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PERSONAL DOSE-EQUIVALENT CONVERSION COEFFICIENTS FOR 1252 RADIONUCLIDES

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Dose conversion coefficients for radionuclides are useful for routine calculations in radiation protection in industry, medicine and research. They give a simple and often sufficient estimate of dose rates during production, handling and storage of radionuclide sources, based solely on the source's activity. The latest compilation of such conversion coefficients dates from 20 y ago, based on nuclear decay data published 30 y ago. The present publication provides radionuclide-specific conversion coefficients to personal dose based on the most recent evaluations of nuclear decay data for 1252 radionuclides and fluence-to-dose-equivalent conversion coefficients for monoenergetic radiations. It contains previously unknown conversion coefficients for >400 nuclides and corrects those conversion coefficients that were based on erroneous decay schemes. For the first time, estimates for the protection quantity $H_p(3)$ are included.

INTRODUCTION

Dose conversion coefficients for radionuclides are useful for routine calculations in radiation protection in industry, medicine and research. They give a simple and often sufficient estimate of dose rates during production, handling and storage of radionuclide sources, based solely on the source's activity. If the dose equivalents thus estimated turn out to be too large to be handled safely, they point out the need for a more detailed risk assessment and potentially for protective measures.

After the introduction of the operational radiation protection quantities in 1993[1], a collection of dose coefficients for radionuclides has been calculated and published by Petoussi *et al.*[2] and widely distributed as an annexe to the Swiss Radiological Protection Ordinance[3] It lists the quantities ambient dose equivalent $H^*(10)$ and directional dose equivalent $H'(0.07.0°)$ for >800 radionuclides contained in ICRP Publication 38[4] At the time of publication, a recommended set of fluence-to-dose-equivalent conversion coefficients were not yet available, and Petoussi *et al.*[2] calculated their own set. This collection has proved useful in numerous applications, but it suffers from a few limitations: ICRP Publication 38 does not list short-lived radionuclides ($t_{1/2} < 2$ min), produced copiously in present day's research facilities, for example, the on-line mass separator ISOLDE at CERN[5]. The nuclear decay data contained in (4) have been in numerous cases superseded by more recent measurements and evaluations. Recently, the ICRP has recommended to limit the dose to the eye lens to 20 mSv in a year. The appropriate operational quantity is personal dose in 3-mm depth $H_p(3)$[6], and it would be useful to have an estimate of this operational quantity.

In 2007, the ICRP has replaced ICRP Report 38[4] with ICRP report 107[7], a compilation of nuclear decay data for 1252 radionuclides. This data set has been used previously to calculate conversion coefficients to exposure rate from photons[8]. Exposure rate is, however, not a recommended protection quantity. A recalculation of the phantom-based operational radiation protection quantities defined by the ICRU[1] was missing; this gap is filled with the present publication.

The motivation for the choice of personal dose $H_p(d)$ as the target quantity of the present calculations is 2-fold: on one hand, personal dose-equivalent $H_p(d)$ is the operational quantity used to estimate effective dose for an individual worker, to protect him from stochastic radiation detriment from exceeding limits on $H_p(10)$ and deterministic damage from exceeding limits on $H_p(0.07)$ or $H_p(3)$. On the other hand, two detailed sets of conversion coefficients have been published recently[9, 10], and missing conversion coefficients are easy to calculate. In any case, the difference between the quantities $H_p(d)$ and $H'(d, 0)$ is small and in any case negligible for the present application, where it is overshadowed by other uncertainties in dose estimation based on source activity only.

The second section of this paper explains the calculation of the personal dose conversion coefficients for radionuclides. The third section reviews the availability of fluence-to-dose-equivalent conversion coefficients for different radiation types and presents new calculations for electrons and positrons in air. In Section 4, the resulting radionuclide-specific personal dose-equivalent conversion coefficients are presented and discussed.

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CALCULATION OF PERSONAL DOSE COEFFICIENTS

The personal dose coefficient $h_p^{A,Z}(d, r)$ for a radionuclide relates the activity $A(A, Z)$ of a radionuclide source with mass number A and proton number Z to $H_p(d)$, the personal dose equivalent at depth d at a reference distance r between the (point-like) radioisotope source and the receptor:

$$H_p(d) = h_p^{A,Z}(d, r) \cdot A(A, Z) \tag{1}$$

In the typical exposure situation of an operator handling a radioactive source, his critical organs and the eye lens will be at a distance of ~1 m, whereas the hands are much closer to the source (order of 0.1 m). This fact is taken into account by calculating $H_p(10)$ and $H_p(3)$, the operational quantities for whole-body dose and the eye-lens dose, at $r = 100$ cm, whereas $H_p(0.07)$, the quantity used to estimate dose to the extremities, is calculated at $r = 10$ cm. Furthermore, it is assumed that source and receptor are surrounded by air.

The radionuclide R(A,Z) can transform in a daughter nuclide R'(A′,Z′) in a variety of decay modes under emission of different particles (Table 1). In the present work, only emitted particles contributing to external exposure are considered. Omitted are therefore alpha-particles and fission fragments, which are a concern for internal exposure, as well as photons and electrons with energies below a threshold under which the particles are stopped in the insensitive layer of skin or the air surrounding the subject. The personal dose from a radionuclide can be represented as a sum of components, each caused by a different radiation type:

$$\begin{aligned} H_p(d) &= H_p(d)_\gamma + H_p(d)_e + H_p(d)_n \\ &= (h_p^{A,Z}(d, r)_\gamma + h_p^{A,Z}(d, r)_e \\ &\quad + h_p^{A,Z}(d, r)_n)A(A, Z) \end{aligned} \tag{2}$$

In the following sections, the calculation of the nuclide-specific conversion coefficients for the different radiation types $h_p^{A,Z}(d, r)_{rad}$ at depth d and a reference distance r is explained in more detail.

Photons

In decay of a radionuclide, discrete photons with energy E_i are emitted with yield Y_i, the emission probability per nuclear transmutation. One can distinguish between gamma-rays, emitted by the nucleus, and X-rays, emitted by the electron shell, but for the present work, the distinction is not important. The personal dose equivalent in a photon radiation field of is calculated from air kerma determined without phantom K_a, by multiplying with a suitable conversion coefficient[7, 11]:

$$H_p(d)_\gamma = K_a \cdot h_k(d) \tag{3}$$

Air kerma of photons with energy E can be related to photon fluence by the relation:

$$K_a(E) = \phi(E) \cdot E \cdot \left(\frac{\mu_{tr}}{\varrho}\right) \tag{4}$$

where μ_{tr} is the mass energy transfer coefficient and ρ the density of air. Introducing the fluence-to-dose-equivalent conversion coefficient:

$$h_p(d, E)_\gamma = h_k(E) \cdot E \cdot \left(\frac{\mu_{tr}}{\varrho}\right) \tag{5}$$

and substituting for the fluence ϕ from a point source at distance r the expression $(4\pi r^2)^{-1}$, the personal dose equivalent for one nuclear transmission can be written as follows:

$$h_p^{A,Z}(d, r)_\gamma = \frac{1}{4\pi r^2} \sum_i h_p(d, E)_\gamma \cdot Y_i \tag{6}$$

Table 1. Sources of the conversion coefficients for monoenergetic radiations used in the calculation of radionuclide-specific dose-equivalent conversion coefficients.

Radiation	Symbol	$d = 10$ mm	$d = 3$ mm, slab phantom	$d = 0.07$ mm, slab phantom
Photons	$h_p(d, E)_\gamma$	In vacuum[9] (Figure 1)	In vacuum[9]	In air[9], $r = 100$ cm (Figure 2)
Electrons	$h_p(d, E)_e$	Calculated for this work in air at $r = 100$ cm; for $E > 15$ MeV from (10) (Figure 3)	Calculated for this work in air at $r = 100$ cm; for $E > 10$ MeV from (10) (Figure 4)	Calculated for this work in air at $r = 10$ cm; for $E > 3$ MeV from (10) (Figure 5)
Positrons		Calculated for this work in air at $r = 100$ cm; Figure 6		Calculated for this work in air at $r = 10$ cm; Figure 6
Neutrons	$h_p(10, E)_n$	In vacuum[12]	—	—

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The summation extends over all photons that are emitted by the parent radionuclide. In the summation, they are weighted by the yield per transmutation Y_i, so that the evaluation of (6) results the conversion coefficient for the photons emitted in one transmutation. The coefficient is the energy-dependent conversion coefficient for photons from fluence to personal dose equivalent at depth d, evaluated for energy E. Here, as in the following instances of conversion coefficients, they are assumed to be a continuous function of particle energy E, although they are tabulated at only a few fixed energy values E_j, where they are either calculated from kerma-conversion coefficients as in Equation (5) or directly in Monte–Carlo radiation transport programmes. For values of E lying between E_j and E_{j+1}, the corresponding conversion coefficient $h_p(d, E)_{rad}$ is evaluated by interpolation.

Electrons and positrons

A nucleus emits electrons with discrete energies as conversion electrons or Auger electrons and electrons or positrons with a continuous energy spectrum in β-decay. The contribution of the discrete spectrum of electrons to personal dose equivalent is similar to the contribution of photons:

$$h_p^{A,Z}(d, r)_e = \frac{1}{4\pi r^2} \sum_i h_p(d, E)_e \cdot Y_i \qquad (7)$$

In Equation (7), the symbols have an analogous meaning as in Equation (6). For the electron/positron emission from β-decay, the dose equivalent is calculated by integration over each branch of the spectrum, and a summation weighted by the yield of the branch Y_i:

$$h_p^{A,Z}(d, r)_e = \frac{1}{4\pi r^2} \sum_i Y_i \int_{E=0}^{E_{max,i}} dE\ \Phi_E h_p(d, E)_e \qquad (8)$$

where $\Phi_E = d\phi(E)/dE$ is the spectral fluence of electrons/positrons.

ICRP report 107[7] tabulates composite β-spectra and integration and summation can be reversed in (5), simplifying the calculation to a single integration over the composite spectrum:

$$h_p^{A,Z}(d, r)_e = \frac{1}{4\pi r^2} \int_{E=0}^{E_{max,i}} dE \left(\sum_i Y_i \Phi_E \right) h_p(d, E)_e \qquad (8a)$$

Note that the conversion coefficients differ for β^--decay (electrons) and β^+-decay (positrons). In the case of β^+-decay, the positron may annihilate before leaving the source, in this case the contribution of the annihilation photons to personal dose must be calculated with Equation (6).

Neutrons

A few heavy radionuclides undergo spontaneous fission and emit neutrons, contributing to personal dose equivalent at 10-mm depth $H_p(10)$. In ICRP report 107[7], yield and energy of fission neutrons are given as a continuous spectrum and the dose equivalent is calculated by integration over this spectrum:

$$h_p^{A,Z}(d, r)_n = \frac{1}{4\pi r^2} \int_{E=0}^{E_{max}} dE\ \Phi_E h_p(10, E)_n \qquad (9)$$

Equation (9) is formally equivalent to Equation (8) for a single β-spectrum.

CONVERSION COEFFICIENTS FOR MONOENERGETIC RADIATIONS

As seen in Section 2, the calculation of radionuclide-specific dose conversion coefficients precedes by a summation or integration over the fluence spectra of the particles/radiations emitted in the decay. In the summand or integrand, the fluence at energy E is multiplied with a fluence-to-dose-equivalent conversion coefficient, which must be evaluated at the same energy E. Values of the conversion coefficients for arbitrary energies E are interpolated from a table of coefficients at fixed energies E_j, calculated with the Monte–Carlo method.

In previous Monte–Carlo calculations of conversion coefficients for monoenergetic radiations, e.g. tabulated in (11, 12), two assumptions were made:

(1) Source and receptor of the radiation are placed in vacuum,
(2) The kerma approximation was used for the calculation of energy deposited by photons in the receptor. This means that the energy imparted by the photon in an interaction is deposited locally. This approximation is valid when secondary electron equilibrium is installed, as is the case for dose in 10-mm depth for photons with energies of <3 MeV for 3-mm depth for energies of <800 keV and for 0.07-mm depth for energies of <300 keV.

These two assumptions would represent a limitation for the usefulness of radionuclide-specific conversion coefficients presented here:

(1) The coefficients are given to estimate external dose rates in practical cases. This implies that source and receptor are surrounded by air, not vacuum.
(2) A realistic estimation of the dose to the skin or the eye lens, at 0.07-mm or 3-mm depth in tissue, is sought. Conversion coefficients calculated without the kerma approximation, explicitly

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transporting secondary electrons, are available in the literature or can be calculated with Monte–Carlo radiation transport programmes.

The conversion coefficients presented in this publication are evaluated for whole-body exposure, i.e. on the water-filled slab phantom of 30 × 30 × 15 cm^3. This is the standard phantom for the quantity $H_p(10)$. For $H_p(3)$, the difference between irradiation on a cylinder phantom representing the head and the slab phantom is small for irradiation under 0°. The results $H_p(0.07)_{slab}$ correspond to a measurement of 'skin dose' on the trunk, as required by many countries' radiation protection dosimetry regulations. This quantity is, however, only an approximate substitute for the quantity $H_p(0.07)_{rod}$ on the cylindrical rod phantom[11] used for dosimetry of extremities. In order to avoid confusion, the quantities for eye and skin dosimetry presented in this work are indicated $H_p(3)_{slab}$ and $H_p(0.07)_{slab}$.

In order to approximately take into account typical exposure situations, the quantities $H_p(10)$ and $H_p(3)$ are calculated for a distance to the source of $r = 100$ cm (exposure to the source in a typical working distance) and $H_p(0.07)$ for a distance of 10 cm (exposure of the hand and forearm while handling a source).The respective air layers have a significant influence electron and positron fluence by absorption and scattering in air. Table 1 gives an overview of the sources of the conversion coefficients and a reference to the corresponding figure. The following sections review these choices.

Photons

Veinot and Hertel[9] have published a comprehensive set of conversion coefficients from fluence to personal dose for monoenergetic photons. The coefficients were calculated with the Monte–Carlo code MCNPX 2.6[13]. In the simulation, a slab phantom of dimensions 30 × 30 × 15 cm^3 made of ICRU 4-component tissue is irradiated uniformly and perpendicular to the front face with a broad beam of monoenergetic photons. The kerma approximation is dropped, i.e. secondary electrons are explicitly transported. This leads to marked differences in conversion coefficients from previous sources (Figure 1). Absorbed dose is scored in receptor volumes at a depth of 0.07, 3 and 10 mm and yields the operational quantities at these depths. Veinot and Hertel did not observe a significant difference between conversion coefficients $h_p(d, E)_\gamma$ for $d =$ 3, 10 mm in vacuum or in 100 cm of air.

Only for $h_p(0.07, E)_{\gamma,\,slab}$, they could find a difference between the calculations in vacuum and in 100 cm of air, owing to the build-up of secondary electrons in the air layer, which contribute to the dose in 0.07-mm depth. In the present work, the air layer of $h_p(0.07, E)_{\gamma,\,slab}$ is supposed to have a depth of only 10 cm. The corresponding conversion coefficients were calculated for a few energies with the Monte–Carlo code FLUKA[14, 15] in an identical numerical set-up as the one used by Veinot and Hertel (see Section 3.3). These calculations showed that the thickness of the air layer (100 cm or 10 cm) was irrelevant. The reason is that secondary electrons contributing to the dose at a depth of 0.07 mm in tissue are generated only in the last few centimetres of air before the phantom, and the additional scattering and absorption in 90 cm of air do not reduce significantly the dose per emitted photon.

To conclude, for the conversion of photon fluence-to-personal dose equivalent, the coefficients published in (9) for vacuum, $h_p(10, E)_\gamma$ and $h_p(3, E)_{\gamma,slab}$ and in air, $h_p(0.07, E)_{\gamma,slab}$, are used. Figures 1 and 2 show a comparison between the coefficients by Veinot and Hertel[9] used in this work, the conversion coefficient used in (2) and the coefficients presently recommended by the ICRU[12].

Neutrons

For neutrons, the conversion coefficients from fluence to personal dose equivalent at a depth of 10 mm are taken from the ICRU report 57[12], confirmed as the presently best available reference in (16). In the energy range of interest for this work, $E = 3$–10 MeV, personal dose is underestimated at most by 20 %.

Electrons and positrons

Veinot and Hertel have published conversion coefficients from fluence to personal dose equivalent for

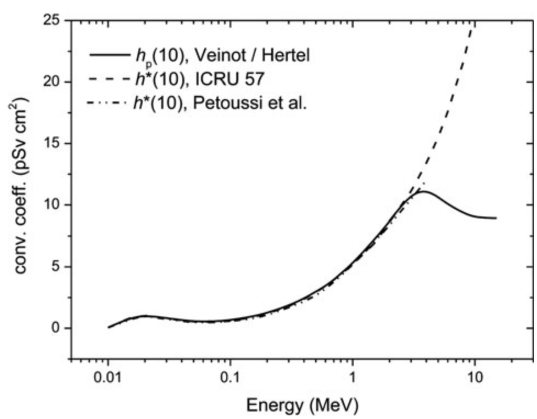

Figure 1. Comparison between the conversion coefficient for photons from fluence to $H^*(10)$ used in (2), the coefficient recommended by the ICRU[12] and the conversion coefficient from fluence to $H_p(10)$ by Veinot and Hertel[9] used in this work. The difference between ambient and personal dose equivalent is negligible until $E = 4$ MeV. Above this value, the influence of secondary electron transport in the calculations leading to (9) is visible.

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electrons[10]. Calculated in vacuum, these coefficients incorporate neither the absorption and scattering of electrons nor the build-up of secondary electrons and inscattering in the air layer between source and phantom. For the present work, conversion coefficients have been calculated for $H_p(d)$ from electrons where source and receptor are separated by an air layer of 100 cm ($d = 10$, 3) or 10 cm ($d = 0.07$).

The Monte–Carlo code FLUKA 2011 2b.2[14, 15] was used for these calculations. A slab phantom (30 × 30 × 15 cm^3) made of ICRU four-component tissue (76.2 % oxygen, 11.1 % carbon, 10.1 % hydrogen and 2.6 % nitrogen) and a density of 1 g cm^{-3} is irradiated with a homogeneous broad beam of monoenergetic electrons or positrons. Source and phantom are separated by a layer of 100 cm of air [10 cm for $H_p(0.07)_{slab}$]. Scoring volumes for absorbed dose are placed at depths of 0.07 mm, 3 mm or 10 mm from the front face of the phantom. The ratio between absorbed dose in the scoring volume at a given depth d and the incident fluence of particles starting from the source yields the respective conversion coefficient. More details on these calculations and full numerical results will be given in another, forthcoming publication.

The comparison of conversion coefficients from different authors and for different conditions are given in Figures 3–5 for $H_p(10)$, $H_p(3)_{slab}$ and $H_p(0.07)_{slab}$, respectively. In Figure 5, the particular behaviour of this coefficient deserves a comment. At energies $E < 100$ keV, the electrons are absorbed or scattered in air and do not contribute to dose in 0.07-mm depth. From energies of >150 keV, the contribution to dose at 0.07-mm depth from electrons passing 10 cm of air is larger than the one of electrons out of vacuum, because of the contribution of inscattered electrons from the air layer. In Figures 3 and 5, one sees that the inscattering effect is more important for the geometry of the slab phantom used in this work for $H_p(d)$ than for the ICRU sphere phantom used in (2) for $H'(d, 0°)$.

For positrons, no conversion coefficients from fluence to personal dose are published. For this work, they have been calculated in the distances of $r = 100$ and 10 cm in air and in vacuum. On the contrary to electrons, positrons contribute to personal dose at all

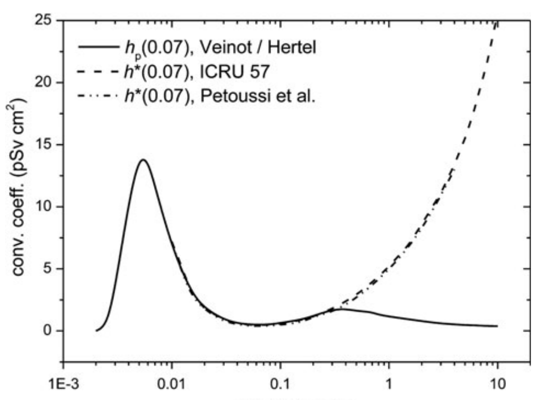

Figure 2. Comparison between the conversion coefficient for photons from fluence to $H'(0.07.0°)$ used in (2), the coefficient recommended by the ICRU[12] and the conversion coefficient from fluence to $H_p(0.07)_{slab}$ by Veinot and Hertel[9] used in this work. The difference between directional and personal dose equivalent is negligible until $E = 300$ keV. The inclusion of full secondary electron transport and absorption and scatter in air in (9) lowers the conversion coefficients significantly above this threshold, with a remarked influence on many radionuclide-specific conversion coefficients.

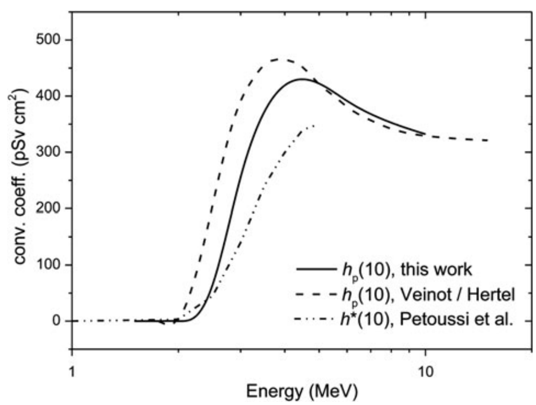

Figure 3. Conversion coefficients for electrons from fluence to $H^*(10)$ for electrons in air used in (2), from fluence to $H_p(10)$ in vacuum from (10) and in air, calculated in this work.

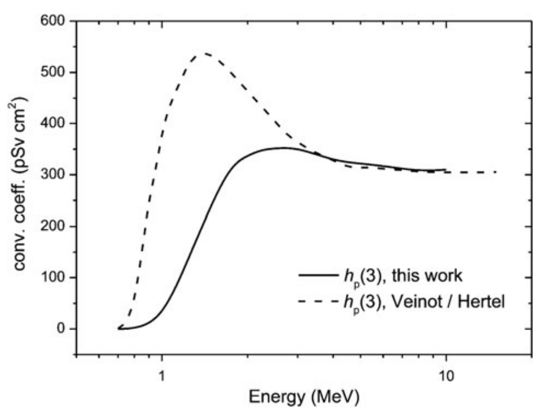

Figure 4. Conversion coefficients for electrons from fluence to $H_p(3)_{slab}$ in vacuum from (10) and in air, calculated in this work.

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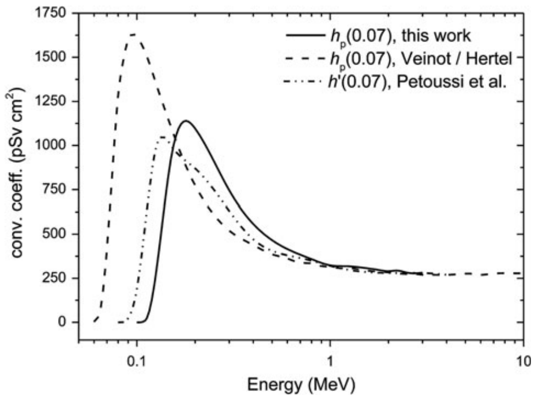

Figure 5. Comparison between the conversion coefficient for electrons from fluence to $H'(0.07, 0°)$ in air used in (2), the coefficient for $H_p(0.07)_{slab}$ in vacuum calculated by Veinot and Hertel[10] and the coefficient for $H_p(0.07)_{slab}$ in air calculated in this work. The coefficients calculated in air vanish for low energies and exceed the coefficient calculated in vacuum in the interval between $E = 150$ keV and 1 MeV, due to the contribution of inscattered electrons from the air layer.

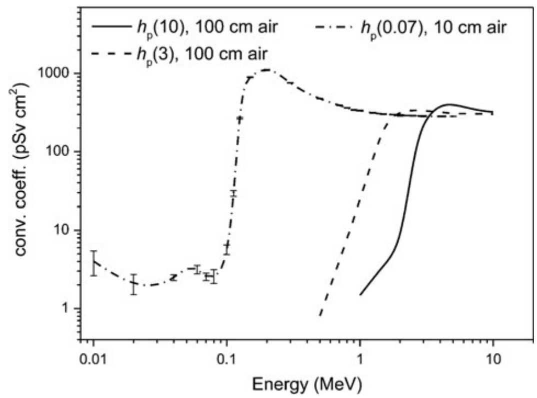

Figure 6. Fluence-to-personal dose conversion coefficients for positrons. The coefficients from fluence to $H_p(10)$ and $H_p(3)_{slab}$ are calculated for a distance r of 100 cm in air, whereas those for $H_p(0.07)_{slab}$ are calculated for $r = 10$ cm. The uncertainty bars show the statistical uncertainty of the Monte–Carlo calculation.

depths also for very low energies, by positrons stopping and annihilating in the phantom or in air. Figure 6 shows the energy dependence of the calculated personal dose conversion coefficients for positrons at depths $d = 0.07$, 3 and 10 mm. A simple argument makes the value of the conversion coefficient at low energies plausible: annihilation photons are created in air or upon first contact with the phantom. One of the two annihilation photons is emitted in the hemisphere where the phantom is placed, and the average conversion coefficient in the range below 0.1 MeV, matches closely the conversion coefficient for photons with $E = 511$ keV in secondary electron equilibrium at 0.07-mm depth.

Interpolation for arbitrary energies

In Equations (6), (7), (8) and (9), the conversion coefficients are required at a specific energy E. A cubic spline interpolation over a logarithmic energy-axis between the monoenergetic values is performed with a tested library function (function *interp1d* from the scipy.interpolate library of the Python programming language[17]).

RESULTS AND DISCUSSION

Presentation of the conversion coefficients

Depending on the decay scheme of the radionuclide, the total personal dose equivalent is composed of contributions from photons, electrons/positrons and neutrons. If required, it is relatively easy to shield most of the electron/positron component of the decay. Table 2 gives two different boundary cases of personal dose equivalent, termed for simplicity 'shielded' and 'unshielded'. In this context, 'shielded' means that directly ionising particles are held back in the source, leading eventually to annihilation of positrons. Photons and neutrons are not affected by the 'shielding', which could for example consist of a light metal or plastic encasing of the radionuclide source. The two totals are defined as the sum of the following contributions to personal dose equivalent:

$$H_p(d)_{unshielded} = H_p(d)_{photon} + H_p(d)_{e^-,\ e^+} + H_p(d)_{neutron}$$

$$H_p(d)_{shielded} = H_p(d)_{photon} + H_p(d)_{annihilation} + H_p(d)_{neutron}$$

$H_p(d)_{e^-,\ e^+}$ includes the contributions from β-decay, internal transition and Auger electrons.

On a first glance, it seems contradictory that $H_p(d)_{shielded}$ exceeds $H_p(d)_{unshielded}$ ($d = 3$, 10 mm) for numerous radioisotopes decaying by β^+-decay. The explanation is that, in a shielded source, the positrons are held back, but annihilation photons are generated, the contribution of which exceeds the contribution of positrons at the specified depths.

Table 3 gives the detailed contributions to personal dose for photons, internal transition and Auger electrons, β-spectra, annihilation photons and neutrons for the three depths of 0.07, 3 and 10 mm. In both tables, the results are given in microsievert per hour

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Table 2. Total personal dose equivalent for the ISO slab phantom, 'shielded' and 'unshielded', for the depths of 10, 3 and 0.07 mm for radionuclides listed in ICRP report 107[7].

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded μSv h^{-1} GBq^{-1}	Shielded	Unshielded μSv h^{-1} GBq^{-1}	Shielded	Unshielded mSv h^{-1} GBq^{-1}	Shielded		
^{3}H	1	3	12.32 y	B−	0	0	0	0	0.0	0.0	^{3}He	
^{7}Be	4	7	53.22 d	EC	9	9	9	9	0.3	0.3	^{7}Li	
^{10}Be	4	10	1.51E + 6 y	B−	0	0	0	0	1726.4	0.0	^{10}B	
^{10}C	6	10	19.255 s	ECB+	156	291	1428	292	1171.0	8.5	^{10}B	
^{11}C	6	11	20.39 m	ECB+	11	174	6	174	1578.6	6.0	^{11}B	
^{14}C	6	14	5.70E + 3 y	B−	0	0	0	0	31.7	0.0	^{14}N	
^{13}N	7	13	9.965 m	ECB+	14	174	38	174	1443.6	6.0	^{13}C	
^{16}N	7	16	7.13 s	B−	3882	209	7246	69	851.8	0.7	^{16}O	
^{14}O	8	14	70.606 s	ECB+	319	447	1248	328	1191.1	7.4	^{14}N	
^{15}O	8	15	122.24 s	ECB+	33	174	876	174	1217.9	6.0	^{15}N	
^{19}O	8	19	26.464 s	B−	1519	140	6217	128	908.8	4.2	^{19}F	
^{17}F	9	17	64.49 s	ECB+	34	174	894	174	1214.7	6.0	^{17}O	
^{18}F	9	18	109.77 m	ECB+	7	169	5	169	1675.6	5.8	^{18}O	
^{19}Ne	10	19	17.22 s	ECB+	49	174	2229	174	1080.2	6.0	^{19}F	
^{24}Ne	10	24	3.38 m	B−	94	92	1462	92	1158.5	3.2	^{24}Na	
^{22}Na	11	22	2.6019 y	ECB+	188	340	175	327	1563.8	7.4	^{22}Ne	
^{24}Na	11	24	14.9590 h	B−	497	496	482	316	1323.6	3.1	^{24}Mg	
^{27}Mg	12	27	9.458 m	B−	140	139	902	138	1211.8	2.3	^{27}Al	
^{28}Mg	12	28	20.915 h	B−	215	215	205	205	1336.5	4.9	^{28}Al	
^{26}Al	13	26	7.17E + 5 y	ECB+	249	380	221	315	1130.3	6.6	^{26}Mg	
^{28}Al	13	28	2.2414 m	B−	299	230	4245	170	982.8	1.6	^{28}Si	
^{29}Al	13	29	6.56 m	B−	196	193	2636	170	1074.8	2.0	^{29}Si	
^{31}Si	14	31	157.3 m	B−	0	0	297	0	1281.4	0.0	^{31}P	
^{32}Si	14	32	132 y	B−	0	0	0	0	321.2	0.0	^{32}P	
^{30}P	15	30	2.498 m	ECB+	414	174	4990	174	940.7	6.0	^{30}Si	
^{32}P	15	32	14.263 d	B−	1	0	736	0	1211.3	0.0	^{32}S	
^{33}P	15	33	25.34 d	B−	0	0	0	0	463.9	0.0	^{33}S	
^{35}S	16	35	87.51 d	B−	0	0	0	0	52.3	0.0	^{35}Cl	
^{37}S	16	37	5.05 m	B−	479	299	1323	126	1179.1	1.1	^{37}Cl	
^{38}S	16	38	170.3 m	B−	230	212	720	143	1401.6	1.3	^{38}Cl	
^{34}Cl	17	34	1.5264 s	ECB+	2353	174	6835	174	857.7	6.0	^{34}S	
^{34m}Cl	17	34	32.00 m	ECB+IT	211	281	1021	213	744.1	5.4	^{34}Cl	^{34}S
^{36}Cl	17	36	3.01E + 5 y	B−ECB+	0	0	0	0	1511.3	0.0	^{36}Ar	^{36}S
^{38}Cl	17	38	37.24 m	B−	2080	181	4598	122	1052.2	1.1	^{38}Ar	
^{39}Cl	17	39	55.6 m	B−	256	209	1705	189	1156.3	3.5	^{39}Ar	
^{40}Cl	17	40	1.35 m	B−	1414	463	5145	299	965.9	3.2	^{40}Ar	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded μSv h^{-1} GBq^{-1}	Shielded	Unshielded μSv h^{-1} GBq^{-1}	Shielded	Unshielded mSv h^{-1} GBq^{-1}	Shielded		
^{37}Ar	18	37	35.04 d	EC	0	0	0	0	0.0	0.0	^{37}Cl	
^{39}Ar	18	39	269 y	B−	0	0	0	0	1560.9	0.0	^{39}K	
^{41}Ar	18	41	109.61 m	B−	184	184	222	169	1395.5	1.9	^{41}K	
^{42}Ar	18	42	32.9 y	B−	0	0	0	0	1559.6	0.0	^{42}K	
^{43}Ar	18	43	5.37 m	B−	1056	211	4358	177	1016.8	2.5	^{43}K	
^{44}Ar	18	44	11.87 m	B−	268	262	527	206	1363.6	4.1	^{44}K	
^{38}K	19	38	7.636 m	ECB+	398	436	3926	332	986.5	7.5	^{38}Ar	
^{40}K	19	40	1.251E + 9 y	B−ECB+	22	22	192	19	1133.6	0.2	^{40}Ca	^{40}Ar
^{42}K	19	42	12.360 h	B−	665	38	4885	32	973.3	0.3	^{42}Ca	
^{43}K	19	43	22.3 h	B−	162	162	186	164	1516.9	6.1	^{43}Ca	
^{44}K	19	44	22.13 m	B−	1939	305	4025	233	1040.0	2.9	^{44}Ca	
^{45}K	19	45	17.3 m	B−	450	245	2609	188	1101.0	4.0	^{45}Ca	
^{46}K	19	46	105 s	B−	4086	336	6731	244	881.3	2.6	^{46}Ca	
^{41}Ca	20	41	1.02E + 5 y	EC	0	0	0	0	0.0	0.0	^{41}K	
^{45}Ca	20	45	162.67 d	B−	0	0	0	0	491.1	0.0	^{45}Sc	
^{47}Ca	20	47	4.536 d	B−	153	152	413	141	1457.8	1.8	^{47}Sc	
^{49}Ca	20	49	8.718 m	B−	321	318	1959	134	1117.5	1.2	^{49}Sc	
^{42m}Sc	21	42	62.0 s	ECB+	615	635	4466	591	978.2	12.9	^{42}Ca	
^{43}Sc	21	43	3.891 h	ECB+	27	168	44	168	1319.4	6.0	^{43}Ca	
^{44}Sc	21	44	3.97 h	ECB+	193	336	477	330	1237.4	7.8	^{44}Ca	
^{44m}Sc	21	44	58.61 h	ITEC	47	47	48	48	298.5	3.2	^{44}Sc	^{44}Ca
^{46}Sc	21	46	83.79 d	B−	304	304	300	300	1015.2	4.5	^{46}Ti	
^{47}Sc	21	47	3.3492 d	B−	20	20	19	19	1356.2	1.9	^{47}Ti	
^{48}Sc	21	48	43.67 h	B−	495	495	478	478	1512.9	6.7	^{48}Ti	
^{49}Sc	21	49	57.2 m	B−	2	0	1429	0	1133.6	0.0	^{49}Ti	
^{50}Sc	21	50	102.5 s	B−	1353	463	6267	419	922.0	6.6	^{50}Ti	
^{44}Ti	22	44	60.0 y	EC	31	31	29	29	3.0	2.9	^{44}Sc	
^{45}Ti	22	45	184.8 m	ECB+	11	148	7	148	1315.9	5.1	^{45}Sc	
^{51}Ti	22	51	5.76 m	B−	65	63	1830	64	1117.8	3.4	^{51}V	
^{52}Ti	22	52	1.7 m	B−	29	28	1035	32	1184.3	3.4	^{52}V	
^{47}V	23	47	32.6 m	ECB+	40	169	1318	169	1114.4	5.8	^{47}Ti	
^{48}V	23	48	15.9735 d	ECB+	355	438	351	420	894.0	7.4	^{48}Ti	
^{49}V	23	49	330 d	EC	0	0	0	0	0.0	0.0	^{49}Ti	
^{50}V	23	50	1.50E + 17 y	ECB−	197	197	166	166	80.2	1.8	^{50}Ti	^{50}Cr
^{52}V	23	52	3.743 m	B−	211	201	3217	176	1032.5	1.8	^{52}Cr	
^{53}V	23	53	1.61 m	B−	160	156	2775	154	1054.0	2.3	^{53}Cr	
^{48}Cr	24	48	21.56 h	ECB+	75	78	75	78	24.8	5.5	^{48}V	
^{49}Cr	24	49	42.3 m	ECB+	43	182	373	182	1261.0	7.5	^{49}V	

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^{51}Cr	24	51	27.7025 d	EC	6	6	6	6	0.7	0.3	^{51}V	
^{55}Cr	24	55	3.497 m	B−	14	0	3240	0	1019.3	0.0	^{55}Mn	
^{56}Cr	24	56	5.94 m	B−	29	28	340	30	1278.6	3.0	^{56}Mn	
^{50m}Mn	25	50	1.75 m	ECB+	1177	705	5838	671	929.6	13.2	^{50}Cr	
^{51}Mn	25	51	46.2 m	ECB+	48	170	2123	170	1048.7	5.8	^{51}Cr	
^{52}Mn	25	52	5.591 d	ECB+	470	520	444	494	552.6	8.2	^{52}Cr	
^{52m}Mn	25	52	21.1 m	ECB+IT	287	367	3580	341	969.4	7.6	^{52}Mn	^{52}Cr
^{53}Mn	25	53	3.7E + 6 y	EC	0	0	0	0	0.0	0.0	^{53}Cr	
^{54}Mn	25	54	312.12 d	ECB+B−	132	132	132	132	2.5	2.3	^{54}Cr	^{54}Fe
^{56}Mn	25	56	2.5789 h	B−	274	239	2424	204	1197.5	2.9	^{56}Fe	
^{57}Mn	25	57	85.4 s	B−	37	18	3208	22	1033.8	1.6	^{57}Fe	
^{58m}Mn	25	58	65.2 s	B−	1699	349	6392	319	908.7	5.0	^{58}Fe	
^{52}Fe	26	52	8.275 h	ECB+	36	127	34	127	980.7	6.3	^{52m}Mn	
^{53}Fe	26	53	8.51 m	ECB+	118	200	3221	199	989.8	7.2	^{53}Mn	
^{53m}Fe	26	53	2.526 m	IT	448	448	418	417	9.8	6.3	^{53}Fe	
^{55}Fe	26	55	2.737 y	EC	0	0	0	0	0.0	0.0	^{55}Mn	
^{59}Fe	26	59	44.495 d	B−	173	173	167	165	953.8	2.2	^{59}Co	
^{60}Fe	26	60	1.5E + 6 y	B−	0	0	0	0	163.4	0.0	^{60m}Co	
^{61}Fe	26	61	5.98 m	B−	239	202	3427	187	1042.0	3.3	^{61}Co	
^{62}Fe	26	62	68 s	B−	88	86	1576	86	1132.7	3.0	^{62}Co	
^{54m}Co	27	54	1.48 m	ECB+	2779	603	7231	576	863.8	13.0	^{54}Fe	
^{55}Co	27	55	17.53 h	ECB+	199	317	354	310	1065.1	7.6	^{55}Fe	
^{56}Co	27	56	77.23 d	ECB+	467	496	434	411	259.4	6.2	^{56}Fe	
^{57}Co	27	57	271.74 d	EC	24	24	27	27	24.9	2.9	^{57}Fe	
^{58}Co	27	58	70.86 d	ECB+	131	157	131	156	276.0	3.2	^{58}Fe	
^{58m}Co	27	58	9.04 h	IT	0	0	0	0	0.0	0.0	^{58}Co	
^{60}Co	27	60	5.2713 y	B−	360	360	338	337	805.6	4.0	^{60}Ni	
^{60m}Co	27	60	10.467 m	ITB−	1	1	2	1	3.1	0.0	^{60}Co	^{60}Ni
^{61}Co	27	61	1.650 h	B−	20	20	67	19	1360.4	1.3	^{61}Ni	
^{62}Co	27	62	1.50 m	B−	1286	220	5826	188	923.8	2.3	^{62}Ni	
^{62m}Co	27	62	13.91 m	B−	457	378	3580	336	1051.3	4.2	^{62}Ni	
^{56}Ni	28	56	6.075 d	ECB+	276	276	271	271	45.4	8.5	^{56}Co	
^{57}Ni	28	57	35.60 h	ECB+	211	282	180	252	740.8	4.8	^{57}Co	
^{59}Ni	28	59	1.01E + 5 y	ECB+	0	0	0	0	0.0	0.0	^{59}Co	
^{63}Ni	28	63	100.1 y	B−	0	0	0	0	0.0	0.0	^{63}Cu	
^{65}Ni	28	65	2.51719 h	B−	80	79	1155	71	1253.6	0.9	^{65}Cu	
^{66}Ni	28	66	54.6 h	B−	0	0	0	0	436.2	0.0	^{66}Cu	
^{57}Cu	29	57	0.1963 s	ECB+	7147	191	8159	190	799.0	6.2	^{57}Ni	
^{59}Cu	29	59	81.5 s	ECB+	807	238	5082	234	921.8	7.1	^{59}Ni	
^{60}Cu	29	60	23.7 m	ECB+	514	557	2367	480	1024.8	9.3	^{60}Ni	
^{61}Cu	29	61	3.333 h	ECB+	40	139	57	138	909.2	4.7	^{61}Ni	
^{62}Cu	29	62	9.673 m	ECB+	198	172	4249	171	942.3	5.9	^{62}Ni	
^{64}Cu	29	64	12.700 h	ECB+B−	1	31	1	31	876.0	1.1	^{64}Ni	^{64}Zn
^{66}Cu	29	66	5.120 m	B−	31	15	3068	15	1038.4	0.2	^{66}Zn	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded		
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}			
^{67}Cu	29	67	61.83 h	B−	21	21	21	21	1194.2	2.0	^{67}Zn	
^{69}Cu	29	69	2.85 m	B−	93	81	2124	79	1129.7	1.4	^{69}Zn	
^{60}Zn	30	60	2.38 m	ECB+	205	259	3421	260	975.8	8.8	^{60}Cu	
^{61}Zn	30	61	89.1 s	ECB+	2022	243	6086	229	878.7	6.9	^{61}Cu	
^{62}Zn	30	62	9.186 h	ECB+	63	77	63	77	159.5	2.9	^{62}Cu	
^{63}Zn	30	63	38.47 m	ECB+	71	184	2250	184	1000.6	6.0	^{63}Cu	
^{65}Zn	30	65	244.06 d	ECB+	83	86	82	84	22.2	1.2	^{65}Cu	
^{69}Zn	30	69	56.4 m	B−	0	0	1	0	1488.3	0.0	^{69}Ga	
^{69m}Zn	30	69	13.76 h	ITB−	72	72	72	72	81.0	3.0	^{69}Zn	^{69}Ga
^{71}Zn	30	71	2.45 m	B−	81	51	2994	51	1052.7	1.5	^{71}Ga	
^{71m}Zn	30	71	3.96 h	B−	261	260	512	261	1303.8	9.0	^{71}Ga	
^{72}Zn	30	72	46.5 h	B−	29	29	33	33	677.7	4.1	^{72}Ga	
^{64}Ga	31	64	2.627 m	ECB+	1970	465	5259	387	909.0	8.6	^{64}Zn	
^{65}Ga	31	65	15.2 m	ECB+	81	198	1601	196	1021.3	7.4	^{65}Zn	
^{66}Ga	31	66	9.49 h	ECB+	1089	314	3372	236	528.5	5.0	^{66}Zn	
^{67}Ga	31	67	3.2612 d	EC	28	28	28	28	16.9	2.2	^{67}Zn	
^{68}Ga	31	68	67.71 m	ECB+	42	161	1203	161	1030.9	5.4	^{68}Zn	
^{70}Ga	31	70	21.14 m	B−EC	2	1	570	1	1227.3	0.0	^{70}Ge	^{70}Zn
^{72}Ga	31	72	14.10 h	B−	399	375	1128	307	1358.6	4.7	^{72}Ge	
^{73}Ga	31	73	4.86 h	B−	61	61	120	65	1374.8	4.7	^{73}Ge	
^{74}Ga	31	74	8.12 m	B−	640	420	2897	320	1109.6	5.6	^{74}Ge	
^{66}Ge	32	66	2.26 h	ECB+	80	118	82	121	427.9	6.5	^{66}Ga	
^{67}Ge	32	67	18.9 m	ECB+	282	235	3744	229	981.5	8.8	^{67}Ga	
^{68}Ge	32	68	270.95 d	EC	0	0	3	3	0.9	0.9	^{68}Ga	
^{69}Ge	32	69	39.05 h	ECB+	109	147	115	146	352.6	3.9	^{69}Ga	
^{71}Ge	32	71	11.43 d	EC	0	0	3	3	1.0	1.0	^{71}Ga	
^{75}Ge	32	75	82.78 m	B−	6	6	24	6	1410.2	0.5	^{75}As	
^{77}Ge	32	77	11.30 h	B−	176	175	1161	171	1330.6	7.5	^{77}As	
^{78}Ge	32	78	88 m	B−	49	49	50	50	1497.1	3.6	^{78}As	
^{68}As	33	68	151.6 s	ECB+	2625	555	6916	510	863.1	11.1	^{68}Ge	
^{69}As	33	69	15.23 m	ECB+	223	191	3977	187	928.3	6.6	^{69}Ge	
^{70}As	33	70	52.6 m	ECB+	538	638	2463	595	995.3	12.3	^{70}Ge	
^{71}As	33	71	65.28 h	ECB+	51	97	52	99	730.8	5.5	^{71}Ge	
^{72}As	33	72	26.0 h	ECB+	295	288	3137	282	919.8	7.6	^{72}Ge	
^{73}As	33	73	80.30 d	EC	3	3	9	9	2.1	2.1	^{73}Ge	
^{74}As	33	74	17.77 d	ECB+B−	76	126	126	128	927.6	4.3	^{74}Ge	^{74}Se
^{76}As	33	76	1.0778 d	B−	141	66	3218	65	1046.9	1.7	^{76}Se	
^{77}As	33	77	38.83 h	B−	1	1	2	2	1473.5	0.1	^{77}Se	

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^{78}As	33	78	90.7 m	B−	900	193	3934	176	1062.8	3.4	^{78}Se	
^{79}As	33	79	9.01 m	B−	7	6	1861	6	1105.5	0.2	^{79m}Se	^{79}Se
^{70}Se	34	70	41.1 m	ECB+	60	130	108	171	695.9	19.7	^{70}As	
^{71}Se	34	71	4.74 m	ECB+	655	262	4685	259	946.3	8.8	^{71}As	
^{72}Se	34	72	8.40 d	EC	14	14	51	51	13.6	13.6	^{72}As	
^{73}Se	34	73	7.15 h	ECB+	88	191	164	206	943.4	13.2	^{73}As	
^{73m}Se	34	73	39.8 m	ITECB+	16	45	171	52	260.5	3.6	^{73}Se	^{73}As
^{75}Se	34	75	119.779 d	EC	71	71	100	100	48.2	15.1	^{75}As	
^{77m}Se	34	77	17.36 s	IT	17	17	30	30	1274.8	5.1	^{77}Se	
^{79}Se	34	79	2.95E + 5 y	B−	0	0	0	0	32.5	0.0	^{79}Br	
^{79m}Se	34	79	3.92 m	ITB−	5	5	27	27	6.7	6.5	^{79}Se	^{79}Br
^{81}Se	34	81	18.45 m	B−	2	1	425	1	1255.4	0.1	^{81}Br	
^{81m}Se	34	81	57.28 m	ITB−	6	6	28	28	7.4	6.6	^{81}Se	^{81}Br
^{83}Se	34	83	22.3 m	B−	408	392	833	356	1424.2	9.1	^{83}Br	
^{83m}Se	34	83	70.1 s	B−	506	143	4079	130	1010.1	2.4	^{83}Br	
^{84}Se	34	84	3.1 m	B−	73	73	280	74	1304.5	3.3	^{84}Br	
^{72}Br	35	72	78.6 s	ECB+	5170	458	7790	436	854.1	11.0	^{72}Se	
^{73}Br	35	73	3.4 m	ECB+	473	243	4544	247	921.4	9.7	^{73m}Se	^{73}Se
^{74}Br	35	74	25.4 m	ECB+	961	570	2977	421	974.0	10.9	^{74}Se	
^{74m}Br	35	74	46 m	ECB+	1358	578	4175	495	908.5	12.5	^{74}Se	
^{75}Br	35	75	96.7 m	ECB+	101	206	660	214	932.3	10.9	^{75}Se	
^{76}Br	35	76	16.2 h	ECB+	547	395	2237	342	640.1	11.4	^{76}Se	
^{76m}Br	35	76	1.31 s	ITECB+	20	20	69	59	14.0	11.3	^{76}Br	^{76}Se
^{77}Br	35	77	57.036 h	ECB+	57	58	85	86	61.5	10.7	^{77}Se	
^{77m}Br	35	77	4.28 m	IT	8	8	29	29	6.1	5.9	^{77}Br	
^{78}Br	35	78	6.46 m	ECB+B−	83	176	2880	178	947.9	6.6	^{78}Se	^{78}Kr
^{80}Br	35	80	17.68 m	B−ECB+	10	13	1199	15	1095.1	0.9	^{80}Kr	^{80}Se
^{80m}Br	35	80	4.4205 h	IT	17	17	59	59	11.5	11.5	^{80}Br	
^{82}Br	35	82	35.30 h	B−	412	412	416	404	1221.4	8.2	^{82}Kr	
^{82m}Br	35	82	6.13 m	ITB−	12	6	132	28	29.8	5.9	^{82}Br	^{82}Kr
^{83}Br	35	83	2.40 h	B−	1	1	3	1	1470.1	0.0	^{83m}Kr	^{83}Kr
^{84}Br	35	84	31.80 m	B−	1204	217	3754	158	1089.1	2.1	^{84}Kr	
^{84m}Br	35	84	6.0 m	B−	416	414	2349	386	1104.6	7.3	^{84}Kr	
^{85}Br	35	85	2.90 m	B−	20	10	2934	10	1047.0	0.2	^{85m}Kr	^{85}Kr
^{74}Kr	36	74	11.50 m	ECB+	76	185	724	197	1017.9	11.4	^{74}Br	
^{75}Kr	36	75	4.29 m	ECB+	859	218	5417	224	912.4	10.8	^{75}Br	
^{76}Kr	36	76	14.8 h	EC	83	83	118	118	25.5	13.5	^{76}Br	^{76m}Br
^{77}Kr	36	77	74.4 m	ECB+	69	180	1055	187	1000.8	10.0	^{77}Br	^{77m}Br
^{79}Kr	36	79	35.04 h	ECB+	37	48	64	75	143.6	8.8	^{79}Br	
^{81}Kr	36	81	2.29E + 5 y	EC	7	7	34	34	7.3	7.2	^{81}Br	
^{81m}Kr	36	81	13.10 s	ITEC	26	26	34	34	1061.8	4.3	^{81}Kr	^{81}Br
^{83m}Kr	36	83	1.83 h	IT	2	2	10	10	1.9	1.9	^{83}Kr	
^{85}Kr	36	85	10.756 y	B−	0	0	0	0	1470.9	0.0	^{85}Rb	
^{85m}Kr	36	85	4.480 h	B−IT	29	29	32	32	1397.2	3.2	^{85}Kr	^{85}Rb

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield		
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded			
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}				
^{87}Kr	36	87	76.3 m	B−	660	108	4498	83	1023.9	2.2	^{87}Rb		
^{88}Kr	36	88	2.84 h	B−	267	250	862	176	1339.0	3.7	^{88}Rb		
^{89}Kr	36	89	3.15 m	B−	1224	256	4381	205	1037.2	4.2	^{89}Rb		
^{77}Rb	37	77	3.77 m	ECB+	1413	260	5764	261	898.9	10.5	^{77}Kr		
^{78}Rb	37	78	17.66 m	ECB+	1281	514	3924	381	886.6	10.3	^{78}Kr		
^{78m}Rb	37	78	5.74 m	ECB+IT	1565	486	5210	444	800.2	11.7	^{78}Rb	^{78}Kr	
^{79}Rb	37	79	22.9 m	ECB+	143	248	1693	261	1125.9	12.9	^{79}Kr		
^{80}Rb	37	80	33.4 s	ECB+	2436	202	6780	202	842.1	6.8	^{80}Kr		
^{81}Rb	37	81	4.576 h	ECB+	47	92	66	112	441.8	7.9	^{81m}Kr	^{81}Kr	
^{81m}Rb	37	81	30.5 m	ITECB+	11	12	32	33	19.0	5.0	^{81}Rb	^{81}Kr	^{81m}Kr
^{82}Rb	37	82	1.273 m	ECB+	528	188	4914	189	893.3	6.4	^{82}Kr		
^{82m}Rb	37	82	6.472 h	ECB+	429	463	483	476	381.8	14.9	^{82}Kr		
^{83}Rb	37	83	86.2 d	EC	91	91	119	119	12.1	9.5	^{83m}Kr	^{83}Kr	
^{84}Rb	37	84	32.77 d	ECB+B−	110	151	246	170	467.5	8.0	^{84}Kr	^{84}Sr	
^{84m}Rb	37	84	20.26 m	IT	70	70	80	80	1126.2	6.4	^{84}Rb		
^{86}Rb	37	86	18.642 d	B−EC	15	14	919	14	1213.6	0.2	^{86}Sr	^{86}Kr	
^{86m}Rb	37	86	1.017 m	IT	92	92	93	93	26.0	3.0	^{86}Rb		
^{87}Rb	37	87	4.923E10 y	B−	0	0	0	0	1143.3	0.0	^{87}Sr		
^{88}Rb	37	88	17.78 m	B−	3097	83	6298	63	895.0	0.7	^{88}Sr		
^{89}Rb	37	89	15.15 m	B−	705	307	2505	259	1152.0	3.5	^{89}Sr		
^{90}Rb	37	90	158 s	B−	3389	201	5643	122	944.3	1.6	^{90}Sr		
^{90m}Rb	37	90	258 s	B−IT	1523	402	4482	297	976.5	4.2	^{90}Sr	^{90}Rb	
^{79}Sr	38	79	2.25 m	ECB+	1690	210	6397	223	873.1	11.2	^{79}Rb		
^{80}Sr	38	80	106.3 m	ECB+	66	82	91	107	191.4	8.4	^{80}Rb		
^{81}Sr	38	81	22.3 m	ECB+	160	236	2754	241	1052.2	10.5	^{81}Rb	^{81m}Rb	
^{82}Sr	38	82	25.36 d	EC	11	11	37	37	6.2	6.2	^{82}Rb		
^{83}Sr	38	83	32.41 h	ECB+	104	146	149	180	405.4	12.0	^{83}Rb		
^{85}Sr	38	85	64.84 d	EC	95	95	122	122	18.4	9.2	^{85}Rb		
^{85m}Sr	38	85	67.63 m	ITECB+	40	40	45	45	87.5	4.3	^{85}Sr	^{85}Rb	
^{87m}Sr	38	87	2.815 h	ITEC	58	58	63	63	304.0	3.7	^{87}Rb	^{87}Sr	
^{89}Sr	38	89	50.53 d	B−	0	0	368	0	1254.2	0.0	^{89}Y		
^{90}Sr	38	90	28.79 y	B−	0	0	0	0	1456.8	0.0	^{90}Y		
^{91}Sr	38	91	9.63 h	B−	120	109	1234	109	1265.6	2.0	^{91m}Y	^{91}Y	
^{92}Sr	38	92	2.66 h	B−	190	190	226	170	1385.5	2.0	^{92}Y		
^{93}Sr	38	93	7.423 m	B−	403	338	1812	313	1699.3	7.4	^{93}Y		
^{94}Sr	38	94	75.3 s	B−	208	200	1787	176	1125.0	1.9	^{94}Y		
^{81}Y	39	81	70.4 s	ECB+	1991	209	6560	224	860.2	11.8	^{81}Sr		
^{83}Y	39	83	7.08 m	ECB+	532	232	4403	246	895.4	11.2	^{83}Sr		

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^{83m}Y	39	83	2.85 m	ECB+IT	227	148	2674	157	739.8	8.0	^{83}Sr	^{83}Y
^{84m}Y	39	84	39.5 m	ECB+	906	623	4281	612	903.6	13.5	^{84}Sr	
^{85}Y	39	85	2.68 h	ECB+	91	187	630	195	830.8	8.0	^{85m}Sr	
^{85m}Y	39	85	4.86 h	ECB+	137	208	1457	202	640.0	7.8	^{85}Sr	^{85m}Sr
^{86}Y	39	86	14.74 h	ECB+	497	537	694	512	449.3	13.4	^{86}Sr	
^{86m}Y	39	86	48 m	ITECB+	39	40	42	41	187.1	3.6	^{86}Y	^{86}Sr
^{87}Y	39	87	79.8 h	ECB+	88	88	113	114	16.0	8.6	^{87m}Sr	
^{87m}Y	39	87	13.37 h	ITECB+	55	56	61	62	366.3	3.7	^{87}Y	^{87}Sr
^{88}Y	39	88	106.65 d	ECB+	379	380	339	338	13.5	9.5	^{88}Sr	
^{89m}Y	39	89	15.663 s	IT	140	140	140	140	10.6	2.3	^{89}Y	
^{90}Y	39	90	64.10 h	B−	2	0	2345	0	1086.9	0.0	^{90}Zr	
^{90m}Y	39	90	3.19 h	ITB−	112	112	115	115	218.8	6.6	^{90}Y	^{90}Zr
^{91}Y	39	91	58.51 d	B−	1	0	457	0	1241.5	0.0	^{91}Zr	
^{91m}Y	39	91	49.71 m	IT	89	89	91	91	67.9	3.1	^{91}Y	
^{92}Y	39	92	3.54 h	B−	760	38	4959	37	979.2	0.6	^{92}Zr	
^{93}Y	39	93	10.18 h	B−	107	14	3794	12	1029.0	0.4	^{93}Zr	
^{94}Y	39	94	18.7 m	B−	1918	115	6113	110	909.8	1.8	^{94}Zr	
^{95}Y	39	95	10.3 m	B−	1530	133	4467	90	1049.2	1.1	^{95}Zr	
^{85}Zr	40	85	7.86 m	ECB+	552	246	4571	245	881.7	8.6	^{85m}Y	^{85}Y
^{86}Zr	40	86	16.5 h	ECB+	80	80	124	124	131.6	14.0	^{86}Y	
^{87}Zr	40	87	1.68 h	ECB+	58	158	2007	161	870.1	6.0	^{87m}Y	^{87}Y
^{88}Zr	40	88	83.4 d	EC	81	81	106	106	54.6	8.6	^{88}Y	
^{89}Zr	40	89	78.41 h	ECB+	156	193	173	211	392.4	7.8	^{89}Y	
^{89m}Zr	40	89	4.161 m	ITECB+	101	104	107	105	79.3	3.3	^{89}Zr	^{89}Y
^{93}Zr	40	93	1.53E + 6 y	B−	0	0	0	0	0.0	0.0	^{93m}Nb	^{93}Nb
^{95}Zr	40	95	64.032 d	B−	118	118	119	119	1030.0	2.4	^{95}Nb	^{95m}Nb
^{97}Zr	40	97	16.744 h	B−	142	140	1156	140	1213.6	2.9	^{97}Nb	
^{87}Nb	41	87	3.75 m	ECB+	1186	220	5958	235	1383.0	13.1	^{87}Zr	
^{88}Nb	41	88	14.5 m	ECB+	1115	676	5349	685	894.0	19.6	^{88}Zr	
^{88m}Nb	41	88	7.78 m	ECB+	1317	638	5286	618	887.9	15.0	^{88}Zr	
^{89}Nb	41	89	2.03 h	ECB+	378	208	3809	190	714.9	6.3	^{89}Zr	^{89m}Zr
^{89m}Nb	41	89	66 m	ECB+	129	225	1897	229	873.1	8.5	^{89m}Zr	
^{90}Nb	41	90	14.60 h	ECB+	500	581	591	469	931.9	12.6	^{90}Zr	
^{91}Nb	41	91	680 y	ECB+	16	17	37	38	6.6	4.9	^{91}Zr	
^{91m}Nb	41	91	60.86 d	ITECB+	18	18	34	33	3.9	3.8	^{91}Nb	^{91}Zr
^{92}Nb	41	92	3.47E + 7 y	EC	253	253	274	274	14.6	10.0	^{92}Zr	
^{92m}Nb	41	92	10.15 d	ECB+	163	164	184	184	8.4	7.3	^{92}Zr	
^{93m}Nb	41	93	16.13 y	IT	3	3	6	6	0.8	0.8	^{93}Nb	
^{94}Nb	41	94	2.03E + 4 y	B−	248	248	249	249	1406.4	4.7	^{94}Mo	
^{94m}Nb	41	94	6.263 m	ITB−	12	12	25	25	9.9	3.0	^{94}Nb	^{94}Mo
^{95}Nb	41	95	34.991 d	B−	123	123	123	123	32.0	2.3	^{95}Mo	
^{95m}Nb	41	95	3.61 d	ITB−	23	23	36	35	2140.6	3.9	^{95}Nb	^{95}Mo
^{96}Nb	41	96	23.35 h	B−	388	388	385	384	1497.5	8.0	^{96}Mo	
^{97}Nb	41	97	72.1 m	B−	108	108	167	109	1362.1	2.7	^{97}Mo	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded	Shielded	$H_p(3)_{slab}$, 100 cm Unshielded	Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded	Shielded	Daughter nuclei with highest yield	
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}			
^{98m}Nb	41	98	51.3 m	B−	438	427	1709	404	1220.8	7.3	^{98}Mo	
^{99}Nb	41	99	15.0 s	B−	477	43	5221	52	993.2	5.6	^{99}Mo	
^{99m}Nb	41	99	2.6 m	B−IT	924	100	4717	74	993.6	1.8	^{99}Mo	^{99}Nb
^{89}Mo	42	89	2.11 m	ECB+	2261	202	6502	199	833.4	6.4	^{89}Nb	
^{90}Mo	42	90	5.56 h	ECB+	120	161	143	184	857.9	12.9	^{90}Nb	
^{91}Mo	42	91	15.49 m	ECB+	606	167	5132	167	862.7	5.9	^{91}Nb	^{91m}Nb
^{91m}Mo	42	91	64.6 s	ECB+IT	259	216	1780	208	457.8	5.1	^{91m}Nb	^{91}Mo
^{93}Mo	42	93	4.0E + 3 y	EC	17	17	35	35	4.4	4.4	^{93m}Nb	^{93}Nb
^{93m}Mo	42	93	6.85 h	ITEC	348	348	329	326	1064.8	7.8	^{93}Mo	^{93}Nb
^{99}Mo	42	99	65.94 h	B−	25	25	51	26	1376.2	1.0	^{99m}Tc	^{99}Tc
^{101}Mo	42	101	14.61 m	B−	220	218	957	199	1494.0	4.4	^{101}Tc	
^{102}Mo	42	102	11.3 m	B−	3	3	6	4	1457.3	0.3	^{102}Tc	
^{91}Tc	43	91	3.14 m	ECB+	1974	357	5429	301	841.6	7.5	^{91}Mo	^{91m}Mo
^{91m}Tc	43	91	3.3 m	ECB+	2059	238	6354	236	838.5	7.8	^{91m}Mo	^{91}Mo
^{92}Tc	43	92	4.25 m	ECB+	1954	594	6454	558	1138.4	16.4	^{92}Mo	
^{93}Tc	43	93	2.75 h	ECB+	220	238	211	227	197.7	6.3	^{93}Mo	
^{93m}Tc	43	93	43.5 m	ITECB+	128	132	160	103	364.4	4.1	^{93}Tc	^{93}Mo
^{94}Tc	43	94	293 m	ECB+	420	438	435	453	201.5	11.9	^{94}Mo	
^{94m}Tc	43	94	52.0 m	ECB+	230	308	2206	297	734.7	8.0	^{94}Mo	
^{95}Tc	43	95	20.0 h	EC	144	144	161	161	8.7	6.6	^{95}Mo	
^{95m}Tc	43	95	61 d	ECB+IT	129	130	146	147	125.7	8.3	^{95}Tc	^{95}Mo
^{96}Tc	43	96	4.28 d	EC	414	414	429	429	16.4	11.3	^{96}Mo	
^{96m}Tc	43	96	51.5 m	ITECB+	16	16	23	23	2.2	2.1	^{96}Tc	^{96}Mo
^{97}Tc	43	97	2.6E + 6 y	EC	18	18	34	34	4.1	4.1	^{97}Mo	
^{97m}Tc	43	97	90.1 d	IT	14	14	25	25	2.9	2.9	^{97}Tc	
^{98}Tc	43	98	4.2E + 6 y	B−	229	229	231	231	1294.7	5.1	^{98}Ru	
^{99}Tc	43	99	2.111E + 5 y	B−	0	0	0	0	906.0	0.0	^{99}Ru	
^{99m}Tc	43	99	6.015 h	ITB−	25	25	26	26	67.5	2.6	^{99}Tc	^{99}Ru
^{101}Tc	43	101	14.2 m	B−	59	59	128	60	1397.3	3.6	^{101}Ru	
^{102}Tc	43	102	5.28 s	B−	2028	13	6656	12	874.4	0.3	^{102}Ru	
^{102m}Tc	43	102	4.35 m	B−IT	374	356	1742	308	1147.6	6.4	^{102}Tc	^{102}Ru
^{104}Tc	43	104	18.3 m	B−	1560	313	5441	257	980.7	6.4	^{104}Ru	
^{105}Tc	43	105	7.6 m	B−	411	130	4129	124	1105.9	5.5	^{105}Ru	
^{92}Ru	44	92	3.65 m	ECB+	330	371	2248	381	1019.1	21.6	^{92}Tc	
^{94}Ru	44	94	51.8 m	ECB+	104	104	119	119	20.0	7.1	^{94m}Tc	
^{95}Ru	44	95	1.643 h	ECB+	187	210	198	215	234.4	8.8	^{95}Tc	^{95m}Tc
^{97}Ru	44	97	2.9 d	EC	61	61	76	76	115.8	7.5	^{97}Tc	^{97m}Tc
^{103}Ru	44	103	39.26 d	B−	85	85	85	85	280.8	3.0	^{103m}Rh	^{103}Rh

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^{105}Ru	44	105	4.44 h	B−	126	126	172	129	1484.6	4.2	^{105}Rh	
^{106}Ru	44	106	373.59 d	B−	0	0	0	0	0.0	0.0	^{106}Rh	
^{107}Ru	44	107	3.75 m	B−	118	54	3169	53	1087.6	1.6	^{107}Rh	
^{108}Ru	44	108	4.55 m	B−	13	13	82	14	1476.4	1.5	^{108}Rh	
^{94}Rh	45	94	70.6 s	ECB+	5787	562	8005	516	813.9	11.0	^{94}Ru	
^{95}Rh	45	95	5.02 m	ECB+	439	385	3008	357	729.3	8.6	^{95}Ru	
^{95m}Rh	45	95	1.96 m	ITECB+	206	128	565	113	192.1	3.6	^{95}Rh	^{95}Ru
^{96}Rh	45	96	9.90 m	ECB+	576	620	2398	603	755.6	14.5	^{96}Ru	
^{96m}Rh	45	96	1.51 m	ITECB+	461	201	1880	189	337.2	5.3	^{96}Rh	^{96}Ru
^{97}Rh	45	97	30.7 m	ECB+	164	241	1105	237	674.6	8.5	^{97}Ru	
^{97m}Rh	45	97	46.2 m	ECB+IT	295	315	681	261	414.4	8.6	^{97}Ru	^{97}Rh
^{98}Rh	45	98	8.7 m	ECB+	633	296	4744	290	848.4	8.7	^{98}Ru	
^{99}Rh	45	99	16.1 d	ECB+	114	121	131	137	104.4	9.0	^{99}Ru	
^{99m}Rh	45	99	4.7 h	ECB+	112	124	123	135	155.6	7.4	^{99}Ru	
^{100}Rh	45	100	20.8 h	ECB+	396	400	444	342	57.0	9.3	^{100}Ru	
^{100m}Rh	45	100	4.6 m	ITECB+	34	35	47	46	10.1	4.7	^{100}Rh	^{100}Ru
^{101}Rh	45	101	3.3 y	EC	72	72	85	85	142.1	8.5	^{101}Ru	
^{101m}Rh	45	101	4.34 d	ECIT	69	69	81	81	175.2	6.7	^{101}Rh	^{101}Ru
^{102}Rh	45	102	207 d	ECB+B−	70	97	91	104	540.1	5.1	^{102}Ru	^{102}Pd
^{102m}Rh	45	102	3.742 y	ECB+IT	365	365	377	377	27.5	12.2	^{102}Rh	^{102}Ru
^{103m}Rh	45	103	56.114 m	IT	2	2	3	3	0.4	0.4	^{103}Rh	
^{104}Rh	45	104	42.3 s	B−EC	6	2	2555	2	1055.2	0.1	^{104}Pd	^{104}Ru
^{104m}Rh	45	104	4.34 m	ITB−	29	29	38	38	5.7	4.1	^{104}Rh	^{104}Pd
^{105}Rh	45	105	35.36 h	B−	14	14	14	14	1146.0	0.9	^{105}Pd	
^{106}Rh	45	106	29.80 s	B−	496	34	4911	34	963.8	1.0	^{106}Pd	
^{106m}Rh	45	106	131 m	B−	445	445	481	431	1475.7	9.8	^{106}Pd	
^{107}Rh	45	107	21.7 m	B−	55	55	113	56	1419.4	3.3	^{107}Pd	
^{108}Rh	45	108	16.8 s	B−	1623	54	6379	54	899.2	2.0	^{108}Pd	
^{109}Rh	45	109	80 s	B−	59	55	2194	57	1145.9	3.7	^{109}Pd	
^{96}Pd	46	96	122 s	ECB+	195	247	283	252	477.9	9.2	^{96m}Rh	
^{97}Pd	46	97	3.10 m	ECB+	435	362	2318	329	725.7	10.1	^{97}Rh	^{97m}Rh
^{98}Pd	46	98	17.7 m	ECB+	85	93	97	105	109.3	7.1	^{98}Rh	
^{99}Pd	46	99	21.4 m	ECB+	152	214	978	209	589.4	8.8	^{99m}Rh	^{99}Rh
^{100}Pd	46	100	3.63 d	EC	59	59	76	76	10.2	8.2	^{100}Rh	
^{101}Pd	46	101	8.47 h	ECB+	83	92	101	109	111.6	8.2	^{101m}Rh	^{101}Rh
^{103}Pd	46	103	16.991 d	EC	21	21	31	31	3.4	3.4	^{103m}Rh	^{103}Rh
^{107}Pd	46	107	6.5E + 6 y	B−	0	0	0	0	0.0	0.0	^{107}Ag	
^{109}Pd	46	109	13.7012 h	B−	11	11	17	14	1440.7	1.5	^{109}Ag	
^{109m}Pd	46	109	4.69 m	IT	27	27	30	30	1405.5	3.0	^{109}Pd	
^{111}Pd	46	111	23.4 m	B−	9	8	1702	7	1122.9	0.2	^{111m}Ag	^{111}Ag
^{112}Pd	46	112	21.03 h	B−	8	8	14	14	501.4	1.6	^{112}Ag	
^{114}Pd	46	114	2.42 m	B−	5	5	197	5	1317.8	0.4	^{114}Ag	
^{99}Ag	47	99	124 s	ECB+	940	362	4499	340	862.4	10.5	^{99}Pd	
^{100m}Ag	47	100	2.24 m	ECB+	2473	436	6388	409	825.4	10.0	^{100}Pd	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded μSv h^{-1} GBq^{-1}	$H_p(10)$, 100 cm Shielded	$H_p(3)_{slab}$, 100 cm Unshielded μSv h^{-1} GBq^{-1}	$H_p(3)_{slab}$, 100 cm Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded mSv h^{-1} GBq^{-1}	$H_p(0.07)_{slab}$, 10 cm Shielded	Daughter nuclei with highest yield	
^{101}Ag	47	101	11.1 m	ECB+	228	261	2522	257	789.7	9.4	^{101}Pd	
^{102}Ag	47	102	12.9 m	ECB+	536	517	2687	475	774.8	11.7	^{102}Pd	
^{102m}Ag	47	102	7.7 m	ECB+IT	331	272	1157	213	375.2	5.0	^{102}Ag	^{102}Pd
^{103}Ag	47	103	65.7 m	ECB+	111	152	212	156	422.5	7.6	^{103}Pd	
^{104}Ag	47	104	69.2 m	ECB+	412	437	436	430	256.7	11.3	^{104}Pd	
^{104m}Ag	47	104	33.5 m	ECB+IT	239	281	2346	258	638.2	8.2	^{104}Ag	^{104}Pd
^{105}Ag	47	105	41.29 d	EC	109	109	120	120	54.4	7.8	^{105}Pd	
^{105m}Ag	47	105	7.23 m	ITECB+	0	0	0	0	0.1	0.0	^{105}Ag	^{105}Pd
^{106}Ag	47	106	23.96 m	ECB+B−	48	127	839	130	677.8	5.4	^{106}Pd	^{106}Cd
^{106m}Ag	47	106	8.28 d	EC	458	458	455	454	40.6	13.0	^{106}Pd	
^{108}Ag	47	108	2.37 m	B−ECB+	4	4	505	4	1212.0	0.2	^{108}Cd	^{108}Pd
^{108m}Ag	47	108	418 y	ECIT	285	285	295	295	29.4	10.7	^{108}Ag	^{108}Pd
^{109m}Ag	47	109	39.6 s	IT	11	11	14	14	1.5	1.5	^{109}Ag	
^{110}Ag	47	110	24.6 s	B−EC	73	5	3766	5	999.0	0.1	^{110}Cd	^{110}Pd
^{110m}Ag	47	110	249.76 d	B−IT	427	427	421	418	434.0	7.7	^{110}Ag	^{110}Cd
^{111}Ag	47	111	7.45 d	B−	5	5	8	5	1443.1	0.3	^{111}Cd	
^{111m}Ag	47	111	64.8 s	ITB−	6	6	8	8	11.2	0.8	^{111}Ag	^{111}Cd
^{112}Ag	47	112	3.130 h	B−	837	101	4424	91	1013.9	1.8	^{112}Cd	
^{113}Ag	47	113	5.37 h	B−	14	12	1249	12	1174.5	0.6	^{113}Cd	^{113m}Cd
^{113m}Ag	47	113	68.7 s	ITB−	38	38	149	39	493.6	2.1	^{113}Ag	^{113}Cd
^{114}Ag	47	114	4.6 s	B−	2770	39	6879	35	863.2	0.8	^{114}Cd	
^{115}Ag	47	115	20.0 m	B−	182	70	3451	59	1129.6	1.9	^{115}Cd	^{115m}Cd
^{116}Ag	47	116	2.68 m	B−	1924	289	5900	222	927.6	4.3	^{116}Cd	
^{117}Ag	47	117	73.6 s	B−	791	173	3991	128	1091.6	3.2	^{117}Cd	^{117m}Cd
^{101}Cd	48	101	1.36 m	ECB+	649	382	3388	347	948.7	10.0	^{101}Ag	
^{102}Cd	48	102	5.5 m	ECB+	134	155	139	160	226.2	7.2	^{102m}Ag	^{102}Ag
^{103}Cd	48	103	7.3 m	ECB+	300	309	1041	265	476.1	7.4	^{103}Ag	
^{104}Cd	48	104	57.7 m	EC	68	68	77	77	6.8	5.6	^{104m}Ag	
^{105}Cd	48	105	55.5 m	ECB+	163	202	370	183	348.4	5.7	^{105m}Ag	^{105}Ag
^{107}Cd	48	107	6.50 h	ECB+	33	33	43	44	7.7	4.6	^{107}Ag	
^{109}Cd	48	109	461.4 d	EC	30	30	40	40	4.3	4.3	^{109}Ag	
^{111m}Cd	48	111	48.50 m	IT	60	60	64	64	1104.6	5.6	^{111}Cd	
^{113}Cd	48	113	7.7E + 15 y	B−	0	0	0	0	752.1	0.0	^{113}In	
^{113m}Cd	48	113	14.1 y	B−IT	0	0	0	0	1393.6	0.0	^{113}Cd	^{113}In
^{115}Cd	48	115	53.46 h	B−	34	34	39	34	1411.2	1.3	^{115m}In	
^{115m}Cd	48	115	44.6 d	B−	6	5	471	5	1241.7	0.1	^{115}In	^{115m}In
^{117}Cd	48	117	2.49 h	B−	162	162	717	150	1237.8	3.7	^{117m}In	^{117}In
^{117m}Cd	48	117	3.36 h	B−	281	281	307	232	1287.6	3.4	^{117}In	^{117m}In

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^{118}Cd	48	118	50.3 m	B−	0	0	0	0	1319.5	0.0	^{118}In	
^{119}Cd	48	119	2.69 m	B−	305	228	1883	188	1224.8	4.1	^{119m}In	^{119}In
^{119m}Cd	48	119	2.20 m	B−	324	320	1146	269	1221.7	4.1	^{119}In	^{119m}In
^{103}In	49	103	60 s	ECB+	1464	414	5371	377	965.3	10.9	^{103}Cd	
^{105}In	49	105	5.07 m	ECB+	553	309	3482	292	771.4	9.8	^{105}Cd	
^{106}In	49	106	6.2 m	ECB+	899	572	3757	570	803.8	14.2	^{106}Cd	
^{106m}In	49	106	5.2 m	ECB+	1710	414	5380	363	805.7	9.4	^{106}Cd	
^{107}In	49	107	32.4 m	ECB+	195	240	807	217	509.5	7.9	^{107}Cd	
^{108}In	49	108	58.0 m	ECB+	576	614	610	596	412.7	14.5	^{108}Cd	
^{108m}In	49	108	39.6 m	ECB+	546	375	2351	304	558.8	7.9	^{108}Cd	
^{109}In	49	109	4.2 h	ECB+	114	121	117	124	252.9	7.0	^{109}Cd	
^{109m}In	49	109	1.34 m	IT	100	100	102	102	79.3	2.7	^{109}In	
^{110}In	49	110	4.9 h	ECB+	505	505	511	511	22.6	12.4	^{110}Cd	
^{110m}In	49	110	69.1 m	ECB+	181	256	1650	247	659.1	7.7	^{110}Cd	
^{111}In	49	111	2.8047 d	EC	93	93	99	99	424.7	9.3	^{111m}Cd	^{111}Cd
^{111m}In	49	111	7.7 m	IT	82	82	82	82	173.2	2.9	^{111}In	
^{112}In	49	112	14.97 m	ECB+B−	22	51	130	53	915.0	2.4	^{112}Cd	^{112}Sn
^{112m}In	49	112	20.56 m	IT	20	20	23	23	1264.5	2.4	^{112}In	
^{113m}In	49	113	1.6579 h	IT	51	51	53	53	629.9	3.0	^{113}In	
^{114}In	49	114	71.9 s	B−ECB+	2	0	1283	0	1145.6	0.0	^{114}Sn	^{114}Cd
^{114m}In	49	114	49.51 d	ITEC	22	22	25	25	2558.2	2.0	^{114}In	^{114}Cd
^{115}In	49	115	4.41E + 14 y	B−	0	0	0	0	1280.6	0.0	^{115}Sn	
^{115m}In	49	115	4.486 h	ITB−	37	37	39	39	1104.5	2.8	^{115}In	^{115}Sn
^{116m}In	49	116	54.41 m	B−	354	354	327	320	1445.1	4.7	^{116}Sn	
^{117}In	49	117	43.2 m	B−	120	120	121	121	1666.9	5.8	^{117m}Sn	^{117}Sn
^{117m}In	49	117	116.2 m	B−IT	21	21	372	22	1302.4	1.8	^{117}In	^{117}Sn
^{118}In	49	118	5.0 s	B−	1818	11	6486	11	883.6	0.1	^{118}Sn	
^{118m}In	49	118	4.364 m	B−	413	412	1208	396	1242.1	6.2	^{118}Sn	
^{119}In	49	119	2.4 m	B−	128	128	517	129	1266.5	3.0	^{119m}Sn	^{119}Sn
^{119m}In	49	119	18.0 m	B−IT	29	12	2915	12	1057.2	0.5	^{119}In	^{119}Sn
^{121}In	49	121	23.1 s	B−	148	144	2703	144	1067.7	2.6	^{121}Sn	^{121m}Sn
^{121m}In	49	121	3.88 m	B−IT	655	19	5380	20	942.2	1.6	^{121}Sn	^{121}In
^{106}Sn	50	106	1.92 m	ECB+	185	216	201	219	377.7	9.4	^{106m}In	
^{108}Sn	50	108	10.30 m	ECB+	136	137	142	143	139.1	8.6	^{108m}In	
^{109}Sn	50	109	18.0 m	ECB+	314	326	310	287	128.0	6.7	^{109}In	^{109m}In
^{110}Sn	50	110	4.11 h	EC	69	69	74	74	93.8	6.1	^{110m}In	
^{111}Sn	50	111	35.3 m	ECB+	45	90	117	89	390.0	3.9	^{111}In	^{111m}In
^{113}Sn	50	113	115.09 d	EC	21	21	26	26	5.4	2.7	^{113m}In	^{113}In
^{113m}Sn	50	113	21.4 m	ITEC	14	14	17	17	1.7	1.7	^{113}Sn	^{113}In
^{117m}Sn	50	117	13.76 d	IT	43	43	47	47	1752.3	4.7	^{117}Sn	
^{119m}Sn	50	119	293.1 d	IT	16	16	19	19	2.0	2.0	^{119}Sn	
^{121}Sn	50	121	27.03 h	B−	0	0	0	0	1025.3	0.0	^{121}Sb	
^{121m}Sn	50	121	43.9 y	ITB−	4	4	5	5	257.9	0.5	^{121}Sn	^{121}Sb
^{123}Sn	50	123	129.2 d	B−	1	1	204	1	1279.9	0.0	^{123}Sb	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded (μSv h^{-1} GBq^{-1})	$H_p(10)$, 100 cm Shielded (μSv h^{-1} GBq^{-1})	$H_p(3)_{slab}$, 100 cm Unshielded (μSv h^{-1} GBq^{-1})	$H_p(3)_{slab}$, 100 cm Shielded (μSv h^{-1} GBq^{-1})	$H_p(0.07)_{slab}$, 10 cm Unshielded (mSv h^{-1} GBq^{-1})	$H_p(0.07)_{slab}$, 10 cm Shielded (mSv h^{-1} GBq^{-1})	Daughter nuclei with highest yield	
^{123m}Sn	50	123	40.06 m	B−	28	28	79	28	1565.3	2.8	^{123}Sb	
^{125}Sn	50	125	9.64 d	B−	52	50	2046	47	1088.6	0.8	^{125}Sb	
^{125m}Sn	50	125	9.52 m	B−	62	60	1502	61	1193.7	3.4	^{125}Sb	
^{126}Sn	50	126	2.30E + 5 y	B−	20	20	21	21	606.6	2.1	^{126m}Sb	
^{127}Sn	50	127	2.10 h	B−	348	282	1294	261	1346.7	5.2	^{127}Sb	
^{127m}Sn	50	127	4.13 m	B−	120	94	3431	91	1035.7	2.9	^{127}Sb	
^{128}Sn	50	128	59.07 m	B−	136	136	142	142	1413.6	8.3	^{128m}Sb	
^{129}Sn	50	129	2.23 m	B−	452	157	4236	153	1021.7	3.4	^{129}Sb	
^{130}Sn	50	130	3.72 m	B−	168	168	210	170	1673.4	7.7	^{130m}Sb	
^{130m}Sn	50	130	1.7 m	B−	696	145	4708	140	1014.4	4.3	^{130}Sb	^{130m}Sb
^{111}Sb	51	111	75 s	ECB+	735	254	4764	255	919.2	9.8	^{111}Sn	
^{113}Sb	51	113	6.67 m	ECB+	145	220	1984	220	708.9	8.2	^{113}Sn	^{113m}Sn
^{114}Sb	51	114	3.49 m	ECB+	901	410	4350	386	750.4	8.5	^{114}Sn	
^{115}Sb	51	115	32.1 m	ECB+	112	162	246	164	444.5	6.7	^{115}Sn	
^{116}Sb	51	116	15.8 m	ECB+	278	342	1399	313	581.2	6.9	^{116}Sn	
^{116m}Sb	51	116	60.3 m	ECB+	469	495	465	485	282.9	12.7	^{116}Sn	
^{117}Sb	51	117	2.80 h	ECB+	48	52	53	56	225.5	5.3	^{117}Sn	
^{118}Sb	51	118	3.6 m	ECB+	81	140	2642	141	728.6	5.2	^{118}Sn	
^{118m}Sb	51	118	5.00 h	ECB+	424	425	423	420	191.7	12.7	^{118}Sn	
^{119}Sb	51	119	38.19 h	EC	24	24	30	30	3.0	3.0	^{119}Sn	
^{120}Sb	51	120	15.89 m	ECB+	28	86	329	89	501.2	4.0	^{120}Sn	
^{120m}Sb	51	120	5.76 d	EC	396	396	396	393	421.9	11.8	^{120}Sn	
^{122}Sb	51	122	2.7238 d	B−ECB+	75	74	543	75	1253.8	2.3	^{122}Te	^{122}Sn
^{122m}Sb	51	122	4.191 m	IT	32	32	35	35	3.5	3.5	^{122}Sb	
^{124}Sb	51	124	60.20 d	B−	270	269	753	239	1212.7	4.6	^{124}Te	
^{124m}Sb	51	124	93 s	ITB−	73	73	84	74	354.0	2.2	^{124}Sb	^{124}Te
^{124}Sbn	51	124	20.2 m	IT	0	0	0	0	0.0	0.0	^{124m}Sb	
^{125}Sb	51	125	2.75856 y	B−	85	85	87	87	601.2	4.2	^{125m}Te	^{125}Te
^{126}Sb	51	126	12.35 d	B−	449	449	696	453	1341.6	11.6	^{126}Te	
^{126m}Sb	51	126	19.15 m	B−IT	256	255	1145	258	1052.7	7.3	^{126}Sb	^{126}Te
^{127}Sb	51	127	3.85 d	B−	115	115	126	116	1455.1	3.5	^{127}Te	^{127m}Te
^{128}Sb	51	128	9.01 h	B−	501	501	883	502	1420.9	12.7	^{128}Te	
^{128m}Sb	51	128	10.4 m	B−IT	319	310	2775	312	1116.9	8.3	^{128}Sb	^{128}Te
^{129}Sb	51	129	4.40 h	B−	222	222	587	211	1320.4	3.9	^{129}Te	^{129m}Te
^{130}Sb	51	130	39.5 m	B−	537	520	1953	511	1634.7	13.4	^{130}Te	
^{130m}Sb	51	130	6.3 m	B−	489	424	3113	417	1322.1	8.5	^{130}Te	
^{131}Sb	51	131	23.03 m	B−	312	302	1073	275	1303.6	4.8	^{131}Te	^{131m}Te
^{133}Sb	51	133	2.5 m	B−	385	379	1398	320	1247.1	4.6	^{133}Te	^{133m}Te

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^{113}Te	52	113	1.7 m	ECB+	1894	341	5772	315	791.1	7.9	^{113}Sb	
^{114}Te	52	114	15.2 m	ECB+	189	212	254	198	249.5	7.0	^{114}Sb	
^{115}Te	52	115	5.8 m	ECB+	376	351	2628	335	716.6	8.5	^{115}Sb	
^{115m}Te	52	115	6.7 m	ECB+	425	396	2330	366	600.0	8.3	^{115}Sb	
^{116}Te	52	116	2.49 h	ECB+	44	45	49	50	16.5	4.4	^{116}Sb	
^{117}Te	52	117	62 m	ECB+	204	241	449	221	330.3	5.8	^{117}Sb	
^{118}Te	52	118	6.00 d	EC	19	19	22	22	2.3	2.3	^{118}Sb	
^{119}Te	52	119	16.05 h	ECB+	135	138	137	140	48.8	5.1	^{119}Sb	
^{119m}Te	52	119	4.70 d	ECB+	241	241	235	233	83.8	7.6	^{119}Sb	
^{121}Te	52	121	19.16 d	EC	113	113	117	117	13.0	5.3	^{121}Sb	
^{121m}Te	52	121	154 d	ITEC	49	49	51	51	237.8	4.4	^{121}Te	^{121}Sb
^{123}Te	52	123	6.00E + 14 y	EC	0	0	0	0	0.0	0.0	^{123}Sb	
^{123m}Te	52	123	119.25 d	IT	36	36	38	38	196.0	3.8	^{123}Te	
^{125m}Te	52	125	57.40 d	IT	31	31	35	35	5.4	3.5	^{125}Te	
^{127}Te	52	127	9.35 h	B−	1	1	1	1	1442.0	0.0	^{127}I	
^{127m}Te	52	127	109 d	ITB−	9	9	11	11	35.3	1.1	^{127}Te	^{127}I
^{129}Te	52	129	69.6 m	B−	14	14	216	14	1309.9	0.8	^{129}I	
^{129m}Te	52	129	33.6 d	ITB−	12	12	189	13	464.8	0.9	^{129}Te	^{129}I
^{131}Te	52	131	25.0 m	B−	73	72	1086	72	1307.1	3.5	^{131}I	
^{131m}Te	52	131	30 h	B−IT	232	231	304	226	1563.1	5.7	^{131}I	^{131}Te
^{132}Te	52	132	3.204 d	B−	57	57	59	59	618.9	5.4	^{132}I	
^{133}Te	52	133	12.5 m	B−	185	181	1425	166	1236.8	4.8	^{133}I	
^{133m}Te	52	133	55.4 m	B−IT	303	289	576	277	1358.6	6.5	^{133}I	^{133}Te
^{134}Te	52	134	41.8 m	B−	152	152	154	154	1621.4	6.6	^{134}I	
^{118}I	53	118	13.7 m	ECB+	2730	328	6316	321	790.6	9.4	^{118}Te	
^{118m}I	53	118	8.5 m	ECB+	753	607	4119	603	800.6	16.2	^{118}Te	
^{119}I	53	119	19.1 m	ECB+	97	164	1120	165	713.4	8.1	^{119}Te	^{119m}Te
^{120}I	53	120	81.6 m	ECB+	1263	384	3978	328	641.3	8.6	^{120}Te	
^{120m}I	53	120	53 m	ECB+	625	553	3267	526	707.2	14.2	^{120}Te	
^{121}I	53	121	2.12 h	ECB+	68	84	70	86	405.5	6.1	^{121}Te	^{121m}Te
^{122}I	53	122	3.63 m	ECB+	318	165	3795	165	737.4	5.8	^{122}Te	
^{123}I	53	123	13.27 h	EC	48	48	51	51	196.4	5.0	^{123}Te	^{123m}Te
^{124}I	53	124	4.1760 d	ECB+	152	183	439	174	279.5	5.6	^{124}Te	
^{125}I	53	125	59.400 d	EC	37	37	42	42	4.3	4.3	^{125}Te	
^{126}I	53	126	12.93 d	ECB+B−	79	80	88	83	693.7	3.4	^{126}Te	^{126}Xe
^{128}I	53	128	24.99 m	B−ECB+	14	13	1372	13	1066.9	0.6	^{128}Xe	^{128}Te
^{129}I	53	129	1.57E + 7 y	B−	18	18	20	20	37.4	2.0	^{129}Xe	
^{130}I	53	130	12.36 h	B−	349	349	355	351	1440.6	9.1	^{130}Xe	
^{130m}I	53	130	8.84 m	ITB−	22	21	395	22	176.3	1.0	^{130}I	^{130}Xe
^{131}I	53	131	8.02070 d	B−	67	67	68	68	1382.5	3.4	^{131m}Xe	^{131}Xe
^{132}I	53	132	2.295 h	B−	358	357	758	353	1350.0	7.4	^{132}Xe	
^{132m}I	53	132	1.387 h	ITB−	63	63	88	65	244.7	2.6	^{132}I	^{132}Xe
^{133}I	53	133	20.8 h	B−	101	101	138	101	1369.8	3.0	^{133}Xe	^{133m}Xe
^{134}I	53	134	52.5 m	B−	401	400	911	389	1320.2	7.2	^{134}Xe	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded	$H_p(10)$, 100 cm Shielded	$H_p(3)_{slab}$, 100 cm Unshielded	$H_p(3)_{slab}$, 100 cm Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded	$H_p(0.07)_{slab}$, 10 cm Shielded	Daughter nuclei with highest yield	
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}			
^{134m}I	53	134	3.60 m	ITB−	66	66	125	69	551.2	5.3	^{134}I	^{134}Xe
^{135}I	53	135	6.57 h	B−	225	225	277	201	1336.9	2.9	^{135}Xe	^{135m}Xe
^{120}Xe	54	120	40 m	ECB+	93	94	98	99	109.4	6.2	^{120}I	
^{121}Xe	54	121	40.1 m	ECB+	192	226	1761	198	552.2	6.9	^{121}I	
^{122}Xe	54	122	20.1 h	EC	27	27	29	29	16.0	2.6	^{122}I	
^{123}Xe	54	123	2.08 h	ECB+	83	117	163	114	505.8	5.9	^{123}I	
^{125}Xe	54	125	16.9 h	ECB+	67	68	70	71	305.0	6.1	^{125}I	
^{127}Xe	54	127	36.4 d	EC	67	67	69	69	367.9	6.2	^{127}I	
^{127m}Xe	54	127	69.2 s	IT	40	40	41	41	1542.5	4.0	^{127}Xe	
^{129m}Xe	54	129	8.88 d	IT	33	33	36	36	2991.0	3.6	^{129}Xe	
^{131m}Xe	54	131	11.84 d	IT	14	14	15	15	1852.8	1.5	^{131}Xe	
^{133}Xe	54	133	5.243 d	B−	18	18	19	19	858.0	1.8	^{133}Cs	
^{133m}Xe	54	133	2.19 d	IT	17	17	19	19	2755.3	1.8	^{133}Xe	
^{135}Xe	54	135	9.14 h	B−	45	45	46	45	1661.8	3.4	^{135}Cs	
^{135m}Xe	54	135	15.29 m	ITB−	75	75	79	75	267.6	2.7	^{135}Xe	^{135}Cs
^{137}Xe	54	137	3.818 m	B−	1214	31	5979	30	918.1	1.0	^{137}Cs	
^{138}Xe	54	138	14.08 m	B−	163	155	1565	123	1301.2	3.4	^{138}Cs	
^{121}Cs	55	121	155 s	ECB+	1717	201	5935	201	878.1	7.6	^{121}Xe	
^{121m}Cs	55	121	122 s	ECB+IT	1166	205	4645	205	831.2	8.7	^{121}Xe	^{121}Cs
^{123}Cs	55	123	5.88 m	ECB+	244	191	3053	191	731.7	7.4	^{123}Xe	
^{124}Cs	55	124	30.8 s	ECB+	2629	195	6430	193	787.0	6.8	^{124}Xe	
^{125}Cs	55	125	45 m	ECB+	81	134	657	133	461.7	5.3	^{125}Xe	
^{126}Cs	55	126	1.64 m	ECB+	785	197	4635	195	754.4	7.0	^{126}Xe	
^{127}Cs	55	127	6.25 h	ECB+	84	89	86	91	90.0	5.1	^{127}Xe	
^{128}Cs	55	128	3.640 m	ECB+	147	155	2802	155	676.8	5.7	^{128}Xe	
^{129}Cs	55	129	32.06 h	ECB+	68	68	71	71	31.1	4.8	^{129}Xe	
^{130}Cs	55	130	29.21 m	ECB+B−	36	93	694	93	505.8	3.9	^{130}Xe	^{130}Ba
^{130m}Cs	55	130	3.46 m	ITEC	29	29	31	31	5.3	3.0	^{130}Cs	^{130}Xe
^{131}Cs	55	131	9.689 d	EC	17	17	19	19	1.9	1.9	^{131}Xe	
^{132}Cs	55	132	6.479 d	ECB+B−	129	130	132	133	42.0	4.7	^{132}Xe	^{132}Ba
^{134}Cs	55	134	2.0648 y	B−EC	251	251	252	252	1051.8	5.9	^{134}Ba	^{134}Xe
^{134m}Cs	55	134	2.903 h	IT	10	10	11	11	338.7	1.2	^{134}Cs	
^{135}Cs	55	135	2.3E + 6 y	B−	0	0	0	0	710.3	0.0	^{135}Ba	
^{135m}Cs	55	135	53 m	IT	255	255	255	255	49.5	4.6	^{135}Cs	
^{136}Cs	55	136	13.16 d	B−	333	333	332	330	1172.4	7.4	^{136}Ba	
^{137}Cs	55	137	30.1671 y	B−	0	0	1	0	1370.7	0.0	^{137m}Ba	^{137}Ba
^{138}Cs	55	138	33.41 m	B−	518	328	4329	276	1024.0	4.3	^{138}Ba	
^{138m}Cs	55	138	2.91 m	ITB−	132	70	974	66	283.1	2.6	^{138}Cs	^{138}Ba

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^{139}Cs	55	139	9.27 m	B−	1296	40	5710	31	926.5	0.4	^{139}Ba	
^{140}Cs	55	140	63.7 s	B−	2877	233	5862	178	939.5	3.0	^{140}Ba	
^{124}Ba	56	124	11.0 m	ECB+	77	107	197	108	390.0	5.1	^{124}Cs	
^{126}Ba	56	126	100 m	ECB+	106	107	107	107	120.3	5.0	^{126}Cs	
^{127}Ba	56	127	12.7 m	ECB+	67	129	1536	127	620.2	5.3	^{127}Cs	
^{128}Ba	56	128	2.43 d	EC	25	25	26	26	26.2	2.4	^{128}Cs	
^{129}Ba	56	129	2.23 h	ECB+	38	66	73	65	305.1	3.5	^{129}Cs	
^{129m}Ba	56	129	2.16 h	ECB+	260	262	254	255	314.0	8.9	^{129}Cs	
^{131}Ba	56	131	11.50 d	EC	99	99	101	101	136.5	6.1	^{131}Cs	
^{131m}Ba	56	131	14.6 m	IT	22	22	22	22	2.3	2.1	^{131}Ba	
^{133}Ba	56	133	10.52 y	EC	92	92	95	95	75.2	6.9	^{133}Cs	
^{133m}Ba	56	133	38.9 h	ITEC	21	21	23	23	2227.1	2.1	^{133}Ba	^{133}Cs
^{135m}Ba	56	135	28.7 h	IT	19	19	20	20	2295.2	1.8	^{135}Ba	
^{137m}Ba	56	137	2.552 m	IT	98	98	100	100	121.6	2.6	^{137}Ba	
^{139}Ba	56	139	83.06 m	B−	11	9	2013	9	1176.7	0.8	^{139}La	
^{140}Ba	56	140	12.752 d	B−	34	34	37	35	1396.4	1.8	^{140}La	
^{141}Ba	56	141	18.27 m	B−	182	148	2514	142	1433.5	5.8	^{141}La	
^{142}Ba	56	142	10.6 m	B−	166	166	290	163	1528.7	4.5	^{142}La	
^{128}La	57	128	5.18 m	ECB+	1167	457	4777	446	872.3	13.9	^{128}Ba	
^{129}La	57	129	11.6 m	ECB+	108	164	1667	164	640.0	7.2	^{129}Ba	^{129m}Ba
^{130}La	57	130	8.7 m	ECB+	852	359	3888	345	718.4	10.8	^{130}Ba	
^{131}La	57	131	59 m	ECB+	92	126	239	126	365.9	6.5	^{131}Ba	
^{132}La	57	132	4.8 h	ECB+	411	308	1966	278	457.6	8.3	^{132}Ba	
^{132m}La	57	132	24.3 m	ITECB+	110	120	150	120	236.7	5.3	^{132}La	^{132}Ba
^{133}La	57	133	3.912 h	ECB+	28	39	29	40	120.5	2.7	^{133}Ba	
^{134}La	57	134	6.45 m	ECB+	83	126	2351	126	621.9	4.6	^{134}Ba	
^{135}La	57	135	19.5 h	ECB+	19	19	20	20	2.4	1.8	^{135}Ba	
^{136}La	57	136	9.87 m	ECB+	29	77	441	78	410.6	3.4	^{136}Ba	
^{137}La	57	137	6.0E + 4 y	EC	16	16	17	17	1.7	1.7	^{137}Ba	
^{138}La	57	138	1.02E + 11 y	ECB−	184	184	171	167	277.5	2.9	^{138}Ba	^{138}Ce
^{140}La	57	140	1.6781 d	B−	329	329	552	284	1349.2	4.9	^{140}Ce	
^{141}La	57	141	3.92 h	B−	10	4	2622	3	1062.7	0.0	^{141}Ce	
^{142}La	57	142	91.1 m	B−	670	300	2123	211	1180.8	3.1	^{142}Ce	
^{143}La	57	143	14.2 m	B−	370	36	4415	31	999.2	0.5	^{143}Ce	
^{130}Ce	58	130	22.9 m	ECB+	91	98	92	99	251.3	5.6	^{130}La	
^{131}Ce	58	131	10.2 m	ECB+	247	269	1863	260	644.7	9.1	^{131}La	
^{132}Ce	58	132	3.51 h	EC	61	61	62	62	130.1	5.5	^{132}La	
^{133}Ce	58	133	97 m	ECB+	64	113	593	113	424.3	6.3	^{133}La	
^{133m}Ce	58	133	4.9 h	ECB+	276	283	302	265	126.7	8.6	^{133}La	
^{134}Ce	58	134	3.16 d	EC	16	16	17	17	3.5	1.7	^{134}La	
^{135}Ce	58	135	17.7 h	ECB+	150	150	151	152	179.3	7.1	^{135}La	
^{137}Ce	58	137	9.0 h	ECB+	18	18	20	20	2.6	1.9	^{137}La	
^{137m}Ce	58	137	34.4 h	ITEC	18	18	18	18	2571.7	1.6	^{137}Ce	^{137}La
^{139}Ce	58	139	137.641 d	EC	41	41	42	42	261.8	4.1	^{139}La	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded µSv h^{-1} GBq^{-1}	Shielded	Unshielded µSv h^{-1} GBq^{-1}	Shielded	Unshielded mSv h^{-1} GBq^{-1}	Shielded		
^{141}Ce	58	141	32.508 d	B−	16	16	16	16	1278.0	1.6	^{141}Pr	
^{143}Ce	58	143	33.039 h	B−	57	57	114	58	1460.8	3.6	^{143}Pr	
^{144}Ce	58	144	284.91 d	B−	5	5	5	5	600.9	0.5	^{144}Pr	^{144m}Pr
^{145}Ce	58	145	3.01 m	B−	145	144	815	145	1280.6	5.1	^{145}Pr	
^{134}Pr	59	134	11 m	ECB+	794	513	3938	503	903.5	16.3	^{134}Ce	
^{134m}Pr	59	134	17 m	ECB+	1722	361	5186	332	762.6	10.1	^{134}Ce	
^{135}Pr	59	135	24 m	ECB+	106	157	1547	155	618.6	6.9	^{135}Ce	
^{136}Pr	59	136	13.1 m	ECB+	381	338	2618	316	577.8	9.3	^{136}Ce	
^{137}Pr	59	137	1.28 h	ECB+	34	70	230	69	307.8	3.0	^{137}Ce	
^{138}Pr	59	138	1.45 m	ECB+	486	141	4104	141	689.2	5.0	^{138}Ce	
^{138m}Pr	59	138	2.12 h	ECB+	369	402	521	400	651.6	10.8	^{138}Ce	
^{139}Pr	59	139	4.41 h	ECB+	19	32	19	32	125.9	2.0	^{139}Ce	
^{140}Pr	59	140	3.39 m	ECB+	39	98	1454	99	528.1	3.9	^{140}Ce	
^{142}Pr	59	142	19.12 h	B−EC	10	8	1754	6	1137.5	0.1	^{142}Nd	^{142}Ce
^{142m}Pr	59	142	14.6 m	IT	0	0	0	0	0.0	0.0	^{142}Pr	
^{143}Pr	59	143	13.57 d	B−	0	0	1	0	1454.3	0.0	^{143}Nd	
^{144}Pr	59	144	17.28 m	B−	108	4	3933	3	1001.4	0.0	^{144}Nd	
^{144m}Pr	59	144	7.2 m	ITB−	6	6	7	6	1.1	0.6	^{144}Pr	^{144}Nd
^{145}Pr	59	145	5.984 h	B−	4	3	797	3	1208.4	0.1	^{145}Nd	
^{146}Pr	59	146	24.15 m	B−	964	147	4161	130	1032.4	2.7	^{146}Nd	
^{147}Pr	59	147	13.4 m	B−	95	91	1862	89	1186.1	4.3	^{147}Nd	
^{148}Pr	59	148	2.29 m	B−	1515	148	5597	134	1018.4	3.8	^{148}Nd	
^{148m}Pr	59	148	2.01 m	B−	1254	156	5991	155	1056.4	6.2	^{148}Nd	
^{134}Nd	60	134	8.5 m	ECB+	74	104	208	104	331.4	6.3	^{134m}Pr	
^{135}Nd	60	135	12.4 m	ECB+	433	225	3393	223	1007.9	10.1	^{135}Pr	
^{136}Nd	60	136	50.65 m	ECB+	57	64	58	64	91.5	4.2	^{136}Pr	
^{137}Nd	60	137	38.5 m	ECB+	162	200	758	192	389.4	6.8	^{137}Pr	
^{138}Nd	60	138	5.04 h	EC	18	18	19	19	12.4	1.8	^{138}Pr	
^{139}Nd	60	139	29.7 m	ECB+	47	81	309	81	307.6	3.3	^{139}Pr	
^{139m}Nd	60	139	5.50 h	ECB+IT	259	261	260	256	404.0	7.2	^{139}Pr	^{139}Nd
^{140}Nd	60	140	3.37 d	EC	15	15	16	16	1.6	1.6	^{140}Pr	
^{141}Nd	60	141	2.49 h	ECB+	19	23	19	23	47.3	1.8	^{141}Pr	
^{141m}Nd	60	141	62.0 s	ITECB+	113	113	118	113	94.9	2.3	^{141}Nd	^{141}Pr
^{144}Nd	60	144	2.29E + 15 y	A	0	0	0	0	0.0	0.0	^{140}Ce	
^{147}Nd	60	147	10.98 d	B−	30	30	30	30	1357.9	1.9	^{147}Pm	
^{149}Nd	60	149	1.728 h	B−	69	68	187	69	1682.1	4.4	^{149}Pm	
^{151}Nd	60	151	12.44 m	B−	137	136	929	133	1344.4	4.5	^{151}Pm	
^{152}Nd	60	152	11.4 m	B−	31	31	36	33	1469.8	2.5	^{152}Pm	

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^{136}Pm	61	136	107 s	ECB+	3481	451	6821	453	835.4	14.0	^{136}Nd	
^{137m}Pm	61	137	2.4 m	ECB+	753	308	3573	306	1415.4	12.9	^{137}Nd	
^{139}Pm	61	139	4.15 m	ECB+	449	160	3651	158	643.7	5.7	^{139}Nd	
^{140}Pm	61	140	9.2 s	ECB+	2950	178	6419	177	741.8	5.9	^{140}Nd	
^{140m}Pm	61	140	5.95 m	ECB+	646	489	3692	487	731.0	12.5	^{140}Nd	
^{141}Pm	61	141	20.90 m	ECB+	86	124	1857	121	508.6	4.2	^{141}Nd	^{141m}Nd
^{142}Pm	61	142	40.5 s	ECB+	850	146	4616	144	686.2	5.0	^{142}Nd	
^{143}Pm	61	143	265 d	EC	61	61	62	62	4.3	2.4	^{143}Nd	
^{144}Pm	61	144	363 d	EC	267	267	270	270	31.0	8.3	^{144}Nd	
^{145}Pm	61	145	17.7 y	ECA	15	15	16	16	1.5	1.5	^{145}Nd	^{141}Pr
^{146}Pm	61	146	5.53 y	ECB−	132	132	132	132	488.1	4.5	^{146}Sm	^{146}Nd
^{147}Pm	61	147	2.6234 y	B−	0	0	0	0	255.5	0.0	^{147}Sm	
^{148}Pm	61	148	5.368 d	B−	88	85	1585	79	1205.9	1.4	^{148}Sm	
^{148m}Pm	61	148	41.29 d	B−IT	327	327	329	329	1227.3	9.3	^{148}Sm	^{148}Pm
^{149}Pm	61	149	53.08 h	B−	2	2	6	2	1428.4	0.1	^{149}Sm	
^{150}Pm	61	150	2.68 h	B−	279	220	1878	204	1237.1	4.8	^{150}Sm	
^{151}Pm	61	151	28.40 h	B−	60	60	63	60	1442.3	3.5	^{151}Sm	
^{152}Pm	61	152	4.12 m	B−	422	45	4419	42	1018.3	1.2	^{152}Sm	
^{152m}Pm	61	152	7.52 m	B−	293	238	1946	227	1497.5	7.7	^{152}Sm	
^{153}Pm	61	153	5.25 m	B−	19	18	769	18	1228.5	1.6	^{153}Sm	
^{154}Pm	61	154	1.73 m	B−	334	247	1845	201	1180.5	3.3	^{154}Sm	
^{154m}Pm	61	154	2.68 m	B−	337	271	2117	245	1392.7	6.7	^{154}Sm	
^{139}Sm	62	139	2.57 m	ECB+	625	243	3810	238	802.1	9.0	^{139}Pm	
^{140}Sm	62	140	14.82 m	ECB+	72	100	248	97	310.7	4.0	^{140}Pm	
^{141}Sm	62	141	10.2 m	ECB+	285	230	2397	220	555.0	7.3	^{141}Pm	
^{141m}Sm	62	141	22.6 m	ECB+IT	299	315	1121	303	937.1	9.9	^{141}Pm	^{141}Sm
^{142}Sm	62	142	72.49 m	ECB+	16	28	17	28	108.5	1.8	^{142}Pm	
^{143}Sm	62	143	8.75 m	ECB+	44	94	1350	94	464.1	3.6	^{143}Pm	
^{143m}Sm	62	143	66 s	ITECB+	111	111	118	112	110.4	2.3	^{143}Sm	^{143}Pm
^{145}Sm	62	145	340 d	EC	29	29	29	29	2.8	2.8	^{145}Pm	
^{146}Sm	62	146	1.03E + 8 y	A	0	0	0	0	0.0	0.0	^{142}Nd	
^{147}Sm	62	147	1.060E11 y	A	0	0	0	0	0.0	0.0	^{143}Nd	
^{148}Sm	62	148	7E + 15 y	A	0	0	0	0	0.0	0.0	^{144}Nd	
^{151}Sm	62	151	90 y	B−	0	0	0	0	0.0	0.0	^{151}Eu	
^{153}Sm	62	153	46.50 h	B−	19	19	18	18	1433.8	1.7	^{153}Eu	
^{155}Sm	62	155	22.3 m	B−	21	21	293	21	1305.7	1.9	^{155}Eu	
^{156}Sm	62	156	9.4 h	B−	23	23	23	23	1349.8	2.2	^{156}Eu	
^{157}Sm	62	157	8.03 m	B−	76	71	2055	70	1231.8	4.1	^{157}Eu	
^{142}Eu	63	142	2.34 s	ECB+	5210	197	7286	192	754.3	6.1	^{142}Sm	
^{142m}Eu	63	142	1.223 m	ECB+	2508	551	6076	548	736.3	13.4	^{142}Sm	
^{143}Eu	63	143	2.59 m	ECB+	1273	182	4656	173	655.7	5.4	^{143}Sm	^{143m}Sm
^{144}Eu	63	144	10.2 s	ECB+	3183	180	6351	174	726.0	5.6	^{144}Sm	
^{145}Eu	63	145	5.93 d	ECB+	194	198	189	181	41.1	4.2	^{145}Sm	
^{146}Eu	63	146	4.61 d	ECB+	370	377	369	359	85.8	8.3	^{146}Sm	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded		
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}			
^{147}Eu	63	147	24.1 d	ECB+A	87	88	87	88	186.9	4.3	^{147}Sm	^{143}Pm
^{148}Eu	63	148	54.5 d	ECB+A	365	365	362	360	57.4	10.5	^{148}Sm	^{144}Pm
^{149}Eu	63	149	93.1 d	EC	21	21	21	21	21.1	1.9	^{149}Sm	
^{150}Eu	63	150	36.9 y	ECB+	267	267	267	266	129.6	10.4	^{150}Sm	
^{150m}Eu	63	150	12.8 h	B−ECB+	8	9	10	9	1293.4	0.4	^{150}Gd	^{150}Sm
^{152}Eu	63	152	13.537 y	ECB+B−	189	189	202	182	438.4	5.3	^{152}Gd	^{152}Sm
^{152m}Eu	63	152	9.3116 h	B−ECB+	50	49	689	49	872.7	1.4	^{152}Gd	^{152}Sm
^{152}Eun	63	152	96 m	IT	17	17	17	17	1.7	1.7	^{152}Eu	
^{154}Eu	63	154	8.593 y	B−EC	193	193	277	187	1152.3	4.2	^{154}Gd	^{154}Sm
^{154m}Eu	63	154	46.0 m	IT	20	20	19	19	1.9	1.9	^{154}Eu	
^{155}Eu	63	155	4.7611 y	B−	14	14	14	14	93.6	1.3	^{155}Gd	
^{156}Eu	63	156	15.19 d	B−	176	174	952	150	1038.9	2.4	^{156}Gd	
^{157}Eu	63	157	15.18 h	B−	58	58	89	58	1428.6	3.2	^{157}Gd	
^{158}Eu	63	158	45.9 m	B−	235	194	2087	184	1165.0	3.3	^{158}Gd	
^{159}Eu	63	159	18.1 m	B−	62	60	1897	60	1151.2	3.2	^{159}Gd	
^{142}Gd	64	142	70.2 s	ECB+	289	172	2502	166	562.5	5.7	^{142}Eu	
^{143m}Gd	64	143	110.0 s	ECB+	1122	345	4253	331	943.0	11.3	^{143}Eu	
^{144}Gd	64	144	4.47 m	ECB+	133	143	1907	127	465.6	4.3	^{144}Eu	
^{145}Gd	64	145	23.0 m	ECB+	299	328	1058	255	346.4	5.0	^{145}Eu	
^{145m}Gd	64	145	85 s	ITECB+	175	113	391	114	196.0	2.9	^{145}Gd	^{145}Eu
^{146}Gd	64	146	48.27 d	EC	65	65	65	65	109.8	6.3	^{146}Eu	
^{147}Gd	64	147	38.1 h	ECB+	236	236	235	234	541.6	8.8	^{147}Eu	
^{148}Gd	64	148	74.6 y	A	0	0	0	0	0.0	0.0	^{144}Sm	
^{149}Gd	64	149	9.28 d	ECB+	101	101	102	102	311.0	6.0	^{149}Eu	
^{150}Gd	64	150	1.79E + 6 y	A	0	0	0	0	0.0	0.0	^{146}Sm	
^{151}Gd	64	151	124 d	ECA	22	22	22	22	120.2	2.1	^{147}Sm	^{151}Eu
^{152}Gd	64	152	1.08E + 14 y	A	0	0	0	0	0.0	0.0	^{148}Sm	
^{153}Gd	64	153	240.4 d	EC	32	32	32	32	3.3	3.1	^{153}Eu	
^{159}Gd	64	159	18.479 h	B−	11	11	13	11	1443.9	0.8	^{159}Tb	
^{162}Gd	64	162	8.4 m	B−	73	73	75	73	1470.3	3.3	^{162}Tb	
^{146}Tb	65	146	23 s	ECB+	2005	518	5103	452	648.2	8.6	^{146}Gd	
^{147}Tb	65	147	1.64 h	ECB+	300	334	829	316	324.2	7.5	^{147}Gd	
^{147m}Tb	65	147	1.87 m	ECB+	239	277	917	241	337.8	4.7	^{147}Gd	
^{148}Tb	65	148	60 m	ECB+	744	357	2991	324	512.4	7.8	^{148}Gd	
^{148m}Tb	65	148	2.20 m	ECB+	481	514	1083	512	397.5	13.8	^{148}Gd	
^{149}Tb	65	149	4.118 h	ECB+A	203	213	243	197	273.4	6.4	^{149}Gd	^{145}Eu
^{149m}Tb	65	149	4.16 m	ECB+A	198	229	484	228	304.6	6.1	^{149}Gd	^{145}Eu
^{150}Tb	65	150	3.48 h	ECB+A	388	341	1088	282	240.5	6.7	^{150}Gd	^{146}Eu

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^{150m}Tb	65	150	5.8 m	ECB+	405	425	470	428	269.2	13.8	^{150}Gd		
^{151}Tb	65	151	17.609 h	ECB+A	175	177	175	175	367.0	8.3	^{151}Gd	^{147}Eu	
^{151m}Tb	65	151	25 s	ITECB+	16	16	16	17	10.3	0.9	^{151}Tb	^{151}Gd	
^{152}Tb	65	152	17.5 h	ECB+	221	229	792	204	323.7	6.7	^{152}Gd		
^{152m}Tb	65	152	4.2 m	ITECB+	137	139	140	139	1614.4	7.7	^{152}Tb	^{152}Gd	
^{153}Tb	65	153	2.34 d	ECB+	67	67	67	67	93.0	4.5	^{153}Gd		
^{154}Tb	65	154	21.5 h	ECB+	310	313	305	243	80.2	5.2	^{154}Gd		
^{155}Tb	65	155	5.32 d	EC	44	44	43	43	113.5	4.0	^{155}Gd		
^{156}Tb	65	156	5.35 d	EC	308	308	298	294	311.6	9.0	^{156}Gd		
^{156m}Tb	65	156	24.4 h	IT	12	12	12	12	1.2	1.2	^{156}Tb		
^{156}Tbn	65	156	5.3 h	IT	1	1	1	1	0.1	0.1	^{156}Tb		
^{157}Tb	65	157	71 y	EC	2	2	2	2	0.2	0.2	^{157}Gd		
^{158}Tb	65	158	180 y	ECB−	134	134	134	133	310.8	3.9	^{158}Gd	^{158}Dy	
^{160}Tb	65	160	72.3 d	B−	175	175	178	173	1418.1	4.1	^{160}Dy		
^{161}Tb	65	161	6.906 d	B−	15	15	16	16	1270.2	1.6	^{161}Dy		
^{162}Tb	65	162	7.60 m	B−	181	181	298	181	1430.8	6.1	^{162}Dy		
^{163}Tb	65	163	19.5 m	B−	137	137	153	137	1535.2	6.1	^{163}Dy		
^{164}Tb	65	164	3.0 m	B−	411	376	1686	354	1458.2	9.5	^{164}Dy		
^{165}Tb	65	165	2.11 m	B−	145	121	2197	110	1149.2	1.8	^{165m}Dy	^{165}Dy	
^{148}Dy	66	148	3.3 m	ECB+	118	125	119	125	67.4	4.4	^{148}Tb		
^{149}Dy	66	149	4.20 m	ECB+	239	250	322	228	156.7	5.9	^{149}Tb	^{149m}Tb	
^{150}Dy	66	150	7.17 m	ECB+A	53	53	53	53	13.7	2.9	^{150}Tb	^{146}Gd	
^{151}Dy	66	151	17.9 m	ECB+A	214	218	218	208	141.1	5.9	^{151}Tb	^{151m}Tb	^{147}Gd
^{152}Dy	66	152	2.38 h	ECA	58	58	58	58	77.2	4.7	^{152}Tb	^{148}Gd	
^{153}Dy	66	153	6.4 h	ECB+A	152	154	148	149	183.6	6.9	^{153}Tb	^{149}Gd	
^{154}Dy	66	154	3.0E + 6 y	A	0	0	0	0	0.0	0.0	^{150}Gd		
^{155}Dy	66	155	9.9 h	ECB+	113	115	111	112	121.3	5.4	^{155}Tb		
^{157}Dy	66	157	8.14 h	EC	69	69	69	69	35.4	4.7	^{157}Tb		
^{159}Dy	66	159	144.4 d	EC	17	17	17	17	1.6	1.6	^{159}Tb		
^{165}Dy	66	165	2.334 h	B−	5	5	55	5	1352.8	0.3	^{165}Ho		
^{165m}Dy	66	165	1.257 m	ITB−	4	4	4	4	37.7	0.3	^{165}Dy	^{165}Ho	
^{166}Dy	66	166	81.6 h	B−	12	12	12	12	1052.1	1.1	^{166}Ho		
^{167}Dy	66	167	6.20 m	B−	93	92	850	93	1966.4	4.4	^{167}Ho		
^{168}Dy	66	168	8.7 m	B−	71	71	100	71	1808.7	3.7	^{168}Ho		
^{150}Ho	67	150	76.8 s	ECB+	3256	312	6108	312	687.3	8.5	^{150}Dy		
^{153}Ho	67	153	2.01 m	ECB+A	159	176	1659	175	643.8	7.1	^{153}Dy	^{149m}Tb	
^{153m}Ho	67	153	9.3 m	ECB+A	191	185	2139	185	672.6	8.0	^{153}Dy	^{149}Tb	
^{154}Ho	67	154	11.76 m	ECB+A	884	308	3837	301	729.5	10.2	^{154}Dy	^{150}Tb	
^{154m}Ho	67	154	3.10 m	ECB+A	392	413	1799	412	675.9	15.5	^{154}Dy	^{150m}Tb	
^{155}Ho	67	155	48 m	ECB+	82	108	351	103	333.1	5.0	^{155}Dy		
^{156}Ho	67	156	56 m	ECB+	449	328	2128	303	875.3	10.2	^{156}Dy		
^{157}Ho	67	157	12.6 m	ECB+	102	111	108	110	311.9	6.4	^{157}Dy		
^{159}Ho	67	159	33.05 m	ECB+	80	80	80	80	177.8	6.1	^{159}Dy		
^{160}Ho	67	160	25.6 m	ECB+	276	277	277	277	138.9	7.3	^{160}Dy		

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield	
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded		
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}			
^{161}Ho	67	161	2.48 h	EC	24	24	25	25	5.2	2.5	^{161}Dy	
^{162}Ho	67	162	15.0 m	ECB+	28	34	27	33	62.3	1.9	^{162}Dy	
^{162m}Ho	67	162	67.0 m	ITECB+	95	96	94	93	206.5	3.9	^{162}Ho	^{162}Dy
^{163}Ho	67	163	4570 y	EC	0	0	0	0	0.0	0.0	^{163}Dy	
^{164}Ho	67	164	29 m	ECB−	10	10	10	10	580.4	0.9	^{164}Dy	^{164}Er
^{164m}Ho	67	164	38.0 m	IT	16	16	15	15	1.5	1.5	^{164}Ho	
^{166}Ho	67	166	26.80 h	B−	7	5	849	5	1200.8	0.3	^{166}Er	
^{166m}Ho	67	166	1.20E + 3 y	B−	269	269	272	270	663.2	9.2	^{166}Er	
^{167}Ho	67	167	3.1 h	B−	66	66	67	66	1485.3	4.0	^{167}Er	
^{168}Ho	67	168	2.99 m	B−	142	140	1503	138	1206.0	3.1	^{168}Er	
^{168m}Ho	67	168	132 s	IT	2	2	2	2	0.2	0.2	^{168}Ho	
^{170}Ho	67	170	2.76 m	B−	281	271	1462	269	1420.4	7.4	^{170}Er	
^{154}Er	68	154	3.73 m	ECB+A	21	26	22	27	45.9	2.4	^{154}Ho	^{150}Dy
^{156}Er	68	156	19.5 m	EC	22	22	23	23	14.0	2.1	^{156}Ho	
^{159}Er	68	159	36 m	ECB+	149	157	152	150	495.7	5.0	^{159}Ho	
^{161}Er	68	161	3.21 h	ECB+	163	163	161	160	481.1	4.5	^{161}Ho	
^{163}Er	68	163	75.0 m	ECB+	13	13	13	13	1.4	1.3	^{163}Ho	
^{165}Er	68	165	10.36 h	EC	13	13	12	12	1.2	1.2	^{165}Ho	
^{167m}Er	68	167	2.269 s	IT	19	19	18	18	1739.0	1.7	^{167}Er	
^{169}Er	68	169	9.40 d	B−	0	0	0	0	843.5	0.0	^{169}Tm	
^{171}Er	68	171	7.516 h	B−	69	69	80	69	1488.3	4.8	^{171}Tm	
^{172}Er	68	172	49.3 h	B−	92	92	92	92	844.2	4.0	^{172}Tm	
^{173}Er	68	173	1.434 m	B−	141	140	910	140	1396.5	6.4	^{173}Tm	
^{161}Tm	69	161	30.2 m	ECB+	191	210	426	186	304.6	7.8	^{161}Er	
^{162}Tm	69	162	21.70 m	ECB+	448	276	1849	235	383.4	5.8	^{162}Er	
^{163}Tm	69	163	1.810 h	ECB+	207	208	195	193	196.3	6.2	^{163}Er	
^{164}Tm	69	164	2.0 m	ECB+	159	126	1957	119	413.1	4.0	^{164}Er	
^{165}Tm	69	165	30.06 h	ECB+	104	104	103	103	394.4	5.7	^{165}Er	
^{166}Tm	69	166	7.70 h	ECB+	289	291	279	255	148.5	6.0	^{166}Er	
^{167}Tm	69	167	9.25 d	EC	33	33	33	33	1740.4	3.0	^{167}Er	
^{168}Tm	69	168	93.1 d	ECB+B−	211	211	211	210	208.0	7.7	^{168}Er	^{168}Yb
^{170}Tm	69	170	128.6 d	B−EC	1	1	2	1	1443.9	0.1	^{170}Yb	^{170}Er
^{171}Tm	69	171	1.92 y	B−	0	0	0	0	0.0	0.0	^{171}Yb	
^{172}Tm	69	172	63.6 h	B−	69	68	646	61	1130.9	1.0	^{172}Yb	
^{173}Tm	69	173	8.24 h	B−	68	68	71	69	1511.8	3.2	^{173}Yb	
^{174}Tm	69	174	5.4 m	B−	291	291	309	291	2092.9	11.7	^{174}Yb	
^{175}Tm	69	175	15.2 m	B−	175	175	412	173	1660.8	4.7	^{175}Yb	
^{176}Tm	69	176	1.85 m	B−	439	285	2424	250	1703.1	7.3	^{176}Yb	

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^{162}Yb	70	162	18.87 m	ECB+	50	50	49	50	31.1	3.8	^{162}Tm	
^{163}Yb	70	163	11.05 m	ECB+	92	119	706	114	270.0	3.9	^{163}Tm	
^{164}Yb	70	164	75.8 m	EC	15	15	15	15	4.1	1.3	^{164}Tm	
^{165}Yb	70	165	9.9 m	ECB+	54	65	75	63	112.5	3.6	^{165}Tm	
^{166}Yb	70	166	56.7 h	EC	25	25	24	24	2.4	2.4	^{166}Tm	
^{167}Yb	70	167	17.5 m	ECB+	60	61	59	60	43.0	5.5	^{167}Tm	
^{169}Yb	70	169	32.026 d	EC	75	75	74	74	517.6	6.9	^{169}Tm	
^{175}Yb	70	175	4.185 d	B−	7	7	7	7	1072.9	0.4	^{175}Lu	
^{177}Yb	70	177	1.911 h	B−	31	31	116	31	1224.8	1.2	^{177}Lu	
^{178}Yb	70	178	74 m	B−	7	7	7	7	1325.7	0.4	^{178}Lu	
^{179}Yb	70	179	8.0 m	B−	163	163	860	164	1548.3	5.5	^{179}Lu	
^{165}Lu	71	165	10.74 m	ECB+	161	182	968	171	490.1	6.9	^{165}Yb	
^{167}Lu	71	167	51.5 m	ECB+	245	253	297	219	291.4	6.6	^{167}Yb	
^{169}Lu	71	169	34.06 h	ECB+	202	203	192	188	84.7	5.2	^{169}Yb	
^{169m}Lu	71	169	160 s	IT	0	0	1	1	0.2	0.2	^{169}Lu	
^{170}Lu	71	170	2.012 d	ECB+	341	341	280	263	36.3	4.6	^{170}Yb	
^{171}Lu	71	171	8.24 d	ECB+	117	117	120	120	12.2	4.8	^{171}Yb	
^{171m}Lu	71	171	79 s	IT	0	0	1	1	0.3	0.3	^{171}Lu	
^{172}Lu	71	172	6.70 d	ECB+	306	306	302	298	219.2	7.5	^{172}Yb	
^{172m}Lu	71	172	3.7 m	IT	0	0	0	0	0.1	0.1	^{172}Lu	
^{173}Lu	71	173	1.37 y	EC	42	42	42	42	31.5	3.7	^{173}Yb	
^{174}Lu	71	174	3.31 y	ECB+	24	24	23	23	2.0	1.5	^{174}Yb	
^{174m}Lu	71	174	142 d	ITEC	16	16	17	17	20.2	2.0	^{174}Lu	^{174}Yb
^{176}Lu	71	176	3.85E + 10 y	B−	87	87	88	88	2057.7	6.9	^{176}Hf	
^{176m}Lu	71	176	3.635 h	B−EC	3	3	49	4	1363.2	0.4	^{176}Hf	^{176}Yb
^{177}Lu	71	177	6.647 d	B−	7	7	7	7	1098.7	0.6	^{177}Hf	
^{177m}Lu	71	177	160.4 d	B−IT	184	184	186	186	1066.9	14.1	^{177}Lu	^{177}Hf
^{178}Lu	71	178	28.4 m	B−	20	19	1274	17	1178.2	0.5	^{178}Hf	
^{178m}Lu	71	178	23.1 m	B−	189	189	194	190	2210.8	12.2	^{178}Hf	
^{179}Lu	71	179	4.59 h	B−	5	5	127	5	1350.0	0.5	^{179}Hf	
^{180}Lu	71	180	5.7 m	B−	231	229	644	219	1508.3	5.6	^{180}Hf	
^{181}Lu	71	181	3.5 m	B−	100	98	1362	99	1519.2	4.4	^{181}Hf	
^{167}Hf	72	167	2.05 m	ECB+	105	110	1589	110	404.8	5.5	^{167}Lu	
^{169}Hf	72	169	3.24 m	ECB+	97	115	260	115	173.6	5.2	^{169}Lu	^{169m}Lu
^{170}Hf	72	170	16.01 h	EC	82	82	83	83	78.5	5.3	^{170}Lu	
^{172}Hf	72	172	1.87 y	EC	31	31	34	34	17.2	3.9	^{172m}Lu	
^{173}Hf	72	173	23.6 h	ECB+	76	76	77	77	113.9	6.3	^{173}Lu	
^{174}Hf	72	174	2.0E + 15 y	A	0	0	0	0	0.0	0.0	^{170}Yb	
^{175}Hf	72	175	70 d	EC	67	67	68	68	234.7	4.7	^{175}Lu	
^{177m}Hf	72	177	51.4 m	IT	412	412	416	416	4528.0	29.2	^{177}Hf	
^{178m}Hf	72	178	31 y	IT	392	392	395	395	1472.5	21.3	^{178}Hf	
^{179m}Hf	72	179	25.05 d	IT	168	168	169	169	960.9	11.1	^{179}Hf	
^{180m}Hf	72	180	5.5 h	ITB−	178	178	179	179	706.0	10.9	^{180}Hf	^{180m}Ta
^{181}Hf	72	181	42.39 d	B−	94	94	94	94	1393.0	4.8	^{181}Ta	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield		
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded			
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}				
^{182}Hf	72	182	9E + 6 y	B−	43	43	44	44	335.3	3.4	^{182}Ta		
^{182m}Hf	72	182	61.5 m	B−IT	159	159	161	160	1318.9	8.1	^{182}Ta	^{182}Hf	^{182m}Ta
^{183}Hf	72	183	1.067 h	B−	129	129	216	128	1404.7	3.8	^{183}Ta		
^{184}Hf	72	184	4.12 h	B−	45	45	51	47	1755.0	4.3	^{184}Ta		
^{170}Ta	73	170	6.76 m	ECB+	2016	180	5002	180	701.7	6.7	^{170}Hf		
^{172}Ta	73	172	36.8 m	ECB+	311	266	1634	255	675.3	8.1	^{172}Hf		
^{173}Ta	73	173	3.14 h	ECB+	84	98	205	94	301.6	4.7	^{173}Hf		
^{174}Ta	73	174	1.14 h	ECB+	150	156	1256	147	690.3	6.5	^{174}Hf		
^{175}Ta	73	175	10.5 h	ECB+	173	174	163	160	213.9	6.1	^{175}Hf		
^{176}Ta	73	176	8.09 h	ECB+	313	312	298	263	90.0	5.4	^{176}Hf		
^{177}Ta	73	177	56.56 h	EC	16	16	17	17	4.8	1.7	^{177}Hf		
^{178}Ta	73	178	9.31 m	ECB+	22	24	25	24	23.6	1.8	^{178}Hf		
^{178m}Ta	73	178	2.36 h	EC	212	212	213	213	837.8	14.2	^{178}Hf		
^{179}Ta	73	179	1.82 y	EC	7	7	7	7	0.9	0.9	^{179}Hf		
^{180}Ta	73	180	8.152 h	ECB−	12	12	13	13	199.7	1.4	^{180}Hf	^{180}W	
^{182}Ta	73	182	114.43 d	B−	196	196	197	190	1080.5	4.8	^{182}W		
^{182m}Ta	73	182	15.84 m	IT	52	52	53	53	2551.2	5.5	^{182}Ta		
^{183}Ta	73	183	5.1 d	B−	58	58	59	59	2019.2	5.3	^{183}W		
^{184}Ta	73	184	8.7 h	B−	261	261	278	262	1871.6	10.4	^{184}W		
^{185}Ta	73	185	49.4 m	B−	30	29	696	30	1589.4	2.9	^{185}W		
^{186}Ta	73	186	10.5 m	B−	361	238	2848	238	1318.1	9.9	^{186}W		
^{177}W	74	177	132 m	ECB+	158	158	160	158	188.7	7.9	^{177}Ta		
^{178}W	74	178	21.6 d	EC	4	4	5	5	0.6	0.6	^{178}Ta		
^{179}W	74	179	37.05 m	EC	17	17	18	18	2.3	2.0	^{179}Ta		
^{179m}W	74	179	6.40 m	ITEC	12	12	13	13	2561.5	1.3	^{179}W	^{179}Ta	
^{181}W	74	181	121.2 d	EC	10	10	11	11	1.3	1.2	^{181}Ta		
^{185}W	74	185	75.1 d	B−	0	0	0	0	1110.7	0.0	^{185}Re		
^{185m}W	74	185	1.597 m	IT	5	5	7	7	533.4	1.1	^{185}W		
^{187}W	74	187	23.72 h	B−	76	76	99	78	1426.9	3.3	^{187}Re		
^{188}W	74	188	69.78 d	B−	0	0	0	0	842.6	0.0	^{188}Re		
^{190}W	74	190	30.0 m	B−	32	32	41	39	2340.3	6.0	^{190}Re		
^{178}Re	75	178	13.2 m	ECB+	388	242	1947	203	588.8	7.1	^{178}W		
^{179}Re	75	179	19.5 m	ECB+	174	176	166	166	204.3	7.2	^{179}W	^{179m}W	
^{180}Re	75	180	2.44 m	ECB+	180	193	335	192	134.6	5.3	^{180}W		
^{181}Re	75	181	19.9 h	ECB+	139	139	140	139	680.6	6.6	^{181}W		
^{182}Re	75	182	64.0 h	EC	289	289	289	281	803.7	12.3	^{182}W		
^{182m}Re	75	182	12.7 h	ECB+	186	188	198	180	57.2	5.3	^{182}W		
^{183}Re	75	183	70.0 d	EC	34	34	36	36	236.4	3.8	^{183}W		

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^{184}Re	75	184	38.0 d	ECB+	146	146	147	147	25.9	4.3	^{184}W	
^{184m}Re	75	184	169 d	ITEC	67	67	73	73	173.8	5.7	^{184}Re	^{184}W
^{186}Re	75	186	3.7183 d	B−EC	4	4	8	5	1400.4	0.7	^{186}Os	^{186}W
^{186m}Re	75	186	2.00E + 5 y	IT	5	5	18	18	5.3	5.3	^{186}Re	
^{187}Re	75	187	4.12E + 10 y	B−	0	0	0	0	0.0	0.0	^{187}Os	
^{188}Re	75	188	17.0040 h	B−	12	10	1332	11	1340.9	0.9	^{188}Os	
^{188m}Re	75	188	18.59 m	IT	16	16	25	25	12.5	4.8	^{188}Re	
^{189}Re	75	189	24.3 h	B−	10	10	13	12	1555.2	1.3	^{189m}Os	^{189}Os
^{190}Re	75	190	3.1 m	B−	224	223	862	224	1736.0	9.3	^{190}Os	
^{190m}Re	75	190	3.2 h	B−IT	159	157	621	162	996.9	8.3	^{190}Re	^{190}Os
^{180}Os	76	180	21.5 m	ECB+	29	29	40	40	51.8	6.0	^{180}Re	
^{181}Os	76	181	105 m	ECB+	215	218	221	216	261.9	10.6	^{181}Re	
^{182}Os	76	182	22.10 h	EC	79	79	87	87	116.0	7.7	^{182m}Re	
^{183}Os	76	183	13.0 h	ECB+	114	114	124	124	121.7	10.4	^{183}Re	
^{183m}Os	76	183	9.9 h	ECB+IT	155	155	161	157	355.5	5.4	^{183}Re	^{183}Os
^{185}Os	76	185	93.6 d	EC	116	116	123	123	29.5	5.7	^{185}Re	
^{186}Os	76	186	2.0E + 15 y	A	0	0	0	0	0.0	0.0	^{182}W	
^{189m}Os	76	189	5.8 h	IT	0	0	3	3	0.8	0.8	^{189}Os	
^{190m}Os	76	190	9.9 m	IT	271	271	280	280	689.5	14.0	^{190}Os	
^{191}Os	76	191	15.4 d	B−	18	18	30	30	81.4	5.4	^{191}Ir	
^{191m}Os	76	191	13.10 h	IT	2	2	5	5	1.4	1.4	^{191}Os	
^{193}Os	76	193	30.11 h	B−	13	13	22	15	1471.5	1.6	^{193m}Ir	^{193}Ir
^{194}Os	76	194	6.0 y	B−	2	2	6	6	1.5	1.5	^{194}Ir	
^{196}Os	76	196	34.9 m	B−	15	15	25	16	1448.4	1.3	^{196}Ir	
^{180}Ir	77	180	1.5 m	ECB+	1360	268	4015	275	957.3	12.2	^{180}Os	
^{182}Ir	77	182	15 m	ECB+	959	235	3435	240	779.8	11.7	^{182}Os	
^{183}Ir	77	183	58 m	ECB+	172	183	304	176	384.0	9.5	^{183m}Os	^{183}Os
^{184}Ir	77	184	3.09 h	ECB+	314	309	886	302	573.9	13.6	^{184}Os	
^{185}Ir	77	185	14.4 h	ECB+	127	131	129	129	303.5	9.7	^{185}Os	
^{186}Ir	77	186	16.64 h	ECB+	254	262	331	253	632.2	12.4	^{186}Os	
^{186m}Ir	77	186	1.92 h	ECB+IT	183	191	311	181	305.4	7.0	^{186}Os	^{186}Ir
^{187}Ir	77	187	10.5 h	ECB+	59	59	70	70	78.2	6.4	^{187}Os	
^{188}Ir	77	188	41.5 h	ECB+	288	288	246	232	379.4	7.8	^{188}Os	
^{189}Ir	77	189	13.2 d	EC	18	18	28	28	56.7	5.1	^{189m}Os	^{189}Os
^{190}Ir	77	190	11.78 d	EC	253	253	263	262	579.5	13.7	^{190}Os	
^{190m}Ir	77	190	1.120 h	IT	0	0	3	3	0.7	0.7	^{190}Ir	
^{190}Irn	77	190	3.087 h	ECIT	14	14	21	21	158.0	3.6	^{190m}Os	^{190}Ir
^{191m}Ir	77	191	4.94 s	IT	17	17	29	29	68.7	5.3	^{191}Ir	
^{192}Ir	77	192	73.827 d	B−EC	142	142	145	145	1637.6	7.9	^{192}Pt	^{192}Os
^{192m}Ir	77	192	1.45 m	ITB−	1	1	9	9	2.6	2.4	^{192}Ir	^{192}Pt
^{192}Irn	77	192	241 y	IT	2	2	19	19	2333.8	5.1	^{192}Ir	
^{193m}Ir	77	193	10.53 d	IT	0	0	3	3	0.9	0.9	^{193}Ir	
^{194}Ir	77	194	19.28 h	B−	17	15	1625	15	1172.8	0.7	^{194}Pt	
^{194m}Ir	77	194	171 d	B−	395	395	402	402	482.3	16.2	^{194}Pt	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded	$H_p(10)$, 100 cm Shielded	$H_p(3)_{slab}$, 100 cm Unshielded	$H_p(3)_{slab}$, 100 cm Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded	$H_p(0.07)_{slab}$, 10 cm Shielded	Daughter nuclei with highest yield		
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}				
^{195}Ir	77	195	2.5 h	B−	14	14	24	22	1476.3	3.7	^{195}Pt		
^{195m}Ir	77	195	3.8 h	B−IT	67	67	75	74	1482.7	5.5	^{195m}Pt	^{195}Ir	^{195}Pt
^{196}Ir	77	196	52 s	B−	198	38	3673	38	1076.1	1.3	^{196}Pt		
^{196m}Ir	77	196	1.40 h	B−	419	419	430	428	1518.8	18.0	^{196}Pt		
^{184}Pt	78	184	17.3 m	ECB+A	134	135	155	156	720.6	15.1	^{184}Ir	^{180}Os	
^{186}Pt	78	186	2.08 h	ECA	118	118	128	128	185.5	7.3	^{186m}Ir	^{186}Ir	^{182}Os
^{187}Pt	78	187	2.35 h	ECB+	101	109	176	122	484.5	9.7	^{187}Ir		
^{188}Pt	78	188	10.2 d	ECA	41	41	52	52	301.5	6.8	^{188}Ir	^{184}Os	
^{189}Pt	78	189	10.87 h	ECB+	87	87	101	101	175.9	8.9	^{189}Ir		
^{190}Pt	78	190	6.50E + 11 y	A	0	0	0	0	0.0	0.0	^{186}Os		
^{191}Pt	78	191	2.802 d	EC	58	58	71	71	145.1	7.9	^{191}Ir		
^{193}Pt	78	193	50 y	EC	1	1	6	6	1.6	1.6	^{193}Ir		
^{193m}Pt	78	193	4.33 d	IT	3	3	8	8	734.6	1.6	^{193}Pt		
^{195m}Pt	78	195	4.02 d	IT	19	19	34	34	419.5	6.2	^{195}Pt		
^{197}Pt	78	197	19.8915 h	B−	6	6	12	12	1406.9	2.0	^{197}Au		
^{197m}Pt	78	197	95.41 m	ITB−	18	18	32	32	1980.3	5.2	^{197}Pt	^{197}Au	
^{199}Pt	78	199	30.80 m	B−	34	34	387	35	1438.3	1.7	^{199}Au		
^{200}Pt	78	200	12.5 h	B−	13	13	19	19	1380.5	2.8	^{200}Au		
^{202}Pt	78	202	44 h	B−	1	0	725	0	1220.4	0.0	^{202}Au		
^{186}Au	79	186	10.7 m	ECB+	1208	245	3490	243	1086.5	10.9	^{186}Pt		
^{187}Au	79	187	8.4 m	ECB+A	153	161	339	155	319.1	7.4	^{187}Pt	^{183}Ir	
^{190}Au	79	190	42.8 m	ECB+	332	323	781	252	424.2	9.5	^{190}Pt		
^{191}Au	79	191	3.18 h	ECB+	106	106	118	118	458.8	8.9	^{191}Pt		
^{192}Au	79	192	4.94 h	ECB+	267	273	371	226	271.5	8.5	^{192}Pt		
^{193}Au	79	193	17.65 h	EC	35	35	44	44	248.5	5.7	^{193}Pt		
^{193m}Au	79	193	3.9 s	ITEC	37	37	47	47	923.7	5.6	^{193}Au	^{193m}Pt	
^{194}Au	79	194	38.02 h	ECB+	156	159	164	150	186.4	7.2	^{194}Pt		
^{195}Au	79	195	186.098 d	EC	20	20	33	33	10.5	5.7	^{195}Pt		
^{195m}Au	79	195	30.5 s	IT	38	38	49	49	951.4	5.8	^{195}Au		
^{196}Au	79	196	6.183 d	ECB−	86	86	94	94	203.8	7.2	^{196}Pt	^{196}Hg	
^{196m}Au	79	196	9.6 h	IT	51	51	75	75	3220.4	11.1	^{196}Au		
^{198}Au	79	198	2.69517 d	B−	70	70	72	71	1513.0	3.2	^{198}Hg		
^{198m}Au	79	198	2.27 d	IT	101	101	115	115	1567.1	12.8	^{198}Au		
^{199}Au	79	199	3.139 d	B−	19	19	22	22	1299.2	2.8	^{199}Hg		
^{200}Au	79	200	48.4 m	B−	43	42	1449	40	1195.4	1.0	^{200}Hg		
^{200m}Au	79	200	18.7 h	B−IT	336	336	343	343	1954.8	15.3	^{200}Au	^{200}Hg	
^{201}Au	79	201	26 m	B−	6	6	44	7	1379.6	0.4	^{201}Hg		
^{202}Au	79	202	28.8 s	B−	93	27	3212	26	1068.5	0.6	^{202}Hg		

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^{190}Hg	80	190	20.0 m	ECB+	42	42	54	54	124.3	7.4	^{190}Au		
^{191m}Hg	80	191	50.8 m	ECB+	238	242	275	244	1142.7	12.1	^{191}Au		
^{192}Hg	80	192	4.85 h	EC	55	55	68	68	202.5	8.2	^{192}Au		
^{193}Hg	80	193	3.80 h	ECB+	132	133	140	138	294.4	7.8	^{193}Au	^{193m}Au	
^{193m}Hg	80	193	11.8 h	ECB+IT	162	163	168	164	171.9	6.9	^{193m}Au	^{193}Hg	^{193}Au
^{194}Hg	80	194	440 y	EC	1	1	7	7	1.6	1.6	^{194}Au		
^{195}Hg	80	195	10.53 h	ECB+	38	38	52	51	59.8	5.7	^{195}Au		
^{195m}Hg	80	195	41.6 h	ITECB+	40	40	57	57	532.4	7.1	^{195}Hg	^{195}Au	
^{197}Hg	80	197	64.94 h	EC	18	18	31	31	9.9	5.1	^{197}Au		
^{197m}Hg	80	197	23.8 h	ITEC	21	21	32	32	2443.0	4.6	^{197}Hg	^{197}Au	
^{199m}Hg	80	199	42.66 m	IT	36	36	46	46	2546.9	5.5	^{199}Hg		
^{203}Hg	80	203	46.612 d	B−	43	43	46	46	754.8	3.9	^{203}Tl		
^{205}Hg	80	205	5.2 m	B−	1	1	263	1	1303.4	0.1	^{205}Tl		
^{206}Hg	80	206	8.15 m	B−	22	22	58	24	1742.5	1.9	^{206}Tl		
^{207}Hg	80	207	2.9 m	B−	393	376	1191	327	1821.8	7.7	^{207}Tl		
^{190}Tl	81	190	2.6 m	ECB+	2484	218	4617	221	587.0	8.5	^{190}Hg		
^{190m}Tl	81	190	3.7 m	ECB+	943	407	2907	412	603.2	14.2	^{190}Hg		
^{194}Tl	81	194	33.0 m	ECB+	522	157	2071	162	365.5	7.3	^{194}Hg		
^{194m}Tl	81	194	32.8 m	ECB+	408	420	973	432	580.8	16.9	^{194}Hg		
^{195}Tl	81	195	1.16 h	ECB+	180	182	191	173	244.1	7.6	^{195}Hg	^{195m}Hg	
^{196}Tl	81	196	1.84 h	ECB+	276	279	687	252	210.8	8.4	^{196}Hg		
^{197}Tl	81	197	2.84 h	ECB+	77	78	87	85	204.5	5.6	^{197}Hg		
^{198}Tl	81	198	5.3 h	ECB+	293	294	291	261	116.6	8.4	^{198}Hg		
^{198m}Tl	81	198	1.87 h	ECB+IT	208	210	228	229	2035.1	13.5	^{198}Tl	^{198}Hg	
^{199}Tl	81	199	7.42 h	ECB+	48	48	58	58	491.4	5.7	^{199}Hg		
^{200}Tl	81	200	26.1 h	ECB+	208	208	222	209	156.2	8.3	^{200}Hg		
^{201}Tl	81	201	72.912 h	EC	22	22	32	32	117.2	4.7	^{201}Hg		
^{202}Tl	81	202	12.23 d	EC	85	85	92	92	64.9	6.1	^{202}Hg		
^{204}Tl	81	204	3.78 y	B−EC	0	0	1	0	1336.4	0.1	^{204}Pb	^{204}Hg	
^{206}Tl	81	206	4.200 m	B−	0	0	269	0	1290.9	0.0	^{206}Pb		
^{206m}Tl	81	206	3.74 m	IT	398	398	419	409	1509.5	17.4	^{206}Tl		
^{207}Tl	81	207	4.77 m	B−	0	0	149	0	1319.2	0.0	^{207}Pb		
^{208}Tl	81	208	3.053 m	B−	440	420	772	275	1491.7	5.6	^{208}Pb		
^{209}Tl	81	209	2.161 m	B−	315	314	1053	280	1286.2	8.0	^{209}Pb		
^{210}Tl	81	210	1.30 m	B−	1142	405	3679	370	1357.5	10.6	^{210}Pb		
^{194}Pb	82	194	12.0 m	ECB+A	172	173	187	183	504.5	11.9	^{194}Tl	^{190}Hg	
^{195m}Pb	82	195	15 m	ECB+	267	280	628	310	613.3	19.0	^{195}Tl		
^{196}Pb	82	196	37 m	ECB+	91	91	111	112	1008.0	11.7	^{196}Tl		
^{197}Pb	82	197	8 m	ECB+	228	233	319	227	231.2	10.5	^{197}Tl		
^{197m}Pb	82	197	43 m	ECB+IT	197	200	257	225	2460.2	15.9	^{197}Tl	^{197}Pb	
^{198}Pb	82	198	2.4 h	EC	82	82	102	102	704.6	11.4	^{198}Tl		
^{199}Pb	82	199	90 m	ECB+	158	162	195	165	216.1	9.5	^{199}Tl		
^{200}Pb	82	200	21.5 h	EC	44	44	69	69	896.1	11.3	^{200}Tl		
^{201}Pb	82	201	9.33 h	ECB+	130	130	148	147	388.1	11.0	^{201}Tl		

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded	$H_p(10)$, 100 cm Shielded	$H_p(3)_{slab}$, 100 cm Unshielded	$H_p(3)_{slab}$, 100 cm Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded	$H_p(0.07)_{slab}$, 10 cm Shielded	Daughter nuclei with highest yield	
					$\mu Sv\ h^{-1}\ GBq^{-1}$		$\mu Sv\ h^{-1}\ GBq^{-1}$		$mSv\ h^{-1}\ GBq^{-1}$			
^{201m}Pb	82	201	61 s	IT	62	62	70	70	570.0	4.0	^{201}Pb	
^{202}Pb	82	202	5.25E + 4 y	ECA	1	1	11	11	3.6	3.6	^{202}Tl	^{198}Hg
^{202m}Pb	82	202	3.53 h	ITEC	322	322	333	331	355.4	10.4	^{202}Pb	^{202}Tl
^{203}Pb	82	203	51.873 h	EC	61	61	78	78	573.8	9.9	^{203}Tl	
^{204m}Pb	82	204	67.2 m	IT	328	328	331	331	224.5	8.2	^{204}Pb	
^{205}Pb	82	205	1.53E + 7 y	EC	1	1	11	11	3.6	3.6	^{205}Tl	
^{209}Pb	82	209	3.253 h	B−	0	0	0	0	1390.2	0.0	^{209}Bi	
^{210}Pb	82	210	22.20 y	B−A	4	4	15	15	3.3	3.3	^{210}Bi	^{206}Hg
^{211}Pb	82	211	36.1 m	B−	11	11	109	11	1343.2	0.4	^{211}Bi	
^{212}Pb	82	212	10.64 h	B−	28	28	35	35	1896.8	4.2	^{212}Bi	
^{214}Pb	82	214	26.8 m	B−	46	46	53	53	2144.0	4.6	^{214}Bi	
^{197}Bi	83	197	9.3 m	ECB+	261	265	941	273	284.3	11.3	^{197}Pb	^{197m}Pb
^{200}Bi	83	200	36.4 m	ECB+	396	402	898	422	629.3	19.3	^{200}Pb	
^{201}Bi	83	201	108 m	ECB+	256	259	289	255	138.5	10.1	^{201}Pb	^{201m}Pb
^{202}Bi	83	202	1.72 h	ECB+	429	437	630	444	539.2	16.5	^{202}Pb	
^{203}Bi	83	203	11.76 h	ECB+	348	348	341	325	237.8	11.3	^{203}Pb	
^{204}Bi	83	204	11.22 h	ECB+	453	453	464	457	371.8	16.2	^{204m}Pb	^{204}Pb
^{205}Bi	83	205	15.31 d	ECB+	247	247	253	235	107.8	9.7	^{205}Pb	
^{206}Bi	83	206	6.243 d	ECB+	514	514	519	514	637.0	18.7	^{206}Pb	
^{207}Bi	83	207	32.9 y	ECB+	243	243	306	254	131.0	10.8	^{207}Pb	
^{208}Bi	83	208	3.68E + 5 y	EC	310	305	191	170	7.9	6.2	^{208}Pb	
^{210}Bi	83	210	5.013 d	B−A	0	0	13	0	1394.8	0.0	^{210}Po	^{206}Tl
^{210m}Bi	83	210	3.04E + 6 y	A	47	47	50	50	566.1	4.0	^{206}Tl	
^{211}Bi	83	211	2.14 m	A	8	8	9	9	82.0	0.6	^{207}Tl	^{211}Po
^{212}Bi	83	212	60.55 m	B−A	17	16	981	19	749.4	1.4	^{212}Po	^{208}Tl
^{212}Bin	83	212	7.0 m	B−	0	0	259	0	1292.5	0.0	^{212m}Po	
^{213}Bi	83	213	45.59 m	B−A	22	22	117	23	1422.3	1.1	^{213}Po	^{209}Tl
^{214}Bi	83	214	19.9 m	B−A	253	210	1243	183	1288.6	3.1	^{214}Po	^{210}Tl
^{215}Bi	83	215	7.6 m	B−	44	43	766	46	1911.3	2.9	^{215}Po	
^{216}Bi	83	216	2.17 m	B−	429	126	4476	127	1118.0	4.8	^{216}Po	
^{203}Po	84	203	36.7 m	ECB+A	246	255	413	264	1056.2	11.7	^{203}Bi	^{199}Pb
^{204}Po	84	204	3.53 h	ECA	200	200	241	240	844.8	18.5	^{204}Bi	^{200}Pb
^{205}Po	84	205	1.66 h	ECB+A	244	247	269	255	213.9	10.5	^{205}Bi	^{201}Pb
^{206}Po	84	206	8.8 d	ECA	202	202	237	235	767.2	15.7	^{206}Bi	^{202}Pb
^{207}Po	84	207	5.80 h	ECB+A	204	205	221	219	172.2	9.6	^{207}Bi	^{203}Pb
^{208}Po	84	208	2.898 y	A	0	0	0	0	0.0	0.0	^{208}Bi	^{204}Pb
^{209}Po	84	209	102 y	A	1	1	1	1	11.1	0.1	^{205}Pb	^{209}Bi
^{210}Po	84	210	138.376 d	A	0	0	0	0	0.0	0.0	^{206}Pb	

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^{211}Po	84	211	0.516 s	A	1	1	1	1	0.4	0.0	^{207}Pb	
^{212}Po	84	212	2.99E − 7 s	A	0	0	0	0	0.0	0.0	^{208}Pb	
^{212m}Po	84	212	45.1 s	A	10	10	6	6	0.7	0.1	^{208}Pb	
^{213}Po	84	213	4.2E − 6 s	A	0	0	0	0	0.0	0.0	^{209}Pb	
^{214}Po	84	214	1.643E − 4 s	A	0	0	0	0	0.0	0.0	^{210}Pb	
^{215}Po	84	215	1.781E − 3 s	A	0	0	0	0	0.0	0.0	^{211}Pb	
^{216}Po	84	216	0.145 s	A	0	0	0	0	0.0	0.0	^{212}Pb	
^{218}Po	84	218	3.10 m	A	0	0	0	0	0.1	0.0	^{214}Pb	^{218}At
^{204}At	85	204	9.2 m	ECB+A	510	392	1654	408	507.6	16.2	^{204}Po	^{200}Bi
^{205}At	85	205	26.2 m	ECB+A	234	186	823	196	443.3	9.7	^{205}Po	^{201}Bi
^{206}At	85	206	30.6 m	ECB+A	455	406	1274	415	522.1	16.1	^{206}Po	^{202}Bi
^{207}At	85	207	1.80 h	ECB+A	308	310	349	308	915.9	12.6	^{207}Po	^{203}Bi
^{208}At	85	208	1.63 h	ECB+A	474	478	549	483	1082.4	18.1	^{208}Po	^{204}Bi
^{209}At	85	209	5.41 h	ECB+A	377	377	405	402	358.1	18.0	^{209}Po	^{205}Bi
^{210}At	85	210	8.1 h	ECB+A	438	438	443	425	568.0	14.9	^{210}Po	^{206}Bi
^{211}At	85	211	7.214 h	ECA	10	10	18	18	3.3	3.1	^{211}Po	^{207}Bi
^{215}At	85	215	1.00E − 4 s	A	0	0	0	0	0.2	0.0	^{211}Bi	
^{216}At	85	216	3.00E − 4 s	A	1	1	1	1	4.9	0.1	^{212}Bi	
^{217}At	85	217	3.23E − 2 s	A	0	0	0	0	1.3	0.0	^{213}Bi	
^{218}At	85	218	1.5 s	A	0	0	3	0	1.0	0.0	^{214}Bi	^{218}Rn
^{219}At	85	219	56 s	A	0	0	0	0	0.0	0.0	^{215}Bi	
^{220}At	85	220	3.71 m	B−A	312	80	3925	84	1549.8	5.7	^{220}Rn	^{216}Bi
^{207}Rn	86	207	9.25 m	ECB+A	173	167	707	179	409.2	9.1	^{207}At	^{203}Po
^{209}Rn	86	209	28.5 m	ECB+A	185	192	332	196	376.8	9.5	^{209}At	^{205}Po
^{210}Rn	86	210	2.4 h	A	11	11	12	12	43.9	0.8	^{206}Po	^{210}At
^{211}Rn	86	211	14.6 h	ECB+A	294	294	309	302	280.5	10.7	^{211}At	^{207}Po
^{212}Rn	86	212	23.9 m	A	0	0	0	0	0.0	0.0	^{208}Po	
^{215}Rn	86	215	2.30usA	327500	0	0	0	0	0.0	0.0	^{211}Po	
^{216}Rn	86	216	4.5E − 5 s	A	0	0	0	0	0.0	0.0	^{212}Po	
^{217}Rn	86	217	5.40E − 4 s	A	0	0	0	0	0.0	0.0	^{213}Po	
^{218}Rn	86	218	3.5E − 2 s	A	0	0	0	0	0.0	0.0	^{214}Po	
^{219}Rn	86	219	3.96 s	A	10	10	11	11	75.9	0.8	^{215}Po	
^{220}Rn	86	220	55.6 s	A	0	0	0	0	0.0	0.0	^{216}Po	
^{222}Rn	86	222	3.8235 d	A	0	0	0	0	0.0	0.0	^{218}Po	
^{223}Rn	86	223	24.3 m	B−	62	62	518	76	1378.1	5.6	^{223}Fr	
^{212}Fr	87	212	20.0 m	ECB+A	176	181	331	196	515.3	10.4	^{212}Rn	^{208}At
^{219}Fr	87	219	2.0E − 2 s	A	1	1	1	1	3.2	0.0	^{215}At	
^{220}Fr	87	220	27.4 s	A	3	3	8	8	25.1	1.3	^{216}At	^{220}Ra
^{221}Fr	87	221	4.9 m	A	6	6	7	7	95.8	0.7	^{217}At	
^{222}Fr	87	222	14.2 m	B−	38	37	730	49	1284.1	5.4	^{222}Ra	
^{223}Fr	87	223	22.00 m	B−A	19	19	36	31	1508.1	4.2	^{223}Ra	^{219}At
^{224}Fr	87	224	3.33 m	B−	100	88	1968	89	1242.0	4.5	^{224}Ra	
^{227}Fr	87	227	2.47 m	B−	84	82	1208	94	1473.4	6.7	^{227}Ra	
^{219}Ra	88	219	10 msA	298739	31	31	36	36	676.2	2.9	^{215}Rn	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm Unshielded	Shielded	$H_p(3)_{slab}$, 100 cm Unshielded	Shielded	$H_p(0.07)_{slab}$, 10 cm Unshielded	Shielded	Daughter nuclei with highest yield		
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}				
^{220}Ra	88	220	1.79E − 2 s	A	1	1	1	1	0.7	0.0	^{216}Rn		
^{221}Ra	88	221	28 s	A	10	10	21	21	320.6	3.3	^{217}Rn		
^{222}Ra	88	222	38.0 s	A	2	2	2	2	7.8	0.1	^{218}Rn		
^{223}Ra	88	223	11.43 d	A	29	29	40	40	608.9	4.9	^{219}Rn		
^{224}Ra	88	224	3.66 d	A	2	2	2	2	29.7	0.2	^{220}Rn		
^{225}Ra	88	225	14.9 d	B−	9	9	15	15	731.3	2.0	^{225}Ac		
^{226}Ra	88	226	1600 y	A	1	1	2	2	58.0	0.2	^{222}Rn		
^{227}Ra	88	227	42.2 m	B−	37	37	89	57	1744.6	6.3	^{227}Ac		
^{228}Ra	88	228	5.75 y	B−	4	4	10	10	1.3	1.3	^{228}Ac		
^{230}Ra	88	230	93 m	B−	17	17	22	22	1399.6	2.3	^{230}Ac		
^{223}Ac	89	223	2.10 m	A	5	5	9	9	22.8	1.3	^{219}Fr		
^{224}Ac	89	224	2.78 h	ECA	51	51	73	73	56.6	9.2	^{224}Ra	^{220}Fr	
^{225}Ac	89	225	10.0 d	A	6	6	15	15	14.4	2.4	^{221}Fr		
^{226}Ac	89	226	29.37 h	B−ECA	28	28	39	36	1229.9	4.2	^{226}Th	^{226}Ra	^{222}Fr
^{227}Ac	89	227	21.772 y	B−A	1	1	2	2	0.4	0.4	^{227}Th	^{223}Fr	
^{228}Ac	89	228	6.15 h	B−	141	141	347	150	1420.0	6.2	^{228}Th		
^{230}Ac	89	230	122 s	B−	117	81	2371	77	1164.8	2.8	^{230}Th		
^{231}Ac	89	231	7.5 m	B−	80	80	399	91	1883.1	8.0	^{231}Th		
^{232}Ac	89	232	119 s	B−	269	162	2483	141	1131.4	4.0	^{232}Th		
^{233}Ac	89	233	145 s	B−	88	85	1755	85	1154.2	2.9	^{233}Th		
^{223}Th	90	223	0.60 s	A	20	20	35	35	154.4	5.0	^{219}Ra		
^{224}Th	90	224	1.05 s	A	5	5	6	6	205.0	0.7	^{220}Ra		
^{226}Th	90	226	30.57 m	A	3	3	6	6	4.8	0.9	^{222}Ra		
^{227}Th	90	227	18.68 d	A	34	34	57	57	316.2	7.5	^{223}Ra		
^{228}Th	90	228	1.9116 y	A	2	2	6	6	3.9	1.0	^{224}Ra		
^{229}Th	90	229	7.34E + 3 y	A	32	32	66	66	202.0	10.0	^{225}Ra		
^{230}Th	90	230	7.538E + 4 y	A	2	2	5	5	1.9	0.8	^{226}Ra		
^{231}Th	90	231	25.52 h	B−	21	21	47	47	524.9	6.8	^{231}Pa		
^{232}Th	90	232	1.405E10 y	A	2	2	5	5	1.2	0.8	^{228}Ra		
^{233}Th	90	233	22.3 m	B−	9	9	37	12	1398.8	1.2	^{233}Pa		
^{234}Th	90	234	24.10 d	B−	4	4	8	8	86.1	1.1	^{234m}Pa		
^{235}Th	90	235	7.1 m	B−	10	9	853	9	1249.1	0.3	^{235}Pa		
^{236}Th	90	236	37.5 m	B−	7	7	15	10	1446.5	0.9	^{236}Pa		
^{227}Pa	91	227	38.3 m	A	9	9	19	19	2.8	2.7	^{223}Ac	^{227}Th	
^{228}Pa	91	228	22 h	ECB+A	232	233	269	262	263.4	15.0	^{228}Th	^{224}Ac	
^{229}Pa	91	229	1.50 d	ECA	20	20	36	36	5.0	4.9	^{229}Th	^{225}Ac	
^{230}Pa	91	230	17.4 d	ECB−A	119	119	142	142	161.1	8.6	^{230}Th	^{230}U	^{226}Ac
^{231}Pa	91	231	3.276E + 4 y	A	19	19	40	40	107.6	5.8	^{227}Ac		

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^{232}Pa	91	232	1.31 d	B−EC	159	159	176	175	756.7	7.4	^{232}U	^{232}Th	
^{233}Pa	91	233	26.967 d	B−	50	50	69	69	1710.6	7.1	^{233}U		
^{234}Pa	91	234	6.70 h	B−	252	252	291	280	1993.1	14.0	^{234}U		
^{234m}Pa	91	234	1.17 m	B−IT	4	3	1651	3	1143.6	0.1	^{234}U	^{234}Pa	
^{235}Pa	91	235	24.5 m	B−	0	0	121	0	1330.0	0.0	^{235m}U	^{235}U	
^{236}Pa	91	236	9.1 m	B−	150	140	1531	137	1373.2	5.0	^{236}U		
^{237}Pa	91	237	8.7 m	B−	99	98	595	99	1321.0	2.3	^{237}U		
^{227}U	92	227	1.1 m	A	28	28	41	41	926.2	4.8	^{223}Th		
^{228}U	92	228	9.1 m	A	3	3	7	7	7.9	0.9	^{224}Th		
^{230}U	92	230	20.8 d	A	3	3	7	7	5.1	1.1	^{226}Th		
^{231}U	92	231	4.2 d	ECA	41	41	82	82	12.8	11.6	^{231}Pa	^{227}Th	
^{232}U	92	232	68.9 y	A	3	3	7	7	1.7	1.1	^{228}Th		
^{233}U	92	233	1.592E + 5 y	A	1	1	4	4	1.3	0.5	^{229}Th		
^{234}U	92	234	2.455E + 5 y	A	2	2	6	6	1.1	1.0	^{230}Th		
^{235}U	92	235	7.04E + 8 y	A	36	36	47	47	100.7	5.5	^{231}Th		
^{235m}U	92	235	26 m	IT	0	0	0	0	0.0	0.0	^{235}U		
^{236}U	92	236	2.342E + 7 y	A	2	2	6	6	0.9	0.9	^{232}Th		
^{237}U	92	237	6.75 d	B−	42	42	63	63	918.2	7.7	^{237}Np		
^{238}U	92	238	4.468E + 9 y	A	2	2	5	5	0.7	0.7	^{234}Th	SF	
^{239}U	92	239	23.45 m	B−	14	14	40	18	1383.8	2.0	^{239}Np		
^{240}U	92	240	14.1 h	B−	8	8	17	17	832.3	2.4	^{240m}Np		
^{242}U	92	242	16.8 m	B−	8	8	25	9	1416.3	0.7	^{242}Np		
^{232}Np	93	232	14.7 m	ECB+	211	212	241	239	388.8	13.1	^{232}U		
^{233}Np	93	233	36.2 m	ECA	25	25	39	39	37.3	4.9	^{233}U	^{229}Pa	
^{234}Np	93	234	4.4 d	ECB+	171	171	212	172	53.1	7.6	^{234}U		
^{235}Np	93	235	396.1 d	ECA	8	8	20	20	3.0	3.0	^{235}U	235m	^{231}Pa
^{236}Np	93	236	1.54E + 5 y	ECB−A	58	58	103	103	1326.6	13.5	^{236}U	^{236}Pu	^{232}Pa
^{236m}Np	93	236	22.5 h	ECB−	15	15	24	24	612.7	3.0	^{236}U	^{236}Pu	
^{237}Np	93	237	2.144E + 6 y	A	20	20	41	41	23.2	5.6	^{233}Pa		
^{238}Np	93	238	2.117 d	B−	97	97	120	107	812.6	3.9	^{238}Pu		
^{239}Np	93	239	2.3565 d	B−	46	46	64	64	1883.0	7.1	^{239}Pu		
^{240}Np	93	240	61.9 m	B−	190	190	250	218	2063.5	11.8	^{240}Pu		
^{240m}Np	93	240	7.22 m	B−IT	59	59	953	67	1243.7	3.6	^{240}Pu	^{240}Np	
^{241}Np	93	241	13.9 m	B−	11	11	53	16	1497.9	1.9	^{241}Pu		
^{242}Np	93	242	2.2 m	B−	54	39	2331	37	1110.6	0.9	^{242}Pu		
^{242m}Np	93	242	5.5 m	B−	168	168	500	196	2239.0	10.5	^{242}Pu		
^{232}Pu	94	232	33.7 m	ECA	18	18	29	29	3.6	3.6	^{232}Np	^{228}U	
^{234}Pu	94	234	8.8 h	ECA	21	21	34	34	4.3	4.2	^{234}Np	^{230}U	
^{235}Pu	94	235	25.3 m	ECA	30	30	48	48	6.7	5.9	^{235}Np	^{231}U	
^{236}Pu	94	236	2.858 y	A	3	3	7	7	1.0	1.0	^{232}U	SF	
^{237}Pu	94	237	45.2 d	ECA	20	20	35	35	4.6	4.6	^{237}Np	^{233}U	
^{238}Pu	94	238	87.7 y	A	3	3	6	6	1.0	0.9	^{234}U	SF	
^{239}Pu	94	239	2.411E + 4 y	A	1	1	3	3	0.5	0.4	^{235m}U	^{235}U	
^{240}Pu	94	240	6564 y	A	3	3	6	6	0.9	0.9	^{236}U	SF	

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Table 2. *Continued*

Nuclides	Z	A	Half-live	Decay Mode	$H_p(10)$, 100 cm		$H_p(3)_{slab}$, 100 cm		$H_p(0.07)_{slab}$, 10 cm		Daughter nuclei with highest yield		
					Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded			
					μSv h^{-1} GBq^{-1}		μSv h^{-1} GBq^{-1}		mSv h^{-1} GBq^{-1}				
^{241}Pu	94	241	14.35 y	B−A	0	0	0	0	0.0	0.0	^{241}Am	^{237}U	
^{242}Pu	94	242	3.75E + 5 y	A	2	2	5	5	0.8	0.7	^{238}U	SF	
^{243}Pu	94	243	4.956 h	B−	8	8	12	12	1273.1	1.4	^{243}Am		
^{244}Pu	94	244	8.00E + 7 y	A	12	5	47	7	9.1	0.7	^{240}U	SF	
^{245}Pu	94	245	10.5 h	B−	71	71	78	76	2148.6	3.9	^{245}Am		
^{246}Pu	94	246	10.84 d	B−	39	39	52	52	456.8	5.9	^{246m}Am		
^{237}Am	95	237	73.0 m	ECA	80	80	101	101	457.9	9.2	^{237}Pu	^{233}Np	
^{238}Am	95	238	98 m	ECB+A	154	155	178	171	45.4	8.4	^{238}Pu	^{234}Np	
^{239}Am	95	239	11.9 h	ECA	67	67	98	98	1065.7	11.4	^{239}Pu	^{235}Np	
^{240}Am	95	240	50.8 h	ECA	179	179	205	205	23.8	9.8	^{240}Pu	^{236}Np	
^{241}Am	95	241	432.2 y	A	16	16	28	28	3.8	3.7	^{237}Np		
^{242}Am	95	242	16.02 h	B−EC	10	10	19	19	1134.1	2.3	^{242}Cm	^{242}Pu	
^{242m}Am	95	242	141 y	ITA	7	7	14	14	2.6	1.9	^{242}Am	^{238}Np	
^{243}Am	95	243	7.37E + 3 y	A	17	17	23	23	2.8	2.8	^{239}Np		
^{244}Am	95	244	10.1 h	B−	153	153	180	179	1773.5	9.6	^{244}Cm		
^{244m}Am	95	244	26 m	B−	6	6	210	9	1315.7	1.0	^{244}Cm		
^{245}Am	95	245	2.05 h	B−	8	8	11	11	1603.1	1.2	^{245}Cm		
^{246}Am	95	246	39 m	B−	157	157	211	193	3513.7	13.7	^{246}Cm		
^{246m}Am	95	246	25.0 m	B−	156	155	396	160	1427.0	4.3	^{246}Cm		
^{247}Am	95	247	23.0 m	B−	31	31	154	39	2115.3	4.0	^{247}Cm		
^{238}Cm	96	238	2.4 h	ECA	25	25	36	36	4.6	4.3	^{238}Am	^{234}Pu	
^{239}Cm	96	239	2.9 h	ECB+	59	59	75	75	81.8	8.3	^{239}Am		
^{240}Cm	96	240	27 d	A	3	3	6	6	1.0	0.9	^{236}Pu	SF	
^{241}Cm	96	241	32.8 d	ECA	109	109	136	136	511.1	11.1	^{241}Am	^{237}Pu	
^{242}Cm	96	242	162.8 d	A	3	3	6	6	0.8	0.8	^{238}Pu	SF	
^{243}Cm	96	243	29.1 y	A	35	35	51	51	904.8	5.8	^{239}Pu	^{243}Am	
^{244}Cm	96	244	18.10 y	A	2	2	5	5	0.7	0.7	^{240}Pu	SF	
^{245}Cm	96	245	8.5E + 3 y	A	32	32	50	50	371.0	6.1	^{241}Pu	SF	
^{246}Cm	96	246	4.76E + 3 y	A	3	2	10	4	2.2	0.5	^{242}Pu	SF	
^{247}Cm	96	247	1.56E + 7 y	A	55	55	56	56	132.6	2.8	^{243}Pu		
^{248}Cm	96	248	3.48E + 5 y	A	861	431	2554	152	564.2	4.0	^{244}Pu	SF	
^{249}Cm	96	249	64.15 m	B−	3	3	4	3	1412.8	0.1	^{249}Bk		
^{250}Cm	96	250	8300 y	A	27729	22475	29734	1504	5300.6	35.5	^{246}Pu	^{250}Bk	SF
^{251}Cm	96	251	16.8 m	B−	20	20	114	22	1486.7	1.1	^{251}Bk		
^{245}Bk	97	245	4.94 d	ECA	60	60	80	80	829.4	8.7	^{245}Cm	^{241}Am	
^{246}Bk	97	246	1.80 d	EC	156	156	179	178	16.2	9.2	^{246}Cm		
^{247}Bk	97	247	1.38E + 3 y	A	31	31	37	37	756.8	3.6	^{243}Am		
^{248m}Bk	97	248	23.7 h	B−EC	16	16	23	22	958.9	2.3	^{248}Cf	^{248}Cm	

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^{249}Bk	97	249	330 d	B− A	0	0	0	0	0.2	0.0	^{249}Cf	^{245}Am	
^{250}Bk	97	250	3.212 h	B−	141	141	205	145	1413.0	3.4	^{250}Cf		
^{251}Bk	97	251	55.6 m	B−	28	28	42	41	1826.3	4.7	^{251}Cf		
^{244}Cf	98	244	19.4 m	A	3	3	5	5	0.7	0.7	^{240}Cm		
^{246}Cf	98	246	35.7 h	A	2	2	4	4	0.6	0.5	^{242}Cm	SF	
^{247}Cf	98	247	3.11 h	ECA	40	40	64	64	68.3	7.5	^{247}Bk	^{243}Cm	
^{248}Cf	98	248	334 d	A	2	2	5	4	0.7	0.6	^{244}Cm	SF	
^{249}Cf	98	249	351 y	A	63	63	69	69	142.8	4.5	^{245}Cm	SF	
^{250}Cf	98	250	13.08 y	A	5	3	17	4	5.1	0.5	^{246}Cm	SF	
^{251}Cf	98	251	900 y	A	35	35	48	48	1604.9	5.5	^{247}Cm		
^{252}Cf	98	252	2.645 y	A	233	106	791	55	199.4	1.7	^{248}Cm	SF	
^{253}Cf	98	253	17.81 d	B− A	6	6	10	10	433.4	1.3	^{253}Es	^{249}Cm	
^{254}Cf	98	254	60.5 d	A	53103	47177	34411	1905	6899.2	45.0	^{250}Cm	SF	
^{255}Cf	98	255	85 m	B−	0	0	0	0	1404.4	0.0	^{255}Es		
^{249}Es	99	249	102.2 m	ECB+A	85	85	100	99	157.7	7.3	^{249}Cf	^{245}Bk	
^{250}Es	99	250	8.6 h	EC	265	265	323	323	1115.8	23.7	^{250}Cf		
^{250m}Es	99	250	2.22 h	ECB+	100	100	115	112	24.7	6.3	^{250}Cf		
^{251}Es	99	251	33 h	ECA	36	36	55	55	157.6	6.5	^{251}Cf	^{247}Bk	
^{253}Es	99	253	20.47 d	A	1	1	1	1	1.4	0.2	^{249}Bk	SF	
^{254}Es	99	254	275.7 d	A	22	22	43	43	8.1	5.5	^{250}Bk	^{254}Fm	SF
^{254m}Es	99	254	39.3 h	B− A	87	85	104	93	1233.8	3.8	^{254}Fm	^{250}Bk	^{254}Cf
^{255}Es	99	255	39.8 d	B− A	0	0	1	0	510.5	0.0	^{255}Fm	^{251}Bk	SF
^{256}Es	99	256	25.4 m	B−	4	4	440	7	1269.0	0.8	^{256}Fm		
^{251}Fm	100	251	5.30 h	ECB+A	40	40	51	51	64.0	4.9	^{251}Es	^{247}Cf	
^{252}Fm	100	252	25.39 h	A	2	2	4	4	0.6	0.4	^{248}Cf	SF	
^{253}Fm	100	253	3.00 d	ECA	31	31	48	48	91.3	5.6	^{253}Es	^{249}Cf	
^{254}Fm	100	254	3.240 h	A	4	3	12	4	3.8	0.5	^{250}Cf	SF	
^{255}Fm	100	255	20.07 h	A	20	20	38	38	6.4	4.8	^{251}Cf	SF	
^{256}Fm	100	256	157.6 m	A	43584	40618	19258	1415	5632.4	33.7	^{252}Cf	SF	
^{257}Fm	100	257	100.5 d	A	51	43	107	58	650.4	6.3	^{253}Cf	SF	

For the meaning of 'shielded' and 'unshielded', refer to the main text.

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Table 3. Contribution of the different decay modes to personal dose equivalent for the ISO slab phantom $H_p(d)$ in 10, 3 and 0.07 mm.

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{3}H	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{7}Be	9	0	0	0	0	9	0	0	0	0.3	0.0	0.0	0.0
^{10}Be	0	0	0	0	0	0	0	0	0	0.0	0.0	1726.4	0.0
^{10}C	116	0	39	174	0	118	0	1311	174	2.4	0.0	1168.6	6.0
^{11}C	0	0	11	174	0	0	0	6	174	0.0	0.0	1578.6	6.0
^{14}C	0	0	0	0	0	0	0	0	0	0.0	0.0	31.7	0.0
^{13}N	0	0	14	174	0	0	0	38	174	0.0	0.0	1443.6	6.0
^{16}N	209	16	3658	0	0	69	13	7164	0	0.7	1.1	850.0	0.0
^{14}O	273	0	46	174	0	153	0	1094	174	1.4	0.0	1189.7	6.0
^{15}O	0	0	33	174	0	0	0	876	174	0.0	0.0	1217.9	6.0
^{19}O	140	0	1380	0	0	128	0	6088	0	4.2	7.2	897.4	0.0
^{17}F	0	0	34	174	0	0	0	894	174	0.0	0.0	1214.7	6.0
^{18}F	0	0	7	169	0	0	0	5	169	0.0	0.0	1675.6	5.8
^{19}Ne	0	0	49	174	0	0	0	2229	174	0.0	0.0	1080.2	6.0
^{24}Ne	92	0	2	0	0	92	0	1369	0	3.2	0.7	1154.6	0.0
^{22}Na	183	0	5	157	0	170	0	5	157	2.0	0.0	1561.8	5.4
^{24}Na	496	0	0	0	0	316	0	166	0	3.1	0.0	1320.5	0.0
^{27}Mg	139	0	1	0	0	138	0	764	0	2.3	0.1	1209.5	0.0
^{28}Mg	215	0	0	0	0	205	0	0	0	4.9	0.1	1331.5	0.0
^{26}Al	237	0	12	143	0	173	0	48	142	1.6	0.0	1128.6	4.9
^{28}Al	230	0	69	0	0	170	0	4076	0	1.6	0.0	981.2	0.0
^{29}Al	193	0	3	0	0	170	0	2465	0	2.0	0.0	1072.8	0.0
^{31}Si	0	0	0	0	0	0	0	297	0	0.0	0.0	1281.4	0.0
^{32}Si	0	0	0	0	0	0	0	0	0	0.0	0.0	321.2	0.0
^{30}P	0	0	414	174	0	0	0	4990	174	0.0	0.0	940.7	6.0
^{32}P	0	0	1	0	0	0	0	736	0	0.0	0.0	1211.3	0.0
^{33}P	0	0	0	0	0	0	0	0	0	0.0	0.0	463.9	0.0
^{35}S	0	0	0	0	0	0	0	0	0	0.0	0.0	52.3	0.0
^{37}S	299	0	180	0	0	126	0	1197	0	1.1	0.0	1178.0	0.0
^{38}S	212	0	18	0	0	143	0	576	0	1.3	0.0	1400.2	0.0
^{34}Cl	0	0	2353	174	0	0	0	6835	174	0.0	0.0	857.7	6.0
^{34m}Cl	187	0	24	94	0	119	0	903	94	2.1	91.9	650.1	3.3
^{36}Cl	0	0	0	0	0	0	0	0	0	0.0	0.0	1511.3	0.0
^{38}Cl	181	0	1898	0	0	122	0	4476	0	1.1	0.0	1051.0	0.0
^{39}Cl	209	0	47	0	0	189	0	1516	0	3.5	1.2	1151.6	0.0
^{40}Cl	463	0	951	0	0	299	0	4846	0	3.2	0.1	962.6	0.0
^{37}Ar	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{39}Ar	0	0	0	0	0	0	0	0	0	0.0	0.0	1560.9	0.0

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^{41}Ar	184	0	0	0	0	169	0	53	0	1.9	0.1	1393.5	0.0
^{42}Ar	0	0	0	0	0	0	0	0	0	0.0	0.0	1559.6	0.0
^{43}Ar	211	0	845	0	0	177	0	4181	0	2.5	0.2	1014.1	0.0
^{44}Ar	262	0	7	0	0	206	0	322	0	4.1	6.5	1353.0	0.0
^{38}K	263	0	136	173	0	158	0	3768	173	1.5	0.0	985.0	6.0
^{40}K	22	0	0	0	0	19	0	174	0	0.2	0.0	1133.5	0.0
^{42}K	38	0	627	0	0	32	0	4853	0	0.3	0.0	973.0	0.0
^{43}K	162	0	0	0	0	164	0	22	0	6.1	1.4	1509.5	0.0
^{44}K	305	0	1634	0	0	233	0	3791	0	2.9	0.1	1037.0	0.0
^{45}K	245	0	205	0	0	188	0	2421	0	4.0	7.9	1089.1	0.0
^{46}K	336	0	3749	0	0	244	0	6487	0	2.6	0.0	878.7	0.0
^{41}Ca	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{45}Ca	0	0	0	0	0	0	0	0	0	0.0	0.0	491.1	0.0
^{47}Ca	152	0	0	0	0	141	0	271	0	1.8	0.1	1455.9	0.0
^{49}Ca	318	0	2	0	0	134	0	1825	0	1.2	0.0	1116.3	0.0
^{42m}Sc	462	0	153	173	0	418	0	4048	173	6.9	1.7	969.6	6.0
^{43}Sc	15	0	12	153	0	15	0	30	153	0.7	0.2	1318.4	5.3
^{44}Sc	171	0	21	164	0	165	0	311	164	2.2	0.1	1235.1	5.7
^{44m}Sc	47	0	0	0	0	48	0	0	0	3.2	295.4	0.0	0.0
^{46}Sc	304	0	0	0	0	300	0	0	0	4.5	0.2	1010.5	0.0
^{47}Sc	20	0	0	0	0	19	0	0	0	1.9	8.8	1345.5	0.0
^{48}Sc	495	0	0	0	0	478	0	0	0	6.7	1.4	1504.8	0.0
^{49}Sc	0	0	2	0	0	0	0	1429	0	0.0	0.0	1133.6	0.0
^{50}Sc	463	0	890	0	0	419	1	5848	0	6.6	1.0	914.5	0.0
^{44}Ti	31	0	0	0	0	29	0	0	0	2.9	0.1	0.0	0.0
^{45}Ti	0	0	11	148	0	0	0	6	148	0.0	0.0	1315.9	5.1
^{51}Ti	63	0	2	0	0	64	0	1766	0	3.4	3.4	1110.9	0.0
^{52}Ti	28	0	1	0	0	32	0	1003	0	3.4	4.7	1176.2	0.0
^{47}V	1	0	39	168	0	1	0	1317	168	0.0	0.0	1114.4	5.8
^{48}V	351	0	5	88	0	333	0	18	88	4.4	0.2	889.4	3.0
^{49}V	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{50}V	197	0	0	0	0	166	0	0	0	1.8	0.1	78.3	0.0
^{52}V	201	0	10	0	0	176	0	3041	0	1.8	0.1	1030.6	0.0
^{53}V	156	0	4	0	0	154	0	2621	0	2.3	0.2	1051.6	0.0
^{48}Cr	75	0	0	3	0	75	0	0	3	5.4	11.0	8.4	0.1
^{49}Cr	21	0	22	162	0	20	0	353	162	1.9	55.5	1203.6	5.6
^{51}Cr	6	0	0	0	0	6	0	0	0	0.3	0.4	0.0	0.0
^{55}Cr	0	0	14	0	0	0	0	3240	0	0.0	0.0	1019.3	0.0
^{56}Cr	28	0	0	0	0	30	0	310	0	3.0	0.0	1275.6	0.0
^{50m}Mn	532	0	645	173	0	498	1	5339	173	7.2	4.4	918.0	6.0
^{51}Mn	1	0	47	169	0	1	0	2123	169	0.0	0.0	1048.7	5.8
^{52}Mn	468	0	2	52	0	442	0	2	52	6.4	0.6	545.5	1.8
^{52m}Mn	198	0	89	168	0	173	0	3406	168	1.8	1.2	966.4	5.8
^{53}Mn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{54}Mn	132	0	0	0	0	132	0	0	0	2.3	0.2	0.0	0.0
^{56}Mn	239	0	35	0	0	204	0	2219	0	2.9	0.3	1194.3	0.0
^{57}Mn	18	0	19	0	0	22	0	3186	0	1.6	4.0	1028.2	0.0
^{58m}Mn	349	0	1350	0	0	319	0	6072	0	5.0	0.7	903.0	0.0
^{52}Fe	31	0	6	97	0	30	0	4	97	2.9	24.0	953.7	3.3
^{53}Fe	31	0	87	169	0	30	0	3191	169	1.4	0.8	987.6	5.8
^{53m}Fe	448	0	0	0	0	417	1	0	0	6.3	3.4	0.0	0.0
^{55}Fe	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{59}Fe	173	0	0	0	0	165	0	1	0	2.2	1.3	950.3	0.0
^{60}Fe	0	0	0	0	0	0	0	0	0	0.0	0.0	163.4	0.0
^{61}Fe	202	0	37	0	0	187	0	3239	0	3.3	2.1	1036.6	0.0
^{62}Fe	86	0	2	0	0	86	0	1489	0	3.0	1.0	1128.7	0.0
^{54m}Co	429	0	2349	174	0	402	1	6828	174	7.1	4.1	852.6	6.0
^{55}Co	184	0	15	132	0	178	0	176	132	3.0	0.4	1061.7	4.6
^{56}Co	463	0	4	33	0	378	1	56	33	5.0	0.4	254.0	1.1
^{57}Co	24	0	0	0	0	27	0	0	0	2.9	22.0	0.0	0.0
^{58}Co	131	0	1	26	0	130	0	1	26	2.3	0.3	273.4	0.9
^{58m}Co	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{60}Co	360	0	0	0	0	337	1	1	0	4.0	0.3	801.3	0.0
^{60m}Co	1	0	0	0	0	1	0	1	0	0.0	0.0	3.0	0.0
^{61}Co	20	0	0	0	0	19	0	48	0	1.3	0.0	1359.0	0.0
^{62}Co	220	0	1067	0	0	188	1	5638	0	2.3	0.1	921.3	0.0
^{62m}Co	378	0	80	0	0	336	1	3243	0	4.2	0.3	1046.8	0.0
^{56}Ni	276	0	0	0	0	271	0	0	0	8.5	36.8	0.0	0.0
^{57}Ni	206	0	5	76	0	176	1	3	76	2.2	1.6	737.0	2.6
^{59}Ni	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{63}Ni	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{65}Ni	79	0	1	0	0	71	0	1084	0	0.9	0.2	1252.5	0.0
^{66}Ni	0	0	0	0	0	0	0	0	0	0.0	0.0	436.2	0.0
^{57}Cu	17	0	7130	174	0	16	0	8143	174	0.2	0.0	798.8	6.0
^{59}Cu	66	0	741	171	0	63	0	5019	171	1.2	0.5	920.1	5.9
^{60}Cu	396	0	118	161	0	320	1	2047	161	3.7	0.3	1020.8	5.5
^{61}Cu	31	0	9	107	0	31	0	26	107	1.0	1.1	907.0	3.7
^{62}Cu	1	0	197	171	0	1	0	4248	170	0.0	0.0	942.3	5.9
^{64}Cu	1	0	0	30	0	1	0	0	30	0.0	0.0	876.0	1.0
^{66}Cu	15	0	16	0	0	15	0	3053	0	0.2	0.0	1038.2	0.0
^{67}Cu	21	0	0	0	0	21	0	0	0	2.0	28.5	1163.8	0.0
^{69}Cu	81	0	12	0	0	79	0	2045	0	1.4	0.6	1127.8	0.0

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^{60}Zn	90	0	115	168	0	91	0	3330	168	3.0	2.0	970.8	5.8
^{61}Zn	72	0	1950	172	0	57	0	6029	172	1.0	0.4	877.3	5.9
^{62}Zn	62	0	1	15	0	63	0	0	15	2.4	1.5	155.6	0.5
^{63}Zn	23	0	49	162	0	22	0	2228	162	0.4	0.1	1000.1	5.6
^{65}Zn	83	0	0	2	0	81	0	0	2	1.1	0.1	21.0	0.1
^{69}Zn	0	0	0	0	0	0	0	1	0	0.0	0.0	1488.3	0.0
^{69m}Zn	72	0	0	0	0	72	0	0	0	3.0	77.6	0.5	0.0
^{71}Zn	51	0	29	0	0	51	0	2943	0	1.5	0.9	1050.4	0.0
^{71m}Zn	260	0	0	0	0	261	0	251	0	9.0	7.2	1287.6	0.0
^{72}Zn	29	0	0	0	0	33	0	0	0	4.1	31.2	642.3	0.0
^{64}Ga	295	0	1675	170	0	217	0	5042	170	2.7	0.3	906.0	5.9
^{65}Ga	42	0	39	156	0	41	0	1560	156	2.0	7.4	1011.9	5.4
^{66}Ga	218	0	871	96	0	140	0	3233	96	1.7	0.2	526.7	3.3
^{67}Ga	28	0	0	0	0	28	0	0	0	2.2	14.7	0.0	0.0
^{68}Ga	6	0	36	155	0	6	0	1197	155	0.1	0.0	1030.8	5.3
^{70}Ga	1	0	1	0	0	1	0	569	0	0.0	0.9	1226.4	0.0
^{72}Ga	375	0	24	0	0	307	0	820	0	4.7	7.0	1346.9	0.0
^{73}Ga	61	0	0	0	0	65	0	55	0	4.7	9.6	1360.5	0.0
^{74}Ga	420	0	220	0	0	320	1	2576	0	5.6	2.1	1101.9	0.0
^{66}Ge	78	0	2	41	0	80	0	2	41	5.1	18.1	404.6	1.4
^{67}Ge	72	0	209	162	0	67	0	3677	162	3.2	45.6	932.7	5.6
^{68}Ge	0	0	0	0	0	3	0	0	0	0.9	0.0	0.0	0.0
^{69}Ge	106	0	3	41	0	105	0	9	41	2.5	0.5	349.6	1.4
^{71}Ge	0	0	0	0	0	3	0	0	0	1.0	0.0	0.0	0.0
^{75}Ge	6	0	0	0	0	6	0	18	0	0.5	3.0	1406.8	0.0
^{77}Ge	175	0	1	0	0	171	0	989	0	7.5	102.0	1221.1	0.0
^{78}Ge	49	0	0	0	0	50	0	0	0	3.6	8.9	1484.6	0.0
^{68}As	383	0	2242	172	0	338	1	6577	172	5.1	2.0	856.0	5.9
^{69}As	27	0	196	164	0	24	0	3953	164	1.0	8.7	918.6	5.6
^{70}As	481	0	57	157	0	437	1	2025	157	6.9	9.6	978.7	5.4
^{71}As	48	0	3	49	0	50	0	2	49	3.8	238.6	488.4	1.7
^{72}As	135	0	160	153	0	129	0	3008	153	2.3	22.9	894.6	5.3
^{73}As	3	0	0	0	0	9	0	0	0	2.1	0.0	0.0	0.0
^{74}As	76	0	0	51	0	78	0	49	51	2.5	1.3	923.8	1.7
^{76}As	66	0	75	0	0	65	0	3153	0	1.7	1.3	1043.9	0.0
^{77}As	1	0	0	0	0	2	0	0	0	0.1	4.3	1469.1	0.0
^{78}As	193	0	707	0	0	176	0	3757	0	3.4	2.1	1057.3	0.0
^{79}As	6	0	2	0	0	6	0	1855	0	0.2	0.2	1105.1	0.0
^{70}Se	54	0	6	75	0	96	0	11	75	17.1	8.8	670.0	2.6
^{71}Se	95	0	560	167	0	92	0	4593	167	3.0	33.3	909.9	5.8
^{72}Se	14	0	0	0	0	51	0	0	0	13.6	0.0	0.0	0.0
^{73}Se	77	0	11	114	0	92	0	72	114	9.3	23.4	910.8	3.9
^{73m}Se	10	0	6	36	0	16	0	155	36	2.4	1.5	256.6	1.2
^{75}Se	71	0	0	0	0	100	0	0	0	15.1	33.1	0.0	0.0

Continued

Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{77m}Se	17	0	0	0	0	30	0	0	0	5.1	1269.7	0.0	0.0
^{79}Se	0	0	0	0	0	0	0	0	0	0.0	0.0	32.5	0.0
^{79m}Se	5	0	0	0	0	27	0	0	0	6.5	0.0	0.2	0.0
^{81}Se	1	0	0	0	0	1	0	423	0	0.1	0.3	1255.0	0.0
^{81m}Se	6	0	0	0	0	28	0	0	0	6.6	0.1	0.7	0.0
^{83}Se	392	0	16	0	0	356	1	476	0	9.1	18.7	1396.4	0.0
^{83m}Se	143	0	363	0	0	130	0	3948	0	2.4	2.4	1005.3	0.0
^{84}Se	73	0	0	0	0	74	0	206	0	3.3	2.4	1298.7	0.0
^{72}Br	285	0	4885	173	0	263	1	7526	173	5.1	33.3	815.7	6.0
^{73}Br	76	0	397	167	0	80	0	4464	167	4.0	4.4	913.0	5.8
^{74}Br	415	0	546	155	0	266	1	2711	155	5.5	26.8	941.6	5.4
^{74m}Br	425	0	933	153	0	342	1	3833	153	7.2	9.9	891.4	5.3
^{75}Br	78	0	23	127	0	86	0	573	127	6.6	13.1	912.6	4.4
^{76}Br	300	0	247	96	0	247	1	1990	96	8.1	2.4	629.6	3.3
^{76m}Br	20	0	0	0	0	59	0	11	0	11.2	0.0	2.8	0.0
^{77}Br	57	0	0	1	0	85	0	0	1	10.6	38.9	12.0	0.0
^{77m}Br	8	0	0	0	0	29	0	0	0	5.9	0.1	0.0	0.0
^{78}Br	15	0	69	161	0	17	0	2863	161	1.0	0.2	946.6	5.6
^{80}Br	9	0	1	4	0	11	0	1188	4	0.7	0.2	1094.3	0.1
^{80m}Br	17	0	0	0	0	59	0	0	0	11.5	0.0	0.0	0.0
^{82}Br	412	0	0	0	0	404	1	12	0	8.2	5.2	1208.0	0.0
^{82m}Br	6	0	6	0	0	28	0	104	0	5.9	0.0	23.9	0.0
^{83}Br	1	0	0	0	0	1	0	1	0	0.0	0.0	1470.0	0.0
^{84}Br	217	0	987	0	0	158	0	3596	0	2.1	0.6	1086.3	0.0
^{84m}Br	414	0	2	0	0	386	1	1962	0	7.3	3.4	1094.0	0.0
^{85}Br	10	0	10	0	0	10	0	2924	0	0.2	0.1	1046.7	0.0
^{74}Kr	51	0	26	135	0	63	0	661	135	6.7	68.7	942.5	4.6
^{75}Kr	52	0	808	167	0	58	0	5359	166	5.1	30.7	876.6	5.7
^{76}Kr	83	0	0	0	0	118	0	0	0	13.5	12.0	0.0	0.0
^{77}Kr	38	0	32	142	0	45	0	1010	142	5.1	40.8	954.9	4.9
^{79}Kr	36	0	0	12	0	63	0	0	12	8.4	6.8	128.4	0.4
^{81}Kr	7	0	0	0	0	34	0	0	0	7.2	0.1	0.0	0.0
^{81m}Kr	26	0	0	0	0	34	0	0	0	4.3	1057.5	0.0	0.0
^{83m}Kr	2	0	0	0	0	10	0	0	0	1.9	0.0	0.0	0.0
^{85}Kr	0	0	0	0	0	0	0	0	0	0.0	0.0	1470.8	0.0
^{85m}Kr	29	0	0	0	0	32	0	0	0	3.2	223.9	1170.1	0.0
^{87}Kr	108	0	552	0	0	83	0	4415	0	2.2	3.5	1018.2	0.0
^{88}Kr	250	0	17	0	0	176	1	685	0	3.7	47.3	1288.0	0.0

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^{89}Kr	256	0	968	0	0	205	1	4174	0	4.2	21.2	1011.8	0.0
^{77}Rb	92	0	1321	168	0	94	0	5671	168	4.8	25.2	868.9	5.8
^{78}Rb	359	0	922	155	0	226	1	3697	155	4.9	4.6	877.1	5.3
^{78m}Rb	335	0	1230	151	0	293	1	4916	151	6.5	6.5	787.2	5.2
^{79}Rb	102	0	40	145	0	116	0	1577	145	7.9	190.4	927.6	5.0
^{80}Rb	30	0	2406	172	0	31	0	6749	171	0.9	0.6	840.6	5.9
^{81}Rb	44	0	3	47	0	65	0	2	47	6.3	2.2	433.2	1.6
^{81m}Rb	11	0	0	2	0	31	0	1	2	4.9	0.0	14.1	0.1
^{82}Rb	21	0	507	166	0	22	0	4891	166	0.7	0.2	892.4	5.7
^{82m}Rb	426	0	3	38	0	438	1	44	38	13.6	5.6	362.6	1.3
^{83}Rb	91	0	0	0	0	119	0	0	0	9.5	2.6	0.0	0.0
^{84}Rb	103	0	6	47	0	122	0	124	47	6.3	0.5	460.7	1.6
^{84m}Rb	70	0	0	0	0	80	0	0	0	6.4	1119.8	0.0	0.0
^{86}Rb	14	0	1	0	0	14	0	905	0	0.2	0.0	1213.4	0.0
^{86m}Rb	92	0	0	0	0	93	0	0	0	3.0	23.0	0.0	0.0
^{87}Rb	0	0	0	0	0	0	0	0	0	0.0	0.0	1143.3	0.0
^{88}Rb	83	0	3014	0	0	63	0	6235	0	0.7	0.1	894.2	0.0
^{89}Rb	307	0	398	0	0	259	1	2245	0	3.5	1.0	1147.4	0.0
^{90}Rb	201	0	3187	0	0	122	0	5521	0	1.6	0.5	942.1	0.0
^{90m}Rb	402	0	1121	0	0	297	1	4185	0	4.2	1.2	971.1	0.0
^{79}Sr	40	0	1651	171	0	52	0	6344	171	5.3	12.2	855.6	5.9
^{80}Sr	65	0	1	17	0	90	0	1	17	7.8	13.6	170.0	0.6
^{81}Sr	84	0	77	153	0	88	0	2665	153	5.2	140.2	906.8	5.3
^{82}Sr	11	0	0	0	0	37	0	0	0	6.2	0.0	0.0	0.0
^{83}Sr	101	0	4	45	0	135	0	14	45	10.4	15.3	379.7	1.5
^{85}Sr	95	0	0	0	0	122	0	0	0	9.2	9.2	0.0	0.0
^{85m}Sr	40	0	0	0	0	45	0	0	0	4.3	83.1	0.0	0.0
^{87m}Sr	58	0	0	0	0	63	0	0	0	3.7	300.3	0.0	0.0
^{89}Sr	0	0	0	0	0	0	0	368	0	0.0	0.0	1254.2	0.0
^{90}Sr	0	0	0	0	0	0	0	0	0	0.0	0.0	1456.8	0.0
^{91}Sr	109	0	11	0	0	109	0	1125	0	2.0	1.4	1262.2	0.0
^{92}Sr	190	0	0	0	0	170	1	55	0	2.0	4.1	1379.4	0.0
^{93}Sr	338	0	65	0	0	313	1	1498	0	7.4	503.3	1188.6	0.0
^{94}Sr	200	0	8	0	0	176	1	1610	0	1.9	0.2	1122.9	0.0
^{81}Y	38	0	1953	170	0	54	0	6507	170	5.9	8.1	846.2	5.9
^{83}Y	72	0	460	160	0	86	0	4317	160	5.6	8.3	881.4	5.5
^{83m}Y	50	0	177	98	0	59	0	2616	98	4.6	200.6	534.7	3.4
^{84m}Y	464	0	443	159	0	453	1	3827	159	8.0	3.2	892.4	5.5
^{85}Y	71	0	21	116	0	79	0	550	116	4.0	2.4	824.4	4.0
^{85m}Y	107	0	29	101	0	101	0	1356	101	4.3	13.4	622.3	3.5
^{86}Y	481	0	16	56	0	457	1	236	56	11.5	9.2	428.7	1.9
^{86m}Y	39	0	0	1	0	40	0	2	1	3.6	177.9	5.7	0.0
^{87}Y	88	0	0	0	0	113	0	0	0	8.5	4.0	3.4	0.0
^{87m}Y	55	0	0	1	0	60	0	0	1	3.7	351.9	10.7	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$	Annihilation	Photon	Electron	$\beta-/\beta+$	Annihilation
	μSv h^{-1} GBq^{-1}					μSv h^{-1} GBq^{-1}				mSv h^{-1} GBq^{-1}			
^{88}Y	379	0	0	0	0	337	2	0	0	9.5	0.4	3.6	0.0
^{89m}Y	140	0	0	0	0	140	0	0	0	2.3	8.3	0.0	0.0
^{90}Y	0	0	2	0	0	0	1	2344	0	0.0	0.1	1086.8	0.0
^{90m}Y	112	0	0	0	0	115	0	0	0	6.6	212.1	0.0	0.0
^{91}Y	0	0	1	0	0	0	0	457	0	0.0	0.0	1241.5	0.0
^{91m}Y	89	0	0	0	0	91	0	0	0	3.1	64.8	0.0	0.0
^{92}Y	38	0	722	0	0	37	1	4921	0	0.6	0.6	978.0	0.0
^{93}Y	14	0	93	0	0	12	0	3781	0	0.4	4.9	1023.7	0.0
^{94}Y	115	0	1803	0	0	110	0	6004	0	1.8	1.0	906.9	0.0
^{95}Y	133	0	1397	0	0	90	0	4377	0	1.1	0.4	1047.7	0.0
^{85}Zr	87	0	466	160	0	85	0	4486	160	3.1	8.1	870.4	5.5
^{86}Zr	80	0	0	0	0	124	0	0	0	14.0	117.4	0.2	0.0
^{87}Zr	15	0	43	143	0	18	0	1989	143	1.1	0.0	869.0	4.9
^{88}Zr	81	0	0	0	0	106	0	0	0	8.6	46.0	0.0	0.0
^{89}Zr	154	0	3	40	0	171	0	2	40	6.5	8.3	377.6	1.4
^{89m}Zr	101	0	0	3	0	102	0	5	3	3.2	51.9	24.2	0.1
^{93}Zr	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{95}Zr	118	0	0	0	0	119	0	0	0	2.4	1.6	1026.0	0.0
^{97}Zr	140	0	1	0	0	140	2	1014	0	2.9	23.8	1186.8	0.0
^{87}Nb	53	0	1133	168	0	67	0	5891	168	7.3	519.4	856.3	5.8
^{88}Nb	514	0	601	162	0	523	1	4825	162	14.0	11.4	868.6	5.6
^{88m}Nb	476	0	842	163	0	455	2	4829	162	9.4	11.7	866.7	5.6
^{89}Nb	77	0	301	132	0	58	0	3750	132	1.8	0.4	712.7	4.5
^{89m}Nb	85	0	44	140	0	89	0	1808	140	3.6	3.5	865.9	4.8
^{90}Nb	487	0	13	94	0	375	5	211	94	9.4	230.8	691.7	3.2
^{91}Nb	16	0	0	0	0	37	0	0	0	4.9	0.0	1.7	0.0
^{91m}Nb	18	0	0	0	0	33	0	0	0	3.8	0.0	0.0	0.0
^{92}Nb	253	0	0	0	0	274	0	0	0	10.0	4.6	0.0	0.0
^{92m}Nb	163	0	0	0	0	184	0	0	0	7.3	0.8	0.4	0.0
^{93m}Nb	3	0	0	0	0	6	0	0	0	0.8	0.0	0.0	0.0
^{94}Nb	248	0	0	0	0	249	0	0	0	4.7	3.1	1398.5	0.0
^{94m}Nb	12	0	0	0	0	25	0	0	0	3.0	0.0	6.9	0.0
^{95}Nb	123	0	0	0	0	123	0	0	0	2.3	1.6	28.1	0.0
^{95m}Nb	23	0	0	0	0	35	0	1	0	3.9	2058.7	78.0	0.0
^{96}Nb	388	0	0	0	0	384	1	0	0	8.0	14.8	1474.6	0.0
^{97}Nb	108	0	0	0	0	109	0	57	0	2.7	2.4	1357.1	0.0
^{98m}Nb	427	0	11	0	0	404	2	1302	0	7.3	27.4	1186.2	0.0
^{99}Nb	43	0	435	0	0	52	0	5169	0	5.6	42.3	945.4	0.0

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^{99m}Nb	100	0	824	0	0	74	0	4643	0	1.8	16.6	975.2	0.0
^{89}Mo	34	0	2228	169	0	31	0	6471	169	0.6	0.2	832.6	5.8
^{90}Mo	117	0	3	45	0	140	0	3	45	11.4	457.1	389.4	1.5
^{91}Mo	3	0	603	163	0	4	0	5129	163	0.3	0.0	862.4	5.6
^{91m}Mo	140	0	120	76	0	132	1	1647	76	2.5	21.3	434.0	2.6
^{93}Mo	17	0	0	0	0	35	0	0	0	4.4	0.0	0.0	0.0
^{93m}Mo	348	0	0	0	0	326	2	0	0	7.8	1057.0	0.0	0.0
^{99}Mo	25	0	0	0	0	26	0	25	0	1.0	31.0	1344.3	0.0
^{101}Mo	218	0	2	0	0	199	1	757	0	4.4	179.3	1310.3	0.0
^{102}Mo	3	0	0	0	0	4	0	2	0	0.3	10.1	1446.8	0.0
^{91}Tc	195	0	1779	162	0	139	1	5289	162	1.9	1.3	838.4	5.6
^{91m}Tc	71	0	1988	167	0	69	0	6284	167	2.0	2.8	833.7	5.8
^{92}Tc	428	0	1527	166	0	392	2	6059	166	10.6	290.1	837.6	5.7
^{93}Tc	219	0	1	19	0	208	2	1	19	5.7	0.4	191.7	0.7
^{93m}Tc	127	0	2	5	0	98	0	62	5	4.0	327.9	32.6	0.2
^{94}Tc	419	0	1	19	0	434	0	1	19	11.3	4.7	185.6	0.6
^{94m}Tc	186	0	44	122	0	174	0	2031	122	3.8	1.1	729.9	4.2
^{95}Tc	144	0	0	0	0	161	0	0	0	6.6	2.1	0.0	0.0
^{95m}Tc	129	0	0	1	0	146	0	0	1	8.3	109.1	8.3	0.0
^{96}Tc	414	0	0	0	0	429	0	0	0	11.3	5.1	0.0	0.0
^{96m}Tc	16	0	0	0	0	23	0	0	0	2.1	0.1	0.0	0.0
^{97}Tc	18	0	0	0	0	34	0	0	0	4.1	0.0	0.0	0.0
^{97m}Tc	14	0	0	0	0	25	0	0	0	2.9	0.0	0.0	0.0
^{98}Tc	229	0	0	0	0	231	0	0	0	5.1	4.9	1284.6	0.0
^{99}Tc	0	0	0	0	0	0	0	0	0	0.0	0.0	906.0	0.0
^{99m}Tc	25	0	0	0	0	26	0	0	0	2.6	64.8	0.0	0.0
^{101}Tc	59	0	0	0	0	60	0	68	0	3.6	38.8	1354.8	0.0
^{102}Tc	13	0	2015	0	0	12	0	6644	0	0.3	0.8	873.4	0.0
^{102m}Tc	356	0	17	0	0	308	2	1431	0	6.4	10.7	1130.5	0.0
^{104}Tc	313	0	1247	0	0	257	1	5183	0	6.4	28.7	945.6	0.0
^{105}Tc	130	0	281	0	0	124	0	4004	0	5.5	87.6	1012.8	0.0
^{92}Ru	261	0	69	110	0	271	1	1977	110	17.8	328.5	672.9	3.8
^{94}Ru	104	0	0	0	0	119	0	0	0	7.1	12.8	0.0	0.0
^{95}Ru	185	0	2	24	0	191	1	6	24	8.0	22.3	204.1	0.8
^{97}Ru	61	0	0	0	0	76	0	0	0	7.5	108.3	0.0	0.0
^{103}Ru	85	0	0	0	0	85	0	0	0	3.0	7.2	270.7	0.0
^{105}Ru	126	0	0	0	0	129	0	43	0	4.2	93.8	1386.5	0.0
^{106}Ru	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{107}Ru	54	0	64	0	0	53	0	3116	0	1.6	31.4	1054.7	0.0
^{108}Ru	13	0	0	0	0	14	0	68	0	1.5	117.9	1357.0	0.0
^{94}Rh	390	0	5396	172	0	345	3	7657	172	5.1	8.8	800.0	5.9
^{95}Rh	260	0	178	125	0	233	1	2774	125	4.3	5.1	719.9	4.3
^{95m}Rh	113	0	93	15	0	97	0	467	15	3.1	105.5	83.5	0.5
^{96}Rh	499	0	77	121	0	482	1	1915	121	10.3	8.2	737.1	4.2

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{96m}Rh	139	0	322	62	0	128	1	1752	62	3.2	0.9	333.2	2.1
^{97}Rh	139	0	25	102	0	136	0	969	102	5.0	11.4	658.2	3.5
^{97m}Rh	284	0	11	31	0	230	1	450	31	7.5	209.3	197.6	1.1
^{98}Rh	139	0	494	157	0	133	0	4611	157	3.3	2.9	842.2	5.4
^{99}Rh	114	0	0	7	0	130	0	0	7	8.8	23.9	71.7	0.2
^{99m}Rh	112	0	1	13	0	122	0	1	13	7.0	20.1	128.5	0.4
^{100}Rh	393	0	3	7	0	335	1	107	7	9.1	7.1	40.8	0.2
^{100m}Rh	34	0	0	1	0	46	0	1	1	4.6	0.2	5.3	0.0
^{101}Rh	72	0	0	0	0	85	0	0	0	8.5	133.6	0.0	0.0
^{101m}Rh	69	0	0	0	0	81	0	0	0	6.7	168.5	0.0	0.0
^{102}Rh	70	0	0	27	0	77	0	14	27	4.1	4.8	531.1	0.9
^{102m}Rh	365	0	0	0	0	377	1	0	0	12.2	15.0	0.4	0.0
^{103m}Rh	2	0	0	0	0	3	0	0	0	0.4	0.0	0.0	0.0
^{104}Rh	2	0	4	0	0	2	0	2553	0	0.1	0.2	1054.9	0.0
^{104m}Rh	29	0	0	0	0	38	0	0	0	4.1	0.0	1.6	0.0
^{105}Rh	14	0	0	0	0	14	0	0	0	0.9	9.5	1135.7	0.0
^{106}Rh	34	0	462	0	0	34	0	4877	0	1.0	2.1	960.8	0.0
^{106m}Rh	445	0	0	0	0	431	2	48	0	9.8	27.4	1438.5	0.0
^{107}Rh	55	0	0	0	0	56	0	57	0	3.3	38.0	1378.1	0.0
^{108}Rh	54	0	1570	0	0	54	0	6325	0	2.0	7.2	890.1	0.0
^{109}Rh	55	0	4	0	0	57	0	2137	0	3.7	55.0	1087.2	0.0
^{96}Pd	188	0	7	59	0	193	1	90	59	7.1	12.7	458.1	2.0
^{97}Pd	250	0	185	112	0	217	1	2100	112	6.2	44.4	675.0	3.9
^{98}Pd	84	0	0	8	0	96	0	0	8	6.8	15.8	86.7	0.3
^{99}Pd	131	0	21	84	0	125	1	852	84	5.9	44.9	538.5	2.9
^{100}Pd	59	0	0	0	0	76	0	0	0	8.2	2.0	0.0	0.0
^{101}Pd	83	0	1	9	0	100	0	0	9	7.9	14.3	89.5	0.3
^{103}Pd	21	0	0	0	0	31	0	0	0	3.4	0.0	0.0	0.0
^{107}Pd	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{109}Pd	11	0	0	0	0	14	0	3	0	1.5	0.0	1439.2	0.0
^{109m}Pd	27	0	0	0	0	30	0	0	0	3.0	1402.5	0.0	0.0
^{111}Pd	8	0	2	0	0	7	0	1694	0	0.2	0.6	1122.1	0.0
^{112}Pd	8	0	0	0	0	14	0	0	0	1.6	0.0	499.8	0.0
^{114}Pd	5	0	0	0	0	5	0	192	0	0.4	10.5	1306.9	0.0
^{99}Ag	214	0	726	148	0	192	1	4306	148	5.4	59.9	797.1	5.1
^{100m}Ag	272	0	2201	164	0	245	2	6142	164	4.4	3.6	817.4	5.7
^{101}Ag	135	0	93	126	0	131	1	2390	126	5.0	46.8	737.9	4.3
^{102}Ag	389	0	147	128	0	347	2	2339	128	7.3	7.7	759.8	4.4

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^{102m}Ag	211	0	120	61	0	152	1	1004	61	2.9	2.7	369.7	2.1
^{103}Ag	104	0	7	48	0	108	1	104	48	5.9	55.7	360.8	1.7
^{104}Ag	409	0	3	27	0	402	1	32	27	10.3	13.3	233.0	0.9
^{104m}Ag	173	0	66	108	0	150	1	2195	108	4.5	5.3	628.4	3.7
^{105}Ag	109	0	0	0	0	120	0	0	0	7.8	46.6	0.0	0.0
^{105m}Ag	0	0	0	0	0	0	0	0	0	0.0	0.1	0.0	0.0
^{106}Ag	25	0	24	102	0	28	0	811	102	1.8	1.3	674.6	3.5
^{106m}Ag	458	0	0	0	0	454	2	0	0	13.0	27.6	0.0	0.0
^{108}Ag	3	0	1	1	0	3	0	501	1	0.2	0.2	1211.7	0.0
^{108m}Ag	285	0	0	0	0	295	0	0	0	10.7	18.7	0.0	0.0
^{109m}Ag	11	0	0	0	0	14	0	0	0	1.5	0.0	0.0	0.0
^{110}Ag	5	0	68	0	0	5	0	3760	0	0.1	0.2	998.7	0.0
^{110m}Ag	427	0	0	0	0	418	2	2	0	7.7	8.7	417.6	0.0
^{111}Ag	5	0	0	0	0	5	0	3	0	0.3	4.9	1437.9	0.0
^{111m}Ag	6	0	0	0	0	8	0	0	0	0.8	1.3	9.1	0.0
^{112}Ag	101	0	735	0	0	91	1	4333	0	1.8	2.4	1009.6	0.0
^{113}Ag	12	0	1	0	0	12	0	1237	0	0.6	10.7	1163.2	0.0
^{113m}Ag	38	0	0	0	0	39	0	110	0	2.1	23.7	467.8	0.0
^{114}Ag	39	0	2731	0	0	35	0	6844	0	0.8	1.5	860.9	0.0
^{115}Ag	70	0	112	0	0	59	0	3392	0	1.9	62.8	1065.0	0.0
^{116}Ag	289	0	1635	0	0	222	2	5676	0	4.3	7.5	915.7	0.0
^{117}Ag	173	0	618	0	0	128	1	3862	0	3.2	60.6	1027.8	0.0
^{101}Cd	247	0	401	134	0	213	2	3173	134	5.3	184.7	758.7	4.6
^{102}Cd	133	0	2	23	0	137	0	1	23	6.4	19.8	200.0	0.8
^{103}Cd	249	0	51	60	0	205	2	834	60	5.3	72.8	398.0	2.1
^{104}Cd	68	0	0	0	0	77	0	0	0	5.6	1.2	0.0	0.0
^{105}Cd	153	0	9	49	0	134	1	235	49	4.0	5.1	339.3	1.7
^{107}Cd	33	0	0	0	0	43	0	0	0	4.6	0.0	3.1	0.0
^{109}Cd	30	0	0	0	0	40	0	0	0	4.3	0.0	0.0	0.0
^{111m}Cd	60	0	0	0	0	64	0	0	0	5.6	1099.0	0.0	0.0
^{113}Cd	0	0	0	0	0	0	0	0	0	0.0	0.0	752.1	0.0
^{113m}Cd	0	0	0	0	0	0	0	0	0	0.0	3.1	1390.6	0.0
^{115}Cd	34	0	0	0	0	34	0	5	0	1.3	3.4	1406.5	0.0
^{115m}Cd	5	0	1	0	0	5	0	466	0	0.1	0.1	1241.5	0.0
^{117}Cd	162	0	1	0	0	150	1	567	0	3.7	35.8	1198.3	0.0
^{117m}Cd	281	0	0	0	0	232	2	73	0	3.4	4.8	1279.4	0.0
^{118}Cd	0	0	0	0	0	0	0	0	0	0.0	0.0	1319.5	0.0
^{119}Cd	228	0	77	0	0	188	1	1694	0	4.1	40.5	1180.2	0.0
^{119m}Cd	320	0	4	0	0	269	2	874	0	4.1	5.5	1212.1	0.0
^{103}In	261	0	1203	154	0	223	1	5147	154	5.6	164.9	794.8	5.3
^{105}In	181	0	373	128	0	164	1	3317	128	5.4	54.4	711.6	4.4
^{106}In	434	0	464	138	0	432	1	3324	138	9.5	25.2	769.2	4.8
^{106m}In	260	0	1451	155	0	208	2	5170	155	4.1	3.7	797.9	5.3
^{107}In	179	0	15	60	0	156	1	649	60	5.8	113.8	389.9	2.1

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$	Annihilation	Photon	Electron	$\beta-/\beta+$	Annihilation
	μSv h^{-1} GBq^{-1}					μSv h^{-1} GBq^{-1}				mSv h^{-1} GBq^{-1}			
^{108}In	571	0	5	43	0	553	2	55	43	13.1	68.2	331.4	1.5
^{108m}In	281	0	264	94	0	210	2	2139	94	4.7	4.1	550.0	3.2
^{109}In	113	0	1	8	0	116	0	0	8	6.7	164.5	81.7	0.3
^{109m}In	100	0	0	0	0	102	0	0	0	2.7	76.6	0.0	0.0
^{110}In	505	0	0	0	0	511	0	0	0	12.4	9.8	0.4	0.0
^{110m}In	148	0	32	108	0	139	0	1511	108	3.9	3.7	651.5	3.7
^{111}In	93	0	0	0	0	99	0	0	0	9.3	415.4	0.0	0.0
^{111m}In	82	0	0	0	0	82	0	0	0	2.9	170.3	0.0	0.0
^{112}In	14	0	8	37	0	16	0	114	37	1.1	0.3	913.5	1.3
^{112m}In	20	0	0	0	0	23	0	0	0	2.4	1262.1	0.0	0.0
^{113m}In	51	0	0	0	0	53	0	0	0	3.0	626.9	0.0	0.0
^{114}In	0	0	1	0	0	0	0	1283	0	0.0	0.0	1145.6	0.0
^{114m}In	22	0	0	0	0	25	0	0	0	2.0	2556.3	0.0	0.0
^{115}In	0	0	0	0	0	0	0	0	0	0.0	0.0	1280.6	0.0
^{115m}In	37	0	0	0	0	39	0	0	0	2.8	1028.4	73.3	0.0
^{116m}In	354	0	0	0	0	320	5	1	0	4.7	9.8	1430.6	0.0
^{117}In	120	0	0	0	0	121	0	0	0	5.8	193.9	1467.3	0.0
^{117m}In	21	0	0	0	0	22	0	350	0	1.8	654.1	646.4	0.0
^{118}In	11	0	1807	0	0	11	0	6476	0	0.1	0.1	883.4	0.0
^{118m}In	412	0	1	0	0	396	4	808	0	6.2	13.9	1222.0	0.0
^{119}In	128	0	0	0	0	129	0	387	0	3.0	2.6	1260.9	0.0
^{119m}In	12	0	18	0	0	12	0	2903	0	0.5	76.5	980.2	0.0
^{121}In	144	0	4	0	0	144	0	2558	0	2.6	4.6	1060.5	0.0
^{121m}In	19	0	636	0	0	20	0	5359	0	1.6	16.1	924.4	0.0
^{106}Sn	182	0	3	34	0	186	1	15	34	8.2	90.4	279.1	1.2
^{108}Sn	136	0	0	1	0	142	0	0	1	8.6	119.1	11.5	0.0
^{109}Sn	312	0	2	14	0	274	3	33	14	6.2	15.1	106.6	0.5
^{110}Sn	69	0	0	0	0	74	0	0	0	6.1	87.7	0.0	0.0
^{111}Sn	39	0	6	51	0	38	0	79	51	2.1	0.5	387.4	1.8
^{113}Sn	21	0	0	0	0	26	0	0	0	2.7	2.8	0.0	0.0
^{113m}Sn	14	0	0	0	0	17	0	0	0	1.7	0.0	0.0	0.0
^{117m}Sn	43	0	0	0	0	47	0	0	0	4.7	1747.6	0.0	0.0
^{119m}Sn	16	0	0	0	0	19	0	0	0	2.0	0.0	0.0	0.0
^{121}Sn	0	0	0	0	0	0	0	0	0	0.0	0.0	1025.3	0.0
^{121m}Sn	4	0	0	0	0	5	0	0	0	0.5	0.0	257.4	0.0
^{123}Sn	1	0	0	0	0	1	0	203	0	0.0	0.0	1279.9	0.0
^{123m}Sn	28	0	0	0	0	28	0	51	0	2.8	202.9	1359.6	0.0
^{125}Sn	50	0	3	0	0	47	0	1998	0	0.8	1.4	1086.4	0.0

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^{125m}Sn	60	0	2	0	0	61	0	1442	0	3.4	50.5	1139.7	0.0
^{126}Sn	20	0	0	0	0	21	0	0	0	2.1	0.0	604.5	0.0
^{127}Sn	282	0	66	0	0	261	2	1031	0	5.2	52.4	1289.1	0.0
^{127m}Sn	94	0	27	0	0	91	0	3340	0	2.9	11.7	1021.1	0.0
^{128}Sn	136	0	0	0	0	142	0	0	0	8.3	27.5	1377.8	0.0
^{129}Sn	157	0	295	0	0	153	1	4083	0	3.4	9.4	1009.0	0.0
^{130}Sn	168	0	0	0	0	170	0	39	0	7.7	269.9	1395.7	0.0
^{130m}Sn	145	0	552	0	0	140	1	4567	0	4.3	26.7	983.5	0.0
^{111}Sb	105	0	631	150	0	105	0	4659	150	4.7	125.9	788.6	5.2
^{113}Sb	104	0	41	116	0	104	0	1879	116	4.2	16.3	688.4	4.0
^{114}Sb	272	0	629	138	0	248	4	4098	138	3.7	6.0	740.7	4.8
^{115}Sb	104	0	9	59	0	106	0	141	58	4.7	11.4	428.5	2.0
^{116}Sb	251	0	27	92	0	221	3	1175	92	3.7	1.1	576.4	3.2
^{116m}Sb	467	0	2	29	0	457	4	4	29	11.7	28.0	243.2	1.0
^{117}Sb	48	0	0	3	0	52	0	0	3	5.2	184.5	35.9	0.1
^{118}Sb	12	0	69	128	0	13	0	2629	128	0.7	0.1	727.8	4.4
^{118m}Sb	424	0	0	0	0	420	4	0	0	12.7	176.4	2.6	0.0
^{119}Sb	24	0	0	0	0	30	0	0	0	3.0	0.0	0.0	0.0
^{120}Sb	15	0	13	72	0	17	0	312	71	1.5	0.0	499.7	2.5
^{120m}Sb	396	0	0	0	0	393	3	0	0	11.8	410.1	0.0	0.0
^{122}Sb	74	0	0	0	0	75	0	469	0	2.3	5.5	1246.1	0.0
^{122m}Sb	32	0	0	0	0	35	0	0	0	3.5	0.0	0.0	0.0
^{124}Sb	269	0	1	0	0	239	2	513	0	4.6	7.2	1200.9	0.0
^{124m}Sb	73	0	0	0	0	74	0	11	0	2.2	5.6	346.3	0.0
^{124}Sbn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{125}Sb	85	0	0	0	0	87	0	0	0	4.2	42.9	554.2	0.0
^{126}Sb	449	0	0	0	0	453	0	242	0	11.6	47.3	1282.7	0.0
^{126m}Sb	255	0	1	0	0	258	0	887	0	7.3	27.0	1018.4	0.0
^{127}Sb	115	0	0	0	0	116	0	9	0	3.5	28.7	1423.0	0.0
^{128}Sb	501	0	0	0	0	502	1	380	0	12.7	77.4	1330.7	0.0
^{128m}Sb	310	0	9	0	0	312	0	2463	0	8.3	76.6	1032.0	0.0
^{129}Sb	222	0	0	0	0	211	1	375	0	3.9	18.3	1298.2	0.0
^{130}Sb	520	0	16	0	0	511	1	1441	0	13.4	413.4	1207.9	0.0
^{130m}Sb	424	0	65	0	0	417	1	2694	0	8.5	247.0	1066.6	0.0
^{131}Sb	302	0	9	0	0	275	2	796	0	4.8	19.6	1279.2	0.0
^{133}Sb	379	0	6	0	0	320	3	1075	0	4.6	6.4	1236.1	0.0
^{113}Te	185	0	1709	156	0	159	1	5611	156	2.5	3.5	785.1	5.4
^{114}Te	185	0	4	27	0	171	1	82	27	6.1	44.3	199.0	0.9
^{115}Te	235	0	142	116	0	219	3	2407	116	4.5	40.4	671.7	4.0
^{115m}Te	296	0	129	100	0	266	2	2062	100	4.9	3.6	591.5	3.5
^{116}Te	44	0	0	1	0	49	0	0	1	4.4	2.1	10.0	0.0
^{117}Te	195	0	10	47	0	174	1	274	47	4.2	2.6	323.4	1.6
^{118}Te	19	0	0	0	0	22	0	0	0	2.3	0.0	0.0	0.0
^{119}Te	134	0	0	4	0	136	0	0	4	5.0	4.6	39.3	0.1

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{119m}Te	241	0	0	1	0	232	2	0	1	7.6	71.1	5.2	0.0
^{121}Te	113	0	0	0	0	117	0	0	0	5.3	7.7	0.0	0.0
^{121m}Te	49	0	0	0	0	51	0	0	0	4.4	233.4	0.0	0.0
^{123}Te	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{123m}Te	36	0	0	0	0	38	0	0	0	3.8	192.2	0.0	0.0
^{125m}Te	31	0	0	0	0	35	0	0	0	3.5	1.8	0.0	0.0
^{127}Te	1	0	0	0	0	1	0	0	0	0.0	0.7	1441.3	0.0
^{127m}Te	9	0	0	0	0	11	0	0	0	1.1	0.0	34.2	0.0
^{129}Te	14	0	0	0	0	14	0	201	0	0.8	4.0	1305.0	0.0
^{129m}Te	12	0	0	0	0	13	0	176	0	0.9	0.3	463.6	0.0
^{131}Te	72	0	1	0	0	72	0	1014	0	3.5	94.3	1209.3	0.0
^{131m}Te	231	0	0	0	0	226	1	77	0	5.7	662.2	895.1	0.0
^{132}Te	57	0	0	0	0	59	0	0	0	5.4	274.9	338.6	0.0
^{133}Te	181	0	4	0	0	166	2	1257	0	4.8	61.2	1170.7	0.0
^{133m}Te	289	0	15	0	0	277	1	298	0	6.5	259.6	1092.5	0.0
^{134}Te	152	0	0	0	0	154	0	0	0	6.6	248.2	1366.6	0.0
^{118}I	169	0	2560	158	0	163	1	6152	158	3.9	8.4	778.3	5.5
^{118m}I	469	0	284	137	0	466	2	3651	137	11.5	43.9	745.2	4.7
^{119}I	72	0	25	92	0	73	0	1047	92	4.9	134.6	573.9	3.2
^{120}I	266	0	998	119	0	209	1	3768	119	4.5	6.8	630.0	4.1
^{120m}I	432	0	192	121	0	405	1	2862	120	10.0	18.0	679.1	4.2
^{121}I	66	0	1	17	0	69	0	1	17	5.5	245.0	155.0	0.6
^{122}I	29	0	289	136	0	29	0	3766	136	1.1	1.5	734.8	4.7
^{123}I	48	0	0	0	0	51	0	0	0	5.0	191.4	0.0	0.0
^{124}I	143	0	8	40	0	134	1	304	40	4.2	4.3	271.0	1.4
^{125}I	37	0	0	0	0	42	0	0	0	4.3	0.0	0.0	0.0
^{126}I	79	0	0	2	0	81	0	7	2	3.4	13.8	676.5	0.1
^{128}I	13	0	1	0	0	13	0	1359	0	0.6	2.6	1063.7	0.0
^{129}I	18	0	0	0	0	20	0	0	0	2.0	0.0	35.4	0.0
^{130}I	349	0	0	0	0	351	1	4	0	9.1	28.3	1403.2	0.0
^{130m}I	21	0	1	0	0	22	0	373	0	1.0	1.7	173.7	0.0
^{131}I	67	0	0	0	0	68	0	0	0	3.4	46.0	1333.1	0.0
^{132}I	357	0	0	0	0	353	1	404	0	7.4	19.6	1323.0	0.0
^{132m}I	63	0	0	0	0	65	0	24	0	2.6	54.2	187.9	0.0
^{133}I	101	0	0	0	0	101	0	36	0	3.0	11.4	1355.4	0.0
^{134}I	400	0	1	0	0	389	2	520	0	7.2	27.4	1285.5	0.0
^{134m}I	66	0	0	0	0	69	0	56	0	5.3	521.3	24.6	0.0
^{135}I	225	0	0	0	0	201	4	71	0	2.9	14.7	1319.4	0.0

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^{120}Xe	93	0	0	1	0	98	0	0	1	6.2	92.2	11.0	0.0
^{121}Xe	143	0	49	84	0	114	1	1646	84	4.1	63.8	484.4	2.9
^{122}Xe	27	0	0	0	0	29	0	0	0	2.6	13.4	0.0	0.0
^{123}Xe	78	0	6	39	0	75	0	88	39	4.5	211.2	290.1	1.4
^{125}Xe	67	0	0	1	0	70	0	0	1	6.0	292.5	6.4	0.0
^{127}Xe	67	0	0	0	0	69	0	0	0	6.2	361.7	0.0	0.0
^{127m}Xe	40	0	0	0	0	41	0	0	0	4.0	1538.4	0.0	0.0
^{129m}Xe	33	0	0	0	0	36	0	0	0	3.6	2987.4	0.0	0.0
^{131m}Xe	14	0	0	0	0	15	0	0	0	1.5	1851.3	0.0	0.0
^{133}Xe	18	0	0	0	0	19	0	0	0	1.8	0.2	856.0	0.0
^{133m}Xe	17	0	0	0	0	19	0	0	0	1.8	2753.5	0.0	0.0
^{135}Xe	45	0	0	0	0	45	0	1	0	3.4	204.3	1454.1	0.0
^{135m}Xe	75	0	0	0	0	75	0	4	0	2.7	257.5	7.3	0.0
^{137}Xe	31	0	1183	0	0	30	0	5949	0	1.0	6.0	911.0	0.0
^{138}Xe	155	0	7	0	0	123	21	1421	0	3.4	96.4	1201.4	0.0
^{121}Cs	46	0	1671	156	0	45	0	5890	156	2.3	101.8	774.1	5.4
^{121m}Cs	79	0	1088	126	0	79	0	4566	126	4.4	187.7	639.1	4.4
^{123}Cs	68	0	176	123	0	68	0	2985	123	3.1	43.8	684.8	4.2
^{124}Cs	36	0	2593	159	0	33	0	6396	159	1.3	12.3	773.4	5.5
^{125}Cs	65	0	16	69	0	64	0	593	69	2.9	6.4	452.4	2.4
^{126}Cs	55	0	729	141	0	54	0	4581	141	2.2	14.8	737.5	4.9
^{127}Cs	83	0	0	5	0	85	0	0	5	4.9	32.7	52.3	0.2
^{128}Cs	35	0	112	120	0	35	0	2767	120	1.6	5.6	669.5	4.1
^{129}Cs	68	0	0	0	0	71	0	0	0	4.8	26.3	0.0	0.0
^{130}Cs	17	0	19	76	0	17	0	677	76	1.2	0.5	504.1	2.6
^{130m}Cs	29	0	0	0	0	31	0	0	0	3.0	2.3	0.0	0.0
^{131}Cs	17	0	0	0	0	19	0	0	0	1.9	0.0	0.0	0.0
^{132}Cs	129	0	0	1	0	132	0	0	1	4.6	5.3	32.1	0.0
^{134}Cs	251	0	0	0	0	252	0	0	0	5.9	13.2	1032.7	0.0
^{134m}Cs	10	0	0	0	0	11	0	0	0	1.2	337.4	0.0	0.0
^{135}Cs	0	0	0	0	0	0	0	0	0	0.0	0.0	710.3	0.0
^{135m}Cs	255	0	0	0	0	255	0	0	0	4.6	44.9	0.0	0.0
^{136}Cs	333	0	0	0	0	330	2	0	0	7.4	223.0	942.1	0.0
^{137}Cs	0	0	0	0	0	0	0	1	0	0.0	0.0	1370.7	0.0
^{138}Cs	328	0	189	0	0	276	5	4047	0	4.3	22.9	996.8	0.0
^{138m}Cs	70	0	61	0	0	66	1	907	0	2.6	97.4	183.0	0.0
^{139}Cs	40	0	1256	0	0	31	1	5678	0	0.4	0.7	925.4	0.0
^{140}Cs	233	0	2644	0	0	178	3	5681	0	3.0	5.1	931.5	0.0
^{124}Ba	71	0	6	36	0	71	0	125	36	3.8	125.8	260.3	1.3
^{126}Ba	106	0	0	1	0	106	1	0	1	4.9	103.4	12.0	0.0
^{127}Ba	35	0	32	94	0	33	0	1503	94	2.0	58.4	559.8	3.3
^{128}Ba	25	0	0	0	0	26	0	0	0	2.4	23.8	0.0	0.0
^{129}Ba	34	0	4	32	0	33	0	40	32	2.4	55.0	247.7	1.1
^{129m}Ba	260	0	0	2	0	253	1	0	2	8.8	286.7	18.5	0.1

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$	Annihilation	Photon	Electron	$\beta-/\beta+$	Annihilation
	μSv h^{-1} GBq^{-1}					μSv h^{-1} GBq^{-1}				mSv h^{-1} GBq^{-1}			
^{131}Ba	99	0	0	0	0	101	0	0	0	6.1	130.3	0.0	0.0
^{131m}Ba	22	0	0	0	0	22	0	0	0	2.1	0.1	0.0	0.0
^{133}Ba	92	0	0	0	0	95	0	0	0	6.9	68.3	0.0	0.0
^{133m}Ba	21	0	0	0	0	23	0	0	0	2.1	2225.0	0.0	0.0
^{135m}Ba	19	0	0	0	0	20	0	0	0	1.8	2293.4	0.0	0.0
^{137m}Ba	98	0	0	0	0	100	0	0	0	2.6	119.0	0.0	0.0
^{139}Ba	9	0	2	0	0	9	0	2005	0	0.8	77.4	1098.4	0.0
^{140}Ba	34	0	0	0	0	35	0	2	0	1.8	28.8	1365.8	0.0
^{141}Ba	148	0	33	0	0	142	1	2371	0	5.8	326.7	1101.0	0.0
^{142}Ba	166	0	0	0	0	163	1	126	0	4.5	122.5	1401.6	0.0
^{128}La	318	0	849	139	0	307	2	4468	139	9.1	140.9	722.3	4.8
^{129}La	70	0	39	94	0	69	0	1597	94	4.0	80.5	555.6	3.3
^{130}La	235	0	617	123	0	221	2	3665	123	6.6	54.1	657.7	4.3
^{131}La	85	0	7	40	0	86	0	154	40	5.1	71.6	289.2	1.4
^{132}La	234	0	178	74	0	204	1	1761	74	5.7	25.1	426.7	2.6
^{132m}La	109	0	2	11	0	109	0	41	11	4.9	152.9	78.9	0.4
^{133}La	27	0	1	12	0	28	0	0	12	2.2	9.1	109.1	0.4
^{134}La	16	0	67	110	0	16	0	2336	110	0.9	0.4	620.6	3.8
^{135}La	19	0	0	0	0	20	0	0	0	1.8	0.5	0.0	0.0
^{136}La	15	0	14	62	0	16	0	424	62	1.2	0.1	409.3	2.1
^{137}La	16	0	0	0	0	17	0	0	0	1.7	0.0	0.0	0.0
^{138}La	184	0	0	0	0	167	4	0	0	2.9	1.7	272.9	0.0
^{140}La	329	0	0	0	0	284	7	261	0	4.9	35.2	1309.1	0.0
^{141}La	4	0	6	0	0	3	0	2619	0	0.0	0.0	1062.7	0.0
^{142}La	300	0	370	0	0	211	4	1908	0	3.1	6.3	1171.4	0.0
^{143}La	36	0	333	0	0	31	1	4384	0	0.5	0.9	997.9	0.0
^{130}Ce	90	0	1	8	0	91	0	0	8	5.4	176.3	69.6	0.3
^{131}Ce	185	0	62	84	0	176	1	1686	84	6.2	151.2	487.3	2.9
^{132}Ce	61	0	0	0	0	62	0	0	0	5.5	124.6	0.0	0.0
^{133}Ce	48	0	16	65	0	49	0	544	64	4.0	2.3	417.9	2.2
^{133m}Ce	274	0	1	8	0	257	2	42	8	8.3	57.4	61.0	0.3
^{134}Ce	16	0	0	0	0	17	0	0	0	1.7	1.8	0.0	0.0
^{135}Ce	150	0	0	1	0	151	0	0	1	7.0	165.7	6.6	0.0
^{137}Ce	18	0	0	0	0	20	0	0	0	1.9	0.6	0.0	0.0
^{137m}Ce	18	0	0	0	0	18	0	0	0	1.6	2570.1	0.0	0.0
^{139}Ce	41	0	0	0	0	42	0	0	0	4.1	257.7	0.0	0.0
^{141}Ce	16	0	0	0	0	16	0	0	0	1.6	65.9	1210.5	0.0
^{143}Ce	57	0	0	0	0	58	0	56	0	3.6	81.0	1376.2	0.0

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^{144}Ce	5	0	0	0	0	5	0	0	0	0.5	9.7	590.8	0.0
^{145}Ce	144	0	1	0	0	145	0	670	0	5.1	37.8	1237.6	0.0
^{134}Pr	389	0	405	124	0	379	1	3558	124	12.0	229.0	662.4	4.3
^{134m}Pr	220	0	1502	141	0	192	2	4992	141	5.2	46.3	711.1	4.9
^{135}Pr	70	0	35	87	0	68	0	1478	87	3.9	105.6	509.1	3.0
^{136}Pr	239	0	142	100	0	216	2	2400	100	5.8	16.6	555.4	3.4
^{137}Pr	26	0	8	44	0	25	0	204	44	1.5	4.0	302.3	1.5
^{138}Pr	10	0	476	131	0	10	2	4092	131	0.5	0.4	688.4	4.5
^{138m}Pr	361	0	7	40	0	360	1	160	40	9.4	357.7	284.5	1.4
^{139}Pr	18	0	1	14	0	18	0	1	14	1.5	0.6	123.8	0.5
^{140}Pr	9	0	30	89	0	9	10	1435	89	0.8	1.1	526.3	3.1
^{142}Pr	8	0	2	0	0	6	0	1748	0	0.1	0.0	1137.4	0.0
^{142m}Pr	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{143}Pr	0	0	0	0	0	0	0	1	0	0.0	0.0	1454.3	0.0
^{144}Pr	4	0	104	0	0	3	0	3930	0	0.0	0.1	1001.3	0.0
^{144m}Pr	6	0	0	0	0	6	0	0	0	0.6	0.0	0.5	0.0
^{145}Pr	3	0	1	0	0	3	0	794	0	0.1	0.2	1208.2	0.0
^{146}Pr	147	0	817	0	0	130	2	4029	0	2.7	12.5	1017.2	0.0
^{147}Pr	91	0	4	0	0	89	1	1772	0	4.3	46.1	1135.7	0.0
^{148}Pr	148	0	1368	0	0	134	2	5461	0	3.8	81.9	932.7	0.0
^{148m}Pr	156	0	1099	0	0	155	1	5835	0	6.2	134.8	915.3	0.0
^{134}Nd	68	0	6	36	0	68	0	140	36	5.1	74.1	252.2	1.2
^{135}Nd	108	0	324	116	0	107	0	3285	116	6.1	375.6	626.2	4.0
^{136}Nd	57	0	1	7	0	57	0	0	7	4.0	21.4	66.1	0.2
^{137}Nd	147	0	16	53	0	139	1	618	53	5.0	48.7	335.8	1.8
^{138}Nd	18	0	0	0	0	19	0	0	0	1.8	10.6	0.0	0.0
^{139}Nd	37	0	9	44	0	37	0	271	44	1.8	8.7	297.1	1.5
^{139m}Nd	259	0	0	2	0	254	1	5	2	7.2	377.5	19.3	0.1
^{140}Nd	15	0	0	0	0	16	0	0	0	1.6	0.0	0.0	0.0
^{141}Nd	19	0	0	5	0	19	0	0	5	1.6	0.4	45.3	0.2
^{141m}Nd	113	0	0	0	0	113	5	0	0	2.3	92.6	0.0	0.0
^{144}Nd	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{147}Nd	30	0	0	0	0	30	0	0	0	1.9	10.6	1345.3	0.0
^{149}Nd	68	0	0	0	0	69	0	118	0	4.4	329.9	1347.8	0.0
^{151}Nd	136	0	1	0	0	133	1	795	0	4.5	90.5	1249.4	0.0
^{152}Nd	31	0	0	0	0	33	0	3	0	2.5	35.6	1431.6	0.0
^{136}Pm	295	0	3186	156	0	296	0	6524	156	8.6	81.3	745.4	5.4
^{137m}Pm	194	0	559	114	0	192	0	3381	114	9.0	798.3	608.1	3.9
^{139}Pm	41	0	407	119	0	39	0	3612	119	1.6	12.3	629.8	4.1
^{140}Pm	23	0	2927	155	0	22	0	6397	155	0.6	0.3	740.9	5.3
^{140m}Pm	373	0	273	116	0	370	2	3320	116	8.5	98.5	624.0	4.0
^{141}Pm	37	0	50	88	0	33	1	1823	88	1.1	10.8	496.7	3.0
^{142}Pm	12	0	838	134	0	11	0	4605	134	0.4	0.1	685.6	4.6
^{143}Pm	61	0	0	0	0	62	0	0	0	2.4	1.9	0.0	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$	Annihilation	Photon	Electron	$\beta-/\beta+$	Annihilation
	μSv h^{-1} GBq^{-1}					μSv h^{-1} GBq^{-1}				mSv h^{-1} GBq^{-1}			
^{144}Pm	267	0	0	0	0	270	0	0	0	8.3	22.8	0.0	0.0
^{145}Pm	15	0	0	0	0	16	0	0	0	1.5	0.0	0.0	0.0
^{146}Pm	132	0	0	0	0	132	0	0	0	4.5	17.8	465.8	0.0
^{147}Pm	0	0	0	0	0	0	0	0	0	0.0	0.0	255.5	0.0
^{148}Pm	85	0	3	0	0	79	1	1506	0	1.4	3.4	1201.2	0.0
^{148m}Pm	327	0	0	0	0	329	0	0	0	9.3	67.8	1150.2	0.0
^{149}Pm	2	0	0	0	0	2	0	4	0	0.1	8.0	1420.2	0.0
^{150}Pm	220	0	59	0	0	204	2	1671	0	4.8	66.0	1166.3	0.0
^{151}Pm	60	0	0	0	0	60	0	3	0	3.5	74.9	1363.9	0.0
^{152}Pm	45	0	377	0	0	42	0	4376	0	1.2	20.9	996.3	0.0
^{152m}Pm	238	0	55	0	0	227	2	1717	0	7.7	335.1	1154.7	0.0
^{153}Pm	18	0	1	0	0	18	0	751	0	1.6	13.2	1213.7	0.0
^{154}Pm	247	0	87	0	0	201	4	1640	0	3.3	23.4	1153.8	0.0
^{154m}Pm	271	0	67	0	0	245	6	1866	0	6.7	267.7	1118.4	0.0
^{139}Sm	124	0	501	119	0	119	1	3691	119	4.8	169.9	627.4	4.1
^{140}Sm	65	0	7	34	0	63	1	185	34	2.8	74.4	233.4	1.2
^{141}Sm	137	0	148	93	0	127	2	2267	93	4.1	34.8	516.1	3.2
^{141m}Sm	258	0	41	57	0	246	2	873	57	8.0	578.8	350.4	2.0
^{142}Sm	15	0	1	13	0	15	0	2	13	1.4	0.0	107.1	0.4
^{143}Sm	15	0	28	79	0	15	0	1335	79	0.9	0.9	462.3	2.7
^{143m}Sm	111	0	0	0	0	111	4	2	0	2.3	107.2	1.0	0.0
^{145}Sm	29	0	0	0	0	29	0	0	0	2.8	0.0	0.0	0.0
^{146}Sm	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{147}Sm	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{148}Sm	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{151}Sm	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{153}Sm	19	0	0	0	0	18	0	0	0	1.7	0.4	1431.6	0.0
^{155}Sm	21	0	0	0	0	21	0	273	0	1.9	19.0	1284.8	0.0
^{156}Sm	23	0	0	0	0	23	0	0	0	2.2	54.6	1293.0	0.0
^{157}Sm	71	0	5	0	0	70	0	1985	0	4.1	106.5	1121.2	0.0
^{142}Eu	36	0	5175	162	0	30	13	7243	162	0.5	2.5	751.3	5.6
^{142m}Eu	407	0	2102	144	0	404	2	5671	144	8.4	23.2	704.7	5.0
^{143}Eu	53	0	1221	129	0	44	2	4611	129	0.9	0.8	654.0	4.5
^{144}Eu	28	0	3155	152	0	22	1	6328	152	0.4	0.1	725.4	5.2
^{145}Eu	194	0	1	4	0	177	2	10	4	4.1	8.1	28.9	0.1
^{146}Eu	369	0	1	8	0	351	3	15	8	8.1	16.8	60.9	0.3
^{147}Eu	87	0	0	1	0	87	0	0	1	4.2	175.6	7.0	0.0
^{148}Eu	365	0	0	0	0	360	2	0	0	10.5	45.1	1.8	0.0

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^{149}Eu	21	0	0	0	0	21	0	0	0	1.9	19.2	0.0	0.0
^{150}Eu	267	0	0	0	0	266	1	0	0	10.4	118.8	0.4	0.0
^{150m}Eu	8	0	0	1	0	8	0	2	1	0.4	5.7	1287.3	0.0
^{152}Eu	189	0	0	0	0	182	1	18	0	5.3	81.4	351.7	0.0
^{152m}Eu	49	0	1	0	0	49	0	640	0	1.4	10.2	861.1	0.0
^{152}Eun	17	0	0	0	0	17	0	0	0	1.7	0.0	0.0	0.0
^{154}Eu	193	0	0	0	0	187	1	89	0	4.2	82.8	1065.3	0.0
^{154m}Eu	20	0	0	0	0	19	0	0	0	1.9	0.0	0.0	0.0
^{155}Eu	14	0	0	0	0	14	0	0	0	1.3	0.3	92.0	0.0
^{156}Eu	174	0	1	0	0	150	3	799	0	2.4	7.3	1029.1	0.0
^{157}Eu	58	0	0	0	0	58	0	31	0	3.2	22.3	1403.0	0.0
^{158}Eu	194	0	41	0	0	184	2	1902	0	3.3	16.8	1144.9	0.0
^{159}Eu	60	0	2	0	0	60	0	1838	0	3.2	22.8	1125.1	0.0
^{142}Gd	81	0	209	92	0	75	1	2426	92	2.6	58.2	501.7	3.2
^{143m}Gd	224	0	898	121	0	210	3	4040	121	7.2	310.7	625.1	4.2
^{144}Gd	63	0	70	79	0	48	1	1858	79	1.5	25.4	438.6	2.7
^{145}Gd	272	0	27	56	0	199	8	851	56	3.0	6.0	337.3	1.9
^{145m}Gd	105	0	70	8	0	106	1	284	8	2.6	155.0	38.4	0.3
^{146}Gd	65	0	0	0	0	65	0	0	0	6.3	103.6	0.0	0.0
^{147}Gd	236	0	0	0	0	234	1	0	0	8.8	531.1	1.7	0.0
^{148}Gd	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{149}Gd	101	0	0	0	0	102	0	0	0	6.0	304.9	0.1	0.0
^{150}Gd	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{151}Gd	22	0	0	0	0	22	0	0	0	2.1	118.1	0.0	0.0
^{152}Gd	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{153}Gd	32	0	0	0	0	32	0	0	0	3.1	0.2	0.0	0.0
^{159}Gd	11	0	0	0	0	11	0	1	0	0.8	3.3	1439.9	0.0
^{162}Gd	73	0	0	0	0	73	0	2	0	3.3	18.5	1448.5	0.0
^{146}Tb	391	0	1613	127	0	325	19	4760	127	4.3	12.2	631.7	4.4
^{147}Tb	287	0	14	48	0	268	4	557	48	5.8	19.3	299.1	1.6
^{147m}Tb	222	0	17	55	0	186	11	720	55	2.8	1.9	333.1	1.9
^{148}Tb	263	0	481	93	0	231	3	2758	93	4.6	8.8	499.0	3.2
^{148m}Tb	463	0	18	51	0	462	1	620	51	12.0	72.2	313.2	1.8
^{149}Tb	201	0	2	12	0	185	2	56	12	6.0	177.7	89.7	0.4
^{149m}Tb	189	0	9	40	0	188	1	295	40	4.7	36.6	263.2	1.4
^{150}Tb	303	0	84	38	0	244	5	840	38	5.4	12.2	223.0	1.3
^{150m}Tb	401	0	4	24	0	404	0	65	24	12.9	84.1	172.2	0.8
^{151}Tb	175	0	0	2	0	173	1	1	2	8.3	340.9	17.8	0.1
^{151m}Tb	16	0	0	0	0	16	0	0	0	0.9	7.0	2.4	0.0
^{152}Tb	194	0	26	34	0	170	3	620	34	5.5	114.1	204.1	1.2
^{152m}Tb	137	0	0	2	0	137	0	3	2	7.6	1589.3	17.5	0.1
^{153}Tb	67	0	0	0	0	67	0	0	0	4.5	86.8	1.7	0.0
^{154}Tb	309	0	2	4	0	239	6	61	4	5.0	46.6	28.6	0.2
^{155}Tb	44	0	0	0	0	43	0	0	0	4.0	109.5	0.0	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{156}Tb	308	0	0	0	0	294	5	0	0	9.0	302.6	0.0	0.0
^{156m}Tb	12	0	0	0	0	12	0	0	0	1.2	0.0	0.0	0.0
^{156}Tbn	1	0	0	0	0	1	0	0	0	0.1	0.0	0.0	0.0
^{157}Tb	2	0	0	0	0	2	0	0	0	0.2	0.0	0.0	0.0
^{158}Tb	134	0	0	0	0	133	0	0	0	3.9	65.5	241.4	0.0
^{160}Tb	175	0	0	0	0	173	1	5	0	4.1	53.7	1360.3	0.0
^{161}Tb	15	0	0	0	0	16	0	0	0	1.6	0.3	1268.3	0.0
^{162}Tb	181	0	0	0	0	181	0	117	0	6.1	94.4	1330.2	0.0
^{163}Tb	137	0	0	0	0	137	0	15	0	6.1	97.5	1431.7	0.0
^{164}Tb	376	0	34	0	0	354	5	1326	0	9.5	257.0	1191.7	0.0
^{165}Tb	121	0	24	0	0	110	1	2085	0	1.8	8.5	1138.9	0.0
^{148}Dy	118	0	1	7	0	119	0	0	7	4.1	4.6	58.6	0.2
^{149}Dy	236	0	3	14	0	214	3	105	14	5.4	50.6	100.7	0.5
^{150}Dy	53	0	0	0	0	53	0	0	0	2.9	9.7	1.1	0.0
^{151}Dy	213	0	1	5	0	202	1	15	5	5.8	95.4	39.9	0.2
^{152}Dy	58	0	0	0	0	58	0	0	0	4.7	72.4	0.0	0.0
^{153}Dy	152	0	0	2	0	147	1	0	2	6.9	155.3	21.4	0.1
^{154}Dy	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{155}Dy	113	0	0	2	0	110	1	0	2	5.3	93.5	22.5	0.1
^{157}Dy	69	0	0	0	0	69	0	0	0	4.7	30.8	0.0	0.0
^{159}Dy	17	0	0	0	0	17	0	0	0	1.6	0.0	0.0	0.0
^{165}Dy	5	0	0	0	0	5	0	50	0	0.3	7.4	1345.1	0.0
^{165m}Dy	4	0	0	0	0	4	0	0	0	0.3	4.9	32.5	0.0
^{166}Dy	12	0	0	0	0	12	0	0	0	1.1	0.3	1050.8	0.0
^{167}Dy	92	0	1	0	0	93	0	757	0	4.4	744.1	1217.9	0.0
^{168}Dy	71	0	0	0	0	71	0	29	0	3.7	393.1	1411.8	0.0
^{150}Ho	170	0	3086	142	0	170	0	5937	142	3.6	7.6	676.1	4.9
^{153}Ho	104	0	54	72	0	103	1	1555	72	4.7	233.5	405.6	2.5
^{153m}Ho	101	0	90	85	0	100	0	2038	85	5.1	198.3	469.1	2.9
^{154}Ho	197	0	687	111	0	190	2	3645	111	6.4	145.3	577.9	3.8
^{154m}Ho	340	0	51	72	0	340	2	1458	72	13.0	252.1	410.8	2.5
^{155}Ho	74	0	8	34	0	69	0	282	34	3.9	109.5	219.7	1.2
^{156}Ho	253	0	196	75	0	227	3	1898	75	7.6	449.5	418.2	2.6
^{157}Ho	101	0	1	10	0	101	0	7	10	6.0	229.8	76.0	0.3
^{159}Ho	80	0	0	0	0	80	0	0	0	6.1	166.9	4.8	0.0
^{160}Ho	276	0	0	1	0	276	0	0	1	7.2	122.8	8.9	0.0
^{161}Ho	24	0	0	0	0	25	0	0	0	2.5	2.8	0.0	0.0
^{162}Ho	27	0	1	7	0	26	1	0	7	1.7	2.9	57.7	0.2

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^{162m}Ho	95	0	0	0	0	93	1	0	0	3.9	202.4	0.2	0.0
^{163}Ho	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{164}Ho	10	0	0	0	0	10	0	1	0	0.9	0.0	579.5	0.0
^{164m}Ho	16	0	0	0	0	15	0	0	0	1.5	0.0	0.0	0.0
^{166}Ho	5	0	1	0	0	5	0	844	0	0.3	0.0	1200.5	0.0
^{166m}Ho	269	0	0	0	0	270	0	2	0	9.2	554.4	99.6	0.0
^{167}Ho	66	0	0	0	0	66	0	0	0	4.0	348.1	1133.3	0.0
^{168}Ho	140	0	2	0	0	138	1	1364	0	3.1	44.5	1158.4	0.0
^{168m}Ho	2	0	0	0	0	2	0	0	0	0.2	0.0	0.0	0.0
^{170}Ho	271	0	10	0	0	269	1	1192	0	7.4	227.3	1185.7	0.0
^{154}Er	21	0	0	5	0	22	0	0	5	2.2	0.0	43.7	0.2
^{156}Er	22	0	0	0	0	23	0	0	0	2.1	11.9	0.0	0.0
^{159}Er	148	0	1	9	0	141	1	11	9	4.7	423.5	67.5	0.3
^{161}Er	163	0	0	0	0	160	2	0	0	4.5	475.7	0.9	0.0
^{163}Er	13	0	0	0	0	13	0	0	0	1.3	0.1	0.0	0.0
^{165}Er	13	0	0	0	0	12	0	0	0	1.2	0.0	0.0	0.0
^{167m}Er	19	0	0	0	0	18	0	0	0	1.7	1737.3	0.0	0.0
^{169}Er	0	0	0	0	0	0	0	0	0	0.0	0.0	843.5	0.0
^{171}Er	69	0	0	0	0	69	0	11	0	4.8	72.2	1411.4	0.0
^{172}Er	92	0	0	0	0	92	0	0	0	4.0	57.3	782.9	0.0
^{173}Er	140	0	1	0	0	140	0	770	0	6.4	145.3	1244.8	0.0
^{161}Tm	184	0	7	25	0	161	2	263	25	6.9	139.5	158.3	0.9
^{162}Tm	214	0	234	62	0	173	5	1671	62	3.7	40.4	339.3	2.1
^{163}Tm	207	0	0	1	0	192	3	0	1	6.1	180.8	9.4	0.0
^{164}Tm	53	0	106	74	0	45	3	1909	74	1.4	9.4	402.3	2.5
^{165}Tm	104	0	0	0	0	103	0	0	0	5.7	388.7	0.1	0.0
^{166}Tm	289	0	1	2	0	252	8	19	2	5.9	127.4	15.2	0.1
^{167}Tm	33	0	0	0	0	33	0	0	0	3.0	1737.4	0.0	0.0
^{168}Tm	211	0	0	0	0	210	0	0	0	7.7	200.2	0.1	0.0
^{170}Tm	1	0	0	0	0	1	0	1	0	0.1	0.0	1443.8	0.0
^{171}Tm	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{172}Tm	68	0	1	0	0	61	3	583	0	1.0	18.5	1111.4	0.0
^{173}Tm	68	0	0	0	0	69	0	3	0	3.2	58.1	1450.4	0.0
^{174}Tm	291	0	0	0	0	291	1	18	0	11.7	688.1	1393.0	0.0
^{175}Tm	175	0	0	0	0	173	1	237	0	4.7	329.8	1326.3	0.0
^{176}Tm	285	0	153	0	0	250	6	2168	0	7.3	544.1	1151.7	0.0
^{162}Yb	50	0	0	0	0	49	0	0	0	3.8	23.7	3.6	0.0
^{163}Yb	79	0	14	41	0	73	1	631	41	2.5	25.7	241.8	1.4
^{164}Yb	15	0	0	0	0	15	0	0	0	1.3	2.8	0.0	0.0
^{165}Yb	53	0	2	12	0	51	0	23	12	3.2	18.8	90.6	0.4
^{166}Yb	25	0	0	0	0	24	0	0	0	2.4	0.0	0.0	0.0
^{167}Yb	60	0	0	1	0	59	0	0	1	5.5	28.2	9.3	0.0
^{169}Yb	75	0	0	0	0	74	0	0	0	6.9	510.7	0.0	0.0
^{175}Yb	7	0	0	0	0	7	0	0	0	0.4	8.9	1063.5	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{177}Yb	31	0	0	0	0	31	1	85	0	1.2	46.5	1177.2	0.0
^{178}Yb	7	0	0	0	0	7	0	0	0	0.4	20.4	1304.9	0.0
^{179}Yb	163	0	1	0	0	164	0	695	0	5.5	285.6	1257.2	0.0
^{165}Lu	137	0	24	45	0	126	2	841	45	5.3	219.0	265.7	1.6
^{167}Lu	242	0	2	10	0	208	6	82	10	6.2	217.0	68.2	0.4
^{169}Lu	202	0	0	0	0	188	4	0	0	5.2	77.2	2.3	0.0
^{169m}Lu	0	0	0	0	0	1	0	0	0	0.2	0.0	0.0	0.0
^{170}Lu	341	0	0	1	0	262	10	7	1	4.6	28.0	3.8	0.0
^{171}Lu	117	0	0	0	0	120	0	0	0	4.8	7.2	0.1	0.0
^{171m}Lu	0	0	0	0	0	1	0	0	0	0.3	0.0	0.0	0.0
^{172}Lu	306	0	0	0	0	298	4	0	0	7.5	211.1	0.6	0.0
^{172m}Lu	0	0	0	0	0	0	0	0	0	0.1	0.0	0.0	0.0
^{173}Lu	42	0	0	0	0	42	0	0	0	3.7	27.8	0.0	0.0
^{174}Lu	24	0	0	0	0	23	0	0	0	1.5	0.1	0.4	0.0
^{174m}Lu	16	0	0	0	0	17	0	0	0	2.0	18.2	0.0	0.0
^{176}Lu	87	0	0	0	0	88	0	0	0	6.9	687.1	1363.6	0.0
^{176m}Lu	3	0	0	0	0	4	0	46	0	0.4	0.0	1362.8	0.0
^{177}Lu	7	0	0	0	0	7	0	0	0	0.6	19.7	1078.4	0.0
^{177m}Lu	184	0	0	0	0	186	0	0	0	14.1	1041.0	11.8	0.0
^{178}Lu	19	0	1	0	0	17	1	1256	0	0.5	8.1	1169.6	0.0
^{178m}Lu	189	0	0	0	0	190	0	4	0	12.2	775.3	1423.3	0.0
^{179}Lu	5	0	0	0	0	5	0	122	0	0.5	20.8	1328.7	0.0
^{180}Lu	229	0	2	0	0	219	8	418	0	5.6	222.8	1279.9	0.0
^{181}Lu	98	0	3	0	0	99	0	1262	0	4.4	336.8	1178.0	0.0
^{167}Hf	43	0	61	66	0	44	0	1546	66	3.2	35.2	366.4	2.3
^{169}Hf	91	0	5	24	0	92	0	168	24	4.4	12.7	156.4	0.8
^{170}Hf	82	0	0	0	0	83	0	0	0	5.3	73.2	0.0	0.0
^{172}Hf	31	0	0	0	0	34	0	0	0	3.9	13.3	0.0	0.0
^{173}Hf	76	0	0	0	0	77	0	0	0	6.3	107.4	0.2	0.0
^{174}Hf	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{175}Hf	67	0	0	0	0	68	0	0	0	4.7	230.0	0.0	0.0
^{177m}Hf	412	0	0	0	0	416	0	0	0	29.2	4498.8	0.0	0.0
^{178m}Hf	392	0	0	0	0	395	0	0	0	21.3	1451.2	0.0	0.0
^{179m}Hf	168	0	0	0	0	169	0	0	0	11.1	949.9	0.0	0.0
^{180m}Hf	178	0	0	0	0	179	0	0	0	10.9	694.6	0.6	0.0
^{181}Hf	94	0	0	0	0	94	0	0	0	4.8	326.4	1061.7	0.0
^{182}Hf	43	0	0	0	0	44	0	0	0	3.4	331.9	0.0	0.0
^{182m}Hf	159	0	0	0	0	160	0	0	0	8.1	628.2	682.5	0.0

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^{183}Hf	129	0	0	0	0	128	1	87	0	3.8	41.3	1359.6	0.0
^{184}Hf	45	0	0	0	0	47	0	3	0	4.3	325.4	1425.3	0.0
^{170}Ta	56	0	1960	124	0	56	0	4946	124	2.5	99.0	600.2	4.3
^{172}Ta	206	0	105	60	0	195	37	1402	60	6.0	338.9	330.4	2.1
^{173}Ta	80	0	4	18	0	76	1	128	18	4.0	176.0	121.5	0.6
^{174}Ta	105	0	44	51	0	96	4	1157	51	4.7	400.3	285.4	1.8
^{175}Ta	173	0	0	1	0	159	4	0	1	6.1	201.4	6.5	0.0
^{176}Ta	311	1	0	2	0	261	22	14	2	5.4	73.8	10.8	0.1
^{177}Ta	16	0	0	0	0	17	0	0	0	1.7	3.1	0.0	0.0
^{178}Ta	22	0	0	2	0	22	3	0	2	1.8	1.3	20.6	0.1
^{178m}Ta	212	0	0	0	0	213	0	0	0	14.2	823.6	0.0	0.0
^{179}Ta	7	0	0	0	0	7	0	0	0	0.9	0.0	0.0	0.0
^{180}Ta	12	0	0	0	0	13	0	0	0	1.4	0.0	198.3	0.0
^{182}Ta	196	0	0	0	0	190	6	1	0	4.8	85.5	990.1	0.0
^{182m}Ta	52	0	0	0	0	53	0	0	0	5.5	2545.7	0.0	0.0
^{183}Ta	58	0	0	0	0	59	0	0	0	5.3	643.6	1370.3	0.0
^{184}Ta	261	0	0	0	0	262	1	15	0	10.4	468.9	1392.2	0.0
^{185}Ta	29	0	1	0	0	30	0	666	0	2.9	357.5	1229.0	0.0
^{186}Ta	238	0	123	0	0	238	1	2609	0	9.9	229.0	1079.1	0.0
^{177}W	158	0	0	0	0	158	2	0	0	7.9	176.5	4.3	0.0
^{178}W	4	0	0	0	0	5	0	0	0	0.6	0.0	0.0	0.0
^{179}W	17	0	0	0	0	18	0	0	0	2.0	0.2	0.0	0.0
^{179m}W	12	0	0	0	0	13	0	0	0	1.3	2560.1	0.0	0.0
^{181}W	10	0	0	0	0	11	0	0	0	1.2	0.2	0.0	0.0
^{185}W	0	0	0	0	0	0	0	0	0	0.0	0.0	1110.7	0.0
^{185m}W	5	0	0	0	0	7	0	0	0	1.1	532.3	0.0	0.0
^{187}W	76	0	0	0	0	78	0	20	0	3.3	52.6	1370.9	0.0
^{188}W	0	0	0	0	0	0	0	0	0	0.0	5.7	836.9	0.0
^{190}W	32	0	0	0	0	39	0	1	0	6.0	889.8	1444.5	0.0
^{178}Re	180	0	208	62	0	141	2	1804	62	4.9	253.5	330.4	2.1
^{179}Re	174	0	0	2	0	164	2	0	2	7.1	180.0	17.2	0.1
^{180}Re	175	0	5	18	0	174	1	160	18	4.7	12.3	117.6	0.6
^{181}Re	139	0	0	0	0	139	1	0	0	6.6	673.9	0.1	0.0
^{182}Re	289	0	0	0	0	281	7	0	0	12.3	791.4	0.0	0.0
^{182m}Re	186	0	1	3	0	177	6	15	3	5.2	31.4	20.6	0.1
^{183}Re	34	0	0	0	0	36	0	0	0	3.8	232.6	0.0	0.0
^{184}Re	146	0	0	0	0	147	0	0	0	4.3	21.6	0.0	0.0
^{184m}Re	67	0	0	0	0	73	0	0	0	5.7	168.2	0.0	0.0
^{186}Re	4	0	0	0	0	5	0	3	0	0.7	80.8	1318.9	0.0
^{186m}Re	5	0	0	0	0	18	0	0	0	5.3	0.0	0.0	0.0
^{187}Re	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{188}Re	10	0	1	0	0	11	0	1320	0	0.9	184.5	1155.5	0.0
^{188m}Re	16	0	0	0	0	25	0	0	0	4.8	7.8	0.0	0.0
^{189}Re	10	0	0	0	0	12	0	1	0	1.3	130.0	1423.8	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{190}Re	223	0	1	0	0	224	1	637	0	9.3	493.0	1233.7	0.0
^{190m}Re	157	0	2	0	0	162	0	459	0	8.3	314.7	673.8	0.0
^{180}Os	29	0	0	0	0	40	0	0	0	6.0	44.8	1.1	0.0
^{181}Os	214	0	0	4	0	212	4	5	4	10.5	222.0	29.4	0.1
^{182}Os	79	0	0	0	0	87	0	0	0	7.7	108.2	0.0	0.0
^{183}Os	114	0	0	0	0	123	0	0	0	10.3	106.8	4.5	0.0
^{183m}Os	155	0	0	0	0	157	4	0	0	5.4	350.0	0.0	0.0
^{185}Os	116	0	0	0	0	123	0	0	0	5.7	23.7	0.0	0.0
^{186}Os	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{189m}Os	0	0	0	0	0	3	0	0	0	0.8	0.0	0.0	0.0
^{190m}Os	271	0	0	0	0	280	0	0	0	14.0	675.5	0.0	0.0
^{191}Os	18	0	0	0	0	30	0	0	0	5.4	70.5	5.5	0.0
^{191m}Os	2	0	0	0	0	5	0	0	0	1.4	0.0	0.0	0.0
^{193}Os	13	0	0	0	0	15	0	6	0	1.6	64.4	1405.5	0.0
^{194}Os	2	0	0	0	0	6	0	0	0	1.5	0.0	0.0	0.0
^{196}Os	15	0	0	0	0	16	0	9	0	1.3	40.9	1406.2	0.0
^{180}Ir	166	0	1194	102	0	173	0	3842	102	8.7	443.1	505.5	3.5
^{182}Ir	143	0	816	92	0	148	0	3286	92	8.5	309.0	462.4	3.2
^{183}Ir	169	0	4	15	0	161	4	139	15	9.0	281.4	93.6	0.5
^{184}Ir	279	0	36	30	0	272	4	611	30	12.6	384.9	176.4	1.0
^{185}Ir	126	0	0	4	0	125	2	3	4	9.6	261.3	32.6	0.1
^{186}Ir	252	0	2	10	0	243	6	82	10	12.1	554.4	65.7	0.3
^{186m}Ir	180	0	4	11	0	170	2	139	11	6.6	230.1	68.7	0.4
^{187}Ir	59	0	0	0	0	70	0	0	0	6.4	71.1	0.7	0.0
^{188}Ir	287	0	0	1	0	232	13	1	1	7.8	367.3	4.3	0.0
^{189}Ir	18	0	0	0	0	28	0	0	0	5.1	51.6	0.0	0.0
^{190}Ir	253	0	0	0	0	262	0	0	0	13.7	565.7	0.0	0.0
^{190m}Ir	0	0	0	0	0	3	0	0	0	0.7	0.0	0.0	0.0
^{190}Irn	14	0	0	0	0	21	0	0	0	3.6	154.4	0.0	0.0
^{191m}Ir	17	0	0	0	0	29	0	0	0	5.3	63.4	0.0	0.0
^{192}Ir	142	0	0	0	0	145	0	0	0	7.9	389.6	1240.1	0.0
^{192m}Ir	1	0	0	0	0	9	0	0	0	2.4	0.0	0.2	0.0
^{192}Irn	2	0	0	0	0	19	0	0	0	5.1	2328.7	0.0	0.0
^{193m}Ir	0	0	0	0	0	3	0	0	0	0.9	0.0	0.0	0.0
^{194}Ir	15	0	2	0	0	15	2	1608	0	0.7	33.1	1138.9	0.0
^{194m}Ir	395	0	0	0	0	402	0	0	0	16.2	347.5	118.5	0.0
^{195}Ir	14	0	0	0	0	22	0	2	0	3.7	38.8	1433.9	0.0
^{195m}Ir	67	0	0	0	0	74	0	0	0	5.5	337.8	1139.3	0.0

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^{196}Ir	38	0	160	0	0	38	51	3585	0	1.3	43.7	1031.1	0.0
^{196m}Ir	419	0	0	0	0	428	1	1	0	18.0	268.5	1232.3	0.0
^{184}Pt	134	0	0	0	0	155	0	0	0	15.1	702.6	2.8	0.0
^{186}Pt	118	0	0	0	0	128	0	0	0	7.3	178.2	0.0	0.0
^{187}Pt	99	0	2	10	0	112	1	63	10	9.4	403.8	71.4	0.4
^{188}Pt	41	0	0	0	0	52	0	0	0	6.8	294.7	0.0	0.0
^{189}Pt	87	0	0	1	0	100	1	0	1	8.9	161.2	5.8	0.0
^{190}Pt	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{191}Pt	58	0	0	0	0	71	0	0	0	7.9	137.2	0.0	0.0
^{193}Pt	1	0	0	0	0	6	0	0	0	1.6	0.0	0.0	0.0
^{193m}Pt	3	0	0	0	0	8	0	0	0	1.6	733.0	0.0	0.0
^{195m}Pt	19	0	0	0	0	34	0	0	0	6.2	413.2	0.0	0.0
^{197}Pt	6	0	0	0	0	12	0	0	0	2.0	27.7	1377.1	0.0
^{197m}Pt	18	0	0	0	0	32	0	0	0	5.2	1928.0	47.1	0.0
^{199}Pt	34	0	0	0	0	35	0	352	0	1.7	133.7	1302.9	0.0
^{200}Pt	13	0	0	0	0	19	0	0	0	2.8	142.4	1235.2	0.0
^{202}Pt	0	0	1	0	0	0	0	725	0	0.0	0.0	1220.4	0.0
^{186}Au	156	0	1052	90	0	154	4	3332	89	7.8	633.9	444.8	3.1
^{187}Au	148	0	5	13	0	142	3	194	13	6.9	230.4	81.8	0.5
^{190}Au	300	0	32	23	0	228	6	547	23	8.7	283.4	132.0	0.8
^{191}Au	106	0	0	0	0	118	0	0	0	8.9	446.7	3.2	0.0
^{192}Au	264	0	3	9	0	217	13	141	9	8.1	209.5	53.9	0.3
^{193}Au	35	0	0	0	0	44	0	0	0	5.7	242.9	0.0	0.0
^{193m}Au	37	0	0	0	0	47	0	0	0	5.6	918.1	0.0	0.0
^{194}Au	156	0	0	3	0	147	13	4	3	7.1	156.7	22.6	0.1
^{195}Au	20	0	0	0	0	33	0	0	0	5.7	4.7	0.0	0.0
^{195m}Au	38	0	0	0	0	49	0	0	0	5.8	945.6	0.0	0.0
^{196}Au	86	0	0	0	0	94	0	0	0	7.2	163.2	33.4	0.0
^{196m}Au	51	0	0	0	0	75	0	0	0	11.1	3209.3	0.0	0.0
^{198}Au	70	0	0	0	0	71	0	1	0	3.2	77.9	1431.8	0.0
^{198m}Au	101	0	0	0	0	115	0	0	0	12.8	1554.3	0.0	0.0
^{199}Au	19	0	0	0	0	22	0	0	0	2.8	718.8	577.6	0.0
^{200}Au	42	0	1	0	0	40	4	1405	0	1.0	25.6	1168.8	0.0
^{200m}Au	336	0	0	0	0	343	0	0	0	15.3	855.1	1084.5	0.0
^{201}Au	6	0	0	0	0	7	0	37	0	0.4	14.7	1364.4	0.0
^{202}Au	27	0	66	0	0	26	1	3185	0	0.6	12.6	1055.2	0.0
^{190}Hg	42	0	0	0	0	54	0	0	0	7.4	116.6	0.3	0.0
^{191m}Hg	237	0	1	5	0	238	3	34	5	12.0	1093.5	37.3	0.2
^{192}Hg	55	0	0	0	0	68	0	0	0	8.2	194.3	0.0	0.0
^{193}Hg	132	0	0	1	0	136	4	0	1	7.7	274.5	12.1	0.0
^{193m}Hg	162	0	0	1	0	163	5	0	1	6.9	157.4	7.7	0.0
^{194}Hg	1	0	0	0	0	7	0	0	0	1.6	0.0	0.0	0.0
^{195}Hg	38	0	0	0	0	51	0	0	0	5.7	52.8	1.3	0.0
^{195m}Hg	40	0	0	0	0	57	0	0	0	7.1	525.1	0.3	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{197}Hg	18	0	0	0	0	31	0	0	0	5.1	4.8	0.0	0.0
^{197m}Hg	21	0	0	0	0	32	0	0	0	4.6	2438.3	0.0	0.0
^{199m}Hg	36	0	0	0	0	46	0	0	0	5.5	2541.3	0.0	0.0
^{203}Hg	43	0	0	0	0	46	0	0	0	3.9	556.6	194.2	0.0
^{205}Hg	1	0	0	0	0	1	0	262	0	0.1	12.0	1291.3	0.0
^{206}Hg	22	0	0	0	0	24	0	34	0	1.9	352.0	1388.6	0.0
^{207}Hg	376	0	16	0	0	327	34	830	0	7.7	590.6	1223.5	0.0
^{190}Tl	111	0	2374	108	0	113	2	4503	108	4.8	70.9	511.4	3.7
^{190m}Tl	334	0	610	73	0	339	3	2566	73	11.6	219.6	371.9	2.5
^{194}Tl	99	0	423	58	0	104	0	1967	58	5.3	61.8	298.4	2.0
^{194m}Tl	391	0	17	29	0	402	0	570	29	15.8	398.4	166.5	1.0
^{195}Tl	180	0	0	2	0	170	14	7	2	7.5	220.4	16.1	0.1
^{196}Tl	258	0	18	22	0	231	14	443	22	7.7	78.4	124.7	0.7
^{197}Tl	76	0	0	2	0	83	3	0	2	5.6	184.0	14.9	0.1
^{198}Tl	292	0	0	1	0	260	21	10	1	8.3	98.8	9.6	0.0
^{198m}Tl	208	0	0	2	0	227	0	1	2	13.5	2008.2	13.4	0.1
^{199}Tl	48	0	0	0	0	58	0	0	0	5.7	485.1	0.6	0.0
^{200}Tl	208	0	0	1	0	209	13	0	1	8.3	142.7	5.3	0.0
^{201}Tl	22	0	0	0	0	32	0	0	0	4.7	112.5	0.0	0.0
^{202}Tl	85	0	0	0	0	92	0	0	0	6.1	58.8	0.0	0.0
^{204}Tl	0	0	0	0	0	0	0	0	0	0.1	0.0	1336.3	0.0
^{206}Tl	0	0	0	0	0	0	2	267	0	0.0	0.9	1289.9	0.0
^{206m}Tl	398	0	0	0	0	409	10	0	0	17.4	1492.1	0.0	0.0
^{207}Tl	0	0	0	0	0	0	0	148	0	0.0	0.1	1319.1	0.0
^{208}Tl	420	19	0	0	0	275	85	413	0	5.6	204.3	1281.7	0.0
^{209}Tl	314	0	1	0	0	280	20	753	0	8.0	59.7	1218.5	0.0
^{210}Tl	405	0	736	0	0	370	13	3295	0	10.6	278.2	1068.7	0.0
^{194}Pb	172	0	0	1	0	182	5	1	1	11.8	484.6	8.1	0.0
^{195m}Pb	258	0	9	21	0	288	2	338	21	18.3	468.6	126.4	0.7
^{196}Pb	91	0	0	1	0	111	0	0	1	11.7	991.1	5.2	0.0
^{197}Pb	226	0	2	7	0	220	12	87	7	10.3	176.6	44.3	0.2
^{197m}Pb	196	0	1	4	0	221	2	34	4	15.8	2419.4	24.9	0.1
^{198}Pb	82	0	0	0	0	102	0	0	0	11.4	693.2	0.0	0.0
^{199}Pb	157	0	1	5	0	161	9	24	5	9.3	175.2	31.6	0.2
^{200}Pb	44	0	0	0	0	69	0	0	0	11.3	884.8	0.0	0.0
^{201}Pb	130	0	0	0	0	147	2	0	0	11.0	375.8	1.3	0.0
^{201m}Pb	62	0	0	0	0	70	0	0	0	4.0	566.0	0.0	0.0
^{202}Pb	1	0	0	0	0	11	0	0	0	3.6	0.0	0.0	0.0

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^{202m}Pb	322	0	0	0	0	331	2	0	0	10.4	345.0	0.0	0.0
^{203}Pb	61	0	0	0	0	78	0	0	0	9.9	563.9	0.0	0.0
^{204m}Pb	328	0	0	0	0	331	0	0	0	8.2	216.3	0.0	0.0
^{205}Pb	1	0	0	0	0	11	0	0	0	3.6	0.0	0.0	0.0
^{209}Pb	0	0	0	0	0	0	0	0	0	0.0	0.0	1390.2	0.0
^{210}Pb	4	0	0	0	0	15	0	0	0	3.3	0.0	0.0	0.0
^{211}Pb	11	0	0	0	0	11	0	98	0	0.4	17.9	1325.0	0.0
^{212}Pb	28	0	0	0	0	35	0	0	0	4.2	1084.3	808.2	0.0
^{214}Pb	46	0	0	0	0	53	0	0	0	4.6	762.4	1377.0	0.0
^{197}Bi	233	0	28	32	0	240	9	691	32	10.2	93.5	180.6	1.1
^{200}Bi	378	0	18	24	0	398	1	499	24	18.5	474.8	136.0	0.8
^{201}Bi	255	0	1	4	0	251	8	30	4	9.9	100.8	27.7	0.1
^{202}Bi	423	0	6	13	0	431	3	197	13	16.0	441.2	82.0	0.5
^{203}Bi	348	0	0	0	0	325	15	1	0	11.3	222.9	3.6	0.0
^{204}Bi	453	0	0	0	0	457	8	0	0	16.2	352.4	3.2	0.0
^{205}Bi	247	0	0	0	0	235	18	0	0	9.7	95.7	2.4	0.0
^{206}Bi	514	0	0	0	0	514	5	0	0	18.7	618.3	0.0	0.0
^{207}Bi	243	0	0	0	0	254	51	0	0	10.8	119.5	0.7	0.0
^{208}Bi	305	5	0	0	0	170	21	0	0	6.2	1.7	0.0	0.0
^{210}Bi	0	0	0	0	0	0	0	13	0	0.0	0.0	1394.8	0.0
^{210m}Bi	47	0	0	0	0	50	0	0	0	4.0	562.1	0.0	0.0
^{211}Bi	8	0	0	0	0	9	0	0	0	0.6	77.6	3.7	0.0
^{212}Bi	16	0	1	0	0	19	1	960	0	1.4	8.6	739.4	0.0
^{212}Bin	0	0	0	0	0	0	0	259	0	0.0	0.0	1292.5	0.0
^{213}Bi	22	0	0	0	0	23	0	94	0	1.1	95.8	1325.3	0.0
^{214}Bi	210	0	43	0	0	183	45	1015	0	3.1	33.7	1251.8	0.0
^{215}Bi	43	0	1	0	0	46	1	719	0	2.9	667.2	1241.1	0.0
^{216}Bi	126	0	304	0	0	127	0	4348	0	4.8	124.0	989.2	0.0
^{203}Po	242	0	4	12	0	252	5	156	12	11.3	968.7	76.1	0.4
^{204}Po	200	0	0	0	0	240	1	0	0	18.5	826.3	0.0	0.0
^{205}Po	243	0	1	4	0	251	6	12	4	10.4	174.8	28.7	0.1
^{206}Po	202	0	0	0	0	235	2	0	0	15.7	751.5	0.0	0.0
^{207}Po	204	0	0	1	0	218	2	0	1	9.5	154.3	8.3	0.0
^{208}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{209}Po	1	0	0	0	0	1	0	0	0	0.1	11.0	0.0	0.0
^{210}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{211}Po	1	0	0	0	0	1	0	0	0	0.0	0.3	0.0	0.0
^{212}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{212m}Po	10	0	0	0	0	6	1	0	0	0.1	0.6	0.0	0.0
^{213}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{214}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{215}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{216}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{218}Po	0	0	0	0	0	0	0	0	0	0.0	0.0	0.1	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{204}At	349	0	161	42	0	365	1	1288	42	14.8	269.2	223.6	1.5
^{205}At	160	0	74	26	0	170	3	649	26	8.8	292.1	142.3	0.9
^{206}At	374	0	81	32	0	383	2	888	32	15.0	335.5	171.5	1.1
^{207}At	307	0	1	3	0	305	12	32	3	12.5	883.8	19.6	0.1
^{208}At	473	0	2	6	0	478	6	65	6	17.9	1029.5	35.0	0.2
^{209}At	377	0	0	0	0	402	3	0	0	18.0	339.0	1.2	0.0
^{210}At	438	0	0	0	0	425	18	0	0	14.9	552.0	1.1	0.0
^{211}At	10	0	0	0	0	18	0	0	0	3.1	0.2	0.0	0.0
^{215}At	0	0	0	0	0	0	0	0	0	0.0	0.2	0.0	0.0
^{216}At	1	0	0	0	0	1	0	0	0	0.1	4.7	0.0	0.0
^{217}At	0	0	0	0	0	0	0	0	0	0.0	1.3	0.0	0.0
^{218}At	0	0	0	0	0	0	0	3	0	0.0	0.0	1.0	0.0
^{219}At	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{220}At	80	0	232	0	0	84	0	3841	0	5.7	625.0	919.1	0.0
^{207}Rn	144	0	29	23	0	156	0	551	23	8.3	273.5	127.4	0.8
^{209}Rn	182	0	3	10	0	186	2	144	10	9.1	305.0	62.7	0.4
^{210}Rn	11	0	0	0	0	12	0	0	0	0.8	43.1	0.0	0.0
^{211}Rn	294	0	0	0	0	302	7	0	0	10.7	269.6	0.1	0.0
^{212}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{215}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{216}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{217}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{218}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{219}Rn	10	0	0	0	0	11	0	0	0	0.8	75.1	0.0	0.0
^{220}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{222}Rn	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{223}Rn	62	0	1	0	0	76	1	442	0	5.6	96.7	1275.7	0.0
^{212}Fr	173	0	3	8	0	187	9	134	8	10.1	456.9	48.2	0.3
^{219}Fr	1	0	0	0	0	1	0	0	0	0.0	3.1	0.0	0.0
^{220}Fr	3	0	0	0	0	8	0	0	0	1.3	18.9	4.9	0.0
^{221}Fr	6	0	0	0	0	7	0	0	0	0.7	95.0	0.0	0.0
^{222}Fr	37	0	1	0	0	49	0	680	0	5.4	46.7	1232.0	0.0
^{223}Fr	19	0	0	0	0	31	0	5	0	4.2	97.7	1406.1	0.0
^{224}Fr	88	0	12	0	0	89	10	1869	0	4.5	84.9	1152.7	0.0
^{227}Fr	82	0	1	0	0	94	1	1114	0	6.7	272.4	1194.3	0.0
^{219}Ra	31	0	0	0	0	36	0	0	0	2.9	673.3	0.0	0.0
^{220}Ra	1	0	0	0	0	1	0	0	0	0.0	0.7	0.0	0.0
^{221}Ra	10	0	0	0	0	21	0	0	0	3.3	317.3	0.0	0.0

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^{222}Ra	2	0	0	0	0	2	0	0	0	0.1	7.7	0.0	0.0
^{223}Ra	29	0	0	0	0	40	0	0	0	4.9	604.0	0.0	0.0
^{224}Ra	2	0	0	0	0	2	0	0	0	0.2	29.5	0.0	0.0
^{225}Ra	9	0	0	0	0	15	0	0	0	2.0	0.0	729.3	0.0
^{226}Ra	1	0	0	0	0	2	0	0	0	0.2	57.8	0.0	0.0
^{227}Ra	37	0	0	0	0	57	0	32	0	6.3	353.9	1384.4	0.0
^{228}Ra	4	0	0	0	0	10	0	0	0	1.3	0.0	0.0	0.0
^{230}Ra	17	0	0	0	0	22	0	0	0	2.3	173.1	1224.3	0.0
^{223}Ac	5	0	0	0	0	9	0	0	0	1.3	21.5	0.0	0.0
^{224}Ac	51	0	0	0	0	73	0	0	0	9.2	47.4	0.0	0.0
^{225}Ac	6	0	0	0	0	15	0	0	0	2.4	12.0	0.0	0.0
^{226}Ac	28	0	0	0	0	36	0	2	0	4.2	42.1	1183.7	0.0
^{227}Ac	1	0	0	0	0	2	0	0	0	0.4	0.0	0.0	0.0
^{228}Ac	141	0	0	0	0	150	5	192	0	6.2	106.0	1307.8	0.0
^{230}Ac	81	0	36	0	0	77	10	2284	0	2.8	28.6	1133.4	0.0
^{231}Ac	80	0	0	0	0	91	0	308	0	8.0	588.2	1286.9	0.0
^{232}Ac	162	0	107	0	0	141	28	2314	0	4.0	9.9	1117.6	0.0
^{233}Ac	85	0	3	0	0	85	0	1669	0	2.9	16.0	1135.2	0.0
^{223}Th	20	0	0	0	0	35	0	0	0	5.0	149.4	0.0	0.0
^{224}Th	5	0	0	0	0	6	0	0	0	0.7	204.4	0.0	0.0
^{226}Th	3	0	0	0	0	6	0	0	0	0.9	3.9	0.0	0.0
^{227}Th	34	0	0	0	0	57	0	0	0	7.5	308.6	0.0	0.0
^{228}Th	2	0	0	0	0	6	0	0	0	1.0	2.9	0.0	0.0
^{229}Th	32	0	0	0	0	66	0	0	0	10.0	192.0	0.0	0.0
^{230}Th	2	0	0	0	0	5	0	0	0	0.8	1.1	0.0	0.0
^{231}Th	21	0	0	0	0	47	0	0	0	6.8	6.2	512.0	0.0
^{232}Th	2	0	0	0	0	5	0	0	0	0.8	0.4	0.0	0.0
^{233}Th	9	0	0	0	0	12	0	25	0	1.2	26.0	1371.7	0.0
^{234}Th	4	0	0	0	0	8	0	0	0	1.1	0.0	85.0	0.0
^{235}Th	9	0	1	0	0	9	0	844	0	0.3	34.2	1214.6	0.0
^{236}Th	7	0	0	0	0	10	0	5	0	0.9	41.2	1404.4	0.0
^{227}Pa	9	0	0	0	0	19	0	0	0	2.7	0.1	0.0	0.0
^{228}Pa	232	0	0	0	0	262	7	0	0	15.0	247.3	1.1	0.0
^{229}Pa	20	0	0	0	0	36	0	0	0	4.9	0.2	0.0	0.0
^{230}Pa	119	0	0	0	0	142	0	0	0	8.6	50.9	101.6	0.0
^{231}Pa	19	0	0	0	0	40	0	0	0	5.8	101.9	0.0	0.0
^{232}Pa	159	0	0	0	0	175	0	1	0	7.4	57.7	691.5	0.0
^{233}Pa	50	0	0	0	0	69	0	0	0	7.1	1427.3	276.2	0.0
^{234}Pa	252	0	0	0	0	280	9	2	0	14.0	786.6	1192.6	0.0
^{234m}Pa	3	0	2	0	0	3	0	1648	0	0.1	7.0	1136.5	0.0
^{235}Pa	0	0	0	0	0	0	0	121	0	0.0	0.0	1330.0	0.0
^{236}Pa	140	0	10	0	0	137	12	1382	0	5.0	165.2	1202.9	0.0
^{237}Pa	98	0	0	0	0	99	0	496	0	2.3	40.6	1278.1	0.0
^{227}U	28	0	0	0	0	41	0	0	0	4.8	921.4	0.0	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$ μSv h^{-1} GBq^{-1}	Annihilation	Photon	Electron	$\beta-/\beta+$ mSv h^{-1} GBq^{-1}	Annihilation
^{228}U	3	0	0	0	0	7	0	0	0	0.9	7.0	0.0	0.0
^{230}U	3	0	0	0	0	7	0	0	0	1.1	4.0	0.0	0.0
^{231}U	41	0	0	0	0	82	0	0	0	11.6	1.2	0.0	0.0
^{232}U	3	0	0	0	0	7	0	0	0	1.1	0.6	0.0	0.0
^{233}U	1	0	0	0	0	4	0	0	0	0.5	0.8	0.0	0.0
^{234}U	2	0	0	0	0	6	0	0	0	1.0	0.1	0.0	0.0
^{235}U	36	0	0	0	0	47	0	0	0	5.5	95.2	0.0	0.0
^{35m}U	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{236}U	2	0	0	0	0	6	0	0	0	0.9	0.0	0.0	0.0
^{237}U	42	0	0	0	0	63	0	0	0	7.7	562.8	347.8	0.0
^{238}U	2	0	0	0	0	5	0	0	0	0.7	0.0	0.0	0.0
^{239}U	14	0	0	0	0	18	0	21	0	2.0	2.7	1379.1	0.0
^{240}U	8	0	0	0	0	17	0	0	0	2.4	13.9	816.1	0.0
^{242}U	8	0	0	0	0	9	0	16	0	0.7	31.3	1384.3	0.0
^{232}Np	211	0	0	0	0	238	2	1	0	13.1	374.1	1.6	0.0
^{233}Np	25	0	0	0	0	39	0	0	0	4.9	32.4	0.0	0.0
^{234}Np	171	0	0	0	0	172	41	0	0	7.6	44.7	0.8	0.0
^{235}Np	8	0	0	0	0	20	0	0	0	3.0	0.0	0.0	0.0
^{236}Np	58	0	0	0	0	103	0	0	0	13.5	1302.2	10.9	0.0
^{236m}Np	15	0	0	0	0	24	0	0	0	3.0	2.7	607.1	0.0
^{237}Np	20	0	0	0	0	41	0	0	0	5.6	17.6	0.0	0.0
^{238}Np	97	0	0	0	0	107	1	13	0	3.9	9.4	799.3	0.0
^{239}Np	46	0	0	0	0	64	0	0	0	7.1	934.2	941.7	0.0
^{240}Np	190	0	0	0	0	218	1	31	0	11.8	632.2	1419.5	0.0
^{240m}Np	59	0	1	0	0	67	1	885	0	3.6	17.2	1222.9	0.0
^{241}Np	11	0	0	0	0	16	0	37	0	1.9	122.7	1373.3	0.0
^{242}Np	39	0	14	0	0	37	3	2291	0	0.9	2.5	1107.2	0.0
^{242m}Np	168	0	0	0	0	196	0	304	0	10.5	938.8	1289.7	0.0
^{232}Pu	18	0	0	0	0	29	0	0	0	3.6	0.0	0.0	0.0
^{234}Pu	21	0	0	0	0	34	0	0	0	4.2	0.0	0.0	0.0
^{235}Pu	30	0	0	0	0	48	0	0	0	5.9	0.8	0.0	0.0
^{236}Pu	3	0	0	0	0	7	0	0	0	1.0	0.0	0.0	0.0
^{237}Pu	20	0	0	0	0	35	0	0	0	4.6	0.0	0.0	0.0
^{238}Pu	3	0	0	0	0	6	0	0	0	0.9	0.0	0.0	0.0
^{239}Pu	1	0	0	0	0	3	0	0	0	0.4	0.1	0.0	0.0
^{240}Pu	3	0	0	0	0	6	0	0	0	0.9	0.0	0.0	0.0
^{241}Pu	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
^{242}Pu	2	0	0	0	0	5	0	0	0	0.7	0.0	0.0	0.0

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^{243}Pu	8	0	0	0	0	12	0	0	0	1.4	13.8	1258.0	0.0
^{244}Pu	4	0	8	0	0	7	0	41	0	0.7	0.0	8.4	0.0
^{245}Pu	71	0	0	0	0	76	0	2	0	3.9	1003.0	1141.7	0.0
^{246}Pu	39	0	0	0	0	52	0	0	0	5.9	389.2	61.6	0.0
^{237}Am	80	0	0	0	0	101	0	0	0	9.2	448.6	0.0	0.0
^{238}Am	154	0	0	0	0	170	7	0	0	8.4	35.1	2.0	0.0
^{239}Am	67	0	0	0	0	98	0	0	0	11.4	1054.3	0.0	0.0
^{240}Am	179	0	0	0	0	205	1	0	0	9.8	14.0	0.0	0.0
^{241}Am	16	0	0	0	0	28	0	0	0	3.7	0.1	0.0	0.0
^{242}Am	10	0	0	0	0	19	0	0	0	2.3	0.0	1131.7	0.0
^{242m}Am	7	0	0	0	0	14	0	0	0	1.9	0.8	0.0	0.0
^{243}Am	17	0	0	0	0	23	0	0	0	2.8	0.1	0.0	0.0
^{244}Am	153	0	0	0	0	179	1	0	0	9.6	814.4	949.4	0.0
^{244m}Am	6	0	0	0	0	9	1	200	0	1.0	10.5	1304.1	0.0
^{245}Am	8	0	0	0	0	11	0	1	0	1.2	185.2	1416.7	0.0
^{246}Am	157	0	0	0	0	193	0	18	0	13.7	2114.4	1385.6	0.0
^{246m}Am	155	0	0	0	0	160	3	232	0	4.3	88.1	1334.5	0.0
^{247}Am	31	0	0	0	0	39	0	114	0	4.0	775.7	1335.6	0.0
^{238}Cm	25	0	0	0	0	36	0	0	0	4.3	0.2	0.0	0.0
^{239}Cm	59	0	0	0	0	75	0	0	0	8.3	72.5	0.9	0.0
^{240}Cm	3	0	0	0	0	6	0	0	0	0.9	0.2	0.0	0.0
^{241}Cm	109	0	0	0	0	136	0	0	0	11.1	500.0	0.0	0.0
^{242}Cm	3	0	0	0	0	6	0	0	0	0.8	0.1	0.0	0.0
^{243}Cm	35	0	0	0	0	51	0	0	0	5.8	899.0	0.0	0.0
^{244}Cm	2	0	0	0	0	5	0	0	0	0.7	0.0	0.0	0.0
^{245}Cm	32	0	0	0	0	50	0	0	0	6.1	364.9	0.0	0.0
^{246}Cm	2	0	1	0	0	4	0	5	0	0.5	0.0	1.6	0.0
^{247}Cm	55	0	0	0	0	56	0	0	0	2.8	129.8	0.0	0.0
^{248}Cm	180	0	429	0	251	152	0	2401	0	4.0	0.1	560.0	0.0
^{249}Cm	3	0	0	0	0	3	0	1	0	0.1	11.5	1401.1	0.0
^{250}Cm	1813	0	5254	0	20661	1504	0	28229	0	35.5	0.0	5265.0	0.0
^{251}Cm	20	0	0	0	0	22	0	92	0	1.1	135.1	1350.4	0.0
^{245}Bk	60	0	0	0	0	80	0	0	0	8.7	820.6	0.0	0.0
^{246}Bk	156	0	0	0	0	178	1	0	0	9.2	7.0	0.0	0.0
^{247}Bk	31	0	0	0	0	37	0	0	0	3.6	753.2	0.0	0.0
^{248m}Bk	16	0	0	0	0	22	0	0	0	2.3	1.2	955.5	0.0
^{249}Bk	0	0	0	0	0	0	0	0	0	0.0	0.0	0.2	0.0
^{250}Bk	141	0	0	0	0	145	2	58	0	3.4	13.7	1395.9	0.0
^{251}Bk	28	0	0	0	0	41	0	1	0	4.7	390.3	1431.2	0.0
^{244}Cf	3	0	0	0	0	5	0	0	0	0.7	0.0	0.0	0.0
^{246}Cf	2	0	0	0	0	4	0	0	0	0.5	0.1	0.0	0.0
^{247}Cf	40	0	0	0	0	64	0	0	0	7.5	60.8	0.0	0.0
^{248}Cf	2	0	0	0	0	4	0	0	0	0.6	0.0	0.2	0.0
^{249}Cf	63	0	0	0	0	69	0	0	0	4.5	138.2	0.0	0.0

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Table 3. *Continued*

Nuclides	Contribution to $H_p(10)$ in 100 cm					Contribution to $H_p(3)_{slab}$ in 100 cm				Contribution to $H_p(0.07)_{slab}$ in 10 cm			
	Photon	Electron	$\beta-/\beta+$	Annihilation	Neutron	Photon	Electron	$\beta-/\beta+$	Annihilation	Photon	Electron	$\beta-/\beta+$	Annihilation
	μSv h^{-1} GBq^{-1}					μSv h^{-1} GBq^{-1}				mSv h^{-1} GBq^{-1}			
^{250}Cf	3	0	2	0	0	4	0	13	0	0.5	0.1	4.5	0.0
^{251}Cf	35	0	0	0	0	48	0	0	0	5.5	1599.4	0.0	0.0
^{252}Cf	64	0	128	0	42	55	0	736	0	1.7	0.0	197.7	0.0
^{253}Cf	6	0	0	0	0	10	0	0	0	1.3	0.0	432.2	0.0
^{254}Cf	2294	0	5926	0	44883	1905	0	32505	0	45.0	0.0	6854.2	0.0
^{255}Cf	0	0	0	0	0	0	0	0	0	0.0	0.0	1404.4	0.0
^{249}Es	85	0	0	0	0	99	1	0	0	7.3	150.3	0.1	0.0
^{250}Es	265	0	0	0	0	323	0	0	0	23.7	1092.1	0.0	0.0
^{250m}Es	100	0	0	1	0	112	3	0	1	6.2	13.7	4.8	0.0
^{251}Es	36	0	0	0	0	55	0	0	0	6.5	151.0	0.0	0.0
^{253}Es	1	0	0	0	0	1	0	0	0	0.2	1.2	0.0	0.0
^{254}Es	22	0	0	0	0	43	0	0	0	5.5	2.6	0.0	0.0
^{254m}Es	85	0	2	0	0	93	0	12	0	3.8	34.8	1195.2	0.0
^{255}Es	0	0	0	0	0	0	0	1	0	0.0	0.0	510.5	0.0
^{256}Es	4	0	1	0	0	7	0	434	0	0.8	0.0	1268.2	0.0
^{251}Fm	40	0	0	0	0	51	0	0	0	4.9	58.9	0.2	0.0
^{252}Fm	2	0	0	0	0	4	0	0	0	0.4	0.0	0.1	0.0
^{253}Fm	31	0	0	0	0	48	0	0	0	5.6	85.7	0.0	0.0
^{254}Fm	3	0	1	0	0	4	0	7	0	0.5	0.0	3.3	0.0
^{255}Fm	20	0	0	0	0	38	0	0	0	4.8	1.7	0.0	0.0
^{256}Fm	1698	0	2965	0	38920	1415	0	17843	0	33.7	0.0	5598.7	0.0
^{257}Fm	43	0	8	0	0	58	0	49	0	6.3	630.8	13.4	0.0

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per gigabecquerels in 1-m distance for depths of 3 and 10 mm and in millisievert per hour per gigabecquerels in 10-cm distance for a depth of 0.07 mm.

Photons and neutrons are only little affected by absorption and scattering in air. Their contribution to personal dose, as well as the 'shielded' personal dose equivalent, can be scaled to other distances r than the reference distance $r_o = 1$ m or 10 cm by multiplying with r^2/r_o^2. For the electron/positron component, scaled results would be affected by a large uncertainty, with a tendency of underestimation for smaller distances.

Comparison with previous work

In this work, the conversion coefficients from activity to personal dose equivalent for >1200 radionuclides have been calculated including full secondary electron transport. Therefore, a comparison with the results of the previous compilation[2], where photon dose has been calculated in the kerma approximation, is possible only for the dose from electrons and positrons. For most radionuclides in (2), the photon component calculated in the kerma approximation is ~100 times larger than the component simply because of the geometrical factor. Figure 7 shows the statistical distribution of the differences between the conversion coefficient for personal dose in 0.07-mm depth from electrons and positrons, from (2) and from the present work, evaluated for the same radionuclide. It can be seen that the present work delivers slightly higher dose estimates than the previous work.

For photons in a depth of 10 mm, where the difference between kerma approximation and electron transport does not play a large role for most photon energies in radioactive decay, the results should also not differ by a large margin. Figure 8 shows a comparison between the conversion coefficients for personal dose in 10-mm-depth photons from (2) and from the present work.

'Outliers' in the tails of the two graphs can be traced back to improvement of knowledge of the relevant nuclear decay schemes in the quarter-century between 1983 and 2008, the years in which the respective data sets were published by the ICRP.

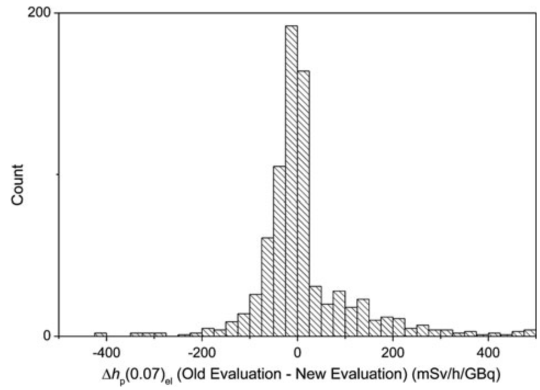

Figure 7. Comparison of the results for $h_p^{A,Z}(0.07)_{e,\,slab}$ for electrons and positrons between the 820 radionuclides in the previous evaluation[2] and the present work. The bin width is 25 mSv. A small tendency of the present work to deliver higher personal dose estimates is discernible.

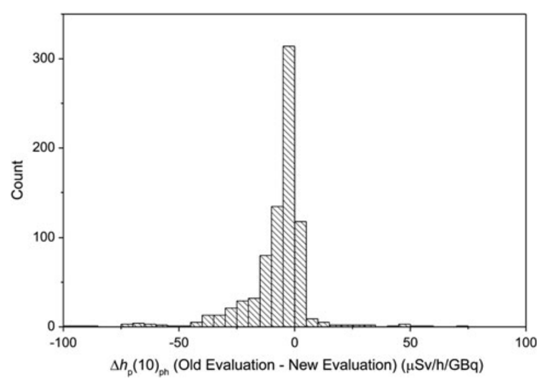

Figure 8. Comparison of the results for $h_p^{A,Z}(10)_\gamma$ for photons between the 820 radionuclides in the previous evaluation[2] and the present work. The bin width is 5 µSv. A small tendency of the present work to deliver higher personal dose estimates is discernible.

SUMMARY

The purpose of this publication is to enlarge and to update the available set of dose conversion coefficients for radionuclides. It is based on the ICRP's latest publication of nuclear decay data for radiation protection purposes and on modern calculations of fluence-to-personal dose conversion coefficients for photons and electrons.

With respect to previously calculated conversion coefficients, the present work

- for the first time lists conversion coefficients for >400 mostly short-lived radionuclides,
- replaces the kerma approximation for photons by full transport of charged secondary particles, resulting in more realistic estimates for $H_p(0.07)_{slab}$,
- includes the (small) difference between electrons and positrons in the calculations and
- presents an approximation for 'shielded' and 'unshielded' radioactive sources.

Comparison with the previously published conversion coefficients shows a globally very good agreement.

The data from this publication will be useful to make rapid estimates of the external radiation hazard when handling or being involuntarily exposed to sealed or unsealed sources of radionuclides.

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