

Verification of the MONDAL software

MONDAL/MONDES is a software package developed by the National Institute of Radiological Sciences, Japan (contact person: N. Ishigure) intended for the estimation of internal doses based on retention or excretion measurements. MONDAL contains the data set for the inhalation case, while MONDES for the ingestion case.

The calculation method is based on the methodology and parameters applied in ICRP Publication No 78, however the software also contains data for radionuclides, which were only in the relevant earlier publication of the ICRP (No 54) and data for several radionuclides, which are absent also from the new and old ICRP publications.

Therefore, the verification of the software could be performed only for the radionuclides of ICRP Publication 78, but the estimations were also performed for all relevant nuclides and the results are presented, too. However, it should be emphasized that the last results are only for information and were not used for the verification.

According to the ICRP methodology used for internal dose assessments, the verification process consisted of two main steps:

- 1) comparison of $m(t)$ values calculated by the software with the tabular data of ICRP 78 for the estimation of radionuclide intake from the measured activity results
- 2) comparison of $e(g)_{inh,j}$ and $e(g)_{ing,j}$ inhalation and ingestion dose factors applied by the software with the data given in the IAEA Basic Safety Standards.

The main parameters applied for the calculation in accordance with the above mentioned ICRP and IBSS publications were the following:

- 1) AMAD = 5 μm , Type M material (if this assumption was not adequate for the given radionuclide, the most restrictive parameters were chosen) for the inhalation case
- 2) f_1 values given for unspecified compounds or the most restrictive ones for the ingestion case.

The selection of radionuclides for the calculations was based on the recent practice of the IAEA laboratories.

The results calculated by MONDAL for the inhalation case are given in Tables 1.a-1.b. The cells with grey colour indicate the values intended only for information and cannot be used for the verification due to the different biokinetic models and parameters applied. The abbreviations in the last column of the Tables are: U – urine, WB - whole-body, Th -thyroid and Lu- lungs.

Table 2. summarizes the retention and excretion values following 1 Bq acute intake from the Tables of the ICRP Publications No 54 and 78. To keep the same structure the radionuclides with no values are also presented. The meaning of grey colour and the abbreviations used are the same as above. The last column now indicates the ICRP publication where the values were taken from. It should be noted, that there are not tabular values for each radionuclides for the total 1-180 days time period.

The relative differences of the retention or excretion function values calculated by the MONDAL software following a single intake by inhalation at different time are given as the percentages of the tabular values of ICRP Publications No 54 and 78 in Table 3. The colour code and abbreviations are the same as above.

The results of the intercomparison clearly indicate the adequacy of the MONDAL software to the ICRP 78 methodology. The relative differences are always below 5 percent, which is in the range of the rounding error.

There are remarkable differences from the ICRP 54 values, but as we noted already the biokinetic models and parameters used are quite different.

The inhalation dose factors calculated by MONDAL are summarized in Table 4. As we have not got the source code of the macros used in MONDAL the dose factors were calculated at each time already used, i.e. for the 1-180 days time period to verify the consistency of the dose estimations. The dose factors calculated at different time agreed well and the averages of them were used for comparison with the dose factors of the IAEA Basic Safety Standards. It can be stated again, that MONDAL complies with the IBSS data set and at the same time with the ICRP Publication No 78, too. In this case the IBSS was chosen as the primary source of verification data, as the ICRP Publication No 78 contains dose factors only for a much more limited set of radionuclides. The relative differences are again well below 5 percent for each radionuclides considered. It should be noted, however that for Ra-226 the original version of MONDAL did not follow the new methodology of ICRP Publication No 71, causing an overestimation of about a factor of 2. This problem could be eliminated by the update of the Ra-226 data in MONDAL following the contact with Mr. Ishigure.

The results calculated by MONDAL for the ingestion case are given in Table 5. The cells with grey colour indicate the values intended only for information and cannot be used for the verification due to the missing information of the ICRP Publication No 54, which presented data only for the inhalation case. The abbreviations in the last column of the Table are: U – urine, WB - whole-body, Th - thyroid and Skel - skeleton. It should be noted, that the retention and excretion functions following a single intake by ingestion are only tabulated until 10 days, treated as a subject of the special monitoring by the ICRP 78.

Table 6. summarizes the retention and excretion values following 1 Bq acute intake from the Tables of the ICRP Publication No 78. To keep the same structure the radionuclides with no values are also presented. The meanings of abbreviations used are the same as above. The last column now indicates the ICRP publication where the values were taken from.

The relative differences of the retention or excretion function values calculated by the MONDAL software following a single intake by ingestion at different time are given as the percentages of the tabular values of ICRP Publications No 78 in Table 7. The abbreviations are the same as above.

The results of the intercomparison clearly indicate the adequacy of the MONDAL software to the ICRP 78 methodology. The relative differences are dominantly below 5 percent, which is in the range of the rounding error. The only exemption is H-3 (HTO), where the relative difference slightly exceeds 5 percent for the measurements performed soon after the intake.

The ingestion dose factors calculated by MONDAL are summarized in Table 8. The dose factors were calculated at each time already used, i.e. for the 1-10 days time period to verify the consistency of the dose estimations. The dose factors calculated at different time agreed well and the averages of them were used for comparison with the dose factors of the IAEA Basic Safety Standards. It can be stated again, that

MONDAL complies with the IBSS data set and at the same time with the ICRP Publication No 78, too. Like the inhalation in this case the IBSS was also chosen as the primary source of the verification data, as the ICRP Publication No 78 contains dose factors only to a much more limited set of radionuclides. The relative differences are again well below 5 percent for each radionuclides considered.

Conclusion: it can be stated, that the parameters applied in and the results calculated by the MONDAL software are consistent with the biokinetic data given in the ICRP Publication No 78 and with the dose factors of IBSS both the inhalation and ingestion cases.

Table 1.a. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 1-30 days – Inhalation case

Nuclide	MONDAL (d)												Chem Sample	
	1		2		5		10		15		30			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
H-3	4.7E+01	8.4E-10	5.0E+01	9.0E-10	6.1E+01	1.1E-09	8.6E+01	1.6E-09	1.2E+02	2.2E-09	3.3E+02	5.9E-09	HTO	U
P-32	2.8E+01	8.0E-08	4.4E+01	1.3E-07	1.4E+02	4.1E-07	3.7E+02	1.1E-06	6.6E+02	1.9E-06	2.3E+03	6.8E-06	M	U
Cr-51	2.1E+00	7.0E-11	3.9E+00	1.3E-10	1.1E+01	3.7E-10	1.6E+01	5.3E-10	2.0E+01	6.7E-10	3.5E+01	1.2E-09	M	WB
Cr-51	1.4E+02	4.9E-09	2.7E+02	9.2E-09	9.3E+02	3.1E-08	1.7E+03	5.9E-08	3.0E+03	1.0E-07	1.0E+04	3.5E-07	M	U
Mn-54	2.0E+00	2.4E-09	3.5E+00	4.2E-09	8.4E+00	1.0E-08	1.0E+01	1.2E-08	1.1E+01	1.4E-08	1.5E+01	1.8E-08	M	WB
Mn-54	1.0E+03	1.2E-06	5.6E+02	6.7E-07	7.8E+02	9.3E-07	1.3E+03	1.6E-06	1.9E+03	2.3E-06	3.2E+03	3.8E-06	M	U
Fe-59	2.0E+00	6.4E-09	3.6E+00	1.1E-08	8.1E+00	2.6E-08	9.6E+00	3.1E-08	1.1E+01	3.4E-08	1.4E+01	4.5E-08	M	WB
Fe-59	7.6E+03	2.4E-05	7.1E+04	2.3E-04	2.2E+05	7.0E-04	4.7E+05	1.5E-03	6.2E+05	2.0E-03	8.6E+05	2.8E-03	M	U
Co-57	2.1E+00	8.1E-10	3.9E+00	1.5E-09	1.1E+01	4.3E-09	1.4E+01	5.5E-09	1.6E+01	6.2E-09	2.0E+01	7.9E-09	M	WB
Co-57	5.1E+01	2.0E-08	1.1E+02	4.3E-08	6.0E+02	2.3E-07	1.0E+03	4.0E-07	1.6E+03	6.1E-07	3.7E+03	1.4E-06	M	U
Co-58	2.1E+00	2.9E-09	4.0E+00	5.6E-09	1.2E+01	1.6E-08	1.5E+01	2.1E-08	1.8E+01	2.5E-08	2.5E+01	3.5E-08	M	WB
Co-58	5.1E+01	7.2E-08	1.1E+02	1.6E-07	6.2E+02	8.7E-07	1.1E+03	1.5E-06	1.7E+03	2.4E-06	4.6E+03	6.4E-06	M	U
Co-60	2.1E+00	1.5E-08	3.9E+00	2.8E-08	1.1E+01	7.8E-08	1.4E+01	9.9E-08	1.5E+01	1.1E-07	1.9E+01	1.3E-07	M	WB
Co-60	5.1E+01	3.6E-07	1.1E+02	7.8E-07	6.0E+02	4.2E-06	1.0E+03	7.1E-06	1.5E+03	1.1E-05	3.5E+03	2.5E-05	M	U
Zn-65	1.9E+00	5.2E-09	2.6E+00	7.4E-09	3.7E+00	1.0E-08	4.0E+00	1.1E-08	4.2E+00	1.2E-08	4.8E+00	1.3E-08	S	WB
Zn-65	5.5E+03	1.5E-05	2.7E+03	7.6E-06	2.8E+03	7.9E-06	3.3E+03	9.2E-06	3.8E+03	1.1E-05	5.8E+03	1.6E-05	S	U
Rb-86	1.7E+00	2.2E-09	2.1E+00	2.7E-09	2.7E+00	3.5E-09	3.5E+00	4.5E-09	4.5E+00	5.9E-09	1.0E+01	1.3E-08	F	WB
Rb-86	3.3E+02	4.2E-07	2.0E+02	2.6E-07	2.3E+02	2.9E-07	3.0E+02	3.8E-07	3.8E+02	5.0E-07	8.5E+02	1.1E-06	F	U
Sr-85	2.1E+00	1.3E-09	4.1E+00	2.6E-09	1.4E+01	9.1E-09	1.8E+01	1.2E-08	2.0E+01	1.3E-08	2.7E+01	1.7E-08	S	WB
Sr-85	1.3E+03	8.0E-07	3.0E+03	1.9E-06	8.1E+03	5.2E-06	1.8E+04	1.2E-05	3.0E+04	1.9E-05	7.8E+04	5.0E-05	S	U
Sr-89	1.3E+03	7.0E-06	3.0E+03	1.7E-05	8.3E+03	4.6E-05	1.9E+04	1.1E-04	3.1E+04	1.7E-04	8.5E+04	4.7E-04	S	U
Sr-90	1.2E+03	9.5E-05	2.9E+03	2.2E-04	7.7E+03	5.9E-04	1.7E+04	1.3E-03	2.5E+04	1.9E-03	5.6E+04	4.4E-03	S	U
Zr-95	2.0E+00	7.3E-09	3.9E+00	1.4E-08	1.2E+01	4.2E-08	1.5E+01	5.5E-08	1.7E+01	6.2E-08	2.3E+01	8.5E-08	M	WB
Zr-95	1.5E+03	5.5E-06	9.7E+02	3.5E-06	1.3E+03	4.5E-06	2.0E+03	7.2E-06	3.1E+03	1.1E-05	9.0E+03	3.2E-05	M	U
Ru-106	2.0E+00	3.4E-08	3.8E+00	6.4E-08	1.0E+01	1.7E-07	1.2E+01	2.1E-07	1.4E+01	2.3E-07	1.7E+01	2.9E-07	M	WB
Ru-106	1.8E+02	3.1E-06	4.8E+02	8.1E-06	9.1E+02	1.5E-05	1.2E+03	2.1E-05	1.6E+03	2.8E-05	3.1E+03	5.3E-05	M	U
Ag-110m	2.0E+00	1.2E-08	3.6E+00	2.2E-08	9.3E+00	5.5E-08	1.1E+01	6.5E-08	1.2E+01	7.0E-08	1.4E+01	8.5E-08	M	WB
Ag-110m	2.9E+04	1.7E-04	1.7E+04	9.9E-05	2.2E+04	1.3E-04	3.1E+04	1.8E-04	3.8E+04	2.3E-04	5.0E+04	3.0E-04	M	U

Table 1.a. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 1-30 days – Inhalation case (Cont.)

Nuclide	MONDAL (d)												Chem Sample	
	1		2		5		10		15		30			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
Sb-124	2.1E+00	9.7E-09	4.0E+00	1.9E-08	1.3E+01	6.1E-08	1.8E+01	8.5E-08	2.1E+01	1.0E-07	3.2E+01	1.5E-07	M	WB
Sb-124	1.7E+02	8.0E-07	4.0E+02	1.9E-06	7.0E+02	3.3E-06	1.3E+03	6.1E-06	2.3E+03	1.1E-05	6.8E+03	3.2E-05	M	U
Sb-125	2.0E+00	6.7E-09	3.9E+00	1.3E-08	1.2E+01	4.1E-08	1.6E+01	5.4E-08	1.8E+01	6.0E-08	2.3E+01	7.5E-08	M	WB
Sb-125	1.7E+02	5.5E-07	3.9E+02	1.3E-06	6.6E+02	2.2E-06	1.2E+03	3.9E-06	1.9E+03	6.4E-06	5.0E+03	1.6E-05	M	U
I-125	7.6E+00	5.5E-08	7.2E+00	5.3E-08	7.7E+00	5.6E-08	8.5E+00	6.2E-08	9.3E+00	6.8E-08	1.2E+01	9.0E-08	F	Th
I-125	3.3E+00	2.4E-08	3.7E+01	2.7E-07	7.7E+03	5.6E-05	4.3E+03	3.1E-05	3.3E+03	2.4E-05	2.9E+03	2.1E-05	F	U
I-129	7.5E+00	3.8E-07	7.1E+00	3.6E-07	7.2E+00	3.7E-07	7.5E+00	3.8E-07	7.8E+00	4.0E-07	8.7E+00	4.4E-07	F	Th
I-129	3.3E+00	1.7E-07	3.6E+01	1.9E-06	7.3E+03	3.7E-04	3.8E+03	1.9E-04	2.8E+03	1.4E-04	2.0E+03	1.0E-04	F	U
I-131	8.2E+00	9.0E-08	8.4E+00	9.2E-08	1.1E+01	1.2E-07	1.8E+01	2.0E-07	2.8E+01	3.1E-07	1.2E+02	1.3E-06	F	Th
I-131	3.6E+00	3.9E-08	4.3E+01	4.8E-07	1.1E+04	1.2E-04	9.0E+03	9.9E-05	1.0E+04	1.1E-04	2.7E+04	3.0E-04	F	U
Cs-134	1.7E+00	1.6E-08	2.0E+00	1.9E-08	2.3E+00	2.2E-08	2.5E+00	2.4E-08	2.6E+00	2.5E-08	2.9E+00	2.8E-08	F	WB
Cs-134	1.3E+02	1.2E-06	9.1E+01	8.7E-07	1.8E+02	1.8E-06	3.8E+02	3.7E-06	4.9E+02	4.7E-06	5.7E+02	5.5E-06	F	U
Cs-137	1.7E+00	1.1E-08	2.0E+00	1.3E-08	2.3E+00	1.5E-08	2.4E+00	1.6E-08	2.5E+00	1.7E-08	2.8E+00	1.9E-08	F	WB
Cs-137	1.3E+02	8.5E-07	9.0E+01	6.0E-07	1.8E+02	1.2E-06	3.8E+02	2.5E-06	4.8E+02	3.2E-06	5.5E+02	3.7E-06	F	U
Ba-140	2.2E+00	3.4E-09	4.0E+00	6.5E-09	1.6E+01	2.6E-08	4.1E+01	6.6E-08	6.4E+01	1.0E-07	1.6E+02	2.6E-07	F	WB
Ba-140	6.2E+01	9.9E-08	3.8E+02	6.1E-07	1.4E+03	2.2E-06	9.9E+03	1.6E-05	4.9E+04	7.8E-05	2.7E+05	4.3E-04	F	U
Ce-141	2.1E+00	5.5E-09	4.0E+00	1.1E-08	1.2E+01	3.2E-08	1.5E+01	4.1E-08	1.7E+01	4.7E-08	2.6E+01	6.9E-08	M	WB
Ce-141	3.1E+06	8.5E-03	1.9E+06	5.1E-03	1.9E+06	5.2E-03	2.0E+06	5.5E-03	2.2E+06	5.9E-03	2.7E+06	7.4E-03	M	U
Ce-144	2.0E+00	4.6E-08	3.8E+00	8.7E-08	1.1E+01	2.5E-07	1.3E+01	2.9E-07	1.3E+01	3.0E-07	1.4E+01	3.3E-07	M	WB
Ce-144	3.1E+06	7.1E-02	1.8E+06	4.2E-02	1.7E+06	4.0E-02	1.7E+06	3.9E-02	1.6E+06	3.8E-02	1.6E+06	3.6E-02	M	U
Hg-203	2.0E+00	3.9E-09	3.8E+00	7.3E-09	1.1E+01	2.1E-08	1.4E+01	2.6E-08	1.6E+01	3.0E-08	2.3E+01	4.4E-08	M	WB
Hg-203	6.4E+03	1.2E-05	3.6E+03	6.9E-06	3.8E+03	7.2E-06	4.3E+03	8.1E-06	4.8E+03	9.1E-06	6.9E+03	1.3E-05	M	U
Ra-226	2.0E+00	4.4E-06	3.7E+00	8.1E-06	1.1E+01	2.4E-05	1.5E+01	3.3E-05	1.6E+01	3.6E-05	2.0E+01	4.3E-05	M	WB
Ra-226	6.3E+02	1.4E-03	3.2E+03	7.1E-03	9.5E+03	2.1E-02	3.7E+04	8.1E-02	7.1E+04	1.6E-01	1.1E+05	2.3E-01	M	U
Ra-228	2.0E+00	3.4E-06	3.7E+00	6.2E-06	1.1E+01	1.8E-05	1.5E+01	2.5E-05	1.6E+01	2.8E-05	2.0E+01	3.4E-05	M	WB
Ra-228	6.3E+02	1.1E-03	3.2E+03	5.5E-03	9.5E+03	1.6E-02	3.7E+04	6.3E-02	7.1E+04	1.2E-01	1.1E+05	1.8E-01	M	U
Th-228	2.0E+00	4.4E-05	3.8E+00	8.4E-05	1.1E+01	2.4E-04	1.3E+01	2.8E-04	1.3E+01	2.9E-04	1.4E+01	3.2E-04	M	Lu
Th-228	9.3E+02	2.1E-02	4.4E+03	9.6E-02	1.0E+04	2.3E-01	1.7E+04	3.8E-01	2.3E+04	5.0E-01	3.5E+04	7.6E-01	M	U

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Nuclide	MONDAL (d)												Chem Sample	
	1		2		5		10		15		30			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
Th-232	2.0E+00	5.8E-05	3.8E+00	1.1E-04	1.1E+01	3.1E-04	1.3E+01	3.6E-04	1.3E+01	3.8E-04	1.4E+01	4.1E-04	M	Lu
Th-232	9.3E+02	2.7E-02	4.4E+03	1.3E-01	1.0E+04	3.0E-01	1.7E+04	5.0E-01	2.2E+04	6.5E-01	3.4E+04	9.7E-01	M	U
U-234	1.7E+01	3.6E-05	1.8E+01	3.8E-05	1.9E+01	3.9E-05	2.0E+01	4.2E-05	2.2E+01	4.5E-05	2.6E+01	5.5E-05	M	Lu
U-234	4.3E+01	9.1E-05	8.9E+02	1.9E-03	1.4E+03	2.9E-03	1.8E+03	3.9E-03	2.3E+03	4.9E-03	3.8E+03	7.9E-03	M	U
U-235	1.7E+01	3.1E-05	1.8E+01	3.2E-05	1.9E+01	3.4E-05	2.0E+01	3.6E-05	2.2E+01	3.9E-05	2.6E+01	4.7E-05	M	Lu
U-235	4.3E+01	7.8E-05	8.9E+02	1.6E-03	1.4E+03	2.5E-03	1.8E+03	3.3E-03	2.3E+03	4.2E-03	3.8E+03	6.8E-03	M	U
U-238	1.7E+01	2.8E-05	1.8E+01	2.9E-05	1.9E+01	3.0E-05	2.0E+01	3.2E-05	2.2E+01	3.4E-05	2.6E+01	4.2E-05	M	Lu
U-238	4.3E+01	6.9E-05	8.9E+02	1.4E-03	1.4E+03	2.2E-03	1.8E+03	2.9E-03	2.3E+03	3.7E-03	3.8E+03	6.0E-03	M	U
Np-237	1.7E+01	2.6E-04	1.8E+01	2.7E-04	1.9E+01	2.8E-04	2.0E+01	3.0E-04	2.2E+01	3.2E-04	2.6E+01	3.9E-04	M	Lu
Np-237	1.6E+02	2.4E-03	7.5E+02	1.1E-02	2.9E+03	4.4E-02	7.8E+03	1.2E-01	1.0E+04	1.5E-01	1.3E+04	2.0E-01	M	U
Pu-238	1.7E+01	5.2E-04	1.8E+01	5.4E-04	1.9E+01	5.6E-04	2.0E+01	6.0E-04	2.2E+01	6.5E-04	2.6E+01	7.8E-04	M	Lu
Pu-238	4.3E+03	1.3E-01	7.6E+03	2.3E-01	2.6E+04	7.7E-01	6.5E+04	1.9E+00	8.9E+04	2.7E+00	1.1E+05	3.2E+00	M	U
Pu-239	1.7E+01	5.6E-04	1.8E+01	5.7E-04	1.9E+01	6.0E-04	2.0E+01	6.4E-04	2.2E+01	6.9E-04	2.6E+01	8.3E-04	M	Lu
Pu-239	4.3E+03	1.4E-01	7.6E+03	2.4E-01	2.6E+04	8.2E-01	6.5E+04	2.1E+00	8.9E+04	2.9E+00	1.1E+05	3.4E+00	M	U
Pu-240	1.7E+01	5.6E-04	1.8E+01	5.7E-04	1.9E+01	6.0E-04	2.0E+01	6.4E-04	2.2E+01	6.9E-04	2.6E+01	8.3E-04	M	Lu
Pu-240	4.3E+03	1.4E-01	7.6E+03	2.4E-01	2.6E+04	8.2E-01	6.5E+04	2.1E+00	8.9E+04	2.9E+00	1.1E+05	3.4E+00	M	U
Am-241	1.7E+01	4.7E-04	1.8E+01	4.8E-04	1.9E+01	5.1E-04	2.0E+01	5.4E-04	2.2E+01	5.8E-04	2.6E+01	7.0E-04	M	Lu
Am-241	5.6E+02	1.5E-02	4.3E+03	1.2E-01	1.4E+04	3.8E-01	2.1E+04	5.6E-01	2.6E+04	6.9E-01	3.8E+04	1.0E+00	M	U
Cm-242	1.7E+01	6.4E-05	1.8E+01	6.7E-05	1.9E+01	7.1E-05	2.1E+01	7.8E-05	2.3E+01	8.5E-05	3.0E+01	1.1E-04	M	Lu
Cm-242	5.6E+02	2.1E-03	4.3E+03	1.6E-02	1.4E+04	5.3E-02	2.2E+04	8.0E-02	2.7E+04	1.0E-01	4.3E+04	1.6E-01	M	U
Cm-244	1.7E+01	3.0E-04	1.8E+01	3.0E-04	1.9E+01	3.2E-04	2.0E+01	3.4E-04	2.2E+01	3.7E-04	2.6E+01	4.4E-04	M	Lu
Cm-244	5.6E+02	9.6E-03	4.3E+03	7.3E-02	1.4E+04	2.4E-01	2.1E+04	3.5E-01	2.6E+04	4.3E-01	3.8E+04	6.5E-01	M	U
Cf-252	1.7E+01	2.3E-04	1.8E+01	2.3E-04	1.9E+01	2.4E-04	2.0E+01	2.6E-04	2.2E+01	2.8E-04	2.7E+01	3.5E-04	M	Lu
Cf-252	7.7E+02	1.0E-02	8.0E+03	1.0E-01	7.0E+04	9.2E-01	7.6E+04	9.8E-01	8.1E+04	1.0E+00	9.7E+04	1.3E+00	M	U

Table 1.b. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 45-180 days – Inhalation case

Nuclide	MONDAL (d)								Chem Sample	
	45		60		90		180			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
H-3	8.6E+02	1.6E-08	2.1E+03	3.7E-08	8.3E+03	1.5E-07	6.2E+04	1.1E-06	HTO	U
P-32	7.8E+03	2.3E-05	9.8E+01	3.3E-09	2.5E+02	8.6E-09	4.0E+03	1.4E-07	M	U
Cr-51	6.0E+01	2.0E-09	9.8E+01	3.3E-09	2.5E+02	8.6E-09	4.0E+03	1.4E-07	M	WB
Cr-51	2.2E+04	7.5E-07	3.9E+04	1.3E-06	1.0E+05	3.6E-06	1.8E+06	6.1E-05	M	U
Mn-54	1.8E+01	2.2E-08	2.2E+01	2.7E-08	3.2E+01	3.8E-08	8.3E+01	9.9E-08	M	WB
Mn-54	4.1E+03	5.0E-06	5.2E+03	6.2E-06	7.9E+03	9.5E-06	2.5E+04	3.0E-05	M	U
Fe-59	1.8E+01	5.8E-08	2.3E+01	7.5E-08	3.8E+01	1.2E-07	1.6E+02	5.2E-07	M	WB
Fe-59	1.1E+06	3.6E-03	1.5E+06	4.7E-03	2.4E+06	7.8E-03	1.1E+07	3.5E-02	M	U
Co-57	2.4E+01	9.4E-09	2.8E+01	1.1E-08	3.7E+01	1.4E-08	7.2E+01	2.8E-08	M	WB
Co-57	5.6E+03	2.2E-06	7.2E+03	2.8E-06	1.0E+04	4.0E-06	2.4E+04	9.4E-06	M	U
Co-58	3.4E+01	4.7E-08	4.4E+01	6.1E-08	7.1E+01	1.0E-07	2.6E+02	3.7E-07	M	WB
Co-58	7.8E+03	1.1E-05	1.1E+04	1.6E-05	2.0E+04	2.8E-05	8.8E+04	1.2E-04	M	U
Co-60	2.2E+01	1.6E-07	2.5E+01	1.8E-07	3.0E+01	2.2E-07	4.9E+01	3.4E-07	M	WB
Co-60	5.1E+03	3.6E-05	6.3E+03	4.5E-05	8.4E+03	6.0E-05	1.6E+04	1.2E-04	M	U
Zn-65	5.4E+00	1.5E-08	5.9E+00	1.6E-08	6.9E+00	1.9E-08	1.0E+01	2.9E-08	S	WB
Zn-65	8.4E+03	2.4E-05	1.1E+04	3.2E-05	1.8E+04	5.1E-05	3.7E+04	1.0E-04	S	U
Rb-86	2.2E+01	2.9E-08	4.9E+01	6.4E-08	2.4E+02	3.1E-07	2.8E+04	3.7E-05	F	WB
Rb-86	1.9E+03	2.4E-06	4.2E+03	5.4E-06	2.0E+04	2.6E-05	2.4E+06	3.1E-03	F	U
Sr-85	3.5E+01	2.2E-08	4.4E+01	2.8E-08	6.7E+01	4.3E-08	2.1E+02	1.3E-07	S	WB
Sr-85	1.6E+05	1.0E-04	2.7E+05	1.8E-04	5.6E+05	3.6E-04	2.2E+06	1.4E-03	S	U
Sr-89	1.8E+05	1.0E-03	3.3E+05	1.8E-03	7.3E+05	4.1E-03	3.7E+06	2.1E-02	S	U
Sr-90	1.0E+05	7.7E-03	1.5E+05	1.1E-02	2.1E+05	1.6E-02	3.2E+05	2.5E-02	S	U
Zr-95	3.0E+01	1.1E-07	3.8E+01	1.4E-07	5.9E+01	2.1E-07	1.8E+02	6.6E-07	M	WB
Zr-95	1.8E+04	6.3E-05	2.7E+04	9.8E-05	5.1E+04	1.8E-04	2.5E+05	8.9E-04	M	U
Ru-106	2.0E+01	3.4E-07	2.4E+01	4.0E-07	3.0E+01	5.1E-07	5.2E+01	8.8E-07	M	WB
Ru-106	4.6E+03	7.9E-05	6.1E+03	1.0E-04	9.3E+03	1.6E-04	2.3E+04	4.0E-04	M	U
Ag-110m	1.7E+01	1.0E-07	2.0E+01	1.2E-07	2.8E+01	1.6E-07	6.2E+01	3.7E-07	M	WB
Ag-110m	6.0E+04	3.5E-04	7.1E+04	4.2E-04	1.0E+05	5.9E-04	2.6E+05	1.6E-03	M	U

Table 1.b. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 45-180 days – Inhalation case (Cont.)

Nuclide	MONDAL (d)								Chem Sample	
	45		60		90		180			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
Sb-124	4.4E+01	2.1E-07	6.0E+01	2.8E-07	1.0E+02	4.9E-07	4.9E+02	2.3E-06	M	WB
Sb-124	1.2E+04	5.4E-05	1.6E+04	7.7E-05	3.0E+04	1.4E-04	1.5E+05	7.0E-04	M	U
Sb-125	2.7E+01	8.9E-08	3.1E+01	1.0E-07	4.0E+01	1.3E-07	7.0E+01	2.3E-07	M	WB
Sb-125	7.1E+03	2.3E-05	8.5E+03	2.8E-05	1.1E+04	3.7E-05	2.1E+04	7.0E-05	M	U
I-125	1.6E+01	1.2E-07	2.1E+01	1.5E-07	3.6E+01	2.6E-07	1.8E+02	1.3E-06	F	Th
I-125	3.3E+03	2.4E-05	4.0E+03	3.0E-05	6.7E+03	4.9E-05	3.3E+04	2.4E-04	F	U
I-129	9.6E+00	4.9E-07	1.1E+01	5.4E-07	1.3E+01	6.5E-07	2.3E+01	1.2E-06	F	Th
I-129	1.9E+03	9.9E-05	2.0E+03	1.0E-04	2.4E+03	1.2E-04	4.1E+03	2.1E-04	F	U
I-131	4.7E+02	5.1E-06	1.9E+03	2.1E-05	3.0E+04	3.3E-04	1.2E+08	1.4E+00	F	Th
I-131	9.4E+04	1.0E-03	3.6E+05	3.9E-03	5.5E+06	6.1E-02	2.3E+10	2.5E+02	F	U
Cs-134	3.2E+00	3.1E-08	3.6E+00	3.4E-08	4.4E+00	4.2E-08	8.5E+00	8.1E-08	F	WB
Cs-134	6.3E+02	6.1E-06	7.0E+02	6.8E-06	8.8E+02	8.4E-06	1.7E+03	1.6E-05	F	U
Cs-137	3.1E+00	2.1E-08	3.4E+00	2.3E-08	4.1E+00	2.7E-08	7.2E+00	4.9E-08	F	WB
Cs-137	6.1E+02	4.1E-06	6.7E+02	4.5E-06	8.1E+02	5.4E-06	1.4E+03	9.6E-06	F	U
Ba-140	4.0E+02	6.5E-07	9.9E+02	1.6E-06	5.8E+03	9.3E-06	1.0E+06	1.6E-03	F	WB
Ba-140	7.2E+05	1.2E-03	1.9E+06	3.1E-03	1.4E+07	2.2E-02	4.7E+09	7.5E+00	F	U
Ce-141	3.7E+01	1.0E-07	5.3E+01	1.4E-07	1.0E+02	2.8E-07	7.5E+02	2.0E-06	M	WB
Ce-141	3.5E+06	9.5E-03	4.6E+06	1.2E-02	7.9E+06	2.1E-02	4.7E+07	1.3E-01	M	U
Ce-144	1.6E+01	3.6E-07	1.7E+01	3.9E-07	1.9E+01	4.4E-07	2.5E+01	5.8E-07	M	WB
Ce-144	1.5E+06	3.4E-02	1.5E+06	3.4E-02	1.5E+06	3.3E-02	1.6E+06	3.6E-02	M	U
Hg-203	3.4E+01	6.4E-08	4.9E+01	9.2E-08	9.8E+01	1.9E-07	6.8E+02	1.3E-06	M	WB
Hg-203	1.0E+04	1.9E-05	1.5E+04	2.8E-05	3.1E+04	5.9E-05	2.7E+05	5.1E-04	M	U
Ra-226	2.3E+01	5.0E-05	2.6E+01	5.8E-05	3.3E+01	7.4E-05	5.7E+01	1.3E-04	M	WB
Ra-226	1.3E+05	2.9E-01	1.6E+05	3.5E-01	2.2E+05	4.9E-01	4.9E+05	1.1E+00	M	U
Ra-228	2.3E+01	3.9E-05	2.7E+01	4.6E-05	3.4E+01	5.9E-05	6.0E+01	1.0E-04	M	WB
Ra-228	1.3E+05	2.3E-01	1.6E+05	2.7E-01	2.3E+05	3.9E-01	5.2E+05	8.9E-01	M	U
Th-228	1.5E+01	3.4E-04	1.6E+01	3.6E-04	1.8E+01	3.9E-04	2.0E+01	4.5E-04	M	Lu
Th-228	4.7E+04	1.0E+00	6.1E+04	1.3E+00	8.8E+04	1.9E+00	1.7E+05	3.8E+00	M	U

Table 1.b. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 45-180 days – Inhalation case (Cont.)

Nuclide	MONDAL (d)								Chem Sample	
	45		60		90		180			
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
Th-232	1.5E+01	4.3E-04	1.5E+01	4.5E-04	1.6E+01	4.7E-04	1.7E+01	5.0E-04	M	Lu
Th-232	4.5E+04	1.3E+00	5.7E+04	1.7E+00	8.1E+04	2.3E+00	1.4E+05	4.2E+00	M	U
U-234	3.1E+01	6.5E-05	3.6E+01	7.5E-05	4.6E+01	9.6E-05	8.4E+01	1.8E-04	M	Lu
U-234	5.0E+03	1.0E-02	6.0E+03	1.3E-02	8.1E+03	1.7E-02	1.5E+04	3.2E-02	M	U
U-235	3.1E+01	5.5E-05	3.6E+01	6.4E-05	4.6E+01	8.3E-05	8.4E+01	1.5E-04	M	Lu
U-235	5.0E+03	8.9E-03	6.0E+03	1.1E-02	8.1E+03	1.5E-02	1.5E+04	2.8E-02	M	U
U-238	3.1E+01	4.9E-05	3.6E+01	5.7E-05	4.6E+01	7.3E-05	8.4E+01	1.3E-04	M	Lu
U-238	5.0E+03	7.9E-03	6.0E+03	9.6E-03	8.1E+03	1.3E-02	1.5E+04	2.5E-02	M	U
Np-237	3.1E+01	4.6E-04	3.6E+01	5.3E-04	4.6E+01	6.9E-04	8.4E+01	1.3E-03	M	Lu
Np-237	1.5E+04	2.3E-01	1.8E+04	2.7E-01	2.3E+04	3.4E-01	3.7E+04	5.6E-01	M	U
Pu-238	3.1E+01	9.2E-04	3.6E+01	1.1E-03	4.6E+01	1.4E-03	8.4E+01	2.5E-03	M	Lu
Pu-238	1.1E+05	3.4E+00	1.2E+05	3.7E+00	1.4E+05	4.2E+00	1.9E+05	5.6E+00	M	U
Pu-239	3.1E+01	9.8E-04	3.6E+01	1.1E-03	4.6E+01	1.5E-03	8.4E+01	2.7E-03	M	Lu
Pu-239	1.1E+05	3.7E+00	1.2E+05	4.0E+00	1.4E+05	4.5E+00	1.9E+05	6.0E+00	M	U
Pu-240	3.1E+01	9.8E-04	3.6E+01	1.1E-03	4.6E+01	1.5E-03	8.4E+01	2.7E-03	M	Lu
Pu-240	1.1E+05	3.7E+00	1.2E+05	4.0E+00	1.4E+05	4.5E+00	1.9E+05	6.0E+00	M	U
Am-241	3.1E+01	8.3E-04	3.6E+01	9.6E-04	4.6E+01	1.2E-03	8.4E+01	2.3E-03	M	Lu
Am-241	4.7E+04	1.3E+00	5.3E+04	1.4E+00	6.4E+04	1.7E+00	9.1E+04	2.5E+00	M	U
Cm-242	3.7E+01	1.4E-04	4.6E+01	1.7E-04	6.7E+01	2.5E-04	1.8E+02	6.7E-04	M	Lu
Cm-242	5.7E+04	2.1E-01	6.9E+04	2.6E-01	9.3E+04	3.5E-01	2.0E+05	7.3E-01	M	U
Cm-244	3.1E+01	5.2E-04	3.6E+01	6.1E-04	4.6E+01	7.9E-04	8.5E+01	1.5E-03	M	Lu
Cm-244	4.7E+04	8.0E-01	5.4E+04	9.1E-01	6.5E+04	1.1E+00	9.3E+04	1.6E+00	M	U
Cf-252	3.2E+01	4.1E-04	3.7E+01	4.8E-04	4.9E+01	6.3E-04	9.5E+01	1.2E-03	M	Lu
Cf-252	1.1E+05	1.5E+00	1.3E+05	1.7E+00	1.6E+05	2.1E+00	2.7E+05	3.5E+00	M	U

Table 2. The retained or excreted activity values given in the ICRP Publications No 54 and 78 corresponding to 1 Bq single intake – Inhalation case (Cont.)

Nuclide	ICRP (d)										Chem	Sample	Model	
	1	2	5	10	15	30	45	60	90	180				
Sb-124	5.6E-01	4.2E-01	1.9E-01	1.5E-01	1.2E-01	7.8E-02	5.4E-02					M	WB	54
Sb-124	no data											M	U	
Sb-125	5.7E-01	4.3E-01	2.1E-01	1.7E-01	1.4E-01	1.1E-01	8.8E-02	7.3E-02				M	WB	54
Sb-125	no data											M	U	
I-125	1.3E-01	1.4E-01	1.3E-01	1.2E-01	1.1E-01	8.1E-02	6.2E-02	4.7E-02				F	Th	78
I-125	3.0E-01	2.7E-02	1.3E-04	2.4E-04	3.0E-04	3.5E-04	3.1E-04	2.5E-04				F	U	78
I-129	1.3E-01	1.4E-01	1.4E-01	1.3E-01	1.3E-01	1.1E-01	1.0E-01	9.4E-02	7.8E-02	4.4E-02		F	Th	78
I-129	3.1E-01	2.7E-02	1.4E-04	2.6E-04	3.6E-04	4.9E-04	5.1E-04	4.9E-04	4.2E-04	2.4E-04		F	U	78
I-131	1.2E-01	1.2E-01	9.0E-02	5.6E-02	3.5E-02							F	Th	78
I-131	2.8E-01	2.3E-02	8.9E-05	1.1E-04	9.8E-05							F	U	78
Cs-134	6.0E-01	5.0E-01	4.3E-01	4.1E-01	3.9E-01	3.5E-01	3.1E-01	2.8E-01	2.3E-01			F	WB	78
Cs-134	7.9E-03	1.1E-02	5.4E-03	2.6E-03	2.1E-03	1.8E-03	1.6E-03	1.4E-03	1.1E-03			F	U	78
Cs-137	6.0E-01	5.0E-01	4.3E-01	4.1E-01	3.9E-01	3.6E-01	3.3E-01	3.0E-01	2.4E-01	1.4E-01		F	WB	78
Cs-137	7.9E-03	1.1E-02	5.4E-03	2.6E-03	2.1E-03	1.8E-03	1.6E-03	1.5E-03	1.2E-03	7.0E-04		F	U	78
Ba-140	no data												WB	
Ba-140	no data												U	
Ce-141	5.8E-01	4.3E-01	2.2E-01	1.8E-01	1.5E-01	9.6E-02	6.8E-02	4.5E-02	2.2E-02			W	WB	54
Ce-141	1.4E-06	1.3E-06	1.3E-06	1.2E-06	1.1E-06	8.5E-07	6.8E-07	5.2E-07	2.9E-07			W	U	54
Ce-144	5.9E-01	4.5E-01	2.4E-01	2.2E-01	2.0E-01	1.7E-01	1.6E-01	1.4E-01	1.2E-01	8.1E-02		W	WB	54
Ce-144	1.4E-06	1.4E-06	1.4E-06	1.4E-06	1.5E-06	1.5E-06	1.6E-06	1.6E-06	1.6E-06	1.4E-06		W	U	54
Hg-203	5.8E-01	4.4E-01	2.3E-01	1.9E-01	1.6E-01	1.0E-01						W	WB	54
Hg-203	no data												U	
Ra-226	5.0E-01	2.7E-01	9.3E-02	6.8E-02	6.2E-02	5.1E-02	4.4E-02	3.8E-02	3.0E-02	1.8E-02		M	WB	78
Ra-226	1.6E-03	3.1E-04	1.1E-04	2.7E-05	1.4E-05	9.5E-06	7.7E-06	6.3E-06	4.5E-06	2.0E-06		M	U	78
Ra-228	5.0E-01	2.7E-01	9.3E-02	6.7E-02	6.1E-02	5.1E-02	4.3E-02	3.7E-02	2.9E-02	1.7E-02		M	WB	78
Ra-228	1.6E-03	3.1E-04	1.1E-04	2.7E-05	1.4E-05	9.4E-06	7.5E-06	6.2E-06	4.4E-06	1.9E-06		M	U	78
Th-228	5.0E-01	2.6E-01	9.2E-02	7.9E-02	7.6E-02	6.9E-02	6.5E-02	6.1E-02	5.7E-02	4.9E-02		M	WB	78
Th-228	1.1E-03	2.3E-04	9.6E-05	5.7E-05	4.4E-05	2.9E-05	2.1E-05	1.6E-05	1.1E-05	5.8E-06		M	U	78

Table 2. The retained or excreted activity values given in the ICRP Publications No 54 and 78 corresponding to 1 Bq single intake – Inhalation case (Cont.)

Nuclide	ICRP (d)										Chem	Sample	Model
	1	2	5	10	15	30	45	60	90	180			
Th-232	5.0E-01	2.6E-01	9.2E-02	8.0E-02	7.7E-02	7.1E-02	6.8E-02	6.5E-02	6.2E-02	5.8E-02	M	WB	78
Th-232	1.1E-03	2.3E-04	9.7E-05	5.8E-05	4.5E-05	3.0E-05	2.2E-05	1.7E-05	1.2E-05	7.0E-06	M	U	78
U-234	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
U-234	2.3E-02	1.1E-03	7.3E-04	5.4E-04	4.3E-04	2.7E-04	2.0E-04	1.7E-04	1.2E-04	6.5E-05	M	U	78
U-235	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
U-235	2.3E-02	1.1E-03	7.3E-04	5.4E-04	4.3E-04	2.7E-04	2.0E-04	1.7E-04	1.2E-04	6.5E-05	M	U	78
U-238	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
U-238	2.3E-02	1.1E-03	7.3E-04	5.4E-04	4.3E-04	2.7E-04	2.0E-04	1.7E-04	1.2E-04	6.5E-05	M	U	78
Np-237	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Np-237	6.2E-03	1.3E-03	3.4E-04	1.3E-04	9.8E-05	7.7E-05	6.5E-05	5.6E-05	4.4E-05	2.7E-05	M	U	78
Pu-238	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Pu-238	2.3E-04	1.3E-04	3.9E-05	1.5E-05	1.1E-05	9.5E-06	8.7E-06	8.1E-06	7.1E-06	5.4E-06	M	U	78
Pu-239	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Pu-239	2.3E-04	1.3E-04	3.9E-05	1.5E-05	1.1E-05	9.5E-06	8.7E-06	8.1E-06	7.1E-06	5.4E-06	M	U	78
Pu-240	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Pu-240	2.3E-04	1.3E-04	3.9E-05	1.5E-05	1.1E-05	9.5E-06	8.7E-06	8.1E-06	7.1E-06	5.4E-06	M	U	78
Am-241	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Am-241	1.8E-03	2.3E-04	7.2E-05	4.9E-05	3.9E-05	2.6E-05	2.1E-05	1.9E-05	1.6E-05	1.1E-05	M	U	78
Cm-242	5.7E-02	5.5E-02	5.2E-02	4.8E-02	4.3E-02	3.4E-02	2.7E-02	2.2E-02	1.5E-02		M	Lu	78
Cm-242	1.8E-03	2.3E-04	7.0E-05	4.7E-05	3.7E-05	2.3E-05	1.8E-05	1.5E-05	1.1E-05		M	U	78
Cm-244	5.8E-02	5.6E-02	5.3E-02	5.0E-02	4.6E-02	3.8E-02	3.3E-02	2.8E-02	2.2E-02	1.2E-02	M	Lu	78
Cm-244	1.8E-03	2.3E-04	7.2E-05	4.9E-05	3.9E-05	2.6E-05	2.1E-05	1.9E-05	1.6E-05	1.1E-05	M	U	78
Cf-252	5.8E-02	5.6E-02	5.3E-02	4.9E-02	4.6E-02	3.8E-02	3.2E-02	2.7E-02	2.0E-02	1.0E-02	M	Lu	78
Cf-252	1.3E-03	1.2E-04	1.4E-05	1.3E-05	1.2E-05	1.0E-05	8.8E-06	7.7E-06	6.1E-06	3.7E-06	M	U	78

Table 3. The relative differences of the results of calculations by MONDAL given as percentages of retained or excreted activity values of the ICRP Publications No 54 and 78 – Inhalation case (Cont.)

Nuclide	Relative difference (%)										Chem.	Sample	Model
	1d	2d	5d	10d	15d	30d	45d	60d	90d	180d			
Sb-124	-15.0	-40.5	-59.5	-63.0	-60.3	-59.9	-57.9				W	WB	54
Sb-124	no data											U	
Sb-125	-12.3	-40.4	-60.3	-63.2	-60.3	-60.5	-57.9	-55.8			W	WB	54
Sb-125	no data											U	
I-125	1.2	-0.8	-0.1	-2.0	-2.2	2.9	0.8	1.3			F	Th	78
I-125	1.0	0.1	-0.1	-3.1	1.0	-1.5	-2.2	0.0			F	U	78
I-129	2.6	0.6	-0.8	2.6	-1.4	4.5	4.2	-3.3	-1.4	-1.2	F	Th	78
I-129	-2.2	2.9	-2.2	1.2	-0.8	2.0	3.2	2.0	-0.8	1.6	F	U	78
I-131	1.6	-0.8	1.0	-0.8	2.0						F	Th	78
I-131	-0.8	1.1	2.1	1.0	2.0						F	U	78
Cs-134	-2.0	0.0	1.1	-2.4	-1.4	-1.5	0.8	-0.8	-1.2		F	WB	78
Cs-134	-2.6	-0.1	2.9	1.2	-2.8	-2.5	-0.8	2.0	3.3		F	U	78
Cs-137	-2.0	0.0	1.1	1.6	2.6	-0.8	-2.2	-2.0	1.6	-0.8	F	WB	78
Cs-137	-2.6	1.0	2.9	1.2	-0.8	1.0	2.5	-0.5	2.9	2.0	F	U	78
Ba-140	no data											WB	
Ba-140	no data											U	
Ce-141	-17.8	-42.3	-61.8	-63.4	-61.0	-60.1	-60.5	-58.2	-54.4		W	WB	54
Ce-141	-76.5	-61.0	-58.7	-56.9	-59.8	-56.5	-58.2	-57.8	-56.7		W	U	54
Ce-144	-15.3	-41.5	-62.1	-65.0	-61.5	-58.0	-60.9	-58.0	-56.1	-50.6	W	WB	54
Ce-144	-77.0	-60.3	-58.0	-58.0	-58.3	-58.3	-58.3	-58.3	-58.3	-55.4	W	U	54
Hg-203	-13.8	-40.2	-60.5	-62.4	-60.9	-56.5					W	WB	54
Hg-203	no data											U	
Ra-226	0.0	0.1	-2.2	-2.0	0.8	-2.0	-1.2	1.2	1.0	-2.5	M	WB	78
Ra-226	-0.8	0.8	-4.3	0.1	0.6	-4.3	-0.1	-0.8	1.0	2.0	M	U	78
Ra-228	0.0	0.1	-2.2	-0.5	2.5	-2.0	1.1	0.1	1.4	-2.0	M	WB	78
Ra-228	-0.8	0.8	-4.3	0.1	0.6	-3.3	2.6	0.8	-1.2	1.2	M	U	78
Th-228	0.0	1.2	-1.2	-2.6	1.2	3.5	2.6	2.5	-2.5	2.0	M	WB	78
Th-228	-2.2	-1.2	4.2	3.2	-1.2	-1.5	1.3	2.5	3.3	1.4	M	U	78

Table 3. The relative differences of the results of calculations by MONDAL given as percentages of retained or excreted activity values of the ICRP Publications No 54 and 78 – Inhalation case (Cont.)

Nuclide	Relative difference (%)										Chem.	Sample	Model
	1d	2d	5d	10d	15d	30d	45d	60d	90d	180d			
Th-232	0.0	1.2	-1.2	-3.8	-0.1	0.6	-2.0	2.6	0.8	1.4	M	WB	78
Th-232	-2.2	-1.2	3.1	1.4	1.0	-2.0	1.0	3.2	2.9	2.0	M	U	78
U-234	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
U-234	1.1	2.1	-2.2	2.9	1.1	-2.5	0.0	-2.0	2.9	2.6	M	U	78
U-235	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
U-235	1.1	2.1	-2.2	2.9	1.1	-2.5	0.0	-2.0	2.9	2.6	M	U	78
U-238	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
U-238	1.1	2.1	-2.2	2.9	1.1	-2.5	0.0	-2.0	2.9	2.6	M	U	78
Np-237	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
Np-237	0.8	2.6	1.4	-1.4	2.0	-0.1	2.6	-0.8	-1.2	0.1	M	U	78
Pu-238	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
Pu-238	1.1	1.2	-1.4	2.6	2.1	-4.3	4.5	2.9	0.6	-2.5	M	U	78
Pu-239	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
Pu-239	1.1	1.2	-1.4	2.6	2.1	-4.3	4.5	2.9	0.6	-2.5	M	U	78
Pu-240	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
Pu-240	1.1	1.2	-1.4	2.6	2.1	-4.3	4.5	2.9	0.6	-2.5	M	U	78
Am-241	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-0.8	M	Lu	78
Am-241	-0.8	1.1	-0.8	-2.8	-1.4	1.2	1.3	-0.7	-2.3	-0.1	M	U	78
Cm-242	3.2	1.0	1.2	-0.8	1.1	-2.0	0.1	-1.2	-0.5		M	Lu	78
Cm-242	-0.8	1.1	2.0	-3.3	0.1	1.1	-2.5	-3.4	-2.2		M	U	78
Cm-244	1.4	-0.8	-0.7	0.0	-1.2	1.2	-2.2	-0.8	-1.2	-2.0	M	Lu	78
Cm-244	-0.8	1.1	-0.8	-2.8	-1.4	1.2	1.3	-2.5	-3.8	-2.2	M	U	78
Cf-252	1.4	-0.8	-0.7	2.0	-1.2	-2.5	-2.3	0.1	2.0	5.3	M	Lu	78
Cf-252	-0.1	4.2	2.0	1.2	2.9	3.1	3.3	-0.1	2.5	0.1	M	U	78

Table 4. The inhalation dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards

Nuclide	MONDAL										IBSS	Relative difference (%)	Chem.	Sample	
	1d	2d	5d	10d	15d	30d	45d	90d	180d	average					
H-3	1.8E-11	1.8E-11	1.8E-11	1.8E-11	1.8E-11	1.9E-11	1.9E-11	1.8E-11	1.8E-11	1.8E-11	1.8E-11	1.8E-11	1.1	HTO	U
P-32	2.9E-09	3.0E-09	3.0E-09	2.9E-09	2.9E-09	3.0E-09	3.0E-09	2.9E-09	2.9E-09	2.9E-09	2.9E-09	2.9E-09	0.8	M	U
Cr-51	3.3E-11	3.3E-11	3.3E-11	3.4E-11	3.4E-11	3.3E-11	3.3E-11	3.4E-11	3.4E-11	3.3E-11	3.4E-11	3.4E-11	-1.7	M	WB
Cr-51	3.5E-11	3.4E-11	3.4E-11	3.3E-11	3.3E-11	3.5E-11	3.5E-11	3.3E-11	3.3E-11	3.4E-11	3.4E-11	3.4E-11	0.4	M	U
Mn-54	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.3E-09	1.3E-09	1.2E-09	1.2E-09	1.2E-09	-0.2	M	WB
Mn-54	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	1.2E-09	-0.3	M	U
Fe-59	3.2E-09	3.1E-09	3.1E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.1E-09	3.1E-09	3.1E-09	3.2E-09	3.2E-09	-2.2	M	WB
Fe-59	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	0.1	M	U
Co-57	3.9E-10	3.8E-10	3.8E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	3.9E-10	-0.9	M	WB
Co-57	3.9E-10	3.9E-10	3.9E-10	3.8E-10	3.8E-10	4.0E-10	4.0E-10	3.8E-10	3.8E-10	3.9E-10	3.9E-10	3.9E-10	-0.2	M	U
Co-58	1.4E-09	1.4E-09	1.4E-09	1.3E-09	1.3E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	-1.5	M	WB
Co-58	1.4E-09	1.5E-09	1.5E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	1.4E-09	2.2	M	U
Co-60	7.1E-09	7.2E-09	7.2E-09	7.1E-09	7.1E-09	7.1E-09	7.1E-09	7.3E-09	7.3E-09	7.1E-09	7.1E-09	7.1E-09	0.7	M	WB
Co-60	7.1E-09	7.1E-09	7.1E-09	7.0E-09	7.0E-09	7.1E-09	7.1E-09	7.3E-09	7.3E-09	7.1E-09	7.1E-09	7.1E-09	-0.6	M	U
Zn-65	2.7E-09	2.8E-09	2.8E-09	2.7E-09	2.7E-09	2.8E-09	2.8E-09	2.9E-09	2.9E-09	2.8E-09	2.8E-09	2.8E-09	-0.6	S	WB
Zn-65	2.7E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.9E-09	2.9E-09	2.8E-09	2.8E-09	2.8E-09	-0.2	S	U
Rb-86	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	-0.7	F	WB
Rb-86	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	1.3E-09	-1.3	F	U
Sr-85	6.2E-10	6.3E-10	6.3E-10	6.5E-10	6.5E-10	6.7E-10	6.7E-10	6.5E-10	6.5E-10	6.3E-10	6.4E-10	6.4E-10	-0.9	S	WB
Sr-85	6.2E-10	6.3E-10	6.3E-10	6.4E-10	6.4E-10	6.7E-10	6.7E-10	6.3E-10	6.3E-10	6.3E-10	6.4E-10	6.4E-10	-1.4	S	U
Sr-89	5.4E-09	5.7E-09	5.7E-09	5.5E-09	5.5E-09	5.8E-09	5.8E-09	5.5E-09	5.5E-09	5.6E-09	5.6E-09	5.6E-09	-0.6	S	U
Sr-90	7.9E-08	7.6E-08	7.6E-08	7.7E-08	7.7E-08	7.6E-08	7.6E-08	7.6E-08	7.6E-08	7.7E-08	7.7E-08	7.7E-08	-0.2	S	U
Zr-95	3.7E-09	3.6E-09	3.6E-09	3.5E-09	3.5E-09	3.7E-09	3.7E-09	3.6E-09	3.6E-09	3.6E-09	3.6E-09	3.6E-09	-0.5	M	WB
Zr-95	3.7E-09	3.6E-09	3.6E-09	3.5E-09	3.5E-09	3.6E-09	3.6E-09	3.5E-09	3.5E-09	3.6E-09	3.6E-09	3.6E-09	-0.4	M	U
Ru-106	1.7E-08	1.7E-08	1.7E-08	1.7E-08	1.7E-08	1.8E-08	1.8E-08	1.6E-08	1.6E-08	1.7E-08	1.7E-08	1.7E-08	-0.5	M	WB
Ru-106	1.7E-08	1.7E-08	1.7E-08	1.6E-08	1.6E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.7E-08	1.7E-08	1.7E-08	-0.8	M	U
Ag-110m	6.0E-09	6.1E-09	6.1E-09	5.9E-09	5.9E-09	5.9E-09	5.9E-09	5.8E-09	5.8E-09	6.0E-09	5.9E-09	5.9E-09	2.3	M	WB
Ag-110m	5.9E-09	5.8E-09	5.8E-09	5.9E-09	5.9E-09	5.8E-09	5.8E-09	6.1E-09	6.1E-09	5.9E-09	5.9E-09	5.9E-09	-0.8	M	U

Table 4. The inhalation dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards (Cont.)

Nuclide	MONDAL										IBSS	Relative difference (%)	Chem.	Sample
	1d	2d	5d	10d	15d	30d	45d	90d	180d	average				
Sb-124	4.6E-09	4.8E-09	4.8E-09	4.7E-09	4.7E-09	4.7E-09	4.7E-09	4.8E-09	4.8E-09	4.7E-09	4.7E-09	0.1	M	WB
Sb-124	4.7E-09	4.8E-09	4.8E-09	4.7E-09	4.7E-09	4.7E-09	4.7E-09	4.8E-09	4.8E-09	4.7E-09	4.7E-09	0.6	M	U
Sb-125	3.4E-09	3.3E-09	3.3E-09	3.4E-09	3.4E-09	3.4E-09	3.4E-09	3.3E-09	3.3E-09	3.4E-09	3.3E-09	1.8	M	WB
Sb-125	3.2E-09	3.3E-09	3.3E-09	3.3E-09	3.3E-09	3.3E-09	3.3E-09	3.4E-09	3.4E-09	3.3E-09	3.3E-09	0.3	M	U
I-125	7.2E-09	7.4E-09	7.4E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	0.1	F	Th
I-125	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	7.2E-09	7.2E-09	7.3E-09	7.3E-09	7.3E-09	7.3E-09	-0.2	F	U
I-129	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	5.1E-08	-0.3	F	Th
I-129	5.2E-08	5.3E-08	5.3E-08	5.1E-08	5.1E-08	5.0E-08	5.0E-08	5.0E-08	5.0E-08	5.2E-08	5.1E-08	1.8	F	U
I-131	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	-0.5	F	Th
I-131	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	1.1E-08	0.2	F	U
Cs-134	9.4E-09	9.5E-09	9.5E-09	9.6E-09	9.6E-09	9.6E-09	9.6E-09	9.6E-09	9.6E-09	9.5E-09	9.6E-09	-1.1	F	WB
Cs-134	9.2E-09	9.6E-09	9.6E-09	1.0E-08	1.0E-08	9.7E-09	9.7E-09	9.6E-09	9.6E-09	9.6E-09	9.6E-09	-0.1	F	U
Cs-137	6.5E-09	6.5E-09	6.5E-09	6.5E-09	6.5E-09	6.7E-09	6.7E-09	6.8E-09	6.8E-09	6.5E-09	6.7E-09	-3.0	F	WB
Cs-137	6.5E-09	6.7E-09	6.7E-09	6.7E-09	6.7E-09	6.6E-09	6.6E-09	6.7E-09	6.7E-09	6.6E-09	6.7E-09	-1.0	F	U
Ba-140	1.5E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	0.3	F	WB
Ba-140	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	1.6E-09	-0.3	F	U
Ce-141	2.6E-09	2.8E-09	2.8E-09	2.7E-09	2.7E-09	2.7E-09	2.7E-09	2.8E-09	2.8E-09	2.7E-09	2.7E-09	-0.1	M	WB
Ce-141	2.7E-09	2.7E-09	2.7E-09	2.7E-09	2.7E-09	2.8E-09	2.8E-09	2.7E-09	2.7E-09	2.7E-09	2.7E-09	0.4	M	U
Ce-144	2.3E-08	2.3E-08	2.3E-08	2.3E-08	2.3E-08	2.2E-08	2.2E-08	2.3E-08	2.3E-08	2.3E-08	2.3E-08	-0.5	M	WB
Ce-144	2.3E-08	2.3E-08	2.3E-08	2.4E-08	2.4E-08	2.3E-08	2.3E-08	2.4E-08	2.4E-08	2.3E-08	2.3E-08	1.2	M	U
Hg-203	2.0E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.3	M	WB
Hg-203	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	1.9E-09	0.0	M	U
Ra-226	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.3E-06	2.3E-06	2.2E-06	2.2E-06	-0.5	M	WB
Ra-226	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.3E-06	2.3E-06	2.2E-06	2.2E-06	0.8	M	U
Ra-228	1.7E-06	1.7E-06	1.7E-06	1.6E-06	1.6E-06	1.7E-06	1.7E-06	1.8E-06	1.8E-06	1.7E-06	1.7E-06	-1.7	M	WB
Ra-228	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.0	M	U
Th-228	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.3E-05	-4.3	M	WB
Th-228	2.3E-05	2.2E-05	2.2E-05	2.3E-05	2.3E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.2E-05	2.3E-05	-3.0	M	U

Table 4. The inhalation dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards (Cont.)

Nuclide	MONDAL										IBSS	Relative difference (%)	Chem.	Sample	
	1d	2d	5d	10d	15d	30d	45d	90d	180d	average					
Th-232	2.9E-05	2.9E-05	2.9E-05	2.8E-05	2.8E-05	2.8E-05	2.8E-05	2.9E-05	2.9E-05	2.9E-05	2.9E-05	2.9E-05	-0.8	M	WB
Th-232	2.9E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	2.9E-05	2.9E-05	3.0E-05	3.0E-05	3.0E-05	2.9E-05	2.9E-05	1.8	M	U
U-234	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.0E-06	2.0E-06	2.1E-06	2.1E-06	2.1E-06	-0.1	M	Lu
U-234	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.2E-06	2.2E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06	0.7	M	U
U-235	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	-0.4	M	Lu
U-235	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	-0.1	M	U
U-238	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.5E-06	1.5E-06	1.6E-06	1.6E-06	1.6E-06	0.8	M	Lu
U-238	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	1.6E-06	-1.2	M	U
Np-237	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	0.1	M	Lu
Np-237	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	-0.8	M	U
Pu-238	3.1E-05	3.0E-05	3.0E-05	2.9E-05	2.9E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	0.1	M	Lu
Pu-238	3.0E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	2.9E-05	2.9E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	3.0E-05	0.3	M	U
Pu-239	3.3E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.1E-05	3.1E-05	3.2E-05	3.2E-05	3.2E-05	-0.1	M	Lu
Pu-239	3.3E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.3E-05	3.3E-05	3.2E-05	3.2E-05	3.2E-05	-0.6	M	U
Pu-240	3.3E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.1E-05	3.1E-05	3.2E-05	3.2E-05	3.2E-05	-0.1	M	Lu
Pu-240	3.3E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.3E-05	3.3E-05	3.2E-05	3.2E-05	3.2E-05	-0.6	M	U
Am-241	2.8E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.6E-05	2.6E-05	2.7E-05	2.7E-05	2.7E-05	-0.2	M	Lu
Am-241	2.7E-05	2.8E-05	2.8E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	2.7E-05	1.6	M	U
Cm-242	3.8E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	1.0	M	Lu
Cm-242	3.8E-06	3.7E-06	3.7E-06	3.8E-06	3.8E-06	3.6E-06	3.6E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06	1.2	M	U
Cm-244	1.8E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	-0.3	M	Lu
Cm-244	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	0.4	M	U
Cf-252	1.4E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	-0.5	M	Lu
Cf-252	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.2E-05	1.2E-05	1.3E-05	1.3E-05	1.3E-05	-1.7	M	U

Table 5. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 1-10 days – Ingestion case

Nuclide	MONDAL (d)								f ₁	Sample
	1 I(Bq)	E(Sv)	2 I(Bq)	E(Sv)	5 I(Bq)	E(Sv)	10 I(Bq)	E(Sv)		
H-3	4.7E+01	8.4E-10	5.0E+01	9.0E-10	6.1E+01	1.1E-09	8.6E+01	1.6E-09	1(HTO)	U
P-32	1.2E+01	2.8E-08	1.9E+01	4.7E-08	6.2E+01	1.5E-07	1.7E+02	4.0E-07	0.8	U
Cr-51	1.4E+00	5.4E-11	2.9E+00	1.1E-10	1.5E+01	5.8E-10	2.9E+01	1.1E-09	0.1	WB
Cr-51	1.0E+02	3.9E-09	1.8E+02	6.7E-09	6.6E+02	2.5E-08	1.3E+03	5.0E-08	0.1	U
Mn-54	1.4E+00	9.6E-10	2.6E+00	1.8E-09	1.0E+01	7.3E-09	1.5E+01	1.1E-08	0.1	WB
Mn-54	7.8E+02	5.5E-07	3.8E+02	2.7E-07	5.3E+02	3.8E-07	9.4E+02	6.7E-07	0.1	U
Fe-59	1.4E+00	2.5E-09	2.6E+00	4.7E-09	9.3E+00	1.7E-08	1.2E+01	2.1E-08	0.1	WB
Fe-59	5.2E+03	9.3E-06	4.9E+04	8.9E-05	1.7E+05	3.1E-04	4.7E+05	8.4E-04	0.1	U
Co-57	1.4E+00	3.0E-10	2.9E+00	6.1E-10	1.8E+01	3.8E-09	3.4E+01	7.2E-09	0.1	WB
Co-57	3.6E+01	7.7E-09	7.0E+01	1.5E-08	4.5E+02	9.4E-08	8.5E+02	1.8E-07	0.1	U
Co-58	1.4E+00	1.1E-09	2.9E+00	2.2E-09	1.9E+01	1.4E-08	3.7E+01	2.7E-08	0.1	WB
Co-58	3.7E+01	2.7E-08	7.1E+01	5.2E-08	4.6E+02	3.4E-07	9.1E+02	6.7E-07	0.1	U
Co-60	1.4E+00	4.8E-09	2.9E+00	9.8E-09	1.8E+01	6.1E-08	3.3E+01	1.1E-07	0.1	WB
Co-60	3.6E+01	1.2E-07	7.0E+01	2.4E-07	4.4E+02	1.5E-06	8.3E+02	2.8E-06	0.1	U
Zn-65	1.2E+00	4.7E-09	1.6E+00	6.0E-09	2.1E+00	8.0E-09	2.2E+00	8.6E-09	0.5	WB
Zn-65	2.2E+03	8.6E-06	1.1E+03	4.4E-06	1.2E+03	4.6E-06	1.4E+03	5.4E-06	0.5	U
Rb-86	1.0E+00	2.9E-09	1.1E+00	3.1E-09	1.3E+00	3.6E-09	1.7E+00	4.7E-09	1	WB
Rb-86	1.6E+02	4.6E-07	9.7E+01	2.7E-07	1.1E+02	3.1E-07	1.4E+02	4.0E-07	1	U
Sr-85	1.4E+00	7.8E-10	2.4E+00	1.3E-09	6.2E+00	3.5E-09	9.0E+00	5.0E-09	0.3	WB
Sr-85	1.8E+01	1.0E-08	4.7E+01	2.6E-08	1.3E+02	7.1E-08	3.0E+02	1.7E-07	0.3	U
Sr-89	1.8E+01	4.7E-08	4.7E+01	1.2E-07	1.3E+02	3.3E-07	3.1E+02	8.0E-07	0.3	U
Sr-90	1.8E+01	5.0E-07	4.5E+01	1.3E-06	1.2E+02	3.4E-06	2.7E+02	7.6E-06	0.3	U
Zr-95	1.4E+00	1.2E-09	3.1E+00	2.7E-09	5.2E+01	4.6E-08	7.2E+02	6.4E-07	0.002	WB
Zr-95	3.1E+04	2.7E-05	1.4E+04	1.3E-05	1.9E+04	1.6E-05	3.2E+04	2.8E-05	0.002	U
Ru-106	1.4E+00	9.7E-09	2.9E+00	2.0E-08	1.9E+01	1.3E-07	3.3E+01	2.3E-07	0.05	WB
Ru-106	1.9E+02	1.3E-06	4.2E+02	2.9E-06	9.2E+02	6.4E-06	1.3E+03	9.2E-06	0.05	U
Ag-110m	1.4E+00	3.9E-09	2.8E+00	7.8E-09	1.6E+01	4.4E-08	2.5E+01	6.9E-08	0.05	WB
Ag-110m	3.4E+04	9.5E-05	1.6E+04	4.5E-05	2.1E+04	6.0E-05	3.2E+04	9.0E-05	0.05	U

Table 5. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 1-10 days – Ingestion case (Cont.)

Nuclide	MONDAL (d)								f ₁	Sample
	1 I(Bq)	E(Sv)	2 I(Bq)	E(Sv)	5 I(Bq)	E(Sv)	10 I(Bq)	E(Sv)		
Sb-124	1.4E+00	3.5E-09	2.8E+00	7.0E-09	1.6E+01	3.9E-08	3.6E+01	9.0E-08	0.1	WB
Sb-124	6.1E+01	1.5E-07	1.2E+02	3.0E-07	2.4E+02	5.9E-07	5.0E+02	1.2E-06	0.1	U
Sb-125	1.4E+00	1.5E-09	2.8E+00	3.0E-09	1.5E+01	1.6E-08	3.2E+01	3.5E-08	0.1	WB
Sb-125	6.0E+01	6.6E-08	1.2E+02	1.3E-07	2.2E+02	2.5E-07	4.4E+02	4.9E-07	0.1	U
I-125	3.7E+00	5.5E-08	3.5E+00	5.3E-08	3.7E+00	5.6E-08	4.1E+00	6.1E-08	1	Th
I-125	1.6E+00	2.4E-08	1.7E+01	2.6E-07	3.7E+03	5.6E-05	2.1E+03	3.1E-05	1	U
I-129	3.6E+00	4.0E-07	3.4E+00	3.8E-07	3.5E+00	3.8E-07	3.6E+00	4.0E-07	1	Th
I-129	1.6E+00	1.7E-07	1.7E+01	1.8E-06	3.5E+03	3.9E-04	1.8E+03	2.0E-04	1	U
I-131	4.0E+00	8.7E-08	4.1E+00	9.0E-08	5.4E+00	1.2E-07	8.6E+00	1.9E-07	1	Th
I-131	1.7E+00	3.8E-08	2.0E+01	4.4E-07	5.4E+03	1.2E-04	4.3E+03	9.6E-05	1	U
Cs-134	1.0E+00	1.9E-08	1.1E+00	2.0E-08	1.1E+00	2.1E-08	1.2E+00	2.3E-08	1	WB
Cs-134	6.3E+01	1.2E-06	4.4E+01	8.3E-07	8.9E+01	1.7E-06	1.8E+02	3.5E-06	1	U
Cs-137	1.0E+00	1.3E-08	1.1E+00	1.4E-08	1.1E+00	1.5E-08	1.2E+00	1.5E-08	1	WB
Cs-137	6.3E+01	8.2E-07	4.4E+01	5.7E-07	8.8E+01	1.2E-06	1.8E+02	2.4E-06	1	U
Ba-140	1.5E+00	3.7E-09	3.2E+00	7.9E-09	3.1E+01	7.6E-08	1.2E+02	3.0E-07	0.1	WB
Ba-140	2.0E+02	4.9E-07	1.0E+03	2.6E-06	3.8E+03	9.6E-06	2.8E+04	7.1E-05	0.1	U
Ce-141	1.4E+00	1.0E-09	3.2E+00	2.3E-09	5.8E+01	4.1E-08	2.0E+03	1.4E-06	0.0005	WB
Ce-141	2.5E+08	1.8E-01	1.1E+08	7.9E-02	1.1E+08	8.0E-02	1.3E+08	8.9E-02	0.0005	U
Ce-144	1.4E+00	7.3E-09	3.1E+00	1.6E-08	5.3E+01	2.7E-07	1.6E+03	8.5E-06	0.0005	WB
Ce-144	2.5E+08	1.3E+00	1.1E+08	5.6E-01	1.0E+08	5.3E-01	1.0E+08	5.4E-01	0.0005	U
Hg-203	1.4E+00	7.6E-10	3.0E+00	1.6E-09	2.9E+01	1.6E-08	6.6E+01	3.6E-08	0.02(Inorg)	WB
Hg-203	1.5E+04	8.1E-06	6.8E+03	3.6E-06	7.0E+03	3.8E-06	8.2E+03	4.4E-06	0.02(Inorg)	U
Ra-226	1.4E+00	3.8E-07	2.6E+00	7.4E-07	1.4E+01	4.0E-06	3.4E+01	9.5E-06	0.2	WB
Ra-226	3.4E+02	9.6E-05	1.8E+03	4.9E-04	5.5E+03	1.5E-03	2.8E+04	7.9E-03	0.2	U
Ra-228	1.4E+00	9.1E-07	2.6E+00	1.8E-06	1.4E+01	9.7E-06	3.4E+01	2.3E-05	0.2	WB
Ra-228	3.4E+02	2.3E-04	1.8E+03	1.2E-03	5.5E+03	3.7E-03	2.8E+04	1.9E-02	0.2	U
Th-228	1.4E+00	1.0E-07	3.0E+00	2.2E-07	5.2E+01	3.8E-06	1.7E+03	1.2E-04	0.0005	WB
Th-228	6.0E+04	4.3E-03	1.9E+05	1.4E-02	6.7E+05	4.8E-02	1.4E+06	9.8E-02	0.0005	U

Table 5. The intake (I) and committed effective dose(E) values calculated by the MONDAL software corresponding to 1 Bq measured activity following a single intake by 1-10 days – Ingestion case (Cont.)

Nuclide	MONDAL (d)								f ₁	Sample
	1	2	5	10	1	2	5	10		
	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)	I(Bq)	E(Sv)		
Th-232	1.4E+00	3.1E-07	3.0E+00	6.7E-07	5.2E+01	1.1E-05	1.7E+03	3.7E-04	0.0005	WB
Th-232	6.0E+04	1.3E-02	1.9E+05	4.2E-02	6.7E+05	1.5E-01	1.3E+06	3.0E-01	0.0005	U
U-234	1.4E+00	6.9E-08	3.0E+00	1.5E-07	4.2E+01	2.1E-06	2.2E+02	1.1E-05	0.02	WB
U-234	7.9E+01	3.9E-06	1.4E+03	7.1E-05	3.3E+03	1.6E-04	5.2E+03	2.6E-04	0.02	U
U-235	1.4E+00	6.5E-08	3.0E+00	1.4E-07	4.2E+01	1.9E-06	2.2E+02	1.0E-05	0.02	WB
U-235	7.9E+01	3.7E-06	1.4E+03	6.7E-05	3.3E+03	1.5E-04	5.2E+03	2.4E-04	0.02	U
U-238	1.4E+00	6.2E-08	3.0E+00	1.3E-07	4.2E+01	1.8E-06	2.2E+02	9.6E-06	0.02	WB
U-238	7.9E+01	3.5E-06	1.4E+03	6.4E-05	3.3E+03	1.5E-04	5.2E+03	2.3E-04	0.02	U
Np-237	6.9E+03	7.6E-04	5.5E+03	6.0E-04	4.7E+03	5.1E-04	4.4E+03	4.9E-04	0.0005	Skel
Np-237	1.0E+04	1.1E-03	3.3E+04	3.0E-03	2.0E+05	2.2E-02	1.2E+06	1.3E-01	0.0005	U
Pu-238	1.1E+04	2.5E-03	6.6E+03	1.5E-03	4.6E+03	1.1E-03	4.1E+03	9.4E-04	0.0005	Skel
Pu-238	3.0E+05	6.8E-02	3.9E+05	8.9E-02	1.5E+06	3.6E-01	5.5E+06	1.3E+00	0.0005	U
Pu-239	1.1E+04	2.7E-03	6.6E+03	1.6E-03	4.6E+03	1.1E-03	4.1E+03	1.0E-03	0.0005	Skel
Pu-239	3.0E+05	7.4E-02	3.9E+05	9.7E-02	1.5E+06	3.9E-01	5.5E+06	1.4E+00	0.0005	U
Pu-240	1.1E+04	2.7E-03	6.6E+03	1.6E-03	4.6E+03	1.1E-03	4.1E+03	1.0E-03	0.0005	Skel
Pu-240	3.0E+05	7.4E-02	3.9E+05	9.7E-02	1.5E+06	3.9E-01	5.5E+06	1.4E+00	0.0005	U
Am-241	7.9E+03	1.6E-03	7.0E+03	1.4E-03	6.6E+03	1.3E-03	6.5E+03	1.3E-03	0.0005	Skel
Am-241	3.4E+04	6.8E-03	2.2E+05	4.4E-02	1.1E+06	2.1E-01	2.0E+06	4.1E-01	0.0005	U
Cm-242	7.9E+03	9.4E-05	7.1E+03	8.5E-05	6.8E+03	8.1E-05	6.8E+03	8.2E-05	0.0005	Skel
Cm-242	3.4E+04	4.1E-04	2.2E+05	2.6E-03	1.1E+06	1.3E-02	2.1E+06	2.6E-02	0.0005	U
Cm-244	7.9E+03	9.4E-04	7.0E+03	8.5E-04	6.6E+03	7.9E-04	6.5E+03	7.8E-04	0.0005	Skel
Cm-244	3.4E+04	4.1E-03	2.2E+05	2.6E-02	1.1E+06	1.3E-01	2.0E+06	2.4E-01	0.0005	U
Cf-252	1.4E+00	1.3E-07	3.0E+00	2.7E-07	5.2E+01	4.7E-06	1.7E+03	1.6E-04	0.0005	WB
Cf-252	4.8E+04	4.3E-03	2.6E+05	2.3E-02	7.7E+07	6.9E+00	8.3E+07	7.5E+00	0.0005	U

Table 6. The retained or excreted activity values given in the ICRP Publication No 78 corresponding to 1 Bq single intake – Ingestion case

Nuclide	ICRP (d)				f ₁	Sample	Model
	1	2	5	10			
H-3	2.3E-02	2.1E-02	1.7E-02	1.2E-02	1(HTO)	U	78
P-32	no data						
Cr-51	no data						
Cr-51	no data						
Mn-54	no data						
Mn-54	no data						
Fe-59	7.3E-01	3.8E-01	1.1E-01	8.5E-02	0.1	WB	78
Fe-59	1.9E-04	2.0E-05	5.8E-06	2.1E-06	0.1	U	78
Co-57	7.1E-01	3.4E-01	5.5E-02	2.9E-02	0.1	WB	78
Co-57	2.8E-02	1.4E-02	2.2E-03	1.2E-03	0.1	U	78
Co-58	7.0E-01	3.4E-01	5.3E-02	2.7E-02	0.1	WB	78
Co-58	2.7E-02	1.4E-02	2.2E-03	1.1E-03	0.1	U	78
Co-60	7.1E-01	3.5E-01	5.6E-02	3.0E-02	0.1	WB	78
Co-60	2.8E-02	1.4E-02	2.3E-03	1.2E-03	0.1	U	78
Zn-65	no data						
Zn-65	no data						
Rb-86	no data						
Rb-86	no data						
Sr-85	7.2E-01	4.2E-01	1.6E-01	1.1E-01	0.3	WB	78
Sr-85	5.6E-02	2.2E-02	7.9E-03	3.3E-03	0.3	U	78
Sr-89	5.6E-02	2.1E-02	7.8E-03	3.2E-03	0.3	U	78
Sr-90	5.6E-02	2.2E-02	8.3E-03	3.7E-03	0.3	U	78
Zr-95	no data						
Zr-95	no data						
Ru-106	7.2E-01	3.5E-01	5.3E-02	3.0E-02	0.05	WB	78
Ru-106	5.3E-03	2.4E-03	1.1E-03	7.6E-04	0.05	U	78
Ag-110m	no data						
Ag-110m	no data						

Table 6. The retained or excreted activity values given in the ICRP Publication No 78 corresponding to 1 Bq single intake – Ingestion case (Cont.)

Nuclide	ICRP (d)				f ₁	Sample	Model
	1	2	5	10			
Sb-124	no data						
Sb-124	no data						
Sb-125	no data						
Sb-125	no data						
I-125	2.7E-01	2.8E-01	2.7E-01	2.4E-01	1	Th	78
I-125	6.2E-01	5.9E-02	2.7E-04	4.9E-04	1	U	78
I-129	2.7E-01	2.9E-01	2.9E-01	2.7E-01	1	Th	78
I-129	6.3E-01	6.0E-02	2.8E-04	5.4E-04	1	U	78
I-131	2.5E-01	2.5E-01	1.9E-01	1.2E-01	1	Th	78
I-131	5.8E-01	5.1E-02	1.8E-04	2.3E-04	1	U	78
Cs-134	9.8E-01	9.5E-01	8.9E-01	8.4E-01	1	WB	78
Cs-134	1.6E-02	2.3E-02	1.1E-02	5.4E-03	1	U	78
Cs-137	9.8E-01	9.5E-01	8.9E-01	8.4E-01	1	WB	78
Cs-137	1.6E-02	2.3E-02	1.1E-02	5.5E-03	1	U	78
Ba-140	no data						
Ba-140	no data						
Ce-141	no data						
Ce-141	no data						
Ce-144	no data						
Ce-144	no data						
Hg-203	no data						
Hg-203	no data						
Ra-226	7.3E-01	3.8E-01	6.9E-02	2.9E-02	0.2	WB	78
Ra-226	2.9E-03	5.7E-04	1.8E-04	3.6E-05	0.2	U	78
Ra-228	7.3E-01	3.8E-01	6.9E-02	2.9E-02	0.2	WB	78
Ra-228	2.9E-03	5.7E-04	1.8E-04	3.5E-05	0.2	U	78
Th-228	7.2E-01	3.3E-01	1.9E-02	5.9E-04	0.0005	WB	78
Th-228	1.7E-05	5.2E-06	1.5E-06	7.3E-07	0.0005	U	78

Table 6. The retained or excreted activity values given in the ICRP Publication No 78 corresponding to 1 Bq single intake – Ingestion case (Cont.)

Nuclide	ICRP (d)				f ₁	Sample	Model
	1	2	5	10			
Th-232	7.2E-01	3.3E-01	1.9E-02	5.9E-04	0.0005	WB	78
Th-232	1.7E-05	5.2E-06	1.5E-06	7.4E-07	0.0005	U	78
U-234	no data						78
U-234	1.3E-02	6.9E-04	3.0E-04	1.9E-04	0.02	U	78
U-235	no data						78
U-235	1.3E-02	6.9E-04	3.0E-04	1.9E-04	0.02	U	78
U-238	no data						78
U-238	1.3E-02	6.9E-04	3.0E-04	1.9E-04	0.02	U	78
Np-237	1.4E-04	1.8E-04	2.1E-04	2.2E-04	0.0005	Skel	78
Np-237	9.8E-05	3.1E-05	5.0E-06	8.4E-07	0.0005	U	78
Pu-238	no data						78
Pu-238	3.4E-06	2.6E-06	6.5E-07	1.8E-07	0.0005	U	78
Pu-239	no data						78
Pu-239	3.4E-06	2.6E-06	6.5E-07	1.8E-07	0.0005	U	78
Pu-240	no data						78
Pu-240	3.4E-06	2.6E-06	6.5E-07	1.8E-07	0.0005	U	78
Am-241	1.3E-04	1.4E-04	1.5E-04	1.5E-04	0.0005	Skel	78
Am-241	3.0E-05	4.6E-06	9.5E-07	4.9E-07	0.0005	U	78
Cm-242	no data						78
Cm-242	3.0E-05	4.5E-06	9.3E-07	4.7E-07	0.0005	U	78
Cm-244	no data						78
Cm-244	3.0E-05	4.6E-06	9.5E-07	4.9E-07	0.0005	U	78
Cf-252	no data						78
Cf-252	2.1E-05	3.8E-06	1.3E-08	1.2E-08	0.0005	U	78

Table 7. The relative differences of the results of calculations by MONDAL given as percentages of retained or excreted activity values of the ICRP Publications No 78 – Ingestion case

Nuclide	Relative difference (%)				f ₁	Sample	Model
	1d	2d	5d	10d			
H-3	-7.5	-4.8	-3.6	-3.1	1(HTO)	U	78
P-32	no data						
Cr-51	no data						
Cr-51	no data						
Mn-54	no data						
Mn-54	no data						
Fe-59	-2.2	1.2	-2.2	-2.0	0.1	WB	78
Fe-59	1.2	2.0	1.4	1.3	0.1	U	78
Co-57	0.6	1.4	1.0	1.4	0.1	WB	78
Co-57	-0.8	2.0	1.0	-2.0	0.1	U	78
Co-58	2.0	1.4	-0.7	0.1	0.1	WB	78
Co-58	0.1	0.6	-1.2	-0.1	0.1	U	78
Co-60	0.6	-1.5	-0.8	1.0	0.1	WB	78
Co-60	-0.8	2.0	-1.2	0.4	0.1	U	78
Zn-65	no data						
Zn-65	no data						
Rb-86	no data						
Rb-86	no data						
Sr-85	-0.8	-0.8	0.8	1.0	0.3	WB	78
Sr-85	-0.8	-3.3	-2.6	1.0	0.3	U	78
Sr-89	-0.8	1.3	-1.4	0.8	0.3	U	78
Sr-90	-0.8	1.0	0.4	0.1	0.3	U	78
Zr-95	no data						
Zr-95	no data						
Ru-106	-0.8	-1.5	-0.7	1.0	0.05	WB	78
Ru-106	-0.7	-0.8	-1.2	1.2	0.05	U	78
Ag-110m	no data						
Ag-110m	no data						

Table 7. The relative differences of the results of calculations by MONDAL given as percentages of retained or excreted activity values of the ICRP Publications No 78 – Ingestion case (Cont.)

Nuclide	Relative difference (%)				f ₁	Sample	Model
	1d	2d	5d	10d			
Sb-124	no data						
Sb-124	no data						
Sb-125	no data						
Sb-125	no data						
I-125	0.1	2.0	0.1	1.6	1	Th	78
I-125	0.8	-0.3	0.1	-2.8	1	U	78
I-129	2.9	1.4	-1.5	2.9	1	Th	78
I-129	-0.8	-2.0	2.0	2.9	1	U	78
I-131	0.0	-2.4	-2.5	-3.1	1	Th	78
I-131	1.4	-2.0	2.9	1.1	1	U	78
Cs-134	2.0	-4.3	2.1	-0.8	1	WB	78
Cs-134	-0.8	-1.2	2.1	2.9	1	U	78
Cs-137	2.0	-4.3	2.1	-0.8	1	WB	78
Cs-137	-0.8	-1.2	3.3	1.0	1	U	78
Ba-140	no data						
Ba-140	no data						
Ce-141	no data						
Ce-141	no data						
Ce-144	no data						
Ce-144	no data						
Hg-203	no data						
Hg-203	no data						
Ra-226	-2.2	1.2	3.5	1.4	0.2	WB	78
Ra-226	1.4	-2.5	1.0	-0.8	0.2	U	78
Ra-228	-2.2	1.2	3.5	1.4	0.2	WB	78
Ra-228	1.4	-2.5	1.0	2.0	0.2	U	78
Th-228	-0.8	1.0	1.2	-0.3	0.0005	WB	78
Th-228	-2.0	1.2	-0.5	-2.2	0.0005	U	78

Table 7. The relative differences of the results of calculations by MONDAL given as percentages of retained or excreted activity values of the ICRP Publications No 78 – Ingestion case (Cont.)

Nuclide	Relative difference (%)					Sample	Model
	1d	2d	5d	10d	f_1		
Th-232	-0.8	1.0	1.2	-0.3	0.0005	WB	78
Th-232	-2.0	1.2	-0.5	4.0	0.0005	U	78
U-234	no data					WB	78
U-234	-2.6	3.5	1.0	1.2	0.02	U	78
U-235	no data					WB	78
U-235	-2.6	3.5	1.0	1.2	0.02	U	78
U-238	no data					WB	78
U-238	-2.6	3.5	1.0	1.2	0.02	U	78
Np-237	3.5	1.0	1.3	3.3	0.0005	Skel	78
Np-237	2.0	-2.2	0.0	-0.8	0.0005	U	78
Pu-238	no data					Skel	78
Pu-238	-2.0	-1.4	2.6	1.0	0.0005	U	78
Pu-239	no data					Skel	78
Pu-239	-2.0	-1.4	2.6	1.0	0.0005	U	78
Pu-240	no data					Skel	78
Pu-240	-2.0	-1.4	2.6	1.0	0.0005	U	78
Am-241	-2.6	2.0	1.0	2.6	0.0005	Skel	78
Am-241	-2.0	-1.2	-4.3	2.0	0.0005	U	78
Cm-242	no data					Skel	78
Cm-242	-2.0	1.0	-2.2	1.3	0.0005	U	78
Cm-244	no data					Skel	78
Cm-244	-2.0	-1.2	-4.3	2.0	0.0005	U	78
Cf-252	no data					WB	78
Cf-252	-0.8	1.2	-0.1	0.4	0.0005	U	78

Table 8. The ingestion dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards

Nuclide	MONDAL					IBSS	Relative difference (%)	f ₁	Sample
	1d	2d	5d	10d	average				
H-3	1.8E-11	1.8E-11	1.8E-11	1.9E-11	1.8E-11	1.8E-11	0.7	1(HTO)	U
P-32	2.3E-09	2.5E-09	2.4E-09	2.4E-09	2.4E-09	2.4E-09	-0.2	0.8	U
Cr-51	3.9E-11	3.8E-11	3.9E-11	3.8E-11	3.8E-11	3.8E-11	0.7	0.1	WB
Cr-51	3.9E-11	3.7E-11	3.8E-11	3.8E-11	3.8E-11	3.8E-11	0.4	0.1	U
Mn-54	6.9E-10	6.9E-10	7.3E-10	7.3E-10	7.1E-10	7.1E-10	0.0	0.1	WB
Mn-54	7.1E-10	7.1E-10	7.2E-10	7.1E-10	7.1E-10	7.1E-10	0.2	0.1	U
Fe-59	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	-0.4	0.1	WB
Fe-59	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	0.2	0.1	U
Co-57	2.1E-10	2.1E-10	2.1E-10	2.1E-10	2.1E-10	2.1E-10	0.9	0.1	WB
Co-57	2.1E-10	2.1E-10	2.1E-10	2.1E-10	2.1E-10	2.1E-10	1.1	0.1	U
Co-58	7.9E-10	7.6E-10	7.4E-10	7.3E-10	7.5E-10	7.4E-10	1.7	0.1	WB
Co-58	7.3E-10	7.3E-10	7.4E-10	7.4E-10	7.3E-10	7.4E-10	-0.8	0.1	U
Co-60	3.4E-09	3.4E-09	3.4E-09	3.3E-09	3.4E-09	3.4E-09	-0.5	0.1	WB
Co-60	3.3E-09	3.4E-09	3.4E-09	3.4E-09	3.4E-09	3.4E-09	-0.4	0.1	U
Zn-65	3.9E-09	3.8E-09	3.8E-09	3.9E-09	3.8E-09	3.9E-09	-1.4	0.5	WB
Zn-65	3.9E-09	4.0E-09	3.8E-09	3.9E-09	3.9E-09	3.9E-09	0.0	0.5	U
Rb-86	2.9E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	0.5	1	WB
Rb-86	2.9E-09	2.8E-09	2.8E-09	2.9E-09	2.8E-09	2.8E-09	1.2	1	U
Sr-85	5.6E-10	5.4E-10	5.6E-10	5.6E-10	5.5E-10	5.6E-10	-0.9	0.3	WB
Sr-85	5.6E-10	5.5E-10	5.5E-10	5.7E-10	5.6E-10	5.6E-10	-0.8	0.3	U
Sr-89	2.6E-09	2.6E-09	2.5E-09	2.6E-09	2.6E-09	2.6E-09	-1.1	0.3	U
Sr-90	2.8E-08	2.9E-08	2.8E-08	2.8E-08	2.8E-08	2.8E-08	1.0	0.3	U
Zr-95	8.6E-10	8.7E-10	8.8E-10	8.9E-10	8.8E-10	8.8E-10	-0.5	0.002	WB
Zr-95	8.7E-10	9.3E-10	8.4E-10	8.8E-10	8.8E-10	8.8E-10	-0.1	0.002	U
Ru-106	6.9E-09	6.9E-09	6.8E-09	7.0E-09	6.9E-09	7.0E-09	-1.3	0.05	WB
Ru-106	6.8E-09	6.9E-09	7.0E-09	7.1E-09	6.9E-09	7.0E-09	-0.8	0.05	U
Ag-110m	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	2.8E-09	-1.1	0.05	WB
Ag-110m	2.8E-09	2.8E-09	2.9E-09	2.8E-09	2.8E-09	2.8E-09	0.7	0.05	U

Table 8. The ingestion dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards (Cont.)

Nuclide	MONDAL					IBSS	Relative difference (%)	f ₁	Sample
	1d	2d	5d	10d	average				
Sb-124	2.5E-09	2.5E-09	2.4E-09	2.5E-09	2.5E-09	2.5E-09	-0.6	0.1	WB
Sb-124	2.5E-09	2.5E-09	2.5E-09	2.4E-09	2.5E-09	2.5E-09	-1.8	0.1	U
Sb-125	1.1E-09	1.1E-09	1.1E-09	1.1E-09	1.1E-09	1.1E-09	-2.2	0.1	WB
Sb-125	1.1E-09	1.1E-09	1.1E-09	1.1E-09	1.1E-09	1.1E-09	0.8	0.1	U
I-125	1.5E-08	1.5E-08	1.5E-08	1.5E-08	1.5E-08	1.5E-08	0.0	1	Th
I-125	1.5E-08	1.5E-08	1.5E-08	1.5E-08	1.5E-08	1.5E-08	0.3	1	U
I-129	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	0.6	1	Th
I-129	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	-1.2	1	U
I-131	2.2E-08	2.2E-08	2.2E-08	2.2E-08	2.2E-08	2.2E-08	0.0	1	Th
I-131	2.2E-08	2.2E-08	2.2E-08	2.2E-08	2.2E-08	2.2E-08	1.0	1	U
Cs-134	1.9E-08	1.8E-08	1.9E-08	1.9E-08	1.9E-08	1.9E-08	-0.7	1	WB
Cs-134	1.9E-08	1.9E-08	1.9E-08	1.9E-08	1.9E-08	1.9E-08	0.6	1	U
Cs-137	1.3E-08	1.3E-08	1.4E-08	1.3E-08	1.3E-08	1.3E-08	-0.3	1	WB
Cs-137	1.3E-08	1.3E-08	1.4E-08	1.3E-08	1.3E-08	1.3E-08	1.8	1	U
Ba-140	2.5E-09	2.5E-09	2.5E-09	2.5E-09	2.5E-09	2.5E-09	-1.1	0.1	WB
Ba-140	2.5E-09	2.6E-09	2.5E-09	2.5E-09	2.5E-09	2.5E-09	1.1	0.1	U
Ce-141	7.1E-10	7.2E-10	7.1E-10	7.0E-10	7.1E-10	7.1E-10	0.0	0.0005	WB
Ce-141	7.2E-10	7.2E-10	7.3E-10	6.8E-10	7.1E-10	7.1E-10	0.4	0.0005	U
Ce-144	5.2E-09	5.2E-09	5.1E-09	5.3E-09	5.2E-09	5.2E-09	-0.1	0.0005	WB
Ce-144	5.2E-09	5.1E-09	5.3E-09	5.4E-09	5.2E-09	5.2E-09	0.9	0.0005	U
Hg-203	5.4E-10	5.3E-10	5.5E-10	5.5E-10	5.4E-10	5.4E-10	0.6	0.02(Inorg)	WB
Hg-203	5.4E-10	5.3E-10	5.4E-10	5.4E-10	5.4E-10	5.4E-10	-0.5	0.02(Inorg)	U
Ra-226	2.7E-07	2.8E-07	2.9E-07	2.8E-07	2.8E-07	2.8E-07	0.1	0.2	WB
Ra-226	2.8E-07	2.7E-07	2.7E-07	2.8E-07	2.8E-07	2.8E-07	-0.9	0.2	U
Ra-228	6.5E-07	6.9E-07	6.9E-07	6.8E-07	6.8E-07	6.7E-07	1.2	0.2	WB
Ra-228	6.8E-07	6.7E-07	6.7E-07	6.8E-07	6.7E-07	6.7E-07	0.5	0.2	U
Th-228	7.1E-08	7.3E-08	7.3E-08	7.1E-08	7.2E-08	7.0E-08	3.0	0.0005	WB
Th-228	7.2E-08	7.4E-08	7.2E-08	7.0E-08	7.2E-08	7.0E-08	2.5	0.0005	U

Table 8. The ingestion dose factors calculated by MONDAL software and the relative differences as percentages of the values of IAEA Basic Safety Standards (Cont.)

Nuclide	MONDAL					IBSS	Relative difference (%)	f ₁	Sample
	1d	2d	5d	10d	average				
Th-232	2.2E-07	2.2E-07	2.1E-07	2.2E-07	2.2E-07	2.2E-07	-0.7	0.0005	WB
Th-232	2.2E-07	2.2E-07	2.2E-07	2.3E-07	2.2E-07	2.2E-07	1.4	0.0005	U
U-234	4.9E-08	5.0E-08	5.0E-08	5.0E-08	5.0E-08	4.9E-08	1.7	0.02	WB
U-234	4.9E-08	5.1E-08	4.8E-08	5.0E-08	5.0E-08	4.9E-08	1.3	0.02	U
U-235	4.6E-08	4.7E-08	4.5E-08	4.5E-08	4.6E-08	4.6E-08	-0.1	0.02	WB
U-235	4.7E-08	4.8E-08	4.5E-08	4.6E-08	4.7E-08	4.6E-08	1.3	0.02	U
U-238	4.4E-08	4.3E-08	4.3E-08	4.4E-08	4.4E-08	4.4E-08	-1.1	0.02	WB
U-238	4.4E-08	4.6E-08	4.5E-08	4.4E-08	4.5E-08	4.4E-08	2.1	0.02	U
Np-237	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	-0.2	0.0005	Skel
Np-237	1.1E-07	9.1E-08	1.1E-07	1.1E-07	1.0E-07	1.1E-07	-4.7	0.0005	U
Pu-238	2.3E-07	2.3E-07	2.4E-07	2.3E-07	2.3E-07	2.3E-07	0.3	0.0005	Skel
Pu-238	2.3E-07	2.3E-07	2.4E-07	2.4E-07	2.3E-07	2.3E-07	1.2	0.0005	U
Pu-239	2.5E-07	2.4E-07	2.4E-07	2.4E-07	2.4E-07	2.5E-07	-2.9	0.0005	Skel
Pu-239	2.5E-07	2.5E-07	2.6E-07	2.5E-07	2.5E-07	2.5E-07	1.0	0.0005	U
Pu-240	2.5E-07	2.4E-07	2.4E-07	2.4E-07	2.4E-07	2.5E-07	-2.9	0.0005	Skel
Pu-240	2.5E-07	2.5E-07	2.6E-07	2.5E-07	2.5E-07	2.5E-07	1.0	0.0005	U
Am-241	2.0E-07	2.0E-07	2.0E-07	2.0E-07	2.0E-07	2.0E-07	-0.1	0.0005	Skel
Am-241	2.0E-07	2.0E-07	1.9E-07	2.1E-07	2.0E-07	2.0E-07	-0.5	0.0005	U
Cm-242	1.2E-08	1.2E-08	1.2E-08	1.2E-08	1.2E-08	1.2E-08	-0.3	0.0005	Skel
Cm-242	1.2E-08	1.2E-08	1.2E-08	1.2E-08	1.2E-08	1.2E-08	0.2	0.0005	U
Cm-244	1.2E-07	1.2E-07	1.2E-07	1.2E-07	1.2E-07	1.2E-07	0.0	0.0005	Skel
Cm-244	1.2E-07	1.2E-07	1.2E-07	1.2E-07	1.2E-07	1.2E-07	-0.6	0.0005	U
Cf-252	9.3E-08	9.0E-08	9.0E-08	9.4E-08	9.2E-08	9.0E-08	2.0	0.0005	WB
Cf-252	9.0E-08	8.8E-08	9.0E-08	9.0E-08	9.0E-08	9.0E-08	-0.6	0.0005	U