

L.W. Packer and  
J-Ch Sublet

# The European Activation File:EAF-2010 biological, clearance and transport libraries

*Enquiries about copyright and reproduction should in the first instance be addressed to the Culham Publications Officer, Culham Centre for Fusion Energy (CCFE), Library, Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB, UK. CCFE is the fusion research arm of the United Kingdom Atomic Energy Authority, which is the copyright holder.*

**The European  
Activation  
File: EAF-2010  
biological,  
clearance and  
transport  
libraries**

**L. W. Packer and J-Ch. Sublet**

EURATOM/CCFE Fusion Association, Culham Science Centre,  
Abingdon, Oxfordshire, OX14 3DB, UK.

March 2010





## **Abstract**

The European Activation System (EASY) includes as the source of nuclear data the European Activation File (EAF). A new version of EAF, EAF-2010, has been developed, and this report gives details of the EAF biological, clearance and transport libraries. The sources of data and the methodology of approximate calculation are described, while the bulk of the report is devoted to a listing of the biological, clearance and transport coefficients of all the 2,006 radionuclides contained in the libraries.

The properties listed are: specific activity, committed effective doses per unit uptake for ingestion and inhalation, the source of the biological data, the transport coefficient ( $A_2$ ), the source of the  $A_2$  value, the clearance level value and the source of the clearance level value.



# Contents

<b><i>Introduction</i></b> .....	<b>1</b>
<b><i>Dosimetric data</i></b> .....	<b>2</b>
<b>Methodology for the estimation of dosimetric data</b> .....	<b>3</b>
Short-lived radionuclides .....	3
Noble gases .....	4
Long-lived $\alpha$ emitters .....	5
<b>Calculational method for dosimetric data</b> .....	<b>5</b>
<b><i>Transport data</i></b> .....	<b>6</b>
<b>Calculational method for transport data</b> .....	<b>6</b>
<b><i>Clearance data</i></b> .....	<b>8</b>
<b>Methodology for the calculation of clearance data</b> .....	<b>8</b>
<b><i>Contents of libraries</i></b> .....	<b>9</b>
<b><i>References</i></b> .....	<b>36</b>
<b><i>Acknowledgements</i></b> .....	<b>38</b>
<b><i>Disclaimer</i></b> .....	<b>38</b>
<b><i>Contact person</i></b> .....	<b>38</b>





## Introduction

Activation of materials will occur in D-T fusion power plants due to the interaction of the neutrons with the materials making up the device. Several parameters are used to assess the relevance of the activation to safety and waste disposal issues, the most important of which are activity, contact  $\gamma$ -dose rate, decay power and potential biological hazard. The latter covers the effect on humans of the ingestion or inhalation of radionuclides. When activated materials contain activity below the clearance index it may be possible to dispose of (or clear from regulatory control) the material with no special precautions.

Neutron-induced or charged particle-induced transmutation accompanying the irradiation of materials is calculated by an inventory code that uses libraries of decay data and cross sections to calculate the numbers of atoms of the various nuclides present after a particular exposure history. In order to calculate the potential biological hazards a further data library is required, containing, for each radionuclide, suitable coefficients to convert activity into dose following ingestion or inhalation.

The European Activation System (EASY) uses nuclear data from the European Activation File (EAF) as input to the FISPACT inventory code. This report gives details of the libraries of biological hazard coefficients (EAF\_HAZ-2010), the legal transport data (EAF\_A2-2010) and the clearance values (EAF\_CLEAR-2010) in the current release of EAF: EAF-2010.

The present work extends the previous work on biological hazard coefficients for use with EAF-3 [1]. The previous work used a methodology for the calculation of approximate coefficients for nuclides that had not been treated by the standard methods. This methodology is repeated here with emphasis on how the method is embedded in the SAFEPAQ-II [2] processing system.

The required coefficients are termed ‘committed effective doses per unit uptake’ and the symbols  $e^{ing}$  and  $e^{inh}$  are used to refer to the coefficients for ingestion and inhalation respectively. The coefficient  $e^{ing}$  is used to convert the activity (Bq) of an ingested radionuclide into the dose (Sv) received by the average person over a 50 year period and has the units  $\text{SvBq}^{-1}$ . A similar definition applies to the coefficient  $e^{inh}$  for inhalation. In FISPACT [3] the potential radiological hazards,  $H^{ing}$  and  $H^{inh}$

for a particular sample of irradiated material are calculated as follows:

$$H^{ing} = \sum_i A_i e_i^{ing} \quad (1a)$$

$$H^{inh} = \sum_i A_i e_i^{inh} \quad (1b)$$

where  $A_i$  is the activity of nuclide  $i$  (Bq) and  $H^{ing}$  and  $H^{inh}$  have units of Sv.

The regulation of transport of radioactive material is based upon guidelines set out by the IAEA [4]: the relevant quantity used in FISPACT calculations is the  $A_2$  coefficient. Each radionuclide has an  $A_2$  value; for safe transport of that material in a standard shipping flask the amount is regulated such that its activity is less than or equal to  $A_2$ . Rules are given in the guidelines for combinations of radionuclides and these are applied in the FISPACT output so that effective  $A_2$  values for a mixture of nuclides can be calculated. Data are given for about 370 radionuclides, for the rest standard values are used that depend on the decay mode.

Materials in devices that have been activated through exposure to neutrons or charged particles become waste following decommissioning, unless recycled. The fate of waste materials depends on the length of time since shutdown, the type of material and the amount of neutron flux. For materials with low activation, disposal with no special precautions is possible. The clearance of a radioactive material depends on the clearance index for that material being less than 1. A clearance index, based on IAEA guidelines [5], is calculated from the clearance level value for each radioactive nuclide, and the radioactive inventory. EAF\_CLEAR-2010 contains the required clearance level values needed to make such calculations.

## ***Dosimetric data***

Many of the radionuclides for which biological hazard data are required are included in the handbooks published by the ICRP and these have been the primary source for the current library. The most recent guidance is contained in the ICRP 68 and 72 publications [6,15]. The National Radiological Protection Board (NRPB) also publishes data [7] for a range of nuclides using a similar computational method [8]. A few fusion specific nuclides not covered in existing ICRP or NRPB reports have been specially calculated with the NRPB methodology by Kendall [9]. Recently a further study of nuclides important for fusion applications was funded; data for these nuclides are available in a report [10]. Data in these references often allow

for the radionuclide to be ingested or inhaled in various chemical forms and for some elements this can make a substantial difference to the values of the coefficients. In all cases except nickel and cobalt (where the maximum impact chemical form is judged unreasonable for fusion applications) the maximum values of the coefficients are used in the current library.

Although many of the nuclides relevant to fusion applications are represented by data in the sources described above, there are also a large number of nuclides for which no data are available. For these nuclides, which are mostly of short half-life, an approximate method described in references 1 and 11 has been employed to generate the dosimetric data. The methodology is described in the following section.

### **Methodology for the estimation of dosimetric data**

#### **Short-lived radionuclides**

It is assumed that the value of  $e_i^{ing}$  for a radionuclide with a stable daughter can be represented as:

$$e_i^{ing} = C^{ing} N_i^{ing} E_i \quad (2)$$

where  $N_i^{ing}$  is the number of disintegrations within the body per unit activity intake of nuclide  $i$  by ingestion ( $\text{Bq}^{-1}$ ),  $E_i$  is the total energy equivalent of emissions from nuclide  $i$  for each radioactive decay (MeV) and  $C^{ing}$  is a parameter which is approximately a constant for a particular element  $j$  ( $\text{SvMeV}^{-1}$ ). A similar expression is used to represent  $e_i^{inh}$ . Note that the nuclide  $i$  is one of the isotopes of element  $j$ , and that all the biological factors in the definition of the coefficients are subsumed into the constant  $C$ . The value of  $E$  is given by the following formula:

$$E = 20E_\alpha + E_\beta + E_\gamma \quad (3)$$

where  $E_\alpha$  is the average  $\alpha$ -energy per decay (MeV),  $E_\beta$  is the average  $\beta$ -energy per decay (MeV) and  $E_\gamma$  is the average  $\gamma$ -energy per decay (MeV). The factor of 20 by which  $E_\alpha$  is multiplied is the value of the quality factor for  $\alpha$  particles recommended by the ICRP [12]. The values of  $N^{ing}$  and  $N^{inh}$  are calculated using the following equations:

$$N^{ing} = (1 - \exp(-\lambda t^{ing}))/\lambda \quad (4a)$$

$$N^{inh} = (1 - \exp(-\lambda t^{inh}))/\lambda \quad (4b)$$

where  $\lambda$  is the decay constant for the nuclide and the parameters  $t^{ing}$  and  $t^{inh}$  are the mean residence times of the nuclide within the body in the cases of ingestion and inhalation respectively. Following reference 2 these are set to values of 3 days for  $t^{ing}$  and 7 days for  $t^{inh}$ . Equations 4 are strictly valid for nuclides that are short-lived compared to the assumed residency times; however, these equations are used for all radionuclides that are not long-lived  $\alpha$  emitters.

Data for all radionuclides of an element  $j$  with half-life less than 1 year are used to calculate a set of parameters  $C_j^{ing}$  and  $C_j^{inh}$  and, although these values are not true 'constants' for the element, in most cases the values for most isotopes of an element are similar. In reference 2 and in the present library the maximum of the values is conservatively taken as representing the element and defined as  $C_j^{ing}$  and  $C_j^{inh}$ . Note that this conservative approach means that many of the estimated values will be overpredicted. For all radionuclides where data are required,  $C_j^{ing}$  and  $C_j^{inh}$  are used with the decay data for the nuclide to calculate approximate values of  $e_i^{ing}$  and  $e_i^{inh}$ .

For some radionuclides for which prediction of dosimetric data is necessary there are no data for any nuclides of that element to be found in the standard references. In these cases data for an element with similar metabolic behaviour are used. Thus data for sodium are used for lithium, data for carbon are used for nitrogen and oxygen and data for silicon are used for boron.

Radionuclides with a radioactive daughter require a modification to equation 1 so that the energy deposited by the daughter is also included. Ignoring the *ing* and *inh* superfixes and using 0 for the parent, 1 for the first daughter, 2 for the second daughter, etc., then the extended equation is:

$$e_0 = C_0 N_0 (E_0 + \lambda_1 N_1 (E_1 + \lambda_2 N_2 (E_2 + \dots))) \quad (5)$$

If it is assumed that the correct coefficient has already been calculated for daughter 1 (i.e. including the effects of daughter 2 etc.), then equation 5 can be written concisely as follows:

$$e_0 = C_0 N_0 (E_0 + \lambda_1 e_1 / C_1) \quad (6)$$

### Noble gases

No values of committed effective doses per unit uptake for the noble gases exist in the literature and it is thus necessary to use  $C_j^{ing}$  and  $C_j^{inh}$  values for an element that is expected to behave in a similar metabolic manner. Following reference 12, the element chosen is yttrium because, like the noble gases, it is very insoluble. For all noble gas radionuclides the method described above is used but with residency times increased

from the standard values. The values used are  $t^{ing} = 7$  days and  $t^{inh} = 500$  days. These values were suggested by Smith [11].

### Long-lived $\alpha$ emitters

For long-lived radionuclides decaying by  $\alpha$  emission, equation 2 is modified to exclude the dependency on  $N$  since, for long half-life nuclides, this becomes a constant (the residence time). The modified form is shown in equation 7:

$$e_i^{ing} = K_j^{ing} E_i \quad (7)$$

where  $K_j^{ing}$  is a 'constant' corresponding to  $C_j^{ing}$  used previously. In calculating values of  $K_j$ , only long-lived  $\alpha$  emitters of the same element are considered. For some radionuclides no other long-lived  $\alpha$  emitters exist and in these cases values of  $K_j$  for another element with similar metabolic behaviour are used. Thus cerium and neodymium are assumed to behave in a similar manner to samarium and hafnium and osmium to behave in a similar manner to gadolinium.

### Calculational method for dosimetric data

The processing system SAFEPAQ-II [3] used for the generation of the EAF cross section and decay data libraries is the natural place to include the calculational methodology of dosimetric data. A table in the Parameter database is defined during the building of the decay data library that contains values of the half-lives and energies required for the estimation of unknown coefficients. These data are used in the following steps to generate the estimates.

- Calculate all the elemental parameters  $C_j$ , in all cases using the maximum value from all the available data for each element.
- Calculate the reduced constants  $K_j$ .
- Considering each radionuclide in turn, check if data exists in the tables of known dosimetric data; if so use the data and mark the nuclide as 'done'.
- Considering each radionuclide in turn, check if the nuclide is marked as done; if not then check if the daughter nuclide is stable. If so, use the elemental parameters and equation 2 to evaluated approximate data and mark nuclide as done.
- Considering each radionuclide in turn, check if nuclide is marked as done; if not, then check if the daughter nuclide is marked as done. If so, use the elemental parameters to evaluated approximate data using equation 6 and mark nuclide as done. Continue to iterate this step until all nuclides are calculated.

The values of  $e_i^{inh}$ ,  $e_i^{ing}$  and the source of the data are added to the database table and it is then possible to print out a listing of the data that forms the EAF\_HAZ-2010 library. The various data sources used in the library are listed in Table 1.

**Table 1.** References of data sources for EAF\_HAZ-2010.

Data source	Reference
ICRP72	16
R245	8
KENDALL	10
NRPB-M	11
Calculated	Current approximate methodology

## Transport data

### Calculational method for transport data

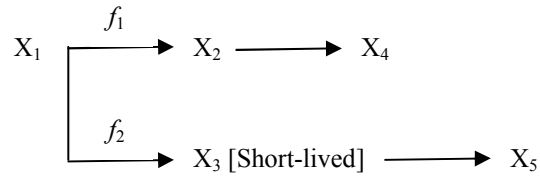
The IAEA regulations [4] give generic values of the  $A_2$  coefficients that should be used for radionuclides not given individually. These values are shown in Table 2.

**Table 2.** Generic values of  $A_2$  coefficients.

Nuclide decay mode	$A_2$ (TBq)
Only $\beta$ or $\gamma$ emitting decay	0.02
$\alpha$ decays included	$9.0 \cdot 10^{-5}$

The SAFEPAQ-II processing system [2] is used to compile the EAF\_A2-2010 library using values of decay modes contained in the Parameter database. Each radionuclide is considered in turn; if an entry is available in the IAEA regulations then this is used, otherwise the decay mode of the nuclide is checked and the correct generic value chosen from Table 2. The  $A_2$  values are added to the database table and it is then possible to generate a listing of the data that forms the EAF\_A2-2010 library. In the listing that follows an entry in the 'A<sub>2</sub> source' column of 'A<sub>2</sub> value' means that the IAEA regulations give individual data; 'BETA' and 'ALPHA' entries indicate that generic values are used.

The IAEA report notes that for a set of nuclides with short-lived decay daughters the  $A_2$  value for the daughter is included in the parent value. Since the EAF\_A2-2010 library actually contains data for these short lived nuclides it is necessary to adjust the IAEA values to avoid double counting. The method is shown in below for a general decay.



If the X<sub>3</sub> nuclide is short-lived then λ<sub>3</sub> >> λ<sub>1</sub> and it can be assumed that the two nuclides are in secular equilibrium. If the activity X<sub>1</sub> is A<sub>1</sub> then activity of X<sub>3</sub> is f<sub>2</sub>A<sub>1</sub>. The A<sub>2</sub> value for nuclide *i* is B<sub>*i*</sub>, and if φ<sub>*i*</sub> is the fraction of activity for nuclide *i* then for a mixture of nuclides the A<sub>2</sub> value is given by equation 8.

$$\frac{1}{B} = \sum_i \frac{\phi_i}{B_i} \tag{8}$$

In this case activity = A<sub>1</sub> + f<sub>2</sub>A<sub>1</sub> and the activity fractions are given in equation 9.

$$\phi_1 = \frac{A_1}{A_1 + f_2 A_1} = \frac{1}{1 + f_2} \tag{9}$$

$$\phi_3 = \frac{f_2 A_1}{A_1 + f_2 A_1} = \frac{f_2}{1 + f_2}$$

Thus the A<sub>2</sub> value for these two nuclides is given by substituting equation 9 into equation 8 to give equation 10.

$$\frac{1}{B} = \frac{1/(1+f_2)}{B_1} + \frac{f_2/(1+f_2)}{B_3} \tag{10}$$

Since B and B<sub>3</sub> are given, this means that the corrected value of A<sub>2</sub> value for X<sub>1</sub> is given by equation 11.

$$\frac{1}{B_1} = \frac{1+f_2}{B} - \frac{f_2}{B_3} \tag{11}$$

The nuclides that have been corrected are shown in Table 3, which contains the uncorrected and the corrected values.

**Table 3.** Uncorrected and corrected A<sub>2</sub> coefficients.

Nuclide	Uncorrected A <sub>2</sub>	Corrected A <sub>2</sub>
Ca-47	0.3	0.191
Ti-44	0.4	0.33
Sr-91	0.3	0.21
Zr-95	0.8	1.4
Mo-99	0.6	0.34
Ru-103	2.0	1.0
Ag-110m	0.4	0.53
Cd-115	0.4	0.25
Te-127m	0.5	0.39
Te-129m	0.4	0.32
Ba-140	0.3	0.24

Nuclide	Uncorrected A <sub>2</sub>	Corrected A <sub>2</sub>
Dy-166	0.3	0.24
W-188	0.3	0.24
Pb-210	0.05	0.026
Am-243	0.001	0.0005

## Clearance data

The safe handling of radioactive waste is recognised as vital to ensure protection of human health and the environment. IAEA publish regulations on these issues, and reference 5 gives information on suggested clearance level values for a set of important radionuclides.

### Methodology for the calculation of clearance data

The clearance index ( $I_c$ ) for a material containing a single radionuclide  $n$  is calculated by equation 12, where  $A_n$  is the activity due to the nuclide and  $L_n$  is the clearance level for the nuclide. If  $I_c \leq 1$  then it is possible to clear the material.

$$I_c = \frac{A_n}{L_n} \quad (12)$$

Most materials contain a mixture of radionuclides, and in this case the clearance index is calculated by equation 13. Again, clearance is possible if  $I_c \leq 1$ .

$$I_c = \sum_i \frac{A_i}{L_i} \quad (13)$$

In equations 12 and 13, activities and clearance levels have units of Bq kg<sup>-1</sup>.

Reference 13 gives clearance values for a number of nuclides and a general formula that can be used to calculate the level for any other nuclide. The formula is given in equation 14,

$$L_i = \min \left\{ \frac{1000}{E_{\gamma,i} + 0.1 \times E_{\beta,i}}, \frac{D}{e_i^{inh}}, \frac{D}{e_i^{ing} \times 10^2} \right\} \quad (14)$$

where:  $D = 20$  mSv y<sup>-1</sup>, i.e. the dose limit for radiation workers [13], and for the  $i^{\text{th}}$  nuclide, the other quantities are:  $E_{\gamma,i}$  - effective photon emission energy (MeV);  $E_{\beta,i}$  - effective beta decay emission energy (MeV);  $e_i^{inh}$  - committed effective dose equivalent from inhalation (Sv Bq<sup>-1</sup>) and  $e_i^{ing}$  - committed effective dose equivalent from ingestion (Sv Bq<sup>-1</sup>). Note that these quantities are available in the EAF\_DEC-2010 and EAF\_HAZ-2010 libraries.

Equation 14 was used to calculate  $L_i$  values for all nuclides not given explicitly in reference 5.



## Contents of libraries

The contents of EAF\_HAZ-2010, EAF\_A2-2010 and EAF\_CLEAR-2010 are listed below. The nuclides that have been added (+) or changed (>) since EAF-2007 are indicated. Column 1 shows the ID of the nuclide as used in FISPACT, column 2 is the nuclide name, column 3 is the specific activity of the nuclide (not part of any library, but a quantity of relevance to hazards), columns 4 and 5 are the committed effective doses per unit uptake for ingestion and inhalation respectively, column 6 is the source of the biological data, column 7 is the A<sub>2</sub> value, column 8 is the source of the A<sub>2</sub> value, column 9 is the clearance value and column 10 is the source of the clearance value.

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
3	H-3	3.5569E+17	4.2000E-11	2.6000E-10	ICRP72	40.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 6	He-6	8.5821E+25	1.4674E-11	7.3370E-12	Calculated	0.02000	BETA	6.18142E+03	Calculated
> 7	Li-5	2.2507E+47	2.5763E-35	1.5608E-35	Calculated	0.02000	BETA	1.00000E+30	Calculated
> 10	Li-8	6.2090E+25	1.0201E-13	6.1799E-14	Calculated	0.00009	ALPHA	1.53035E+03	Calculated
> 11	Li-9	2.5935E+26	2.0951E-15	1.2693E-15	Calculated	0.02000	BETA	1.66800E+03	Calculated
> 12	Be-6	1.3869E+46	4.3705E-34	3.7753E-34	Calculated	0.02000	BETA	1.00000E+30	Calculated
13	Be-7	1.2937E+19	2.8000E-11	5.5000E-11	ICRP72	20.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 14	Be-8	7.4490E+41	4.0981E-31	3.5400E-31	Calculated	0.00009	ALPHA	4.88028E+28	Calculated
> 16	Be-10	8.2559E+11	1.1000E-09	3.5000E-08	ICRP72	0.60000	A2 VALUE	3.96493E+04	Calculated
> 17	Be-11	2.7424E+24	2.9875E-13	2.5807E-13	Calculated	0.00009	ALPHA	5.30923E+02	Calculated
> 18	Be-12	1.6295E+27	8.4269E-16	7.2793E-16	Calculated	0.02000	BETA	1.78094E+03	Calculated
> 19	Be-13	6.4043E+34	2.3021E-23	1.9886E-23	Calculated	0.02000	BETA	8.68774E+20	Calculated
> 20	B-8	6.7556E+25	2.1786E-12	1.0757E-12	Calculated	0.00009	ALPHA	2.01219E+02	Calculated
> 21	B-9	5.7890E+43	1.2613E-31	6.2277E-32	Calculated	0.02000	BETA	1.58566E+29	Calculated
> 24	B-12	1.7200E+27	3.7726E-15	1.8627E-15	Calculated	0.00009	ALPHA	1.38618E+03	Calculated
> 25	B-13	1.8503E+27	3.3481E-15	1.6531E-15	Calculated	0.02000	BETA	1.06230E+03	Calculated
> 26	B-14	2.3810E+27	4.7982E-15	2.3691E-15	Calculated	0.02000	BETA	1.50495E+02	Calculated
> 27	B-15	2.8136E+27	1.0455E-16	5.1621E-17	Calculated	0.02000	BETA	1.98674E+02	Calculated
> 28	C-9	3.6538E+26	9.1947E-14	6.8960E-14	Calculated	0.02000	BETA	1.86011E+02	Calculated
> 29	C-10	2.1642E+24	6.8748E-13	5.1561E-13	Calculated	0.02000	BETA	5.47899E+02	Calculated
> 30	C-11	3.1016E+22	2.4000E-11	1.8000E-11	ICRP72	0.60000	A2 VALUE	9.45266E+02	Calculated
33	C-14	1.6572E+14	5.8000E-10	5.8000E-09	ICRP72	3.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 34	C-15	1.1355E+25	2.2187E-13	1.6641E-13	Calculated	0.02000	BETA	2.55923E+02	Calculated
> 35	C-16	3.4893E+25	3.0521E-13	2.2891E-13	Calculated	0.02000	BETA	6.45936E+02	Calculated
> 36	C-17	1.2706E+26	9.1472E-14	6.8604E-14	Calculated	0.02000	BETA	2.48390E+02	Calculated
> 37	N-11	6.4165E+46	2.3763E-34	1.7822E-34	Calculated	0.02000	BETA	1.00000E+30	Calculated
> 38	N-12	3.1574E+27	1.4480E-15	1.0860E-15	Calculated	0.02000	BETA	5.09302E+02	Calculated
> 39	N-13	5.3669E+22	1.2637E-11	9.4777E-12	Calculated	0.60000	A2 VALUE	9.35261E+02	Calculated
> 42	N-16	3.6576E+24	7.2809E-13	5.4606E-13	Calculated	0.00009	ALPHA	2.04522E+02	Calculated
> 43	N-17	5.8854E+24	1.1527E-12	8.6451E-13	Calculated	0.02000	BETA	4.66660E+03	Calculated
> 44	N-18	3.6781E+25	8.0470E-14	6.0352E-14	Calculated	0.02000	BETA	1.98954E+02	Calculated
> 45	N-19	8.0996E+25	6.1117E-14	4.5838E-14	Calculated	0.02000	BETA	2.96520E+02	Calculated
> 46	N-20	1.6036E+26	7.6229E-14	5.7172E-14	Calculated	0.02000	BETA	2.24306E+02	Calculated
> 47	O-14	4.2203E+23	4.0450E-12	3.0337E-12	Calculated	0.02000	BETA	2.94313E+02	Calculated
> 48	O-15	2.2720E+23	3.0083E-12	2.2562E-12	Calculated	0.02000	BETA	9.13755E+02	Calculated
> 52	O-19	8.1626E+23	1.0215E-12	7.6611E-13	Calculated	0.02000	BETA	8.50680E+02	Calculated
> 53	O-20	1.5446E+24	1.2030E-12	9.0223E-13	Calculated	0.02000	BETA	8.49487E+02	Calculated
> 54	O-21	5.8097E+24	3.9869E-13	2.9901E-13	Calculated	0.02000	BETA	3.13371E+02	Calculated
> 55	O-22	8.4290E+24	3.7355E-13	2.8017E-13	Calculated	0.02000	BETA	5.17788E+02	Calculated
> 56	F-15	6.7792E+46	8.3650E-35	1.0072E-34	Calculated	0.02000	BETA	1.00000E+30	Calculated
> 57	F-16	2.3700E+45	8.2837E-34	9.9743E-34	Calculated	0.02000	BETA	1.00000E+30	Calculated
> 58	F-17	3.8070E+23	6.8546E-13	8.2535E-13	Calculated	0.02000	BETA	9.13627E+02	Calculated
59	F-18	3.5222E+21	4.9000E-11	5.9000E-11	ICRP72	0.60000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 61	F-20	1.8922E+24	2.7402E-13	3.2994E-13	Calculated	0.02000	BETA	5.28707E+02	Calculated
> 62	F-21	4.7805E+24	7.2819E-14	8.7681E-14	Calculated	0.02000	BETA	1.26414E+03	Calculated
> 63	F-22	4.4849E+24	2.0773E-13	2.5012E-13	Calculated	0.02000	BETA	1.67178E+02	Calculated
> 64	F-23	8.1372E+24	9.8559E-14	1.1867E-13	Calculated	0.02000	BETA	3.87751E+02	Calculated
> 65	F-24	4.3467E+25	3.4051E-14	4.1478E-14	Calculated	0.02000	BETA	3.85862E+02	Calculated
> 66	Ne-17	2.2462E+26	9.4808E-11	4.7404E-11	Calculated	0.02000	BETA	2.62766E+02	Calculated
> 67	Ne-18	1.3865E+25	7.4327E-11	3.7163E-11	Calculated	0.02000	BETA	7.96885E+02	Calculated
> 68	Ne-19	1.2757E+24	3.9575E-10	1.9788E-10	Calculated	0.02000	BETA	8.95044E+02	Calculated
> 72	Ne-23	4.8799E+23	8.8928E-10	4.4464E-10	Calculated	0.02000	BETA	2.76397E+03	Calculated

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 73	Ne-24	8.5785E+22	1.3757E-08	7.0717E-09	Calculated	0.02000	BETA	1.60720E+03	Calculated
> 74	Ne-25	2.7738E+25	4.0165E-11	2.0083E-11	Calculated	0.02000	BETA	1.48368E+03	Calculated
> 75	Ne-26	8.1495E+25	1.2678E-11	6.3389E-12	Calculated	0.02000	BETA	1.57755E+09	Calculated
> 76	Ne-27	4.8299E+26	5.6671E-12	2.8336E-12	Calculated	0.02000	BETA	2.19531E+02	Calculated
> 77	Na-20	4.6779E+25	5.6160E-15	3.4023E-15	Calculated	0.02000	BETA	3.53732E+02	Calculated
> 78	Na-21	8.8392E+23	8.5144E-14	5.1583E-14	Calculated	0.02000	BETA	8.71689E+02	Calculated
79	Na-22	2.3107E+17	3.2000E-09	1.3000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+02	IAEA-G-1.7
81	Na-24	3.2312E+20	4.3000E-10	2.7000E-10	ICRP72	0.20000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 82	Na-24m	8.6134E+26	8.6521E-20	5.2417E-20	Calculated	0.02000	BETA	2.12174E+03	Calculated
> 83	Na-25	2.8026E+23	2.0404E-13	1.2362E-13	Calculated	0.02000	BETA	1.70489E+03	Calculated
> 84	Na-26	1.4870E+25	1.0537E-14	6.3836E-15	Calculated	0.02000	BETA	3.97894E+02	Calculated
> 85	Na-27	5.1374E+25	3.4285E-15	2.0771E-15	Calculated	0.02000	BETA	6.54515E+02	Calculated
> 86	Na-28	4.8880E+26	4.7733E-16	2.9373E-16	Calculated	0.02000	BETA	5.70926E+02	Calculated
> 87	Na-29	3.2055E+26	2.0451E-15	1.2407E-15	Calculated	0.02000	BETA	2.32889E+02	Calculated
> 88	Na-30	2.8740E+26	3.0561E-15	1.8516E-15	Calculated	0.02000	BETA	1.89312E+02	Calculated
> 89	Mg-21	1.6284E+26	4.5764E-15	2.2756E-15	Calculated	0.02000	BETA	5.05051E+02	Calculated
> 90	Mg-22	4.9194E+24	2.4507E-13	1.2158E-13	Calculated	0.02000	BETA	5.37736E+02	Calculated
> 91	Mg-23	1.6041E+24	5.5278E-13	2.7487E-13	Calculated	0.02000	BETA	8.39691E+02	Calculated
> 95	Mg-27	2.7259E+22	1.8465E-11	9.1820E-12	Calculated	0.02000	BETA	1.03632E+03	Calculated
> 96	Mg-28	1.9825E+20	2.2000E-09	1.2000E-09	ICRP72	0.30000	A2 VALUE	7.14416E+02	Calculated
> 97	Mg-29	1.1077E+25	1.8246E-13	9.0729E-14	Calculated	0.02000	BETA	4.71340E+02	Calculated
> 98	Mg-30	4.1548E+25	7.1383E-14	3.5496E-14	Calculated	0.02000	BETA	3.91997E+02	Calculated
> 99	Mg-31	5.8551E+25	6.4296E-14	3.1972E-14	Calculated	0.02000	BETA	2.43019E+02	Calculated
> 100	Al-23	3.8602E+25	1.2535E-13	8.9531E-14	Calculated	0.02000	BETA	2.36248E+02	Calculated
> 101	Al-24	8.4718E+24	5.3889E-13	3.8492E-13	Calculated	0.02000	BETA	1.03078E+02	Calculated
> 102	Al-24m	1.3379E+26	3.4617E-14	2.4727E-14	Calculated	0.02000	BETA	1.71821E+03	Calculated
> 103	Al-25	2.3254E+24	4.0509E-13	2.8935E-13	Calculated	0.02000	BETA	8.47676E+02	Calculated
> 104	Al-26	7.0992E+11	3.5000E-09	2.0000E-08	ICRP72	0.10000	A2 VALUE	3.68354E+02	Calculated
> 105	Al-26m	2.5316E+24	3.5380E-13	2.5272E-13	Calculated	0.02000	BETA	8.55063E+02	Calculated
> 107	Al-28	1.1094E+23	9.2062E-12	6.5759E-12	Calculated	0.02000	BETA	5.24491E+02	Calculated
> 108	Al-29	3.6594E+22	2.1000E-11	1.5000E-11	NRPB-M	0.02000	BETA	6.76500E+02	Calculated
> 109	Al-30	3.8142E+24	4.8010E-13	3.4293E-13	Calculated	0.02000	BETA	2.67278E+02	Calculated
> 110	Al-31	2.0920E+25	6.9058E-14	4.9327E-14	Calculated	0.02000	BETA	9.51290E+02	Calculated
> 111	Al-32	3.9543E+26	4.8988E-15	3.5002E-15	Calculated	0.02000	BETA	8.80719E+02	Calculated
> 112	Al-33	3.0342E+26	1.3927E-14	9.9530E-15	Calculated	0.02000	BETA	2.38753E+02	Calculated
> 113	Al-34	2.1809E+26	2.7187E-14	1.9420E-14	Calculated	0.02000	BETA	1.72738E+02	Calculated
> 114	Si-25	7.5883E+25	3.6719E-14	1.8130E-14	Calculated	0.02000	BETA	7.98085E+02	Calculated
> 115	Si-26	7.1887E+24	3.3920E-13	1.6748E-13	Calculated	0.02000	BETA	7.05726E+02	Calculated
> 116	Si-27	3.7093E+24	3.2548E-13	1.6070E-13	Calculated	0.02000	BETA	8.34697E+02	Calculated
120	Si-31	1.4287E+21	1.6000E-10	7.9000E-11	ICRP72	0.60000	A2 VALUE	1.00000E+06	IAEA-G-1.7
> 121	Si-32	3.1340E+15	5.6000E-10	1.1000E-07	ICRP72	0.50000	A2 VALUE	1.54619E+05	IAEA-G-1.7
> 122	Si-33	2.0482E+24	7.5739E-13	3.7466E-13	Calculated	0.02000	BETA	4.00000E+02	Calculated
> 123	Si-34	4.4350E+24	3.8811E-13	1.9163E-13	Calculated	0.02000	BETA	6.02410E+02	Calculated
> 124	Si-35	1.5297E+25	2.1804E-13	1.0767E-13	Calculated	0.02000	BETA	2.11028E+02	Calculated
> 125	Si-36	2.5776E+25	1.6551E-13	8.1721E-14	Calculated	0.02000	BETA	5.05500E+02	Calculated
> 126	P-28	5.5169E+25	5.2626E-14	1.3102E-13	Calculated	0.02000	BETA	1.92781E+02	Calculated
> 127	P-29	3.4790E+24	3.5685E-13	8.8846E-13	Calculated	0.02000	BETA	3.88035E+02	Calculated
> 128	P-30	9.2902E+22	7.6120E-12	1.8952E-11	Calculated	0.02000	BETA	8.57862E+02	Calculated
130	P-32	1.0589E+19	2.4000E-09	3.4000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+06	IAEA-G-1.7
131	P-33	5.7727E+18	2.4000E-10	1.5000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+06	IAEA-G-1.7
> 132	P-34	9.9086E+23	6.7448E-13	1.6793E-12	Calculated	0.02000	BETA	1.73631E+03	Calculated
> 133	P-35	2.5234E+23	2.5807E-12	6.4287E-12	Calculated	0.02000	BETA	5.93507E+02	Calculated
> 134	P-36	2.0718E+24	9.4343E-13	2.3489E-12	Calculated	0.02000	BETA	1.54583E+02	Calculated
> 135	P-37	4.8865E+24	2.7849E-13	6.8044E-13	Calculated	0.02000	BETA	3.44947E+02	Calculated
> 136	P-38	1.7171E+25	1.0306E-13	2.4700E-13	Calculated	0.02000	BETA	3.11828E+02	Calculated
> 137	P-39	5.6352E+25	6.7430E-14	1.6580E-13	Calculated	0.02000	BETA	3.11015E+02	Calculated
> 138	P-40	6.9586E+25	6.8999E-14	1.7156E-13	Calculated	0.02000	BETA	2.05756E+02	Calculated
> 139	S-29	7.6982E+25	2.1515E-13	2.3114E-13	Calculated	0.02000	BETA	1.99258E+02	Calculated
> 140	S-30	1.1818E+25	6.4483E-13	6.9276E-13	Calculated	0.02000	BETA	5.50542E+02	Calculated
> 141	S-31	5.2388E+24	6.9470E-13	7.4633E-13	Calculated	0.02000	BETA	8.07957E+02	Calculated
145	S-35	1.5822E+18	7.7000E-10	1.9000E-09	ICRP72	3.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 147	S-37	3.7710E+22	1.5000E-11	1.3000E-11	NRPB-M	0.02000	BETA	3.31539E+02	Calculated
> 148	S-38	1.0759E+21	6.0000E-10	3.6000E-10	NRPB-M	0.02000	BETA	5.73331E+02	Calculated
> 149	S-39	9.3130E+23	4.7864E-12	4.9386E-12	Calculated	0.02000	BETA	4.97844E+02	Calculated
> 150	S-40	1.1866E+24	6.6707E-12	7.1665E-12	Calculated	0.02000	BETA	6.19059E+02	Calculated
> 151	S-41	5.1187E+24	1.9687E-12	2.1150E-12	Calculated	0.02000	BETA	3.28984E+02	Calculated
> 152	Cl-32	4.3793E+25	9.6823E-14	7.3865E-14	Calculated	0.02000	BETA	2.13174E+02	Calculated
> 153	Cl-33	5.0409E+24	3.1451E-13	2.3993E-13	Calculated	0.02000	BETA	7.96018E+02	Calculated
> 154	Cl-34	8.0515E+24	1.8764E-13	1.4315E-13	Calculated	0.02000	BETA	8.10651E+02	Calculated
> 155	Cl-34m	6.3793E+21	9.7000E-11	7.4000E-11	NRPB-M	0.02000	BETA	4.94254E+02	Calculated
157	Cl-36	1.2218E+12	9.3000E-10	7.3000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+03	IAEA-G-1.7
159	Cl-38	4.9257E+21	1.2000E-10	4.5000E-11	ICRP72	0.20000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 160	Cl-38m	1.5376E+25	5.7659E-14	2.9076E-14	Calculated	0.02000	BETA	1.48955E+03	Calculated
> 161	Cl-39	3.2110E+21	8.5000E-11	4.6000E-11	ICRP72	0.02000	BETA	6.50773E+02	Calculated

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 162	Cl-40	1.2893E+23	1.8149E-11	1.3846E-11	Calculated	0.02000	BETA	2.36268E+02	Calculated
> 163	Cl-41	2.6532E+23	8.5836E-12	6.5483E-12	Calculated	0.02000	BETA	4.73690E+02	Calculated
> 164	Cl-42	1.4625E+24	1.7257E-12	1.3218E-12	Calculated	0.02000	BETA	2.86689E+02	Calculated
> 165	Cl-43	3.1640E+24	1.0177E-12	8.0035E-13	Calculated	0.02000	BETA	3.47867E+02	Calculated
> 166	Cl-44	1.6949E+25	3.4720E-13	2.6523E-13	Calculated	0.02000	BETA	2.33696E+02	Calculated
> 167	Cl-45	2.3200E+25	3.4826E-13	2.7055E-13	Calculated	0.02000	BETA	2.78419E+02	Calculated
> 168	Ar-33	7.3139E+25	3.5526E-12	1.7763E-12	Calculated	0.02000	BETA	5.67215E+02	Calculated
> 169	Ar-34	1.4546E+25	6.3287E-11	3.1643E-11	Calculated	0.02000	BETA	7.49706E+02	Calculated
> 170	Ar-35	6.7238E+24	6.8188E-11	3.4094E-11	Calculated	0.02000	BETA	7.83657E+02	Calculated
> 172	Ar-37	3.7298E+18	9.8566E-09	3.8110E-08	Calculated	40.00000	A2 VALUE	2.02909E+06	Calculated
> 174	Ar-39	1.2620E+15	1.0622E-06	3.7870E-05	Calculated	20.00000	A2 VALUE	1.88286E+04	Calculated
> 176	Ar-41	1.5496E+21	1.3321E-07	6.6607E-08	Calculated	0.30000	A2 VALUE	7.51411E+02	Calculated
> 177	Ar-42	9.5519E+15	3.9708E-06	1.5703E-04	Calculated	0.02000	BETA	5.03677E+03	Calculated
> 178	Ar-43	3.0153E+22	1.1417E-08	6.1864E-09	Calculated	0.02000	BETA	6.14253E+02	Calculated
> 179	Ar-44	1.3335E+22	5.3693E-08	2.6846E-08	Calculated	0.02000	BETA	5.24659E+02	Calculated
> 180	Ar-45	4.3215E+23	2.0231E-09	1.0768E-09	Calculated	0.02000	BETA	3.14465E+02	Calculated
> 181	Ar-46	1.0810E+24	8.4284E-10	4.2142E-10	Calculated	0.02000	BETA	4.69484E+02	Calculated
> 182	Ar-47	1.5322E+25	7.4299E-11	3.7039E-11	Calculated	0.02000	BETA	2.81194E+02	Calculated
> 183	K-36	3.3921E+25	5.0735E-14	1.2080E-14	Calculated	0.02000	BETA	1.72529E+02	Calculated
> 184	K-37	9.2086E+24	6.9301E-14	1.6509E-14	Calculated	0.02000	BETA	7.65164E+02	Calculated
> 185	K-38	2.4077E+22	3.3146E-11	7.8918E-12	Calculated	0.02000	BETA	3.02057E+02	Calculated
> 186	K-38m	1.1898E+25	5.1057E-14	1.2157E-14	Calculated	0.02000	BETA	7.92480E+02	Calculated
188	K-40	2.6165E+08	6.2000E-09	2.1000E-09	ICRP72	0.90000	A2 VALUE	1.00000E+04	IAEA-G-1.7
190	K-42	2.2358E+20	4.3000E-10	1.2000E-10	ICRP72	0.20000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 191	K-43	1.2158E+20	2.5000E-10	1.4000E-10	ICRP72	0.60000	A2 VALUE	1.00289E+03	Calculated
> 192	K-44	7.1511E+21	8.4000E-11	2.0000E-11	ICRP72	0.02000	BETA	3.94496E+02	Calculated
> 193	K-45	8.9443E+21	5.4000E-11	1.5000E-11	ICRP72	0.02000	BETA	5.17358E+02	Calculated
> 194	K-46	8.6494E+22	8.6281E-12	2.0543E-12	Calculated	0.02000	BETA	3.46895E+02	Calculated
> 195	K-47	5.0792E+23	1.3051E-12	3.0845E-13	Calculated	0.02000	BETA	3.56552E+02	Calculated
> 196	K-48	1.2798E+24	1.0273E-12	2.4459E-13	Calculated	0.02000	BETA	1.48896E+02	Calculated
> 197	Ca-37	6.4492E+25	3.0368E-14	6.8401E-14	Calculated	0.02000	BETA	6.81663E+02	Calculated
> 198	Ca-38	2.4981E+25	1.6254E-13	3.6612E-13	Calculated	0.02000	BETA	6.18119E+02	Calculated
> 199	Ca-39	1.2461E+25	1.5869E-13	3.5744E-13	Calculated	0.02000	BETA	7.82336E+02	Calculated
> 201	Ca-41	3.1351E+12	1.9000E-10	1.8000E-10	ICRP72	-1.00000	A2 VALUE	1.38614E+06	Calculated
205	Ca-45	6.5930E+17	7.1000E-10	3.7000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
207	Ca-47	2.2674E+19	1.6000E-09	2.1000E-09	ICRP72	0.19000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 208	Ca-48	5.2046E-03	2.0657E-08	1.0860E-07	Calculated	0.02000	BETA	3.76811E+03	Calculated
> 209	Ca-49	1.6297E+22	1.0892E-10	2.4541E-10	Calculated	0.02000	BETA	3.07305E+02	Calculated
> 210	Sc-40	5.7276E+25	1.0094E-11	3.9117E-12	Calculated	0.02000	BETA	1.34069E+02	Calculated
> 211	Sc-41	1.7087E+25	1.1127E-11	4.3122E-12	Calculated	0.02000	BETA	7.83593E+02	Calculated
> 212	Sc-42	1.4610E+25	1.2581E-11	4.8756E-12	Calculated	0.02000	BETA	7.86219E+02	Calculated
> 213	Sc-42m	1.6043E+23	1.7727E-09	6.8698E-10	Calculated	0.02000	BETA	2.30958E+02	Calculated
> 214	Sc-43	6.9364E+20	1.9000E-10	1.1000E-10	ICRP72	0.02000	BETA	9.73904E+02	Calculated
> 215	Sc-44	6.6440E+20	3.5000E-10	1.8000E-10	ICRP72	0.50000	A2 VALUE	4.55503E+02	Calculated
> 216	Sc-44m	4.5012E+19	2.4000E-09	1.4000E-09	ICRP72	0.02000	BETA	3.58997E+03	Calculated
> 218	Sc-45m	2.8570E+25	2.1123E-14	8.1860E-15	Calculated	0.02000	BETA	5.34443E+05	Calculated
219	Sc-46	1.2547E+18	1.5000E-09	6.8000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+02	IAEA-G-1.7
> 220	Sc-46m	4.8574E+23	1.3895E-11	5.4011E-12	Calculated	0.02000	BETA	1.12551E+04	Calculated
221	Sc-47	3.0706E+19	5.4000E-10	7.3000E-10	ICRP72	0.70000	A2 VALUE	1.00000E+05	IAEA-G-1.7
222	Sc-48	5.5371E+19	1.7000E-09	1.1000E-09	ICRP72	0.30000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 223	Sc-49	2.4847E+21	8.2000E-11	4.0000E-11	ICRP72	0.02000	BETA	1.17195E+04	Calculated
> 224	Sc-50	8.1526E+22	2.5884E-09	1.0031E-09	Calculated	0.02000	BETA	2.97574E+02	Calculated
> 225	Sc-50m	2.3876E+25	9.2870E-12	3.5991E-12	Calculated	0.02000	BETA	3.72478E+03	Calculated
> 226	Sc-51	6.6066E+23	3.5225E-10	1.3651E-10	Calculated	0.02000	BETA	3.94608E+02	Calculated
> 227	Sc-52	9.7976E+23	3.9339E-10	1.4842E-10	Calculated	0.02000	BETA	3.14687E+02	Calculated
> 228	Ti-41	1.2732E+26	1.2718E-17	9.3265E-18	Calculated	0.02000	BETA	6.94927E+02	Calculated
> 229	Ti-42	4.9975E+25	5.2648E-14	3.8609E-14	Calculated	0.02000	BETA	6.06683E+02	Calculated
> 230	Ti-43	1.9086E+25	6.8327E-14	5.0123E-14	Calculated	0.02000	BETA	6.82239E+02	Calculated
> 231	Ti-44	5.0150E+15	5.8000E-09	1.2000E-07	ICRP72	0.33000	A2 VALUE	7.17748E+03	Calculated
> 232	Ti-45	8.3736E+20	1.5000E-10	9.3000E-11	ICRP72	0.02000	BETA	1.09989E+03	Calculated
> 238	Ti-51	2.3544E+22	1.5000E-11	1.1000E-11	NRPB-M	0.02000	BETA	2.21509E+03	Calculated
> 239	Ti-52	7.8780E+22	1.2103E-11	8.2420E-12	Calculated	0.02000	BETA	4.90484E+03	Calculated
> 240	Ti-53	2.4108E+23	6.2010E-12	4.5474E-12	Calculated	0.02000	BETA	4.73709E+02	Calculated
> 241	Ti-54	5.1580E+24	4.3623E-13	3.1990E-13	Calculated	0.02000	BETA	6.34101E+02	Calculated
> 242	Ti-55	1.5501E+25	1.5683E-13	1.1501E-13	Calculated	0.02000	BETA	3.64609E+02	Calculated
> 243	V-44	8.5518E+25	2.4592E-14	1.7892E-14	Calculated	0.02000	BETA	2.01571E+02	Calculated
> 244	V-45	1.7223E+25	5.7255E-14	4.1062E-14	Calculated	0.02000	BETA	7.64670E+02	Calculated
> 245	V-46	2.1496E+25	4.0186E-14	2.9229E-14	Calculated	0.02000	BETA	7.67458E+02	Calculated
> 246	V-47	4.5449E+21	6.3000E-11	2.9000E-11	ICRP72	0.02000	BETA	9.29919E+02	Calculated
247	V-48	6.3073E+18	2.0000E-09	2.4000E-09	ICRP72	0.40000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 248	V-49	2.9909E+17	1.8000E-11	3.4000E-11	ICRP72	40.00000	A2 VALUE	7.66129E+05	Calculated
> 249	V-50	1.8917E+00	6.4115E-09	1.0881E-08	Calculated	0.02000	BETA	7.01726E+02	Calculated
> 251	V-52	3.5763E+22	1.4000E-11	9.2000E-12	NRPB-M	0.02000	BETA	6.43172E+02	Calculated
> 252	V-53	8.1113E+22	4.9329E-12	3.5879E-12	Calculated	0.02000	BETA	8.75579E+02	Calculated

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 253	V-54	1.5538E+23	6.7362E-12	4.8995E-12	Calculated	0.02000	BETA	2.36223E+02	Calculated
> 254	V-55	1.1616E+24	6.7662E-13	4.9213E-13	Calculated	0.02000	BETA	1.07825E+03	Calculated
> 255	V-56	3.4540E+25	4.5833E-14	3.4291E-14	Calculated	0.02000	BETA	2.96404E+02	Calculated
> 256	V-57	2.0941E+25	7.9938E-14	5.8148E-14	Calculated	0.02000	BETA	3.28199E+02	Calculated
> 257	V-58	3.7708E+25	1.1590E-13	8.4302E-14	Calculated	0.02000	BETA	5.60051E+02	Calculated
> 258	Cr-46	3.4926E+25	1.2507E-14	5.4813E-15	Calculated	0.02000	BETA	7.51371E+02	Calculated
> 259	Cr-47	1.7777E+25	1.6171E-14	6.4561E-15	Calculated	0.02000	BETA	7.53872E+02	Calculated
> 260	Cr-48	1.1215E+20	2.0000E-10	2.2000E-10	ICRP72	0.02000	BETA	2.30477E+03	Calculated
> 261	Cr-49	3.3919E+21	6.1000E-11	3.5000E-11	ICRP72	0.02000	BETA	9.03433E+02	Calculated
> 262	Cr-50	1.4713E+00	1.2657E-09	1.2942E-09	Calculated	0.02000	BETA	8.56751E+03	Calculated
263	Cr-51	3.4232E+18	3.8000E-11	3.7000E-11	ICRP72	30.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 267	Cr-55	3.5771E+22	1.4111E-12	6.1841E-13	Calculated	0.02000	BETA	8.78011E+03	Calculated
> 268	Cr-56	2.0937E+22	5.2126E-12	2.5155E-12	Calculated	0.02000	BETA	6.56363E+03	Calculated
> 269	Cr-57	3.4742E+23	4.6042E-13	2.0178E-13	Calculated	0.02000	BETA	1.52175E+03	Calculated
> 270	Cr-58	1.0291E+24	2.8787E-13	1.2616E-13	Calculated	0.02000	BETA	6.68449E+02	Calculated
> 271	Cr-59	1.5394E+25	2.1426E-14	9.4817E-15	Calculated	0.02000	BETA	3.59324E+02	Calculated
> 272	Mn-48	5.5041E+25	2.3382E-14	1.0492E-14	Calculated	0.02000	BETA	2.02433E+02	Calculated
> 273	Mn-49	2.2319E+25	4.9083E-14	2.3741E-14	Calculated	0.02000	BETA	7.11809E+02	Calculated
> 274	Mn-50	2.9435E+25	1.8334E-14	7.7056E-15	Calculated	0.02000	BETA	7.51328E+02	Calculated
> 275	Mn-50m	7.9582E+22	1.0542E-11	4.4306E-12	Calculated	0.02000	BETA	2.02184E+02	Calculated
276	Mn-51	2.9557E+21	9.3000E-11	4.1000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
277	Mn-52	1.6623E+19	1.8000E-09	1.4000E-09	ICRP72	0.30000	A2 VALUE	1.00000E+03	IAEA-G-1.7
278	Mn-52m	6.3174E+21	6.9000E-11	2.9000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
279	Mn-53	6.7894E+10	3.0000E-11	5.4000E-11	ICRP72	-1.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
280	Mn-54	2.8695E+17	7.1000E-10	1.5000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+02	IAEA-G-1.7
282	Mn-56	8.0267E+20	2.5000E-10	1.2000E-10	ICRP72	0.30000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 283	Mn-57	8.5845E+22	1.6028E-12	6.7365E-13	Calculated	0.02000	BETA	4.76062E+03	Calculated
> 284	Mn-58	1.1050E+23	4.1610E-12	1.7488E-12	Calculated	0.02000	BETA	3.91645E+02	Calculated
> 285	Mn-58m	2.6683E+24	1.2411E-13	5.2161E-14	Calculated	0.02000	BETA	2.48196E+03	Calculated
> 286	Mn-59	1.5429E+24	1.9015E-13	8.2187E-14	Calculated	0.02000	BETA	1.34433E+03	Calculated
> 287	Mn-60	1.3654E+23	3.0724E-12	1.2913E-12	Calculated	0.02000	BETA	2.60417E+03	Calculated
> 288	Mn-60m	3.8903E+24	1.5097E-13	6.3451E-14	Calculated	0.02000	BETA	3.37610E+02	Calculated
> 289	Mn-61	1.0223E+25	6.0921E-14	2.5604E-14	Calculated	0.02000	BETA	2.19368E+03	Calculated
> 290	Mn-62	7.6571E+24	1.4476E-13	6.0840E-14	Calculated	0.02000	BETA	3.95599E+02	Calculated
> 291	Mn-63	2.4113E+25	4.6164E-14	1.9402E-14	Calculated	0.02000	BETA	2.96442E+02	Calculated
> 292	Mn-64	7.3501E+25	1.8953E-14	7.9658E-15	Calculated	0.02000	BETA	2.24467E+02	Calculated
> 294	Fe-50	5.3901E+25	1.1640E-14	1.1431E-14	Calculated	0.02000	BETA	3.34766E+02	Calculated
> 295	Fe-51	4.4763E+20	9.3408E-10	9.3228E-10	Calculated	0.02000	BETA	7.19804E+02	Calculated
296	Fe-52	2.6973E+20	1.4000E-09	6.3000E-10	ICRP72	0.30000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 297	Fe-52m	1.7506E+23	2.5585E-12	2.5846E-12	Calculated	0.02000	BETA	1.96685E+02	Calculated
> 298	Fe-53	1.5441E+22	9.1763E-12	9.0122E-12	Calculated	0.02000	BETA	7.72232E+02	Calculated
> 299	Fe-53m	5.0930E+22	6.4667E-12	6.3511E-12	Calculated	0.02000	BETA	3.29524E+02	Calculated
301	Fe-55	8.8034E+16	3.3000E-10	7.7000E-10	ICRP72	40.00000	A2 VALUE	1.00000E+06	IAEA-G-1.7
305	Fe-59	1.8424E+18	1.8000E-09	4.0000E-09	ICRP72	0.90000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 306	Fe-60	1.4714E+11	1.1000E-07	2.8000E-07	ICRP72	0.20000	A2 VALUE	1.81818E+05	Calculated
> 307	Fe-61	1.9092E+22	6.8852E-12	6.7618E-12	Calculated	0.02000	BETA	6.68235E+02	Calculated
> 308	Fe-62	9.9110E+22	2.4375E-12	2.3939E-12	Calculated	0.02000	BETA	1.69924E+03	Calculated
> 309	Fe-63	1.0872E+24	2.2174E-13	2.1778E-13	Calculated	0.02000	BETA	1.72964E+03	Calculated
> 310	Fe-64	3.2641E+24	8.7704E-14	8.6136E-14	Calculated	0.02000	BETA	4.42312E+03	Calculated
> 311	Fe-65	4.9441E+24	9.6725E-14	9.4996E-14	Calculated	0.02000	BETA	3.28984E+02	Calculated
> 312	Co-52	6.9852E+25	2.7670E-11	2.0290E-11	Calculated	0.02000	BETA	2.47776E+02	Calculated
> 313	Co-53	3.2845E+25	2.8315E-11	2.3318E-11	Calculated	0.02000	BETA	6.96324E+02	Calculated
> 314	Co-54	4.0043E+25	1.4878E-11	1.2252E-11	Calculated	0.02000	BETA	7.34799E+02	Calculated
> 315	Co-54m	8.7133E+22	9.1972E-09	7.5742E-09	Calculated	0.02000	BETA	2.41821E+02	Calculated
316	Co-55	1.2039E+20	1.0000E-09	5.3000E-10	ICRP72	0.50000	A2 VALUE	1.00000E+04	IAEA-G-1.7
317	Co-56	1.1171E+18	2.5000E-09	6.7000E-09	ICRP72	0.30000	A2 VALUE	1.00000E+02	IAEA-G-1.7
318	Co-57	3.1219E+17	2.1000E-10	1.0000E-09	ICRP72	10.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
319	Co-58	1.1768E+18	7.4000E-10	2.1000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
320	Co-58m	2.2487E+20	2.4000E-11	1.7000E-11	ICRP72	40.00000	A2 VALUE	1.00000E+07	IAEA-G-1.7
322	Co-60	4.1871E+16	3.4000E-09	3.1000E-08	ICRP72	0.40000	A2 VALUE	1.00000E+02	IAEA-G-1.7
323	Co-60m	1.1087E+22	1.7000E-12	1.4000E-12	ICRP72	0.02000	BETA	1.00000E+06	IAEA-G-1.7
324	Co-61	1.1533E+21	7.4000E-11	5.1000E-11	ICRP72	0.02000	BETA	1.00000E+05	IAEA-G-1.7
> 325	Co-62	7.4887E+22	5.0522E-09	4.1606E-09	Calculated	0.02000	BETA	5.66820E+02	Calculated
326	Co-62m	8.0755E+21	4.7000E-11	2.1000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
> 327	Co-63	2.4207E+23	8.1296E-10	6.6951E-10	Calculated	0.02000	BETA	3.32316E+03	Calculated
> 328	Co-64	2.1763E+25	1.8036E-11	1.4853E-11	Calculated	0.02000	BETA	1.96067E+03	Calculated
> 329	Co-65	5.3568E+24	8.2318E-11	6.7792E-11	Calculated	0.02000	BETA	2.62314E+03	Calculated
> 330	Co-66	2.7169E+25	2.8438E-11	2.4025E-11	Calculated	0.02000	BETA	3.23637E+02	Calculated
> 331	Co-67	1.4672E+25	3.7226E-11	3.1044E-11	Calculated	0.02000	BETA	1.03144E+03	Calculated
> 332	Co-68	3.0872E+25	3.8684E-11	3.1857E-11	Calculated	0.02000	BETA	2.61212E+02	Calculated
> 333	Co-68m	3.8397E+24	3.2504E-10	2.6768E-10	Calculated	0.02000	BETA	4.30410E+02	Calculated
> 334	Co-69	2.6671E+25	4.7553E-11	3.9161E-11	Calculated	0.02000	BETA	2.74936E+02	Calculated
> 335	Ni-53	1.7512E+26	6.7585E-15	3.3792E-15	Calculated	0.02000	BETA	1.59770E+03	Calculated
> 336	Ni-54	7.4385E+25	1.8035E-14	9.0176E-15	Calculated	0.02000	BETA	3.09935E+02	Calculated





ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 509	Br-85	2.8251E+22	4.4373E-09	4.9668E-09	Calculated	0.02000	BETA	6.04425E+03	Calculated
> 510	Br-86	8.8333E+22	4.8559E-09	5.4206E-09	Calculated	0.02000	BETA	2.86410E+02	Calculated
> 511	Br-87	8.6218E+22	1.1169E-10	1.2467E-10	Calculated	0.02000	BETA	3.07984E+02	Calculated
> 512	Br-88	2.8773E+23	2.4745E-09	2.7980E-09	Calculated	0.02000	BETA	2.98371E+02	Calculated
> 513	Kr-72	3.3734E+23	1.6860E-09	8.4301E-10	Calculated	0.02000	BETA	6.93001E+02	Calculated
> 514	Kr-73	2.0963E+23	2.1750E-09	1.0875E-09	Calculated	0.02000	BETA	5.74618E+02	Calculated
> 515	Kr-74	8.1825E+21	1.4587E-08	7.2857E-09	Calculated	0.02000	BETA	8.39870E+02	Calculated
> 516	Kr-75	2.1642E+22	8.5221E-09	4.2606E-09	Calculated	0.02000	BETA	6.95229E+02	Calculated
> 517	Kr-76	1.0315E+20	2.6603E-07	1.3304E-07	Calculated	0.02000	BETA	2.34996E+03	Calculated
> 518	Kr-77	1.2156E+21	8.8824E-08	4.4412E-08	Calculated	0.02000	BETA	9.03931E+02	Calculated
> 519	Kr-78	1.5432E+03	1.3828E-05	4.9386E-04	Calculated	0.02000	BETA	1.44633E+03	Calculated
> 520	Kr-79	4.1930E+19	3.9795E-07	2.0641E-07	Calculated	0.02000	BETA	3.84268E+03	Calculated
> 521	Kr-79m	1.0578E+23	2.3298E-10	1.1944E-10	Calculated	0.02000	BETA	2.04889E+04	Calculated
> 523	Kr-81	7.7842E+11	6.1960E-08	2.2128E-06	Calculated	40.00000	A2 VALUE	1.26464E+05	Calculated
> 524	Kr-81m	3.9081E+23	2.9139E-11	1.4570E-11	Calculated	0.02000	BETA	7.26750E+03	Calculated
> 527	Kr-83m	7.6418E+20	3.1923E-09	1.5962E-09	Calculated	0.02000	BETA	1.51303E+05	Calculated
> 529	Kr-85	1.4488E+16	1.1184E-06	3.8255E-05	Calculated	10.00000	A2 VALUE	1.78825E+04	Calculated
> 530	Kr-85m	3.0481E+20	7.6946E-08	3.8856E-08	Calculated	3.00000	A2 VALUE	5.46968E+03	Calculated
> 532	Kr-87	1.0491E+21	1.1242E-07	5.6208E-08	Calculated	0.20000	A2 VALUE	1.08579E+03	Calculated
> 533	Kr-88	4.6440E+20	3.9272E-07	2.0366E-07	Calculated	0.02000	BETA	5.03287E+02	Calculated
> 534	Kr-89	2.4839E+22	8.3509E-09	4.7556E-09	Calculated	0.02000	BETA	5.06719E+02	Calculated
> 535	Kr-90	1.4363E+23	2.5582E-09	1.2800E-09	Calculated	0.02000	BETA	7.31797E+02	Calculated
> 536	Rb-77	2.3988E+22	9.4414E-11	1.4931E-11	Calculated	0.02000	BETA	5.93479E+02	Calculated
> 537	Rb-78	5.0552E+21	4.7415E-10	7.4984E-11	Calculated	0.02000	BETA	2.39184E+02	Calculated
> 538	Rb-78m	1.5553E+22	1.5157E-10	2.3971E-11	Calculated	0.02000	BETA	2.97927E+02	Calculated
> 539	Rb-79	3.8493E+21	5.0000E-11	1.6000E-11	ICRP72	0.02000	BETA	6.74293E+02	Calculated
> 540	Rb-80	1.5361E+23	9.2794E-12	1.4675E-12	Calculated	0.02000	BETA	7.20885E+02	Calculated
> 541	Rb-81	3.1313E+20	5.4000E-11	3.4000E-11	ICRP72	0.80000	A2 VALUE	1.50466E+03	Calculated
> 542	Rb-81m	2.8422E+21	9.7000E-12	7.0000E-12	ICRP72	0.02000	BETA	2.79769E+04	Calculated
> 543	Rb-82	6.6714E+22	1.6327E-11	2.5820E-12	Calculated	0.02000	BETA	8.00351E+02	Calculated
> 544	Rb-82m	2.1870E+20	1.3000E-10	1.1000E-10	ICRP72	0.02000	BETA	3.43388E+02	Calculated
> 545	Rb-83	6.7596E+17	1.9000E-09	6.9000E-10	ICRP72	2.00000	A2 VALUE	2.01234E+03	Calculated
> 546	Rb-84	1.7186E+18	2.8000E-09	1.0000E-09	ICRP72	1.00000	A2 VALUE	1.10910E+03	Calculated
> 547	Rb-84m	4.0640E+21	4.9264E-11	8.0265E-12	Calculated	0.02000	BETA	2.55818E+03	Calculated
549	Rb-86	3.0169E+18	2.8000E-09	9.3000E-10	ICRP72	0.50000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 550	Rb-86m	7.9652E+22	2.9830E-12	4.9202E-13	Calculated	0.02000	BETA	1.82809E+03	Calculated
551	Rb-87	3.1642E+06	1.5000E-09	5.0000E-10	ICRP72	-1.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 552	Rb-88	4.4459E+21	9.0000E-11	1.6000E-11	ICRP72	0.02000	BETA	1.14567E+03	Calculated
> 553	Rb-89	5.0809E+21	4.7000E-11	1.4000E-11	ICRP72	0.02000	BETA	4.29713E+02	Calculated
> 554	Rb-90	2.9382E+22	5.6124E-11	8.8852E-12	Calculated	0.02000	BETA	4.06138E+02	Calculated
> 555	Rb-90m	1.7994E+22	1.1154E-10	1.7655E-11	Calculated	0.02000	BETA	2.51206E+02	Calculated
> 556	Rb-91	7.8618E+22	2.2083E-11	3.4608E-12	Calculated	0.02000	BETA	3.51711E+02	Calculated
> 557	Rb-92	1.0109E+24	2.1051E-12	3.1983E-13	Calculated	0.02000	BETA	4.90883E+02	Calculated
> 558	Rb-93	7.7451E+23	3.9239E-12	6.2024E-13	Calculated	0.02000	BETA	3.55350E+02	Calculated
> 559	Rb-94	1.6448E+24	1.9280E-12	3.0483E-13	Calculated	0.02000	BETA	3.27056E+02	Calculated
> 560	Sr-78	3.3687E+22	6.0601E-11	4.2718E-11	Calculated	0.02000	BETA	7.24953E+02	Calculated
> 561	Sr-79	3.9174E+22	2.3308E-11	1.8476E-11	Calculated	0.02000	BETA	7.18760E+02	Calculated
> 562	Sr-80	8.1886E+20	3.4000E-10	1.4000E-10	ICRP72	0.02000	BETA	2.02964E+03	Calculated
> 563	Sr-81	3.8552E+21	7.7000E-11	3.7000E-11	ICRP72	0.02000	BETA	6.79029E+02	Calculated
> 564	Sr-82	2.3083E+18	6.1000E-09	1.1000E-08	ICRP72	0.20000	A2 VALUE	1.19625E+05	Calculated
> 565	Sr-83	4.3147E+19	4.9000E-10	3.4000E-10	ICRP72	0.02000	BETA	1.26404E+03	Calculated
> 566	Sr-83m	1.0170E+24	8.3633E-14	5.8725E-14	Calculated	0.02000	BETA	4.32514E+03	Calculated
568	Sr-85	8.7738E+17	5.6000E-10	8.1000E-10	ICRP72	2.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
569	Sr-85m	1.2118E+21	6.1000E-12	4.3000E-12	ICRP72	5.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
572	Sr-87m	4.7378E+20	3.0000E-11	2.1000E-11	ICRP72	3.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
574	Sr-89	1.0746E+18	2.6000E-09	7.9000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+06	IAEA-G-1.7
575	Sr-90	5.1103E+15	2.8000E-08	1.6000E-07	ICRP72	0.30000	A2 VALUE	1.00000E+03	IAEA-G-1.7
576	Sr-91	1.3244E+20	6.5000E-10	4.1000E-10	ICRP72	0.20000	A2 VALUE	1.00000E+04	IAEA-G-1.7
577	Sr-92	4.6552E+20	4.3000E-10	2.3000E-10	ICRP72	0.30000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 578	Sr-93	1.0087E+22	6.9892E-11	4.9255E-11	Calculated	0.02000	BETA	4.35209E+02	Calculated
> 579	Sr-94	5.9026E+22	8.3583E-12	5.8869E-12	Calculated	0.02000	BETA	6.61972E+02	Calculated
> 580	Sr-95	1.8400E+23	4.3274E-12	3.0488E-12	Calculated	0.02000	BETA	5.05094E+02	Calculated
> 581	Sr-96	4.1054E+24	3.2089E-13	2.2620E-13	Calculated	0.02000	BETA	8.91165E+02	Calculated
> 582	Y-81	7.3265E+22	3.5326E-09	1.6137E-09	Calculated	0.02000	BETA	7.27507E+02	Calculated
> 583	Y-82	5.3632E+23	4.8621E-10	2.4794E-10	Calculated	0.02000	BETA	6.36943E+02	Calculated
> 584	Y-83	1.1844E+22	1.4213E-08	7.1031E-09	Calculated	0.02000	BETA	6.45578E+02	Calculated
> 585	Y-83m	2.9438E+22	5.1637E-09	2.5805E-09	Calculated	0.02000	BETA	7.66284E+02	Calculated
> 586	Y-84	1.0813E+24	1.9383E-10	9.6916E-11	Calculated	0.02000	BETA	6.60100E+02	Calculated
> 587	Y-84m	2.0725E+21	1.4449E-07	7.2245E-08	Calculated	0.02000	BETA	2.44186E+02	Calculated
> 588	Y-85	5.0940E+20	1.5000E-10	1.4000E-10	NRPB-M	0.02000	BETA	7.54318E+02	Calculated
> 589	Y-85m	2.8090E+20	3.2000E-10	2.5000E-10	NRPB-M	0.02000	BETA	7.08617E+02	Calculated
> 590	Y-86	9.1560E+19	9.6000E-10	4.7000E-10	ICRP72	0.02000	BETA	2.78406E+02	Calculated
> 591	Y-86m	1.6870E+21	5.6000E-11	2.8000E-11	ICRP72	0.02000	BETA	4.49614E+03	Calculated
> 592	Y-87	1.6613E+19	5.5000E-10	3.9000E-10	ICRP72	1.00000	A2 VALUE	2.18019E+03	Calculated





ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 672	Mo-89	3.7080E+22	9.6725E-12	7.1306E-12	Calculated	0.02000	BETA	7.03383E+02	Calculated
673	Mo-90	2.3194E+20	2.2000E-10	3.6000E-10	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
> 674	Mo-91	4.9403E+21	5.3662E-11	3.9852E-11	Calculated	0.02000	BETA	8.90671E+02	Calculated
> 675	Mo-91m	7.1076E+22	4.8486E-12	3.6009E-12	Calculated	0.02000	BETA	6.93339E+02	Calculated
> 676	Mo-92	7.5748E-04	7.0422E-09	1.2203E-08	Calculated	0.02000	BETA	6.06465E+03	Calculated
677	Mo-93	3.5594E+13	3.1000E-09	2.3000E-09	ICRP72	20.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 678	Mo-93m	1.8219E+20	1.1000E-10	1.7000E-10	ICRP72	0.02000	BETA	4.29511E+02	Calculated
> 683	Mo-98	1.3510E+03	4.7833E-10	8.2888E-10	Calculated	0.02000	BETA	8.92857E+04	Calculated
684	Mo-99	1.7778E+19	6.0000E-10	9.9000E-10	ICRP72	0.34000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 685	Mo-100	1.3373E-02	1.2958E-08	2.2454E-08	Calculated	0.02000	BETA	3.29598E+03	Calculated
686	Mo-101	4.7189E+21	4.1000E-11	2.6000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
> 687	Mo-102	6.0413E+21	3.8572E-11	2.8646E-11	Calculated	0.02000	BETA	1.87405E+04	Calculated
> 688	Mo-103	5.9736E+22	5.1391E-12	3.8514E-12	Calculated	0.02000	BETA	1.30237E+03	Calculated
> 689	Mo-104	6.6950E+22	1.5067E-12	1.1187E-12	Calculated	0.02000	BETA	3.78788E+03	Calculated
> 690	Mo-105	1.1176E+23	4.0059E-12	3.0599E-12	Calculated	0.02000	BETA	1.34464E+03	Calculated
> 691	Tc-90	5.3356E+23	9.3653E-09	9.3633E-09	Calculated	0.02000	BETA	4.79333E+02	Calculated
> 692	Tc-90m	9.4349E+22	6.3229E-08	6.2282E-08	Calculated	0.02000	BETA	2.94299E+02	Calculated
> 693	Tc-91	2.4369E+22	2.3512E-07	2.1369E-07	Calculated	0.02000	BETA	4.06589E+02	Calculated
> 694	Tc-91m	2.3188E+22	2.2566E-07	2.0510E-07	Calculated	0.02000	BETA	5.95948E+02	Calculated
> 695	Tc-92	1.7202E+22	2.9072E-07	2.6422E-07	Calculated	0.02000	BETA	2.43546E+02	Calculated
> 696	Tc-93	4.5381E+20	5.5000E-11	3.5000E-11	ICRP72	0.02000	BETA	6.35817E+02	Calculated
> 697	Tc-93m	1.7214E+21	2.5000E-11	1.7000E-11	ICRP72	0.02000	BETA	1.22429E+03	Calculated
> 698	Tc-94	2.5284E+20	2.0000E-10	1.3000E-10	ICRP72	0.02000	BETA	3.76950E+02	Calculated
> 699	Tc-94m	1.4247E+21	1.0000E-10	4.6000E-11	ICRP72	0.02000	BETA	4.98653E+02	Calculated
> 700	Tc-95	6.1086E+19	1.8000E-10	1.1000E-10	ICRP72	0.02000	BETA	1.25457E+03	Calculated
> 701	Tc-95m	8.3451E+17	5.6000E-10	1.2000E-09	ICRP72	2.00000	A2 VALUE	1.44942E+03	Calculated
702	Tc-96	1.1770E+19	1.1000E-09	7.0000E-10	ICRP72	0.40000	A2 VALUE	1.00000E+03	IAEA-G-1.7
703	Tc-96m	1.4085E+21	1.2000E-11	7.5000E-12	ICRP72	0.40000	A2 VALUE	1.00000E+06	IAEA-G-1.7
704	Tc-97	5.2498E+10	6.8000E-11	1.8000E-09	ICRP72	-1.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
705	Tc-97m	5.5272E+17	5.5000E-10	4.1000E-09	ICRP72	10.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 706	Tc-98	3.1419E+10	2.0000E-09	4.5000E-08	ICRP72	0.70000	A2 VALUE	7.10640E+02	Calculated
707	Tc-99	6.2495E+11	6.4000E-10	1.3000E-08	ICRP72	0.90000	A2 VALUE	1.00000E+03	IAEA-G-1.7
708	Tc-99m	1.9506E+20	2.2000E-11	2.0000E-11	ICRP72	4.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 709	Tc-100	2.6444E+23	4.2733E-09	3.8838E-09	Calculated	0.02000	BETA	4.66855E+03	Calculated
> 710	Tc-101	4.8553E+21	1.9000E-11	1.2000E-11	ICRP72	0.02000	BETA	2.60562E+03	Calculated
> 711	Tc-102	7.7576E+23	2.0700E-09	1.8814E-09	Calculated	0.02000	BETA	3.63294E+03	Calculated
> 712	Tc-102m	1.5694E+22	1.6621E-07	1.5107E-07	Calculated	0.02000	BETA	3.86284E+02	Calculated
> 713	Tc-103	7.4838E+22	1.2918E-08	1.2017E-08	Calculated	0.02000	BETA	2.88770E+03	Calculated
> 714	Tc-104	3.6586E+21	8.0000E-11	2.9000E-11	ICRP72	0.02000	BETA	4.87926E+02	Calculated
> 715	Tc-105	8.7255E+21	1.9946E-07	1.9212E-07	Calculated	0.02000	BETA	1.25097E+03	Calculated
> 716	Tc-106	1.0948E+23	2.8826E-08	2.6656E-08	Calculated	0.02000	BETA	4.19301E+02	Calculated
> 717	Tc-107	1.8416E+23	1.8923E-08	1.6715E-08	Calculated	0.02000	BETA	1.38821E+03	Calculated
> 718	Tc-108	7.4815E+23	6.4373E-09	5.8507E-09	Calculated	0.02000	BETA	5.82751E+02	Calculated
> 719	Tc-109	4.4563E+24	1.3923E-09	1.2534E-09	Calculated	0.02000	BETA	4.32517E+02	Calculated
> 720	Ru-92	2.0736E+22	1.0640E-10	4.9802E-11	Calculated	0.02000	BETA	4.57697E+02	Calculated
> 721	Ru-93	7.5250E+22	1.1949E-11	5.5930E-12	Calculated	0.02000	BETA	7.32508E+02	Calculated
> 722	Ru-93m	4.1597E+23	2.6844E-12	1.2565E-12	Calculated	0.02000	BETA	4.66200E+02	Calculated
> 723	Ru-94	1.4301E+21	9.4000E-11	4.4000E-11	ICRP72	0.02000	BETA	1.92298E+03	Calculated
> 724	Ru-95	7.4357E+20	5.7000E-11	8.2000E-11	NRPB-M	0.02000	BETA	8.02341E+02	Calculated
> 725	Ru-96	2.0585E+00	2.8162E-08	3.0759E-08	Calculated	0.02000	BETA	3.67850E+03	Calculated
726	Ru-97	1.7191E+19	1.5000E-10	1.1000E-10	ICRP72	5.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
732	Ru-103	1.1958E+18	7.3000E-10	3.0000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
734	Ru-105	2.4893E+20	2.6000E-10	1.8000E-10	ICRP72	0.60000	A2 VALUE	1.00000E+04	IAEA-G-1.7
735	Ru-106	1.2243E+17	7.0000E-09	6.6000E-08	ICRP72	0.20000	A2 VALUE	1.00000E+02	IAEA-G-1.7
> 736	Ru-107	1.7353E+22	2.6486E-11	1.1610E-11	Calculated	0.02000	BETA	2.20410E+03	Calculated
> 737	Ru-108	1.4327E+22	4.1780E-11	1.9557E-11	Calculated	0.02000	BETA	1.07673E+04	Calculated
> 738	Ru-109	1.1109E+23	8.2719E-12	3.7983E-12	Calculated	0.02000	BETA	5.65365E+02	Calculated
> 739	Ru-110	3.2739E+23	3.2959E-12	1.5428E-12	Calculated	0.02000	BETA	6.64729E+03	Calculated
> 740	Ru-111	1.7752E+24	8.0264E-13	3.8097E-13	Calculated	0.02000	BETA	4.79562E+02	Calculated
> 741	Rh-95	1.4611E+22	3.1959E-11	3.1540E-11	Calculated	0.02000	BETA	3.90778E+02	Calculated
> 742	Rh-95m	3.7396E+22	1.4882E-11	1.4476E-11	Calculated	0.02000	BETA	1.10011E+03	Calculated
> 743	Rh-96	7.3266E+21	8.6544E-11	7.7770E-11	Calculated	0.02000	BETA	2.45399E+02	Calculated
> 744	Rh-96m	4.8036E+22	1.2884E-11	1.1578E-11	Calculated	0.02000	BETA	7.81250E+02	Calculated
> 745	Rh-97	2.3384E+21	1.0457E-10	9.4260E-11	Calculated	0.02000	BETA	7.10840E+02	Calculated
> 746	Rh-97m	1.5538E+21	1.9976E-10	1.7995E-10	Calculated	0.02000	BETA	4.73809E+02	Calculated
> 747	Rh-98	8.1485E+21	4.8743E-11	4.3801E-11	Calculated	0.02000	BETA	5.24753E+02	Calculated
> 748	Rh-98m	2.0301E+22	2.1051E-11	1.8917E-11	Calculated	0.02000	BETA	4.10004E+02	Calculated
> 749	Rh-99	3.0340E+18	5.1000E-10	8.7000E-10	ICRP72	2.00000	A2 VALUE	1.96928E+03	Calculated
> 750	Rh-99m	2.4972E+20	6.6000E-11	4.0000E-11	ICRP72	0.02000	BETA	1.54914E+03	Calculated
> 751	Rh-100	5.5797E+19	7.1000E-10	3.5000E-10	ICRP72	0.02000	BETA	3.64117E+02	Calculated
> 752	Rh-100m	1.5138E+22	2.9813E-12	1.6355E-12	Calculated	0.02000	BETA	2.14638E+04	Calculated
> 753	Rh-101	4.0965E+16	5.5000E-10	5.4000E-09	ICRP72	3.00000	A2 VALUE	3.17614E+03	Calculated
> 754	Rh-101m	1.1007E+19	2.2000E-10	2.1000E-10	ICRP72	0.02000	BETA	3.25130E+03	Calculated
> 755	Rh-102	4.4725E+16	2.6000E-09	1.7000E-08	ICRP72	0.50000	A2 VALUE	4.70973E+02	Calculated



ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
> 838	Ag-117	4.9044E+22	4.5246E-12	2.7088E-12	Calculated	0.02000	BETA	8.17638E+02	Calculated
> 839	Ag-117m	6.6862E+23	2.9452E-13	1.7846E-13	Calculated	0.02000	BETA	1.25809E+03	Calculated
> 840	Ag-118	9.5677E+23	4.6789E-13	2.9857E-13	Calculated	0.02000	BETA	8.74493E+02	Calculated
> 841	Ag-118m	1.7700E+24	2.8699E-13	1.8313E-13	Calculated	0.02000	BETA	6.15385E+02	Calculated
> 842	Ag-119	1.6715E+24	2.8946E-13	1.8329E-13	Calculated	0.02000	BETA	6.60595E+02	Calculated
> 843	Ag-119m	5.8462E+23	9.5042E-13	6.0391E-13	Calculated	0.02000	BETA	5.16849E+02	Calculated
> 844	Ag-120	2.9751E+24	1.7527E-13	1.1184E-13	Calculated	0.02000	BETA	7.66295E+02	Calculated
> 845	Ag-121	4.4257E+24	1.4495E-13	9.2498E-14	Calculated	0.02000	BETA	7.15811E+02	Calculated
> 846	Ag-122	7.1326E+24	9.9645E-14	6.3586E-14	Calculated	0.02000	BETA	6.95722E+02	Calculated
> 847	Ag-122m	2.2824E+24	3.7117E-13	2.3685E-13	Calculated	0.02000	BETA	2.84684E+02	Calculated
> 848	Cd-102	1.2412E+22	1.3917E-10	1.7157E-10	Calculated	0.02000	BETA	1.19645E+03	Calculated
> 849	Cd-103	9.2604E+21	1.2183E-10	1.6259E-10	Calculated	0.02000	BETA	4.73037E+02	Calculated
> 850	Cd-104	1.1610E+21	5.4000E-11	3.5000E-11	ICRP72	0.02000	BETA	5.28312E+03	Calculated
> 851	Cd-105	1.1949E+21	4.7358E-10	6.3787E-10	Calculated	0.02000	BETA	7.80336E+02	Calculated
> 852	Cd-106	1.8924E+02	4.7798E-08	1.4923E-07	Calculated	0.02000	BETA	3.61011E+03	Calculated
> 853	Cd-107	1.6635E+20	6.2000E-11	8.3000E-11	ICRP72	0.02000	BETA	4.57272E+04	Calculated
> 854	Cd-108	2.9899E-01	4.6935E-09	1.4654E-08	Calculated	0.02000	BETA	3.67652E+04	Calculated
855	Cd-109	9.5898E+16	2.0000E-09	8.1000E-09	ICRP72	2.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
> 858	Cd-111m	1.2923E+21	1.0898E-10	1.4582E-10	Calculated	0.02000	BETA	3.39291E+03	Calculated
860	Cd-113	1.5020E+01	2.5000E-08	1.2000E-07	ICRP72	0.02000	BETA	1.00000E+03	IAEA-G-1.7
> 861	Cd-113m	8.0245E+15	2.3000E-08	1.1000E-07	ICRP72	0.50000	A2 VALUE	5.39973E+04	Calculated
> 862	Cd-114	1.9355E-01	9.2490E-09	2.8877E-08	Calculated	0.02000	BETA	1.86567E+04	Calculated
863	Cd-115	1.8876E+19	1.4000E-09	1.1000E-09	ICRP72	0.25000	A2 VALUE	1.00000E+04	IAEA-G-1.7
864	Cd-115m	9.4591E+17	3.3000E-09	7.7000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 865	Cd-116	3.3565E-03	4.8385E-08	1.5107E-07	Calculated	0.02000	BETA	3.56633E+03	Calculated
> 866	Cd-117	3.9832E+20	2.8000E-10	1.7000E-10	ICRP72	0.02000	BETA	8.91620E+02	Calculated
> 867	Cd-117m	2.9518E+20	2.8000E-10	2.1000E-10	ICRP72	0.02000	BETA	4.86562E+02	Calculated
> 868	Cd-118	1.1731E+21	6.1399E-10	8.2156E-10	Calculated	0.02000	BETA	6.21118E+04	Calculated
> 869	Cd-119	2.1750E+22	3.9621E-11	5.1801E-11	Calculated	0.02000	BETA	6.38461E+02	Calculated
> 870	Cd-119m	2.6594E+22	5.3688E-11	7.1836E-11	Calculated	0.02000	BETA	4.48024E+02	Calculated
> 871	Cd-120	6.8526E+22	1.5503E-11	2.0744E-11	Calculated	0.02000	BETA	1.47710E+04	Calculated
> 872	Cd-121	2.5572E+23	5.9272E-12	7.9311E-12	Calculated	0.02000	BETA	5.60862E+02	Calculated
> 873	Cd-121m	4.1594E+23	4.1645E-12	5.5725E-12	Calculated	0.02000	BETA	4.45820E+02	Calculated
> 874	Cd-122	6.5342E+23	2.2208E-12	2.9715E-12	Calculated	0.02000	BETA	8.01925E+03	Calculated
> 875	Cd-123	1.6171E+24	1.1734E-12	1.5702E-12	Calculated	0.02000	BETA	4.86286E+02	Calculated
> 876	Cd-123m	1.8659E+24	1.1165E-12	1.4940E-12	Calculated	0.02000	BETA	4.01362E+02	Calculated
> 877	Cd-124	3.3686E+24	6.5982E-13	8.8289E-13	Calculated	0.02000	BETA	3.08150E+03	Calculated
> 878	Cd-125	5.1408E+24	4.9489E-13	6.6320E-13	Calculated	0.02000	BETA	4.80322E+02	Calculated
> 879	In-106	1.0594E+22	5.2829E-10	3.6242E-10	Calculated	0.02000	BETA	2.73823E+02	Calculated
> 880	In-106m	1.2632E+22	4.4506E-10	3.0532E-10	Calculated	0.02000	BETA	3.22061E+02	Calculated
> 881	In-107	2.0084E+21	1.1539E-09	7.9160E-10	Calculated	0.02000	BETA	6.52469E+02	Calculated
> 882	In-107m	7.7469E+22	4.0748E-11	2.7955E-11	Calculated	0.02000	BETA	1.55168E+03	Calculated
> 883	In-108	1.1116E+21	3.7473E-09	2.5708E-09	Calculated	0.02000	BETA	3.08005E+02	Calculated
> 884	In-108m	1.6253E+21	2.6172E-09	1.7955E-09	Calculated	0.02000	BETA	3.53245E+02	Calculated
> 885	In-109	2.5349E+20	6.6000E-11	4.2000E-11	ICRP72	0.02000	BETA	1.57066E+03	Calculated
> 886	In-109m	4.7672E+22	1.6839E-11	1.1535E-11	Calculated	0.02000	BETA	1.62876E+03	Calculated
> 887	In-109n	1.8339E+25	1.4020E-13	9.6139E-14	Calculated	0.02000	BETA	4.79128E+02	Calculated
> 888	In-110	2.1530E+20	2.4000E-10	1.3000E-10	ICRP72	0.02000	BETA	3.24668E+02	Calculated
> 889	In-110m	9.1605E+20	1.0000E-10	4.7000E-11	ICRP72	0.02000	BETA	6.10745E+02	Calculated
890	In-111	1.5532E+19	2.9000E-10	2.3000E-10	ICRP72	3.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
> 891	In-111m	7.9405E+21	8.1325E-11	5.5852E-11	Calculated	0.02000	BETA	2.09899E+03	Calculated
> 892	In-112	4.2292E+21	1.0000E-11	7.4000E-12	ICRP72	0.02000	BETA	3.17754E+03	Calculated
> 893	In-112m	3.0033E+21	7.5802E-11	5.2763E-11	Calculated	0.02000	BETA	2.13746E+04	Calculated
895	In-113m	6.1945E+20	2.8000E-11	2.0000E-11	ICRP72	2.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 896	In-114	5.0969E+22	1.7632E-11	1.2096E-11	Calculated	0.02000	BETA	1.23012E+04	Calculated
897	In-114m	8.4830E+17	4.1000E-09	9.3000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+04	IAEA-G-1.7
898	In-115	2.6104E+02	3.2000E-08	3.9000E-07	ICRP72	0.02000	BETA	1.00000E+03	IAEA-G-1.7
899	In-115m	2.2495E+20	8.6000E-11	5.9000E-11	ICRP72	1.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
> 900	In-116	2.5362E+23	6.1304E-12	4.2057E-12	Calculated	0.02000	BETA	7.09572E+03	Calculated
> 901	In-116m	1.0993E+21	6.4000E-11	4.5000E-11	ICRP72	0.02000	BETA	3.96504E+02	Calculated
> 902	In-116n	1.6596E+24	1.5403E-13	1.0639E-13	Calculated	0.02000	BETA	1.28895E+04	Calculated
> 903	In-117	1.3776E+21	3.1000E-11	2.9000E-11	ICRP72	0.02000	BETA	1.38769E+03	Calculated
> 904	In-117m	5.1214E+20	1.2000E-10	7.2000E-11	ICRP72	0.02000	BETA	7.44655E+03	Calculated
> 905	In-118	7.0806E+23	3.1021E-12	2.1282E-12	Calculated	0.02000	BETA	3.76274E+03	Calculated
> 906	In-118m	1.3260E+22	2.8544E-10	1.9582E-10	Calculated	0.02000	BETA	3.53766E+02	Calculated
> 907	In-118n	4.1651E+23	9.4512E-12	6.4839E-12	Calculated	0.02000	BETA	1.16014E+04	Calculated
> 908	In-119	2.4379E+22	6.2888E-11	4.3144E-11	Calculated	0.02000	BETA	1.20849E+03	Calculated
> 909	In-119m	3.2505E+21	4.7000E-11	1.7000E-11	ICRP72	0.02000	BETA	8.62679E+03	Calculated
> 910	In-120	1.1303E+24	2.4413E-12	1.6748E-12	Calculated	0.02000	BETA	2.07921E+03	Calculated
> 911	In-120m	7.5350E+22	6.0754E-11	4.1680E-11	Calculated	0.02000	BETA	3.36777E+02	Calculated
> 912	In-120n	7.5350E+22	6.0630E-11	4.1595E-11	Calculated	0.02000	BETA	3.36700E+02	Calculated
> 913	In-121	1.4945E+23	1.3983E-11	9.5929E-12	Calculated	0.02000	BETA	9.78892E+02	Calculated
> 914	In-121m	1.4830E+22	1.1827E-10	8.1140E-11	Calculated	0.02000	BETA	4.65241E+03	Calculated
> 915	In-122	2.2827E+24	1.5052E-12	1.0326E-12	Calculated	0.02000	BETA	1.13054E+03	Calculated





ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
>1087	Xe-134m	1.0749E+25	6.6048E-12	3.3024E-12	Calculated	0.02000	BETA	5.25487E+02	Calculated
>1088	Xe-135	9.4036E+19	2.1476E-07	1.0738E-07	Calculated	2.00000	A2 VALUE	3.57494E+03	Calculated
>1089	Xe-135m	3.3727E+21	1.1472E-08	5.7360E-09	Calculated	0.02000	BETA	2.29926E+03	Calculated
>1090	Xe-136	4.6346E-04	1.1985E-05	4.2803E-04	Calculated	0.02000	BETA	1.66877E+03	Calculated
>1091	Xe-137	1.3309E+22	5.0082E-09	2.5092E-09	Calculated	0.02000	BETA	2.77787E+03	Calculated
>1092	Xe-138	3.5827E+21	4.2303E-08	2.0336E-08	Calculated	0.02000	BETA	8.41533E+02	Calculated
>1093	Xe-139	7.5726E+22	2.1848E-09	1.0924E-09	Calculated	0.02000	BETA	8.70099E+02	Calculated
>1094	Xs-122	1.6150E+23	2.2675E-12	1.1350E-12	Calculated	0.02000	BETA	6.45330E+02	Calculated
>1095	Cs-122m	1.2681E+22	3.2628E-11	1.6330E-11	Calculated	0.02000	BETA	3.05335E+02	Calculated
>1096	Cs-122n	9.5107E+24	3.8553E-14	1.9297E-14	Calculated	0.02000	BETA	2.70270E+05	Calculated
>1097	Cs-123	9.5772E+21	1.8040E-11	9.0307E-12	Calculated	0.02000	BETA	8.60752E+02	Calculated
>1098	Cs-123m	1.9977E+24	9.1260E-14	4.5680E-14	Calculated	0.02000	BETA	1.80695E+04	Calculated
>1099	Cs-124	1.0937E+23	1.6763E-12	8.3817E-13	Calculated	0.02000	BETA	7.66065E+02	Calculated
>1100	Cs-124m	5.3471E+23	3.8906E-13	1.9453E-13	Calculated	0.02000	BETA	3.18066E+03	Calculated
>1101	Cs-125	1.1926E+21	3.5000E-11	2.3000E-11	ICRP72	0.02000	BETA	1.38159E+03	Calculated
>1102	Cs-125m	3.7131E+24	1.5552E-14	9.5425E-15	Calculated	0.02000	BETA	3.75094E+03	Calculated
>1103	Cs-126	3.3692E+22	4.3446E-12	2.1723E-12	Calculated	0.02000	BETA	7.86078E+02	Calculated
>1104	Cs-127	1.4619E+20	2.4000E-11	3.8000E-11	ICRP72	0.02000	BETA	2.30418E+03	Calculated
>1105	Cs-128	1.5025E+22	6.8918E-12	3.4459E-12	Calculated	0.02000	BETA	1.02128E+03	Calculated
1106	Cs-129	2.7935E+19	6.0000E-11	7.7000E-11	ICRP72	4.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
>1107	Cs-130	1.8334E+21	2.8000E-11	1.4000E-11	ICRP72	0.02000	BETA	1.84694E+03	Calculated
>1108	Cs-130m	1.5478E+22	9.9247E-16	4.9623E-16	Calculated	0.02000	BETA	6.06672E+03	Calculated
1109	Cs-131	3.8087E+18	5.8000E-11	4.7000E-11	ICRP72	30.00000	A2 VALUE	1.00000E+06	IAEA-G-1.7
1110	Cs-132	5.6090E+18	5.0000E-10	3.0000E-10	ICRP72	1.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
1112	Cs-134	4.7834E+16	1.9000E-08	2.0000E-08	ICRP72	0.70000	A2 VALUE	1.00000E+02	IAEA-G-1.7
1113	Cs-134m	2.9777E+20	2.0000E-11	6.0000E-11	ICRP72	0.60000	A2 VALUE	1.00000E+06	IAEA-G-1.7
1114	Cs-135	4.2631E+10	2.0000E-09	8.6000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1115	Cs-135m	9.7301E+20	1.9000E-11	1.6000E-11	ICRP72	0.02000	BETA	6.23500E+02	Calculated
1116	Cs-136	2.7282E+18	3.0000E-09	2.8000E-09	ICRP72	0.50000	A2 VALUE	1.00000E+03	IAEA-G-1.7
>1117	Cs-136m	1.6165E+23	4.4623E-13	2.3409E-13	Calculated	0.02000	BETA	1.47420E+03	Calculated
1118	Cs-137	3.2162E+15	1.3000E-08	3.9000E-08	ICRP72	0.60000	A2 VALUE	1.00000E+02	IAEA-G-1.7
1119	Cs-138	1.5099E+21	9.2000E-11	4.3000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
>1120	Cs-138m	1.7335E+22	8.8017E-12	4.1892E-12	Calculated	0.02000	BETA	2.23986E+03	Calculated
>1121	Cs-139	5.4026E+21	1.9740E-11	9.8698E-12	Calculated	0.02000	BETA	2.11833E+03	Calculated
>1122	Cs-140	4.6835E+22	4.1638E-12	2.0819E-12	Calculated	0.02000	BETA	5.34246E+02	Calculated
>1123	Cs-141	1.1925E+23	1.4312E-12	7.1558E-13	Calculated	0.02000	BETA	5.39986E+02	Calculated
>1124	Ba-123	2.0962E+22	1.5107E-07	9.8582E-08	Calculated	0.02000	BETA	1.77201E+03	Calculated
>1125	Ba-124	5.1040E+21	4.5639E-07	2.9762E-07	Calculated	0.02000	BETA	1.76600E+03	Calculated
>1126	Ba-125	1.5913E+22	9.8489E-08	6.9757E-08	Calculated	0.02000	BETA	2.13372E+03	Calculated
>1127	Ba-126	5.5253E+20	2.6000E-10	1.1000E-10	ICRP72	0.02000	BETA	1.76389E+03	Calculated
>1128	Ba-127	4.3164E+21	1.9212E-07	1.3710E-07	Calculated	0.02000	BETA	1.29604E+03	Calculated
>1129	Ba-127m	1.7311E+24	5.0725E-10	3.6024E-10	Calculated	0.02000	BETA	1.24486E+04	Calculated
>1130	Ba-128	1.5544E+19	2.7000E-09	1.4000E-09	ICRP72	0.02000	BETA	1.49938E+04	Calculated
>1131	Ba-129	3.7793E+20	9.8567E-07	6.8938E-07	Calculated	0.02000	BETA	2.08681E+03	Calculated
>1132	Ba-129m	4.2032E+20	1.8583E-06	1.2538E-06	Calculated	0.02000	BETA	8.23472E+02	Calculated
1134	Ba-131	3.1954E+18	4.5000E-10	8.7000E-10	ICRP72	2.00000	A2 VALUE	1.00000E+04	IAEA-G-1.7
>1135	Ba-131m	3.6401E+21	4.9000E-12	7.8000E-12	ICRP72	0.02000	BETA	1.13435E+04	Calculated
>1137	Ba-133	9.4427E+15	1.5000E-09	1.0000E-08	ICRP72	3.00000	A2 VALUE	2.45693E+03	Calculated
>1138	Ba-133m	2.2838E+19	5.4000E-10	4.6000E-10	ICRP72	0.60000	A2 VALUE	1.12270E+04	Calculated
>1141	Ba-135m	2.9948E+19	4.3000E-10	3.6000E-10	ICRP72	0.02000	BETA	1.22441E+04	Calculated
>1143	Ba-136m	9.9593E+24	1.1561E-10	7.5392E-11	Calculated	0.02000	BETA	5.16282E+02	Calculated
>1145	Ba-137m	1.9912E+22	1.8649E-08	1.2162E-08	Calculated	0.02000	BETA	1.65435E+03	Calculated
>1147	Ba-139	6.0298E+20	1.2000E-10	5.9000E-11	ICRP72	0.02000	BETA	7.50247E+03	Calculated
1148	Ba-140	2.7051E+18	2.6000E-09	5.8000E-09	ICRP72	0.24000	A2 VALUE	1.00000E+03	IAEA-G-1.7
>1149	Ba-141	2.7023E+21	7.0000E-11	3.4000E-11	ICRP72	0.02000	BETA	1.03541E+03	Calculated
>1150	Ba-142	4.6247E+21	3.5000E-11	2.2000E-11	ICRP72	0.02000	BETA	9.21758E+02	Calculated
>1151	Ba-143	2.0142E+23	2.1918E-08	1.2956E-08	Calculated	0.02000	BETA	8.08933E+02	Calculated
>1152	La-128	1.0878E+22	1.7365E-11	7.4961E-12	Calculated	0.02000	BETA	3.20410E+02	Calculated
>1153	La-128m	3.8848E+22	4.3593E-12	1.8818E-12	Calculated	0.02000	BETA	3.96867E+02	Calculated
>1154	La-129	4.6523E+21	1.7471E-11	7.6952E-12	Calculated	0.02000	BETA	1.01644E+03	Calculated
>1155	La-129m	5.7822E+24	1.5068E-14	6.6280E-15	Calculated	0.02000	BETA	1.68067E+04	Calculated
>1156	La-130	6.1554E+21	1.9589E-11	8.4558E-12	Calculated	0.02000	BETA	4.32754E+02	Calculated
>1157	La-131	9.0074E+20	3.5000E-11	2.3000E-11	ICRP72	0.02000	BETA	1.47115E+03	Calculated
>1158	La-132	1.8313E+20	3.9000E-10	1.6000E-10	ICRP72	0.02000	BETA	5.00011E+02	Calculated
>1159	La-132m	2.1704E+21	3.3118E-11	1.3760E-11	Calculated	0.02000	BETA	2.03666E+03	Calculated
>1160	La-133	2.2301E+20	9.9000E-12	1.1000E-11	ICRP72	0.02000	BETA	7.62024E+03	Calculated
>1161	La-134	8.0548E+21	6.4622E-12	2.7895E-12	Calculated	0.02000	BETA	1.26280E+03	Calculated
>1162	La-135	4.4076E+19	3.0000E-11	1.4000E-11	ICRP72	0.02000	BETA	2.75844E+04	Calculated
>1163	La-136	5.1864E+21	4.8133E-12	2.0777E-12	Calculated	0.02000	BETA	2.24793E+03	Calculated
>1164	La-136m	2.6942E+25	1.1745E-15	5.0700E-16	Calculated	0.02000	BETA	6.48508E+03	Calculated
>1165	La-137	1.6103E+12	8.1000E-11	8.7000E-09	ICRP72	6.00000	A2 VALUE	3.81018E+04	Calculated
1166	La-138	9.4036E+05	1.1000E-09	1.5000E-07	ICRP72	0.02000	BETA	1.00000E+03	IAEA-G-1.7
1168	La-140	2.0572E+19	2.0000E-09	1.1000E-09	ICRP72	0.40000	A2 VALUE	1.00000E+03	IAEA-G-1.7
>1169	La-141	2.0992E+20	3.6000E-10	1.5000E-10	ICRP72	0.02000	BETA	8.12796E+03	Calculated

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
>1170	La-142	5.3812E+20	1.8000E-10	8.9000E-11	ICRP72	0.02000	BETA	4.50981E+02	Calculated
>1171	La-143	3.4427E+21	5.6000E-11	2.1000E-11	ICRP72	0.02000	BETA	1.77639E+03	Calculated
>1172	La-144	7.1088E+22	1.8874E-12	8.2299E-13	Calculated	0.02000	BETA	3.14108E+02	Calculated
>1173	La-145	1.1614E+23	1.3891E-12	5.6189E-13	Calculated	0.02000	BETA	4.50495E+02	Calculated
>1174	La-146	4.5622E+23	4.5486E-13	1.9635E-13	Calculated	0.02000	BETA	6.99687E+02	Calculated
>1175	La-146m	2.8605E+23	7.2068E-13	3.1109E-13	Calculated	0.02000	BETA	6.48845E+02	Calculated
>1176	La-147	7.0760E+23	2.3686E-13	9.2616E-14	Calculated	0.02000	BETA	2.56681E+03	Calculated
>1177	Ce-129	1.5418E+22	1.9581E-11	4.7212E-11	Calculated	0.02000	BETA	5.50637E+02	Calculated
>1178	Ce-130	2.3385E+21	8.7681E-11	2.0973E-10	Calculated	0.02000	BETA	2.01856E+03	Calculated
>1179	Ce-131	5.3142E+21	1.6202E-11	4.9651E-11	Calculated	0.02000	BETA	1.35221E+03	Calculated
>1180	Ce-131m	1.0628E+22	1.1980E-11	3.4104E-11	Calculated	0.02000	BETA	3.14218E+03	Calculated
>1181	Ce-132	2.5043E+20	3.1000E-10	2.2000E-10	NRPB-M	0.02000	BETA	3.65386E+03	Calculated
>1182	Ce-133	5.3962E+20	1.0000E-10	1.1000E-10	NRPB-M	0.02000	BETA	2.03635E+03	Calculated
>1183	Ce-133m	1.7804E+20	5.2729E-10	1.3299E-09	Calculated	0.02000	BETA	5.96239E+02	Calculated
>1184	Ce-134	1.1417E+19	2.5000E-09	1.3000E-09	ICRP72	0.02000	BETA	3.50601E+04	Calculated
>1185	Ce-135	4.8558E+19	7.9000E-10	5.0000E-10	ICRP72	0.02000	BETA	1.21260E+03	Calculated
>1186	Ce-135m	1.5471E+23	3.9737E-13	5.1432E-13	Calculated	0.02000	BETA	3.25302E+03	Calculated
>1187	Ce-136	1.3904E+03	7.2390E-09	4.0402E-08	Calculated	0.02000	BETA	4.13411E+03	Calculated
>1188	Ce-137	9.4103E+19	2.5000E-11	1.0000E-11	ICRP72	0.02000	BETA	2.54237E+04	Calculated
>1189	Ce-137m	2.4620E+19	5.4000E-10	4.4000E-10	ICRP72	0.02000	BETA	1.32082E+04	Calculated
1191	Ce-139	2.5269E+17	2.6000E-10	1.9000E-09	ICRP72	2.00000	A2 VALUE	1.00000E+03	IAEA-G-1.7
>1192	Ce-139m	5.3566E+22	7.0602E-13	1.6948E-12	Calculated	0.02000	BETA	1.41918E+03	Calculated
1194	Ce-141	1.0550E+18	7.1000E-10	3.8000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1195	Ce-142	1.8642E+00	4.2409E-09	2.3669E-08	Calculated	0.02000	BETA	7.05667E+03	Calculated
1196	Ce-143	2.4557E+19	1.1000E-09	8.3000E-10	ICRP72	0.60000	A2 VALUE	1.00000E+04	IAEA-G-1.7
1197	Ce-144	1.1779E+17	5.2000E-09	5.3000E-08	ICRP72	0.20000	A2 VALUE	1.00000E+04	IAEA-G-1.7
>1198	Ce-145	1.6274E+22	6.0127E-12	1.2187E-11	Calculated	0.02000	BETA	1.47648E+03	Calculated
>1199	Ce-146	3.5264E+21	3.8704E-11	9.2576E-11	Calculated	0.02000	BETA	2.92654E+03	Calculated
>1200	Ce-147	4.9844E+22	2.8158E-12	5.6212E-12	Calculated	0.02000	BETA	3.30728E+03	Calculated
>1201	Ce-148	5.0390E+22	3.7846E-12	9.0525E-12	Calculated	0.02000	BETA	2.73224E+03	Calculated
>1202	Ce-149	5.2884E+23	5.2995E-13	1.3631E-12	Calculated	0.02000	BETA	3.75406E+03	Calculated
>1203	Pr-134	3.0559E+21	1.0407E-10	7.4589E-11	Calculated	0.02000	BETA	4.57523E+02	Calculated
>1204	Pr-134m	4.7228E+21	8.1637E-11	5.9818E-11	Calculated	0.02000	BETA	4.47024E+02	Calculated
>1205	Pr-135	2.1486E+21	8.6582E-11	5.2897E-11	Calculated	0.02000	BETA	1.05152E+03	Calculated
>1206	Pr-136	3.9075E+21	3.3000E-11	1.4000E-11	ICRP72	0.02000	BETA	4.67165E+02	Calculated
>1207	Pr-137	6.6164E+20	4.0000E-11	2.1000E-11	ICRP72	0.02000	BETA	2.60986E+03	Calculated
>1208	Pr-138	3.4790E+22	4.6057E-12	3.7215E-12	Calculated	0.02000	BETA	1.07399E+03	Calculated
>1209	Pr-138m	3.9659E+20	1.3000E-10	7.4000E-11	ICRP72	0.02000	BETA	4.05701E+02	Calculated
>1210	Pr-139	1.8928E+20	3.1000E-11	2.0000E-11	ICRP72	0.02000	BETA	7.46037E+03	Calculated
>1211	Pr-140	1.4668E+22	5.9344E-12	4.7951E-12	Calculated	0.02000	BETA	1.67458E+03	Calculated
1213	Pr-142	4.2734E+19	1.3000E-09	5.5000E-10	ICRP72	0.40000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1214	Pr-142m	3.3578E+21	1.7000E-11	7.0000E-12	ICRP72	0.02000	BETA	2.71518E+05	Calculated
1215	Pr-143	2.4931E+18	1.2000E-09	2.4000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+06	IAEA-G-1.7
>1216	Pr-144	2.7976E+21	5.0000E-11	1.8000E-11	ICRP72	0.02000	BETA	6.50083E+03	Calculated
>1217	Pr-144m	7.0061E+21	2.0626E-11	7.7276E-12	Calculated	0.02000	BETA	5.44102E+04	Calculated
>1218	Pr-145	1.3371E+20	3.9000E-10	1.7000E-10	ICRP72	0.02000	BETA	1.18611E+04	Calculated
>1219	Pr-146	1.9742E+21	8.9451E-11	7.2278E-11	Calculated	0.02000	BETA	8.93575E+02	Calculated
>1220	Pr-147	3.4818E+21	3.3000E-11	1.8000E-11	ICRP72	0.02000	BETA	1.09170E+03	Calculated
>1221	Pr-148	2.0538E+22	1.1501E-11	9.2927E-12	Calculated	0.02000	BETA	5.23234E+02	Calculated
>1222	Pr-148m	2.3283E+22	1.0679E-11	8.6286E-12	Calculated	0.02000	BETA	4.60083E+02	Calculated
>1223	Pr-149	2.0671E+22	1.4895E-11	1.3364E-11	Calculated	0.02000	BETA	7.07679E+02	Calculated
>1224	Pr-150	4.5642E+23	4.5504E-13	3.6768E-13	Calculated	0.02000	BETA	1.28663E+03	Calculated
>1225	Pr-151	1.4633E+23	3.1426E-12	2.4403E-12	Calculated	0.02000	BETA	1.24642E+03	Calculated
>1226	Nd-135	4.1809E+21	3.2775E-11	1.7339E-11	Calculated	0.02000	BETA	7.30994E+02	Calculated
>1227	Nd-135m	9.3755E+21	1.7676E-11	9.5761E-12	Calculated	0.02000	BETA	5.69889E+02	Calculated
>1228	Nd-136	1.0106E+21	9.9000E-11	5.4000E-11	ICRP72	0.02000	BETA	3.49030E+03	Calculated
>1229	Nd-137	1.3198E+21	3.9711E-11	2.2366E-11	Calculated	0.02000	BETA	8.39081E+02	Calculated
>1230	Nd-137m	1.9055E+24	3.5575E-14	2.0353E-14	Calculated	0.02000	BETA	2.60402E+03	Calculated
>1231	Nd-138	1.6682E+20	6.4000E-10	2.5000E-10	ICRP72	0.02000	BETA	2.29915E+04	Calculated
>1232	Nd-139	1.6863E+21	2.0000E-11	1.0000E-11	ICRP72	0.02000	BETA	2.26327E+03	Calculated
>1233	Nd-139m	1.5176E+20	2.5000E-10	1.5000E-10	ICRP72	0.02000	BETA	3.69004E+02	Calculated
>1234	Nd-140	1.0247E+19	2.8000E-09	2.0000E-09	R245	0.02000	BETA	3.52104E+04	Calculated
>1235	Nd-141	3.3091E+20	8.3000E-12	5.0000E-12	ICRP72	0.02000	BETA	1.25912E+04	Calculated
>1236	Nd-141m	4.7780E+22	5.1992E-13	3.1320E-13	Calculated	0.02000	BETA	1.42456E+03	Calculated
>1239	Nd-144	4.0138E+01	6.7466E-08	9.4832E-08	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
1242	Nd-147	2.9950E+18	1.1000E-09	2.4000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1243	Nd-148	3.3120E-02	3.4151E-09	4.8003E-09	Calculated	0.02000	BETA	5.18457E+03	Calculated
1244	Nd-149	4.5058E+20	1.2000E-10	8.9000E-11	ICRP72	0.50000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1245	Nd-150	4.2014E-03	5.9624E-09	8.3808E-09	Calculated	0.02000	BETA	2.9656E+03	Calculated
>1246	Nd-151	3.7055E+21	3.0000E-11	1.7000E-11	ICRP72	0.02000	BETA	1.10677E+03	Calculated
>1247	Nd-152	4.0169E+21	1.4447E-11	8.7032E-12	Calculated	0.02000	BETA	5.07007E+03	Calculated
>1248	Nd-153	8.6378E+22	8.2980E-13	5.1593E-13	Calculated	0.02000	BETA	1.60274E+03	Calculated
>1249	Nd-154	1.0470E+23	1.0295E-12	6.2017E-13	Calculated	0.02000	BETA	1.82245E+03	Calculated
>1250	Pm-135	6.3138E+22	5.5337E-12	4.7003E-12	Calculated	0.02000	BETA	3.49839E+02	Calculated









ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
1496	Er-169	3.0424E+18	3.7000E-10	1.0000E-09	ICRP72	1.00000	A2 VALUE	1.00000E+06	IAEA-G-1.7
1498	Er-171	9.0250E+19	3.6000E-10	2.2000E-10	ICRP72	0.50000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1499	Er-172	1.3679E+19	1.0000E-09	1.1000E-09	ICRP72	0.02000	BETA	1.89197E+03	Calculated
>1500	Er-173	2.8734E+22	2.9009E-12	3.8552E-12	Calculated	0.02000	BETA	1.11101E+03	Calculated
>1501	Er-174	1.2499E+22	1.5466E-11	2.0574E-11	Calculated	0.02000	BETA	1.42045E+03	Calculated
>1502	Er-175	3.3139E+22	3.9895E-12	5.2998E-12	Calculated	0.02000	BETA	7.43128E+02	Calculated
>1503	Tm-158	1.1068E+22	2.0424E-09	1.9768E-09	Calculated	0.02000	BETA	5.84529E+02	Calculated
>1504	Tm-159	4.7839E+21	5.4075E-09	5.2115E-09	Calculated	0.02000	BETA	6.81979E+02	Calculated
>1505	Tm-160	4.6276E+21	5.0799E-09	4.7453E-09	Calculated	0.02000	BETA	7.71209E+02	Calculated
>1506	Tm-160m	3.5033E+22	7.1088E-10	6.6545E-10	Calculated	0.02000	BETA	2.63130E+03	Calculated
>1507	Tm-161	1.1376E+21	1.3960E-08	1.2508E-08	Calculated	0.02000	BETA	9.97410E+02	Calculated
>1508	Tm-161m	8.6459E+21	1.9539E-09	1.7592E-09	Calculated	0.02000	BETA	1.63428E+03	Calculated
>1509	Tm-162	1.9798E+21	2.9000E-11	1.6000E-11	ICRP72	0.02000	BETA	6.05290E+02	Calculated
>1510	Tm-162m	1.0608E+23	2.5680E-11	2.4695E-11	Calculated	0.02000	BETA	3.24675E+03	Calculated
>1511	Tm-163	3.9318E+20	5.3000E-11	5.9000E-11	NRPB-M	0.02000	BETA	7.69669E+02	Calculated
>1512	Tm-164	2.1219E+22	4.1374E-10	4.0086E-10	Calculated	0.02000	BETA	1.29534E+03	Calculated
>1513	Tm-164m	8.3212E+21	9.2148E-11	8.9278E-11	Calculated	0.02000	BETA	3.26143E+03	Calculated
>1514	Tm-165	2.3387E+19	3.2000E-10	2.8000E-10	NRPB-M	0.02000	BETA	1.81161E+03	Calculated
>1515	Tm-166	9.0750E+19	2.8000E-10	1.7000E-10	ICRP72	0.02000	BETA	5.09187E+02	Calculated
>1516	Tm-167	3.1288E+18	5.6000E-10	1.1000E-09	ICRP72	0.80000	A2 VALUE	1.86273E+04	Calculated
>1517	Tm-168	3.0901E+17	9.6000E-10	3.1000E-09	NRPB-M	0.02000	BETA	8.00011E+02	Calculated
1519	Tm-170	2.2107E+17	1.3000E-09	7.0000E-09	ICRP72	0.60000	A2 VALUE	1.00000E+05	IAEA-G-1.7
1520	Tm-171	4.0377E+16	1.1000E-10	1.4000E-09	ICRP72	40.00000	A2 VALUE	1.00000E+06	IAEA-G-1.7
>1521	Tm-172	1.0603E+19	1.7000E-09	1.1000E-09	ICRP72	0.02000	BETA	1.87522E+03	Calculated
>1522	Tm-173	8.1368E+19	3.1000E-10	1.8000E-10	ICRP72	0.02000	BETA	2.38469E+03	Calculated
>1523	Tm-174	7.4067E+21	2.0301E-09	1.9669E-09	Calculated	0.02000	BETA	5.46411E+02	Calculated
>1524	Tm-175	2.6220E+21	2.7000E-11	1.8000E-11	ICRP72	0.02000	BETA	8.28089E+02	Calculated
>1525	Tm-176	2.0811E+22	7.9323E-10	7.6854E-10	Calculated	0.02000	BETA	5.58650E+02	Calculated
>1526	Tm-177	2.6211E+22	8.0753E-10	7.1639E-10	Calculated	0.02000	BETA	8.55559E+02	Calculated
>1527	Tm-178	7.8190E+22	4.4862E-10	3.6935E-10	Calculated	0.02000	BETA	4.88935E+02	Calculated
>1528	Tm-179	1.1663E+23	2.5564E-10	2.4748E-10	Calculated	0.02000	BETA	5.65823E+02	Calculated
>1529	Yb-159	3.1265E+22	7.2629E-12	8.5186E-12	Calculated	0.02000	BETA	1.60171E+03	Calculated
>1530	Yb-160	9.0622E+21	1.6091E-11	1.8320E-11	Calculated	0.02000	BETA	3.61783E+03	Calculated
>1531	Yb-161	1.0292E+22	1.7899E-11	2.0294E-11	Calculated	0.02000	BETA	9.23647E+02	Calculated
>1532	Yb-162	2.2767E+21	2.3000E-11	1.4000E-11	ICRP72	0.02000	BETA	4.18698E+03	Calculated
>1533	Yb-163	3.8641E+21	1.1887E-11	1.3995E-11	Calculated	0.02000	BETA	1.32450E+03	Calculated
>1534	Yb-164	5.5987E+20	9.2533E-11	1.0890E-10	Calculated	0.02000	BETA	1.89664E+04	Calculated
>1535	Yb-165	4.2606E+21	4.4422E-12	5.2268E-12	Calculated	0.02000	BETA	2.85063E+03	Calculated
>1536	Yb-166	1.2324E+19	9.5000E-10	7.7000E-10	ICRP72	0.02000	BETA	1.13008E+04	Calculated
>1537	Yb-167	2.3814E+21	6.7000E-12	6.9000E-12	ICRP72	0.02000	BETA	3.55341E+03	Calculated
>1538	Yb-168	6.0588E+02	5.5984E-08	1.5373E-07	Calculated	0.00009	ALPHA	1.40677E+04	Calculated
>1539	Yb-169	8.9320E+17	7.1000E-10	3.0000E-09	ICRP72	1.00000	A2 VALUE	3.08227E+03	Calculated
>1540	Yb-169m	5.3715E+22	2.8968E-14	7.0083E-14	Calculated	0.02000	BETA	4.13208E+05	Calculated
1546	Yb-175	6.5990E+18	4.4000E-10	7.3000E-10	ICRP72	0.90000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>1548	Yb-176m	2.0811E+23	1.8452E-13	2.1715E-13	Calculated	0.02000	BETA	1.08723E+03	Calculated
>1549	Yb-177	3.4291E+20	8.8000E-11	6.9000E-11	ICRP72	0.02000	BETA	4.13678E+03	Calculated
>1550	Yb-177m	3.6803E+23	1.1443E-13	1.0247E-13	Calculated	0.02000	BETA	5.95742E+03	Calculated
>1551	Yb-178	5.2833E+20	1.2000E-10	7.5000E-11	ICRP72	0.02000	BETA	1.56838E+03	Calculated
>1552	Yb-179	4.8596E+21	1.0831E-11	1.2714E-11	Calculated	0.02000	BETA	1.05592E+03	Calculated
>1553	Yb-180	1.6109E+22	7.9565E-12	9.3638E-12	Calculated	0.02000	BETA	1.19822E+03	Calculated
>1554	Yb-181	3.8446E+22	3.0317E-12	3.6162E-12	Calculated	0.02000	BETA	7.01097E+02	Calculated
>1555	Lu-162	3.1358E+22	1.1940E-09	3.5799E-09	Calculated	0.02000	BETA	6.18685E+02	Calculated
>1556	Lu-162m	2.8640E+22	1.5650E-09	4.8037E-09	Calculated	0.02000	BETA	3.83474E+02	Calculated
>1557	Lu-162n	2.2603E+22	2.0216E-09	6.2193E-09	Calculated	0.02000	BETA	3.74008E+02	Calculated
>1558	Lu-163	1.0764E+22	4.5239E-09	1.5515E-08	Calculated	0.02000	BETA	2.33100E+02	Calculated
>1559	Lu-164	1.3515E+22	1.2440E-09	4.2662E-09	Calculated	0.02000	BETA	1.06940E+03	Calculated
>1560	Lu-165	3.9297E+21	3.9598E-09	1.3579E-08	Calculated	0.02000	BETA	7.45979E+02	Calculated
>1561	Lu-166	1.5821E+22	1.2708E-09	4.2111E-09	Calculated	0.02000	BETA	4.58022E+02	Calculated
>1562	Lu-166m	2.9594E+22	5.5175E-10	1.8136E-09	Calculated	0.02000	BETA	1.14325E+03	Calculated
>1563	Lu-166n	1.9807E+22	1.0501E-09	3.4836E-09	Calculated	0.02000	BETA	4.65571E+02	Calculated
>1564	Lu-167	8.0921E+20	2.0940E-08	7.0239E-08	Calculated	0.02000	BETA	9.74344E+02	Calculated
>1565	Lu-167m	4.1674E+22	4.1653E-10	1.3979E-09	Calculated	0.02000	BETA	1.76295E+03	Calculated
>1566	Lu-168	7.5320E+21	4.4239E-09	1.5171E-08	Calculated	0.02000	BETA	2.25882E+02	Calculated
>1567	Lu-168m	6.1830E+21	2.8220E-09	9.6779E-09	Calculated	0.02000	BETA	4.37139E+02	Calculated
>1568	Lu-169	2.0151E+19	4.6000E-10	3.8000E-10	ICRP72	0.02000	BETA	8.20951E+02	Calculated
>1569	Lu-169m	1.5443E+22	1.1263E-11	3.7062E-11	Calculated	0.02000	BETA	2.77778E+05	Calculated
>1570	Lu-170	1.4198E+19	9.9000E-10	6.6000E-10	ICRP72	0.02000	BETA	3.95993E+02	Calculated
>1571	Lu-170m	3.6661E+24	1.5728E-13	5.2879E-13	Calculated	0.02000	BETA	8.91266E+04	Calculated
>1572	Lu-171	3.4259E+18	6.7000E-10	8.8000E-10	ICRP72	0.02000	BETA	1.53815E+03	Calculated
>1573	Lu-171m	3.1307E+22	1.6017E-11	5.4774E-11	Calculated	0.02000	BETA	1.14546E+05	Calculated
>1574	Lu-172	4.1939E+18	1.3000E-09	1.6000E-09	ICRP72	0.60000	A2 VALUE	5.08557E+02	Calculated
>1575	Lu-172m	1.0936E+22	2.7177E-11	9.2105E-11	Calculated	0.02000	BETA	1.75812E+05	Calculated
>1576	Lu-173	5.7247E+16	2.6000E-10	2.4000E-09	ICRP72	8.00000	A2 VALUE	5.72142E+03	Calculated
>1577	Lu-174	2.1366E+16	2.7000E-10	4.2000E-09	ICRP72	9.00000	A2 VALUE	8.25390E+03	Calculated













ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
1982	Po-207	9.6586E+19	1.1000E-10	8.2000E-11	ICRP72	0.00009	ALPHA	1.00000E+04	IAEA-G-1.7
>1983	Po-207m	7.2283E+23	2.5084E-13	3.7723E-13	Calculated	0.02000	BETA	9.05849E+02	Calculated
>1984	Po-208	2.1706E+16	7.7000E-07	2.4000E-06	R245	0.00009	ALPHA	2.59740E+04	Calculated
>1985	Po-209	6.2053E+14	7.7000E-07	2.4000E-06	R245	0.00009	ALPHA	2.59740E+04	Calculated
1986	Po-210	1.6626E+17	1.2000E-06	4.3000E-06	ICRP72	0.02000	A2 VALUE	1.00000E+03	IAEA-G-1.7
>1987	Po-211	3.8342E+24	4.8716E-12	7.5564E-12	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1988	Po-211m	7.7586E+22	2.4197E-10	3.7532E-10	Calculated	0.00009	ALPHA	6.70737E+02	Calculated
>1989	Po-212	6.6076E+30	3.3208E-18	5.1509E-18	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1990	Po-212m	4.3660E+22	6.6166E-10	1.0263E-09	Calculated	0.00009	ALPHA	1.09565E+04	Calculated
>1991	Po-213	4.6662E+29	4.4839E-17	6.9787E-17	Calculated	0.00009	ALPHA	4.25293E+07	Calculated
>1992	Po-214	1.1916E+28	1.5976E-15	2.5101E-15	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1993	Po-215	1.0907E+27	1.8274E-14	2.8745E-13	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1994	Po-216	1.2883E+25	1.5438E-12	2.1737E-11	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1995	Po-217	1.3085E+24	1.2357E-11	1.9167E-11	Calculated	0.00009	ALPHA	3.62429E+04	Calculated
>1996	Po-218	1.0301E+22	1.5898E-09	4.8181E-08	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>1997	Po-219	1.5883E+22	2.1743E-09	2.0840E-08	Calculated	0.00009	ALPHA	2.26989E+03	Calculated
>1998	At-205	1.2970E+21	1.7542E-10	1.7481E-09	Calculated	0.00009	ALPHA	9.11577E+02	Calculated
>1999	At-206	1.1258E+21	9.7036E-11	5.5470E-10	Calculated	0.00009	ALPHA	4.28492E+02	Calculated
>2000	At-207	3.1121E+20	2.4000E-10	2.3000E-09	ICRP72	0.00009	ALPHA	4.99725E+02	Calculated
>2001	At-208	3.4190E+20	1.9421E-10	2.0069E-09	Calculated	0.00009	ALPHA	3.28694E+02	Calculated
>2002	At-209	1.0256E+20	1.1649E-09	1.1645E-08	Calculated	0.00009	ALPHA	4.44264E+02	Calculated
>2003	At-210	6.8170E+19	1.1914E-09	1.7131E-08	Calculated	0.00009	ALPHA	3.36566E+02	Calculated
2004	At-211	7.6180E+19	1.1000E-08	1.1000E-07	ICRP72	0.50000	A2 VALUE	1.00000E+06	IAEA-G-1.7
>2005	At-212	6.2709E+24	4.1405E-13	4.1364E-12	Calculated	0.00009	ALPHA	4.83028E+10	Calculated
>2006	At-212m	1.6547E+25	1.6108E-13	1.6092E-12	Calculated	0.00009	ALPHA	1.25821E+05	Calculated
>2007	At-213	1.5678E+31	1.9592E-19	1.9573E-18	Calculated	0.00009	ALPHA	1.02083E+17	Calculated
>2008	At-214	3.4957E+30	8.4897E-19	8.4813E-18	Calculated	0.00009	ALPHA	2.35581E+16	Calculated
>2009	At-215	1.9415E+28	2.5238E-16	2.5213E-15	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2010	At-216	6.4416E+27	4.0431E-16	4.0391E-15	Calculated	0.00009	ALPHA	4.94667E+13	Calculated
>2011	At-217	5.9553E+25	3.9395E-14	3.9357E-13	Calculated	0.00009	ALPHA	3.24467E+06	Calculated
>2012	At-218	1.2765E+24	1.7333E-12	1.7316E-11	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2013	At-219	3.5295E+22	1.3467E-10	8.2354E-09	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2014	At-220	8.5231E+21	5.5552E-10	3.0710E-08	Calculated	0.00009	ALPHA	2.03808E+03	Calculated
>2015	At-221	1.3686E+22	3.1109E-10	3.1078E-09	Calculated	0.02000	BETA	1.16650E+03	Calculated
>2016	At-222	3.4817E+22	8.3292E-11	1.2793E-08	Calculated	0.02000	BETA	6.16136E+02	Calculated
>2017	Rn-208	1.3737E+21	1.3380E-06	7.7832E-07	Calculated	0.00009	ALPHA	1.85082E+03	Calculated
>2018	Rn-209	1.1680E+21	5.5309E-07	2.7652E-07	Calculated	0.00009	ALPHA	1.01159E+03	Calculated
>2019	Rn-210	2.3007E+20	1.2129E-05	5.9369E-06	Calculated	0.00009	ALPHA	1.64890E+03	Calculated
>2020	Rn-211	3.7612E+19	4.2101E-05	2.1065E-05	Calculated	0.00009	ALPHA	4.75049E+02	Calculated
>2021	Rn-212	1.3731E+21	2.1241E-06	1.0632E-06	Calculated	0.00009	ALPHA	9.41557E+03	Calculated
>2022	Rn-213	7.8392E+25	4.7733E-11	2.3867E-11	Calculated	0.00009	ALPHA	4.18996E+08	Calculated
>2023	Rn-214	7.2245E+30	5.8128E-16	2.9395E-16	Calculated	0.00009	ALPHA	3.44069E+13	Calculated
>2024	Rn-215	8.4413E+29	8.7560E-15	4.3780E-15	Calculated	0.00009	ALPHA	2.28416E+12	Calculated
>2025	Rn-216	4.2945E+28	1.7892E-13	8.9461E-14	Calculated	0.00009	ALPHA	1.11781E+11	Calculated
>2026	Rn-217	3.5622E+27	2.0604E-12	1.0320E-12	Calculated	0.00009	ALPHA	6.18213E+06	Calculated
>2027	Rn-218	5.4707E+25	1.2252E-10	6.1673E-11	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2028	Rn-219	4.8130E+23	1.3893E-08	4.1553E-08	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2029	Rn-220	3.4001E+22	1.8978E-07	5.2686E-07	Calculated	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2030	Rn-221	1.2591E+21	4.6002E-06	2.3001E-06	Calculated	0.00009	ALPHA	4.34762E+03	Calculated
>2031	Rn-222	5.6919E+18	6.8594E-04	5.3542E-03	Calculated	0.00400	A2 VALUE	1.00000E+03	IAEA-G-1.7
>2032	Rn-223	1.2890E+21	2.3552E-08	8.3460E-09	Calculated	0.02000	BETA	2.54690E+03	Calculated
>2033	Rn-224	2.9023E+20	1.3975E-07	7.0561E-08	Calculated	0.02000	BETA	3.86663E+03	Calculated
>2034	Rn-225	6.6344E+21	9.7635E-09	4.9110E-09	Calculated	0.02000	BETA	1.01764E+03	Calculated
>2035	Fr-218	1.9147E+27	1.3980E-12	6.2376E-12	Calculated	0.00009	ALPHA	1.43060E+10	Calculated
>2036	Fr-218m	8.7036E+25	3.1021E-11	1.3841E-10	Calculated	0.00009	ALPHA	6.44734E+08	Calculated
>2037	Fr-219	9.5298E+25	3.6887E-11	1.6458E-10	Calculated	0.00009	ALPHA	2.78440E+05	Calculated
>2038	Fr-220	6.9244E+22	3.3222E-08	1.4823E-07	Calculated	0.00009	ALPHA	9.06598E+04	Calculated
>2039	Fr-221	6.4240E+21	3.3183E-07	1.4806E-06	Calculated	0.00009	ALPHA	3.25688E+04	Calculated
>2040	Fr-222	2.2067E+21	7.2000E-10	1.4000E-08	ICRP72	0.02000	BETA	4.02108E+03	Calculated
2041	Fr-223	1.4310E+21	2.4000E-09	8.9000E-10	ICRP72	0.00009	ALPHA	1.00000E+03	IAEA-G-1.7
>2042	Fr-224	9.3258E+21	1.1995E-09	5.4199E-09	Calculated	0.02000	BETA	1.60522E+03	Calculated
>2043	Fr-225	7.7292E+21	1.2149E-09	5.5004E-09	Calculated	0.02000	BETA	1.50180E+03	Calculated
>2044	Fr-226	3.7689E+22	3.3511E-10	1.4952E-09	Calculated	0.02000	BETA	1.79140E+03	Calculated
>2045	Fr-227	1.2406E+22	7.3900E-10	3.2820E-09	Calculated	0.02000	BETA	1.95460E+03	Calculated
>2046	Fr-228	4.8171E+22	3.2996E-10	1.4720E-09	Calculated	0.02000	BETA	1.23442E+03	Calculated
>2047	Ra-220	1.0540E+26	4.3258E-11	1.5778E-09	Calculated	0.00009	ALPHA	2.15054E+05	Calculated
>2048	Ra-221	6.7453E+22	6.3733E-08	2.3274E-06	Calculated	0.00009	ALPHA	2.27130E+04	Calculated
>2049	Ra-222	4.9478E+22	8.0352E-08	2.9443E-06	Calculated	0.00009	ALPHA	1.07819E+05	Calculated
2050	Ra-223	1.8953E+18	1.0000E-07	8.7000E-06	ICRP72	0.00700	A2 VALUE	1.00000E+03	IAEA-G-1.7
2051	Ra-224	5.9248E+18	6.5000E-08	3.4000E-06	ICRP72	0.02000	A2 VALUE	1.00000E+03	IAEA-G-1.7
2052	Ra-225	1.4507E+18	9.9000E-08	7.7000E-06	ICRP72	0.00400	A2 VALUE	1.00000E+04	IAEA-G-1.7
2053	Ra-226	3.6577E+13	2.8000E-07	9.5000E-06	ICRP72	0.00300	A2 VALUE	1.00000E+03	IAEA-G-1.7
2054	Ra-227	7.2616E+20	8.1000E-11	4.6000E-10	ICRP72	0.02000	BETA	1.00000E+05	IAEA-G-1.7
2055	Ra-228	1.0088E+16	6.9000E-07	1.6000E-05	ICRP72	0.02000	A2 VALUE	1.00000E+03	IAEA-G-1.7



ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
2130	Np-240	4.4586E+20	8.2000E-11	9.0000E-11	ICRP72	0.02000	BETA	1.00000E+04	IAEA-G-1.7
>2131	Np-240m	3.9163E+21	8.4898E-12	3.6205E-10	Calculated	0.02000	BETA	2.46853E+03	Calculated
>2132	Np-241	2.0763E+21	7.3944E-12	3.4779E-10	Calculated	0.02000	BETA	1.25303E+04	Calculated
>2133	Np-242	1.3064E+22	2.7981E-12	1.1880E-10	Calculated	0.02000	BETA	3.01117E+03	Calculated
>2134	Np-242m	5.2256E+21	1.1131E-11	4.7257E-10	Calculated	0.02000	BETA	1.00950E+03	Calculated
>2135	Np-243	1.5471E+22	3.0606E-12	1.2925E-10	Calculated	0.02000	BETA	1.28403E+03	Calculated
>2136	Np-244	1.2447E+22	5.8222E-12	2.4718E-10	Calculated	0.02000	BETA	8.03559E+02	Calculated
>2137	Np-245	4.4356E+22	1.4420E-12	5.7841E-11	Calculated	0.02000	BETA	1.02145E+03	Calculated
>2138	Np-246	1.0602E+23	9.1919E-13	3.9587E-11	Calculated	0.02000	BETA	6.00853E+02	Calculated
>2139	Pu-232	8.8967E+20	1.6792E-08	1.9646E-08	Calculated	0.00009	ALPHA	1.06371E+04	Calculated
>2140	Pu-233	1.4284E+21	3.8983E-10	4.5124E-10	Calculated	0.00009	ALPHA	3.02252E+02	Calculated
2141	Pu-234	5.6298E+19	1.6000E-10	2.4000E-08	ICRP72	0.00009	ALPHA	1.00000E+05	IAEA-G-1.7
2142	Pu-235	1.1699E+21	2.1000E-12	1.5000E-12	ICRP72	0.00009	ALPHA	1.00000E+05	IAEA-G-1.7
2143	Pu-236	1.9607E+16	8.7000E-08	4.0000E-05	ICRP72	0.00300	A2 VALUE	1.00000E+03	IAEA-G-1.7
2144	Pu-237	4.4991E+17	1.0000E-10	3.9000E-10	ICRP72	20.00000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>2145	Pu-237m	9.7829E+24	2.2202E-15	2.6199E-15	Calculated	0.02000	BETA	6.87077E+03	Calculated
2146	Pu-238	6.3360E+14	2.3000E-07	1.1000E-04	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2147	Pu-239	2.2947E+12	2.5000E-07	1.2000E-04	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2148	Pu-240	8.3960E+12	2.5000E-07	1.2000E-04	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2149	Pu-241	3.8292E+15	4.8000E-09	2.3000E-06	ICRP72	0.06000	A2 VALUE	1.00000E+04	IAEA-G-1.7
2150	Pu-242	1.4631E+11	2.4000E-07	1.1000E-04	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2151	Pu-243	9.6255E+19	8.5000E-11	8.6000E-11	ICRP72	0.02000	BETA	1.00000E+06	IAEA-G-1.7
2152	Pu-244	6.7745E+08	2.4000E-07	1.1000E-04	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
>2153	Pu-245	4.5061E+19	7.2000E-10	4.3000E-10	ICRP72	0.02000	BETA	2.31630E+03	Calculated
>2154	Pu-246	1.8096E+18	3.3000E-09	8.0000E-09	ICRP72	0.02000	BETA	7.39251E+03	Calculated
>2155	Pu-247	8.6141E+18	1.9217E-08	3.3184E-08	Calculated	0.02000	BETA	1.47420E+03	Calculated
>2156	Am-237	4.0203E+20	1.8000E-11	2.6000E-11	ICRP72	0.00009	ALPHA	2.42994E+03	Calculated
>2157	Am-238	2.9821E+20	3.2000E-11	1.9000E-10	ICRP72	0.00009	ALPHA	1.10699E+03	Calculated
>2158	Am-239	4.0760E+19	2.4000E-10	2.4000E-10	ICRP72	0.00009	ALPHA	3.56631E+03	Calculated
>2159	Am-240	9.5082E+18	5.8000E-10	4.3000E-10	ICRP72	0.00009	ALPHA	9.61941E+02	Calculated
2160	Am-241	1.2678E+14	2.0000E-07	9.6000E-05	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2161	Am-242	2.9864E+19	3.0000E-10	2.0000E-08	ICRP72	0.02000	BETA	1.00000E+06	IAEA-G-1.7
2162	Am-242m	3.8755E+14	1.9000E-07	9.2000E-05	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2163	Am-243	7.3892E+12	2.0000E-07	9.6000E-05	ICRP72	0.00050	A2 VALUE	1.00000E+02	IAEA-G-1.7
>2164	Am-244	4.7038E+19	4.6000E-10	3.7000E-09	ICRP72	0.02000	BETA	1.14389E+03	Calculated
>2165	Am-244m	1.0963E+21	2.9000E-11	1.6000E-10	ICRP72	0.02000	BETA	1.59163E+04	Calculated
>2166	Am-245	2.3080E+20	6.2000E-11	5.6000E-11	ICRP72	0.02000	BETA	1.77881E+04	Calculated
>2167	Am-246	7.2494E+20	5.8000E-11	6.9000E-11	ICRP72	0.02000	BETA	1.18101E+03	Calculated
>2168	Am-246m	1.1309E+21	3.4000E-11	2.3000E-11	ICRP72	0.02000	BETA	9.39347E+02	Calculated
>2169	Am-247	1.2243E+21	3.4680E-11	1.6745E-09	Calculated	0.02000	BETA	5.38186E+03	Calculated
>2170	Am-248	9.3480E+21	1.3687E-11	6.6097E-10	Calculated	0.02000	BETA	8.60882E+02	Calculated
>2171	Am-249	2.7931E+22	4.0398E-12	1.7283E-10	Calculated	0.02000	BETA	1.16054E+03	Calculated
>2172	Am-250	5.4547E+21	3.0561E-11	1.5137E-09	Calculated	0.02000	BETA	6.55594E+02	Calculated
>2173	Cm-238	2.0295E+20	8.0000E-11	4.9000E-09	ICRP72	0.00009	ALPHA	1.07980E+04	Calculated
>2174	Cm-239	1.6168E+20	4.3523E-10	1.6971E-09	Calculated	0.02000	BETA	8.16163E+02	Calculated
>2175	Cm-240	7.4540E+17	7.6000E-09	3.5000E-06	ICRP72	0.02000	A2 VALUE	5.71429E+05	Calculated
>2176	Cm-241	6.1104E+17	9.1000E-10	3.7000E-08	ICRP72	1.00000	A2 VALUE	1.95755E+03	Calculated
2177	Cm-242	1.2250E+17	1.2000E-08	5.9000E-06	ICRP72	0.01000	A2 VALUE	1.00000E+04	IAEA-G-1.7
2178	Cm-243	1.8140E+15	1.5000E-07	6.9000E-05	ICRP72	0.00100	A2 VALUE	1.00000E+03	IAEA-G-1.7
2179	Cm-244	3.0109E+15	1.2000E-07	5.7000E-05	ICRP72	0.00200	A2 VALUE	1.00000E+03	IAEA-G-1.7
2180	Cm-245	6.3500E+12	2.1000E-07	9.9000E-05	ICRP72	0.00090	A2 VALUE	1.00000E+02	IAEA-G-1.7
2181	Cm-246	1.1365E+13	2.1000E-07	9.8000E-05	ICRP72	0.00090	A2 VALUE	1.00000E+02	IAEA-G-1.7
2182	Cm-247	3.3460E+09	1.9000E-07	9.0000E-05	ICRP72	0.00100	A2 VALUE	1.00000E+02	IAEA-G-1.7
2183	Cm-248	1.5682E+11	7.7000E-07	3.6000E-04	ICRP72	0.00030	A2 VALUE	1.00000E+02	IAEA-G-1.7
>2184	Cm-249	4.3541E+20	3.1000E-11	4.0000E-11	ICRP72	0.02000	BETA	2.08130E+04	Calculated
>2185	Cm-250	6.6116E+12	4.4000E-06	2.1000E-03	ICRP72	0.00009	ALPHA	2.04082E+02	Calculated
>2186	Cm-251	1.6493E+21	3.4506E-11	1.4957E-10	Calculated	0.02000	BETA	6.44825E+03	Calculated
>2187	Bk-243	1.0601E+20	9.6955E-10	1.8144E-07	Calculated	0.00009	ALPHA	5.65911E+03	Calculated
>2188	Bk-244	1.0921E+20	4.1360E-08	3.0867E-06	Calculated	0.00009	ALPHA	4.46309E+02	Calculated
>2189	Bk-245	3.9907E+18	5.7000E-10	2.1000E-09	ICRP72	0.00009	ALPHA	4.18532E+03	Calculated
>2190	Bk-246	1.0908E+19	4.8000E-10	3.3000E-10	ICRP72	0.02000	BETA	1.17135E+03	Calculated
>2191	Bk-247	3.8795E+13	3.5000E-07	6.9000E-05	ICRP72	0.00080	A2 VALUE	6.83905E+03	Calculated
>2192	Bk-248	5.9245E+15	3.2522E-06	5.3718E-04	Calculated	0.00009	ALPHA	3.72318E+03	Calculated
>2193	Bk-248m	1.9722E+19	2.6934E-09	2.1684E-07	Calculated	0.02000	BETA	1.43472E+04	Calculated
2194	Bk-249	6.0615E+16	9.7000E-10	1.6000E-07	ICRP72	0.30000	A2 VALUE	1.00000E+05	IAEA-G-1.7
>2195	Bk-250	1.4413E+20	1.4000E-10	1.0000E-09	ICRP72	0.02000	BETA	1.06938E+03	Calculated
>2196	Bk-251	4.9835E+20	3.7999E-10	2.6979E-08	Calculated	0.02000	BETA	2.49521E+03	Calculated
>2197	Bk-252	1.5332E+22	9.6803E-10	6.8729E-08	Calculated	0.00009	ALPHA	2.18531E+03	Calculated
>2198	Bk-253	2.7489E+21	1.0187E-10	7.2520E-09	Calculated	0.02000	BETA	1.67420E+03	Calculated
>2199	Bk-254	2.7380E+22	1.9181E-11	1.3724E-09	Calculated	0.02000	BETA	8.94484E+02	Calculated
>2200	Cf-244	1.4693E+21	7.0000E-11	1.4000E-08	ICRP72	0.00009	ALPHA	1.42857E+08	Calculated
>2201	Cf-245	6.3085E+20	8.8373E-07	3.9736E-05	Calculated	0.00009	ALPHA	2.71166E+03	Calculated
2202	Cf-246	1.3199E+19	3.3000E-09	4.5000E-07	ICRP72	0.00009	ALPHA	1.00000E+06	IAEA-G-1.7
>2203	Cf-247	1.5085E+20	4.8083E-07	2.1608E-05	Calculated	0.00009	ALPHA	3.20513E+02	Calculated

ID	Nuclide	Act(Bq/kg)	e <sup>ing</sup> (Sv/Bq)	e <sup>inh</sup> (Sv/Bq)	Haz source	A <sub>2</sub> (TBq)	A <sub>2</sub> source	C(Bq/kg)	Clear source
2204	Cf-248	5.8397E+16	2.8000E-08	8.8000E-06	ICRP72	0.00600	A2 VALUE	1.00000E+03	IAEA-G-1.7
2205	Cf-249	1.5130E+14	3.5000E-07	7.0000E-05	ICRP72	0.00080	A2 VALUE	1.00000E+02	IAEA-G-1.7
2206	Cf-250	4.0438E+15	1.6000E-07	3.4000E-05	ICRP72	0.00200	A2 VALUE	1.00000E+03	IAEA-G-1.7
2207	Cf-251	5.8666E+13	3.6000E-07	7.1000E-05	ICRP72	0.00070	A2 VALUE	1.00000E+02	IAEA-G-1.7
2208	Cf-252	1.9838E+16	9.0000E-08	2.0000E-05	ICRP72	0.00300	A2 VALUE	1.00000E+03	IAEA-G-1.7
2209	Cf-253	1.0718E+18	1.4000E-09	1.3000E-06	ICRP72	0.04000	A2 VALUE	1.00000E+05	IAEA-G-1.7
2210	Cf-254	3.1428E+17	4.0000E-07	4.1000E-05	ICRP72	0.00100	A2 VALUE	1.00000E+03	IAEA-G-1.7
>2211	Cf-255	3.2086E+20	1.1504E-07	6.9451E-06	Calculated	0.00009	ALPHA	3.78266E+03	Calculated
>2212	Es-249	2.7330E+20	2.7592E-10	2.3413E-08	Calculated	0.00009	ALPHA	2.44128E+03	Calculated
>2213	Es-250	5.3914E+19	1.6582E-09	1.4116E-07	Calculated	0.02000	BETA	8.03361E+02	Calculated
>2214	Es-250m	2.0885E+20	2.1000E-11	6.3000E-10	ICRP72	0.02000	BETA	1.85154E+03	Calculated
>2215	Es-251	1.3994E+19	1.7000E-10	2.1000E-09	ICRP72	0.00009	ALPHA	2.53891E+04	Calculated
>2216	Es-252	4.0631E+16	6.9190E-07	1.3669E-04	Calculated	0.00009	ALPHA	4.76568E+03	Calculated
2217	Es-253	9.3256E+17	6.1000E-09	2.7000E-06	ICRP72	0.00009	ALPHA	1.00000E+05	IAEA-G-1.7
2218	Es-254	6.9018E+16	2.8000E-08	8.6000E-06	ICRP72	0.00009	ALPHA	1.00000E+02	IAEA-G-1.7
2219	Es-254m	1.1610E+19	4.2000E-09	4.7000E-07	ICRP72	0.00009	ALPHA	1.00000E+04	IAEA-G-1.7
>2220	Es-255	4.7587E+17	4.0068E-07	4.7450E-05	Calculated	0.00009	ALPHA	4.21496E+04	Calculated
>2221	Es-256	1.2348E+21	1.1316E-09	9.6031E-08	Calculated	0.02000	BETA	1.59684E+03	Calculated
>2222	Es-256m	5.9575E+19	2.2629E-08	1.9231E-06	Calculated	0.02000	BETA	1.17546E+04	Calculated
>2223	Es-257	2.4405E+18	1.8826E-08	6.5788E-06	Calculated	0.00009	ALPHA	3.36288E+03	Calculated
>2224	Fm-250	9.2731E+20	1.5612E-10	3.2107E-08	Calculated	0.00009	ALPHA	1.47895E+05	Calculated
>2225	Fm-250m	9.2761E+23	1.6785E-13	3.4520E-11	Calculated	0.00009	ALPHA	8.33333E+02	Calculated
>2226	Fm-251	8.7042E+19	3.4078E-11	6.9274E-09	Calculated	0.00009	ALPHA	6.04705E+03	Calculated
>2227	Fm-252	1.8116E+19	2.7000E-09	3.2000E-07	ICRP72	0.00009	ALPHA	2.17239E+06	Calculated
>2228	Fm-253	6.3632E+18	9.1000E-10	4.0000E-07	ICRP72	0.00009	ALPHA	1.07052E+04	Calculated
2229	Fm-254	1.4085E+20	4.4000E-10	6.1000E-08	ICRP72	0.00009	ALPHA	1.00000E+07	IAEA-G-1.7
2230	Fm-255	2.2648E+19	2.5000E-09	2.7000E-07	ICRP72	0.00009	ALPHA	1.00000E+05	IAEA-G-1.7
>2231	Fm-256	1.7237E+20	1.3294E-10	2.7342E-08	Calculated	0.00009	ALPHA	7.31472E+07	Calculated
>2232	Fm-257	1.8698E+17	1.5000E-08	7.1000E-06	ICRP72	0.00009	ALPHA	7.95345E+03	Calculated
>2233	Fm-258	4.3711E+27	2.1702E-08	4.4633E-06	Calculated	0.02000	BETA	4.48103E+05	Calculated

## References

- [1] RA Forrest, 'Dosimetric data for FISPACT 2', AEA FUS **182**, 1992.
- [2] RA Forrest and LW Packer, 'SAFEPAQ-II User manual', CCFE-R (10) **05**, Issue 8, 2010.
- [3] RA Forrest 'FISPACT-2007: User manual', UKAEA FUS **534**, 2007.
- [4] 'Regulations for the safe transport of radioactive material', 1996 Edition IAEA Safety Series No. **ST-1**, IAEA Vienna.
- [5] 'Application of the concepts of exclusion, exemption and clearance', IAEA Safety Standards Series No. **RS-G-1.7**, IAEA Vienna, 2004.
- [6] International Commission on Radiological Protection, 'Dose coefficients for intakes of radionuclides by workers', ICRP Publication **68**, 1995.
- [7] AW Phipps, GM Kendall, JW Stather and TP Fell, 'Committed equivalent organ doses and committed

- equivalent doses from intakes of radionuclides*', **NRPB-R245**, 1991.
- [8] NRPB, *The calculation of doses from internal emitters using a new computer program: Quality control on the RAPID database*', **NRPB-M215**, 1990.
- [9] GM Kendall, Personal communication to KR Smith, NRPB, 1989.
- [10] AW Phipps and TJ Silk, *Dosimetric data for fusion applications*', **NRPB-M589**, 1995.
- [11] KR Smith, *Dosimetric data for FISPACT*', Culham Report, **CLM-R299**, 1990.
- [12] International Commission on Radiological Protection, *Limits for intakes of radionuclides by workers*', ICRP Publication **30**, Parts 1-3 (1979-1981) and Supplements to Parts 1-3 (1979-1982), Pergamon Press, Oxford.
- [13] *Clearance levels for radionuclides in solid materials: application of exemption principles*', 1994 Draft Safety Guide, IAEA Safety Series No. **111.G-1-5**, IAEA Vienna.
- [14] International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*', ICRP Publication **60**, Annals of the ICRP 21, No 1 - 3, 1991.
- [15] International Commission on Radiological Protection, *Age-dependent doses to members of the public from intake of radionuclides: Part 5 Compilation of ingestion and inhalation dose coefficients*', ICRP Publication **72**, 1996.

## ***Acknowledgements***

The development of EAF and the production of this documentation have been supported by United Kingdom Engineering and Sciences Research Council and the European Communities under the contract of Association between EURATOM and CCFE, and was partially carried out within the framework of F4E grant agreement. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

## ***Disclaimer***

Neither the author nor CCFE accept responsibility for consequences arising from any errors either in the present documentation, or in the EASY system.

## ***Contact person***

Feedback on the use of EAF is welcomed. Please contact L. W. Packer with comments or in case of problems.

Lee Packer  
EURATOM/CCFE Association  
D3 Culham Science Centre  
Abingdon  
Oxfordshire OX14 3DB  
Tel: +44 1235 466458  
Fax: +44 1235 466435  
e-mail: [lee.packer@ccfe.ac.uk](mailto:lee.packer@ccfe.ac.uk)  
Internet: [www.ccfe.ac.uk/EASY.aspx](http://www.ccfe.ac.uk/EASY.aspx)