-11	8.7E-12	5.6E-12	3.5E-12	3.0E-12
		M	0.02	3.5E-11	0.01	2.1E-11	9.8E-12	6.3E-12	3.9E-12	3.4E-12
Al-29	6.56 m	F	0.02	7.2E-11	0.01	4.2E-11	1.9E-11	1.2E-11	7.6E-12	6.5E-12
		M	0.02	9.3E-11	0.01	5.4E-11	2.5E-11	1.6E-11	1.0E-11	8.6E-12
<b>Phosphorus</b>										
P-30	2.498 m	F	1	3.4E-11	0.8	2.0E-11	9.0E-12	5.9E-12	3.6E-12	3.2E-12
		M	1	3.8E-11	0.8	2.3E-11	1.0E-11	6.7E-12	4.2E-12	3.7E-12
<b>Sulphur</b>										
S-37 (inorganic)	5.05 m	F	1	6.1E-11	0.8	3.8E-11	1.8E-11	1.1E-11	7.0E-12	6.0E-12
		M	0.2	7.6E-11	0.1	4.7E-11	2.2E-11	1.4E-11	8.7E-12	7.4E-12
		S	0.02	7.7E-11	0.01	4.8E-11	2.2E-11	1.4E-11	8.9E-12	7.6E-12
S-38 (inorganic)	170.3 m	F	1	1.3E-09	0.8	9.1E-10	4.4E-10	2.8E-10	1.7E-10	1.4E-10
		M	0.2	2.9E-09	0.1	1.7E-09	8.3E-10	5.3E-10	3.3E-10	2.7E-10
		S	0.02	3.1E-09	0.01	1.8E-09	8.7E-10	5.6E-10	3.5E-10	2.9E-10
<b>Chlorine</b>										
Cl-34m	32.00 m	F	1	3.4E-10	1	1.9E-10	8.9E-11	5.5E-11	3.2E-11	2.7E-11
		M	1	5.0E-10	1	2.9E-10	1.3E-10	8.4E-11	5.3E-11	4.4E-11
Cl-40	1.35 m	F	1	2.4E-11	1	1.6E-11	7.4E-12	4.7E-12	2.9E-12	2.5E-12
		M	1	2.6E-11	1	1.7E-11	8.0E-12	5.1E-12	3.1E-12	2.7E-12
<b>Potassium</b>										
K-38	7.636 m	F	1	1.1E-10	1	6.5E-11	3.0E-11	1.9E-11	1.2E-11	9.7E-12
<b>Calcium</b>										
Ca-49	8.718 m	F	0.6	1.3E-10	0.3	7.8E-11	3.5E-11	2.2E-11	1.3E-11	1.1E-11
		M	0.2	1.9E-10	0.1	1.1E-10	5.2E-11	3.3E-11	2.1E-11	1.8E-11
		S	0.02	2.0E-10	0.01	1.2E-10	5.4E-11	3.5E-11	2.2E-11	1.8E-11
<b>Titanium</b>										
Ti-51	5.76 m	F	0.02	5.4E-11	0.01	3.1E-11	1.3E-11	8.8E-12	5.5E-12	4.8E-12
		M	0.02	7.0E-11	0.01	3.9E-11	1.7E-11	1.2E-11	7.3E-12	6.4E-12
		S	0.02	7.2E-11	0.01	4.0E-11	1.8E-11	1.2E-11	7.5E-12	6.6E-12
<b>Vanadium</b>										
V-50	1.5E+17 y	F	0.02	1.5E-07	0.01	1.5E-07	1.1E-07	9.7E-08	8.6E-08	8.4E-08
		M	0.02	6.2E-08	0.01	6.0E-08	4.7E-08	3.9E-08	3.7E-08	3.7E-08
V-52	3.743 m	F	0.02	4.6E-11	0.01	2.7E-11	1.3E-11	8.1E-12	5.0E-12	4.3E-12
		M	0.02	5.5E-11	0.01	3.3E-11	1.5E-11	9.7E-12	6.1E-12	5.2E-12
V-53	1.61 m	F	0.02	2.0E-11	0.01	1.2E-11	5.6E-12	3.6E-12	2.3E-12	2.0E-12
		M	0.02	2.2E-11	0.01	1.3E-11	6.1E-12	4.0E-12	2.5E-12	2.2E-12

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Chromium</b>										
Cr-55	3.497 m	F	0.2	3.6E-11	0.1	2.0E-11	8.7E-12	5.8E-12	3.6E-12	3.2E-12
		M	0.2	4.4E-11	0.1	2.4E-11	1.1E-11	7.1E-12	4.5E-12	4.0E-12
		S	0.2	4.5E-11	0.1	2.5E-11	1.1E-11	7.2E-12	4.6E-12	4.1E-12
Cr-56	5.94 m	F	0.2	7.9E-11	0.1	4.6E-11	2.1E-11	1.3E-11	7.9E-12	6.8E-12
		M	0.2	1.1E-10	0.1	6.5E-11	3.0E-11	1.9E-11	1.2E-11	1.1E-11
		S	0.2	1.2E-10	0.1	6.7E-11	3.1E-11	2.0E-11	1.3E-11	1.1E-11
<b>Manganese</b>										
Mn-57	1.42333 m	F	0.2	1.6E-11	0.1	9.3E-12	4.1E-12	2.8E-12	1.7E-12	1.6E-12
		M	0.2	1.8E-11	0.1	1.0E-11	4.5E-12	3.0E-12	1.9E-12	1.7E-12
Mn-58m	1.08666 m	F	0.2	1.8E-11	0.1	1.1E-11	5.3E-12	3.4E-12	2.1E-12	1.8E-12
		M	0.2	1.9E-11	0.1	1.2E-11	5.6E-12	3.6E-12	2.2E-12	1.9E-12
<b>Iron</b>										
Fe-53	8.51 m	F	0.6	9.8E-11	0.1	5.6E-11	2.5E-11	1.6E-11	9.5E-12	8.0E-12
		M	0.2	1.2E-10	0.1	7.1E-11	3.2E-11	2.1E-11	1.3E-11	1.1E-11
		S	0.02	1.3E-10	0.01	7.3E-11	3.3E-11	2.1E-11	1.3E-11	1.1E-11
<b>Cobalt</b>										
Co-62	1.50 m	F	0.6	2.2E-11	0.1	1.3E-11	6.2E-12	4.0E-12	2.5E-12	2.2E-12
		M	0.2	2.4E-11	0.1	1.5E-11	6.8E-12	4.4E-12	2.7E-12	2.4E-12
		S	0.02	2.4E-11	0.01	1.5E-11	6.8E-12	4.4E-12	2.8E-12	2.4E-12
<b>Copper</b>										
Cu-62	9.74 m	F	1	1.1E-10	0.5	6.1E-11	2.7E-11	1.7E-11	1.0E-11	8.9E-12
		M	1	1.5E-10	0.5	8.3E-11	3.7E-11	2.4E-11	1.5E-11	1.3E-11
		S	1	1.5E-10	0.5	8.6E-11	3.8E-11	2.5E-11	1.5E-11	1.3E-11
Cu-66	5.088 m	F	1	5.1E-11	0.5	2.8E-11	1.2E-11	7.9E-12	4.9E-12	4.4E-12
		M	1	6.5E-11	0.5	3.5E-11	1.5E-11	1.0E-11	6.5E-12	5.7E-12
		S	1	6.6E-11	0.5	3.6E-11	1.6E-11	1.0E-11	6.6E-12	5.9E-12
<b>Arsenic</b>										
As-68	2.52666 m	M	1	5.5E-11	0.5	3.5E-11	1.7E-11	1.1E-11	6.6E-12	5.6E-12
As-79	9.01 m	M	1	1.4E-10	0.5	7.5E-11	3.3E-11	2.2E-11	1.5E-11	1.3E-11
<b>Selenium</b>										
Se-71	4.74 m	F	1	6.7E-11	0.8	4.0E-11	1.8E-11	1.2E-11	7.1E-12	6.0E-12
		M	0.2	8.3E-11	0.1	4.9E-11	2.3E-11	1.5E-11	9.1E-12	7.8E-12
		S	0.02	8.5E-11	0.01	5.0E-11	2.3E-11	1.5E-11	9.3E-12	8.0E-12
Se-72	8.40 d	F	1	3.0E-08	0.8	2.0E-08	1.1E-08	8.4E-09	2.6E-09	2.0E-09
		M	0.2	2.6E-08	0.1	1.6E-08	8.8E-09	6.0E-09	3.9E-09	3.3E-09
		S	0.02	2.5E-08	0.01	1.6E-08	8.7E-09	5.8E-09	4.3E-09	3.7E-09
Se-79m	3.92 m	F	1	1.7E-11	0.8	1.0E-11	4.6E-12	3.1E-12	2.1E-12	1.8E-12
		M	0.2	2.1E-11	0.1	1.3E-11	5.7E-12	3.9E-12	2.7E-12	2.3E-12
		S	0.02	2.1E-11	0.01	1.3E-11	5.9E-12	4.0E-12	2.8E-12	2.4E-12
<b>Bromine</b>										
Br-77m	4.28 m	F	1	2.3E-11	1	1.4E-11	6.2E-12	4.2E-12	2.8E-12	2.4E-12
		M	1	2.9E-11	1	1.7E-11	7.9E-12	5.4E-12	3.6E-12	3.1E-12

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Br-78	6.46 m	F	1	6.8E-11	1	3.9E-11	1.8E-11	1.1E-11	7.0E-12	6.0E-12
		M	1	8.8E-11	1	5.1E-11	2.3E-11	1.5E-11	9.3E-12	8.0E-12
Br-82m	6.13 m	F	1	1.3E-11	1	9.1E-12	4.6E-12	2.8E-12	1.7E-12	1.4E-12
		M	1	1.8E-11	1	1.2E-11	6.4E-12	4.1E-12	2.9E-12	2.3E-12
Br-84m	6.0 m	F	1	7.7E-11	1	4.8E-11	2.3E-11	1.4E-11	8.8E-12	7.4E-12
		M	1	9.6E-11	1	6.0E-11	2.8E-11	1.8E-11	1.1E-11	9.4E-12
<b>Rubidium</b>										
Rb-77	3.77 m	F	1	7.3E-11	1	4.3E-11	2.0E-11	1.2E-11	7.6E-12	6.5E-12
		M	1	9.4E-11	1	5.5E-11	2.6E-11	1.6E-11	1.0E-11	8.9E-12
		S	1	9.7E-11	1	5.6E-11	2.6E-11	1.7E-11	1.1E-11	9.1E-12
Rb-78	17.66 m	F	1	2.3E-10	1	1.4E-10	6.5E-11	4.0E-11	2.4E-11	2.0E-11
		M	1	3.2E-10	1	1.9E-10	8.8E-11	5.5E-11	3.4E-11	2.8E-11
		S	1	3.3E-10	1	1.9E-10	9.1E-11	5.7E-11	3.5E-11	2.9E-11
Rb-82	1.273 m	F	1	1.7E-11	1	1.0E-11	4.8E-12	3.1E-12	1.9E-12	1.7E-12
Rb-84m	20.26 m	F	1	4.8E-11	1	3.0E-11	1.4E-11	9.0E-12	5.6E-12	4.7E-12
Rb-86m	1.017 m	F	1	1.6E-12	1	1.2E-12	6.2E-13	3.7E-13	2.2E-13	1.7E-13
Rb-90	2.63333 m	F	1	4.3E-11	1	2.5E-11	1.1E-11	7.4E-12	4.6E-12	4.0E-12
Rb-90m	4.3 m	F	1	6.9E-11	1	4.2E-11	2.0E-11	1.3E-11	7.7E-12	6.5E-12
<b>Yttrium</b>										
Y-83	7.08 m	M	0.001	1.2E-10	1E-04	7.3E-11	3.3E-11	2.1E-11	1.3E-11	1.1E-11
		S	0.001	1.3E-10	1E-04	7.4E-11	3.4E-11	2.2E-11	1.4E-11	1.1E-11
Y-83m	2.85 m	M	0.001	5.3E-11	1E-04	3.1E-11	1.4E-11	9.2E-12	5.8E-12	4.9E-12
		S	0.001	5.4E-11	1E-04	3.2E-11	1.5E-11	9.5E-12	5.9E-12	5.1E-12
Y-84m	40 m	M	0.001	6.0E-10	1E-04	3.7E-10	1.8E-10	1.1E-10	6.9E-11	5.6E-11
		S	0.001	6.2E-10	1E-04	3.8E-10	1.8E-10	1.1E-10	7.2E-11	5.8E-11
Y-85	2.68 h	M	0.001	9.4E-10	1E-04	5.8E-10	2.8E-10	1.8E-10	1.1E-10	9.1E-11
		S	0.001	9.7E-10	1E-04	6.0E-10	2.9E-10	1.9E-10	1.2E-10	9.6E-11
Y-85m	4.86 h	M	0.001	1.7E-09	1E-04	1.1E-09	5.1E-10	3.2E-10	2.0E-10	1.6E-10
		S	0.001	1.8E-09	1E-04	1.1E-09	5.3E-10	3.4E-10	2.0E-10	1.7E-10
Y-87m	13.37 h	M	0.001	1.2E-09	1E-04	7.6E-10	3.8E-10	2.5E-10	1.7E-10	1.3E-10
		S	0.001	1.2E-09	1E-04	7.9E-10	4.0E-10	2.6E-10	1.7E-10	1.4E-10
<b>Zirconium</b>										
Zr-85	7.86 m	F	0.02	1.2E-10	0.002	7.3E-11	3.3E-11	2.1E-11	1.2E-11	1.0E-11
		M	0.02	1.7E-10	0.002	1.0E-10	4.6E-11	2.9E-11	1.8E-11	1.5E-11
		S	0.02	1.8E-10	0.002	1.0E-10	4.8E-11	3.0E-11	1.9E-11	1.6E-11
Zr-87	1.68 h	F	0.02	5.9E-10	0.002	3.4E-10	1.5E-10	9.5E-11	5.3E-11	4.4E-11
		M	0.02	9.2E-10	0.002	5.5E-10	2.6E-10	1.7E-10	1.1E-10	8.7E-11
		S	0.02	9.5E-10	0.002	5.8E-10	2.7E-10	1.7E-10	1.1E-10	9.2E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Zr-89m	4.18 m	F	0.02	8.7E-12	0.002	6.3E-12	3.2E-12	1.9E-12	1.2E-12	9.4E-13
		M	0.02	1.1E-11	0.002	7.7E-12	3.9E-12	2.4E-12	1.5E-12	1.2E-12
		S	0.02	1.1E-11	0.002	7.8E-12	4.0E-12	2.5E-12	1.6E-12	1.3E-12
<b>Niobium</b>										
Nb-88m	7.8 m	F	0.02	1.3E-10	0.01	8.1E-11	3.9E-11	2.4E-11	1.5E-11	1.2E-11
		M	0.02	1.7E-10	0.01	1.0E-10	4.8E-11	3.0E-11	1.9E-11	1.6E-11
		S	0.02	1.7E-10	0.01	1.0E-10	5.0E-11	3.1E-11	1.9E-11	1.6E-11
Nb-91	6.8E+2 y	F	0.02	1.6E-09	0.01	1.1E-09	5.6E-10	3.2E-10	2.0E-10	1.7E-10
		M	0.02	1.9E-09	0.01	1.5E-09	8.0E-10	5.0E-10	3.7E-10	2.9E-10
		S	0.02	5.7E-09	0.01	5.3E-09	3.4E-09	2.4E-09	2.0E-09	1.9E-09
Nb-91m	60.86 d	F	0.02	6.1E-09	0.01	3.5E-09	1.7E-09	9.2E-10	5.3E-10	4.5E-10
		M	0.02	1.5E-08	0.01	1.0E-08	6.3E-09	4.6E-09	4.3E-09	3.3E-09
		S	0.02	1.8E-08	0.01	1.3E-08	7.7E-09	5.7E-09	5.3E-09	4.1E-09
Nb-92	3.47E+7 y	F	0.02	2.5E-08	0.01	2.1E-08	1.2E-08	8.2E-09	5.7E-09	5.1E-09
		M	0.02	2.2E-08	0.01	1.8E-08	1.1E-08	7.8E-09	6.1E-09	5.3E-09
		S	0.02	6.3E-08	0.01	6.2E-08	4.4E-08	3.2E-08	2.9E-08	2.7E-08
Nb-92m	10.15 d	F	0.02	2.6E-09	0.01	2.0E-09	1.0E-09	6.7E-10	4.2E-10	3.5E-10
		M	0.02	3.0E-09	0.01	2.2E-09	1.2E-09	7.9E-10	5.3E-10	4.2E-10
		S	0.02	3.1E-09	0.01	2.3E-09	1.3E-09	8.1E-10	5.5E-10	4.4E-10
Nb-94m	6.26 m	F	0.02	2.6E-12	0.01	1.7E-12	8.5E-13	4.9E-13	3.1E-13	2.5E-13
		M	0.02	3.3E-12	0.01	2.1E-12	1.1E-12	6.3E-13	4.1E-13	3.3E-13
		S	0.02	3.4E-12	0.01	2.2E-12	1.1E-12	6.4E-13	4.2E-13	3.4E-13
<b>Molybdenum</b>										
Mo-91	15.49 m	F	1	1.6E-10	0.8	9.2E-11	4.1E-11	2.5E-11	1.5E-11	1.3E-11
		M	0.2	2.4E-10	0.1	1.3E-10	6.0E-11	3.8E-11	2.4E-11	2.0E-11
		S	0.02	2.5E-10	0.01	1.4E-10	6.2E-11	3.9E-11	2.4E-11	2.1E-11
Mo-102	11.3 m	F	1	2.0E-10	0.8	1.1E-10	4.5E-11	2.9E-11	1.8E-11	1.6E-11
		M	0.2	2.9E-10	0.1	1.5E-10	6.7E-11	4.4E-11	2.8E-11	2.4E-11
		S	0.02	3.0E-10	0.01	1.6E-10	6.9E-11	4.5E-11	2.9E-11	2.5E-11
<b>Technetium</b>										
Tc-102m	4.35 m	F	1	5.7E-11	0.8	3.6E-11	1.7E-11	1.1E-11	6.6E-12	5.5E-12
		M	0.2	6.7E-11	0.1	4.2E-11	2.0E-11	1.3E-11	7.8E-12	6.6E-12
		S	0.02	6.8E-11	0.01	4.2E-11	2.0E-11	1.3E-11	8.0E-12	6.7E-12
<b>Ruthenium</b>										
Ru-95	1.643 h	F	0.1	2.4E-10	0.05	1.8E-10	9.2E-11	5.6E-11	3.2E-11	2.6E-11
		M	0.1	3.2E-10	0.05	2.3E-10	1.2E-10	7.3E-11	4.4E-11	3.5E-11
		S	0.02	3.3E-10	0.01	2.3E-10	1.2E-10	7.5E-11	4.6E-11	3.6E-11
<b>Rhodium</b>										
Rh-97	30.7 m	F	0.1	1.7E-10	0.05	1.0E-10	4.9E-11	3.0E-11	1.8E-11	1.5E-11
		M	0.1	2.5E-10	0.05	1.5E-10	7.0E-11	4.4E-11	2.8E-11	2.3E-11
		S	0.1	2.6E-10	0.05	1.5E-10	7.3E-11	4.6E-11	2.9E-11	2.4E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	<i>f</i> <sub>1</sub>	<i>e</i> ( $\tau$ )		<i>f</i> <sub>1</sub>	<i>e</i> ( $\tau$ )				
			<1y	3 Months	$\geq$ 1y	<i>f</i> <sub>1</sub>	1 Years	5 Years	10 Years	15 Years	Adult
Rh-97m	46.2 m	F	0.1	1.9E-10	0.05	1.3E-10	6.5E-11	4.0E-11	2.3E-11	1.9E-11	
		M	0.1	2.5E-10	0.05	1.7E-10	8.5E-11	5.3E-11	3.3E-11	2.7E-11	
		S	0.1	2.6E-10	0.05	1.8E-10	8.8E-11	5.5E-11	3.4E-11	2.7E-11	
Rh-98	8.7 m	F	0.1	1.1E-10	0.05	6.3E-11	2.9E-11	1.8E-11	1.1E-11	9.3E-12	
		M	0.1	1.4E-10	0.05	8.3E-11	3.8E-11	2.4E-11	1.5E-11	1.3E-11	
		S	0.1	1.5E-10	0.05	8.5E-11	3.9E-11	2.5E-11	1.5E-11	1.3E-11	
Rh-100m	4.6 m	F	0.1	1.6E-11	0.05	1.1E-11	5.7E-12	3.6E-12	2.3E-12	1.9E-12	
		M	0.1	2.0E-11	0.05	1.4E-11	7.1E-12	4.6E-12	3.0E-12	2.4E-12	
		S	0.1	2.1E-11	0.05	1.4E-11	7.2E-12	4.7E-12	3.1E-12	2.5E-12	
<b>Palladium</b>											
Pd-98	17.7 m	F	0.05	2.0E-10	0.005	1.2E-10	5.3E-11	3.3E-11	1.9E-11	1.6E-11	
		M	0.05	3.1E-10	0.005	1.8E-10	8.2E-11	5.1E-11	3.2E-11	2.7E-11	
		S	0.05	3.2E-10	0.005	1.8E-10	8.5E-11	5.3E-11	3.4E-11	2.8E-11	
Pd-99	21.4 m	F	0.05	1.3E-10	0.005	8.4E-11	4.0E-11	2.5E-11	1.5E-11	1.2E-11	
		M	0.05	1.9E-10	0.005	1.2E-10	5.6E-11	3.5E-11	2.2E-11	1.8E-11	
		S	0.05	2.0E-10	0.005	1.2E-10	5.7E-11	3.7E-11	2.3E-11	1.9E-11	
Pd-109m	4.69 m	F	0.05	3.0E-11	0.005	1.7E-11	7.6E-12	5.0E-12	3.0E-12	2.6E-12	
		M	0.05	4.4E-11	0.005	2.6E-11	1.2E-11	8.1E-12	5.5E-12	4.6E-12	
		S	0.05	4.6E-11	0.005	2.7E-11	1.2E-11	8.5E-12	5.7E-12	4.9E-12	
Pd-111	23.4 m	F	0.05	1.6E-10	0.005	8.6E-11	3.7E-11	2.4E-11	1.5E-11	1.3E-11	
		M	0.05	2.7E-10	0.005	1.4E-10	6.6E-11	4.3E-11	2.9E-11	2.5E-11	
		S	0.05	2.8E-10	0.005	1.5E-10	6.9E-11	4.6E-11	3.1E-11	2.6E-11	
Pd-112	21.03 h	F	0.05	7.4E-09	0.005	4.2E-09	1.8E-09	1.1E-09	5.9E-10	4.9E-10	
		M	0.05	1.2E-08	0.005	7.0E-09	3.2E-09	2.1E-09	1.2E-09	1.0E-09	
		S	0.05	1.2E-08	0.005	7.3E-09	3.4E-09	2.2E-09	1.3E-09	1.1E-09	
<b>Silver</b>											
Ag-101	11.1 m	F	0.1	1.1E-10	0.05	6.5E-11	3.0E-11	1.9E-11	1.1E-11	9.5E-12	
		M	0.1	1.5E-10	0.05	8.7E-11	4.0E-11	2.6E-11	1.6E-11	1.3E-11	
		S	0.02	1.5E-10	0.01	8.9E-11	4.2E-11	2.6E-11	1.7E-11	1.4E-11	
Ag-105m	7.23 m	F	0.1	1.4E-12	0.05	7.9E-13	3.7E-13	2.3E-13	1.4E-13	1.2E-13	
		M	0.1	1.7E-12	0.05	9.2E-13	4.6E-13	2.9E-13	2.0E-13	1.6E-13	
		S	0.02	1.7E-12	0.01	9.5E-13	4.8E-13	3.0E-13	2.1E-13	1.7E-13	
Ag-108	2.37 m	F	0.1	2.2E-11	0.05	1.3E-11	5.4E-12	3.7E-12	2.3E-12	2.1E-12	
		M	0.1	2.5E-11	0.05	1.5E-11	6.3E-12	4.3E-12	2.7E-12	2.4E-12	
		S	0.02	2.6E-11	0.01	1.5E-11	6.4E-12	4.4E-12	2.8E-12	2.5E-12	
Ag-111m	1.08 m	F	0.1	1.3E-12	0.05	7.8E-13	4.1E-13	2.7E-13	1.8E-13	1.5E-13	
		M	0.1	1.8E-12	0.05	1.2E-12	6.3E-13	4.4E-13	3.3E-13	2.7E-13	
		S	0.02	1.9E-12	0.01	1.2E-12	6.7E-13	4.6E-13	3.6E-13	2.9E-13	
Ag-113	5.37 h	F	0.1	1.0E-09	0.05	5.6E-10	2.3E-10	1.4E-10	7.4E-11	6.3E-11	
		M	0.1	1.9E-09	0.05	1.1E-09	4.9E-10	3.2E-10	1.9E-10	1.6E-10	
		S	0.02	2.1E-09	0.01	1.2E-09	5.2E-10	3.4E-10	2.1E-10	1.7E-10	

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$		$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	$f_1$	1 Years	5 Years	10 Years	15 Years	Adult
Ag-113m	1.145 m	F	0.1	7.4E-12	0.05	4.3E-12	1.9E-12	1.3E-12	7.6E-13	6.7E-13	
		M	0.1	9.8E-12	0.05	5.8E-12	2.6E-12	1.7E-12	1.1E-12	9.4E-13	
		S	0.02	1.0E-11	0.01	6.0E-12	2.7E-12	1.8E-12	1.1E-12	9.7E-13	
<b>Cadmium</b>											
Cd-105	55.5 m	F	0.1	1.6E-10	0.05	1.1E-10	5.3E-11	3.3E-11	1.9E-11	1.6E-11	
		M	0.1	2.3E-10	0.05	1.5E-10	7.2E-11	4.5E-11	2.8E-11	2.3E-11	
		S	0.1	2.4E-10	0.05	1.5E-10	7.4E-11	4.7E-11	2.9E-11	2.4E-11	
Cd-111m	48.54 m	F	0.1	1.0E-10	0.05	6.4E-11	2.9E-11	1.9E-11	1.2E-11	1.0E-11	
		M	0.1	1.8E-10	0.05	1.1E-10	5.3E-11	3.7E-11	2.6E-11	2.2E-11	
		S	0.1	1.9E-10	0.05	1.2E-10	5.6E-11	3.9E-11	2.8E-11	2.3E-11	
Cd-113m	14.1 y	F	0.1	3.0E-07	0.05	2.7E-07	1.7E-07	1.3E-07	1.1E-07	1.1E-07	
		M	0.1	1.4E-07	0.05	1.2E-07	7.8E-08	5.9E-08	5.3E-08	5.3E-08	
		S	0.1	1.1E-07	0.05	7.8E-08	5.0E-08	3.6E-08	3.1E-08	3.0E-08	
Cd-118	50.3 m	F	0.1	5.4E-10	0.05	2.7E-10	1.1E-10	7.1E-11	4.1E-11	3.5E-11	
		M	0.1	9.3E-10	0.05	4.9E-10	2.2E-10	1.4E-10	8.7E-11	7.4E-11	
		S	0.1	9.8E-10	0.05	5.1E-10	2.3E-10	1.5E-10	9.3E-11	7.8E-11	
<b>Indium</b>											
In-107	32.4 m	F	0.04	1.5E-10	0.02	9.8E-11	4.7E-11	2.9E-11	1.7E-11	1.4E-11	
		M	0.04	2.3E-10	0.02	1.5E-10	7.2E-11	4.6E-11	3.0E-11	2.4E-11	
In-108	58.0 m	F	0.04	3.3E-10	0.02	2.5E-10	1.3E-10	7.8E-11	4.6E-11	3.7E-11	
		M	0.04	4.3E-10	0.02	3.1E-10	1.6E-10	9.9E-11	6.0E-11	4.8E-11	
In-108m	39.6 m	F	0.04	2.8E-10	0.02	1.7E-10	8.3E-11	5.1E-11	3.0E-11	2.4E-11	
		M	0.04	4.0E-10	0.02	2.4E-10	1.2E-10	7.2E-11	4.5E-11	3.7E-11	
In-109m	1.34 m	F	0.04	3.7E-12	0.02	2.7E-12	1.4E-12	8.5E-13	5.1E-13	4.1E-13	
		M	0.04	4.2E-12	0.02	3.1E-12	1.6E-12	9.7E-13	6.0E-13	4.8E-13	
In-111m	7.7 m	F	0.04	1.5E-11	0.02	1.0E-11	4.8E-12	3.0E-12	1.8E-12	1.5E-12	
		M	0.04	1.9E-11	0.02	1.3E-11	6.2E-12	4.0E-12	2.5E-12	2.1E-12	
In-112m	20.56 m	F	0.04	1.2E-10	0.02	6.8E-11	3.0E-11	2.0E-11	1.2E-11	1.1E-11	
		M	0.04	2.0E-10	0.02	1.2E-10	5.3E-11	3.6E-11	2.5E-11	2.1E-11	
In-114	1.19833 m	F	0.04	1.2E-11	0.02	7.2E-12	3.1E-12	2.1E-12	1.4E-12	1.2E-12	
		M	0.04	1.4E-11	0.02	7.9E-12	3.4E-12	2.3E-12	1.5E-12	1.3E-12	
In-118m	4.364 m	F	0.04	5.5E-11	0.02	3.6E-11	1.7E-11	1.1E-11	6.6E-12	5.6E-12	
		M	0.04	6.7E-11	0.02	4.3E-11	2.0E-11	1.3E-11	8.1E-12	6.8E-12	
In-119	2.4 m	F	0.04	2.5E-11	0.02	1.5E-11	6.9E-12	4.5E-12	2.8E-12	2.5E-12	
		M	0.04	2.9E-11	0.02	1.8E-11	7.9E-12	5.2E-12	3.3E-12	2.9E-12	
<b>Tin</b>											
Sn-108	10.30 m	F	0.04	8.3E-11	0.02	5.4E-11	2.6E-11	1.6E-11	9.4E-12	7.6E-12	
		M	0.04	1.2E-10	0.02	7.5E-11	3.6E-11	2.3E-11	1.4E-11	1.1E-11	
Sn-109	18.0 m	F	0.04	8.1E-11	0.02	6.1E-11	3.2E-11	1.9E-11	1.1E-11	9.1E-12	
		M	0.04	1.0E-10	0.02	7.5E-11	3.9E-11	2.4E-11	1.5E-11	1.2E-11	

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Sn-113m	21.4 m	F	0.04	1.8E-11	0.02	1.1E-11	5.2E-12	3.4E-12	2.4E-12	2.0E-12
		M	0.04	3.1E-11	0.02	1.9E-11	9.7E-12	6.5E-12	4.9E-12	4.1E-12
Sn-125m	9.52 m	F	0.04	7.9E-11	0.02	4.4E-11	1.9E-11	1.3E-11	7.7E-12	6.7E-12
		M	0.04	1.1E-10	0.02	6.1E-11	2.7E-11	1.8E-11	1.1E-11	9.8E-12
<b>Antimony</b>										
Sb-114	3.49 m	F	0.2	4.6E-11	0.1	2.9E-11	1.4E-11	8.8E-12	5.4E-12	4.5E-12
		M	0.02	5.4E-11	0.01	3.4E-11	1.6E-11	1.0E-11	6.3E-12	5.3E-12
		S	0.02	5.5E-11	0.01	3.5E-11	1.6E-11	1.0E-11	6.4E-12	5.4E-12
Sb-118	3.6 m	F	0.2	3.3E-11	0.1	2.0E-11	8.9E-12	5.7E-12	3.5E-12	3.1E-12
		M	0.02	4.0E-11	0.01	2.3E-11	1.1E-11	6.9E-12	4.3E-12	3.7E-12
		S	0.02	4.0E-11	0.01	2.4E-11	1.1E-11	7.0E-12	4.4E-12	3.8E-12
Sb-122m	4.191 m	F	0.2	1.1E-11	0.1	6.6E-12	3.1E-12	2.0E-12	1.2E-12	1.0E-12
		M	0.02	1.7E-11	0.01	1.0E-11	5.2E-12	3.4E-12	2.4E-12	2.0E-12
		S	0.02	1.8E-11	0.01	1.1E-11	5.4E-12	3.6E-12	2.5E-12	2.1E-12
Sb-124m	1.55 m	F	0.2	5.1E-12	0.1	3.3E-12	1.5E-12	1.0E-12	6.2E-13	5.3E-13
		M	0.02	5.9E-12	0.01	3.8E-12	1.8E-12	1.2E-12	7.6E-13	6.5E-13
		S	0.02	6.0E-12	0.01	3.9E-12	1.9E-12	1.2E-12	8.0E-13	6.8E-13
<b>Tellurium</b>										
Te-117	62 m	F	0.6	2.0E-10	0.3	1.4E-10	7.0E-11	4.3E-11	2.5E-11	2.0E-11
		M	0.2	3.0E-10	0.1	2.0E-10	9.8E-11	6.2E-11	3.9E-11	3.1E-11
		S	0.02	3.1E-10	0.01	2.0E-10	1.0E-10	6.4E-11	4.0E-11	3.3E-11
Te-118	6.00 d	F	0.6	1.2E-08	0.3	7.5E-09	3.4E-09	1.9E-09	1.1E-09	8.5E-10
		M	0.2	2.0E-08	0.1	1.3E-08	6.3E-09	4.1E-09	2.7E-09	2.3E-09
		S	0.02	2.2E-08	0.01	1.3E-08	6.8E-09	4.4E-09	3.0E-09	2.6E-09
Te-119	16.03 h	F	0.6	6.5E-10	0.3	5.2E-10	2.7E-10	1.6E-10	9.4E-11	7.5E-11
		M	0.2	9.1E-10	0.1	6.8E-10	3.5E-10	2.2E-10	1.3E-10	1.0E-10
		S	0.02	9.9E-10	0.01	7.1E-10	3.6E-10	2.3E-10	1.4E-10	1.1E-10
Te-119m	4.70 d	F	0.6	2.8E-09	0.3	2.1E-09	1.1E-09	6.9E-10	4.1E-10	3.4E-10
		M	0.2	3.9E-09	0.1	2.8E-09	1.5E-09	9.9E-10	6.5E-10	5.2E-10
		S	0.02	4.1E-09	0.01	3.0E-09	1.6E-09	1.0E-09	6.9E-10	5.5E-10
<b>Iodine</b>										
I-118	13.7 m	F	1	6.8E-10	1	5.5E-10	2.7E-10	1.4E-10	8.3E-11	5.8E-11
		M	0.2	4.3E-10	0.1	2.5E-10	1.2E-10	6.9E-11	4.2E-11	3.4E-11
		S	0.02	3.5E-10	0.01	2.0E-10	9.1E-11	5.7E-11	3.5E-11	3.0E-11
I-119	19.1 m	F	1	1.7E-10	1	1.2E-10	5.6E-11	3.2E-11	1.9E-11	1.5E-11
		M	0.2	1.8E-10	0.1	1.1E-10	5.1E-11	3.2E-11	2.0E-11	1.7E-11
		S	0.02	1.8E-10	0.01	1.1E-10	5.0E-11	3.2E-11	2.0E-11	1.7E-11
I-122	3.63 m	F	1	3.9E-11	1	2.3E-11	1.0E-11	6.7E-12	4.1E-12	3.5E-12
		M	0.2	4.6E-11	0.1	2.7E-11	1.2E-11	7.8E-12	4.9E-12	4.2E-12
		S	0.02	4.6E-11	0.01	2.7E-11	1.2E-11	8.0E-12	5.0E-12	4.3E-12

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	≥1y	1 Years	5 Years	10 Years	15 Years	Adult
<b>Caesium</b>										
Cs-126	1.64 m	F	1	2.0E-11	1	1.2E-11	5.5E-12	3.6E-12	2.2E-12	1.9E-12
		M	0.2	2.2E-11	0.1	1.3E-11	6.0E-12	3.9E-12	2.4E-12	2.1E-12
		S	0.02	2.2E-11	0.01	1.3E-11	6.1E-12	4.0E-12	2.5E-12	2.1E-12
Cs-128	3.62 m	F	1	3.3E-11	1	1.9E-11	8.8E-12	5.7E-12	3.5E-12	3.0E-12
		M	0.2	3.9E-11	0.1	2.3E-11	1.0E-11	6.8E-12	4.2E-12	3.7E-12
		S	0.02	4.0E-11	0.01	2.3E-11	1.1E-11	6.9E-12	4.3E-12	3.7E-12
Cs-130m	3.46 m	F	1	1.7E-11	1	1.0E-11	4.7E-12	3.0E-12	1.9E-12	1.6E-12
		M	0.2	2.5E-11	0.1	1.5E-11	6.9E-12	4.5E-12	3.0E-12	2.5E-12
		S	0.02	2.6E-11	0.01	1.5E-11	7.1E-12	4.6E-12	3.1E-12	2.6E-12
Cs-139	9.27 m	F	1	1.4E-10	1	7.2E-11	3.1E-11	2.0E-11	1.2E-11	1.0E-11
		M	0.2	2.2E-10	0.1	1.2E-10	5.1E-11	3.3E-11	2.1E-11	1.8E-11
		S	0.02	2.3E-10	0.01	1.2E-10	5.4E-11	3.5E-11	2.2E-11	1.9E-11
<b>Barium</b>										
Ba-124	11.0 m	F	0.6	1.9E-10	0.2	1.1E-10	5.0E-11	3.1E-11	1.8E-11	1.6E-11
		M	0.2	2.6E-10	0.1	1.5E-10	6.6E-11	4.2E-11	2.6E-11	2.2E-11
		S	0.02	2.7E-10	0.01	1.5E-10	6.8E-11	4.3E-11	2.7E-11	2.3E-11
Ba-127	12.7 m	F	0.6	8.5E-11	0.2	5.2E-11	2.4E-11	1.5E-11	8.9E-12	7.9E-12
		M	0.2	1.2E-10	0.1	6.9E-11	3.2E-11	2.1E-11	1.3E-11	1.1E-11
		S	0.02	1.2E-10	0.01	7.1E-11	3.3E-11	2.1E-11	1.4E-11	1.1E-11
Ba-129	2.23 h	F	0.6	1.8E-10	0.2	1.3E-10	6.4E-11	3.7E-11	2.0E-11	2.0E-11
		M	0.2	2.7E-10	0.1	1.7E-10	8.5E-11	5.4E-11	3.5E-11	2.9E-11
		S	0.02	2.9E-10	0.01	1.8E-10	8.8E-11	5.7E-11	3.6E-11	3.0E-11
Ba-129m	2.16 h	F	0.6	3.0E-10	0.2	2.5E-10	1.3E-10	7.7E-11	4.4E-11	3.9E-11
		M	0.2	4.0E-10	0.1	2.9E-10	1.5E-10	9.7E-11	6.0E-11	4.8E-11
		S	0.02	4.1E-10	0.01	3.0E-10	1.6E-10	9.9E-11	6.2E-11	4.9E-11
Ba-137m	2.552 m	F	0.6	4.9E-12	0.2	3.5E-12	1.7E-12	1.1E-12	6.6E-13	5.4E-13
		M	0.2	5.5E-12	0.1	3.9E-12	1.9E-12	1.2E-12	7.3E-13	6.0E-13
		S	0.02	5.5E-12	0.01	3.9E-12	1.9E-12	1.2E-12	7.4E-13	6.1E-13
<b>Lanthanum</b>										
La-129	11.6 m	F	0.005	9.1E-11	5E-04	5.5E-11	2.5E-11	1.6E-11	9.6E-12	8.0E-12
		M	0.005	1.3E-10	5E-04	7.6E-11	3.5E-11	2.3E-11	1.4E-11	1.2E-11
La-130	8.7 m	F	0.005	9.8E-11	5E-04	5.9E-11	2.7E-11	1.7E-11	1.0E-11	8.6E-12
		M	0.005	1.3E-10	5E-04	7.6E-11	3.5E-11	2.2E-11	1.4E-11	1.2E-11
La-132m	24.3 m	F	0.005	1.3E-10	5E-04	8.5E-11	4.1E-11	2.5E-11	1.5E-11	1.2E-11
		M	0.005	2.0E-10	5E-04	1.3E-10	6.1E-11	3.9E-11	2.4E-11	2.0E-11
La-133	3.912 h	F	0.005	1.5E-10	5E-04	1.0E-10	4.8E-11	3.0E-11	1.7E-11	1.4E-11
		M	0.005	2.3E-10	5E-04	1.5E-10	7.0E-11	4.5E-11	2.8E-11	2.3E-11
La-134	6.45 m	F	0.005	4.8E-11	5E-04	2.8E-11	1.3E-11	8.1E-12	4.9E-12	4.2E-12
		M	0.005	6.2E-11	5E-04	3.6E-11	1.6E-11	1.0E-11	6.5E-12	5.6E-12

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
La-136	9.87 m	F	0.005	3.4E-11	5E-04	2.0E-11	9.2E-12	5.8E-12	3.6E-12	3.0E-12
		M	0.005	4.7E-11	5E-04	2.7E-11	1.2E-11	8.0E-12	5.1E-12	4.3E-12
<b>Cerium</b>										
Ce-130	22.9 m	F	0.005	2.4E-10	5E-04	1.4E-10	6.7E-11	4.1E-11	2.4E-11	2.0E-11
		M	0.005	3.8E-10	5E-04	2.2E-10	1.0E-10	6.5E-11	4.1E-11	3.4E-11
		S	0.005	4.0E-10	5E-04	2.3E-10	1.1E-10	6.7E-11	4.3E-11	3.5E-11
Ce-131	10.2 m	F	0.005	1.0E-10	5E-04	6.2E-11	2.9E-11	1.8E-11	1.1E-11	9.2E-12
		M	0.005	1.4E-10	5E-04	8.5E-11	4.0E-11	2.6E-11	1.7E-11	1.4E-11
		S	0.005	1.4E-10	5E-04	8.7E-11	4.2E-11	2.7E-11	1.7E-11	1.4E-11
Ce-131m	5.0 m	F	0.005	5.8E-11	5E-04	3.5E-11	1.6E-11	1.0E-11	6.2E-12	5.3E-12
		M	0.005	7.6E-11	5E-04	4.5E-11	2.1E-11	1.4E-11	8.6E-12	7.3E-12
		S	0.005	7.8E-11	5E-04	4.6E-11	2.2E-11	1.4E-11	8.9E-12	7.6E-12
Ce-132	3.51 h	F	0.005	9.7E-10	5E-04	6.2E-10	2.9E-10	1.8E-10	9.9E-11	8.1E-11
		M	0.005	1.4E-09	5E-04	9.2E-10	4.4E-10	2.8E-10	1.6E-10	1.3E-10
		S	0.005	1.5E-09	5E-04	9.5E-10	4.6E-10	2.9E-10	1.7E-10	1.4E-10
Ce-133	97 m	F	0.005	3.0E-10	5E-04	1.8E-10	8.4E-11	5.2E-11	3.0E-11	2.5E-11
		M	0.005	4.9E-10	5E-04	2.9E-10	1.4E-10	9.2E-11	6.1E-11	5.0E-11
		S	0.005	5.1E-10	5E-04	3.0E-10	1.5E-10	9.6E-11	6.4E-11	5.2E-11
Ce-133m	4.9 h	F	0.005	7.7E-10	5E-04	5.6E-10	2.8E-10	1.8E-10	1.0E-10	8.2E-11
		M	0.005	1.1E-09	5E-04	7.5E-10	3.8E-10	2.4E-10	1.5E-10	1.2E-10
		S	0.005	1.1E-09	5E-04	7.7E-10	3.9E-10	2.5E-10	1.5E-10	1.2E-10
Ce-146	13.52 m	F	0.005	1.7E-10	5E-04	9.7E-11	4.3E-11	2.7E-11	1.6E-11	1.4E-11
		M	0.005	2.8E-10	5E-04	1.6E-10	7.1E-11	4.6E-11	3.0E-11	2.5E-11
		S	0.005	2.9E-10	5E-04	1.6E-10	7.4E-11	4.8E-11	3.1E-11	2.6E-11
<b>Praseodymium</b>										
Pr-134	17 m	M	0.005	3.4E-10	5E-04	2.0E-10	9.0E-11	5.7E-11	3.5E-11	2.9E-11
		S	0.005	3.5E-10	5E-04	2.0E-10	9.4E-11	5.9E-11	3.7E-11	3.1E-11
Pr-134m	11 m	M	0.005	2.1E-10	5E-04	1.3E-10	6.0E-11	3.8E-11	2.3E-11	1.9E-11
		S	0.005	2.1E-10	5E-04	1.3E-10	6.2E-11	3.9E-11	2.4E-11	2.0E-11
Pr-135	24 m	M	0.005	2.2E-10	5E-04	1.3E-10	6.1E-11	3.9E-11	2.5E-11	2.0E-11
		S	0.005	2.3E-10	5E-04	1.3E-10	6.3E-11	4.0E-11	2.6E-11	2.1E-11
Pr-138	1.45 m	M	0.005	1.7E-11	5E-04	1.0E-11	4.6E-12	3.0E-12	1.9E-12	1.7E-12
		S	0.005	1.7E-11	5E-04	1.0E-11	4.7E-12	3.0E-12	1.9E-12	1.7E-12
Pr-140	3.39 m	M	0.005	2.5E-11	5E-04	1.5E-11	6.8E-12	4.4E-12	2.8E-12	2.4E-12
		S	0.005	2.6E-11	5E-04	1.5E-11	6.9E-12	4.5E-12	2.8E-12	2.4E-12
Pr-144m	7.2 m	M	0.005	9.2E-11	5E-04	4.7E-11	2.1E-11	1.3E-11	8.5E-12	7.2E-12
		S	0.005	9.6E-11	5E-04	4.9E-11	2.2E-11	1.4E-11	9.0E-12	7.6E-12
Pr-146	24.15 m	M	0.005	3.4E-10	5E-04	1.9E-10	8.4E-11	5.3E-11	3.3E-11	2.8E-11
		S	0.005	3.5E-10	5E-04	1.9E-10	8.7E-11	5.5E-11	3.5E-11	2.9E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$		$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Neodymium</b>											
Nd-135	12.4 m	M	0.005	2.8E-10	5E-04	1.6E-10	7.6E-11	4.8E-11	3.1E-11	2.6E-11	
		S	0.005	2.9E-10	5E-04	1.7E-10	7.9E-11	5.0E-11	3.2E-11	2.7E-11	
Nd-137	38.5 m	M	0.005	3.0E-10	5E-04	1.8E-10	8.6E-11	5.5E-11	3.4E-11	2.8E-11	
		S	0.005	3.1E-10	5E-04	1.9E-10	8.9E-11	5.7E-11	3.6E-11	2.9E-11	
Nd-140	3.37 d	M	0.005	1.1E-08	5E-04	6.3E-09	3.0E-09	2.0E-09	1.3E-09	1.1E-09	
		S	0.005	1.1E-08	5E-04	6.5E-09	3.2E-09	2.1E-09	1.3E-09	1.1E-09	
Nd-141m	1.03333 m	M	0.005	2.6E-12	5E-04	1.9E-12	9.4E-13	5.8E-13	3.6E-13	2.9E-13	
		S	0.005	2.6E-12	5E-04	1.9E-12	9.5E-13	5.9E-13	3.6E-13	2.9E-13	
Nd-144	2.29E+15y	M	0.005	2.0E-05	5E-04	1.9E-05	1.2E-05	8.5E-06	7.7E-06	7.8E-06	
		S	0.005	1.1E-05	5E-04	9.6E-06	6.1E-06	4.0E-06	3.4E-06	3.4E-06	
Nd-152	11.4 m	M	0.005	2.6E-10	5E-04	1.4E-10	6.2E-11	4.1E-11	2.6E-11	2.2E-11	
		S	0.005	2.7E-10	5E-04	1.5E-10	6.5E-11	4.2E-11	2.7E-11	2.3E-11	
<b>Promethium</b>											
Pm-138	3.24 m	M	0.005	8.2E-11	5E-04	5.0E-11	2.3E-11	1.5E-11	8.9E-12	7.4E-12	
		S	0.005	8.4E-11	5E-04	5.1E-11	2.4E-11	1.5E-11	9.1E-12	7.6E-12	
Pm-139	4.15 m	M	0.005	6.4E-11	5E-04	3.7E-11	1.7E-11	1.1E-11	6.9E-12	5.9E-12	
		S	0.005	6.6E-11	5E-04	3.8E-11	1.8E-11	1.1E-11	7.1E-12	6.0E-12	
Pm-140m	5.95 m	M	0.005	1.0E-10	5E-04	6.5E-11	3.1E-11	2.0E-11	1.2E-11	1.0E-11	
		S	0.005	1.1E-10	5E-04	6.7E-11	3.2E-11	2.0E-11	1.2E-11	1.0E-11	
Pm-152	4.12 m	M	0.005	6.3E-11	5E-04	3.5E-11	1.5E-11	1.0E-11	6.4E-12	5.6E-12	
		S	0.005	6.4E-11	5E-04	3.6E-11	1.6E-11	1.0E-11	6.5E-12	5.8E-12	
<b>Samarium</b>											
Sm-140	14.82 m	M	0.005	3.8E-10	5E-04	2.1E-10	9.6E-11	6.0E-11	3.7E-11	3.2E-11	
Sm-143	8.83 m	M	0.005	5.9E-11	5E-04	3.4E-11	1.5E-11	9.8E-12	6.2E-12	5.3E-12	
Sm-143m	1.1 m	M	0.005	9.9E-12	5E-04	6.0E-12	2.8E-12	1.8E-12	1.1E-12	9.3E-13	
Sm-148	7E+15 y	M	0.005	2.1E-05	5E-04	1.9E-05	1.3E-05	8.9E-06	8.1E-06	8.2E-06	
<b>Europium</b>											
Eu-143	2.59 m	M	0.005	5.1E-11	5E-04	3.0E-11	1.4E-11	8.8E-12	5.5E-12	4.7E-12	
Eu-152n	96 m	M	0.005	7.3E-11	5E-04	4.4E-11	2.3E-11	1.5E-11	9.6E-12	8.1E-12	
Eu-154m	46.0 m	M	0.005	4.1E-11	5E-04	2.4E-11	1.2E-11	7.5E-12	5.1E-12	4.3E-12	
Eu-159	18.1 m	M	0.005	2.5E-10	5E-04	1.4E-10	6.3E-11	4.1E-11	2.7E-11	2.3E-11	
<b>Gadolinium</b>											
Gd-145m	1.41666 m	F	0.005	1.2E-11	5E-04	7.8E-12	3.8E-12	2.4E-12	1.4E-12	1.2E-12	
		M	0.005	1.5E-11	5E-04	9.5E-12	4.7E-12	2.9E-12	1.8E-12	1.5E-12	
Gd-150	1.79E+6 y	F	0.005	7.4E-05	5E-04	6.7E-05	4.1E-05	2.9E-05	2.4E-05	2.4E-05	
		M	0.005	2.8E-05	5E-04	2.5E-05	1.7E-05	1.1E-05	1.0E-05	1.0E-05	

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Terbium</b>										
Tb-147m	1.87 m	M	0.005	1.6E-11	5E-04	1.1E-11	5.4E-12	3.4E-12	2.1E-12	1.7E-12
Tb-148	60 m	M	0.005	6.4E-10	5E-04	3.9E-10	1.9E-10	1.2E-10	8.1E-11	6.9E-11
Tb-148m	2.20 m	M	0.005	2.3E-11	5E-04	1.7E-11	8.5E-12	5.3E-12	3.4E-12	2.9E-12
Tb-149m	4.16 m	M	0.005	2.6E-11	5E-04	1.8E-11	8.9E-12	5.6E-12	3.6E-12	3.0E-12
Tb-150m	5.8 m	M	0.005	3.9E-11	5E-04	2.8E-11	1.4E-11	8.8E-12	5.4E-12	4.3E-12
Tb-152	17.5 h	M	0.005	3.0E-09	5E-04	2.0E-09	9.7E-10	6.2E-10	3.7E-10	3.0E-10
Tb-152m	4.2 m	M	0.005	5.3E-11	5E-04	3.3E-11	1.5E-11	1.0E-11	6.4E-12	5.5E-12
Tb-162	7.60 m	M	0.005	9.6E-11	5E-04	5.7E-11	2.6E-11	1.7E-11	1.1E-11	9.7E-12
Tb-163	19.5 m	M	0.005	1.6E-10	5E-04	9.7E-11	4.5E-11	3.0E-11	2.0E-11	1.7E-11
Tb-164	3.0 m	M	0.005	5.5E-11	5E-04	3.5E-11	1.6E-11	1.1E-11	6.8E-12	5.8E-12
Tb-165	2.11 m	M	0.005	5.1E-11	5E-04	3.0E-11	1.4E-11	9.1E-12	5.9E-12	5.2E-12
<b>Dysprosium</b>										
Dy-149	4.20 m	M	0.005	3.4E-10	5E-04	2.2E-10	1.4E-10	9.6E-11	8.3E-11	7.1E-11
Dy-150	7.17 m	M	0.005	1.6E-09	5E-04	1.1E-09	6.9E-10	4.8E-10	4.3E-10	3.6E-10
Dy-151	17.9 m	M	0.005	6.1E-10	5E-04	4.0E-10	2.6E-10	1.8E-10	1.5E-10	1.3E-10
Dy-152	2.38 h	M	0.005	5.2E-10	5E-04	3.5E-10	1.8E-10	1.1E-10	7.2E-11	5.9E-11
Dy-153	6.4 h	M	0.005	1.0E-09	5E-04	6.8E-10	3.5E-10	2.3E-10	1.6E-10	1.3E-10
Dy-154	3.0E+6 y	M	0.005	3.0E-05	5E-04	2.8E-05	1.8E-05	1.2E-05	1.1E-05	1.1E-05
Dy-165m	1.257 m	M	0.005	1.7E-11	5E-04	9.6E-12	4.3E-12	2.9E-12	1.9E-12	1.7E-12
Dy-167	6.20 m	M	0.005	1.1E-10	5E-04	6.3E-11	2.9E-11	1.9E-11	1.2E-11	1.1E-11
Dy-168	8.7 m	M	0.005	2.3E-10	5E-04	1.3E-10	5.8E-11	3.9E-11	2.5E-11	2.2E-11
<b>Holmium</b>										
Ho-152	2.69666 m	M	0.005	2.3E-10	5E-04	1.5E-10	9.8E-11	6.7E-11	6.1E-11	5.1E-11
Ho-153	2.02 m	M	0.005	2.4E-11	5E-04	1.5E-11	7.4E-12	4.8E-12	3.2E-12	2.7E-12
Ho-153m	9.3 m	M	0.005	1.4E-10	5E-04	8.5E-11	4.1E-11	2.7E-11	1.8E-11	1.5E-11
Ho-154	11.76 m	M	0.005	1.7E-10	5E-04	1.0E-10	4.6E-11	2.9E-11	1.8E-11	1.5E-11
Ho-154m	3.10 m	M	0.005	4.4E-11	5E-04	2.8E-11	1.3E-11	8.5E-12	5.3E-12	4.5E-12
Ho-156	56 m	M	0.005	5.7E-10	5E-04	3.4E-10	1.6E-10	1.0E-10	6.6E-11	5.5E-11
Ho-158	11.3 m	M	0.005	6.6E-11	5E-04	4.6E-11	2.3E-11	1.5E-11	9.5E-12	7.8E-12
Ho-160	25.6 m	M	0.005	1.1E-10	5E-04	7.7E-11	4.0E-11	2.5E-11	1.6E-11	1.3E-11
Ho-163	4570 y	M	0.005	8.8E-10	5E-04	7.5E-10	4.8E-10	3.3E-10	2.5E-10	2.6E-10
Ho-168	2.99 m	M	0.005	4.3E-11	5E-04	2.6E-11	1.2E-11	7.7E-12	4.9E-12	4.3E-12

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Ho-168m	2.2 m	M	0.005	3.2E-11	5E-04	1.9E-11	8.6E-12	5.7E-12	3.7E-12	3.2E-12
Ho-170	2.76 m	M	0.005	4.9E-11	5E-04	3.0E-11	1.4E-11	9.3E-12	6.0E-12	5.1E-12
<b>Erbiun</b>										
Er-155	5.3 m	M	0.005	6.9E-11	5E-04	4.2E-11	2.0E-11	1.3E-11	8.4E-12	7.1E-12
Er-156	19.5 m	M	0.005	2.0E-10	5E-04	1.1E-10	5.6E-11	3.6E-11	2.4E-11	1.9E-11
Er-159	36 m	M	0.005	1.5E-10	5E-04	9.9E-11	5.0E-11	3.2E-11	2.1E-11	1.7E-11
Er-163	75.0 m	M	0.005	1.2E-11	5E-04	8.0E-12	4.0E-12	2.5E-12	1.5E-12	1.2E-12
<b>Thulium</b>										
Tm-159	9.13 m	M	0.005	1.1E-10	5E-04	6.4E-11	3.1E-11	2.0E-11	1.3E-11	1.1E-11
Tm-163	1.810 h	M	0.005	3.0E-10	5E-04	2.1E-10	1.1E-10	7.0E-11	4.5E-11	3.7E-11
Tm-164	2.0 m	M	0.005	2.2E-11	5E-04	9.6E-12	4.4E-12	2.9E-12	1.8E-12	1.6E-12
Tm-165	30.06 h	M	0.005	1.8E-09	5E-04	1.2E-09	6.1E-10	4.0E-10	2.7E-10	2.2E-10
Tm-168	93.1 d	M	0.005	2.2E-08	5E-04	1.6E-08	9.8E-09	6.7E-09	5.5E-09	4.5E-09
<b>Ytterbium</b>										
Yb-163	11.05 m	M	0.005	7.7E-11	5E-04	4.9E-11	2.4E-11	1.5E-11	9.8E-12	8.1E-12
		S	0.005	7.9E-11	5E-04	5.1E-11	2.5E-11	1.6E-11	1.0E-11	8.4E-12
Yb-164	75.8 m	M	0.005	4.4E-10	5E-04	2.6E-10	1.2E-10	7.7E-11	4.9E-11	4.1E-11
		S	0.005	4.5E-10	5E-04	2.7E-10	1.3E-10	8.0E-11	5.2E-11	4.3E-11
Yb-165	9.9 m	M	0.005	4.1E-11	5E-04	2.6E-11	1.3E-11	8.4E-12	5.9E-12	4.8E-12
		S	0.005	4.3E-11	5E-04	2.6E-11	1.3E-11	8.7E-12	6.1E-12	5.0E-12
<b>Lutetium</b>										
Lu-164	3.14 m	M	0.005	7.4E-11	5E-04	4.3E-11	2.0E-11	1.3E-11	8.1E-12	6.9E-12
		S	0.005	7.5E-11	5E-04	4.4E-11	2.0E-11	1.3E-11	8.3E-12	7.1E-12
Lu-165	10.74 m	M	0.005	1.3E-10	5E-04	7.8E-11	3.7E-11	2.4E-11	1.6E-11	1.4E-11
		S	0.005	1.3E-10	5E-04	8.0E-11	3.9E-11	2.5E-11	1.7E-11	1.4E-11
Lu-166	2.65 m	M	0.005	4.4E-11	5E-04	2.9E-11	1.4E-11	9.0E-12	5.7E-12	4.9E-12
		S	0.005	4.5E-11	5E-04	2.9E-11	1.4E-11	9.1E-12	5.9E-12	5.0E-12
Lu-166m	1.41 m	M	0.005	2.3E-11	5E-04	1.5E-11	7.0E-12	4.6E-12	2.9E-12	2.5E-12
		S	0.005	2.3E-11	5E-04	1.5E-11	7.1E-12	4.6E-12	3.0E-12	2.5E-12
Lu-167	51.5 m	M	0.005	3.0E-10	5E-04	2.0E-10	1.0E-10	6.6E-11	4.6E-11	3.7E-11
		S	0.005	3.2E-10	5E-04	2.1E-10	1.1E-10	6.9E-11	4.8E-11	3.9E-11
Lu-168m	6.7 m	M	0.005	6.1E-11	5E-04	4.1E-11	2.0E-11	1.3E-11	8.4E-12	6.9E-12
		S	0.005	6.2E-11	5E-04	4.2E-11	2.1E-11	1.3E-11	8.6E-12	7.1E-12
Lu-169m	2.66666 m	M	0.005	4.2E-12	5E-04	2.9E-12	1.5E-12	1.0E-12	7.0E-13	5.6E-13
		S	0.005	4.4E-12	5E-04	3.0E-12	1.6E-12	1.1E-12	7.5E-13	6.1E-13

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Lu-171m	1.31666 m	M	0.005	2.4E-12	5E-04	1.5E-12	8.2E-13	5.7E-13	4.6E-13	3.8E-13
		S	0.005	2.4E-12	5E-04	1.5E-12	8.4E-13	5.9E-13	4.8E-13	3.9E-13
Lu-172m	3.7 m	M	0.005	4.8E-12	5E-04	3.1E-12	1.8E-12	1.2E-12	9.1E-13	7.4E-13
		S	0.005	5.0E-12	5E-04	3.3E-12	1.9E-12	1.3E-12	9.8E-13	7.9E-13
<b>Hafnium</b>										
Hf-167	2.05 m	F	0.02	1.9E-11	0.002	1.2E-11	5.6E-12	3.6E-12	2.2E-12	1.8E-12
		M	0.02	2.5E-11	0.002	1.5E-11	7.6E-12	4.9E-12	3.2E-12	2.7E-12
Hf-169	3.24 m	F	0.02	1.2E-11	0.002	8.1E-12	4.0E-12	2.5E-12	1.5E-12	1.3E-12
		M	0.02	1.5E-11	0.002	9.9E-12	5.0E-12	3.2E-12	2.1E-12	1.7E-12
Hf-174	2.0E+15 y	F	0.02	7.7E-05	0.002	7.1E-05	4.7E-05	3.6E-05	3.1E-05	3.1E-05
		M	0.02	2.9E-05	0.002	2.6E-05	1.8E-05	1.4E-05	1.3E-05	1.3E-05
<b>Tantalum</b>										
Ta-170	6.76 m	M	0.01	1.4E-10	0.001	8.2E-11	3.8E-11	2.5E-11	1.6E-11	1.3E-11
		S	0.01	1.5E-10	0.001	8.4E-11	3.9E-11	2.5E-11	1.6E-11	1.4E-11
Ta-178	9.31 m	M	0.01	1.4E-11	0.001	8.5E-12	4.1E-12	2.7E-12	1.9E-12	1.6E-12
		S	0.01	1.4E-11	0.001	8.8E-12	4.2E-12	2.8E-12	2.0E-12	1.7E-12
<b>Tungsten</b>										
W-179m	6.40 m	F	0.6	4.9E-11	0.3	2.9E-11	1.3E-11	8.6E-12	5.4E-12	4.8E-12
W-185m	1.597 m	F	0.6	1.7E-11	0.3	9.9E-12	4.4E-12	3.0E-12	2.0E-12	1.8E-12
W-190	30.0 m	F	0.6	4.1E-10	0.3	2.3E-10	1.0E-10	6.8E-11	4.2E-11	3.6E-11
<b>Rhenium</b>										
Re-179	19.5 m	F	1	8.9E-11	0.8	5.7E-11	2.7E-11	1.7E-11	1.0E-11	8.4E-12
		M	1	1.1E-10	0.8	7.1E-11	3.5E-11	2.2E-11	1.5E-11	1.2E-11
Re-180	2.44 m	F	1	1.8E-11	0.8	1.2E-11	5.5E-12	3.6E-12	2.3E-12	1.9E-12
		M	1	2.0E-11	0.8	1.3E-11	6.2E-12	4.1E-12	2.6E-12	2.2E-12
Re-183	70.0 d	F	1	5.3E-09	0.8	2.8E-09	1.7E-09	7.2E-10	4.4E-10	3.7E-10
		M	1	1.6E-08	0.8	1.0E-08	5.4E-09	4.0E-09	3.4E-09	2.8E-09
Re-190	3.1 m	F	1	4.3E-11	0.8	2.7E-11	1.2E-11	7.9E-12	4.9E-12	4.3E-12
		M	1	5.1E-11	0.8	3.1E-11	1.4E-11	9.3E-12	5.8E-12	5.1E-12
<b>Osmium</b>										
Os-177	2.8 m	F	0.02	3.4E-11	0.01	2.1E-11	9.8E-12	6.2E-12	3.9E-12	3.3E-12
		M	0.02	4.6E-11	0.01	2.8E-11	1.3E-11	8.6E-12	5.7E-12	4.8E-12
		S	0.02	4.7E-11	0.01	2.9E-11	1.4E-11	8.9E-12	5.9E-12	4.9E-12
Os-179	6.5 m	F	0.02	1.7E-10	0.01	1.0E-10	4.8E-11	2.7E-11	1.6E-11	1.3E-11
		M	0.02	2.2E-10	0.01	1.3E-10	6.2E-11	3.6E-11	2.2E-11	1.8E-11
		S	0.02	2.3E-10	0.01	1.4E-10	6.3E-11	3.7E-11	2.3E-11	1.9E-11
Os-183	13.0 h	F	0.02	8.0E-10	0.01	5.4E-10	2.7E-10	1.6E-10	9.4E-11	7.6E-11
		M	0.02	1.3E-09	0.01	8.9E-10	4.6E-10	3.1E-10	2.1E-10	1.7E-10
		S	0.02	1.4E-09	0.01	9.3E-10	4.9E-10	3.3E-10	2.3E-10	1.9E-10

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Os-183m	9.9 h	F	0.02	7.5E-10	0.01	5.5E-10	2.8E-10	1.7E-10	9.9E-11	8.0E-11
		M	0.02	1.1E-09	0.01	7.6E-10	4.0E-10	2.6E-10	1.7E-10	1.4E-10
		S	0.02	1.1E-09	0.01	8.0E-10	4.2E-10	2.7E-10	1.8E-10	1.5E-10
Os-186	2.0E+15 y	F	0.02	6.1E-06	0.01	4.5E-06	2.2E-06	1.4E-06	8.4E-07	7.3E-07
		M	0.02	7.1E-06	0.01	5.1E-06	3.0E-06	1.9E-06	1.4E-06	1.2E-06
		S	0.02	1.6E-05	0.01	1.4E-05	8.5E-06	5.3E-06	4.4E-06	4.2E-06
Os-190m	9.9 m	F	0.02	4.8E-11	0.01	3.3E-11	1.6E-11	1.0E-11	6.3E-12	5.2E-12
		M	0.02	6.3E-11	0.01	4.2E-11	2.1E-11	1.3E-11	8.4E-12	6.9E-12
		S	0.02	6.5E-11	0.01	4.4E-11	2.1E-11	1.4E-11	8.6E-12	7.1E-12
Os-196	34.9 m	F	0.02	3.7E-10	0.01	1.9E-10	8.4E-11	5.3E-11	3.2E-11	2.7E-11
		M	0.02	6.2E-10	0.01	3.3E-10	1.5E-10	9.7E-11	6.3E-11	5.3E-11
		S	0.02	6.5E-10	0.01	3.4E-10	1.5E-10	1.0E-10	6.6E-11	5.6E-11
<b>Iridium</b>										
Ir-179	1.31666 m	F	0.02	4.8E-11	0.01	2.9E-11	1.3E-11	7.8E-12	4.7E-12	3.9E-12
		M	0.02	6.1E-11	0.01	3.6E-11	1.7E-11	1.0E-11	6.2E-12	5.1E-12
		S	0.02	6.2E-11	0.01	3.7E-11	1.7E-11	1.0E-11	6.4E-12	5.3E-12
Ir-180	1.5 m	F	0.02	1.8E-11	0.01	1.2E-11	5.5E-12	3.5E-12	2.2E-12	1.9E-12
		M	0.02	2.3E-11	0.01	1.4E-11	6.8E-12	4.5E-12	2.9E-12	2.4E-12
		S	0.02	2.3E-11	0.01	1.5E-11	7.0E-12	4.6E-12	3.0E-12	2.5E-12
Ir-181	4.90 m	F	0.02	4.4E-11	0.01	2.8E-11	1.3E-11	8.5E-12	5.3E-12	4.4E-12
		M	0.02	5.9E-11	0.01	3.7E-11	1.8E-11	1.2E-11	7.7E-12	6.4E-12
		S	0.02	6.0E-11	0.01	3.8E-11	1.9E-11	1.2E-11	8.0E-12	6.6E-12
Ir-183	58 m	F	0.02	2.2E-10	0.01	1.5E-10	7.3E-11	4.5E-11	2.7E-11	2.2E-11
		M	0.02	3.2E-10	0.01	2.1E-10	1.1E-10	7.1E-11	4.7E-11	3.8E-11
		S	0.02	3.3E-10	0.01	2.2E-10	1.1E-10	7.4E-11	5.0E-11	4.0E-11
Ir-196m	1.40 h	F	0.02	5.1E-10	0.01	3.4E-10	1.6E-10	1.0E-10	6.1E-11	5.0E-11
		M	0.02	8.0E-10	0.01	5.1E-10	2.5E-10	1.7E-10	1.1E-10	9.1E-11
		S	0.02	8.3E-10	0.01	5.3E-10	2.7E-10	1.7E-10	1.2E-10	9.6E-11
<b>Platinum</b>										
Pt-183	6.5 m	F	0.02	7.4E-11	0.01	4.6E-11	2.2E-11	1.4E-11	8.4E-12	7.1E-12
Pt-184	17.3 m	F	0.02	1.4E-10	0.01	9.2E-11	4.4E-11	2.8E-11	1.7E-11	1.4E-11
Pt-187	2.35 h	F	0.02	3.3E-10	0.01	2.2E-10	1.0E-10	6.5E-11	3.7E-11	3.1E-11
Pt-190	6.5E+11 y	F	0.02	1.0E-06	0.01	6.6E-07	3.2E-07	2.0E-07	1.3E-07	1.1E-07
Pt-202	44 h	F	0.02	1.3E-08	0.01	7.2E-09	3.1E-09	1.9E-09	9.7E-10	8.2E-10
<b>Gold</b>										
Au-186	10.7 m	F	0.2	1.5E-10	0.1	9.1E-11	4.3E-11	2.7E-11	1.6E-11	1.3E-11
		M	0.2	2.1E-10	0.1	1.3E-10	5.9E-11	3.8E-11	2.4E-11	2.0E-11
		S	0.2	2.2E-10	0.1	1.3E-10	6.1E-11	3.9E-11	2.4E-11	2.0E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Au-187	8.4 m	F	0.2	4.5E-11	0.1	3.0E-11	1.5E-11	9.1E-12	5.5E-12	4.5E-12
		M	0.2	6.6E-11	0.1	4.4E-11	2.2E-11	1.4E-11	9.3E-12	7.5E-12
		S	0.2	6.9E-11	0.1	4.5E-11	2.3E-11	1.5E-11	9.7E-12	7.9E-12
Au-188	8.84 m	F	0.2	6.9E-11	0.1	4.2E-11	2.0E-11	1.2E-11	7.6E-12	6.3E-12
		M	0.2	9.5E-11	0.1	5.8E-11	2.7E-11	1.7E-11	1.1E-11	9.3E-12
		S	0.2	9.8E-11	0.1	5.9E-11	2.8E-11	1.8E-11	1.2E-11	9.7E-12
Au-189m	4.59 m	F	0.2	2.4E-11	0.1	1.5E-11	6.9E-12	4.5E-12	2.8E-12	2.4E-12
		M	0.2	3.4E-11	0.1	2.1E-11	9.8E-12	6.6E-12	4.4E-12	3.7E-12
		S	0.2	3.5E-11	0.1	2.2E-11	1.0E-11	6.8E-12	4.5E-12	3.9E-12
Au-190	42.8 m	F	0.2	1.7E-10	0.1	1.2E-10	5.9E-11	3.6E-11	2.1E-11	1.7E-11
		M	0.2	2.4E-10	0.1	1.6E-10	7.8E-11	4.9E-11	3.0E-11	2.5E-11
		S	0.2	2.5E-10	0.1	1.6E-10	8.1E-11	5.1E-11	3.1E-11	2.5E-11
Au-191	3.18 h	F	0.2	2.8E-10	0.1	1.9E-10	9.4E-11	5.8E-11	3.3E-11	2.7E-11
		M	0.2	4.9E-10	0.1	3.3E-10	1.7E-10	1.1E-10	7.9E-11	6.4E-11
		S	0.2	5.2E-10	0.1	3.5E-10	1.8E-10	1.2E-10	8.5E-11	6.8E-11
Au-192	4.94 h	F	0.2	6.1E-10	0.1	4.6E-10	2.3E-10	1.4E-10	8.3E-11	6.7E-11
		M	0.2	8.1E-10	0.1	5.9E-10	3.0E-10	1.9E-10	1.2E-10	9.2E-11
		S	0.2	8.3E-10	0.1	6.1E-10	3.1E-10	2.0E-10	1.2E-10	9.5E-11
Au-196	6.183 d	F	0.2	1.6E-09	0.1	1.0E-09	5.0E-10	3.1E-10	1.7E-10	1.4E-10
		M	0.2	3.9E-09	0.1	2.6E-09	1.4E-09	9.9E-10	7.7E-10	6.1E-10
		S	0.2	4.2E-09	0.1	2.9E-09	1.6E-09	1.1E-09	8.6E-10	6.8E-10
Au-196m	9.6 h	F	0.2	1.4E-09	0.1	8.6E-10	3.8E-10	2.4E-10	1.3E-10	1.1E-10
		M	0.2	3.2E-09	0.1	2.1E-09	1.1E-09	7.2E-10	5.4E-10	4.3E-10
		S	0.2	3.4E-09	0.1	2.2E-09	1.1E-09	7.4E-10	5.9E-10	4.7E-10
<b>Mercury</b>										
Hg-187 (inorganic)	2.2 m	F	0.04	3.5E-11	0.02	2.2E-11	1.0E-11	6.5E-12	4.1E-12	3.6E-12
		M	0.04	4.2E-11	0.02	2.6E-11	1.2E-11	7.8E-12	5.0E-12	4.3E-12
Hg-187 (organic)	2.2 m	F	0.8	3.5E-11	0.4	2.2E-11	1.0E-11	6.5E-12	4.1E-12	3.6E-12
Hg-187m (inorganic)	2.4 m	F	0.04	4.0E-11	0.02	2.5E-11	1.1E-11	7.5E-12	4.8E-12	4.1E-12
		M	0.04	4.7E-11	0.02	2.9E-11	1.4E-11	9.0E-12	5.8E-12	4.9E-12
Hg-187m (organic)	2.4 m	F	0.8	4.0E-11	0.4	2.5E-11	1.1E-11	7.5E-12	4.8E-12	4.1E-12
Hg-188 (inorganic)	3.25 m	F	0.04	3.1E-11	0.02	1.9E-11	9.0E-12	5.6E-12	3.4E-12	2.9E-12
		M	0.04	4.3E-11	0.02	2.6E-11	1.2E-11	7.9E-12	5.1E-12	4.2E-12
Hg-188 (organic)	3.25 m	F	0.8	3.2E-11	0.4	1.9E-11	9.0E-12	5.6E-12	3.4E-12	2.9E-12
Hg-190 (inorganic)	20.0 m	F	0.04	9.4E-11	0.02	6.3E-11	3.1E-11	1.9E-11	1.1E-11	9.2E-12
		M	0.04	1.4E-10	0.02	8.9E-11	4.4E-11	2.8E-11	1.8E-11	1.4E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Hg-190 (organic)	20.0 m	F	0.8	9.1E-11	0.4	6.3E-11	3.1E-11	1.9E-11	1.1E-11	9.1E-12
Hg-191m (inorganic)	50.8 m	F	0.04	2.3E-10	0.02	1.6E-10	7.7E-11	4.7E-11	2.8E-11	2.3E-11
		M	0.04	3.5E-10	0.02	2.3E-10	1.2E-10	7.6E-11	5.1E-11	4.1E-11
Hg-191m (organic)	50.8 m	F	0.8	2.1E-10	0.4	1.5E-10	7.5E-11	4.6E-11	2.7E-11	2.2E-11
Hg-192 (inorganic)	4.85h	F	0.04	7.3E-10	0.02	5.2E-10	2.6E-10	1.6E-10	9.1E-11	7.4E-11
		M	0.04	1.1E-09	0.02	7.4E-10	3.8E-10	2.4E-10	1.5E-10	1.2E-10
Hg-192 (organic)	4.85h	F	0.8	5.7E-10	0.4	4.8E-10	2.4E-10	1.5E-10	8.3E-11	6.7E-11
Hg-205 (inorganic)	5.2 m	F	0.04	4.0E-11	0.02	2.3E-11	9.8E-12	6.6E-12	4.2E-12	3.7E-12
		M	0.04	5.2E-11	0.02	2.9E-11	1.3E-11	8.6E-12	5.5E-12	4.9E-12
Hg-205 (organic)	5.2 m	F	0.8	4.1E-11	0.4	2.3E-11	9.8E-12	6.6E-12	4.2E-12	3.7E-12
Hg-206 (inorganic)	8.15 m	F	0.04	1.0E-10	0.02	5.6E-11	2.4E-11	1.6E-11	1.0E-11	8.9E-12
		M	0.04	1.5E-10	0.02	8.3E-11	3.7E-11	2.5E-11	1.6E-11	1.4E-11
Hg-206 (organic)	8.15 m	F	0.8	1.0E-10	0.4	5.6E-11	2.4E-11	1.6E-11	1.0E-11	8.9E-12
<b>Thallium</b>										
Tl-190	2.6 m	F	1	4.0E-11	1	2.5E-11	1.2E-11	7.3E-12	4.5E-12	3.8E-12
Tl-190m	3.7 m	F	1	4.9E-11	1	3.3E-11	1.6E-11	9.9E-12	6.0E-12	4.9E-12
Tl-196	1.84 h	F	1	2.7E-10	1	2.0E-10	1.0E-10	6.0E-11	3.5E-11	2.8E-11
Tl-206	4.199 m	F	1	3.4E-11	1	1.9E-11	8.3E-12	5.6E-12	3.5E-12	3.2E-12
Tl-206m	3.74 m	F	1	6.2E-11	1	3.8E-11	1.8E-11	1.1E-11	7.1E-12	6.0E-12
Tl-207	4.77 m	F	1	3.7E-11	1	2.1E-11	8.9E-12	6.0E-12	3.8E-12	3.4E-12
Tl-208	3.053 m	F	1	4.3E-11	1	2.8E-11	1.3E-11	8.6E-12	5.3E-12	4.5E-12
Tl-209	2.161 m	F	1	3.1E-11	1	2.0E-11	9.2E-12	5.9E-12	3.7E-12	3.2E-12
Tl-210	1.30 m	F	1	2.5E-11	1	1.6E-11	7.6E-12	5.0E-12	3.1E-12	2.7E-12
<b>Lead</b>										
Pb-194	12.0 m	F	0.6	8.9E-11	0.2	5.6E-11	2.6E-11	1.6E-11	9.7E-12	8.0E-12
		M	0.2	1.3E-10	0.1	8.0E-11	3.8E-11	2.4E-11	1.5E-11	1.3E-11
		S	0.02	1.4E-10	0.01	8.3E-11	3.9E-11	2.5E-11	1.6E-11	1.3E-11
Pb-196	37 m	F	0.6	1.5E-10	0.2	1.1E-10	5.3E-11	3.2E-11	1.9E-11	1.6E-11
		M	0.2	2.2E-10	0.1	1.5E-10	7.3E-11	4.6E-11	3.0E-11	2.4E-11
		S	0.02	2.3E-10	0.01	1.5E-10	7.5E-11	4.8E-11	3.1E-11	2.5E-11

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Pb-197	8 m	F	0.6	3.2E-11	0.2	2.4E-11	1.2E-11	7.2E-12	4.3E-12	3.5E-12
		M	0.2	4.3E-11	0.1	3.0E-11	1.6E-11	9.8E-12	6.4E-12	5.1E-12
		S	0.02	4.4E-11	0.01	3.1E-11	1.6E-11	1.0E-11	6.6E-12	5.3E-12
Pb-197m	43 m	F	0.6	2.4E-10	0.2	1.6E-10	7.6E-11	4.7E-11	2.8E-11	2.4E-11
		M	0.2	3.8E-10	0.1	2.5E-10	1.2E-10	8.0E-11	5.5E-11	4.5E-11
		S	0.02	4.0E-10	0.01	2.6E-10	1.3E-10	8.3E-11	5.8E-11	4.7E-11
Pb-204m	67.2 m	F	0.6	1.9E-10	0.2	1.4E-10	7.4E-11	4.5E-11	2.7E-11	2.2E-11
		M	0.2	2.5E-10	0.1	1.8E-10	9.4E-11	5.8E-11	3.6E-11	2.8E-11
		S	0.02	2.6E-10	0.01	1.9E-10	9.6E-11	6.0E-11	3.7E-11	2.9E-11
<b>Bismuth</b>										
Bi-197	9.33 m	F	0.1	9.7E-11	0.05	6.4E-11	3.1E-11	1.9E-11	1.2E-11	9.6E-12
		M	0.1	1.3E-10	0.05	8.6E-11	4.3E-11	2.7E-11	1.8E-11	1.4E-11
Bi-204	11.22 h	F	0.1	2.2E-09	0.05	1.6E-09	8.6E-10	5.3E-10	3.1E-10	2.5E-10
		M	0.1	2.8E-09	0.05	2.0E-09	1.0E-09	6.7E-10	4.1E-10	3.3E-10
Bi-208	3.68E+5 y	F	0.1	4.5E-09	0.05	3.3E-09	1.8E-09	1.1E-09	6.8E-10	5.6E-10
		M	0.1	2.0E-08	0.05	1.7E-08	1.0E-08	7.0E-09	5.5E-09	4.6E-09
Bi-211	2.14 m	F	0.1	7.5E-09	0.05	4.6E-09	2.3E-09	1.6E-09	1.2E-09	1.1E-09
		M	0.1	8.6E-09	0.05	5.3E-09	2.6E-09	1.9E-09	1.5E-09	1.2E-09
Bi-215	7.6 m	F	0.1	3.8E-08	0.05	2.3E-08	1.1E-08	7.5E-09	5.4E-09	4.7E-09
		M	0.1	6.0E-08	0.05	3.7E-08	1.8E-08	1.3E-08	1.0E-08	8.7E-09
<b>Polonium</b>										
Po-204	3.53 h	F	0.2	1.3E-09	0.1	9.0E-10	4.5E-10	2.8E-10	1.7E-10	1.4E-10
		M	0.2	2.6E-09	0.1	1.8E-09	1.0E-09	6.6E-10	4.9E-10	4.0E-10
		S	0.02	2.8E-09	0.01	1.9E-09	1.1E-09	7.0E-10	5.3E-10	4.3E-10
Po-206	8.8 d	F	0.2	1.2E-07	0.1	6.3E-08	2.9E-08	1.7E-08	1.0E-08	8.3E-09
		M	0.2	2.7E-07	0.1	1.8E-07	1.1E-07	7.8E-08	7.0E-08	5.8E-08
		S	0.02	2.9E-07	0.01	1.9E-07	1.2E-07	8.7E-08	7.9E-08	6.5E-08
Po-208	2.898 y	F	0.2	1.0E-05	0.1	5.9E-06	2.7E-06	1.6E-06	9.5E-07	7.6E-07
		M	0.2	2.0E-05	0.1	1.3E-05	7.9E-06	5.4E-06	4.5E-06	3.8E-06
		S	0.02	3.2E-05	0.01	2.5E-05	1.4E-05	9.9E-06	7.8E-06	6.9E-06
Po-209	102 y	F	0.2	1.0E-05	0.1	5.9E-06	2.7E-06	1.6E-06	9.5E-07	7.6E-07
		M	0.2	2.0E-05	0.1	1.3E-05	7.8E-06	5.3E-06	4.3E-06	3.7E-06
		S	0.02	3.9E-05	0.01	3.2E-05	1.8E-05	1.3E-05	1.0E-05	9.7E-06
Po-218	3.10 m	F	0.2	6.6E-09	0.1	4.1E-09	2.2E-09	1.6E-09	1.2E-09	9.7E-10
		M	0.2	1.3E-08	0.1	8.2E-09	4.6E-09	3.3E-09	2.8E-09	2.3E-09
		S	0.02	1.3E-08	0.01	8.7E-09	4.8E-09	3.5E-09	3.0E-09	2.4E-09
<b>Astatine</b>										
At-205	26.2 m	F	1	1.5E-09	1	9.5E-10	5.0E-10	3.4E-10	2.9E-10	2.3E-10
		M	1	3.2E-09	1	2.1E-09	1.3E-09	9.1E-10	8.4E-10	6.8E-10

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
At-208	1.63 h	F	1	6.2E-10	1	4.3E-10	2.2E-10	1.3E-10	8.4E-11	6.8E-11
		M	1	2.2E-09	1	1.5E-09	8.9E-10	6.0E-10	4.9E-10	4.1E-10
At-209	5.41 h	F	1	4.8E-09	1	3.5E-09	2.0E-09	1.3E-09	9.6E-10	8.4E-10
		M	1	1.3E-08	1	8.5E-09	5.5E-09	4.0E-09	3.5E-09	3.0E-09
At-210	8.1 h	F	1	3.8E-08	1	2.7E-08	1.2E-08	7.3E-09	4.1E-09	3.6E-09
		M	1	6.5E-08	1	4.5E-08	2.4E-08	1.6E-08	1.2E-08	1.0E-08
<b>Francium</b>										
Fr-212	20.0 m	F	1	1.4E-08	1	8.9E-09	4.5E-09	3.2E-09	2.5E-09	2.1E-09
Fr-221	4.9 m	F	1	3.8E-08	1	2.3E-08	1.1E-08	7.9E-09	5.9E-09	5.0E-09
<b>Radium</b>										
Ra-230	93 m	F	0.6	6.8E-10	0.2	4.3E-10	1.9E-10	1.1E-10	5.9E-11	6.1E-11
		M	0.2	1.1E-09	0.1	6.4E-10	3.0E-10	2.0E-10	1.3E-10	1.1E-10
		S	0.02	1.2E-09	0.01	6.6E-10	3.1E-10	2.0E-10	1.3E-10	1.1E-10
<b>Actinium</b>										
Ac-223	2.10 m	F	0.005	4.7E-08	5E-04	2.8E-08	1.3E-08	9.5E-09	6.8E-09	5.9E-09
		M	0.005	5.5E-08	5E-04	3.3E-08	1.6E-08	1.1E-08	8.1E-09	7.0E-09
		S	0.005	5.6E-08	5E-04	3.4E-08	1.6E-08	1.1E-08	8.2E-09	7.1E-09
Ac-229	62.7 m	F	0.005	1.9E-10	5E-04	1.1E-10	5.3E-11	4.0E-11	2.7E-11	2.5E-11
		M	0.005	3.1E-10	5E-04	1.8E-10	8.4E-11	5.6E-11	4.1E-11	3.5E-11
		S	0.005	3.2E-10	5E-04	1.8E-10	8.6E-11	5.7E-11	4.1E-11	3.4E-11
Ac-230	2.03333 m	F	0.005	2.3E-11	5E-04	1.4E-11	6.1E-12	4.0E-12	2.5E-12	2.2E-12
		M	0.005	2.6E-11	5E-04	1.5E-11	6.9E-12	4.6E-12	2.9E-12	2.6E-12
		S	0.005	2.6E-11	5E-04	1.6E-11	7.0E-12	4.7E-12	2.9E-12	2.6E-12
<b>Thorium</b>										
Th-233	22.3 m	F	0.005	1.1E-10	5E-04	5.9E-11	2.6E-11	1.7E-11	1.0E-11	8.9E-12
		M	0.005	1.7E-10	5E-04	9.5E-11	4.3E-11	2.9E-11	2.0E-11	1.7E-11
		S	0.005	1.8E-10	5E-04	9.9E-11	5.5E-11	3.1E-11	2.2E-11	1.8E-11
<b>Protactinium</b>										
Pa-229	1.50 d	M	0.005	2.6E-08	5E-04	1.8E-08	1.1E-08	8.5E-09	8.0E-09	6.4E-09
		S	0.005	2.9E-08	5E-04	2.0E-08	1.3E-08	9.6E-09	9.1E-09	7.3E-09
Pa-234m	1.17 m	M	0.005	1.4E-11	5E-04	7.9E-12	3.5E-12	2.4E-12	1.5E-12	1.3E-12
		S	0.005	1.4E-11	5E-04	8.0E-12	3.5E-12	2.4E-12	1.5E-12	1.4E-12
Pa-236	9.1 m	M	0.005	1.2E-10	5E-04	7.1E-11	3.2E-11	2.1E-11	1.3E-11	1.2E-11
		S	0.005	1.3E-10	5E-04	7.3E-11	3.3E-11	2.2E-11	1.4E-11	1.2E-11
<b>Uranium</b>										
U-228	9.1 m	F	0.04	1.9E-07	0.02	1.1E-07	5.3E-08	3.7E-08	2.7E-08	2.3E-08
		M	0.04	2.7E-07	0.02	1.7E-07	8.0E-08	5.7E-08	4.2E-08	3.6E-08
		S	0.02	2.8E-07	0.002	1.7E-07	8.3E-08	5.9E-08	4.4E-08	3.8E-08

Table 5-(continued)

Nuclide	Physical Half-life	Type	$f_1$	$e(\tau)$	$f_1$	$e(\tau)$				
			<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
<b>Neptunium</b>										
Np-231	48.8 m	F	0.005	2.5E-09	5E-04	1.5E-09	6.8E-10	4.6E-10	3.1E-10	2.7E-10
		M	0.005	8.4E-09	5E-04	5.0E-09	3.0E-09	2.2E-09	2.1E-09	1.7E-09
		S	0.005	8.4E-09	5E-04	5.4E-09	3.3E-09	2.5E-09	2.3E-09	1.8E-09
Np-240m	7.22 m	F	0.005	6.1E-11	5E-04	3.5E-11	1.6E-11	1.0E-11	6.5E-12	5.7E-12
		M	0.005	8.2E-11	5E-04	4.7E-11	2.1E-11	1.4E-11	8.9E-12	7.7E-12
		S	0.005	8.4E-11	5E-04	4.8E-11	2.1E-11	1.4E-11	9.1E-12	7.9E-12
Np-241	13.9 m	F	0.005	9.1E-11	5E-04	5.6E-11	2.5E-11	1.8E-11	1.3E-11	1.1E-11
		M	0.005	1.2E-10	5E-04	7.1E-11	3.3E-11	2.3E-11	1.6E-11	1.4E-11
		S	0.005	1.3E-10	5E-04	7.2E-11	3.3E-11	2.2E-11	1.5E-11	1.3E-11
<b>Plutonium</b>										
Pu-232	34.1 m	F	0.005	4.2E-08	5E-04	2.5E-08	1.2E-08	8.6E-09	6.2E-09	5.4E-09
		M	0.005	1.1E-07	5E-04	6.8E-08	3.6E-08	2.6E-08	2.3E-08	1.8E-08
		S	1E-04	1.1E-07	1E-05	7.1E-08	3.8E-08	2.8E-08	2.5E-08	2.0E-08
<b>Americium</b>										
Am-247	23.0 m	F	0.005	1.6E-10	5E-04	9.0E-11	3.9E-11	2.6E-11	1.6E-11	1.4E-11
		M	0.005	2.6E-10	5E-04	1.5E-10	6.6E-11	4.5E-11	3.0E-11	2.6E-11
		S	0.005	2.7E-10	5E-04	1.5E-10	6.9E-11	4.7E-11	3.2E-11	2.7E-11
<b>Curium</b>										
Cm-239	2.9 h	F	0.005	3.1E-10	5E-04	1.9E-10	9.1E-11	5.6E-11	3.2E-11	2.6E-11
		M	0.005	5.5E-10	5E-04	3.4E-10	1.7E-10	1.1E-10	7.9E-11	6.3E-11
		S	0.005	5.7E-10	5E-04	3.5E-10	1.8E-10	1.2E-10	8.4E-11	6.7E-11
<b>Berkelium</b>										
Bk-244	4.35 h	M	0.005	3.7E-09	5E-04	3.0E-09	1.8E-09	1.3E-09	1.1E-09	1.0E-09
Bk-248m	23.7 h	M	0.005	7.2E-08	5E-04	5.5E-08	3.3E-08	2.3E-08	1.9E-08	1.6E-08
Bk-251	55.6 m	M	0.005	3.5E-10	5E-04	2.1E-10	9.9E-11	7.0E-11	5.0E-11	4.3E-11
<b>Californium</b>										
Cf-247	3.11 h	M	0.005	2.4E-10	5E-04	1.6E-10	9.4E-11	6.5E-11	5.1E-11	4.4E-11
Cf-255	85 m	M	0.005	2.5E-08	5E-04	1.8E-08	1.1E-08	8.0E-09	7.2E-09	5.8E-09
Cf-256	12.3 m	M	0.005	2.3E-05	5E-04	1.3E-05	5.4E-06	3.6E-06	2.0E-06	1.9E-06
<b>Einsteinium</b>										
Es-249	102.2 m	M	0.005	1.2E-09	5E-04	8.1E-10	4.3E-10	3.2E-10	2.8E-10	2.4E-10
Es-255	39.8 d	M	0.005	1.7E-05	5E-04	1.2E-05	7.3E-06	5.3E-06	4.9E-06	3.9E-06
Es-256	25.4 m	M	0.005	2.0E-06	5E-04	1.2E-06	5.1E-07	3.4E-07	2.1E-07	1.9E-07
<b>Fermium</b>										
Fm-251	5.30 h	M	0.005	9.3E-09	5E-04	5.7E-09	3.4E-09	2.5E-09	2.3E-09	1.9E-09
Fm-256	157.6 m	M	0.005	4.0E-05	5E-04	2.3E-05	9.7E-06	6.5E-06	3.7E-06	3.5E-06

**Table 6 Effective dose coefficients for workers**  
**Soluble or reactive gases (Class SR-1 and SR-2)**

Nuclide/Chemical form	$t_{1/2}$	$e_{inh}(50) (\text{Sv Bq}^{-1})$
Sulphur-37 vapour	5.05 m	1.1E-11
Sulphur-38 vapour	170.3 m	2.0E-10
Ruthenium-95 tetroxide	1.643 h	4.6E-11
Tellurium-117 vapour	62 m	2.9E-11
Tellurium-118 vapour	6.00 d	1.9E-09
Tellurium-119 vapour	16.03 h	1.0E-10
Tellurium-119m vapour	4.70 d	6.3E-10
Elemental iodine-118	13.7 m	1.7E-10
Methyl iodine-118	13.7 m	9.7E-11
Elemental iodine-119	19.1 m	5.6E-11
Methyl iodine-119	19.1 m	1.7E-11
Elemental iodine-122	3.63 m	1.9E-11
Methyl iodine-122	3.63 m	1.1E-12
Mercury-187 vapour	2.2 m	1.8E-11
Mercury-187m vapour	2.4 m	2.2E-11
Mercury-188 vapour	3.25 m	1.7E-11
Mercury-190 vapour	20.0 m	9.6E-11
Mercury-191m vapour	50.8 m	3.2E-10
Mercury-192 vapour	4.85 h	1.0E-09
Mercury-205 vapour	5.2 m	1.3E-11
Mercury-206 vapour	8.15 m	4.2E-11

**Table 7** Effective dose coefficients for members of the public  
Inhalation dose coefficients,  $e(\tau)$ , to age 70 y ( $\text{Sv Bq}^{-1}$ ) for soluble or reactive gases and vapours (Class SR-1 and SR-2)

Nuclide	Physical Half-life	Absorp-tion deposit	% deposit	$f_1$		$e(\tau)$		$f_1$		$e(\tau)$	
				<1y	3 Months	$\geq 1y$	1 Years	5 Years	10 Years	15 Years	Adult
Sulphur-37 dioxide	5.05 m	F	85	1	7.0E-11	0.8	4.5E-11	2.6E-11	1.8E-11	1.3E-11	1.1E-11
Carbon disulphide-37	5.05 m	F	100	1	8.2E-11	0.8	5.2E-11	3.1E-11	2.1E-11	1.5E-11	1.3E-11
Sulphur-38 dioxide	170.3 m	F	85	1	1.6E-09	0.8	9.9E-10	5.5E-10	3.6E-10	2.5E-10	2.0E-10
Carbon-38 disulphide	170.3 m	F	100	1	1.6E-09	0.8	1.0E-09	5.5E-10	3.4E-10	2.2E-10	1.8E-10
Ruthenium-95 tetroxide	1.643 h	F	100	0.1	3.8E-10	0.05	2.3E-10	1.3E-10	8.3E-11	5.6E-11	4.6E-11
Tellurium-117 vapour	62 m	F	100	0.6	2.1E-10	0.3	1.4E-10	8.1E-11	5.1E-11	3.6E-11	2.9E-11
Tellurium-118 vapour	6.00 d	F	100	0.6	2.5E-08	0.3	1.5E-08	7.6E-09	4.2E-09	2.6E-09	1.9E-09
Tellurium-119 vapour	16.03 h	F	100	0.6	7.3E-10	0.3	5.2E-10	3.1E-10	1.9E-10	1.3E-10	1.0E-10
Tellurium-119m vapour	4.70 d	F	100	0.6	4.4E-09	0.3	2.9E-09	1.8E-09	1.1E-09	7.8E-10	6.3E-10
Elemental iodine-118	13.7 m	V	100	1	1.5E-09	1	1.2E-09	7.0E-10	3.7E-10	2.4E-10	1.7E-10
Methyl iodine-118	13.7 m	V	70	1	1.5E-09	1	8.5E-10	4.8E-10	2.3E-10	1.5E-10	9.7E-11
Elemental iodine-119	19.1 m	V	100	1	4.0E-10	1	2.8E-10	1.6E-10	9.7E-11	6.8E-11	5.6E-11
Methyl iodine-119	19.1 m	V	70	1	1.7E-10	1	1.4E-10	7.4E-11	3.7E-11	2.4E-11	1.7E-11
Elemental iodine-122	3.63 m	V	100	1	1.0E-10	1	6.7E-11	4.0E-11	2.8E-11	2.1E-11	1.9E-11
Methyl iodine-122	3.63 m	V	70	1	1.3E-11	1	8.4E-12	4.3E-12	2.3E-12	1.5E-12	1.1E-12
Mercury-187 vapour	2.2 m	a	70	0.04	7.6E-11	0.02	5.5E-11	3.5E-11	2.6E-11	2.0E-11	1.8E-11
Mercury-187m vapour	2.4 m	a	70	0.04	9.2E-11	0.02	6.7E-11	4.3E-11	3.2E-11	2.4E-11	2.2E-11
Mercury-188 vapour	3.25 m	a	70	0.04	7.3E-11	0.02	5.3E-11	3.4E-11	2.5E-11	1.8E-11	1.7E-11
Mercury-190 vapour	20.0 m	a	70	0.04	4.0E-10	0.02	2.9E-10	1.9E-10	1.4E-10	1.0E-10	9.6E-11
Mercury-191m vapour	50.8 m	a	70	0.04	1.3E-09	0.02	9.7E-10	6.3E-10	4.6E-10	3.5E-10	3.2E-10
Mercury-192 vapour	4.85 h	a	70	0.04	4.2E-09	0.02	3.1E-09	2.0E-09	1.5E-09	1.1E-09	1.0E-09
Mercury-205 vapour	5.2 m	a	70	0.04	5.5E-11	0.02	3.9E-11	2.5E-11	1.8E-11	1.4E-11	1.3E-11
Mercury-206 vapour	8.15 m	a	70	0.04	1.8E-10	0.02	1.3E-10	8.3E-11	6.1E-11	4.6E-11	4.2E-11

a Deposition 10%:20%:40% (bronchial:bronchiolar:alveolar-interstitial), 1.7 day retention half-time (ICRP Publication 68)

**Table 8** Effective dose rates for exposure of adults  
Inert gases (Class SR-0)

Nuclide	Physical half-life	Effective dose rate per unit air concentration (Sv d <sup>-1</sup> /Bq m <sup>-3</sup> )
N-13	9.965 m	4.0E-09
O-14	1.17677 m	1.4E-08
O-15	2.03733 m	4.0E-09
Ar-42	32.9 y	1.3E-11
Ar-44	11.87 m	8.1E-09
Kr-75	4.29 m	5.1E-09
Kr-89	3.15 m	8.3E-09
Xe-127m	1.15333 m	6.0E-10
Xe-137	3.818 m	9.4E-10

# 国際単位系(SI)と換算表

表1 SI基本単位および補助単位

量	名称	記号
長さ	メートル	m
質量	キログラム	kg
時間	秒	s
電流	アンペア	A
熱力学温度	ケルビン	K
物質量	モル	mol
光强度	カンデラ	cd
平面角	ラジアン	rad
立体角	ステラジアン	sr

表3 固有の名称をもつSI組立単位

量	名称	記号	他のSI単位による表現
周波数	ヘルツ	Hz	s <sup>-1</sup>
圧力、応力	ニュートン	N	m·kg/s <sup>2</sup>
エネルギー、仕事、熱量	パスカル	Pa	N/m <sup>2</sup>
工率、放射束	ジュール	J	N·m
電気量、電荷	ワット	W	J/s
電位、電圧、起電力	クロン	C	A·s
静電容量	ボルト	V	W/A
電気抵抗	オーム	Ω	V/A
コンダクタンス	ジーメンス	S	A/V
磁束	ウェーバ	Wb	V·s
磁束密度	テスラ	T	Wb/m <sup>2</sup>
インダクタンス	ヘンリー	H	Wb/A
セルシウス温度	セルシウス度	°C	
光束度	ルーメン	lm	cd·sr
照度	ルクス	lx	lm/m <sup>2</sup>
放射能	ベクレル	Bq	s <sup>-1</sup>
吸収線量	グレイ	Gy	J/kg
線量等量	シーベルト	Sv	J/kg

表2 SIと併用される単位

名称	記号
分、時、日	min, h, d
度、分、秒	°, ', "
リットル	l, L
トン	t
電子ボルト	eV
原子質量単位	u

$$1 \text{ eV} = 1.60218 \times 10^{-19} \text{ J}$$

$$1 \text{ u} = 1.66054 \times 10^{-27} \text{ kg}$$

表5 SI接頭語

倍数	接頭語	記号
$10^{18}$	エクサ	E
$10^{15}$	ペタ	P
$10^{12}$	テラ	T
$10^9$	ギガ	G
$10^6$	メガ	M
$10^3$	キロ	k
$10^2$	ヘクト	h
$10^1$	デカ	da
$10^{-1}$	デシ	d
$10^{-2}$	センチ	c
$10^{-3}$	ミリ	m
$10^{-6}$	マイクロ	μ
$10^{-9}$	ナノ	n
$10^{-12}$	ピコ	p
$10^{-15}$	フェムト	f
$10^{-18}$	アト	a

(注)

- 表1～5は「国際単位系」第5版、国際度量衡局1985年刊行による。ただし、1eVおよび1uの値はCODATAの1986年推奨値によった。
- 表4には海里、ノット、アール、ヘクタールも含まれているが日常の単位なのでここでは省略した。
- barは、JISでは流体の圧力を表わす場合に限り表2のカテゴリーに分類されている。
- ECC規格理事会指令ではbar、barnおよび「血圧の単位」mmHgを表2のカテゴリーに入れている。

## 換算表

力	N(=10 <sup>5</sup> dyn)	kgf	lbf
1	0.101972	0.224809	
9.80665	1	2.20462	
4.44822	0.453592	1	

粘度  $1 \text{ Pa}\cdot\text{s}(\text{N}\cdot\text{s}/\text{m}^2) = 10 \text{ P(ボアズ)}(\text{g}/(\text{cm}\cdot\text{s}))$

動粘度  $1 \text{ m}^2/\text{s} = 10^4 \text{ St(ストークス)}(\text{cm}^2/\text{s})$

圧力	MPa(=10bar)	kgf/cm <sup>2</sup>	atm	mmHg(Torr)	lbf/in <sup>2</sup> (psi)
1	10.1972	9.86923	7.50062 × 10 <sup>3</sup>	145.038	
力	0.0980665	1	0.967841	735.559	14.2233
	0.101325	1.03323	1	760	14.6959
	1.33322 × 10 <sup>-4</sup>	1.35951 × 10 <sup>-3</sup>	1.31579 × 10 <sup>-3</sup>	1	1.93368 × 10 <sup>-2</sup>
	6.89476 × 10 <sup>-3</sup>	7.03070 × 10 <sup>-2</sup>	6.80460 × 10 <sup>-2</sup>	51.7149	1

エネルギー・仕事・熱量	J(=10 <sup>7</sup> erg)	kgf·m	kW·h	cal(計量法)	Btu	ft·lbf	eV	1 cal = 4.18605J (計量法)	
								= 4.184J (熱化学)	= 4.1855J (15°C)
1	0.101972	2.77778 × 10 <sup>-7</sup>	0.238889	9.47813 × 10 <sup>-4</sup>	0.737562	6.24150 × 10 <sup>18</sup>			
9.80665	1	2.72407 × 10 <sup>-6</sup>	2.34270	9.29487 × 10 <sup>-3</sup>	7.23301	6.12082 × 10 <sup>19</sup>			
3.6 × 10 <sup>6</sup>	3.67098 × 10 <sup>5</sup>	1	8.59999 × 10 <sup>5</sup>	3412.13	2.65522 × 10 <sup>6</sup>	2.24694 × 10 <sup>25</sup>			
4.18605	0.426858	1.16279 × 10 <sup>-6</sup>	1	3.96759 × 10 <sup>-3</sup>	3.08747	2.61272 × 10 <sup>19</sup>			
1055.06	107.586	2.93072 × 10 <sup>-4</sup>	252.042	1	778.172	6.58515 × 10 <sup>21</sup>			
1.35582	0.138255	3.76616 × 10 <sup>-7</sup>	0.323890	1.28506 × 10 <sup>-3</sup>	1	8.46233 × 10 <sup>18</sup>			
1.60218 × 10 <sup>-19</sup>	1.63377 × 10 <sup>-20</sup>	4.45050 × 10 <sup>-26</sup>	3.82743 × 10 <sup>-20</sup>	1.51857 × 10 <sup>-22</sup>	1.18171 × 10 <sup>-19</sup>	1			

放射能	Bq	Ci
	1	2.70270 × 10 <sup>-11</sup>
	$3.7 \times 10^{10}$	1

吸収線量	Gy	rad
	1	100
	0.01	1

照射線量	C/kg	R
	1	3876
	$2.58 \times 10^{-4}$	1

線量当量	Sv	rem
	1	100
	0.01	1

(86年12月26日現在)

**Dose Coefficients for Radionuclides Produced in High Energy Proton Accelerator Facilities: Coefficients for Radionuclides not Listed in ICRP Publications**

