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Assessment of Radiation Exposure of Astronauts in Space

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GUEST EDITORIAL

RADIATION PROTECTION FOR ASTRONAUTS – THE FINAL FRONTIER?

When Captain James T. Kirk and the crew of the Starship Enterprise of the famous TV series 'Star Trek' set off to their final frontier, they were concerned about many dangers but perhaps not about their radiation exposure. In contrast, real space travellers such as modern-day astronauts to the International Space Station are exposed to radiation of galactic and solar origin during their missions, and this exposure is of considerable concern in terms of radiation risk to astronauts. In fact, for proposed deep space missions to Mars and beyond, these exposures are likely to be limiting factors for such endeavours.

It is a coincidence that ICRP is publishing this first report on the subject almost exactly 100 years after the detection of cosmic radiation by Austrian physicist Victor Hess in 1912. Ever since manned space missions began, the issue of cosmic radiation exposure and associated risks of astronauts has been the subject of many publications and reports.

It is difficult to imagine a class of radiation exposure that is more complex in terms of its radiation fields, and more challenging in terms of dose assessment, than that presented to astronauts by the radiation environment of space. Ionising radiations present in space range from soft x rays to very-high-energy photons and extremely energetic heavy ions. Integral fluence rates for different particles may vary by some 10 orders of magnitude, with corresponding energy ranges varying over eight orders of magnitude. Galactic radiation arises from outside the solar system within supernova explosions, neutron stars, pulsars, and other high-energy, yet-to-be-determined phenomena. Galactic cosmic radiation (GCR) is composed of protons (83%), helium ions (14%), heavier ions (1%), and electrons (2%). Closer to home, the Sun emits particles continuously in the form of protons and electrons, albeit of lower energy than GCR, in addition to large amounts of gamma rays, and hard and soft x rays. Solar particle events (SPEs) are rare but can be a significant source of high radiation exposure, particularly if astronauts are performing extravehicular activities during such an event. Due to the Earth's magnetic dipole, many of the particles from the Sun and outer space become trapped, creating upper and lower radiation belts of electrons and protons, respectively. The reader of this report is immediately confronted by the question – are astronauts occupationally exposed in the ICRP sense, and are they subject to the traditional principles of the ICRP system of radiological

protection (i.e. justification, optimisation, and limitation)? *Publication 103* (ICRP, 2007) states that 'the exposure of astronauts in space is a special case of environmental exposure from natural radiation sources which are present in this environment and are quite different from those on Earth...Although astronauts are exposed to ionising radiation during their occupational activities, they are usually not classified as being occupationally exposed in the sense of the ICRP system for radiation protection of workers on Earth and aircraft crews'. As indicated in the report's title, the focus of the Task Group was not on radiation protection, but on exposure assessment. This assessment can be performed with computational methods and in the form of physical measurement of tissue doses and particle fluences, and can include biomarkers of exposure. Using published data on particle spectra of galactic and solar origin, Monte Carlo or deterministic radiation transport codes are used to assess organ and tissue doses directly, or to provide values of energy-/particle-dependent incident fluence rates which may then be combined with dose conversion coefficients to report organ dose. Annex A of this report and its accompanying CD provide an extensive set of newly calculated conversion coefficients and mean quality factors for a range of space radiation particles, including protons, neutrons, alpha particles, and heavy ions up to nickel. These calculations – which complement the reference external dose conversion coefficients reported previously in *Publication 116* (ICRP, 2010) and in ICRU Report 84 (ICRU, 2010) – are based upon PHITS Monte Carlo simulations using the *Publication 110* (ICRP, 2009) reference computational phantoms.

The unusual nature of the space radiation environment with respect to the range of particle types and energies one may encounter requires the adoption of different methods for dose assessment from those used generally by ICRP. For example, the applicability of a radiation weighting factor (w_R) of 20 for all heavy ions of all energies is questionable. *Publication 103* (ICRP, 2007) states that 'The selection of a single w_R value of 20 for all types and energies of heavy charged particles is a conservative estimate and is recommended as sufficient for general application in radiological protection. For applications in space, where these particles contribute significantly to the total dose in the human body, a more realistic approach may have to be used'.

As alternatives to the use of w_R to weight organ doses, the report provides explicit guidance on the use of quality factors as a function of either unrestricted linear energy transfer [$Q(L)$ functions from *Publication 60* (ICRP, 1991)] or particle charge and energy [$Q(Z,E)$ functions as proposed by NASA (Cucinotta et al., 2011)]. As quality factors of either form are used to weight values of tissue absorbed dose, the resultant quantity is the 'dose equivalent' as defined in *Publication 26* (ICRP, 1977) and not the 'equivalent dose' defined in *Publication 60* (ICRP, 1991).

In long-term missions, the exposure of astronauts will be higher than the annual limits recommended for exposure of workers on Earth. In practice, radiation protection of astronauts is based on individual risk assessments and risk limitations. Career limits imposed on astronauts are generally values of radiation-exposure-induced death (REID), and a value of 3% REID at the upper 95% confidence level is currently imposed on National Aeronautics and Space Administration flight crew. To determine REID values, one presently applies age- and gender-dependent risk

models directly to values of organ dose equivalent (Q-weighted absorbed doses). The conversion coefficients that relate particle fluence to mean absorbed doses in organs and tissues of the human body, and corresponding mean quality factors for all types of radiation present in space provided in this report are an important database for assessment of the exposure of astronauts and thus risk. Future options would perhaps rely on biophysical models that are not dose based. Values of effective dose equivalent may be estimated for recording purposes, but they are not to be used for risk assessment.

The issues of radiation protection in space are destined to evolve as the nature of the exposed individuals changes. This evolution has been observed even within the existing space programmes from the 1960s to early 2010s. In the early days of the space race, astronauts were selected almost exclusively from a limited and highly selective cohort of military officers. Today, scientists and engineers are sent to the International Space Station for environmental-, industrial-, and space-related research activities. These individuals present a broader range of body morphometries, and thus the use of a limited set of reference computational phantoms is perhaps insufficient for organ dose assessment, particularly for soft-spectra SPEs. With modern medical imaging and anatomical modelling software, one can envisage tailor-made and astronautic-specific phantoms for dose assessments. These developments, coupled with increasingly sophisticated measurements of radiation particle fields, energies, and fluence rates, will significantly reduce uncertainties in organ dose assessment during space missions. The conversion of organ doses to cancer and non-cancer risks – the foundations of space radiation protection programmes – will nevertheless still require significant and new scientific investigations of dose response in radiation conditions not easily replicated on Earth. With these advances, and with the expansion of individuals who may be able to travel to space (i.e. space tourism perhaps), the issue of radiological protection in space will be an ongoing issue of interest as well as responsibility for ICRP.

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Assessment of Radiation Exposure of Astronauts in Space

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Abstract–During their occupational activities in space, astronauts are exposed to ionising radiation from natural radiation sources present in this environment. They are, however, not usually classified as being occupationally exposed in the sense of the general ICRP system for radiation protection of workers applied on Earth. The exposure assessment and risk-related approach described in this report is clearly restricted to the special situation in space, and should not be applied to any other exposure situation on Earth. The report describes the terms and methods used to assess the radiation exposure of astronauts, and provides data for the assessment of organ doses. Chapter 1 describes the specific situation of astronauts in space, and the differences in the radiation fields compared with those on Earth. In Chapter 2, the radiation fields in space are described in detail, including galactic cosmic radiation, radiation from the Sun and its special solar particle events, and the radiation belts surrounding the Earth. Chapter 3 deals with the quantities used in radiological protection, describing the *Publication 103* (ICRP, 2007) system of dose quantities, and subsequently presenting the special approach for applications in space; due to the strong contribution of heavy ions in the radiation field, radiation weighting is based on the radiation quality factor, Q, instead of the radiation weighting factor, w_R. In Chapter 4, the methods of fluence and dose measurement in space are described, including instrumentation for fluence measurements, radiation spectrometry, and area and individual monitoring. The use of biomarkers for the assessment of mission doses is also described. The methods of determining quantities describing the radiation fields within a spacecraft are given in Chapter 5. Radiation transport calculations are the most important tool. Some physical data used in radiation transport codes are presented, and the various codes used for calculations in high-energy radiation fields in space are described. Results of calculations and measurements of radiation fields in spacecraft are given. Some data for shielding possibilities are also presented. Chapter 6 addresses methods of determining mean absorbed doses and dose equivalents in organs and tissues of the human body. Calculated conversion coefficients of fluence to mean absorbed dose in an organ or tissue are given for

heavy ions up to $Z = 28$ for energies from 10 MeV/u to 100 GeV/u. For the same set of ions and ion energies, mean quality factors in organs and tissues are presented using, on the one hand, the $Q(L)$ function defined in *Publication 60* (ICRP, 1991), and, on the other hand, a Q function proposed by the National Aeronautics and Space Administration. Doses in the body obtained by measurements are compared with results from calculations, and biodosimetric measurements for the assessment of mission doses are also presented. In Chapter 7, operational measures are considered for assessment of the exposure of astronauts during space missions. This includes preflight mission design, area and individual monitoring during flights in space, and dose recording. The importance of the magnitude of uncertainties in dose assessment is considered. Annex A shows conversion coefficients and mean quality factors for protons, charged pions, neutrons, alpha particles, and heavy ions ($2 < Z \leq 28$), and particle energies up to 100 GeV/u.
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Keywords: Radiation fields in space; Protection and operational quantities; Dose measurements; Radiation transport and shielding; Conversion coefficients

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PREFACE

Space flight is one of the occupational exposures from natural radiation sources listed in *Publication 60* (ICRP, 1991), but the number of people involved in space flight is small and no guidelines have been developed by ICRP.

This report is the first ICRP publication to deal with the topic of radiation exposures of astronauts in space. The following terms of reference were given to the Task Group preparing this report:

- analyse the radiation fields in space with special attention to the high-linear energy transfer components and solar particle events;
- investigate the application of dose quantities used in radiological protection;
- describe devices for measurement of particle fluences and doses in the space environment;
- describe procedures for the assessment of doses to astronauts performed by measurements and calculations; and
- present data of fluence to dose conversion coefficients for heavy ions.

The report was prepared by the Task Group on Radiation Protection in Space of ICRP Committee 2. The membership of the Task Group was:

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MAIN POINTS

- **In space, astronauts are exposed to ionising radiation from natural radiation sources that are always present in this environment. Although these exposures occur in the context of their occupation, astronauts – due to their exceptional exposure situation – are not usually classified as being occupationally exposed in the sense of the general ICRP system for radiation protection of workers applied on Earth or for aircraft crews. The different – more risk-related – concept of exposure assessment described in this report is clearly restricted to the special situation in space, and should not be applied to any other exposure situation on Earth or for aircraft crews.**
- **The radiation field that astronauts are exposed to in space is very complex. It contains electrons, protons, alpha particles, and heavier ions up to very high energies from galactic cosmic radiation, protons and electrons emitted from the Sun, protons and electrons trapped in belts by the magnetic field of the Earth, and various secondary radiations including neutrons created by interactions between primary radiation and materials of the spacecraft. Doses of astronauts in space are significant fractions of a mSv day^{-1} and, depending on the time spent in space, mission doses to astronauts may far exceed 100 mSv. Only external radiation exposure to astronauts needs to be considered.**
- **Due to the specifics of the radiation field in space, not all concepts of quantities defined for radiological protection applications on Earth are appropriate for applications in space missions, especially when risk assessment is an important task. A radiation weighting factor (w_R) of 20 for all types and energies of heavy ions in the definition of equivalent dose is not justified. For heavy ions, the ratio of w_R and mean quality factors averaged over the human body is up to 10 depending on the type and energy of the ion.**
- **No specific operational dose quantity is recommended for area monitoring in space. Quantities to be measured are radiation fluence rates, the energy distributions of different types of particles, and linear energy transfer (LET) distributions. For individual monitoring, measurement of absorbed dose at the surface of the body in combination with LET distributions may be appropriate for an assessment of effective dose equivalent or organ dose equivalent.**
- **Radiation transport calculations are important tools for information about radiation exposure of astronauts. Based on data about the primary radiation fields, transport calculations are able to calculate radiation fields inside a spacecraft, on the body of astronauts, and in organs or tissues of anthropomorphic phantoms.**
- **Generally, two different procedures may be applied for the assessment of doses in the astronaut's body by calculations. One may either assess the radiation field parameters near to an astronaut and then apply fluence to dose conversion coefficients for all types of particles involved for the assessment of organ doses,**

or one may calculate organ doses in a body using the radiation field data outside of the spacecraft and a code that combines radiation transport into the spacecraft and into the human body. Measurements with individual dosimeters near to the body of an astronaut, in combination with calculations, may be directly correlated to doses in the human body.

- **This report presents conversion coefficients for mean absorbed doses in organs and tissues of the body for heavy ions up to $Z = 28$. The calculations are based on the reference voxel phantoms following the 2007 Recommendations of ICRP (ICRP, 2007). Data are given for isotropic exposure of the body. Also, mean quality factors, Q_T, for the specified organs and tissues of the body are presented. Q_T values vary between approximately 2 and 25.**
- **Information and data are also presented for the quality factor concept derived from the track structure of charged particles in tissue as proposed by the National Aeronautics and Space Administration (Cucinotta et al., 2011). This results in a different distribution of Q in terms of LET with a stronger decrease in Q with increasing LET.**

EXECUTIVE SUMMARY

(a) Astronauts live and work in low Earth orbits for extended periods of time, especially during the operation and maintenance of the International Space Station (ISS) and scientific investigations. Furthermore, plans have already been discussed for deep space missions of astronauts.

(b) *Publication 103* (ICRP, 2007) stated that 'Exceptional cases of cosmic radiation exposures, such as exposure in space travel, where doses may be significant and some type of control warranted, should be dealt with separately from the conventional approach of occupational exposure'. Therefore, although in space, astronauts are exposed to ionising radiation from natural radiation sources which are always present in this environment during their occupational activities, their exposure is not usually classified as occupational in the sense of the general ICRP system for radiation protection of workers applied on Earth and for aircraft crew. The exposure assessment and risk-related approach described in this report is clearly restricted to the special situation in space and should not be applied to any other exposure situation on Earth. This report demonstrates this exceptional situation, describes the terms and methods used to assess the radiation exposure of astronauts, and provides data for the assessment of organ doses.

(c) This report contains seven chapters. Chapter 1 describes the specific situation of astronauts in space, and the differences between radiation fields in space and on Earth, thereby showing areas where approaches applied in radiological protection measures on Earth need to be modified.

(d) In Chapter 2, the radiation fields in space are described in detail. The solar system with the Sun at its centre is embedded in a complex mixture of galactic cosmic radiation (GCR) – protons, alpha particles, and heavy ions – that enters the heliosphere continuously from all directions. Inside the heliosphere, the GCR fluence rate and particle energy distributions are modulated by the interplanetary magnetic field produced by the charged particles emitted continuously by the Sun, the so-called 'solar wind'. In addition to the solar wind, the Sun occasionally emits unusually large pulses of energetic particles – mainly protons and electrons – called 'solar particle events' (SPEs). Celestial bodies equipped with a magnetic moment like the Earth are surrounded by toroidal belts of particulate radiation. Such radiation belts constitute an important third source of primary exposure. Fluence rates of cosmic radiation are not constant; they vary between two extremes which correspond in time with maximum and minimum solar activity. Solar activity and cosmic radiation fluence rates are inversely correlated. In Sections 2.2–2.5, the various components of the radiation field in space are presented and the influence of the Earth's magnetic field is described.

(e) Chapter 3 deals with the quantities used in radiological protection. The system of dose quantities as given in *Publication 103* (ICRP, 2007) is described and relative

biological effectiveness is discussed, especially with respect to the large contribution of heavy ions and the very high energies. A single w_R value of 20 for all heavy ions of all energies is not appropriate for space radiation fields. Hence, for space applications, the concept of a quality factor, $Q(L)$, is also applied to the protection quantities. The approach for applications in space is described in detail in Section 3.3.

(f) In Chapter 4, the methods of fluence and dose measurements in space are described. These include instrumentation for fluence measurements, radiation spectrometry, area dosimetry, and individual monitoring. Passive and active devices are mentioned, and the use of biomarkers for the assessment of mission doses is described. Some advice for quality control and the assessment of uncertainties is also given in this chapter.

(g) In Chapter 5, the methods of determining quantities describing the radiation fields within a spacecraft are given. Radiation transport calculations are the most important tool for the assessment of radiation fields inside a spacecraft, starting from the radiation field in free space and considering the walls and equipment in the spacecraft. In this chapter, some physical data used in radiation transport codes are presented, and the various codes used for calculations in high-energy radiation fields are described. Results of calculations of radiation fields in spacecraft are given. A discussion of shielding possibilities is also included in this chapter.

(h) Chapter 6 addresses methods of determining mean absorbed doses and dose equivalents in organs and tissues of the human body. Calculated conversion coefficients of fluence to mean absorbed dose in an organ or tissue are given for heavy ions up to $Z = 28$ for energies from 10 MeV/u to 100 GeV/u. For the same set of ions and ion energies, mean quality factors in organs and tissues are presented using, on the one hand, the $Q(L)$ function defined in *Publication 60* (ICRP, 1991) and, on the other hand, a $Q(Z, E)$ function proposed by the National Aeronautics and Space Administration (Cucinotta et al., 2011). Assessment of doses in the body by measurements are described in Section 6.4, and results are compared with calculations. Biodosimetric measurements for the assessment of mission doses are presented in Section 6.5.

(i) In Chapter 7, operational measures are considered for assessment of the exposure of astronauts during space missions. This includes preflight mission design, area and individual monitoring during flights in space, and dose recording. The importance of considering uncertainties in dose assessment is also mentioned.

(j) Annex A provides conversion coefficients and mean quality factors for protons, charged pions, neutrons, alpha particles, and heavy ions ($2 < Z \leq 28$).

GLOSSARY

Absorbed dose, D

The absorbed dose is the quotient of $\mathrm{d}\bar{\varepsilon}$ by $\mathrm{d}m$:

$$D = \frac{\mathrm{d}\bar{\varepsilon}}{\mathrm{d}m}$$

where $\mathrm{d}\bar{\varepsilon}$ is the mean energy imparted by ionising radiation to matter of mass $\mathrm{d}m$. The SI unit of absorbed dose is joule per kilogram (J kg^{-1}), and its special name is gray (Gy).

Ambient dose equivalent, $H^*(10)$

The dose equivalent at a point in a radiation field that would be produced by the corresponding expanded and aligned field in the ICRU sphere at a depth of 10 mm on the radius vector opposing the direction of the aligned field. The SI unit of ambient dose equivalent is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv).

Biomarker

A traceable substance indicating changes in a cell or an organ caused by environmental actions (e.g. by ionising radiation).

Charged particle equilibrium

Charged particle equilibrium in a volume of interest means that the energies, numbers, and directions of the charged particles are constant throughout this volume. This is equivalent to saying that the distribution of charged particle radiance with respect to energy does not vary within the volume. In particular, it follows that the sums of the energies (excluding rest energies) of charged particles entering and leaving the volume are equal.

Cross section, σ

The cross section of a target entity for a particular interaction produced by incident charged or uncharged particles of a given type and energy is given by:

$$\sigma = \frac{N}{\Phi}$$

where N is the mean number of such interactions per target entity subjected to particle fluence, Φ. The SI unit of cross section is m^2. A special unit often used for the cross section is the barn, where 1 barn = 10^{-28} m^2. A full description of an interaction process requires, inter alia, knowledge of the distributions of cross

sections in terms of energy and direction of all emergent particles from the interaction. Such distributions, sometimes called 'differential cross sections', are obtained by differentiations of σ with respect to energy and solid angle.

Deterministic effect, see 'Tissue reaction'

Detriment

The total harm to health experienced by an exposed group and its descendants as a result of the group's exposure to a radiation source. Detriment is a multidimensional concept; its principal components are the stochastic quantities probability of attributable fatal cancer, weighted probability of attributable non-fatal cancer, weighted probability of severe heritable effects, and length of life lost if the harm occurs.

Directional dose equivalent, $H'(d, \Omega)$

The dose equivalent at a point in a radiation field that would be produced by the corresponding expanded field in the ICRU sphere at a depth, d, on a radius in a specified direction, Ω. The SI unit of directional dose equivalent is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv).

Dose conversion coefficient

A coefficient relating a dose quantity to a physical quantity, both for internal and external radiation exposure. In internal dosimetry, this term is also called a 'dose coefficient'.

Dose equivalent, H

The dose equivalent at a point in tissue is given by:

$$H = QD$$

where D is the absorbed dose and Q is the quality factor for the specific radiation at that point. The SI unit of dose equivalent is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv).

Dose equivalent in an organ or tissue, $H_{T,Q}$

The product of the mean quality factor, Q_T, and the mean absorbed dose, D_T, in an organ or tissue T:

$$H_{T,Q} = Q_T D_T$$

A quantity introduced by ICRP in *Publication 26* (ICRP, 1977) and replaced by equivalent dose in an organ or tissue in *Publication 60* (ICRP, 1991).

Dose limit

Recommended value of a dose to an individual that should not be exceeded in planned exposure situations.

Effective charge number, Z^*

The charge number Z of a nucleus reduced by a factor depending on the relative velocity β (velocity of the nucleus relative to the velocity of light) which takes account of the fact that the nucleus is not completely ionised at low velocities.

$$Z^* = Z(1 - \exp(-125\beta Z^{2/3}))$$

Effective dose, E

The tissue weighted sum of equivalent dose in an organ or tissue from all specified organs and tissues of the body, given by the expression:

$$E = \sum_{\mathrm{T}} w_{\mathrm{T}} \sum_{\mathrm{R}} w_{\mathrm{R}} D_{\mathrm{T,R}} = \sum_{\mathrm{T}} w_{\mathrm{T}} H_{\mathrm{T}}$$

where H_{T} is the equivalent dose in an organ or tissue T, $D_{\mathrm{T,R}}$ is the mean absorbed dose in an organ or tissue T from radiation of type R, w_{R} is the radiation weighting factor, and w_{T} is the tissue weighting factor. The sum is performed over organs and tissues considered to be sensitive to the induction of stochastic effects. The SI unit of effective dose is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv).

Effective dose equivalent, H_{E}

The tissue weighted sum of dose equivalent in an organ or tissue from all specified organs and tissues of the body, given by the expression:

$$H_{\mathrm{E}} = \sum_{\mathrm{T}} w_{\mathrm{T}} H_{\mathrm{T,Q}}$$

where $H_{\mathrm{T,Q}}$ is the dose equivalent in an organ or tissue T. The SI unit of effective dose equivalent is joule per kilogram (J kg^{-1}), and its special name is sievert (Sv). A quantity introduced by ICRP in *Publication 26* (ICRP, 1977) and replaced by effective dose in *Publication 60* (ICRP, 1991).

Equivalent dose in an organ or tissue, H_{T}

The equivalent dose in an organ or tissue is given by:

$$H_{\mathrm{T}} = \sum_{\mathrm{R}} w_{\mathrm{R}} D_{\mathrm{T,R}}$$

where $D_{T,R}$ is the mean absorbed dose from radiation of type R in the specified organ or tissue T, and w_R is the radiation weighting factor. The SI unit of equivalent dose is joule per kilogram ($J\,kg^{-1}$), and its special name is sievert (Sv).

Expanded and aligned field

A field where the fluence and its energy distribution are the same as in the expanded field, but the fluence is unidirectional.

Expanded field

A field where the fluence and its direction and energy distribution have the same values throughout the volume of interest as in the actual field at the point of reference.

Fluence, Φ

The quotient of dN by da, where dN is the number of particles incident on a sphere of cross-sectional area da, thus:

$$\Phi = \frac{dN}{da}$$

The SI unit of fluence is m^{-2}.

Galactic cosmic radiation (GCR)

Charged particle radiation that enters the heliosphere continuously from outer space from all directions. The radiation contains electrons (approximately 2%) and a broad range of charged particles from protons up to high Z particles with energies up to several hundreds of GeV and even higher. The fluence rate of GCR in the heliosphere is inversely correlated with the solar activity. It is caused by the solar magnetic field, which is coupled to the solar wind.

Geomagnetic cut-off rigidity, see 'Rigidity threshold'

Heavy ions

Ions of elements heavier than He.

Heliosphere

The space around the Sun and its planets that is filled by solar particles emitted from the Sun (the solar wind) and the corresponding solar magnetic field.

ICRU 4-element tissue

ICRU 4-element tissue has a density of 1 g cm^{-3}, and a mass composition of 76.2% oxygen, 11.1% carbon, 10.1% hydrogen, and 2.6% nitrogen.

ICRU sphere

The ICRU sphere is a 30-cm tissue-equivalent (ICRU 4-element tissue) sphere.

K, *K*p index

Index quantifying disturbances in the horizontal component of the Earth's magnetic field with a number in the range 0–9, with 1 being calm and $\geq$5 indicating a geomagnetic storm. The *K* index is derived from the maximum fluctuations of horizontal components observed on a magnetometer during a 3-h interval. The official planetary *K*p index is derived by calculating a weighted average of *K* indices from a network of geomagnetic observatories.

Kerma, *K*

Quantity for ionising uncharged particles, defined by the quotient of $\mathrm{d}E_{\mathrm{tr}}$ by $\mathrm{d}m$, where $\mathrm{d}E_{\mathrm{tr}}$ is the mean sum of the initial kinetic energies of all the charged particles liberated in a mass $\mathrm{d}m$ of a material by the uncharged particles incident on $\mathrm{d}m$, thus:

$$K = \frac{\mathrm{d}E_{\mathrm{tr}}}{\mathrm{d}m}$$

The SI unit of kerma is joule per kilogram (J kg^{-1}), and its special name is gray (Gy).

Kerma approximation

Kerma is sometimes used as an approximation to absorbed dose. The numerical value of kerma approaches that of absorbed dose to the degree that charged-particle equilibrium exists, radiative losses are negligible, and the kinetic energies of the uncharged particles are large compared with the binding energies of the liberated charged particles.

Lineal energy

The quotient of ε_i by $\bar{l}$, where ε_i is the energy imparted to the matter in a given volume by a single energy-deposition event i, and $\bar{l}$ is the mean chord length of that volume, thus:

$$y = \frac{\varepsilon_i}{\bar{l}}$$

The SI unit of lineal energy is joule per metre (J m^{-1}), often given in keV μm^{-1}.

Linear energy transfer/unrestricted linear energy transfer, L or LET

The quotient of dE by dl, where dE is the mean energy lost by the charged particle due to electronic interactions in traversing a distance dl, thus:

$$L = \frac{\mathrm{d}E}{\mathrm{d}l}$$

The SI unit of linear energy transfer is joule per metre (J m^{-1}), often given in keV μm^{-1}.

Linear-non-threshold model

A dose–response model that is based on the concept that, in the low dose range, radiation doses greater than zero will increase the risk of excess cancer and/or heritable disease in a simple proportionate manner.

Low Earth orbit (LEO)

Orbit in space near to the Earth where astronauts are protected against parts of particles of galactic and solar origin by the Earth's magnetic field. The shielding depends on the inclination of the spacecraft. On the other hand, the Earth's magnetic field is responsible for formation of the trapped radiation belts where (mainly) protons and electrons of galactic and solar origin are stored.

Low-/high-LET radiation

Radiation where the energy transfer to matter is performed by charged particles with low linear energy transfer (LET < 10 keV μm^{-1}, low-LET radiation) alone or by charged particles with high LET (LET > 10 keV μm^{-1}, high-LET radiation). Photons above approximately 15 keV, electrons, and muons are low-LET radiations, while neutrons, ions, and pions are generally high-LET radiations.

Magnetosphere

The Earth's magnetic dipole field that extends over a distance from Earth up to approximately 75,000 km around the geomagnetic equator. Charged particles in a specific energy range are trapped in the magnetic field. They move in spirals along the geomagnetic field lines, are reflected back between the magnetic poles acting as mirrors, and form radiation belts where the density of electrons and protons is much higher than outside of these areas. The belts were discovered by Van Allen and named 'Van Allen belts'.

Mean absorbed dose in an organ or tissue, D_T

The mean absorbed dose in a specified organ or tissue T is given by:

$$D_T = \frac{1}{m_T} \int D \mathrm{d}m$$

where m_T is the mass of the organ or tissue T, and D is the absorbed dose in the mass element dm. The SI unit of mean absorbed dose is joule per kilogram (J kg^{-1}), and its special name is gray (Gy).

Nuclear track detectors

Detectors where the tracks of passing charged particles can subsequently be made visible by suitable chemical treatment and viewed microscopically. These passive detectors are plastic nuclear etched track detectors where the tracks are made visible by chemical etching or nuclear emulsions. Etched track detectors are generally insensitive for radiation with an LET in water below approximately 10 keV μm^{-1}.

Occupational exposure

The radiation exposure of workers incurred as a result of their work. The Commission limits its use of 'occupational exposures' to radiation exposures incurred at work as a result of situations that can reasonably be regarded as being the responsibility of the operating management.

Operational quantities

Quantities used in practical applications for monitoring and investigating situations involving external exposure and intakes of radionuclides. They are defined for measurements and assessment of doses in the body.

Optically stimulated luminescence dosimeters

Detectors where the energy stored by particles in the detector material (crystals) is released as luminescence light by optical laser stimulation. The amount of emitted light is proportional to the absorbed dose.

Organ absorbed dose

Short phrase for 'mean absorbed dose in an organ or tissue'.

Organ dose equivalent

Short phrase for 'dose equivalent in an organ or tissue'.

Organ equivalent dose

Short phrase for 'equivalent dose in an organ or tissue'.

Particle radiance, $\dot{\Phi}_{\Omega}$

The quotient of $\mathrm{d}\dot{\Phi}$ by $\mathrm{d}\Omega$, where $\mathrm{d}\dot{\Phi}$ is the fluence rate of particles propagating within a solid angle $\mathrm{d}\Omega$ around a specified direction, thus:

$$\mathrm{d}\dot{\Phi}_{\Omega} = \frac{\mathrm{d}\dot{\Phi}}{\mathrm{d}\Omega}$$

The SI unit of particle radiance is $\mathrm{m}^{-2}\,\mathrm{s}^{-1}\,\mathrm{sr}^{-1}$.

Personal dose equivalent, $H_{\mathrm{p}}(d)$

The dose equivalent in soft tissue at an appropriate depth, d, below a specified point on the human body. The soft tissue is ICRU 4-element tissue. The SI unit of personal dose equivalent is joule per kilogram ($\mathrm{J\,kg^{-1}}$), and its special name is sievert (Sv). The specified point is usually given by the position where the individual dosimeter is worn. For the assessment of effective dose, a depth of 10 mm is recommended, and for the assessment of equivalent dose to the skin and the lens of the eye, depths of 0.07 mm and 3 mm are recommended, respectively.

Protection quantities

Dose quantities related to the human body used for setting exposure limits and in the context of optimisation. They have been developed by the Commission for radiological protection to allow quantification of the detriment to people from exposure of the human body to ionising radiation from both whole- and partial-body external irradiation and from intakes of radionuclides.

Quality factor, Q

A dimensionless factor defined to reflect the relative biological effectiveness of high-LET radiations compared with low-LET radiations at low exposure levels. Q is usually given by a function $Q(L)$, where L is the unrestricted LET in water. The quality factor at a point in tissue, is given by:

$$Q = \frac{1}{D}\int_{L=0}^{\infty} Q(L) D_L \mathrm{d}L$$

where D is the absorbed dose at that point, D_L is the distribution of D in unrestricted linear energy transfer, L, at the point of interest, and $Q(L)$ is the quality factor as a function of L. The integration is to be performed over D_L, due to all charged particles, excluding their secondary electrons.

Radiation belt, see 'Magnetosphere'

Radiation weighting factor, w_R

A dimensionless factor by which the mean absorbed dose in an organ or tissue, D_T, is multiplied to reflect the relative biological effectiveness of high-LET radiations compared with low-LET radiations. The product of w_R and D_T is the equivalent dose in the organ or tissue T.

Reference level

In emergency or existing controllable exposure situations, this represents the level of dose or risk above which it is judged to be inappropriate to plan to allow exposures to occur, and below which optimisation of protection should be implemented. The chosen value for a reference level will depend upon the prevailing circumstances of the exposure under consideration.

Reference male and reference female (reference individual)

An idealised male or female with characteristics defined by the Commission for the purpose of radiological protection, and with the anatomical and physiological characteristics defined in *Publication 89* (ICRP, 2002).

Reference person

An idealised person for whom the equivalent doses in organs and tissues are calculated by averaging the corresponding doses of reference male and reference female. The equivalent doses for the reference person are used for calculation of effective dose.

Reference phantom

The computational phantom of the human body (male or female voxel phantom based on medical imaging data) defined in *Publication 110* (ICRP, 2009) with the anatomical and physiological characteristics defined in *Publication 89* (ICRP, 2002).

Reference value

Value of a quantity recommended by the Commission for use in dosimetric applications or biokinetic models. Reference values are fixed and specified with no uncertainty, independent of the fact that the basis of these values may include many uncertainties.

Relative biological effectiveness (RBE)

The ratio of absorbed dose of a low-LET reference radiation to absorbed dose of the radiation considered that gives an identical biological effect. RBE values vary with absorbed dose, absorbed dose rate, and the biological endpoint considered.

In radiological protection, the RBE at low and very low doses (RBE_M) is of particular interest.

Rigidity, R

The magnetic rigidity of an ion given by its momentum (often given in units of GeV c^{-1}) divided by its charge. Parameter used for characterising the movement of a high-energy charged particle in the magnetic field in space.

Rigidity threshold (geomagnetic cut-off rigidity), R_c

For each point inside the Earth's magnetosphere and each direction from that point, there exists a rigidity threshold below which the cosmic particles are not able to reach this point. This rigidity is called the 'geomagnetic cut-off rigidity'.

Solar cosmic radiation

Radiation emitted from the Sun. The radiation includes continuously emitted electrons and protons (solar wind), and high-energy particles (mainly electrons and protons) emitted during solar particle events.

Solar cycle

Variation of the solar activity between two extremes with a cycle time of approximately 11 years. The solar activity can be described by the number of observed sunspots.

Solar particle event

An eruption at the Sun's surface that releases a large number of particles (mainly electrons and protons with a few helium ions and heavy-charged particles) over the course of hours or days.

Solar wind

Mainly low-energy electrons and protons emitted continuously from the Sun into the heliosphere and producing the interplanetary magnetic field. The intensity of the solar wind depends on solar activity, and varies with the solar cycle.

South Atlantic anomaly

An area where the radiation belt, and hence the trapped protons, comes closer to the Earth's surface due to a displacement of the magnetic dipole axes from the Earth's centre.

Stochastic effects

Effects resulting from damage in a single cell, such as cancer and heritable effects. The frequency of the event, but not its severity, increases with an increase in the dose. For protection purposes, it is assumed that there is no threshold dose.

Thermoluminescence detector

Detectors where the energy stored by particles in the detector material (crystals) is released as light by heating. The amount of emitted light is proportional to the absorbed dose. The function between the actual temperature during fast heating and the intensity of the emitted light (glow curve) shows various peaks. The peak heights or area under the peaks are proportional to absorbed dose.

Tissue reaction

Injury in populations of cells, characterised by a threshold dose and an increase in the severity of the reaction as the dose is increased further, also termed 'deterministic effect'. In some cases, these effects are modifiable by postirradiation procedures including biological response modifiers.

Tissue weighting factor, w_T

Factor by which the equivalent dose in an organ or tissue T is weighted to represent the relative contribution of that organ or tissue to overall radiation detriment from stochastic effects. It is defined such that:

$$\sum_T w_T = 1$$

Trapped particles

Particles trapped in the Earth's magnetic field as a result of the interaction of galactic cosmic radiation and solar cosmic radiation with the Earth's magnetic field and the atmosphere. Mainly protons and electrons are involved (see also 'Magnetosphere').

Voxel phantom

Computational anthropomorphic phantom based on medical tomographic images in which the anatomy is described by small three-dimensional volume elements (voxels). Collections of these voxels are used to specify the organs and tissues of the human body.

1. INTRODUCTION

(1) The radiation field in space is very different from environmental radiation fields on Earth, both with respect to the various types of radiation involved and their intensities. The term 'space' generally means the galactic space outside of the Earth's aviation altitudes. The primary radiation field on the Earth's surface is composed of low-linear energy transfer (LET) radiations with small high-LET components including neutrons from cosmic radiation and alpha particles emitted from terrestrial radionuclides. In contrast, the primary radiation field in space includes electrons, protons, neutrons, alpha particles, and heavy ions up to very high energies. Additional secondary radiations (e.g. gamma radiation, electrons, muons, neutrons, pions, and collision and projectile fragments) are produced by interactions within the materials of a spacecraft and its equipment and the astronauts themselves.

(2) In manned space flights, astronauts may experience three different exposure conditions. The first situation is in low Earth orbits (LEOs) where they are protected against low-energy particles of galactic and solar origin depending on the inclination of the spacecraft in the Earth's magnetic field. However, this magnetic field is responsible for the formation of trapped radiation belts, and, in LEOs, astronauts are exposed to albedo radiation particles created through interactions of the solar and galactic particles with the nuclei of the Earth's atmosphere. Secondly, when leaving the Earth's magnetic field to deep space in interplanetary missions, the radiation exposure is due solely to particles of solar and galactic origin, which are directly incident on the spacecraft. Thirdly, in planetary missions, radiation from approximately one hemisphere is shielded by the mass of the planet. If there is no atmosphere, the primary radiation interacts with the nuclei of the soil, which leads to the production of secondary particles with a high contribution of high-LET components. If a thin atmosphere is present, as in the case of Mars, both interactions in the atmosphere and in the soil contribute to secondary radiation. Additionally, astronauts can be exposed sporadically to high-energy electrons and protons from the Sun in solar particle events (SPEs).

(3) Astronauts live and work in LEOs for extended periods of time, and are involved in deep space missions. They live under environmental conditions that are exceptionally different from those encountered on Earth. For missions outside the magnetosphere, ionising radiation is recognised as the key factor through its impact on the crew's health and performance. Obviously, the radiation environment is quite different from that on Earth; human exposure in space is much higher than on Earth and, apart from SPEs, cannot be avoided by shielding. This is due to extremely high energies of particles in space radiation fields and their high penetration depth in matter, combined with the release of secondary radiations (e.g. fragments, neutrons, and photons) in interactions of the primary radiation with that material. The exposure of astronauts in space is a special case of environmental exposure and is defined as an existing exposure situation by the Commission. In long-term missions, the exposure of astronauts will be higher than the annual limits recommended for exposure of workers on Earth. *Publication 103* (ICRP, 2007) stated that 'Exceptional cases of cosmic radiation exposures, such as exposure in space travel, where doses may be

significant and some type of control warranted, should be dealt with separately'. Therefore, although astronauts are exposed to ionising radiation during their occupational activities, they are not usually classified as being occupationally exposed in the sense of the ICRP system for radiation protection of workers on Earth and aircraft crew. Thus, for a specific mission, reference values for doses or risks may be selected at appropriate levels, and no dose limits may be applied for the given mission. The more risk-related approach of exposure assessment presented in this report is clearly restricted to the special situation in space, and should not be applied to any other exposure situation on Earth.

(4) Over the last two decades, there has been marked development in activities in space, including an increase in the number of astronauts participating in space missions. Nevertheless, even today, the number of astronauts is small compared with the large number of occupationally exposed persons on Earth and in civil aviation. However, considering the extraordinary exposure situation of this group, radiological protection concepts need to be well defined and realistically implemented with respect to the specific situation found in the space environment and during long-term space missions.

(5) The basis for any measure in radiological protection should always be knowledge of the radiation fields involved. Therefore, measurement of environmental radiation and assessment of the exposure of astronauts are very important tasks. Given the discovery of cosmic radiation by Hess in 1912 (Compton, 1936), the study of cosmic radiation and its various components has been underway for a long time. This has become even more important over the last 50 years, as activities in space have increased and frequently include the presence of astronauts. Obviously, the basic information regarding cosmic radiations and their various components can only be obtained through measurements, and this has been carried out for many years. The specific environmental situation in and around a spacecraft can be estimated either by various measurements at different positions in the specific spacecraft, or by radiation transport calculations when the spacecraft design is sufficiently modelled and the specific composition of the external radiation field, including its variation in time, is appropriately considered within the simulation code applied. Some parts of this report, therefore, deal with the various components of the radiation field in space (Chapter 2), and with the computer codes and calculational approaches used to simulate both radiation shielding possibilities for the various radiation fields incident upon the spacecraft and the resulting tissue absorbed doses imparted to the astronauts within the spacecraft (Chapters 5 and 6).

(6) The specific radiation field in space with its important contribution of heavy ions does not allow simple application of the complete system of dosimetric quantities defined for use in radiological protection on Earth. The radiation weighting factor of 20 defined for all heavy ions of all energies is not appropriate in space. In addition, the concept of operational dose quantities for external exposure situations is not applicable to the space situation because very-high-energy particles are involved. The concept of operational quantities for external exposure has been introduced by ICRU and ICRP, mainly looking at electron, photon, and neutron radiations of energies up to a few tens of MeV, and has not considered radiation

fields in space which include many other particle types with even higher energies. This topic will be discussed in more detail in Chapter 3.

(7) On Earth, radiological protection of workers and the primary dose limits defined are aimed at limiting the probability of the occurrence of stochastic effects (e.g. risk of cancer or hereditary effects) to an acceptable level compared with other health risks during human life, while at the same time avoiding detriments in humans by deterministic effects (tissue reactions). For practical reasons, the primary limits are defined in terms of doses (effective dose and equivalent dose to the skin, hands, feet, and lens of the eye where specific limits have been defined for avoiding deterministic effects) which can be assessed with sufficient precision for applications in radiological protection, and not in terms of radiation risks, the value of which depends on many individual factors (e.g. age, sex, individual genetic properties). Especially at low levels of exposure, knowledge regarding these risks is very limited and combined with high uncertainties. The value of effective dose is calculated by averaging organ equivalent doses over both sexes and using mean values of weighting factors obtained from epidemiological data, hence from large groups of exposed and unexposed persons. Effective dose should, therefore, not be used for the assessment of individual risks. In addition to 'limitation' of doses and risks, the principle of optimisation is generally applied in radiological protection, which means that even below exposure limits, optimisation of radiation protection always needs to be considered and might require further measures.

(8) The situation in space is quite different; exposure of astronauts by environmental radiation cannot be avoided in space, and prevention by shielding cannot be completely achieved. Nevertheless, optimisation of radiation protection is an important task, especially because doses to astronauts might exceed 100 mSv in long-term missions. The occurrence of deterministic effects cannot generally be excluded. In addition, the knowledge of radiobiological effects of cosmic radiation, particularly heavy ions, is very limited. The number of individuals involved is small, and hence individual risk assessment is of much higher interest. As a consequence, values of mean absorbed doses in organs and tissues of the human body play an important role, since the weighting factors used in the definition of effective dose or equivalent dose in an organ or tissue are not appropriate in the radiation field in space. In addition, for many years, the use of organ dose equivalent has been preferred by many space agencies instead of the quantity 'equivalent dose in an organ or tissue' (see Chapter 3).

(9) Radiation monitoring in the spacecraft environment and assessment of doses in the human body of astronauts are important parts of the radiological protection measures for space missions. Due to the complex radiation field and the special requirements for use in space flight, radiation monitoring needs specific measurement devices and procedures. Usually, more than one type of dosimeter is needed for this task, and additional calculations are often necessary to interpret device response (see Chapters 4 and 6).

(10) The calculation of conversion coefficients that relate values of particle fluence or dose external to the human body to values of absorbed dose and mean quality factors in organs and tissues within the body is an important task, often used for

the assessment of doses in the body from external measurements. While reference data on conversion coefficients related to the reference voxel phantoms defined in *Publication 110* (ICRP, 2009) were published in *Publication 116* (ICRP, 2010), data for heavy ions have only become available recently (Sato et al., 2010). In the present report, data are presented for isotropic irradiation of both male and female voxel phantoms. Omnidirectional irradiation (isotropic) is the most realistic exposure situation in space. While shielding effects may result in less isotropic exposure, the movement of the astronauts within the spacecraft balances the situation. Hence, data are presented for isotropic irradiation alone (see Chapter 6 and Annex A). The use of conversion coefficients is, however, not the only method for assessing organ doses in the body. Based on knowledge of the radiation field outside a spacecraft, calculation of organ doses can be performed, including full radiation transport through the walls and the equipment of a spacecraft and through the body of the astronaut (see Chapter 6).

(11) On Earth, biological dosimetry is mainly restricted to applications in accidental exposure situations due to the usually low doses of occupationally exposed workers and the difficulty in measuring doses below approximately 50 mSv by this method with acceptable uncertainty; however, the situation in space is quite different. Mission doses may be above this 'threshold', and biological dosimetry (e.g. study of biological effects on lymphocytes in the human body) allows a very individual assessment if the individual sensitivity of the astronaut is determined in advance and individual calibration is performed. Methods and measurements are discussed in Chapters 4 and 6 of this report.

2. RADIATION ENVIRONMENT IN SPACE

(12) The radiation environment in space is a complex mixture of particles of solar and galactic origin with a broad range of energies. For radiological protection, the relevant radiation fields are galactic cosmic radiation (GCR), particles ejected from the Sun during solar particle events (SPE), and secondary radiation produced through interaction with the planet's atmospheric nuclei. Solar wind particles, even when enhanced due to higher solar activity, do not contribute significantly to radiation exposure of humans due to their relatively low energy and hence their absorption in already very thin shielding materials. Nevertheless, the magnetic field associated with the solar wind modulates the fluence rate of GCR in the energy range below approximately 1 GeV/u. During phases of higher solar activity, the cosmic radiation fluence rate is decreased by a factor of three to four compared with phases of minimum solar activity.

(13) Presently, there is no measurable contribution to radiation exposure by primary electromagnetic ionising radiation, such as from solar x-ray flares as occurred on 4 November 2003 coordinated universal time (UTC) 19:29, or from conspicuous extreme gamma radiation bursts such as occurred on 27 December 2004 UTC 21:30:26.55. This effect has, therefore, been ignored, although on a geological time scale, its impact on the biosphere may have been significant. Secondary electromagnetic radiation contributes as bremsstrahlung emitted from charged particles upon penetration through matter, and as gamma radiation from the decay of neutral pions π^0 created in the Earth's atmosphere.

(14) From the point of view of radiological protection, the focus is on the particulate components of primary space radiation of ions and electrons. Other particle types, e.g. neutrons and pions, however, came in from radiation interactions with spacecraft material and the bodies of astronauts. Electrons might become relevant during extravehicular activities (EVAs) or if manned activities in the outer radiation belts become an issue; however, this will not be the case for the foreseeable future.

(15) Exposure to cosmic radiation on the Earth's surface is reduced to a low level due to the Earth's magnetic field and an atmospheric shield with a thickness of approximately $1000\ \mathrm{g\,cm^{-2}}$. Leaving Earth, astronauts are shielded by the structure of the spacecraft and its interior by an average of approximately $20\ \mathrm{g\,cm^{-2}}$, a shielding close to that of the Martian atmosphere; and in LEOs, they are still protected by the Earth's magnetic field which limits even exposure to solar energetic particles to a level far below the cause of early radiation effects in man.

(16) In the absence of sporadic SPEs, the radiation exposure in LEOs the radiation exposure inside spacecraft is determined by GCR (protons and heavier ions) and trapped protons with a dominant contribution from those inside the South Atlantic anomaly (SAA), an area where the radiation belt comes closer to the Earth's surface due to displacement of the magnetic dipole axes from the Earth's centre. In addition, an albedo source of neutrons is produced as the interaction product of the primary galactic particles with the nuclei of the Earth's atmosphere. Outside the spacecraft, the exposure of astronauts is

dominated by the electrons of the horns of the radiation belt, located at approximately 60° latitude in Polar regions.

(17) All these radiations from different sources and their interactions by various mechanisms determine the actual field of ionising radiation at any given time and location within the heliosphere. Its complexity is unrivalled by anything known from terrestrial experience. The radiation field inside a spacecraft is even more complex due to the interaction of the high-energy particles with the spacecraft shielding material and the body tissues of the astronauts.

(18) In deep space missions, the Earth's radiation belts will be crossed in a couple of minutes and therefore their contribution to the astronauts' radiation exposure is quite small. However, the subsequent protection by the Earth's magnetic field is then lost, leaving only mission planning and shielding measures as a means of exposure reduction. The following sections describe the radiation field in space and the interaction of the charged particles with the magnetic field and shielding materials. Some numbers are given for radiation exposure in LEOs and in interplanetary missions.

2.1. Primary radiation fields

(19) Three major primary sources of radiation can be specified in space.

- The solar system with the Sun at its centre is embedded in a complex mixture of ionising radiation, GCR, which enters the heliosphere continuously from all directions. Inside the heliosphere, the GCR fluence rate and particle energy distributions are modulated by the interplanetary magnetic field produced by the charged particles emitted continuously by the Sun, the so-called 'solar wind'.
- In addition to the solar wind, the Sun occasionally emits unusually large pulses of energetic particles, mostly protons and electrons with a small and variable contribution from helium and heavy ions, ejected into space by these solar eruptions. The most significant of these SPEs are produced by the expulsion of large amounts of material in coronal-mass ejections.
- Celestial bodies equipped with a magnetic moment like the Earth are surrounded by toroidal belts of particulate radiation that are constantly replenished by solar particles, and secondary particles caused by the interaction of solar and galactic particles with the atmosphere. Such radiation belts constitute an important third primary exposure source.

(20) Fig. 2.1 illustrates these three sources of ionising radiation in space, their respective spatial scales, and the dominant role that the Sun plays in modifying their composition. The highest energies measured for GCR particles (Fig. 2.1) are too large to be compatible with their postulated acceleration and containment by intragalactic magnetic fields, thereby giving rise to speculations about extragalactic sources for this part and hence extending the spatial scales even further. The corresponding intensities, however, are too low to contribute substantially to radiation exposures.

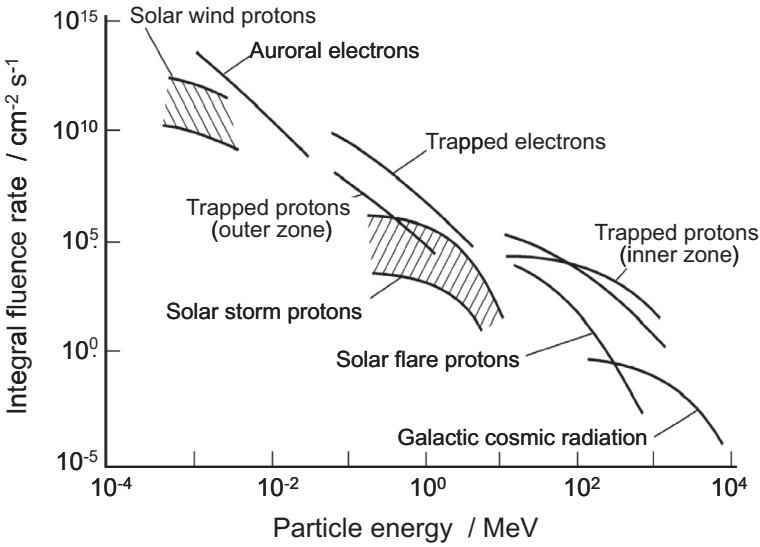

Fig. 2.1. Synoptic view of integral particle fluence rate of space radiation vs upper boundary of particle energy (Wilson, 1978).

(21) In addition to their variation with location in space, the intensity and particulate composition in these fields are subject to temporal variations. As far as space radiation is concerned, two temporal scales of space weather events are relevant. Similar to the annual alternation between summer and winter of ordinary weather on Earth, there is a nearly regular change in solar activity between phases of maximal ('summer') and minimal ('winter') solar activity. The solar 'year' in this case is the Schwabe cycle, a period of approximately 11 years; however, the duration (presently) varies due to as-yet-unknown mechanisms between 9 and 13.6 years. One measure of this activity, for which a continuous observational record exists since 1755, is the Zürich sunspot number (Hathaway et al., 2002). Apparently, the maximum solar activity is inversely associated with the length of the cycle. In addition to field variation during the regular solar cycle, episodes of extreme solar activity are characterised by explosive releases of magnetic energy (Chen, 2001) that eject giant masses of charged particles from the Sun's corona into the interplanetary magnetic field. After further acceleration in this field, particle energies up to several GeV can be attained. The impact of these SPEs on the radiation field in space can last for days to weeks.

(22) Further observed solar periodicities such as the magnetic Hale cycle of 22 years, the Gleisberg cycle of approximately 88 years, and the De Vries or Suess cycle of approximately 210 years have not yet been shown to modulate the radiation field substantially, although their impact on the biosphere is likely to be important, as reported in a recent study on glacial climate cycles (Braun et al., 2005).

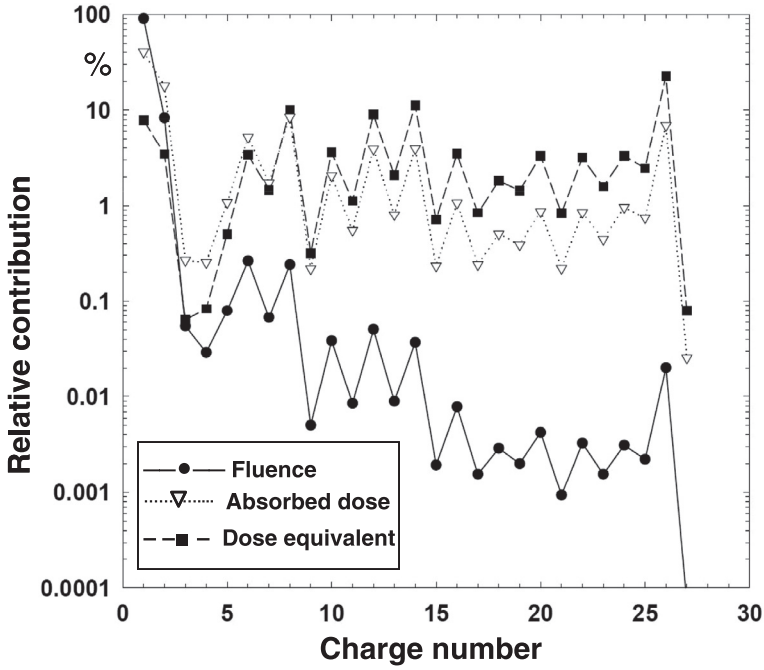

Fig. 2.2. Elemental composition of galactic charged particles in free space and their relative contribution to absorbed dose and dose equivalent in tissue (Cucinotta et al., 2001a).

2.2. Galactic cosmic radiation

(23) GCR originates outside the solar system and is incident isotropically on Earth. There is no conclusive proof regarding the mechanisms accelerating the charged particles, and the astrophysical sites where matter becomes cosmic particle radiation. There is no information about the directional position of their sources as these particles are scrambled by irregular interstellar magnetic fields on their way towards the Earth. Due to their high energies (up to 10^{20} eV), they most probably originate from supernova explosions, neutron stars, pulsars, or other sources where high-energy phenomena are involved. Detected radiation consists of 98% baryons and 2% electrons. The baryonic component is composed of approximately 85% protons (hydrogen nuclei), with the remainder being alpha particles (approximately 14%) and heavier nuclei (approximately 1%). Fig. 2.2 shows the abundances of these elements up to iron relative to silicon. The ions heavier than alpha particles are termed 'HZE particles' [high charge (charge numbers $Z > 2$) and high energy]. Although iron ions are one-tenth as abundant as carbon or oxygen, their contribution to absorbed dose in tissue is substantial as this dose is proportional to the square of the particle charge. This is indicated in Fig. 2.2 (Cucinotta et al., 2001a).

(24) In addition to GCR, a so-called 'anomalous component' is observed. It consists of originally neutral particles coming from the interstellar gas that become

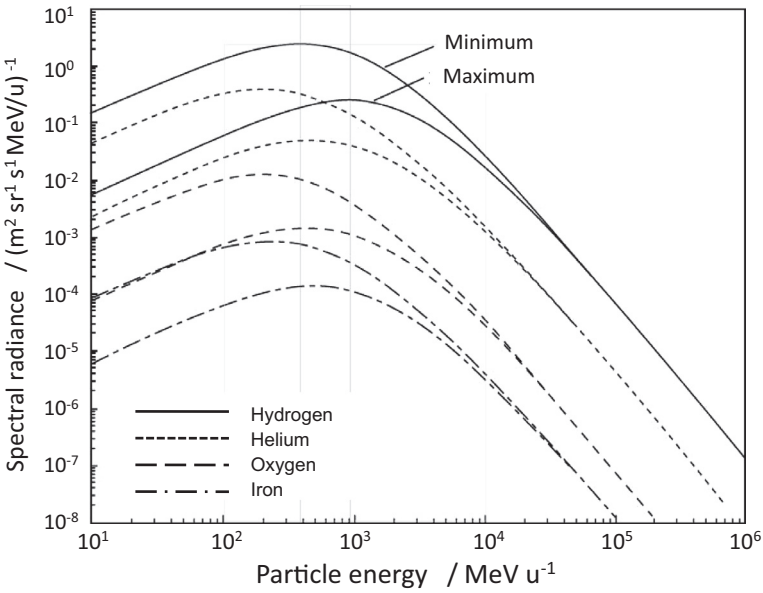

Fig. 2.3. Energy distribution of radiance vs particle energy for four galactic cosmic radiation particles and their modification by solar activity [for solar minimum (1977) and solar maximum (1959)] at ua[1] as relevant for radiological protection (Badhwar, 1997).

singly ionised by solar radiation after entering the heliosphere. These particles are then accelerated in collision regions between fast- and slow-moving streams of the solar wind. They are able to penetrate deeper into the magnetic field than fully ionised cosmic particles. Their energies are approximately 20 MeV/u, and consequently they can only contribute to radiation effects behind thin shielding. However, it has to be considered that they lose all their electrons after penetration of a very small amount of shielding material, and thus also deposit energy proportional to the square of their charge number Z.

(25) In this report, energies of GCR nuclei are presented as kinetic energy per atomic mass unit (amu or u), E. This has the advantage that all nuclei with the same value of energy per amu move with nearly the same velocity regardless of their mass. Using this energy scale, the energy distributions of the different cosmic ray nuclei are very similar. Fluence rate distributions in energy for hydrogen, helium, oxygen, and iron are shown in Fig. 2.3. At energies E above some GeV/u, the fluence rate is well represented by a power law $N(E) \sim E^{-\gamma}$ with γ of approximately 2.5. Towards lower energies, the distributions get flatter and show a maximum at a few hundred MeV/u.

(26) Fluence rates of cosmic radiation are not constant; they vary between two extremes that correspond in time with maximum and minimum solar activity. Solar activity and cosmic radiation fluence rates are inversely correlated. The slope of the energy distribution in Fig. 2.3 for energies below several GeV/u is affected by this

[1]The astronomical unit, ua, is a unit of length approximately equal to the mean Earth-Sun distance. 1ua = 1.495 978 706 91 10^{11} m.

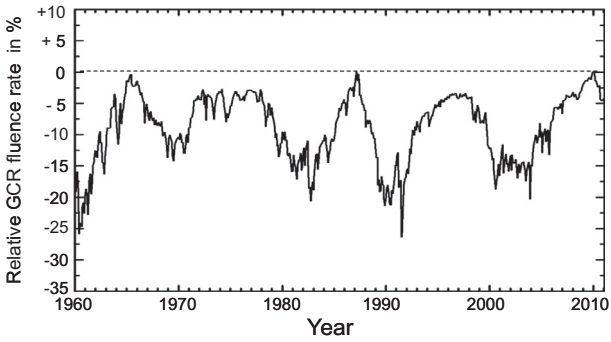

Fig. 2.4. Relative fluence rate variation of galactic cosmic radiation (GCR) with time in the solar cycle of the heliocentric potential measured by the neutron monitor in Kiel (NMDB, 2011).

modulation of the cosmic radiation fluence rate (Badhwar, 1997). It is caused by the solar magnetic field, which is coupled to the solar wind. The solar wind is a continuous stream of highly-ionised plasma emerging from the Sun. Its intensity depends on solar activity, which can be described by the number of observed sunspots. During the minimum of the 11-year solar cycle, the solar wind has minimum strength and its effect on the energy distribution is smaller than at maximum solar activity. Cosmic particles incident on the solar system interact with the solar magnetic field and thus lose energy. This leads to flattened energy spectra at lower energies. With increasing solar activity, the maximum fluence rate is shifted to higher particle energies. At 100 MeV/u, the particle fluence rates differ by a factor of approximately 10 between maximum and minimum solar activity conditions, whereas at approximately 4 GeV/u, a variation of approximately 20% is observed.

(27) Monitoring of solar modulation is possible on Earth based on the fluence rate of secondary neutrons produced in the Earth's atmosphere by interactions of GCR. This fluence rate has been measured over longer periods by different ground-based stations using neutron monitors. Fig. 2.4 shows an example of data taken over several years with the neutron monitor at Kiel University (NMDB, 2011). It can be seen that details of the modulation seem to be unpredictable statistical fluctuations. However, maxima and minima clearly appear to be inversely correlated to the 11-year solar cycle with a roughly sinusoidal form around an average particle fluence rate. However, the magnitude of the extremes undergoes fluctuations. Predictions for future satellite missions are limited in accuracy within a factor of two or even more based on such unpredictable fluctuations.

2.3. Solar cosmic radiation

(28) As well as electromagnetic radiation, the Sun emits particle radiation continuously, mainly consisting of protons and electrons, the solar wind. The intensities of these low-energy particles vary by two orders of magnitude between approximately 10^{10} and 10^{12} particles $cm^{-2}\,s^{-1}\,sr^{-1}$. In terms of velocity, this particle stream is characterised by velocities between approximately 300 km s^{-1} and 800 km s^{-1} and

more. The particle energies, however, are so low (for protons, between 100 eV and 3.5 keV) that the particles will be stopped within the first few microns of unshielded skin. They are, therefore, not of concern for radiation effects in humans.

(29) Nevertheless, the temporal variation of the solar wind is a major driver that determines radiation exposure from GCR in space, at least within the inner heliosphere. The heliosphere itself can be defined as that domain of the interstellar space which the solar wind which is filled by particles of the solar wind. The magnetic field based on the solar wind provides a similar shielding as the geomagnetic field. The shielding strength can be simulated in terms of a pseudo-electrostatic heliocentric potential against which the charged particles have to work when entering the heliosphere from the local interstellar medium. This potential modifies the GCR energy distributions to the same degree as the interplanetary magnetic field.

(30) Occasionally, the surface of the Sun releases large amounts of energy in sudden local outbursts of gamma radiation, hard and soft x rays, and radio waves in a wide frequency band (coronal-mass ejection). In these SPEs, large currents and moving magnetic fields in the solar corona accelerate solar matter. Coronal particles with energies up to several GeV escape into the interplanetary space. They spiral around the interplanetary magnetic field lines. Within the ecliptic plane, field lines expand from the Sun into the interplanetary medium like the stream of water from a rotating garden hose. They connect the Earth with a certain spot on the western part of the

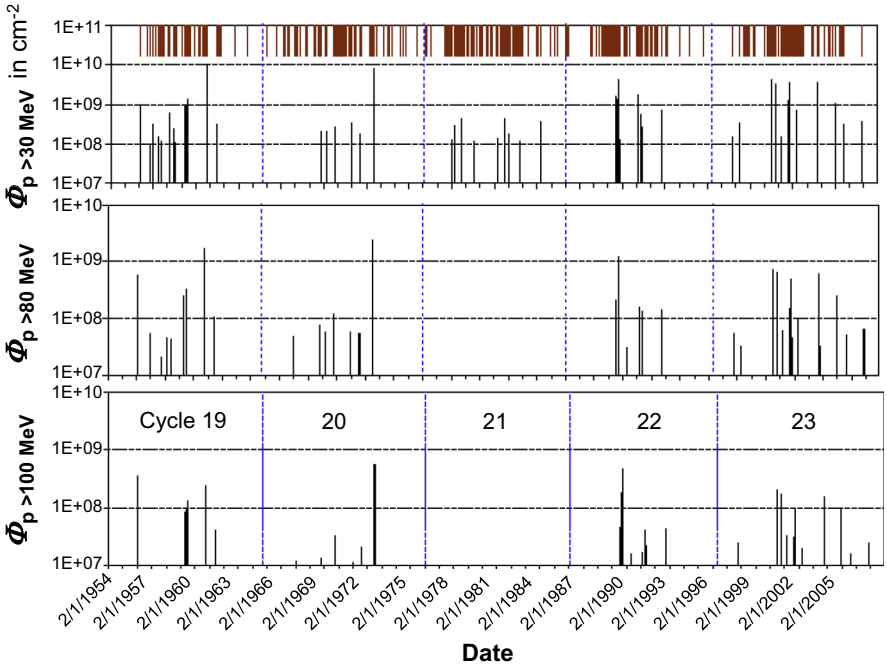

Fig. 2.5. Occurrence of major solar particle events in Solar Cycles 19–23 and the integral particle fluence, Φ_p, for protons with energies >30 MeV, >60 MeV, and >100 MeV (Kim et al., 2011).

Sun. The number and energy distribution of particles observed in SPEs on Earth is different from GCR and depends on this connection. SPEs show an enormous variability in particle fluence rates and energy distribution, and have the potential to expose space crew to life-threateningly high doses.

(31) An SPE that is well connected with high particle fluence rates observed on Earth is an infrequent event, most likely to be observed during the period of increasing and decreasing maximum solar activity. Therefore, major SPEs are observed on Earth as random events with low frequency, typically one per month. They last for several hours or days. Events with significant fluence rates of protons with higher energies can be observed as 'ground-level events' (GLEs) by neutron monitors. Fig. 2.5 shows the distribution of GLEs observed over five solar cycles. Long gaps with no events can be seen during solar minimum activity. Between the last GLE in Cycle 21 and the first GLE in Cycle 22, there was a quiet period of 65 months followed by a sequence of 11 GLEs within 1 year with the approaching maximum of the 23rd solar cycle.

(32) As high-energy particles arrive first and are followed by particles of lower energies, the energy distribution of SPE particles observed on Earth depends on time, t, after onset of the event. Above energies of approximately 10 MeV, SPE particle energy distributions roughly follow the power law $I(E) = I_0E^{-\gamma}$, where I_0 is the total number of particles of the type considered at time t, E is the energy of a particle, γ is a parameter, and $I(E)$ is the distribution of the number of particles with respect to E. After the onset of the event, the exponent γ decreases with time. This means that the contribution by high-energy particles decreases with time during the event. The constant I_0 shows a great deal of structure during the event caused by field irregularities and shock structures in the interplanetary medium. Due to the stochastic occurrence of SPEs, capabilities for the prediction of SPEs and their strength are very limited, (Reedy, 1996) and it would be very useful for long-term missions in space if the modelling and forecasting of such events could be improved.

(33) Particles from strong SPEs can induce adverse skin reactions in astronauts if they get caught outside shielding, since above approximately 10 MeV, protons can penetrate spacesuits and reach the skin or the lens of the eye. Depending on the particle intensities, they may induce erythema or trigger late radiation cataracts within the lens of the eye. While the latter take several years to develop and hence pose no threat to safe completion of a mission, severe erythema may well induce performance decrements that could compromise mission success. Anorexia, fatigue, nausea, vomiting, and diarrhoea can also occur. They constitute the symptoms of the prodromic syndrome as the early warning signs (within hours, depending on the dose) that potentially life-threatening doses may have been incurred. As such, these symptoms will hardly pose a serious threat, unless, for example, emesis occurred in a spacesuit.

(34) Since 1955, five SPEs with intensities and energies large enough to jeopardise crew health behind normal or even enhanced spacecraft shielding have been observed. For these strong events, integral fluence distributions (total number of particles per area above an energy E) have been measured by satellite instruments (see Fig. 2.6). For a further event – that of 23 February 1956 – the fluence distribu-

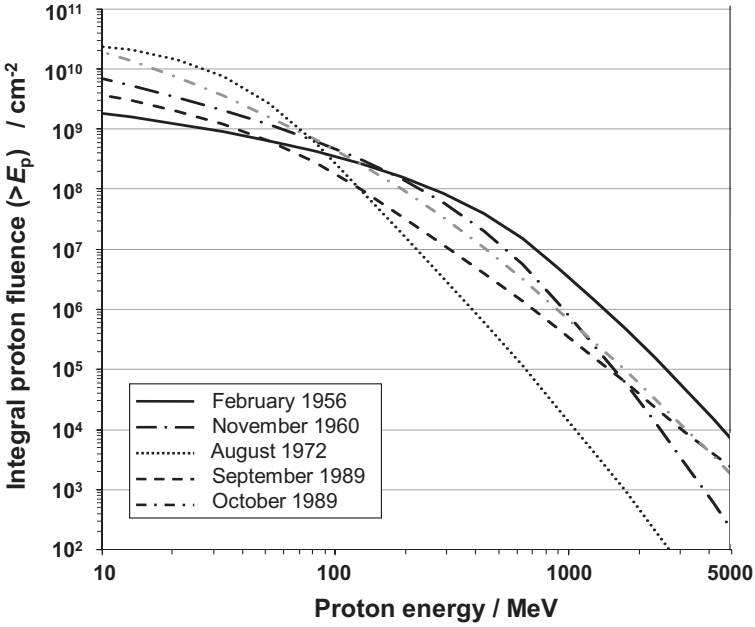

Fig. 2.6. Integral fluence spectra of protons from historical 'worst-case' solar particle events (Kim et al., 2010a).

tion has been inferred from an analysis of the count rates of terrestrial neutron monitors that recorded the induced secondary neutrons. Such enhancements of neutron count rates are monitored in a worldwide net of neutron monitor stations, a selected subset of which forms the so-called 'Spaceship Earth'. GLEs indicate that associated SPE protons with energies above approximately 450 MeV were sufficiently numerous to raise the neutron fluence rate at sea level by at least 5%.

(35) A comprehensive list of GLEs observed since 23 February 1956 (GLE No. 5) and 14 July 2000 (GLE No. 59), together with all neutron monitor stations where these events were observed, is kept by the Australian Antarctica Data Centre (http://data.aad.gov.au/aadc/gle/events.cfm). Among all these GLEs, the enhancement by GLE No. 5 measured in Leeds (lat. 53.83 N, long. 358.42 E, alt. 100 m, Pc = 2.20 GV) is approximately 4600% higher than the pre-event count rate, whereas for other SPEs, the enhancement very rarely exceeds a 100% increase.

(36) A small amount of solar particles with low energies also reach the Earth from SPEs at other positions of the Sun which are not fully directed at the Earth. These fluence rates add up to a solar component that dominates over the galactic component at energies below 30 MeV/u. Depending on the conditions of the interplanetary medium, this component undergoes fluctuations that are highly variable and unpredictable. During periods of maximum solar activity, when the fluence rate of GCR is

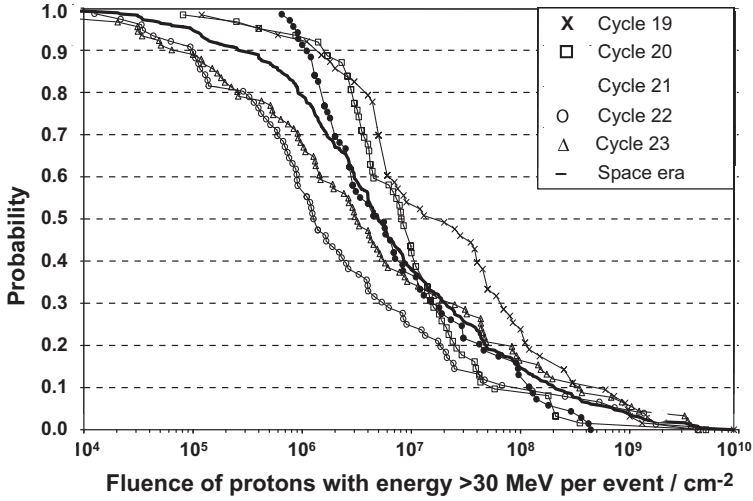

Fig. 2.7. Probability of a solar particle event with protons exceeding an energy of 30 MeV vs proton fluence per event for different cycles and for the complete space era (Kim et al., 2011).

depressed and SPEs are more frequent, the contribution of the solar component is more significant.

(37) For long-term mission planning, in addition to the magnitude that a worst-case event can attain, the frequency of occurrence of events and the proton energy distribution are also important. Fig. 2.7 gives the probability that a particle event with protons of energies above 30 MeV will occur, based on the random nature of SPE occurrence and event size, and based on the records taken for fluence measurements of the last five solar cycles.

2.4. Trapped radiation

(38) The radiation field around the Earth comprises the third radiation source. The particles trapped in the radiation belts discovered by Van Allen are a result of the interaction of GCR and Solar cosmic radiation (SCR) with the Earth's magnetic field and the atmosphere. The radiation belts consist of electrons, protons, and some heavier ions. Electrons reach energies of up to 7 MeV and protons up to 700 MeV. The energy of heavy ions is less than 50 MeV/u, and because of their limited penetration capacity, they are of no consequence for satellite electronics or radiological protection of humans. Charged particles with these energies moving into a dipole field can never enter inner areas of this field. However, if they are put into this field for any reason, they are restricted to certain positions and cannot escape. They move in spirals along the geomagnetic field lines and are reflected back between the magnetic poles, acting as mirror points. Different processes contribute to fill in particles in the radiation belt, and two main zones of captured particles are observed. The inner belt is mainly formed by decaying neutrons, coming from the atmosphere

in which they are produced in cosmic particle interactions, and producing protons and electrons. The outer belt consists mainly of trapped solar particles, and is populated largely by electrons. During disturbance of the magnetosphere by magnetic storms related to solar flares, where the geomagnetic cut-off is usually depressed, particles of lower energies can penetrate from outside towards the inner regions and fill them. The radiation belts extend over a distance from Earth from approximately 200 km to approximately 75,000 km around the geomagnetic equator. Energy loss by cyclotron radiation and by penetration into the upper atmosphere near the geomagnetic mirror points constitutes the major loss mechanisms for the trapped particle population.

(39) Extensive measurements during recent decades with more advanced and dedicated instrumentation on several satellites in well-coordinated orbits yielded the main quantitative database which then became integrated in the AP-8 trapped proton model (Sawyer and Vette, 1976), which provides energy distributions of average proton fluence rates during quiet magnetospheric conditions. A major application of the AP-8 model is the assessment of radiation exposure from trapped radiation during manned LEO missions such as on the International Space Station (ISS). The AE-8 trapped electron model (Vette, 1991) serves the same purpose of prediction of radiation doses, mainly for the radiation environment in geostationary orbits where energetic electrons constitute the dominant source of ionising radiation.

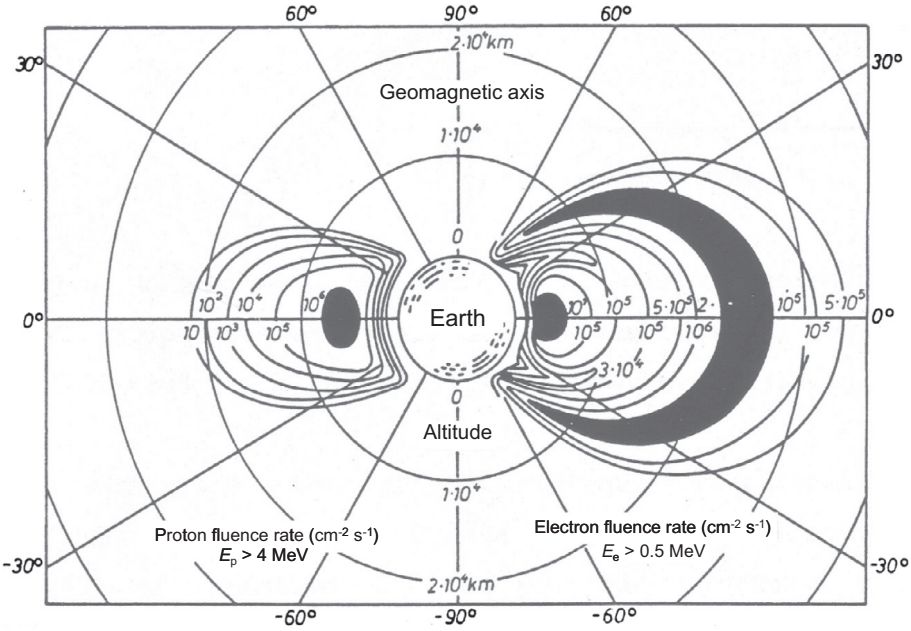

Fig. 2.8. Fluence rates in inner and outer terrestrial radiation belts for trapped protons and electrons in $cm^{-2}\,s^{-1}$ (Allkofer, 1975).

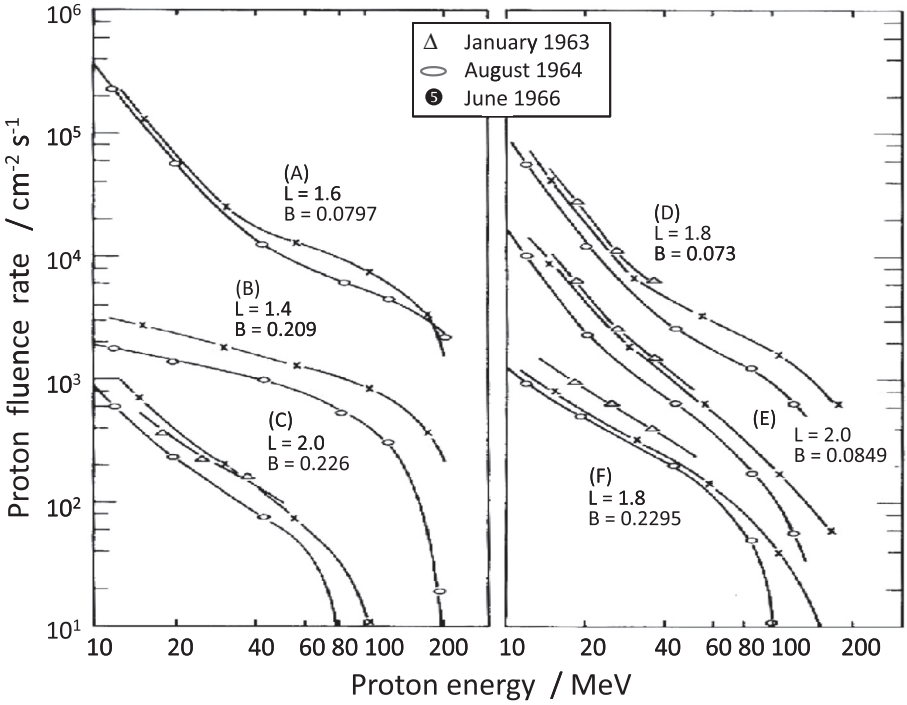

Fig. 2.9. Fluence rates of inner belt protons measured at various locations within the belts as expressed in the *B*,*L*-coordinate system (Freden and Paulikas, 1964; Filius, 1965).

(40) An improved AE-9/AP-9 model is being developed as part of the Proton Spectrometer Belt Research (PSBR) Program, and is planned to be released in the near future by a consortium of institutions, including the National Reconnaissance Office, Aerospace Cooperation, Air Force Research Laboratory, Los Alamos National Laboratory, and Naval Research Laboratory.

(41) There is a strong east–west effect in trapped proton fluence rates. At the bottom of their path around the magnetic field lines, protons are travelling eastwards, whereas those at the top of their path are travelling westwards. The westward-travelling particles have emerged from a region of the atmosphere at lower altitude. Therefore, they encounter a denser atmosphere and are more efficiently removed by interactions with the nuclei of the atmosphere (Lenchek and Singer, 1962).

(42) Fig. 2.8 displays the spatial distribution of electron fluence rate for electron energies above 0.5 MeV (right) and of proton fluence rate for proton energies above 4 MeV (left), at which energy the latter are able to penetrate approximately 1.4 g cm^{-2} Al (ICRU, 1993a), the shielding provided by lighter spacecraft. Proton fluence rates in the inner belt are intense, and protons reach sufficient energies to penetrate the shielding provided by walls and equipment of spacecraft. Their energy distribution, as shown in Fig. 2.9, needs to be known in order to assess radiation

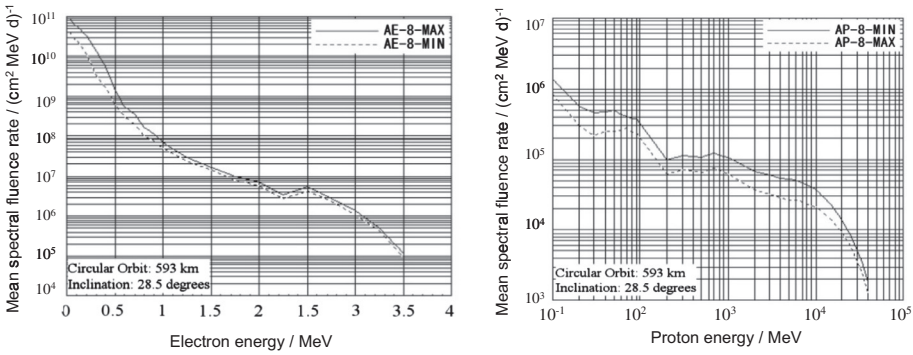

Fig. 2.10. Left: Mean energy distribution of fluence rate of trapped electrons at solar minimum and maximum conditions calculated with the AE-8 model for the position of the Hubble Space Telescope (Jones, 2000). Right: Mean energy distribution of fluence rate of trapped protons at solar minimum and maximum conditions calculated with the AP-8 model for the position of the Hubble Space Telescope (Jones, 2000).

exposures of astronauts. The data in Fig. 2.9 are the results of measurements of the energy distribution of trapped proton fluence rate in the early 1960s (Freden and Paulikas, 1964; Filius, 1965). The B, L coordinates are used as a natural coordinate system to specify the satellite position within the geomagnetic field. Here, B denotes the magnetic field strength at a given point, and L denotes the altitude in units of Earth radii at which the magnetic field line through this point intersects the plane through the geomagnetic equator.

(43) Fig. 2.10 shows the fluence rate energy distributions of trapped electrons and protons averaged over the orbit of the Hubble Space Telescope. Electron fluence rates during the solar maximum are greater than during the solar minimum, pointing to the Sun as the dominant primary source that feeds the trapped electron population. In contrast, the trapped proton fluence rates reflect the (Forbush) modulation of GCR intensity by the solar wind, which results in higher intensities during solar minimum conditions.

(44) The fluence rates and energy distributions shown pertain to quiet magnetic conditions of the terrestrial and interplanetary magnetic fields during minimum and maximum solar activity. In addition to the regular solar cycle variation, both magnetic storms and intensive fluence rates from energetic SPEs significantly shift positions and energies of trapped particle populations so that additional, although transient, radiation belts can be created.

(45) The trapped radiation is modulated by the solar cycle; with increasing solar activity, proton intensity decreases, while electron intensity increases. Diurnal variations by a factor of between 6 and 16 are observed in the outer electron belt, and short-term variations due to magnetic storms may raise the average fluence rate by two or three orders of magnitude. The centre of the inner belt is quite stable, especially with respect to protons. However, at the lower edge of the belt, electron and proton intensities may vary by up to a factor of 5. For the majority of LEO space

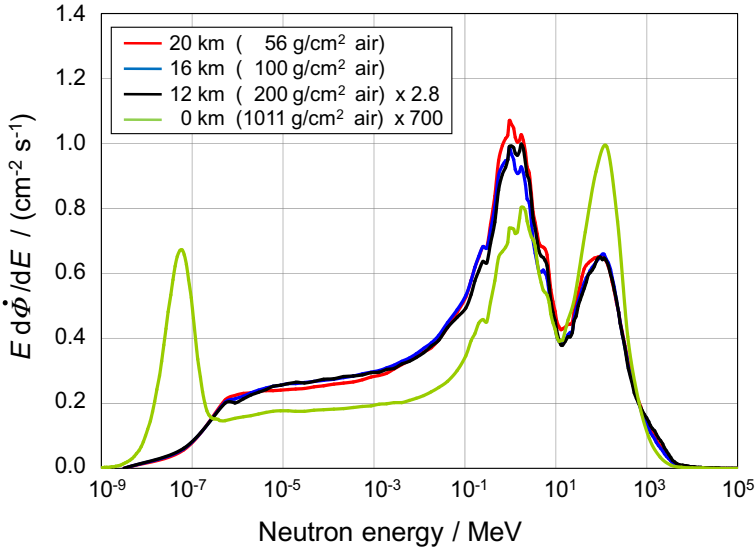

Fig. 2.11. Distribution of energy fluence rate of neutrons from cosmic radiation on the ground and in different atmospheric depths at air flight altitudes measured with Bonner spheres during the AIR ER 2 flights and on the ground at sea level vs neutron energy (Goldhagen et al., 2004).

missions, protons are an important part of the radiation exposure inside spacecraft. Due to their higher energies and correspondingly longer range, their total dose surpasses that of electrons at shielding thicknesses above approximately 0.3 g cm^{-2} Al. At lower shielding (e.g. in the case of EVAs), the absorbed dose to the skin is dominated by the electron contribution, and may reach up to 10 mGy per day.

(46) Of special importance for LEOs is the South Atlantic Anomaly (SAA), a region over the coast of Brazil where the radiation belt extends down to altitudes of 200 km. This behaviour is due to an 11° inclination of the Earth's geomagnetic dipole axis from its axis of rotation towards North America and a 500 km displacement of the dipole centre towards the western Pacific, with corresponding significantly reduced field strength values. Radiation received in LEOs at low inclinations includes GCR and that due to passages through the SAA. At an orbit with 28.5° inclination, six orbital rotations per day pass through the SAA, while nine orbital rotations per day do not pass through the SAA. Although traversing the SAA takes less than approximately 15 min and occupies less than 10% of the time in orbit, this region accounts for a significant fraction of total exposure.

(47) In addition to the trapped charged particles in radiation belts, GCR produces secondary neutrons by nuclear reactions in the upper atmosphere of the Earth. Neutrons are produced in two energy regions by two processes. Neutrons in the region between 1 and 10 MeV are mainly evaporation products of highly excited nuclei with a fairly isotropic angular distribution. High-energy neutrons originate as knock-on neutrons mainly in peripheral collisions, or in charge exchange reactions of high-

energy protons. Their energy distribution peaks at approximately 100 MeV. They leak into the exosphere and also contribute to the exposure in spacecraft. Measured neutron energy distributions in the Earth's atmosphere are shown in Fig. 2.11. Their contribution to the radiation field in LEOs is, however, relatively low. A similar neutron field as measured in the atmosphere is produced by interactions of GCR with the spacecraft material and the astronaut's body (see Para. 157). This contribution to the exposure of astronauts is substantial (Bartlett et al., 2006).

2.5. Interaction with magnetic fields

(48) To reach spacecraft in LEOs, a charged particle from GCR or the solar cosmic radiation (SCR) has to penetrate the Earth's magnetic field. Penetrability is a property related to the ion's magnetic rigidity, which is given by its momentum divided by its charge. All particles with the same rigidity follow a track with the same curvature in a given magnetic field. For each point inside the magnetosphere and each direction from that point, there is a rigidity threshold below which the cosmic particles are not able to reach this point. This rigidity is called the 'geomagnetic cut-off rigidity' and is proportional to the magnetic field component perpendicular to the direction of particle motion. For a particle moving towards the centre of the Earth, for example, the cut-off rigidity has a maximum value at the equator, since the particle moves perpendicular to the field lines and the cut-off rigidity vanishes at the pole, since the particle moves in the direction of the field lines. Therefore, geomagnetic shielding is less effective for high inclination orbits than for low inclination orbits. This means that in low inclination orbits, only particles of high energy have

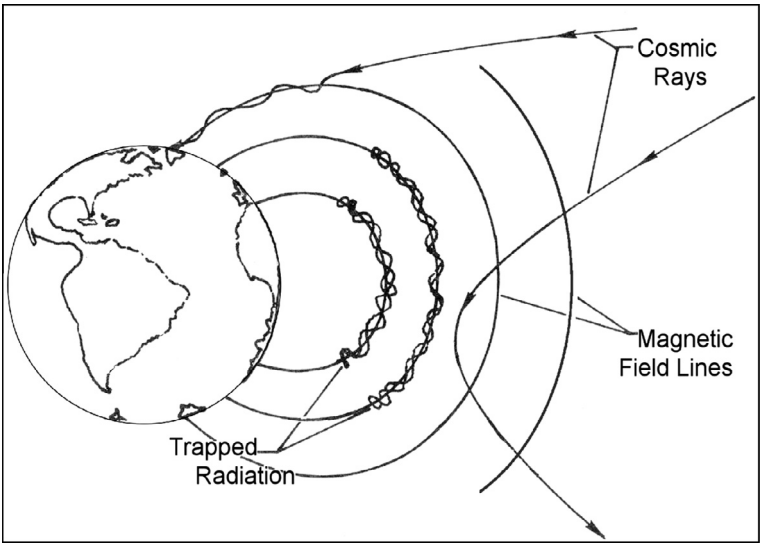

Fig. 2.12. Deflection and trapping of charged particles by the geomagnetic field (Spjeldvik and Rothwell, 1983).

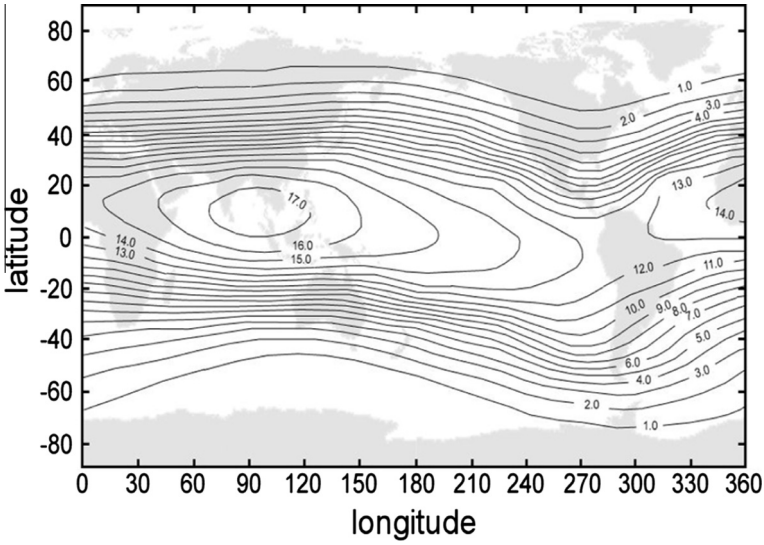

Fig. 2.13. Map of vertical cut-off rigidities in Gigavolt (GV) for the geomagnetic field model of Epoch 2000.0 (Smart and Shea, 2008).

access. Towards higher inclinations, additional particles of lower energies are observed. For a geomagnetic latitude λ, the vertical cut-off rigidity R_c can be calculated approximately by $R_c = 14.9\cos^4\lambda/(r/r_e)^2$, where r/r_e is the ratio of the distance r from the dipole centre to the Earth's radius, r_e. The rigidity for particles arriving from directions other than vertical is dependent on the angle of incidence. Due to latitude-dependent shielding, the number of particles incident in the altitude of orbiting spacecraft increases from lower inclinations to higher inclinations.

(49) In LEOs, as well as at aviation heights, a second shielding mechanism has to be incorporated into the transport of the primary GCR or SPE ions. Whereas the geomagnetic field, on the one hand, is responsible for the added radiation exposure in LEOs from trapped radiation, it also causes a fairly substantial reduction in radiation exposure, at least near the geomagnetic equator (which differs from the geographic equator). This stems from the deflection due to the Lorentz force of charged particles by the geomagnetic field, as illustrated in Fig. 2.12.

(50) Fig. 2.13 provides a global map of the vertical cut-off rigidities for the geomagnetic field model of Epoch (2000.0) (Smart and Shea, 2008). Epoch is a moment in time used as a reference point. Epoch 2000.0 means the date 2000, Jan 1.5 (12h on January 1). For a homogeneous dipole field, the iso-rigidity lines would be parallel to the (geomagnetic) equator. The marked asymmetry with a peak above 17 GV of the cut-off rigidity at the Indian Ocean (long. 90 E, lat. 10 N) reflects the offset from the geographic centre of the magnetic centre by approximately 450 km in this direction. At the opposite side, in the South Atlantic, this offset results in the corresponding subsidence of the lower fringes of the inner proton belt, thereby creating the SAA. This explains why the bulk of radiation exposure in most LEOs is accumulated in this region.

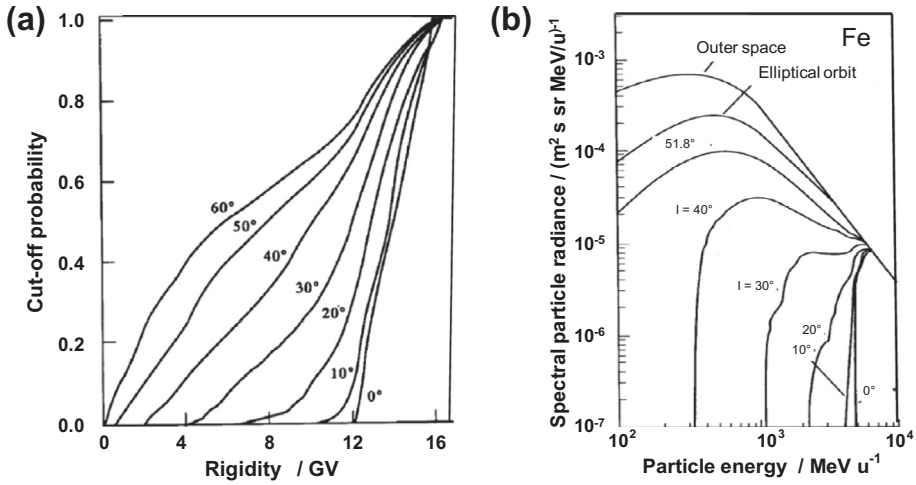

Fig. 2.14. (a) Cut-off rigidity probability for different inclinations for a circular orbit at 223 km (Heinrich and Spill, 1979). (b) Energy distributions of iron nuclei for outer space and for orbits at 223 km altitude of different inclinations (Heinrich and Spill, 1979).

(51) For a given orbit, the shielding due to this effect is expressed by the geomagnetic transmission factor which specifies the fraction of the GCR or solar particle fluence rate of a given particle energy (or momentum given in units of GeV c^{-1}) that has access to this orbit, or by the cut-off rigidity probability that specifies the probability that a particle with a given rigidity reaches that orbit. Fig. 2.14(a) demonstrates the dependence of the geomagnetic shielding on the orbit inclination for a circular orbit at 223 km altitude. For an orbit of 28.5° inclination which evades the SAA for a large fraction, GCR with a momentum below approximately 4.2 GeV c^{-1} does not generally reach the flight route.

(52) For a 45° inclination, this momentum threshold drops to approximately 1.1 GeV c^{-1}, and for polar orbits, at least 20% of particles with the lowest energies always have access to this altitude. On the other hand, the shielding effect vanishes for ions with a momentum above approximately 15 GeV c^{-1}, where at any inclination, all charged ions reach this orbit. Fig. 2.14(b) shows the influence of the magnetic shielding on the particle spectra (e.g. for Fe), which varies strongly between differing inclinations. The functions in Fig. 2.14 do not, however, include the shadow effect of the Earth itself.

(53) The shadow effect of the Earth for the Hubble Space Telescope at a 28.5° inclination reduces the fluence rate of even the most energetic GCR by approximately 30%. An Earth observation satellite (e.g. TERRA), on the other hand, must use a near polar orbit and therefore can be accessed by charged particles of all energies. Its higher altitude also slightly reduces the shielding by the Earth's shadow. The high inclination of the ISS of 51.6° makes this manned spacecraft accessible to SPE ions of 100 MeV/u or above. This is particularly important as, in the case of

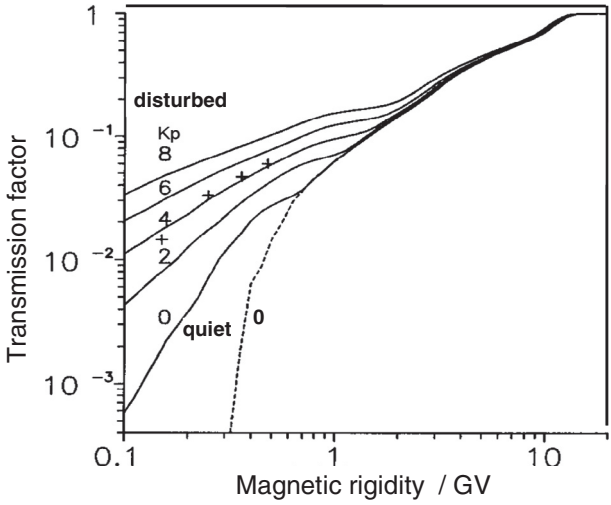

Fig. 2.15. Calculated geomagnetic transmission functions for the International Space Station orbit vs magnetic rigidity for a quiet time geomagnetic field (dotted line) (Langel, 1992) and for disturbed geomagnetic conditions (solid lines) as expressed by the *K*p index (Nymnik, 1999). The crosses are the results from Boberg et al. (1993) for $Kp = 5$.

geomagnetic disturbances which often accompany solar events, this geomagnetic shielding is further reduced. Fig. 2.15 demonstrates this loss of geomagnetic shielding for the ISS for storms, as characterised by the *K*p index of global geomagnetic activity (http://isgi.cetp.ipsl.fr/des_kp_ind.html) which can vary between 0 and 9. Under such storm conditions, a much larger fraction of SPE ions can reach the orbit of the ISS.

3. QUANTITIES USED IN RADIOLOGICAL PROTECTION

(54) The description and quantification of exposure of humans to ionising radiation needs the definition of specific quantities and units. For many years, this has been performed by ICRU and ICRP, and the actual definitions can be found in their publications (ICRU, 1993b, 2011; ICRP, 2007). Human exposure to ionising radiation can occur from radiation incident on the human body (external exposure) or from radionuclides incorporated in the body (internal exposure). For exposure of astronauts in space, internal exposure is of very little relevance; therefore, this chapter concentrates on the concept of quantities relevant for external radiation exposure.

(55) In the past, the definition of the specific quantities for radiological protection has mainly considered occupational and public exposure situations on Earth, concentrating on human exposures by photons, electrons, neutrons, and alpha particles in internal exposure. In addition, the protection quantities are defined for application in situations of low dose and low dose rates. Limits are given in terms of these quantities in order to limit the probability of the occurrence of stochastic detriments to humans to an acceptable level and to avoid deterministic effects (tissue reactions).

(56) The exposure situations in space are different from those on Earth, mainly due to the strong differences in the radiation fields (see Chapter 2) and to the higher environmental dose rate in space than on Earth, whereby the likelihood of stochastic effects is increased and deterministic effects cannot be excluded. The high contribution of heavy ions in GCR and secondary radiation to doses in the human body needs to be considered in particular.

(57) The consequences for the definition of appropriate radiation protection quantities for use in space situations are considered in the following sections. Organisations active in space missions have already defined detailed procedures for the assessment of human exposure in space (NCRP, 2000, 2002). In principle, they are interested not only in the determination of individual doses, but in the assessment of individual radiation risks based on such doses, and this has some consequences for the definition of dose quantities. The astronauts can be treated as individuals or as members of small groups. Information on sex and age can be applied, and better information on the astronaut's organ size and shape might be available; there may be the possibility of applying individual sensitivity factors to the assessed organ doses if specific individual risks need to be determined (Atwell, 1994; Bahadori et al., 2011, 2012).

3.1. Dose quantities in radiological protection

(58) In radiological protection, the system of dose quantities defined by ICRP and ICRU (ICRP, 1991, 2007; ICRU, 1993b) and generally used in situations on Earth

and in flights at normal aviation altitudes includes protection quantities and operational quantities. Protection quantities (e.g. equivalent dose in an organ or tissue, effective dose) are based on mean absorbed doses to the organs and tissues of the human body, and can be related to the risks of ionising radiation exposure. The ICRP system of protection quantities is shown in Fig. 3.1 (ICRP, 2007).

(59) Operational quantities (e.g. ambient dose equivalent or personal dose equivalent) are defined for use in measurements that enable an assessment to be made of effective dose or mean dose in organs or tissues of humans that are generally not measurable.

(60) In radiation biology, clinical radiology, and radiological protection, the absorbed dose, D, is the fundamental physical dose quantity. It is used for all types of ionising radiation and any irradiation geometry.

(61) Absorbed dose, D, is defined as the quotient of $\mathrm{d}\bar{\varepsilon}$ by $\mathrm{d}m$, where $\mathrm{d}\bar{\varepsilon}$ is the mean energy imparted by ionising radiation to matter of mass $\mathrm{d}m$, thus:

$$D = \frac{\mathrm{d}\bar{\varepsilon}}{\mathrm{d}m} \tag{3.1}$$

The SI unit of absorbed dose is J kg^{-1} and its special name is gray (Gy). Absorbed dose takes account of the radiation field inside and outside the specified volume of mass $\mathrm{d}m$, and hence of all charged particles that were produced in or enter that volume. Its value is derived from the mean value of the stochastic quantity of energy imparted, ε, and does not reflect the random fluctuations of the interaction events

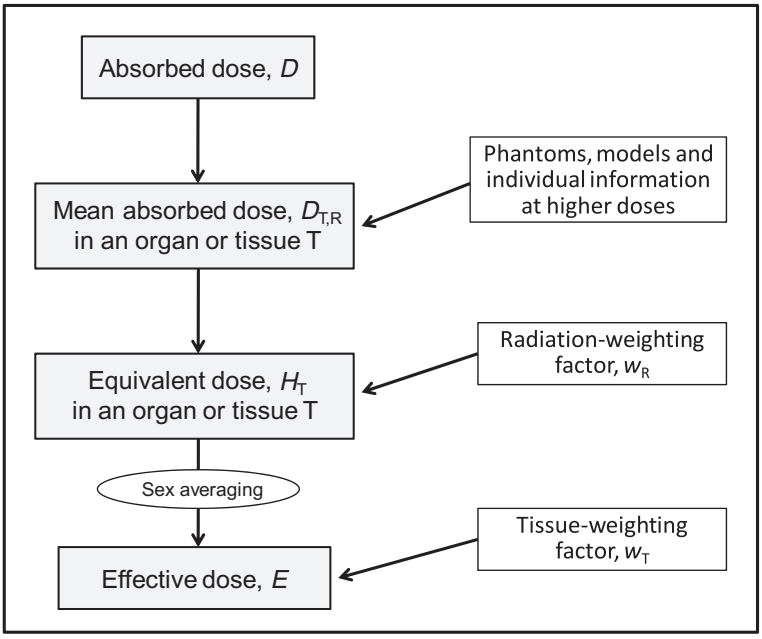

Fig. 3.1. Dose quantities for radiological protection (protection quantities) recommended by ICRP (2007).

in tissue. Generally, absorbed dose is a measurable quantity and primary standards exist to allow its determination by measurement.

3.1.1. Protection quantities

(62) Generally, radiological protection is concerned with controlling exposures to ionising radiation so that tissue reactions are prevented and the detriment from stochastic effects is limited to accepted levels. The fundamental protection quantities are based on mean absorbed doses imparted to organs and tissues of the human body. These quantities are designed to allow quantification of the exposure to ionising radiation from both whole- and partial-body irradiation (ICRP, 1991, 2007). The estimated doses can then be compared with recommended dose limits (e.g. for occupationally exposed people) or, at higher doses, mean absorbed doses in organs and tissues may be used for the assessment of risk of cancer or other detriments.

Mean absorbed dose in an organ or tissue

(63) In radiological protection, the main interest is directed not to the absorbed dose at a point in the human body, but to the absorbed dose averaged over a tissue or organ volume. The mean absorbed dose, $D_{\mathrm{T,R}}$, in an organ or tissue T due to radiation of type R is the basic quantity for the definition of the protection quantities equivalent dose and effective dose used for describing exposures at low doses and dose rates where stochastic effects are dominant. In a mixed radiation fields, the mean absorbed dose, D_{T}, in an organ or tissue T is given by:

$$D_{\mathrm{T}} = \sum_{\mathrm{R}} D_{\mathrm{T,R}} \tag{3.2}$$

(64) The mean absorbed dose is not always representative of the local absorbed dose throughout an organ or tissue (e.g. for low-penetrating radiation). For strongly-penetrating radiation, however, the absorbed dose distribution within most organs may be sufficiently homogeneous, and thus the mean absorbed dose is generally a suitable measure of the dose throughout the organ or tissue.

Equivalent dose in an organ or tissue

(65) The protection quantity equivalent dose in an organ or tissue, H_{T}, is defined by:

$$H_{\mathrm{T}} = \sum_{\mathrm{R}} w_{\mathrm{R}} D_{\mathrm{T,R}} \tag{3.3}$$

where w_{R} is the radiation weighting factor for radiation R which considers the differences in the radiobiological effectiveness of different radiations (see Section 3.2.2), and $D_{\mathrm{T,R}}$ is the average absorbed dose in the volume of a specified organ or tissue, T, due to radiation of type R. R is given by the type and, in the case of neutrons, the energy of radiation either incident on the body or emitted by radionuclides residing within the body. The sum is performed over all types of radiations involved. The SI unit of equivalent dose is J kg^{-1} and its special name is sievert (Sv). Equivalent doses,

Table 3.1. Tissue weighting factors, w_T (ICRP, 2007).

Organ/tissue	w_T	Total contribution
Lung, stomach, colon*, bone marrow, breast, remainder†	0.12	0.72
Gonads‡	0.08	0.08
Thyroid, oesophagus, bladder, liver	0.04	0.16
Bone surface, skin, brain, salivary glands	0.01	0.04

* The dose to the colon is taken to be the mass-weighted mean of upper large intestine (ULI) and lower large intestine (LLI) doses, as in the *Publication 60* (ICRP, 1991) formulation.

† The specified remainder tissues (14 in total, 13 for each sex) are: adrenals, extrathoracic tissue, gallbladder, heart, kidneys, lymphatic nodes, muscle, oral mucosa, pancreas, prostate (♂), small intestine, spleen, thymus, and uterus/cervix (♀).

‡ The w_T for gonads is applied to the mean of the doses to testes and ovaries.

H_T^M and H_T^F, are specified in male and female bodies represented by male and female reference voxel phantoms.

Effective dose

(66) Effective dose, E, was introduced in *Publication 60* (ICRP, 1991), and was redefined in *Publication 103* (ICRP, 2007) as:

$$E = \sum_T w_T H_T \tag{3.4}$$

where w_T is the tissue weighting factor for organ or tissue T representing the relative contribution of that organ or tissue to the total health detriment resulting from uniform irradiation of the body at low doses and dose rates. It is $\sum w_T = 1$. The sum is performed over 14 organs and tissues of the human body considered individually in the definition of E, and for which specific w_T values are given in Table 3.1, and remainder tissues representing a mean value of further tissues (14 tissues, but only 13 tissues for each gender) (see Table 3.1).

(67) The SI unit of effective dose is J kg^{-1}, and its special name is sievert (Sv). The same unit is also used for operational dose quantities. Care must be taken in ensuring that the quantities used are stated clearly.

(68) In the calculation of effective dose, the equivalent dose H_T is taken as the mean value averaged over the male and female organ or tissue:

$$H_T = 0.5\left(H_T^M + H_T^F\right) \tag{3.5}$$

(69) The concept of tissue weighting factors was introduced in 1977 (ICRP, 1977), extended in 1991 (ICRP, 1991), and further modified in 2007 (ICRP, 2007). The values of w_T for the specified tissues and organs are based on the detriment due to stochastic effects after radiation exposure and on judgements. They represent mean values for humans averaged over all ages and both sexes.

(70) The use of effective dose allows exposures in very different situations (e.g. internal and external exposure to different types of radiation and inhomogeneous exposures of the body) to be combined, and results in a single dose value that simplifies the specification of exposure limits considerably. Effective dose, however, is not designed as a quantity considering individual properties of a specific person,

Table 3.2. Operational quantities for external exposure.

Task	Operational quantities for:	
	Area monitoring	Individual monitoring
Control of effective dose	Ambient dose equivalent, $H*(10)$	Personal dose equivalent, $H_p(10)$
Control of doses to skin, hands, and feet	Directional dose equivalent, $H'(0.07, \Omega)$	Personal dose equivalent, $H_p(0.07)$
Control of doses to the lens of the eye	Directional dose equivalent, $H'(3, \Omega)$	Personal dose equivalent, $H_p(3)$

and should, therefore, not be applied for an assessment of radiation risk of an individual.

3.1.2. Operational quantities for external exposure

(71) The protection quantities defined by mean organ or tissue doses in the human body are not measurable in practice and, therefore, cannot be used as quantities in radiation monitoring. For radiation measurements in situations of external exposure (area or individual monitoring), specific operational dose quantities have been defined by ICRU (1985, 1988, 1993b, 2001). In monitoring at low doses, the values of these quantities are taken as sufficiently accurate assessments of effective dose or skin dose or dose to the lens of the eye, respectively, if their values are below the recommended limits for occupational exposure.

(72) The basis for definition of the operational quantities is the quantity dose equivalent, H, defined by:

$$H = QD \tag{3.6}$$

where D is the absorbed dose at the point of interest in tissue, and Q is the corresponding mean quality factor due to the charged particles at that point.

(73) Table 3.2 shows how different operational quantities can be applied for the different tasks of monitoring of external exposures (ICRP, 2007).

(74) The operational quantities for area monitoring at a location in a radiation field are defined by the dose equivalent at a point in a simple phantom, the ICRU sphere. It is a sphere of tissue-equivalent material [30 cm in diameter, ICRU (soft) tissue with density 1 g cm^{-3}, mass composition 76.2% oxygen, 11.1% carbon, 10.1% hydrogen, 2.6% nitrogen]. These quantities are defined to be point quantities fulfilling the condition of being additive with respect to the different components of the radiation field at the point of interest. For its definition, the terms 'expanded' and 'expanded and aligned' fields are introduced (see Glossary), and the value of the quantity is given by the dose at a point at a fixed depth in the sphere. The sphere is hypothetical, a mathematical construct for determination of the values of the quantities for area monitoring.

Ambient dose equivalent, $H^*(10)$

(75) For area monitoring, the operational quantity for assessing effective dose is the ambient dose equivalent, $H^*(10)$, defined by ICRU (2001) as:

The ambient dose equivalent, $H^*(10)$, at a point in a radiation field, is the dose equivalent that would be produced by the corresponding expanded and aligned field in the ICRU sphere at a depth of 10 mm on the radius vector opposing the direction of the aligned field.

(76) In most practical situations on Earth, the ambient dose equivalent provides a conservative estimate of the effective dose that a person would receive at that position. This, however, may not be the case for persons in high-energy radiation fields, such as cosmic radiation fields (Pellicioni, 1998).

Directional dose equivalent, $H'(d,\Omega)$

(77) For area monitoring, the operational quantity for assessing the dose to the skin, the extremities (hands, arms, feet), and the lens of the eye is the directional dose equivalent, $H'(d,\Omega)$ defined by:

The directional dose equivalent, $H'(d,\Omega)$, at a point in a radiation field, is the dose equivalent that would be produced by the corresponding expanded field in the ICRU sphere at a depth, d, on a radius in a specified direction, Ω.

(78) For assessing the dose to the skin and the extremities, $d = 0.07$ mm is used and $H'(\mathrm{d},\Omega)$ is then written $H'(0.07,\Omega)$. In case of monitoring the dose to the lens of the eye, the quantity $H'(3,\Omega)$ with $d = 3$ mm was recommended by ICRU.

Personal dose equivalent, $H_p(d)$

(79) Individual monitoring of external exposure is usually performed with personal dosimeters worn on the body, and the operational quantity defined for this application takes this situation into account. For individual monitoring, the operational quantity is the personal dose equivalent, $H_p(d)$:

The personal dose equivalent, $H_p(d)$, is the dose equivalent in ICRU (soft) tissue (see Section 5.3) at an appropriate depth, d, below a specified point on the human body.

(80) The specified point is usually given by the position where the personal dosimeter is worn. A depth $d = 10$ mm is recommended for the assessment of effective dose, and a depth $d = 0.07$ mm is recommended for the assessment of equivalent dose to the skin, hands, and feet. In special cases of monitoring, a depth $d = 3$ mm has been proposed to be appropriate for the assessment of dose to the lens of the eye.

3.2. Description of radiation quality

(81) The biological effectiveness of ionising radiation with respect to the induction of cancer or other tissue reactions in the human body and of hereditary effects depends on the type and energy of the radiation, on the tissue type exposed, on the dose and dose rate applied to the tissue, and on the detriment considered. The induced

effects also differ in the latency time between the exposure and the occurrence of the effects.

(82) In radiological protection, the effectiveness at low doses and dose rates is the main area of interest. For these doses and dose rates, the stochastic effects (cancer induction and hereditary effects) are important, and the standard approach in radiological protection is that the shape of the dose–response relationship at low doses and dose rates is based on the model that the probability of a stochastic effect is proportional to the applied dose (linear-non-threshold (LNT) model) (ICRP, 2005).

(83) At higher doses, however, when non-stochastic effects (deterministic effects, tissue reactions) may occur, the linear-non-threshold model is not an acceptable approximation. Tissue reactions always occur above a dose threshold. The threshold dose value depends on the type of tissue reaction, and is generally above an applied absorbed dose of 0.5–2 Gy.

(84) In principle, for risk estimates from exposure to different types of ionising radiation, the absolute values of biological effectiveness of radiation with respect to the induced effect need to be known. The most common procedure for taking care of the differences in biological effectiveness, however, is the use of risk factors for a reference radiation (usually photons), and consideration of the differences of other types of radiation by application of the relative biological effectiveness (RBE) factor. This factor was introduced by Failla and Henshaw (1931), and was discussed in detail in *Publication 92* (ICRP, 2003). While RBE values always depend on the biological endpoint considered and on the dose and dose rate applied, for definition of quantities in radiological protection, a single set of radiation weighting factors and radiation quality factors has been chosen (ICRP, 2007) based on data at low doses and dose rates. This is discussed in the following sections.

3.2.1. Relative biological effectiveness

(85) In radiobiology, the differences in the effectiveness of the different ionising radiations have led to the definition of RBE. RBE values are given as the ratio of the absorbed doses of two types of radiation producing the same specified biological effect under identical irradiation conditions (dose value of a reference radiation divided by the corresponding dose value of the considered radiation at the same level of the specified biological effect). RBE values depend on the conditions of exposure, including the biological effect investigated, the tissue or cell type exposed, the dose and dose rate, and the dose fractionation scheme. Therefore, for a given type of radiation, experimental investigations often provide a large range of RBE values (ICRP, 2003). As the basis for selecting radiation weighting factors (see Section 3.2.2), RBE values with respect to stochastic effects (cancer induction and hereditary effects) are the main focus. Usually, RBE values increase with decreasing dose and dose rate, and are believed to reach maximum values (RBE_M) at low doses and low dose rates. RBE_M values are most relevant for radiological protection applications. In *Publication 92* (ICRP, 2003), different methods are discussed to determine RBE_M at low doses and dose rates. The discussion includes various types of high-LET radiation

(e.g. protons, neutrons, alpha particles). For heavy ions, however, very limited data were available at that time.

(86) Generally, low-LET radiation is taken as reference radiation, mostly high-energy x rays or gamma rays from ^{60}Co or ^{137}Cs. There are, however, substantial differences in the biological effectiveness of photons of different energies (Schmidt et al., 2002). Nevertheless, there is no international recommendation for the definition of a specific photon source as a general reference radiation. This has the consequence that a broad range of experimental data with photons has been used as a basis for the definition of radiation weighting and quality factors (ICRP, 2003).

(87) While, on the one hand, RBE_M values are the basis for the definition of radiation weighting factors and the $Q(L)$ function, on the other hand, RBE values are used for the assessment of radiation risks from human exposures by different types and energies of radiation. A risk factor for the radiation and tissue of interest is obtained by multiplying the risk factor for the reference radiation (e.g. photons) by the corresponding RBE value. However, there is uncertainty for risk assessment because RBE values are often determined by investigating biological effects in single cells or small animals at higher doses, while radiation risks are assessed for stochastic effects (e.g. cancer induction and hereditary effects) in humans.

(88) The biological effectiveness of ionising radiation is known to be correlated with its energy deposition properties along the tracks of charged particles, especially with the ionisation density along their tracks. For applications in radiological protection, the complex structure of the charged particle tracks in tissue is characterised by a single parameter, the unrestricted LET, L_∞ (often denoted as LET or L) in water. Unrestricted LET, L_∞ means that the transfer energy includes the energies of all emitted delta electrons independent of their range, while restricted LET, L_Δ, means that only delta electrons with energies of less than Δ are considered. In general, LET is not simply related to the biological effectiveness because, for example, ions of different Z show different effectiveness at the same LET value (Cucinotta et al., 2000a).

(89) The study of the LET dependence of RBE is concentrated on the study of radiation effects in single cells by irradiating thin cell samples with charged particles of various types and energies. In animal experiments, however, with long ranges of charged particles in the tissue, the LET dependence of an effect (e.g. cancer induction) is more difficult to study.

(90) For neutrons and alpha particles, a broad range of experimental data for many different biological endpoints exists, including data from animals (NCRP, 1990; ICRP, 2003); however, the situation for high-energy charged particles is more problematic. Epidemiological data on cancer induction in humans from exposure to high-energy particles and heavy ions are not available, and experimental data on cancer induction in animals are scarce (ICRP, 2003). Most RBE data for high-energy protons and heavy ions have been obtained from experiments with cells at high doses (>1 Gy) and high dose rates which are of particular interest for heavy-ion radiotherapy applications (Taucher-Scholz and Kraft, 1999; Durante et al., 2002; George et al., 2003), with only a few studies of tumours in mice (Fry et al., 1985; Alpen et al., 1993; Weil et al., 2009).

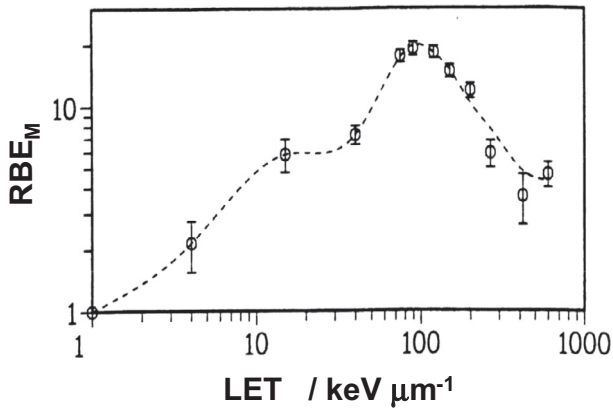

Fig. 3.2. Maximum relative biological effectiveness (RBE_M) vs linear energy transfer (LET) for oncogene transformations in C3H10T1/2 cells of embryos of mice (Brenner and Hall, 1992).

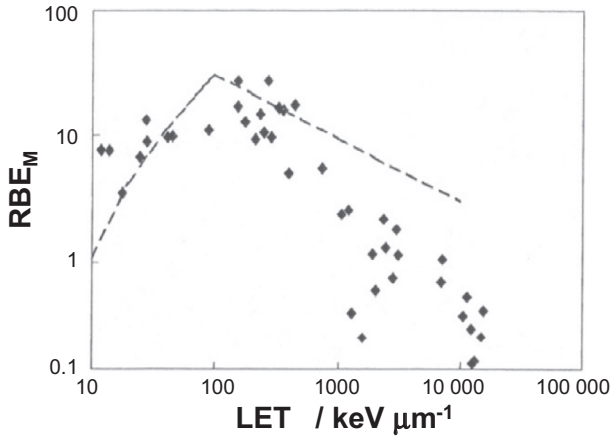

Fig. 3.3. Maximum relative biological effectiveness (RBE_M) vs linear energy transfer (LET) for the induction of mutations at the hprt locus in Chinese hamster V79 cells. Data are from Kiefer et al. (1999, 2001). The dashed line shows the $Q(L)$ function as defined in *Publication 60* (ICRP, 1991).

(91) Experimental data of RBE vs LET have been obtained for various biological endpoints. The general shape of the RBE–LET relationship is always similar. At low LET values, there is an increase in RBE with increasing LET up to approximately 100–150 keV μm^{-1}, and for higher LET values, RBE decreases with increasing LET. Figs 3.2–3.4 show some typical examples of RBE–LET relationships obtained for different biological endpoints.

(92) In general, the biological effectiveness is not simply related to LET, especially for heavy ions with high LET values. This is because the width of a particle track depends on the velocity of the particles. Particles of different Z show different effec-

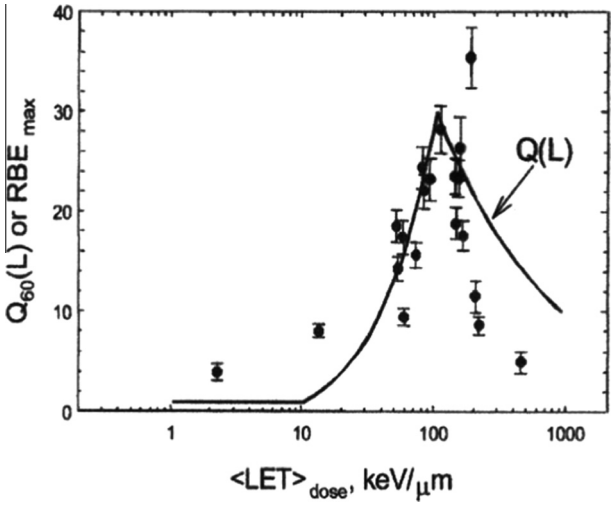

Fig. 3.4. Maximum relative biological effectiveness (RBE_{max}) vs linear energy transfer (LET) for total chromosomal exchanges measured within the first cell cycle using the premature chromosome condensation method (George and Cucinotta, 2007; Cucinotta et al., 2008). The line shows the $Q(L)$ function as defined in *Publication 60* (ICRP, 1991).

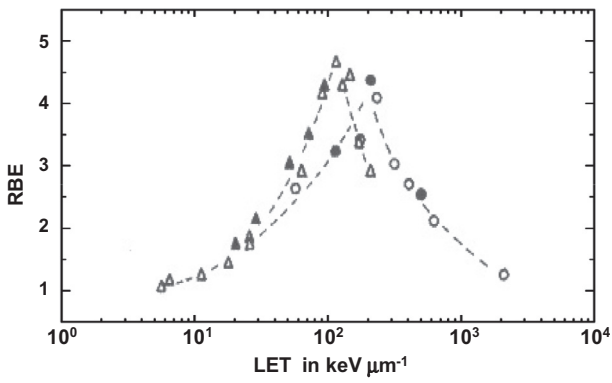

Fig. 3.5. Relative biological effectiveness (RBE) for inactivation of V79 hamster cells (closed symbols) and T1 mammalian cells (open symbols) exposed to beams of accelerated heavy ions (▲, △ deuterons and He ions; •, ○ heavier ions) vs linear energy transfer (LET) (Thacker et al., 1979).

tiveness at the same LET value (Cucinotta et al., 2011). The position of the peak RBE vs LET depends on particle charge number and does not occur at a fixed LET (see Figs 3.5 and 3.6). The peak position changes from less than 100 keV μm^{-1} to more than 150 keV μm^{-1} as Z increases from protons with $Z = 1$ to Fe with $Z = 26$. RBE depends on charge Z and energy E of the particle, and not on LET alone. At a fixed value of LET less than the peak position, particles with lower Z are more biologically effective. In addition, the slope of rise of RBE with LET is

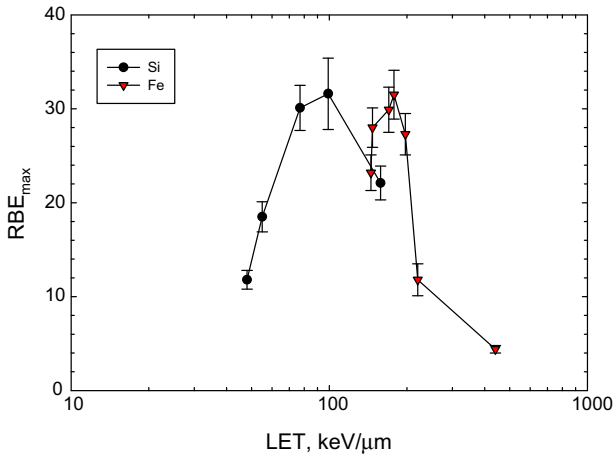

Fig. 3.6. Maximum relative biological effectiveness (RBE_{max}) vs linear energy transfer (LET) for chromosomal aberrations (total exchange) of human lymphocytes exposed to Si and Fe nuclei, relative to low-dose and low-dose-rate gamma rays (George and Cucinotta, 2007).

variable with the endpoint/system studied, and the slope of decrease of RBE at high LET values is predicted to be proportional to LET^{-1} rather than $LET^{-1/2}$.

(93) For the same LET value, the distribution of delta rays varies strongly with the ion considered (see Fig. 3.7). The approach of describing radiation quality in terms of LET assumes that the various ion tracks shown in Fig. 3.7 produce the same cancer risk, although the initial physicochemical stages are quite distinct. Hence, there is considerable support to relate RBE to a function better correlated to the track structure of the charged particles passing tissue (Cucinotta et al., 2011), especially to the spatial distribution of delta rays along the tracks. Arguments by Katz (1970) and Katz et al. (1972) and observations by Goodhead et al. (1980) support the hypothesis that, especially for heavy ions, biological effects are strongly influenced by particle track structure including delta-ray effects rather than by the stopping power (LET) alone.

(94) A parameter Z^{*2}/β^2, where Z^* is the effective charge number of the nuclei and β is the velocity of the nuclei relative to the light velocity, has been proposed (Katz, 1970; Katz et al., 1972) to be a better descriptor of energy deposition in small volumes than LET, especially for heavy ions. This is based on the idea that a reaction cross section with respect to biological reactions in tissue should include the effect of delta rays. A value of Z^* can be obtained using the following equation given by Barkas (1963):

$$Z^* = Z(1 - \exp(-125\beta Z^{2/3})) \tag{3.7}$$

where Z is the charge number of the nuclei considered. As an example, Fig. 3.8 shows calculations comparing the frequency of energy deposition above 300 eV in a volume of about the size of a nucleosome. Obviously, the parameter Z^{*2}/β^2 pro-

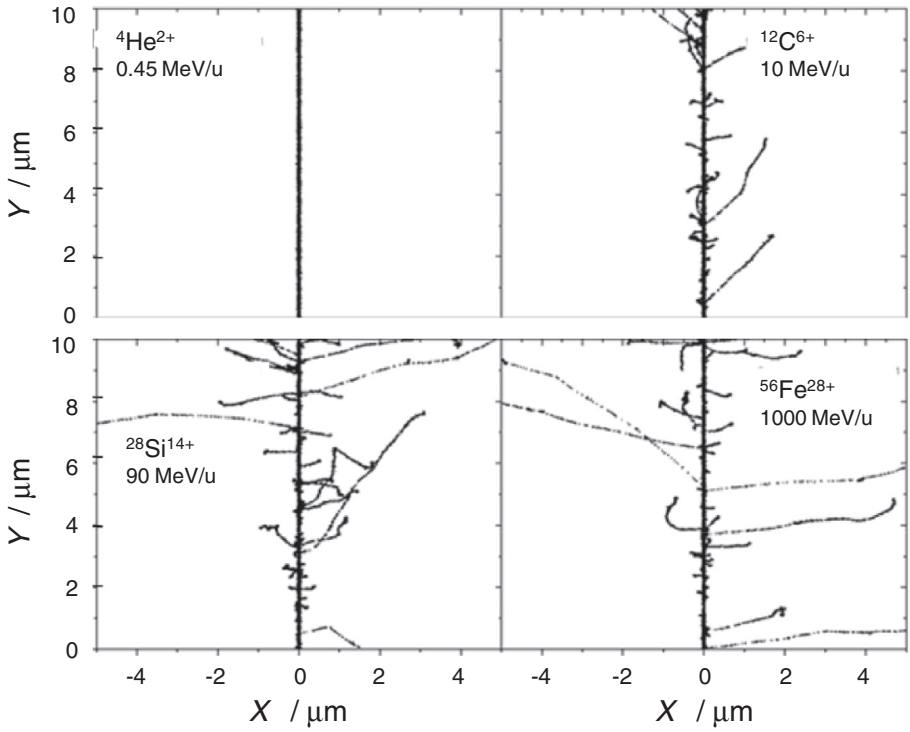

Fig. 3.7. Simulated track segments for the following ions in water: ^{4}He (0.45 MeV/u), ^{12}C (10 MeV/u), ^{28}Si (90 MeV/u), and ^{56}Fe (1 GeV/u). Shown are projections over the XY plane. Ions are generated at the origin along the *Y* axis in liquid water at 25 °C under identical linear energy transfer conditions (~150 keV µm^{-1}). Each dot represents a radiolytic species (Plante and Cucinotta, 2008).

vides an improved descriptor of energy deposition in small volumes compared with LET.

(95) As a consequence, an RBE function has been derived and described to be dependent on two parameters of the particle, either given by E and Z, or alternatively by Z^{*2}/β^2 (Cucinotta et al., 2011). In Fig. 3.9, the same RBE data as shown in Fig. 3.5 are plotted against Z^{*2}/β^2, and this plot may be a better basis for defining a quality factor function than using the LET parameter.

3.2.2. Radiation weighting factor

(96) Radiation weighting factors (w_R) have been used in the definition of the protection quantity equivalent dose in an organ or tissue in *Publication 60* (ICRP, 1991) and numerically modified in *Publication 103* (ICRP, 2007). Values of w_R are given for various types of radiation either incident on the human body or emitted by radionuclides in the body. Data for w_R are given in Table 3.3. The same values of the radiation weighting factors are applied to all tissues and organs of the body, independent

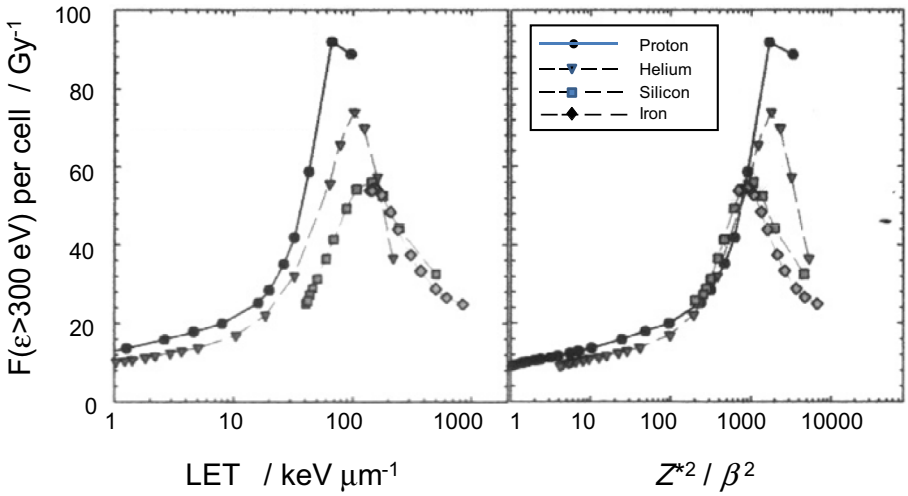

Fig. 3.8. Number of nucleosomes per cell receiving 300 eV or more as a function of linear energy transfer (LET) (left) or Z^{*2}/β^2 (right). Calculated data are shown for H, He, Si, and Fe nuclei (Cucinotta, 2011).

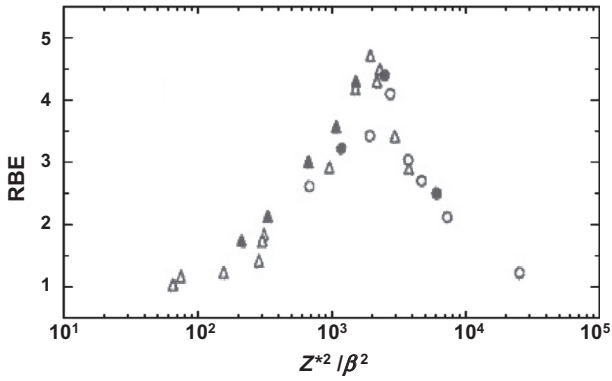

Fig. 3.9. Relative biological effectiveness (RBE) for inactivation of V79 hamster cells (closed symbols) and T1 mammalian cells (open symbols) exposed to beams of accelerated heavy ions (▲, △ deuterons and He ions; •, ○ heavier ions) vs $(Z^*/\beta)^2$ (Thacker et al., 1979).

of the degradation of the primary radiation and the production of secondary radiations of different radiation quality. It may be seen as a mean factor representing radiation quality averaged over the different tissues and organs of the body. The application of w_R values is restricted to low doses and dose rates, and should not be applied in cases of higher doses where tissue reactions may occur.

(97) A single weighting factor value is given for each type of particle except neutrons. This simplification is seen to provide sufficient precision for general applications in radiological protection, even if it is well known that radiation quality also depends on the energy of the particle involved. This is especially the case for heavy

Table 3.3. Radiation weighting factors*, w_R (ICRP, 2007).

Radiation type	Radiation weighting factor, w_R
Photons	1
Electrons and muons	1
Protons and charged pions	2
Alpha particles, fission fragments, heavy ions	20
Neutrons	A continuous curve as a function of neutron energy [see Eq. (3.9) and Fig. 3.2]

* All values relate to the radiation incident on the body or, for internal sources, emitted from the source.

ions of high energies; however, these are less important for radiological protection in most radiation fields on Earth.

(98) For neutrons, the following function is recommended for the calculation of radiation weighting factors (ICRP, 2007):

$$W_R = \begin{cases} 2.5 + 18.2e^{-[\ln(E_n)]^2/6}, & E_n < 1 \text{ MeV} \\ 5.0 + 17.0e^{-[\ln(2E_n)]^2/6}, & 1 \text{ MeV} \le E_n \le 50 \text{ MeV} \\ 2.5 + 3.25e^{-[\ln(0.04E_n)]^2/6}, & E_n > 50 \text{ MeV} \end{cases} \tag{3.8}$$

where the neutron energy, E_n, is given in MeV (see also Fig. 3.10).

(99) For applications in space, where high-energy heavy ions contribute significantly to the total dose in the human body, a more realistic approach for radiation weighting should be chosen (ICRP, 2007). This could, for example, be based on the calculation of mean quality factors in the human body (see Section 3.2.3). Some other difficulties with the w_R concept for application in high-energy radiation fields have been discussed by Pellicioni (1998).

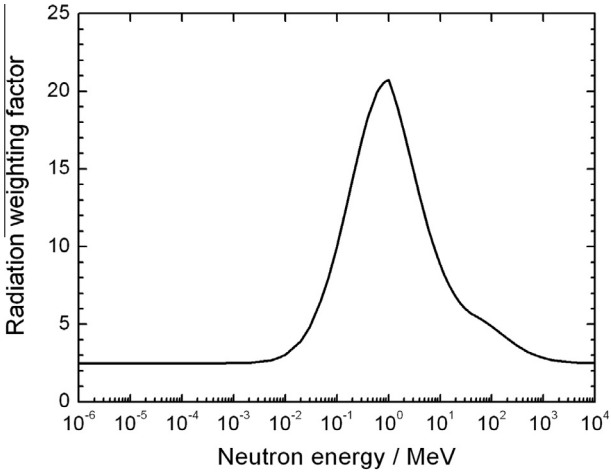

Fig. 3.10. Radiation weighting factor (w_R) for neutrons vs neutron energy (ICRP, 2007).

3.2.3. Quality factor

(100) Radiation quality is strongly correlated with the energy deposition properties along the tracks of charged particles, especially with the ionisation density along their tracks. For applications in radiological protection, the different biological effectiveness of radiation is considered by introducing the quality factor function, $Q(L)$. $Q(L)$ characterises the biological effectiveness of a charged particle, with L at a point of interest in tissue relative to the effectiveness of a reference radiation at this point. Q is defined by a function of L in water (not in tissue) as given in various publications of ICRP and ICRU (ICRP/ICRU, 1963; ICRU, 1970, 1986, 2011; ICRP, 1977, 1991). RBE values provide the basis for the selection of a quality factor function used in the definition of the specific dose quantities in radiological protection (see Section 4.2). For this application, all photons and electrons (all low-LET radiation with $L < 10$ keV μm^{-1}) are weighted by $Q = 1$. This approximation is sufficient for usual radiation protection applications, and simplifies measurements and calculations considerably.

(101) The actual quality factor function $Q(L)$ with L for charged particles in water was given in *Publication 60* (ICRP, 1991):

$$Q(L) = \begin{cases} 1 & L < 10 \text{ keV } \mu\text{m}^{-1} \\ 0.32L - 2.210 \text{ keV } \mu\text{m}^{-1} \leq & L \leq 100 \text{ keV } \mu\text{m}^{-1} \\ 300/\sqrt{L} & L > 100 \text{ keV } \mu\text{m}^{-1} \end{cases} \tag{3.9}$$

(102) The $Q(L)$ function is the outcome of radiobiological investigations on cellular and molecular systems, as well as on the results of animal experiments (ICRP, 2003), and has not been changed since 1990. However, the function includes some judgements for simplifying radiological protection practice, e.g. $Q(L) = 1$ for $L < 10$ keV μm^{-1}, even it is well known that the RBE of photons increases with decreasing energy (ICRP, 2003).

(103) The quality factor Q at a point in tissue is then given by:

$$Q = \frac{1}{D} \int_{L=0}^{L=\infty} Q(L) D_L \mathrm{d}L \tag{3.10}$$

where D is the absorbed dose in tissue and $D_L = dD/dL$ is the distribution of D in L (for charged particles in water) at the point of interest in tissue.

(104) For neutron exposure of the human body, the radiation field is modified in the body by moderation of the incident neutrons and secondary radiation from neutron reactions. Therefore, for a given neutron exposure situation, the value of the quality factor depends on the position in the body, and the mean radiation quality factor in organs and tissues of the body may differ. For each organ or tissue T, a tissue-mean radiation quality factor, Q_T, can be calculated using:

$$Q_\mathrm{T} = \frac{1}{m_\mathrm{T} D_\mathrm{T}} \int_{m_\mathrm{T}} \int_\mathrm{L} Q(L) D_L \mathrm{d}L \mathrm{d}m \tag{3.11}$$

where m_T is the mass of the organ or tissue T. A body-mean quality factor, Q_E, averaged over the human body by considering the mean organ absorbed doses, D_T, and the tissue weighting factors, w_T, is given by:

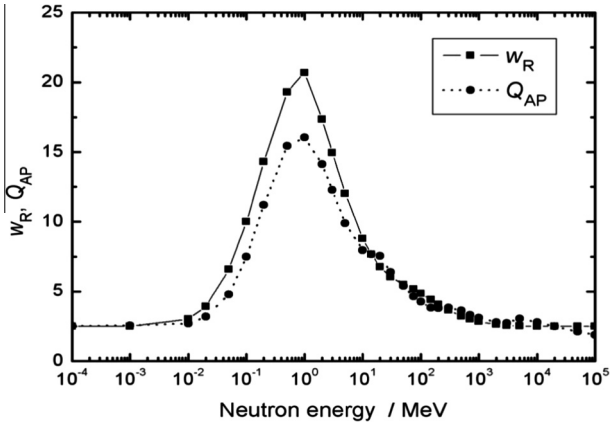

Fig. 3.11. Radiation weighting factor (w_R) and body-averaged mean quality factor ($Q_{E,AP}$) calculated for neutrons (AP incidence) vs neutron energy (Sato et al., 2009).

$$Q_E = \sum_T w_T Q_T D_T \Big/ \sum_T w_T D_T \tag{3.12}$$

(105) Fig. 3.11 shows both the radiation weighting factor and the body-mean quality factor, $Q_{E,AP}$, for mono-energetic neutrons (antero-posterior (AP) incidence) vs neutron energy. $Q_{E,AP}$ are averaged data from calculations using the adult male and female reference phantoms. Values of Q_E are similar for other directions of neutron incidence (e.g. isotropic). Obviously, stronger differences between w_R and Q_E

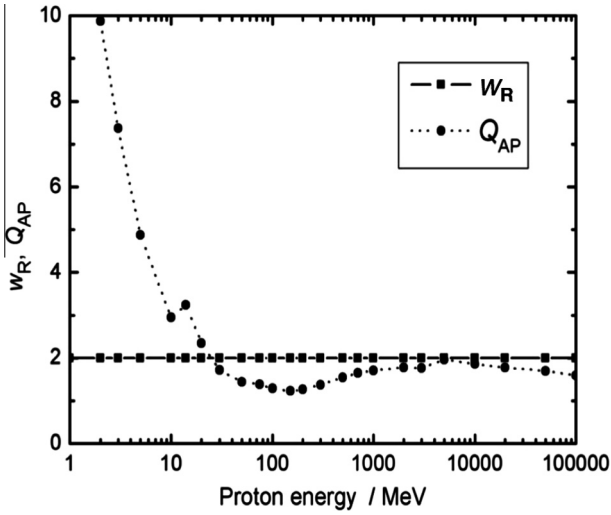

Fig. 3.12. Radiation weighting factor (w_R) and body-averaged mean quality factor ($Q_{E,AP}$) calculated for protons (AP incidence) vs proton energy (Sato et al., 2009).

are only for neutron energies between 0.1 and 10 MeV. For neutron energies above 10 MeV, the difference is negligible. Differences between Q_T and w_R for a single organ may, however, be much larger.

(106) Similar calculations have been performed for incident protons by Sato et al. (2009), and these data are shown in Fig. 3.12.

(107)While there are large differences between the radiation weighting factor and the mean quality factor for energies of incident protons below approximately 10 MeV, they are much lower at higher proton energies and are less than 20% at proton energies above 1 GeV. Protons below approximately 10 MeV, however, are low-penetrating radiation that are mainly stopped in the skin of exposed persons, and hence contribute little to the effective dose in cosmic radiation fields with many protons of high energies. When exposure of the skin needs special attention, protons below approximately 10 MeV need to be considered. In such cases, the absorbed dose to the skin, and not the effective dose, is of prime interest.

(108) At proton energies above 20 MeV, the mean quality factor is always between 1 and 2. At these energies, protons can be seen to be low-LET particles. The increase of Q at energies above 150 MeV is due to proton reactions in tissue where secondary charged particles are produced.

(109) While the difference between w_R and the mean quality factor is relatively small for high-energy neutrons and protons, the situation is quite different for heavy ions.

(110) The body-mean quality factor varies strongly with the type and energy of the ion (Sato et al., 2010), while the w_R value has been fixed at 20 for all heavy ions and all energies. For example, Fig. 3.13 shows body-mean values of Q_E for ^{4}He, ^{12}C, ^{24}Mg, and ^{56}Fe ions with isotropic (ISO) radiation incidence to the body. The value

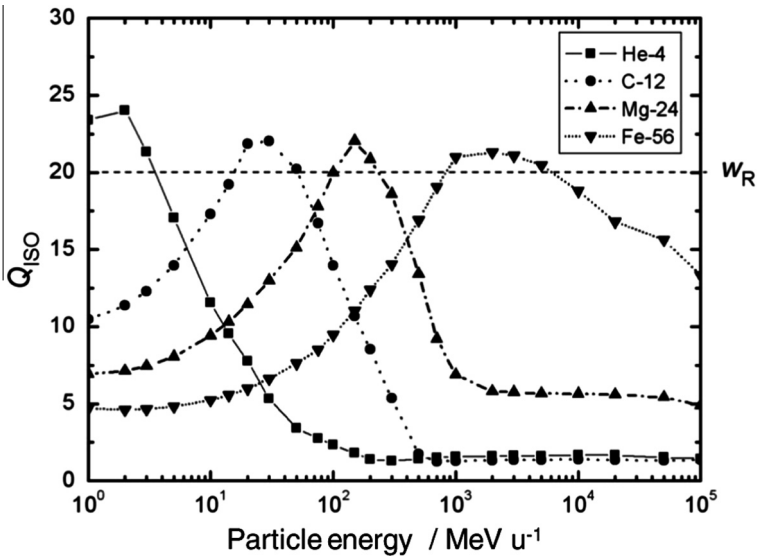

Fig. 3.13. Radiation weighting factor (w_R) and body-averaged quality factors ($Q_{E,ISO}$) for ^{4}He, ^{12}C, ^{24}Mg, and ^{56}Fe (ISO incidence) vs particle energy (Sato et al., 2010).

varies between approximately 2 and 24 depending on the ion type and energy. There are also strong variations in Q_T depending on the position of the organ or tissue in the human body. This situation underlines the decision not to select a single radiation weighting factor value for all heavy ions and all particle energies. The recommended concept of quantities for use in radiological protection of astronauts in space takes account of this fact (see Section 4.3.1).

(111) Similar to the dependence of RBE for high-energy ions, a different way of defining a quality factor function may be derived from the track structure of the charged particles rather than being related solely to LET. Cucinotta et al. (2011) proposed a functional dependence of a quality factor on two parameters of the particle, Z and E, which can be expressed in terms of Z^{*2}/β^2 and LET. As the RBE values for the induction of leukaemia and solid cancers are quite different, they proposed two different functions $Q(Z, E)$ for leukaemia and solid cancers (see Fig. 3.14).

(112) The general ideas discussed on track-structure models have been used to define a cross section function related to risk, which may be written as:

$$\Sigma(Z, E) = \Sigma_0 P(Z, E) + (\alpha_\gamma\ L/6.24)(1 - P(Z, E)) \tag{3.13}$$

with:

$$P(Z, E) = (1 - \exp(-Z^{*2}/\kappa\beta^2))^m \tag{3.14}$$

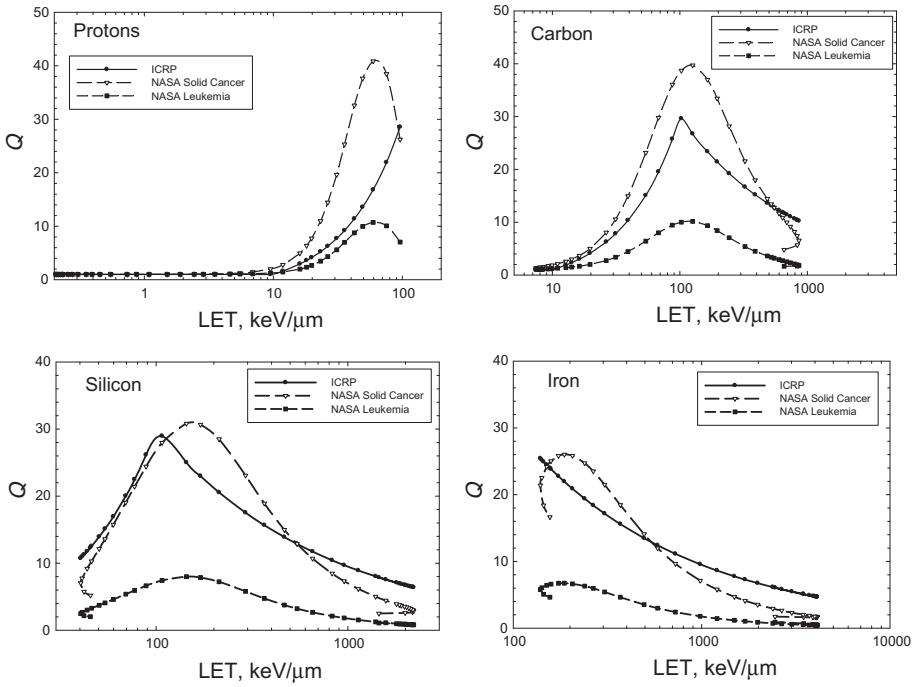

Fig. 3.14. Linear energy transfer (LET) dependence of the quality factor (Q) for H, C, Si, and Fe nuclei as defined by ICRP (1991) and proposed by the National Aeronautics and Space Administration (NASA) (Cucinotta, 2011), differently defined for considering relative risks of either solid cancer or leukaemia.

where Σ_0, m, and κ are parameters that should be based on fits to data from radiobiology experiments, and the low-LET slope, α_γ, estimated from epidemiological data for gamma radiations. The parameter β is the particle velocity relative to the velocity of light. Z^* is the effective charge number which includes a velocity-dependent correction to Z at low particle energies (Barkas, 1963), as defined in Eq. (3.7). Using the equations above, a quality factor function, $Q(Z, E)$ can then be defined by:

$$Q(Z,E) = (1 - P(Z,E)) + 6.24(\Sigma_0/(\alpha_\gamma L))P(Z,E) \tag{3.15}$$

(113) Note that L is not an independent variable in addition to Z and E, but for a given Z and E, the L value is fixed. Alternatively, one may write $Q(Z, L)$ or $Q(E, Z^{*2}/\beta^2)$. At high particle energies, this function defines a $1/L$ dependence of Q different from the $1/L^{1/2}$ dependence given by the $Q(L)$ function of Eq. (3.10). The interpretation of the parameters is quite general, and is not tied to a particular track structure model per se, but rather is an efficient parameterisation of radiobiological data for particles. The parameters can be described as follows: Σ_0 is the maximum value of the cross section, which is related to $\mathrm{RBE}_{\max}$ for the most biologically effective particle types; m is the slope of the cross section for increasing ionisation density, with values $m > 1$ necessary to have RBE > 1; and κ determines the saturation value of the cross section with increasing Z^{*2}/β^2, where RBE begins to decline.

(114) High-energy protons of approximately 150 MeV have LET similar to gamma radiation, and their kinetic energy is below a value where nuclear reactions become important. Many experiments have shown the biological effectiveness for those protons to be very similar to gamma radiation. For protons of this energy, it is $\mathrm{P}(Z, E) << 1$ and $Q \sim 1$.

(115) For solid cancer risks, radiobiological data are sparse. However, the largest RBE for HZE nuclei is in the range from 20 to 50 for solid tumours in rodents, and for chromosomal aberrations and mutations in human cells. A lower value is found for leukaemia. This assumes a linear dose response at low doses for charged particles, ignoring non-targeted effects or other possible mechanisms that may lead to deviations from linearity. Thus, for example, if a peak RBE value of approximately 40 is assumed for Si at 100 keV $\mu\mathrm{m}^{-1}$ where $\mathrm{P}(Z, E) \sim 1$, Σ_0/α_γ can be estimated as $40 \times 100/6.24$. A comparison of the quality factor based on LET and on both L and Z is shown in Fig. 3.14. The influence of the uncertainties in the values of these parameters, which describe the uncertainties in information on $\mathrm{RBE}_{\max}$ and the peak position of $\mathrm{RBE}_{\max}$ with LET for different particles, can be investigated using Monte Carlo methods (Cucinotta et al., 2011).

3.3. Approach for space applications

(116) The situation in a space vehicle is characterised by the primary radiation field consisting of various high-energy charged particles from protons up to heavy ions such as ^{56}Fe or even higher Z values, and by radiation components of photons, electrons, neutrons, and other reaction products from the interaction of primary particles with the materials of the spacecraft (see Chapter 2). This results in many different types of radiation together with broad energy distributions up to particle energies of many GeV/u.

(117) Individual doses are generally higher than in usual exposure situations on Earth. As a consequence, deterministic effects in specific organs (e.g. lens of the eye or skin) cannot be ignored. This needs specific consideration and will be discussed further in Section 4.3.3.

(118) The consequence of this specific situation is that some concepts of the quantities used in radiological protection on Earth have to be reconsidered for use in space. For example, the operational quantity for area monitoring of penetrating radiation, which is based on the dose equivalent at 10 mm depth of the ICRU sphere, has been mainly designed on the basis of photon and neutron data for control of effective dose, and is limited in its application to radiation with energies where secondary charged particle equilibrium is achieved at approximately 10 mm depth in tissue. This is not the case for very-high-energy particles. For this situation, computer modelling and simulation of exposure situations become very important in addition to measurements.

3.3.1. Protection quantities

(119) Radiation risk estimates are generally based on absorbed doses in the tissues and organs of the human body, and the concept of the mean absorbed dose, D_T, in various organs and tissues of the body (see Section 3.1.1) has been assumed to be applicable for astronauts in space. However, this concept can be limited by the fact that fluence rates of heavy ions are very low. If few particles pass an organ with a high energy transfer along each single particle track, averaging the dose over an organ is a simplification that increases the uncertainty when risk estimates are considered. Another problem arises due to the large fraction of charged particles in the radiation field. Depending on their energy, they may be stopped in the human body, and hence the depth dose distribution may not be sufficiently homogenous over larger tissues or organs in the body to consider an averaged value. Nevertheless, the mean absorbed dose in organs or tissues of the body is a very useful concept for radiological protection practice, and this problem is less important for omnidirectional (isotropic) exposure of an astronaut, which can often be assumed in space.

(120) D_T is a quantity that cannot be measured but is usually determined by applying calculated conversion coefficients that relate the mean dose in an organ or tissue to an external radiation field quantity (fluence for particles or air kerma for photons). D_T is not calculated for any individual but for adult male and female reference persons (ICRP, 2009), and is therefore restricted in the assessment of individual doses. The charged particles in the energy range of several GeV/u which are present in space have very long ranges in tissue, which results in relatively homogeneous exposure of the human body, and variation of the mean organ doses is not very large, especially in cases of isotropic exposure (see Section 7.3).

(121) Obviously, the general use of $w_R = 20$ for all heavy ions does not reflect the variation of RBE with type and energy of heavy ions, and the Q approach is better correlated with the assumption of a general dependence of RBE on LET and possibly on Z^{*2}/β^2 (see Section 3.1.3). Therefore, it is suggested that the approach applied by the space agencies (NCRP, 2000) should be followed, and the term 'dose equivalent in an organ or tissue T′, $H_{T,Q}$, should be used, defined by:

$$H_{T,Q} = Q_T D_T \tag{3.16}$$

with the mean quality factor Q_T in an organ or tissue T for the given radiation field. When using the $Q(L)$ function, Q_T is calculated by:

$$Q_T = \frac{1}{m_T D_T} \int_{m_T} \int_{L=0}^{L=\infty} Q(L) D_L \mathrm{d}L \mathrm{d}m \tag{3.17}$$

with the mass, m_T, of the organ or tissue considered.

(122) If a quality factor is defined by a function $Q(Z, E)$, a Q_T value can be calculated by:

$$Q_T = \frac{1}{m_T D_T} \int_{m_T} \sum_Z \int_E Q(Z, E) D_E(Z, E) \mathrm{d}E \mathrm{d}m \tag{3.18a}$$

or alternatively:

$$Q_T = \frac{1}{m_T D_T} \int_{m_T} \sum_Z \int_L Q(Z, L) D_L(Z, L) \mathrm{d}L \mathrm{d}m \tag{3.18b}$$

(123) Similar to equivalent dose in an organ or tissue, H_T, the value of dose equivalent in an organ or tissue is defined for organs and tissues in males and females by:

$$H^M_{T,Q} = Q^M_T D^M_T \quad \text{and} \quad H^F_{T,Q} = Q^F_T D^F_T \tag{3.19}$$

(124) In most cases, the difference in Q_T for males and females is small and a tissue-mean quality factor, Q_T, can be used for both sexes.

(125) Based on the definition of effective dose, E, the effective dose equivalent, H_E, can be calculated by applying the tissue weighting factors, w_T, as given in *Publication 103* (ICRP, 2007):

$$H_E = \sum_T w_T H_{T,Q} \tag{3.20}$$

where for $H_{T,Q,}$ the mean value from doses for the male and female phantoms is chosen. Note that this quantity was defined in *Publication 26* (ICRP, 1977) but with different tissue weighting factors, and was replaced by the quantity effective dose in *Publication 60* (ICRP, 1991).

(126) An application of the quantity effective dose equivalent, however, is not recommended for the assessment of doses of individuals or small groups of astronauts when these should become a basis for risk estimates. The recommended w_T values are single values for both sexes and are based on data for persons of all ages including children. They are not appropriate for a realistic risk assessment for male and female astronauts; risk estimates should be based on either absorbed dose or dose equivalent data for the organs and tissues of males or females, and corresponding risk factors for these tissues for male and female adults [see Table A.4.19 in Annex B of *Publication 103* (ICRP, 2007)]. If necessary, the age of the person considered should be taken into account. Even the quality factor may differ depending on whether leukaemia, solid cancer induction, or mortality is being considered (see Fig. 3.14).

(127) If, nevertheless, a value of effective dose equivalent is needed for recording, H_E should be calculated by:

$$H^M_E = \sum_T w_T H^M_{T,Q} \quad \text{or} \quad H^F_E = \sum_T w_T H^F_{T,Q} \tag{3.21}$$

depending on the sex of the astronaut.

3.3.2. Operational quantities

(128) Radiation monitoring in a spacecraft and individual monitoring for each astronaut is a necessary measure for radiological protection in space and the assessment of mission doses of astronauts.

(129) On Earth, area monitoring in terms of the quantity ambient dose equivalent, $H^*(10)$, provides, in fields of penetrating radiation, the exposure, in terms of effective dose, that a person would receive when staying for a given time at the position of the area monitor. In most external fields of strongly-penetrating radiation on Earth, only low-LET radiation (mostly x and gamma radiation), electrons, and (in a few cases) neutrons are important for radiological protection. As a consequence, most area monitors used in radiological protection measure either photon or neutron doses, and the total ambient dose equivalent is then achieved by adding these dose components. Concentrating on photons, electrons, and neutrons alone has strongly influenced the idea of defining a special measurable dose quantity in an appropriate simple phantom (the ICRU sphere) for area monitoring and the assessment of effective dose.

(130) The consequence of the specific situation in space is that some concepts of the quantities used in radiological protection on Earth have to be revisited. For example, the operational quantity for area monitoring of penetrating radiation which is based on the dose equivalent at 10 mm depth of the ICRU sphere in aligned fields has been mainly designed on the basis of photon and neutron data for control of effective dose, and is limited in its application to radiation with energies where secondary charged particle equilibrium can be achieved at approximately 10 mm depth in tissue. This is not the case for very-high-energy particles.

(131) In radiation fields in space with the large spectrum of different types of particles of very high energies, the definition of $H^*(10)$ is inappropriate (ICRP, 2010), and it is difficult to define a dose quantity independent from the human body with the same properties as ambient dose equivalent for photon and neutron radiation of conventional energy. In addition, monitoring and assessment of doses in the human body during space missions may not be restricted to effective dose equivalent and dose equivalent to the skin, the lens of the eye, and the extremities, but should also include other organs and tissues of the body. As such, no specific dose quantity for area monitoring in space has been defined to date. The monitors used serve mainly as instruments for recording the environmental radiation outside or inside a spacecraft, and for warning in cases of very intensive SPEs. They measure particle fluence, LET distributions, or absorbed doses in detector materials (see Chapter 4). These data are used as input or validation data for calculations of doses in the human body.

(132) In individual monitoring, the situation is similar to area monitoring, and a dosimeter calibrated in terms of $H_p(10)$ in photon or neutron radiation fields on Earth and worn on the body of an astronaut in space will not automatically provide an estimate of effective dose equivalent in complex space radiation fields.

(133) A specific operational dose quantity for individual monitoring in space has not been defined by ICRU or ICRP. Different quantities and procedures may be applied for an assessment of organ dose or effective dose equivalent (see Chapter 4). A combi-

nation of measurements of absorbed dose and LET distributions at the surface of the body may become an appropriate way for individual dose assessment (see Section 4.3.3). Data from area monitoring within the spacecraft combined with calculated dose conversion coefficients can also be used to calculate organ dose equivalents or effective dose equivalents for persons present in that radiation field (see Chapter 6). This, however, requires knowledge of the fluence and energy distribution of all components of the radiation field, which, in addition, may vary with time. Furthermore, application of methods of biological dosimetry may provide a comparative way of assessing mission doses of astronauts (see Sections 4.3.4 and 6.4.2).

(134) Specific attention is needed for the measurement of doses from low-penetrating radiation (e.g. electrons or solar low-energy protons), which may contribute significantly to doses to the skin and the lens of the eye, especially in situations when astronauts are working outside the spacecraft or during large solar flare events.

3.3.3. Quantities for high doses

(135) At high doses near to thresholds where deterministic effects (tissue reactions) may occur, organ dose equivalent and effective dose equivalent should not generally be used for the assessment of radiation risks. While $H_{T,Q}$ and H_E may give an indication, if such dose range is reached, risk estimates should be based on mean absorbed doses in organs or tissues, maximum dose values in organs or tissues, or on organ dose equivalent depending on the actual situation and the availability of risk factors for the different types of radiation and doses involved. Generally, tissue reactions occur above a threshold dose in the range of 0.5–2 Gy.

(136) The mean absorbed dose in an organ or tissue, D_T, and the RBE weighted mean absorbed dose, RBE $\cdot$ D_T, when high-LET radiation is involved, is the appropriate quantity for assessing risks of deterministic effects at higher doses. The RBE value to be chosen may depend on the organ or tissue considered and the specific dose and dose rate, as well as on the type and severity of the tissue reaction considered. In some cases of deterministic effects, however, not only the mean dose in an organ or tissue but also the local dose in that tissue may become important (e.g. local skin dose).

(137) The dose limits for tissue reactions are given in terms of the mean absorbed dose in an organ or tissue, D_T, and this value weighted by an appropriate RBE should be applied. The RBE values may be taken from *Publication 58* (ICRP, 1989), which recommends values of 6 (range 4–8) for neutrons of energy 1–5 MeV, 3.5 (2–5) for neutrons of energy 5–50 MeV, 2.5 (1–4) for heavy ions, and 1.5 for protons.

(138) Measurements of particle fluence, LET distributions, or absorbed doses can be performed in any radiation field, even in strong radiation fields producing high doses (e.g. during SPEs) where non-stochastic tissue reactions cannot be excluded completely. Measurements of $H_p(d)$, which is defined using the fixed $Q(L)$ relationship, may also be performed in such intense radiation fields for the purpose of dose recording. For risk assessment, however, it must be considered that the $Q(L)$ function has been defined based on RBE_{max} data at low doses and, therefore, its application in radiation protection dosimetry is usually limited to the low-dose range.

4. METHODS OF MEASUREMENT OF RADIATION FLUENCES AND DOSES

(139) Radiation transport calculations, measurements, and interpretation of data are essential components for operational radiation safety. The measurements include an assessment of the environment at the exterior surface of the spacecraft or habitat, assessment of the interior environments in the spacecraft/habitat and the EVA suit, use of personal dosimeters, and determination of the transmission of radiation to internal organs or tissues.

(140) Individual monitoring of occupationally exposed persons on Earth is mainly performed to ensure that the exposure is below legal dose limits, which are generally set to limit exposure risks to an acceptable level. While the basic limits are given in terms of effective dose, it is generally accepted that at doses far below the limits, the measured personal dose equivalent assesses effective dose appropriately in routine radiological protection applications (ICRP, 2007). The situation in space, however, is significantly different. Doses to astronauts in space may be much higher than annual dose limits for occupationally exposed persons on Earth, especially in long-term missions. It is, therefore, important to obtain more precise information about doses and exposure risks. For planning purposes and for operational radiation safety programmes, risk assessment is seen to be as important as dose recording for astronauts in space. For any risk assessment, however, knowledge of the radiation incident on the human body and/or the assessment of doses in the human body are basic preconditions.

(141) Calculations are essential to mission planning in that they provide preflight estimates of the doses that will be received by the astronauts during the different phases of a proposed mission. They are also an important part of the dose assessment process for determining the doses received by the astronauts during the mission.

4.1. Measurement quantities

(142) The objective of the adopted dose assessment approach in radiological protection is generally to determine the specific protection quantities defined for the low-dose range for limiting the probability of stochastic effects and for avoiding deterministic effects (tissue reactions) in the human body. For applications on Earth, these quantities are the equivalent dose in an organ or tissue, H_T, and the effective dose, E (see Section 3.1). For the special situation of astronauts in space, the quantities mean absorbed dose in an organ or tissue, D_T, and dose equivalent in an organ or tissue, $H_{T,Q}$, are proposed for use instead (see Section 3.3). At higher doses, when deterministic effects may occur, a different weighted absorbed dose is required. In this case, a mean RBE value needs to be determined from the information on the radiation field components and the specific RBE values of the different types of particles involved. There is an important role for biodosimetry. Individual biomarker measurements on astronauts can consolidate other dosimetric approaches.

(143) The radiation environment external to a spacecraft in LEO consists of electrons, positrons, neutrons, protons, and all stable atomic nuclei (up to charge $Z = 92$). Particle energies range from a few eV for trapped electrons and thermal neutrons to 10^{14} MeV for GCR (see Chapter 2). Most of the electrons will not penetrate the wall of the spacecraft, but could penetrate the spacesuits worn during EVAs, resulting in doses to the skin and lens of the eye. Nuclear interactions of neutrons, protons, and heavier nuclei with spacecraft, spacesuits, the Earth's atmosphere, and the human body produce secondary radiation which adds to the radiation field. Radiation monitoring techniques vary according to particle type, energy, and measurement location (inside or outside spacecraft, inside EVA suit). The radiation environment can be classified on the following basis:

- trapped electrons – outside the spacecraft and inside the EVA suit;
- trapped protons (<10 MeV) – do not penetrate the spacecraft or the EVA suit;
- protons and light charged particles (>10 MeV) – outside and inside the spacecraft, and inside the EVA suit;
- GCR and secondary photons – outside and inside the spacecraft, and inside the EVA suit;
- secondary charged particles – inside the spacecraft and inside the EVA suit; and
- neutrons – outside and inside the spacecraft, and inside the EVA suit.

(144) In addition to variations in the primary external radiation field, the relative contribution of each component (including the secondary radiation) to organ and tissue absorbed doses and dose equivalents at each location will also vary according to additional factors, including the mass distribution inside the spacecraft and the construction of the EVA suit.

(145) Mean absorbed doses and dose equivalents in organs and tissues of a human body are generally not directly measurable. An approach to the estimation of these quantities is given in Chapter 6. This includes: (1) calculations of particle type and energy, and direction distributions of fluence in radiation fields at the location of an astronaut plus the application of organ absorbed dose and dose equivalent conversion coefficients; (2) direct assessment of organ absorbed doses and dose equivalents for an astronaut by radiation transport calculation using energy and direction distributions of fluence from outside the spacecraft or at the astronaut's location; and (3) measurement of absorbed dose or dose equivalent near or on the astronaut, and the use of results from calculations applying anthropomorphic phantoms.

(146) The main objectives of environmental measurements are the provision of radiation field data of particle types, fluences, microdosimetric quantities, absorbed doses, and dose equivalents using detectors in assemblies of various sizes, both integral and differential (with respect to time, LET, energy, or direction, as appropriate), and, in some cases, normalised to calculations of the radiation field components. For personal monitoring, the same quantities might be determined, but, more importantly, data are required for the determination of absorbed dose and dose equivalent. Absorbed dose and dose equivalent values measured by personal dosimeters worn on the body can be applied as estimates of D and H at a point in adjacent tissue, or can be used with prior data as estimates of absorbed dose or dose equivalent to specific

organs and tissues at greater depths. Environmental monitoring can provide radiation field data as an input for calculations that will yield estimates of doses in the human body, or may even be used to assess individual risks directly. It may measure dose quantities such as absorbed dose, D, the distribution of D in L, D_L, or dose equivalent, H. It can also provide measurements in support of in-flight dose management, dose recording, and optimisation actions.

(147) Radiation detectors determine a particular measurement quantity. These include: (1) particle type and energy, and direction distributions of fluence; (2) dose deposition in the detector material; and (3) other dosimetric quantities such as L or lineal energy, y. In addition, there are calibration data on detector response and normalisation of detector response (e.g. normalised to equivalent water absorbed dose for a radiation type and energy).

(148) Several types of instrumentation are available, including both active and passive devices. Active instrumentation should have a time resolution sufficient to identify temporal variations in the radiation field. Alarm or warning capabilities of instruments can be used to support in-flight implementation of dose management and optimisation actions. Passive detectors provide integration of the exposure information over long time intervals. They are usually very robust, small in their dimensions, and need no power supply. Some devices also allow on-demand readout. For all instrumentation used for measurements in space, the following must be established: (1) full response characterisation and calibration; (2) measurement model description; and (3) knowledge of uncertainties. Comparison of instrument responses is also useful. Many details of instrumentation for dosimetry in space have been published in review papers by Benton and Benton (2001a), Badhwar et al. (2002b), Reitz (2006), Berger (2008), and Caffrey and Hamby (2011). Further information has been presented by the HAMLET collaboration (HAMLET, 2011) and others [e.g. Doke et al. (2001, 2004), Borak et al. (2004), and Terasawa et al. (2005)].

4.2. Purpose of measurements

(149) Measurements are performed for the purpose of determining individual exposures, monitoring changes in the radiation environment, and performing optimisation. Instrumentation positioned inside or outside of the spacecraft or habitat can provide essential data for characterisation of the primary fields impinging on the spacecraft, such as galactic radiation, the trapped particle radiation field, and the field caused by SPEs. Such data from outside allow corrections to be made to the input data of transport codes to determine the field inside the spacecraft or habitat, and so can reduce dose assessment uncertainties. Ion chambers or other active detectors with well-defined wall thicknesses can serve to monitor short-term variations in the electron environment for EVAs.

(150) Selectively located active and passive instrumentation allows radiation monitoring and further adjustments to the calculated internal environment. Particle spectrometers can provide data for the evaluation of transmission factors and response functions of dosimetric devices, and allow evaluation of calculated values and uncertainties of dosimetric quantities. Both active and passive devices are useful for deter-

mining absorbed dose, absorbed dose distribution over LET, absorbed dose distribution over lineal energy, and estimates of dose equivalent. Personal dosimeters worn by astronauts can determine some of these quantities for adjacent tissues.

(151) Short- and long-term variations, depending on solar activity, modify the environmental radiation field (components, particle fluences, energies, and direction distributions), so energy- and direction-sensitive instrumentation is mandatory. In addition, active instrumentation allows the time resolution of trapped, solar, and GCR components.

4.3. Instrumentation for radiation spectrometry, area, and personal monitoring

4.3.1. General

(152) No single device can determine the required dose quantities for all components of the radiation field. As there are large variations in the relative contributions to total absorbed dose and dose equivalent from the different particle types, it is not generally possible to determine the absorbed dose or dose equivalent from a single component (or a few components) and apply a correction factor to determine the absorbed dose or dose equivalent for the entire radiation field.

(153) The dosimetry may be simplified by considering the radiation in terms of its energy deposition properties characterised by LET (or lineal energy). These include both low-LET charged particles (LET < 10 keV μm^{-1}) and high-LET charged particles (LET $\geq$ 10 keV μm^{-1}). High-LET particles may be separated into high-energy heavy ions ($Z > 2$) and their fragments, and the mainly high-LET particles produced by the strong force interactions of neutrons and high-energy protons. Often, separate dose measurements are performed for these categories, with the aim of minimising any overlap of response to avoid 'double counting'. The choice of measurement devices is dictated by radiation response characteristics (dependence on particle type and energy, and on the quantity to be determined), operational characteristics (direct determination of dose quantities, input to model calculations, desired accuracy, dose management, and optimisation support), and practical issues such as reliability, robustness, and availability. The addition of devices measuring L and y distributions of energy deposition in tissue from all particles has improved the situation of dosimetry in space substantially.

(154) Another important consideration is the time required for analysis of the measured data compared with the duration of the mission. For long-term missions, it might be desirable to have readout facilities for passive devices onboard.

(155) Additional passive personal dosimeters may be needed on the astronauts during EVAs to take account of the spatial variations in the degree of shielding provided by the spacesuit and the spacecraft.

(156) The development of a set of coefficients that directly relate dose equivalent obtained with thermoluminescence detectors (TLDs) and nuclear etched track detectors at the surface of a body to mean organ absorbed dose or dose equivalent for the space radiation environment is desirable in principle. This is, however, a very difficult task due to the complexity of the radiation field in space. While it might be possible

for the GCR component, it seems to be impossible for trapped radiation due to its strong variation with time and location.

(157) Neutrons are generated by interactions of GCR and higher-energy protons with the Earth's atmosphere, another body (e.g. the spacecraft or habitat), or with fellow astronauts. The energy distribution of those neutrons has several maxima due to reactions producing neutrons from the incident GCR nuclei or the target atoms in spacecraft materials or tissue (see Fig. 2.11). The lowest energy maximum occurs at approximately 1 MeV from neutrons produced from the nuclear evaporation process from target atoms in interaction with GCR. A second broader maximum occurs at approximately 100 MeV from knockout and cascade reactions leading to fast neutrons emitted from target nuclei. At higher energies, there is an even broader maximum at approximately 1000 MeV due to neutrons produced from the GCR nuclei by either evaporation or knockout and cascade reactions. Various methods are applied for neutron monitoring in space (Benton and Badhwar, 2001b). To detect absorbed dose to tissue and dose equivalent from the high-LET secondary particles from neutron interactions, and for similar particles produced by strong force interactions of higher energy protons, it is preferable to use detector materials and shielding that closely match tissue elemental composition.

4.3.2. Active devices

(158) Active devices record and display data in real time or near-real time. This enables measurement of fluence rates or dose rates, as well as time-integrated values. Most active instruments can be turned on or off in order to operate in specific circumstances such as EVAs and during an SPE. Active detectors require electrical power that can be provided through connections with power supplies in the spacecraft or through batteries. Over recent years, a broad range of different types of active instruments has been used for radiation measurements onboard the International Space Station (ISS), either for scientific investigations (see Table 4.1) or for operational area monitoring (see Table 4.2). Various types of instruments are described below.

Tissue-equivalent proportional counters

(159) A tissue-equivalent proportional counter (TEPC) is a low-pressure proportional counter with a wall of tissue-equivalent material especially designed for use in microdosimetry and radiological protection (ICRU, 1983; Menzel et al., 1989). The pressure of the gas in the detector is chosen to simulate a volume of tissue comparable to the dimensions of the nuclei of mammalian cells. The charge produced by an ionising particle traversing the chamber volume is collected and, by calibration of the detector, the electrical signal can be related to the energy loss of the crossing particle in that simulated tissue volume. Data are recorded on an event-by-event basis, such that one can obtain a distribution of energy deposition events in a small element of tissue with a known covering material in terms of lineal energy, y, which can be correlated with LET, and therefore characterises the ionisation density along tracks of particles and radiation quality. The lineal energy, y, is defined by the quotient $\varepsilon/\bar{l}$,

Table 4.1. Active radiation detectors applied onboard the International Space Station for scientific applications during recent years, some of them during the dosimetric mapping experiment (DOSMAP) [Reitz et al. (2005)] or in combination with the MATROSHKA phantom (Dettmann et al., 2007).

Instrument	References	Heritage	Measured parameters
DOSTEL – silicon telescope	Beaujean et al. (1999); Reitz et al. (2005)	Christian Albrechts University Kiel, German Aerospace Centre, Cologne, Germany	LET distribution, absorbed dose, dose equivalent
Silicon scintillator device	Reitz et al. (2009)	Christian Albrechts University Kiel, German Aerospace Centre, Cologne, Germany	Absorbed dose, neutron dose, organ dose
LIULIN – silicon detector	Dachev et al. (2002, 2006, 2011)	Solar Terrestrial Influences Laboratory, Bulgaria	Absorbed dose, dose rate
ALTCRISS – silicon strip detector	Casolino et al. (2007); Semkova et al. (2007)	INFN and University of Rome Tor Vergata, Rome, Italy	Particle energy distribution up to iron nuclei, LET distribution, dose equivalent
ALTEA – silicon strip detector	Narici (2008); Zaconte et al. (2010a,b); Di Fino et al. (2011)		
Bonner ball neutron detector	Koshiishi et al. (2007)	Japan Aerospace Exploration Agency, Japan	Neutron energy distribution and neutron dose

LET, linear energy transfer.

where ε is the energy transferred to the chamber gas by ionisation by a crossing particle, and $\bar{l}$ is the mean path length of the charged particles in the chamber volume. Consideration should be given to factors that influence performance, such as wall effects.

(160) The response to photons and neutrons depends on the probability of the production of secondary charged particles in the wall passing the detector volume, and hence on the wall material. Generally, materials that are tissue equivalent with respect to neutrons are chosen (e.g. A-150 plastic). For incident charged particles, each particle crossing the chamber volume produces a signal. Depending on the shape of the volume, a broad y distribution is obtained, even for incident monoenergetic charged particles. The y distribution is further modified by straggling effects and secondary charged particles produced in the chamber wall (see Fig. 4.1).

(161) The term $y \cdot f(y)$ as a function of y approximates the dose distribution in terms of LET, and can be used to determine a mean quality factor for the absorbed dose to the detector configuration (Schmitz et al., 1995). When the data are integrated over the distribution of y or L, the TEPC can generate absorbed dose and absorbed dose rate. Data from a TEPC can be displayed continuously or stored for later transmission to mission control. Special TEPC systems have been designed for use in spacecraft (Caffrey and Hamby, 2011).

Table 4.2. Active and semi-active radiation detectors used onboard the space shuttle and International Space Station for area monitoring.

Instrument	References	Heritage	Measured parameters
Tissue-equivalent proportional counter	Badhwar et al. (1994); Johnson et al. (2006)	NASA Johnson Space Center, Houston, USA	LET distribution, absorbed dose, dose equivalent
Charged particle detector system (IV-CPDS)	Lee et al. (2007)		LET distribution, particle energy distribution, nuclear abundances up to oxygen
Charged particle detector system (EV-CPDS)			
Ionisation chamber (R-16)	Benghin (2008); Lishnevskii et al. (2010)	Moscow State University, Moscow, Russia	Absorbed dose, dose rate
Silicon detector unit (DB8)		Space Research Institute, Bulgaria	Absorbed dose, dose rate
TL – system (PILLE)	Apáthy et al. (2002, 2007); Deme et al. (2006)	KFKI, Hungary	Absorbed dose, dose rate
RRMD-III – silicon strip detector telescope	Doke et al. (2001)	Waseda University, Japan Aerospace Exploration Agency, Japan	LET distribution, absorbed dose, dose equivalent

NASA, National Aeronautics and Space Administration; LET, linear energy transfer.

Semiconductor devices

(162) Semiconductor devices for the detection of charged particles are thin diodes, mainly Si diodes (thickness of approximately 50–5000 μm), that record the energy deposited by a charged particle in the sensitive volume of the detector. For particles with normal incidence and fully traversing the sensitive detector volume, the ratio of the deposited energy to the thickness of the detector yields the approximate LET for the incident particle in that material. If charged particles from various directions pass the detector, a mean path length in the sensitive detector volume needs to be determined for assessing an LET distribution. Thus, a single detector can provide an estimate of the charged particle fluence distribution in LET and time. This distribution can be integrated to yield dose and dose rate for protons and heavier charged particles in the detector material, and by the use of conversion coefficients, can determine dose to tissue. Some detectors are used as a telescope, which restricts the response to a smaller solid angle.

(163) Several multi-array solid-state detectors are combined to form a particle telescope that measures both energy deposition and flight direction. When these data are combined, the detector yields a more accurate estimate of LET in the detector material, and thus the distribution of fluence in LET, direction, and time. Using appropriate conversion coefficients, the data can also be used to obtain D_L distributions and Q values for heavy charged particles, but with the restriction that the incident

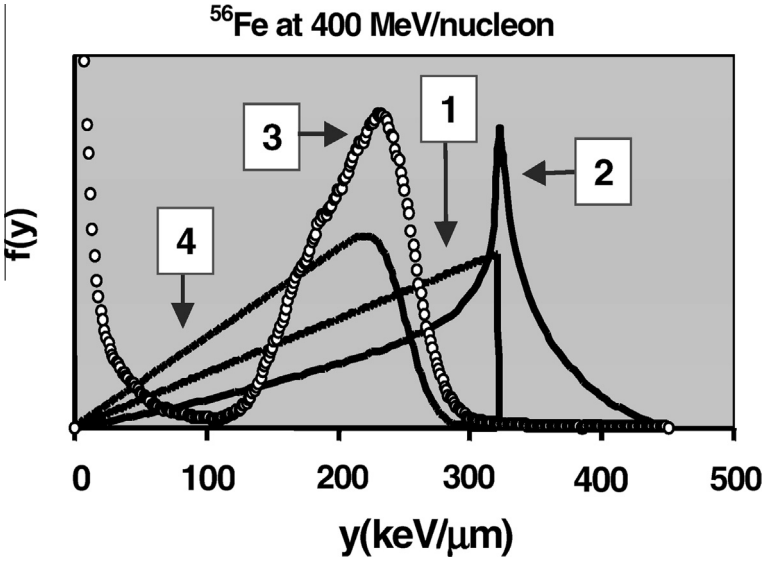

Fig. 4.1. Frequency distribution, f(y), of lineal energy in a tissue-equivalent proportional counter for a uniform fluence of ^{56}Fe ions. Curves 1 and 2 are calculated by multiplying the chord length in a sphere (Curve 1) and a cylinder (Curve 2) by the linear energy transfer (LET) of the Fe ion. Curve 3 shows data from measurements with a spherical detector, and Curve 4 shows the results of a calculation using restricted LET, L_{Δ}, adjusted for straggling (NCRP, 2002).

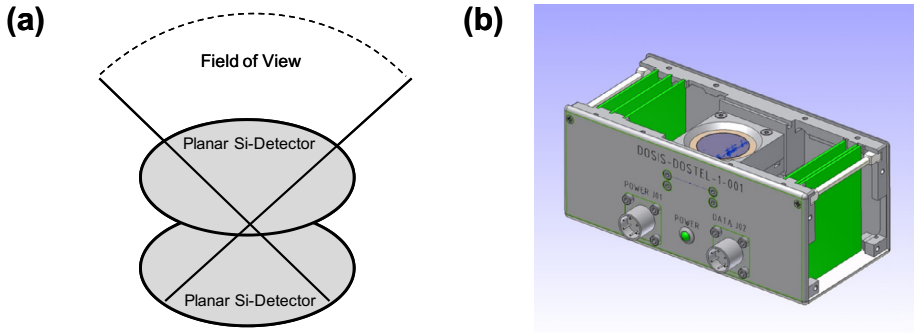

Fig. 4.2. Schematic view (a,b) of the charged particle spectrometer DOSTEL designed for space applications (Beaujean et al., 1999; Reitz et al., 2005).

particles originate from a fixed direction depending on the orientation of the detector. Due to size limitations, this type of detector is only sensitive over a restricted solid angle.

(164) The energy lost in solid-state detectors of a telescope can also be used to identify the particle charge as well as the incident energy to ultimately obtain the dis-

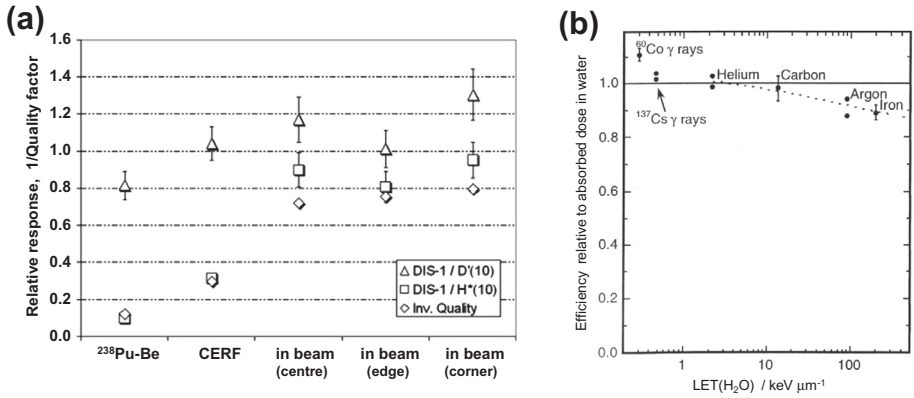

Fig. 4.3. Relative response of the direct ion storage (DIS-1) dosimeter. (a) Dosimeter reading in terms of personal dose equivalent, H_p(DIS), normalised to absorbed dose in 10 mm depth of tissue, $D(10)$ (triangles), and ambient dose equivalent, $H^*(10)$ (squares). The inverse of the quality factor, $1/Q$, is also indicated (diamonds) (Otto, 2010). (b) Efficiencies of DIS-1 relative to absorbed dose in water as a function of linear energy transfer [LET (H_2O)]. Each point for ^{60}Co gamma radiation, carbon, and iron ions represents an average value from six samples (1 standard deviation). Two of the samples were irradiated with each of three doses (10 mGy, 25 mGy, and 50 mGy in water). Points for ^{137}Cs gamma radiation, helium ions, and argon ions represent two samples irradiated with a dose of 10 mGy (Yasuda, 2001).

tribution of fluence in energy, particle charge number, and time (see Fig. 4.2). Several of these detectors can be combined to point in different directions to provide a more complete description of the radiation field either outside or inside a spacecraft.

Direct ion storage devices

(165) Direct ion storage devices (DIS) combine an ionisation chamber with a semiconductor device. Specifically, the DIS is based on coupling a gas-filled ion chamber with a semiconductor non-volatile memory cell, where the charges produced in the chamber volume are stored. These are compact integrating devices that can be read out periodically without deleting the information, and are used to estimate accumulated doses over periods of several hours to at least 1 year. The response of the DIS to charged particles incident on the detector and passing the chamber volume is approximately equal to the energy deposited, while the response to photons and neutrons incident on the DIS and producing secondary charged particles in the detector depends on the material and thickness of the chamber wall. As shown in Fig. 4.3, the response of the DIS only shows small LET dependence, therefore providing a good estimation of absorbed dose to the device for use in the heavy ion fields in space. The response to low-energy charged particles incident on the DIS also depends on chamber wall thickness due to energy loss in the wall.

Bonner sphere spectrometer

(166) In principle, a Bonner sphere spectrometer consisting of a set of Bonner spheres of different sizes is well suited for measuring neutron fluence and spectral dis-

tributions of neutrons. On the ground, neutrons over a wide energy range are often monitored by such moderator-based survey instruments, the responses of which have also been extended to higher energies by introducing a layer of heavy metal in their moderator (Wiegel and Alevra, 2002). These modified instruments, however, are not well suited for use in spacecraft because of their heavy weight as well as their high sensitivity to HZE particles. A Bonner ball neutron detector was used on a space shuttle (STS) flight (Matsumoto et al., 2001) and on the ISS (Koshiishi et al., 2007) for measuring the fluence of neutrons with energies below approximately 15 MeV. However, high-energy neutrons are also present in spacecraft (see Para. 157). Further measurements were performed onboard the Russian segment of the ISS (Tret'yakov et al., 2010). The development of new instruments with a light weight and less sensitivity to HZE particles is necessary to monitor neutron fluence or doses precisely in spacecraft.

Electron detectors

(167) Active electron detectors need to be specially configured to measure low-LET radiations, particularly electrons below approximately 1 MeV. Electrons of these energies are normally not an issue inside the spacecraft, but could be of concern during EVAs as electrons above a few hundred keV can penetrate the spacesuits. As the trapped electron fluence rate can change by many orders of magnitude during and following a large magnetic storm, due to short-term perturbations of the geomagnetic field, it is recommended that an active detector sensitive to electrons should be installed outside the spacecraft to serve as a monitor for fluctuations in the electron component of the space radiation environment to enable dose management during EVAs. Such a monitor could be a simple ionisation chamber or solid-state detector with a wall thickness sufficient to strongly attenuate very-low-energy electrons but thin enough to record electrons that could penetrate a spacesuit (Evans et al., 2008).

Active personal dosimeters

(168) Active personal dosimeters (APDs) can give an instant indication of both accumulated dose and dose rate. Preset visual and audible alarms are also provided, so these devices can be used simultaneously as an integrating dosimeter and as an alarm dosimeter. APDs can be used supplementary to passive dosimeters used for routine dosimetry. It is clear that for low-LET radiation, the energy and directional response characteristics of APDs are, in most cases, as good as passive dosimeters for the measurement of doses in continuous radiation fields with acceptable accuracy.

(169) An ideal personal dosimeter would be active, store integrated dose data and dose rate time profiles, and respond to all field components allowing a sufficiently precise determination of absorbed dose rate and dose equivalent rate to adjacent tissues. Most available electronic personal dosimeters have been designed to measure absorbed dose to tissue under a defined covering layer from photon and beta radiation, and their high-LET response characteristics are not well determined. Such dosimeters might be considered for measurement of the low-LET component of

the fields in spacecraft/habitats. However, even if used only to determine the low-LET component, a full characterisation of their charged particle and neutron response is necessary. Pixel-based detectors can be used as personal dosimeters. They can provide energy deposit distributions, energy, and charge for all particles. They are based on a readout chip that embeds the electronics for each pixel within the pixel's footprint. Careful calibration is necessary, as for other devices.

(170) If APDs are not used, it may be necessary to develop onboard readout capabilities for passive dosimeters, especially on long-term missions in space. Although onboard readout of nuclear etched track detectors is not feasible, onboard systems for readout of TLDs and optically stimulated luminescence dosimeters (OSLDs) already exist.

4.3.3. Passive devices

(171) Passive devices can be used for both area monitoring and personal monitoring. No single passive device is capable of dose measurement across the full energy and direction distribution of particles available in space. The instrumentation and detectors should be designed to have optimum performance in the types of particles noted above, namely: low-LET charged particles (i.e. $L < 10$ keV μm^{-1}), including such particles produced by non-ionising particles incident on the instrumentation; high-LET charged particles from neutrons and protons that undergo strong-force interactions; and high-LET heavy charged particles (HZE). TLDs, radiophotoluminescence (RPL) glasses, and OSLDs are used for photon, electron, and charged particle dosimetry. For neutron dosimetry, plastic nuclear etched track detectors (PNTDs) are well suited for measurements in neutron and heavy charged particle fields. In space applications, measurement systems combining both detector types are often used in personal dosimetry.

Luminescence detectors

(172) Most passive dosimeters in current use are TLDs. TLDs are small sintered chips or pellets of crystals that show luminescence after exposure to ionising radiation. By fast controlled heating of the material, the stored energy is released as emitted light. The function between the intensity of the emitted light and the actual temperature of the material shows various peaks (the glow curve). The peak heights or the peak areas of the glow curve, depending on the techniques used, are proportional to absorbed dose deposited multiplied by a coefficient to adjust for the light generated in the material for the energy stored. Various materials doped with different elements are in use for personal dosimetry.

(173) An alternative to TLDs is RPL glasses. Small glass elements respond, as in TLDs, to incident ionising radiation, storing energy in metastable electronic levels. The energy is released as light when the glass is exposed to ultraviolet laser illumination.

(174) OSLDs have also been proposed. In OSLDs, the stored energy is released by optical laser stimulation. TLDs, RPL glasses, OSLDs, or similar types of dosimeters will have to be fully characterised for the specific space environment.

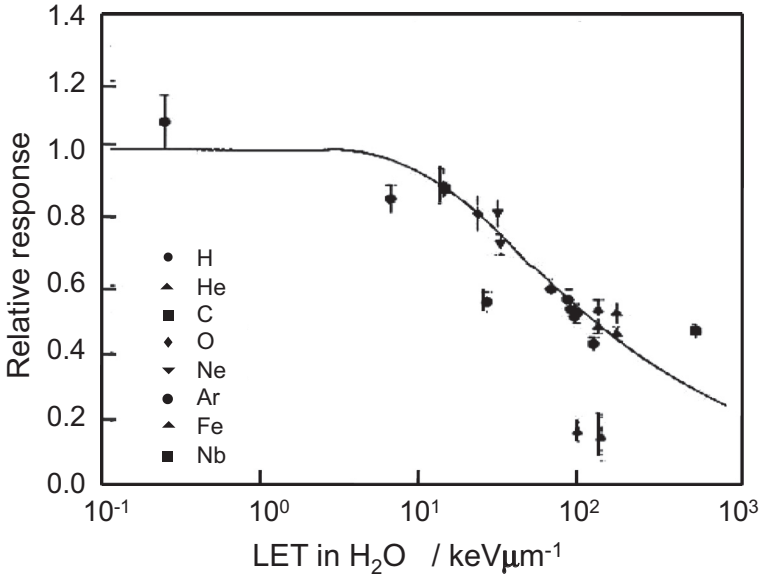

Fig. 4.4. Relative response of thermoluminescence detectors (TLDs) for various charged particles. The relative response (relative to ^{60}Co gamma rays) of Peak 5 from TLD-700 vs mean linear energy transfer (LET) (in water) in the detector is shown (Benton et al., 2000).

(175) There may be a need for some passive elements to be read out frequently on-board, and others that are read only on return to Earth. The readout mode of the luminescence dosimeters should be considered carefully.

(176) TLDs, RPL glasses, and OSLDs measure absorbed dose in their material and are mainly calibrated in terms of absorbed dose in tissue or water in ^{137}Cs or ^{60}Co gamma radiation reference fields. The detector response, relative to the response to the reference radiation, depends on the energy deposition in the track structure of a traversing particle, and therefore on the particle type. While for $L < 10$ keV μm^{-1}, L dependence of the response is generally only small, TLDs, RPL glasses, and OLSDs show strong LET dependence of the response above approximately 10 keV μm^{-1}, generally with decreasing response with increasing LET (see Fig. 4.4). This needs to be well understood for dosimetry in space radiation fields.

Nuclear track detectors

(177) To detect the high-LET component of the radiation field, PNTDs and nuclear emulsions can be employed. Damage to the material is caused by the passage of a charged particle, and these particle tracks can be viewed microscopically, either before or after being realised by suitable chemical treatment. Etched track detectors are generally insensitive for radiation with an LET in water below approximately 10 keV μm^{-1} (depending on material), and may be employed in a method that pro-

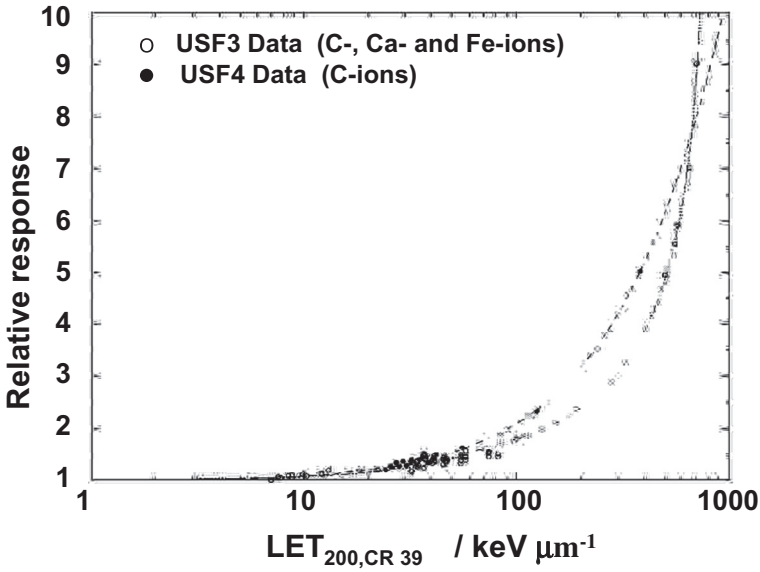

Fig. 4.5. Relative response of poly allyl diglycol carbonate detectors (CR-39®) as a function of restricted linear energy transfer, LET_{200} (Keegan, 1996).

vides D, D_L, D averaged over certain ranges of L, and H. With suitable detector sets, etched track detectors and nuclear emulsions can determine the charged particle type and its direction in the detection medium, and can allow an analysis of the radiation field at the position of the detector. The analysis of the response of poly allyl diglycol carbonate (PADC), sometimes referred to by the trademark CR-39®, in terms of the dependence on LET allows the determination of absorbed dose and dose equivalent to a small element of tissue from all charged particles above approximately 10 keV μm^{-1} (see Fig. 4.5). The detectors can separate the heavy charged particle and neutron contributions by looking at the particle ranges. A further separation procedure to detect the neutron dose component can be made using thin detectors and coincidence techniques, or by using a thin PADC detector and a combination of electrochemical and chemical etching. Stacks of PADC detectors can be used for spectrometry of HZE particles (Gunther et al., 2002).

Superheated emulsions

(178) Superheated emulsion detectors, sometimes referred to as 'superheated drop' or 'bubble' detectors, are small droplets of a liquid above its normal boiling point suspended in a visco-elastic medium. The droplets remain in the liquid phase until a charged particle interacts inside or near the surface of the droplet. This transfers energy to the droplet and may cause local evaporation. If sufficient energy has been transferred and a critical radius is exceeded, all the liquid in the droplet will be vaporised and the bubble will become visible. Superheated emulsion detectors re-

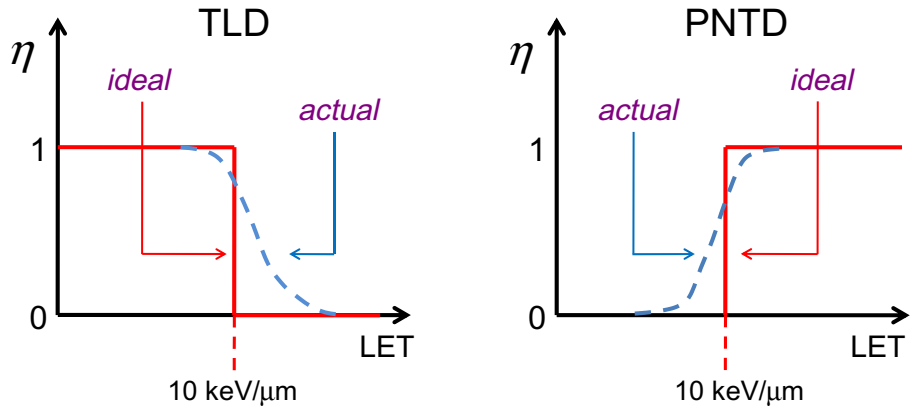

Fig. 4.6. Schematic relative dose responses of a thermoluminescence detector (TLD) and a plastic nuclear etched track detector (PNTD).

spond to neutrons and heavy charged particles. A clear calibration procedure is required. Recent data on bubble detector responses are presented by Lewis et al. (2012).

Combined detector systems

(179) A combination of one detector for the measurement of the low-LET component and one detector for the high-LET component can allow the determination of dose equivalent in the complex radiation field in space. For passive dosimetry, with a package of TLD (or OSLD) and PNTD, the dose equivalent in adjacent tissue near the surface of the body is determined by:

$$H = D_{\mathrm{TLD}} - \int_{L>10\ \mathrm{keV\ \mu m^{-1}}} \eta_{\mathrm{TLD}}(L) D_{\mathrm{L,PNTD}} dL + \int_{L>10\ \mathrm{keV\ \mu m^{-1}}} Q(L) D_{\mathrm{L,PNTD}} dL \tag{4.1}$$

where D_{TLD} is the total absorbed dose recorded by the TLD (equivalent for OSLD), and $D_{\mathrm{L,PNTD}}$ is the absorbed dose distribution in L determined by the etched track detector in the high-LET range ($L > 10$ keV μm^{-1}) for which Q is dependent upon L. The correction term considers the non-zero response of the TLD in the region $L > 10$ keV μm^{-1}. $\eta_{\mathrm{TLD}}(L)$ is its relative dose response in that region. The correction guarantees that intermediate LET components are not considered twice (see Fig. 4.6). It is recognised that this requires the verification of LET dependence of the response of both the low-LET and high-LET detector systems, and the elimination of one detector signal in the range where the responses are overlapping. Detector systems combining a TLD and a PNTD have been used onboard spacecrafts (Doke et al., 1995, 2002; Nagamatsu et al., 2006, 2011; Hajek et al., 2008; Jadrníčková et al., 2009; Zhou et al., 2008, 2009; Tawara et al., 2011).

(180) An alternative method is to obtain data on the y or L distribution of energy deposition from a TEPC or a particle spectrometer used as a passive area dosimeter, and to apply this for correcting a measurement with a low-LET detector to obtain the full dose equivalent at the dosimeter's location. For such a correction, the efficiency function, $\varepsilon(L)$, of the low-y or low-LET detector needs to be known, and an effective efficiency needs to be established.

4.4. Biomarkers of exposure

(181) Biomarkers of health effects can be divided into three categories (Brooks, 1999): biodosimetry that is a measure of exposure, biomarkers of risk, and biomarkers of the presence of disease. The term 'biodosimetry' in this context refers to a biological measurement to assess a biologically based dose equivalent. Due to the complex nature of the space environment, including nuclear and atomic processes occurring within tissues, and the large uncertainties in conversion of doses to risk, biodosimetry is performed routinely on the small population of astronauts involved in ISS missions, and would likely be used in future space missions. There are also limitations in the size of devices that can be worn and practical obstacles to wearing a physical dosimeter at all times in space, which make biodosimetry an attractive supplement to physical dosimetry. To be useful as a biodosimetric method, the radiation quality dependence of the absorbed dose response of the assays should be similar to the $Q(L)$ relation from Eq. (3.10). Biodosimetry assays would likely be carried out on lymphocytes from a routine blood sample (IAEA, 2011). Biomarker assays may require samples from other tissues including skin, swabs from the oral cavity to collect cells, urine, or bone marrow. There are several biodosimetric methods that can be used for space travel, as summarised below.

Micronuclei

(182) Micronuclei result from the loss of whole chromosomes or acentric chromosome fragments from daughter nuclei following cell division (Prosser et al., 1988). They appear as small, membrane-bound inclusions in the cytoplasm. Their assessment is relatively easy and rapid, and by including cytochalasin B in the cell cultures, analysis of cells is restricted to those in their second postexposure cycle. This has greatly increased assay sensitivity. If individual pre-exposure levels of micronucleus frequency are available, absorbed doses as low as 50 mGy can be detected; without knowledge of the background frequency, the detection level is estimated to be 100 mGy. A modification of the assay uses a fluorescent pan-centromere probe to distinguish two types of micronuclei: those derived from whole chromosomes and those derived from chromosome fragments. By restricting analysis to the fragment type, much of the background noise in the assay can be reduced (Vral et al., 1997).

(183) The frequency of micronuclei has been used for estimating exposures for a number of radiation accidents with reasonable agreement with physical dose estimates. The drawbacks are that few studies have been performed with high-LET exposures, and the assay is not reliable for partial-body exposures. Micronuclei are unstable structures, meaning that their frequency reduces with time due to the

turnover of lymphocytes. This makes the assay unsuitable as a biodosimeter in astronauts exposed to space radiations over prolonged missions.

Acentric fragments in prematurely condensed chromosomes

(184) Interphase chromosomes can be prematurely condensed to be observable microscopically either by fusion with mitotic cells or by treatment with a phosphatase inhibitor (calyculin A) (Blakely et al., 2003). Structural and numerical chromosomal alterations can be observed as an increase (or decrease) in centric chromosome number or from the presence of acentric fragments. The method has been used in a laboratory setting to assess exposure to x rays and gamma radiation. The advantages are that non-dividing cells can be used for assay and the analysis is quite straightforward. The current drawback is that the assay has had no application as a true biodosimeter, and issues such as responsiveness to partial-body exposures or chronic exposures have not been addressed. Further investigation appears to be warranted to assess the value of prematurely condensed chromosomes as a biodosimeter in the space environment.

(185) The fact that this prematurely condensed chromosome method has not been used in biodosimetry means that a lower detection level has not been established. A reasonable assumption is that it will be no more sensitive than other cytogenetic methods, given similar cell numbers analysed. The advantage is a greater ease in obtaining large numbers of cells for analysis. As with micronuclei, this signal is also unstable with time due to the replacement of lymphocytes from the stem cell pool.

Chromosomal aberrations

(186) The method that has been used most extensively in biodosimetry is that of the analysis of structural chromosome aberrations. The incorporation of fluorescence in-situ hybridisation (FISH) techniques (Cornforth, 2001; Edwards et al., 2005) has enabled the assessment of symmetrical (transmissible) translocations. Unlike the assays described above, these are stable aberrations that pass successfully through cell division and are more suited to prolonged space missions. This allows for reliable dose estimation at long intervals after exposure. Chromosome aberration dosimetry has been applied successfully to radiation accident victims, atomic bomb survivors, and a wide range of occupationally and medically exposed persons including astronauts (George et al., 2001; Cucinotta et al., 2008). These scenarios include chronic exposures and partial-body exposures for which specific methods have been developed to aid in exposure estimation. The distribution of aberrations among cells is useful in this regard. Even with this strong record of success, the application of the method for dosimetry in astronauts in space has some drawbacks, as evidenced by published studies (Obe et al., 1999; Testard and Sabatier, 1999). One problem is the interindividual variation in response, but this can be overcome by individual calibration and determination of background in advance. The response is generally low due to the nature of the exposures, by which only a small number of cells will actually be traversed. This is especially the case for heavy charged particles. On the other hand, the effective area (or volume) of the blood system, which is distributed over the

whole body, is much larger than that of a passive dosimeter; biodosimetry sees the rare events better than a small physical dosimeter.

(187) Additional laboratory investigation is required in order to consider the use of cytogenetic analysis as a reliable dosimeter for space missions. Skilled technicians are required to implement biodosimetric assays. However, the level of skill and time required to analyse data is no more demanding than physical dosimetry, and the costs of biodosimetry are lower than the costs of physical dosimetry if the launch mass and crew time involved for physical dosimetry is considered.

(188) The detection of low doses using chromosomal aberrations is dependent upon the number of cells analysed and whether an individual calibration curve is made prior to the exposure of interest. This point was addressed by (Bauchinger, 1995), who estimated that for 5000 cells analysed (using a generalised background frequency for dicentrics), a significant increase in dicentrics should be observed at approximately 100 mGy for a group of individuals. Twenty thousand cells would need to be analysed to detect 50 mGy. Knowledge of the pre-exposure dicentric frequency can lower this detection level without increasing the number of cells analysed.

(189) Tucker et al. (1997) reported a lower detection level of approximately 50 mSv for effective dose for occupationally exposed individuals using FISH analysis of stable aberrations. The exposure was chronic in this case; a situation for which this type of translocation analysis is particularly applicable. Again, the sensitivity of the assay would be increased if the pre-exposure aberration frequency was available. It might be further increased if the dose response to a reference radiation was determined using a blood sample obtained prior to space missions (George et al., 2001). The number of painted chromosomes used also affects the sensitivity of the assay. The older studies painted only one or two chromosomes. Newer studies involved a larger number of chromosome paints or painting of the entire genome, which increases the sensitivity. Tucker has recently reviewed the low-dose sensitivity of the FISH translocation assay (Tucker, 2008).

Other biomarker methods

(190) Several other assays have been proposed or developed as biomarker approaches. These include complementary DNA (cDNA) arrays to measure gene expression (Mezentsev and Amundson, 2011), prolonged life span of erythrocytes bearing transferring receptors on their membrane (Gong et al., 1999), gene mutation assays, and electron paramagnetic resonance spectroscopy. A review on electron paramagnetic resonance dosimetry with tooth enamel is given by Fattibene and Callens (2010). For these methods to be applied to space biodosimetry, the dose, radiation quality, and duration of the signal over many months will need to be understood. A more recent assay is the measurement of telomere length. Telomeres are the short repetitive DNA regions that cap the end of chromosomes, protecting them from deterioration. Reduction in the average length of the telomere has been associated with several late effects, including cancer, neurological disorders, and aging (Schoeftner et al., 2009). Measurement techniques include southern blot, Q-FISH (Williams et al., 2008), and flow cytometry. These latter two assays allow rapid analysis of many cells. However, the radiation quality and dose response of the assay

to proton and heavy ion irradiation will have to be studied further before it can be considered for a deployable biodosimeter for space missions.

4.5. Instrument characterisation and calibration

(191) For instrument characterisation and calibration in a laboratory, it is necessary to specify the relevant calibration conditions clearly, including the characteristics of the reference radiation source, the irradiation facility, and the conversion coefficients used. Accurate calibrations are essential, before and after a mission if this is possible, as are meaningful instrument response comparisons. Calibration (ISO/IEC, 2007; JCGM, 2008a) covers a number of the procedures included in a type test. In the first step, a series of calibration factors (or calibration coefficients, see below) or responses may be determined for a set of reference conditions, usually a set of radiation energies and angles, to establish a matrix of calibration factors/coefficients or responses, or a calibration/response function. The second step, when used, applies these data to obtain the value of the desired quantity from the instrument indication.

(192) All instrumentation should be fully tested prior to use. This procedure is especially important for applications in space where an exchange of instruments during a mission is often not possible. Failure of any part of the test should be clearly detailed, and reasons for the failure should be considered. Fully tested means determination of the instrument performance characteristics, including detection limit; tests of influence quantities, including other particle field components; and tests of the reliability of the complete system, including system software.

(193) For a fully tested instrument, a reference calibration (determination of a single calibration factor or calibration coefficient for one set of reference conditions) is sufficient to ensure a traceable absolute dose measurement. The reference calibration of the instrument should be repeated at regular intervals. This may not be possible in space applications, in which case there should be periodic checks on the performance which may be undertaken using non-reference fields and a fixed procedure. In addition to the type test, some instruments should have a traceable individual normalisation/calibration factor. For re-usable dosimeters, this factor should be checked periodically and adjusted if necessary.

(194) The response characteristics of all types of devices should be determined by a combination of calculation and measurements. Using Monte Carlo or other simulations, the response of an instrument is determined in terms of particle fluence and its energy distribution. The energy dependence of the response should be simulated for the particle types and a range of energies relevant to the radiation fields in space, plus the angle dependence of response of the instrument, if any. The simulated instrument response must be benchmarked in reference radiation fields. For simulation of the response characteristics of personal dosimeters, some irradiations should be performed with the dosimeter positioned on either an anthropomorphic phantom or a surrogate.

(195) Where an instrument consists of more than one detector or more than one signal channel, the result of any algorithm to calculate the measured value should

be treated as the instrument indication in all determinations of calibration coefficient, factor, or response.

(196) Experimental response data for active and passive devices should be determined for photons and for the following energy ranges of protons, heavy ions, and neutrons, as appropriate: protons from <10 MeV to 1 GeV; helium from 10 MeV/u to 1 GeV/u; high-Z, high-energy ions (e.g. C, Si, Fe) from 50 MeV/u to 1 GeV/u; electrons from 0.5 MeV to 10 MeV; and neutrons from approximately 1 MeV to 400 MeV, mono-energetic or quasi-monoenergetic; plus response data for fields that replicate the field produced by the interactions of GCR with shielding material. All the radiation fields used must be well characterised and traceable to national metrology institute standards, or related to these standards via a traceability network (e.g. quasi-mono-energetic neutron fields) or as part of an international comparison programme. The InterComparison of Cosmic rays with Heavy Ions Beams At NIRS (ICCHIBAN) series of investigations has been undertaken to study the heavy ion, and later proton, response of active and passive instruments (Uchihori et al., 2002; Yasuda et al., 2006).

(197) There are a number of International Organization for Standardization (ISO) standards for photon, beta, and neutron radiation, covering radiation fields for most radiation protection situations on Earth. The situation for space applications is more complex. Well-specified mixed radiation reference fields with very-high-energy particles and a large component of heavy ions do not exist on Earth. There are heavy ion and high-energy neutron radiation fields available at high-energy accelerators [e.g. EG at GSI in Germany; HIMAC, TIARA, CYRIC, and RCNP in Japan; National Aeronautics and Space Administration (NASA) Space Radiation Laboratory at BNL in the USA; TSL in Sweden; NPI in the Czech Republic; iThemba in South Africa; NFS in France; CERN in Switzerland]. In some instances, a broad range of secondary particles produced in the shielding surrounding a target can replicate components of the radiation fields in space, and can be used for testing and intercomparison measurements of various detector systems. The precise specification of these radiation fields, however, can be a problem. Calculations are needed for the beam particle and secondary particles, fluence rate and its energy distribution, and any scattered components. The specific detector response to heavy ions can also be determined using beams from heavy ion accelerators where the fluence rate of the heavy ion considered is well specified.

(198) Determination of the dosimetric characteristics of the instrument (device or combination of devices) and its reference calibration is closely interlinked. The result of a response characterisation is the detailed description of the dosimetric properties of a given instrument. This includes the dependence of the response on particle type, energy, angle of radiation incidence, and various influential quantities. A reference calibration without a prior dosimetric characterisation can be misleading, as the calibration can be misinterpreted as applying to the radiation field in space without correction. An instrument dedicated to a specific type of radiation (e.g. neutrons) can also have a response for other particle types. This needs to be taken into account by calibrations.

(199) In modern instruments, the software has become of increasing importance for generation of the measured value. Therefore, the final version of the software should be available at the beginning of the type test, as a great part of the software test is indirectly covered by the metrological test. The manufacturer should be aware of the fact that any change in the software may invalidate the type test. For example, dosimetric system software may be guided by WELMEC Software Guide 7.2 (WELMEC, 2008).

4.6. Accuracy and uncertainties for measurements in spacecraft

(200) Astronauts are exposed to complex, multicomponent fields that are difficult to determine routinely. Radiation quality-weighted organ absorbed doses can be significant, and a main objective is that the uncertainties in the fluence rate and its energy distribution, and in the assessments of detector absorbed dose and radiation quality, should be minimised. Nevertheless, one of the objectives should be to meet the general requirement that the total relative combined standard uncertainty of detector absorbed dose or dose equivalent should be minimised. The total relative uncertainty in a subsequent estimate of organ dose or dose equivalent will be greater.

(201) The uncertainty in measurement assesses the measurement accuracy or metrological quality of measurements or fitness for purpose of a measured quantity value. Measurement accuracy is an assessment of the uncertainty. Guidance is based on documents and recommendations prepared by the Joint Committee for Guides in Metrology (JCGM), which give definitions and guidance for metrology in general. These are available from the website of the Bureau International des Poids et Mesures: JCGM 200 (JCGM, 2008a), JCGM 100 (JCGM, 2008b), and JCGM 104 (JCGM, 2009). These definitions and guidance are published by ISO and the International Electrotechnical Commission (IEC) (ISO/IEC, 2005, 2007, 2009).

(202) An essential aspect of quality assurance is assessing the extent to which it is reasonable to believe that the reported number is a good estimate of the true dose value. The greater this belief, confidence, or probability that the measured value is within a certain defined range around the true value, or rather that the true value is within a certain range of the observed value, the better the quality of the measurement. In evaluation of the uncertainty, all knowledge of the instrument and evaluating system, both from experience and from type testing, should be used, possibly in combination with detailed information on the instrument assembly usage.

(203) In order to obtain dose data for which the quality is traceable and can be recognised, it is recommended that the terms and definitions given in the documents issued by JCGM and the ISO framework should be followed. In the formulation stage, all input/influence quantities that may contribute to the uncertainty should be identified, and must be considered in the measurement model; all model input/influence quantities should be characterised by a best estimate and either a probability density function (PDF) or a (combined) standard uncertainty. The shape of the PDF can be taken from measured data or from an assigned distribution. Results from a type test or other characterisation of the response of a dosimetric system may be used as inputs to the uncertainty assessment; other parameters such as stan-

dard uncertainty and coverage intervals must be derived from the PDF of the output quantity.

(204) *Publication 75* (ICRP, 1997) recommended that 'In practice, it is usually possible to achieve an accuracy of about 10% at the 95% confidence level for measurements of radiation fields in good laboratory conditions. In the workplace where the energy and directional distribution of the particles in the radiation field are generally not well known, the uncertainties of an assessment will be significantly greater. Non-uniformity and uncertain orientation of the radiation field will introduce errors in the use of standard models. The overall uncertainty at the 95% confidence level in the estimation of effective dose around the relevant dose limit may well be a factor of 1.5 in either direction for photons and may be substantially greater for neutrons of uncertain energy, and for electrons. Greater uncertainties are also inevitable at low levels of effective dose for all qualities of radiation'. These statements of ICRP strictly apply to the assessment of E and H_T for occupational exposure at low doses on Earth. ICRU has published recommendations on the acceptable levels of total uncertainty for dose measurements in radiological protection in Reports 47 and 66 (ICRU, 1992, 2001) which are broadly consistent with ICRP statements. For single measurements of the operational quantities, ICRU recommends that '...in most cases, an overall uncertainty of one standard deviation of 30% should be acceptable', and states 'The error of instruments may substantially exceed this limit at some radiation energies and for certain angles of incidence, but conform to it when they occur in a radiation field with a broad energy spectrum and broad angular distribution'.

(205) The statistical uncertainty of laboratory calibrations is commonly far less than the above uncertainties. However, the absorbed dose and dose equivalent response of devices are frequently appreciably energy and angle dependent. In order to minimise the total uncertainty in practical measurements, either determination of the response is required for the radiation field in which it is to be used, or a simulation of this field may be used to determine and apply correction factors to the calibration factor of an instrument. It may also be possible to calculate the response in this field from knowledge of the field and the detailed energy and angle dependence of response of the device. Frequently, it is the direction distribution of the radiation which has the greatest influence. For measurements in space, additional information on the particle type, energy, and direction distributions are available. Using these data, accuracies of more than a factor of 1.5 at the 95% confidence level (equivalent to a standard deviation for a normal distribution of approximately 0.25) should be achieved for the estimation of organ absorbed dose and organ dose equivalent.

(206) At doses approaching or exceeding mission risk limits, or career risk limits, the upper 95% coverage probability is used to include the measurement uncertainty for assessment of the cancer risk projections from estimations of organ doses and radiation quality and tissue weighting factors (see also Section 7.5). Obviously, reduction of measurement uncertainties is seen to be an important task for mission planning.

5. RADIATION FIELDS INSIDE SPACECRAFT AND ON PLANETARY SURFACES

(207) The radiation field inside or near spacecraft includes various components of the primary radiation field in space (see Chapter 2) partially absorbed in the walls of the spacecraft, and secondary radiation which is produced by scattering and reactions of the primary radiation in the walls and other materials within the spacecraft. Due to variation of the primary radiation field with time and the non-homogeneous distribution of materials within the spacecraft, the internal radiation field depends on the location in the spacecraft and time during the mission.

(208) The radiation field near planetary surfaces is determined by several factors, such as the existence and strength of a magnetic field, the thickness and composition of the atmosphere, and the planetary material near to the surface. Scattering, absorption, and reactions in the planetary atmosphere and the ground material are also important.

5.1. General

(209) The physical description of the interaction of space radiation with matter requires knowledge of the energy and isotopic distribution of primary and secondary charged particles and neutrons produced in atomic and nuclear collision processes in the transport of radiation through matter. Computer codes describing protons, HZE nuclei, and secondary radiation energy distributions and their transport through matter are used for shielding design of spacecraft and planetary habitats, and organ exposure assessments. The codes need to be benchmarked against space dosimetry results. The broad range of ion types and energies of the GCR and solar particles, and the large number of materials of interest in spacecraft structures, planetary atmospheres, and tissues require a detailed description of the basic physical processes including the development of reliable computer models. Studies of potential risk mitigation including operational, shielding, and biomedical approaches must rely on theoretical models in the form of radiation transport codes to make projections and to support design studies of such missions.

(210) Dominant physical processes in the penetration of high-energy nuclei through matter are energy loss through atomic and molecular collisions, and absorption and particle production from nuclear interactions with spacecraft materials and tissues. For heavy ions with high kinetic energies (>100 MeV/u), nuclear absorption by fragmentation is the dominant reaction mode (Hufner, 1985; Townsend and Cucinotta, 1996). The nuclear absorption cross section scales by the nuclear mass number to a power, $A^{1/3}$ and fragmentation of GCR nuclei is more efficient per unit mass for materials with light constituent atoms. At lower energies (<100 MeV/u), elastic scattering, compound nucleus formation, or excitations of discrete nuclear levels that decay by gamma emission or particle emission are dominant interaction modes. However, the short range and high stopping powers of heavy ions reduce

the importance of nuclear reactions at lower energies, except for neutrons. High-energy protons and neutrons interact through knockout and spallation reactions (Hufner, 1985). Such processes lead to a build-up of light particles ($Z \leq 2$) and localised production near the primary track of heavy ion target fragments with large values of LET and short ranges (Wilson et al., 1991; Cucinotta et al., 1996).

5.2. Physics of space radiation transport

5.2.1. Radiation transport

(211) The description of the passage of high-energy nuclei through matter can be made using the Boltzmann transport equations for atomic and nuclear collisions. The equations may be solved by either numerical and analytic techniques – the straight-ahead approximation – or by Monte Carlo techniques, which sample from interaction processes for individual primaries or their secondaries to develop histories of charged particle passage and energy deposition in materials. The Monte Carlo method is widely used in particle physics, and is often applied in simulating radiation transport through matter and the calculation of dose distributions.

(212) The relevant Boltzmann transport equations are derived on the basis of conservation principles (Wilson et al., 2001) for the fluence rate, $\dot{\Phi}_{\mathrm{j}}(x, \Omega, E)$ of type j particles as:

$$\Omega \cdot \nabla \dot{\Phi}_{\mathrm{j}}(x, \Omega, E) = \sum_{\mathrm{k}} \int \int \sigma_{\mathrm{j,k}}(\Omega, \Omega', E, E') \dot{\Phi}_{\mathrm{k}}(x, \Omega', E') dE' d\Omega' - \sigma_{\mathrm{j}} \Phi_{\mathrm{j}}(x, \Omega, E) \tag{5.1}$$

where $\sigma_{\mathrm{j}}(E)$ and $\sigma_{\mathrm{jk}}(\Omega, \Omega', E, E')$ are the media macroscopic cross sections. $\sigma_{\mathrm{jk}}(\Omega, \Omega', E, E')$ represents all those processes by which the particles of type k moving in direction Ω' with energy E' produce a particle of type j in direction Ω with energy E. The fluence rate, $\dot{\Phi}_{\mathrm{j}}(x, \Omega, E)$, is the main physical quantity used to determine the physical or biological response by folding it with an appropriate response function for the physical or biological system under study.

(213) There may be several reactions that produce a particular product, and the appropriate cross sections for Eq. (5.1) are the inclusive reactions. The total cross section $\sigma_{\mathrm{j}}(E)$ with the medium for each particle type of energy E may be expanded as:

$$\sigma_{\mathrm{j}}(E) = \sigma_{\mathrm{j}}^{\mathrm{at}}(E) + \sigma_{\mathrm{j}}^{\mathrm{el}}(E) + \sigma_{\mathrm{j}}^{\mathrm{r}}(E) \tag{5.2}$$

where the first term refers to collision with atomic electrons, the second term is for elastic nuclear scattering, and the third term describes nuclear reactions. The microscopic cross sections and average energy transfer are ordered as follows:

$$\sigma_{\mathrm{j}}^{\mathrm{at}}(E) \sim 10^{-16}\ \mathrm{cm}^2 \text{ with } \delta E_{\mathrm{at}} \sim 10^2\ \mathrm{eV} \tag{5.3}$$

$$\sigma_{\mathrm{j}}^{\mathrm{el}}(E) \sim 10^{-19}\ \mathrm{cm}^2 \text{ with } \delta E_{\mathrm{el}} \sim 10^6\ \mathrm{eV} \tag{5.4}$$

$$\sigma_{\mathrm{j}}^{\mathrm{r}}(E) \sim 10^{-24}\ \mathrm{cm}^2 \text{ with } \delta E_{\mathrm{r}} \sim 10^8\ \mathrm{eV} \tag{5.5}$$

Over a distance of 1 g cm^{-2} of a material, many atomic collisions ($\sim 10^6$) occur, along with far fewer nuclear Coulomb elastic collisions ($\sim 10^3$); nuclear reactions are separated by many cm depending on energy and particle type. For neutrons, it is $\sigma_n^{at}(E) \sim 0$ and the nuclear elastic process appears as the first-order perturbation. Mean free paths for elastic scattering of neutrons may become quite small, especially at low energies in the resonance region (ICRU, 2000).

(214) The solution of Eq. (5.1) involves hundreds of multidimensional integro-differential equations that are coupled together by thousands of cross-terms and must be solved consistently subject to boundary conditions that ultimately relate to the external environment and the geometry of the astronaut's body and/or a complex spacecraft. A series of approximate solutions can be studied and indicate a high level of accuracy for most applications (Wilson et al., 2001; Tweed et al., 2005). The mean energy loss can be introduced in a continuous slowing down approximation, and straggling can be neglected for the broad energy spectra of the space radiation. The highly directional Coulomb cross section for charged ions (Wong et al., 1990) and nuclear elastic scattering for neutrons generally dominate the second perturbation term. The angular dispersion and its effects on lateral beam spread and range straggling are important corrections when comparing with laboratory measurements. The nuclear elastic scattering is especially important to neutron fields and has been treated using Monte Carlo or multigroup methods (Hughes et al., 1997). The third perturbation term consists of complex energy and angle functions. Results from Monte Carlo codes (Alsmiller et al., 1965) provided the basis for the generation of analytical techniques and the simplification of boundary conditions used in space shield code development (Wilson et al., 1991).

5.2.2. Atomic processes

(215) The transport coefficients describe the atomic/molecular and nuclear processes by which the particle fields are modified by the presence of material (Wilson et al., 2001). As such, basic atomic and nuclear theories provide the input to the transport code databases. The first-order physical perturbation on the right side of Eq. (5.1) is the atomic/molecular cross sections noted in Eq. (5.3) for which those terms in Eq. (5.1) are expanded about the energy moments as:

$$S_n(E) = \Sigma_i \Sigma_l \varepsilon_i^n \sigma_i(E) \tag{5.6}$$

where ε_i is based on the electronic excitation energy, and $\sigma_i(E)$ is the total atomic/molecular cross section for delivering ε_i energy to the orbital electrons (including discrete and continuum levels). The first moment ($n = 1$) is the usual stopping power, and the usual continuous slowing down approximation is achieved by neglecting the higher-energy moments. The second moment represents the energy straggling (Payne, 1969) due to the stochastic distribution of energy loss.

(216) Stopping power databases are derived semi-empirically as the Bethe reduction of Eq. (5.6) in terms of mean excitation energies and shell corrections (Fano, 1963; Wilson et al., 1991). The linear stopping power, S, is adequately described by the Bethe-Bloch formula for most ion energies (Bichsel, 1992):

$$S = \frac{4\pi Z_P^2 Z_T N_T e^4}{mv^2}\left\{\ln\left(\frac{2mc^2\beta^2\gamma^2}{I}\right) - \beta^2 - \frac{C(\beta)}{Z_T} + Z_P L_1(\beta) + Z_P^2 L_2(\beta) + L_3(\beta)\right\} \tag{5.7}$$

where e is the electronic charge, Z_P and Z_T are the charge numbers of the incident and the target atoms, N_T is the density of target atoms, m is the mass of the electron, c is the speed of light, $\beta = v/c$, and I is the mean excitation energy. In Eq. (5.7), the various terms are the shell correction $C(\beta)$, Barkas correction, $L_1(\beta)$, Bloch term, $L_2(\beta)$, and Mott and density corrections $L_1(\beta)$. The range of the ion is evaluated from the stopping power as:

$$R(E) = \int_0^E \frac{\mathrm{d}E'}{S(E')} \tag{5.8}$$

(217) The second energy moment is related to energy or range straggling and provides corrections to the ion slowing down spectrum (Fano, 1963; Payne, 1969). For broad-energy beams, conditions of GCR or SPE transport straggling effects are negligible; however, they are important for laboratory studies with mono-energetic beams and for understanding radiation detector response. The next physical perturbation term is the Coulomb scattering by the atomic nucleus, typically represented by Rutherford scattering modified by screening of the nuclear charge by the orbital electrons using the Thomas-Fermi distribution for atomic orbits. The total nuclear Coulomb cross section found by integrating over the scattering directions is related to the radiation length. The differential cross section is highly peaked in the forward direction, and significant beam divergence is only seen after many scatterings. Numerical solutions to the Coulomb multiple-scattering problem have been investigated for many years (Fermi, 1940), and accurately describe experimental data with HZE (Wong et al., 1990) or proton beams (Carlsson and Rosander, 1973).

5.2.3. Nuclear interactions

(218) The extent of the nuclear interaction cross section database required for the transport of cosmic radiation is for energies from 1 MeV/u to energies of tens of GeV/u, including a large number of projectile and target material combinations. The types of cross sections required for transport involve total yields and multiplicities, inclusive secondary energy spectra, and inclusive double differential cross sections in angle and energy. Total absorption plays a critical role in ensuring a reasonable solution to the Boltzmann equation, including the accuracy of particle conservation as a function of depth in the shield (Wilson et al., 1991). Similarly, in Monte Carlo approaches, the absorption cross section plays the critical role of determining the probability of interaction events along the trajectory of a primary particle in the shielding. In addition, exclusive cross sections are used in some event generators in Monte Carlo transport codes. The total cross section, σ_{TOT}, is found from the elastic amplitude in the forward direction as found in the optical theorem (Wilson et al., 1991) as the imaginary part of the elastic scattering amplitude (Im f):

Table 5.1. Reaction products in nuclear reactions important to space radiation studies.

Reaction type	Secondary	Mechanism	Comment
Nucleon–nucleus	Nucleon	Evaporation	High LET, small range
		Knockout and elastic, quasi-elastic scattering	Large range
Nucleon–nucleus	Light particle (p, d, t, α, n)	Evaporation	High LET, small range
		Knockout, pickup	Large range
Nucleon–nucleus	Heavy recoil	Elastic scattering	High LET, small range
		Fragmentation or spallation	High LET, small range
Nucleus–nucleus	Nucleon or light particle	Target or projectile	Low LET, large range
		Knockout or evaporation	High LET, small range
Nucleus–nucleus	Heavy ion	Projectile fragment	Moderate LET, large range
Nucleus–nucleus	Heavy ion	Target fragment	High LET, small range
Nucleon or nucleus–nucleus	Pion, kaon, anti-nucleon, gamma	Target reaction Proj. $E > 500$ MeV/u	Deep penetration (>50 g cm^{-2})

LET, linear energy transfer.

$$\sigma_{\mathrm{TOT}} = \frac{4\pi}{k} \mathrm{Im}\, f(q = 0) \tag{5.9}$$

where q is the momentum transfer, and k is the relative momentum of projectile and target nuclei.

(219) The total absorption cross section is also found from the elastic scattering amplitude by using:

$$\sigma_{\mathrm{TOT}} = \sigma_{\mathrm{ABS}} + \sigma_{\mathrm{EL}} \tag{5.10}$$

where σ_{EL} is the total elastic cross section. Formulae for these cross sections can be derived from microscopic theories of nuclear multiple scattering (Cucinotta et al., 1997). The absorption cross sections are accurately represented by energy-dependent variants of the Bradt–Peters equation (Townsend and Wilson, 1986):

$$\sigma_{\mathrm{ABS}} = \pi r_0^2 c_1(E)(A_{\mathrm{p}}^{1/3} + A_{\mathrm{T}}^{1/3} - c_2(E))^2 \tag{5.11}$$

where r_0, $c_1(E)$, and $c_2(E)$ are parameters fit to experimental data. Absorption cross sections have been well studied both experimentally and theoretically, and are known with a few percent uncertainties (Tripathi et al., 2001). The absorption cross section rises at low energy as reaction channels open, and reaches a minimum at a few hundred MeV/u before rising again as meson production channels open.

(220) Table 5.1 shows reaction partners and secondaries of relevant reactions broken into distinct reaction types or mechanisms. Low-energy evaporation products including heavy ion target fragments are high-LET events important in biological damage. Knockout products from proton or neutron reactions and projectile fragments from nuclei of GCR are typically of low to moderate LET; however, their large ranges lead to radiation build-up through further reactions. The abrasion–ablation models (Hufner et al., 1975; Townsend et al., 1986; Townsend and Cucinotta, 1996; Wilson et al., 1995b; Cucinotta et al., 1997, 1998) are used to describe heavy ion fragmentation cross sections. The description of nuclear reactions through abrasion

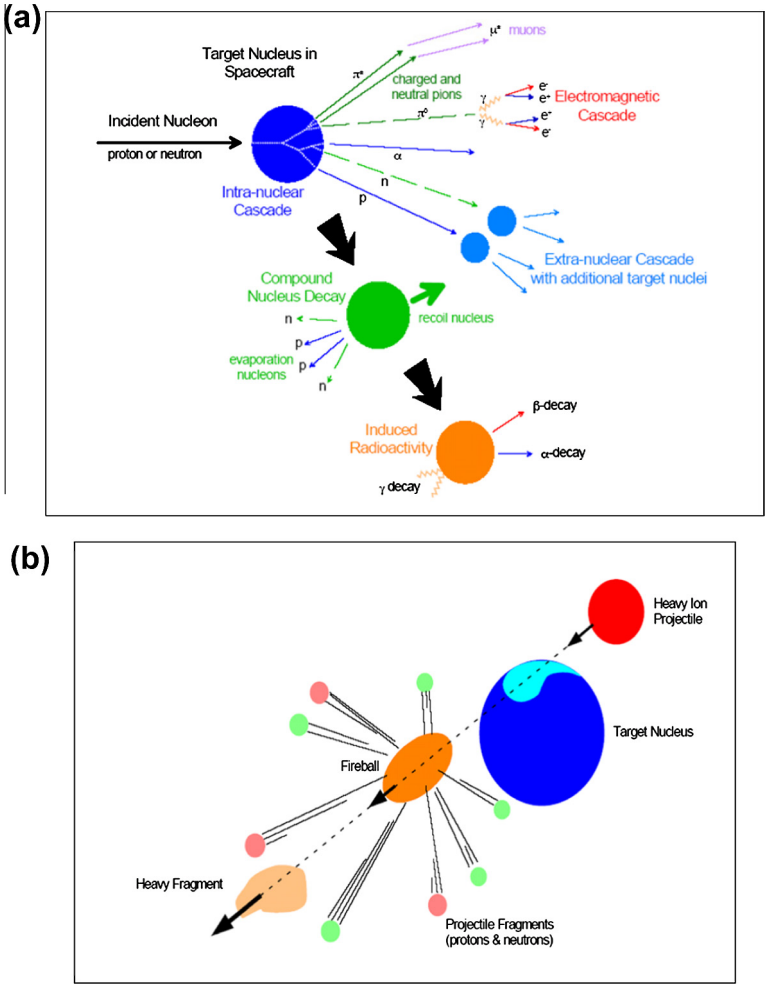

Fig. 5.1. (a) Schematic diagram of the reaction of an incident nucleon with a target nucleus at high energies (ICRU, 1978). (b) Schematic diagram of a relativistic heavy ion reaction with a target nucleus (Miller, 1997).

(particle removal during ion–ion interaction) and ablation (nuclear de-excitation after the abrasion step) is illustrated in Fig. 5.1, which shows the roles of projectile overlap, fireball formation in central regions, and the decay of the prefragment spectators (NCRP, 2006). The individual steps of abrasion and ablation can be described in both semi-classical or quantum mechanical approaches (Cucinotta et al., 1995; Casolino et al., 2007). These different reaction processes have been described by quantum multiple scattering theories, semi-classical methods such as quantum molecular dynamics, and Monte Carlo approaches to nuclear reactions using an intranuclear cascade model

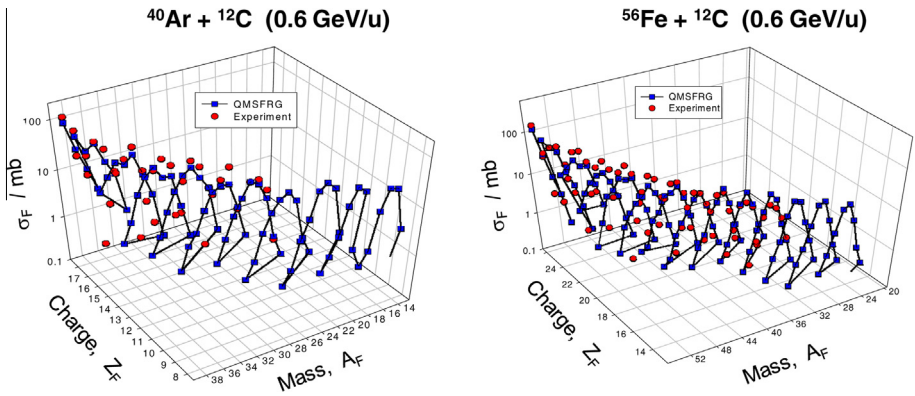

Fig. 5.2. Comparisons between the QMSFRG model (Cucinotta et al., 2006) and experiments for isotopic distribution of fragments for ^{40}Ar on ^{12}C at 0.6 GeV/u (left panel) and ^{56}Fe on ^{12}C interactions at 0.6 GeV/u (right panel).

(see Durante and Cucinotta, 2011 and references therein for a review of nuclear reaction models).

(221) Examples of fragmentation cross sections for Ar and Fe projectiles are shown in Fig. 5.2 in comparison to the quantum multiple scattering fragmentation (QMSFRG) model (Cucinotta et al., 2002, 2006b, 2007). Available fragmentation cross section data sets for target atoms of interest for space missions were reviewed by Durante and Cucinotta (2011) and NCRP (2006). One feature of the elemental distribution of the fragments is the strong even–odd effect in the charge number of the fragments observed. The effect appears to be largest for intermediate mass projectiles (A = 20–40) and depends on the isospin of the projectile (Knott et al., 1996, 1997). Theoretical models provide a good representation of the odd–even effect if accurate nuclear de-excitation models are used (Cucinotta et al., 2002, 2006b, 2007). Fig. 5.2 shows comparisons of fragmentation cross sections of the QMSFRG model with experiments for several beam energies of ^{56}Fe interacting with a variety of target nuclei. Good agreement between experiments and the QMSFRG model within 25% for most fragment cross sections has been achieved, as shown in Fig. 5.3. A larger database for cross sections for proton- and neutron-induced reactions now exists, with recent surveys of such data provided in ICRU Report 63 (ICRU, 2000). Above kinetic energies of a few thousand MeV/u, multiple meson production processes are dominant and reaction models based on patron or quark–gluon models can be used to describe nuclear interaction cross sections (Fasso et al., 2005).

(222) The momentum distribution of heavy projectile fragments is forward peaked and described as a Gaussian distribution in the projectile rest frame with a small downshift in the average momentum from the velocity of the projectile. The longitudinal momentum width, σ_L, is well described by Goldhaber (1974):

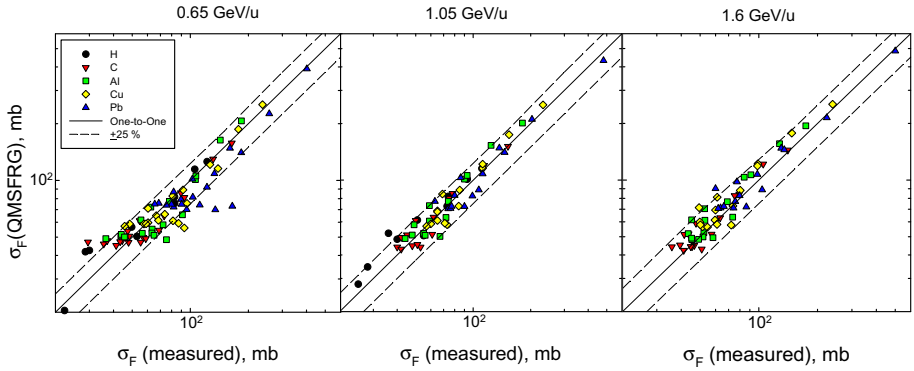

Fig. 5.3. Comparisons between experiments and the QMSFRG model for fragmentation cross sections for ^{56}Fe projectiles of different energies interacting with several target nuclei (Cucinotta et al., 2006) where the dashed lines show ±25% ranges of the experimental data.

$$\sigma_{\mathrm{L}} = \sigma_0 \left[\frac{n(A_{\mathrm{p}} - n)}{A_{\mathrm{p}} - 1} \right]^{1/2} \tag{5.12}$$

where n is the number of nucleons removed from the projectile, and σ_0 is approximately related to the Fermi momentum of the projectile, p_{F}, by $\sigma_0 = p_{\mathrm{F}}/\sqrt{5}$. The transverse width is approximately the same as the longitudinal width for heavier fragments. A small momentum downshift of the fragments relative to the projectile also occurs, and is dependent on the fragment mass (Tull, 1990). Transformation of the Gaussian distribution to the laboratory rest frame reveals a narrow angular distribution for the projectile fragments that are strictly forward peaked in a narrow cone (<5°), which leads to the success of the straight-ahead approximation in transport models. For lighter fragments, the longitudinal and transverse widths diverge and the Gaussian model breaks down. This is due to the multiple sources for light particle production, including projectile abrasion, projectile ablation, target abrasion, and target ablation, as well as a possible intermediate source due to the formation of an intermediate rapidity fireball in central collisions.

5.3. Proton, neutron, and heavy ion transport codes

(223) Several radiation transport codes have been developed for applications in radiotherapy, physical experiments at high-energy accelerators, detector simulations, and radiation protection in space. The different radiation transport codes use distinct nuclear databases and methods including their treatment of nuclear interactions, secondary radiation, and shielding geometries. It is unlikely that space radiation problems can be handled with a 'one size fits all approach', and the specific application will drive the method to be used. Complex spacecraft and organ geometry are described using ray-tracing distributions, combinatorial geometry models of complex structures, or voxel-based methods. Ray tracing methods are able to treat thousands of spacecraft parts accurately and can directly integrate engineering designs in a

CAD format. Ray tracing methods have only been developed for bi-directional fields (forward–backward scattering); however, they have been shown to be quite accurate for the omnidirectional radiation fields in space. Combinatorial geometry models, often used by Monte Carlo codes, rely on approximations that paradoxically wash out the fine details of surface and angular effects that three-dimensional transport models are intended to describe.

(224) Models of GCR, trapped radiation, or SPEs are usually used as the boundary condition for transport codes. Several transport codes used in space applications are summarised below:

FLUKA (FLUctuating KAscades)

(225) FLUKA is a general-purpose Monte Carlo programme for calculations of particle and photon transport (Ferrari et al., 2007; Andersen et al., 2004; Fasso et al., 2005; Battistoni et al., 2007) that can simulate the interactions and propagation of approximately 60 different particles in matter, including heavy ions (http://www.fluka.org). The programme can also describe the transport of polarised photons (e.g. synchrotron radiation) and optical photons. Photonuclear interactions can be simulated. Time evolution of the radioactive nuclei inventory and tracking of emitted radiation from unstable residual nuclei can be performed.

(226) Depending on the energies of the primary particles, hadronic interactions are simulated by different physical models (Ballarini et al., 2004). For higher energies, the Dual Parton model is used. Below 3–5 GeV c^{-1}, the PEANUT (Cascade–Pre-equilibrium model) package includes a very detailed generalised intranuclear cascade (GINC) and a pre-equilibrium stage, while at high energies, the Gribov-Glauber multiple collision mechanism is included in a less-refined GINC. Nuclear interactions generated by ions are treated through interfaces to external event generators, except for the low-energy (<150 MeV/u) range for which a model based on the Boltzmann master equation has been implemented. The relativistic quantum molecular dynamics generator is invoked from 100 MeV/u to 5 GeV/u, and the DPMJET code is used for energies over 5 GeV/u.

(227) The transport of charged particles is described by applying a multiple scattering algorithm based on Moliere's theory of Coulomb scattering. The algorithm includes an accurate treatment of curved trajectories in magnetic fields. The energy loss is determined according to the Bethe–Bloch theory and from bremsstrahlung and pair production. Ionisation fluctuations are accounted for.

(228) For neutrons with energies lower than 20 MeV, FLUKA employs a multi-group transport algorithm that uses a subdivision of the neutron energy range in 260 groups and is based on neutron cross section libraries containing more than 200 different materials, selected for their use in physics, dosimetry, and accelerator engineering. Energy depositions for nuclei other than hydrogen are calculated by kerma coefficients.

(229) FLUKA can handle very complex geometries using an improved version of the well-known combinatorial geometry package. Repetitive structures (lattices) and voxel geometries can be handled. Various visualisation and debugging tools are also available.

GEANT4

(230) The Monte Carlo code GEANT4 (Agostinelli et al., 2003; Allison et al., 2006) stands for GEometry ANd Tracking, and is a software toolkit for simulating the passage of particles through matter. It has been developed and maintained by the GEANT4 Collaboration which is a worldwide team of physicists and software engineers (see http://geant4.web.cern.ch/geant4). GEANT4 and its predecessors were designed to utilise the physics models, to handle complex geometries, and to enable its easy adaptation for optimal use in different sets of tasks. It has its applications in high energy, nuclear, and accelerator physics as well as studies in radiation protection, medical, and space science.

(231) The toolkit includes facilities for handling tracking, geometry, physics models, detector response, run management, visualisation, and user interface. The software offers a large set of physical processes (e.g. electromagnetic, hadronic, and optical model), different types of particles (leptons, bosons, mesons, baryons, etc.), and databases with properties of matter and elements. Physics processes cover a wide range of energies that range from 250 eV up to 1 TeV depending on the case. Several of the modules contained in GEANT4 are recreations of physics in other codes including HZETRN and HETC. Spacecraft geometry models are available including multilayered shielding simulation software (Bernabeu and Casanova, 2007).

(232) The toolkit is implemented in C++ programming language making use of the object-oriented technique. This approach allows users to manage complexity and limit dependencies by defining uniform interfaces and common organisational principles in order to create an application for solving a specific problem.

HETC-HEDS (High-energy Transport Code-Human Exploration)

(233) HETC is a high-energy Monte Carlo radiation transport code that was developed at Oak Ridge National Laboratory (Townsend et al., 2002). The code was originally developed for transport calculations with incident high-energy protons, neutrons, π^+, π^-, μ^+, or μ^- alone. Subsequently, Townsend et al. (2005) extended the model specifically for space radiation shielding applications. The code, now called HETC-HEDS, has been modified to include the transport of heavier nuclei (Charara et al., 2008).

(234) HETC-HEDS includes nucleus–nucleus cross sections, range–energy tables scaled from the proton data, and a nuclear collision module for heavy ion interactions. Non-elastic nucleon collisions and charged pion collisions with hydrogen at energies above 3.5 GeV and 2.5 GeV, respectively, are treated using calculational methods that use experimental data for the total non-elastic n–p, p–p, π^+–p, and π^-–p cross sections and analytic fits to experimental data. The intranuclear cascade evaporation concept of particle–nucleus interaction is used to determine the effect of particle–nucleus collisions below 3.5 GeV for nucleons and 2.5 GeV for charged pions. Following the intranuclear cascade, the excitation energy left in the nucleus is treated using an evaporation model. The particles allowed during evaporation include protons, neutrons, d, ^{3}H, ^{3}He, and ^{4}He.

(235) HETC-HEDS uses the combinatorial geometry package so virtually arbitrary geometries are allowed. Each particle in the cascade is followed until it eventually

disappears by escaping from the geometric boundaries of the system, undergoes nuclear collision or absorption, comes to rest due to energy losses from ionisation and excitation of atomic electrons, or decays in the case of pions and muons.

HZETRN [High charge (Z) and Energy Transport code]

(236) HZETRN was developed by Wilson et al. (1991, 2004) at NASA. It solves the Boltzmann equation using numerical methods. The early version used the straight-ahead approximation, but more recent versions use bi-directional transport or three-dimensional transport for laboratory studies (Kim et al., 2012). Recently, ray tracing representations of voxel models of human geometries have been developed (Slaba et al., 2010). Nuclear interactions are treated by the NUCFRG2 model (Wilson et al., 1994a) or QMSFRG model (Cucinotta et al., 2007) with proton and neutron cross sections described by the Bertini and Ranft models. Ray tracing methods are used to treat complex radiation geometries; this is powerful because spacecraft engineers can use their designs directly in the transport code evaluations. Computer runs on small computer workstations can be performed in less than 1 h for complex spacecraft geometries with multilayer materials and deep shielding conditions (>100 g cm^{-2}), combined with models of the organ shielding of the human body.

MCNPX (Monte Carlo N-Particle eXtended)

(237) The Los Alamos Monte Carlo code MCNPX (http://mcnpx.lanl.gov) and its predecessors are very widely distributed (Waters, 2002; Pelowitz, 2008). The code is capable of tracking many particle types (nucleons and light ions) and over 2000 heavy ions up to very high energies. It uses standard evaluated data libraries for neutrons, photons, electrons, protons, and photonuclear interactions, and uses physics models for other particle types and at energies for which tabular data are not available.

(238) Current physics modules include the Bertini and Isabel models taken from the LAHET code system, CEM 03, and INCL4 (James et al., 2009). The incorporation of a heavy ion physics model has enabled the transport of recoil nuclei. This model automatically transports all residuals that are produced from any reaction even if the source particle is not a heavy ion. Current stopping powers for heavy ions have been adjusted in an ad-hoc fashion (Pelowitz, 2008) so they better match SRIM results (Ziegler et al., 2008). Charged particles are slowed down to a lower total energy limit of 5 MeV, at which point their remaining energy is deposited locally.

PHITS (Particle and Heavy-Ion Transport code System)

(239) The Monte Carlo radiation transport code PHITS (http://phits.jaea.go.jp) was developed in collaboration with several institutes including Japan Atomic Energy Agency (JAEA), Research Organization for Information Science and Technology (RIST), High Energy Accelerator Research Organization (KEK), and Chalmers University of Technology (Niita et al., 2010; Sihver et al., 2010a). Nuclear interactions are described by various models such as JAM and JQMD up to 100 GeV/u. The code can determine the energy of charged particles emitted from low-energy neutron-induced nuclear reactions using the event generator mode (Iwamoto et al., 2007; Niita et al., 2007) in combination with nuclear data libraries. This feature enables the direct calculation of dose equivalent in organs or tissues which cannot be calculated by

employing the conventional kerma approximation. The accuracy of the code for use in space dosimetry was well verified by calculating neutron spectra inside the space shuttle (Sato et al., 2006) and doses inside anthropomorphic phantoms (Sato et al., 2011) using simplified geometries of spacecraft. The code is also used for computational analyses of the MATROSHKA and MATROSHKA-R experiments in space (Sihver et al., 2010b; Koliskova et al., 2012).

5.3.1. Intercomparison and validation of radiation transport codes

(240) The accuracy of space radiation transport models for prediction of energy spectra of charged particles and neutrons after primary radiation has passed through matter can be assessed by comparison with laboratory experiments with proton and heavy ion beams or from measurements in spacecraft. Spaceflight measurements, however, involve many factors such that potential inadequacies in radiation transport models are difficult to isolate relative to possible inaccuracies in environmental or shielding models. Also, space validation is limited by the access to space and current spacecraft materials, and may not be representative of model predictions for other material types such as those that occur on planetary surfaces or in advanced material selection concepts. In this respect, laboratory validation is advantageous to validate radiation transport computer codes and associated database models,

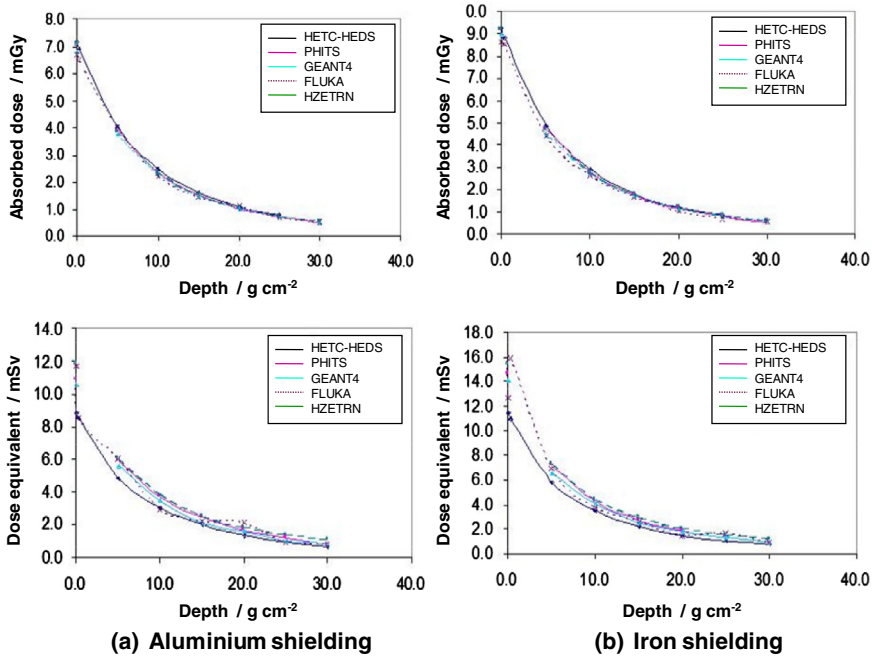

Fig. 5.4. Intercomparison of transport codes for depth-dose distributions of absorbed dose and dose equivalent from solar particle events in aluminium and iron shielding (Wilson, 2009).

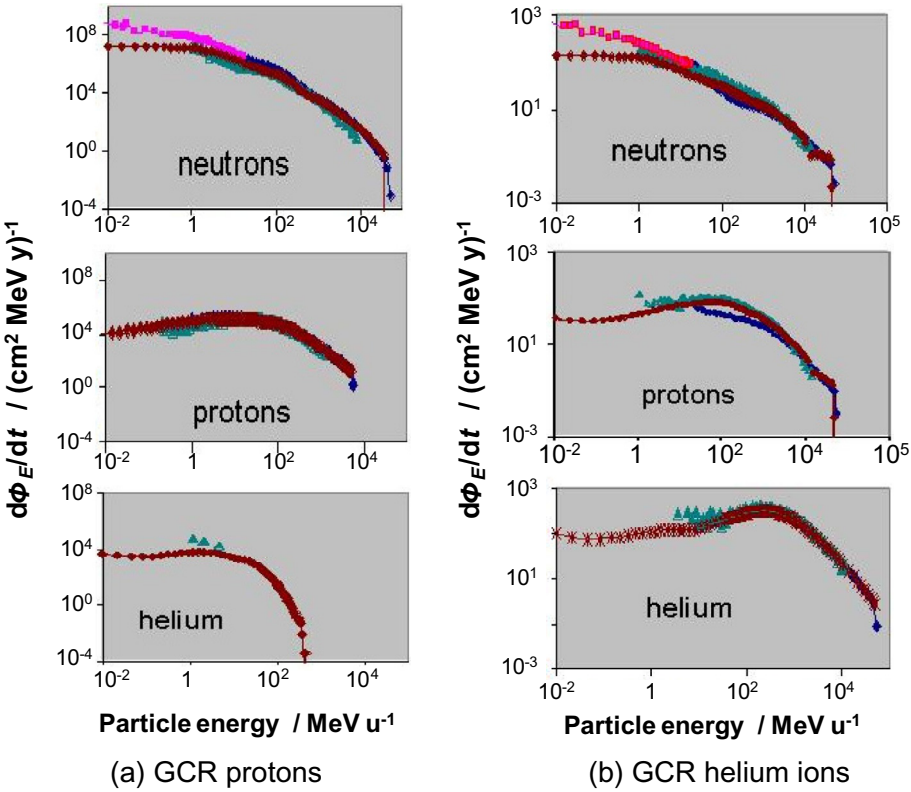

Fig. 5.5. Intercomparison of energy distributions (energy distribution of fluence rate, $d\Phi_E/dt$) of light ions from galactic cosmic radiation at solar minima calculated by different transport codes (Heinbockel et al., 2011b). ♦, HETC-HEDS; ▲, FLUKA; ♦, ✻, HZETRAN2006.

and to provide tests for studying material properties for reducing biological doses (Schimmerling et al., 1999). Nevertheless, spaceflight measurements provide important tests of predictive capability of several factors, and are needed for final validation of transport codes.

(241) Recently, extensive benchmarking of the calculated projectile fragmentation cross sections from the reactions of 300–1000 MeV/u ^{28}Si, ^{40}Ar, and ^{56}Fe ions on polyethylene, carbon, aluminium, and copper targets (relevant to space radiation protection) was undertaken using PHITS, FLUKA, HETC-HEDS, and MCNPX. Calculated results were compared with measurements (Sihver et al., 2008).

(242) An overall 'reasonable' agreement between calculations and measurements was found. However, a general trend of a slight underestimation of the calculated fragment production cross sections (partial charge-changing cross sections) was observed. HETC-HEDS seems to underestimate these cross sections more than the

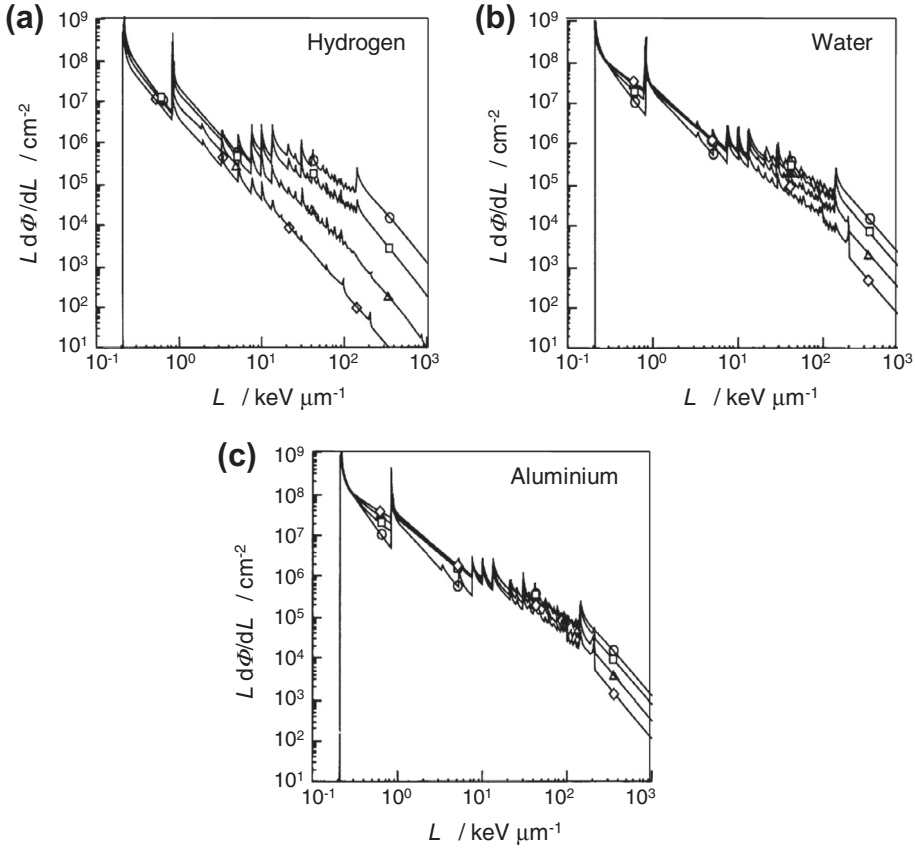

Fig. 5.6. Linear energy transfer (L) distribution of particle fluence in space calculated using the HZETRN code for increasing amounts of liquid hydrogen (a), water (b), and aluminium (c) shielding (Wilson et al., 1995c). ○, without shielding; □, with shielding thickness of 5 g cm^{-2}; △, with shielding thickness of 15 g cm^{-2}; ◇, with shielding thickness of 30 g cm^{-2}.

other codes included in this benchmarking. PHITS also seems to underestimate the total charge-changing cross sections, which is in agreement with other observations (Sihver et al., 2007).

(243) A recent intercomparison of transport codes for SPE and GCR test cases indicates fairly good agreement between the various codes (Hein-bockel et al., 2011a, 2011b). Fig. 5.4 shows comparisons of results of depth-dose distributions from different codes for a large SPE. Fig. 5.5 shows a comparison of energy spectra of secondary particles produced by protons and helium ions of GCR at solar minimum calculated with various codes.

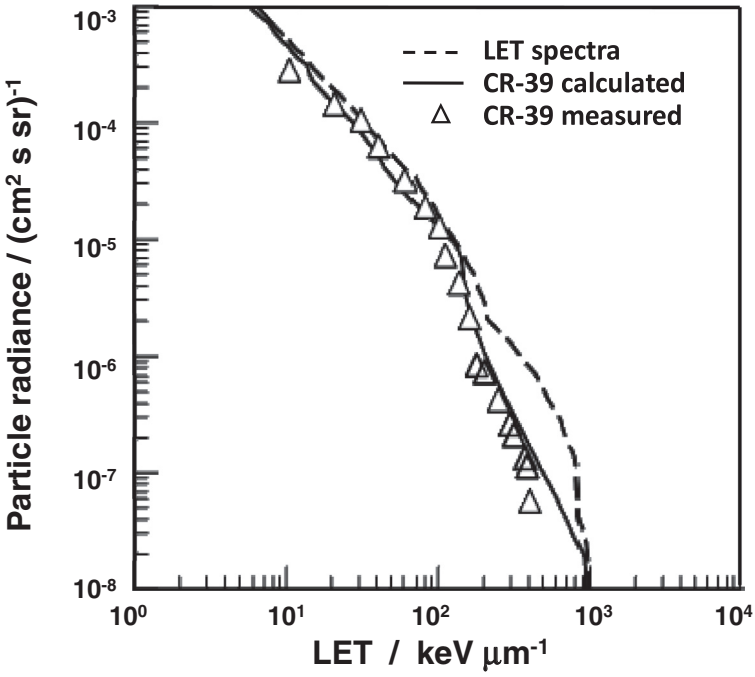

Fig. 5.7. Comparisons of linear energy transfer (LET) distributions of particle radiance measured by nuclear etched track detectors of LET distributions and model calculations of LET distributions on space shuttle missions (Wilson et al., 1994b; Shinn et al., 1998).

5.4. Radiation fields inside spacecraft

(244) Radiation fields inside spacecraft are determined by the external radiation incident on the spacecraft, and the secondary radiation produced by the interactions with the walls and the equipment inside and outside the spacecraft. The internal radiation field varies with time due to variation of the external radiation (see Chapter 2) and the location in the spacecraft due to the specific arrangement of the equipment and the shielding properties of the different walls and spacecraft components. Important effects are absorption, scattering, and degradation of the primary radiation, and production of secondary radiation. As such, the radiation field inside a spacecraft – and also in the outer region near to the spacecraft – includes projectile and target fragments, neutrons, photons, pions, and muons in addition to the radiation components of the primary field. Assessment of the inner radiation field and its components can be performed either by measurements or by simulations using environmental models and radiation transport codes.

(245) The interior environment depends on the types and amounts of radiation shielding. The LET distributions of particle fluence for increasing amounts of liquid hydrogen, water, or aluminium shielding are shown in Fig. 5.6. The higher fluence at large values of LET (>50 keV μm^{-1}) for aluminium compared with the other mate-

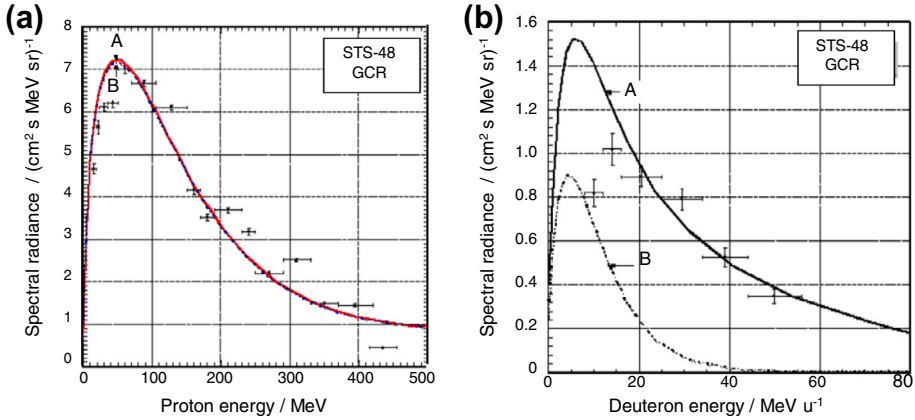

Fig. 5.8. Comparison of calculated (HZETRN code) and measured energy distributions of particle radiance of secondary protons (a) and deuterons (b) from galactic cosmic radiation (GCR) during space shuttle flight STS-48 (Badhwar et al., 1995). Calculated proton and deuteron radiance: (a) including knockout particles from proton- and neutron-induced reactions; (b) without those contributions.

rials is due to the contributions of secondary neutrons and charged particles produced in the shielding, which is reduced for materials containing hydrogen.

(246) The measurements on NASA space shuttle (STS) flights over many years and on the Russian space station Mir have allowed for a large number of comparisons of radiation transport calculations with flight measurements (Cucinotta et al., 2000b). Passive measurements with nuclear etched track detectors (PADC) have limitations at both low-LET (<5 keV μm^{-1}) tracks and short tracks from target fragments, or stopping GCR ions of high-LET tracks. The use of active dosimeters on STS flights has allowed for separation of GCR contributions from those of trapped protons, which is not possible with passive dosimetry (Badhwar and Cucinotta, 2000). Active detector measurements include tissue-equivalent proportional counters, charged particle telescopes (Badhwar et al., 1995), and active Bonner spheres embedded with proportional counters (Koshiishi et al., 2007).

(247) Measurements on STS flights were performed by Badhwar and Cucinotta (2000) using a cylindrical TEPC with a length-to-diameter ratio of 1 simulating a 2-μm diameter site and covering a lineal energy range of 0.25–1250 keV μm^{-1}. TEPC measurements on several missions in space have been compared with calculations using HZETRN for total absorbed dose and dose equivalent. The comparisons use the free space GCR model of Badhwar and O'Neill (1992) and representations of the STS or Mir shielding distribution around the detectors. The difference is found to be less than 15% for the majority of comparisons. A comparison of LET distributions measured by PADC and calculated using HZETRN is shown in Fig. 5.7. They show good agreement when the response of the PADC to short tracks is also considered (Wilson et al., 1994b; Shinn et al., 1998).

(248) Energy distributions of particle radiance measured on space shuttle flight STS-48 are shown in Fig. 5.8. Charged particle telescopes are used which provide

measurements of the energy spectra of light particles from about 15 MeV to 400 MeV for protons and other $Z = 1$ and $Z = 2$ ions from 5 MeV to 70 MeV/u (see above). These measurements are strictly secondary radiation from GCR, since the Earth's geomagnetic cut-offs exclude particles below a few hundred MeV/u from entering the spacecraft's orbit. Excellent agreement with the HZETRN code for protons is found. For deuteron spectra, the agreement is only satisfactory when knock-out deuterons from proton- and neutron-induced reactions are included. For ^{3}He and ^{4}He, the agreement is less satisfactory, and may point to a deficiency in the evaporation cross sections of the FLUKA model used by HZETRN.

(249) Detailed simulations of the radiation environment in the ISS from trapped proton radiation have been performed by Wilson et al. (2007) using HZETRN and Ersmark et al. (2007) using GEANT4. The anisotropy of the radiation field due to variation in shielding has also been studied.

5.5. Radiation shielding

(250) Shielding models are applied for the spacecraft and spacesuits, and allow evaluation of the interior environment to which the astronauts are exposed. The models describe the distribution of materials in the walls of and within the spacecraft, and appropriate computational procedures are used to evaluate the interior field of transmitted particles. The internal environment, especially that based on protons from the SAA, shows a non-homogenous distribution with large spatial gradients and variations with time over both short- and long-term temporal scales.

(251) The interior radiation environment can be well described using computational models. High-speed computational procedures allow rapid mapping of the interior of the spacecraft.

(252) The interior environment of the spacecraft is monitored by various instruments, which can be used to adjust the trapped particle intensity, reduce the uncertainty in the model estimates, evaluate transmission factors, and evaluate calculated dosimetric quantities.

(253) Materials with light constituent atoms, such as hydrogen, are most efficient per mass of material at slowing down ions, attenuating heavy ion fluences through projectile fragmentation, and minimising the build-up of neutrons and other target fragments produced directly from the atoms of the shielding material by nuclear interactions. Energy loss through ionisation is proportional to the number of electrons per atom (Z/A), where Z is the charge number and A is the mass number, and the energy loss per area mass is proportional to $Z/(\rho A)$ where ρ is the density of the material. For GCR, materials such as aluminium (the most common spacecraft material) have relatively flat depth-dose equivalent responses due to the build-up of light particles in balance with the attenuation of heavy ions (Wilson et al., 1995a). Materials such as concrete or lead have a response to GCR that is predicted to increase the dose with shielding depth because of the large production of neutrons and target fragments. Spacecraft materials are often deficient in hydrogen and therefore neutron fluence energy distributions will change appreciably in the first

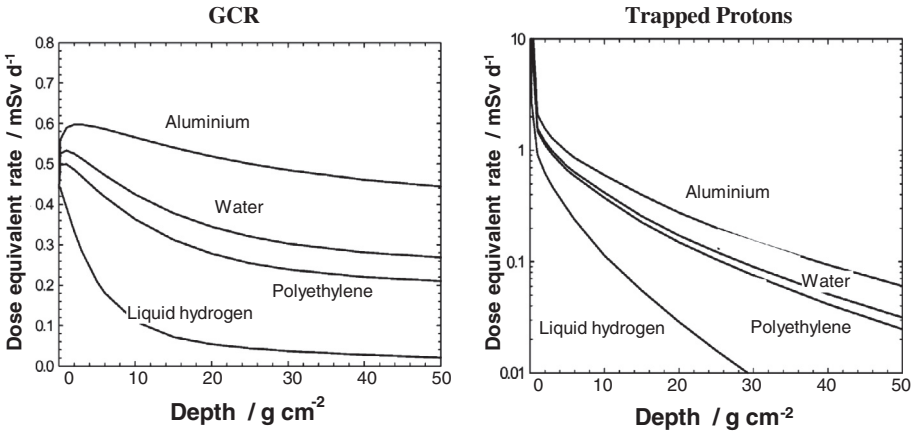

Fig. 5.9. Calculated dose equivalent rate in tissue vs shielding thickness for different shielding materials in the International Space Station orbit for galactic cosmic radiation (GCR) and trapped protons and solar minimum conditions (Cucinotta et al., 2000b).

few cm of tissue as low-energy neutrons (<5 MeV) are produced more frequently compared with aluminium or other common spacecraft materials.

(254) For a given area density and a given incident charged particle, ionisation energy loss increases with the charge-to-mass ratio of the target nucleus (Z_T/A_T), while the fragmentation cross section per mass is proportional to $A_T^{-1/3}$. Hence, hydrogen is the most efficient material for shielding against heavy ions, and materials abundant in loosely bonded hydrogen atoms are excellent candidates for efficient radiation shielding.

(255) Having just one shielding material is an ideal case that will, in practice, be very difficult to realise. The final shielding effectiveness will therefore also depend on the geometry and the abundance of the other materials used in the shielding. Ultimately, detailed simulations will always be mandatory in evaluating and designing a realistic spacecraft or habitat. Simulations suggest that shielding is effective against trapped protons in LEOs, but its efficiency is poor against GCR penetration. This is demonstrated clearly in Fig. 5.9.

(256) In the case of thicker shields, neutrons, which are negligible as primary components of space radiation, can become a noticeable source of radiation exposure. This occurs not only in heavier shielded spacecraft, but also on planetary or lunar surfaces which lack an atmosphere that is sufficiently thick to attenuate the primary radiation source to a reasonably low level. On the surface of Mars and even more so on the lunar surface, these secondary 'albedo' neutrons emerging from the ground contribute significantly to the overall exposure, particularly as neutrons interact by producing high-LET radiation with high radiobiological effectiveness.

(257) An immense body of work has already been undertaken in developing shielding strategies for human space exploration missions. This activity has resulted in numerous workshops and publications in this field. As mentioned above, all cal-

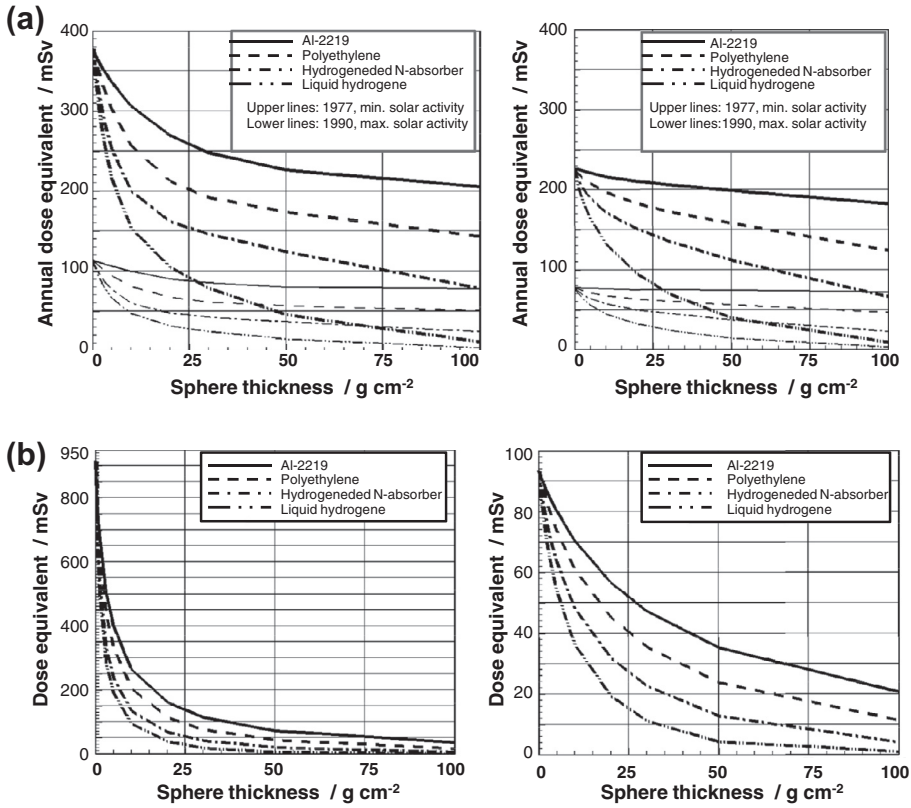

Fig. 5.10. Set of calculations showing dose equivalents for different shielding materials vs shielding thickness on the surface of the Moon (left) and Mars (right) for galactic cosmic radiation (GCR) (a), and a worst-case solar particle event (SPE) taking 4× the fluence of the SPE in September 1989 (b) (Wilson et al., 2001).

culations and measurements show that hydrogenous materials are the best candidates per unit mass basis. The next set of figures (Fig. 5.10) taken from Wilson et al. (1999, 2001) show this clearly for GCR on the Earth's moon and Mars, and a worst-case SPE.

(258) Much of the protection inside a spacecraft is provided by structural elements and equipment in the spacecraft. For the structure of the spacecraft, a compromise between shielding efficiency and mechanical stability needs to be chosen, with multifunctional materials needed to optimise the process. For a shelter inside the spacecraft, there are no such restrictions – if the material is acceptable for space application – and the efficiency per mass is the only important endpoint. Some recent studies were performed for different shielding materials as shown in Fig. 5.11 for vertical incidence (Zeitlin et al., 2006). The effect of the incidence angle of the particles

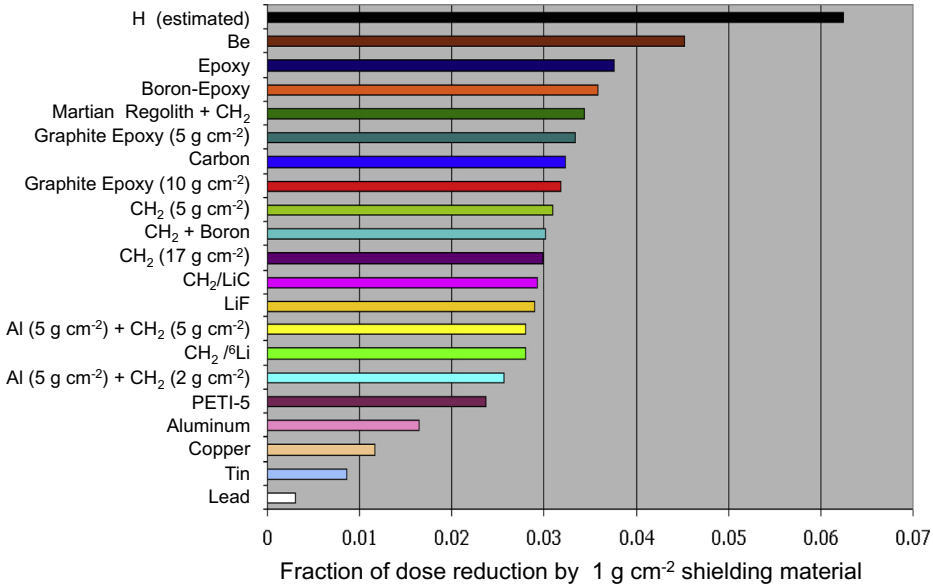

Fig. 5.11. Fraction of dose reduction in a body by 1 g cm^{-2} thick shielding with different shielding materials and incident Fe particles of 1067 MeV/u (Zeitlin et al., 2006).

in producing secondary neutrons is complex and exhibits a strong interaction with the type of shielding material. Such studies, of course, need to be extended.

(259) Since the earliest attempts at in-situ space radiation dosimetry, it has been known that, even for the simplest transport problems, satisfactory agreement between measurements and calculations would not be attainable unless the detailed thickness distribution around the point of interest was known, especially if areas of thinner shielding were present. Therefore, estimates of radiation exposures for 'homogeneous' 'isotropic' shields of 'average' thickness can only serve for qualitative comparison of different configurations. For accurate quantitative assessments of radiation exposures, knowledge of the distribution of the surrounding shield matter as a function of representative shield thickness is essential.

(260) Shielding to GCR is generally limited. Nevertheless, with the selection of optimised shield material and an optimal inclusion of consumables in the shield design, a significant dose reduction of approximately 30% can be achieved at solar minimum and, to a lesser extent, at solar maximum. For SPEs, the reduction is highly dependent on the energy distribution of the initial protons; however, shielding can reduce effective doses by factors of 2 to >10. As a first step, definition, procurement, and characterisation of candidate flexible materials to be used in future manned missions in LEOs and beyond are needed for inhabited structures. Computer codes are the tools to characterise such materials. The next step is improvement and validation of the models and tools for shielding analysis, by comparison with measurements

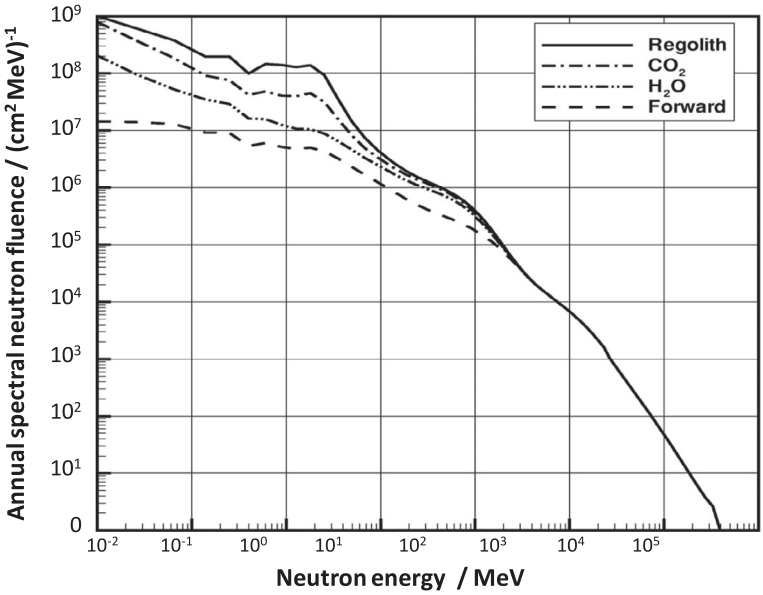

Fig. 5.12. Energy distribution of neutron fluence on the surface of Mars calculated with HZETRN showing the annual contributions from the forward component produced by galactic cosmic radiation in the Mars atmosphere and the albedo component that is dependent on the composition of the surface of Mars (Wilson et al., 2004).

from accelerator shielding studies and with flight measurements, correlation, and tuning of models, with the objective of reducing the overall uncertainty.

5.6. Lunar and Mars surfaces

(261) Two effects strongly influence the radiation environment on planetary or lunar surfaces compared with GCR in free space. Due to the shielding of the ground, the cosmic radiation is only incident on the surface in 2π geometry. In addition, albedo radiation occurs from the surface of Mars or the Earth's moon. Photons, neutrons, or secondary charged particles produced by neutrons will occur and will be dependent on the soil and atmospheric (on Mars) atomic composition, including the presence of CO_2 or water frost, and higher neutron fluence rate from lunar or Mars regolith (Clowdsley et al., 2000). Neutrons may be divided into a forward component produced by GCR interactions with the atmosphere, and albedo components on planetary surfaces such as Mars. Albedo neutrons may be produced as deep as 1 m into the soil, and their flux will be influenced by the soil composition and seasonal variations in temperature, as illustrated in Fig. 5.12. Large dust storms on Mars could lead to additional scattering of neutrons and charged particles (Wilson et al., 1995a). More detailed information on the radiation environment on the surfaces of the Earth's moon and Mars is given in recent publications (Tripathi et al., 2006; De Angelis et al., 2007; Reitz et al., 2012).

6. RADIATION FIELDS AND DOSES IN THE HUMAN BODY

(262) The radiation fields inside astronauts differ from those outside because of interactions with atoms and nuclei in the human body. The analysis of particle transport inside the body is indispensable for the estimation of doses in astronauts, and risks of both stochastic and deterministic effects due to cosmic radiation exposures. Various simulation codes (see Section 6.3) and computational phantoms, which represent the anatomy of the human body or parts thereof, have been employed for this analysis. In radiological protection, the mean absorbed dose in an organ or tissue, D_T, is the basic quantity for a specification of doses in humans (see Chapter 3). In addition, appropriate weighting factors need to be applied to D_T for the assessment of risk of stochastic or deterministic detriments due to radiation exposure.

(263) Generally, two different procedures may be applied for the assessment of doses in the human body, either by calculations or by measurements combined with calculations. Radiation field parameters (e.g. energy distribution of particle radiance, LET distributions) outside or inside a spacecraft may be determined either by measurements or calculations, and then doses in organs and tissues of the human body may be calculated using particle transport codes. There are two possibilities in performing this task. One may either assess the radiation field parameters (e.g. energy and direction distribution of fluence, D_L distributions etc.) (Section 6.3) near to an astronaut and then apply fluence to dose conversion coefficients for all types of particles involved for the assessment of organ doses (see Section 7.2), or one can calculate organ doses in a body using the radiation field data outside of the spacecraft and a code that combines radiation transport in the spacecraft and in the human body (see Section 7.3).

(264) Alternatively, absorbed dose or dose equivalent may be measured near to the body of the person of interest, and these values may be directly correlated to doses in the human body. This is the usual procedure performed in individual dosimetry on Earth, where the reading of an individual dosimeter for strongly-penetrating radiation is taken to be a sufficiently precise value of effective dose for the purpose of usual radiological protection. In space, however, this method is difficult because of the very complex radiation field, which also shows variations with time and position within a spacecraft. As shown in Chapter 4, no single device is able to fulfil this task, and a set of different detectors may be necessary for the assessment of dose equivalent in an organ or tissue, or effective dose equivalent. The location and orientation of a person within the spacecraft can introduce variations in organ doses due to the anisotropic spacecraft shielding distributions, which can be important for solar protons and trapped radiation (Wilson et al., 1995c). In any case, particle transport calculations need to be used to test if a system is appropriate for the foreseen task.

6.1. Phantoms

(265) The first computational phantom was developed at the Oak Ridge National Laboratory (Snyder et al., 1969) for the Medical Internal Radiation Dose (MIRD)

Committee of the Society of Nuclear Medicine. The MIRD phantom, designed as a hermaphrodite including organs and tissues of both sexes, has been widely used in radiation protection research, in combination with various Monte Carlo codes. On the other hand, the Computerized Anatomical Man (CAM) (Billings and Yucker, 1973) and Computerized Anatomical Female (CAF) (Yucker and Huston, 1990) phantoms were developed in 1973 and 1990, respectively. They have a long history in space radiation research at NASA, in combination with the transport code HZETRN. These phantoms are based upon mathematical expressions representing planes, and cylindrical, conical, elliptical, and spherical surfaces that describe the shape and position of idealised body organs.

(266) As an extension and improvement to these earlier models, various groups have developed a new type of anatomical phantom during the last two decades, called 'tomographic' or 'voxel' phantoms. Voxel phantoms are anatomical models based on computed tomography, magnetic resonance, or other images obtained from high-resolution scans of a single individual and, thus, offer a more realistic replication of human anatomy. They consist of a large number of volume elements (voxels) and are the most detailed representation of human anatomy at the present time. However, being derived from a specific individual, these models do not represent the average Caucasian man or woman as defined by *Publication 23* (ICRP, 1975) and *Publication 89* (ICRP, 2002). To avoid this inconsistency, the Commission introduced reference voxel phantoms representing the adult Reference Male and Reference Female defined in *Publication 110* (ICRP, 2009), which were constructed based on medical image data of real people, but their anatomical parameters were modified to be consistent with those given in *Publication 89* (ICRP, 2002). These phantoms are used by the Commission in establishing radiation protection guidance and reference data (e.g. conversion coefficients for dosimetric quantities). All data published in *Publication 116* (ICRP, 2010) were calculated using the male and female reference phantoms positioned in vacuum. NASA has used the voxel approach based on the MAX and FAX models developed by Kramer et al. (1982) in a ray tracing approach appropriate for the HZETRN code (Kim et al., 2010b; Slaba et al., 2010).

(267) One limitation of the phantoms is that their resolutions are not sufficiently high to reproduce the thin structure of a tissue or organ located at or near to the surface of the human body (e.g. skin and lens of the eye). This causes both over- and underestimation of doses in such tissues and organs for irradiation by low-energy particles such as trapped protons and electrons. Thus, special procedures are required to calculate the dose precisely in such tissues or organs using the phantoms. A more detailed description of this issue is given in *Publication 110* (ICRP, 2009).

(268) For realisation of anthropomorphic phantoms, several materials such as water and tissue-equivalent plastics are used on Earth. On the other hand, only solid plastic phantoms can be launched into space for practical reasons. The RANDO® phantoms of the head and upper torso were mounted on the space shuttle (Konradi et al., 1992; Yasuda et al., 2000; Badhwar et al., 2002a) and the ISS (Cucinotta et al., 2008). The other RANDO® phantom was exposed outside and inside the ISS as part of the MATROSHKA project (Reitz et al., 2009). A spherical phantom composed of tissue-equivalent plastic was also mounted inside the ISS as part of the MAT-

ROSHKA-R project (Shurshakov et al., 2004). A number of passive and active detectors were inserted in or attached on the phantoms. The data obtained from the detectors are useful in validating the accuracy of particle transport simulations performed using the computational phantoms.

6.2. Dose conversion coefficients

6.2.1. Mean absorbed dose in organs and tissues

(269) For a given organ T and radiation type R, the mean absorbed dose in the organ, $D_{\mathrm{T,R}}$, can be obtained by folding the energy distribution of the fluence of particles incident on the human body with the fluence to absorbed dose conversion coefficients for that organ, $\mathrm{d}_{\mathrm{T,R}}(E)$:

$$D_{\mathrm{T,R}} = \int_0^\infty d_{\mathrm{T,R}}(E)\frac{\mathrm{d}\Phi_{\mathrm{R}}}{\mathrm{d}E}\mathrm{d}E \tag{6.1}$$

where Φ_{R} is the fluence of particles of type R incident on the body. As conversion coefficients, $d_{\mathrm{T,R}}$, are mainly available for homogeneous exposure of the human body, the application of this equation always assumes a uniform exposure of the body. In cases where this assumption is not approximately satisfied, further considerations are needed for the application of this approach.

(270) For assessing organ doses, it is necessary to have conversion coefficients for all organs and tissues of the human body, for all particles and energies of interest, and for the real geometry of irradiation.

(271) For the calculation of conversion coefficients, exposure of a mathematical anthropomorphic phantom is simulated for the incidence of mono-energetic particles according to simple geometries, mainly homogeneous frontal incidence, and incidence from the right or left side, from the back, or rotational and isotropic exposure. Isotropic irradiation is usually assumed to appropriately describe the exposure of astronauts to cosmic radiation, mainly due to the isotropic fluence rate of GCR and the movement of the astronauts in the spacecraft. Nevertheless, this assumption may not always represent the situation well (Wilson et al., 1995c).

(272) The absorbed doses in the various organs and tissues of the human body are estimated from the energies deposited in the regions assigned to each organ divided by their masses. In the case of voxel phantoms, the mean absorbed doses in the organs are estimated from the energies deposited in the voxels assigned to each organ divided by the organ mass. This method has been applied in most organs, including skin, for calculation of the conversion coefficients adopted by the Commission. Exceptions are red bone marrow (RBM) and bone surface (endosteum), which are not defined explicitly in the reference phantoms. According to Schlatt et al. (2007), the mean absorbed dose in red bone marrow, D_{RBM}, and in endosteum, $D_{\mathrm{Endosteum}}$, are determined respectively by:

$$D_{\mathrm{RBM}} = \sum_{\mathrm{i}} \frac{m_{\mathrm{RBM,i}}}{m_{\mathrm{RBM}}} D_{\mathrm{spongiosa,i}} \tag{6.2}$$

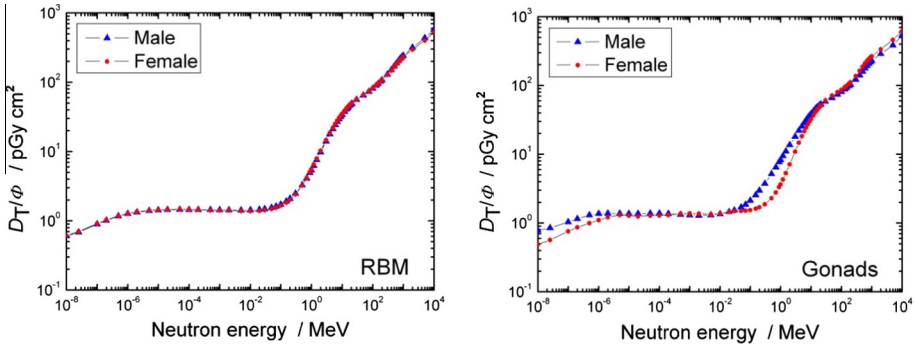

Fig. 6.1. Fluence to mean absorbed dose conversion coefficients for red bone marrow (RBM, left) and gonads (right) as a function of neutron energy for isotropic irradiation of the adult male and female reference phantoms (ICRP, 2010).

and

$$D_{\text{Endosteum}} = \sum_{\text{i}} \frac{m_{\text{Endosteum,i}}}{m_{\text{Endosteum}}} D_{\text{spongiosa,i}} \tag{6.3}$$

where $m_{\text{RBM,i}}$ is the mass of RBM in i-th spongiosa region, m_{RBM} is the total mass of RBM, $D_{\text{spongiosa,i}}$ is the dose of ith spongiosa region, $m_{\text{Endosteum,i}}$ is the mass of endosteum in ith spongiosa region, and $m_{\text{Endosteum}}$ is the total mass of endosteum.

(273) As an example, conversion coefficients for RBM and gonads published by the Commission for isotropic irradiation of the reference adult male and female phantoms are shown in Fig. 6.1 as a function of neutron energy (ICRP, 2010).

(274) Fig. 6.2 shows similar conversion coefficients for RBM and skin as a function of energy for protons (ICRP, 2010). It should be noted that the gender depen-

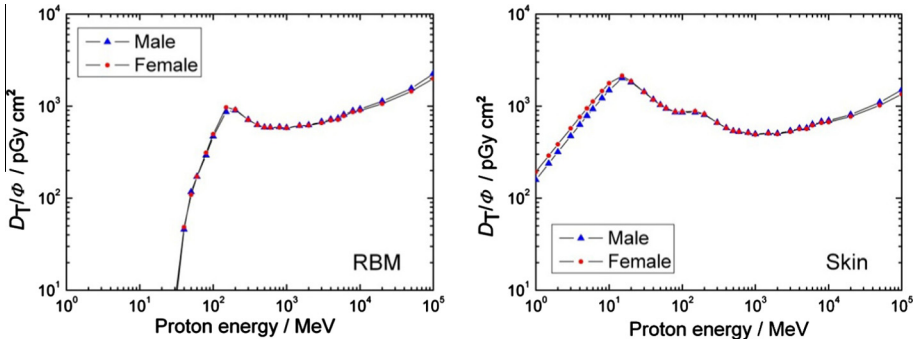

Fig. 6.2. Fluence to mean absorbed dose conversion coefficients for red bone marrow (RBM, left) and skin (right) as a function of proton energy for isotropic irradiation of the adult male and female reference phantoms (ICRP, 2010).

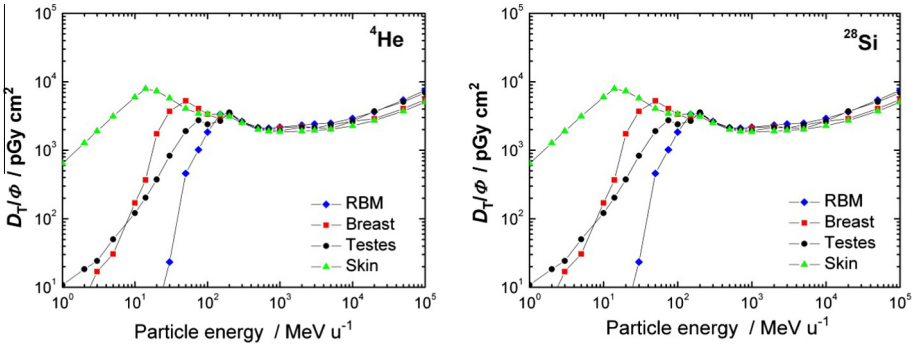

Fig. 6.3. Fluence to mean absorbed dose conversion coefficients for various tissues as a function of particle energy for isotropic irradiation of the reference adult male phantom by ^{4}He (left) and ^{28}Si ions (right). RBM, red bone marrow.

dence of organ doses is only significant for a few organs, and varies with the type and energy of the radiation involved.

(275) The fluence to mean absorbed dose conversion coefficients for organs and tissues of the body have been calculated systematically for heavy ions with atomic numbers up to 28 and energies from 1 MeV/u to 100 GeV/u using the PHITS code coupled to the reference voxel phantoms (Sato et al., 2010), following the instructions given in *Publication 103* (ICRP, 2007). Values for some heavy ions are given in Annex A. A full set of data for males and females, and isotropic exposure of the body is given on the CD supplied with this report.

(276) As an example, the data for RBM, breast, stomach, and skin are plotted in Fig. 6.3 for isotropic irradiation of the reference adult male phantom with ^{4}He and ^{28}Si ions.

(277) It can be seen from Fig. 6.3 that the dose conversion coefficients for the organs are very different for energies below approximately 200 MeV, while they are very similar for high energies. At low energies, the incident particles have short ranges in tissue and will generally stop near to the surface (i.e. skin). At high energies, on the other hand, the incident particles have very long ranges and generally penetrate the human body without forming the Bragg peak. Thus, the doses are distributed more uniformly inside the human body in comparison with low-energy particle irradiations.

6.2.2. Organ and effective dose equivalent

(278) While fluence to mean absorbed dose conversion coefficients for organs and tissues, $d_{T,R}$, are the basis for dose assessment in the human body, in mixed radiation fields with radiations of very different radiation quality, fluence to dose equivalent conversion coefficients, $h_{T,Q,R}$, for organs and tissues are often more appropriate for radiation protection applications and risk assessments in space. Most space organisations [the space agencies of USA (NASA), Europe (ESA), Japan (JAXA),

China (CSA), and Russia (FSA)] have adopted the quantity dose equivalent to organs and tissues since the late 1990s (NCRP, 2000).

(279) The calculation of mean dose equivalents in organs and tissues and effective dose equivalent are more complex than those for absorbed doses because the doses at the point of interest must be weighted by the quality factor as a function of LET. In this case, the charge and energy of ionising particles depositing the energy at that point have to be determined. If kerma factors are used for determining the mean absorbed dose in tissues and organs (e.g. for neutrons below approximately 20 MeV), this does not allow the evaluation of a Q value unless one includes further corrections.

(280) The dose equivalent in an organ or tissue T, $H_{\mathrm{T,Q}}$, is calculated by:

$$H_{\mathrm{T,Q}} = \sum_{\mathrm{R}} \int_E h_{\mathrm{T,Q,R}}(E) \frac{\mathrm{d}\Phi_E}{\mathrm{d}E} \mathrm{d}E = \sum_{\mathrm{R}} \int_E Q_{\mathrm{T,R}}(E) d_{\mathrm{T,R}}(E) \frac{\mathrm{d}\Phi_E}{\mathrm{d}E} \mathrm{d}E \tag{6.4}$$

with the mean quality factor $Q_{\mathrm{T,R}}$ based on $Q(L)$ as given in Eq. (3.10).

(281) The mean quality factors, $Q_{\mathrm{T,R}}$, and the fluence to organ dose equivalent conversion coefficients, $h_{\mathrm{T,Q,R}}$, for organs and tissues have been calculated systematically for heavy ions with atomic numbers up to 28 and energies from 1 MeV/u to 100 GeV/u using the PHITS code coupled to the reference voxel phantoms (Sato et al., 2010). Some data of mean quality factors for organs and tissues and isotropic exposure of the body are given in Annex A; a full set is provided on the accompanying CD.

(282) The organ dose equivalent conversion coefficients obtained by PHITS for RBM, breast, gonads (testes and ovaries, respectively), and skin of the adult male and female reference phantoms are depicted in Figs 6.4 and 6.5 for isotropic irradiation by ^{4}He and ^{56}Fe.

(283) As far as fluence to effective dose equivalent conversion coefficients are concerned, the data for neutrons are very similar to those for effective dose. Larger dif-

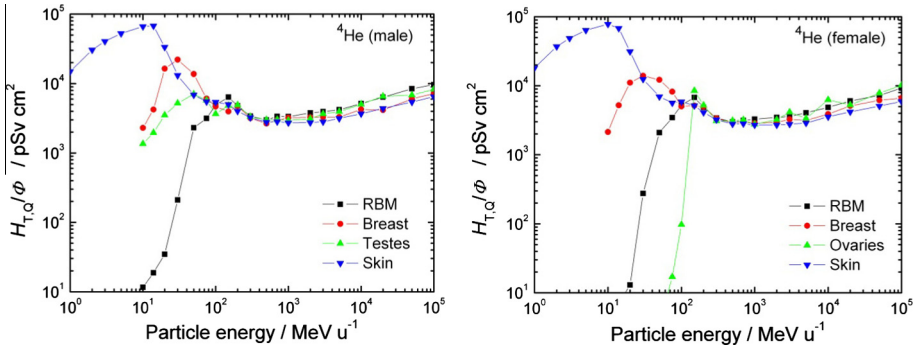

Fig. 6.4. Fluence to organ dose equivalent conversion coefficients for various tissues as a function of the particle energy for ^{4}He ions and isotropic irradiation of the adult male (left) and female (right) reference phantom. RBM, red bone marrow.

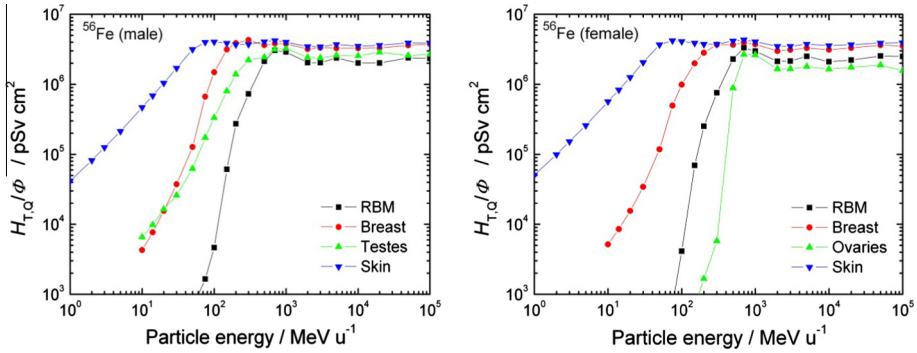

Fig. 6.5. Fluence to organ dose equivalent conversion coefficients for various tissues as a function of the particle energy for ^{56}Fe ions and isotropic irradiation of the adult male (left) and female (right) reference phantom. RBM, red bone marrow.

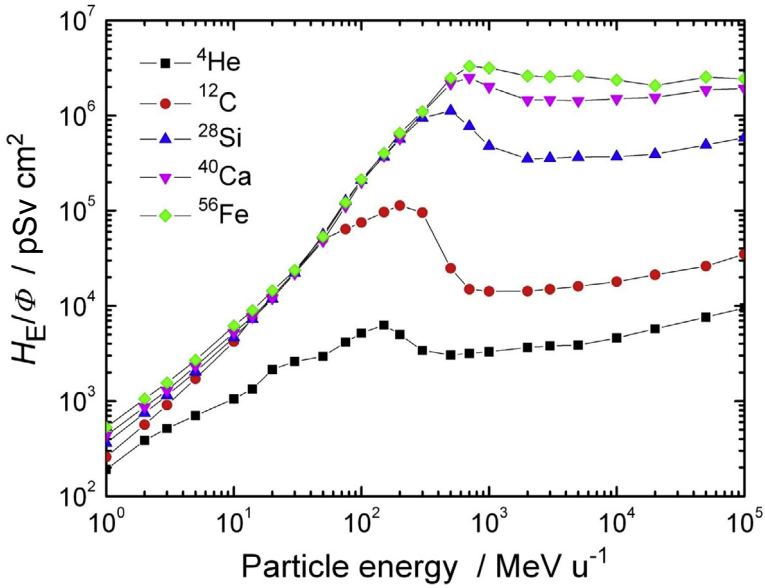

Fig. 6.6. Fluence to effective dose equivalent conversion coefficients for several particles as a function of the particle energy for isotropic irradiation of the adult male reference phantom.

ferences between conversion coefficients for effective dose and effective dose equivalent exist for low-energy protons, where the value of the mean quality factor is much higher than the value of 2 for the radiation weighting factor. In high-energy proton fields, however, this difference is not very important because of the small contribution of low-energy protons to effective dose and effective dose equivalent. Fig. 6.6 presents some fluence to effective dose equivalent conversion coefficients for several

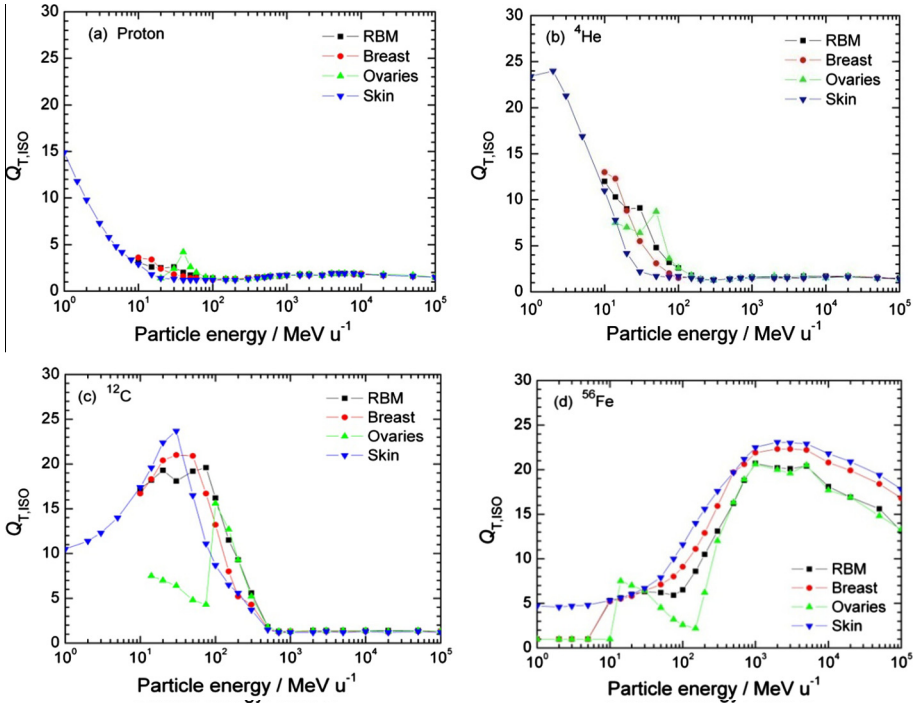

Fig. 6.7. Mean quality factors, $Q_{T,ISO}$, based on $Q(L)$ as defined in *Publication 103* (ICRP, 2007), of some tissues as a function of particle energy for isotropic exposure of the adult female reference phantom by (a) protons, (b) ^{4}He, (c) ^{12}C, and (d) ^{56}Fe. RBM, red bone marrow.

heavy ions and exposure of the adult male reference phantom. Generally, differences between calculated values of H_E for a male or female reference phantom are very small.

(284) The ratio of the mean dose equivalent in an organ to the mean absorbed dose in that organ gives the mean quality factor for that organ. As an example, Fig. 6.7(a–d) shows the mean quality factors for RBM, breast, stomach, and skin for exposure of the adult female reference phantom by protons, ^{4}He, ^{12}C, and ^{56}Fe ions.

(285) As can be seen in Fig. 6.7, for isotropic exposure to a specific ion type, the differences in Q_T of the different organs and tissues are relatively small. Therefore, a human body averaged quality factor, $Q_{E,ISO}$ {performed by weighting the organs and tissues [see Eq. (3.12)] using the tissue weighting factors given by the Commission (ICRP, 2007)} represents the radiation quality well in isotropic exposure situations. Generally, differences between values of $Q_{E,ISO}$ calculated for a male or female reference phantom are very small.

(286) For anteroposterior radiation, body averaged quality factors for neutrons and protons are shown in Figs 3.11 and 3.12. Data for isotropic exposure are given

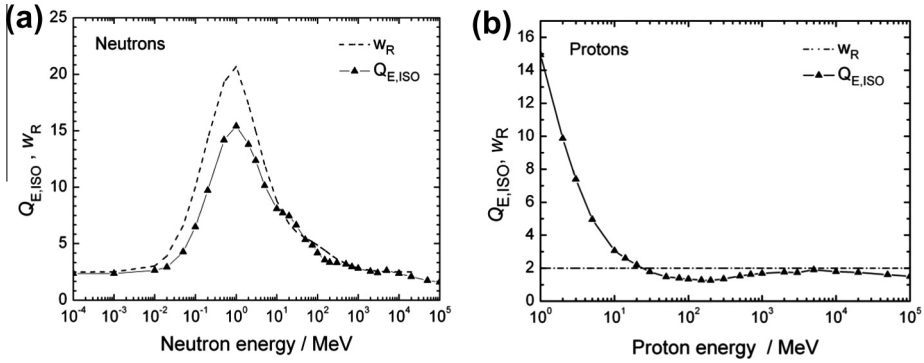

Fig. 6.8. Phantom averaged quality factor, $Q_{E,ISO}$, as a function of neutron energy (a) and proton energy (b) for isotropic exposure of the adult male reference phantom. The w_R functions are also shown (dashed line).

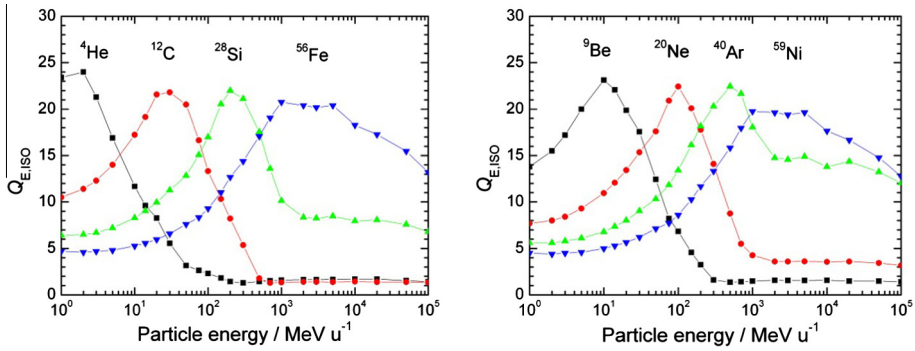

Fig. 6.9. Phantom averaged quality factor, $Q_{E,ISO}$, as function of particle energy for various particles and isotropic exposure of the adult male reference phantom.

in Annex A and presented in Fig. 6.8(a,b). Fig. 6.9 shows similar data for various heavy ions.

(287) Mean quality factors for organs and tissues, $Q_{T,NASA}$, based on the Q function as proposed by NASA for solid cancer (see Fig. 3.14), were also calculated using the PHITS code coupled to the reference voxel phantoms (Sato et al., 2013). As an example, Fig. 6.10(a–d) shows $Q_{T,NASA}$ of RBM, breast, stomach, and skin for isotropic exposure to protons, ^{4}He, ^{12}C, and ^{56}Fe ions. The values of RBM were calculated using the NASA quality factor for leukaemia which is 1/4 of that for solid cancer.

(288) For protons and light ions, the values of $Q_{T,NASA}$ are generally larger than the corresponding data based on the $Q(L)$ function given in Eq. (3.9), except for RBM (see Tables A1, A5–A12). For heavier ions, however, the values of $Q_{T,NASA}$ are generally smaller than the corresponding values based on the ICRP function,

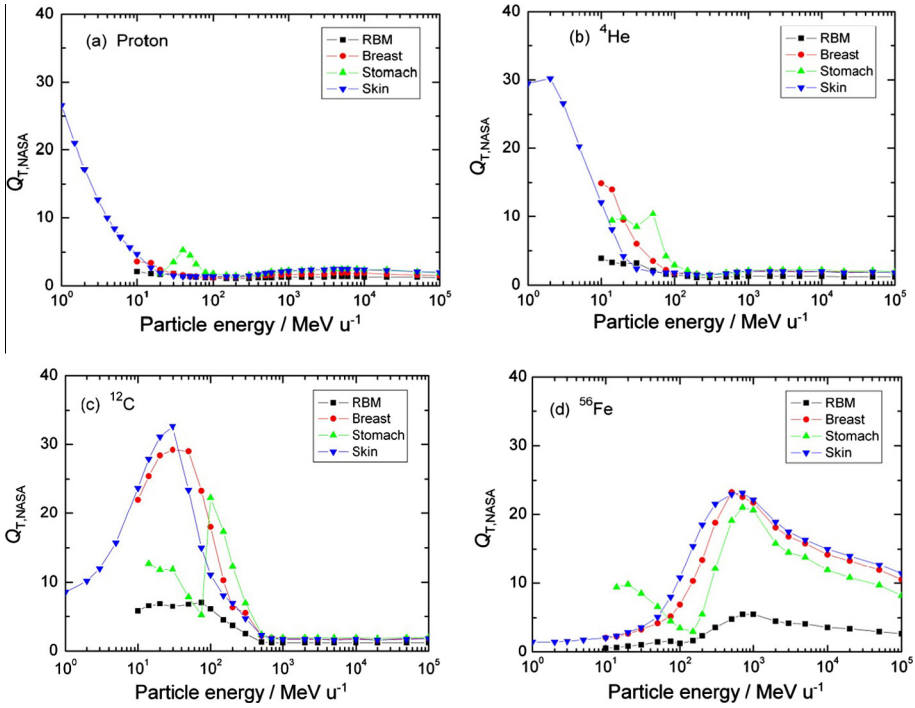

Fig. 6.10. Mean quality factors, $Q_{T,NASA}$, based on the Q function proposed by the National Aeronautics and Space Administration (NASA), of some organs as a function of particle energy for isotropic exposure of the adult female reference phantom by (a) protons, (b) ^{4}He, (c) ^{12}C, and (d) ^{56}Fe. RBM, red bone marrow.

especially for very low and very high particle energies. The smaller $Q_{T,NASA}$ observed at low energies is attributed to the strong decrease of $Q_{T,NASA}$ with increasing L in the high-LET region, while for high particle energies, the consideration of the track structure in the NASA concept is important.

(289) Fig. 6.11 shows human body averaged quality factors based on $Q_{T,NASA}$ for isotropic exposure of the adult female reference phantom by various particles. The tissue weighting factors, w_T, as defined in *Publication 103* (ICRP, 2007), were adopted in the calculation.

6.3. Calculation of organ doses of astronauts within spacecraft

(290) Generally, organ doses in a body may be calculated using the radiation field parameters outside the spacecraft and a code that combines radiation transport in the spacecraft and in the human body. In principle, this procedure takes account of all inhomogeneities of the radiation field inside the spacecraft due to the variations in the spacecraft wall and the distribution of the material inside the spacecraft. The approach has been realised by NASA using the fast radiation transport code

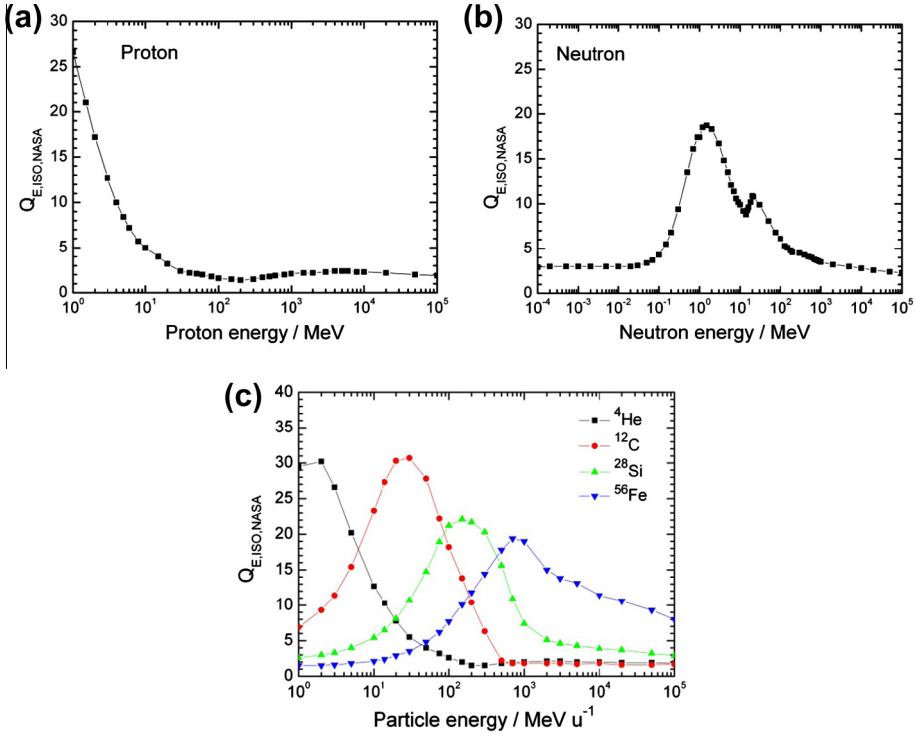

Fig. 6.11. Phantom averaged quality factor, $Q_{E,ISO,NASA}$, as function of particle energy for isotropic exposure of the adult female reference phantom by protons (a), neutrons (b), and various ions (c).

HZETRN together with various human phantoms (Wilson et al., 1995c; Badhwar et al., 2002a; Cucinotta et al., 2008). The external radiation field parameters needed include the energy and direction distribution of the fluence of all types of radiation involved, and the time dependence of some contributions. This approach can be applied to the field for EVAs and for astronauts in a habitat on the Earth's moon or a planet.

(291) For checking this method, phantom torsos comprised of realistic distributions of human tissue-equivalent materials have been flown on several space shuttle missions. Organ dose equivalents have been estimated using a combined TLD and PNTD (CR-39®) detector methodology (Yasuda et al., 2000; Badhwar et al., 2002b). Table 6.1 shows a comparison of data calculated using the HZETRN/QMSFRG model (Cucinotta et al., 2008) with those from measurements of Yasuda et al. (2000) on space shuttle mission STS-91, which flew in a 51.6 inclination orbit to the Mir station in a similar orbit as flown by the ISS. The corresponding data calculated by PHITS coupled with the dose conversion coefficients for isotropic irradiation are also given in Table 6.1 (Sato et al., 2011). The comparison shows very good agreement between measured and both sets of calculated data. The NASA

Table 6.1. Comparison of measured organ dose equivalent for space shuttle STS-91 mission using a combined plastic nuclear etched track detector/thermoluminescence detector method and data calculated using the HZETRN/QMSFRG model with random orientation in the spacecraft (Yasuda et al., 2000), as well as using PHITS coupled with the dose conversion coefficients (DCCs) for isotropic irradiation (Sato et al., 2011).

Tissue	Organ dose equivalent/mSv				
	Measured	HZETRN/QMSFRG	Diff. %	PHITS/DCC	Diff. %
Skin	4.5 ± 0.05	4.7	4.4	5.3	18.5
Thyroid	4.0 ± 0.21	4.0	0	4.2	4.9
Bone surface	5.2 ± 0.22	4.0	−23.1	4.3	−17.8
Oesophagus	3.4 ± 0.49	3.7	8.8	3.6	5.4
Lung	4.4 ± 0.76	3.8	−13.6	3.9	−12.3
Stomach	4.3 ± 0.94	3.6	−16.3	3.5	−17.5
Liver	4.0 ± 0.51	3.7	−7.5	3.6	−10.7
Bone marrow	3.4 ± 0.40	3.9	14.7	3.7	9.5
Colon	3.6 ± 0.42	3.9	8.3	3.7	1.9
Bladder	3.6 ± 0.24	3.5	−2.8	3.5	−2.3
Gonad	4.7 ± 0.71	3.9	−17.0	4.2	−10.3
Breast	4.5 ± 0.11	4.5	0	5.2	16.2
Remainder	4.0 ± 0.57	4.0	0	3.7	−6.5
Effective dose equivalent	4.1 ± 0.22	3.9	4.9	3.9	4.9

Table 6.2. Comparison of the organ absorbed dose rate measured by the International Space Station Increment-2 Phantom Torso experiment (July–August 2001) with predictions obtained using the HZETRN/QMSFRG model at a fixed location in the spacecraft (Badhwar et al., 2002a).

Organ	Absorbed dose rate trapped radiation (mGy d^{-1})		Absorbed dose rate from GCR (mGy d^{-1})		Total absorbed dose rate (mGy d^{-1})		Difference (%)
	Exp.	Model	Exp.	Model	Exp.	Model	
Brain	0.051	0.066	0.076	0.077	0.127	0.143	13.3
Thyroid	0.062	0.072	0.074	0.077	0.136	0.148	9.4
Heart	0.054	0.061	0.075	0.076	0.129	0.137	6.7
Stomach	0.050	0.057	0.076	0.077	0.126	0.133	5.5
Colon	0.055	0.056	0.073	0.076	0.128	0.131	2.5

GCR, galactic cosmic radiation.

phantom torso experiment that was flown on STS-91 (Badhwar et al., 2002a,b) was re-flown on ISS Increment 2 in 2001. This experiment included several small active silicon detectors located at critical organ positions in the torso that provide time-dependent dose data. The correlation of the time-dependent data to the ISS trajectory allows for separation of the individual contributions from trapped protons and GCR to organ doses. Table 6.2 compares the HZETRN/QMSFRG results (without scaling) with the measurements, indicating good agreement. The results show that the ratio of GCR to trapped proton absorbed dose is approximately

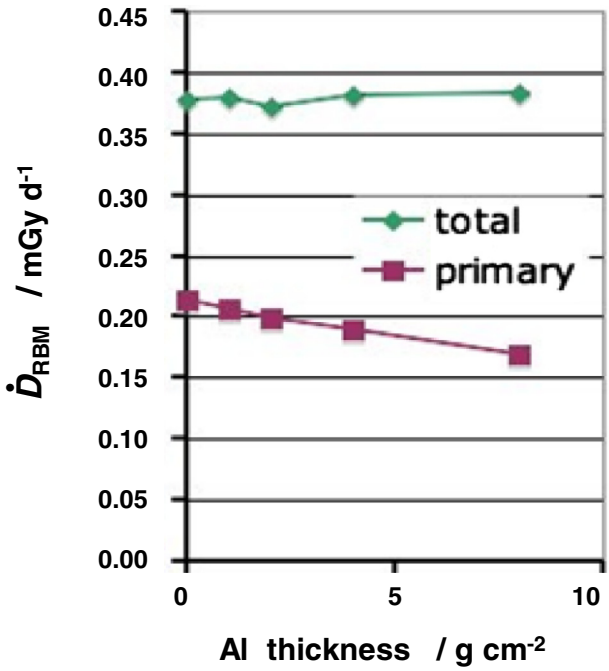

Fig. 6.12. Absorbed dose rate to red bone marrow (RBM) of a voxel phantom inside a capsule of 1 g cm^{-2} of Al exposed to galactic cosmic radiation as a function of the thickness of additional Al wall shielding (Ferrari, 2007).

1.5. Mean quality factors without tissue shielding for GCR (~3.5) are more than twice as high as that for the trapped protons (~1.5). These results support the assumption that organ dose equivalents for ISS missions and many space shuttle missions are predominantly from GCR.

(292) A number of authors have evaluated the doses received in interplanetary missions using the same approach (Badhwar et al., 1994; Zapp et al., 2002; Hoff et al., 2004; Ballarini et al., 2006; Cucinotta and Durante, 2006a; Trovati et al., 2006). The FLUKA code associated with a Golem voxel phantom (Zankl and Witmann, 2001) was used for an estimate of the doses inside a capsule-like enclosure with variable Al wall thickness (Ferrari, 2007). It was supposed that particles of GCR are incident uniformly and isotropically on the spacecraft. As an example, Fig. 6.12 shows calculated results in terms of absorbed dose rate to RBM as a function of the thickness of the aluminium wall. The contribution of the primary particles to the total dose rate is also shown in Fig. 6.12.

(293) The calculated absorbed dose rate behind 1 g cm^{-2} of aluminium resulted in 0.378 mGy d^{-1}, with 59% due to protons, 21% due to alpha particles, 10% due to ions of $2 < Z \leq 8$, 5% due to ions of $8 < Z \leq 14$, and 5% due to ions of $Z > 14$. The absorbed dose rate contributions of the various ion groups include those of pri-

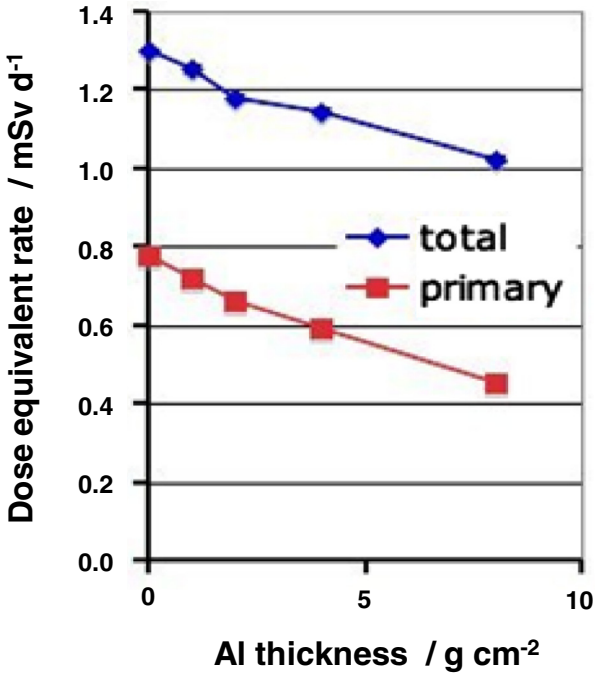

Fig. 6.13. Dose equivalent rate to red bone marrow of a voxel phantom inside a capsule of 1 g cm^{-2} of Al exposed to galactic cosmic radiation as a function of the thickness of additional Al wall shielding (Ferrari, 2007).

mary ions and of all products generated in their interactions. The absorbed dose rate contribution of the uncollided particles was 0.206 mGy d^{-1}.

(294) Examples of direct evaluation of the organ dose equivalent rates from external radiation fluence rates of GCR without use of conversion coefficients are shown in Fig. 6.13. Similar to simulations described above (see Fig. 6.12), the figure shows the dose equivalent rate to RBM as a function of the thickness of the aluminium wall of a capsule (Ferrari, 2007). It should be noted that the tissue weighting factors recommended in *Publication 60* (ICRP, 1991) were applied for these data.

(295) The calculated RBM dose equivalent rate behind 1 g cm^{-2} of aluminium is 1.26 mSv d^{-1}, with 31% due to protons, 11% due to alpha particles, 13% due to ions of $2 < Z \leq 8$, 16% due to ions of $8 < Z \leq 14$, and 29% due to ions of $Z > 14$. The contributions of the various ion groups include the primary ion contributions and those of all products generated in their interactions. The contribution of the uncollided particles was 0.72 mSv d^{-1}.

(296) Several other authors used the method described above in order to determine the organ dose equivalent and effective dose equivalent received by the astronauts, especially for studying the shielding effect of the wall thickness of the capsule. Slaba et al. (2010) computed the protection quantities under both a GCR and SPE environment. The spherical shell of aluminium was assumed to be isotropically irradi-

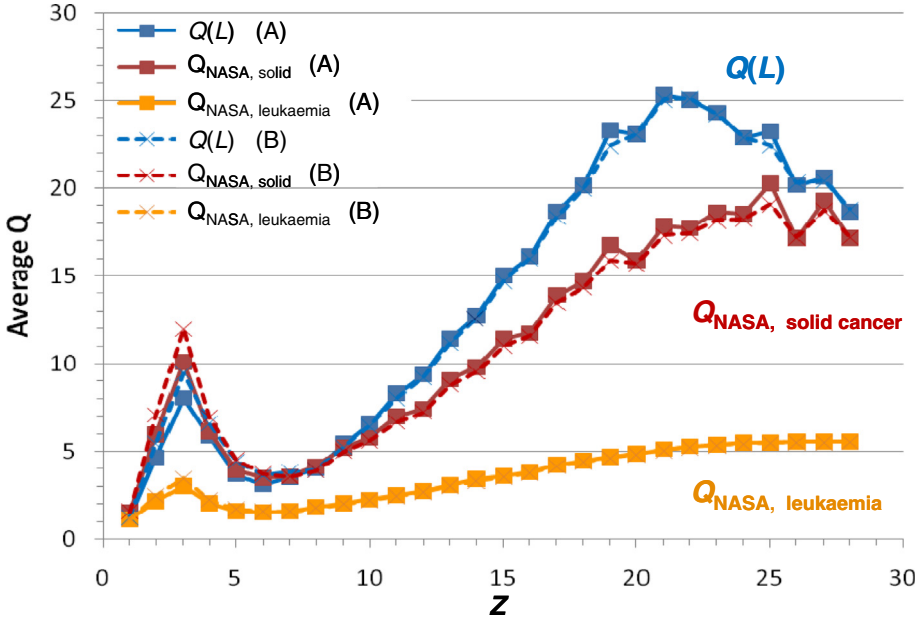

Fig. 6.14. Comparison of body-averaged quality factor values as a function of primary incident particle of charge Z calculated by applying either the ICRP $Q(L)$ function or the NASA quality factors for solid cancers or leukaemia for thin or thick aluminium shielding conditions (Cucinotta et al., 2013). (A) 5 g cm^{-2} Al shielding; (B) 20 g cm^{-2} Al shielding.

ated, and various computational models (CAM, CAF, MAX, FAX) have been used. Ballarini et al. (2006) and Trovati et al. (2006) calculated GCR and SPE organ doses in deep space with different shielding by Monte Carlo simulations using the FLUKA code coupled to a mathematical model and a voxel phantom.

(297) Furthermore, it is of interest to determine the extent to which the values of dose equivalent in these radiation fields depend on the different concepts of quality factor. As a function of Z of the primary incident particles (isotropic exposure of the body) with an energy distribution as given in the GCR field, Fig. 6.14 shows a comparison of body-averaged mean quality factors using the $Q(L)$ relationship and the recent NASA approach to quality factors based on particle track structure concepts and using different quality factor values for solid cancers and leukaemia (Cucinotta et al., 2013). The calculations are made using the HZETRN code for solar minimum in the orbit of the ISS. Different calculations were carried out applying either thin (5 g cm^{-2}) or thick (20 g cm^{-2}) aluminium shielding. Differences between the approaches mainly occur for low- and high-Z particles.

6.4. Assessment of doses in the body by measurements

(298) Specific operational quantities for an assessment of dose in the body of astronauts in space have never been defined. Some properties of the radiation field,

however, may provide some help in the determination of effective dose equivalents of astronauts. Firstly, there is a major component of very-high-energy particles with long ranges in tissue in the field which strongly contribute to doses in the body. Secondly, the radiation incident on the body may be nearly isotropic considering the situation that the astronauts are usually moving around and are not fixed in a particular location or orientation for a long period. Therefore, isotropic exposure of astronauts has been assumed in calculations, resulting in a relatively homogeneous dose distribution within the body from GCR exposure (see Figs 6.12 and 6.13). This, however, is not the case for low-penetrating radiation which mainly contributes to doses of the skin and other tissues near to the surface.

(299) Any dose-measuring system, therefore, must have the ability to discriminate between strongly- and low-penetrating radiations. In addition, information about the distribution of absorbed dose in tissue in terms of L, D_L is necessary for the assessment of equivalent dose in the body.

(300) Measurements of dose distributions and organ doses in human phantoms in space have been performed by NASA [see Section 6.3 (Wilson et al., 1995c; Badhwar et al., 2002a; Cucinotta et al., 2008)], and in the MATROSHKA collaboration (Reitz and Berger, 2006; Reitz et al., 2009) and exploited by members of the HAMLET collaboration (www.fp7-hamlet.eu). A tissue-equivalent anthropomorphic phantom, called MATROSHKA, has been equipped with hundreds of dosimeters of different types, mostly TLDs and NTDs, and exposed in space during various ISS missions.

(301) The MATROSHKA experiments provide detailed depth-dose distributions in a human phantom exposed outside the ISS (MTR-1 mission) and in two locations inside the ISS at different shielding locations (MTR-2A and MTR-2B missions). Fig. 6.15(a) shows the measured dose rate distribution in the MATROSHKA phan-

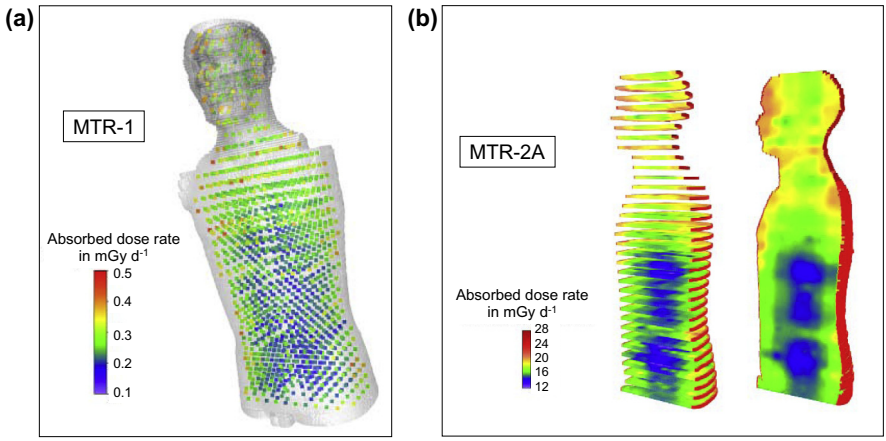

Fig. 6.15. (a) Measured absorbed dose rate distribution in the MATROSHKA phantom for the MTR-1 mission outside of the International Space Station (ISS) based on thermoluminescence detector readings (Berger et al., 2012). (b) Absorbed dose rate distribution in the MATROSHKA phantom for the MTR-A2 mission inside the ISS obtained by interpolation of point doses over the whole phantom volume (Berger et al., 2012).

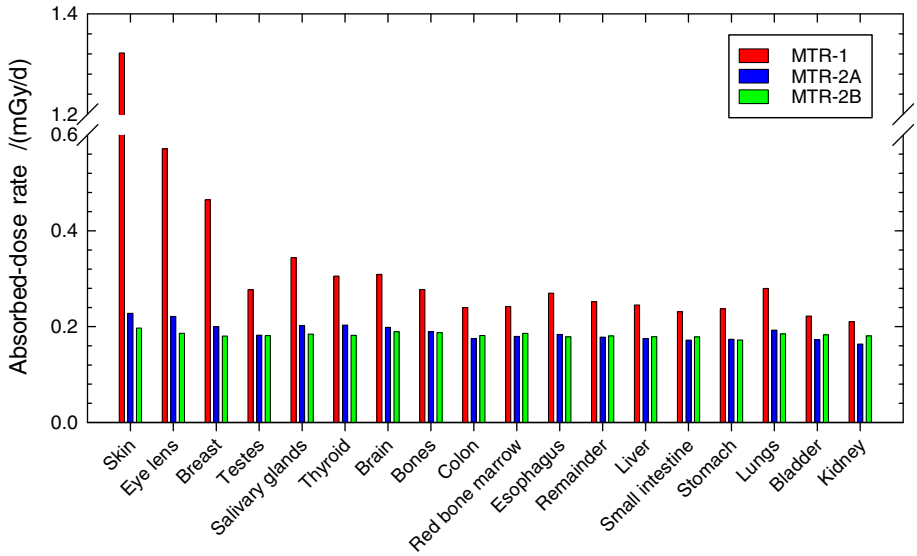

Fig. 6.16. Mean absorbed dose rates in organs and tissues of the MATROSHKA phantom during different space missions at the International Space Station determined from measurements using thermoluminescence detectors and plastic nuclear etched track detectors (Reitz, 2012).

tom for the MTR-1 mission based on TLD readings at 1598 locations inside the phantom. For measurements with the phantom outside the ISS, the absorbed dose rates range from 0.1 mGy d^{-1} to 0.5 mGy d^{-1}, with the highest dose at the phantom surface. For other missions inside the ISS, due to spacecraft shielding, the absorbed dose rates are mainly restricted to a range from 0.13 mGy d^{-1} to 0.23 mGy d^{-1}.

(302) Computed tomography scans of the MATROSHKA phantom are taken in order to build up a voxel model called NUNDO (Numerical Rando). A computer program allows calculation of dose distributions by interpolation of point doses over the whole phantom volume [see Fig. 6.15(b)]. For total absorbed dose and dose equivalent rate distributions, and hence an assessment of mean absorbed dose rates and dose equivalent rates in organs and tissues, data measured by TLDs and PNTDs have been combined. The dose equivalent rate was calculated using quality factors as defined in *Publication 60* (ICRP, 1991).

(303) The high dose gradient near to the skin for the MTR-1 missions is due to the high contribution of electrons and protons at the SAA. Inside the ISS, this contribution is strongly reduced due to shielding by the spacecraft (see Figs 6.16 and 6.17). The dose rates in the deeper lying organs are nearly constant due to the high particle energies and nearly isotropic fluence distribution of GCR. This is even more the case for astronauts moving within the spacecraft.

(304) The measured organ absorbed dose data were compared with corresponding values obtained from dose conversion coefficients multiplied by cosmic radiation fluence rates in the spacecraft calculated by PHITS using a simplified geometry of the ISS (Sato et al., 2011). The agreement was found to be quite satisfactory in spite of

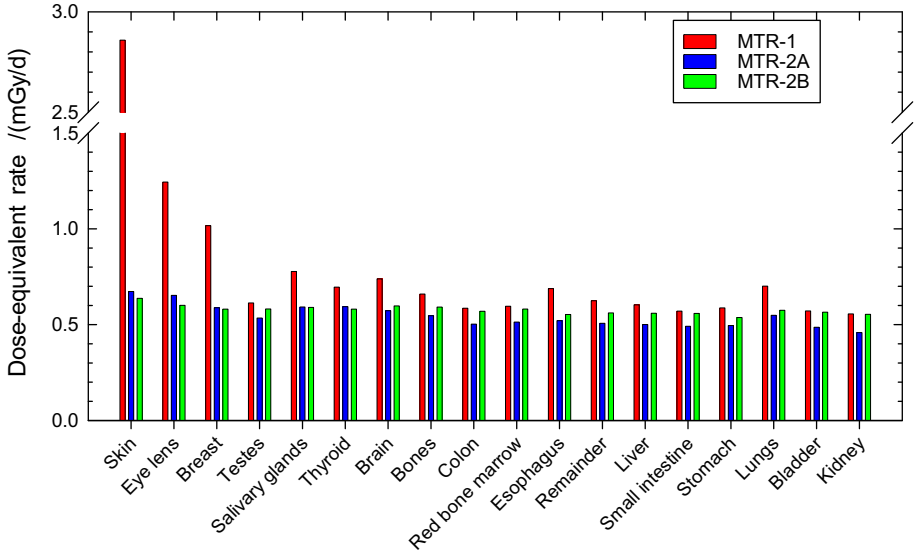

Fig. 6.17. Mean dose equivalent rates in organs and tissues of the MATROSHKA phantom during different space missions at the International Space Station determined from measurements using thermoluminescence detectors and plastic nuclear etched track detectors (Reitz, 2012).

Table 6.3. Organ absorbed dose rates measured by the MATROSHKA experiment outside the International Space Station (Reitz et al., 2009) in comparison with corresponding calculated dose rates obtained from PHITS simulations (Sato et al., 2011).

Organ/tissue	Measured absorbed dose rate, mGy d^{-1}	Calculated absorbed dose rate, mGy d^{-1}
Skin	0.944	1.814
Salivary glands	0.33	0.435
Breast	0.39	0.690
Lung	0.26	0.279
Oesophagus	0.24	0.250
Stomach	0.242	0.245

some discrepancies observed for some organs, taking account of the various approximations introduced, in premise the hypothesis of isotropic irradiation.

(305) Similar data have been calculated for comparison with organ absorbed doses measured by the MATROSHKA experiment outside the ISS. As shown in Table 6.3, acceptable agreement was achieved.

(306) Agreement was very good for the interior organs such as lung, oesophagus, and stomach. The calculation, however, substantially overestimates the measured absorbed dose rates for the organs located near to the surface of the body, especially the skin. This is probably due to the effect of a high yield of low-energy trapped protons and electrons encountered, and also to some differences between phantoms and

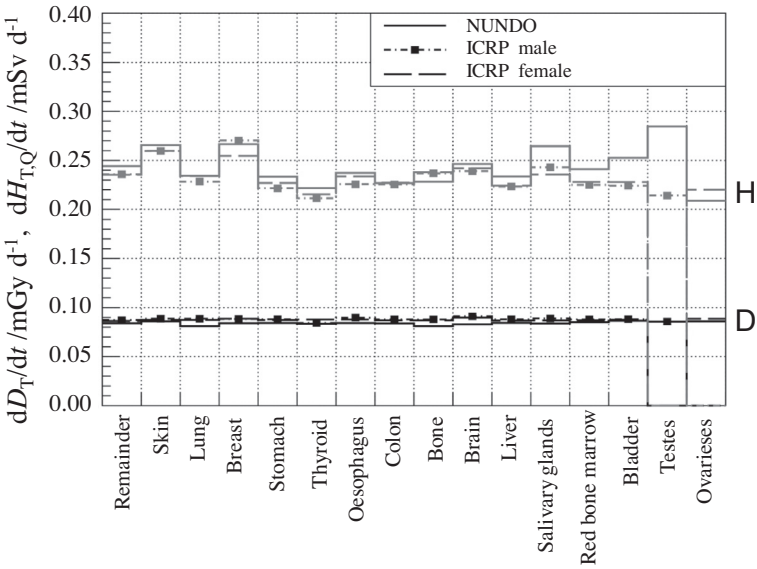

Fig. 6.18. Mean absorbed dose rate and dose equivalent rate in various organs and tissues calculated for galactic cosmic radiation using the GEANT4 code and the NUNDO model and the ICRP reference male and female phantoms (Matthiä et al., 2013).

geometries of their surrounding environment employed in the calculation and experiment.

(307) The accuracy of heavy ion transport codes was discussed in Section 5.3.1. With respect to the different anthropomorphic voxel models used, the differences in the values of absorbed dose and dose equivalent of single organs and tissues calculated using the NUNDO model (MATROSHKA) or the ICRP reference voxel phantoms are quite small, as shown in Fig. 6.18 (Matthiä et al., 2013).

6.5. Biodosimetric measurements

(308) Biodosimetric measurements offer an alternative to the measurement of individual doses external to the body of an astronaut for the assessment of effective dose equivalent, because of the very complex radiation field in the spacecraft which varies in intensity and composition with time. Lymphocytes in the human body are circulating and hence provide a target that is well distributed over the human body. In addition, the RBE-LET dependence for total chromosomal exchanges during the first cell cycle is similar to the $Q(L)$ relationship defined by the Commission (see Fig. 3.4) when using the premature chromosome condensation method (Cucinotta et al., 2008).

(309) The method has already been applied for estimating doses of astronauts in space shuttle flights (George et al., 2001), at the Mir station (Yang et al., 1997; Fedorenko et al., 2001), and at the ISS (Cucinotta et al., 2008).

Table 6.4. Data of mission doses of International Space Station astronauts obtained by biological dosimetry and by measurements with individual dosimeters (Cucinotta et al., 2008). The data of skin dose equivalent and effective dose equivalent were obtained by calculations adjusted to the individual's dosimeter readings.

Astronaut	RBE · *D*/mGy		Individual dosimeter reading/mGy	Skin dose equivalent (calc.)/mSv	Effective dose equivalent (calc.)/mSv
	Individual based calibration	Population-based calibration			
1	94 ± 12	128 ± 25	31	89.9	77.6
2	127 ± 57	84 ± 41	30	86.5	73.7
3	78 ± 16	81 ± 19	33	96.4	82.1
4	60 ± 24	87 ± 20	32	93.8	79.9
5	36 ± 15	54 ± 26	29	85.1	72.5
6	59 ± 19	61 ± 21	32	90.8	80.0
7	41 ± 19	72 ± 27	29	83.3	70.6
8	83 ± 29	40 ± 21	31	88.3	74.7
9	113 ± 17	130 ± 25	40	115	98.6
10	–	75 ± 26	31	88.3	74.5
11	74 ± 32	55 ± 26	22	64.5	54.7
12	128 ± 40	71 ± 24	23	65.4	55.7
13	134 ± 45	88 ± 29	22	64.7	59.8
14	66 ± 21	59 ± 15	26	78.0	66.3
15	83 ± 27	125 ± 52	30	88.6	75.2
16	10 ± 24	15 ± 35	20	56.8	47.5
17	147 ± 48	134 ± 66	36	103.0	86.3
18	113 ± 26	109 ± 34	30	83.7	76.9
19	119 ± 32	69 ± 23	24	70.1	59.5
Mean*	85 ± 38	81 ± 32	28.9 ± 4.9	83.8 ± 14.1	71.9 ± 12.0

RBE, relative biological effectiveness.

* Uncertainties listed are based on the data variation in the column and do not include measurement uncertainties.

(310) In Table 6.4, doses obtained by physical and biological dosimetry for ISS missions are compared, where the comparison includes biomarker results based on an individual or population-related calibration using gamma radiation (Cucinotta et al., 2008). The different results described represent mission lengths of 4–7 months. Biomarker results are given in terms of RBE · *D* (unit: mGy). This RBE-weighted dose value may be compared with values of dose equivalent to organs or tissues (here with the dose equivalent of the skin), and effective dose equivalent obtained from dosimeter readings and applying the $Q(L)$ relation as given by *Publication 103* (ICRP, 2007). The overall agreement between the methods lends confidence that the complex environment in space has been characterised adequately.

7. OPERATIONAL RADIATION PROTECTION IN SPACE

(311) The guiding principles used for radiation protection on Earth, including justification, optimisation, and limitation, are also essential for radiation protection during space travel. However, operational radiation protection for astronauts in space differs significantly from those requirements for external radiation exposure on Earth (EC, 2009). On Earth, doses are generally well below annual limits; if constraints are approached, better estimates of effective dose are made from the results of measurements of operational quantities. For astronauts, doses are mainly based on the environmental situation in space, being typically around 1 mSv per day. Radiation protection for missions includes a large range of different measures, all of which should have the aim of reducing the radiation exposure of astronauts to a level where the health risks are acceptable (NCRP, 1989). In contrast to many of the other flight risks, effects from radiation exposure can have long latency times, and cancer and other detriments may occur long after a space mission has ended. However, as noted by NCRP (1989, 1997) and discussed by others (Schimmerling, 2010; Cucinotta et al., 2010), the acceptance of radiation risks in space flight should consider many factors, both dependent and independent of other flight risks.

(312) Assessment of the radiation exposure of astronauts in space is a major task in operational radiation protection for each mission. This is performed prospectively by calculating organ and tissue doses weighted for radiation quality and, if necessary, effective dose equivalent considering tissue weighting, for comparison with mission dose or risk reference values related to stochastic and tissue reactions. After the mission, all available data should be combined, including results from measurements of area and individual instruments, to assess the doses and the probability of a radiation-induced event.

(313) There may be defined special dose reference levels for short-term exposure, annual exposure, and an astronaut's career. The dose reference levels should apply to the assessed total detriment, to the lens of the eye, and to the skin. The total detriment is related to a probability of cancer risk. The doses to the skin and the lens of the eye are related to tissue reactions to avoid the occurrence of impairment during or after a mission. The complex nature of the radiation field in space requires continuous analysis of the environment by calculation, area monitoring of the astronauts' environment, and, where possible, analysis of the results of active personal dosimeters in order to meet reference or action levels.

7.1. Preflight mission design

(314) The design of the flight mission needs to have the aim of reducing radiation exposures in line with optimisation concepts. The application of optimisation procedures requires that the space radiation environment be well known, both outside and inside a spacecraft. This requires knowledge of the external radiation environment with its various components (see Chapter 2), the spacecraft/habitat construction,

and the results of transport calculations modelling the internal radiation environment.

(315) The design of the spacecraft/habitat requires the use of radiation transport codes to compute dose equivalents. As described in Chapter 5, the computer codes may be one- or three-dimensional, deterministic, or based on Monte Carlo methods. The construction of a spacecraft/habitat should include areas where the dose rates are lower than elsewhere in the spacecraft. There should be area monitors with visual displays of dose rates.

(316) To reduce uncertainties (see Section 7.5), further improvements are needed in the models of GCR, solar energetic particles, and trapped radiation to allow accurate forecasting of the fully integrated model of the radiation environment incident on the spacecraft/habitat. Models have been developed for each of the radiation components. These models have several shortcomings: (i) the GCR models inadequately characterise the solar cycle dependency and the scaling with heliocentric distance; (ii) the SPE models have an incomplete understanding of the acceleration mechanism of the transport through the heliosphere and a lack of prediction capability; and (iii) the radiation belt models no longer reflect the current state of the Earth's magnetosphere and lack the ability to properly describe the dynamic behaviour of the trapped particles.

(317) The forecast models require an improved understanding of the physical processes on the Sun, the transport and acceleration of the solar wind through the heliosphere, and the processes in the magnetosphere (wave–particle interactions, source and loss processes, and acceleration mechanisms). The space environment is highly variable on very different time scales as a result of the variability of solar activity.

(318) In general, all aspects of the space environment are affected, but SPEs and coronal-mass ejections are the most dramatic radiation events and may constitute a serious hazard for several missions. All the radiation components (including GCR and trapped) are also modulated by SPEs (e.g. Forbush decreases in GCR fluences). An accurate prediction of SPEs and coronal-mass ejections would allow for a more effective approach in the shielding strategy. Forecasting through real-time observation and propagation modelling should be improved.

(319) Astronauts are particularly vulnerable during EVAs, when they should be monitored with active dosimeters. Real-time space weather predictions and remote satellite and area instrumentation will assist in EVA activity. The real-time measurements will provide guidance, and can suggest changes in mission scheduling to maintain the total risk below predefined mission reference values.

(320) The development of shielding requirements and strategies is important for the achievement of optimisation tasks. Exposure can be reduced by decreasing the exposure time or by passive shielding. Passive shielding may cause an increased risk by increasing the dose equivalent from any generated secondary particles, and projectile and target fragments (including neutrons). For shielding effectiveness, the use of a shielding material with a low mean atomic mass is generally better.

(321) Information about radiation transport codes (see Chapter 5) is important, and the strengths and weaknesses of the codes should be investigated in detail via benchmarking procedures against experimental data, including data obtained with

advanced anthropomorphic phantoms exposed at accelerators. The physics at the basis of the particle transport and cross-sectional data tables must also be improved to further develop the codes.

7.2. Area monitoring

(322) Area monitors at well-selected locations in the spacecraft can determine the environmental conditions, and are appropriate for an immediate warning about changing exposure conditions.

(323) Instruments are required to determine the radiation environment in terms of particle type, fluence rate, energy and direction distributions, and, in some instances, dose quantities. Dose quantities used to assess exposures to astronauts and to monitor radiation at a number of locations should give values for absorbed dose rate. These data can be used to implement optimisation measures. Area monitors at well-selected locations in the spacecraft can be appropriate for immediate warning about changing exposure conditions. This can be of importance before or during SPEs, electron belt enhancements, and EVAs. Real-time calibration of instruments should be explored.

(324) If appropriately designed and accurately calibrated instruments are used, it may be that a quantity measured in a fixed position in a spacecraft can, along with appropriate occupancy data, provide the basis for an adequate assessment of exposure to an astronaut or of doses to the local skin or the extremities. While, in principle, this procedure may be applicable to astronauts in space, the large variation in intensity of the radiation field and composition of radiation types inside a spacecraft, and variation with time together with the flexibility of the astronaut's position, means that area monitoring is not sufficient to completely substitute individual monitoring, especially given the high individual exposure to astronauts and the interest in providing a basis for individual risk estimates.

7.3. Individual monitoring

(325) The assessment of organ and tissue absorbed doses, together with radiation quality factors, of individual astronauts can be accomplished by calculations using anthropomorphic phantoms or by measurements using personal dosimeters (see Chapter 6).

(326) One method of calculation of organ and tissue absorbed doses and radiation quality factors performs this directly for a standard male or female phantom for various locations in a spacecraft with appropriate shielding. The phantoms can be adjusted to approximate a particular astronaut. The results are normalised using readings of area monitors and personal dosimeters. Another method requires knowledge of particle fluence, and applies conversion coefficients from particle type, energy, and direction distribution of fluence to organ and tissue absorbed doses and corresponding radiation quality factors for uniform irradiation of an astronaut.

(327) Individual monitoring is mainly performed using personal dosimeters worn at the surface of the body. The personal dosimeter serves as the dosimeter of record.

A single dosimeter system is, however, not sufficient to provide an assessment of the absorbed dose at the surface of the body weighted by radiation quality. The broad range of different types of particles requires at least two detectors, one sensitive to low-LET radiation and the other sensitive to high-LET radiation. Due to a possible anisotropy of the exposure in the spacecraft due to variations in shielding properties, it may be useful to wear more than one dosimeter. Also, care needs to be taken regarding low-energy electrons and particles that are stopped in the skin and, therefore, contribute only marginally to organ doses other than skin dose, but may induce a large signal in an external dosimeter.

(328) The use of adequate active personal radiation detectors would enable improved characterisation (input energy, nuclear abundance, fluence rate, direction) of the radiation field, both on the body of the astronaut and in the environment. The measurement of dose rate can contribute directly to optimisation procedures.

(329) The results of biomarker measurements can also be used to estimate individual radiation exposure. The determinations can be collaborative and provide all the experimental radiation information and relative codes needed to achieve an efficient risk assessment, minimising the uncertainties in the final risk estimates.

7.4. Dose recording

(330) Astronauts in space are exceptionally exposed and the assessment of their individual exposures should be part of the radiation protection programme for space flight. Astronauts should be informed of their doses and risk assessments as soon as possible. Their doses should be registered regularly, and a long-term registry for all missions should be maintained.

(331) The dose record is the formal statement of the astronaut's exposure and should be kept as a confidential medical record. The record should contain the history of the exposure and all the calculations and experimental results, including all information on the particle types and their energy and direction distributions of fluence; computer codes; conversion coefficients and weighting factors; and area monitor, personal dosimeter, and biomarker results.

7.5. Consideration of uncertainties

(332) There are large uncertainties in projecting cancer risks and the risks of other late effects from ionising radiation on Earth. Space radiation carries additional considerations, which further increase uncertainties. As astronauts in space approach a significant exposure, calculation of uncertainty bounds is needed because exposures leading to acceptable levels of risk may no longer be confidently avoided when the uncertainties are considered.

(333) It is important to provide all the information needed to establish the uncertainties of organ risk estimates. The overall uncertainty will be reduced by improvements in modelling of radiation sources and transport of the field through the spacecraft or habitat, improved accuracy of radiation transport codes, improved accuracy of radiation monitoring, better estimation of dose and dose rate effective-

ness factor, better determination of radiation quality factors, and better understanding of the statistics and dosimetry of epidemiological data.

(334) A full risk model may need to be developed using real-time radiation readings, space weather forecasts, and risk assessments. This can allow changes to the mission, with an assessment of uncertainties, whilst maintaining the total risk below predefined mission reference values.

(335) Uncertainties in estimates of exposures and the relationship between exposure and risk are a major concern for operational radiation protection in space due to the types of radiation, which includes heavy ions and neutrons, and the higher exposure levels, which may approach exposure and risk reference levels. Schimmerling (2010) described an operational approach where an evaluation of uncertainties is included in the radiation protection approach. Obviously, 'acceptable' levels of cumulative exposure depend on the uncertainty, and hence reduction of uncertainties is seen to be an important task for mission planning. Methods to estimate uncertainties in exposure and risks are described elsewhere (Cucinotta et al., 2001b; NCRP, 2006).

8. CONCLUSIONS

(336) In space, astronauts live under extraordinarily different environmental conditions compared with those on Earth. The radiation environment in space needs specific attention and considerations regarding the exposure of astronauts, and the limitation of such exposures to a level where the health risks are comparable with other risks during space missions.

(337) The number of astronauts undergoing missions in space is very small compared with the number of occupationally exposed persons on Earth. In long-term missions, however, doses to the astronauts are generally higher than those in other working places on Earth. Hence, a more individually based dose and risk assessment should be performed for astronauts in space compared with persons on Earth, where these exposures are usually much less than the limits defined for occupationally exposed persons.

(338) The following points are mentioned specifically:

- The primary radiation field in space is complex and includes electrons, protons, alpha particles, and heavy ions up to very high energies. Additional secondary radiation (e.g. gamma radiation, muons, neutrons, and pions) is produced by interactions in the materials of a spacecraft, its equipment, and the astronauts.
- The physics at the basis of the particle transport and cross-sectional data tables must be improved to further develop the computational methods. There is a lack of experimental cross section data for light fragments and neutrons. Codes need to be improved to treat all primary and secondary cascades including photons, protons, light ions, heavy ions, mesons, and electromagnetic cascades. The nuclear interaction database needs to be updated, especially for neutrons and light ions.
- The simple concept of considering the differences in radiobiological effectiveness by radiation weighting factors, w_R, (e.g. a constant radiation weighting factor of 20 for all heavy ions of all energies) is not appropriate for dosimetry in space, and the quality factor, Q, is applied for the definition of the quantity dose equivalent in an organ or tissue of the human body.
- The basis for risk assessments for the astronauts are the dose equivalents in organs and tissues of adult males and females, $H^{M}_{T,Q}$ and $H^{F}_{T,Q}$, which are based on mean absorbed doses, D_T, and mean quality factors in the corresponding organs or tissues, Q_T.
- Conversion coefficients that relate particle fluence to mean absorbed doses in organs and tissues of the human body, and corresponding mean quality factors for all types of radiation present in space, are an important database for assessment of the exposure of astronauts. For the estimation of radiation risks of astronauts based on mean absorbed doses in the body, an assessment of the uncertainty of D_T and Q_T would be very useful.

- The concept of operational dose quantities for area monitoring of external exposure and an assessment of effective dose is not applicable because many different types of particles are involved with very high energies. Instead, the measurement and determination of particle fluence and its distribution in energy and direction is more important, and provides a basis for an assessment of doses.
- A broad range of instrumentation has been designed specifically for fluence and dose measurements in space. Obviously, a single instrument is not sufficient for the determination of all particle radiances and their energy distributions, and for an assessment of organ doses in the human body. Particle spectrometers, individual dosimeters, and specific instruments measuring the low-penetrating radiation on the body of an astronaut are needed.
- While passive individual dosimeters are generally appropriate to measure mission doses integrated over the flight time, active detector systems allow the measurement of fluctuations in the exposure and also the inclusion of warning capabilities (e.g. in cases of a large SPE).
- The use of biomarkers of health effects is an attractive supplement to physical dosimetry. Biomarkers from blood samples from astronauts can be used to assess individual mission doses. In addition, biomarkers may serve for an individual risk assessment or an indication for the presence of a disease. Biodosimetry is performed routinely on the small population of astronauts involved in ISS missions, and would likely be used in future space missions. To be useful as a biodosimetric method, the radiation quality dependence of the response of the specific assay needs to be known.

(339) The exposure of astronauts in space is a special case of environmental exposure from natural radiation sources that are present in this environment, and are quite different from those on Earth. In space missions, especially in long-term interplanetary missions, their exposure will be higher than the annual limits recommended for exposure of workers on Earth. Although astronauts are exposed to ionising radiation during their occupational activities, they are not usually classified as being occupationally exposed in the sense of the ICRP system for radiation protection of workers on Earth and aircraft crews. Thus, for a specific mission, reference levels for risks or doses may be selected at appropriate levels, and no dose limits may be applied for a given mission. The exposure assessment and risk-related approach described in this report is clearly restricted to the exceptional situation in space, and should not be applied to any other exposure situation on Earth.

REFERENCES

Agostinelli, S., Allison, J., Amako, K., et al., 2003. GEANT4 – a simulation toolkit. Nucl. Instr. Meth. Phys. Res. A506, 250–303.

Allison, J., Amako, K., Apostolakis, J., et al., 2006. Geant4 developments and applications. IEEE Transact. Nucl. Sci. 53, 270–278.

Allkofer, O.C., 1975. Introduction to Cosmic Radiation. Buchreihe der Atomenergie, München.

Alpen, E.L., Powers-Risius, P., Curtis, S.B., et al., 1993. Tumorigenic potential of high-Z, high-LET charged particle radiations. Radiat. Res. 88, 132–143.

Alsmiller, R.G. Jr, Irving, D.C., Kinney, W.E., et al., 1965. The validity of the straightahead approximation in space vehicle shielding design studies. In: Reetz, A. Jr. (Ed.), Second Symposium on Protection Against Radiations in Space, NASA SP-71, National Technical Information Service, Springfield, VA, pp. 177–181.

Andersen, V., Ballarini, F., Battistoni, G., et al., 2004. The FLUKA code for space applications: recent developments. Adv. Space Res. 34, 1302–1310.

Apáthy, I., Deme, S., Fehér, I., et al., 2002. Dose measurements in space by the Hungarian Pille TLD system. Radiat. Meas. 35, 381–391.

Apáthy, I., Akatov, Y.A., Arkhangelsky, V.V., et al., 2007. TL dose measurements on board the Russian segment of the ISS by the 'Pille' system during Expedition-8, -9 and -10. Acta Astronaut. 60, 322–328.

Atwell, W., 1994. Anatomical models for space radiation application – an overview. Adv. Space Res. 14 (10), 415–422.

Badhwar, G.D., 1997. The radiation environment in low earth orbit. Radiat. Res. 148, S3–S10.

Badhwar, G.D., O'Neill, P.M., 1992. An improved model of GCR for space exploration missions. Nucl. Tracks Radiat. Meas. 20, 403–410.

Badhwar, G.D., Cucinotta, F.A., Braby, L.A., et al., 1994. Measurements on the shuttle of the LET spectra of galactic cosmic radiation and comparison with the radiation transport model. Radiat. Res. 139, 344–351.

Badhwar, G.D., Patel, J.U., Cucinotta, F.A., et al., 1995. Measurements of secondary particle energy spectrum in the Space Shuttle. Radiat. Meas. 24, 129–138.

Badhwar, G.D., Cucinotta, F.A., 2000. A comparison on depth dependence of dose and linear energy transfers spectra in aluminum and polyethylene. Radiat. Res. 153, 1–8.

Badhwar, G.D., Atwell, W., Badavi, F.F., et al., 2002a. Space radiation absorbed dose distribution in a human phantom. Radiat. Res. 157, 76–91.

Badhwar, G.D., Atwell, W., Reitz, G., et al., 2002b. Radiation measurements on the Mir Orbital Station. Radiat. Meas. 35, 393–422.

Bahadori, A.A., Van Baalen, M., Shavers, M.R., et al., 2011. Effect of anatomical modeling on space radiation dose estimates: a comparison of doses for NASA phantoms and the 5th, 50th, and 95th percentile male and female astronauts. Phys. Med. Biol. 56, 1671–1694.

Bahadori, A.A., Van Baalen, M., Shavers, M.R., et al., 2012. Dosimetric impacts of microgravity: an analysis of 5th, 50th, and 95th percentile male and female astronauts. Phys. Med. Biol. 57, 1047–1070.

Ballarini, F., Battistoni, G., Cerutti, F., et al., 2004. Nuclear Models in FLUKA: Present Capabilities, Open Problems and Future Improvements. SLAC-PUB-10813. SLAC, Stanford, CA.

Ballarini, F., Battistoni, G., Cerutti, F., et al., 2006. GCR and SPE organ doses in deep space with different shielding: Monte Carlo simulations based on the FLUKA code coupled to anthropomorphic phantoms. Adv. Space Res. 37, 1791–1797.

Barkas, W.H., 1963. Nuclear Research Emulsions, Vol. I. Academic Press, New York.

Bartlett, D.T., Hager, L.G., Tanner, R.J., 2006. Results of measurements on shuttle missions to the ISS of the neutron component of the radiation field. Adv. Space Res. 37, 1668–1671.

Battistoni, G., Muraro, S., Sala, P.R., et al., 2007. The FLUKA code: description and benchmarking. In: Fermilab, Albrow, M., Raja, R. (Eds.), Proceedings of the Hadronic Shower Simulation Workshop 2006. AIP Conference Proceedings 896, pp. 31–49.

Bauchinger, M., 1995. Quantification of low-level radiation exposure by conventional chromosome aberration analysis. Mutat. Res. 339 (3), 177–189.

Beaujean, R., Kopp, J., Reitz, G., 1999. Active dosimetry on recent space flights. Radiat. Prot. Dosim. 85, 223–226.

Behrens, R., Dietze, G., Zankl, M., 2010. Dose conversion coefficients for electron exposure of the human eye lens. Phys. Med. Biol. 54, 4069–4087, corrigendum: Phys. Med. Biol. 55. 3937–3945.

Benghin, V.V., 2008. On-board predicting algorithm of radiation exposure for the International Space Station radiation monitoring system. J. Atmos. Sol. Terr. Phys. 70, 675–679.

Benton, E.R., Frank, A.L., Benton, E.V., 2000. efficiency of ^{7}LiF for doses deposited by high-LET particles. Radiat. Meas. 32, 211–214.

Benton, E.R., Benton, E.V., 2001a. Space radiation dosimetry in low-Earth orbit and beyond. Nucl. Instr. Meth. B184, 255–294.

Benton, E.V., Badhwar, G.D. (Eds.), 2001b. Prediction and measurements of secondary neutrons in space. Radiat. Meas. 33, 227–392.

Berger, T., 2008. Radiation dosimetry onboard the International Space Station ISS. Z. Med. Phys. 18, 265–275.

Berger, T., Bilski, P., Hajek, M., et al., 2012. The MATROSHKA experiment: results and comparison from EVA (MTR-1) and IVA (MTR-2A/2B) exposure. Radiat. Res., submitted for publication.

Bernabeu, J., Casanova, I., 2007. Moon surface radiation environment analysis for February 1956 solar event conditions. Adv. Space Res. 42, 1906–1912.

Bichsel, H., 1992. Stopping power and ranges of fast ions in heavy elements. Phys. Rev. A46, 5761–5773.

Billings, M.P., Yucker, W.R., 1973. The Computerized Anatomical Man (CAM) Model. Summary, Final Report, MDC-G4655. McDonnell Douglas Company, Huntington Beach, CA.

Blakely, W.F., Miller, A.C., Grace, M.B., et al., 2003. Radiation biodosimetry: applications for spaceflight. Adv. Space Res. 31, 1487–1493.

Boberg, P.R., Adams, J.H., Beaujean, N.L., et al., 1993. The mean charge state of solar energetic oxygen at 10 MeV/nucleon. In: Proceedings of 23th Intern. Cosmic Ray Conf., Vol. 3. Calgary, Canada, pp. 396–399.

Borak, T.B., Doke, T., Fuse, T., et al., 2004. Comparisons of LET distributions for protons with energies between 50 and 200 MeV determined using a spherical tissue-equivalent proportional counter (TEPC) and a position-sensitive silicon spectrometer (RRMD-III). Radiat. Res. 162, 687–692.

Braun, H., Christl, M., Rahmstorf, S., et al., 2005. Possible solar origin of the 1470 year glacial climate cycle demonstrated in a coupled model. Nature 438, 208–211.

Brenner, D.J., Hall, E.J., 1992. Commentary 2 to Cox and Little: radiation-induced oncogenic transformation: the interplay between dose, dose protraction, and radiation quality. Adv. Radiat. Biol. 16, 167–179.

Brooks, A.L., 1999. Biomarkers of exposure, sensitivity, and disease. Int. J. Radiat. Biol. 75, 1481–1503.

Caffrey, J.A., Hamby, D.M., 2011. A review of instruments and methods for dosimetry in space. Adv. Space Res. 47, 563–574.

Carlsson, J., Rosander, K., 1973. Effects of multiple scattering on proton beams in radiotherapy. Phys. Med. Biol. 18, 633–640.

Casolino, M., Altamura, F., Minori, M., et al., 2007. The Altcriss project on board the International Space Station. Adv. Space Res. 40, 1746–1753.

Charara, Y.M., Townsend, L.W., Gabriel, T.A., et al., 2008. HETC-HEDS code validation using laboratory beam energy loss spectra Data. IEEE Trans. Nucl. Sci. 55, 3164–3168.

Chen, J., 2001. Physics of coronal mass ejections: a new paradigm of solar eruption. Space Sci. Rev. 95, 165–190.

Clowdsley, M.S., Wilson, J.W., Kim, M.Y., et al., 2000. Neutron environment on the Martian surface. Phys. Med. XVII, 94–97.

Cornforth, M.N., 2001. Analyzing radiation-induced complex chromosome rearrangements by combinatorial painting. Radiat. Res. 155, 643–659.

Compton, A.H., 1936. Recent developments in cosmic rays. Rev. Sci. Instrum. 7, 71–82.

Cucinotta, F.A., Townsend, L.W., Wilson, J.W., et al., 1995. Light ion component of the galactic cosmic rays: nuclear interactions and transport theory. Adv. Space Res. 17, 77–86.

Cucinotta, F.A., Wilson, J.W., Shinn, J.L., et al., 1996. Effects of target fragmentation on evaluation of LET spectra from space radiations: implications for space radiation protection studies. Radiat. Meas. 26, 923–934.

Cucinotta, F.A., Wilson, J.W., Shinn, J.L., et al., 1997. Computational procedures and data-base development. In: Wilson, J.W., Miller, J., Konradi, A., Cucinotta, F.A. (Eds.), NASA Workshop on Shielding Strategies for Human Space Exploration. NASA CP-3360. National Technical Information Service, Springfield, VA 22161.

Cucinotta, F.A., Wilson, J.W., Tripathi, R.K., et al., 1998. Microscopic fragmentation model for galactic cosmic ray studies. Adv. Space Res. 22, 533–537.

Cucinotta, F.A., Nikjoo, H., Goodhead, D.T., 2000a. Model of the radial distribution of energy imparted in nanometer volumes from HZE particles. Radiat. Res. 153, 459–468.

Cucinotta, F.A., Wilson, J.W., Williams, J.R., et al., 2000b. Analysis of Mir-18 results for physical and biological dosimetry: radiation shielding effectiveness in LEO. Radiat. Meas. 132, 181–191.

Cucinotta, F.A., Schimmerling, W., Wilson, J.W., et al., 2001a. Space Radiation Cancer Risk Projections for Explorative Missions: Uncertainty Reduction and Mitigation. NASA JSC Document (JSC-29295). NASA, Washington, DC.

Cucinotta, F.A., Schimmerling, W., Peterson, L.E., et al., 2001b. Space radiation cancer risks and uncertainties for Mars missions. Radiat. Res. 156, 682–688.

Cucinotta, F.A., Wilson, J.W., Saganti, P., et al., 2002. Physics of the Isotopic Dependence of GCR Fluence Behind Shielding. NASA TP-2003-210792. National Technical Information Service, Springfield, VA 22161.

Cucinotta, F.A., Durante, M., 2006a. Cancer risk from exposure to galactic cosmic rays: implications for space exploration by human beings. Lancet Oncol. 7, 431–435.

Cucinotta, F.A., Wilson, J.W., Saganti, P., et al., 2006b. Isotopic dependence of GCR fluence behind shielding. Radiat. Meas. 41, 1235–1249.

Cucinotta, F.A., Kim, M.Y., Schneider, S.I., et al., 2007. Description of light ion production cross sections and fluxes on the Mars surface using the QMSFRG model. Radiat. Environ. Biophys. 46, 101–106.

Cucinotta, F.A., Kim, M.Y., Willingham, V., et al., 2008. Physical and biological organ dosimetry analysis for International Space Station astronauts. Radiat. Res. 170, 127–138.

Cucinotta, F.A., Hu, S., Schwadron, N.A., et al., 2010. Space radiation risk limits and Earth–Moon–Mars environmental models. Space Weather 8(12), http://dx.doi.org/10.1029/2009SW000564.

Cucinotta, F.A., Kim, M.Y., Chapell, L.J., 2011. Space Radiation Cancer Risk Projections and Uncertainties – 2010. NASA/TP-2011-216155. National Technical Information Service, Springfield, VA 22161.

Cucinotta, F.A., Chappell, L., Kim, M.Y., 2013. Space radiation cancer risk projections and uncertainties – 2012, NASA/TP-2013-217375. National Technical Information Service, Spring, field, VA 22161.

Dachev, T., Tomov, B., Matviichuk, Y., et al., 2002. Calibration results obtained with Liulin-4 type dosimeters. Adv. Space Res. 30, 917–925.

Dachev, T., Atwell, W., Semones, E., et al., 2006. Observations of the SAA radiation distribution by Liulin-E094 instrument on ISS. Adv. Space Res. 37, 1672–1677.

Dachev, T., Semkova, J., Tomov, B., et al., 2011. Space Shuttle drops down the SAA doses on ISS. Adv. Space Res. 47, 2030–2038.

De Angelis, G., Badavi, F.F., Clem, J.M., et al., 2007. Modeling of the lunar radiation environment. Nucl. Phys. B – Proc. Suppl. 166, 169–183.

Deme, S., Apáthy, I., Pázmándi, T., et al., 2006. On-board TLD measurements on Mir and ISS. Radiat. Prot. Dosim. 120, 438–441.

Dettmann, J., Reitz, G., Gianfiglio, G., 2007. MATROSHKA – the first ESA external payload on the International Space Station. Acta Astronaut. 60, 17–23.

Di Fino, L., Casolino, M., De Santis, C., et al., 2011. Heavy ions anisotropy measured by ALTEA in the International Space Station. Radiat. Res. 176, 397–406.

Doke, T., Hayashi, T., Kikuchi, J., et al., 2001. Measurements of LET-distribution, dose equivalent and quality factor with the RRMD-III on the Space Shuttle Missions STS-84, -89 and -91. Radiat. Meas. 33, 373–387.

Doke, T., Hayashi, T., Nagaoka, S., et al., 1995. Estimation of dose equivalent in STS-47 by a combination of TLDs and CR-39. Radiat. Meas. 24, 75–82.

Doke, T., Hayashi, T., Kikuchi, J., et al., 2002. Dose equivalents inside the MIR Space Station measured by the combination of CR-39 plates and TLDs and their comparison with those on Space Shuttle STS-79, -84 and -91 missions. Radiat. Meas. 35, 505–510.

Doke, T., Fuse, T., Hara, K., et al., 2004. Measurement of linear energy transfer distribution at CERN-EU high-energy reference field facility with real-time radiation monitoring device III and its comparison with dosimetric telescope. Jpn. J. Appl. Phys. 43, 3576–3581.

Durante, M., Cucinotta, F.A., 2011. The physical basis for radiation protection in space. Rev. Mod. Phys. 83, 1245–1281.

Durante, M., George, K., Wu, H., Cucinotta, F.A., 2002. Karyotypes of human lymphocytes exposed to high-energy iron ions. Radiat. Res. 158, 581–590.

EC, 2009. Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation. Radiation Protection No. 160 of the European Radiation Dosimetry Group, WG2. European Commission, Luxembourg.

Edwards, A.A., Lindholm, C., Darroudi, F., et al., 2005. Review of translocations detected by FISH for retrospective biological dosimetry applications. Radiat. Prot. Dosim. 113, 396–402.

Ersmark, T., Carlson, P., Daly, E., et al., 2007. Geant4 Monte Carlo simulations of the belt proton radiation environment on board the International Space Station/Columbus. IEEE Trans. Nucl. Sci. 54, 1444–1453.

Evans, H.D.R., Bühler, P., Hajdas, W., et al., 2008. Results from the ESA SREM monitors and comparison with existing radiation belt models. Adv. Space Res. 42, 1527–1537.

Failla, G., Henshaw, P., 1931. The relative biological effectiveness of X-rays and gamma-rays. Radiology 17, 1–43.

Fano, U., 1963. Penetration of protons, alpha particles, and mesons. Ann. Rev. Nucl. Sci 13, 1–66.

Fasso, A., Ferrari, A., Ranft, J., et al., 2005. FLUKA: a Multi-particle Transport Code. CERN-2005-10, INFN/TC_05/11, SLAC-R-773, CERN, Geneva.

Fattibene, P., Callens, F., 2010. EPR dosimetry with tooth enamel: a review. Appl. Radiat. Isot. 68, 2033–2116.

Fedorenko, B., Druzhinin, S., Yudaeva, L., et al., 2001. Cytogenetic studies of blood lymphocytes from cosmonauts after long-term space flights on Mir station. Adv. Space Res. 27, 355–359.

Fermi, E., 1940. Summer Lectures. University of Chicago, Chicago.

Ferrari, A., 2007. Fragmentation in Human Tissue; from Cancer Therapy to Space Missions. Frankfurt Institute for Advanced Studies, Frankfurt. Available at: http://fias.uni-frankfurt.de/nufra2007/talks/ferrari.pdf (last accessed 2 April 2013).

Ferrari, A., Ranft, J., Sala, P.R., 2001. The FLUKA radiation transport code and its use for space. In: Proceedings of the 1st International Workshop on Space Radiation Research and 11th Annual NASA Space Radiation Health Investigators' Workshop. Phys. Med. 17 (Suppl. 1), 1–295.

Filius, R.W., 1965. Trapped Protons of the Inner Radiation Belt. Dissertation. Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa.

Freden, S.C., Paulikas, G.A., 1964. Trapped protons at low altitudes in the South Atlantic magnetic anomaly. J. Geophys. Res. 69, 1259–1269.

Fry, R.J.M., Powers-Risius, P., Alpen, E.L., et al., 1985. High LET radiation carcinogenesis. Radiat. Res. 104, S188–S195.

George, K., Cucinotta, F.A., 2007. The influence of shielding on the biological effectiveness of accelerated particles for the induction of chromosome damage. Adv. Space Res. 39, 1076–1081.

George, K., Durante, M., Wu, H., et al., 2001. Chromosome aberrations in the blood lymphocytes of astronauts after space flight. Radiat. Res. 156 (6), 731–738.

George, K., Durante, M., Willingham, V., et al., 2003. Biological effectiveness of accelerated particles for the induction of chromosome damage measured in metaphase and interphase human lymphocytes. Radiat. Res. 160, 425–435.

Goldhaber, A.S., 1974. Statistical models of fragmentation processes. Phys. Lett. 53B, 306–309.

Goldhagen, P., Clem, J.M., Wilson, J.W., 2004. The energy spectrum of cosmic ray induced neutrons measured on an airplane over a wide range of altitude and latitude. Radiat. Prot. Dosim. 110, 387–392.

Gong, J.K., Glomski, C.A., Guo, Y., 1999. A lifelong, wide-range radiation biodosimeter: erythrocytes with transferrin receptors. Health Phys. 77, 713–718.

Goodhead, D.T., Munson, R.J., Thacker, J., et al., 1980. Mutation and inactivation of cultured mammalian cells exposed to beams of accelerated heavy ions. IV. Biophysical interpretation. Int. J. Radiat. Biol. 37, 135–167.

Gunther, W., Leugner, D., Becker, E., et al., 2002. Energy spectrum of 50–250 MeV/nucleon iron nuclei inside the MIR space craft. Radiat. Meas. 35, 511–514.

Hajek, M., Berger, T., Vana, N., et al., 2008. Convolution of TLD and SSNTD measurements during the BRADOS-1 experiment onboard ISS (2001). Radiat. Meas. 43, 1231–1236.

HAMLET, 2011. Human Model MATROSHKA for Radiation Exposure Determination of Astronauts. Seventh Framework Programme (FP7) of the EU. German Aerospace Center (DLR), Cologne. Available at: http://www.fp7-hamlet.eu.

Hathaway, D.H., Wilson, R.M., Reichmann, E.J., 2002. Group sunspot numbers: sunspot cycle characteristics. Solar Phys. 211, 357–370.

Heinbockel, J.H., Slaba, T.C., Blattnig, S.R., et al., 2011a. Comparison of the transport codes HZETRN, HETC and FLUKA for a solar particle event. Adv. Space Res. 47, 1079–1088.

Heinbockel, J.H., Slaba, T.C., Tripathi, R.K., et al., 2011b. Comparison of the transport codes HZETRN, HETC and FLUKA for galactic cosmic rays. Adv. Space Res. 47, 1089–1105.

Heinrich, W., Spill, A., 1979. Geomagnetic shielding of cosmic rays for different satellite orbits. J. Geophys. Res. 84, 4401.

Hoff, J.L., Townsend, L.W., Zapp, E.N., 2004. Interplanetary crew doses and dose equivalents: variations among different bone marrow and skin sites. Adv. Space Res. 34, 1347–1352.

Hufner, J., 1985. Heavy fragments produced in proton–nucleus and nucleus–nucleus collisions at relativistic energies. Phys. Rep. 125, 129–185.

Hufner, J., Schafer, K., Schurmann, B., 1975. Abrasion-ablation in reactions between relativistic heavy ions. Phys. Rev. C12, 1888–1898.

Hughes, H.G., Prael, R.E., Little, R.C., 1997. The LAHET/MCNP Code Merger. LA-UR-97-4891. X-Division Research Note XTM-RN(U)97-012. Los Alamos National Laboratory, Los Alamos, NM.

IAEA, 2011. Cytogenetic Dosimetry: Applications in Preparedness for and Response to Radiation Emergencies. International Atomic Energy Agency, Vienna.

ICRP/ICRU, 1963. Report of the RBE Committee of the ICRP and ICRU. Health Phys. 9, 357.

ICRP, 1977. Recommendations of the International Commission on Radiological Protection. ICRP Publication 26. Ann. ICRP 1(3).

ICRP, 1989. RBE for deterministic effects. ICRP Publication 58. Ann. ICRP 20(4).

ICRP, 1991. 1990 Recommendations of the International Commission on Radiological Protection. ICRP Publication 60. Ann. ICRP 21(1–3).

ICRP, 1997. General principles for the radiation protection of workers. ICRP Publication 75. Ann. ICRP 27(1).

ICRP, 2002. Basic anatomical and physiological data for use in radiological protection: reference values. ICRP Publication 89. Ann. ICRP 32 (3–4).

ICRP, 2003. Relative biological effectiveness (RBE), quality factor (Q), and radiation weighting factor (w_R). ICRP Publication 92. Ann. ICRP 33(4).

ICRP, 2005. Low-dose extrapolation of radiation-related cancer risk. ICRP Publication 99. Ann. ICRP 35(4).

ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37(2–4).

ICRP, 2009. Adult reference computational phantoms. ICRP Publication 110. Ann. ICRP 39(2).

ICRP, 2010. Conversion coefficients for radiological protection quantities for external radiation exposures. ICRP Publication 116. Ann. ICRP 40(1).

ICRU, 1970. Linear Energy Transfer. ICUP Report 16. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1978. Basic Aspects of High Energy Particle Interactions and Radiation Dosimetry. ICRU Report 28. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1983. Microdosimetry. ICRU Report 36. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1985. Determination of Dose Equivalents Resulting from External Radiation Sources. ICRU Report 39. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1986. The Quality Factor in Radiation Protection. ICRU Report 40. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1988. Determination of Dose Equivalents from External Radiation Sources – Part 2. ICRU Report 43. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1992. Measurements of Dose Equivalents from External Photon and Electron Radiations. ICRU Report 47. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1993a. Stopping Powers and Ranges of Protons and Alpha Particles with Data Disk. ICRU Report 49. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 1993b. Quantities and Units in Radiation Protection Dosimetry. ICRU Report 51. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 2000. Nuclear Data for Neutron and Proton Radiotherapy and for Radiation Protection. ICRU Report 63. International Commission on Radiation Units and Measurements, Bethesda, MD.

ICRU, 2001. Determination of operational dose equivalent quantities for neutrons. ICRU Report 66. J. ICRU 1(3).

ICRU, 2010. Reference data for the validation of doses from cosmic radiation exposure of aircraft crew. ICRU Report 84. J. ICRU 10(2).

ICRU, 2011. Fundamental quantities and units for ionizing radiation (revised). ICRU Report 85a. J. ICRU 11(1a).

ISO/IEC, 2005. Guide to the Expression of Uncertainty in Measurement (GUM). Guide 98-3. International Organization for Standardization, Geneva.

ISO/IEC, 2007. International Vocabulary of Basic and General Terms in Metrology (VIM). Guide 99. International Organization for Standardization, Geneva.

ISO/IEC, 2009. Uncertainty of Measurement – Part 1: Introduction to the Expression of Uncertainty in Measurement. Guide 98-1. International Organization for Standardization, Geneva.

Iwamoto, Y., Niita, K., Sakamoto, Y., et al., 2007. Validation of the event generator mode in the PHITS code and its application. International Conference on Nuclear Data for Science and Technology 2007. http://dx.doi.org/10.1051/ndata:07417. EDP Sciences, Nice, France.

Jadrníčková, I., Tateyama, R., Yasuda, N., et al., 2009. Variation of absorbed doses onboard of ISS Russian Service Module as measured with passive detectors. Radiat. Meas. 44, 901–904.

James, M.R., McKinney, G.W., Durkee, J.W., et al., 2009. MCMPX 2.7.X – New Features Being Developed. IEEE/NSS, Orlando. Available at: http://mcnpx.lanl.gov/opendocs/misc/LA-UR-09-6788.pdf (last accessed 2 April 2013).

JCGM, 2008a. International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM). JCGM 200, ISO/IEC Guide 99. Joint Committee for Guides in Metrology. BIPM, Sévres.

JCGM, 2008b. Evaluation of Measurement Data – Guide to the Expression of Uncertainty in Measurement. JCGM 100, ISO/IEC Guide 98-3. Joint Committee for Guides in Metrology. BIPM, Sévres.

JCGM, 2009. Evaluation of Measurement Data – an Introduction to the 'Guide to the Expression of Uncertainty in Measurement'. JCGM 104, ISO/IEC Guide 98-1. Joint Committee for Guides in Metrology. BIPM, Sévres.

Johnson, A.S., Golightly, M.J., Lin, T., et al., 2006. A comparison of measurements and predictions for the April 15 and April 18, 2001 solar proton events. Adv. Space Res. 37, 1678–1684.

Jones, M.R., 2000. ACS WFC CCD Radiation Test: the Radiation Environment. ACS Institutional Science Report 00-09. Space Telescope Science Institute. Baltimore, MA.

Katz, R., 1970. RBE, LET and z/β^{α}. Health Phys. 18, 175.

Katz, R., Sharma, S.C., Homayoonfar, M., 1972. The structure of particle tracks. In: Attix, F.H. (Ed.), Topics in Radiation Dosimetry Supplement 1. Academic Press, New York, pp. 317–383.

Keegan, R., 1996. LET Spectrum Generation and Proton Induced Secondary Contribution to Total Dose Measured in Low-Earth Orbit. PhD Thesis. University College, Dublin.

Kiefer, J., Schreiber, A., Gutermuth, F., et al., 1999. Mutation induction by different types of radiation at the *Hprt* locus. Mutat. Res. 431, 429–448.

Kiefer, J., Schmidt, P., Koch, S., 2001. Mutations in mammalian cells induced by heavy charged particles: an indicator for risk assessment in space. Radiat. Res. 156, 607–611.

Kim, Y., Atwell, W., Tylka, A.J., et al., 2010a. Radiation dose assessments of solar particle events with spectral representation at high energies for the improvement of radiation protection. 38th COSPAR Scientific Assembly, Bremen 2010. Paper No. F24-0005-10.

Kim, M.Y., Qualles, G.D., Slaba, T.C., et al., 2010b. Comparison of organ dose and dose equivalent for human phantoms of CAM vs. MAX. Adv. Space Res. 45, 850–857.

Kim, Y., De Angelis, G., Cucinotta, F.A., 2011. Probalistic assessment of radiation risk of astronauts in space missions. Acta Astronaut. 68, 747–759.

Kim, M.H., Wilson, J.W., Cucinotta, F.A., 2012. Description of transport codes for space radiation shielding. Health Phys. 103 (5), 621–639.

Knott, C.N., Albergo, S., Caccia, Z., et al., 1996. Interactions of relativistic neon to nickel projectiles in hydrogen, elemental production cross sections. Phys. Rev. C53, 347–357.

Knott, C.N., Albergo, S., Caccia, Z., et al., 1997. Interactions of relativistic ^{36}Ar and ^{40}Ar nuclei in hydrogen: isotopic production cross sections. Phys. Rev. C56, 398–406.

Koliskova, Z., Sihver, L., Ambrozova, I., et al., 2012. Simulations of absorbed dose on the phantom surface of MATROSHKA-R experiment at the ISS. Adv. Space Res. 49, 230–236.

Konradi, A., Atwell, W., Badhwar, G.D., et al., 1992. Low earth orbit radiation dose distribution in a phantom head. Nucl. Tracks Radiat. Meas. 20, 49–54.

Koshiishi, H., Matsumoto, H., Chishiki, A., et al., 2007. Evaluation of the neutron radiation environment inside the International Space Station based on the Bonner Ball Neutron Detector experiment. Radiat. Meas. 42, 1510–1520.

Kramer, R., Zankl, M., Williams, G., et al., 1982. The Calculation of Dose from External Photon Exposures Using Reference Human Phantoms and Monte Carlo Methods, Part I: the Male (Adam) and Female (Eva) Adult Mathematical Phantoms. GSF Report S-885. GSF – National Research Centre for Environment and Health, Neuherberg.

Langel, R., 1992. The International Geomagnetic Reference Field (IGRF) 1991 Revision. International Association of Geomagnetism and Aeronomy (IAGA), Division V, WG 8. EOS Trans. American Geoph. Union 73 (16), 182.

Lee, K., Flanders, J., Semones, E., et al., 2007. Simultaneous observation of the radiation environment inside and outside the ISS. Adv. Space Res. 40, 1558–1561.

Lenchek, A.M., Singer, S.F., 1962. Effects of the finite gyroradii of geomagnetically trapped protons. J. Geophys. Res. 67, 4073–4075.

Lewis, B.J., Smith, M.B., Ing, H., et al., 2012. Review of bubble detector response characteristics and results from space. Radiat. Prot. Dosim. 150, 1–21.

Lishnevskii, A.E., Panasyuk, M.I., Benghin, V.V., et al., 2010. Variations of radiation environment onboard the ISS in the year 2008. Cosmic Res. 48, 212–217.

Manger, R.P., Bellamy, M.B., Eckerman, K.F., 2012. Dose conversion coefficients for neutron exposure to the lens of the human eye. Radiat. Prot. Dosim. 148, 507–513.

Matsumoto, H., Goka, T., Koga, K., et al., 2001. Real-time measurement of low-energy-range neutron spectra on board the space shuttle STS-89 (S/MM-8). Radiat. Meas. 33, 321–333.

Matthiä, D., Berger, T., Reitz, G., 2013. Organ shielding and doses in low earth orbit calculated for spherical and anthropomorphic phantoms. Adv. Space Res. http://dx.doi.org/0.1016/j.asr.2013.03.025.

Menzel, H.G., Paretzke, H.G., Booz, J. (Eds.), 1989. Implementation of dose equivalent meters based on microdosimetric techniques in radiation protection. Radiat. Prot. Dosim. 29 (1–2).

Mezentsev, A., Amundson, S.A., 2011. Global gene expression to low- or high-dose radiation in a human three-dimensional tissue model. Radiat. Res. 175, 677–688.

Miller, J., 1997. Database development and laboratory validation. In: Wilson, J.W., Miller, J., Konradi, A., Cucinotta, F.A. (Eds.), NASA Shielding Strategies for Human Space Exploration. CP-3360. NASA Langley Research Center, Hampton, VA.

Nagamatsu, A., Masukawa, M., Kamigaichi, S., et al., 2006. Development of the space radiation dosimetry system 'PADLES'. 20th Workshop on Radiation Detectors and Their Users in Tsukuba, 2006. pp. 26–36. Available at: http://ccdb5fs.kek.jp/tiff/2006/0627/0627046.pdf (last accessed 2 April 2013).

Nagamatsu, A., Murakami, K., Yokota, A., et al., 2011. Space radiation damage to HDTV camera CCDs onboard the International Space Station. Radiat. Meas. 46, 205–212.

Narici, L., 2008. Heavy ions light flashes and brain functions: recent observations at accelerators and in spaceflight. N. J. Phys. 10, 075010.

NCRP, 1989. Guidance on Radiation Received in Space Activities. NCRP Report No. 98. National Council on Radiation Protection and Measurements, Bethesda, MD.

NCRP, 1990. The Relative Biological Effectiveness of Radiations of Different Quality. NCRP Report No. 104. National Council on Radiation Protection and Measurements, Bethesda, MD.

NCRP, 1997. Acceptability of Risk from Radiation – Application to Human Space Flight. NCRP Symposium Proceedings No. 3. National Council on Radiation Protection and Measurements, Bethesda, MD.

NCRP, 2000. Radiation Protection Guidance for Activities in Low-Earth Orbit. NCRP Report No. 132. National Council on Radiation Protection and Measurements. Bethesda, MD.

NCRP, 2002. Operational Radiation Safety Program for Astronauts in Low-Earth Orbit: a Basic Framework. NCRP Report No. 142. National Council on Radiation Protection and Measurements, Bethesda, MD.

NCRP, 2006. Information Needed to Make Radiation Protection Recommendations for Space Missions Beyond Low-Earth Orbit. NCRP Report No. 153. National Council on Radiation Protection and Measurements, Bethesda, MD.

Niita, K., Iwamoto, Y., Sato, T., et al., 2007. A new treatment of radiation behaviour beyond one-body observables. International Conference on Nuclear Data for Science and Technology 2007. April 22-27, 2007, Nice, France, eds. O.Bersillon, F.Gunsing, E.Bauge, R.Jacqmin, and S.Leray, EDP Sciences, Vol. 1, 308 http://dx.doi.org/10.1051/ndata:07398.

Niita, K., Matsuda, N., Iwamoto, Y., et al., 2010. PHITS: Particle and Heavy Ion Transport Code System, Version 2.23. JAEA-Data/Code 2010-022.

NMDB, 2011. Real Time Database for High Resolution Monitor Measurements. EU 7th Research Programme. Neutron Monitor Data Base. Available at: http://www.nmdb.eu/?q=node/138 (last accessed 2 April 2013).

Nymnik, R.A., 1999. The problems of cosmic ray particle simulation for the near-Earth orbital and interplanetary flight conditions. Radiat. Meas. 30, 669–677.

Obe, G., Facius, R., Reitz, G., et al., 1999. Manned missions to Mars and chromosome damage. Int. J. Radiat. Biol. 75, 429–433.

Otto, T., 2010. Response of the DIS-1 personal dosimeter to neutrons, protons and other hadrons. Radiat. Meas. 45, 1564–1567.

Payne, M.G., 1969. Energy straggling of heavy charged particles in thick absorbers. Phys. Rev. 185, 611–623.

Pellicioni, M., 1998. Radiation weighting factors and high energy radiation. Radiat. Prot. Dosim. 80, 371–378.

Pelowitz, D.B., 2008. MCNPX User's Manual, Version 2.6.0. LA-CP-07-1473. Los Alamos National Laboratory, Los Alamos, NM.

Plante, I., Cucinotta, F.A., 2008. Ionization and excitation cross sections for the interaction of HZE particles in liquid water and application to Monte-Carlo simulation of radiation tracks. N. J. Phys. 10, 125020.

Prosser, J.S., Moquet, J.E., Lloyd, D.C., et al., 1988. Radiation induction of micronuclei in human lymphocytes. Mutat. Res. 199, 37–45.

Reedy, R.C., 1996. Constraints on solar particle events from comparisons of recent events and million-year averages. In: Balasubramaniam, K.S., Kiel, S.L, Smartt, R.N. (Eds.), Solar Drivers of Interplanetary and Terrestrial Disturbances, ASP Conf. Ser, Vol. 95. Astronomical Society of the Pacific, pp. 429–436.

Reitz, G., 2006. Past and future application of solid-state detectors in manned spaceflight. Radiat. Prot. Dosim. 120, 387–396.

Reitz, G., 2012. Private communication.

Reitz, G., Beaujean, R., Benton, E., et al., 2005. Space radiation measurements onboard ISS – the DOSMAP experiment. Radiat. Prot. Dosim. 116, 374–379.

Reitz, G., Berger, T., 2006. The MATROSHKA facility – dose determination during an EVA. Radiat. Prot. Dosim. 120, 442–445.

Reitz, G., Berger, T., Bilski, P., et al., 2009. Astronaut's organ doses inferred from measurements in a human phantom outside the International Space Station. Radiat. Res. 171, 225–235.

Reitz, G., Berger, T., Matthiae, D., 2012. Radiation exposure in the Moon environment. Planet. Space Sci. 74, 78–83.

Sato, T., Niita, K., Iwase, H., et al., 2006. Applicability of particle and heavy ion transport code PHITS to the shielding design of spacecrafts. Radiat. Meas. 41, 1142–1146.

Sato, T., Endo, A., Zankl, M., et al., 2009. Fluence-to-dose conversion coefficients for neutrons and protons calculated using the PHITS code and ICRP/ICRU adult reference computational phantoms. Phys. Med. Biol. 54, 1997–2014.

Sato, T., Endo, A., Niita, K., 2010. Fluence-to-dose conversion coefficients for heavy ions calculated using PHITS code and ICRP/ICRU adult reference computational phantoms. Phys. Med. Biol. 55, 2235–2246.

Sato, T., Endo, A., Niita, K., 2011. Dose estimation for astronauts using dose conversion coefficients calculated by the PHITS code and the ICRP/ICRU adult reference computational phantoms. Radiat. Environ. Biophys. 50, 115–123.

Sato, T., Endo, A., Niita, K., 2013. Comparison of mean quality factors for astronauts calculated using the Q-functions proposed by ICRP, ICRU, and NASA. Adv. Space Res. http://dx.doi.org/0.1016/j.asr.2013.03.013.

Sawyer, D.M., Vette, J.I., 1976. AP-8 Trapped Proton Environment for Solar Maximum and Solar Minimum. NSSDC/WDC-A-R& S 76-06, National Space Science Data Center, NASA.

Schimmerling, W., Wilson, J.W., Cucinotta, F.A., et al., 1999. Requirements for simulating space radiations with particle accelerators. In: Fujitaka, K., Majima, H., Ando, K., Yasuda, H., Susuki, M. (Eds.), Risk Evaluation of Cosmic-ray Exposure in Long-term Manned Space Mission. Kodansha Scientific Ltd., Tokyo, pp. 1–16.

Schimmerling, W., 2010. Accepting space radiation risks. Radiat. Env. Biophys. 49, 325–329.

Schlatt, H., Zankl, M., Petoussi-Henss, N., 2007. Organ dose conversion coefficients for voxel models of the reference male and female from idealized photon exposures. Phys. Med. Biol. 53, 2123–2145.

Schmidt, E., Regulla, D., Kramer, H.M., 2002. The effect of 29 keV X-rays on the dose response of chromosome aberrations in human lymphocytes. Radiat. Res. 158, 771–777.

Schmitz, T., Waker, A.J., Kliauga, P., et al. (Eds.), 1995. Design, construction and use of tissue-equivalent proportional counters – EURADOS report. Radiat. Prot. Dosim. 61.

Schoeftner, S., Blanco, R., de Silanes, I.L., et al., 2009. Telomere shortening relaxes X chromosome inactivation and forces global transcriptome alterations. Proc. Natl. Acad. Sci. 106, 19393–19398.

Semkova, J., Koleva, R., Shurshakov, V., et al., 2007. Status and calibration results of Liulin-5 charged particle telescope designed for radiation measurements in a human phantom onboard the International Space Station. Adv. Space Res. 40, 1586–1592.

Shinn, J.L., Cucinotta, F.A., Simonsen, L.C., et al., 1998. Validation of a comprehensive space radiation transport code. IEEE Trans. Nucl. Sci. 45, 2711–2719.

Shurshakov, V.A., Akatov, Y.A., Petrov, V.M., et al., 2004. MATROSHKA-R Experiment Onboard the ISS: Current Status and Preliminary Results. 9th WRMISS Meeting, 8–10 September, Vienna.

Sihver, L., Mancusi, D., Niita, K., et al., 2007. Recent developments and benchmarking of the PHITS code. Adv. Space Res. 40, 1320–1331.

Sihver, L., Mancusi, D., Niita, K., et al., 2008. Benchmarking of calculated projectile fragmentation cross-sections using the 3-D, MC codes PHITS, FLUKA, HETC-HEDS, MCNPX_HI, and NUCFRG2. Acta Astronaut. 63, 865–877.

Sihver, L., Sato, T., Gustafsson, K., et al., 2010a. An update about recent developments of the PHITS code. Adv. Space Res. 45, 892–899.

Sihver, L., Sato, T., Puchalska, M., et al., 2010b. Simulations of MATROSHKA experiments at the International Space Station using PHITS. Radiat. Environ. Biophys. 49, 351–357.

Slaba, T.C., Qualls, G.D., Clowdsley, M.S., et al., 2010. Utilization of CAM, CAF, MAX, and FAX for space radiation analyses using HZETRN. Adv. Space Res. 45, 866–883.

Smart, D.F., Shea, M.A., 2008. World grid of calculated cosmic ray vertical cutoff rigidities for Epoch 2000.0. In: Caballero, R., D'Olivo, J.C., Medina-Tanco, G., Nellen, L., Sánchez, F.A., Valdés-Galicia, J.F. (Eds.), Proceedings of the 30th International Cosmic Ray Conference. Universidad Nacional Autónoma de México, Mexico City, Vol. 1, pp. 737–740.

Snyder, W.S., Ford, M.R., Warner, G.G., et al., 1969. Estimates of absorbed fractions for monoenergetic photon sources uniformly distributed in various organs of a heterogeneous phantom. MIRD Pamphlet No. 5. J. Nucl. Med. 10 (Suppl. 3), 46–51.

Spjeldvik, W.N., Rothwell, P.L., 1983. The Earth Radiation Belts. AFGL-TR-83-0240. Air Force Geophysics Laboratory, Hanscom AFB, MA.

Taucher-Scholz, G., Kraft, G., 1999. Influence of radiation quality on the yield of DNA strand breaks for SV40 DNA irradiated in solution. Radiat. Res. 151, 595–604.

Tawara, H., Masukawa, M., Nagamatsu, A., et al., 2011. Characteristics of Mg_2SiO_4:Tb (TLD-MSO-S) relevant for space radiation dosimetry. Radiat. Meas. 46, 709–716.

Terasawa, K., Borak, T.B., Doke, T., et al., 2005. The response of the silicon-based linear energy transfer spectrometer (RRMD-III) to protons from 1 to 70 MeV. Jpn. J. Appl. Phys. 44, 7608–7613.

Testard, I., Sabatier, L., 1999. Biological dosimetry for astronauts: a real challenge. Mutat. Res. 430 (2), 315–326.

Thacker, J., Stretch, A., Stephens, M.A., 1979. Mutation and inactivation of cultured mammalian cells exposed to beams of accelerated heavy ions. II. Chinese hamster V79 cells. Int. J. Radiat. Biol. 38, 137–148.

Townsend, L.W., Wilson, J.W., 1986. Energy-dependent parameterizations of heavy-ion absorption cross sections. Radiat. Res. 106, 283–287.

Townsend, L.W., Wilson, J.W., Cucinotta, F.A., et al., 1986. Comparison of optical model differences in heavy ion fragmentation: optical versus geometric. Phys. Rev. C34, 1491–1495.

Townsend, L.W., Cucinotta, F.A., 1996. Overview of nuclear fragmentation models and needs. Adv. Space Res. 17, 59–68.

Townsend, L.W., Miller, T.M., Gabriel, T.A., 2002. Modifications to the HETC Radiation Transport Code for Space Radiation Shielding Applications: a Status Report. 12th Biennial ANS Radiation Protection and Shielding Division Topical Meeting, Sante Fe, NM.

Townsend, L.W., Miller, T.M., Gabriel, T.A., 2005. HETC radiation transport code development for cosmic ray shielding applications in space. Radiat. Prot. Dosim. 116, 135–139.

Tret'yakov, V.I., Mitrofanov, I.G., Bobronitskii, Y.I., et al., 2010. The first stage of the 'BTN-Neutron' space experiment onboard the Russian segment of the International Space Station. Cosmic Res. 48, 285–299.

Tripathi, R.K., Wilson, J.W., Cucinotta, F.A., 2001. Medium modified two-body scattering amplitude from proton-nucleus total cross-sections. Nucl. Instrum. Meth. Phys. Res B173, 391–396.

Tripathi, R.K., Wilson, J.W., Badavi, F.F., et al., 2006. A characterization of the moon radiation environment for radiation analysis. Adv. Space Res. 37, 1749–1758.

Trovati, S., Ballarini, F., Battistoni, G., et al., 2006. Human exposure to space radiation: role of primary and secondary particles. Radiat. Prot. Dosim. 122, 362–366.
Tucker, J.D., Tawn, E.J., Holdsworth, D., et al., 1997. Biological dosimetry of radiation workers at the Sellafield nuclear facility. Radiat. Res. 148, 216–226.
Tucker, J.D., 2008. Low-dose ionizing radiation and chromosome translocations: a review of the major considerations for human biological dosimetry. Mutat. Res. 659, 211–220.
Tull, C.E., 1990. Relativistic Heavy Ion Fragmentation at HISS. LBL-29718. University of California, Berkeley, CA.
Tweed, J., Waker, S.A., Wilson, J.W., et al., 2005. Computational methods for the HZETRN code. Adv. Space Res. 35, 194–201.
Uchihori, Y., Fujitaka, K., Yasuda, N., et al., 2002. Intercomparison of radiation instruments for cosmic-ray with heavy ion beams at NIRS (ICCHIBAN Project). J. Radiat. Res. 43S, S81–S85.
Vette, J.I., 1991. The AE-8 Trapped Electron Model Environment. NSSDC/WDC-A-R& S 91-24, National Space Science Data Center, NASA.
Vral, A., Thierens, H., De Ridder, L., 1997. In vitro micronucleus-centromere assay to detect radiation damage induced by low doses in human lymphocytes. Int. J. Radiat. Biol. 71, 61–68.
Waters, L.S. (Ed.), 2002. MCNPX User's Manual, Version 2.3.0. Los Alamos National Laboratory Report LA-UR-02-2607, Los Alamos, NM.
Weil, M.M., Bedford, J.S., Bielefeldt-Ohmann, H., et al., 2009. Incidence of acute myeloid leukemia and hepatocellular carcinoma in mice irradiated with 1 GeV/nucleon ^{56}Fe ions. Radiat. Res. 172, 213–219.
WELMEC, 2008. Software Guide (Measuring Instruments Directive 2004/22/EC). WELMEC 7.2 Issue 4. WELMEC Secretariat, Ljubljana.
Wiegel, B., Alevra, A.V., 2002. NEMUS – the PTB neutron multisphere spectrometer: Bonner spheres and more. Nucl. Instrum. Meth. A476, 36–41.
Williams, J.R., Zhang, Y., Zhou, H., et al., 2008. Overview of radiosensitivity of human tumor cells to low-dose-rate irradiation. Int. J. Radiat. Oncol. Biol. Phys. 72 (3), 909–917.
Wilson, J.W., 1978. Environmental Geophysics and SPS Shielding. Lawrence Berkeley Laboratory Report LBL-8581. pp. 33–116, Berkeley, CA.
Wilson, J.W., Townsend, L.W., Schimmerling, W., et al., 1991. Transport Methods and Interactions for Space Radiations. NASA RP, 1257.
Wilson, J.W., Shinn, J.L., Townsend, L.W., et al., 1994a. NUCFRG2: a semiempirical nuclear fragmentation model. Nucl. Instrum. Meth. Phys. Res. B94, 95–102.
Wilson, J.W., Tweed, J., Nealy, J.E., et al., 1994b. Galactic cosmic ray transport methods: past, present, and future. Adv. Space Res. 14, 841–852.
Wilson, J.W., Kim, M., Schimmerling, W., et al., 1995a. Issues in space radiation protection. Health Phys. 68, 50–58.
Wilson, J.W., Tripathi, R.K., Cucinotta, F.A., et al., 1995b. An Evaluation of the Semiempirical Nuclear Fragmentation Database. NASA TP, 3533.
Wilson, J.W., Nealy, J.E., Wood, J.S., et al., 1995c. Variations in astronaut radiation exposure due to anisotropic shield distribution. Health Phys. 69, 34–45.
Wilson, J.W., Cucinotta, F.A., Shinn, J.L., et al., 1999. Shielding from solar particles events in space. Radiat. Meas. 30, 361–382.
Wilson, J.W., Cucinotta, F.A., Miller, J., et al., 2001. Approaches and issues related to shield material design to protect astronauts from space radiation. Materials Design 22, 541–554.
Wilson, J.W., Tripathi, R.K., Qualls, G.D., et al., 2004. Space radiation transport method development. Adv. Space Res. 34, 1319–1327.
Wilson, J.W., Nealy, J.E., Dachev, T.P., et al., 2007. Time serial analysis of the induced LEO environment within the ISS 6A. Adv. Space Res. 40, 1562–1570.
Wilson, J.W., 2009. Private communication.
Wong, M., Schimmerling, W., Phillips, M.H., et al., 1990. The multiple scattering of very heavy charged particles. Med. Phys. 17, 163–171.
Yang, T.C., George, K.A., Johnson, A.S., et al., 1997. Biodosimetry results from space flight Mir-18. Radiat. Res. 148, 17–23.

Yasuda, H., Badhwar, G.D., Komiyama, T., et al., 2000. Effective dose equivalent on the ninth shuttle–Mir mission (STS-91). Radiat. Res. 154, 705–713.

Yasuda, H., 2001. Responses of a direct ion storage dosimeter (DIS-1) to heavy charged particles. Radiat. Res. 156, 805–808.

Yasuda, N., Uchihori, Y., Benton, E.R., et al., 2006. The intercomparison of cosmic rays with heavy ion beams at NIRS (ICCHIBAN) project. Radiat. Prot. Dosim. 120, 414–420.

Yucker, W.R., Huston, S.L., 1990. Computerized Anatomical Female. Final Report. Report MDC H6107. McDonnell Douglas Corporation, Huntington Beach, CA.

Zaconte, V., Casolino, M., De Santis, C., et al., 2010a. The radiation environment in the ISS-USLab measured by ALTEA: spectra and relative nuclear abundances in the polar, equatorial and SAA regions. Adv. Space Res. 46, 797–799.

Zaconte, V., Casolino, M., Di Fino, L., et al., 2010b. High energy radiation fluences in the ISS-USLab: ion discrimination and particle abundances. Radiat. Meas. 45, 168–172.

Zankl, M., Witmann, A., 2001. The adult male voxel model 'Golem' segmented from whole-body CT patient data. Radiat. Env. Biophys. 40, 153–162.

Zapp, E.N., Townsend, L.W., Cucinotta, F.A., 2002. Solar particle event organ doses and dose equivalents for interplanetary crews: variations due to body size. Adv. Space Res. 30, 975–979.

Zeitlin, C., Guetersloh, S.B., Heilbronn, L.H., et al., 2006. Measurements of materials shielding properties with 1 GeV/u ^{56}Fe. Nucl. Instr. Meth. Phys. Res. B 252, 308–318.

Zhou, D., O'Sullivan, D., Semones, E., et al., 2008. Radiation dosimetry for high LET particles in low Earth orbit. Acta Astronaut. 63, 855–864.

Zhou, D., Semones, E., Gaza, R., et al., 2009. Radiation measured during ISS Expedition 13 with different dosimeters. Adv. Space Res. 43, 1212–1219.

Ziegler, J.F., Biersack, J.P., Ziegler, M.D., 2008. SRIM – The Stopping and Range of Ions in Matter. Lulu Press Co., Morrisville, NC, USA.

ANNEX A. CONVERSION COEFFICIENTS (PARTICLE FLUENCE TO MEAN ABSORBED DOSE IN AN ORGAN OR TISSUE) AND MEAN QUALITY FACTORS FOR PROTONS, NEUTRONS, CHARGED PIONS, ALPHA PARTICLES, AND HEAVY IONS ($2 < Z \leq 28$)

(A1) Conversion coefficients for mean absorbed doses in organs and tissues for adult males and females based on the reference voxel phantoms (ICRP, 2009) are given for heavy ions ($2 < Z \leq 28$) with energies from 10 MeV/u to 100 GeV/u. Data for the skin are given for the particle energy range from 1 MeV/u to 100 GeV/u. The exposure geometry is always isotropic radiation incidence. The data were evaluated based on their calculated values using the PHITS code (Sato et al., 2010) in combination with the reference voxel phantoms (ICRP, 2009) or the human eyeball model (Behrens et al., 2010; Manger et al., 2012). The eyeball model was only used for calculating the data for the lens of the eye for particle energies below 100 MeV/u. At low particle energies, the data fluctuate to some extent due to the statistical uncertainties in the Monte Carlo simulation. Care should be taken in the use of data for the skin, especially at low particle energies, because its anatomy is not well reproduced by the reference voxel phantoms.

(A2) Based on the $Q(L)$ function (ICRP, 1991), mean quality factors for organs and tissues of the adult male and female reference phantom are given for the heavy ions and energies mentioned above (Sato et al., 2010).

(A3) In addition to the mean quality factors based on $Q(L)$, data are presented for mean quality factors for organs and tissues of the adult male and female reference phantom based on the Q concept developed by Cucinotta et al. (2011) (see Section 3.2.3). In this concept, different quality factor values are assigned to solid cancer and leukaemia. The quality factors for leukaemia are smaller than those for solid cancer, and were only employed in the calculation of the mean quality factors for RBM. The data were also evaluated based on their calculated values using the PHITS code (Sato et al., 2013).

(A4) Furthermore, conversion coefficients from *Publication 116* (ICRP, 2010) for isotropic exposure and mean quality factors are given for protons, neutrons, charged pions, and alpha particles. The conversion coefficients for organ doses are the same as the corresponding data annexed to *Publication 116* (ICRP, 2010), except for the eye lens data for protons and alpha particles below 100 MeV/u which were re-evaluated based on their calculated values using the PHITS code in combination with the eyeball model (Behrens et al., 2010; Manger et al., 2012). The energy range considered is the same as in *Publication 116* (ICRP, 2010) for pions and alpha particles, whereas it has been extended from 10 GeV to 100 GeV for neutrons and protons. The conversion coefficients for mean absorbed doses in organs or tissues for neutrons and protons with energies above 10 GeV and the mean quality factors were evaluated based on their calculated values using the PHITS code (Sato et al., 2009, 2010, 2013).

(A5) The complete set of data is included on the accompanying CD, which additionally includes conversion coefficients for effective dose equivalent and a module for preparing graphs. All data are also available on a data file that can be downloaded from the ICRP website (www.icrp.org).

Table A.1. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by protons.

	Red bone marrow						Breast					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.60E-01	3.2	2	8.29E-02	3.1	2.1	4.75E+01	3.7	6.3	4.05E+01	3.6	6.1
1.50E+01	4.95E-01	2.6	1.8	1.62E-01	2.6	1.8	1.43E+02	3.5	5.7	1.38E+02	3.4	5.6
2.00E+01	1.00E+00	2.5	1.7	3.39E-01	2.5	1.7	4.34E+02	2.5	4.1	3.11E+02	2.4	3.9
3.00E+01	5.86E+00	2.6	1.8	7.44E+00	2.6	1.8	9.75E+02	1.8	2.7	6.29E+02	1.8	2.6
4.00E+01	4.58E+01	2.1	1.6	4.84E+01	2	1.5	1.32E+03	1.5	2	8.61E+02	1.6	2.1
5.00E+01	1.17E+02	1.7	1.4	1.09E+02	1.7	1.4	1.34E+03	1.4	1.8	9.96E+02	1.4	1.9
6.00E+01	1.72E+02	1.5	1.3	1.72E+02	1.6	1.3	1.25E+03	1.3	1.5	1.04E+03	1.4	1.7
8.00E+01	2.92E+02	1.4	1.2	3.11E+02	1.4	1.2	1.03E+03	1.2	1.4	9.68E+02	1.3	1.5
1.00E+02	4.70E+02	1.4	1.2	4.97E+02	1.4	1.2	8.68E+02	1.2	1.4	8.58E+02	1.2	1.4
1.50E+02	8.63E+02	1.3	1.1	9.66E+02	1.3	1.1	7.13E+02	1.2	1.4	8.31E+02	1.3	1.5
2.00E+02	9.01E+02	1.3	1.1	9.17E+02	1.3	1.1	8.74E+02	1.4	1.5	9.13E+02	1.3	1.5
3.00E+02	7.12E+02	1.4	1.1	7.11E+02	1.4	1.1	6.83E+02	1.5	1.6	6.95E+02	1.4	1.6
4.00E+02	6.28E+02	1.5	1.2	6.27E+02	1.5	1.2	6.03E+02	1.5	1.9	6.15E+02	1.5	1.8
5.00E+02	5.92E+02	1.5	1.2	5.89E+02	1.5	1.2	5.69E+02	1.5	1.9	5.74E+02	1.5	1.9
6.00E+02	5.89E+02	1.6	1.2	5.86E+02	1.6	1.2	5.34E+02	1.5	2	5.63E+02	1.6	2.1
8.00E+02	5.95E+02	1.7	1.3	5.88E+02	1.6	1.3	5.47E+02	1.5	2	5.49E+02	1.6	2.1
1.00E+03	5.84E+02	1.7	1.3	5.78E+02	1.7	1.3	5.35E+02	1.6	2.2	5.38E+02	1.7	2.3
1.50E+03	6.16E+02	1.8	1.3	6.12E+02	1.8	1.3	5.41E+02	1.7	2.2	5.57E+02	1.7	2.3
2.00E+03	6.24E+02	1.8	1.3	6.17E+02	1.8	1.3	5.45E+02	1.8	2.3	5.50E+02	1.7	2.4
3.00E+03	6.78E+02	1.7	1.3	6.59E+02	1.7	1.3	5.76E+02	1.8	2.4	5.87E+02	1.7	2.4
4.00E+03	7.19E+02	1.9	1.4	7.02E+02	1.9	1.4	6.07E+02	2	2.6	6.34E+02	1.9	2.6
5.00E+03	7.36E+02	1.9	1.4	7.12E+02	1.9	1.4	6.48E+02	2	2.7	6.32E+02	1.9	2.5
6.00E+03	8.06E+02	1.9	1.4	7.81E+02	1.9	1.4	6.86E+02	1.9	2.5	6.84E+02	1.9	2.5
8.00E+03	8.88E+02	1.8	1.4	8.60E+02	1.9	1.4	7.43E+02	1.7	2.4	7.46E+02	1.8	2.5
1.00E+04	9.30E+02	1.8	1.3	8.93E+02	1.8	1.3	7.37E+02	1.7	2.3	7.58E+02	1.9	2.4
2.00E+04	1.13E+03	1.7	1.3	1.06E+03	1.7	1.3	8.92E+02	1.6	2.3	8.58E+02	1.7	2.3
5.00E+04	1.56E+03	1.6	1.3	1.45E+03	1.6	1.3	1.13E+03	1.6	2.2	1.17E+03	1.6	2.1
1.00E+05	2.25E+03	1.5	1.2	2.00E+03	1.5	1.2	1.50E+03	1.6	1.9	1.50E+03	1.5	2

	Colon						Lungs					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.50E-03	1	1	3.70E-03	1	1	2.50E-03	1	1	2.60E-03	1	1
1.50E+01	1.01E-02	1.3	1.3	1.03E-02	1.3	1.3	9.20E-03	1	1	1.13E-02	1.4	1.4
2.00E+01	2.22E-02	2	2.1	1.83E-02	1.8	1.8	1.87E-02	1.9	1.9	1.52E-02	1.7	1.7
3.00E+01	3.07E-01	4.3	7.7	4.06E-02	2.5	3.4	4.17E-02	2.6	3.5	4.25E-02	2.6	3.5
4.00E+01	1.83E+00	2.3	4.4	1.77E-01	3.8	6.5	3.39E-01	4.4	7.9	1.78E-01	3.9	6.5
5.00E+01	1.06E+01	2.2	3.6	1.61E+01	2.4	4	6.45E+00	2.5	4.2	4.44E+00	2.6	4.4
6.00E+01	6.63E+01	2	3.1	8.17E+01	1.9	3	4.59E+01	2	3.1	4.19E+01	2.1	3.4

(continued on next page)

Table A.1. (*continued*)

E	Colon						Lungs					
	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+01	3.50E+02	1.5	2.1	3.68E+02	1.5	2.1	2.66E+02	1.6	2.3	3.97E+02	1.6	2.3
1.00E+02	5.51E+02	1.4	1.8	5.76E+02	1.4	1.7	6.40E+02	1.4	1.9	8.34E+02	1.4	1.8
1.50E+02	7.98E+02	1.3	1.5	8.22E+02	1.3	1.6	1.00E+03	1.3	1.5	1.09E+03	1.3	1.5
2.00E+02	8.77E+02	1.3	1.5	9.07E+02	1.3	1.4	9.22E+02	1.2	1.4	9.19E+02	1.2	1.4
3.00E+02	7.29E+02	1.3	1.6	7.23E+02	1.3	1.6	7.11E+02	1.4	1.6	7.08E+02	1.3	1.6
4.00E+02	6.32E+02	1.4	1.8	6.36E+02	1.5	1.7	6.27E+02	1.4	1.8	6.24E+02	1.5	1.7
5.00E+02	5.96E+02	1.6	1.8	5.96E+02	1.5	1.8	5.90E+02	1.5	1.9	5.87E+02	1.6	1.9
6.00E+02	5.92E+02	1.6	2	5.90E+02	1.6	2	5.89E+02	1.6	2	5.75E+02	1.6	2
8.00E+02	6.03E+02	1.7	2.2	5.98E+02	1.7	2.2	5.89E+02	1.7	2.2	5.75E+02	1.7	2.1
1.00E+03	5.91E+02	1.7	2.2	5.86E+02	1.8	2.2	5.79E+02	1.7	2.3	5.67E+02	1.7	2.3
1.50E+03	6.22E+02	1.8	2.4	6.23E+02	1.8	2.2	6.05E+02	1.8	2.4	5.94E+02	1.7	2.3
2.00E+03	6.28E+02	1.7	2.4	6.26E+02	1.7	2.2	6.15E+02	1.8	2.4	5.96E+02	1.8	2.3
3.00E+03	6.86E+02	1.7	2.4	6.73E+02	1.8	2.3	6.65E+02	1.7	2.4	6.38E+02	1.8	2.3
4.00E+03	7.31E+02	1.9	2.5	7.20E+02	1.9	2.6	7.01E+02	1.9	2.6	6.75E+02	1.9	2.5
5.00E+03	7.49E+02	1.9	2.5	7.40E+02	1.9	2.6	7.21E+02	1.9	2.6	6.89E+02	1.9	2.5
6.00E+03	8.35E+02	1.9	2.5	8.17E+02	1.9	2.5	7.88E+02	1.9	2.5	7.56E+02	1.8	2.5
8.00E+03	9.04E+02	1.8	2.5	8.92E+02	1.9	2.4	8.64E+02	1.8	2.4	8.25E+02	1.8	2.5
1.00E+04	9.45E+02	1.7	2.4	9.32E+02	1.8	2.4	9.03E+02	1.8	2.4	8.48E+02	1.8	2.4
2.00E+04	1.16E+03	1.7	2.2	1.11E+03	1.7	2.2	1.06E+03	1.7	2.3	9.77E+02	1.8	2.3
5.00E+04	1.65E+03	1.6	2.1	1.53E+03	1.6	2.1	1.41E+03	1.6	2.1	1.32E+03	1.6	2.1
1.00E+05	2.25E+03	1.5	2.1	2.12E+03	1.5	2	2.03E+03	1.5	2	1.80E+03	1.5	2

E	Stomach wall						Gonads					
	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.50E-03	1	1	1.50E-03	1	1	2.68E+01	3.2	5.3	0.00E+00	1	1
1.50E+01	7.40E-03	1	1	8.10E-03	1	1	5.08E+01	2.7	4.2	4.00E-03	1	1
2.00E+01	1.81E-02	1.8	1.8	1.69E-02	1.8	1.8	1.01E+02	2.4	3.7	8.30E-03	1	1
3.00E+01	4.61E-02	2.7	3.7	4.20E-02	2.6	3.5	2.25E+02	1.9	2.7	4.09E-02	2.5	3.4
4.00E+01	9.24E-02	3.3	5.1	1.01E-01	3.3	5.3	3.62E+02	1.6	2.2	6.19E-02	2.9	4.3
5.00E+01	2.21E-01	4	7	1.01E+01	2.6	4.5	5.06E+02	1.5	2.1	1.56E-01	3.7	6.3
6.00E+01	1.00E+01	2.9	5.1	1.03E+02	2	3.2	6.18E+02	1.4	1.9	2.88E-01	4.3	7.6
8.00E+01	2.16E+02	1.6	2.2	3.70E+02	1.5	2	6.89E+02	1.3	1.5	8.47E-01	4.4	14.3
1.00E+02	4.13E+02	1.4	1.9	5.90E+02	1.4	1.8	6.14E+02	1.2	1.4	4.46E+00	3.1	6.8
1.50E+02	8.09E+02	1.3	1.6	9.04E+02	1.3	1.6	7.37E+02	1.2	1.4	9.42E+02	1.4	1.7
2.00E+02	9.45E+02	1.3	1.5	9.10E+02	1.3	1.5	9.06E+02	1.2	1.4	1.00E+03	1.2	1.5
3.00E+02	7.22E+02	1.4	1.5	7.20E+02	1.3	1.6	7.03E+02	1.3	1.5	7.29E+02	1.3	1.7
4.00E+02	6.35E+02	1.4	1.8	6.37E+02	1.4	1.7	6.13E+02	1.3	1.7	6.50E+02	1.5	1.7
5.00E+02	5.96E+02	1.6	1.8	5.89E+02	1.5	1.8	5.75E+02	1.5	1.9	5.90E+02	1.5	1.8
6.00E+02	6.07E+02	1.7	2	5.89E+02	1.6	2.1	5.73E+02	1.6	2	6.20E+02	1.5	2
8.00E+02	6.03E+02	1.7	2.1	5.90E+02	1.6	2.2	5.92E+02	1.7	2.1	5.93E+02	1.5	2.1
1.00E+03	5.97E+02	1.8	2.3	5.82E+02	1.7	2.3	5.51E+02	1.7	2.2	5.95E+02	1.6	2.3
1.50E+03	6.28E+02	1.8	2.4	6.10E+02	1.8	2.3	6.02E+02	1.7	2.4	6.54E+02	1.7	2.4
2.00E+03	6.35E+02	1.7	2.4	6.14E+02	1.8	2.4	5.99E+02	1.8	2.5	6.54E+02	1.8	2.5
3.00E+03	6.99E+02	1.7	2.4	6.66E+02	1.7	2.4	6.41E+02	1.8	2.5	7.07E+02	1.9	2.5
4.00E+03	7.45E+02	2	2.4	7.11E+02	1.9	2.5	6.84E+02	2	2.6	7.59E+02	2	2.6
5.00E+03	7.62E+02	1.9	2.6	7.33E+02	1.9	2.5	6.96E+02	2	2.7	7.92E+02	2	2.6
6.00E+03	8.26E+02	1.9	2.5	8.04E+02	1.9	2.5	7.74E+02	1.9	2.5	8.54E+02	2	2.5
8.00E+03	9.11E+02	1.8	2.5	8.83E+02	1.9	2.5	8.16E+02	1.9	2.4	9.65E+02	2	2.3
1.00E+04	9.78E+02	1.8	2.4	9.05E+02	1.8	2.4	8.66E+02	1.9	2.3	1.01E+03	2	2.2

Table A.1. (*continued*)

	Stomach wall						Gonads					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+04	1.14E+03	1.7	2.3	1.10E+03	1.8	2.4	1.03E+03	1.9	2.2	1.45E+03	1.9	2.2
5.00E+04	1.64E+03	1.6	2.1	1.50E+03	1.7	2.1	1.56E+03	1.8	2.1	1.72E+03	1.7	2.2
1.00E+05	2.31E+03	1.5	2	2.14E+03	1.5	1.9	2.26E+03	1.6	2.1	2.18E+03	1.6	2.1

	Liver						Oesophagus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.00E-03	1	1	2.60E-03	1	1	3.00E-03	1	1	2.90E-03	1	1
1.50E+01	9.40E-03	1	1	1.16E-02	1.4	1.4	5.80E-03	1	1	9.70E-03	1	1
2.00E+01	1.59E-02	1.7	1.7	2.08E-02	1.9	2	2.49E-02	2.1	2.4	1.39E-02	1.6	1.6
3.00E+01	4.36E-02	2.6	3.5	4.42E-02	2.6	3.6	1.55E-01	3.7	6.2	4.05E-02	2.5	3.4
4.00E+01	9.87E-02	3.3	5.3	2.98E-01	4.3	7.6	1.30E+00	2.5	4.4	2.01E-01	4	6.8
5.00E+01	5.61E+00	2.6	4.6	1.07E+01	2.4	4.1	9.35E+00	2.2	3.5	5.83E+00	2.6	4.5
6.00E+01	4.10E+01	1.9	3.1	7.13E+01	1.9	3.1	3.33E+01	1.9	3	3.23E+01	1.9	2.8
8.00E+01	2.06E+02	1.6	2.2	3.17E+02	1.5	2.1	1.66E+02	1.5	2	1.70E+02	1.5	2
1.00E+02	4.07E+02	1.4	1.9	5.45E+02	1.4	1.8	2.36E+02	1.4	1.9	3.33E+02	1.5	1.9
1.50E+02	8.33E+02	1.3	1.6	9.25E+02	1.3	1.6	1.04E+03	1.3	1.6	1.10E+03	1.3	1.5
2.00E+02	9.38E+02	1.3	1.5	9.27E+02	1.3	1.5	9.72E+02	1.3	1.5	9.54E+02	1.2	1.4
3.00E+02	7.23E+02	1.4	1.6	7.17E+02	1.4	1.6	7.22E+02	1.3	1.6	7.18E+02	1.3	1.6
4.00E+02	6.35E+02	1.5	1.7	6.32E+02	1.5	1.8	6.22E+02	1.3	1.8	6.41E+02	1.6	1.7
5.00E+02	6.00E+02	1.5	1.9	5.96E+02	1.5	1.9	6.03E+02	1.4	1.9	5.99E+02	1.6	2
6.00E+02	6.02E+02	1.6	2	5.88E+02	1.6	2	5.83E+02	1.6	2	6.02E+02	1.6	2
8.00E+02	6.04E+02	1.7	2.2	5.98E+02	1.7	2.2	6.03E+02	1.6	2.1	6.00E+02	1.6	2.2
1.00E+03	5.97E+02	1.7	2.3	5.81E+02	1.7	2.2	5.93E+02	1.7	2.3	5.82E+02	1.6	2.3
1.50E+03	6.29E+02	1.8	2.4	6.14E+02	1.8	2.3	6.30E+02	1.7	2.3	6.34E+02	1.6	2.3
2.00E+03	6.39E+02	1.8	2.4	6.20E+02	1.8	2.4	6.39E+02	1.8	2.3	6.15E+02	1.7	2.4
3.00E+03	6.93E+02	1.8	2.4	6.72E+02	1.8	2.4	7.21E+02	1.8	2.4	6.72E+02	1.8	2.5
4.00E+03	7.37E+02	1.9	2.5	7.12E+02	1.9	2.6	7.43E+02	1.9	2.5	7.03E+02	1.9	2.8
5.00E+03	7.58E+02	1.9	2.5	7.30E+02	1.9	2.5	7.49E+02	1.9	2.5	7.31E+02	2	2.8
6.00E+03	8.36E+02	1.9	2.5	8.02E+02	1.9	2.5	8.46E+02	1.9	2.5	7.73E+02	1.9	2.7
8.00E+03	9.12E+02	1.8	2.4	8.72E+02	1.8	2.5	9.04E+02	1.9	2.5	8.55E+02	1.9	2.7
1.00E+04	9.68E+02	1.8	2.4	9.03E+02	1.8	2.4	9.24E+02	1.8	2.4	8.69E+02	1.9	2.5
2.00E+04	1.14E+03	1.7	2.2	1.07E+03	1.7	2.2	1.18E+03	1.8	2.4	1.07E+03	1.9	2.4
5.00E+04	1.60E+03	1.6	2.1	1.43E+03	1.6	2.1	1.59E+03	1.6	2.3	1.30E+03	1.5	2.1
1.00E+05	2.23E+03	1.5	2	1.93E+03	1.5	2	2.30E+03	1.5	2.1	1.61E+03	1.5	2

	Thyroid						Urinary bladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	3.00E-03	1	1	2.90E-03	1	1	3.70E-03	1	1

(continued on next page)

Table A.1. (*continued*)

	Thyroid						Urinary bladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.50E+01	2.70E-03	1	1	1.85E-02	1.8	1.8	4.90E-03	1	1	9.20E-03	1	1
2.00E+01	4.36E-02	2.6	3.5	2.50E-02	2.1	2.4	1.70E-02	1.8	1.8	1.50E-02	1.7	1.7
3.00E+01	2.29E-01	4.1	7.1	3.78E-02	2.5	3.2	4.29E-02	2.6	3.5	1.30E+00	3.5	5.7
4.00E+01	4.93E+01	2.5	4	8.07E+01	2.5	4	8.80E-02	3.2	5	1.04E+02	2.3	3.6
5.00E+01	2.69E+02	1.9	3	3.71E+02	1.8	2.8	1.99E-01	3.9	6.8	2.36E+02	1.6	2.4
6.00E+01	5.47E+02	1.6	2.3	6.29E+02	1.5	2.2	6.61E-01	3	7.1	3.10E+02	1.4	2
8.00E+01	6.82E+02	1.4	1.6	6.44E+02	1.3	1.6	1.72E+02	1.6	2.3	3.70E+02	1.4	1.7
1.00E+02	6.42E+02	1.2	1.6	5.97E+02	1.3	1.5	3.05E+02	1.4	1.9	4.72E+02	1.3	1.6
1.50E+02	9.06E+02	1.2	1.5	9.67E+02	1.3	1.5	7.69E+02	1.3	1.6	7.40E+02	1.3	1.6
2.00E+02	9.26E+02	1.2	1.4	1.00E+03	1.2	1.5	9.30E+02	1.3	1.5	9.59E+02	1.2	1.5
3.00E+02	7.06E+02	1.6	1.6	7.13E+02	1.3	1.5	7.30E+02	1.4	1.5	7.13E+02	1.3	1.6
4.00E+02	6.16E+02	1.4	1.7	6.08E+02	1.3	1.6	6.36E+02	1.5	1.7	6.27E+02	1.4	1.7
5.00E+02	5.75E+02	1.5	1.9	5.73E+02	1.4	1.8	6.14E+02	1.5	1.8	5.96E+02	1.6	1.8
6.00E+02	6.03E+02	1.6	2	5.51E+02	1.4	2	6.08E+02	1.6	2.1	5.88E+02	1.8	2
8.00E+02	5.76E+02	1.6	2.2	5.74E+02	1.6	2.2	6.09E+02	1.6	2.1	5.93E+02	1.8	2.1
1.00E+03	5.64E+02	1.7	2.4	5.53E+02	1.6	2.4	5.94E+02	1.6	2.2	5.85E+02	1.8	2.2
1.50E+03	5.57E+02	1.7	2.4	5.79E+02	1.7	2.4	6.74E+02	1.8	2.3	6.31E+02	1.8	2.3
2.00E+03	5.95E+02	1.8	2.4	5.96E+02	1.8	2.4	6.48E+02	1.8	2.4	6.12E+02	1.8	2.4
3.00E+03	6.28E+02	1.9	2.5	6.07E+02	1.8	2.5	7.00E+02	1.8	2.4	6.79E+02	1.8	2.4
4.00E+03	6.39E+02	1.9	2.7	6.50E+02	1.9	2.7	7.77E+02	1.8	2.5	7.03E+02	1.9	2.5
5.00E+03	6.99E+02	1.9	2.8	6.74E+02	1.9	2.8	7.51E+02	1.8	2.6	7.36E+02	1.9	2.5
6.00E+03	7.27E+02	1.8	2.7	7.28E+02	1.8	2.8	8.63E+02	1.9	2.6	8.26E+02	1.9	2.5
8.00E+03	8.33E+02	1.8	2.7	7.60E+02	1.7	2.7	9.46E+02	2	2.5	8.96E+02	1.8	2.5
1.00E+04	8.20E+02	1.7	2.4	7.78E+02	1.6	2.4	1.02E+03	2	2.4	9.33E+02	1.8	2.4
2.00E+04	1.03E+03	1.5	2.2	8.80E+02	1.6	2.2	1.28E+03	1.6	2.1	1.20E+03	1.7	2.3
5.00E+04	1.31E+03	1.4	2	1.22E+03	1.5	2.1	1.84E+03	1.6	2.1	1.73E+03	1.7	1.9
1.00E+05	2.14E+03	1.3	1.9	1.43E+03	1.5	2	2.67E+03	1.5	2	2.20E+03	1.4	1.9

	Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.14E-01	3.2	5.3	1.80E-01	3.9	6.6	2.50E-03	1	1	3.00E-03	1	1
1.50E+01	1.52E+00	2.6	4.2	3.43E-01	4.4	7.9	8.70E-03	1	1	1.00E-02	1.3	1.3
2.00E+01	2.99E+00	2.5	3.9	7.17E-01	2.5	4	1.37E-02	1.6	1.6	1.95E-02	1.9	1.9
3.00E+01	1.81E+01	2.6	4.1	1.62E+01	2.6	4.2	5.32E-02	2.8	4	4.67E-02	2.7	3.7
4.00E+01	1.15E+02	2.1	3.1	1.08E+02	2	3.1	1.37E+00	3.4	5.6	4.65E+00	3.2	5.3
5.00E+01	2.68E+02	1.7	2.5	2.40E+02	1.7	2.5	4.70E+01	2.3	3.8	9.69E+01	2.1	3.5
6.00E+01	4.04E+02	1.5	2.2	3.75E+02	1.6	2.2	1.96E+02	1.8	2.8	2.93E+02	1.7	2.6
8.00E+01	6.64E+02	1.4	1.8	6.51E+02	1.4	1.9	6.00E+02	1.5	2	7.15E+02	1.4	2
1.00E+02	8.45E+02	1.3	1.7	8.44E+02	1.4	1.7	9.60E+02	1.4	1.8	1.06E+03	1.4	1.7
1.50E+02	9.63E+02	1.3	1.5	1.00E+03	1.3	1.5	1.21E+03	1.2	1.4	1.19E+03	1.2	1.4
2.00E+02	8.69E+02	1.3	1.5	8.76E+02	1.3	1.5	8.87E+02	1.2	1.4	8.70E+02	1.3	1.4
3.00E+02	6.91E+02	1.4	1.6	6.91E+02	1.4	1.6	6.95E+02	1.4	1.6	6.90E+02	1.4	1.6
4.00E+02	6.10E+02	1.4	1.8	6.11E+02	1.5	1.8	6.15E+02	1.4	1.8	6.11E+02	1.4	1.7
5.00E+02	5.74E+02	1.5	1.9	5.72E+02	1.5	1.9	5.76E+02	1.5	1.9	5.75E+02	1.6	1.9
6.00E+02	5.70E+02	1.6	2	5.68E+02	1.6	2	5.72E+02	1.6	2	5.65E+02	1.6	2
8.00E+02	5.64E+02	1.7	2.2	5.63E+02	1.6	2.2	5.57E+02	1.6	2.1	5.59E+02	1.7	2.1
1.00E+03	5.53E+02	1.7	2.3	5.51E+02	1.7	2.2	5.49E+02	1.7	2.2	5.39E+02	1.7	2.2
1.50E+03	5.78E+02	1.8	2.4	5.76E+02	1.8	2.4	5.78E+02	1.8	2.3	5.67E+02	1.8	2.4
2.00E+03	5.79E+02	1.8	2.4	5.77E+02	1.8	2.4	5.64E+02	1.8	2.4	5.55E+02	1.8	2.4
3.00E+03	6.24E+02	1.8	2.4	6.16E+02	1.8	2.4	6.13E+02	1.8	2.4	5.94E+02	1.8	2.4

Table A.1. (*continued*)

	Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
4.00E+03	6.60E+02	1.9	2.6	6.52E+02	1.9	2.6	6.44E+02	1.9	2.6	6.26E+02	1.9	2.5
5.00E+03	6.69E+02	1.9	2.6	6.57E+02	1.9	2.6	6.49E+02	1.9	2.6	6.22E+02	1.9	2.6
6.00E+03	7.29E+02	1.9	2.5	7.18E+02	1.9	2.6	7.10E+02	1.9	2.5	6.85E+02	1.9	2.5
8.00E+03	7.96E+02	1.9	2.5	7.85E+02	1.9	2.5	7.56E+02	1.8	2.5	7.37E+02	1.9	2.4
1.00E+04	8.22E+02	1.8	2.5	8.05E+02	1.8	2.4	7.83E+02	1.8	2.4	7.53E+02	1.8	2.4
2.00E+04	9.63E+02	1.8	2.3	9.22E+02	1.7	2.3	8.81E+02	1.7	2.3	7.94E+02	1.7	2.3
5.00E+04	1.31E+03	1.6	2.1	1.26E+03	1.6	2.1	1.12E+03	1.6	2.2	1.05E+03	1.6	2.2
1.00E+05	1.83E+03	1.5	2	1.70E+03	1.5	2	1.47E+03	1.6	2	1.36E+03	1.6	2

	Salivary glands						Skin					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.59E+02	14.9	26.6	1.93E+02	14.9	26.6
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	2.38E+02	11.8	21	2.89E+02	11.8	21
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.17E+02	9.8	17.2	3.85E+02	9.8	17.2
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.74E+02	7.3	12.7	5.75E+02	7.3	12.7
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.29E+02	5.8	10.1	7.62E+02	5.8	10
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.81E+02	4.8	8.4	9.44E+02	4.8	8.4
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.31E+02	4.2	7.2	1.12E+03	4.2	7.2
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.22E+03	3.4	5.7	1.46E+03	3.4	5.7
1.00E+01	8.19E-01	4	6.7	3.90E-03	1	1	1.49E+03	2.9	4.8	1.78E+03	2.9	4.7
1.50E+01	4.33E+00	4.8	8.3	2.81E-02	2.2	2.6	2.02E+03	2	3.1	2.14E+03	1.8	2.7
2.00E+01	3.51E+01	3	4.9	1.05E+00	4.9	8.2	1.82E+03	1.5	2	1.87E+03	1.4	1.9
3.00E+01	2.42E+02	2.2	3.4	7.39E+01	2.6	4.1	1.43E+03	1.3	1.5	1.42E+03	1.3	1.5
4.00E+01	5.39E+02	1.8	2.5	2.75E+02	1.9	2.8	1.18E+03	1.2	1.4	1.17E+03	1.2	1.4
5.00E+01	7.52E+02	1.5	2.1	4.89E+02	1.6	2.4	1.03E+03	1.2	1.4	1.03E+03	1.2	1.4
6.00E+01	8.32E+02	1.4	1.8	6.60E+02	1.5	2	9.40E+02	1.2	1.4	9.47E+02	1.2	1.4
8.00E+01	8.41E+02	1.3	1.6	7.73E+02	1.3	1.6	8.56E+02	1.2	1.4	8.68E+02	1.2	1.4
1.00E+02	8.15E+02	1.3	1.5	8.27E+02	1.3	1.6	8.55E+02	1.2	1.4	8.67E+02	1.2	1.4
1.50E+02	1.04E+03	1.3	1.5	1.07E+03	1.3	1.5	8.53E+02	1.2	1.4	8.80E+02	1.2	1.4
2.00E+02	8.81E+02	1.2	1.5	8.96E+02	1.2	1.5	8.05E+02	1.3	1.4	8.18E+02	1.2	1.4
3.00E+02	6.86E+02	1.3	1.6	6.90E+02	1.3	1.6	6.63E+02	1.3	1.6	6.62E+02	1.3	1.5
4.00E+02	6.09E+02	1.4	1.7	6.10E+02	1.5	1.6	5.81E+02	1.4	1.7	5.80E+02	1.4	1.7
5.00E+02	5.70E+02	1.5	1.7	5.79E+02	1.5	1.7	5.39E+02	1.5	1.9	5.38E+02	1.5	1.9
6.00E+02	5.58E+02	1.7	2.1	5.52E+02	1.5	2.1	5.28E+02	1.6	2	5.26E+02	1.6	2
8.00E+02	5.63E+02	1.7	2.2	5.92E+02	1.6	2.2	5.15E+02	1.7	2.1	5.12E+02	1.7	2.1
1.00E+03	5.35E+02	1.7	2.3	5.32E+02	1.6	2.3	4.98E+02	1.7	2.2	4.92E+02	1.7	2.2
1.50E+03	5.61E+02	1.8	2.4	5.55E+02	1.6	2.4	5.11E+02	1.7	2.3	5.05E+02	1.7	2.3
2.00E+03	5.53E+02	1.8	2.4	5.52E+02	1.7	2.4	5.06E+02	1.7	2.4	4.98E+02	1.7	2.4
3.00E+03	5.95E+02	1.9	2.4	5.95E+02	1.7	2.4	5.40E+02	1.7	2.4	5.29E+02	1.7	2.4
4.00E+03	6.32E+02	1.9	2.5	6.45E+02	1.9	2.5	5.77E+02	1.9	2.6	5.66E+02	1.9	2.5
5.00E+03	6.31E+02	1.9	2.5	6.55E+02	2	2.5	5.79E+02	1.9	2.5	5.67E+02	1.9	2.5
6.00E+03	6.88E+02	1.9	2.4	6.94E+02	1.9	2.4	6.35E+02	1.9	2.5	6.19E+02	1.9	2.5
8.00E+03	7.43E+02	1.9	2.4	7.61E+02	1.8	2.4	6.79E+02	1.9	2.4	6.62E+02	1.9	2.4
1.00E+04	7.77E+02	1.9	2.4	7.50E+02	1.8	2.4	6.95E+02	1.9	2.4	6.72E+02	1.8	2.4
2.00E+04	9.08E+02	1.8	2.3	8.93E+02	1.7	2.3	8.06E+02	1.7	2.3	7.69E+02	1.7	2.3
5.00E+04	1.10E+03	1.7	2.2	1.07E+03	1.6	2.2	1.10E+03	1.6	2.1	1.02E+03	1.6	2.1
1.00E+05	1.46E+03	1.4	2	1.42E+03	1.5	2	1.50E+03	1.5	1.9	1.35E+03	1.5	2

	Remainder tissues						Adrenals					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

(*continued on next page*)

Table A.1. (*continued*)

	Remainder tissues						Adrenals					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.30E+00	3.1	5.2	3.63E-01	3.3	5.3	2.00E-03	1	1	1.20E-03	1	1
1.50E+01	4.52E+00	2.8	4.5	8.22E-01	2.8	4.4	5.80E-03	1	1	5.20E-03	1	1
2.00E+01	9.67E+00	2.4	3.8	1.48E+00	2.5	4	1.53E-02	1.7	1.7	1.33E-02	1.6	1.6
3.00E+01	3.01E+01	2.1	3.1	9.51E+00	2.4	3.8	5.04E-02	2.7	3.9	5.03E-02	2.7	3.9
4.00E+01	6.68E+01	1.8	2.5	3.85E+01	1.9	2.8	1.09E-01	3.4	5.5	9.16E-02	3.3	5.1
5.00E+01	1.03E+02	1.6	2.3	7.33E+01	1.7	2.4	2.56E-01	4.2	7.3	2.24E-01	4.1	7
6.00E+01	1.42E+02	1.5	2.1	1.18E+02	1.6	2.3	6.46E-01	2.5	5.8	3.82E-01	4.5	8.2
8.00E+01	2.73E+02	1.5	2	2.64E+02	1.5	2	5.47E+01	2	3.5	1.04E+01	2.8	4.5
1.00E+02	4.62E+02	1.4	1.8	5.12E+02	1.4	1.9	3.69E+02	1.5	2.1	2.02E+02	1.6	2.5
1.50E+02	9.03E+02	1.3	1.6	9.68E+02	1.3	1.5	7.15E+02	1.4	1.6	9.64E+02	1.3	1.5
2.00E+02	9.21E+02	1.3	1.5	9.32E+02	1.3	1.5	1.00E+03	1.2	1.5	9.77E+02	1.2	1.5
3.00E+02	7.19E+02	1.3	1.6	7.18E+02	1.4	1.6	7.30E+02	1.4	1.6	7.47E+02	1.5	1.6
4.00E+02	6.31E+02	1.5	1.7	6.35E+02	1.5	1.7	6.37E+02	1.5	1.8	6.56E+02	1.5	1.8
5.00E+02	5.98E+02	1.5	1.9	5.94E+02	1.5	1.9	6.22E+02	1.5	1.9	6.35E+02	1.5	1.9
6.00E+02	5.94E+02	1.6	2	5.93E+02	1.6	2	6.12E+02	1.5	2	5.90E+02	1.7	2
8.00E+02	5.93E+02	1.6	2.1	5.90E+02	1.6	2.1	6.13E+02	1.6	2.1	6.19E+02	1.7	2.1
1.00E+03	5.87E+02	1.7	2.2	5.81E+02	1.7	2.3	6.06E+02	1.6	2.1	6.01E+02	1.8	2.1
1.50E+03	6.13E+02	1.7	2.3	6.11E+02	1.7	2.3	6.47E+02	1.6	2.1	6.46E+02	1.9	2.1
2.00E+03	6.26E+02	1.8	2.4	6.19E+02	1.8	2.4	6.39E+02	1.8	2.2	6.53E+02	1.9	2.2
3.00E+03	6.78E+02	1.8	2.4	6.63E+02	1.8	2.4	7.02E+02	1.9	2.2	7.01E+02	1.9	2.3
4.00E+03	7.18E+02	1.9	2.5	7.08E+02	1.9	2.5	7.42E+02	1.9	2.2	7.63E+02	1.9	2.3
5.00E+03	7.38E+02	1.9	2.5	7.25E+02	1.9	2.5	7.59E+02	1.9	2.5	7.87E+02	2	2.5
6.00E+03	8.14E+02	1.9	2.5	7.94E+02	1.9	2.5	8.74E+02	1.8	2.5	8.68E+02	2	2.5
8.00E+03	8.87E+02	1.9	2.5	8.74E+02	1.9	2.5	9.36E+02	1.7	2.3	9.24E+02	2	2.4
1.00E+04	9.37E+02	1.8	2.4	9.05E+02	1.8	2.4	9.78E+02	1.7	2.3	9.75E+02	1.8	2.4
2.00E+04	1.11E+03	1.8	2.3	1.06E+03	1.7	2.3	1.14E+03	1.7	2.1	1.16E+03	1.6	2.2
5.00E+04	1.58E+03	1.6	2.1	1.47E+03	1.6	2.1	1.68E+03	1.6	2	1.90E+03	1.6	2
1.00E+05	2.21E+03	1.5	2	2.00E+03	1.5	2	2.57E+03	1.5	1.9	2.53E+03	1.5	1.9

	Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.61E+01	3.1	5.2	4.44E+00	3.3	5.3	3.00E-03	1	1	5.00E-03	1	1
1.50E+01	4.90E+01	2.7	4.3	9.25E+00	2.6	4	1.27E-02	1.5	1.5	1.14E-02	1.4	1.4
2.00E+01	9.15E+01	2.3	3.6	1.44E+01	2.3	3.7	2.32E-02	2	2.2	1.58E-02	1.7	1.7
3.00E+01	2.34E+02	2	2.9	7.08E+01	2.3	3.6	4.84E-02	2.7	3.8	7.40E-02	3.1	4.7
4.00E+01	4.14E+02	1.6	2.3	1.97E+02	1.8	2.5	1.11E-01	3.4	5.5	1.01E-01	3.3	5.3
5.00E+01	5.30E+02	1.5	2	3.00E+02	1.6	2.2	3.60E-01	4.5	8	2.93E-01	4.3	7.6
6.00E+01	5.91E+02	1.4	1.9	3.42E+02	1.4	1.9	8.85E+00	2.5	4	4.01E-01	4.6	8.3
8.00E+01	7.04E+02	1.4	1.8	4.55E+02	1.4	1.8	8.72E+01	1.7	2.5	8.89E+00	2.3	3.9
1.00E+02	8.90E+02	1.4	1.7	9.56E+02	1.4	1.7	2.41E+02	1.5	1.9	2.30E+02	1.7	2.6
1.50E+02	1.09E+03	1.3	1.4	1.08E+03	1.2	1.4	8.39E+02	1.4	1.6	9.79E+02	1.3	1.6
2.00E+02	8.56E+02	1.3	1.5	8.99E+02	1.3	1.5	9.36E+02	1.4	1.5	9.42E+02	1.3	1.5
3.00E+02	6.77E+02	1.3	1.6	6.95E+02	1.3	1.6	7.36E+02	1.3	1.6	7.29E+02	1.4	1.6
4.00E+02	6.16E+02	1.4	1.8	6.14E+02	1.4	1.9	6.48E+02	1.4	1.7	6.55E+02	1.4	1.7
5.00E+02	5.85E+02	1.5	1.9	5.57E+02	1.6	1.9	6.04E+02	1.5	1.8	6.15E+02	1.6	1.8
6.00E+02	5.66E+02	1.6	2	5.86E+02	1.7	2	5.99E+02	1.5	2	6.06E+02	1.6	2

Table A.1. (*continued*)

	Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+02	5.49E+02	1.7	2.2	5.62E+02	1.7	2.2	6.22E+02	1.5	2.3	6.03E+02	1.6	2.3
1.00E+03	5.44E+02	1.8	2.3	5.43E+02	1.7	2.3	5.92E+02	1.6	2.3	6.10E+02	1.6	2.4
1.50E+03	5.51E+02	1.8	2.4	5.50E+02	1.8	2.4	6.16E+02	1.8	2.4	6.41E+02	1.8	2.4
2.00E+03	5.66E+02	1.8	2.5	5.66E+02	1.8	2.5	6.84E+02	1.9	2.4	6.66E+02	1.8	2.4
3.00E+03	6.01E+02	1.8	2.6	5.99E+02	1.8	2.6	6.90E+02	1.9	2.4	6.88E+02	1.9	2.4
4.00E+03	6.34E+02	1.8	2.6	6.31E+02	1.8	2.6	7.56E+02	1.9	2.4	7.52E+02	2	2.4
5.00E+03	6.64E+02	1.9	2.7	6.49E+02	1.9	2.7	7.90E+02	1.9	2.4	8.18E+02	2	2.4
6.00E+03	6.90E+02	1.9	2.6	6.99E+02	2	2.6	8.63E+02	2	2.5	8.38E+02	2	2.5
8.00E+03	7.36E+02	1.9	2.5	7.66E+02	2	2.5	9.33E+02	2	2.5	9.15E+02	2	2.5
1.00E+04	7.73E+02	1.8	2.4	7.51E+02	2	2.4	1.00E+03	2	2.6	1.01E+03	2	2.6
2.00E+04	8.39E+02	1.8	2.2	8.83E+02	2	2.2	1.19E+03	1.8	2.4	1.20E+03	1.8	2.4
5.00E+04	1.15E+03	1.6	2.1	1.19E+03	1.6	2.1	1.58E+03	1.6	2.1	1.44E+03	1.7	2.1
1.00E+05	1.47E+03	1.6	1.9	1.59E+03	1.5	1.9	2.35E+03	1.5	2	2.05E+03	1.3	2

	Heart wall						Kidneys					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.10E-03	1	1	2.30E-03	1	1	2.10E-03	1	1	2.10E-03	1	1
1.50E+01	6.30E-03	1	1	8.20E-03	1	1	1.15E-02	1.4	1.4	7.00E-03	1	1
2.00E+01	1.49E-02	1.7	1.7	1.82E-02	1.8	1.8	1.66E-02	1.7	1.7	2.06E-02	1.9	2
3.00E+01	4.21E-02	2.6	3.5	4.76E-02	2.7	3.7	4.07E-02	2.5	3.4	4.19E-02	2.6	3.5
4.00E+01	9.99E-02	3.3	5.3	9.81E-02	3.3	5.3	9.05E-02	3.3	5.1	1.03E-01	3.4	5.4
5.00E+01	2.69E-01	4.2	7.4	1.33E+00	3.5	5.5	2.00E-01	4	6.8	2.13E-01	4	6.9
6.00E+01	1.17E+01	2.5	4.3	2.75E+01	2.2	3.5	4.02E-01	4.6	8.3	3.78E-01	4.5	8.1
8.00E+01	1.79E+02	1.6	2.3	2.25E+02	1.6	2.2	6.56E+01	2	3.2	6.20E+01	1.9	3
1.00E+02	3.65E+02	1.4	1.9	5.19E+02	1.4	1.9	3.79E+02	1.5	2.1	4.05E+02	1.6	2.2
1.50E+02	9.40E+02	1.3	1.6	1.05E+03	1.3	1.5	7.81E+02	1.3	1.6	9.00E+02	1.3	1.5
2.00E+02	9.55E+02	1.3	1.5	9.40E+02	1.2	1.4	9.28E+02	1.3	1.5	9.13E+02	1.3	1.5
3.00E+02	7.21E+02	1.4	1.6	7.19E+02	1.4	1.6	7.30E+02	1.3	1.6	7.23E+02	1.4	1.6
4.00E+02	6.37E+02	1.4	1.7	6.33E+02	1.5	1.8	6.31E+02	1.4	1.7	6.45E+02	1.5	1.8
5.00E+02	6.02E+02	1.6	1.9	5.90E+02	1.5	1.9	6.04E+02	1.6	1.9	5.96E+02	1.5	1.9
6.00E+02	6.02E+02	1.6	1.9	5.89E+02	1.6	2	6.11E+02	1.6	1.9	5.90E+02	1.6	2
8.00E+02	6.05E+02	1.7	2.2	5.85E+02	1.6	2.1	6.07E+02	1.7	2.2	6.00E+02	1.6	2.1
1.00E+03	5.94E+02	1.7	2.2	5.85E+02	1.7	2.2	6.06E+02	1.7	2.2	5.92E+02	1.7	2.2
1.50E+03	6.16E+02	1.7	2.3	6.11E+02	1.7	2.3	6.35E+02	1.7	2.3	6.31E+02	1.7	2.3
2.00E+03	6.39E+02	1.8	2.3	6.17E+02	1.8	2.3	6.54E+02	1.7	2.4	6.36E+02	1.8	2.3
3.00E+03	6.82E+02	1.8	2.4	6.56E+02	1.8	2.3	7.09E+02	1.8	2.4	6.86E+02	1.8	2.4
4.00E+03	7.43E+02	2	2.5	6.98E+02	1.9	2.5	7.50E+02	1.8	2.6	7.37E+02	1.9	2.6
5.00E+03	7.53E+02	1.9	2.5	7.19E+02	1.9	2.6	7.62E+02	1.9	2.5	7.60E+02	1.9	2.6
6.00E+03	8.29E+02	1.9	2.5	7.74E+02	1.9	2.5	8.60E+02	1.9	2.5	8.34E+02	2	2.4
8.00E+03	8.99E+02	1.8	2.4	8.55E+02	1.8	2.4	9.44E+02	1.9	2.5	9.16E+02	1.9	2.4
1.00E+04	9.43E+02	1.7	2.4	8.77E+02	1.8	2.3	1.00E+03	1.8	2.4	9.46E+02	1.9	2.4
2.00E+04	1.13E+03	1.7	2.2	1.02E+03	1.7	2.3	1.19E+03	1.6	2.3	1.12E+03	1.7	2.2
5.00E+04	1.52E+03	1.6	2	1.40E+03	1.5	2.1	1.78E+03	1.6	2.1	1.57E+03	1.6	2.1
1.00E+05	2.30E+03	1.5	2	1.84E+03	1.5	2	2.48E+03	1.5	2	2.23E+03	1.5	2

(continued on next page)

Table A.1. (*continued*)

	Lymphatic nodes						Muscle					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.08E+00	3.6	6	6.90E-03	1	1	1.73E+00	3.2	5.3	1.45E-01	3.7	6.1
1.50E+01	6.26E+00	3.6	6.1	4.84E-02	2.7	3.8	3.40E+00	2.8	4.6	3.44E-01	4.4	7.9
2.00E+01	2.52E+01	2.7	4.4	3.47E-01	4.4	8	8.84E+00	2.6	4.2	1.26E+00	2.7	5.3
3.00E+01	9.40E+01	2	3	8.78E+00	2.8	4.6	5.49E+01	2.3	3.6	1.67E+01	2.4	3.8
4.00E+01	1.69E+02	1.7	2.3	9.99E+01	2.1	3.1	1.78E+02	1.9	2.7	7.17E+01	2	3
5.00E+01	2.28E+02	1.5	2.1	1.88E+02	1.6	2.3	3.31E+02	1.6	2.4	1.93E+02	1.8	2.7
6.00E+01	2.57E+02	1.4	1.8	2.39E+02	1.5	2	4.79E+02	1.5	2.1	3.57E+02	1.6	2.3
8.00E+01	3.38E+02	1.4	1.7	3.41E+02	1.4	1.8	6.94E+02	1.4	1.8	6.41E+02	1.4	1.9
1.00E+02	4.71E+02	1.4	1.7	5.25E+02	1.4	1.8	8.10E+02	1.3	1.6	8.16E+02	1.3	1.6
1.50E+02	8.70E+02	1.3	1.6	9.57E+02	1.3	1.5	9.10E+02	1.2	1.5	9.57E+02	1.2	1.5
2.00E+02	9.12E+02	1.2	1.5	9.24E+02	1.2	1.4	8.57E+02	1.3	1.5	8.80E+02	1.3	1.5
3.00E+02	7.19E+02	1.4	1.6	7.14E+02	1.3	1.5	6.97E+02	1.4	1.6	6.99E+02	1.4	1.6
4.00E+02	6.31E+02	1.4	1.7	6.24E+02	1.4	1.7	6.15E+02	1.4	1.7	6.18E+02	1.4	1.7
5.00E+02	5.92E+02	1.5	1.8	5.92E+02	1.4	1.9	5.78E+02	1.5	1.9	5.79E+02	1.5	1.9
6.00E+02	5.86E+02	1.5	2	5.86E+02	1.6	2	5.72E+02	1.6	2	5.74E+02	1.6	2
8.00E+02	5.90E+02	1.6	2.1	5.85E+02	1.6	2.1	5.70E+02	1.7	2.1	5.71E+02	1.7	2.2
1.00E+03	5.88E+02	1.7	2.2	5.77E+02	1.7	2.2	5.56E+02	1.7	2.2	5.57E+02	1.7	2.3
1.50E+03	6.14E+02	1.7	2.4	6.11E+02	1.7	2.2	5.83E+02	1.8	2.3	5.83E+02	1.7	2.3
2.00E+03	6.22E+02	1.7	2.4	6.12E+02	1.8	2.4	5.84E+02	1.8	2.4	5.84E+02	1.8	2.4
3.00E+03	6.80E+02	1.8	2.4	6.56E+02	1.9	2.4	6.30E+02	1.8	2.4	6.28E+02	1.8	2.4
4.00E+03	7.18E+02	1.9	2.4	7.05E+02	1.9	2.4	6.72E+02	1.9	2.6	6.69E+02	1.9	2.6
5.00E+03	7.36E+02	1.9	2.5	7.15E+02	2	2.5	6.80E+02	1.9	2.5	6.77E+02	1.9	2.5
6.00E+03	8.16E+02	1.9	2.6	7.88E+02	1.8	2.6	7.50E+02	1.9	2.5	7.42E+02	1.9	2.5
8.00E+03	8.91E+02	1.9	2.6	8.53E+02	1.8	2.5	8.15E+02	1.8	2.5	8.07E+02	1.9	2.5
1.00E+04	9.27E+02	1.8	2.4	8.90E+02	1.8	2.4	8.42E+02	1.8	2.4	8.31E+02	1.8	2.4
2.00E+04	1.12E+03	1.8	2.3	1.05E+03	1.7	2.3	9.90E+02	1.7	2.3	9.57E+02	1.7	2.3
5.00E+04	1.57E+03	1.7	2.1	1.46E+03	1.6	2.1	1.39E+03	1.6	2.1	1.33E+03	1.6	2.1
1.00E+05	2.18E+03	1.5	2	1.99E+03	1.6	2	1.94E+03	1.5	2	1.80E+03	1.5	2

	Oral mucosa						Pancreas					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.90E-03	1	1	9.95E-02	3.3	5.3	3.70E-03	1	1	2.30E-03	1	1
1.50E+01	1.48E-02	1.6	1.6	9.66E-01	4.4	6.8	6.40E-03	1	1	8.70E-03	1	1
2.00E+01	1.65E-02	1.7	1.7	3.11E+00	2.7	4.5	1.77E-02	1.8	1.8	1.31E-02	1.5	1.5
3.00E+01	5.96E+00	3.2	5	2.59E+01	2.4	3.9	4.00E-02	2.5	3.4	3.36E-02	2.4	3
4.00E+01	5.96E+01	2	3	1.05E+02	1.8	2.7	7.46E-02	3.1	4.7	8.99E-02	3.2	5.1
5.00E+01	9.63E+01	1.6	2.3	1.61E+02	1.7	2.3	1.93E-01	3.9	6.7	2.11E-01	4	6.9
6.00E+01	1.40E+02	1.6	2.2	2.60E+02	1.6	2.2	3.52E-01	4.5	8	4.30E-01	4.6	8.4
8.00E+01	4.64E+02	1.5	2.1	6.32E+02	1.5	2.1	8.19E-01	6.2	7.5	1.75E+01	2.4	7.5
1.00E+02	9.61E+02	1.4	1.8	9.42E+02	1.3	1.8	1.12E+01	2.8	3.6	3.35E+02	1.6	3.6
1.50E+02	1.08E+03	1.3	1.5	1.03E+03	1.2	1.5	9.19E+02	1.4	1.6	9.21E+02	1.3	1.6
2.00E+02	8.62E+02	1.3	1.5	9.21E+02	1.3	1.5	9.55E+02	1.3	1.5	9.33E+02	1.3	1.5

Table A.1. (*continued*)

	Oral mucosa						Pancreas					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+02	6.97E+02	1.3	1.5	6.89E+02	1.3	1.5	7.45E+02	1.3	1.5	7.28E+02	1.4	1.5
4.00E+02	6.17E+02	1.5	1.5	6.07E+02	1.4	1.5	6.53E+02	1.5	1.7	6.45E+02	1.5	1.7
5.00E+02	5.77E+02	1.5	1.8	5.82E+02	1.6	1.8	6.15E+02	1.6	1.8	6.02E+02	1.6	1.8
6.00E+02	5.78E+02	1.6	1.9	5.79E+02	1.6	1.9	6.12E+02	1.6	2	6.07E+02	1.6	2
8.00E+02	5.73E+02	1.6	2.1	5.76E+02	1.6	2.1	6.30E+02	1.7	2.1	6.20E+02	1.7	2.1
1.00E+03	5.48E+02	1.6	2.2	5.53E+02	1.7	2.2	6.25E+02	1.7	2.2	5.99E+02	1.7	2.2
1.50E+03	5.72E+02	1.7	2.3	5.51E+02	1.7	2.3	6.47E+02	1.7	2.3	6.33E+02	1.7	2.3
2.00E+03	5.82E+02	1.8	2.3	5.68E+02	1.8	2.3	6.62E+02	1.7	2.4	6.43E+02	1.8	2.4
3.00E+03	6.13E+02	1.8	2.3	6.08E+02	1.8	2.3	7.32E+02	1.8	2.4	6.93E+02	1.8	2.4
4.00E+03	6.58E+02	1.9	2.4	6.61E+02	1.9	2.4	7.70E+02	1.8	2.5	7.30E+02	1.8	2.5
5.00E+03	6.34E+02	1.9	2.5	6.37E+02	1.9	2.5	7.85E+02	1.8	2.6	7.42E+02	1.8	2.6
6.00E+03	7.05E+02	1.9	2.5	6.77E+02	1.9	2.5	8.70E+02	1.9	2.6	8.30E+02	1.9	2.6
8.00E+03	7.71E+02	1.8	2.5	7.97E+02	1.9	2.5	9.71E+02	1.9	2.5	9.28E+02	1.9	2.5
1.00E+04	8.12E+02	1.8	2.4	7.79E+02	1.8	2.4	1.03E+03	1.8	2.4	9.59E+02	1.8	2.4
2.00E+04	9.33E+02	1.8	2.3	9.20E+02	1.8	2.3	1.27E+03	1.8	2.3	1.10E+03	1.7	2.3
5.00E+04	1.20E+03	1.6	2.1	1.21E+03	1.6	2.1	1.77E+03	1.6	2.1	1.55E+03	1.7	2.1
1.00E+05	1.62E+03	1.6	2	1.50E+03	1.5	2	2.58E+03	1.5	2	2.21E+03	1.5	2

	Prostate (male)/uterus (female)						Small intestine wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.90E-03	1	1	4.70E-03	1	1	2.00E-03	1	1	2.50E-03	1	1
1.50E+01	4.40E-03	1	1	1.03E-02	1.3	1.3	1.02E-02	1.3	1.3	1.00E-02	1.3	1.3
2.00E+01	1.44E-02	1.6	1.6	1.58E-02	1.7	1.7	1.63E-02	1.7	1.7	1.83E-02	1.8	1.8
3.00E+01	6.08E-02	2.9	4.3	3.87E-02	2.5	3.3	4.02E-02	2.5	3.4	4.38E-02	2.6	3.6
4.00E+01	8.46E-02	3.2	5	8.71E-02	3.2	5	1.01E-01	3.3	5.3	9.25E-02	3.3	5.1
5.00E+01	1.70E-01	3.8	6.4	1.70E-01	3.8	6.4	2.13E+00	2.8	4.9	2.59E-01	4.2	7.3
6.00E+01	3.63E-01	4.5	8	3.79E-01	4.5	8.1	1.82E+01	2.1	3.4	1.37E+01	2.4	4.1
8.00E+01	1.10E+00	6.2	7.1	3.14E+00	3.5	5.3	1.75E+02	1.6	2.3	1.97E+02	1.6	2.3
1.00E+02	2.94E+01	2.2	3.5	1.31E+02	1.7	2.6	3.63E+02	1.4	1.9	4.38E+02	1.4	1.9
1.50E+02	8.66E+02	1.3	1.6	8.48E+02	1.3	1.6	8.09E+02	1.3	1.6	8.63E+02	1.3	1.6
2.00E+02	9.77E+02	1.3	1.5	1.01E+03	1.2	1.4	8.93E+02	1.3	1.5	9.23E+02	1.3	1.5
3.00E+02	7.52E+02	1.3	1.5	7.30E+02	1.3	1.6	7.36E+02	1.3	1.6	7.29E+02	1.3	1.6
4.00E+02	6.27E+02	1.5	1.7	6.58E+02	1.4	1.8	6.37E+02	1.4	1.7	6.38E+02	1.4	1.8
5.00E+02	6.17E+02	1.5	1.8	5.98E+02	1.5	1.9	6.02E+02	1.5	1.9	5.96E+02	1.5	1.8
6.00E+02	5.97E+02	1.6	1.9	6.01E+02	1.5	2.1	6.03E+02	1.6	2	6.00E+02	1.6	2
8.00E+02	5.85E+02	1.6	2	6.10E+02	1.6	2.2	6.12E+02	1.7	2.2	6.03E+02	1.7	2.2
1.00E+03	6.25E+02	1.6	2.1	5.98E+02	1.6	2.3	6.00E+02	1.7	2.3	5.96E+02	1.7	2.2
1.50E+03	6.67E+02	1.7	2.2	6.74E+02	1.7	2.4	6.33E+02	1.8	2.3	6.30E+02	1.7	2.3
2.00E+03	6.50E+02	1.7	2.3	6.61E+02	1.7	2.4	6.46E+02	1.8	2.3	6.41E+02	1.8	2.3
3.00E+03	7.51E+02	1.9	2.5	6.93E+02	1.8	2.4	7.02E+02	1.8	2.3	6.90E+02	1.8	2.4
4.00E+03	7.42E+02	2	2.7	7.45E+02	1.8	2.7	7.55E+02	1.9	2.5	7.36E+02	1.9	2.5
5.00E+03	7.95E+02	1.9	2.7	7.85E+02	1.8	2.7	7.69E+02	1.9	2.5	7.46E+02	1.8	2.5
6.00E+03	8.69E+02	1.8	2.6	8.85E+02	1.9	2.5	8.59E+02	1.9	2.4	8.34E+02	1.8	2.4
8.00E+03	9.46E+02	1.8	2.4	9.68E+02	2	2.5	9.34E+02	1.8	2.4	9.18E+02	1.8	2.4
1.00E+04	1.08E+03	1.8	2.3	1.02E+03	1.9	2.3	9.77E+02	1.8	2.4	9.53E+02	1.9	2.4
2.00E+04	1.24E+03	1.8	2.1	1.20E+03	1.7	2.2	1.18E+03	1.8	2.3	1.16E+03	1.7	2.3
5.00E+04	2.11E+03	1.6	2.1	1.78E+03	1.7	2.1	1.71E+03	1.6	2.1	1.56E+03	1.6	2.1
1.00E+05	2.81E+03	1.5	2	2.35E+03	1.5	2	2.42E+03	1.5	2	2.21E+03	1.5	2

(*continued on next page*)

Table A.1. (*continued*)

	Spleen						Thymus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.60E-03	1	1	1.30E-03	1	1	2.20E-03	1	1	9.40E-03	1	1
1.50E+01	7.50E-03	1	1	7.10E-03	1	1	1.36E-02	1.6	1.6	1.28E-02	1.5	1.5
2.00E+01	1.90E-02	1.9	1.9	2.16E-02	2	2.1	2.35E-02	2.1	2.2	1.89E-02	1.9	1.9
3.00E+01	4.25E-02	2.6	3.5	4.67E-02	2.7	3.7	1.86E+00	4	6.4	1.06E+00	3.8	6.4
4.00E+01	1.14E-01	3.5	5.6	1.15E-01	3.5	5.6	4.73E+01	2.2	3.4	2.55E+01	2.3	3.6
5.00E+01	2.25E-01	4.1	7	2.33E-01	4.1	7.1	1.47E+02	1.8	2.9	1.08E+02	1.9	2.9
6.00E+01	4.38E+00	2.9	5.2	2.55E+01	2.6	4.5	3.32E+02	1.7	2.4	2.64E+02	1.7	2.6
8.00E+01	1.84E+02	1.7	2.5	3.36E+02	1.6	2.3	6.06E+02	1.4	1.8	5.08E+02	1.4	1.8
1.00E+02	5.01E+02	1.4	1.9	6.31E+02	1.4	1.8	6.15E+02	1.3	1.5	5.24E+02	1.3	1.6
1.50E+02	8.54E+02	1.3	1.6	9.19E+02	1.3	1.5	1.06E+03	1.3	1.6	1.11E+03	1.2	1.5
2.00E+02	9.21E+02	1.3	1.5	9.23E+02	1.3	1.5	9.27E+02	1.3	1.5	9.31E+02	1.2	1.5
3.00E+02	7.14E+02	1.3	1.5	7.12E+02	1.3	1.5	6.97E+02	1.3	1.7	7.16E+02	1.4	1.7
4.00E+02	6.34E+02	1.5	1.7	6.29E+02	1.4	1.7	6.14E+02	1.4	1.8	6.33E+02	1.5	1.8
5.00E+02	5.90E+02	1.4	1.8	5.87E+02	1.5	1.9	5.84E+02	1.6	1.9	5.93E+02	1.6	1.9
6.00E+02	6.06E+02	1.6	1.9	5.82E+02	1.6	1.9	5.82E+02	1.7	2	6.18E+02	1.6	2
8.00E+02	5.91E+02	1.7	2.1	5.77E+02	1.6	2.1	5.60E+02	1.8	2.1	5.58E+02	1.6	2.1
1.00E+03	5.86E+02	1.7	2.3	5.74E+02	1.7	2.3	5.62E+02	1.8	2.4	5.62E+02	1.6	2.4
1.50E+03	6.15E+02	1.8	2.4	6.08E+02	1.7	2.4	5.79E+02	1.8	2.4	5.75E+02	1.6	2.4
2.00E+03	6.21E+02	1.8	2.4	6.10E+02	1.7	2.4	5.90E+02	1.8	2.4	5.86E+02	1.7	2.4
3.00E+03	6.63E+02	1.8	2.4	6.71E+02	1.8	2.4	6.58E+02	1.8	2.4	6.47E+02	1.7	2.4
4.00E+03	7.09E+02	1.9	2.6	6.92E+02	1.8	2.6	6.88E+02	1.9	2.4	6.87E+02	1.9	2.4
5.00E+03	7.65E+02	1.9	2.5	7.18E+02	2	2.5	6.97E+02	1.9	2.4	6.68E+02	1.9	2.4
6.00E+03	8.19E+02	1.9	2.5	7.98E+02	1.9	2.5	7.77E+02	1.9	2.5	7.51E+02	1.9	2.5
8.00E+03	9.24E+02	1.9	2.4	8.73E+02	1.9	2.4	8.25E+02	1.9	2.6	8.41E+02	1.9	2.6
1.00E+04	9.47E+02	1.8	2.4	9.02E+02	1.7	2.4	8.74E+02	1.9	2.6	8.68E+02	1.8	2.6
2.00E+04	1.12E+03	1.7	2.3	1.04E+03	1.6	2.3	1.14E+03	1.8	2.4	9.61E+02	1.7	2.4
5.00E+04	1.80E+03	1.6	2.1	1.48E+03	1.6	2.1	1.31E+03	1.6	2.2	1.20E+03	1.6	2.2
1.00E+05	2.19E+03	1.4	2	2.24E+03	1.5	2	1.88E+03	1.4	2	1.50E+03	1.4	2

	Lens of the eye					
E	Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1
1.50E+00	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1
4.00E+00	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1
6.00E+00	0.00E+00	1	1	0.00E+00	1	1
8.00E+00	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1
1.50E+01	1.08E+02	7.2	12.5	1.08E+02	7.2	12.5
2.00E+01	1.66E+03	2.5	4.1	1.66E+03	2.5	4.1
3.00E+01	1.64E+03	1.4	1.8	1.64E+03	1.4	1.8
4.00E+01	1.30E+03	1.3	1.4	1.30E+03	1.3	1.4
5.00E+01	1.14E+03	1.3	1.5	1.14E+03	1.3	1.5
6.00E+01	1.05E+03	1.2	1.3	1.05E+03	1.2	1.3
8.00E+01	1.02E+03	1.2	1.4	1.02E+03	1.2	1.4
1.00E+02	9.27E+02	1.2	1.3	9.27E+02	1.2	1.3
1.50E+02	8.30E+02	1.2	1.4	8.30E+02	1.2	1.4
2.00E+02	7.55E+02	1.3	1.4	7.55E+02	1.3	1.4

Table A.1. (*continued*)

	Lens of the eye					
E	Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+02	6.64E+02	1.3	1.6	6.64E+02	1.3	1.6
4.00E+02	6.12E+02	1.4	1.7	6.12E+02	1.4	1.7
5.00E+02	5.81E+02	1.5	1.9	5.81E+02	1.5	1.9
6.00E+02	5.60E+02	1.6	2	5.60E+02	1.6	2
8.00E+02	5.37E+02	1.7	2.1	5.37E+02	1.7	2.1
1.00E+03	5.25E+02	1.7	2.2	5.25E+02	1.7	2.2
1.50E+03	5.15E+02	1.7	2.3	5.15E+02	1.7	2.3
2.00E+03	5.16E+02	1.7	2.4	5.16E+02	1.7	2.4
3.00E+03	5.27E+02	1.7	2.3	5.27E+02	1.7	2.3
4.00E+03	5.40E+02	1.9	2.6	5.40E+02	1.9	2.6
5.00E+03	5.54E+02	1.9	2.5	5.54E+02	1.9	2.5
6.00E+03	5.67E+02	1.9	2.5	5.67E+02	1.9	2.5
8.00E+03	5.90E+02	1.9	2.4	5.90E+02	1.9	2.4
1.00E+04	6.10E+02	1.8	2.4	6.10E+02	1.8	2.4
2.00E+04	6.37E+02	1.7	2.3	6.37E+02	1.7	2.3
5.00E+04	1.06E+03	1.6	2.1	1.06E+03	1.6	2.1
1.00E+05	1.27E+03	1.5	2	1.27E+03	1.5	2

Table A.2. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by neutrons.

	Red bone marrow						Breast					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	5.00E-01	1.9	1.3	5.07E-01	1.9	1.3	5.03E-01	2	2.9	5.81E-01	1.7	2.1
1.00E-08	6.02E-01	2	1.4	6.14E-01	2	1.4	6.85E-01	2.3	2.8	6.58E-01	1.7	2.1
2.50E-08	6.85E-01	2.1	1.4	7.05E-01	2.1	1.4	7.41E-01	2.4	2.9	7.39E-01	1.8	2.1
1.00E-07	8.93E-01	2.2	1.5	9.11E-01	2.2	1.5	8.48E-01	2.3	2.8	9.06E-01	1.7	2.1
2.00E-07	1.01E+00	2.2	1.5	1.03E+00	2.2	1.5	9.38E-01	2.3	2.9	9.89E-01	1.7	2
5.00E-07	1.17E+00	2.3	1.5	1.18E+00	2.3	1.5	1.04E+00	2.3	2.7	1.09E+00	1.7	1.9
1.00E-06	1.26E+00	2.3	1.5	1.27E+00	2.3	1.5	1.10E+00	2.2	2.7	1.14E+00	1.6	1.9
2.00E-06	1.33E+00	2.3	1.5	1.35E+00	2.3	1.5	1.13E+00	2.2	2.6	1.17E+00	1.6	1.9
5.00E-06	1.39E+00	2.3	1.5	1.41E+00	2.3	1.5	1.12E+00	2.2	2.4	1.18E+00	1.5	1.8
1.00E-05	1.42E+00	2.3	1.5	1.44E+00	2.3	1.5	1.11E+00	2.1	2.3	1.19E+00	1.5	1.8
2.00E-05	1.44E+00	2.4	1.5	1.45E+00	2.4	1.5	1.08E+00	2.1	2.2	1.16E+00	1.5	1.7
5.00E-05	1.44E+00	2.4	1.5	1.46E+00	2.4	1.5	1.02E+00	2	2	1.13E+00	1.4	1.7
1.00E-04	1.44E+00	2.4	1.5	1.46E+00	2.4	1.5	9.91E-01	1.9	1.9	1.12E+00	1.4	1.6
2.00E-04	1.44E+00	2.4	1.5	1.45E+00	2.4	1.5	9.64E-01	1.9	1.9	1.09E+00	1.5	1.7
5.00E-04	1.43E+00	2.4	1.5	1.42E+00	2.4	1.5	9.36E-01	1.8	1.8	1.03E+00	1.5	1.7
1.00E-03	1.43E+00	2.5	1.6	1.41E+00	2.5	1.6	9.27E-01	1.8	1.9	1.02E+00	1.5	1.7
2.00E-03	1.42E+00	2.4	1.6	1.41E+00	2.4	1.6	9.40E-01	1.9	1.9	1.04E+00	1.5	1.7
5.00E-03	1.42E+00	2.4	1.6	1.39E+00	2.4	1.6	9.94E-01	2	2	1.04E+00	1.8	1.8
1.00E-02	1.42E+00	2.5	1.6	1.38E+00	2.5	1.6	1.10E+00	2.2	2.2	1.09E+00	2.5	2.5
2.00E-02	1.45E+00	2.6	1.6	1.39E+00	2.6	1.6	1.34E+00	5.8	5.8	1.26E+00	4	4
3.00E-02	1.48E+00	2.8	1.6	1.42E+00	2.8	1.6	1.58E+00	6	6	1.43E+00	5.8	5.8
5.00E-02	1.54E+00	3.2	1.6	1.48E+00	3.2	1.6	2.03E+00	10.1	10.1	1.78E+00	9.1	9.1
7.00E-02	1.61E+00	3.7	1.6	1.55E+00	3.7	1.6	2.45E+00	12	12	2.11E+00	11.2	11.2
1.00E-01	1.72E+00	4.4	1.7	1.65E+00	4.4	1.7	3.05E+00	15	15	2.58E+00	13.4	13.4
1.50E-01	1.90E+00	5.7	1.9	1.83E+00	5.7	1.9	3.96E+00	18.8	18.8	3.32E+00	16.5	16.5
2.00E-01	2.09E+00	7	2.2	2.02E+00	7	2.2	4.79E+00	19.2	19.2	4.01E+00	17.3	17.3
3.00E-01	2.48E+00	9	2.7	2.41E+00	9	2.7	6.28E+00	21.2	21.2	5.29E+00	19.3	19.3
5.00E-01	3.28E+00	11.8	3.7	3.25E+00	11.8	3.7	8.82E+00	20.6	22	7.55E+00	19.9	21.1
7.00E-01	4.09E+00	13.5	4.4	4.13E+00	13.5	4.4	1.10E+01	19.3	23.9	9.55E+00	18.9	23.1
9.00E-01	4.91E+00	13.9	4.8	5.05E+00	13.9	4.8	1.29E+01	18	24.4	1.14E+01	18.4	23.9
1.00E+00	5.34E+00	14.2	4.9	5.53E+00	14.2	4.9	1.37E+01	17.7	22.9	1.22E+01	18	23.4
1.20E+00	6.22E+00	14.4	5.2	6.49E+00	14.4	5.2	1.54E+01	17.5	23.6	1.39E+01	17.1	23.7
1.50E+00	7.57E+00	14.4	5.4	7.93E+00	14.4	5.4	1.76E+01	16.6	23.7	1.61E+01	16	22.8
2.00E+00	9.80E+00	13.8	5.4	1.03E+01	13.8	5.4	2.08E+01	14.8	20.1	1.93E+01	14.6	21.4
3.00E+00	1.40E+01	12.3	5	1.46E+01	12.3	5	2.62E+01	11.2	17.4	2.47E+01	12.1	18.2
4.00E+00	1.78E+01	11.3	4.6	1.85E+01	11.3	4.6	3.05E+01	10.3	14.8	2.92E+01	11	15.3
5.00E+00	2.12E+01	10.3	4.3	2.20E+01	10.3	4.3	3.42E+01	9.4	13.8	3.31E+01	9.6	14
6.00E+00	2.42E+01	9.3	4	2.52E+01	9.3	4	3.74E+01	8.1	11.9	3.64E+01	8.5	12.3
7.00E+00	2.69E+01	8.7	3.7	2.80E+01	8.7	3.7	4.02E+01	8	11	3.94E+01	8.2	11.5
8.00E+00	2.94E+01	8.4	3.5	3.05E+01	8.4	3.5	4.26E+01	7.9	10.3	4.22E+01	7.7	10.4
9.00E+00	3.17E+01	8.2	3.4	3.29E+01	8.2	3.4	4.49E+01	7.8	9.8	4.47E+01	7.5	10.1
1.00E+01	3.38E+01	8.2	3.3	3.50E+01	8.2	3.3	4.69E+01	7.7	9.3	4.71E+01	7.3	9.9
1.20E+01	3.76E+01	8.2	3.2	3.88E+01	8.2	3.2	5.03E+01	7.6	8.9	5.13E+01	7.3	9.1
1.40E+01	4.08E+01	7.9	3.1	4.21E+01	7.9	3.1	5.30E+01	7.5	9	5.48E+01	7.3	9.1
1.50E+01	4.23E+01	7.9	3.2	4.36E+01	7.9	3.2	5.41E+01	7.4	9.4	5.63E+01	7.3	9.6
1.60E+01	4.36E+01	7.9	3.3	4.49E+01	7.9	3.3	5.51E+01	7.4	10.3	5.76E+01	7.3	10
1.80E+01	4.61E+01	7.8	3.5	4.73E+01	7.8	3.5	5.68E+01	7.4	11.2	5.99E+01	7.3	11.1
2.00E+01	4.82E+01	7.7	3.6	4.94E+01	7.7	3.6	5.81E+01	7.4	12.4	6.17E+01	7.3	12
2.10E+01	4.91E+01	7.6	3.6	5.03E+01	7.6	3.6	5.87E+01	7.4	12.3	6.24E+01	7.3	12
3.00E+01	5.57E+01	7.1	3.6	5.68E+01	7.1	3.6	6.19E+01	7.1	11.2	6.64E+01	6.8	11.9
5.00E+01	6.45E+01	5.7	2.9	6.57E+01	5.7	2.9	6.40E+01	6.5	9.5	6.88E+01	5.5	8.8
7.50E+01	7.28E+01	4.7	2.5	7.42E+01	4.7	2.5	6.55E+01	6.1	6.8	7.09E+01	4.8	8.4
1.00E+02	8.06E+01	4.2	2.4	8.20E+01	4.2	2.4	6.78E+01	5.1	6.5	7.38E+01	4.8	6.9
1.30E+02	8.92E+01	4.1	2.2	9.07E+01	4.1	2.2	7.13E+01	4.9	6	7.79E+01	4.6	6.4
1.50E+02	9.46E+01	3.7	2.1	9.59E+01	3.7	2.1	7.40E+01	4.5	5.8	8.07E+01	4.3	6.2
1.80E+02	1.02E+02	3.6	2	1.03E+02	3.6	2	7.83E+01	4.4	5.6	8.48E+01	4.2	5.9
2.00E+02	1.07E+02	3.4	2	1.08E+02	3.4	2	8.13E+01	4.2	5.5	8.75E+01	4	5.8
3.00E+02	1.29E+02	3.4	1.9	1.29E+02	3.4	1.9	9.64E+01	4	5.3	1.01E+02	3.9	5.7

Table A.2. (*continued*)

	Red bone marrow						Breast					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
4.00E+02	1.50E+02	3.4	1.9	1.48E+02	3.4	1.9	1.11E+02	3.9	5.1	1.14E+02	3.8	5.4
5.00E+02	1.70E+02	3.2	1.8	1.66E+02	3.2	1.8	1.23E+02	3.6	4.5	1.28E+02	3.5	4.7
6.00E+02	1.88E+02	3.1	1.8	1.83E+02	3.1	1.8	1.35E+02	3.5	4.3	1.41E+02	3.5	4.6
7.00E+02	2.05E+02	2.9	1.7	1.98E+02	2.9	1.7	1.45E+02	3.4	4.2	1.53E+02	3.4	4.5
8.00E+02	2.19E+02	3.1	1.6	2.10E+02	3.1	1.6	1.55E+02	3.4	4.2	1.63E+02	3.4	4.5
9.00E+02	2.31E+02	2.9	1.6	2.22E+02	2.9	1.6	1.63E+02	3.4	4.2	1.71E+02	3.4	4.4
1.00E+03	2.42E+02	2.8	1.6	2.31E+02	2.8	1.6	1.70E+02	3.2	4.2	1.78E+02	3.2	4.4
2.00E+03	3.15E+02	2.6	1.5	2.95E+02	2.6	1.5	2.24E+02	2.6	3.7	2.21E+02	2.7	3.9
5.00E+03	4.36E+02	2.6	1.4	4.02E+02	2.6	1.4	3.04E+02	2.6	3.4	2.96E+02	2.7	3.6
1.00E+04	5.77E+02	2.3	1.4	5.27E+02	2.3	1.4	3.81E+02	2.3	3	3.89E+02	2.4	3.2
2.00E+04	8.03E+02	2	1.4	7.31E+02	2	1.4	5.64E+02	2	2.6	5.07E+02	2.1	2.7
5.00E+04	1.28E+03	1.8	1.4	1.11E+03	1.8	1.4	8.61E+02	1.7	2.3	7.75E+02	1.9	2.4
1.00E+05	1.92E+03	1.6	1.4	1.64E+03	1.6	1.4	1.30E+03	1.6	2.3	1.19E+03	1.9	2.4

	Colon						Lungs					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.97E-01	1.8	2.1	5.04E-01	1.8	2.1	4.82E-01	1.9	2.5	5.19E-01	2	2.7
1.00E-08	6.10E-01	1.8	2.3	6.14E-01	1.8	2.3	5.87E-01	2.1	2.6	6.28E-01	2.1	2.9
2.50E-08	6.99E-01	1.9	2.4	7.03E-01	1.9	2.4	6.65E-01	2.1	2.7	7.16E-01	2.2	2.9
1.00E-07	9.11E-01	2	2.5	9.10E-01	2	2.5	8.77E-01	2.3	3	9.34E-01	2.4	3.2
2.00E-07	1.04E+00	2	2.7	1.03E+00	2	2.7	9.99E-01	2.3	3.1	1.06E+00	2.6	3.4
5.00E-07	1.20E+00	2.2	2.9	1.20E+00	2.2	2.9	1.17E+00	2.4	3.4	1.23E+00	2.7	3.6
1.00E-06	1.30E+00	2.2	2.8	1.30E+00	2.2	2.8	1.27E+00	2.5	3.5	1.33E+00	2.7	3.7
2.00E-06	1.37E+00	2.3	3	1.37E+00	2.3	3	1.34E+00	2.5	3.5	1.41E+00	2.7	3.8
5.00E-06	1.44E+00	2.3	2.9	1.43E+00	2.3	2.9	1.42E+00	2.6	3.6	1.48E+00	2.8	3.8
1.00E-05	1.47E+00	2.3	3.1	1.46E+00	2.3	3.1	1.45E+00	2.6	3.6	1.51E+00	2.9	4
2.00E-05	1.49E+00	2.3	3	1.48E+00	2.3	3	1.47E+00	2.6	3.7	1.53E+00	2.9	4
5.00E-05	1.50E+00	2.4	3.1	1.49E+00	2.4	3.1	1.48E+00	2.7	3.6	1.54E+00	2.9	4.1
1.00E-04	1.51E+00	2.4	3.2	1.50E+00	2.4	3.2	1.48E+00	2.8	3.8	1.53E+00	2.9	4.1
2.00E-04	1.51E+00	2.4	3.1	1.50E+00	2.4	3.1	1.48E+00	2.8	3.9	1.52E+00	3	4.2
5.00E-04	1.49E+00	2.4	3.2	1.48E+00	2.4	3.2	1.48E+00	2.8	3.9	1.48E+00	3	4.3
1.00E-03	1.48E+00	2.4	3.2	1.47E+00	2.4	3.2	1.48E+00	2.8	3.9	1.47E+00	3.1	4.3
2.00E-03	1.48E+00	2.4	3.2	1.47E+00	2.4	3.2	1.47E+00	2.9	3.9	1.46E+00	3	4.3
5.00E-03	1.48E+00	2.4	3.2	1.47E+00	2.4	3.2	1.47E+00	2.9	4	1.44E+00	3	4.4
1.00E-02	1.49E+00	2.4	3.3	1.48E+00	2.4	3.3	1.47E+00	2.9	4	1.43E+00	3.1	4.4
2.00E-02	1.50E+00	2.6	3.3	1.49E+00	2.6	3.3	1.49E+00	2.9	4	1.42E+00	3.1	4.4
3.00E-02	1.51E+00	2.7	3.3	1.51E+00	2.7	3.3	1.51E+00	3.1	4.1	1.43E+00	3	4.4
5.00E-02	1.56E+00	2.8	3.3	1.55E+00	2.8	3.3	1.56E+00	3.2	4.1	1.47E+00	3.5	4.4
7.00E-02	1.61E+00	3.1	3.6	1.60E+00	3.1	3.6	1.60E+00	3.4	4.2	1.52E+00	3.8	4.5
1.00E-01	1.70E+00	3.5	3.6	1.69E+00	3.5	3.6	1.69E+00	3.8	4.3	1.61E+00	4.3	4.7
1.50E-01	1.87E+00	4.6	4.6	1.86E+00	4.6	4.6	1.84E+00	5	5.1	1.79E+00	5.4	5.4
2.00E-01	2.04E+00	5.9	5.9	2.04E+00	5.9	5.9	2.01E+00	6	6	1.99E+00	6.6	6.6
3.00E-01	2.41E+00	8.1	8.1	2.41E+00	8.1	8.1	2.38E+00	8.2	8.2	2.42E+00	9.1	9.1
5.00E-01	3.19E+00	10.9	11	3.21E+00	10.9	11	3.20E+00	11.4	11.7	3.39E+00	12.7	12.7
7.00E-01	4.02E+00	12.7	14.4	4.04E+00	12.7	14.4	4.08E+00	13.1	14.9	4.43E+00	14	15.9
9.00E-01	4.87E+00	13.5	16.4	4.90E+00	13.5	16.4	5.02E+00	14	16.9	5.54E+00	15.2	18.2
1.00E+00	5.30E+00	13.9	16.5	5.34E+00	13.9	16.5	5.51E+00	14.3	17.5	6.11E+00	15.4	18.2
1.20E+00	6.20E+00	14.1	18.3	6.24E+00	14.1	18.3	6.53E+00	14.7	18.8	7.27E+00	15.5	20.1
1.50E+00	7.57E+00	14	18.9	7.62E+00	14	18.9	8.11E+00	14.8	19.8	9.01E+00	15.2	20.5
2.00E+00	9.85E+00	13.6	19	9.92E+00	13.6	19	1.07E+01	14.3	20.1	1.18E+01	14.6	20.3
3.00E+00	1.42E+01	12.4	18.1	1.43E+01	12.4	18.1	1.57E+01	12.7	18.6	1.69E+01	12.7	18.7
4.00E+00	1.81E+01	11.2	16.3	1.83E+01	11.2	16.3	2.00E+01	11.5	16.4	2.14E+01	11.4	16.5
5.00E+00	2.16E+01	10.2	14.9	2.20E+01	10.2	14.9	2.39E+01	10.4	14.9	2.54E+01	10.5	14.9
6.00E+00	2.48E+01	9.4	13.3	2.53E+01	9.4	13.3	2.73E+01	9.4	13.4	2.89E+01	9.3	13.2
7.00E+00	2.77E+01	8.8	12.6	2.82E+01	8.8	12.6	3.03E+01	9	12.6	3.20E+01	8.8	12.6
8.00E+00	3.03E+01	8.3	11.6	3.09E+01	8.3	11.6	3.30E+01	8.3	11.8	3.48E+01	8.3	11.7
9.00E+00	3.27E+01	8.1	11.1	3.33E+01	8.1	11.1	3.55E+01	8.2	11.1	3.73E+01	8.1	11.2

(continued on next page)

Table A.2. (*continued*)

	Colon						Lungs					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+01	3.48E+01	8.3	10.9	3.55E+01	8.3	10.9	3.77E+01	8.3	11	3.96E+01	8.1	11
1.20E+01	3.87E+01	8	10.2	3.94E+01	8	10.2	4.16E+01	8	10.1	4.35E+01	8.1	10.2
1.40E+01	4.21E+01	7.6	9.7	4.27E+01	7.6	9.7	4.50E+01	7.9	9.7	4.69E+01	7.8	9.7
1.50E+01	4.36E+01	7.6	10	4.41E+01	7.6	10	4.64E+01	7.6	10	4.84E+01	7.7	10.1
1.60E+01	4.50E+01	7.5	10.3	4.55E+01	7.5	10.3	4.78E+01	7.5	10.3	4.97E+01	7.5	10.3
1.80E+01	4.75E+01	7.4	11	4.79E+01	7.4	11	5.02E+01	7.4	10.9	5.21E+01	7.4	10.9
2.00E+01	4.97E+01	7.4	11.8	4.99E+01	7.4	11.8	5.22E+01	7.3	11.7	5.42E+01	7.4	11.8
2.10E+01	5.08E+01	7.3	11.6	5.09E+01	7.3	11.6	5.32E+01	7.2	11.6	5.52E+01	7.3	11.6
3.00E+01	5.80E+01	6.6	10.3	5.75E+01	6.6	10.3	5.96E+01	6.2	10.8	6.15E+01	6	10.5
5.00E+01	6.79E+01	5.4	9.1	6.69E+01	5.4	9.1	6.81E+01	5.1	8.3	6.99E+01	5	8.8
7.50E+01	7.69E+01	4.5	7.3	7.56E+01	4.5	7.3	7.62E+01	4.4	6.8	7.73E+01	4.5	6.7
1.00E+02	8.47E+01	4.3	6.3	8.34E+01	4.3	6.3	8.34E+01	3.9	6	8.39E+01	4.1	6.1
1.30E+02	9.32E+01	4.1	5.6	9.19E+01	4.1	5.6	9.10E+01	3.9	5.5	9.09E+01	3.9	5.7
1.50E+02	9.86E+01	3.4	5.2	9.71E+01	3.4	5.2	9.57E+01	3.7	5.3	9.52E+01	3.6	5.4
1.80E+02	1.06E+02	3.3	5	1.05E+02	3.3	5	1.02E+02	3.6	4.9	1.01E+02	3.6	4.9
2.00E+02	1.11E+02	3.2	4.9	1.09E+02	3.2	4.9	1.06E+02	3.4	4.8	1.05E+02	3.4	4.9
3.00E+02	1.34E+02	3.2	4.8	1.32E+02	3.2	4.8	1.26E+02	3.4	4.7	1.22E+02	3.4	4.8
4.00E+02	1.55E+02	3.1	4.5	1.52E+02	3.1	4.5	1.44E+02	3.4	4.6	1.39E+02	3.4	4.7
5.00E+02	1.76E+02	3.1	4.3	1.71E+02	3.1	4.3	1.63E+02	3.2	4.3	1.54E+02	3.3	4.5
6.00E+02	1.95E+02	3.1	4.1	1.88E+02	3.1	4.1	1.80E+02	3.2	4.3	1.69E+02	3.1	4.4
7.00E+02	2.11E+02	2.9	4	2.03E+02	2.9	4	1.95E+02	2.9	4.1	1.81E+02	3	4.2
8.00E+02	2.26E+02	2.8	4	2.16E+02	2.8	4	2.08E+02	3	3.9	1.93E+02	3	4
9.00E+02	2.38E+02	2.8	3.7	2.28E+02	2.8	3.7	2.19E+02	3	3.9	2.02E+02	2.9	3.9
1.00E+03	2.49E+02	2.7	3.7	2.38E+02	2.7	3.7	2.29E+02	2.8	3.8	2.11E+02	2.9	3.9
2.00E+03	3.22E+02	2.5	3.3	3.13E+02	2.5	3.3	2.94E+02	2.7	3.7	2.68E+02	2.7	3.5
5.00E+03	4.46E+02	2.6	3.2	4.43E+02	2.6	3.2	3.95E+02	2.6	3.1	3.59E+02	2.6	3.1
1.00E+04	5.84E+02	2.2	2.9	5.94E+02	2.2	2.9	5.14E+02	2.2	3	4.57E+02	2.3	3
2.00E+04	8.14E+02	1.9	2.6	7.57E+02	1.9	2.6	7.24E+02	2	2.9	6.23E+02	2.1	2.9
5.00E+04	1.31E+03	1.7	2.6	1.22E+03	1.7	2.6	1.13E+03	1.8	2.6	9.48E+02	1.9	2.5
1.00E+05	1.95E+03	1.6	2.5	1.86E+03	1.6	2.5	1.62E+03	1.6	2.4	1.39E+03	1.7	2.4

	Stomach wall						Gonads					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.52E-01	1.5	1.8	5.09E-01	1.5	2.2	6.45E-01	2.5	2.9	3.75E-01	1.2	1.5
1.00E-08	5.49E-01	1.6	1.9	6.29E-01	1.7	2.2	7.78E-01	2.6	3.6	4.90E-01	1.3	1.7
2.50E-08	6.32E-01	1.6	1.9	7.14E-01	1.7	2.3	8.49E-01	3	3.7	5.68E-01	1.3	1.8
1.00E-07	8.34E-01	1.8	2.1	9.24E-01	1.9	2.5	1.03E+00	3	3.7	7.57E-01	1.3	1.9
2.00E-07	9.41E-01	1.9	2.3	1.05E+00	1.9	2.7	1.15E+00	3	3.6	8.66E-01	1.3	2
5.00E-07	1.09E+00	1.9	2.3	1.24E+00	2.1	3	1.30E+00	3	3.5	9.97E-01	1.4	2
1.00E-06	1.21E+00	1.9	2.5	1.36E+00	2.2	3	1.36E+00	3	3.5	1.10E+00	1.4	2
2.00E-06	1.30E+00	2	2.6	1.42E+00	2.2	3	1.38E+00	2.9	3.4	1.21E+00	1.5	2
5.00E-06	1.39E+00	2	2.6	1.48E+00	2.3	3.1	1.37E+00	2.7	3.2	1.30E+00	1.5	2
1.00E-05	1.41E+00	2	2.6	1.52E+00	2.4	3.2	1.36E+00	2.5	3	1.28E+00	1.5	2
2.00E-05	1.42E+00	2	2.6	1.54E+00	2.4	3.2	1.36E+00	2.2	2.8	1.25E+00	1.5	2
5.00E-05	1.44E+00	2.1	2.7	1.55E+00	2.4	3.1	1.38E+00	2.1	2.8	1.28E+00	1.6	2.1
1.00E-04	1.46E+00	2.2	2.9	1.54E+00	2.4	3.1	1.38E+00	2	2.8	1.28E+00	1.6	2.1
2.00E-04	1.47E+00	2.2	2.9	1.52E+00	2.4	3.2	1.36E+00	2	2.7	1.31E+00	1.6	2.1
5.00E-04	1.46E+00	2.2	2.9	1.49E+00	2.3	3.2	1.32E+00	2.1	2.7	1.36E+00	1.6	2.1
1.00E-03	1.45E+00	2.2	2.9	1.49E+00	2.4	3.2	1.30E+00	2.3	2.7	1.37E+00	1.6	1.9
2.00E-03	1.44E+00	2.2	2.8	1.49E+00	2.4	3.2	1.28E+00	2.3	2.8	1.36E+00	1.6	1.8
5.00E-03	1.44E+00	2.2	2.8	1.47E+00	2.4	3.1	1.30E+00	2.3	3	1.34E+00	1.7	1.8
1.00E-02	1.45E+00	2.2	2.8	1.45E+00	2.4	3.1	1.35E+00	3	3.1	1.37E+00	1.8	1.8
2.00E-02	1.46E+00	2.2	2.9	1.46E+00	2.5	3.1	1.45E+00	3.8	3.8	1.45E+00	1.9	1.9
3.00E-02	1.47E+00	2.3	3	1.47E+00	2.6	3.2	1.53E+00	4.2	4.2	1.48E+00	2	2
5.00E-02	1.51E+00	2.3	3	1.51E+00	2.7	3.2	1.70E+00	5.5	5.5	1.50E+00	2.5	2.5
7.00E-02	1.56E+00	2.7	3	1.57E+00	3.4	3.5	1.86E+00	7.4	7.4	1.51E+00	2.8	2.8
1.00E-01	1.64E+00	3	3.1	1.66E+00	4	4	2.12E+00	9.1	9.1	1.54E+00	3.1	3.1
1.50E-01	1.78E+00	3.2	3.6	1.84E+00	4.6	4.8	2.55E+00	12	12	1.61E+00	3.3	3.3

Table A.2. (*continued*)

	Stomach wall						Gonads					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E-01	1.92E+00	4.3	4.4	2.04E+00	6.3	6.3	2.97E+00	13.1	13.1	1.70E+00	3.4	3.4
3.00E-01	2.21E+00	6.1	6.1	2.44E+00	8.9	8.9	3.75E+00	14.5	14.5	1.88E+00	3.5	3.7
5.00E-01	2.84E+00	8.9	9.4	3.31E+00	12.2	12.2	5.17E+00	16.5	17.7	2.30E+00	4.5	4.5
7.00E-01	3.53E+00	10.6	12.3	4.23E+00	13.5	14.8	6.47E+00	17.4	21.1	2.79E+00	4.8	7.8
9.00E-01	4.26E+00	11.9	14.2	5.19E+00	13.9	16.5	7.68E+00	17.4	21.2	3.35E+00	7.8	9.3
1.00E+00	4.65E+00	12.5	14.7	5.68E+00	14.6	17	8.26E+00	17.9	21.4	3.65E+00	8.2	9.7
1.20E+00	5.46E+00	13.2	16	6.67E+00	14.8	18.3	9.41E+00	16.2	21.5	4.29E+00	11.5	12.9
1.50E+00	6.73E+00	13.2	17.8	8.17E+00	13.9	19.1	1.10E+01	15.9	22	5.32E+00	12.5	14.4
2.00E+00	8.91E+00	13.1	18.7	1.06E+01	13.8	19.5	1.36E+01	14.2	21.7	7.13E+00	12	15.1
3.00E+00	1.32E+01	12.2	17.4	1.52E+01	12.3	17.9	1.80E+01	12.2	17.9	1.09E+01	11	16.9
4.00E+00	1.71E+01	11.6	16	1.93E+01	11.3	16.2	2.20E+01	10.5	15.9	1.47E+01	10.5	16.8
5.00E+00	2.08E+01	10.8	15.2	2.31E+01	10.4	15.1	2.55E+01	9.7	14	1.83E+01	9.8	14.4
6.00E+00	2.40E+01	9.2	13.4	2.64E+01	9	13.2	2.87E+01	9.2	12.8	2.16E+01	9.7	13.9
7.00E+00	2.70E+01	8.8	12.8	2.94E+01	8.7	12.8	3.15E+01	8.7	12.5	2.47E+01	8.2	12.4
8.00E+00	2.96E+01	8.4	11.9	3.21E+01	8.6	11.8	3.41E+01	8	11.2	2.75E+01	8	12.3
9.00E+00	3.20E+01	8.2	11.6	3.46E+01	8.4	11.2	3.65E+01	7.9	11	3.02E+01	7.9	12.2
1.00E+01	3.42E+01	8.1	11.2	3.69E+01	8.3	11.1	3.87E+01	8	10.9	3.26E+01	7.8	10.2
1.20E+01	3.80E+01	7.9	10.3	4.09E+01	8.2	10.1	4.24E+01	7.9	10	3.70E+01	7.6	9.3
1.40E+01	4.13E+01	7.8	9.6	4.43E+01	7.9	9.7	4.56E+01	7.8	9.2	4.10E+01	7.6	9
1.50E+01	4.27E+01	7.8	10.2	4.58E+01	7.8	10.3	4.70E+01	7.7	9.6	4.28E+01	7.6	9.8
1.60E+01	4.41E+01	7.5	10.7	4.72E+01	7.4	10.5	4.82E+01	7.6	9.7	4.45E+01	7.6	10
1.80E+01	4.65E+01	7.5	10.8	4.97E+01	7.4	11.1	5.04E+01	7.5	10.8	4.76E+01	7.6	10.8
2.00E+01	4.86E+01	7.4	11.6	5.19E+01	7.3	12	5.23E+01	7.4	11.2	5.04E+01	7.5	11.1
2.10E+01	4.95E+01	7.3	11.5	5.29E+01	7.2	11.7	5.31E+01	7.3	11.2	5.17E+01	7.3	11.1
3.00E+01	5.64E+01	6.3	10.3	5.99E+01	6.2	9.7	5.87E+01	6	11.8	6.05E+01	6	11
5.00E+01	6.63E+01	5	7.8	6.93E+01	4.5	7.8	6.60E+01	5.5	9.2	7.14E+01	4.6	9.3
7.50E+01	7.54E+01	4.3	7.1	7.78E+01	4	7.1	7.38E+01	4.5	7.5	7.98E+01	4.5	7.9
1.00E+02	8.33E+01	4	6	8.51E+01	4	6.1	8.06E+01	4	6.6	8.68E+01	4.2	7.6
1.30E+02	9.18E+01	3.5	5.5	9.29E+01	3.8	5.7	8.79E+01	4	5.7	9.44E+01	3.8	5.9
1.50E+02	9.70E+01	3.2	5.2	9.77E+01	3.4	5.2	9.23E+01	3.9	5.5	9.92E+01	3.4	5.7
1.80E+02	1.04E+02	3.1	4.7	1.04E+02	3.3	4.9	9.85E+01	3.7	5.4	1.06E+02	3.3	5.4
2.00E+02	1.09E+02	3.1	4.6	1.09E+02	3.3	4.8	1.02E+02	3.6	5.1	1.11E+02	3.3	4.8
3.00E+02	1.31E+02	3	4.5	1.30E+02	3.2	4.6	1.21E+02	3.5	4.9	1.37E+02	3.2	4.5
4.00E+02	1.52E+02	3	4.4	1.49E+02	3.2	4.5	1.40E+02	3.6	4.9	1.63E+02	3.1	4.3
5.00E+02	1.72E+02	3	4.4	1.68E+02	3.1	4.4	1.59E+02	3.3	4.5	1.87E+02	3	4
6.00E+02	1.91E+02	3	4.2	1.85E+02	3.1	4.2	1.77E+02	3.3	4.3	2.09E+02	2.9	4
7.00E+02	2.08E+02	2.8	4	2.00E+02	3	4.1	1.93E+02	3.2	4.1	2.27E+02	2.9	3.7
8.00E+02	2.23E+02	2.6	3.8	2.13E+02	2.9	3.9	2.07E+02	3.1	4	2.42E+02	2.8	3.6
9.00E+02	2.36E+02	2.5	3.7	2.24E+02	2.9	3.8	2.18E+02	3.2	3.9	2.55E+02	2.7	3.4
1.00E+03	2.47E+02	2.6	3.6	2.34E+02	2.9	3.7	2.28E+02	3	3.8	2.66E+02	2.7	3.3
2.00E+03	3.25E+02	2.5	3.5	3.02E+02	2.5	3.4	2.88E+02	2.9	3.4	3.37E+02	2.3	3
5.00E+03	4.50E+02	2.4	3	4.14E+02	2.4	3.2	3.85E+02	2.9	3.3	4.62E+02	2.3	3
1.00E+04	6.01E+02	2.2	3	5.44E+02	2.4	3.1	5.34E+02	2.7	3	6.18E+02	1.9	2.8
2.00E+04	8.37E+02	2.1	2.7	7.48E+02	2.1	2.7	8.78E+02	2.4	2.8	8.06E+02	1.8	2.8
5.00E+04	1.33E+03	1.7	2.7	1.15E+03	1.6	2.5	1.08E+03	1.7	2.6	1.31E+03	1.7	2.6
1.00E+05	1.92E+03	1.6	2.4	1.79E+03	1.6	2.5	1.80E+03	1.5	2.4	2.20E+03	1.5	2.4

	Liver						Oesophagus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.79E-01	1.7	2.2	5.20E-01	1.8	2.3	4.51E-01	1.6	2.3	5.20E-01	1.6	2.3
1.00E-08	5.83E-01	1.8	2.2	6.38E-01	2	2.6	5.58E-01	1.6	2.3	6.21E-01	1.6	2.3
2.50E-08	6.64E-01	1.8	2.4	7.28E-01	2.1	2.6	6.40E-01	1.9	2.3	7.06E-01	1.9	2.3
1.00E-07	8.72E-01	2	2.6	9.46E-01	2.1	2.9	8.51E-01	2	2.4	9.19E-01	2	2.4
2.00E-07	9.85E-01	2	2.7	1.07E+00	2.2	3	9.67E-01	2.1	2.6	1.04E+00	2.1	2.6
5.00E-07	1.15E+00	2.1	2.8	1.24E+00	2.3	3.1	1.11E+00	2	2.7	1.20E+00	2	2.7
1.00E-06	1.25E+00	2.2	2.9	1.35E+00	2.3	3.2	1.22E+00	2	2.7	1.30E+00	2	2.7
2.00E-06	1.33E+00	2.3	3	1.42E+00	2.4	3.2	1.32E+00	2.2	2.7	1.39E+00	2.2	2.7

(continued on next page)

Table A.2. (*continued*)

	Liver						Oesophagus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E-06	1.40E+00	2.2	3	1.50E+00	2.4	3.4	1.46E+00	2.1	2.8	1.46E+00	2.1	2.8
1.00E-05	1.44E+00	2.3	3	1.53E+00	2.5	3.4	1.49E+00	2.1	3	1.52E+00	2.1	3
2.00E-05	1.46E+00	2.4	3.1	1.55E+00	2.5	3.4	1.46E+00	2.2	3	1.56E+00	2.2	3
5.00E-05	1.47E+00	2.4	3.1	1.57E+00	2.6	3.4	1.46E+00	2.3	3.1	1.60E+00	2.3	3.1
1.00E-04	1.48E+00	2.3	3.1	1.58E+00	2.6	3.5	1.49E+00	2.2	3.1	1.62E+00	2.2	3.1
2.00E-04	1.48E+00	2.3	3.2	1.56E+00	2.6	3.5	1.52E+00	2.3	3.3	1.61E+00	2.3	3.3
5.00E-04	1.49E+00	2.4	3.2	1.52E+00	2.6	3.6	1.53E+00	2.3	3.3	1.57E+00	2.3	3.3
1.00E-03	1.50E+00	2.5	3.3	1.51E+00	2.6	3.6	1.53E+00	2.4	3.2	1.57E+00	2.4	3.2
2.00E-03	1.49E+00	2.5	3.4	1.51E+00	2.6	3.6	1.52E+00	2.4	3.2	1.57E+00	2.4	3.2
5.00E-03	1.49E+00	2.5	3.3	1.49E+00	2.6	3.7	1.52E+00	2.4	3.4	1.54E+00	2.4	3.4
1.00E-02	1.49E+00	2.5	3.3	1.49E+00	2.6	3.7	1.53E+00	2.4	3.5	1.50E+00	2.4	3.5
2.00E-02	1.51E+00	2.5	3.3	1.50E+00	2.7	3.7	1.54E+00	2.5	3.5	1.49E+00	2.5	3.5
3.00E-02	1.53E+00	2.5	3.4	1.51E+00	2.8	3.8	1.56E+00	2.5	3.5	1.50E+00	2.5	3.5
5.00E-02	1.57E+00	2.8	3.5	1.55E+00	3	3.9	1.61E+00	2.5	3.5	1.55E+00	2.5	3.5
7.00E-02	1.62E+00	3	3.5	1.60E+00	3.1	3.9	1.66E+00	2.4	3.5	1.59E+00	2.4	3.5
1.00E-01	1.69E+00	3.2	3.6	1.68E+00	4	4.1	1.74E+00	3.1	3.5	1.67E+00	3.1	3.5
1.50E-01	1.83E+00	4.1	4.1	1.83E+00	4.6	4.6	1.85E+00	4.4	4.4	1.81E+00	4.4	4.4
2.00E-01	1.97E+00	4.8	4.8	2.00E+00	6.1	6.1	1.96E+00	4.6	4.8	1.97E+00	4.6	4.8
3.00E-01	2.27E+00	6.6	6.6	2.37E+00	7.5	7.5	2.23E+00	6.6	6.6	2.30E+00	6.6	6.6
5.00E-01	2.91E+00	9.4	9.6	3.17E+00	10.7	10.9	2.84E+00	9.2	9.2	3.04E+00	9.2	9.2
7.00E-01	3.59E+00	11.5	12.8	4.04E+00	12.8	14.3	3.51E+00	11	11.6	3.86E+00	11	11.6
9.00E-01	4.31E+00	12.4	14.8	4.96E+00	13.6	16.4	4.25E+00	11.8	14.8	4.76E+00	11.8	14.8
1.00E+00	4.69E+00	12.6	15.1	5.43E+00	13.8	16.5	4.64E+00	13.1	15.7	5.23E+00	13.1	15.7
1.20E+00	5.50E+00	13.1	16.6	6.40E+00	14.4	18.3	5.48E+00	13.6	17.1	6.21E+00	13.6	17.1
1.50E+00	6.77E+00	13.2	17.9	7.86E+00	14.3	19	6.81E+00	14.1	18.8	7.72E+00	14.1	18.8
2.00E+00	8.95E+00	13.2	18.6	1.02E+01	14.1	19.5	9.09E+00	13.4	18.4	1.02E+01	13.4	18.4
3.00E+00	1.31E+01	12.3	17.6	1.47E+01	12.6	18.1	1.36E+01	13	17.9	1.51E+01	13	17.9
4.00E+00	1.70E+01	11.4	16	1.88E+01	11.3	16.2	1.77E+01	11.5	16.3	1.95E+01	11.5	16.3
5.00E+00	2.05E+01	10.4	14.8	2.24E+01	10.4	15.1	2.15E+01	10.6	14.8	2.34E+01	10.6	14.8
6.00E+00	2.37E+01	9.3	13.4	2.57E+01	9.4	13.4	2.48E+01	10.4	13.7	2.69E+01	10.4	13.7
7.00E+00	2.66E+01	8.9	12.7	2.86E+01	8.9	12.6	2.79E+01	9.1	13.1	3.01E+01	9.1	13.1
8.00E+00	2.92E+01	8.3	11.8	3.13E+01	8.3	11.7	3.06E+01	8.6	12	3.29E+01	8.6	12
9.00E+00	3.15E+01	8.2	11.3	3.37E+01	8.2	11.1	3.30E+01	8.2	11.4	3.55E+01	8.2	11.4
1.00E+01	3.37E+01	8.1	11.1	3.59E+01	8.1	10.9	3.52E+01	8.3	11.1	3.78E+01	8.3	11.1
1.20E+01	3.77E+01	8	10.3	3.97E+01	8	10.3	3.91E+01	8.1	10.6	4.18E+01	8.1	10.6
1.40E+01	4.11E+01	7.7	9.9	4.30E+01	7.8	9.8	4.24E+01	7.9	10	4.52E+01	7.9	10
1.50E+01	4.26E+01	7.7	10.1	4.45E+01	7.8	10.1	4.39E+01	7.8	10.5	4.67E+01	7.8	10.5
1.60E+01	4.40E+01	7.6	10.4	4.58E+01	7.5	10.4	4.52E+01	7.8	10.8	4.81E+01	7.8	10.8
1.80E+01	4.66E+01	7.5	11	4.83E+01	7.5	11	4.77E+01	7.8	11.6	5.06E+01	7.8	11.6
2.00E+01	4.89E+01	7.4	11.7	5.04E+01	7.4	11.7	4.99E+01	7.8	12.5	5.27E+01	7.8	12.5
2.10E+01	4.99E+01	7.3	11.6	5.14E+01	7.3	11.6	5.09E+01	7.7	12.4	5.37E+01	7.7	12.4
3.00E+01	5.71E+01	6.5	10.8	5.82E+01	6.1	10.6	5.86E+01	6.7	11.3	6.05E+01	6.7	11.3
5.00E+01	6.68E+01	5.2	8.7	6.77E+01	5.4	8.8	6.99E+01	5.8	9.9	6.98E+01	5.8	9.9
7.50E+01	7.58E+01	4.6	7.5	7.63E+01	4.4	7.5	7.89E+01	5.6	7.5	7.81E+01	5.6	7.5
1.00E+02	8.41E+01	3.9	6.2	8.37E+01	4	6.5	8.56E+01	4.8	7	8.52E+01	4.8	7
1.30E+02	9.32E+01	3.9	5.6	9.17E+01	3.8	5.5	9.27E+01	4.5	5.8	9.30E+01	4.5	5.8
1.50E+02	9.89E+01	3.6	5.4	9.66E+01	3.4	5.1	9.72E+01	4	5.4	9.77E+01	4	5.4
1.80E+02	1.07E+02	3.5	4.9	1.03E+02	3.3	4.9	1.04E+02	3.9	5	1.05E+02	3.9	5
2.00E+02	1.11E+02	3.4	4.8	1.08E+02	3.1	4.7	1.08E+02	3.6	4.8	1.09E+02	3.6	4.8
3.00E+02	1.33E+02	3.3	4.6	1.28E+02	3	4.7	1.30E+02	3.5	4.5	1.29E+02	3.5	4.5
4.00E+02	1.55E+02	3.2	4.6	1.48E+02	3.1	4.6	1.53E+02	3.4	4.4	1.49E+02	3.4	4.4
5.00E+02	1.76E+02	3.1	4.1	1.66E+02	3.2	4.4	1.75E+02	3.3	4.3	1.66E+02	3.3	4.3
6.00E+02	1.96E+02	3.1	4	1.83E+02	3	4.3	1.95E+02	3.2	4.2	1.83E+02	3.2	4.2
7.00E+02	2.14E+02	2.9	3.9	1.98E+02	2.9	3.9	2.13E+02	3.1	4	1.97E+02	3.1	4
8.00E+02	2.29E+02	2.9	3.8	2.11E+02	2.9	3.8	2.28E+02	3	3.8	2.10E+02	3	3.8
9.00E+02	2.43E+02	2.9	3.8	2.22E+02	2.8	3.8	2.41E+02	2.9	3.6	2.20E+02	2.9	3.6
1.00E+03	2.54E+02	2.8	3.6	2.33E+02	2.9	3.7	2.51E+02	2.8	3.4	2.30E+02	2.8	3.4
2.00E+03	3.30E+02	2.6	3.5	3.00E+02	2.5	3.6	3.22E+02	2.3	3.4	2.91E+02	2.3	3.4
5.00E+03	4.51E+02	2.5	3	4.10E+02	2.6	3.1	4.48E+02	2.4	3.2	3.85E+02	2.4	3.2
1.00E+04	5.97E+02	2.2	2.9	5.32E+02	2.2	2.8	5.97E+02	2.2	3	4.80E+02	2.2	3

Table A.2. (*continued*)

	Liver						Oesophagus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+04	8.48E+02	2.1	2.8	7.65E+02	2	2.8	8.58E+02	2.4	2.9	7.37E+02	2.4	2.9
5.00E+04	1.30E+03	1.7	2.4	1.16E+03	1.8	2.6	1.28E+03	1.8	2.8	1.09E+03	1.8	2.8
1.00E+05	1.97E+03	1.6	2.4	1.67E+03	1.7	2.5	1.89E+03	1.6	2.4	1.48E+03	1.6	2.4

	Thyroid						Urinary bladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	6.77E-01	2.2	2.9	5.61E-01	2.2	2.9	4.53E-01	1.5	1.7	4.81E-01	2.1	2.8
1.00E-08	7.49E-01	2.3	3.2	7.55E-01	2.3	3.2	5.32E-01	1.5	1.9	6.15E-01	2.1	2.9
2.50E-08	8.49E-01	2.4	3.3	8.05E-01	2.4	3.3	6.02E-01	1.7	1.9	6.98E-01	2.2	2.9
1.00E-07	1.07E+00	2.5	3.5	1.00E+00	2.5	3.5	8.08E-01	1.7	2.1	8.99E-01	2.3	3
2.00E-07	1.19E+00	2.6	3.6	1.11E+00	2.6	3.6	9.38E-01	1.7	2.2	1.01E+00	2.3	3
5.00E-07	1.35E+00	2.6	3.6	1.28E+00	2.6	3.6	1.10E+00	1.8	2.2	1.16E+00	2.3	3
1.00E-06	1.43E+00	2.7	3.6	1.41E+00	2.7	3.6	1.18E+00	1.9	2.3	1.26E+00	2.3	3
2.00E-06	1.46E+00	2.6	3.7	1.52E+00	2.6	3.7	1.25E+00	1.9	2.4	1.33E+00	2.3	3.1
5.00E-06	1.51E+00	2.7	3.7	1.57E+00	2.7	3.7	1.32E+00	1.9	2.4	1.40E+00	2.3	3
1.00E-05	1.55E+00	2.7	3.6	1.58E+00	2.7	3.6	1.37E+00	1.9	2.5	1.43E+00	2.3	3
2.00E-05	1.56E+00	2.7	3.6	1.59E+00	2.7	3.6	1.41E+00	2	2.5	1.45E+00	2.2	3
5.00E-05	1.53E+00	2.6	3.6	1.53E+00	2.6	3.6	1.44E+00	2	2.6	1.42E+00	2.2	3
1.00E-04	1.50E+00	2.7	3.7	1.50E+00	2.7	3.7	1.43E+00	2	2.7	1.40E+00	2.2	3
2.00E-04	1.47E+00	2.7	3.7	1.49E+00	2.7	3.7	1.41E+00	2	2.6	1.38E+00	2.2	3
5.00E-04	1.43E+00	2.6	3.6	1.46E+00	2.6	3.6	1.41E+00	2.1	2.7	1.35E+00	2.2	2.9
1.00E-03	1.42E+00	2.7	3.6	1.42E+00	2.7	3.6	1.42E+00	2.1	2.7	1.34E+00	2.2	3
2.00E-03	1.42E+00	2.7	3.6	1.38E+00	2.7	3.6	1.42E+00	2.1	2.8	1.33E+00	2.2	3
5.00E-03	1.40E+00	2.7	3.6	1.32E+00	2.7	3.6	1.40E+00	2.1	2.8	1.30E+00	2.1	2.9
1.00E-02	1.41E+00	2.8	3.6	1.31E+00	2.8	3.6	1.41E+00	2.1	2.8	1.29E+00	2.1	3
2.00E-02	1.45E+00	3	3.6	1.34E+00	3	3.6	1.44E+00	2.1	3	1.34E+00	2.5	2.9
3.00E-02	1.50E+00	3.6	3.7	1.39E+00	3.6	3.7	1.46E+00	2.2	2.8	1.39E+00	2.7	2.9
5.00E-02	1.61E+00	4.4	4.4	1.51E+00	4.4	4.4	1.51E+00	2.3	2.9	1.49E+00	3.5	3.5
7.00E-02	1.72E+00	5.7	5.7	1.65E+00	5.7	5.7	1.55E+00	2.5	2.9	1.58E+00	3.7	3.7
1.00E-01	1.91E+00	7.1	7.1	1.85E+00	7.1	7.1	1.62E+00	2.7	3	1.71E+00	5.5	5.5
1.50E-01	2.22E+00	9.6	9.6	2.19E+00	9.6	9.6	1.73E+00	3.2	3.4	1.94E+00	6.9	6.9
2.00E-01	2.55E+00	11.6	11.6	2.54E+00	11.6	11.6	1.85E+00	4	4	2.18E+00	7.1	7.1
3.00E-01	3.18E+00	14.2	14.2	3.24E+00	14.2	14.2	2.10E+00	5.6	5.6	2.65E+00	9.8	9.8
5.00E-01	4.42E+00	16.6	16.6	4.60E+00	16.6	16.6	2.65E+00	8.4	8.4	3.57E+00	11.8	13
7.00E-01	5.66E+00	17.5	19.6	5.91E+00	17.5	19.6	3.26E+00	10	11.5	4.49E+00	13.2	15.8
9.00E-01	6.89E+00	17.3	20.9	7.19E+00	17.3	20.9	3.91E+00	11.4	13.6	5.42E+00	13.3	17.1
1.00E+00	7.50E+00	17.2	20.9	7.82E+00	17.2	20.9	4.26E+00	11.9	14	5.89E+00	14.1	17.2
1.20E+00	8.69E+00	16.7	21.6	9.06E+00	16.7	21.6	4.98E+00	12.6	15.6	6.82E+00	14.5	18.6
1.50E+00	1.04E+01	16.1	21.6	1.08E+01	16.1	21.6	6.12E+00	13	17	8.20E+00	13.6	19
2.00E+00	1.32E+01	14.9	20.7	1.36E+01	14.9	20.7	8.07E+00	12.6	17.6	1.04E+01	13.4	19.3
3.00E+00	1.81E+01	12.7	18.2	1.86E+01	12.7	18.2	1.20E+01	11.9	17.1	1.46E+01	12.7	18
4.00E+00	2.23E+01	11.4	15.7	2.29E+01	11.4	15.7	1.57E+01	10.8	15.6	1.84E+01	11	16.1
5.00E+00	2.61E+01	10.3	14.3	2.68E+01	10.3	14.3	1.92E+01	10.1	14.5	2.20E+01	10.6	15
6.00E+00	2.94E+01	9.2	12.8	3.02E+01	9.2	12.8	2.23E+01	9.1	13	2.52E+01	8.6	13.2
7.00E+00	3.23E+01	8.6	12	3.32E+01	8.6	12	2.52E+01	8.6	12.2	2.81E+01	8.4	12.2
8.00E+00	3.50E+01	8.3	11	3.60E+01	8.3	11	2.78E+01	8.1	11.5	3.08E+01	8.3	11.9
9.00E+00	3.74E+01	8.1	10.6	3.85E+01	8.1	10.6	3.02E+01	8.1	10.9	3.32E+01	8.2	11.4
1.00E+01	3.97E+01	8.1	10.4	4.08E+01	8.1	10.4	3.24E+01	7.9	10.6	3.54E+01	8	10.8
1.20E+01	4.36E+01	8	9.8	4.48E+01	8	9.8	3.63E+01	7.6	10	3.94E+01	7.8	10.6
1.40E+01	4.70E+01	8	9.5	4.83E+01	8	9.5	3.96E+01	7.5	9.5	4.27E+01	7.6	10
1.50E+01	4.84E+01	8	10.1	4.98E+01	8	10.1	4.11E+01	7.4	9.9	4.42E+01	7.5	10.4
1.60E+01	4.98E+01	7.9	10.5	5.12E+01	7.9	10.5	4.25E+01	7.4	10.1	4.56E+01	7.4	10.6
1.80E+01	5.22E+01	7.9	11.6	5.37E+01	7.9	11.6	4.51E+01	7.3	10.6	4.82E+01	7.2	11.3
2.00E+01	5.42E+01	7.7	12.3	5.58E+01	7.7	12.3	4.74E+01	7.2	11.2	5.04E+01	7	11.5
2.10E+01	5.52E+01	7.7	12.3	5.68E+01	7.7	12.3	4.85E+01	7.1	11.1	5.14E+01	6.9	11.4
3.00E+01	6.13E+01	7.1	12	6.32E+01	7.1	12	5.64E+01	6.2	10.1	5.84E+01	6.5	10.4
5.00E+01	6.93E+01	5.9	9.3	7.11E+01	5.9	9.3	6.83E+01	5.1	8.2	6.80E+01	5.2	8.1

(continued on next page)

Table A.2. (*continued*)

	Thyroid						Urinary bladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	7.60E+01	4.8	7.6	7.68E+01	4.8	7.6	7.92E+01	4.3	7.3	7.66E+01	4.3	6.9
1.00E+02	8.13E+01	4.2	6.7	8.13E+01	4.2	6.7	8.86E+01	4	6.5	8.40E+01	3.9	6.3
1.30E+02	8.68E+01	4.1	5.8	8.63E+01	4.1	5.8	9.85E+01	3.9	5.3	9.23E+01	3.8	5.8
1.50E+02	9.02E+01	4	5.6	8.97E+01	4	5.6	1.05E+02	3.2	4.9	9.76E+01	3.4	5.5
1.80E+02	9.52E+01	3.8	5.4	9.48E+01	3.8	5.4	1.13E+02	3.2	4.8	1.05E+02	3.3	5.1
2.00E+02	9.85E+01	3.7	5.2	9.83E+01	3.7	5.2	1.19E+02	3.2	4.7	1.10E+02	3.2	5.2
3.00E+02	1.15E+02	3.6	5	1.15E+02	3.6	5	1.44E+02	3.2	4.6	1.32E+02	3.2	4.8
4.00E+02	1.32E+02	3.6	5	1.32E+02	3.6	5	1.65E+02	3.1	4.3	1.53E+02	3.2	4.6
5.00E+02	1.47E+02	3.4	4.6	1.47E+02	3.4	4.6	1.84E+02	3	4	1.72E+02	3	4.4
6.00E+02	1.62E+02	3.3	4.4	1.60E+02	3.3	4.4	2.02E+02	3	4	1.90E+02	3	4.3
7.00E+02	1.76E+02	3.2	4.2	1.72E+02	3.2	4.2	2.18E+02	2.8	3.9	2.06E+02	2.8	4.1
8.00E+02	1.88E+02	3.1	4.1	1.81E+02	3.1	4.1	2.32E+02	2.8	3.7	2.20E+02	2.9	3.9
9.00E+02	1.98E+02	3.1	4	1.90E+02	3.1	4	2.44E+02	2.8	3.5	2.32E+02	2.7	3.8
1.00E+03	2.08E+02	2.9	3.9	1.97E+02	2.9	3.9	2.56E+02	2.6	3.4	2.43E+02	2.6	3.8
2.00E+03	2.69E+02	2.8	3.5	2.45E+02	2.8	3.5	3.38E+02	2.5	3.1	3.16E+02	2.5	3.5
5.00E+03	3.74E+02	2.7	3.4	3.33E+02	2.7	3.4	4.83E+02	2.4	2.9	4.44E+02	2.5	3.1
1.00E+04	5.23E+02	2.4	3.1	4.45E+02	2.4	3.1	6.52E+02	2.1	2.8	5.96E+02	2.2	2.9
2.00E+04	6.88E+02	2.1	2.9	6.36E+02	2.1	2.9	9.26E+02	1.9	2.7	8.05E+02	2	2.8
5.00E+04	1.06E+03	1.8	2.7	8.37E+02	1.8	2.7	1.37E+03	1.6	2.5	1.27E+03	1.7	2.6
1.00E+05	1.61E+03	1.7	2.5	1.28E+03	1.7	2.5	2.36E+03	1.5	2.4	1.92E+03	1.6	2.5

	Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	5.51E-01	2.1	2.7	5.46E-01	2.1	2.7	5.26E-01	2	2.7	5.26E-01	2.1	2.8
1.00E-08	6.53E-01	2.2	3	6.57E-01	2.2	3	6.39E-01	2.2	2.9	6.41E-01	2.2	3.1
2.50E-08	7.37E-01	2.3	3.1	7.41E-01	2.3	3.1	7.30E-01	2.3	3.1	7.36E-01	2.3	3.1
1.00E-07	9.46E-01	2.5	3.3	9.48E-01	2.5	3.3	9.64E-01	2.4	3.3	9.72E-01	2.5	3.4
2.00E-07	1.06E+00	2.5	3.4	1.06E+00	2.5	3.4	1.09E+00	2.5	3.4	1.10E+00	2.6	3.5
5.00E-07	1.20E+00	2.5	3.5	1.20E+00	2.5	3.5	1.27E+00	2.6	3.6	1.27E+00	2.6	3.7
1.00E-06	1.28E+00	2.6	3.5	1.28E+00	2.6	3.5	1.38E+00	2.6	3.7	1.37E+00	2.7	3.8
2.00E-06	1.33E+00	2.5	3.5	1.34E+00	2.5	3.5	1.46E+00	2.6	3.7	1.45E+00	2.7	3.8
5.00E-06	1.37E+00	2.6	3.6	1.39E+00	2.6	3.6	1.52E+00	2.7	3.7	1.51E+00	2.8	3.8
1.00E-05	1.38E+00	2.6	3.5	1.40E+00	2.6	3.5	1.54E+00	2.7	3.7	1.53E+00	2.8	3.8
2.00E-05	1.38E+00	2.6	3.5	1.40E+00	2.6	3.5	1.55E+00	2.7	3.8	1.53E+00	2.8	3.8
5.00E-05	1.37E+00	2.5	3.5	1.39E+00	2.5	3.5	1.55E+00	2.7	3.9	1.52E+00	2.8	3.8
1.00E-04	1.35E+00	2.6	3.6	1.37E+00	2.6	3.6	1.54E+00	2.8	3.9	1.51E+00	2.8	4
2.00E-04	1.33E+00	2.6	3.6	1.33E+00	2.6	3.6	1.53E+00	2.8	3.9	1.46E+00	2.8	3.9
5.00E-04	1.31E+00	2.6	3.5	1.27E+00	2.6	3.5	1.52E+00	2.8	3.9	1.38E+00	2.8	3.9
1.00E-03	1.29E+00	2.6	3.5	1.26E+00	2.6	3.5	1.50E+00	2.8	3.9	1.36E+00	2.8	3.9
2.00E-03	1.27E+00	2.6	3.5	1.26E+00	2.6	3.5	1.48E+00	2.8	3.9	1.36E+00	2.8	3.9
5.00E-03	1.26E+00	2.6	3.5	1.22E+00	2.6	3.5	1.46E+00	2.8	3.9	1.31E+00	2.8	3.9
1.00E-02	1.26E+00	2.7	3.5	1.21E+00	2.7	3.5	1.46E+00	2.9	4	1.28E+00	2.8	3.9
2.00E-02	1.30E+00	3	3.6	1.23E+00	3	3.6	1.47E+00	3	3.9	1.30E+00	3	3.9
3.00E-02	1.34E+00	3.5	3.6	1.27E+00	3.5	3.6	1.49E+00	3.2	3.9	1.34E+00	3.4	4
5.00E-02	1.44E+00	4.3	4.3	1.36E+00	4.3	4.3	1.57E+00	4	4.2	1.43E+00	4.2	4.2
7.00E-02	1.56E+00	5.6	5.6	1.47E+00	5.6	5.6	1.66E+00	4.5	4.5	1.54E+00	5	5
1.00E-01	1.74E+00	7	7	1.64E+00	7	7	1.82E+00	5.9	5.9	1.71E+00	6.7	6.7
1.50E-01	2.05E+00	9.4	9.4	1.94E+00	9.4	9.4	2.10E+00	7.8	7.8	2.03E+00	8.5	8.5
2.00E-01	2.38E+00	11.5	11.5	2.24E+00	11.5	11.5	2.41E+00	9.5	9.5	2.38E+00	10.3	10.3
3.00E-01	3.04E+00	14	14	2.87E+00	14	14	3.06E+00	12.5	12.5	3.11E+00	14.1	14.1
5.00E-01	4.36E+00	16.4	16.6	4.16E+00	16.4	16.6	4.42E+00	15.8	15.8	4.65E+00	16.9	16.9
7.00E-01	5.63E+00	17.2	19.6	5.45E+00	17.2	19.6	5.82E+00	17.2	19.4	6.23E+00	17.5	20
9.00E-01	6.87E+00	17	20.9	6.73E+00	17	20.9	7.23E+00	17.2	20.4	7.83E+00	17.6	21.1
1.00E+00	7.49E+00	17	20.9	7.36E+00	17	20.9	7.94E+00	16.9	21.1	8.63E+00	17.2	21.6
1.20E+00	8.71E+00	16.5	21.6	8.62E+00	16.5	21.6	9.37E+00	16.6	21.6	1.02E+01	17	22.2
1.50E+00	1.05E+01	15.8	21.6	1.04E+01	15.8	21.6	1.15E+01	16.1	21.9	1.25E+01	16.3	22.3
2.00E+00	1.33E+01	14.7	20.7	1.32E+01	14.7	20.7	1.49E+01	15	21.2	1.60E+01	15.1	21.6
3.00E+00	1.83E+01	12.6	18.3	1.81E+01	12.6	18.3	2.08E+01	13.1	19.1	2.20E+01	12.7	18.9

Table A.2. (*continued*)

	Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
4.00E+00	2.24E+01	11.2	15.8	2.23E+01	11.2	15.8	2.58E+01	11.4	16.4	2.70E+01	11.4	16.5
5.00E+00	2.60E+01	10.2	14.3	2.58E+01	10.2	14.3	3.00E+01	10.3	14.8	3.12E+01	10.1	14.9
6.00E+00	2.91E+01	9.1	12.8	2.90E+01	9.1	12.8	3.37E+01	9.1	13.1	3.48E+01	9.1	12.9
7.00E+00	3.19E+01	8.5	12.1	3.18E+01	8.5	12.1	3.68E+01	8.7	12.4	3.79E+01	8.5	12.3
8.00E+00	3.44E+01	8.2	11.1	3.43E+01	8.2	11.1	3.96E+01	8.1	11.6	4.07E+01	8	11.4
9.00E+00	3.67E+01	8	10.7	3.66E+01	8	10.7	4.21E+01	7.9	10.9	4.32E+01	7.9	10.9
1.00E+01	3.88E+01	8	10.4	3.87E+01	8	10.4	4.43E+01	8	10.8	4.54E+01	7.8	10.5
1.20E+01	4.25E+01	8	9.9	4.24E+01	8	9.9	4.81E+01	7.8	9.9	4.92E+01	7.7	9.9
1.40E+01	4.56E+01	7.9	9.6	4.55E+01	7.9	9.6	5.11E+01	7.5	9.5	5.24E+01	7.5	9.5
1.50E+01	4.70E+01	7.9	10.2	4.68E+01	7.9	10.2	5.25E+01	7.5	9.8	5.37E+01	7.4	9.7
1.60E+01	4.82E+01	7.8	10.6	4.81E+01	7.8	10.6	5.36E+01	7.3	10.1	5.49E+01	7.4	10
1.80E+01	5.04E+01	7.8	11.7	5.03E+01	7.8	11.7	5.57E+01	7.3	10.8	5.69E+01	7.3	10.7
2.00E+01	5.23E+01	7.7	12.4	5.21E+01	7.7	12.4	5.75E+01	7.2	11.4	5.86E+01	7.2	11.3
2.10E+01	5.31E+01	7.6	12.4	5.29E+01	7.6	12.4	5.82E+01	7.1	11.3	5.94E+01	7.1	11.2
3.00E+01	5.87E+01	7	12.1	5.85E+01	7	12.1	6.35E+01	6.1	9.8	6.41E+01	6.3	10.3
5.00E+01	6.57E+01	5.8	9.4	6.57E+01	5.8	9.4	7.06E+01	5.2	8.1	6.98E+01	5	7.8
7.50E+01	7.20E+01	4.7	7.7	7.22E+01	4.7	7.7	7.67E+01	4.1	6.8	7.51E+01	4.3	6.7
1.00E+02	7.76E+01	4.2	6.8	7.79E+01	4.2	6.8	8.19E+01	4	6.3	8.00E+01	3.9	6.3
1.30E+02	8.38E+01	4.1	5.9	8.42E+01	4.1	5.9	8.72E+01	3.9	5.4	8.49E+01	3.8	6
1.50E+02	8.76E+01	4	5.7	8.80E+01	4	5.7	9.04E+01	3.7	5.3	8.77E+01	3.7	5.5
1.80E+02	9.30E+01	3.8	5.5	9.35E+01	3.8	5.5	9.50E+01	3.6	5.2	9.17E+01	3.6	5.3
2.00E+02	9.66E+01	3.7	5.3	9.70E+01	3.7	5.3	9.81E+01	3.5	5.1	9.43E+01	3.6	5.2
3.00E+02	1.14E+02	3.6	5.1	1.14E+02	3.6	5.1	1.13E+02	3.4	5	1.08E+02	3.5	5.1
4.00E+02	1.31E+02	3.6	5.1	1.30E+02	3.6	5.1	1.28E+02	3.3	4.8	1.22E+02	3.4	5
5.00E+02	1.47E+02	3.3	4.7	1.46E+02	3.3	4.7	1.43E+02	3.3	4.6	1.36E+02	3.4	4.8
6.00E+02	1.62E+02	3.3	4.5	1.60E+02	3.3	4.5	1.56E+02	3.3	4.5	1.48E+02	3.4	4.6
7.00E+02	1.76E+02	3.2	4.3	1.73E+02	3.2	4.3	1.68E+02	3.3	4.4	1.60E+02	3.3	4.5
8.00E+02	1.88E+02	3.1	4.2	1.84E+02	3.1	4.2	1.78E+02	3.2	4.3	1.69E+02	3.3	4.4
9.00E+02	1.97E+02	3.1	4	1.93E+02	3.1	4	1.87E+02	3.1	4.3	1.77E+02	3.2	4.3
1.00E+03	2.06E+02	2.9	4	2.01E+02	2.9	4	1.94E+02	3	4.2	1.84E+02	3	4
2.00E+03	2.61E+02	2.8	3.6	2.54E+02	2.8	3.6	2.41E+02	2.9	3.8	2.27E+02	2.9	3.8
5.00E+03	3.52E+02	2.7	3.5	3.38E+02	2.7	3.5	3.16E+02	2.8	3.7	2.93E+02	2.8	3.7
1.00E+04	4.60E+02	2.4	3.1	4.36E+02	2.4	3.1	3.99E+02	2.7	3.4	3.79E+02	2.6	3.5
2.00E+04	6.32E+02	2.1	3	5.94E+02	2.1	3	5.55E+02	2.3	3.1	4.83E+02	2.3	3
5.00E+04	9.99E+02	1.8	2.8	9.14E+02	1.8	2.8	8.20E+02	2.1	2.8	7.35E+02	2	2.9
1.00E+05	1.51E+03	1.7	2.5	1.32E+03	1.7	2.5	1.13E+03	1.7	2.5	9.50E+02	1.7	2.5

	Salivary glands						Skin					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	6.22E-01	2.5	3.9	6.12E-01	2.5	3.9	9.93E-01	9.8	14.4	1.02E+00	9.8	14.4
1.00E-08	7.41E-01	2.8	4	7.49E-01	2.8	4	8.81E-01	7.9	11.3	8.80E-01	7.9	11.3
2.50E-08	8.21E-01	3.2	4.4	8.49E-01	3.2	4.4	8.70E-01	6.8	9.7	8.62E-01	6.8	9.7
1.00E-07	1.04E+00	3.3	4.6	1.06E+00	3.3	4.6	9.10E-01	5.1	7.2	8.97E-01	5.1	7.2
2.00E-07	1.13E+00	3.3	4.7	1.17E+00	3.3	4.7	9.42E-01	4.5	6.3	9.26E-01	4.5	6.3
5.00E-07	1.24E+00	3.2	4.7	1.30E+00	3.2	4.7	9.78E-01	3.9	5.4	9.60E-01	3.9	5.4
1.00E-06	1.31E+00	3.2	4.6	1.38E+00	3.2	4.6	9.96E-01	3.6	4.9	9.78E-01	3.6	4.9
2.00E-06	1.37E+00	3.2	4.5	1.43E+00	3.2	4.5	1.00E+00	3.4	4.6	9.92E-01	3.4	4.6
5.00E-06	1.38E+00	3.3	4.5	1.46E+00	3.3	4.5	9.99E-01	3.1	4.3	9.91E-01	3.1	4.3
1.00E-05	1.37E+00	3.3	4.4	1.46E+00	3.3	4.4	9.86E-01	3	4	9.73E-01	3	4
2.00E-05	1.34E+00	3.2	4.4	1.45E+00	3.2	4.4	9.71E-01	2.9	3.9	9.54E-01	2.9	3.9
5.00E-05	1.32E+00	3.2	4.2	1.43E+00	3.2	4.2	9.42E-01	2.8	3.7	9.27E-01	2.8	3.7
1.00E-04	1.29E+00	3.1	4.1	1.42E+00	3.1	4.1	9.19E-01	2.7	3.6	9.06E-01	2.7	3.6
2.00E-04	1.27E+00	3	4.1	1.39E+00	3	4.1	8.99E-01	2.7	3.5	8.79E-01	2.7	3.5
5.00E-04	1.25E+00	3	4.1	1.32E+00	3	4.1	8.78E-01	2.6	3.4	8.32E-01	2.6	3.4
1.00E-03	1.23E+00	3.1	4.1	1.29E+00	3.1	4.1	8.76E-01	2.6	3.3	8.33E-01	2.6	3.3
2.00E-03	1.22E+00	3.1	4.1	1.28E+00	3.1	4.1	8.94E-01	2.7	3.2	8.69E-01	2.7	3.2
5.00E-03	1.21E+00	3.2	4.1	1.24E+00	3.2	4.1	9.78E-01	3.3	3.3	9.45E-01	3.3	3.3

(continued on next page)

Table A.2. (*continued*)

	Salivary glands						Skin					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-02	1.23E+00	3.2	4	1.23E+00	3.2	4	1.14E+00	4.5	4.5	1.10E+00	4.5	4.5
2.00E-02	1.32E+00	4.1	4.1	1.28E+00	4.1	4.1	1.46E+00	7.1	7.1	1.43E+00	7.1	7.1
3.00E-02	1.43E+00	5.8	5.8	1.36E+00	5.8	5.8	1.76E+00	9.4	9.4	1.74E+00	9.4	9.4
5.00E-02	1.65E+00	6.2	6.2	1.52E+00	6.2	6.2	2.31E+00	12.9	12.9	2.30E+00	12.9	12.9
7.00E-02	1.88E+00	8.5	8.5	1.68E+00	8.5	8.5	2.80E+00	15.2	15.2	2.81E+00	15.2	15.2
1.00E-01	2.21E+00	11.2	11.2	1.93E+00	11.2	11.2	3.46E+00	17.6	17.6	3.48E+00	17.6	17.6
1.50E-01	2.75E+00	12.2	12.2	2.35E+00	12.2	12.2	4.41E+00	19.6	19.6	4.43E+00	19.6	19.6
2.00E-01	3.27E+00	14.5	14.5	2.77E+00	14.5	14.5	5.23E+00	20.6	20.6	5.25E+00	20.6	20.6
3.00E-01	4.26E+00	16.7	16.7	3.60E+00	16.7	16.7	6.63E+00	21.2	21.2	6.66E+00	21.2	21.2
5.00E-01	6.09E+00	19.1	19.1	5.23E+00	19.1	19.1	8.93E+00	20.8	23.5	8.99E+00	20.8	23.5
7.00E-01	7.76E+00	18.1	21.6	6.81E+00	18.1	21.6	1.09E+01	19.6	25.2	1.10E+01	19.6	25.2
9.00E-01	9.30E+00	17.2	22.4	8.35E+00	17.2	22.4	1.26E+01	18.5	25.1	1.28E+01	18.5	25.1
1.00E+00	1.00E+01	17.1	22.3	9.10E+00	17.1	22.3	1.34E+01	18.1	23.7	1.36E+01	18.1	23.7
1.20E+00	1.15E+01	16.9	22.8	1.06E+01	16.9	22.8	1.48E+01	17.1	24.3	1.52E+01	17.1	24.3
1.50E+00	1.35E+01	16.3	22.4	1.26E+01	16.3	22.4	1.68E+01	15.9	23.4	1.71E+01	15.9	23.4
2.00E+00	1.66E+01	14.6	21.2	1.58E+01	14.6	21.2	1.96E+01	14.3	21.5	2.00E+01	14.3	21.5
3.00E+00	2.20E+01	12.6	18.6	2.13E+01	12.6	18.6	2.45E+01	11.9	18.1	2.48E+01	11.9	18.1
4.00E+00	2.65E+01	10.9	15.9	2.59E+01	10.9	15.9	2.85E+01	10.5	15.2	2.88E+01	10.5	15.2
5.00E+00	3.02E+01	10.3	14.4	2.99E+01	10.3	14.4	3.20E+01	9.6	13.8	3.23E+01	9.6	13.8
6.00E+00	3.35E+01	9	12.4	3.33E+01	9	12.4	3.50E+01	8.5	12.1	3.53E+01	8.5	12.1
7.00E+00	3.65E+01	8.4	12	3.63E+01	8.4	12	3.77E+01	8.2	11.7	3.81E+01	8.2	11.7
8.00E+00	3.91E+01	7.9	11.3	3.90E+01	7.9	11.3	4.01E+01	7.8	10.8	4.05E+01	7.8	10.8
9.00E+00	4.16E+01	7.6	10.8	4.14E+01	7.6	10.8	4.23E+01	8	10.4	4.28E+01	8	10.4
1.00E+01	4.38E+01	7.6	10.6	4.35E+01	7.6	10.6	4.43E+01	8.1	10.5	4.48E+01	8.1	10.5
1.20E+01	4.76E+01	7.5	9.6	4.70E+01	7.5	9.6	4.76E+01	8.2	9.9	4.81E+01	8.2	9.9
1.40E+01	5.07E+01	7.5	9.2	4.99E+01	7.5	9.2	5.00E+01	8.2	9.8	5.06E+01	8.2	9.8
1.50E+01	5.21E+01	7.5	9.8	5.12E+01	7.5	9.8	5.10E+01	8.2	10.4	5.15E+01	8.2	10.4
1.60E+01	5.32E+01	7.3	10.3	5.23E+01	7.3	10.3	5.17E+01	8.2	10.9	5.22E+01	8.2	10.9
1.80E+01	5.52E+01	7.3	11	5.43E+01	7.3	11	5.28E+01	8.3	12	5.32E+01	8.3	12
2.00E+01	5.68E+01	7.2	12.2	5.60E+01	7.2	12.2	5.35E+01	8.3	13.1	5.37E+01	8.3	13.1
2.10E+01	5.75E+01	7.1	12.1	5.67E+01	7.1	12.1	5.37E+01	8.1	12.9	5.38E+01	8.1	12.9
3.00E+01	6.16E+01	6.5	11.3	6.21E+01	6.5	11.3	5.44E+01	7	11.3	5.40E+01	7	11.3
5.00E+01	6.54E+01	5.2	9	6.92E+01	5.2	9	5.45E+01	6	9.7	5.36E+01	6	9.7
7.50E+01	6.87E+01	5.2	6.5	7.51E+01	5.2	6.5	5.59E+01	5.3	8.2	5.51E+01	5.3	8.2
1.00E+02	7.23E+01	4.5	6.4	8.00E+01	4.5	6.4	5.85E+01	4.8	7.6	5.77E+01	4.8	7.6
1.30E+02	7.69E+01	3.6	6.2	8.51E+01	3.6	6.2	6.21E+01	4.7	6.6	6.13E+01	4.7	6.6
1.50E+02	7.99E+01	3.5	6.1	8.81E+01	3.5	6.1	6.45E+01	4.3	6.4	6.37E+01	4.3	6.4
1.80E+02	8.43E+01	3.5	5.9	9.23E+01	3.5	5.9	6.83E+01	4.2	6.2	6.72E+01	4.2	6.2
2.00E+02	8.72E+01	3.5	5.1	9.50E+01	3.5	5.1	7.08E+01	4.1	5.9	6.96E+01	4.1	5.9
3.00E+02	1.02E+02	3.5	4.9	1.09E+02	3.5	4.9	8.35E+01	4.1	5.8	8.14E+01	4.1	5.8
4.00E+02	1.17E+02	3.5	4.8	1.22E+02	3.5	4.8	9.60E+01	4	5.8	9.33E+01	4	5.8
5.00E+02	1.33E+02	3.5	4.7	1.36E+02	3.5	4.7	1.08E+02	3.8	5.4	1.05E+02	3.8	5.4
6.00E+02	1.48E+02	3.4	4.6	1.49E+02	3.4	4.6	1.19E+02	3.8	5.1	1.16E+02	3.8	5.1
7.00E+02	1.60E+02	3.4	4.4	1.60E+02	3.4	4.4	1.29E+02	3.5	4.8	1.25E+02	3.5	4.8
8.00E+02	1.69E+02	3.4	4.3	1.70E+02	3.4	4.3	1.38E+02	3.5	4.6	1.33E+02	3.5	4.6
9.00E+02	1.77E+02	3.4	4.1	1.79E+02	3.4	4.1	1.45E+02	3.5	4.6	1.40E+02	3.5	4.6
1.00E+03	1.84E+02	3.3	3.8	1.86E+02	3.3	3.8	1.52E+02	3.4	4.5	1.45E+02	3.4	4.5
2.00E+03	2.26E+02	2.9	3.6	2.36E+02	2.9	3.6	1.93E+02	3.1	4	1.81E+02	3.1	4
5.00E+03	3.00E+02	2.6	3.6	3.11E+02	2.6	3.6	2.62E+02	3	3.7	2.43E+02	3	3.7
1.00E+04	4.17E+02	2.6	3.1	3.97E+02	2.6	3.1	3.46E+02	2.6	3.3	3.17E+02	2.6	3.3
2.00E+04	5.55E+02	2.1	2.9	5.28E+02	2.1	2.9	4.71E+02	2.2	3	4.29E+02	2.2	3
5.00E+04	7.94E+02	1.7	2.8	8.55E+02	1.7	2.8	7.66E+02	1.9	2.8	6.69E+02	1.9	2.8
1.00E+05	1.15E+03	1.6	2.7	1.14E+03	1.6	2.7	1.13E+03	1.7	2.5	9.95E+02	1.7	2.5

	Remainder tissues						Adrenals					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.93E-01	1.9	2.4	5.15E-01	1.9	2.3	4.89E-01	1.5	1.7	4.65E-01	1.5	1.7
1.00E-08	5.99E-01	1.9	2.6	6.21E-01	1.9	2.5	5.54E-01	1.5	1.8	5.75E-01	1.5	1.8
2.50E-08	6.84E-01	2.1	2.7	7.08E-01	2.1	2.6	6.29E-01	1.7	1.9	6.33E-01	1.7	1.9

Table A.2. (*continued*)

	Remainder tissues						Adrenals					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-07	8.80E-01	2.2	2.8	9.23E-01	2.2	2.8	8.19E-01	1.7	2	8.54E-01	1.7	2
2.00E-07	9.93E-01	2.2	2.9	1.05E+00	2.2	2.9	9.31E-01	1.7	2.2	9.98E-01	1.7	2.2
5.00E-07	1.14E+00	2.2	3	1.20E+00	2.3	3	1.09E+00	1.8	2.2	1.16E+00	1.8	2.2
1.00E-06	1.24E+00	2.3	3	1.30E+00	2.3	3.1	1.19E+00	1.9	2.3	1.26E+00	1.9	2.3
2.00E-06	1.31E+00	2.3	3.1	1.38E+00	2.3	3.1	1.25E+00	1.9	2.4	1.34E+00	1.9	2.4
5.00E-06	1.37E+00	2.3	3.1	1.45E+00	2.4	3.1	1.29E+00	1.9	2.4	1.44E+00	1.9	2.4
1.00E-05	1.40E+00	2.3	3.1	1.48E+00	2.4	3.2	1.31E+00	1.9	2.5	1.46E+00	1.9	2.5
2.00E-05	1.41E+00	2.3	3.2	1.48E+00	2.4	3.2	1.34E+00	1.9	2.5	1.44E+00	1.9	2.5
5.00E-05	1.42E+00	2.3	3.2	1.49E+00	2.4	3.3	1.42E+00	2	2.6	1.43E+00	2	2.6
1.00E-04	1.43E+00	2.4	3.2	1.49E+00	2.4	3.3	1.46E+00	2	2.6	1.45E+00	2	2.6
2.00E-04	1.44E+00	2.4	3.2	1.48E+00	2.5	3.3	1.47E+00	2	2.6	1.46E+00	2	2.6
5.00E-04	1.44E+00	2.4	3.3	1.45E+00	2.5	3.3	1.48E+00	2	2.7	1.45E+00	2	2.7
1.00E-03	1.43E+00	2.4	3.3	1.45E+00	2.5	3.3	1.49E+00	2	2.7	1.47E+00	2	2.7
2.00E-03	1.42E+00	2.4	3.3	1.44E+00	2.5	3.4	1.49E+00	2.1	2.8	1.48E+00	2.1	2.8
5.00E-03	1.42E+00	2.4	3.3	1.42E+00	2.5	3.4	1.46E+00	2.1	2.8	1.49E+00	2.1	2.8
1.00E-02	1.42E+00	2.5	3.3	1.42E+00	2.5	3.4	1.44E+00	2.1	2.8	1.52E+00	2.1	2.8
2.00E-02	1.45E+00	2.6	3.4	1.43E+00	2.7	3.5	1.46E+00	2.1	3	1.53E+00	2.1	3
3.00E-02	1.49E+00	2.9	3.4	1.45E+00	2.8	3.4	1.48E+00	2.1	2.8	1.53E+00	2.1	2.8
5.00E-02	1.56E+00	3.3	3.6	1.51E+00	3.1	3.5	1.51E+00	2.3	2.9	1.54E+00	2.3	2.9
7.00E-02	1.63E+00	3.9	3.9	1.57E+00	3.5	3.7	1.54E+00	2.5	2.9	1.57E+00	2.5	2.9
1.00E-01	1.74E+00	4.7	4.7	1.67E+00	4.2	4.2	1.60E+00	2.7	3	1.62E+00	2.7	3
1.50E-01	1.93E+00	5.8	5.8	1.85E+00	5.2	5.2	1.71E+00	3.1	3.4	1.71E+00	3.1	3.4
2.00E-01	2.12E+00	7.1	7.1	2.03E+00	6.6	6.6	1.83E+00	3.9	4	1.81E+00	3.9	4
3.00E-01	2.52E+00	9.2	9.2	2.43E+00	8.6	8.6	2.09E+00	5.5	5.5	2.02E+00	5.5	5.5
5.00E-01	3.34E+00	12	12.3	3.27E+00	11.6	11.8	2.66E+00	8.2	8.4	2.53E+00	8.2	8.4
7.00E-01	4.18E+00	13.1	15.4	4.18E+00	13.1	15	3.27E+00	9.9	11.6	3.12E+00	9.9	11.6
9.00E-01	5.04E+00	13.8	16.8	5.13E+00	13.9	16.6	3.92E+00	11.2	13.7	3.78E+00	11.2	13.7
1.00E+00	5.48E+00	13.9	17.2	5.62E+00	14.2	16.9	4.26E+00	11.7	14.1	4.14E+00	11.7	14.1
1.20E+00	6.39E+00	14.2	18.6	6.62E+00	14.3	18.4	4.98E+00	12.4	15.7	4.89E+00	12.4	15.7
1.50E+00	7.77E+00	14.3	19.4	8.13E+00	14.3	19.2	6.11E+00	12.8	17.1	6.09E+00	12.8	17.1
2.00E+00	1.01E+01	13.6	19.3	1.06E+01	13.8	19.3	8.05E+00	12.4	17.7	8.17E+00	12.4	17.7
3.00E+00	1.45E+01	12.4	18.1	1.52E+01	12.4	18.1	1.19E+01	11.7	17.3	1.24E+01	11.7	17.3
4.00E+00	1.85E+01	11.3	16.3	1.95E+01	11.2	16.2	1.56E+01	10.6	15.7	1.64E+01	10.6	15.7
5.00E+00	2.22E+01	10.3	14.8	2.32E+01	10.3	14.8	1.91E+01	9.9	14.6	2.00E+01	9.9	14.6
6.00E+00	2.54E+01	9.2	13.3	2.66E+01	9.3	13.5	2.22E+01	8.9	13.1	2.34E+01	8.9	13.1
7.00E+00	2.84E+01	8.8	12.6	2.96E+01	8.8	12.5	2.51E+01	8.4	12.4	2.64E+01	8.4	12.4
8.00E+00	3.10E+01	8.3	11.8	3.24E+01	8.4	11.7	2.77E+01	7.9	11.6	2.91E+01	7.9	11.6
9.00E+00	3.35E+01	8.2	11.2	3.48E+01	8.3	11.1	3.01E+01	7.9	11.1	3.16E+01	7.9	11.1
1.00E+01	3.57E+01	8.1	10.9	3.71E+01	8.1	10.8	3.23E+01	7.8	10.8	3.39E+01	7.8	10.8
1.20E+01	3.95E+01	7.9	10.3	4.10E+01	7.9	10.3	3.62E+01	7.5	10.2	3.79E+01	7.5	10.2
1.40E+01	4.28E+01	7.7	9.7	4.43E+01	7.7	9.7	3.95E+01	7.4	9.6	4.14E+01	7.4	9.6
1.50E+01	4.43E+01	7.7	10.2	4.57E+01	7.7	10.1	4.10E+01	7.3	10	4.29E+01	7.3	10
1.60E+01	4.56E+01	7.5	10.4	4.71E+01	7.5	10.4	4.24E+01	7.3	10.2	4.43E+01	7.3	10.2
1.80E+01	4.80E+01	7.4	11	4.95E+01	7.4	10.9	4.50E+01	7.1	10.7	4.69E+01	7.1	10.7
2.00E+01	5.01E+01	7.3	11.7	5.16E+01	7.2	11.5	4.73E+01	7	11.3	4.92E+01	7	11.3
2.10E+01	5.11E+01	7.2	11.5	5.25E+01	7.1	11.4	4.83E+01	6.9	11.2	5.03E+01	6.9	11.2
3.00E+01	5.80E+01	6.3	10.6	5.91E+01	6.3	10.4	5.60E+01	6.1	10.2	5.76E+01	6.1	10.2
5.00E+01	6.77E+01	5.4	8.8	6.83E+01	5.2	8.6	6.77E+01	5	8.3	6.74E+01	5	8.3
7.50E+01	7.67E+01	4.5	7.2	7.66E+01	4.4	7.2	7.93E+01	4.2	7.4	7.55E+01	4.2	7.4
1.00E+02	8.45E+01	4.1	6.7	8.38E+01	4	6.6	8.95E+01	3.9	6.6	8.26E+01	3.9	6.6
1.30E+02	9.29E+01	3.9	5.6	9.16E+01	3.8	5.4	1.00E+02	3.8	5.4	9.09E+01	3.8	5.4
1.50E+02	9.80E+01	3.5	5.3	9.64E+01	3.4	5.2	1.07E+02	3.1	4.9	9.63E+01	3.1	4.9
1.80E+02	1.05E+02	3.4	5.1	1.04E+02	3.4	5	1.17E+02	3.2	4.9	1.04E+02	3.2	4.9
2.00E+02	1.10E+02	3.3	4.9	1.08E+02	3.3	4.8	1.23E+02	3.1	4.8	1.10E+02	3.1	4.8
3.00E+02	1.32E+02	3.3	4.8	1.29E+02	3.3	4.7	1.50E+02	3.1	4.6	1.34E+02	3.1	4.6
4.00E+02	1.52E+02	3.2	4.6	1.48E+02	3.2	4.6	1.74E+02	3	4.4	1.56E+02	3	4.4
5.00E+02	1.70E+02	3.2	4.4	1.66E+02	3.1	4.4	1.94E+02	2.9	4.1	1.75E+02	2.9	4.1
6.00E+02	1.88E+02	3.1	4.3	1.82E+02	3.1	4.3	2.12E+02	2.9	4.1	1.92E+02	2.9	4.1
7.00E+02	2.03E+02	3	4.1	1.96E+02	3	4.1	2.28E+02	2.7	4	2.06E+02	2.7	4

(continued on next page)

Table A.2. (*continued*)

	Remainder tissues						Adrenals					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+02	2.17E+02	3	4	2.09E+02	3	3.9	2.42E+02	2.8	3.8	2.19E+02	2.8	3.8
9.00E+02	2.29E+02	2.9	3.8	2.20E+02	2.9	3.8	2.54E+02	2.7	3.6	2.30E+02	2.7	3.6
1.00E+03	2.39E+02	2.8	3.7	2.30E+02	2.8	3.7	2.65E+02	2.5	3.5	2.40E+02	2.5	3.5
2.00E+03	3.12E+02	2.6	3.4	2.95E+02	2.6	3.4	3.43E+02	2.5	3.2	3.11E+02	2.5	3.2
5.00E+03	4.31E+02	2.5	3.2	4.02E+02	2.5	3.1	4.74E+02	2.4	2.9	4.48E+02	2.4	2.9
1.00E+04	5.65E+02	2.3	3	5.26E+02	2.2	3	6.07E+02	2.1	2.9	6.30E+02	2.1	2.9
2.00E+04	8.14E+02	2	2.9	7.20E+02	2	2.8	8.89E+02	1.9	2.8	7.03E+02	1.9	2.8
5.00E+04	1.24E+03	1.7	2.6	1.11E+03	1.7	2.6	1.48E+03	1.6	2.5	1.11E+03	1.6	2.5
1.00E+05	1.86E+03	1.6	2.5	1.73E+03	1.6	2.5	2.03E+03	1.5	2.5	1.98E+03	1.5	2.5

	Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	5.81E-01	2.4	3.7	5.49E-01	2.4	3.1	4.33E-01	1.3	1.6	4.93E-01	1.4	1.5
1.00E-08	6.89E-01	2.7	3.8	6.66E-01	2.7	3.4	5.02E-01	1.3	1.7	5.57E-01	1.4	1.7
2.50E-08	7.41E-01	3.1	4.3	7.79E-01	2.8	3.5	6.03E-01	1.5	1.8	6.26E-01	1.6	1.7
1.00E-07	9.17E-01	3.2	4.5	9.98E-01	3	3.9	7.98E-01	1.6	1.9	8.48E-01	1.7	1.8
2.00E-07	1.03E+00	3.2	4.6	1.10E+00	3	4	8.74E-01	1.6	2.1	9.81E-01	1.7	2
5.00E-07	1.17E+00	3.1	4.6	1.24E+00	3.1	4.2	1.02E+00	1.7	2.1	1.11E+00	1.8	2
1.00E-06	1.25E+00	3.1	4.5	1.34E+00	3.2	4.2	1.14E+00	1.7	2.2	1.20E+00	1.8	2.1
2.00E-06	1.31E+00	3.1	4.4	1.45E+00	3.2	4.3	1.23E+00	1.7	2.3	1.31E+00	1.8	2.2
5.00E-06	1.35E+00	3.2	4.4	1.52E+00	3.2	4.3	1.30E+00	1.8	2.3	1.39E+00	1.9	2.2
1.00E-05	1.35E+00	3.2	4.4	1.53E+00	3.2	4.3	1.33E+00	1.8	2.4	1.42E+00	1.9	2.3
2.00E-05	1.35E+00	3.1	4.4	1.51E+00	3.3	4.3	1.35E+00	1.8	2.4	1.41E+00	1.9	2.3
5.00E-05	1.32E+00	3.1	4.2	1.50E+00	3.3	4.4	1.38E+00	1.9	2.5	1.45E+00	2	2.5
1.00E-04	1.30E+00	3	4.1	1.48E+00	3.3	4.4	1.39E+00	1.9	2.5	1.50E+00	1.9	2.5
2.00E-04	1.29E+00	3	4.1	1.46E+00	3.3	4.4	1.40E+00	1.9	2.5	1.51E+00	2	2.5
5.00E-04	1.28E+00	3	4.1	1.42E+00	3.3	4.5	1.42E+00	1.9	2.6	1.47E+00	2	2.5
1.00E-03	1.28E+00	3	4.2	1.42E+00	3.3	4.5	1.43E+00	2	2.6	1.47E+00	2	2.5
2.00E-03	1.26E+00	3.1	4.1	1.40E+00	3.3	4.5	1.42E+00	2	2.7	1.46E+00	2	2.7
5.00E-03	1.25E+00	3.2	4.2	1.35E+00	3.3	4.5	1.39E+00	2	2.7	1.47E+00	2.1	2.7
1.00E-02	1.27E+00	3.2	4.1	1.33E+00	3.4	4.5	1.39E+00	2	2.7	1.50E+00	2.1	2.7
2.00E-02	1.36E+00	4.1	4.1	1.35E+00	3.5	4.5	1.42E+00	2	2.9	1.52E+00	2.1	2.8
3.00E-02	1.46E+00	5.7	5.7	1.39E+00	3.8	4.5	1.45E+00	2.1	2.7	1.52E+00	2.1	2.7
5.00E-02	1.65E+00	6.2	6.2	1.50E+00	4.4	4.6	1.51E+00	2.2	2.8	1.54E+00	2.2	2.8
7.00E-02	1.84E+00	8.5	8.5	1.62E+00	5.2	5.2	1.57E+00	2.4	2.8	1.57E+00	2.5	2.8
1.00E-01	2.11E+00	11.2	11.2	1.81E+00	6.5	6.5	1.64E+00	2.6	2.9	1.63E+00	2.7	2.9
1.50E-01	2.56E+00	12.2	12.2	2.13E+00	8.4	8.4	1.75E+00	3.1	3.4	1.74E+00	3.1	3.3
2.00E-01	3.00E+00	14.5	14.5	2.46E+00	10.2	10.2	1.87E+00	3.9	3.9	1.85E+00	3.9	3.9
3.00E-01	3.89E+00	16.7	16.7	3.13E+00	12.8	12.8	2.10E+00	5.4	5.4	2.08E+00	5.5	5.5
5.00E-01	5.60E+00	19.1	19.5	4.53E+00	15.3	15.4	2.59E+00	8.1	8.3	2.59E+00	8.1	8.2
7.00E-01	7.21E+00	18.2	22.3	5.97E+00	16.4	18.5	3.13E+00	9.7	11.3	3.19E+00	9.8	11.3
9.00E-01	8.75E+00	17.3	23.1	7.40E+00	16.5	20	3.73E+00	11.1	13.5	3.87E+00	11.1	13.4
1.00E+00	9.49E+00	17.2	23.1	8.12E+00	16.4	19.9	4.06E+00	11.5	13.8	4.24E+00	11.6	13.7
1.20E+00	1.09E+01	17	23.6	9.53E+00	16.1	20.8	4.75E+00	12.2	15.4	5.03E+00	12.3	15.3
1.50E+00	1.30E+01	16.4	23.2	1.16E+01	15.5	21	5.86E+00	12.6	16.8	6.26E+00	12.7	16.7
2.00E+00	1.63E+01	14.7	22.1	1.48E+01	14.5	20.3	7.80E+00	12.2	17.4	8.40E+00	12.3	17.4
3.00E+00	2.19E+01	12.7	19.3	2.04E+01	12.5	18.2	1.17E+01	11.6	17	1.27E+01	11.6	17
4.00E+00	2.66E+01	11	16.5	2.52E+01	11.2	15.9	1.54E+01	10.5	15.4	1.67E+01	10.5	15.4
5.00E+00	3.05E+01	10.4	15	2.93E+01	10.2	14.4	1.88E+01	9.8	14.4	2.05E+01	9.8	14.4
6.00E+00	3.40E+01	9.1	13	3.29E+01	9	12.8	2.20E+01	8.9	12.9	2.38E+01	8.9	12.9
7.00E+00	3.69E+01	8.5	12.5	3.61E+01	8.6	12.1	2.50E+01	8.4	12.2	2.68E+01	8.4	12.2
8.00E+00	3.96E+01	8	11.8	3.89E+01	8.2	11.3	2.77E+01	7.9	11.5	2.96E+01	7.9	11.5
9.00E+00	4.19E+01	7.7	11.2	4.14E+01	8	10.7	3.02E+01	7.9	10.9	3.20E+01	7.9	10.9
1.00E+01	4.40E+01	7.7	11.1	4.36E+01	7.8	10.6	3.25E+01	7.7	10.6	3.43E+01	7.7	10.6
1.20E+01	4.75E+01	7.6	10.1	4.74E+01	7.8	9.8	3.66E+01	7.5	10	3.82E+01	7.4	10
1.40E+01	5.04E+01	7.6	9.6	5.06E+01	7.6	9.4	4.01E+01	7.4	9.5	4.15E+01	7.3	9.5
1.50E+01	5.16E+01	7.6	10.3	5.19E+01	7.5	9.7	4.17E+01	7.3	9.8	4.29E+01	7.2	9.9
1.60E+01	5.27E+01	7.4	10.8	5.32E+01	7.4	10	4.32E+01	7.2	10.1	4.43E+01	7.2	10.1

Table A.2. (*continued*)

	Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.80E+01	5.46E+01	7.4	11.5	5.53E+01	7.3	10.7	4.58E+01	7.1	10.6	4.67E+01	7.1	10.6
2.00E+01	5.62E+01	7.3	12.7	5.70E+01	7.1	11.3	4.81E+01	7	11.2	4.88E+01	7	11.2
2.10E+01	5.69E+01	7.2	12.7	5.78E+01	7.1	11.2	4.92E+01	6.9	11.1	4.97E+01	6.9	11.1
3.00E+01	6.15E+01	6.6	11.9	6.26E+01	6.3	10.4	5.65E+01	6.1	10.1	5.67E+01	6.1	10.1
5.00E+01	6.70E+01	5.3	9.5	6.87E+01	5.2	8.4	6.58E+01	5	8.2	6.69E+01	5	8.3
7.50E+01	7.21E+01	5.3	6.8	7.46E+01	4.4	7	7.46E+01	4.2	7.3	7.75E+01	4.2	7.3
1.00E+02	7.69E+01	4.6	6.8	8.02E+01	4	6.3	8.27E+01	3.9	6.6	8.70E+01	3.9	6.6
1.30E+02	8.24E+01	3.6	6.5	8.65E+01	3.9	5.5	9.17E+01	3.8	5.3	9.72E+01	3.8	5.3
1.50E+02	8.59E+01	3.6	6.5	9.03E+01	3.6	5.3	9.75E+01	3.2	4.9	1.03E+02	3.1	4.9
1.80E+02	9.10E+01	3.6	6.2	9.56E+01	3.6	5.1	1.06E+02	3.2	4.8	1.12E+02	3.1	4.8
2.00E+02	9.42E+01	3.6	5.4	9.88E+01	3.4	5	1.11E+02	3.1	4.7	1.18E+02	3.1	4.7
3.00E+02	1.10E+02	3.6	5.2	1.13E+02	3.4	4.8	1.37E+02	3.1	4.6	1.42E+02	3.1	4.6
4.00E+02	1.24E+02	3.6	5.1	1.25E+02	3.4	4.8	1.61E+02	3.1	4.4	1.63E+02	3	4.4
5.00E+02	1.36E+02	3.6	5	1.37E+02	3.2	4.5	1.82E+02	3	4.1	1.83E+02	2.9	4.1
6.00E+02	1.47E+02	3.5	4.8	1.47E+02	3.3	4.3	2.02E+02	3	4	2.00E+02	2.9	4.1
7.00E+02	1.58E+02	3.5	4.7	1.56E+02	3	4.1	2.20E+02	2.8	4	2.16E+02	2.7	4
8.00E+02	1.67E+02	3.5	4.6	1.64E+02	3.1	4	2.36E+02	2.8	3.7	2.30E+02	2.8	3.8
9.00E+02	1.75E+02	3.5	4.4	1.72E+02	3	3.9	2.50E+02	2.8	3.6	2.42E+02	2.7	3.6
1.00E+03	1.83E+02	3.4	4	1.78E+02	2.9	3.9	2.62E+02	2.6	3.4	2.53E+02	2.5	3.5
2.00E+03	2.35E+02	3	3.9	2.28E+02	2.7	3.5	3.49E+02	2.5	3.1	3.25E+02	2.5	3.2
5.00E+03	3.14E+02	2.7	3.8	3.18E+02	2.6	3.3	4.89E+02	2.4	2.9	4.44E+02	2.4	3
1.00E+04	3.92E+02	2.7	3.4	4.09E+02	2.4	3	6.30E+02	2.1	2.9	5.85E+02	2.1	2.9
2.00E+04	4.92E+02	2.1	3.1	5.53E+02	2.1	2.9	9.30E+02	1.9	2.8	7.45E+02	1.9	2.9
5.00E+04	7.85E+02	1.8	3	6.53E+02	1.7	2.6	1.42E+03	1.7	2.5	1.35E+03	1.6	2.6
1.00E+05	1.21E+03	1.7	2.9	1.32E+03	1.6	2.5	2.03E+03	1.5	2.5	1.81E+03	1.5	2.6

	Heart wall						Kidneys					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.51E-01	1.6	2	5.13E-01	1.8	2	4.76E-01	1.5	1.9	5.03E-01	1.5	1.9
1.00E-08	5.50E-01	1.7	2.1	6.09E-01	1.8	2.2	5.84E-01	1.6	2.1	6.07E-01	1.6	2.1
2.50E-08	6.30E-01	1.9	2.2	7.01E-01	1.9	2.4	6.69E-01	1.7	2.2	6.95E-01	1.7	2.2
1.00E-07	8.36E-01	1.8	2.4	9.13E-01	2	2.4	8.68E-01	1.7	2.3	9.01E-01	1.7	2.3
2.00E-07	9.55E-01	1.9	2.6	1.04E+00	2.1	2.6	9.82E-01	1.8	2.3	1.02E+00	1.8	2.3
5.00E-07	1.12E+00	1.9	2.6	1.22E+00	2.2	2.9	1.14E+00	1.9	2.5	1.18E+00	1.9	2.5
1.00E-06	1.23E+00	2	2.7	1.34E+00	2.2	3	1.23E+00	1.9	2.6	1.27E+00	1.9	2.6
2.00E-06	1.31E+00	2.1	2.7	1.42E+00	2.3	3.2	1.31E+00	1.9	2.6	1.35E+00	1.9	2.6
5.00E-06	1.38E+00	2.1	2.8	1.48E+00	2.3	3.1	1.37E+00	2	2.8	1.44E+00	2	2.8
1.00E-05	1.41E+00	2.1	2.8	1.52E+00	2.5	3.2	1.41E+00	2.1	2.8	1.47E+00	2.1	2.8
2.00E-05	1.43E+00	2.1	2.8	1.54E+00	2.5	3.2	1.43E+00	2.1	2.8	1.50E+00	2.1	2.8
5.00E-05	1.45E+00	2.1	2.8	1.56E+00	2.5	3.2	1.45E+00	2.2	2.9	1.54E+00	2.2	2.9
1.00E-04	1.47E+00	2.2	3	1.57E+00	2.5	3.3	1.47E+00	2.3	3	1.55E+00	2.3	3
2.00E-04	1.48E+00	2.2	3	1.56E+00	2.6	3.3	1.49E+00	2.3	3.2	1.55E+00	2.3	3.2
5.00E-04	1.49E+00	2.2	3	1.56E+00	2.6	3.5	1.50E+00	2.3	3.2	1.53E+00	2.3	3.2
1.00E-03	1.49E+00	2.2	3.1	1.56E+00	2.6	3.6	1.49E+00	2.3	3.2	1.51E+00	2.3	3.2
2.00E-03	1.48E+00	2.4	3.2	1.55E+00	2.5	3.6	1.48E+00	2.4	3.2	1.51E+00	2.4	3.2
5.00E-03	1.49E+00	2.4	3.3	1.52E+00	2.5	3.7	1.49E+00	2.4	3.3	1.51E+00	2.4	3.3
1.00E-02	1.51E+00	2.4	3.3	1.50E+00	2.5	3.7	1.50E+00	2.4	3.3	1.50E+00	2.4	3.3
2.00E-02	1.53E+00	2.5	3.2	1.51E+00	2.8	3.7	1.52E+00	2.5	3.3	1.51E+00	2.5	3.3
3.00E-02	1.55E+00	2.7	3.3	1.53E+00	2.9	3.6	1.54E+00	2.5	3.3	1.53E+00	2.5	3.3
5.00E-02	1.60E+00	2.7	3.3	1.58E+00	2.9	3.6	1.58E+00	2.6	3.4	1.56E+00	2.6	3.4
7.00E-02	1.64E+00	2.7	3.5	1.62E+00	3	3.7	1.61E+00	2.6	3.6	1.59E+00	2.6	3.6
1.00E-01	1.71E+00	2.9	3.7	1.69E+00	3.2	3.8	1.66E+00	2.8	3.6	1.65E+00	2.8	3.6
1.50E-01	1.83E+00	3.5	3.9	1.83E+00	4.2	4.2	1.76E+00	3.2	3.7	1.76E+00	3.2	3.7
2.00E-01	1.96E+00	4.3	4.3	1.98E+00	5	5	1.87E+00	3.9	3.9	1.88E+00	3.9	3.9
3.00E-01	2.24E+00	5.6	5.6	2.32E+00	6.4	6.4	2.12E+00	5.3	5.3	2.14E+00	5.3	5.3
5.00E-01	2.87E+00	8.4	8.7	3.09E+00	9.8	10.5	2.66E+00	7.7	8	2.75E+00	7.7	8
7.00E-01	3.56E+00	10.3	12.1	3.95E+00	12.2	13.2	3.25E+00	10	11.1	3.43E+00	10	11.1

(continued on next page)

Table A.2. (*continued*)

	Heart wall						Kidneys					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
9.00E-01	4.30E+00	11.8	14.1	4.88E+00	13.1	15.9	3.89E+00	11.3	13.4	4.18E+00	11.3	13.4
1.00E+00	4.70E+00	12	14.5	5.37E+00	13.8	16.4	4.23E+00	11.3	13.7	4.57E+00	11.3	13.7
1.20E+00	5.53E+00	13	16.4	6.37E+00	14.1	17.9	4.95E+00	12.8	15.8	5.40E+00	12.8	15.8
1.50E+00	6.84E+00	13.3	17.5	7.89E+00	14.2	18.8	6.10E+00	12.9	17.1	6.67E+00	12.9	17.1
2.00E+00	9.10E+00	13.5	19.2	1.04E+01	14.7	19.6	8.09E+00	13.2	18.1	8.82E+00	13.2	18.1
3.00E+00	1.35E+01	12.3	17.7	1.52E+01	12.5	18.1	1.21E+01	12.1	17.3	1.30E+01	12.1	17.3
4.00E+00	1.76E+01	11.5	16.3	1.95E+01	11.5	16.5	1.58E+01	11.4	16.1	1.70E+01	11.4	16.1
5.00E+00	2.13E+01	10.2	14.7	2.34E+01	10.3	14.5	1.93E+01	10.3	14.7	2.06E+01	10.3	14.7
6.00E+00	2.46E+01	9.5	13.4	2.68E+01	9.6	13.6	2.25E+01	9.4	13.5	2.39E+01	9.4	13.5
7.00E+00	2.76E+01	9	12.7	2.99E+01	8.8	12.7	2.54E+01	8.8	12.7	2.69E+01	8.8	12.7
8.00E+00	3.03E+01	8.2	11.8	3.27E+01	8.7	11.9	2.80E+01	8.5	12	2.95E+01	8.5	12
9.00E+00	3.28E+01	8.2	11.3	3.52E+01	8.4	11.4	3.05E+01	8.3	11.5	3.20E+01	8.3	11.5
1.00E+01	3.51E+01	8.2	11	3.75E+01	8.1	11	3.27E+01	8.2	11.1	3.42E+01	8.2	11.1
1.20E+01	3.91E+01	8.1	10.3	4.15E+01	8	10.3	3.66E+01	8.2	10.4	3.80E+01	8.2	10.4
1.40E+01	4.26E+01	7.8	9.8	4.49E+01	7.7	9.7	4.00E+01	7.7	9.7	4.13E+01	7.7	9.7
1.50E+01	4.41E+01	7.5	10.1	4.64E+01	7.5	9.9	4.15E+01	7.7	10.1	4.28E+01	7.7	10.1
1.60E+01	4.56E+01	7.5	10.2	4.78E+01	7.5	10.3	4.29E+01	7.7	10.4	4.41E+01	7.7	10.4
1.80E+01	4.82E+01	7.4	10.9	5.03E+01	7.5	10.8	4.54E+01	7.4	11	4.66E+01	7.4	11
2.00E+01	5.05E+01	7.3	11.6	5.24E+01	7.4	11.5	4.76E+01	7.3	11.8	4.87E+01	7.3	11.8
2.10E+01	5.16E+01	7.2	11.5	5.34E+01	7.3	11.4	4.86E+01	7.2	11.6	4.97E+01	7.2	11.6
3.00E+01	5.90E+01	6.8	11	6.02E+01	6.5	10.5	5.56E+01	6.4	10.1	5.68E+01	6.4	10.1
5.00E+01	6.90E+01	5.5	8.6	6.95E+01	5.8	9.3	6.54E+01	5.5	8.5	6.72E+01	5.5	8.5
7.50E+01	7.80E+01	4.6	6.8	7.78E+01	4.5	7.5	7.50E+01	4.5	7.2	7.69E+01	4.5	7.2
1.00E+02	8.59E+01	3.9	6.3	8.49E+01	3.9	6.9	8.39E+01	3.8	6.7	8.54E+01	3.8	6.7
1.30E+02	9.46E+01	3.8	5.8	9.25E+01	3.6	5.6	9.39E+01	3.7	5.3	9.47E+01	3.7	5.3
1.50E+02	9.99E+01	3.5	5.6	9.71E+01	3.5	5.3	1.00E+02	3.6	5.2	1.00E+02	3.6	5.2
1.80E+02	1.07E+02	3.5	5	1.04E+02	3.5	4.9	1.09E+02	3.4	5.1	1.08E+02	3.4	5.1
2.00E+02	1.12E+02	3.4	4.9	1.08E+02	3.3	4.7	1.15E+02	3.2	5	1.13E+02	3.2	5
3.00E+02	1.34E+02	3.4	4.8	1.28E+02	3.3	4.6	1.40E+02	3.1	4.5	1.36E+02	3.1	4.5
4.00E+02	1.54E+02	3.3	4.6	1.47E+02	3.2	4.6	1.62E+02	3.1	4.4	1.56E+02	3.1	4.4
5.00E+02	1.74E+02	3.2	4.1	1.65E+02	3.2	4.5	1.82E+02	3.1	4.3	1.75E+02	3.1	4.3
6.00E+02	1.93E+02	3.1	4	1.81E+02	3.2	4.5	2.01E+02	3	4.1	1.92E+02	3	4.1
7.00E+02	2.09E+02	3.1	4	1.96E+02	3.1	4.2	2.18E+02	3	4	2.08E+02	3	4
8.00E+02	2.24E+02	3	4	2.08E+02	3.1	3.9	2.33E+02	2.7	3.9	2.21E+02	2.7	3.9
9.00E+02	2.36E+02	3	3.9	2.19E+02	3	3.8	2.46E+02	2.6	3.8	2.33E+02	2.6	3.8
1.00E+03	2.47E+02	2.8	3.5	2.29E+02	2.9	3.7	2.58E+02	2.6	3.6	2.44E+02	2.6	3.6
2.00E+03	3.20E+02	2.7	3.5	2.93E+02	2.8	3.4	3.39E+02	2.6	3.5	3.19E+02	2.6	3.5
5.00E+03	4.45E+02	2.6	3.3	3.92E+02	2.5	3	4.73E+02	2.5	3.2	4.40E+02	2.5	3.2
1.00E+04	5.89E+02	2.1	3	5.02E+02	2.2	2.9	6.25E+02	2.2	2.9	5.70E+02	2.2	2.9
2.00E+04	8.05E+02	2	2.8	7.12E+02	2.1	2.8	8.87E+02	2	2.7	7.96E+02	2	2.7
5.00E+04	1.27E+03	1.8	2.6	1.07E+03	1.8	2.5	1.40E+03	1.7	2.6	1.25E+03	1.7	2.6
1.00E+05	1.83E+03	1.7	2.5	1.61E+03	1.7	2.4	2.02E+03	1.6	2.4	1.85E+03	1.6	2.4

	Lymphatic nodes						Muscle					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	5.03E-01	1.4	1.8	5.02E-01	1.4	1.8	5.90E-01	2.7	3.8	5.74E-01	2.5	3.4
1.00E-08	5.96E-01	1.5	1.9	6.13E-01	1.5	1.9	7.03E-01	2.9	4.1	6.88E-01	2.7	3.7
2.50E-08	6.75E-01	1.6	1.8	7.01E-01	1.6	1.8	7.94E-01	3.1	4.3	7.80E-01	2.8	3.9
1.00E-07	8.64E-01	1.6	1.9	8.92E-01	1.6	1.9	1.02E+00	3.2	4.5	1.01E+00	3	4.2
2.00E-07	9.68E-01	1.6	1.8	9.97E-01	1.6	1.8	1.14E+00	3.2	4.6	1.14E+00	3.1	4.3
5.00E-07	1.11E+00	1.6	1.9	1.16E+00	1.6	1.9	1.28E+00	3.3	4.7	1.30E+00	3.2	4.5
1.00E-06	1.21E+00	1.6	1.9	1.26E+00	1.6	1.9	1.37E+00	3.3	4.7	1.39E+00	3.2	4.6
2.00E-06	1.28E+00	1.6	1.9	1.32E+00	1.6	1.9	1.43E+00	3.3	4.7	1.46E+00	3.3	4.6
5.00E-06	1.31E+00	1.6	1.9	1.35E+00	1.6	1.9	1.47E+00	3.3	4.7	1.51E+00	3.3	4.6
1.00E-05	1.32E+00	1.6	1.9	1.37E+00	1.6	1.9	1.48E+00	3.4	4.7	1.53E+00	3.3	4.6
2.00E-05	1.33E+00	1.6	1.9	1.40E+00	1.6	1.9	1.48E+00	3.3	4.7	1.54E+00	3.3	4.6
5.00E-05	1.34E+00	1.6	2	1.40E+00	1.6	2	1.47E+00	3.3	4.7	1.53E+00	3.3	4.7
1.00E-04	1.34E+00	1.6	1.9	1.39E+00	1.6	1.9	1.45E+00	3.3	4.7	1.52E+00	3.3	4.7

Table A.2. (*continued*)

	Lymphatic nodes						Muscle					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E-04	1.34E+00	1.6	1.9	1.37E+00	1.6	1.9	1.43E+00	3.3	4.7	1.48E+00	3.3	4.7
5.00E-04	1.34E+00	1.6	1.9	1.35E+00	1.6	1.9	1.41E+00	3.3	4.7	1.42E+00	3.3	4.7
1.00E-03	1.34E+00	1.6	1.9	1.35E+00	1.6	1.9	1.39E+00	3.3	4.7	1.40E+00	3.3	4.7
2.00E-03	1.34E+00	1.6	2	1.36E+00	1.6	2	1.37E+00	3.3	4.6	1.40E+00	3.3	4.7
5.00E-03	1.34E+00	1.6	2	1.33E+00	1.6	2	1.36E+00	3.3	4.6	1.36E+00	3.3	4.7
1.00E-02	1.35E+00	1.7	2.1	1.32E+00	1.7	2.1	1.36E+00	3.4	4.5	1.34E+00	3.4	4.7
2.00E-02	1.40E+00	1.9	2.1	1.34E+00	1.9	2.1	1.40E+00	3.7	4.6	1.36E+00	3.6	4.7
3.00E-02	1.45E+00	2.2	2.2	1.37E+00	2.2	2.2	1.45E+00	4.1	4.6	1.39E+00	3.8	4.7
5.00E-02	1.54E+00	3.1	3.1	1.45E+00	3.1	3.1	1.56E+00	5.1	5.1	1.47E+00	4.5	4.8
7.00E-02	1.64E+00	3.7	3.7	1.52E+00	3.7	3.7	1.69E+00	6.2	6.2	1.56E+00	5.2	5.2
1.00E-01	1.79E+00	4.9	4.9	1.65E+00	4.9	4.9	1.89E+00	7.8	7.8	1.72E+00	6.5	6.5
1.50E-01	2.02E+00	7.2	7.2	1.87E+00	7.2	7.2	2.23E+00	10.2	10.2	1.99E+00	8.5	8.5
2.00E-01	2.26E+00	8.8	8.8	2.10E+00	8.8	8.8	2.57E+00	12	12	2.29E+00	10.3	10.3
3.00E-01	2.73E+00	10	10	2.56E+00	10	10	3.27E+00	14.5	14.5	2.90E+00	12.9	12.9
5.00E-01	3.67E+00	12.6	12.8	3.53E+00	12.6	12.8	4.65E+00	16.6	17.2	4.16E+00	15.5	15.9
7.00E-01	4.60E+00	14.4	16.5	4.54E+00	14.4	16.5	5.96E+00	17.1	20	5.45E+00	16.5	19
9.00E-01	5.54E+00	15.2	18	5.57E+00	15.2	18	7.24E+00	17	21	6.74E+00	16.6	20.5
1.00E+00	6.02E+00	14.7	18.2	6.10E+00	14.7	18.2	7.86E+00	17	21.2	7.38E+00	16.6	20.5
1.20E+00	6.99E+00	14.3	19.3	7.16E+00	14.3	19.3	9.11E+00	16.5	21.8	8.66E+00	16.3	21.3
1.50E+00	8.45E+00	14.2	20	8.74E+00	14.2	20	1.09E+01	15.8	21.8	1.05E+01	15.7	21.5
2.00E+00	1.08E+01	13.3	19.5	1.13E+01	13.3	19.5	1.37E+01	14.6	20.9	1.33E+01	14.6	20.8
3.00E+00	1.54E+01	12.1	18	1.60E+01	12.1	18	1.87E+01	12.5	18.5	1.83E+01	12.7	18.6
4.00E+00	1.95E+01	11.1	16.2	2.03E+01	11.1	16.2	2.29E+01	11.2	16.1	2.26E+01	11.3	16.3
5.00E+00	2.32E+01	10.2	14.9	2.41E+01	10.2	14.9	2.66E+01	10.1	14.5	2.63E+01	10.3	14.7
6.00E+00	2.66E+01	9.2	13.2	2.75E+01	9.2	13.2	2.98E+01	9	12.9	2.96E+01	9.1	13.1
7.00E+00	2.96E+01	8.7	12.4	3.06E+01	8.7	12.4	3.27E+01	8.5	12.2	3.26E+01	8.7	12.3
8.00E+00	3.22E+01	8.3	11.9	3.34E+01	8.3	11.9	3.53E+01	8.1	11.4	3.52E+01	8.2	11.5
9.00E+00	3.47E+01	8.3	11.1	3.59E+01	8.3	11.1	3.76E+01	8	10.8	3.76E+01	8.1	10.9
1.00E+01	3.69E+01	8.2	10.8	3.81E+01	8.2	10.8	3.98E+01	7.9	10.6	3.98E+01	7.9	10.8
1.20E+01	4.08E+01	7.7	10.2	4.21E+01	7.7	10.2	4.35E+01	7.8	9.9	4.36E+01	7.9	9.9
1.40E+01	4.40E+01	7.6	9.6	4.54E+01	7.6	9.6	4.67E+01	7.6	9.5	4.68E+01	7.7	9.6
1.50E+01	4.55E+01	7.6	9.9	4.69E+01	7.6	9.9	4.80E+01	7.6	9.8	4.82E+01	7.6	9.9
1.60E+01	4.68E+01	7.3	10.2	4.82E+01	7.3	10.2	4.93E+01	7.4	10.1	4.95E+01	7.5	10.2
1.80E+01	4.91E+01	7.4	10.2	5.06E+01	7.4	10.2	5.15E+01	7.3	10.8	5.17E+01	7.3	10.8
2.00E+01	5.11E+01	7.3	10.8	5.27E+01	7.3	10.8	5.33E+01	7.2	11.4	5.36E+01	7.2	11.5
2.10E+01	5.21E+01	7.2	10.7	5.36E+01	7.2	10.7	5.42E+01	7.1	11.3	5.45E+01	7.1	11.4
3.00E+01	5.86E+01	6.1	10	5.98E+01	6.1	10	5.97E+01	6.3	10.6	6.03E+01	6.4	10.6
5.00E+01	6.77E+01	4.6	8.2	6.84E+01	4.6	8.2	6.66E+01	5.2	8.5	6.78E+01	5.3	8.5
7.50E+01	7.61E+01	4.6	7.2	7.65E+01	4.6	7.2	7.27E+01	4.5	7	7.44E+01	4.4	7.1
1.00E+02	8.36E+01	4.3	7	8.33E+01	4.3	7	7.82E+01	4.1	6.4	8.00E+01	4	6.3
1.30E+02	9.18E+01	4	5.5	9.06E+01	4	5.5	8.42E+01	4	5.6	8.62E+01	3.9	5.6
1.50E+02	9.67E+01	3.5	5.4	9.51E+01	3.5	5.4	8.80E+01	3.7	5.4	8.99E+01	3.6	5.4
1.80E+02	1.03E+02	3.4	5.2	1.02E+02	3.4	5.2	9.34E+01	3.6	5.2	9.53E+01	3.6	5.1
2.00E+02	1.08E+02	3.4	4.6	1.06E+02	3.4	4.6	9.69E+01	3.4	5.2	9.88E+01	3.4	5
3.00E+02	1.28E+02	3.4	4.5	1.25E+02	3.4	4.5	1.14E+02	3.4	5	1.16E+02	3.4	4.9
4.00E+02	1.47E+02	3.3	4.4	1.44E+02	3.3	4.4	1.31E+02	3.4	4.9	1.33E+02	3.4	4.8
5.00E+02	1.66E+02	3.2	4.2	1.62E+02	3.2	4.2	1.48E+02	3.3	4.7	1.49E+02	3.3	4.6
6.00E+02	1.84E+02	3.1	4.2	1.78E+02	3.1	4.2	1.64E+02	3.2	4.5	1.64E+02	3.3	4.4
7.00E+02	2.00E+02	3.1	3.9	1.92E+02	3.1	3.9	1.78E+02	3.1	4.2	1.77E+02	3	4.1
8.00E+02	2.14E+02	3	3.8	2.05E+02	3	3.8	1.89E+02	3.1	4.1	1.89E+02	3.1	4.1
9.00E+02	2.26E+02	2.9	3.7	2.15E+02	2.9	3.7	2.00E+02	3	4	1.99E+02	3	3.9
1.00E+03	2.36E+02	2.9	3.6	2.25E+02	2.9	3.6	2.08E+02	2.9	3.9	2.07E+02	2.9	3.9
2.00E+03	3.04E+02	2.5	3.4	2.87E+02	2.5	3.4	2.65E+02	2.7	3.5	2.62E+02	2.7	3.5
5.00E+03	4.17E+02	2.5	3.2	3.91E+02	2.5	3.2	3.59E+02	2.6	3.3	3.51E+02	2.6	3.3
1.00E+04	5.57E+02	2.1	2.9	5.10E+02	2.1	2.9	4.75E+02	2.4	3	4.57E+02	2.4	3
2.00E+04	7.84E+02	2	2.9	7.34E+02	2	2.9	6.66E+02	2.1	3	6.27E+02	2.1	2.9
5.00E+04	1.26E+03	1.7	2.7	1.12E+03	1.7	2.7	1.06E+03	1.8	2.7	9.64E+02	1.7	2.6
1.00E+05	1.87E+03	1.7	2.6	1.70E+03	1.7	2.6	1.58E+03	1.6	2.5	1.45E+03	1.6	2.5

(*continued on next page*)

Table A.2. (*continued*)

	Oral mucosa						Pancreas					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	5.81E-01	2.9	3.6	6.48E-01	2.9	3.6	3.75E-01	1.2	1.2	4.74E-01	1.3	1.6
1.00E-08	7.02E-01	3	4	7.55E-01	3	4	4.94E-01	1.2	1.3	5.53E-01	1.3	1.6
2.50E-08	8.10E-01	3.2	4.2	8.65E-01	3.2	4.2	5.72E-01	1.4	1.4	6.38E-01	1.4	1.9
1.00E-07	1.04E+00	3.4	4.6	1.09E+00	3.4	4.6	7.20E-01	1.3	1.4	8.51E-01	1.5	1.9
2.00E-07	1.18E+00	3.4	4.7	1.20E+00	3.4	4.7	8.25E-01	1.3	1.4	9.66E-01	1.6	1.9
5.00E-07	1.35E+00	3.5	4.8	1.35E+00	3.5	4.8	9.69E-01	1.3	1.6	1.11E+00	1.7	1.9
1.00E-06	1.46E+00	3.5	4.9	1.45E+00	3.5	4.9	1.04E+00	1.3	1.6	1.21E+00	1.7	2.1
2.00E-06	1.54E+00	3.5	4.9	1.52E+00	3.5	4.9	1.09E+00	1.4	1.6	1.30E+00	1.8	2.2
5.00E-06	1.61E+00	3.5	4.9	1.57E+00	3.5	4.9	1.18E+00	1.4	1.7	1.39E+00	1.8	2.2
1.00E-05	1.62E+00	3.5	5	1.57E+00	3.5	5	1.21E+00	1.4	1.8	1.43E+00	1.9	2.3
2.00E-05	1.62E+00	3.5	5	1.54E+00	3.5	5	1.23E+00	1.4	1.8	1.46E+00	1.8	2.2
5.00E-05	1.60E+00	3.5	5.1	1.52E+00	3.5	5.1	1.25E+00	1.4	1.8	1.49E+00	1.8	2.4
1.00E-04	1.59E+00	3.5	5.1	1.49E+00	3.5	5.1	1.28E+00	1.5	1.9	1.51E+00	1.9	2.4
2.00E-04	1.57E+00	3.5	5.1	1.46E+00	3.5	5.1	1.30E+00	1.5	1.9	1.50E+00	1.9	2.5
5.00E-04	1.54E+00	3.5	5.1	1.41E+00	3.5	5.1	1.31E+00	1.5	2	1.48E+00	1.9	2.6
1.00E-03	1.52E+00	3.5	5.2	1.37E+00	3.5	5.2	1.33E+00	1.5	2	1.47E+00	1.9	2.6
2.00E-03	1.49E+00	3.4	5.2	1.35E+00	3.4	5.2	1.35E+00	1.6	2	1.48E+00	2	2.6
5.00E-03	1.47E+00	3.5	5.2	1.30E+00	3.5	5.2	1.36E+00	1.6	2	1.46E+00	2.1	2.7
1.00E-02	1.46E+00	3.6	5.2	1.29E+00	3.6	5.2	1.37E+00	1.7	2	1.46E+00	2.1	2.7
2.00E-02	1.49E+00	3.9	5.3	1.31E+00	3.9	5.3	1.39E+00	1.7	2.1	1.47E+00	2.1	2.7
3.00E-02	1.53E+00	4.3	5.4	1.34E+00	4.3	5.4	1.41E+00	1.7	2.1	1.50E+00	2.1	2.7
5.00E-02	1.62E+00	5.4	5.6	1.45E+00	5.4	5.6	1.46E+00	1.8	2.1	1.55E+00	2.3	2.8
7.00E-02	1.72E+00	6.5	6.5	1.57E+00	6.5	6.5	1.50E+00	1.7	2.1	1.58E+00	2.5	2.9
1.00E-01	1.87E+00	8.3	8.3	1.77E+00	8.3	8.3	1.55E+00	1.8	2.1	1.64E+00	2.6	3
1.50E-01	2.13E+00	9.2	9.2	2.12E+00	9.2	9.2	1.62E+00	1.9	2.1	1.73E+00	2.6	3.3
2.00E-01	2.42E+00	10.7	10.7	2.47E+00	10.7	10.7	1.68E+00	1.9	2.2	1.83E+00	3.5	3.5
3.00E-01	3.03E+00	12.9	12.9	3.19E+00	12.9	12.9	1.83E+00	2.4	2.6	2.06E+00	5.2	5.2
5.00E-01	4.33E+00	16.9	16.9	4.64E+00	16.9	16.9	2.16E+00	3.6	3.9	2.60E+00	6.6	6.9
7.00E-01	5.66E+00	17.1	19.6	6.09E+00	17.1	19.6	2.54E+00	5.2	5.9	3.23E+00	10.2	10.2
9.00E-01	6.99E+00	17.3	20	7.53E+00	17.3	20	2.99E+00	6.6	7.5	3.93E+00	11.1	12.2
1.00E+00	7.65E+00	17.3	20.6	8.25E+00	17.3	20.6	3.23E+00	7.2	7.7	4.31E+00	11.3	12.4
1.20E+00	8.97E+00	17.2	22	9.66E+00	17.2	22	3.79E+00	8.8	10.9	5.11E+00	12.2	15.2
1.50E+00	1.09E+01	16.8	22.2	1.17E+01	16.8	22.2	4.73E+00	10.7	13.6	6.37E+00	13.2	16.6
2.00E+00	1.40E+01	15.4	21.6	1.48E+01	15.4	21.6	6.47E+00	10.9	14.4	8.54E+00	13.5	17.5
3.00E+00	1.94E+01	13.4	19.6	2.03E+01	13.4	19.6	1.02E+01	11.8	16.5	1.28E+01	12	17.5
4.00E+00	2.40E+01	11.3	16.5	2.49E+01	11.3	16.5	1.39E+01	11.2	16.2	1.69E+01	11.4	16
5.00E+00	2.79E+01	10.5	14.4	2.88E+01	10.5	14.4	1.74E+01	10.4	15.1	2.06E+01	10.7	15.3
6.00E+00	3.13E+01	8.8	13.4	3.22E+01	8.8	13.4	2.07E+01	9.3	13.3	2.40E+01	9.7	13.9
7.00E+00	3.43E+01	8.4	12.3	3.51E+01	8.4	12.3	2.36E+01	8.9	12.8	2.70E+01	8.9	12.7
8.00E+00	3.68E+01	8.3	11.2	3.77E+01	8.3	11.2	2.63E+01	8.4	12.1	2.97E+01	8.4	12.2
9.00E+00	3.91E+01	8.2	10.8	3.99E+01	8.2	10.8	2.88E+01	8.3	11.2	3.22E+01	8.4	11.6
1.00E+01	4.11E+01	8.1	10.5	4.19E+01	8.1	10.5	3.11E+01	8.3	11.1	3.44E+01	8.3	11.2
1.20E+01	4.45E+01	7.9	10	4.54E+01	7.9	10	3.53E+01	8.2	10.4	3.84E+01	8.2	10.3
1.40E+01	4.72E+01	7.6	9.5	4.81E+01	7.6	9.5	3.89E+01	8	9.9	4.18E+01	8	9.5
1.50E+01	4.84E+01	7.6	10	4.93E+01	7.6	10	4.06E+01	8	10.3	4.33E+01	8	10.4
1.60E+01	4.95E+01	7.4	10.5	5.04E+01	7.4	10.5	4.21E+01	7.9	10.5	4.47E+01	7.8	10.6
1.80E+01	5.14E+01	7.2	11.1	5.22E+01	7.2	11.1	4.49E+01	7.7	11.1	4.72E+01	7.7	11.4
2.00E+01	5.30E+01	7.1	12	5.38E+01	7.1	12	4.74E+01	7.5	11.4	4.94E+01	7.5	11.9
2.10E+01	5.38E+01	7	11.9	5.45E+01	7	11.9	4.85E+01	7.3	11.3	5.05E+01	7.3	11.8
3.00E+01	5.91E+01	6.1	10.8	5.94E+01	6.1	10.8	5.66E+01	6.2	10.1	5.80E+01	5.8	10.6
5.00E+01	6.70E+01	5.1	8.7	6.64E+01	5.1	8.7	6.84E+01	5.8	9.9	6.91E+01	5.2	9.6
7.50E+01	7.44E+01	4.4	7.1	7.29E+01	4.4	7.1	7.92E+01	4.4	6.9	7.89E+01	4.3	7.9
1.00E+02	8.03E+01	4	6.5	7.86E+01	4	6.5	8.84E+01	4.2	6.5	8.71E+01	3.9	7
1.30E+02	8.64E+01	4	5.6	8.51E+01	4	5.6	9.83E+01	3.9	5.2	9.60E+01	3.7	5.1
1.50E+02	9.01E+01	3.7	5.5	8.93E+01	3.7	5.5	1.04E+02	3.3	4.8	1.02E+02	3.3	5
1.80E+02	9.52E+01	3.6	5.3	9.55E+01	3.6	5.3	1.13E+02	3.3	4.7	1.10E+02	3.3	4.9
2.00E+02	9.85E+01	3.5	5.2	9.95E+01	3.5	5.2	1.18E+02	3.2	4.6	1.15E+02	3.3	4.8
3.00E+02	1.13E+02	3.5	5	1.19E+02	3.5	5	1.41E+02	3	4.5	1.40E+02	3.3	4.8
4.00E+02	1.27E+02	3.5	4.9	1.36E+02	3.5	4.9	1.64E+02	3.1	4.4	1.62E+02	3.3	4.7
5.00E+02	1.39E+02	3.4	4.6	1.51E+02	3.4	4.6	1.86E+02	2.9	4.3	1.81E+02	3.1	4.6

Table A.2. (*continued*)

	Oral mucosa						Pancreas					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
6.00E+02	1.51E+02	3.3	4.4	1.64E+02	3.3	4.4	2.07E+02	2.7	4.3	2.00E+02	3	4.5
7.00E+02	1.62E+02	3.2	4.2	1.75E+02	3.2	4.2	2.26E+02	2.7	4.2	2.16E+02	2.9	4.4
8.00E+02	1.72E+02	3.2	4	1.85E+02	3.2	4	2.43E+02	2.8	3.9	2.30E+02	2.9	4.2
9.00E+02	1.81E+02	3.1	4	1.93E+02	3.1	4	2.58E+02	2.9	3.7	2.42E+02	2.9	3.9
1.00E+03	1.89E+02	3	3.9	2.01E+02	3	3.9	2.71E+02	2.8	3.6	2.53E+02	2.9	3.6
2.00E+03	2.47E+02	2.9	3.5	2.52E+02	2.9	3.5	3.58E+02	2.5	3.5	3.23E+02	2.8	3.1
5.00E+03	3.38E+02	2.8	3.2	3.34E+02	2.8	3.2	5.01E+02	2.5	3.1	4.34E+02	2.2	2.9
1.00E+04	4.25E+02	2.6	2.9	4.26E+02	2.6	2.9	6.78E+02	2.3	3.1	5.76E+02	2.2	2.9
2.00E+04	6.67E+02	2.3	2.9	5.27E+02	2.3	2.9	1.02E+03	2	3	7.80E+02	2	2.6
5.00E+04	8.13E+02	2	2.6	8.97E+02	2	2.6	1.44E+03	1.6	2.5	1.23E+03	1.7	2.6
1.00E+05	1.31E+03	1.9	2.4	1.24E+03	1.9	2.4	2.22E+03	1.6	2.4	1.94E+03	1.7	2.5

	Prostate (male)/uterus (female)						Small intestine wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.29E-01	1.3	1.6	4.28E-01	1.5	1.6	4.67E-01	1.5	1.8	4.65E-01	1.5	1.8
1.00E-08	5.40E-01	1.3	1.7	5.20E-01	1.5	1.7	5.63E-01	1.5	2	5.74E-01	1.5	2
2.50E-08	6.08E-01	1.5	1.7	5.88E-01	1.7	1.7	6.44E-01	1.7	2	6.60E-01	1.7	2
1.00E-07	7.73E-01	1.4	1.8	7.76E-01	1.6	1.8	8.42E-01	1.8	2.2	8.64E-01	1.8	2.2
2.00E-07	8.92E-01	1.4	1.8	8.93E-01	1.6	1.8	9.58E-01	1.8	2.3	9.80E-01	1.8	2.3
5.00E-07	1.03E+00	1.4	2	1.02E+00	1.5	2	1.11E+00	1.9	2.4	1.14E+00	1.9	2.4
1.00E-06	1.12E+00	1.4	2	1.09E+00	1.5	1.9	1.21E+00	1.9	2.4	1.24E+00	1.9	2.4
2.00E-06	1.17E+00	1.5	2	1.16E+00	1.6	1.9	1.29E+00	1.9	2.5	1.32E+00	1.9	2.5
5.00E-06	1.23E+00	1.5	2.1	1.24E+00	1.6	2	1.36E+00	2	2.6	1.39E+00	2	2.6
1.00E-05	1.28E+00	1.5	2.1	1.30E+00	1.6	2.1	1.40E+00	2	2.6	1.43E+00	2	2.6
2.00E-05	1.32E+00	1.5	2.2	1.33E+00	1.6	2.1	1.42E+00	2	2.6	1.45E+00	2	2.6
5.00E-05	1.32E+00	1.5	2.2	1.35E+00	1.6	2.1	1.44E+00	2.1	2.8	1.46E+00	2.1	2.8
1.00E-04	1.35E+00	1.6	2.3	1.38E+00	1.7	2.2	1.46E+00	2.1	2.8	1.46E+00	2.1	2.8
2.00E-04	1.38E+00	1.6	2.3	1.39E+00	1.7	2.2	1.46E+00	2.1	2.8	1.46E+00	2.1	2.8
5.00E-04	1.38E+00	1.6	2.4	1.37E+00	1.7	2.3	1.46E+00	2.1	2.8	1.44E+00	2.1	2.8
1.00E-03	1.37E+00	1.6	2.4	1.37E+00	1.7	2.3	1.46E+00	2.1	2.8	1.44E+00	2.1	2.8
2.00E-03	1.38E+00	1.7	2.4	1.38E+00	1.8	2.3	1.45E+00	2.2	3	1.44E+00	2.2	3
5.00E-03	1.38E+00	1.7	2.3	1.35E+00	1.8	2.3	1.45E+00	2.2	2.9	1.42E+00	2.2	2.9
1.00E-02	1.39E+00	1.8	2.3	1.34E+00	1.9	2.3	1.45E+00	2.2	2.9	1.42E+00	2.2	2.9
2.00E-02	1.42E+00	1.8	2.4	1.36E+00	1.9	2.4	1.47E+00	2.2	3.1	1.43E+00	2.2	3.1
3.00E-02	1.46E+00	1.8	2.4	1.40E+00	1.9	2.3	1.49E+00	2.2	2.9	1.45E+00	2.2	2.9
5.00E-02	1.51E+00	1.9	2.4	1.45E+00	2	2.4	1.53E+00	2.4	3	1.49E+00	2.4	3
7.00E-02	1.53E+00	1.8	2.4	1.49E+00	1.9	2.3	1.57E+00	2.6	3	1.53E+00	2.6	3
1.00E-01	1.58E+00	1.9	2.4	1.54E+00	2	2.3	1.64E+00	2.8	3.1	1.60E+00	2.8	3.1
1.50E-01	1.66E+00	2	2.4	1.62E+00	2.1	2.4	1.76E+00	3.3	3.5	1.72E+00	3.3	3.5
2.00E-01	1.75E+00	2	2.5	1.71E+00	2	2.4	1.89E+00	4.1	4.1	1.86E+00	4.1	4.1
3.00E-01	1.94E+00	2.6	3	1.88E+00	2.6	2.9	2.16E+00	5.8	5.8	2.15E+00	5.8	5.8
5.00E-01	2.33E+00	3.8	4.4	2.29E+00	3.9	4.3	2.75E+00	8.6	8.7	2.81E+00	8.6	8.7
7.00E-01	2.76E+00	5.5	6.6	2.78E+00	5.6	6.4	3.39E+00	10.3	11.9	3.54E+00	10.3	11.9
9.00E-01	3.26E+00	7	8.4	3.36E+00	7.1	8.2	4.07E+00	11.8	14.1	4.32E+00	11.8	14.1
1.00E+00	3.54E+00	7.7	8.7	3.68E+00	7.7	8.5	4.43E+00	12.2	14.4	4.73E+00	12.2	14.4
1.20E+00	4.18E+00	9.3	12.2	4.37E+00	9.4	11.8	5.19E+00	13	16.1	5.58E+00	13	16.1
1.50E+00	5.25E+00	11.3	15.2	5.48E+00	11.4	14.8	6.38E+00	13.4	17.5	6.88E+00	13.4	17.5
2.00E+00	7.20E+00	11.5	16	7.43E+00	11.6	15.6	8.43E+00	13	18.1	9.06E+00	13	18.1
3.00E+00	1.12E+01	12.5	18.3	1.14E+01	12.5	17.8	1.25E+01	12.3	17.7	1.33E+01	12.3	17.7
4.00E+00	1.51E+01	11.8	18	1.53E+01	11.8	17.5	1.63E+01	11.2	16.1	1.72E+01	11.2	16.1
5.00E+00	1.88E+01	11	16.8	1.90E+01	11	16.3	1.98E+01	10.4	14.9	2.08E+01	10.4	14.9
6.00E+00	2.22E+01	9.8	14.7	2.23E+01	9.8	14.3	2.30E+01	9.4	13.4	2.41E+01	9.4	13.4
7.00E+00	2.52E+01	9.4	14.2	2.53E+01	9.4	13.8	2.59E+01	8.8	12.6	2.71E+01	8.8	12.6
8.00E+00	2.80E+01	8.9	13.3	2.81E+01	8.9	13	2.86E+01	8.3	11.9	2.98E+01	8.3	11.9
9.00E+00	3.06E+01	8.7	12.4	3.06E+01	8.7	12	3.10E+01	8.3	11.3	3.22E+01	8.3	11.3
1.00E+01	3.29E+01	8.7	12.3	3.30E+01	8.7	11.9	3.32E+01	8.2	11	3.45E+01	8.2	11
1.20E+01	3.71E+01	8.6	11.5	3.72E+01	8.6	11.2	3.71E+01	7.9	10.3	3.85E+01	7.9	10.3

(continued on next page)

Table A.2. (*continued*)

	Prostate (male)/uterus (female)						Small intestine wall					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.40E+01	4.07E+01	8.4	10.9	4.08E+01	8.4	10.6	4.05E+01	7.8	9.8	4.19E+01	7.8	9.8
1.50E+01	4.23E+01	8.4	11.3	4.24E+01	8.4	11	4.20E+01	7.7	10.2	4.34E+01	7.7	10.2
1.60E+01	4.38E+01	8.3	11.5	4.39E+01	8.3	11.2	4.34E+01	7.6	10.4	4.49E+01	7.6	10.4
1.80E+01	4.64E+01	8.1	12.2	4.66E+01	8.1	11.9	4.60E+01	7.5	10.9	4.74E+01	7.5	10.9
2.00E+01	4.88E+01	7.9	12.5	4.90E+01	7.8	12.2	4.82E+01	7.4	11.5	4.96E+01	7.4	11.5
2.10E+01	4.98E+01	7.7	12.4	5.01E+01	7.7	12	4.93E+01	7.3	11.4	5.07E+01	7.3	11.4
3.00E+01	5.77E+01	6.5	11	5.83E+01	6.4	10.7	5.67E+01	6.4	10.4	5.79E+01	6.4	10.4
5.00E+01	7.04E+01	6.1	10.8	7.08E+01	6.1	10.5	6.74E+01	5.3	8.5	6.78E+01	5.3	8.5
7.50E+01	8.22E+01	4.6	7.5	8.20E+01	4.5	7.3	7.75E+01	4.4	7.5	7.69E+01	4.4	7.5
1.00E+02	9.08E+01	4.4	7.1	9.07E+01	4.3	6.9	8.65E+01	4.1	6.7	8.50E+01	4.1	6.7
1.30E+02	9.96E+01	4.1	5.6	9.97E+01	4	5.5	9.61E+01	4	5.4	9.38E+01	4	5.4
1.50E+02	1.05E+02	3.5	5.2	1.05E+02	3.4	5	1.02E+02	3.3	5	9.94E+01	3.3	5
1.80E+02	1.13E+02	3.5	5.1	1.14E+02	3.4	4.9	1.10E+02	3.3	4.9	1.07E+02	3.3	4.9
2.00E+02	1.19E+02	3.3	5	1.19E+02	3.3	4.8	1.16E+02	3.2	4.8	1.12E+02	3.2	4.8
3.00E+02	1.43E+02	3.1	4.8	1.43E+02	3.1	4.7	1.39E+02	3.3	4.7	1.36E+02	3.3	4.7
4.00E+02	1.65E+02	3.2	4.7	1.66E+02	3.2	4.6	1.61E+02	3.2	4.4	1.57E+02	3.2	4.4
5.00E+02	1.87E+02	3	4.7	1.87E+02	2.9	4.5	1.81E+02	3.1	4.1	1.77E+02	3.1	4.1
6.00E+02	2.08E+02	2.8	4.6	2.07E+02	2.8	4.5	2.00E+02	3.1	4.1	1.95E+02	3.1	4.1
7.00E+02	2.26E+02	2.8	4.5	2.25E+02	2.8	4.4	2.18E+02	2.9	4	2.11E+02	2.9	4
8.00E+02	2.43E+02	3	4.2	2.40E+02	2.9	4	2.33E+02	2.9	3.8	2.25E+02	2.9	3.8
9.00E+02	2.57E+02	3.1	3.9	2.54E+02	3	3.8	2.46E+02	2.9	3.6	2.36E+02	2.9	3.6
1.00E+03	2.69E+02	2.9	3.9	2.66E+02	2.8	3.8	2.57E+02	2.7	3.5	2.47E+02	2.7	3.5
2.00E+03	3.48E+02	2.6	3.8	3.43E+02	2.5	3.7	3.35E+02	2.6	3.2	3.18E+02	2.6	3.2
5.00E+03	4.76E+02	2.6	3.3	4.72E+02	2.5	3.2	4.68E+02	2.5	2.9	4.42E+02	2.5	2.9
1.00E+04	6.54E+02	2.4	3.2	6.36E+02	2.3	3.1	6.19E+02	2.2	2.9	5.91E+02	2.2	2.9
2.00E+04	1.03E+03	2.1	3.2	9.11E+02	2	3.1	8.87E+02	2	2.8	8.41E+02	2	2.8
5.00E+04	1.35E+03	1.7	2.6	1.40E+03	1.6	2.5	1.42E+03	1.7	2.5	1.27E+03	1.7	2.5
1.00E+05	2.43E+03	1.7	2.5	2.20E+03	1.6	2.4	2.18E+03	1.6	2.5	1.89E+03	1.6	2.5

	Spleen						Thymus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	4.95E-01	1.9	2.4	5.58E-01	2	2.5	5.45E-01	2.2	2.8	5.20E-01	1.8	2.7
1.00E-08	6.17E-01	1.9	2.5	6.76E-01	2	2.9	6.93E-01	2.3	3.1	6.75E-01	1.9	3
2.50E-08	7.11E-01	2	2.6	7.73E-01	2.4	3	8.03E-01	2.3	3.1	7.71E-01	2	3
1.00E-07	9.21E-01	2.1	2.6	1.01E+00	2.4	3.2	1.02E+00	2.6	3.4	9.90E-01	2.3	3.2
2.00E-07	1.04E+00	2.1	2.9	1.14E+00	2.3	3.2	1.13E+00	2.6	3.5	1.13E+00	2.4	3.3
5.00E-07	1.19E+00	2.2	2.9	1.29E+00	2.4	3.2	1.26E+00	2.7	3.7	1.32E+00	2.4	3.5
1.00E-06	1.30E+00	2.2	3	1.38E+00	2.4	3.3	1.36E+00	2.7	3.8	1.42E+00	2.5	3.6
2.00E-06	1.39E+00	2.4	3.1	1.43E+00	2.4	3.3	1.44E+00	2.8	3.8	1.50E+00	2.6	3.5
5.00E-06	1.49E+00	2.5	3.3	1.50E+00	2.7	3.4	1.51E+00	2.8	3.8	1.58E+00	2.7	3.6
1.00E-05	1.52E+00	2.5	3.3	1.56E+00	2.8	3.5	1.54E+00	2.8	3.9	1.59E+00	2.7	3.6
2.00E-05	1.52E+00	2.4	3.4	1.60E+00	2.8	3.7	1.55E+00	2.8	3.8	1.57E+00	2.7	3.6
5.00E-05	1.53E+00	2.4	3.4	1.61E+00	2.6	3.8	1.55E+00	2.8	3.9	1.53E+00	2.8	3.6
1.00E-04	1.54E+00	2.6	3.4	1.60E+00	2.6	3.8	1.53E+00	2.8	4	1.52E+00	2.8	3.7
2.00E-04	1.56E+00	2.6	3.5	1.57E+00	2.7	3.8	1.51E+00	2.8	3.9	1.51E+00	2.8	3.6
5.00E-04	1.55E+00	2.6	3.6	1.53E+00	2.7	3.9	1.50E+00	2.8	3.9	1.48E+00	2.9	3.6
1.00E-03	1.54E+00	2.5	3.7	1.53E+00	2.7	3.9	1.49E+00	2.8	3.9	1.46E+00	2.9	3.6
2.00E-03	1.53E+00	2.5	3.7	1.54E+00	2.8	4.2	1.48E+00	2.8	4	1.43E+00	3	3.7
5.00E-03	1.52E+00	2.5	3.7	1.52E+00	2.8	4.2	1.45E+00	2.8	3.9	1.39E+00	3	3.6
1.00E-02	1.53E+00	2.9	3.7	1.50E+00	2.8	4.2	1.42E+00	2.7	3.8	1.39E+00	2.7	3.7
2.00E-02	1.58E+00	2.9	3.7	1.49E+00	3.1	4.1	1.42E+00	3	3.8	1.41E+00	3	3.7
3.00E-02	1.60E+00	2.8	3.7	1.50E+00	3	4	1.46E+00	3.2	3.9	1.44E+00	3.1	3.7
5.00E-02	1.64E+00	2.8	4	1.53E+00	3.2	4.1	1.56E+00	3.5	4	1.52E+00	3.1	3.7
7.00E-02	1.67E+00	3	4	1.58E+00	3.3	4.2	1.68E+00	4.9	4.9	1.61E+00	3.2	4.3
1.00E-01	1.73E+00	3.5	4.2	1.66E+00	3.9	4.2	1.87E+00	5.2	5.2	1.74E+00	5.2	5.2
1.50E-01	1.85E+00	4.4	4.4	1.82E+00	4.4	4.4	2.17E+00	6.9	6.9	1.96E+00	5.5	5.5
2.00E-01	1.99E+00	4.8	4.8	1.99E+00	5	5.6	2.48E+00	8.4	8.4	2.20E+00	9.7	9.7
3.00E-01	2.29E+00	6.2	6.3	2.38E+00	7.1	7.1	3.06E+00	12.7	12.7	2.72E+00	12.4	12.4

Table A.2. (*continued*)

	Spleen						Thymus					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E-01	2.97E+00	9.2	9.7	3.21E+00	12.1	12.1	4.21E+00	14.5	15.7	3.81E+00	14.2	14.7
7.00E-01	3.69E+00	11.3	13.1	4.11E+00	12.7	14.6	5.32E+00	14.7	18.2	4.94E+00	15.2	18.3
9.00E-01	4.45E+00	13.1	14.6	5.06E+00	13.8	16.4	6.41E+00	14.9	18.5	6.07E+00	15.9	18.6
1.00E+00	4.85E+00	13.7	14.9	5.54E+00	14.9	17.3	6.95E+00	14.7	20.1	6.65E+00	15.9	18.9
1.20E+00	5.67E+00	14	16.8	6.53E+00	15	19	8.02E+00	14.7	20.6	7.80E+00	14.7	19.3
1.50E+00	6.96E+00	13.9	18.7	8.02E+00	14.8	18.9	9.59E+00	14.5	20.4	9.50E+00	14.5	20.2
2.00E+00	9.12E+00	13.3	18.9	1.04E+01	13.5	18.8	1.21E+01	14.2	20.1	1.22E+01	14.4	20.8
3.00E+00	1.33E+01	12.2	17.5	1.50E+01	12.3	17.8	1.67E+01	12.5	17.8	1.73E+01	12.6	18.5
4.00E+00	1.73E+01	11.5	16.1	1.91E+01	11.2	16.6	2.09E+01	12.2	16.9	2.18E+01	11.5	16.4
5.00E+00	2.08E+01	10.2	14.8	2.28E+01	10.4	14.5	2.46E+01	10.9	14	2.57E+01	10.6	14.7
6.00E+00	2.40E+01	9.2	13.1	2.62E+01	9.5	13.6	2.78E+01	9.7	12.8	2.92E+01	9.4	14.1
7.00E+00	2.69E+01	9.2	12.8	2.91E+01	8.7	12.8	3.08E+01	9.1	12.2	3.23E+01	9.4	12.4
8.00E+00	2.95E+01	8.4	11.7	3.18E+01	8.2	11.8	3.34E+01	8.8	11.6	3.51E+01	9.2	11.3
9.00E+00	3.19E+01	8.1	11.3	3.42E+01	8	11	3.58E+01	8.3	11.1	3.77E+01	8.8	10.9
1.00E+01	3.40E+01	8.1	10.6	3.65E+01	8	10.6	3.79E+01	8.2	10.7	4.00E+01	8.2	10.5
1.20E+01	3.77E+01	7.8	9.9	4.03E+01	7.7	10.5	4.17E+01	8.1	10.2	4.40E+01	8.1	10.3
1.40E+01	4.10E+01	7.7	9.7	4.36E+01	7.6	9.8	4.49E+01	8	9.5	4.74E+01	8	10
1.50E+01	4.24E+01	7.7	10.5	4.51E+01	7.6	10.3	4.63E+01	7.9	10	4.90E+01	7.9	10.1
1.60E+01	4.37E+01	7.6	10.6	4.64E+01	7.4	10.4	4.76E+01	7.5	10	5.04E+01	7.5	10.5
1.80E+01	4.62E+01	7.4	11.2	4.89E+01	7.2	10.8	5.00E+01	7	10.9	5.28E+01	7.1	11
2.00E+01	4.83E+01	7.3	11.6	5.10E+01	7.1	11.1	5.21E+01	6.7	11.6	5.50E+01	6.7	11.3
2.10E+01	4.93E+01	7.2	11.5	5.19E+01	7.1	11	5.31E+01	6.6	11.5	5.59E+01	6.7	11.2
3.00E+01	5.67E+01	6.5	10.5	5.87E+01	6.8	10.2	6.00E+01	6	11	6.21E+01	6.3	10
5.00E+01	6.77E+01	6.3	8.1	6.83E+01	4.8	7.8	6.98E+01	5.4	8.8	6.94E+01	5.1	7.6
7.50E+01	7.76E+01	4.6	7.4	7.68E+01	4.7	7	7.86E+01	4.5	7.4	7.53E+01	4.3	6.4
1.00E+02	8.58E+01	4.5	6.8	8.37E+01	4.5	5.7	8.61E+01	4.1	6.8	8.05E+01	3.9	6
1.30E+02	9.44E+01	3.8	5.5	9.13E+01	3.8	5.1	9.39E+01	3.9	6.4	8.64E+01	3.8	5.8
1.50E+02	9.96E+01	3.3	4.8	9.60E+01	3.3	5	9.86E+01	3.8	5.8	9.01E+01	3.7	5.2
1.80E+02	1.07E+02	3.4	4.7	1.03E+02	3.4	4.7	1.05E+02	3.7	5.6	9.55E+01	3.6	5.1
2.00E+02	1.12E+02	3.2	4.7	1.07E+02	3.3	4.7	1.10E+02	3.7	5.4	9.90E+01	3.6	5
3.00E+02	1.34E+02	3.2	4.6	1.28E+02	3.3	4.6	1.30E+02	3.5	5.2	1.16E+02	3.4	4.8
4.00E+02	1.54E+02	3.2	4.6	1.47E+02	3.2	4.6	1.48E+02	3.4	5	1.33E+02	3.3	4.7
5.00E+02	1.72E+02	3.2	4.5	1.64E+02	3.2	4.5	1.65E+02	3.4	4.8	1.50E+02	3.4	4.5
6.00E+02	1.90E+02	3.2	4.2	1.79E+02	3.2	4.2	1.80E+02	3.3	4.5	1.66E+02	3.3	4.3
7.00E+02	2.05E+02	3.1	4	1.93E+02	3.1	4	1.94E+02	3.2	4.4	1.81E+02	3.2	4.2
8.00E+02	2.19E+02	3	3.9	2.06E+02	3.1	3.9	2.05E+02	3.2	4.3	1.93E+02	3.2	4.1
9.00E+02	2.32E+02	2.9	3.7	2.17E+02	3	3.7	2.15E+02	3.1	4.1	2.05E+02	3.1	4
1.00E+03	2.43E+02	2.8	3.7	2.27E+02	2.9	3.6	2.25E+02	2.9	3.9	2.14E+02	3	3.8
2.00E+03	3.20E+02	2.5	3.2	2.98E+02	2.7	3.1	2.88E+02	2.7	3.5	2.72E+02	2.8	3.5
5.00E+03	4.49E+02	2.4	3	4.11E+02	2.5	3	3.94E+02	2.5	3.2	3.46E+02	2.7	3.4
1.00E+04	5.85E+02	2.1	2.8	5.22E+02	2.1	3	5.10E+02	2.3	2.9	4.19E+02	2.5	3.2
2.00E+04	8.06E+02	2	2.8	7.81E+02	2.1	3	7.24E+02	2	2.4	6.55E+02	2.1	2.7
5.00E+04	1.38E+03	1.7	2.7	1.13E+03	1.7	2.7	9.89E+02	1.7	2.5	9.36E+02	1.9	2.6
1.00E+05	2.01E+03	1.6	2.5	1.87E+03	1.7	2.5	1.51E+03	1.5	2.2	1.65E+03	1.6	2.2

	Lens of the eye					
E	Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E-09	7.86E-01	9.8	14.4	7.86E-01	9.8	14.4
1.00E-08	8.48E-01	7.9	11.3	8.48E-01	7.9	11.3
2.50E-08	8.55E-01	6.8	9.7	8.55E-01	6.8	9.7
1.00E-07	8.63E-01	5.1	7.2	8.63E-01	5.1	7.2
2.00E-07	8.71E-01	4.5	6.3	8.71E-01	4.5	6.3
5.00E-07	8.90E-01	3.9	5.4	8.90E-01	3.9	5.4
1.00E-06	9.15E-01	3.6	4.9	9.15E-01	3.6	4.9
2.00E-06	9.49E-01	3.4	4.6	9.49E-01	3.4	4.6
5.00E-06	1.00E+00	3.1	4.3	1.00E+00	3.1	4.3
1.00E-05	1.04E+00	3	4	1.04E+00	3	4

(continued on next page)

Table A.2. (*continued*)

	Lens of the eye					
E	Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E-05	1.07E+00	2.9	3.9	1.07E+00	2.9	3.9
5.00E-05	1.09E+00	2.8	3.7	1.09E+00	2.8	3.7
1.00E-04	1.09E+00	2.7	3.6	1.09E+00	2.7	3.6
2.00E-04	1.08E+00	2.7	3.5	1.08E+00	2.7	3.5
5.00E-04	1.05E+00	2.6	3.4	1.05E+00	2.6	3.4
1.00E-03	1.02E+00	2.6	3.3	1.02E+00	2.6	3.3
2.00E-03	1.01E+00	2.7	3.2	1.01E+00	2.7	3.2
5.00E-03	1.04E+00	3.3	3.3	1.04E+00	3.3	3.3
1.00E-02	1.13E+00	4.5	4.5	1.13E+00	4.5	4.5
2.00E-02	1.35E+00	7.1	7.1	1.35E+00	7.1	7.1
3.00E-02	1.55E+00	9.4	9.4	1.55E+00	9.4	9.4
5.00E-02	1.94E+00	12.9	12.9	1.94E+00	12.9	12.9
7.00E-02	2.29E+00	15.2	15.2	2.29E+00	15.2	15.2
1.00E-01	2.78E+00	17.6	17.6	2.78E+00	17.6	17.6
1.50E-01	3.52E+00	19.6	19.6	3.52E+00	19.6	19.6
2.00E-01	4.20E+00	20.6	20.6	4.20E+00	20.6	20.6
3.00E-01	5.45E+00	21.2	21.2	5.45E+00	21.2	21.2
5.00E-01	7.64E+00	20.8	23.5	7.64E+00	20.8	23.5
7.00E-01	9.58E+00	19.6	25.2	9.58E+00	19.6	25.2
9.00E-01	1.13E+01	18.5	25.1	1.13E+01	18.5	25.1
1.00E+00	1.22E+01	18.1	23.7	1.22E+01	18.1	23.7
1.20E+00	1.38E+01	17.1	24.3	1.38E+01	17.1	24.3
1.50E+00	1.59E+01	15.9	23.4	1.59E+01	15.9	23.4
2.00E+00	1.92E+01	14.3	21.5	1.92E+01	14.3	21.5
3.00E+00	2.47E+01	11.9	18.1	2.47E+01	11.9	18.1
4.00E+00	2.92E+01	10.5	15.2	2.92E+01	10.5	15.2
5.00E+00	3.31E+01	9.6	13.8	3.31E+01	9.6	13.8
6.00E+00	3.64E+01	8.5	12.1	3.64E+01	8.5	12.1
7.00E+00	3.94E+01	8.2	11.7	3.94E+01	8.2	11.7
8.00E+00	4.20E+01	7.8	10.8	4.20E+01	7.8	10.8
9.00E+00	4.43E+01	8	10.4	4.43E+01	8	10.4
1.00E+01	4.64E+01	8.1	10.5	4.64E+01	8.1	10.5
1.20E+01	5.01E+01	8.2	9.9	5.01E+01	8.2	9.9
1.40E+01	5.32E+01	8.2	9.8	5.32E+01	8.2	9.8
1.50E+01	5.45E+01	8.2	10.4	5.45E+01	8.2	10.4
1.60E+01	5.58E+01	8.2	10.9	5.58E+01	8.2	10.9
1.80E+01	5.80E+01	8.3	12	5.80E+01	8.3	12
2.00E+01	5.99E+01	8.3	13.1	5.99E+01	8.3	13.1
2.10E+01	6.08E+01	8.1	12.9	6.08E+01	8.1	12.9
3.00E+01	6.69E+01	7	11.3	6.69E+01	7	11.3
5.00E+01	7.45E+01	6	9.7	7.45E+01	6	9.7
7.50E+01	7.94E+01	5.3	8.2	7.94E+01	5.3	8.2
1.00E+02	8.23E+01	4.8	7.6	8.23E+01	4.8	7.6
1.30E+02	8.48E+01	4.7	6.6	8.48E+01	4.7	6.6
1.50E+02	8.60E+01	4.3	6.4	8.60E+01	4.3	6.4
1.80E+02	8.75E+01	4.2	6.2	8.75E+01	4.2	6.2
2.00E+02	8.84E+01	4.1	5.9	8.84E+01	4.1	5.9
3.00E+02	9.16E+01	4.1	5.8	9.16E+01	4.1	5.8
4.00E+02	9.41E+01	4	5.8	9.41E+01	4	5.8
5.00E+02	9.62E+01	3.8	5.4	9.62E+01	3.8	5.4
6.00E+02	9.81E+01	3.8	5.1	9.81E+01	3.8	5.1
7.00E+02	9.99E+01	3.5	4.8	9.99E+01	3.5	4.8
8.00E+02	1.02E+02	3.5	4.6	1.02E+02	3.5	4.6
9.00E+02	1.03E+02	3.5	4.6	1.03E+02	3.5	4.6
1.00E+03	1.05E+02	3.4	4.5	1.05E+02	3.4	4.5
2.00E+03	1.19E+02	3.1	4	1.19E+02	3.1	4
5.00E+03	1.57E+02	3	3.7	1.57E+02	3	3.7
1.00E+04	2.15E+02	2.6	3.3	2.15E+02	2.6	3.3
2.00E+04	3.27E+02	2.2	3	3.27E+02	2.2	3
5.00E+04	8.17E+02	1.9	2.8	8.17E+02	1.9	2.8
1.00E+05	1.34E+03	1.7	2.5	1.34E+03	1.7	2.5

Table A.3. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by positive pions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	5.13E+01	1	1	5.37E+01	1	1	1.70E+02	1.1	1.4	1.53E+02	1.1	1.3	5.08E+01	1	1.1	5.09E+01	1	1.1
1.50E+00	5.20E+01	1	1	5.65E+01	1	1	1.98E+02	1.1	1.4	1.67E+02	1.1	1.3	5.18E+01	1	1.1	5.30E+01	1	1.1
2.00E+00	5.35E+01	1	1	5.82E+01	1	1	2.18E+02	1.1	1.3	1.77E+02	1.1	1.3	5.33E+01	1	1.1	5.42E+01	1	1.1
3.00E+00	5.70E+01	1	1	6.12E+01	1	1	2.45E+02	1.1	1.4	1.95E+02	1.1	1.3	5.65E+01	1	1.1	5.68E+01	1	1.1
4.00E+00	6.11E+01	1	1	6.50E+01	1	1	2.69E+02	1.1	1.4	2.15E+02	1.1	1.4	5.99E+01	1	1.1	6.05E+01	1	1.1
5.00E+00	6.54E+01	1	1	6.95E+01	1	1	3.02E+02	1.2	1.4	2.46E+02	1.1	1.4	6.35E+01	1	1.1	6.42E+01	1	1.1
6.00E+00	6.91E+01	1	1	7.36E+01	1	1	3.47E+02	1.2	1.5	2.83E+02	1.2	1.5	6.67E+01	1	1.1	6.72E+01	1	1.1
8.00E+00	7.42E+01	1	1	7.97E+01	1	1	4.72E+02	1.2	1.6	3.69E+02	1.2	1.5	7.09E+01	1	1.1	7.11E+01	1	1.1
1.00E+01	7.93E+01	1	1	8.62E+01	1	1	5.93E+02	1.2	1.6	4.47E+02	1.2	1.5	7.40E+01	1	1.1	7.52E+01	1	1.1
1.50E+01	1.06E+02	1.1	1.1	1.14E+02	1.1	1.1	7.72E+02	1.2	1.5	5.86E+02	1.2	1.4	8.49E+01	1	1.1	8.93E+01	1	1.1
2.00E+01	1.48E+02	1.1	1.1	1.55E+02	1.1	1.1	7.98E+02	1.2	1.4	6.45E+02	1.2	1.4	1.13E+02	1	1.1	1.09E+02	1	1.1
3.00E+01	2.39E+02	1.1	1.1	2.54E+02	1.1	1.1	6.72E+02	1.2	1.3	6.13E+02	1.2	1.3	2.32E+02	1.1	1.3	2.50E+02	1.1	1.3
4.00E+01	3.43E+02	1.1	1.1	3.73E+02	1.1	1.1	5.45E+02	1.2	1.3	5.46E+02	1.2	1.3	3.64E+02	1.1	1.3	4.00E+02	1.1	1.3
5.00E+01	4.45E+02	1.2	1.1	4.86E+02	1.2	1.1	4.65E+02	1.3	1.3	4.82E+02	1.2	1.3	4.54E+02	1.2	1.3	4.60E+02	1.2	1.3
6.00E+01	5.22E+02	1.2	1.1	5.68E+02	1.2	1.1	4.35E+02	1.3	1.4	5.05E+02	1.2	1.4	5.04E+02	1.2	1.4	5.09E+02	1.2	1.4
8.00E+01	5.67E+02	1.2	1.1	5.91E+02	1.2	1.1	4.86E+02	1.4	1.5	5.59E+02	1.3	1.5	5.41E+02	1.2	1.5	5.73E+02	1.2	1.5
1.00E+02	5.47E+02	1.3	1.1	5.54E+02	1.3	1.1	5.15E+02	1.4	1.6	5.26E+02	1.4	1.6	5.38E+02	1.3	1.6	5.40E+02	1.3	1.6
1.50E+02	5.21E+02	1.5	1.2	5.24E+02	1.5	1.2	4.85E+02	1.4	1.8	5.08E+02	1.4	1.8	5.24E+02	1.4	1.7	5.28E+02	1.4	1.7
2.00E+02	5.36E+02	1.6	1.2	5.39E+02	1.6	1.2	5.25E+02	1.4	1.8	5.26E+02	1.5	1.8	5.43E+02	1.5	1.8	5.39E+02	1.5	1.8
3.00E+02	5.13E+02	1.6	1.2	5.11E+02	1.6	1.2	4.68E+02	1.4	1.8	4.82E+02	1.5	1.8	5.23E+02	1.6	1.9	5.14E+02	1.6	1.9
4.00E+02	4.81E+02	1.5	1.2	4.77E+02	1.5	1.2	4.40E+02	1.4	1.7	4.47E+02	1.5	1.8	4.88E+02	1.5	1.9	4.84E+02	1.5	1.9
5.00E+02	4.70E+02	1.5	1.2	4.66E+02	1.5	1.2	4.31E+02	1.4	1.7	4.37E+02	1.5	1.8	4.74E+02	1.5	1.9	4.73E+02	1.5	1.9
6.00E+02	4.75E+02	1.5	1.2	4.70E+02	1.5	1.2	4.35E+02	1.4	1.6	4.39E+02	1.5	1.8	4.77E+02	1.5	1.9	4.77E+02	1.5	1.9
8.00E+02	5.04E+02	1.6	1.2	4.99E+02	1.6	1.2	4.56E+02	1.4	1.7	4.60E+02	1.5	1.8	5.08E+02	1.5	1.9	5.04E+02	1.5	1.9
1.00E+03	5.31E+02	1.6	1.2	5.25E+02	1.6	1.2	4.75E+02	1.4	1.7	4.80E+02	1.5	1.8	5.38E+02	1.6	2	5.32E+02	1.6	2
1.50E+03	5.77E+02	1.6	1.2	5.68E+02	1.6	1.2	5.04E+02	1.5	1.8	5.12E+02	1.5	1.8	5.84E+02	1.6	1.9	5.80E+02	1.6	1.9
2.00E+03	5.93E+02	1.6	1.2	5.83E+02	1.6	1.2	5.16E+02	1.4	1.8	5.23E+02	1.5	1.8	6.01E+02	1.5	1.9	5.99E+02	1.5	1.9
3.00E+03	5.93E+02	1.5	1.2	5.77E+02	1.5	1.2	5.24E+02	1.4	1.9	5.20E+02	1.4	1.7	6.02E+02	1.5	1.9	5.96E+02	1.5	1.9
4.00E+03	6.06E+02	1.4	1.2	5.87E+02	1.4	1.2	5.34E+02	1.4	1.7	5.27E+02	1.4	1.7	6.16E+02	1.5	1.8	6.05E+02	1.5	1.8
5.00E+03	6.32E+02	1.5	1.2	6.12E+02	1.5	1.2	5.50E+02	1.3	1.8	5.45E+02	1.4	1.7	6.44E+02	1.4	1.8	6.30E+02	1.4	1.8
6.00E+03	6.62E+02	1.4	1.2	6.40E+02	1.4	1.2	5.68E+02	1.3	1.6	5.67E+02	1.4	1.6	6.76E+02	1.4	1.7	6.59E+02	1.4	1.7
8.00E+03	7.14E+02	1.4	1.2	6.84E+02	1.4	1.2	6.03E+02	1.3	1.7	6.04E+02	1.4	1.6	7.26E+02	1.4	1.7	7.08E+02	1.4	1.7
1.00E+04	7.50E+02	1.4	1.2	7.13E+02	1.4	1.2	6.34E+02	1.4	1.7	6.29E+02	1.4	1.6	7.61E+02	1.4	1.7	7.39E+02	1.4	1.7
1.50E+04	8.12E+02	1.4	1.2	7.73E+02	1.4	1.2	6.89E+02	1.4	1.7	6.68E+02	1.4	1.6	8.28E+02	1.4	1.7	8.05E+02	1.4	1.7
2.00E+04	8.63E+02	1.4	1.1	8.23E+02	1.4	1.1	7.37E+02	1.4	1.6	6.95E+02	1.4	1.5	8.81E+02	1.4	1.7	8.64E+02	1.4	1.7
3.00E+04	9.50E+02	1.4	1.2	8.91E+02	1.4	1.2	7.81E+02	1.4	1.4	7.44E+02	1.3	1.5	9.67E+02	1.4	1.7	9.38E+02	1.4	1.7
4.00E+04	1.02E+03	1.4	1.1	9.44E+02	1.4	1.1	8.25E+02	1.3	1.4	7.89E+02	1.3	1.5	1.04E+03	1.4	1.7	1.01E+03	1.4	1.7
5.00E+04	1.07E+03	1.4	1.2	9.93E+02	1.4	1.2	8.66E+02	1.3	1.4	8.28E+02	1.3	1.6	1.10E+03	1.3	1.7	1.07E+03	1.3	1.7
6.00E+04	1.13E+03	1.4	1.2	1.04E+03	1.4	1.2	9.01E+02	1.4	1.5	8.63E+02	1.3	1.5	1.16E+03	1.3	1.7	1.11E+03	1.3	1.7
8.00E+04	1.23E+03	1.3	1.1	1.12E+03	1.3	1.1	9.48E+02	1.3	1.5	9.28E+02	1.3	1.5	1.25E+03	1.3	1.6	1.18E+03	1.3	1.6
1.00E+05	1.32E+03	1.3	1.2	1.19E+03	1.3	1.2	1.01E+03	1.4	1.6	9.85E+02	1.3	1.5	1.34E+03	1.3	1.6	1.25E+03	1.3	1.6
1.50E+05	1.51E+03	1.3	1.1	1.37E+03	1.3	1.1	1.17E+03	1.3	1.5	1.10E+03	1.3	1.5	1.55E+03	1.3	1.6	1.45E+03	1.3	1.6
2.00E+05	1.68E+03	1.3	1.1	1.51E+03	1.3	1.1	1.27E+03	1.2	1.5	1.20E+03	1.3	1.5	1.75E+03	1.3	1.6	1.63E+03	1.3	1.6

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	5.59E+01	1	1.1	6.27E+01	1	1.1	4.22E+01	1	1.1	5.51E+01	1	1.1	1.18E+02	1.1	1.2	3.11E+01	1	1.1
1.50E+00	5.77E+01	1	1.1	6.53E+01	1	1.1	4.30E+01	1	1.1	5.71E+01	1	1.1	1.18E+02	1.1	1.3	3.11E+01	1	1.1
2.00E+00	5.91E+01	1	1.1	6.79E+01	1	1.1	4.43E+01	1	1.1	5.76E+01	1	1.1	1.17E+02	1.1	1.2	3.68E+01	1	1.1
3.00E+00	6.15E+01	1	1.1	7.20E+01	1	1.1	4.72E+01	1	1.1	5.99E+01	1	1.1	1.24E+02	1.1	1.2	4.06E+01	1	1.1
4.00E+00	6.48E+01	1	1.1	7.57E+01	1	1.1	4.96E+01	1	1.1	6.45E+01	1	1.1	1.39E+02	1.1	1.2	4.15E+01	1	1.1
5.00E+00	6.87E+01	1	1.1	7.98E+01	1	1.1	5.25E+01	1	1.1	6.88E+01	1	1.1	1.57E+02	1.1	1.3	4.21E+01	1	1.1
6.00E+00	7.21E+01	1	1.1	8.35E+01	1	1.1	5.51E+01	1	1.1	7.20E+01	1	1.1	1.72E+02	1.1	1.3	4.26E+01	1	1.1
8.00E+00	7.63E+01	1	1.1	8.89E+01	1	1.1	5.74E+01	1	1.1	7.49E+01	1	1.1	1.96E+02	1.1	1.3	4.27E+01	1	1.1
1.00E+01	7.95E+01	1	1.1	9.27E+01	1	1.1	5.84E+01	1	1.1	7.83E+01	1	1.1	2.23E+02	1.1	1.5	4.40E+01	1	1.2
1.50E+01	9.10E+01	1	1.1	1.05E+02	1	1.1	6.71E+01	1	1.1	9.37E+01	1	1.1	2.97E+02	1.2	1.4	5.22E+01	1	1.1
2.00E+01	1.12E+02	1	1.1	1.32E+02	1	1.1	8.63E+01	1	1.1	1.24E+02	1	1.1	3.65E+02	1.2	1.4	6.25E+01	1	1.1
3.00E+01	2.04E+02	1.1	1.2	2.51E+02	1.1	1.2	1.77E+02	1.1	1.2	2.55E+02	1.1	1.2	4.67E+02	1.1	1.4	8.98E+01	1	1.1
4.00E+01	4.11E+02	1.1	1.3	5.22E+02	1.1	1.3	3.04E+02	1.1	1.3	3.97E+02	1.1	1.3	4.46E+02	1.2	1.3	1.30E+02	1	1.1
5.00E+01	5.87E+02	1.2	1.3	6.36E+02	1.2	1.3	4.21E+02	1.2	1.3	4.94E+02	1.2	1.3	3.76E+02	1.2	1.4	3.35E+02	1.1	1.3
6.00E+01	6.29E+02	1.2	1.4	6.59E+02	1.2	1.4	5.07E+02	1.2	1.4	5.49E+02	1.2	1.4	4.50E+02	1.2	1.4	5.89E+02	1.1	1.3
8.00E+01	6.10E+02	1.3	1.5	6.04E+02	1.3	1.5	5.75E+02	1.2	1.4	5.71E+02	1.3	1.4	6.04E+02	1.3	1.5	6.35E+02	1.1	1.4
1.00E+02	5.60E+02	1.4	1.6	5.49E+02	1.3	1.6	5.64E+02	1.3	1.6	5.52E+02	1.3	1.6	5.20E+02	1.3	1.5	5.98E+02	1.2	1.5

(continued on next page)

Table A.3. (*continued*)

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.50E+02	5.32E+02	1.4	1.8	5.31E+02	1.4	1.8	5.27E+02	1.4	1.7	5.29E+02	1.4	1.7	5.00E+02	1.4	1.7	5.35E+02	1.3	1.7
2.00E+02	5.46E+02	1.5	1.9	5.47E+02	1.5	1.9	5.42E+02	1.5	1.8	5.38E+02	1.5	1.8	5.24E+02	1.5	1.8	5.64E+02	1.4	1.9
3.00E+02	5.12E+02	1.5	1.9	5.09E+02	1.5	1.9	5.24E+02	1.5	1.9	5.16E+02	1.5	1.9	5.47E+02	1.5	1.9	5.41E+02	1.6	2
4.00E+02	4.81E+02	1.6	1.9	4.74E+02	1.5	1.9	4.92E+02	1.6	1.8	4.82E+02	1.5	1.9	4.81E+02	1.5	1.9	4.97E+02	1.6	1.9
5.00E+02	4.73E+02	1.5	1.9	4.64E+02	1.5	1.9	4.79E+02	1.6	1.9	4.69E+02	1.5	1.9	4.60E+02	1.5	1.8	4.80E+02	1.6	1.8
6.00E+02	4.79E+02	1.6	1.9	4.70E+02	1.5	1.9	4.82E+02	1.6	1.9	4.73E+02	1.5	1.9	4.59E+02	1.6	1.8	4.85E+02	1.5	1.7
8.00E+02	5.06E+02	1.6	1.9	4.98E+02	1.5	1.9	5.10E+02	1.6	1.9	5.00E+02	1.5	1.9	4.91E+02	1.6	1.8	5.21E+02	1.5	1.6
1.00E+03	5.33E+02	1.6	1.9	5.22E+02	1.5	1.9	5.42E+02	1.6	1.9	5.26E+02	1.6	2	5.26E+02	1.7	1.9	5.50E+02	1.4	1.8
1.50E+03	5.79E+02	1.6	1.9	5.63E+02	1.5	1.9	5.94E+02	1.6	1.9	5.74E+02	1.6	2	5.66E+02	1.6	1.9	5.89E+02	1.5	1.7
2.00E+03	5.93E+02	1.6	1.9	5.77E+02	1.5	1.9	6.09E+02	1.6	1.9	5.86E+02	1.6	2	5.74E+02	1.6	1.9	6.15E+02	1.5	1.8
3.00E+03	5.88E+02	1.5	1.8	5.70E+02	1.5	1.8	6.11E+02	1.5	1.8	5.82E+02	1.5	1.9	5.73E+02	1.5	1.8	6.28E+02	1.5	1.6
4.00E+03	5.98E+02	1.5	1.8	5.76E+02	1.5	1.7	6.25E+02	1.5	1.8	5.98E+02	1.5	1.8	5.76E+02	1.4	1.7	6.29E+02	1.5	1.6
5.00E+03	6.21E+02	1.4	1.7	5.97E+02	1.4	1.7	6.52E+02	1.5	1.8	6.26E+02	1.5	1.6	5.94E+02	1.3	1.7	6.48E+02	1.5	1.5
6.00E+03	6.49E+02	1.4	1.7	6.21E+02	1.4	1.7	6.82E+02	1.4	1.7	6.53E+02	1.5	1.6	6.21E+02	1.4	1.6	6.82E+02	1.4	1.5
8.00E+03	6.96E+02	1.4	1.7	6.62E+02	1.4	1.7	7.30E+02	1.4	1.7	6.92E+02	1.4	1.6	6.81E+02	1.4	1.7	7.48E+02	1.5	1.5
1.00E+04	7.29E+02	1.4	1.7	6.90E+02	1.4	1.7	7.65E+02	1.4	1.7	7.21E+02	1.4	1.7	7.19E+02	1.4	1.8	7.86E+02	1.3	1.8
1.50E+04	7.85E+02	1.4	1.7	7.39E+02	1.4	1.7	8.29E+02	1.4	1.7	7.81E+02	1.4	1.8	7.67E+02	1.4	1.9	8.64E+02	1.4	1.6
2.00E+04	8.29E+02	1.4	1.7	7.74E+02	1.4	1.7	8.70E+02	1.3	1.7	8.25E+02	1.4	1.8	8.23E+02	1.3	1.9	9.32E+02	1.3	2
3.00E+04	8.99E+02	1.4	1.7	8.37E+02	1.4	1.7	9.67E+02	1.4	1.7	8.99E+02	1.4	1.8	8.98E+02	1.3	1.9	1.02E+03	1.4	1.7
4.00E+04	9.57E+02	1.4	1.7	8.89E+02	1.4	1.6	1.05E+03	1.3	1.7	9.62E+02	1.4	1.8	9.46E+02	1.3	1.8	1.07E+03	1.3	1.9
5.00E+04	1.01E+03	1.4	1.7	9.31E+02	1.4	1.6	1.11E+03	1.4	1.7	1.01E+03	1.4	1.7	9.93E+02	1.3	1.6	1.11E+03	1.3	1.6
6.00E+04	1.05E+03	1.3	1.6	9.68E+02	1.4	1.6	1.16E+03	1.3	1.8	1.06E+03	1.4	1.7	1.04E+03	1.4	1.5	1.16E+03	1.4	1.9
8.00E+04	1.14E+03	1.3	1.6	1.03E+03	1.3	1.6	1.25E+03	1.3	1.8	1.14E+03	1.3	1.6	1.14E+03	1.4	1.5	1.27E+03	1.4	1.7
1.00E+05	1.21E+03	1.3	1.6	1.10E+03	1.3	1.6	1.32E+03	1.3	1.8	1.22E+03	1.3	1.6	1.21E+03	1.4	1.5	1.37E+03	1.4	1.7
1.50E+05	1.37E+03	1.3	1.6	1.24E+03	1.3	1.5	1.52E+03	1.3	1.7	1.40E+03	1.3	1.6	1.38E+03	1.4	1.5	1.59E+03	1.4	1.5
2.00E+05	1.53E+03	1.3	1.6	1.35E+03	1.3	1.5	1.79E+03	1.3	1.7	1.62E+03	1.3	1.6	1.54E+03	1.4	1.5	1.71E+03	1.4	1.5

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	4.33E+01	1	1.1	5.35E+01	1	1.1	3.78E+01	1	1.1	4.98E+01	1	1.1	7.86E+01	1	1	7.86E+01	1	1
1.50E+00	4.46E+01	1	1.1	5.46E+01	1	1.1	4.34E+01	1	1.1	5.17E+01	1	1.1	7.79E+01	1	1.1	7.79E+01	1	1.1
2.00E+00	4.54E+01	1	1.1	5.60E+01	1	1.1	4.47E+01	1	1.1	5.23E+01	1	1.1	8.24E+01	1	1	8.24E+01	1	1
3.00E+00	4.80E+01	1	1.1	5.90E+01	1	1.1	4.54E+01	1	1.1	5.46E+01	1	1.1	9.21E+01	1	1.1	9.21E+01	1	1.1
4.00E+00	5.18E+01	1	1.1	6.28E+01	1	1.1	4.85E+01	1	1.1	5.77E+01	1	1.1	9.86E+01	1	1.1	9.86E+01	1	1.1
5.00E+00	5.48E+01	1	1.1	6.67E+01	1	1.1	5.27E+01	1	1.1	6.15E+01	1	1.1	1.06E+02	1	1.1	1.06E+02	1	1.1
6.00E+00	5.71E+01	1	1.1	6.97E+01	1	1.1	5.57E+01	1	1.1	6.48E+01	1	1.1	1.11E+02	1	1.1	1.11E+02	1	1.1
8.00E+00	6.05E+01	1	1.1	7.34E+01	1	1.1	5.75E+01	1	1.1	6.87E+01	1	1.1	1.19E+02	1	1.1	1.19E+02	1	1.1
1.00E+01	6.33E+01	1	1.1	7.69E+01	1	1.1	5.96E+01	1	1.1	7.12E+01	1	1.1	1.28E+02	1	1.1	1.28E+02	1	1.1
1.50E+01	7.15E+01	1	1.1	8.96E+01	1	1.1	6.95E+01	1	1.1	8.01E+01	1	1.1	1.47E+02	1.1	1.2	1.61E+02	1.1	1.2
2.00E+01	8.88E+01	1	1.1	1.17E+02	1	1.1	8.75E+01	1	1.1	1.04E+02	1	1.1	2.79E+02	1.1	1.3	3.10E+02	1.1	1.3
3.00E+01	1.72E+02	1.1	1.2	2.36E+02	1.1	1.2	1.54E+02	1.1	1.2	2.02E+02	1.1	1.2	5.01E+02	1.1	1.3	4.99E+02	1.1	1.3
4.00E+01	2.93E+02	1.1	1.3	3.80E+02	1.1	1.3	2.59E+02	1.1	1.3	2.82E+02	1.1	1.3	4.57E+02	1.2	1.3	4.41E+02	1.2	1.3
5.00E+01	4.11E+02	1.2	1.3	4.91E+02	1.2	1.3	4.02E+02	1.1	1.3	5.18E+02	1.1	1.3	4.86E+02	1.2	1.4	4.88E+02	1.2	1.4
6.00E+01	5.01E+02	1.2	1.4	5.57E+02	1.2	1.4	6.50E+02	1.2	1.4	6.90E+02	1.2	1.4	5.91E+02	1.3	1.4	6.05E+02	1.3	1.4
8.00E+01	5.72E+02	1.2	1.5	5.83E+02	1.3	1.5	6.75E+02	1.2	1.5	6.61E+02	1.2	1.5	5.51E+02	1.3	1.6	5.80E+02	1.3	1.6
1.00E+02	5.65E+02	1.3	1.6	5.59E+02	1.3	1.6	5.40E+02	1.3	1.6	5.41E+02	1.3	1.6	5.59E+02	1.5	1.7	5.59E+02	1.5	1.7
1.50E+02	5.28E+02	1.4	1.7	5.33E+02	1.4	1.7	5.31E+02	1.4	1.8	5.25E+02	1.4	1.8	5.36E+02	1.5	1.9	5.36E+02	1.5	1.9
2.00E+02	5.41E+02	1.5	1.8	5.44E+02	1.5	1.8	5.41E+02	1.4	1.8	5.43E+02	1.4	1.8	5.43E+02	1.6	1.9	5.43E+02	1.6	1.9
3.00E+02	5.23E+02	1.5	1.9	5.12E+02	1.5	1.9	5.23E+02	1.5	1.9	5.26E+02	1.5	1.9	4.94E+02	1.5	2	4.94E+02	1.5	2
4.00E+02	4.93E+02	1.5	1.9	4.79E+02	1.5	1.9	4.94E+02	1.5	1.9	4.86E+02	1.5	1.9	4.60E+02	1.5	1.9	4.60E+02	1.5	1.9
5.00E+02	4.81E+02	1.6	1.9	4.69E+02	1.5	1.9	4.82E+02	1.5	1.9	4.69E+02	1.5	1.9	4.55E+02	1.6	1.9	4.55E+02	1.6	1.9
6.00E+02	4.84E+02	1.6	1.9	4.74E+02	1.5	1.9	4.85E+02	1.5	1.9	4.71E+02	1.5	1.9	4.63E+02	1.6	1.8	4.63E+02	1.6	1.8
8.00E+02	5.12E+02	1.6	1.9	5.03E+02	1.6	1.9	5.14E+02	1.5	1.9	5.05E+02	1.5	1.9	4.85E+02	1.6	1.9	4.85E+02	1.6	1.9
1.00E+03	5.41E+02	1.6	2	5.30E+02	1.6	1.9	5.45E+02	1.6	1.9	5.36E+02	1.6	1.9	5.04E+02	1.6	1.9	5.04E+02	1.6	1.9
1.50E+03	5.89E+02	1.6	1.9	5.74E+02	1.6	1.9	5.90E+02	1.5	1.9	5.78E+02	1.5	1.9	5.34E+02	1.6	1.9	5.34E+02	1.6	1.9
2.00E+03	6.08E+02	1.5	1.9	5.89E+02	1.6	1.9	6.05E+02	1.5	1.9	5.85E+02	1.5	1.9	5.40E+02	1.6	1.9	5.40E+02	1.6	1.9
3.00E+03	6.07E+02	1.5	1.9	5.83E+02	1.5	1.8	5.99E+02	1.5	1.8	5.84E+02	1.5	1.8	5.45E+02	1.5	1.9	5.45E+02	1.5	1.9
4.00E+03	6.19E+02	1.5	1.8	5.94E+02	1.5	1.8	6.11E+02	1.5	1.9	6.00E+02	1.5	1.9	5.67E+02	1.5	1.8	5.67E+02	1.5	1.8
5.00E+03	6.48E+02	1.4	1.8	6.19E+02	1.4	1.8	6.40E+02	1.5	1.7	6.26E+02	1.5	1.7	5.93E+02	1.4	1.8	5.93E+02	1.4	1.8
6.00E+03	6.81E+02	1.4	1.8	6.48E+02	1.4	1.8	6.71E+02	1.5	1.8	6.52E+02	1.5	1.8	6.12E+02	1.4	1.9	6.12E+02	1.4	1.9
8.00E+03	7.33E+02	1.4	1.8	6.94E+02	1.4	1.8	7.20E+02	1.5	1.7	6.89E+02	1.5	1.7	6.28E+02	1.4	1.9	6.28E+02	1.4	1.9
1.00E+04	7.67E+02	1.4	1.8	7.27E+02	1.4	1.7	7.54E+02	1.4	1.8	7.18E+02	1.4	1.8	6.43E+02	1.4	2	6.43E+02	1.4	2
1.50E+04	8.32E+02	1.4	1.7	7.86E+02	1.4	1.7	8.16E+02	1.5	1.7	7.63E+02	1.5	1.7	7.01E+02	1.3	1.9	7.01E+02	1.3	1.9
2.00E+04	8.84E+02	1.4	1.7	8.30E+02	1.4	1.7	8.66E+02	1.5	1.7	7.95E+02	1.5	1.7	7.47E+02	1.3	1.9	7.47E+02	1.3	1.9
3.00E+04	9.67E+02	1.4	1.7	8.96E+02	1.4	1.7	9.53E+02	1.4	1.6	8.59E+02	1.4	1.6	8.05E+02	1.3	1.8	8.05E+02	1.3	1.8
4.00E+04	1.04E+03	1.4	1.7	9.54E+02	1.4	1.7	1.01E+03	1.4	1.5	9.13E+02	1.4	1.5	8.49E+02	1.3	1.7	8.49E+02	1.3	1.7
5.00E+04	1.11E+03	1.4	1.7	1.01E+03	1.4	1.7	1.06E+03	1.4	1.5	9.63E+02	1.4	1.5	8.87E+02	1.4	1.7	8.87E+02	1.4	1.7
6.00E+04	1.16E+03	1.4	1.7	1.05E+03	1.4	1.7	1.12E+03	1.4	1.5	1.01E+03	1.4	1.5	9.24E+02	1.3	1.6	9.24E+02	1.3	1.6

Table A.3. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+04	1.26E+03	1.3	1.7	1.13E+03	1.3	1.6	1.23E+03	1.4	1.6	1.10E+03	1.4	1.6	1.01E+03	1.3	1.6	1.01E+03	1.3	1.6
1.00E+05	1.34E+03	1.3	1.7	1.21E+03	1.3	1.6	1.34E+03	1.4	1.6	1.18E+03	1.4	1.6	1.09E+03	1.3	1.5	1.09E+03	1.3	1.5
1.50E+05	1.52E+03	1.3	1.6	1.36E+03	1.3	1.6	1.51E+03	1.3	1.7	1.34E+03	1.3	1.7	1.20E+03	1.3	1.5	1.20E+03	1.3	1.5
2.00E+05	1.70E+03	1.3	1.6	1.50E+03	1.3	1.6	1.62E+03	1.3	1.6	1.45E+03	1.3	1.6	1.29E+03	1.3	1.6	1.29E+03	1.3	1.6

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	3.46E+01	1	1.1	5.48E+01	1	1.1	7.62E+01	1	1.1	7.47E+01	1	1.1	7.03E+01	1	1.1	7.59E+01	1	1
1.50E+00	3.77E+01	1	1.1	5.50E+01	1	1.1	7.74E+01	1	1.1	7.75E+01	1	1.1	7.16E+01	1	1.1	7.64E+01	1	1
2.00E+00	3.92E+01	1	1.1	5.48E+01	1	1.1	7.96E+01	1	1.1	7.92E+01	1	1.1	7.24E+01	1	1.1	7.79E+01	1	1.1
3.00E+00	4.20E+01	1	1.1	5.70E+01	1	1.1	8.48E+01	1	1.1	8.32E+01	1	1.1	7.62E+01	1	1.1	8.14E+01	1	1
4.00E+00	4.50E+01	1	1.1	6.34E+01	1	1.1	9.11E+01	1	1.1	8.90E+01	1	1.1	8.25E+01	1	1.1	8.69E+01	1	1.1
5.00E+00	4.79E+01	1	1.1	7.00E+01	1	1.1	9.75E+01	1	1.1	9.53E+01	1	1.1	8.78E+01	1	1.1	9.39E+01	1	1
6.00E+00	5.00E+01	1	1.2	7.55E+01	1	1.1	1.03E+02	1	1.1	1.01E+02	1	1.1	9.20E+01	1	1.1	9.95E+01	1	1.1
8.00E+00	5.07E+01	1	1.1	8.32E+01	1	1.1	1.13E+02	1	1.1	1.11E+02	1	1.1	9.76E+01	1	1.1	1.05E+02	1	1.1
1.00E+01	5.22E+01	1	1.1	9.21E+01	1	1.1	1.24E+02	1	1.1	1.23E+02	1	1.1	1.03E+02	1	1.1	1.10E+02	1	1.1
1.50E+01	6.10E+01	1	1.1	1.32E+02	1.1	1.2	1.79E+02	1.1	1.2	1.77E+02	1.1	1.2	1.22E+02	1	1.1	1.38E+02	1	1.1
2.00E+01	7.39E+01	1	1.1	1.93E+02	1.1	1.3	2.66E+02	1.1	1.3	2.57E+02	1.1	1.3	1.72E+02	1.1	1.2	2.01E+02	1.1	1.2
3.00E+01	1.34E+02	1.1	1.2	2.79E+02	1.1	1.3	4.30E+02	1.1	1.3	4.24E+02	1.1	1.3	3.84E+02	1.1	1.3	4.41E+02	1.1	1.3
4.00E+01	2.38E+02	1.1	1.3	3.42E+02	1.1	1.3	5.39E+02	1.2	1.3	5.47E+02	1.2	1.3	6.13E+02	1.1	1.3	6.64E+02	1.1	1.3
5.00E+01	3.59E+02	1.1	1.3	3.99E+02	1.1	1.3	5.86E+02	1.2	1.4	6.05E+02	1.2	1.4	7.30E+02	1.2	1.4	7.49E+02	1.2	1.4
6.00E+01	4.65E+02	1.1	1.4	4.53E+02	1.1	1.3	5.95E+02	1.2	1.4	6.18E+02	1.2	1.4	7.41E+02	1.2	1.4	7.34E+02	1.2	1.4
8.00E+01	5.74E+02	1.2	1.5	6.03E+02	1.2	1.4	5.60E+02	1.3	1.5	5.73E+02	1.3	1.5	6.06E+02	1.3	1.5	5.98E+02	1.3	1.5
1.00E+02	5.75E+02	1.4	1.6	5.66E+02	1.3	1.6	5.27E+02	1.4	1.6	5.34E+02	1.4	1.6	5.26E+02	1.4	1.6	5.32E+02	1.4	1.6
1.50E+02	5.30E+02	1.5	1.7	5.33E+02	1.4	1.7	5.18E+02	1.5	1.8	5.21E+02	1.5	1.8	5.31E+02	1.5	1.8	5.33E+02	1.5	1.8
2.00E+02	5.44E+02	1.6	1.8	5.49E+02	1.5	1.9	5.27E+02	1.5	1.8	5.30E+02	1.5	1.8	5.45E+02	1.5	1.8	5.40E+02	1.5	1.8
3.00E+02	5.24E+02	1.6	1.9	5.19E+02	1.5	2	4.91E+02	1.5	1.9	4.91E+02	1.5	1.9	4.96E+02	1.5	1.9	4.92E+02	1.5	1.9
4.00E+02	4.94E+02	1.6	1.9	4.79E+02	1.5	1.9	4.61E+02	1.5	1.9	4.59E+02	1.5	1.9	4.62E+02	1.5	1.9	4.58E+02	1.5	1.8
5.00E+02	4.83E+02	1.5	1.9	4.64E+02	1.5	2	4.52E+02	1.5	1.9	4.50E+02	1.5	1.9	4.53E+02	1.5	1.9	4.48E+02	1.5	1.8
6.00E+02	4.89E+02	1.5	1.9	4.68E+02	1.5	1.9	4.56E+02	1.5	1.9	4.55E+02	1.5	1.9	4.58E+02	1.5	1.8	4.52E+02	1.5	1.8
8.00E+02	5.21E+02	1.6	2	4.92E+02	1.5	1.9	4.79E+02	1.5	1.9	4.78E+02	1.5	1.9	4.80E+02	1.5	1.9	4.72E+02	1.5	1.9
1.00E+03	5.49E+02	1.6	2	5.16E+02	1.5	1.8	5.01E+02	1.6	1.9	5.00E+02	1.6	1.9	4.98E+02	1.5	1.9	4.90E+02	1.5	1.9
1.50E+03	6.07E+02	1.6	2	5.75E+02	1.5	1.8	5.39E+02	1.6	1.9	5.36E+02	1.6	1.9	5.36E+02	1.5	1.9	5.26E+02	1.6	1.9
2.00E+03	6.32E+02	1.6	2	5.96E+02	1.5	1.8	5.52E+02	1.5	1.9	5.49E+02	1.5	1.9	5.49E+02	1.5	1.8	5.36E+02	1.5	1.9
3.00E+03	6.27E+02	1.5	1.9	5.93E+02	1.4	1.7	5.47E+02	1.5	1.8	5.42E+02	1.5	1.8	5.35E+02	1.5	1.8	5.27E+02	1.5	1.8
4.00E+03	6.42E+02	1.5	1.8	6.04E+02	1.4	1.7	5.55E+02	1.5	1.8	5.48E+02	1.5	1.8	5.36E+02	1.5	1.7	5.28E+02	1.5	1.7
5.00E+03	6.74E+02	1.5	1.8	6.31E+02	1.4	1.5	5.75E+02	1.4	1.7	5.67E+02	1.4	1.7	5.53E+02	1.4	1.7	5.42E+02	1.4	1.7
6.00E+03	7.09E+02	1.5	1.7	6.63E+02	1.4	1.6	5.99E+02	1.4	1.7	5.89E+02	1.4	1.7	5.74E+02	1.4	1.6	5.61E+02	1.4	1.7
8.00E+03	7.62E+02	1.5	1.8	7.16E+02	1.5	1.6	6.40E+02	1.4	1.7	6.26E+02	1.4	1.7	6.13E+02	1.4	1.6	5.93E+02	1.4	1.7
1.00E+04	7.98E+02	1.5	1.8	7.47E+02	1.5	1.6	6.68E+02	1.4	1.7	6.51E+02	1.4	1.7	6.37E+02	1.4	1.6	6.14E+02	1.4	1.6
1.50E+04	8.73E+02	1.4	1.8	8.11E+02	1.4	1.7	7.16E+02	1.4	1.7	6.99E+02	1.4	1.7	6.75E+02	1.4	1.7	6.48E+02	1.4	1.6
2.00E+04	9.41E+02	1.4	1.8	8.72E+02	1.4	1.6	7.56E+02	1.4	1.7	7.39E+02	1.4	1.7	7.05E+02	1.4	1.6	6.75E+02	1.4	1.6
3.00E+04	1.03E+03	1.4	1.7	9.47E+02	1.4	1.7	8.23E+02	1.4	1.6	7.97E+02	1.4	1.6	7.54E+02	1.4	1.6	7.19E+02	1.4	1.6
4.00E+04	1.11E+03	1.4	1.8	1.00E+03	1.4	1.7	8.75E+02	1.4	1.6	8.43E+02	1.4	1.6	7.92E+02	1.4	1.6	7.62E+02	1.4	1.6
5.00E+04	1.18E+03	1.4	1.7	1.05E+03	1.3	1.6	9.20E+02	1.3	1.7	8.83E+02	1.3	1.7	8.27E+02	1.3	1.6	7.98E+02	1.3	1.6
6.00E+04	1.25E+03	1.3	1.9	1.10E+03	1.3	1.7	9.63E+02	1.3	1.7	9.20E+02	1.3	1.7	8.61E+02	1.3	1.6	8.27E+02	1.3	1.7
8.00E+04	1.37E+03	1.3	2	1.19E+03	1.3	1.6	1.05E+03	1.3	1.6	9.87E+02	1.3	1.6	9.19E+02	1.3	1.6	8.70E+02	1.3	1.6
1.00E+05	1.46E+03	1.3	1.9	1.29E+03	1.3	1.6	1.12E+03	1.3	1.6	1.05E+03	1.3	1.6	9.75E+02	1.3	1.6	9.17E+02	1.3	1.6
1.50E+05	1.62E+03	1.3	1.8	1.50E+03	1.3	1.6	1.27E+03	1.3	1.6	1.20E+03	1.3	1.6	1.10E+03	1.3	1.5	1.04E+03	1.3	1.6
2.00E+05	1.81E+03	1.3	1.6	1.66E+03	1.3	1.6	1.39E+03	1.3	1.6	1.31E+03	1.3	1.6	1.20E+03	1.3	1.5	1.15E+03	1.3	1.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	1.04E+02	1	1.1	9.28E+01	1	1.1	6.98E+02	1.5	2.1	7.73E+02	1.5	2.1	5.20E+01	1	1.1	5.43E+01	1	1.1
1.50E+00	1.12E+02	1	1.1	9.18E+01	1	1.1	7.51E+02	1.5	2.1	8.33E+02	1.5	2.1	5.46E+01	1	1.1	5.66E+01	1	1.1
2.00E+00	1.16E+02	1	1.1	9.69E+01	1	1.1	8.20E+02	1.5	2.1	9.16E+02	1.5	2.1	5.61E+01	1	1.1	5.82E+01	1	1.1
3.00E+00	1.27E+02	1	1.1	1.08E+02	1	1.1	9.54E+02	1.4	2	1.07E+03	1.4	2	5.96E+01	1	1.1	6.13E+01	1	1.1
4.00E+00	1.40E+02	1	1.1	1.16E+02	1	1.1	1.08E+03	1.4	1.9	1.20E+03	1.4	1.9	6.38E+01	1	1.1	6.55E+01	1	1.1
5.00E+00	1.51E+02	1	1.1	1.27E+02	1	1.1	1.16E+03	1.4	1.9	1.26E+03	1.4	1.9	6.80E+01	1	1.1	7.05E+01	1	1.1
6.00E+00	1.62E+02	1	1.1	1.36E+02	1	1.1	1.22E+03	1.3	1.8	1.24E+03	1.3	1.8	7.19E+01	1	1.1	7.47E+01	1	1.1
8.00E+00	1.92E+02	1.1	1.2	1.49E+02	1.1	1.2	1.07E+03	1.2	1.5	1.07E+03	1.2	1.5	7.90E+01	1	1.1	8.08E+01	1	1.1
1.00E+01	2.35E+02	1.1	1.3	1.70E+02	1.1	1.3	9.30E+02	1.2	1.4	9.25E+02	1.2	1.4	8.72E+01	1	1.2	8.61E+01	1	1.1
1.50E+01	3.93E+02	1.1	1.3	2.76E+02	1.1	1.3	7.26E+02	1.1	1.2	7.23E+02	1.1	1.2	1.14E+02	1.1	1.2	1.06E+02	1.1	1.2

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Table A.3. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	5.11E+02	1.1	1.4	3.90E+02	1.1	1.4	6.26E+02	1.1	1.2	6.26E+02	1.1	1.2	1.43E+02	1.1	1.2	1.39E+02	1.1	1.2
3.00E+01	5.52E+02	1.1	1.4	5.20E+02	1.1	1.4	5.41E+02	1.1	1.3	5.44E+02	1.1	1.3	2.21E+02	1.1	1.3	2.35E+02	1.1	1.3
4.00E+01	5.48E+02	1.1	1.4	5.69E+02	1.1	1.4	5.14E+02	1.2	1.3	5.21E+02	1.2	1.3	3.33E+02	1.1	1.3	3.61E+02	1.1	1.3
5.00E+01	5.54E+02	1.2	1.4	5.96E+02	1.2	1.4	5.05E+02	1.2	1.3	5.14E+02	1.2	1.3	4.50E+02	1.1	1.3	4.99E+02	1.1	1.3
6.00E+01	5.63E+02	1.3	1.4	6.15E+02	1.3	1.4	5.00E+02	1.2	1.4	5.11E+02	1.2	1.4	5.37E+02	1.2	1.4	5.93E+02	1.2	1.4
8.00E+01	5.49E+02	1.3	1.5	5.97E+02	1.3	1.5	4.89E+02	1.3	1.5	4.99E+02	1.3	1.5	5.87E+02	1.2	1.5	6.06E+02	1.2	1.5
1.00E+02	5.14E+02	1.5	1.6	5.52E+02	1.5	1.6	4.79E+02	1.3	1.6	4.85E+02	1.3	1.6	5.58E+02	1.3	1.6	5.57E+02	1.3	1.6
1.50E+02	5.13E+02	1.5	1.7	5.25E+02	1.5	1.7	4.72E+02	1.5	1.8	4.72E+02	1.5	1.8	5.26E+02	1.4	1.7	5.29E+02	1.4	1.7
2.00E+02	5.28E+02	1.6	1.8	5.31E+02	1.6	1.8	4.69E+02	1.6	1.9	4.71E+02	1.6	1.9	5.46E+02	1.5	1.8	5.47E+02	1.5	1.8
3.00E+02	4.89E+02	1.5	1.8	4.86E+02	1.5	1.8	4.40E+02	1.6	1.9	4.39E+02	1.6	1.9	5.21E+02	1.5	1.9	5.13E+02	1.5	1.9
4.00E+02	4.55E+02	1.5	1.8	4.54E+02	1.5	1.8	4.18E+02	1.5	1.8	4.15E+02	1.5	1.8	4.86E+02	1.5	1.9	4.81E+02	1.5	1.9
5.00E+02	4.44E+02	1.5	1.8	4.45E+02	1.5	1.8	4.12E+02	1.5	1.7	4.08E+02	1.5	1.7	4.73E+02	1.5	1.9	4.71E+02	1.5	1.9
6.00E+02	4.49E+02	1.5	1.9	4.48E+02	1.5	1.9	4.15E+02	1.5	1.8	4.11E+02	1.5	1.8	4.76E+02	1.5	1.9	4.76E+02	1.5	1.9
8.00E+02	4.74E+02	1.6	1.9	4.71E+02	1.6	1.9	4.33E+02	1.5	1.8	4.27E+02	1.5	1.8	5.04E+02	1.5	1.9	5.03E+02	1.5	1.9
1.00E+03	4.96E+02	1.6	2	4.95E+02	1.6	2	4.49E+02	1.5	1.8	4.43E+02	1.5	1.8	5.30E+02	1.6	1.9	5.28E+02	1.6	1.9
1.50E+03	5.23E+02	1.6	1.9	5.33E+02	1.6	1.9	4.77E+02	1.5	1.9	4.70E+02	1.5	1.9	5.77E+02	1.6	1.9	5.71E+02	1.5	2
2.00E+03	5.29E+02	1.5	1.9	5.42E+02	1.5	1.9	4.88E+02	1.5	1.9	4.79E+02	1.5	1.9	5.95E+02	1.5	1.9	5.87E+02	1.5	1.9
3.00E+03	5.24E+02	1.4	1.8	5.34E+02	1.4	1.8	4.87E+02	1.4	1.7	4.77E+02	1.4	1.7	5.95E+02	1.5	1.8	5.80E+02	1.5	1.9
4.00E+03	5.28E+02	1.4	1.7	5.35E+02	1.4	1.7	4.95E+02	1.4	1.6	4.84E+02	1.4	1.6	6.06E+02	1.5	1.8	5.89E+02	1.5	1.8
5.00E+03	5.44E+02	1.3	1.7	5.51E+02	1.3	1.7	5.11E+02	1.4	1.7	4.99E+02	1.4	1.7	6.31E+02	1.5	1.7	6.13E+02	1.4	1.7
6.00E+03	5.66E+02	1.4	1.7	5.72E+02	1.4	1.7	5.30E+02	1.4	1.6	5.17E+02	1.4	1.6	6.61E+02	1.4	1.7	6.42E+02	1.4	1.7
8.00E+03	6.06E+02	1.3	1.7	6.06E+02	1.3	1.7	5.62E+02	1.4	1.6	5.45E+02	1.4	1.6	7.14E+02	1.4	1.7	6.90E+02	1.4	1.7
1.00E+04	6.33E+02	1.3	1.8	6.24E+02	1.3	1.8	5.83E+02	1.4	1.6	5.64E+02	1.4	1.6	7.50E+02	1.4	1.7	7.22E+02	1.4	1.7
1.50E+04	6.63E+02	1.3	1.8	6.67E+02	1.3	1.8	6.21E+02	1.4	1.6	6.00E+02	1.4	1.6	8.08E+02	1.4	1.7	7.76E+02	1.4	1.7
2.00E+04	6.86E+02	1.3	1.7	7.02E+02	1.3	1.7	6.53E+02	1.4	1.5	6.27E+02	1.4	1.5	8.55E+02	1.4	1.7	8.22E+02	1.4	1.8
3.00E+04	7.53E+02	1.4	1.7	7.42E+02	1.4	1.7	7.06E+02	1.3	1.6	6.72E+02	1.3	1.6	9.35E+02	1.4	1.7	8.92E+02	1.4	1.7
4.00E+04	8.03E+02	1.3	1.6	7.83E+02	1.3	1.6	7.48E+02	1.3	1.6	7.09E+02	1.3	1.6	1.01E+03	1.4	1.6	9.49E+02	1.4	1.7
5.00E+04	8.40E+02	1.4	1.6	8.24E+02	1.4	1.6	7.86E+02	1.3	1.6	7.42E+02	1.3	1.6	1.07E+03	1.4	1.6	9.98E+02	1.4	1.7
6.00E+04	8.72E+02	1.3	1.6	8.60E+02	1.3	1.6	8.19E+02	1.3	1.6	7.71E+02	1.3	1.6	1.12E+03	1.4	1.6	1.04E+03	1.4	1.7
8.00E+04	9.19E+02	1.3	1.6	9.47E+02	1.3	1.6	8.80E+02	1.3	1.5	8.21E+02	1.3	1.5	1.21E+03	1.3	1.6	1.12E+03	1.3	1.7
1.00E+05	9.60E+02	1.3	1.6	1.02E+03	1.3	1.6	9.35E+02	1.3	1.6	8.68E+02	1.3	1.6	1.29E+03	1.3	1.6	1.19E+03	1.3	1.7
1.50E+05	1.09E+03	1.3	1.5	1.12E+03	1.3	1.5	1.06E+03	1.3	1.6	9.78E+02	1.3	1.6	1.48E+03	1.3	1.6	1.37E+03	1.3	1.6
2.00E+05	1.21E+03	1.3	1.5	1.12E+03	1.3	1.5	1.18E+03	1.3	1.5	1.06E+03	1.3	1.5	1.66E+03	1.3	1.6	1.55E+03	1.3	1.6

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	3.62E+01	1	1.1	3.56E+01	1	1.1	9.70E+01	1.1	1.2	8.93E+01	1	1.1	3.77E+01	1	1.1	3.38E+01	1	1.1
1.50E+00	3.53E+01	1	1.1	3.68E+01	1	1.1	1.05E+02	1.1	1.2	9.00E+01	1	1.1	3.91E+01	1	1.1	3.64E+01	1	1.1
2.00E+00	3.72E+01	1	1.1	3.79E+01	1	1.1	1.11E+02	1.1	1.2	8.97E+01	1	1.1	3.77E+01	1	1.1	3.89E+01	1	1.1
3.00E+00	4.16E+01	1	1.1	4.06E+01	1	1.1	1.23E+02	1.1	1.2	9.10E+01	1	1.1	3.77E+01	1	1.1	4.34E+01	1	1.1
4.00E+00	4.44E+01	1	1.3	4.54E+01	1	1.3	1.33E+02	1.1	1.3	9.73E+01	1	1.1	4.22E+01	1	1.1	4.75E+01	1	1.1
5.00E+00	4.58E+01	1	1.1	5.05E+01	1	1.1	1.43E+02	1.1	1.3	1.07E+02	1	1.1	4.70E+01	1	1.1	5.11E+01	1	1.1
6.00E+00	4.70E+01	1	1.1	5.40E+01	1	1.1	1.54E+02	1.1	1.2	1.16E+02	1	1.1	5.02E+01	1	1.1	5.40E+01	1	1.1
8.00E+00	5.06E+01	1	1.1	5.70E+01	1	1.1	1.83E+02	1.1	1.3	1.34E+02	1	1.1	5.09E+01	1	1.1	5.83E+01	1	1.1
1.00E+01	5.43E+01	1	1.1	5.82E+01	1	1.1	2.18E+02	1.2	1.3	1.51E+02	1.1	1.2	5.11E+01	1	1.1	6.06E+01	1	1.1
1.50E+01	6.44E+01	1	1.1	6.29E+01	1	1.1	3.24E+02	1.2	1.4	2.07E+02	1.2	1.3	5.62E+01	1	1.1	6.39E+01	1	1.1
2.00E+01	7.81E+01	1	1.1	6.93E+01	1	1.1	3.93E+02	1.2	1.4	2.89E+02	1.2	1.3	6.59E+01	1	1.1	6.99E+01	1	1.1
3.00E+01	1.02E+02	1	1.1	1.08E+02	1	1.1	4.70E+02	1.2	1.4	3.62E+02	1.3	1.3	1.19E+02	1.1	1.2	1.14E+02	1	1.2
4.00E+01	2.59E+02	1.1	1.2	2.09E+02	1.1	1.2	5.30E+02	1.1	1.3	5.77E+02	1.3	1.3	2.19E+02	1.1	1.2	2.21E+02	1.1	1.2
5.00E+01	4.16E+02	1.1	1.3	3.74E+02	1.1	1.3	6.75E+02	1.1	1.4	7.50E+02	1.2	1.3	3.50E+02	1.1	1.3	3.75E+02	1.1	1.3
6.00E+01	4.19E+02	1.2	1.3	6.30E+02	1.2	1.3	6.79E+02	1.2	1.4	6.63E+02	1.2	1.4	4.72E+02	1.1	1.4	5.50E+02	1.1	1.4
8.00E+01	6.13E+02	1.2	1.4	6.89E+02	1.2	1.4	5.69E+02	1.3	1.5	5.82E+02	1.2	1.4	5.57E+02	1.1	1.5	6.27E+02	1.2	1.5
1.00E+02	5.88E+02	1.4	1.5	5.53E+02	1.4	1.5	5.24E+02	1.4	1.6	5.35E+02	1.3	1.5	5.44E+02	1.2	1.6	5.73E+02	1.3	1.7
1.50E+02	5.12E+02	1.4	1.6	5.10E+02	1.4	1.6	5.19E+02	1.5	1.8	5.41E+02	1.4	1.7	5.27E+02	1.4	1.8	5.22E+02	1.3	1.9
2.00E+02	5.67E+02	1.5	1.8	5.20E+02	1.5	1.8	5.27E+02	1.6	1.9	5.58E+02	1.5	1.7	5.62E+02	1.5	1.9	5.43E+02	1.4	2
3.00E+02	5.21E+02	1.6	1.9	5.08E+02	1.6	1.9	4.87E+02	1.5	1.9	5.03E+02	1.5	1.8	5.55E+02	1.7	2	5.14E+02	1.4	2.1
4.00E+02	4.89E+02	1.6	2	4.88E+02	1.6	2	4.58E+02	1.5	1.9	4.64E+02	1.6	1.7	5.07E+02	1.6	1.9	4.92E+02	1.5	2.2
5.00E+02	4.78E+02	1.6	2	4.84E+02	1.6	2	4.49E+02	1.4	1.9	4.53E+02	1.6	1.7	4.86E+02	1.7	1.9	4.89E+02	1.5	2.2
6.00E+02	4.84E+02	1.7	1.9	4.93E+02	1.7	1.9	4.52E+02	1.5	1.9	4.55E+02	1.6	1.6	4.89E+02	1.6	1.8	4.95E+02	1.5	2.1
8.00E+02	5.23E+02	1.7	1.9	5.23E+02	1.7	1.9	4.67E+02	1.5	1.9	4.77E+02	1.5	1.8	5.18E+02	1.6	1.9	5.18E+02	1.5	2.1
1.00E+03	5.61E+02	1.6	1.9	5.43E+02	1.6	1.9	4.82E+02	1.5	1.9	4.99E+02	1.5	1.9	5.46E+02	1.6	1.9	5.42E+02	1.5	2
1.50E+03	6.05E+02	1.6	2	5.82E+02	1.6	2	5.18E+02	1.5	1.9	5.35E+02	1.5	2	5.96E+02	1.6	2	5.88E+02	1.5	2
2.00E+03	6.19E+02	1.5	1.9	6.13E+02	1.5	1.9	5.32E+02	1.4	1.9	5.46E+02	1.5	1.9	6.11E+02	1.6	1.9	6.05E+02	1.5	1.9
3.00E+03	6.24E+02	1.4	1.8	6.02E+02	1.4	1.8	5.21E+02	1.4	1.8	5.35E+02	1.5	1.8	6.19E+02	1.6	1.9	5.92E+02	1.5	1.9
4.00E+03	6.42E+02	1.4	1.8	6.07E+02	1.4	1.8	5.24E+02	1.4	1.9	5.36E+02	1.5	1.9	6.36E+02	1.6	1.7	6.11E+02	1.5	1.7
5.00E+03	6.72E+02	1.3	1.7	6.37E+02	1.3	1.7	5.42E+02	1.4	1.8	5.49E+02	1.4	1.7	6.64E+02	1.5	1.8	6.47E+02	1.4	1.7
6.00E+03	7.05E+02	1.3	1.7	6.74E+02	1.3	1.7	5.65E+02	1.4	1.8	5.69E+02	1.4	1.9	6.96E+02	1.5	1.7	6.84E+02	1.4	1.6

Table A.3. (*continued*)

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+03	7.55E+02	1.4	1.6	7.30E+02	1.4	1.6	6.03E+02	1.4	1.7	6.10E+02	1.4	1.6	7.59E+02	1.4	1.8	7.40E+02	1.4	1.6
1.00E+04	7.86E+02	1.3	1.7	7.60E+02	1.3	1.7	6.23E+02	1.3	1.7	6.39E+02	1.5	1.7	8.00E+02	1.5	1.7	7.77E+02	1.3	1.6
1.50E+04	8.49E+02	1.3	1.6	8.18E+02	1.3	1.6	6.61E+02	1.3	1.6	6.87E+02	1.4	1.4	8.52E+02	1.4	1.9	8.36E+02	1.3	1.7
2.00E+04	9.01E+02	1.3	1.6	8.67E+02	1.3	1.6	6.94E+02	1.3	1.5	7.27E+02	1.4	1.8	8.90E+02	1.4	1.8	8.90E+02	1.3	1.8
3.00E+04	1.00E+03	1.3	1.6	9.49E+02	1.3	1.6	7.38E+02	1.3	1.6	7.64E+02	1.3	1.7	9.74E+02	1.3	1.8	9.74E+02	1.4	1.9
4.00E+04	1.09E+03	1.3	1.5	1.04E+03	1.3	1.5	7.80E+02	1.4	1.6	7.92E+02	1.3	2.1	1.07E+03	1.3	1.7	1.04E+03	1.5	1.7
5.00E+04	1.16E+03	1.3	1.6	1.11E+03	1.3	1.6	8.19E+02	1.4	1.6	8.23E+02	1.2	1.8	1.15E+03	1.4	1.6	1.09E+03	1.6	1.7
6.00E+04	1.22E+03	1.4	1.6	1.17E+03	1.4	1.6	8.54E+02	1.4	1.7	8.58E+02	1.3	1.9	1.23E+03	1.4	1.4	1.13E+03	1.5	1.6
8.00E+04	1.33E+03	1.3	1.7	1.23E+03	1.3	1.7	9.04E+02	1.4	1.6	9.23E+02	1.3	1.7	1.33E+03	1.4	1.4	1.21E+03	1.5	1.8
1.00E+05	1.41E+03	1.4	1.7	1.30E+03	1.4	1.7	9.55E+02	1.3	1.6	9.83E+02	1.3	1.5	1.42E+03	1.4	1.5	1.27E+03	1.4	1.8
1.50E+05	1.59E+03	1.3	1.7	1.53E+03	1.3	1.7	1.09E+03	1.3	1.4	1.12E+03	1.2	1.5	1.63E+03	1.4	1.5	1.44E+03	1.3	1.8
2.00E+05	1.89E+03	1.3	1.5	1.85E+03	1.3	1.5	1.18E+03	1.3	1.4	1.21E+03	1.2	1.4	1.89E+03	1.5	1.6	1.67E+03	1.3	1.6

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	4.19E+01	1	1.1	5.15E+01	1	1.1	4.03E+01	1	1.1	4.51E+01	1	1.1	6.24E+01	1	1.1	6.07E+01	1	1.1
1.50E+00	4.38E+01	1	1.1	5.30E+01	1	1.1	4.25E+01	1	1.1	4.67E+01	1	1.1	6.48E+01	1	1.1	6.29E+01	1	1.1
2.00E+00	4.47E+01	1	1.1	5.36E+01	1	1.1	4.32E+01	1	1.1	4.81E+01	1	1.1	6.77E+01	1	1.1	6.48E+01	1	1.1
3.00E+00	4.70E+01	1	1.1	5.54E+01	1	1.1	4.45E+01	1	1.1	5.05E+01	1	1.1	7.45E+01	1	1.1	6.85E+01	1	1.1
4.00E+00	4.98E+01	1	1.1	6.05E+01	1	1.1	4.69E+01	1	1.1	5.33E+01	1	1.1	8.13E+01	1	1.1	7.29E+01	1	1.1
5.00E+00	5.18E+01	1	1.1	6.56E+01	1	1.1	4.99E+01	1	1.1	5.61E+01	1	1.1	8.67E+01	1	1.1	7.78E+01	1	1.1
6.00E+00	5.34E+01	1	1.1	6.93E+01	1	1.1	5.25E+01	1	1.1	5.88E+01	1	1.1	9.19E+01	1.1	1.1	8.24E+01	1.1	1.1
8.00E+00	5.65E+01	1	1.1	7.28E+01	1	1.1	5.58E+01	1	1.1	6.41E+01	1	1.1	1.05E+02	1.1	1.2	9.01E+01	1.1	1.2
1.00E+01	5.96E+01	1	1.1	7.57E+01	1	1.1	5.84E+01	1	1.1	6.67E+01	1	1.1	1.23E+02	1.1	1.2	9.95E+01	1.1	1.2
1.50E+01	6.83E+01	1	1.1	8.52E+01	1	1.1	6.48E+01	1	1.1	7.08E+01	1	1.1	1.73E+02	1.1	1.3	1.39E+02	1.1	1.3
2.00E+01	8.39E+01	1	1.1	1.05E+02	1	1.1	7.29E+01	1	1.1	8.02E+01	1	1.1	2.07E+02	1.1	1.3	1.92E+02	1.1	1.3
3.00E+01	1.59E+02	1.1	1.2	2.08E+02	1.1	1.2	1.07E+02	1	1.1	1.32E+02	1	1.1	2.65E+02	1.1	1.3	2.78E+02	1.1	1.3
4.00E+01	2.83E+02	1.1	1.3	3.68E+02	1.1	1.3	2.65E+02	1.1	1.3	2.83E+02	1.1	1.3	3.45E+02	1.1	1.3	3.81E+02	1.1	1.3
5.00E+01	4.22E+02	1.2	1.3	5.22E+02	1.1	1.3	4.30E+02	1.1	1.3	5.07E+02	1.1	1.3	4.34E+02	1.2	1.3	4.86E+02	1.2	1.3
6.00E+01	5.40E+02	1.2	1.4	6.20E+02	1.2	1.4	4.72E+02	1.2	1.4	5.77E+02	1.2	1.4	5.10E+02	1.2	1.4	5.64E+02	1.2	1.4
8.00E+01	6.15E+02	1.2	1.4	6.22E+02	1.2	1.5	5.62E+02	1.2	1.5	5.86E+02	1.2	1.5	5.67E+02	1.3	1.5	5.89E+02	1.3	1.5
1.00E+02	5.81E+02	1.3	1.6	5.69E+02	1.3	1.6	5.61E+02	1.3	1.6	5.52E+02	1.3	1.6	5.52E+02	1.3	1.6	5.56E+02	1.3	1.6
1.50E+02	5.35E+02	1.4	1.7	5.33E+02	1.4	1.8	5.32E+02	1.4	1.7	5.31E+02	1.4	1.7	5.23E+02	1.4	1.8	5.28E+02	1.4	1.8
2.00E+02	5.53E+02	1.5	1.8	5.47E+02	1.5	1.9	5.54E+02	1.5	1.8	5.45E+02	1.5	1.8	5.35E+02	1.5	1.8	5.47E+02	1.5	1.8
3.00E+02	5.26E+02	1.6	1.9	5.21E+02	1.5	1.9	5.26E+02	1.5	1.9	5.16E+02	1.5	1.9	5.10E+02	1.6	1.9	5.18E+02	1.6	1.9
4.00E+02	4.91E+02	1.6	1.9	4.84E+02	1.5	1.9	4.89E+02	1.5	1.9	4.85E+02	1.5	1.9	4.81E+02	1.6	1.9	4.81E+02	1.6	1.9
5.00E+02	4.79E+02	1.6	1.9	4.70E+02	1.5	1.9	4.77E+02	1.5	1.9	4.77E+02	1.5	1.9	4.71E+02	1.6	1.8	4.68E+02	1.6	1.8
6.00E+02	4.84E+02	1.6	1.9	4.75E+02	1.5	1.9	4.83E+02	1.5	1.9	4.84E+02	1.5	1.9	4.76E+02	1.6	1.8	4.71E+02	1.6	1.8
8.00E+02	5.10E+02	1.6	1.9	5.06E+02	1.5	2	5.16E+02	1.5	1.9	5.14E+02	1.5	1.9	5.03E+02	1.6	1.9	4.97E+02	1.6	1.9
1.00E+03	5.35E+02	1.6	2	5.34E+02	1.6	2	5.43E+02	1.6	1.9	5.40E+02	1.6	1.9	5.30E+02	1.6	1.9	5.22E+02	1.6	1.9
1.50E+03	5.86E+02	1.6	1.9	5.73E+02	1.6	2	5.90E+02	1.6	2	5.86E+02	1.6	2	5.75E+02	1.6	1.9	5.67E+02	1.6	1.9
2.00E+03	6.02E+02	1.6	1.9	5.85E+02	1.6	2	6.12E+02	1.6	1.9	6.07E+02	1.6	1.9	5.91E+02	1.6	1.9	5.84E+02	1.6	1.9
3.00E+03	5.99E+02	1.5	1.8	5.76E+02	1.5	1.9	6.18E+02	1.5	1.9	6.01E+02	1.5	1.9	5.90E+02	1.5	1.8	5.78E+02	1.5	1.8
4.00E+03	6.12E+02	1.5	1.8	5.84E+02	1.5	1.8	6.33E+02	1.5	1.8	6.08E+02	1.5	1.8	6.04E+02	1.5	1.8	5.88E+02	1.5	1.8
5.00E+03	6.38E+02	1.5	1.8	6.08E+02	1.5	1.7	6.61E+02	1.4	1.8	6.34E+02	1.4	1.8	6.31E+02	1.5	1.7	6.12E+02	1.5	1.7
6.00E+03	6.68E+02	1.4	1.7	6.36E+02	1.4	1.7	6.95E+02	1.4	1.7	6.65E+02	1.4	1.7	6.60E+02	1.4	1.7	6.38E+02	1.4	1.7
8.00E+03	7.16E+02	1.4	1.7	6.83E+02	1.4	1.7	7.52E+02	1.4	1.8	7.21E+02	1.4	1.8	7.09E+02	1.4	1.7	6.81E+02	1.4	1.7
1.00E+04	7.52E+02	1.4	1.7	7.15E+02	1.4	1.8	7.91E+02	1.4	1.8	7.58E+02	1.4	1.8	7.42E+02	1.4	1.7	7.10E+02	1.4	1.7
1.50E+04	8.16E+02	1.4	1.7	7.61E+02	1.4	1.9	8.59E+02	1.4	1.8	8.23E+02	1.4	1.8	8.04E+02	1.4	1.7	7.67E+02	1.4	1.7
2.00E+04	8.62E+02	1.4	1.7	7.87E+02	1.4	1.9	9.07E+02	1.4	1.8	8.73E+02	1.4	1.8	8.56E+02	1.4	1.7	8.15E+02	1.4	1.7
3.00E+04	9.43E+02	1.4	1.7	8.53E+02	1.4	1.8	1.00E+03	1.4	1.7	9.50E+02	1.4	1.7	9.39E+02	1.4	1.8	8.86E+02	1.4	1.8
4.00E+04	1.01E+03	1.4	1.7	9.14E+02	1.3	1.7	1.09E+03	1.4	1.7	1.01E+03	1.4	1.7	1.00E+03	1.4	1.8	9.45E+02	1.4	1.8
5.00E+04	1.06E+03	1.4	1.6	9.68E+02	1.4	1.7	1.16E+03	1.4	1.7	1.06E+03	1.4	1.7	1.06E+03	1.4	1.9	9.95E+02	1.4	1.9
6.00E+04	1.11E+03	1.4	1.7	1.02E+03	1.3	1.7	1.22E+03	1.4	1.7	1.11E+03	1.4	1.7	1.12E+03	1.3	1.8	1.04E+03	1.3	1.8
8.00E+04	1.21E+03	1.4	1.6	1.10E+03	1.3	1.6	1.32E+03	1.3	1.7	1.21E+03	1.3	1.7	1.21E+03	1.3	1.8	1.11E+03	1.3	1.8
1.00E+05	1.30E+03	1.3	1.6	1.18E+03	1.3	1.7	1.41E+03	1.3	1.7	1.29E+03	1.3	1.7	1.30E+03	1.3	1.7	1.18E+03	1.3	1.7
1.50E+05	1.48E+03	1.3	1.6	1.32E+03	1.3	1.6	1.61E+03	1.3	1.7	1.49E+03	1.3	1.7	1.47E+03	1.3	1.6	1.36E+03	1.3	1.6
2.00E+05	1.67E+03	1.3	1.6	1.43E+03	1.3	1.6	1.84E+03	1.3	1.7	1.66E+03	1.3	1.7	1.65E+03	1.3	1.7	1.50E+03	1.3	1.7

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	7.91E+01	1	1.1	7.32E+01	1	1.1	7.40E+01	1	1.1	8.36E+01	1	1.1	2.69E+01	1	1.1	3.85E+01	1	1.1
1.50E+00	8.22E+01	1	1.1	7.57E+01	1	1.1	7.50E+01	1	1.1	8.28E+01	1	1.1	2.92E+01	1	1.2	4.18E+01	1	1.1
2.00E+00	8.49E+01	1	1.1	7.80E+01	1	1.1	7.70E+01	1	1.1	8.84E+01	1	1.1	2.90E+01	1	1.2	4.20E+01	1	1.1

(*continued on next page*)

Table A.3. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	9.11E+01	1	1.1	8.27E+01	1	1.1	8.18E+01	1	1.1	9.85E+01	1	1.1	2.84E+01	1	1.1	4.32E+01	1	1.1
4.00E+00	9.87E+01	1	1.1	8.85E+01	1	1.1	8.85E+01	1	1.1	1.04E+02	1	1.1	2.95E+01	1	1.1	4.73E+01	1	1.1
5.00E+00	1.06E+02	1	1.1	9.45E+01	1	1.1	9.39E+01	1	1.1	1.12E+02	1	1.1	3.17E+01	1	1.1	5.13E+01	1	1.1
6.00E+00	1.13E+02	1	1.1	9.99E+01	1	1.1	9.71E+01	1	1.1	1.19E+02	1	1.1	3.36E+01	1	1.1	5.42E+01	1	1.1
8.00E+00	1.26E+02	1	1.1	1.09E+02	1	1.1	1.03E+02	1	1.1	1.30E+02	1	1.1	3.50E+01	1	1.1	5.68E+01	1	1.1
1.00E+01	1.43E+02	1.1	1.2	1.19E+02	1	1.1	1.12E+02	1	1.1	1.39E+02	1	1.1	3.56E+01	1	1.2	5.79E+01	1	1.1
1.50E+01	2.12E+02	1.1	1.3	1.61E+02	1.1	1.2	1.48E+02	1.1	1.2	1.81E+02	1.1	1.2	4.03E+01	1	1.2	6.29E+01	1	1.1
2.00E+01	3.01E+02	1.1	1.3	2.34E+02	1.1	1.3	1.94E+02	1.2	1.2	2.38E+02	1.2	1.2	4.59E+01	1	1.1	7.07E+01	1	1.1
3.00E+01	4.48E+02	1.1	1.3	4.11E+02	1.1	1.3	3.09E+02	1.2	1.3	4.07E+02	1.2	1.3	6.59E+01	1	1.1	1.08E+02	1	1.1
4.00E+01	5.26E+02	1.2	1.3	5.33E+02	1.1	1.3	5.90E+02	1.2	1.3	5.58E+02	1.2	1.3	1.05E+02	1.1	1.2	2.34E+02	1.1	1.2
5.00E+01	5.54E+02	1.2	1.4	5.84E+02	1.2	1.3	7.20E+02	1.2	1.3	6.37E+02	1.2	1.3	2.23E+02	1.1	1.2	4.77E+02	1.1	1.3
6.00E+01	5.59E+02	1.2	1.4	5.93E+02	1.2	1.4	6.91E+02	1.2	1.3	6.58E+02	1.2	1.3	5.12E+02	1.2	1.3	6.12E+02	1.2	1.4
8.00E+01	5.41E+02	1.3	1.5	5.62E+02	1.3	1.5	5.98E+02	1.2	1.4	6.12E+02	1.2	1.4	6.20E+02	1.2	1.4	5.86E+02	1.3	1.5
1.00E+02	5.22E+02	1.4	1.6	5.33E+02	1.4	1.6	5.38E+02	1.3	1.5	5.63E+02	1.3	1.5	5.69E+02	1.4	1.6	5.53E+02	1.4	1.6
1.50E+02	5.19E+02	1.4	1.7	5.25E+02	1.4	1.8	5.32E+02	1.4	1.7	5.27E+02	1.4	1.7	5.31E+02	1.4	1.7	5.33E+02	1.5	1.8
2.00E+02	5.28E+02	1.5	1.8	5.35E+02	1.5	1.8	5.54E+02	1.5	1.8	5.25E+02	1.5	1.8	5.44E+02	1.5	1.8	5.55E+02	1.5	1.9
3.00E+02	4.94E+02	1.5	1.9	4.97E+02	1.5	1.9	5.15E+02	1.5	1.9	4.85E+02	1.5	1.9	5.38E+02	1.5	2	5.22E+02	1.5	1.9
4.00E+02	4.63E+02	1.5	1.9	4.64E+02	1.5	1.9	4.73E+02	1.5	1.9	4.61E+02	1.5	1.9	5.05E+02	1.5	1.9	4.90E+02	1.5	1.9
5.00E+02	4.54E+02	1.5	1.9	4.55E+02	1.5	1.9	4.55E+02	1.5	1.9	4.53E+02	1.5	1.9	4.89E+02	1.5	1.9	4.81E+02	1.5	1.9
6.00E+02	4.59E+02	1.5	1.9	4.59E+02	1.5	1.9	4.55E+02	1.5	1.9	4.55E+02	1.5	1.9	4.92E+02	1.5	1.9	4.86E+02	1.5	1.9
8.00E+02	4.83E+02	1.5	1.9	4.84E+02	1.6	1.9	4.76E+02	1.5	2	4.79E+02	1.5	2	5.24E+02	1.6	1.9	5.14E+02	1.5	2
1.00E+03	5.07E+02	1.6	1.9	5.07E+02	1.6	1.9	4.95E+02	1.5	2	5.05E+02	1.5	2	5.56E+02	1.6	1.9	5.43E+02	1.6	2
1.50E+03	5.45E+02	1.6	1.9	5.45E+02	1.6	1.9	5.36E+02	1.5	2	5.39E+02	1.5	2	6.12E+02	1.6	1.9	5.93E+02	1.6	2
2.00E+03	5.58E+02	1.5	1.9	5.59E+02	1.5	1.9	5.60E+02	1.5	1.9	5.41E+02	1.5	1.9	6.29E+02	1.6	1.9	6.08E+02	1.6	2
3.00E+03	5.55E+02	1.5	1.8	5.52E+02	1.5	1.8	5.56E+02	1.5	1.8	5.30E+02	1.5	1.8	6.33E+02	1.6	1.9	6.04E+02	1.5	1.9
4.00E+03	5.64E+02	1.5	1.8	5.59E+02	1.5	1.8	5.55E+02	1.5	1.8	5.42E+02	1.5	1.8	6.50E+02	1.5	1.9	6.18E+02	1.5	1.8
5.00E+03	5.86E+02	1.4	1.7	5.80E+02	1.4	1.7	5.72E+02	1.5	1.8	5.64E+02	1.5	1.8	6.82E+02	1.5	1.9	6.46E+02	1.4	1.8
6.00E+03	6.12E+02	1.4	1.7	6.04E+02	1.4	1.7	5.95E+02	1.4	1.8	5.85E+02	1.4	1.8	7.17E+02	1.5	1.9	6.77E+02	1.5	1.7
8.00E+03	6.54E+02	1.4	1.7	6.44E+02	1.4	1.7	6.33E+02	1.4	1.8	6.16E+02	1.4	1.8	7.72E+02	1.5	1.8	7.28E+02	1.4	1.8
1.00E+04	6.84E+02	1.4	1.7	6.71E+02	1.4	1.7	6.56E+02	1.4	1.8	6.41E+02	1.4	1.8	8.12E+02	1.4	1.7	7.62E+02	1.5	1.8
1.50E+04	7.35E+02	1.4	1.7	7.21E+02	1.4	1.7	7.02E+02	1.4	1.8	6.87E+02	1.4	1.8	8.82E+02	1.4	1.7	8.27E+02	1.4	1.7
2.00E+04	7.76E+02	1.4	1.7	7.62E+02	1.4	1.7	7.47E+02	1.4	1.7	7.13E+02	1.4	1.7	9.26E+02	1.4	1.7	8.95E+02	1.5	1.7
3.00E+04	8.47E+02	1.4	1.7	8.24E+02	1.4	1.7	7.91E+02	1.3	1.8	7.52E+02	1.3	1.8	1.02E+03	1.4	1.7	9.74E+02	1.5	1.6
4.00E+04	9.04E+02	1.4	1.7	8.75E+02	1.4	1.6	8.37E+02	1.3	1.6	8.01E+02	1.3	1.6	1.11E+03	1.4	1.6	1.02E+03	1.4	1.7
5.00E+04	9.54E+02	1.3	1.6	9.20E+02	1.3	1.6	8.79E+02	1.3	1.7	8.47E+02	1.3	1.7	1.19E+03	1.4	1.6	1.06E+03	1.4	1.6
6.00E+04	1.00E+03	1.3	1.6	9.61E+02	1.3	1.6	9.14E+02	1.4	1.6	8.84E+02	1.4	1.6	1.26E+03	1.4	1.6	1.11E+03	1.3	1.7
8.00E+04	1.08E+03	1.3	1.6	1.03E+03	1.3	1.7	9.61E+02	1.3	1.7	9.37E+02	1.3	1.7	1.36E+03	1.4	1.6	1.21E+03	1.3	1.7
1.00E+05	1.16E+03	1.3	1.6	1.10E+03	1.3	1.7	1.02E+03	1.3	1.6	9.80E+02	1.3	1.6	1.44E+03	1.3	1.6	1.29E+03	1.3	1.7
1.50E+05	1.33E+03	1.3	1.6	1.25E+03	1.3	1.7	1.19E+03	1.3	1.6	1.11E+03	1.3	1.6	1.62E+03	1.3	1.6	1.49E+03	1.3	1.7
2.00E+05	1.47E+03	1.3	1.6	1.38E+03	1.3	1.6	1.32E+03	1.3	1.4	1.33E+03	1.3	1.4	1.86E+03	1.3	1.6	1.67E+03	1.3	1.6

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	2.45E+01	1	1.1	3.02E+01	1	1.1	4.03E+01	1	1.1	4.29E+01	1	1.1	4.74E+01	1	1.1	5.93E+01	1	1.1
1.50E+00	2.70E+01	1	1.1	3.17E+01	1	1.1	4.21E+01	1	1.1	4.49E+01	1	1.1	4.76E+01	1	1.1	6.06E+01	1	1.1
2.00E+00	2.89E+01	1	1.1	3.35E+01	1	1.1	4.29E+01	1	1.1	4.60E+01	1	1.1	4.96E+01	1	1.1	6.13E+01	1	1.1
3.00E+00	3.26E+01	1	1.1	3.65E+01	1	1.1	4.48E+01	1	1.1	4.85E+01	1	1.1	5.38E+01	1	1.1	6.40E+01	1	1.1
4.00E+00	3.50E+01	1	1.1	3.84E+01	1	1.1	4.78E+01	1	1.1	5.19E+01	1	1.1	5.65E+01	1	1.1	6.89E+01	1	1.1
5.00E+00	3.74E+01	1	1.1	4.08E+01	1	1.1	5.10E+01	1	1.1	5.47E+01	1	1.1	5.88E+01	1	1.1	7.27E+01	1	1.1
6.00E+00	3.98E+01	1	1.1	4.26E+01	1	1.1	5.34E+01	1	1.1	5.69E+01	1	1.1	6.10E+01	1	1.1	7.51E+01	1	1.1
8.00E+00	4.28E+01	1	1.1	4.37E+01	1	1.1	5.58E+01	1	1.1	6.04E+01	1	1.1	6.50E+01	1	1.1	7.69E+01	1	1.1
1.00E+01	4.33E+01	1	1.1	4.46E+01	1	1.1	5.82E+01	1	1.1	6.37E+01	1	1.1	6.89E+01	1	1.1	7.99E+01	1	1.1
1.50E+01	4.49E+01	1	1.1	5.01E+01	1	1.1	6.75E+01	1	1.1	7.35E+01	1	1.1	7.84E+01	1	1.1	9.26E+01	1.1	1.1
2.00E+01	5.16E+01	1	1.2	5.67E+01	1	1.1	8.39E+01	1	1.1	9.05E+01	1	1.1	9.29E+01	1	1.1	1.20E+02	1	1.1
3.00E+01	7.97E+01	1	1.1	9.00E+01	1	1.1	1.58E+02	1.1	1.2	1.73E+02	1.1	1.2	1.57E+02	1.1	1.2	2.43E+02	1.1	1.2
4.00E+01	1.29E+02	1	1.1	1.77E+02	1.1	1.2	2.75E+02	1.1	1.3	3.01E+02	1.1	1.3	3.49E+02	1.1	1.3	4.58E+02	1.1	1.3
5.00E+01	3.21E+02	1.1	1.2	3.28E+02	1.1	1.3	3.97E+02	1.2	1.3	4.29E+02	1.2	1.3	4.72E+02	1.2	1.3	5.21E+02	1.1	1.3
6.00E+01	5.74E+02	1.1	1.3	5.02E+02	1.2	1.3	4.92E+02	1.2	1.4	5.22E+02	1.2	1.4	5.36E+02	1.2	1.4	5.75E+02	1.1	1.4
8.00E+01	6.39E+02	1.1	1.4	6.37E+02	1.2	1.4	5.57E+02	1.3	1.4	5.80E+02	1.3	1.4	5.82E+02	1.3	1.5	5.82E+02	1.2	1.5
1.00E+02	6.06E+02	1.2	1.5	5.95E+02	1.4	1.6	5.46E+02	1.3	1.6	5.62E+02	1.3	1.6	5.68E+02	1.3	1.6	5.58E+02	1.3	1.6
1.50E+02	5.34E+02	1.4	1.6	5.36E+02	1.5	1.7	5.25E+02	1.4	1.7	5.30E+02	1.4	1.7	5.33E+02	1.4	1.7	5.35E+02	1.4	1.8
2.00E+02	5.49E+02	1.5	1.7	5.66E+02	1.6	1.8	5.46E+02	1.5	1.8	5.47E+02	1.5	1.8	5.44E+02	1.5	1.8	5.43E+02	1.5	1.9
3.00E+02	5.47E+02	1.6	1.7	5.43E+02	1.6	1.9	5.28E+02	1.5	1.9	5.23E+02	1.5	1.9	5.18E+02	1.6	1.8	5.12E+02	1.5	1.9
4.00E+02	5.11E+02	1.6	1.8	4.97E+02	1.6	1.9	4.94E+02	1.5	1.9	4.90E+02	1.5	1.9	4.88E+02	1.6	1.9	4.82E+02	1.5	1.9
5.00E+02	4.91E+02	1.6	1.8	4.80E+02	1.6	1.8	4.80E+02	1.5	1.9	4.78E+02	1.5	1.9	4.77E+02	1.5	1.9	4.71E+02	1.6	1.9
6.00E+02	4.90E+02	1.5	2	4.84E+02	1.5	1.8	4.84E+02	1.5	1.9	4.82E+02	1.5	1.9	4.81E+02	1.5	1.9	4.75E+02	1.5	2
8.00E+02	5.18E+02	1.5	2	5.17E+02	1.5	1.9	5.13E+02	1.5	1.9	5.09E+02	1.5	1.9	5.05E+02	1.6	1.9	5.01E+02	1.5	2
1.00E+03	5.44E+02	1.4	2.1	5.42E+02	1.6	1.9	5.41E+02	1.6	2	5.36E+02	1.6	2	5.34E+02	1.6	2	5.26E+02	1.5	2

Table A.3. (*continued*)

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.50E+03	5.93E+02	1.4	2	5.94E+02	1.5	1.9	5.92E+02	1.6	1.9	5.85E+02	1.6	1.9	5.88E+02	1.6	1.9	5.70E+02	1.5	2
2.00E+03	6.18E+02	1.4	2	6.20E+02	1.6	1.9	6.12E+02	1.5	1.9	6.03E+02	1.5	1.9	6.11E+02	1.6	1.9	5.87E+02	1.5	2
3.00E+03	6.29E+02	1.4	1.8	6.13E+02	1.5	1.9	6.14E+02	1.5	1.9	6.02E+02	1.5	1.9	6.06E+02	1.6	1.9	5.80E+02	1.5	1.9
4.00E+03	6.30E+02	1.4	1.7	6.25E+02	1.5	1.8	6.30E+02	1.5	1.8	6.16E+02	1.5	1.8	6.14E+02	1.5	1.9	5.89E+02	1.4	1.9
5.00E+03	6.51E+02	1.5	1.6	6.55E+02	1.4	1.8	6.60E+02	1.5	1.8	6.43E+02	1.5	1.8	6.40E+02	1.5	1.8	6.14E+02	1.4	1.8
6.00E+03	6.88E+02	1.4	1.5	6.91E+02	1.5	1.8	6.94E+02	1.5	1.7	6.73E+02	1.5	1.7	6.71E+02	1.4	1.8	6.43E+02	1.4	1.8
8.00E+03	7.78E+02	1.4	1.6	7.52E+02	1.5	1.8	7.52E+02	1.4	1.7	7.25E+02	1.4	1.7	7.22E+02	1.4	1.8	6.93E+02	1.4	1.8
1.00E+04	8.35E+02	1.4	1.6	7.89E+02	1.4	1.9	7.92E+02	1.4	1.7	7.62E+02	1.4	1.7	7.60E+02	1.4	1.7	7.27E+02	1.4	1.8
1.50E+04	8.99E+02	1.4	1.7	8.49E+02	1.4	1.9	8.53E+02	1.4	1.7	8.25E+02	1.4	1.7	8.30E+02	1.4	1.7	7.70E+02	1.4	1.8
2.00E+04	9.65E+02	1.4	1.6	9.18E+02	1.4	1.9	9.09E+02	1.4	1.7	8.77E+02	1.4	1.7	8.77E+02	1.4	1.6	8.07E+02	1.4	1.8
3.00E+04	1.05E+03	1.4	1.6	1.01E+03	1.4	1.8	1.01E+03	1.4	1.7	9.61E+02	1.4	1.7	9.63E+02	1.4	1.7	8.88E+02	1.4	1.8
4.00E+04	1.14E+03	1.4	1.5	1.06E+03	1.4	1.8	1.08E+03	1.4	1.7	1.03E+03	1.4	1.7	1.03E+03	1.4	1.7	9.45E+02	1.3	1.7
5.00E+04	1.22E+03	1.4	1.5	1.11E+03	1.4	1.7	1.14E+03	1.4	1.7	1.08E+03	1.4	1.7	1.10E+03	1.4	1.7	9.92E+02	1.3	1.7
6.00E+04	1.29E+03	1.3	1.5	1.16E+03	1.4	1.7	1.20E+03	1.4	1.7	1.13E+03	1.4	1.7	1.15E+03	1.4	1.6	1.04E+03	1.3	1.7
8.00E+04	1.38E+03	1.3	1.5	1.24E+03	1.3	1.7	1.31E+03	1.3	1.6	1.21E+03	1.3	1.6	1.25E+03	1.3	1.6	1.13E+03	1.3	1.7
1.00E+05	1.49E+03	1.3	1.5	1.32E+03	1.3	1.7	1.41E+03	1.3	1.6	1.28E+03	1.3	1.6	1.32E+03	1.3	1.6	1.22E+03	1.3	1.7
1.50E+05	1.69E+03	1.2	1.5	1.53E+03	1.3	1.6	1.61E+03	1.3	1.6	1.49E+03	1.3	1.6	1.50E+03	1.3	1.5	1.40E+03	1.3	1.7
2.00E+05	1.70E+03	1.2	1.5	1.67E+03	1.3	1.6	1.78E+03	1.3	1.6	1.69E+03	1.3	1.6	1.70E+03	1.2	1.6	1.53E+03	1.3	1.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	6.80E+01	1	1.1	6.18E+01	1	1.1	1.97E+02	1.5	2.1	1.97E+02	1.5	2.1
1.50E+00	7.57E+01	1	1.1	7.25E+01	1	1.1	2.19E+02	1.5	2.1	2.19E+02	1.5	2.1
2.00E+00	7.60E+01	1	1.1	7.50E+01	1	1.1	2.30E+02	1.5	2.1	2.30E+02	1.5	2.1
3.00E+00	7.46E+01	1	1.2	7.41E+01	1	1.1	2.49E+02	1.4	2	2.49E+02	1.4	2
4.00E+00	7.56E+01	1	1.1	7.58E+01	1	1.1	2.80E+02	1.4	1.9	2.80E+02	1.4	1.9
5.00E+00	8.14E+01	1	1.1	8.25E+01	1	1.1	3.21E+02	1.4	1.9	3.21E+02	1.4	1.9
6.00E+00	8.78E+01	1	1.1	8.89E+01	1	1.1	3.80E+02	1.3	1.8	3.80E+02	1.3	1.8
8.00E+00	9.82E+01	1	1.1	9.71E+01	1	1.1	5.36E+02	1.2	1.5	5.36E+02	1.2	1.5
1.00E+01	1.08E+02	1	1.1	1.04E+02	1	1.1	6.56E+02	1.2	1.4	6.56E+02	1.2	1.4
1.50E+01	1.37E+02	1	1.2	1.34E+02	1	1.1	7.32E+02	1.1	1.2	7.32E+02	1.1	1.2
2.00E+01	1.94E+02	1.1	1.3	1.98E+02	1.1	1.2	6.63E+02	1.1	1.2	6.63E+02	1.1	1.2
3.00E+01	4.27E+02	1.1	1.3	4.18E+02	1.1	1.3	5.99E+02	1.1	1.3	5.99E+02	1.1	1.3
4.00E+01	4.52E+02	1.1	1.3	3.94E+02	1.1	1.3	5.80E+02	1.2	1.3	5.80E+02	1.2	1.3
5.00E+01	4.41E+02	1.1	1.4	4.97E+02	1.1	1.3	5.76E+02	1.2	1.3	5.76E+02	1.2	1.3
6.00E+01	5.27E+02	1.2	1.4	6.43E+02	1.2	1.4	5.72E+02	1.2	1.4	5.72E+02	1.2	1.4
8.00E+01	6.17E+02	1.2	1.5	6.23E+02	1.3	1.4	5.48E+02	1.3	1.5	5.48E+02	1.3	1.5
1.00E+02	5.53E+02	1.3	1.6	5.38E+02	1.5	1.6	5.12E+02	1.3	1.6	5.12E+02	1.3	1.6
1.50E+02	5.20E+02	1.4	1.8	5.23E+02	1.4	1.7	5.10E+02	1.5	1.8	5.10E+02	1.5	1.8
2.00E+02	5.29E+02	1.5	1.8	5.80E+02	1.6	1.9	5.02E+02	1.6	1.9	5.02E+02	1.6	1.9
3.00E+02	5.11E+02	1.5	1.8	5.11E+02	1.4	1.9	4.60E+02	1.6	1.9	4.60E+02	1.6	1.9
4.00E+02	4.74E+02	1.5	1.9	4.75E+02	1.5	1.9	4.34E+02	1.5	1.8	4.34E+02	1.5	1.8
5.00E+02	4.59E+02	1.5	1.8	4.64E+02	1.4	1.8	4.27E+02	1.5	1.7	4.27E+02	1.5	1.7
6.00E+02	4.63E+02	1.5	1.9	4.69E+02	1.4	1.8	4.34E+02	1.5	1.8	4.34E+02	1.5	1.8
8.00E+02	4.92E+02	1.5	1.9	4.95E+02	1.5	1.7	4.44E+02	1.5	1.8	4.44E+02	1.5	1.8
1.00E+03	5.17E+02	1.5	2	5.20E+02	1.5	1.8	4.49E+02	1.5	1.8	4.49E+02	1.5	1.8
1.50E+03	5.61E+02	1.5	1.9	5.64E+02	1.6	1.8	4.62E+02	1.5	1.9	4.62E+02	1.5	1.9
2.00E+03	5.76E+02	1.4	2	5.74E+02	1.5	1.9	4.89E+02	1.5	1.9	4.89E+02	1.5	1.9
3.00E+03	5.73E+02	1.4	1.8	5.70E+02	1.5	1.8	4.96E+02	1.4	1.7	4.96E+02	1.4	1.7
4.00E+03	5.84E+02	1.5	1.8	5.69E+02	1.5	1.7	4.91E+02	1.4	1.6	4.91E+02	1.4	1.6
5.00E+03	6.08E+02	1.5	1.7	5.80E+02	1.5	1.7	5.06E+02	1.4	1.7	5.06E+02	1.4	1.7
6.00E+03	6.33E+02	1.5	1.8	6.01E+02	1.4	1.6	5.31E+02	1.4	1.6	5.31E+02	1.4	1.6
8.00E+03	6.78E+02	1.5	1.8	6.44E+02	1.4	1.7	5.71E+02	1.4	1.6	5.71E+02	1.4	1.6
1.00E+04	7.13E+02	1.4	1.7	6.70E+02	1.4	1.7	5.98E+02	1.4	1.6	5.98E+02	1.4	1.6
1.50E+04	7.62E+02	1.4	1.6	7.21E+02	1.3	1.7	6.30E+02	1.4	1.6	6.30E+02	1.4	1.6
2.00E+04	8.00E+02	1.3	1.6	7.51E+02	1.3	1.6	6.47E+02	1.4	1.5	6.47E+02	1.4	1.5
3.00E+04	8.82E+02	1.3	1.5	8.07E+02	1.3	1.7	6.82E+02	1.3	1.6	6.82E+02	1.3	1.6
4.00E+04	9.46E+02	1.3	1.5	8.64E+02	1.3	1.7	7.13E+02	1.3	1.6	7.13E+02	1.3	1.6
5.00E+04	9.89E+02	1.3	1.5	9.16E+02	1.3	1.7	7.43E+02	1.3	1.6	7.43E+02	1.3	1.6
6.00E+04	1.02E+03	1.3	1.5	9.63E+02	1.4	1.7	7.63E+02	1.3	1.6	7.63E+02	1.3	1.6
8.00E+04	1.06E+03	1.3	1.6	1.04E+03	1.4	1.7	7.92E+02	1.3	1.5	7.92E+02	1.3	1.5
1.00E+05	1.13E+03	1.3	1.5	1.11E+03	1.4	1.6	8.23E+02	1.3	1.6	8.23E+02	1.3	1.6
1.50E+05	1.37E+03	1.3	1.6	1.29E+03	1.3	1.5	8.99E+02	1.3	1.6	8.99E+02	1.3	1.6
2.00E+05	1.60E+03	1.3	1.5	1.50E+03	1.3	1.4	9.74E+02	1.3	1.5	9.74E+02	1.3	1.5

Table A.4. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organ and tissues of the male and female reference phantoms for isotropic exposure by negative pions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	5.28E+01	2.1	1.5	5.57E+01	2.1	1.5	2.14E+02	2	2.7	1.81E+02	2	3.3	5.28E+01	2.2	3.3	5.27E+01	2.2	3.3
1.50E+00	5.59E+01	2.4	1.5	5.83E+01	2.4	1.5	2.27E+02	2.1	3.5	2.01E+02	2.2	3.3	5.53E+01	2.3	3.2	5.63E+01	2.3	3.2
2.00E+00	5.70E+01	2.4	1.6	5.95E+01	2.4	1.6	2.43E+02	2.6	3.8	2.11E+02	2.4	4	5.67E+01	2.5	3.7	5.71E+01	2.5	3.7
3.00E+00	5.84E+01	2.7	1.7	6.13E+01	2.7	1.7	2.81E+02	2.9	4.6	2.35E+02	2.7	4.4	5.90E+01	2.6	3.9	5.79E+01	2.6	3.9
4.00E+00	6.06E+01	2.7	1.7	6.31E+01	2.7	1.7	3.24E+02	3.2	4.7	2.70E+02	3.3	4.8	6.07E+01	2.6	3.9	5.95E+01	2.6	3.9
5.00E+00	6.27E+01	2.7	1.7	6.47E+01	2.7	1.7	3.86E+02	3.8	5.3	3.25E+02	3.5	5.1	6.16E+01	2.7	3.9	6.17E+01	2.7	3.9
6.00E+00	6.47E+01	2.8	1.7	6.64E+01	2.8	1.7	4.74E+02	4	5.5	3.93E+02	4.3	6.5	6.24E+01	2.8	4	6.35E+01	2.8	4
8.00E+00	6.86E+01	2.8	1.7	7.01E+01	2.8	1.7	7.30E+02	4.3	7.9	5.45E+02	4.5	7.3	6.42E+01	2.9	4.1	6.56E+01	2.9	4.1
1.00E+01	7.54E+01	2.8	1.8	7.81E+01	2.8	1.8	9.39E+02	5.1	7.7	6.64E+02	5	7.2	6.61E+01	2.8	4.2	6.76E+01	2.8	4.2
1.50E+01	1.14E+02	3.8	2	1.20E+02	3.8	2	1.10E+03	4.3	6.6	8.03E+02	4.4	6.3	7.68E+01	2.8	4.3	8.02E+01	2.8	4.3
2.00E+01	1.72E+02	4.2	2.2	1.74E+02	4.2	2.2	1.02E+03	3.8	5.3	8.12E+02	3.8	5.6	1.01E+02	3	4.5	1.11E+02	3	4.5
3.00E+01	2.73E+02	3.7	2	2.85E+02	3.7	2	7.21E+02	2.3	3	6.78E+02	2.9	4	2.92E+02	4.3	6.2	2.97E+02	4.3	6.2
4.00E+01	3.83E+02	3.5	1.9	4.12E+02	3.5	1.9	5.43E+02	2.2	2.9	5.55E+02	2.4	3	4.39E+02	3.6	5.3	4.65E+02	3.6	5.3
5.00E+01	4.84E+02	3.3	1.9	5.29E+02	3.3	1.9	4.64E+02	2.2	2.6	4.83E+02	2.3	2.9	4.96E+02	3.1	4.5	4.96E+02	3.1	4.5
6.00E+01	5.52E+02	3	1.8	6.37E+02	3	1.8	4.03E+02	2.2	2.5	5.11E+02	2.2	2.8	5.28E+02	2.9	4	5.29E+02	2.9	4
8.00E+01	5.64E+02	2.4	1.5	5.85E+02	2.4	1.5	4.84E+02	2.2	2.4	5.82E+02	2.2	2.4	5.44E+02	2.5	3.4	5.87E+02	2.5	3.4
1.00E+02	5.13E+02	1.9	1.4	5.14E+02	1.9	1.4	4.95E+02	1.7	2.3	4.97E+02	1.9	2.2	5.15E+02	2.1	2.6	5.20E+02	2.1	2.6
1.50E+02	4.27E+02	1.8	1.3	4.26E+02	1.8	1.3	4.18E+02	1.6	2.3	4.28E+02	1.8	2.2	4.35E+02	1.8	2.2	4.31E+02	1.8	2.2
2.00E+02	4.05E+02	1.8	1.3	4.06E+02	1.8	1.3	3.98E+02	1.6	2.2	4.05E+02	1.8	2.1	4.13E+02	1.8	2.3	4.07E+02	1.8	2.3
3.00E+02	3.97E+02	1.8	1.3	3.96E+02	1.8	1.3	3.87E+02	1.5	2.2	3.92E+02	1.7	2.1	3.99E+02	1.7	2.2	3.98E+02	1.7	2.2
4.00E+02	4.04E+02	1.6	1.2	4.02E+02	1.6	1.2	3.91E+02	1.5	2	3.96E+02	1.6	2	4.05E+02	1.7	2.1	4.05E+02	1.7	2.1
5.00E+02	4.21E+02	1.6	1.2	4.18E+02	1.6	1.2	4.02E+02	1.5	2	4.07E+02	1.6	1.9	4.22E+02	1.6	2	4.22E+02	1.6	2
6.00E+02	4.40E+02	1.6	1.2	4.37E+02	1.6	1.2	4.15E+02	1.5	2	4.20E+02	1.6	1.9	4.42E+02	1.6	2	4.42E+02	1.6	2
8.00E+02	4.73E+02	1.6	1.3	4.66E+02	1.6	1.3	4.36E+02	1.5	2.1	4.39E+02	1.6	1.9	4.75E+02	1.6	2	4.73E+02	1.6	2
1.00E+03	4.96E+02	1.7	1.2	4.86E+02	1.7	1.2	4.48E+02	1.5	2.1	4.53E+02	1.6	1.9	4.99E+02	1.6	2.1	4.93E+02	1.6	2.1
1.50E+03	5.34E+02	1.7	1.3	5.26E+02	1.7	1.3	4.82E+02	1.6	2.2	4.82E+02	1.6	1.9	5.42E+02	1.6	2	5.38E+02	1.6	2
2.00E+03	5.56E+02	1.7	1.3	5.48E+02	1.7	1.3	5.03E+02	1.5	2.1	4.97E+02	1.5	1.9	5.60E+02	1.6	2	5.62E+02	1.6	2
3.00E+03	5.68E+02	1.5	1.2	5.55E+02	1.5	1.2	5.04E+02	1.4	1.9	5.02E+02	1.5	1.8	5.74E+02	1.5	1.9	5.69E+02	1.5	1.9
4.00E+03	5.90E+02	1.5	1.2	5.72E+02	1.5	1.2	5.11E+02	1.4	1.8	5.15E+02	1.4	1.7	6.00E+02	1.5	1.8	5.88E+02	1.5	1.8
5.00E+03	6.21E+02	1.5	1.2	6.00E+02	1.5	1.2	5.31E+02	1.3	1.6	5.36E+02	1.4	1.7	6.34E+02	1.5	1.8	6.18E+02	1.5	1.8
6.00E+03	6.54E+02	1.5	1.2	6.30E+02	1.5	1.2	5.55E+02	1.3	1.6	5.59E+02	1.4	1.6	6.69E+02	1.5	1.8	6.51E+02	1.5	1.8
8.00E+03	7.08E+02	1.4	1.2	6.77E+02	1.4	1.2	6.02E+02	1.3	1.5	5.95E+02	1.4	1.6	7.21E+02	1.4	1.8	7.04E+02	1.4	1.8
1.00E+04	7.46E+02	1.4	1.2	7.09E+02	1.4	1.2	6.31E+02	1.3	1.5	6.19E+02	1.4	1.6	7.57E+02	1.4	1.7	7.40E+02	1.4	1.7
1.50E+04	8.12E+02	1.4	1.2	7.67E+02	1.4	1.2	6.75E+02	1.3	1.6	6.60E+02	1.4	1.6	8.26E+02	1.4	1.7	8.00E+02	1.4	1.7
2.00E+04	8.65E+02	1.4	1.2	8.13E+02	1.4	1.2	7.15E+02	1.2	1.7	6.95E+02	1.3	1.6	8.79E+02	1.4	1.7	8.49E+02	1.4	1.7
3.00E+04	9.48E+02	1.4	1.2	8.90E+02	1.4	1.2	7.69E+02	1.3	1.8	7.50E+02	1.3	1.6	9.69E+02	1.4	1.7	9.40E+02	1.4	1.7
4.00E+04	1.02E+03	1.4	1.1	9.50E+02	1.4	1.1	8.21E+02	1.3	1.9	7.96E+02	1.3	1.5	1.05E+03	1.4	1.7	1.00E+03	1.4	1.7
5.00E+04	1.08E+03	1.4	1.2	1.00E+03	1.4	1.2	8.66E+02	1.3	1.9	8.37E+02	1.3	1.5	1.11E+03	1.4	1.7	1.06E+03	1.4	1.7
6.00E+04	1.13E+03	1.4	1.2	1.05E+03	1.4	1.2	9.01E+02	1.3	1.8	8.74E+02	1.3	1.5	1.17E+03	1.4	1.7	1.11E+03	1.4	1.7
8.00E+04	1.23E+03	1.4	1.1	1.13E+03	1.4	1.1	9.69E+02	1.3	1.6	9.42E+02	1.3	1.5	1.26E+03	1.3	1.7	1.20E+03	1.3	1.7
1.00E+05	1.32E+03	1.3	1.2	1.21E+03	1.3	1.2	1.03E+03	1.2	1.6	1.01E+03	1.3	1.6	1.35E+03	1.3	1.7	1.28E+03	1.3	1.7
1.50E+05	1.52E+03	1.3	1.1	1.38E+03	1.3	1.1	1.16E+03	1.3	1.5	1.12E+03	1.3	1.5	1.55E+03	1.3	1.7	1.46E+03	1.3	1.7
2.00E+05	1.66E+03	1.3	1.1	1.51E+03	1.3	1.1	1.25E+03	1.3	1.6	1.18E+03	1.3	1.5	1.73E+03	1.3	1.7	1.58E+03	1.3	1.7

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	5.64E+01	2	3.1	6.29E+01	2	3	4.51E+01	2	3.1	5.50E+01	2	3.1	1.24E+02	2.1	3.4	3.50E+01	2.1	3.3
1.50E+00	5.62E+01	2.2	3.2	6.50E+01	2.2	3	4.74E+01	2.2	3.3	5.78E+01	2.1	3.3	1.32E+02	2.3	3.8	3.57E+01	2.2	3.5
2.00E+00	5.69E+01	2.2	3.6	6.60E+01	2.3	3.4	4.85E+01	2.3	3.5	5.98E+01	2.1	3.3	1.38E+02	2.4	4.1	3.61E+01	2.4	3.8
3.00E+00	5.88E+01	2.6	3.7	6.70E+01	2.3	3.7	4.93E+01	2.7	4	6.10E+01	2.5	3.6	1.52E+02	2.7	4.5	3.85E+01	2.4	4
4.00E+00	6.04E+01	2.6	3.8	6.78E+01	2.4	3.7	5.06E+01	2.8	4.2	6.19E+01	2.7	3.8	1.66E+02	3	5.2	4.04E+01	2.7	4.4
5.00E+00	6.15E+01	2.7	4.1	6.87E+01	2.5	3.8	5.25E+01	3	4.3	6.47E+01	2.7	4	1.77E+02	3.2	5.3	4.09E+01	4.7	4.8
6.00E+00	6.24E+01	2.8	4.1	6.95E+01	2.5	3.8	5.40E+01	3.5	4.4	6.71E+01	2.7	4	1.91E+02	3.4	5.5	4.04E+01	4.8	5
8.00E+00	6.40E+01	2.7	4.3	7.06E+01	2.5	3.8	5.56E+01	3.5	4.5	6.78E+01	2.7	4.1	2.40E+02	4.8	5.9	3.90E+01	4.9	5.2
1.00E+01	6.56E+01	2.7	4.4	7.21E+01	2.5	3.9	5.60E+01	3.4	4.6	6.91E+01	2.7	4.2	2.94E+02	4.6	6.3	3.88E+01	5.1	5.2
1.50E+01	7.30E+01	2.7	4.4	8.05E+01	2.7	3.9	6.17E+01	3.3	4.6	8.28E+01	2.8	4.3	4.03E+02	4.6	6.2	4.26E+01	5.1	5.5
2.00E+01	9.03E+01	2.8	4.5	1.10E+02	2.7	4.1	8.21E+01	3.3	4.6	1.17E+02	2.8	4.3	4.65E+02	4	6	5.01E+01	5	6.2
3.00E+01	2.32E+02	3.9	5.9	2.91E+02	3.9	6.1	1.94E+02	4.5	6	2.84E+02	4.5	6.4	5.41E+02	3.8	4.9	8.32E+01	4.8	5.8
4.00E+01	4.78E+02	4	5.7	6.20E+02	4.1	5.8	3.40E+02	3.8	5.3	4.53E+02	3.6	5.1	4.81E+02	2.6	3.7	1.14E+02	4.7	5
5.00E+01	6.59E+02	3.5	4.9	6.71E+02	3	4.3	4.59E+02	3.2	4.9	5.46E+02	3.2	4.7	3.92E+02	2.3	3.4	3.96E+02	4.2	4.3
6.00E+01	6.58E+02	2.8	3.9	6.83E+02	2.7	3.9	5.37E+02	3	4.2	5.84E+02	2.9	3.8	4.22E+02	2.2	3.3	6.60E+02	3.5	3.5
8.00E+01	5.89E+02	2.2	2.9	5.80E+02	2.1	2.6	5.79E+02	2.9	3.6	5.70E+02	2.3	3.2	5.59E+02	2.1	2.8	6.21E+02	3	3.3
1.00E+02	5.11E+02	1.9	2.3	4.96E+02	1.9	2.1	5.35E+02	2	2.8	5.21E+02	1.9	2.6	5.00E+02	1.7	2.4	5.50E+02	2	2.5
1.50E+02	4.26E+02	1.8	2.1	4.23E+02	1.8	2.2	4.36E+02	1.8	2.3	4.35E+02	1.8	2.1	4.21E+02	1.7	2.2	4.41E+02	2	2.1
2.00E+02	4.07E+02	1.8	2.2	4.08E+02	1.8	2.2	4.14E+02	1.8	2.3	4.14E+02	1.8	2.3	3.94E+02	1.7	2.2	4.24E+02	2	2.1

Table A.4. (*continued*)

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+02	3.97E+02	1.8	2.1	3.98E+02	1.7	2.1	4.04E+02	1.8	2.2	4.04E+02	1.8	2.2	3.83E+02	1.7	2.1	4.11E+02	2	2.2
4.00E+02	4.06E+02	1.7	2.1	4.04E+02	1.7	2.1	4.10E+02	1.7	2.1	4.09E+02	1.7	2.1	3.97E+02	1.7	2.1	4.17E+02	2	2
5.00E+02	4.24E+02	1.7	2	4.19E+02	1.6	2.1	4.26E+02	1.7	2.1	4.24E+02	1.7	2.1	4.17E+02	1.6	2.1	4.33E+02	1.9	2.1
6.00E+02	4.43E+02	1.6	2	4.36E+02	1.6	2	4.46E+02	1.6	2.1	4.42E+02	1.6	2.1	4.35E+02	1.7	2.1	4.50E+02	1.9	1.9
8.00E+02	4.75E+02	1.6	2	4.65E+02	1.6	2	4.82E+02	1.7	2.1	4.73E+02	1.7	2.1	4.62E+02	1.7	1.9	4.88E+02	1.8	1.9
1.00E+03	4.98E+02	1.6	2.1	4.87E+02	1.6	2	5.09E+02	1.7	2.2	4.95E+02	1.6	2.1	4.84E+02	1.7	2	5.22E+02	1.8	1.9
1.50E+03	5.37E+02	1.6	2	5.26E+02	1.6	2	5.49E+02	1.7	2.1	5.30E+02	1.6	2.1	5.25E+02	1.6	1.8	5.60E+02	1.6	2
2.00E+03	5.58E+02	1.6	2	5.44E+02	1.6	2	5.70E+02	1.6	2.1	5.50E+02	1.6	2	5.42E+02	1.6	1.8	5.87E+02	1.6	2
3.00E+03	5.66E+02	1.5	1.9	5.45E+02	1.5	1.9	5.83E+02	1.6	1.9	5.59E+02	1.5	2	5.44E+02	1.5	1.7	5.98E+02	1.5	1.9
4.00E+03	5.83E+02	1.5	1.8	5.60E+02	1.5	1.8	6.00E+02	1.5	1.8	5.78E+02	1.5	1.9	5.66E+02	1.5	1.7	6.15E+02	1.5	1.9
5.00E+03	6.10E+02	1.5	1.8	5.87E+02	1.4	1.8	6.29E+02	1.5	1.7	6.07E+02	1.5	1.8	5.97E+02	1.5	1.6	6.46E+02	1.4	1.8
6.00E+03	6.40E+02	1.4	1.8	6.14E+02	1.4	1.7	6.64E+02	1.5	1.7	6.37E+02	1.5	1.8	6.24E+02	1.5	1.5	6.79E+02	1.4	2
8.00E+03	6.89E+02	1.4	1.8	6.58E+02	1.4	1.7	7.27E+02	1.5	1.8	6.89E+02	1.5	1.7	6.64E+02	1.5	1.6	7.26E+02	1.5	1.8
1.00E+04	7.23E+02	1.4	1.7	6.86E+02	1.4	1.7	7.69E+02	1.5	1.8	7.23E+02	1.4	1.8	7.01E+02	1.4	1.6	7.55E+02	1.5	2
1.50E+04	7.82E+02	1.4	1.7	7.34E+02	1.4	1.7	8.39E+02	1.4	1.8	7.81E+02	1.4	1.7	7.58E+02	1.4	1.8	8.41E+02	1.5	1.7
2.00E+04	8.29E+02	1.4	1.7	7.76E+02	1.4	1.7	8.97E+02	1.4	1.7	8.35E+02	1.4	1.8	7.89E+02	1.4	1.8	9.15E+02	1.4	1.6
3.00E+04	8.97E+02	1.4	1.7	8.38E+02	1.4	1.7	9.66E+02	1.4	1.7	9.15E+02	1.4	1.8	8.77E+02	1.4	1.7	1.00E+03	1.4	1.6
4.00E+04	9.57E+02	1.4	1.7	8.83E+02	1.4	1.7	1.04E+03	1.4	1.7	9.77E+02	1.4	1.8	9.63E+02	1.3	1.5	1.06E+03	1.4	1.7
5.00E+04	1.01E+03	1.4	1.7	9.24E+02	1.4	1.7	1.10E+03	1.3	1.7	1.03E+03	1.4	1.8	1.03E+03	1.4	1.4	1.11E+03	1.4	2
6.00E+04	1.06E+03	1.4	1.7	9.65E+02	1.4	1.7	1.16E+03	1.3	1.6	1.07E+03	1.3	1.8	1.08E+03	1.3	1.4	1.16E+03	1.4	2
8.00E+04	1.16E+03	1.3	1.6	1.05E+03	1.3	1.7	1.26E+03	1.3	1.7	1.15E+03	1.3	1.7	1.15E+03	1.3	1.4	1.29E+03	1.4	1.9
1.00E+05	1.24E+03	1.3	1.6	1.12E+03	1.3	1.6	1.36E+03	1.3	1.7	1.22E+03	1.3	1.6	1.20E+03	1.3	1.4	1.43E+03	1.3	1.9
1.50E+05	1.41E+03	1.3	1.6	1.26E+03	1.3	1.6	1.56E+03	1.3	1.6	1.41E+03	1.3	1.6	1.34E+03	1.2	1.4	1.66E+03	1.1	1.7
2.00E+05	1.53E+03	1.3	1.6	1.37E+03	1.3	1.5	1.70E+03	1.3	1.5	1.56E+03	1.3	1.6	1.51E+03	1.2	1.3	1.62E+03	1.1	1.7

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	4.61E+01	2.3	3.5	5.43E+01	2.3	3.1	4.02E+01	2.3	3.4	5.30E+01	2.3	3.4	7.13E+01	2.1	3.2	7.99E+01	2.1	3.2
1.50E+00	4.86E+01	2.4	3.5	5.73E+01	2.4	3.2	4.67E+01	2.4	3.6	5.27E+01	2.4	3.6	7.31E+01	2.2	3.3	8.71E+01	2.2	3.3
2.00E+00	5.04E+01	2.5	3.9	5.84E+01	2.5	3.6	4.70E+01	2.5	3.9	5.33E+01	2.5	3.9	7.51E+01	2.3	3.3	8.83E+01	2.3	3.3
3.00E+00	5.22E+01	2.6	4.1	5.95E+01	2.6	3.8	4.50E+01	3	4	5.47E+01	3	4	7.88E+01	2.3	3.4	9.07E+01	2.3	3.4
4.00E+00	5.33E+01	2.7	4.3	6.05E+01	2.7	3.9	4.54E+01	3	4.2	5.46E+01	3	4.2	8.29E+01	2.3	3.4	9.65E+01	2.3	3.4
5.00E+00	5.42E+01	2.7	4.3	6.18E+01	2.7	4	4.83E+01	3	4.3	5.49E+01	3	4.3	8.55E+01	2.4	3.5	9.72E+01	2.4	3.5
6.00E+00	5.51E+01	2.7	4.4	6.31E+01	2.7	4	5.13E+01	3	4.4	5.66E+01	3	4.4	8.84E+01	2.4	3.6	9.68E+01	2.4	3.6
8.00E+00	5.75E+01	2.9	4.4	6.52E+01	2.9	4.1	5.45E+01	3	4.5	6.24E+01	3	4.5	9.44E+01	2.5	3.8	9.87E+01	2.5	3.8
1.00E+01	6.00E+01	2.9	4.5	6.77E+01	2.9	4.2	5.55E+01	3	4.6	6.43E+01	3	4.6	1.02E+02	2.6	4	1.10E+02	2.6	4
1.50E+01	6.62E+01	2.9	4.6	7.76E+01	2.9	4.3	6.24E+01	2.9	4.7	6.84E+01	2.9	4.7	1.52E+02	3.2	4.2	1.80E+02	3.2	4.2
2.00E+01	8.54E+01	3	4.8	1.08E+02	3	4.5	7.71E+01	2.8	4.8	8.18E+01	2.8	4.8	3.60E+02	4.5	6.8	4.53E+02	4.5	6.8
3.00E+01	1.90E+02	4.1	6.1	2.57E+02	4.2	6.3	1.80E+02	4	6.1	1.98E+02	4	6.1	5.70E+02	3.9	5.3	5.94E+02	3.9	5.3
4.00E+01	3.33E+02	3.9	5.5	4.28E+02	3.8	5.4	2.31E+02	4	5.3	2.91E+02	4	5.3	4.80E+02	3	4	4.62E+02	3	4
5.00E+01	4.53E+02	3.5	4.9	5.36E+02	3.3	4.7	3.99E+02	4	4.9	6.20E+02	4	4.9	5.08E+02	3	3.9	4.99E+02	3	3.9
6.00E+01	5.32E+02	3.1	4.4	5.85E+02	2.9	4.2	7.18E+02	3.2	4.8	7.64E+02	3.2	4.8	5.41E+02	2.7	3.8	5.98E+02	2.7	3.8
8.00E+01	5.71E+02	2.5	3.5	5.75E+02	2.4	3.2	6.34E+02	2.3	3.1	6.43E+02	2.3	3.1	5.53E+02	2.2	3	6.18E+02	2.2	3
1.00E+02	5.31E+02	2.1	2.8	5.17E+02	1.9	2.5	5.45E+02	1.7	2.3	4.89E+02	1.7	2.3	5.06E+02	2	2.4	4.95E+02	2	2.4
1.50E+02	4.31E+02	1.7	2.2	4.28E+02	1.7	2.2	4.38E+02	1.7	2.2	4.22E+02	1.7	2.2	4.27E+02	1.7	2.1	4.14E+02	1.7	2.1
2.00E+02	4.06E+02	1.8	2.3	4.06E+02	1.8	2.2	4.12E+02	1.8	2.3	4.12E+02	1.8	2.3	4.11E+02	1.7	2	3.97E+02	1.7	2
3.00E+02	3.99E+02	1.7	2.2	3.97E+02	1.7	2.2	3.96E+02	1.8	2.2	4.11E+02	1.8	2.2	3.95E+02	1.5	1.9	3.93E+02	1.5	1.9
4.00E+02	4.08E+02	1.7	2.2	4.05E+02	1.7	2.1	4.08E+02	1.7	2.2	4.11E+02	1.7	2.2	3.93E+02	1.5	1.8	3.99E+02	1.5	1.8
5.00E+02	4.26E+02	1.7	2.1	4.22E+02	1.7	2.1	4.29E+02	1.7	2.1	4.20E+02	1.7	2.1	4.08E+02	1.5	1.9	4.11E+02	1.5	1.9
6.00E+02	4.48E+02	1.7	2.1	4.41E+02	1.6	2.1	4.50E+02	1.6	2.1	4.36E+02	1.6	2.1	4.30E+02	1.5	1.9	4.28E+02	1.5	1.9
8.00E+02	4.80E+02	1.7	2.1	4.71E+02	1.6	2.1	4.82E+02	1.6	2.1	4.63E+02	1.6	2.1	4.71E+02	1.6	2	4.69E+02	1.6	2
1.00E+03	5.02E+02	1.7	2.1	4.93E+02	1.6	2.1	5.05E+02	1.6	2.1	4.83E+02	1.6	2.1	4.98E+02	1.6	2	5.04E+02	1.6	2
1.50E+03	5.43E+02	1.6	2.1	5.35E+02	1.6	2.1	5.42E+02	1.7	2.1	5.31E+02	1.7	2.1	5.20E+02	1.6	2.1	5.26E+02	1.6	2.1
2.00E+03	5.67E+02	1.6	2	5.53E+02	1.6	2	5.63E+02	1.7	2.1	5.59E+02	1.7	2.1	5.39E+02	1.6	2	5.19E+02	1.6	2
3.00E+03	5.80E+02	1.6	1.9	5.57E+02	1.6	1.9	5.80E+02	1.6	1.9	5.66E+02	1.6	1.9	5.52E+02	1.6	1.9	5.00E+02	1.6	1.9
4.00E+03	6.04E+02	1.5	1.9	5.74E+02	1.5	1.8	6.00E+02	1.6	1.9	5.80E+02	1.6	1.9	5.67E+02	1.5	1.8	5.21E+02	1.5	1.8
5.00E+03	6.38E+02	1.5	1.8	6.05E+02	1.5	1.8	6.30E+02	1.6	1.7	6.04E+02	1.6	1.7	5.89E+02	1.6	1.7	5.58E+02	1.6	1.7
6.00E+03	6.72E+02	1.5	1.8	6.37E+02	1.5	1.8	6.62E+02	1.5	1.6	6.29E+02	1.5	1.6	6.12E+02	1.5	1.7	5.93E+02	1.5	1.7
8.00E+03	7.27E+02	1.5	1.8	6.93E+02	1.5	1.8	7.14E+02	1.5	1.6	6.74E+02	1.5	1.6	6.44E+02	1.5	1.6	6.49E+02	1.5	1.6
1.00E+04	7.64E+02	1.4	1.8	7.29E+02	1.4	1.8	7.53E+02	1.4	1.6	7.06E+02	1.4	1.6	6.69E+02	1.5	1.7	6.84E+02	1.5	1.7
1.50E+04	8.28E+02	1.4	1.8	7.82E+02	1.4	1.7	8.24E+02	1.4	1.7	7.50E+02	1.4	1.7	7.54E+02	1.4	1.6	7.14E+02	1.4	1.6
2.00E+04	8.80E+02	1.4	1.8	8.26E+02	1.4	1.8	8.68E+02	1.3	1.7	7.88E+02	1.3	1.7	8.21E+02	1.4	1.7	7.41E+02	1.4	1.7
3.00E+04	9.63E+02	1.4	1.7	8.99E+02	1.4	1.8	9.28E+02	1.3	1.8	8.58E+02	1.3	1.8	8.77E+02	1.4	1.6	7.96E+02	1.4	1.6
4.00E+04	1.04E+03	1.4	1.7	9.60E+02	1.4	1.8	9.96E+02	1.3	1.7	9.20E+02	1.3	1.7	9.20E+02	1.4	1.7	8.42E+02	1.4	1.7
5.00E+04	1.10E+03	1.4	1.7	1.02E+03	1.4	1.7	1.06E+03	1.3	1.8	9.73E+02	1.3	1.8	9.65E+02	1.4	1.7	8.91E+02	1.4	1.7
6.00E+04	1.16E+03	1.4	1.7	1.07E+03	1.4	1.7	1.11E+03	1.3	1.7	1.02E+03	1.3	1.7	1.01E+03	1.4	1.7	9.40E+02	1.4	1.7

(continued on next page)

Table A.4. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+04	1.25E+03	1.4	1.7	1.16E+03	1.3	1.7	1.19E+03	1.3	1.7	1.08E+03	1.3	1.7	1.08E+03	1.4	1.5	1.02E+03	1.4	1.5
1.00E+05	1.34E+03	1.3	1.7	1.25E+03	1.3	1.6	1.29E+03	1.4	1.6	1.14E+03	1.4	1.6	1.16E+03	1.3	1.4	1.09E+03	1.3	1.4
1.50E+05	1.55E+03	1.3	1.6	1.42E+03	1.3	1.6	1.54E+03	1.3	1.6	1.30E+03	1.3	1.6	1.37E+03	1.3	1.3	1.16E+03	1.3	1.3
2.00E+05	1.71E+03	1.3	1.6	1.54E+03	1.3	1.6	1.67E+03	1.3	1.6	1.48E+03	1.3	1.6	1.52E+03	1.3	1.3	1.29E+03	1.3	1.3

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	3.73E+01	2.1	3.1	5.95E+01	2.1	3	7.52E+01	2	3	7.42E+01	2	3	6.60E+01	2	3.2	6.97E+01	2	3.1
1.50E+00	3.95E+01	2.4	3.4	6.11E+01	2.4	3.2	7.93E+01	2.1	3	7.72E+01	2.1	3	6.58E+01	2.3	3.3	7.41E+01	2.1	3.2
2.00E+00	4.27E+01	2.4	3.5	6.33E+01	2.4	3.3	8.07E+01	2.2	3.4	7.85E+01	2.2	3.4	6.66E+01	2.3	3.7	7.48E+01	2.1	3.4
3.00E+00	4.75E+01	2.7	4.1	6.78E+01	2.7	3.4	8.29E+01	2.3	3.6	8.07E+01	2.3	3.6	6.81E+01	2.4	3.8	7.46E+01	2.3	3.6
4.00E+00	4.89E+01	2.7	4.3	7.03E+01	2.7	3.5	8.60E+01	2.4	3.6	8.33E+01	2.4	3.6	6.93E+01	2.6	3.8	7.51E+01	2.4	3.7
5.00E+00	4.77E+01	2.7	4.4	7.12E+01	2.7	3.8	8.91E+01	2.4	3.7	8.58E+01	2.4	3.7	7.16E+01	2.6	3.9	7.66E+01	2.4	3.7
6.00E+00	4.70E+01	2.8	4.4	7.34E+01	2.7	4	9.26E+01	2.4	3.7	8.86E+01	2.4	3.7	7.39E+01	2.5	3.9	7.83E+01	2.4	3.7
8.00E+00	4.88E+01	2.8	4.6	8.20E+01	2.7	4.1	1.00E+02	2.4	3.8	9.55E+01	2.4	3.8	7.78E+01	2.6	3.9	8.22E+01	2.4	3.8
1.00E+01	5.02E+01	2.8	4.8	9.08E+01	2.8	4.8	1.16E+02	2.6	4	1.11E+02	2.6	4	8.16E+01	2.6	4	8.68E+01	2.4	3.8
1.50E+01	5.58E+01	3.8	4.9	1.53E+02	4.2	5.9	2.01E+02	3.9	5.7	1.95E+02	3.9	5.7	9.96E+01	2.6	4.1	1.15E+02	2.5	3.9
2.00E+01	7.38E+01	4.2	5.1	2.75E+02	4.4	6.8	3.29E+02	4.3	6.3	3.11E+02	4.3	6.3	1.58E+02	3.4	5.2	2.04E+02	3.7	5.8
3.00E+01	1.54E+02	4	6.3	3.14E+02	4	5.3	5.19E+02	3.8	5.5	5.06E+02	3.8	5.5	4.34E+02	4.3	6.3	5.18E+02	4.2	6.2
4.00E+01	3.02E+02	3.8	6.1	3.73E+02	3.4	5	6.11E+02	3.3	4.6	6.17E+02	3.3	4.6	7.12E+02	3.8	5.3	7.72E+02	3.6	5.2
5.00E+01	3.51E+02	3.5	4.6	3.99E+02	3.3	4.3	6.32E+02	2.9	4.1	6.51E+02	2.9	4.1	8.05E+02	3.3	4.6	8.27E+02	3.2	4.3
6.00E+01	4.80E+02	3.1	4.3	4.51E+02	3	3.8	6.15E+02	2.6	3.5	6.39E+02	2.6	3.5	7.69E+02	2.8	3.8	7.65E+02	2.7	3.5
8.00E+01	6.32E+02	2.5	3.6	6.19E+02	2.4	3.5	5.42E+02	2	2.6	5.54E+02	2	2.6	5.77E+02	1.6	2	5.62E+02	1.6	2.2
1.00E+02	5.32E+02	2.4	2.9	5.52E+02	2.4	2.7	4.83E+02	1.8	2.2	4.87E+02	1.8	2.2	4.72E+02	1.6	1.9	4.67E+02	1.6	2.1
1.50E+02	4.39E+02	1.8	2.4	4.37E+02	1.9	2.2	4.20E+02	1.7	2.2	4.20E+02	1.7	2.2	4.20E+02	1.7	2.1	4.19E+02	1.7	2.1
2.00E+02	4.17E+02	2	2.5	4.01E+02	1.8	2.3	4.03E+02	1.7	2.2	4.02E+02	1.7	2.2	4.10E+02	1.7	2.1	4.07E+02	1.7	2.1
3.00E+02	4.03E+02	1.8	2.3	3.96E+02	1.7	2.2	3.91E+02	1.7	2.1	3.91E+02	1.7	2.1	3.98E+02	1.7	2.1	3.97E+02	1.7	2.1
4.00E+02	4.10E+02	1.7	2.2	4.05E+02	1.7	2.1	3.96E+02	1.6	2	3.95E+02	1.6	2	4.00E+02	1.6	2	4.00E+02	1.6	2
5.00E+02	4.28E+02	1.7	2.1	4.22E+02	1.7	2.2	4.10E+02	1.6	2	4.08E+02	1.6	2	4.11E+02	1.6	2	4.11E+02	1.6	2
6.00E+02	4.51E+02	1.6	2.1	4.42E+02	1.7	2.1	4.26E+02	1.6	2	4.24E+02	1.6	2	4.26E+02	1.6	2	4.25E+02	1.6	1.9
8.00E+02	4.87E+02	1.7	2.1	4.76E+02	1.7	2.3	4.52E+02	1.6	2	4.49E+02	1.6	2	4.51E+02	1.6	2	4.47E+02	1.6	2
1.00E+03	5.10E+02	1.7	2.1	4.97E+02	1.7	2.2	4.70E+02	1.6	2	4.67E+02	1.6	2	4.68E+02	1.6	2	4.62E+02	1.6	2
1.50E+03	5.56E+02	1.7	2.1	5.33E+02	1.7	2.2	5.03E+02	1.6	2	5.01E+02	1.6	2	5.00E+02	1.6	2	4.90E+02	1.6	2
2.00E+03	5.89E+02	1.6	2.1	5.57E+02	1.6	2.1	5.19E+02	1.6	2	5.18E+02	1.6	2	5.14E+02	1.6	1.9	5.04E+02	1.5	1.9
3.00E+03	6.02E+02	1.6	2	5.69E+02	1.6	2	5.26E+02	1.5	1.9	5.21E+02	1.5	1.9	5.14E+02	1.5	1.9	5.04E+02	1.5	1.9
4.00E+03	6.23E+02	1.5	1.9	5.87E+02	1.5	1.9	5.42E+02	1.5	1.8	5.34E+02	1.5	1.8	5.24E+02	1.5	1.8	5.14E+02	1.5	1.8
5.00E+03	6.59E+02	1.5	1.8	6.17E+02	1.5	1.7	5.67E+02	1.4	1.7	5.57E+02	1.4	1.7	5.45E+02	1.4	1.8	5.33E+02	1.4	1.7
6.00E+03	6.97E+02	1.5	1.8	6.51E+02	1.5	1.8	5.93E+02	1.4	1.7	5.82E+02	1.4	1.7	5.67E+02	1.4	1.7	5.54E+02	1.4	1.7
8.00E+03	7.55E+02	1.5	1.7	7.12E+02	1.5	1.7	6.35E+02	1.4	1.7	6.21E+02	1.4	1.7	6.01E+02	1.4	1.7	5.87E+02	1.4	1.7
1.00E+04	7.96E+02	1.5	1.8	7.53E+02	1.5	1.7	6.64E+02	1.4	1.7	6.47E+02	1.4	1.7	6.23E+02	1.4	1.7	6.09E+02	1.4	1.7
1.50E+04	8.71E+02	1.4	1.8	8.13E+02	1.5	1.6	7.15E+02	1.4	1.7	6.96E+02	1.4	1.7	6.65E+02	1.4	1.6	6.50E+02	1.4	1.7
2.00E+04	9.39E+02	1.4	1.8	8.55E+02	1.4	1.6	7.55E+02	1.4	1.7	7.35E+02	1.4	1.7	6.98E+02	1.4	1.6	6.82E+02	1.4	1.6
3.00E+04	1.04E+03	1.4	1.7	9.33E+02	1.3	1.7	8.23E+02	1.4	1.7	7.98E+02	1.4	1.7	7.58E+02	1.4	1.6	7.32E+02	1.4	1.6
4.00E+04	1.12E+03	1.4	1.7	1.01E+03	1.3	1.7	8.78E+02	1.4	1.6	8.45E+02	1.4	1.6	8.08E+02	1.4	1.6	7.64E+02	1.4	1.6
5.00E+04	1.20E+03	1.4	1.6	1.07E+03	1.3	1.8	9.24E+02	1.3	1.7	8.87E+02	1.3	1.7	8.48E+02	1.4	1.6	7.93E+02	1.4	1.6
6.00E+04	1.26E+03	1.4	1.7	1.13E+03	1.3	1.7	9.66E+02	1.3	1.7	9.26E+02	1.3	1.7	8.79E+02	1.3	1.6	8.22E+02	1.4	1.6
8.00E+04	1.38E+03	1.4	1.6	1.23E+03	1.3	1.8	1.04E+03	1.3	1.7	1.00E+03	1.3	1.7	9.35E+02	1.3	1.6	8.84E+02	1.3	1.6
1.00E+05	1.49E+03	1.3	1.7	1.33E+03	1.3	1.7	1.11E+03	1.3	1.7	1.06E+03	1.3	1.7	9.88E+02	1.3	1.6	9.38E+02	1.3	1.6
1.50E+05	1.69E+03	1.3	1.7	1.49E+03	1.3	1.6	1.27E+03	1.3	1.6	1.20E+03	1.3	1.6	1.10E+03	1.3	1.7	1.05E+03	1.3	1.6
2.00E+05	1.81E+03	1.2	1.7	1.60E+03	1.2	1.5	1.39E+03	1.3	1.6	1.31E+03	1.3	1.6	1.21E+03	1.3	1.7	1.15E+03	1.3	1.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	1.06E+02	1.9	2.8	9.97E+01	1.9	2.8	1.30E+03	6.7	9.7	1.47E+03	6.7	9.7	5.56E+01	2.1	3.2	5.78E+01	2.1	3.2
1.50E+00	1.20E+02	1.9	2.9	9.97E+01	1.9	2.9	1.48E+03	7.2	10.5	1.69E+03	7.2	10.5	5.93E+01	2.3	3.4	6.06E+01	2.3	3.2
2.00E+00	1.23E+02	1.9	3	9.95E+01	1.9	3	1.65E+03	7.5	10.7	1.89E+03	7.5	10.7	6.10E+01	2.4	3.7	6.18E+01	2.4	3.5
3.00E+00	1.30E+02	2.1	3.1	1.05E+02	2.1	3.1	1.90E+03	7.4	10.7	2.19E+03	7.4	10.7	6.37E+01	2.6	4	6.42E+01	2.5	3.7
4.00E+00	1.39E+02	2.2	3.2	1.09E+02	2.2	3.2	2.07E+03	7.2	10.4	2.34E+03	7.2	10.4	6.67E+01	2.7	4.1	6.63E+01	2.6	3.8
5.00E+00	1.48E+02	2.3	3.3	1.15E+02	2.3	3.3	2.13E+03	7	10	2.39E+03	7	10	6.94E+01	2.9	4.2	6.77E+01	2.6	4
6.00E+00	1.63E+02	2.3	3.3	1.23E+02	2.3	3.3	2.17E+03	6.4	9.1	2.10E+03	6.4	9.1	7.28E+01	3	4.3	6.93E+01	2.7	4
8.00E+00	2.16E+02	2.7	3.7	1.39E+02	2.7	3.7	1.54E+03	4.5	6.4	1.50E+03	4.5	6.4	8.21E+01	3.2	4.7	7.31E+01	2.8	4.2
1.00E+01	3.01E+02	3.4	5.3	1.58E+02	3.4	5.3	1.19E+03	3.5	5	1.16E+03	3.5	5	9.30E+01	3.3	5	7.94E+01	3	4.4
1.50E+01	5.61E+02	4.7	6.6	3.46E+02	4.7	6.6	8.09E+02	2.5	3.4	7.95E+02	2.5	3.4	1.26E+02	3.8	5.8	1.13E+02	3.5	5.3
2.00E+01	7.05E+02	4.6	6.4	5.20E+02	4.6	6.4	6.64E+02	2.3	3	6.58E+02	2.3	3	1.61E+02	3.8	5.7	1.53E+02	3.8	5.4
3.00E+01	6.38E+02	3.6	4.9	5.85E+02	3.6	4.9	5.60E+02	2.3	3	5.63E+02	2.3	3	2.44E+02	3.8	5.5	2.59E+02	4	5.6
4.00E+01	5.86E+02	3	4	5.67E+02	3	4	5.30E+02	2.3	3	5.37E+02	2.3	3	3.67E+02	3.5	5.3	4.12E+02	3.8	5.4

Table A.4. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+01	5.25E+02	2.7	3.5	6.24E+02	2.7	3.5	5.18E+02	2.3	3	5.28E+02	2.3	3	4.83E+02	3.3	4.7	5.50E+02	3.4	4.8
6.00E+01	6.07E+02	2.5	3.5	6.91E+02	2.5	3.5	5.07E+02	2.1	2.8	5.19E+02	2.1	2.8	5.76E+02	3.1	4.3	6.51E+02	3.1	4.2
8.00E+01	5.74E+02	2.2	2.6	6.03E+02	2.2	2.6	4.81E+02	1.9	2.5	4.90E+02	1.9	2.5	5.87E+02	2.4	3.3	6.05E+02	2.4	3.1
1.00E+02	4.58E+02	1.6	2.2	4.89E+02	1.6	2.2	4.53E+02	1.8	2.2	4.57E+02	1.8	2.2	5.22E+02	2	2.6	5.20E+02	1.9	2.5
1.50E+02	4.15E+02	1.7	2.2	4.29E+02	1.7	2.2	4.06E+02	1.6	2	4.04E+02	1.6	2	4.29E+02	1.7	2.2	4.28E+02	1.7	2.2
2.00E+02	3.98E+02	1.7	2.1	4.20E+02	1.7	2.1	3.86E+02	1.7	2.1	3.84E+02	1.7	2.1	4.05E+02	1.8	2.3	4.09E+02	1.8	2.2
3.00E+02	3.87E+02	1.6	2.1	4.02E+02	1.6	2.1	3.71E+02	1.7	2	3.70E+02	1.7	2	3.97E+02	1.7	2.2	3.98E+02	1.7	2.2
4.00E+02	3.93E+02	1.6	2	4.00E+02	1.6	2	3.73E+02	1.5	1.8	3.71E+02	1.5	1.8	4.07E+02	1.7	2.1	4.04E+02	1.7	2.1
5.00E+02	4.05E+02	1.6	2	4.10E+02	1.6	2	3.83E+02	1.5	1.8	3.80E+02	1.5	1.8	4.24E+02	1.7	2.1	4.20E+02	1.6	2.1
6.00E+02	4.20E+02	1.6	1.9	4.23E+02	1.6	1.9	3.95E+02	1.6	1.9	3.91E+02	1.6	1.9	4.44E+02	1.6	2	4.39E+02	1.6	2
8.00E+02	4.45E+02	1.6	1.9	4.50E+02	1.6	1.9	4.14E+02	1.6	1.9	4.09E+02	1.6	1.9	4.74E+02	1.6	2	4.70E+02	1.6	2
1.00E+03	4.62E+02	1.6	1.9	4.70E+02	1.6	1.9	4.27E+02	1.6	1.9	4.22E+02	1.6	1.9	4.95E+02	1.6	2.1	4.91E+02	1.7	2.1
1.50E+03	4.91E+02	1.6	1.9	4.98E+02	1.6	1.9	4.52E+02	1.6	1.9	4.46E+02	1.6	1.9	5.36E+02	1.6	2	5.29E+02	1.7	2
2.00E+03	5.07E+02	1.6	1.9	5.04E+02	1.6	1.9	4.65E+02	1.6	1.9	4.58E+02	1.6	1.9	5.58E+02	1.6	2	5.48E+02	1.6	2
3.00E+03	5.06E+02	1.5	1.8	5.04E+02	1.5	1.8	4.72E+02	1.4	1.7	4.63E+02	1.4	1.7	5.69E+02	1.5	1.9	5.54E+02	1.6	1.9
4.00E+03	5.19E+02	1.5	1.7	5.21E+02	1.5	1.7	4.85E+02	1.4	1.6	4.75E+02	1.4	1.6	5.89E+02	1.5	1.9	5.71E+02	1.5	1.8
5.00E+03	5.41E+02	1.4	1.7	5.44E+02	1.4	1.7	5.05E+02	1.4	1.7	4.93E+02	1.4	1.7	6.20E+02	1.5	1.8	6.00E+02	1.5	1.8
6.00E+03	5.65E+02	1.4	1.7	5.67E+02	1.4	1.7	5.26E+02	1.4	1.6	5.12E+02	1.4	1.6	6.53E+02	1.4	1.8	6.31E+02	1.4	1.8
8.00E+03	6.01E+02	1.4	1.7	6.01E+02	1.4	1.7	5.58E+02	1.4	1.6	5.42E+02	1.4	1.6	7.07E+02	1.4	1.7	6.82E+02	1.4	1.7
1.00E+04	6.28E+02	1.4	1.7	6.24E+02	1.4	1.7	5.79E+02	1.4	1.7	5.63E+02	1.4	1.7	7.43E+02	1.4	1.8	7.16E+02	1.4	1.7
1.50E+04	6.73E+02	1.4	1.7	6.68E+02	1.4	1.7	6.20E+02	1.4	1.6	5.99E+02	1.4	1.6	8.07E+02	1.4	1.7	7.71E+02	1.4	1.7
2.00E+04	7.03E+02	1.4	1.7	6.94E+02	1.4	1.7	6.53E+02	1.4	1.6	6.28E+02	1.4	1.6	8.59E+02	1.4	1.7	8.12E+02	1.4	1.7
3.00E+04	7.61E+02	1.4	1.7	7.44E+02	1.4	1.7	7.06E+02	1.3	1.5	6.74E+02	1.3	1.5	9.37E+02	1.4	1.7	8.83E+02	1.4	1.7
4.00E+04	8.08E+02	1.3	1.7	7.91E+02	1.3	1.7	7.50E+02	1.3	1.6	7.11E+02	1.3	1.6	1.00E+03	1.4	1.7	9.41E+02	1.4	1.7
5.00E+04	8.46E+02	1.3	1.6	8.32E+02	1.3	1.6	7.88E+02	1.3	1.6	7.44E+02	1.3	1.6	1.06E+03	1.4	1.6	9.93E+02	1.4	1.7
6.00E+04	8.78E+02	1.3	1.6	8.66E+02	1.3	1.6	8.21E+02	1.3	1.5	7.73E+02	1.3	1.5	1.12E+03	1.4	1.6	1.04E+03	1.4	1.7
8.00E+04	9.41E+02	1.3	1.5	9.08E+02	1.3	1.5	8.83E+02	1.3	1.5	8.28E+02	1.3	1.5	1.22E+03	1.3	1.6	1.14E+03	1.3	1.6
1.00E+05	1.01E+03	1.3	1.6	9.50E+02	1.3	1.6	9.41E+02	1.3	1.6	8.79E+02	1.3	1.6	1.31E+03	1.3	1.6	1.22E+03	1.3	1.6
1.50E+05	1.15E+03	1.3	1.6	1.07E+03	1.3	1.6	1.07E+03	1.3	1.8	9.84E+02	1.3	1.8	1.50E+03	1.3	1.6	1.39E+03	1.3	1.6
2.00E+05	1.20E+03	1.3	1.7	1.21E+03	1.3	1.7	1.16E+03	1.3	1.5	1.07E+03	1.3	1.5	1.65E+03	1.3	1.6	1.50E+03	1.3	1.6

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	3.82E+01	2.3	3.7	4.88E+01	2.3	3.7	1.11E+02	2.2	3.4	7.92E+01	2.2	3.2	3.60E+01	2.3	3.1	4.25E+01	2.3	3.4
1.50E+00	4.11E+01	2.4	3.8	4.88E+01	2.4	3.8	1.28E+02	2.4	3.7	8.86E+01	2.3	3.2	4.03E+01	2.4	3.2	4.29E+01	2.4	3.4
2.00E+00	4.12E+01	2.5	3.8	4.88E+01	2.5	3.8	1.33E+02	2.4	4.2	9.24E+01	2.3	3.2	4.32E+01	2.5	3.8	4.46E+01	2.5	3.5
3.00E+00	4.40E+01	2.7	4.2	5.26E+01	2.7	4.2	1.43E+02	2.9	4.5	9.68E+01	2.3	3.3	4.70E+01	2.7	3.9	4.78E+01	2.7	3.9
4.00E+00	4.75E+01	2.8	4.4	5.48E+01	2.8	4.4	1.56E+02	2.9	4.6	9.66E+01	2.3	3.4	4.91E+01	2.8	4.5	4.90E+01	2.8	4.1
5.00E+00	4.63E+01	2.9	4.6	5.61E+01	2.9	4.6	1.73E+02	3.6	4.7	1.02E+02	2.4	3.6	4.94E+01	2.9	5.2	4.92E+01	2.9	4.1
6.00E+00	4.57E+01	3	4.7	5.70E+01	3	4.7	1.93E+02	4	4.9	1.10E+02	2.6	3.6	4.95E+01	2.9	5.3	4.91E+01	2.9	4.2
8.00E+00	5.03E+01	3	4.9	5.81E+01	3	4.9	2.41E+02	4.4	6.1	1.23E+02	2.9	3.8	5.05E+01	2.9	5.6	4.88E+01	2.9	4.3
1.00E+01	5.54E+01	3	5	5.88E+01	3	5	2.90E+02	4.4	6.3	1.36E+02	3.5	4.5	5.05E+01	3.1	5.7	5.02E+01	3.1	4.3
1.50E+01	6.17E+01	3.1	5	6.20E+01	3.1	5	4.22E+02	4.5	6.7	2.75E+02	4	6.2	5.33E+01	3.1	5.7	5.52E+01	3.1	4.3
2.00E+01	6.29E+01	3.1	5.1	7.04E+01	3.1	5.1	4.96E+02	3.7	5.9	3.09E+02	3.9	5.7	6.46E+01	3.1	5.9	6.34E+01	3.1	4.5
3.00E+01	7.90E+01	3.8	5.6	9.07E+01	3.8	5.6	5.40E+02	3.7	4.4	3.54E+02	3.8	5.2	1.24E+02	3.9	6.7	8.37E+01	3.9	5.8
4.00E+01	3.30E+02	4.2	6.2	2.33E+02	4.2	6.2	5.61E+02	2.9	4.3	7.01E+02	3.7	4.9	2.34E+02	3.9	6.3	1.81E+02	3.9	5.7
5.00E+01	4.45E+02	4.2	4.8	4.15E+02	4.2	4.8	7.50E+02	2.8	4.1	7.79E+02	3	4.2	3.80E+02	3.4	5.6	4.88E+02	3.4	5.7
6.00E+01	4.75E+02	3.8	4.6	7.27E+02	3.8	4.6	6.84E+02	2.5	3.4	6.73E+02	2.3	3.1	6.06E+02	3.1	5.4	6.28E+02	3.2	4.9
8.00E+01	6.29E+02	2.5	3.5	6.36E+02	2.5	3.5	5.61E+02	1.8	2.6	6.01E+02	2	2.8	6.25E+02	2.5	3.5	6.29E+02	2.5	2.9
1.00E+02	5.55E+02	2	2.9	5.30E+02	2	2.9	4.82E+02	1.7	2.1	4.91E+02	1.9	2.2	5.59E+02	2.1	2.6	5.47E+02	2.1	2.7
1.50E+02	4.39E+02	1.7	2.4	4.19E+02	1.7	2.4	4.21E+02	1.7	2.1	4.27E+02	1.8	2.1	4.31E+02	1.7	2.5	4.41E+02	1.7	2.3
2.00E+02	4.06E+02	1.7	2.4	4.02E+02	1.7	2.4	3.99E+02	1.5	2.1	4.06E+02	1.7	2.1	4.09E+02	1.9	2.5	4.21E+02	1.9	2.2
3.00E+02	3.90E+02	1.6	2.2	3.92E+02	1.6	2.2	3.80E+02	1.5	2.1	3.96E+02	1.6	2.1	4.13E+02	1.8	2.4	4.06E+02	1.9	2.2
4.00E+02	4.13E+02	1.5	2.2	4.02E+02	1.5	2.2	3.90E+02	1.5	2	3.99E+02	1.6	2	4.16E+02	1.8	2.2	4.09E+02	1.8	2
5.00E+02	4.41E+02	1.5	2.1	4.24E+02	1.5	2.1	4.07E+02	1.6	2	4.09E+02	1.5	2	4.27E+02	1.7	2.1	4.25E+02	1.8	2.3
6.00E+02	4.63E+02	1.5	2	4.50E+02	1.5	2	4.22E+02	1.5	1.9	4.24E+02	1.7	2	4.45E+02	1.6	2.1	4.46E+02	1.6	2.2
8.00E+02	4.91E+02	1.7	1.9	4.90E+02	1.7	1.9	4.42E+02	1.6	1.9	4.55E+02	1.6	2	4.77E+02	1.6	2.1	4.86E+02	1.7	2.4
1.00E+03	5.11E+02	1.7	2	5.18E+02	1.7	2	4.57E+02	1.5	1.9	4.77E+02	1.7	2	5.00E+02	1.5	2.3	5.14E+02	1.6	2.3
1.50E+03	5.47E+02	1.7	2	5.61E+02	1.7	2	4.92E+02	1.6	1.8	4.97E+02	1.6	2	5.44E+02	1.5	2.1	5.57E+02	1.7	2.2
2.00E+03	5.77E+02	1.7	2	5.79E+02	1.7	2	5.09E+02	1.6	1.8	5.06E+02	1.6	1.9	5.68E+02	1.5	2.2	5.72E+02	1.5	2.2
3.00E+03	5.94E+02	1.6	1.9	5.84E+02	1.6	1.9	5.11E+02	1.5	1.8	5.10E+02	1.5	1.8	5.91E+02	1.5	1.9	5.72E+02	1.5	1.9
4.00E+03	6.14E+02	1.5	1.8	6.00E+02	1.5	1.8	5.20E+02	1.5	1.7	5.26E+02	1.4	1.7	6.21E+02	1.5	2	5.90E+02	1.5	2
5.00E+03	6.46E+02	1.3	1.7	6.31E+02	1.3	1.7	5.39E+02	1.4	1.7	5.50E+02	1.4	1.7	6.58E+02	1.4	1.8	6.24E+02	1.4	1.7
6.00E+03	6.81E+02	1.4	1.8	6.67E+02	1.4	1.8	5.59E+02	1.4	1.7	5.74E+02	1.3	1.6	6.96E+02	1.5	2	6.62E+02	1.5	1.8
8.00E+03	7.50E+02	1.4	1.9	7.40E+02	1.4	1.9	5.90E+02	1.3	1.7	6.10E+02	1.3	1.5	7.57E+02	1.5	1.8	7.29E+02	1.4	1.6
1.00E+04	8.03E+02	1.5	2.1	7.92E+02	1.5	2.1	6.10E+02	1.4	1.8	6.42E+02	1.3	1.5	7.98E+02	1.6	1.8	7.68E+02	1.4	1.6

(continued on next page)

Table A.4. (*continued*)

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.50E+04	8.63E+02	1.5	2	8.33E+02	1.5	2	6.68E+02	1.4	1.7	6.99E+02	1.3	1.5	8.70E+02	1.6	1.7	8.24E+02	1.3	1.6
2.00E+04	9.18E+02	1.4	2.2	8.70E+02	1.4	2.2	7.20E+02	1.5	1.8	7.12E+02	1.3	1.5	9.10E+02	1.5	1.7	8.74E+02	1.3	1.5
3.00E+04	1.01E+03	1.4	1.9	9.49E+02	1.4	1.9	7.68E+02	1.4	1.7	7.59E+02	1.4	1.4	9.77E+02	1.5	1.6	9.43E+02	1.4	1.7
4.00E+04	1.08E+03	1.3	2	1.03E+03	1.3	2	8.02E+02	1.4	1.7	8.01E+02	1.3	1.3	1.07E+03	1.4	1.5	1.01E+03	1.3	1.5
5.00E+04	1.14E+03	1.3	1.6	1.10E+03	1.3	1.6	8.30E+02	1.4	1.8	8.35E+02	1.4	1.4	1.15E+03	1.4	1.5	1.07E+03	1.4	1.6
6.00E+04	1.20E+03	1.4	1.6	1.16E+03	1.4	1.6	8.57E+02	1.4	1.6	8.66E+02	1.3	1.5	1.21E+03	1.4	1.4	1.14E+03	1.4	1.4
8.00E+04	1.33E+03	1.3	1.5	1.27E+03	1.3	1.5	9.19E+02	1.4	1.7	9.30E+02	1.3	1.6	1.28E+03	1.3	1.5	1.28E+03	1.4	1.5
1.00E+05	1.46E+03	1.3	1.5	1.37E+03	1.3	1.5	9.82E+02	1.3	1.6	9.86E+02	1.3	1.6	1.34E+03	1.3	1.5	1.41E+03	1.4	1.5
1.50E+05	1.75E+03	1.3	1.5	1.55E+03	1.3	1.5	1.10E+03	1.3	1.7	1.11E+03	1.3	1.5	1.56E+03	1.3	1.7	1.60E+03	1.4	1.6
2.00E+05	1.91E+03	1.3	1.6	1.65E+03	1.3	1.6	1.17E+03	1.3	1.7	1.27E+03	1.3	1.3	1.80E+03	1.3	1.8	1.62E+03	1.5	1.8

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	4.63E+01	2.3	3.3	5.14E+01	2.4	3.1	4.37E+01	2.2	3.2	4.64E+01	2.2	3.2	6.50E+01	2	3	6.50E+01	2	3
1.50E+00	4.68E+01	2.4	3.6	5.61E+01	2.4	3.1	4.69E+01	2.6	3.5	5.01E+01	2.6	3.5	7.05E+01	2.3	3	6.76E+01	2.3	3
2.00E+00	4.77E+01	2.5	4	5.63E+01	2.5	3.7	4.91E+01	2.6	4	5.19E+01	2.6	4	7.41E+01	2.3	3.3	6.85E+01	2.3	3.3
3.00E+00	4.90E+01	2.7	4.1	5.55E+01	2.7	3.8	5.03E+01	2.7	4	5.36E+01	2.7	4	7.99E+01	2.4	3.4	7.05E+01	2.4	3.4
4.00E+00	4.94E+01	2.9	4.2	5.59E+01	2.8	3.9	5.10E+01	3	4.1	5.37E+01	3	4.1	8.42E+01	2.5	3.7	7.42E+01	2.5	3.7
5.00E+00	5.00E+01	3.1	4.2	5.82E+01	2.8	4	5.13E+01	3.1	4.4	5.37E+01	3.1	4.4	8.82E+01	2.5	3.8	7.77E+01	2.5	3.8
6.00E+00	5.08E+01	3.1	4.3	6.04E+01	2.8	4.2	5.10E+01	3.1	4.4	5.44E+01	3.1	4.4	9.45E+01	2.5	3.9	8.06E+01	2.5	3.9
8.00E+00	5.24E+01	3.1	4.5	6.17E+01	3	4.3	5.13E+01	3.1	4.5	5.64E+01	3.1	4.5	1.17E+02	3	4.3	8.52E+01	3	4.3
1.00E+01	5.42E+01	3.1	4.6	6.28E+01	3.1	4.4	5.32E+01	3.1	4.6	5.79E+01	3.1	4.6	1.45E+02	3.1	4.9	9.67E+01	3.1	4.9
1.50E+01	6.01E+01	3.2	4.7	6.92E+01	3.1	4.4	5.85E+01	3.1	4.7	6.20E+01	3.1	4.7	2.11E+02	3.9	6.5	1.58E+02	3.9	6.5
2.00E+01	7.69E+01	3.1	4.7	8.92E+01	3	4.5	6.52E+01	3.1	4.8	7.06E+01	3.1	4.8	2.47E+02	4.3	6.1	2.43E+02	4.3	6.1
3.00E+01	1.69E+02	4	6.1	2.13E+02	4.1	5.8	9.85E+01	3	4.9	1.16E+02	3	4.9	2.94E+02	3.5	4.9	2.88E+02	3.5	4.9
4.00E+01	3.15E+02	3.8	5.4	4.08E+02	3.7	5.7	3.15E+02	4.2	6	3.41E+02	4.2	6	3.72E+02	3.4	4.8	4.18E+02	3.4	4.8
5.00E+01	4.65E+02	3.7	5.1	5.75E+02	3.3	5.1	4.75E+02	3.7	5.3	5.69E+02	3.7	5.3	4.63E+02	3.1	4.7	5.30E+02	3.1	4.7
6.00E+01	5.76E+02	3.4	4.6	6.62E+02	2.8	4.3	5.23E+02	3.2	4.4	6.18E+02	3.2	4.4	5.37E+02	3	4.4	6.05E+02	3	4.4
8.00E+01	6.09E+02	2.4	3.4	6.10E+02	2.4	2.9	5.68E+02	2.5	3.4	5.97E+02	2.5	3.4	5.69E+02	2.6	3.2	5.92E+02	2.6	3.2
1.00E+02	5.36E+02	1.8	2.4	5.15E+02	1.8	2.2	5.31E+02	2.1	2.7	5.30E+02	2.1	2.7	5.19E+02	2	2.5	5.19E+02	2	2.5
1.50E+02	4.30E+02	1.8	2.2	4.27E+02	1.7	2.2	4.31E+02	1.8	2.2	4.34E+02	1.8	2.2	4.29E+02	1.7	2.1	4.29E+02	1.7	2.1
2.00E+02	4.09E+02	1.8	2.3	4.09E+02	1.8	2.2	4.01E+02	1.8	2.3	4.09E+02	1.8	2.3	4.09E+02	1.8	2.2	4.13E+02	1.8	2.2
3.00E+02	4.02E+02	1.8	2.2	3.98E+02	1.7	2.2	3.99E+02	1.7	2.2	4.00E+02	1.7	2.2	3.98E+02	1.7	2.2	4.00E+02	1.7	2.2
4.00E+02	4.10E+02	1.7	2.2	4.05E+02	1.7	2.1	4.10E+02	1.7	2.1	4.08E+02	1.7	2.1	4.04E+02	1.7	2.1	4.06E+02	1.7	2.1
5.00E+02	4.26E+02	1.7	2.1	4.22E+02	1.7	2.1	4.29E+02	1.7	2.1	4.28E+02	1.7	2.1	4.20E+02	1.7	2.1	4.22E+02	1.7	2.1
6.00E+02	4.46E+02	1.7	2.1	4.39E+02	1.6	2	4.51E+02	1.7	2.1	4.50E+02	1.7	2.1	4.40E+02	1.6	2.1	4.41E+02	1.6	2.1
8.00E+02	4.79E+02	1.7	2.1	4.65E+02	1.6	2.1	4.86E+02	1.7	2.1	4.82E+02	1.7	2.1	4.73E+02	1.6	2.1	4.68E+02	1.6	2.1
1.00E+03	5.03E+02	1.7	2.1	4.85E+02	1.6	2.1	5.10E+02	1.7	2.1	5.04E+02	1.7	2.1	4.97E+02	1.6	2.1	4.85E+02	1.6	2.1
1.50E+03	5.42E+02	1.6	2	5.25E+02	1.6	2	5.50E+02	1.7	2.1	5.46E+02	1.7	2.1	5.33E+02	1.6	2	5.24E+02	1.6	2
2.00E+03	5.66E+02	1.6	2	5.44E+02	1.6	2	5.75E+02	1.6	2	5.65E+02	1.6	2	5.54E+02	1.6	2	5.46E+02	1.6	2
3.00E+03	5.77E+02	1.6	1.9	5.51E+02	1.5	1.9	5.89E+02	1.6	2	5.72E+02	1.6	2	5.66E+02	1.5	2	5.52E+02	1.5	2
4.00E+03	5.93E+02	1.5	1.8	5.69E+02	1.5	1.8	6.13E+02	1.5	1.9	5.93E+02	1.5	1.9	5.87E+02	1.5	1.9	5.71E+02	1.5	1.9
5.00E+03	6.22E+02	1.5	1.7	5.98E+02	1.5	1.8	6.49E+02	1.5	1.8	6.26E+02	1.5	1.8	6.18E+02	1.5	1.9	6.00E+02	1.5	1.9
6.00E+03	6.55E+02	1.5	1.8	6.27E+02	1.5	1.8	6.86E+02	1.5	1.8	6.61E+02	1.5	1.8	6.50E+02	1.4	1.8	6.30E+02	1.4	1.8
8.00E+03	7.11E+02	1.5	1.7	6.74E+02	1.5	1.7	7.50E+02	1.5	1.8	7.22E+02	1.5	1.8	7.00E+02	1.4	1.8	6.75E+02	1.4	1.8
1.00E+04	7.49E+02	1.4	1.8	7.05E+02	1.4	1.8	7.95E+02	1.4	1.8	7.66E+02	1.4	1.8	7.35E+02	1.4	1.7	7.08E+02	1.4	1.7
1.50E+04	8.21E+02	1.4	1.7	7.55E+02	1.4	1.7	8.57E+02	1.4	1.8	8.17E+02	1.4	1.8	8.02E+02	1.4	1.7	7.73E+02	1.4	1.7
2.00E+04	8.78E+02	1.4	1.8	7.95E+02	1.3	1.7	9.04E+02	1.4	1.7	8.68E+02	1.4	1.7	8.55E+02	1.4	1.6	8.15E+02	1.4	1.6
3.00E+04	9.48E+02	1.4	1.7	8.76E+02	1.3	1.9	9.97E+02	1.4	1.7	9.60E+02	1.4	1.7	9.35E+02	1.4	1.7	8.83E+02	1.4	1.7
4.00E+04	1.00E+03	1.4	1.7	9.30E+02	1.3	1.9	1.08E+03	1.4	1.7	1.02E+03	1.4	1.7	1.00E+03	1.4	1.7	9.37E+02	1.4	1.7
5.00E+04	1.06E+03	1.4	1.6	9.74E+02	1.4	2	1.15E+03	1.4	1.7	1.08E+03	1.4	1.7	1.06E+03	1.3	1.7	9.86E+02	1.3	1.7
6.00E+04	1.12E+03	1.4	1.6	1.02E+03	1.4	1.8	1.21E+03	1.4	1.7	1.13E+03	1.4	1.7	1.12E+03	1.3	1.7	1.03E+03	1.3	1.7
8.00E+04	1.22E+03	1.3	1.6	1.11E+03	1.4	1.9	1.32E+03	1.3	1.7	1.24E+03	1.3	1.7	1.23E+03	1.3	1.7	1.13E+03	1.3	1.7
1.00E+05	1.32E+03	1.3	1.6	1.19E+03	1.4	1.7	1.43E+03	1.3	1.6	1.35E+03	1.3	1.6	1.32E+03	1.3	1.6	1.21E+03	1.3	1.6
1.50E+05	1.52E+03	1.3	1.7	1.37E+03	1.3	1.7	1.68E+03	1.3	1.6	1.51E+03	1.3	1.6	1.49E+03	1.3	1.6	1.38E+03	1.3	1.6
2.00E+05	1.67E+03	1.3	1.7	1.52E+03	1.3	1.7	1.87E+03	1.3	1.6	1.58E+03	1.3	1.6	1.63E+03	1.3	1.6	1.51E+03	1.3	1.6

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	8.17E+01	1.9	3	7.37E+01	1.9	2.9	6.76E+01	2	2.8	8.23E+01	2	2.8	3.06E+01	2.2	3.9	5.57E+01	1.9	3.4
1.50E+00	8.60E+01	2	3	7.65E+01	2	2.9	7.09E+01	2.1	2.8	8.55E+01	2.1	2.8	3.61E+01	2.5	4.2	5.83E+01	2.5	3.4
2.00E+00	8.86E+01	2.1	3.4	7.82E+01	2.1	3.3	7.11E+01	2.2	3.2	8.71E+01	2.2	3.2	3.70E+01	2.8	4.7	5.95E+01	2.8	3.7
3.00E+00	9.30E+01	2.3	3.5	8.08E+01	2.2	3.5	7.24E+01	2.2	3.5	9.24E+01	2.2	3.5	3.67E+01	3.2	4.7	6.13E+01	2.8	3.9
4.00E+00	9.72E+01	2.3	3.6	8.35E+01	2.3	3.5	7.79E+01	2.3	3.5	9.90E+01	2.3	3.5	3.78E+01	3.2	4.8	6.31E+01	2.8	4.1
5.00E+00	1.01E+02	2.4	3.7	8.61E+01	2.3	3.5	8.29E+01	2.3	3.6	9.83E+01	2.3	3.6	3.88E+01	3.2	4.8	6.47E+01	2.8	4.2
6.00E+00	1.07E+02	2.4	3.7	8.90E+01	2.3	3.6	8.63E+01	2.3	3.6	9.74E+01	2.3	3.6	3.96E+01	3.2	4.9	6.64E+01	3	4.3

Table A.4. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
8.00E+00	1.21E+02	2.6	3.9	9.60E+01	2.4	3.7	9.17E+01	2.5	3.7	1.00E+02	2.5	3.7	4.22E+01	3.3	5	7.01E+01	3.1	4.4
1.00E+01	1.46E+02	3	4.6	1.08E+02	2.5	4	1.00E+02	2.6	3.8	1.16E+02	2.6	3.8	4.31E+01	3.4	5.2	7.81E+01	3.3	4.5
1.50E+01	2.53E+02	4.2	6.2	1.68E+02	3.4	5	1.33E+02	3.4	5.2	1.89E+02	3.4	5.2	4.35E+01	3.4	5.4	1.20E+02	3.3	4.6
2.00E+01	3.75E+02	4.3	6.3	2.73E+02	4.2	6.1	1.83E+02	3.9	5.4	2.56E+02	3.9	5.4	4.76E+01	3.4	5.9	1.74E+02	3.3	4.6
3.00E+01	5.29E+02	3.7	5.4	4.86E+02	3.9	5.7	3.48E+02	4.3	6	4.67E+02	4.3	6	6.34E+01	3.4	6.1	2.85E+02	3.2	5
4.00E+01	5.84E+02	3.2	4.5	6.00E+02	3.4	4.8	6.95E+02	3.4	5.7	6.45E+02	3.4	5.7	9.00E+01	3.4	5.9	4.12E+02	4.2	5.9
5.00E+01	5.89E+02	2.8	3.9	6.25E+02	3	4.1	7.71E+02	3.4	4.5	7.03E+02	3.4	4.5	2.15E+02	4.2	5.7	5.29E+02	3.9	5.7
6.00E+01	5.75E+02	2.6	3.5	6.10E+02	2.6	3.5	6.87E+02	2.6	3.4	6.84E+02	2.6	3.4	5.74E+02	3.8	4.8	6.37E+02	3.5	4.7
8.00E+01	5.28E+02	2.1	2.8	5.46E+02	2.1	2.8	5.75E+02	2.2	2.7	5.90E+02	2.2	2.7	6.41E+02	2.6	3.8	5.85E+02	2.3	3.2
1.00E+02	4.83E+02	1.9	2.4	4.91E+02	1.9	2.3	4.85E+02	1.8	2.2	5.07E+02	1.8	2.2	5.28E+02	2.1	3	5.14E+02	1.9	2.6
1.50E+02	4.22E+02	1.7	2.1	4.23E+02	1.7	2.1	4.18E+02	1.7	2.1	4.21E+02	1.7	2.1	4.33E+02	1.7	2.3	4.26E+02	1.7	2.2
2.00E+02	4.03E+02	1.7	2.2	4.05E+02	1.7	2.2	4.10E+02	1.8	2.1	4.06E+02	1.8	2.1	4.15E+02	1.9	2.3	4.06E+02	1.9	2.3
3.00E+02	3.92E+02	1.7	2.1	3.93E+02	1.7	2.1	4.04E+02	1.8	2	3.92E+02	1.8	2	4.12E+02	1.8	2.2	3.96E+02	1.8	2.2
4.00E+02	3.98E+02	1.7	2.1	3.98E+02	1.6	2	4.05E+02	1.7	2	3.94E+02	1.7	2	4.19E+02	1.7	2.1	4.02E+02	1.7	2.1
5.00E+02	4.12E+02	1.6	2	4.13E+02	1.6	2	4.15E+02	1.6	2	4.06E+02	1.6	2	4.35E+02	1.7	2.1	4.18E+02	1.7	2.1
6.00E+02	4.28E+02	1.6	2	4.29E+02	1.6	2	4.30E+02	1.6	2	4.23E+02	1.6	2	4.55E+02	1.6	2.1	4.37E+02	1.6	2
8.00E+02	4.55E+02	1.6	2	4.55E+02	1.6	2	4.53E+02	1.6	2.1	4.49E+02	1.6	2.1	4.95E+02	1.7	2.1	4.66E+02	1.6	2.1
1.00E+03	4.74E+02	1.6	2	4.73E+02	1.6	2	4.68E+02	1.6	2.1	4.68E+02	1.6	2.1	5.25E+02	1.7	2.1	4.86E+02	1.7	2.1
1.50E+03	5.08E+02	1.6	2	5.07E+02	1.6	2	5.02E+02	1.6	2	5.04E+02	1.6	2	5.71E+02	1.7	2	5.26E+02	1.7	2.1
2.00E+03	5.27E+02	1.6	2	5.25E+02	1.6	2	5.14E+02	1.6	1.9	5.15E+02	1.6	1.9	5.92E+02	1.6	2	5.48E+02	1.7	2
3.00E+03	5.35E+02	1.5	1.9	5.31E+02	1.5	1.9	5.19E+02	1.6	1.8	5.17E+02	1.6	1.8	6.04E+02	1.5	1.9	5.55E+02	1.6	1.9
4.00E+03	5.51E+02	1.5	1.8	5.46E+02	1.5	1.8	5.37E+02	1.6	1.8	5.30E+02	1.6	1.8	6.30E+02	1.5	1.9	5.72E+02	1.6	1.9
5.00E+03	5.77E+02	1.5	1.8	5.71E+02	1.5	1.8	5.63E+02	1.6	1.7	5.53E+02	1.6	1.7	6.67E+02	1.5	1.8	6.00E+02	1.6	1.8
6.00E+03	6.05E+02	1.4	1.7	5.98E+02	1.4	1.7	5.89E+02	1.4	1.7	5.78E+02	1.4	1.7	7.06E+02	1.5	1.8	6.30E+02	1.5	1.9
8.00E+03	6.48E+02	1.4	1.7	6.39E+02	1.4	1.7	6.28E+02	1.4	1.6	6.16E+02	1.4	1.6	7.65E+02	1.5	1.8	6.77E+02	1.5	1.8
1.00E+04	6.78E+02	1.4	1.7	6.67E+02	1.4	1.7	6.51E+02	1.3	1.6	6.33E+02	1.3	1.6	8.04E+02	1.4	1.8	7.09E+02	1.4	1.8
1.50E+04	7.33E+02	1.4	1.7	7.17E+02	1.4	1.7	6.97E+02	1.4	1.6	6.71E+02	1.4	1.6	8.79E+02	1.4	1.7	7.67E+02	1.4	1.7
2.00E+04	7.76E+02	1.4	1.7	7.57E+02	1.4	1.7	7.38E+02	1.4	1.6	7.04E+02	1.4	1.6	9.43E+02	1.4	1.8	8.13E+02	1.4	1.7
3.00E+04	8.48E+02	1.4	1.7	8.24E+02	1.4	1.7	8.12E+02	1.4	1.6	7.61E+02	1.4	1.6	1.04E+03	1.4	1.8	8.90E+02	1.4	1.6
4.00E+04	9.07E+02	1.4	1.7	8.76E+02	1.4	1.6	8.56E+02	1.4	1.5	8.03E+02	1.4	1.5	1.12E+03	1.4	1.8	9.50E+02	1.4	1.6
5.00E+04	9.57E+02	1.3	1.7	9.20E+02	1.3	1.6	8.85E+02	1.4	1.6	8.39E+02	1.4	1.6	1.20E+03	1.4	1.7	1.00E+03	1.4	1.7
6.00E+04	1.00E+03	1.3	1.7	9.62E+02	1.3	1.6	9.10E+02	1.4	1.5	8.75E+02	1.4	1.5	1.26E+03	1.4	1.7	1.05E+03	1.4	1.8
8.00E+04	1.09E+03	1.3	1.7	1.04E+03	1.3	1.6	9.76E+02	1.4	1.6	9.41E+02	1.4	1.6	1.36E+03	1.3	1.7	1.13E+03	1.4	1.8
1.00E+05	1.16E+03	1.3	1.6	1.11E+03	1.3	1.6	1.05E+03	1.4	1.5	1.00E+03	1.4	1.5	1.46E+03	1.3	1.7	1.21E+03	1.3	1.7
1.50E+05	1.33E+03	1.3	1.6	1.26E+03	1.3	1.6	1.19E+03	1.4	1.5	1.14E+03	1.4	1.5	1.66E+03	1.3	1.6	1.38E+03	1.3	1.6
2.00E+05	1.46E+03	1.3	1.6	1.38E+03	1.3	1.6	1.27E+03	1.4	1.4	1.23E+03	1.4	1.4	1.78E+03	1.3	1.6	1.51E+03	1.3	1.6

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	3.66E+01	2.2	3	3.44E+01	2.2	3.8	4.48E+01	2.3	3.4	4.61E+01	2.3	3.4	4.69E+01	2.2	3	6.18E+01	2.4	3.2
1.50E+00	3.76E+01	2.3	3.1	3.70E+01	2.5	4.1	4.73E+01	2.4	3.5	4.95E+01	2.4	3.5	4.93E+01	2.5	3.1	6.27E+01	2.4	3.3
2.00E+00	3.72E+01	2.3	3.3	3.84E+01	2.8	4.2	4.84E+01	2.5	3.9	5.08E+01	2.5	3.9	5.13E+01	2.5	3.5	6.27E+01	2.5	3.5
3.00E+00	3.75E+01	2.5	4.2	4.05E+01	2.9	4.4	4.94E+01	2.7	4.2	5.21E+01	2.7	4.2	5.38E+01	2.5	3.7	6.30E+01	2.5	3.6
4.00E+00	4.00E+01	2.6	4.3	4.29E+01	3.3	4.5	5.08E+01	2.8	4.2	5.30E+01	2.8	4.2	5.39E+01	2.5	3.9	6.37E+01	2.5	3.7
5.00E+00	4.04E+01	2.6	4.3	4.50E+01	3.3	4.8	5.24E+01	2.9	4.3	5.46E+01	2.9	4.3	5.41E+01	2.8	4.1	6.40E+01	2.5	4.1
6.00E+00	4.06E+01	2.7	4.4	4.65E+01	3.3	4.8	5.37E+01	2.9	4.4	5.61E+01	2.9	4.4	5.56E+01	2.9	4.2	6.51E+01	2.5	4.2
8.00E+00	4.35E+01	2.7	4.4	4.74E+01	3.4	4.9	5.58E+01	2.9	4.5	5.80E+01	2.9	4.5	6.18E+01	2.9	4.3	6.98E+01	2.6	4.3
1.00E+01	4.61E+01	2.7	4.4	4.65E+01	3.5	5	5.76E+01	3.1	4.5	5.91E+01	3.1	4.5	6.55E+01	3.1	4.5	7.49E+01	2.5	4.4
1.50E+01	5.38E+01	2.8	4.5	4.85E+01	3.5	5	6.31E+01	3.1	4.6	6.52E+01	3.1	4.6	6.86E+01	3.1	4.6	8.85E+01	2.5	4.5
2.00E+01	6.38E+01	2.8	4.5	5.77E+01	3.5	5.3	7.81E+01	3.1	4.7	7.84E+01	3.1	4.7	8.38E+01	3.2	4.8	9.40E+01	3	4.5
3.00E+01	7.14E+01	2.8	4.5	7.55E+01	3.5	5.4	1.65E+02	3.9	6	1.90E+02	3.9	6	1.65E+02	3.8	5.8	2.83E+02	4.2	6
4.00E+01	1.09E+02	4.5	5.9	1.50E+02	4	5.5	3.01E+02	3.9	5.6	3.64E+02	3.9	5.6	4.08E+02	3.9	6.1	5.00E+02	4	5.5
5.00E+01	3.88E+02	3.8	5.5	3.93E+02	3.9	5.6	4.34E+02	3.4	4.9	4.74E+02	3.4	4.9	4.96E+02	3.4	4.8	5.67E+02	3.1	4.4
6.00E+01	5.96E+02	3.5	5.1	6.28E+02	3.7	4.9	5.25E+02	3.1	4.4	5.53E+02	3.1	4.4	5.53E+02	3.1	4.3	6.37E+02	3.1	4.1
8.00E+01	5.93E+02	2	4.2	6.95E+02	3	3.9	5.65E+02	2.5	3.4	5.79E+02	2.5	3.4	5.82E+02	2.6	3.3	5.85E+02	2.1	3
1.00E+02	5.44E+02	1.9	3.4	5.44E+02	1.8	2.6	5.22E+02	2.1	2.7	5.30E+02	2.1	2.7	5.31E+02	2	2.7	5.23E+02	1.9	2.5
1.50E+02	4.34E+02	1.8	2.5	4.36E+02	1.8	2.4	4.31E+02	1.7	2.2	4.36E+02	1.7	2.2	4.30E+02	1.8	2.3	4.31E+02	1.8	2.3
2.00E+02	4.03E+02	1.7	2.5	4.14E+02	1.8	2.4	4.07E+02	1.8	2.3	4.14E+02	1.8	2.3	4.02E+02	1.8	2.3	4.05E+02	1.8	2.2
3.00E+02	3.84E+02	1.7	2.4	4.01E+02	1.7	2.3	4.00E+02	1.7	2.2	4.02E+02	1.7	2.2	3.92E+02	1.7	2.2	3.98E+02	1.7	2.1
4.00E+02	4.03E+02	1.7	2.2	4.12E+02	1.7	2.2	4.09E+02	1.7	2.1	4.09E+02	1.7	2.1	4.02E+02	1.7	2.1	4.03E+02	1.7	2.1
5.00E+02	4.32E+02	1.8	2.1	4.34E+02	1.7	2.2	4.27E+02	1.7	2.1	4.27E+02	1.7	2.1	4.21E+02	1.7	2	4.17E+02	1.6	2
6.00E+02	4.58E+02	1.9	2	4.58E+02	1.7	2.1	4.49E+02	1.7	2.1	4.46E+02	1.7	2.1	4.41E+02	1.7	2	4.35E+02	1.6	2
8.00E+02	4.84E+02	1.8	2	4.87E+02	1.7	2.1	4.84E+02	1.7	2.1	4.77E+02	1.7	2.1	4.76E+02	1.6	2.1	4.72E+02	1.6	2
1.00E+03	5.01E+02	1.7	2.1	5.05E+02	1.7	2.1	5.10E+02	1.7	2.1	4.99E+02	1.7	2.1	5.00E+02	1.6	2.1	4.97E+02	1.7	2
1.50E+03	5.66E+02	1.7	2.2	5.47E+02	1.7	2	5.49E+02	1.6	2.1	5.43E+02	1.6	2.1	5.44E+02	1.6	2	5.33E+02	1.7	2
2.00E+03	6.00E+02	1.6	2.2	5.78E+02	1.6	1.9	5.71E+02	1.6	2	5.69E+02	1.6	2	5.69E+02	1.6	2	5.54E+02	1.6	2

(continued on next page)

Table A.4. (*continued*)

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	6.01E+02	1.6	2.1	5.93E+02	1.6	1.9	5.88E+02	1.6	1.9	5.76E+02	1.6	1.9	5.80E+02	1.6	1.9	5.55E+02	1.6	1.9
4.00E+03	6.24E+02	1.5	1.9	6.11E+02	1.5	1.8	6.12E+02	1.5	1.9	5.97E+02	1.5	1.9	5.99E+02	1.5	1.8	5.74E+02	1.5	1.9
5.00E+03	6.62E+02	1.5	1.7	6.43E+02	1.5	1.8	6.47E+02	1.5	1.8	6.29E+02	1.5	1.8	6.29E+02	1.5	1.8	6.04E+02	1.5	1.7
6.00E+03	6.99E+02	1.4	1.6	6.80E+02	1.4	1.8	6.84E+02	1.5	1.8	6.63E+02	1.5	1.8	6.61E+02	1.5	1.8	6.35E+02	1.4	1.8
8.00E+03	7.54E+02	1.4	1.6	7.40E+02	1.4	1.8	7.43E+02	1.5	1.8	7.18E+02	1.5	1.8	7.18E+02	1.5	1.8	6.80E+02	1.4	1.7
1.00E+04	7.92E+02	1.4	1.5	7.79E+02	1.4	1.7	7.83E+02	1.4	1.8	7.56E+02	1.4	1.8	7.58E+02	1.5	1.9	7.09E+02	1.4	1.7
1.50E+04	8.62E+02	1.4	1.6	8.55E+02	1.4	1.7	8.55E+02	1.4	1.7	8.19E+02	1.4	1.7	8.23E+02	1.4	1.8	7.70E+02	1.4	1.7
2.00E+04	9.08E+02	1.3	1.5	9.17E+02	1.4	1.6	9.06E+02	1.4	1.7	8.68E+02	1.4	1.7	8.80E+02	1.4	1.8	8.22E+02	1.4	1.7
3.00E+04	9.97E+02	1.3	1.6	9.95E+02	1.4	1.7	9.94E+02	1.4	1.7	9.54E+02	1.4	1.7	9.58E+02	1.4	1.7	8.98E+02	1.4	1.7
4.00E+04	1.10E+03	1.3	1.4	1.06E+03	1.4	1.7	1.08E+03	1.4	1.7	1.02E+03	1.4	1.7	1.03E+03	1.4	1.7	9.56E+02	1.4	1.6
5.00E+04	1.19E+03	1.3	1.4	1.12E+03	1.4	1.8	1.15E+03	1.4	1.7	1.08E+03	1.4	1.7	1.09E+03	1.4	1.6	1.00E+03	1.4	1.6
6.00E+04	1.26E+03	1.3	1.6	1.18E+03	1.3	1.8	1.21E+03	1.4	1.7	1.14E+03	1.4	1.7	1.14E+03	1.4	1.7	1.05E+03	1.3	1.7
8.00E+04	1.40E+03	1.3	1.6	1.31E+03	1.3	1.7	1.32E+03	1.3	1.7	1.23E+03	1.3	1.7	1.24E+03	1.3	1.7	1.13E+03	1.3	1.7
1.00E+05	1.51E+03	1.3	1.8	1.42E+03	1.3	1.7	1.43E+03	1.3	1.6	1.33E+03	1.3	1.6	1.34E+03	1.3	1.7	1.20E+03	1.3	1.7
1.50E+05	1.69E+03	1.3	1.6	1.62E+03	1.3	1.6	1.64E+03	1.3	1.6	1.52E+03	1.3	1.6	1.54E+03	1.3	1.6	1.38E+03	1.3	1.7
2.00E+05	1.90E+03	1.3	1.6	1.69E+03	1.3	1.5	1.78E+03	1.3	1.6	1.63E+03	1.3	1.6	1.71E+03	1.2	1.6	1.48E+03	1.3	1.6

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	7.44E+01	1.9	3.5	6.47E+01	1.9	3	2.86E+02	6.7	9.7	2.86E+02	6.7	9.7
1.50E+00	7.01E+01	2	3.7	6.45E+01	2	3.1	3.21E+02	7.2	10.5	3.21E+02	7.2	10.5
2.00E+00	7.06E+01	2.3	3.8	6.39E+01	2.2	3.2	3.45E+02	7.5	10.7	3.45E+02	7.5	10.7
3.00E+00	7.15E+01	2.5	4	6.82E+01	2.5	3.5	3.73E+02	7.4	10.7	3.73E+02	7.4	10.7
4.00E+00	7.26E+01	2.5	4	7.31E+01	2.5	3.5	4.01E+02	7.2	10.4	4.01E+02	7.2	10.4
5.00E+00	7.50E+01	2.5	4	7.08E+01	2.6	3.7	4.58E+02	7	10	4.58E+02	7	10
6.00E+00	7.85E+01	2.5	4	6.95E+01	2.7	3.7	5.66E+02	6.4	9.1	5.66E+02	6.4	9.1
8.00E+00	8.86E+01	2.5	4	7.64E+01	2.7	3.7	8.94E+02	4.5	6.4	8.94E+02	4.5	6.4
1.00E+01	1.02E+02	2.8	4	8.71E+01	2.7	4.5	1.08E+03	3.5	5	1.08E+03	3.5	5
1.50E+01	1.56E+02	3.7	5	1.13E+02	3.5	5.2	9.83E+02	2.5	3.4	9.83E+02	2.5	3.4
2.00E+01	2.49E+02	4.5	5.4	2.05E+02	4.2	5.3	7.98E+02	2.3	3	7.98E+02	2.3	3
3.00E+01	5.28E+02	4	6.2	4.37E+02	4.8	5.9	6.47E+02	2.3	3	6.47E+02	2.3	3
4.00E+01	4.58E+02	2.8	4.4	3.98E+02	3.9	4.6	5.91E+02	2.3	3	5.91E+02	2.3	3
5.00E+01	4.09E+02	2.6	4.2	5.05E+02	3.3	4.5	5.79E+02	2.3	3	5.79E+02	2.3	3
6.00E+01	5.76E+02	2.4	3.5	8.07E+02	3	4.4	5.71E+02	2.1	2.8	5.71E+02	2.1	2.8
8.00E+01	5.87E+02	2.2	3.2	6.17E+02	2.2	2.9	5.35E+02	1.9	2.5	5.35E+02	1.9	2.5
1.00E+02	5.12E+02	2	2.3	5.20E+02	1.9	2.1	4.76E+02	1.8	2.2	4.76E+02	1.8	2.2
1.50E+02	4.23E+02	1.4	2.2	4.13E+02	1.6	2	4.19E+02	1.6	2	4.19E+02	1.6	2
2.00E+02	3.97E+02	1.6	2.2	4.03E+02	1.6	2	3.97E+02	1.7	2.1	3.97E+02	1.7	2.1
3.00E+02	4.00E+02	1.6	2.1	4.06E+02	1.5	1.9	3.75E+02	1.7	2	3.75E+02	1.7	2
4.00E+02	4.09E+02	1.6	2.1	4.06E+02	1.5	1.9	3.68E+02	1.5	1.8	3.68E+02	1.5	1.8
5.00E+02	4.23E+02	1.7	1.9	4.15E+02	1.4	1.8	3.78E+02	1.5	1.8	3.78E+02	1.5	1.8
6.00E+02	4.39E+02	1.7	1.9	4.30E+02	1.6	1.8	3.94E+02	1.6	1.9	3.94E+02	1.6	1.9
8.00E+02	4.62E+02	1.6	1.9	4.56E+02	1.6	1.7	4.13E+02	1.6	1.9	4.13E+02	1.6	1.9
1.00E+03	4.83E+02	1.6	2	4.73E+02	1.7	1.9	4.24E+02	1.6	1.9	4.24E+02	1.6	1.9
1.50E+03	5.21E+02	1.6	2	5.08E+02	1.6	1.9	4.54E+02	1.6	1.9	4.54E+02	1.6	1.9
2.00E+03	5.37E+02	1.6	2.1	5.26E+02	1.6	1.9	4.68E+02	1.6	1.9	4.68E+02	1.6	1.9
3.00E+03	5.43E+02	1.5	2	5.37E+02	1.5	1.9	4.73E+02	1.4	1.7	4.73E+02	1.4	1.7
4.00E+03	5.56E+02	1.5	1.9	5.48E+02	1.4	1.8	4.82E+02	1.4	1.6	4.82E+02	1.4	1.6
5.00E+03	5.81E+02	1.4	1.7	5.71E+02	1.4	1.7	4.97E+02	1.4	1.7	4.97E+02	1.4	1.7
6.00E+03	6.13E+02	1.4	1.7	5.98E+02	1.4	1.7	5.22E+02	1.4	1.6	5.22E+02	1.4	1.6
8.00E+03	6.75E+02	1.4	1.6	6.44E+02	1.4	1.6	5.62E+02	1.4	1.6	5.62E+02	1.4	1.6
1.00E+04	7.08E+02	1.5	1.8	6.73E+02	1.5	1.5	5.82E+02	1.4	1.7	5.82E+02	1.4	1.7
1.50E+04	7.66E+02	1.5	1.7	7.18E+02	1.4	1.6	6.11E+02	1.4	1.6	6.11E+02	1.4	1.6
2.00E+04	8.34E+02	1.5	1.8	7.39E+02	1.4	1.6	6.39E+02	1.4	1.6	6.39E+02	1.4	1.6
3.00E+04	8.91E+02	1.5	1.7	7.87E+02	1.3	1.6	6.83E+02	1.3	1.5	6.83E+02	1.3	1.5
4.00E+04	9.32E+02	1.5	1.8	8.45E+02	1.4	1.7	7.12E+02	1.3	1.6	7.12E+02	1.3	1.6
5.00E+04	9.80E+02	1.4	1.7	8.99E+02	1.4	1.7	7.43E+02	1.3	1.6	7.43E+02	1.3	1.6
6.00E+04	1.03E+03	1.4	1.7	9.46E+02	1.4	1.7	7.64E+02	1.3	1.5	7.64E+02	1.3	1.5
8.00E+04	1.13E+03	1.4	1.7	1.03E+03	1.3	1.6	8.02E+02	1.3	1.5	8.02E+02	1.3	1.5
1.00E+05	1.22E+03	1.3	1.5	1.10E+03	1.3	1.6	8.35E+02	1.3	1.6	8.35E+02	1.3	1.6
1.50E+05	1.40E+03	1.3	1.6	1.24E+03	1.3	1.6	9.07E+02	1.3	1.8	9.07E+02	1.3	1.8
2.00E+05	1.50E+03	1.2	1.5	1.42E+03	1.2	1.8	9.69E+02	1.3	1.5	9.69E+02	1.3	1.5

Table A.5. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{4}He ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	9.60E-01	12.1	3.9	3.05E-01	12	3.9	1.73E+02	13.3	15.5	1.64E+02	13	14.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.90E+00	9.9	3.3	6.78E-01	10.3	3.3	3.68E+02	11.5	12.3	4.23E+02	12.3	14	3.78E-02	7.1	9.6	4.92E-02	7	9.5
2.00E+01	4.12E+00	8.4	3	1.44E+00	9	3.1	1.74E+03	9.4	10.2	1.26E+03	8.8	9.5	1.12E-01	7	9.5	8.43E-02	9.8	9.8
3.00E+01	2.39E+01	8.8	3.1	3.04E+01	9.1	3.2	3.81E+03	5.8	6.2	2.53E+03	5.5	6	1.48E+00	9.4	10.1	4.67E-01	9.5	9.5
5.00E+01	4.71E+02	4.9	2.1	4.36E+02	4.8	2.1	5.28E+03	2.6	3.1	3.94E+03	3.1	3.5	4.18E+01	6.8	8.2	6.80E+01	7.8	9.2
7.50E+01	1.02E+03	3.1	1.6	1.08E+03	3.2	1.6	4.06E+03	1.5	1.9	4.11E+03	2	2.2	1.15E+03	4.1	4.7	1.14E+03	4	4.6
1.00E+02	1.90E+03	2.6	1.5	2.01E+03	2.6	1.5	3.35E+03	1.4	1.5	3.35E+03	1.5	1.7	2.24E+03	2.5	2.9	2.37E+03	2.5	2.8
1.50E+02	3.36E+03	1.9	1.3	3.77E+03	1.8	1.3	2.84E+03	1.4	1.7	3.23E+03	1.6	1.8	3.14E+03	1.8	2	3.23E+03	1.8	2.1
2.00E+02	3.42E+03	1.4	1.2	3.48E+03	1.4	1.1	3.40E+03	1.4	1.6	3.55E+03	1.4	1.6	3.36E+03	1.5	1.7	3.47E+03	1.4	1.7
3.00E+02	2.61E+03	1.3	1.1	2.62E+03	1.3	1.1	2.65E+03	1.2	1.6	2.59E+03	1.3	1.5	2.66E+03	1.3	1.6	2.69E+03	1.3	1.5
5.00E+02	2.13E+03	1.4	1.2	2.13E+03	1.4	1.2	2.05E+03	1.3	1.7	2.08E+03	1.4	1.7	2.12E+03	1.5	1.8	2.20E+03	1.5	1.9
7.00E+02	2.10E+03	1.6	1.2	2.09E+03	1.5	1.2	1.98E+03	1.5	1.9	1.97E+03	1.5	1.9	2.14E+03	1.5	2	2.10E+03	1.5	2
1.00E+03	2.09E+03	1.6	1.3	2.05E+03	1.6	1.3	2.01E+03	1.6	2	1.91E+03	1.5	2	2.09E+03	1.6	2.2	2.07E+03	1.6	2.2
2.00E+03	2.22E+03	1.7	1.3	2.17E+03	1.6	1.3	2.05E+03	1.6	2	1.96E+03	1.5	2.1	2.25E+03	1.6	2.2	2.21E+03	1.6	2.2
3.00E+03	2.32E+03	1.7	1.3	2.24E+03	1.6	1.3	2.06E+03	1.6	2.1	2.03E+03	1.6	2.1	2.36E+03	1.6	2.2	2.29E+03	1.6	2.2
5.00E+03	2.47E+03	1.7	1.3	2.38E+03	1.7	1.3	2.06E+03	1.6	1.8	2.09E+03	1.5	2	2.55E+03	1.6	2.2	2.47E+03	1.7	2.2
1.00E+04	3.03E+03	1.7	1.3	2.86E+03	1.7	1.3	2.66E+03	1.6	1.9	2.43E+03	1.6	2	3.05E+03	1.6	2.2	3.00E+03	1.7	2.2
2.00E+04	3.76E+03	1.7	1.2	3.55E+03	1.7	1.2	2.98E+03	1.5	2	3.00E+03	1.7	1.9	3.82E+03	1.7	2	3.72E+03	1.7	2.1
5.00E+04	5.27E+03	1.6	1.2	4.83E+03	1.5	1.2	4.01E+03	1.5	1.9	3.85E+03	1.6	1.9	5.41E+03	1.5	2	5.13E+03	1.6	1.9
1.00E+05	6.91E+03	1.4	1.2	6.14E+03	1.5	1.2	5.17E+03	1.4	1.7	4.73E+03	1.4	1.8	6.96E+03	1.4	1.9	6.56E+03	1.4	1.9

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.15E+02	11.8	13.2	0.00E+00	1	1
1.40E+01	1.81E-02	7.5	9.8	1.75E-02	7.3	9.9	3.05E-02	6.6	9.9	3.28E-02	7.5	9.4	2.08E+02	9.4	10.6	0.00E+00	1	1
2.00E+01	1.29E-01	7.6	9.5	1.44E-01	6.1	9.9	1.32E-01	12	12	1.56E-01	7	9.8	3.89E+02	9	9.2	8.31E-02	5.4	10.4
3.00E+01	3.76E-01	6.8	8.8	4.53E-01	5.8	8.5	1.96E-01	8.4	8.5	4.20E-01	6.4	8.5	8.84E+02	5.9	6.3	1.79E-01	5.4	8.9
5.00E+01	2.75E+01	7.7	9.3	1.94E+01	7.4	9.7	2.08E+00	4.5	8.3	4.51E+01	8.7	10.4	1.96E+03	3.6	4.1	4.71E-01	6.2	9.9
7.50E+01	7.67E+02	4.2	4.9	1.08E+03	4.6	5.3	6.15E+02	4.2	5.1	1.21E+03	3.6	4.2	2.73E+03	2.1	2.5	2.63E+00	4.7	7.9
1.00E+02	2.60E+03	3	3.4	3.39E+03	2.7	3.1	1.68E+03	2.8	3.2	2.35E+03	2.6	2.9	2.44E+03	1.5	1.9	3.04E+01	3.2	7.2
1.50E+02	3.94E+03	1.8	2	4.30E+03	1.7	2	3.13E+03	1.9	2.2	3.45E+03	1.8	2.1	2.68E+03	1.8	2.1	3.53E+03	2.4	2.5
2.00E+02	3.48E+03	1.4	1.6	3.51E+03	1.3	1.5	3.57E+03	1.5	1.7	3.45E+03	1.4	1.6	3.51E+03	1.4	1.6	3.73E+03	1.4	1.6
3.00E+02	2.62E+03	1.3	1.5	2.61E+03	1.3	1.5	2.65E+03	1.3	1.6	2.66E+03	1.3	1.5	2.56E+03	1.3	1.5	2.57E+03	1.4	1.6
5.00E+02	2.13E+03	1.4	1.8	2.10E+03	1.4	1.8	2.13E+03	1.4	1.9	2.14E+03	1.4	1.8	2.15E+03	1.4	1.8	2.23E+03	1.4	2.1
7.00E+02	2.05E+03	1.5	2	2.06E+03	1.5	2	2.18E+03	1.5	2	2.19E+03	1.6	1.9	2.01E+03	1.5	2	2.29E+03	1.4	2.2
1.00E+03	2.05E+03	1.6	2.2	2.00E+03	1.6	2.1	2.13E+03	1.6	2.2	2.08E+03	1.6	2.1	1.97E+03	1.5	2.2	1.97E+03	1.4	2.2
2.00E+03	2.19E+03	1.7	2.2	2.10E+03	1.6	2.2	2.28E+03	1.6	2.2	2.15E+03	1.7	2.2	2.07E+03	1.5	2.1	2.15E+03	1.5	2.3
3.00E+03	2.25E+03	1.6	2.2	2.19E+03	1.6	2.1	2.39E+03	1.7	2.2	2.27E+03	1.6	2.2	2.16E+03	1.7	2.1	2.43E+03	1.7	2.2
5.00E+03	2.38E+03	1.6	2.2	2.27E+03	1.6	2.2	2.56E+03	1.7	2.2	2.38E+03	1.7	2.2	2.32E+03	1.7	2.1	2.59E+03	1.8	2.2
1.00E+04	2.89E+03	1.7	2.1	2.70E+03	1.6	2.1	3.02E+03	1.8	2.2	2.87E+03	1.5	2.2	2.80E+03	1.8	2.1	3.29E+03	1.8	2
2.00E+04	3.54E+03	1.7	1.9	3.29E+03	1.7	1.9	3.91E+03	1.8	2	3.52E+03	1.7	2	3.64E+03	1.6	1.8	4.06E+03	1.7	1.8
5.00E+04	4.91E+03	1.6	2	4.42E+03	1.6	1.9	5.47E+03	1.5	2	5.01E+03	1.5	2.1	4.89E+03	1.5	2	5.22E+03	1.5	1.9
1.00E+05	6.19E+03	1.4	1.9	5.41E+03	1.4	1.9	7.02E+03	1.5	2	6.37E+03	1.4	1.9	6.37E+03	1.4	2	7.27E+03	1.4	1.8

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.18E-02	7.5	9.8	3.01E-02	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	7.80E-02	3.5	7.3

(continued on next page)

Table A.5. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	1.06E-01	7.5	9.6	1.22E-01	7.1	9.5	1.84E-02	6.2	9.3	2.94E-02	6.2	9.7	1.48E-02	10.1	10.1	3.14E-01	4.4	7.9
3.00E+01	3.22E-01	6.9	8.8	3.62E-01	6.8	8.7	7.91E-01	6.1	9.1	2.60E-01	7	9	6.96E-01	8.5	8.5	1.55E+00	3.8	6.1
5.00E+01	2.29E+01	8.7	10.3	4.50E+01	7.8	9.4	3.32E+01	6.2	7.7	2.35E+01	8.5	9.8	1.07E+03	5.7	6.9	1.37E+03	5.9	6.4
7.50E+01	6.04E+02	4.2	4.8	9.99E+02	4	4.6	5.87E+02	4	4.8	5.15E+02	3.8	4.7	2.66E+03	2.6	2.9	2.59E+03	2.1	2.5
1.00E+02	1.66E+03	2.8	3.2	2.23E+03	2.7	3	9.87E+02	2.6	3.1	1.36E+03	3.4	3.9	2.52E+03	1.8	2	2.41E+03	1.8	2.1
1.50E+02	3.23E+03	1.9	2.2	3.63E+03	1.8	2.1	3.92E+03	1.9	2.3	4.33E+03	1.8	2	3.46E+03	1.8	2	3.84E+03	1.8	2
2.00E+02	3.56E+03	1.5	1.7	3.48E+03	1.4	1.6	3.68E+03	1.4	1.6	3.63E+03	1.3	1.5	3.58E+03	1.5	1.6	3.85E+03	1.4	1.6
3.00E+02	2.65E+03	1.3	1.5	2.62E+03	1.3	1.5	2.69E+03	1.3	1.5	2.60E+03	1.2	1.4	2.62E+03	1.2	1.5	2.64E+03	1.3	1.5
5.00E+02	2.16E+03	1.5	1.9	2.12E+03	1.4	1.8	2.16E+03	1.4	1.9	2.18E+03	1.4	1.9	2.08E+03	1.6	1.8	2.21E+03	1.5	1.9
7.00E+02	2.14E+03	1.6	2	2.09E+03	1.6	2	2.23E+03	1.6	2	2.15E+03	1.5	2	1.95E+03	1.4	2	2.07E+03	1.5	2.1
1.00E+03	2.11E+03	1.6	2.2	2.08E+03	1.6	2.1	2.11E+03	1.6	2.2	2.02E+03	1.6	2	2.00E+03	1.4	2.1	1.98E+03	1.4	2.1
2.00E+03	2.29E+03	1.7	2.3	2.17E+03	1.7	2.2	2.25E+03	1.7	2.3	2.19E+03	1.7	2.2	2.09E+03	1.5	2.2	1.98E+03	1.5	2.2
3.00E+03	2.38E+03	1.7	2.2	2.30E+03	1.6	2.2	2.33E+03	1.7	2.2	2.26E+03	1.6	2	2.17E+03	1.6	2.2	2.06E+03	1.6	2.2
5.00E+03	2.52E+03	1.6	2.2	2.44E+03	1.7	2.2	2.41E+03	1.9	2.2	2.37E+03	1.4	2.2	2.25E+03	1.8	2.1	2.17E+03	1.6	1.9
1.00E+04	3.07E+03	1.7	2.2	2.85E+03	1.7	2.2	3.03E+03	1.7	2.1	2.77E+03	1.7	2.3	2.74E+03	1.7	2.1	2.65E+03	1.5	2.2
2.00E+04	3.85E+03	1.7	2	3.57E+03	1.7	2	3.85E+03	1.7	1.9	3.49E+03	1.7	1.8	3.53E+03	1.7	1.9	2.95E+03	1.5	1.9
5.00E+04	5.34E+03	1.6	2	4.95E+03	1.6	2	5.18E+03	1.5	1.9	4.50E+03	1.5	2	4.44E+03	1.6	1.8	3.95E+03	1.4	1.7
1.00E+05	7.07E+03	1.4	1.9	6.16E+03	1.4	1.9	6.65E+03	1.6	1.8	5.89E+03	1.5	1.8	5.66E+03	1.5	1.8	5.01E+03	1.4	1.9

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.24E+00	11.9	13.3	6.90E-01	11.9	13.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.56E-02	4.2	8.8	5.98E+00	9.8	10.8	1.42E+00	10.3	10.8	2.54E-02	7.2	10	3.00E-02	7.2	9.6
2.00E+01	2.79E-02	6.4	9.3	2.74E-01	4.9	7.6	1.22E+01	8.5	9.4	2.92E+00	9.3	9.7	8.48E-02	7.3	9.3	1.77E-01	6.8	9.5
3.00E+01	1.30E-01	6.6	8.8	8.35E+00	10.7	10.7	7.39E+01	8.8	9.7	6.55E+01	9.3	10.2	4.69E-01	6.2	8	3.82E-01	7.9	7.9
5.00E+01	1.90E+00	9.4	9.8	9.79E+02	4.5	5.1	1.08E+03	4.8	5.4	9.67E+02	4.8	5.4	1.99E+02	7.7	8.9	4.00E+02	7.1	8.1
7.50E+01	4.07E+02	5.5	6.2	1.45E+03	2.4	2.9	2.39E+03	3	3.4	2.32E+03	3.1	3.5	1.94E+03	3.7	4.2	2.42E+03	3.5	4
1.00E+02	1.20E+03	2.5	2.9	1.96E+03	2.2	2.6	3.40E+03	2.3	2.6	3.38E+03	2.3	2.6	3.90E+03	2.6	2.9	4.25E+03	2.5	2.8
1.50E+02	3.11E+03	2.2	2.5	2.87E+03	1.9	2.3	3.77E+03	1.6	1.8	3.92E+03	1.6	1.8	4.71E+03	1.5	1.7	4.70E+03	1.4	1.6
2.00E+02	3.59E+03	1.5	1.7	3.71E+03	1.4	1.7	3.31E+03	1.3	1.5	3.33E+03	1.3	1.5	3.37E+03	1.2	1.4	3.27E+03	1.2	1.4
3.00E+02	2.65E+03	1.3	1.6	2.60E+03	1.3	1.5	2.55E+03	1.3	1.5	2.56E+03	1.3	1.5	2.55E+03	1.3	1.5	2.56E+03	1.3	1.5
5.00E+02	2.15E+03	1.4	1.8	2.17E+03	1.5	2	2.10E+03	1.4	1.8	2.10E+03	1.4	1.8	2.11E+03	1.4	1.7	2.09E+03	1.4	1.8
7.00E+02	2.12E+03	1.5	2.1	2.11E+03	1.5	2.1	2.02E+03	1.5	2	2.03E+03	1.5	2	2.03E+03	1.5	1.9	2.10E+03	1.5	1.9
1.00E+03	2.19E+03	1.5	2.2	2.09E+03	1.7	2.1	1.99E+03	1.6	2.1	1.97E+03	1.6	2.1	1.98E+03	1.5	2.1	1.95E+03	1.5	2.1
2.00E+03	2.31E+03	1.6	2.2	2.19E+03	1.7	2.2	2.05E+03	1.6	2.2	2.03E+03	1.6	2.2	2.00E+03	1.6	2.1	1.98E+03	1.6	2.1
3.00E+03	2.50E+03	1.7	2.3	2.32E+03	1.6	2.2	2.12E+03	1.6	2.2	2.10E+03	1.6	2.1	2.08E+03	1.6	2.1	1.99E+03	1.6	2.1
5.00E+03	2.64E+03	1.8	2.4	2.57E+03	1.6	2.1	2.23E+03	1.6	2.1	2.19E+03	1.6	2.1	2.14E+03	1.6	2.1	2.11E+03	1.6	2
1.00E+04	3.21E+03	1.7	2.1	2.98E+03	1.7	2.3	2.63E+03	1.7	2.1	2.60E+03	1.7	2.1	2.45E+03	1.7	2.1	2.35E+03	1.7	2
2.00E+04	4.13E+03	1.6	2	3.76E+03	1.7	2.2	3.23E+03	1.7	2	3.11E+03	1.7	2	2.92E+03	1.7	1.9	2.77E+03	1.7	1.9
5.00E+04	5.71E+03	1.5	2	5.10E+03	1.5	1.9	4.36E+03	1.6	2	4.12E+03	1.6	2	3.87E+03	1.6	2	3.49E+03	1.6	1.9
1.00E+05	7.58E+03	1.4	2	6.80E+03	1.5	1.7	5.66E+03	1.4	1.9	5.34E+03	1.4	1.9	4.66E+03	1.4	1.9	4.53E+03	1.4	1.9

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.37E+02	23.4	29.5	7.74E+02	23.4	29.5	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.27E+03	24	30.2	1.54E+03	24	30.2	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.90E+03	21.3	26.6	2.29E+03	21.3	26.6	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.11E+03	16.9	20.2	3.78E+03	16.9	20.2	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.75E+00	14.2	16.2	0.00E+00	1	1	5.97E+03	11.1	12.1	7.11E+03	11	12.1	1.08E+01	11.8	13.1	1.70E+00	12.1	13.9
1.40E+01	7.90E+00	11.4	13	1.46E-01	4.9	7.2	7.89E+03	8.6	9.1	8.73E+03	7.8	8.1	1.61E+01	9.6	10.6	2.88E+00	11.1	11.4
2.00E+01	1.47E+02	10.7	12.1	5.32E+00	12.8	17.6	7.28E+03	4.6	4.6	7.47E+03	4.2	4.2	4.04E+01	8.7	9.4	6.91E+00	8.2	9
3.00E+01	9.65E+02	7.5	8.1	2.90E+02	9.2	10	5.71E+03	2.3	2.6	5.67E+03	2.2	2.4	1.20E+02	6.9	7.3	4.04E+01	7.7	8.9
5.00E+01	3.00E+03	3.7	4.1	1.97E+03	4.3	4.9	4.05E+03	1.7	1.9	4.09E+03	1.7	1.9	4.06E+02	4	4.6	2.91E+02	4.4	5.1
7.50E+01	3.26E+03	2.1	2.4	3.17E+03	2.4	2.8	3.44E+03	1.6	1.8	3.53E+03	1.6	1.8	9.11E+02	3.2	3.7	8.72E+02	3.3	3.9
1.00E+02	3.26E+03	1.8	2	3.30E+03	2	2.3	3.38E+03	1.6	1.8	3.44E+03	1.7	1.8	1.82E+03	2.7	3	2.08E+03	2.8	3.3
1.50E+02	3.87E+03	1.8	2	4.13E+03	1.8	1.9	3.34E+03	1.5	1.6	3.43E+03	1.5	1.6	3.46E+03	1.9	2.2	3.79E+03	1.8	2.1
2.00E+02	3.32E+03	1.2	1.4	3.41E+03	1.3	1.4	3.09E+03	1.3	1.5	3.15E+03	1.3	1.5	3.50E+03	1.4	1.6	3.52E+03	1.4	1.6
3.00E+02	2.56E+03	1.3	1.5	2.57E+03	1.2	1.5	2.49E+03	1.3	1.5	2.48E+03	1.3	1.5	2.63E+03	1.3	1.5	2.66E+03	1.3	1.5
5.00E+02	2.07E+03	1.3	1.8	2.16E+03	1.5	1.8	1.99E+03	1.4	1.7	1.99E+03	1.4	1.7	2.15E+03	1.5	1.8	2.15E+03	1.4	1.8
7.00E+02	1.96E+03	1.5	1.9	2.09E+03	1.5	1.9	1.89E+03	1.5	1.9	1.88E+03	1.5	1.9	2.13E+03	1.5	2	2.11E+03	1.5	2

Table A.5. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+03	1.99E+03	1.5	2.1	2.00E+03	1.5	2.1	1.82E+03	1.5	2	1.80E+03	1.5	2	2.10E+03	1.6	2.2	2.07E+03	1.6	2.2
2.00E+03	1.98E+03	1.6	2.2	1.97E+03	1.6	2.1	1.83E+03	1.5	2	1.80E+03	1.5	2	2.23E+03	1.6	2.3	2.17E+03	1.7	2.2
3.00E+03	1.99E+03	1.5	2.1	1.98E+03	1.5	2.1	1.88E+03	1.5	2	1.85E+03	1.5	2	2.31E+03	1.6	2.2	2.27E+03	1.7	2.2
5.00E+03	2.10E+03	1.6	1.9	2.08E+03	1.4	2.1	1.97E+03	1.6	2	1.92E+03	1.5	1.9	2.49E+03	1.6	2.2	2.40E+03	1.7	2.2
1.00E+04	2.39E+03	1.5	2.1	2.47E+03	1.6	2.2	2.30E+03	1.6	2	2.22E+03	1.6	2	2.98E+03	1.7	2.2	2.82E+03	1.7	2.2
2.00E+04	2.98E+03	1.6	1.9	2.86E+03	1.6	2	2.75E+03	1.6	1.9	2.62E+03	1.6	1.8	3.75E+03	1.7	2.1	3.54E+03	1.7	2
5.00E+04	3.88E+03	1.7	2	3.70E+03	1.6	1.8	3.62E+03	1.5	1.8	3.39E+03	1.5	1.9	5.13E+03	1.6	2	4.79E+03	1.5	2
1.00E+05	4.98E+03	1.4	1.8	4.63E+03	1.5	2.1	4.64E+03	1.4	1.8	4.24E+03	1.4	1.8	6.84E+03	1.4	1.9	6.09E+03	1.5	1.9

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.25E+02	11.8	13	2.01E+01	12.1	13.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.78E+02	9.4	10.4	3.16E+01	11	11	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	2.37E-02	4.7	9	1.40E-01	4.8	9.6	3.85E+02	8.3	8.9	7.09E+01	7.8	8.3	2.55E-02	7.7	8.9	4.64E-02	5.6	9.7
3.00E+01	2.17E-01	5.4	9.1	7.06E-01	5.4	9.2	9.37E+02	6.5	6.8	3.02E+02	7.3	8.6	2.03E-01	6.1	9.3	8.32E-02	5.6	9
5.00E+01	1.33E+00	8.5	11.3	2.62E+00	6.9	9.9	2.05E+03	3.4	3.9	1.23E+03	4	4.6	2.77E+00	5	9.2	6.95E-01	5.8	10.4
7.50E+01	7.03E+01	7.2	7.9	2.18E+01	6.5	9.3	2.58E+03	2.4	2.7	1.59E+03	2.4	3	1.91E+02	4	5.9	2.10E+01	4.3	7.1
1.00E+02	1.47E+03	3.4	3.9	7.51E+02	3.8	4.5	3.52E+03	2.4	2.7	3.80E+03	2.7	3.3	8.40E+02	2.9	3.5	1.10E+03	4.6	5
1.50E+02	2.56E+03	2.2	2.4	3.76E+03	2	2.2	4.18E+03	1.6	1.7	4.27E+03	1.7	1.8	3.02E+03	1.8	2.3	4.05E+03	2	2.3
2.00E+02	3.63E+03	1.5	1.6	3.70E+03	1.5	1.7	3.33E+03	1.3	1.5	3.42E+03	1.3	1.5	3.47E+03	1.4	1.8	3.42E+03	1.4	1.6
3.00E+02	2.66E+03	1.3	1.6	2.74E+03	1.3	1.6	2.55E+03	1.3	1.5	2.60E+03	1.2	1.4	2.66E+03	1.3	1.5	2.74E+03	1.3	1.6
5.00E+02	2.28E+03	1.5	1.8	2.22E+03	1.4	1.9	2.06E+03	1.4	1.7	2.12E+03	1.4	1.6	2.20E+03	1.6	1.9	2.17E+03	1.4	1.7
7.00E+02	2.26E+03	1.5	2.2	2.09E+03	1.5	2.2	1.98E+03	1.6	2	2.17E+03	1.4	1.9	2.19E+03	1.5	2.1	2.16E+03	1.5	1.8
1.00E+03	2.23E+03	1.8	2.3	2.20E+03	1.6	2.3	1.91E+03	1.6	2.1	2.01E+03	1.5	2.2	2.12E+03	1.6	2.1	2.17E+03	1.8	2.2
2.00E+03	2.42E+03	1.7	2.4	2.27E+03	1.7	2.1	1.94E+03	1.7	2.1	2.02E+03	1.6	2.2	2.33E+03	1.5	2.3	2.30E+03	1.8	2.2
3.00E+03	2.37E+03	1.7	2.4	2.40E+03	1.7	2.2	2.05E+03	1.5	2.1	1.96E+03	1.7	2.2	2.47E+03	1.5	2.2	2.43E+03	1.8	2.3
5.00E+03	2.65E+03	1.7	2.4	2.61E+03	1.8	2.2	2.11E+03	1.5	2	2.12E+03	1.8	2.2	2.68E+03	1.7	2.3	2.47E+03	1.7	2.3
1.00E+04	3.14E+03	1.7	2.4	3.17E+03	1.7	2.1	2.37E+03	1.6	2.1	2.36E+03	1.7	2.3	3.14E+03	1.8	2.2	2.94E+03	1.7	2.2
2.00E+04	4.17E+03	1.7	2.2	3.85E+03	1.7	2	2.95E+03	1.6	2.1	2.98E+03	1.6	2	4.07E+03	1.7	2.1	3.75E+03	1.6	2
5.00E+04	5.57E+03	1.7	2.1	5.20E+03	1.6	2.1	3.67E+03	1.6	2.1	3.68E+03	1.5	1.7	5.38E+03	1.6	2.2	5.26E+03	1.5	1.9
1.00E+05	7.89E+03	1.5	2	6.86E+03	1.5	2	4.83E+03	1.5	1.8	4.68E+03	1.5	2	7.51E+03	1.3	1.8	6.83E+03	1.4	2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	8.41E+00	12.5	14.6	0.00E+00	1	1
1.40E+01	3.43E-02	6.9	9.8	0.00E+00	1	1	2.69E-02	6.8	9.8	1.69E-02	7	10.1	1.96E+01	11	11.9	5.17E-02	6.1	8.8
2.00E+01	1.22E-01	7.5	9.6	4.87E-02	7.1	9.6	5.13E-02	7.9	9.3	9.94E-02	7.9	9.8	1.04E+02	10.2	11	8.10E-01	7	12.3
3.00E+01	2.49E-01	7.2	9.1	2.90E-01	7.1	8.9	2.62E-01	7	9.1	2.95E-01	7.2	9.3	3.74E+02	6.9	7.2	3.59E+01	9.5	10.7
5.00E+01	2.15E+00	5.3	10	8.23E+00	9.1	11.5	1.62E+00	6.1	9.5	1.73E+00	5.9	9.5	8.99E+02	3.6	4.1	7.38E+02	4.4	4.8
7.50E+01	4.87E+02	4.7	5.4	7.11E+02	4.3	5	9.81E+01	7.1	8.8	9.49E+01	6	7.6	1.25E+03	2.7	3	1.22E+03	2.8	3.2
1.00E+02	1.49E+03	2.9	3.4	2.14E+03	3	3.4	1.53E+03	3.5	4	1.62E+03	3.6	4.2	1.87E+03	2.4	2.8	2.17E+03	2.6	2.9
1.50E+02	3.64E+03	2	2.3	4.05E+03	1.8	2.1	3.04E+03	1.9	2.3	3.49E+03	1.8	2.1	3.44E+03	1.9	2.2	3.71E+03	1.8	2.1
2.00E+02	3.60E+03	1.4	1.6	3.58E+03	1.3	1.5	3.49E+03	1.5	1.7	3.47E+03	1.5	1.7	3.47E+03	1.4	1.6	3.49E+03	1.4	1.6
3.00E+02	2.65E+03	1.3	1.5	2.63E+03	1.3	1.5	2.64E+03	1.3	1.6	2.67E+03	1.3	1.5	2.63E+03	1.3	1.6	2.65E+03	1.3	1.5
5.00E+02	2.13E+03	1.4	1.8	2.14E+03	1.4	1.8	2.12E+03	1.5	1.9	2.17E+03	1.5	1.9	2.15E+03	1.4	1.8	2.14E+03	1.4	1.9
7.00E+02	2.14E+03	1.5	2	2.07E+03	1.5	2	2.16E+03	1.5	2	2.13E+03	1.6	2	2.07E+03	1.5	2	2.11E+03	1.5	1.9
1.00E+03	2.09E+03	1.6	2.2	2.04E+03	1.6	2.1	2.15E+03	1.6	2.2	2.11E+03	1.6	2.2	2.07E+03	1.6	2.2	2.02E+03	1.7	2.1
2.00E+03	2.22E+03	1.6	2.2	2.16E+03	1.6	2.2	2.34E+03	1.7	2.3	2.21E+03	1.6	2.2	2.22E+03	1.7	2.2	2.15E+03	1.6	2.1
3.00E+03	2.34E+03	1.6	2.3	2.27E+03	1.6	2.2	2.38E+03	1.6	2.3	2.35E+03	1.6	2.2	2.33E+03	1.6	2.1	2.26E+03	1.6	2.2
5.00E+03	2.48E+03	1.6	2.2	2.30E+03	1.6	2.1	2.69E+03	1.6	2.3	2.56E+03	1.6	2.2	2.45E+03	1.6	2.1	2.39E+03	1.7	2.2
1.00E+04	3.02E+03	1.7	2.2	2.77E+03	1.6	2.1	3.23E+03	1.7	2.2	2.97E+03	1.6	2.2	2.99E+03	1.7	2.1	2.84E+03	1.6	2.1
2.00E+04	3.77E+03	1.6	2	3.42E+03	1.7	2	4.06E+03	1.7	2.1	3.82E+03	1.6	2	3.70E+03	1.6	2.1	3.56E+03	1.7	2.1
5.00E+04	5.19E+03	1.6	1.9	4.68E+03	1.6	1.9	5.76E+03	1.6	2	5.18E+03	1.5	1.9	5.14E+03	1.6	2	4.76E+03	1.6	2
1.00E+05	6.75E+03	1.4	1.9	5.88E+03	1.4	1.9	7.77E+03	1.4	2	6.59E+03	1.4	1.9	6.72E+03	1.5	1.8	6.03E+03	1.4	1.9

(continued on next page)

Table A.5. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.88E+00	11.9	13.2	5.55E-01	12.1	13.2	0.00E+00	1	1	1.51E+00	13	14.2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.12E+01	9.8	10.7	1.09E+00	10.5	11.6	3.36E-02	5.6	9.1	4.60E+00	13	14.2	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.56E+01	9.3	10.2	5.32E+00	11.2	12.6	1.15E-01	6.6	9	1.22E+01	10	11	4.59E-02	6.8	9.7	1.29E-02	7.1	10.1
3.00E+01	2.22E+02	8	8.6	6.76E+01	8.5	9.2	1.93E+01	13.4	13.4	1.14E+02	8	9	1.62E-01	7.1	9.5	3.63E-01	7.1	9.2
5.00E+01	1.33E+03	4.4	5	7.79E+02	5.2	5.9	3.80E+02	4.1	4.9	6.03E+02	3.5	4.5	1.14E+00	6.7	10.6	1.55E+00	6.1	9.8
7.50E+01	2.58E+03	2.8	3.2	2.29E+03	3.1	3.5	1.44E+03	4	4.5	2.06E+03	3	3.9	5.58E+00	5.4	8.3	2.31E+01	6.6	9.3
1.00E+02	3.25E+03	2.1	2.4	3.29E+03	2.2	2.6	3.73E+03	2.9	3.3	3.89E+03	2.3	2.6	6.26E+01	5.8	7.6	1.37E+03	3.8	4.6
1.50E+02	3.55E+03	1.6	1.8	3.73E+03	1.6	1.8	4.43E+03	1.6	1.8	4.11E+03	1.6	1.8	3.47E+03	2.3	2.7	3.58E+03	1.9	2.2
2.00E+02	3.27E+03	1.4	1.6	3.36E+03	1.4	1.6	3.35E+03	1.3	1.4	3.44E+03	1.3	1.5	3.59E+03	1.5	1.7	3.42E+03	1.5	1.6
3.00E+02	2.57E+03	1.3	1.5	2.59E+03	1.3	1.5	2.51E+03	1.4	1.5	2.57E+03	1.3	1.5	2.70E+03	1.3	1.5	2.68E+03	1.3	1.5
5.00E+02	2.10E+03	1.4	1.8	2.10E+03	1.4	1.8	2.01E+03	1.3	1.8	2.16E+03	1.4	1.9	2.14E+03	1.5	1.9	2.20E+03	1.4	1.9
7.00E+02	2.03E+03	1.5	2	2.04E+03	1.5	2	2.14E+03	1.6	2	2.09E+03	1.5	2	2.11E+03	1.5	2.1	2.10E+03	1.6	2.1
1.00E+03	2.00E+03	1.6	2.1	1.99E+03	1.6	2.1	2.03E+03	1.5	2.1	2.01E+03	1.6	2.1	2.20E+03	1.7	2.2	2.14E+03	1.6	2.3
2.00E+03	2.08E+03	1.6	2.2	2.07E+03	1.6	2.2	2.08E+03	1.6	2.2	1.95E+03	1.6	2.1	2.37E+03	1.6	2.4	2.23E+03	1.7	2.3
3.00E+03	2.16E+03	1.6	2.1	2.14E+03	1.6	2.1	2.10E+03	1.6	2.1	1.99E+03	1.7	2	2.47E+03	1.7	2.3	2.39E+03	1.7	2.2
5.00E+03	2.27E+03	1.6	2.1	2.25E+03	1.6	2.1	2.25E+03	1.7	2.3	2.22E+03	1.8	2.2	2.67E+03	1.7	2.3	2.54E+03	1.7	2.3
1.00E+04	2.72E+03	1.7	2.1	2.68E+03	1.6	2.1	2.60E+03	1.7	2.2	2.26E+03	1.7	2.1	3.26E+03	1.7	2.3	3.00E+03	1.6	2.3
2.00E+04	3.33E+03	1.7	2	3.23E+03	1.7	1.9	3.24E+03	1.7	2.1	2.95E+03	1.6	2.1	4.19E+03	1.6	2.1	3.78E+03	1.6	2.1
5.00E+04	4.52E+03	1.5	1.9	4.35E+03	1.6	1.9	3.92E+03	1.5	1.9	3.80E+03	1.7	2.1	5.91E+03	1.6	1.9	5.31E+03	1.5	2
1.00E+05	5.93E+03	1.4	1.9	5.54E+03	1.4	1.9	5.40E+03	1.5	2	4.90E+03	1.6	1.9	7.78E+03	1.4	2	6.75E+03	1.4	1.9

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.67E-02	6.9	10.2	1.86E-02	7	9.6	2.41E-02	7.3	9.7	3.23E-02	6.2	10.1	4.84E-02	6.6	9.7
2.00E+01	3.41E-02	5.2	9.4	4.31E-02	6.9	9.8	7.83E-02	8.6	9.6	8.37E-02	7.2	9.6	1.46E-01	7.2	9.5	1.25E-01	6.4	9.9
3.00E+01	2.84E-01	7.2	9.3	4.88E-01	7.3	9.3	3.90E-01	5.6	9	3.36E-01	7	8.9	3.12E-01	6.9	9	3.68E-01	6.9	8.8
5.00E+01	1.18E+00	6.2	10.2	1.72E+00	6.8	10.3	8.43E+00	7.7	10.1	2.02E+00	5.4	8.7	1.42E+00	5.3	8.9	3.20E+00	5	7.9
7.50E+01	2.38E+00	5.2	7.9	1.03E+01	4.9	7.9	4.80E+02	4.7	5.4	5.59E+02	4.6	5.3	4.29E+02	5.3	6.1	9.10E+02	4.6	5.2
1.00E+02	1.35E+02	4.6	5.5	5.40E+02	4.6	5.4	1.47E+03	2.9	3.3	1.80E+03	2.9	3.4	1.97E+03	3	3.4	2.58E+03	2.6	3
1.50E+02	3.18E+03	1.9	2.2	3.21E+03	2.1	2.4	3.20E+03	2	2.3	3.33E+03	1.9	2.2	3.27E+03	1.9	2.2	3.61E+03	1.8	2
2.00E+02	3.80E+03	1.5	1.7	3.81E+03	1.5	1.7	3.39E+03	1.5	1.7	3.49E+03	1.4	1.6	3.55E+03	1.4	1.7	3.51E+03	1.4	1.6
3.00E+02	2.68E+03	1.4	1.5	2.66E+03	1.3	1.5	2.69E+03	1.3	1.6	2.68E+03	1.3	1.5	2.66E+03	1.3	1.5	2.65E+03	1.3	1.5
5.00E+02	2.23E+03	1.4	1.8	2.17E+03	1.4	1.9	2.13E+03	1.5	1.8	2.19E+03	1.4	1.9	2.15E+03	1.5	1.8	2.12E+03	1.4	1.8
7.00E+02	2.33E+03	1.5	2.3	2.16E+03	1.6	2.1	2.14E+03	1.6	2	2.14E+03	1.5	2	2.10E+03	1.6	2	2.11E+03	1.6	2
1.00E+03	2.19E+03	1.6	2.4	2.07E+03	1.6	2.3	2.13E+03	1.6	2.2	2.08E+03	1.6	2.2	2.12E+03	1.6	2.2	2.07E+03	1.6	2.2
2.00E+03	2.35E+03	1.6	2.3	2.29E+03	1.7	2.3	2.28E+03	1.6	2.3	2.24E+03	1.7	2.2	2.24E+03	1.7	2.2	2.18E+03	1.7	2.2
3.00E+03	2.42E+03	1.6	2.3	2.43E+03	1.7	2.2	2.40E+03	1.7	2.3	2.38E+03	1.6	2.2	2.34E+03	1.7	2.2	2.29E+03	1.7	2.2
5.00E+03	2.69E+03	1.6	2.3	2.69E+03	1.7	2.3	2.59E+03	1.6	2.2	2.46E+03	1.6	2.1	2.55E+03	1.5	2.2	2.37E+03	1.6	2.2
1.00E+04	3.37E+03	1.7	2.3	3.09E+03	1.7	2.3	3.20E+03	1.7	2.2	3.07E+03	1.8	2.2	2.95E+03	1.7	2.2	2.98E+03	1.7	2.3
2.00E+04	4.06E+03	1.6	2	4.08E+03	1.7	2	4.01E+03	1.7	2	3.83E+03	1.7	2	3.65E+03	1.7	2.1	3.50E+03	1.7	2.1
5.00E+04	5.78E+03	1.6	1.8	5.63E+03	1.5	2.1	5.61E+03	1.6	1.9	5.29E+03	1.6	2	5.40E+03	1.6	2	4.82E+03	1.5	2.1
1.00E+05	7.82E+03	1.5	1.7	6.91E+03	1.4	1.9	7.53E+03	1.4	1.9	6.86E+03	1.4	1.9	7.21E+03	1.4	1.9	6.04E+03	1.5	1.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.51E-02	5.8	8.7	0.00E+00	1	1	1.94E+01	21.3	26.9	1.94E+01	21.3	26.9
2.00E+01	3.63E-01	6.4	8.2	0.00E+00	1	1	6.61E+03	9.9	10.6	6.61E+03	9.9	10.6
3.00E+01	7.55E+00	14.5	14.5	2.77E+00	5.3	7.5	6.50E+03	3.3	3.6	6.50E+03	3.3	3.6
5.00E+01	5.95E+02	5.5	6.2	4.09E+02	5.6	6.6	4.53E+03	1.9	2.1	4.53E+03	1.9	2.1
7.50E+01	2.24E+03	3.1	3.4	1.83E+03	3.1	3.4	4.02E+03	1.7	1.8	4.02E+03	1.7	1.8
1.00E+02	2.38E+03	1.8	2.2	2.03E+03	2.1	2.3	3.69E+03	1.6	1.7	3.69E+03	1.6	1.7
1.50E+02	3.98E+03	2.2	2.3	4.42E+03	1.8	2	3.67E+03	1.4	1.4	3.67E+03	1.4	1.4

Table A.5. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.53E+03	1.3	1.5	3.71E+03	1.2	1.4	3.25E+03	1.2	1.5	3.25E+03	1.2	1.5
3.00E+02	2.59E+03	1.4	1.5	2.66E+03	1.3	1.5	2.71E+03	1.2	1.6	2.71E+03	1.2	1.6
5.00E+02	2.23E+03	1.5	1.7	2.09E+03	1.4	1.8	2.21E+03	1.4	1.6	2.21E+03	1.4	1.6
7.00E+02	2.02E+03	1.6	1.8	2.12E+03	1.5	2	2.03E+03	1.5	1.6	2.03E+03	1.5	1.6
1.00E+03	1.99E+03	1.6	2.2	2.00E+03	1.6	2.1	1.86E+03	1.5	1.6	1.86E+03	1.5	1.6
2.00E+03	2.10E+03	1.6	2.2	2.13E+03	1.6	2.2	1.81E+03	1.6	1.7	1.81E+03	1.6	1.7
3.00E+03	2.23E+03	1.7	2.1	2.19E+03	1.6	2	1.79E+03	1.5	1.9	1.79E+03	1.5	1.9
5.00E+03	2.25E+03	1.7	2.3	2.26E+03	1.8	2	1.79E+03	1.5	1.9	1.79E+03	1.5	1.9
1.00E+04	2.76E+03	1.7	2.2	2.55E+03	1.6	2	1.97E+03	1.5	2	1.97E+03	1.5	2
2.00E+04	3.49E+03	1.7	2.1	3.28E+03	1.5	1.9	2.48E+03	1.6	2	2.48E+03	1.6	2
5.00E+04	4.89E+03	1.7	1.9	4.25E+03	1.4	2.2	3.30E+03	1.5	2	3.30E+03	1.5	2
1.00E+05	5.82E+03	1.4	1.8	5.23E+03	1.5	1.8	3.81E+03	1.4	1.9	3.81E+03	1.4	1.9

Table A.6. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{7}Li ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.58E+00	19.8	5.3	4.68E-01	19.7	5.3	3.10E+02	20.7	21	2.53E+02	20.6	20.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.90E+00	16.9	4.6	9.58E-01	15.9	4.4	5.56E+02	18.6	18.1	4.94E+02	18.4	17.7	1.05E-01	7.1	9.6	1.26E-01	7	9.5
2.00E+01	4.40E+00	14.3	4	2.02E+00	12.9	3.8	2.22E+03	17.6	16.9	1.79E+03	16.9	15.7	3.89E-01	7	9.5	6.19E-01	6.9	10.3
3.00E+01	2.31E+01	13.2	3.6	2.54E+01	15.4	4.3	6.13E+03	12.4	10.6	4.08E+03	12.1	10.2	2.82E+00	8.4	11	2.24E+00	7.4	9.4
5.00E+01	5.60E+02	11.3	3.1	5.50E+02	10.7	3	1.08E+04	6.8	5.6	7.25E+03	7.1	5.9	4.06E+01	9.1	10	2.61E+01	10.1	11.5
7.50E+01	1.55E+03	6	2	1.59E+03	6.3	2.1	9.12E+03	3.1	2.8	8.06E+03	3.9	3.5	1.04E+03	9.3	8.2	1.12E+03	8.9	7.8
1.00E+02	2.68E+03	4.7	1.8	2.85E+03	4.7	1.8	7.85E+03	2	2.1	7.28E+03	2.4	2.4	3.30E+03	5.3	4.7	3.49E+03	5.3	4.7
1.50E+02	5.36E+03	3	1.5	6.03E+03	3.1	1.5	5.63E+03	1.5	1.7	6.16E+03	1.9	2.1	5.26E+03	2.8	2.7	5.30E+03	2.7	2.7
2.00E+02	6.32E+03	2	1.3	6.59E+03	1.9	1.2	5.85E+03	1.9	1.9	6.61E+03	1.9	2	5.87E+03	2	2.1	6.16E+03	2	2.2
3.00E+02	5.08E+03	1.5	1.2	5.13E+03	1.5	1.2	5.25E+03	1.4	1.6	5.38E+03	1.4	1.6	5.18E+03	1.5	1.7	5.18E+03	1.5	1.7
5.00E+02	4.19E+03	1.6	1.2	4.24E+03	1.6	1.2	4.32E+03	1.6	1.8	4.24E+03	1.5	1.8	4.20E+03	1.6	1.9	4.23E+03	1.6	1.9
7.00E+02	4.15E+03	1.7	1.2	4.14E+03	1.6	1.3	4.23E+03	1.5	1.9	3.98E+03	1.5	1.9	4.19E+03	1.7	2	4.19E+03	1.7	2.1
1.00E+03	4.39E+03	1.7	1.3	4.35E+03	1.7	1.3	4.22E+03	1.6	1.9	4.17E+03	1.6	2	4.37E+03	1.7	2.2	4.45E+03	1.7	2.2
2.00E+03	5.04E+03	1.8	1.3	4.95E+03	1.7	1.3	4.60E+03	1.7	2.1	4.63E+03	1.6	2.1	5.09E+03	1.7	2.3	5.04E+03	1.7	2.3
3.00E+03	5.48E+03	1.7	1.3	5.35E+03	1.7	1.3	4.90E+03	1.7	2.1	4.84E+03	1.6	2.1	5.55E+03	1.8	2.3	5.51E+03	1.8	2.2
5.00E+03	5.94E+03	1.7	1.3	5.72E+03	1.7	1.3	4.97E+03	1.7	2.1	5.11E+03	1.6	2.1	5.92E+03	1.7	2.3	5.93E+03	1.7	2.3
1.00E+04	7.18E+03	1.7	1.3	6.98E+03	1.7	1.3	6.07E+03	1.6	2.1	6.03E+03	1.6	2	7.39E+03	1.7	2.2	7.39E+03	1.7	2.2
2.00E+04	7.64E+03	1.6	1.3	7.32E+03	1.6	1.3	5.96E+03	1.6	2.1	6.25E+03	1.6	2	7.95E+03	1.6	2.1	7.47E+03	1.7	2
5.00E+04	1.16E+04	1.5	1.2	1.08E+04	1.6	1.2	8.36E+03	1.6	1.9	8.30E+03	1.5	1.9	1.18E+04	1.5	2	1.15E+04	1.5	2
1.00E+05	1.68E+04	1.5	1.2	1.50E+04	1.4	1.2	1.15E+04	1.5	1.8	1.21E+04	1.4	1.8	1.72E+04	1.4	1.9	1.65E+04	1.5	1.9

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.08E+02	19.8	19.3	0.00E+00	1	1
1.40E+01	1.01E-01	7.5	9.8	1.09E-01	7.3	9.9	8.83E-02	6.6	9.9	1.47E-01	7.5	9.4	2.78E+02	17.2	16.1	0.00E+00	1	1
2.00E+01	7.20E-01	7.6	9.5	7.11E-01	7.7	10.5	5.79E-01	7.6	10.6	7.64E-01	7	9.8	4.96E+02	15.4	14.1	2.78E-01	5.4	10.4
3.00E+01	2.37E+00	6.8	8.8	2.35E+00	8	9.9	2.08E+00	6.8	8.9	3.15E+00	6.4	8.5	1.14E+03	12.1	10.5	2.31E+00	5.4	8.9
5.00E+01	2.17E+01	9.1	10.3	1.90E+01	6.5	9.3	1.02E+01	6.2	8.5	2.23E+01	6.6	9.2	3.04E+03	7.9	6.7	1.24E+01	6.2	9.9
7.50E+01	7.00E+02	8.9	7.9	8.06E+02	9.6	8.6	4.82E+02	11.5	10.3	1.43E+03	9.1	7.9	5.36E+03	5.2	4.4	3.80E+01	4.7	7.9
1.00E+02	2.97E+03	6.1	5.3	4.30E+03	6.2	5.4	2.20E+03	5.7	5.1	3.32E+03	5.1	4.5	5.04E+03	2.7	2.6	1.35E+02	3.3	5.2
1.50E+02	6.73E+03	2.7	2.7	7.18E+03	2.6	2.6	4.85E+03	3	3	5.82E+03	2.7	2.7	4.88E+03	2.1	2.3	5.37E+03	4	3.7
2.00E+02	6.84E+03	1.8	2	6.99E+03	1.7	1.8	6.29E+03	2.2	2.3	6.39E+03	2	2.1	6.44E+03	2.2	2.2	6.78E+03	1.9	2.4
3.00E+02	5.22E+03	1.4	1.7	5.28E+03	1.4	1.6	5.12E+03	1.5	1.7	5.15E+03	1.5	1.7	5.03E+03	1.4	1.7	4.92E+03	1.4	1.7
5.00E+02	4.23E+03	1.6	1.9	4.26E+03	1.5	1.9	4.11E+03	1.5	1.9	4.33E+03	1.6	1.9	4.39E+03	1.5	1.9	4.11E+03	1.8	2
7.00E+02	4.16E+03	1.6	2	4.17E+03	1.6	2	4.16E+03	1.7	2.1	4.17E+03	1.6	2	4.17E+03	1.6	1.9	4.06E+03	1.7	2
1.00E+03	4.38E+03	1.7	2.2	4.39E+03	1.7	2.2	4.46E+03	1.7	2.2	4.24E+03	1.7	2.2	4.64E+03	1.6	2.2	4.58E+03	1.7	2.3
2.00E+03	4.99E+03	1.7	2.2	4.87E+03	1.7	2.2	5.08E+03	1.8	2.3	4.93E+03	1.8	2.3	4.98E+03	1.7	2.2	5.34E+03	1.8	2.3
3.00E+03	5.37E+03	1.7	2.2	5.17E+03	1.7	2.2	5.56E+03	1.7	2.3	5.42E+03	1.7	2.3	5.21E+03	1.7	2.2	5.78E+03	1.7	2.3
5.00E+03	5.70E+03	1.7	2.2	5.33E+03	1.7	2.2	5.90E+03	1.7	2.3	5.88E+03	1.7	2.3	5.62E+03	1.7	2	6.60E+03	1.8	2.3
1.00E+04	6.85E+03	1.7	2.2	6.60E+03	1.7	2.2	7.47E+03	1.7	2.2	7.25E+03	1.7	2.2	7.06E+03	1.7	2.1	8.03E+03	1.8	2.3
2.00E+04	7.42E+03	1.6	2.1	6.80E+03	1.6	2	8.17E+03	1.6	2.2	7.69E+03	1.7	1.9	7.73E+03	1.6	2	8.02E+03	1.8	1.9
5.00E+04	1.05E+04	1.5	2	9.87E+03	1.5	2	1.17E+04	1.6	2	1.02E+04	1.5	1.9	1.10E+04	1.6	1.8	1.12E+04	1.6	2
1.00E+05	1.56E+04	1.5	1.9	1.36E+04	1.4	1.9	1.85E+04	1.4	1.9	1.61E+04	1.4	1.9	1.57E+04	1.4	2	1.82E+04	1.4	2.1

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.25E-02	7.5	9.8	1.16E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	6.34E-01	7.5	9.6	6.67E-01	7.1	9.5	2.67E-01	6.2	9.3	1.43E+00	6.2	9.7	6.36E-01	5.2	7.6	7.62E-01	4.4	7.9
3.00E+01	2.16E+00	6.9	8.8	2.40E+00	6.8	8.7	2.33E+00	6.1	9.1	2.69E+00	7	9	1.77E+00	8.1	6.4	4.74E+00	3.8	6.1
5.00E+01	1.32E+01	6.9	9.8	2.34E+01	9.6	11	3.73E+01	11.9	11.2	1.12E+01	9.1	10	8.83E+02	12.8	11.7	1.32E+03	13	11.6

Table A.6. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	6.11E+02	8.9	7.9	9.97E+02	9	7.8	5.28E+02	9.6	8.6	5.05E+02	8.7	8.2	4.83E+03	6.6	5.6	5.13E+03	5.9	5
1.00E+02	2.12E+03	5.7	5	3.05E+03	5.4	4.8	1.46E+03	4.6	4	1.52E+03	4.7	4.5	5.10E+03	3.1	3	4.81E+03	3	2.6
1.50E+02	4.93E+03	3.1	3	5.72E+03	2.9	2.9	5.77E+03	4.2	3.8	7.12E+03	3.6	3.3	6.00E+03	2.8	2.6	6.66E+03	2.8	2.7
2.00E+02	6.22E+03	2.1	2.2	6.54E+03	1.9	2.1	7.21E+03	2	2.1	7.23E+03	1.8	1.9	6.45E+03	2.1	2	7.17E+03	2	2
3.00E+02	5.09E+03	1.5	1.7	5.15E+03	1.4	1.7	5.00E+03	1.4	1.7	5.28E+03	1.5	1.7	5.23E+03	1.3	1.6	5.19E+03	1.4	1.6
5.00E+02	4.14E+03	1.6	1.9	4.30E+03	1.6	1.9	4.00E+03	1.5	2	4.53E+03	1.5	1.8	4.35E+03	1.5	1.9	4.35E+03	1.6	1.9
7.00E+02	4.17E+03	1.7	2.1	4.13E+03	1.7	2.1	4.26E+03	1.7	2.1	4.31E+03	1.6	2.1	3.99E+03	1.7	1.9	4.18E+03	1.7	2
1.00E+03	4.39E+03	1.7	2.2	4.40E+03	1.7	2.2	4.53E+03	1.8	2.2	4.32E+03	1.6	2.2	4.50E+03	1.7	2.2	4.10E+03	1.7	2.1
2.00E+03	5.10E+03	1.8	2.3	5.02E+03	1.7	2.3	4.92E+03	1.7	2.3	5.19E+03	1.7	2.3	4.72E+03	1.7	2.2	4.57E+03	1.8	2.1
3.00E+03	5.66E+03	1.7	2.3	5.44E+03	1.7	2.3	5.48E+03	1.8	2.2	5.39E+03	1.7	2.2	5.21E+03	1.8	2.1	4.61E+03	1.8	2.1
5.00E+03	6.09E+03	1.7	2.3	5.82E+03	1.8	2.2	5.57E+03	1.7	2.2	5.65E+03	1.7	2.3	5.34E+03	1.8	2.1	5.76E+03	1.8	2.1
1.00E+04	7.36E+03	1.7	2.2	6.97E+03	1.7	2.2	7.14E+03	1.8	2.2	7.08E+03	1.7	2.3	6.43E+03	1.7	2.2	6.33E+03	1.7	2.1
2.00E+04	7.90E+03	1.6	2.1	7.40E+03	1.6	2.1	7.63E+03	1.6	2.1	7.97E+03	1.7	2.1	6.91E+03	1.6	2	6.03E+03	1.6	2
5.00E+04	1.20E+04	1.5	2	1.09E+04	1.6	2	1.14E+04	1.4	2.1	1.11E+04	1.6	2	1.08E+04	1.6	2	9.25E+03	1.5	1.7
1.00E+05	1.77E+04	1.5	1.9	1.54E+04	1.4	1.9	1.65E+04	1.5	2	1.49E+04	1.4	2	1.50E+04	1.6	2	1.28E+04	1.5	1.8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	5.15E+00	19.8	19.3	1.10E+00	19.8	19.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	8.36E-02	4.2	8.8	8.63E+00	17.2	16.2	2.01E+00	16.7	15.6	1.15E-01	7.2	10	1.24E-01	7.2	9.6
2.00E+01	3.86E-01	6.4	9.3	5.50E-01	4.9	7.6	1.78E+01	14.7	13.5	4.12E+00	13.8	13.2	8.70E-01	7.3	9.3	4.89E-01	6.8	10.7
3.00E+01	9.06E-01	6.6	8.8	5.96E+00	5	6.8	6.76E+01	13.8	12.6	5.01E+01	16	15.2	3.25E+00	6.2	8	3.21E+00	5.7	8.7
5.00E+01	1.09E+01	6.6	9.7	1.25E+03	11.4	10.1	1.33E+03	10.9	9.5	1.23E+03	10.7	9.3	6.99E+01	12.1	12.6	1.82E+02	14.1	13.5
7.50E+01	1.77E+02	10.9	11.1	2.50E+03	5.2	4.6	3.66E+03	6.2	5.3	3.45E+03	6.3	5.4	2.31E+03	8.3	7.1	3.14E+03	7.8	6.6
1.00E+02	1.75E+03	6	5.1	3.10E+03	3.6	3.6	5.59E+03	4.2	3.8	5.50E+03	4.3	3.9	5.58E+03	5.1	4.5	6.38E+03	4.9	4.3
1.50E+02	4.25E+03	3.4	3.2	4.29E+03	2.7	2.6	6.96E+03	2.4	2.4	7.21E+03	2.5	2.5	8.89E+03	2.6	2.6	9.22E+03	2.5	2.4
2.00E+02	6.20E+03	2.2	2.3	6.40E+03	2.2	2.3	6.58E+03	1.7	1.9	6.69E+03	1.7	1.8	7.09E+03	1.4	1.6	7.12E+03	1.4	1.6
3.00E+02	5.06E+03	1.4	1.7	5.14E+03	1.4	1.7	5.13E+03	1.4	1.7	5.15E+03	1.4	1.7	5.26E+03	1.4	1.6	5.27E+03	1.4	1.6
5.00E+02	4.39E+03	1.7	2	4.21E+03	1.5	1.9	4.24E+03	1.5	1.8	4.26E+03	1.5	1.8	4.39E+03	1.5	1.8	4.48E+03	1.5	1.8
7.00E+02	4.31E+03	1.7	2.1	4.24E+03	1.7	2	4.13E+03	1.6	2	4.10E+03	1.6	2	4.16E+03	1.6	1.9	4.05E+03	1.6	1.9
1.00E+03	4.49E+03	1.8	2.3	4.37E+03	1.8	2.3	4.25E+03	1.7	2.1	4.21E+03	1.7	2.1	4.26E+03	1.7	2.1	4.15E+03	1.6	2.1
2.00E+03	5.33E+03	1.8	2.4	5.07E+03	1.8	2.2	4.72E+03	1.7	2.2	4.64E+03	1.7	2.2	4.61E+03	1.7	2.2	4.64E+03	1.7	2.1
3.00E+03	5.79E+03	1.7	2.3	5.31E+03	1.7	2.2	5.03E+03	1.7	2.2	5.02E+03	1.7	2.2	4.91E+03	1.7	2.1	4.86E+03	1.6	2.1
5.00E+03	6.17E+03	1.7	2.3	5.93E+03	1.7	2.2	5.43E+03	1.7	2.2	5.32E+03	1.7	2.2	5.17E+03	1.7	2.1	4.87E+03	1.6	2.1
1.00E+04	7.71E+03	1.7	2.2	7.42E+03	1.6	2.2	6.42E+03	1.7	2.2	6.32E+03	1.7	2.2	6.16E+03	1.7	2.1	5.79E+03	1.7	2.1
2.00E+04	8.70E+03	1.6	2.2	7.92E+03	1.6	2.1	6.76E+03	1.6	2	6.58E+03	1.6	2	6.17E+03	1.6	2	5.85E+03	1.6	2
5.00E+04	1.25E+04	1.6	2.1	1.20E+04	1.5	2	9.78E+03	1.5	2	9.66E+03	1.5	2	8.14E+03	1.6	2	8.52E+03	1.6	2
1.00E+05	1.85E+04	1.4	1.9	1.61E+04	1.5	1.9	1.39E+04	1.4	1.9	1.32E+04	1.5	1.9	1.18E+04	1.5	1.9	1.09E+04	1.4	1.9

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.11E+03	17	18.4	1.35E+03	17	18.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.22E+03	19.7	24.9	2.69E+03	19.7	24.9	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.32E+03	22.1	26.8	4.03E+03	22.1	26.8	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.48E+03	23.6	25.4	6.64E+03	23.6	25.4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.00E+00	21.7	21.8	0.00E+00	1	1	1.06E+04	19.3	18.6	1.27E+04	19.3	18.5	1.60E+01	19.8	19.2	2.85E+00	20	19.4
1.40E+01	1.34E+01	18.7	19.1	1.80E-01	4.9	7.2	1.42E+04	16.4	14.8	1.68E+04	16.3	14.7	2.46E+01	17.2	16	4.36E+00	16.6	15.6
2.00E+01	1.40E+02	19.5	19.5	2.96E+00	4.8	15.6	1.56E+04	11.6	9.3	1.61E+04	10.9	8.5	4.46E+01	15.9	14.7	8.98E+00	14.5	13.3
3.00E+01	1.11E+03	14.9	13.5	1.95E+02	17.3	16.6	1.26E+04	6.8	4.9	1.27E+04	6.3	4.5	1.57E+02	12.9	11.3	3.12E+01	14.1	13.1
5.00E+01	4.87E+03	8.8	7.3	2.83E+03	9.8	8.4	8.98E+03	3.3	2.7	9.00E+03	3.2	2.7	6.20E+02	8.7	7.4	4.05E+02	9.8	8.6
7.50E+01	6.66E+03	4.5	3.8	5.59E+03	5.3	4.5	7.31E+03	2.3	2.3	7.35E+03	2.3	2.3	1.32E+03	6	5.3	1.22E+03	6.8	5.9
1.00E+02	6.34E+03	2.9	2.7	6.14E+03	3.3	3.1	6.76E+03	2.2	2.2	6.86E+03	2.2	2.2	2.57E+03	4.9	4.4	2.60E+03	5.2	4.7
1.50E+02	6.65E+03	2.3	2.4	7.40E+03	2.6	2.5	6.58E+03	1.9	2	6.74E+03	1.9	2	5.46E+03	3.1	3	6.22E+03	3.2	3
2.00E+02	6.89E+03	1.7	1.8	6.96E+03	1.6	1.8	6.23E+03	1.6	1.8	6.37E+03	1.6	1.8	6.53E+03	2	2.1	6.66E+03	2	2
3.00E+02	5.42E+03	1.4	1.6	5.47E+03	1.4	1.6	5.17E+03	1.4	1.6	5.19E+03	1.4	1.6	5.14E+03	1.5	1.7	5.20E+03	1.4	1.7
5.00E+02	4.10E+03	1.5	1.8	4.25E+03	1.5	1.7	4.15E+03	1.5	1.7	4.18E+03	1.5	1.7	4.20E+03	1.6	1.9	4.29E+03	1.6	1.9
7.00E+02	4.15E+03	1.6	1.9	4.12E+03	1.6	2	3.94E+03	1.5	1.8	3.92E+03	1.5	1.8	4.18E+03	1.6	2	4.18E+03	1.7	2.1
1.00E+03	4.14E+03	1.6	2	4.12E+03	1.6	2.1	3.98E+03	1.6	2	3.91E+03	1.6	2	4.41E+03	1.7	2.2	4.40E+03	1.7	2.2
2.00E+03	4.71E+03	1.7	2.1	4.71E+03	1.6	2.1	4.24E+03	1.6	2	4.17E+03	1.6	2	5.08E+03	1.7	2.3	5.08E+03	1.7	2.3
3.00E+03	4.66E+03	1.6	2.1	4.59E+03	1.7	2.2	4.47E+03	1.6	2	4.41E+03	1.6	2	5.44E+03	1.7	2.3	5.48E+03	1.7	2.3

(continued on next page)

Table A.6. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	5.34E+03	1.7	2.1	5.01E+03	1.6	2.1	4.76E+03	1.6	2	4.64E+03	1.6	2	5.94E+03	1.7	2.3	5.69E+03	1.7	2.2
1.00E+04	6.02E+03	1.6	2.1	6.16E+03	1.6	2.2	5.59E+03	1.6	2	5.48E+03	1.6	2	7.08E+03	1.7	2.2	6.92E+03	1.7	2.2
2.00E+04	6.24E+03	1.6	2.1	5.98E+03	1.6	2	5.88E+03	1.6	1.9	5.61E+03	1.6	1.9	7.59E+03	1.6	2.1	7.30E+03	1.6	2.1
5.00E+04	8.70E+03	1.6	2.1	8.58E+03	1.5	1.8	8.32E+03	1.5	2	7.94E+03	1.5	1.9	1.13E+04	1.5	2.1	1.07E+04	1.5	2
1.00E+05	1.09E+04	1.4	1.8	1.07E+04	1.4	2	1.15E+04	1.4	1.8	1.07E+04	1.4	1.8	1.61E+04	1.5	1.9	1.52E+04	1.5	2

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.84E+02	19.7	19.2	3.59E+01	20.1	19.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	2.80E+02	17.2	15.9	5.39E+01	16.8	16.2	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.38E-01	4.7	9	2.20E-01	4.8	9.6	4.39E+02	15.4	14.1	8.83E+01	14.2	12.8	3.58E-01	7.7	8.9	3.29E-01	5.6	9.7
3.00E+01	1.05E+00	5.4	9.1	2.25E+00	5.4	9.2	1.26E+03	12.4	10.7	2.04E+02	13.9	12.6	3.40E+00	6.1	9.3	2.09E+00	5.6	9
5.00E+01	8.55E+00	9.8	12.2	6.04E+00	6.9	9.9	3.51E+03	7.6	6.5	1.90E+03	8.7	7.6	9.79E+00	5	9.2	8.45E+00	5.8	10.4
7.50E+01	4.67E+01	6.3	5.7	4.42E+01	4.6	7.4	4.92E+03	4.7	4.1	2.97E+03	4.7	4.3	2.07E+02	10.4	9.6	4.53E+01	4.3	7.1
1.00E+02	1.17E+03	8	7.2	6.08E+02	8.8	7.6	5.71E+03	3.4	3.1	4.73E+03	5.1	4.7	9.92E+02	6.4	5.5	4.83E+02	7.3	7.6
1.50E+02	4.26E+03	3	2.8	5.48E+03	4.2	4	8.26E+03	2.4	2.4	7.95E+03	2.3	2.3	4.76E+03	4	3.7	5.48E+03	3.9	3.4
2.00E+02	6.28E+03	2.4	2.3	6.59E+03	2.1	2.2	6.95E+03	1.5	1.7	6.97E+03	1.8	1.8	6.36E+03	2.1	2.5	6.82E+03	2.1	2
3.00E+02	5.05E+03	1.4	1.7	5.17E+03	1.4	1.7	5.25E+03	1.5	1.6	5.36E+03	1.4	1.6	5.07E+03	1.6	1.7	5.27E+03	1.5	1.7
5.00E+02	4.15E+03	1.6	1.9	4.27E+03	1.6	1.7	4.45E+03	1.7	1.7	4.28E+03	1.6	1.8	4.11E+03	1.6	1.9	4.31E+03	1.6	2.1
7.00E+02	4.08E+03	1.7	1.8	4.28E+03	1.7	2.2	4.10E+03	1.6	2	3.96E+03	1.5	2	4.47E+03	1.6	2.1	4.33E+03	1.7	2.1
1.00E+03	4.46E+03	1.8	2.3	4.43E+03	1.8	2.3	4.23E+03	1.6	2	4.38E+03	1.6	2	4.55E+03	1.7	2.3	4.55E+03	1.8	2.2
2.00E+03	5.16E+03	1.8	2.3	5.32E+03	1.7	2.3	4.59E+03	1.7	2.1	4.89E+03	1.7	2.2	5.44E+03	1.7	2.4	5.41E+03	1.8	2.4
3.00E+03	5.48E+03	1.8	2.4	6.23E+03	1.8	2.3	4.63E+03	1.6	2.1	4.92E+03	1.7	2.2	5.73E+03	1.8	2.3	5.76E+03	1.8	2.3
5.00E+03	6.09E+03	1.6	2.4	5.63E+03	1.7	2.3	5.14E+03	1.7	2.1	5.16E+03	1.8	2.2	6.17E+03	1.7	2.3	6.04E+03	1.8	2.3
1.00E+04	7.78E+03	1.7	2.4	7.14E+03	1.7	2.3	6.21E+03	1.7	2.1	5.68E+03	1.8	2.3	7.54E+03	1.7	2.3	7.36E+03	1.8	2.2
2.00E+04	7.39E+03	1.7	2.3	8.29E+03	1.7	2.1	5.97E+03	1.6	2.1	6.07E+03	1.6	2	8.17E+03	1.6	2.1	6.72E+03	1.7	2
5.00E+04	1.12E+04	1.5	2.2	1.21E+04	1.6	2.2	9.03E+03	1.5	2	8.71E+03	1.5	1.8	1.28E+04	1.5	2.1	1.07E+04	1.6	2
1.00E+05	1.83E+04	1.6	2	1.71E+04	1.6	2	1.11E+04	1.5	1.9	1.04E+04	1.5	1.9	1.86E+04	1.5	1.9	1.33E+04	1.5	2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.25E+01	21	20.4	0.00E+00	1	1
1.40E+01	9.68E-02	6.9	9.8	0.00E+00	1	1	2.41E-01	6.8	9.8	9.40E-02	7	10.1	2.30E+01	18.1	17.5	1.25E-01	6.1	8.8
2.00E+01	5.72E-01	7.5	9.6	3.87E-01	7.1	9.6	5.07E-01	7.9	9.3	3.79E-01	7.9	9.8	1.04E+02	18.5	17.6	3.05E+00	17.7	11.8
3.00E+01	2.02E+00	7.2	9.1	2.73E+00	7.1	8.9	2.09E+00	7	9.1	2.55E+00	7.2	9.3	5.15E+02	13.8	12.2	2.27E+01	14.4	13.7
5.00E+01	1.16E+01	6	9.3	1.36E+01	6.8	8.3	9.20E+00	6.1	9.5	9.71E+00	5.9	9.5	1.51E+03	8.3	6.9	1.06E+03	10.6	9.3
7.50E+01	3.69E+02	10.3	9.6	5.48E+02	9.6	8.8	5.17E+01	4	6.2	6.26E+01	5.2	6.1	2.17E+03	4.8	4.2	2.03E+03	5.3	4.6
1.00E+02	1.87E+03	5.8	5.2	2.39E+03	6	5.3	1.25E+03	7.8	7	1.24E+03	7.7	7	2.90E+03	4.1	3.7	2.94E+03	4.2	3.9
1.50E+02	5.34E+03	3.5	3.3	6.57E+03	3.2	3	4.79E+03	3.1	3	5.75E+03	3.1	3	5.32E+03	2.9	2.9	6.22E+03	3	2.9
2.00E+02	6.80E+03	2	2.2	7.21E+03	1.9	2	5.82E+03	2.1	2.2	6.17E+03	2	2.1	6.33E+03	2.1	2.1	6.63E+03	1.9	2
3.00E+02	5.20E+03	1.5	1.7	5.26E+03	1.4	1.7	5.11E+03	1.5	1.7	5.22E+03	1.5	1.7	5.11E+03	1.5	1.7	5.21E+03	1.4	1.6
5.00E+02	4.13E+03	1.6	1.9	4.40E+03	1.5	1.9	4.16E+03	1.6	2	4.27E+03	1.6	1.9	4.27E+03	1.5	1.9	4.28E+03	1.6	1.8
7.00E+02	4.24E+03	1.7	2.1	4.11E+03	1.6	2	4.16E+03	1.7	2.1	4.29E+03	1.7	2.1	4.14E+03	1.5	2	4.21E+03	1.6	2
1.00E+03	4.45E+03	1.7	2.2	4.48E+03	1.7	2.2	4.34E+03	1.7	2.3	4.42E+03	1.7	2.2	4.38E+03	1.7	2.2	4.36E+03	1.6	2.2
2.00E+03	5.11E+03	1.7	2.3	5.14E+03	1.7	2.3	5.26E+03	1.8	2.3	5.18E+03	1.8	2.3	5.02E+03	1.7	2.2	5.00E+03	1.7	2.2
3.00E+03	5.56E+03	1.8	2.3	5.41E+03	1.7	2.2	5.68E+03	1.8	2.3	5.79E+03	1.7	2.3	5.48E+03	1.7	2.2	5.33E+03	1.7	2.2
5.00E+03	5.73E+03	1.7	2.3	5.52E+03	1.7	2.2	6.31E+03	1.7	2.3	5.92E+03	1.7	2.3	5.88E+03	1.7	2.3	5.69E+03	1.7	2.2
1.00E+04	7.13E+03	1.7	2.2	6.81E+03	1.6	2.2	7.61E+03	1.7	2.3	7.59E+03	1.7	2.2	7.16E+03	1.7	2.2	6.92E+03	1.7	2.1
2.00E+04	7.81E+03	1.7	2.1	7.25E+03	1.6	2	8.07E+03	1.6	2.2	7.96E+03	1.6	2	7.64E+03	1.6	2.1	7.23E+03	1.6	2.1
5.00E+04	1.14E+04	1.5	2	1.03E+04	1.5	2	1.25E+04	1.6	2	1.14E+04	1.5	2	1.12E+04	1.5	2	1.08E+04	1.5	2.1
1.00E+05	1.73E+04	1.4	1.9	1.43E+04	1.4	1.9	1.87E+04	1.5	1.9	1.81E+04	1.5	2	1.61E+04	1.5	1.9	1.52E+04	1.4	1.9

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

Table A.6. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.16E+01	19.8	19.3	9.51E-01	19.8	19.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.54E+01	17.2	16.1	1.66E+00	16.6	15.7	1.01E-01	5.6	9.1	8.61E-02	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.18E+01	16.2	15.2	5.51E+00	15.1	14.8	8.82E-01	6.6	9	1.58E+01	17	16.8	5.86E-01	6.8	9.7	5.79E-01	7.1	10.1
3.00E+01	2.26E+02	14.4	13.1	6.21E+01	15.5	14.5	8.49E+00	14.1	15.3	9.50E+01	15.1	14.3	1.70E+00	7.1	9.5	2.35E+00	7.1	9.2
5.00E+01	1.81E+03	9.8	8.3	8.43E+02	10.8	9.4	5.96E+02	10.2	8.7	9.72E+02	9.6	7.9	7.62E+00	6.7	10.6	9.02E+00	6.1	9.8
7.50E+01	4.25E+03	5.9	5	3.41E+03	6.7	5.7	1.47E+03	7	6	2.61E+03	7	6.3	2.83E+01	5.4	8.3	5.21E+01	4.2	6.5
1.00E+02	5.67E+03	3.9	3.5	5.43E+03	4.3	3.9	4.68E+03	5.8	5	5.25E+03	5.2	4.5	1.07E+02	3.6	5.6	7.30E+02	8.2	7.7
1.50E+02	6.56E+03	2.3	2.4	6.87E+03	2.4	2.4	7.96E+03	2.4	2.4	7.71E+03	2.4	2.4	3.68E+03	5	4.6	5.57E+03	3.4	3.2
2.00E+02	6.31E+03	1.7	1.9	6.53E+03	1.7	1.9	7.02E+03	1.6	1.7	6.71E+03	1.6	1.9	6.45E+03	2.2	2.3	6.43E+03	2	2.1
3.00E+02	5.17E+03	1.4	1.7	5.19E+03	1.4	1.6	5.31E+03	1.4	1.6	5.30E+03	1.4	1.6	5.13E+03	1.5	1.7	5.18E+03	1.4	1.7
5.00E+02	4.23E+03	1.5	1.8	4.25E+03	1.5	1.8	4.38E+03	1.6	1.9	4.14E+03	1.4	1.8	4.08E+03	1.6	2	4.23E+03	1.6	1.9
7.00E+02	4.12E+03	1.6	2	4.13E+03	1.6	2	4.01E+03	1.6	2	4.06E+03	1.7	2	4.16E+03	1.7	2.1	4.34E+03	1.6	2.1
1.00E+03	4.28E+03	1.7	2.1	4.25E+03	1.7	2.1	4.45E+03	1.7	2.1	4.19E+03	1.7	2.1	4.59E+03	1.8	2.3	4.43E+03	1.8	2.3
2.00E+03	4.75E+03	1.7	2.2	4.75E+03	1.7	2.2	4.63E+03	1.7	2.2	4.74E+03	1.7	2.2	5.41E+03	1.8	2.4	5.09E+03	1.7	2.3
3.00E+03	5.08E+03	1.7	2.2	5.09E+03	1.7	2.2	5.10E+03	1.7	2.3	5.01E+03	1.7	2.2	5.96E+03	1.7	2.3	5.73E+03	1.8	2.3
5.00E+03	5.49E+03	1.7	2.2	5.41E+03	1.7	2.2	5.57E+03	1.7	2.3	4.99E+03	1.6	2.3	6.47E+03	1.8	2.4	6.10E+03	1.8	2.2
1.00E+04	6.58E+03	1.7	2.2	6.53E+03	1.7	2.2	5.98E+03	1.7	2.1	5.91E+03	1.7	2.3	7.70E+03	1.7	2.3	7.39E+03	1.7	2.3
2.00E+04	6.92E+03	1.6	2	6.78E+03	1.6	2	5.94E+03	1.7	2	6.18E+03	1.5	2.1	8.57E+03	1.7	2.2	8.07E+03	1.6	2.1
5.00E+04	1.02E+04	1.5	2	1.01E+04	1.5	2	9.61E+03	1.6	1.9	8.20E+03	1.5	2	1.26E+04	1.6	2.1	1.08E+04	1.5	2.1
1.00E+05	1.42E+04	1.4	1.9	1.40E+04	1.4	1.9	1.10E+04	1.4	2	1.19E+04	1.5	1.9	1.82E+04	1.4	1.9	1.72E+04	1.4	2.2

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.11E-01	6.9	10.2	9.86E-02	7.4	9.6	1.15E-01	7.3	9.7	8.82E-02	6.2	10.1	1.19E-01	6.6	9.7
2.00E+01	3.52E-01	5.2	9.4	2.41E-01	6.9	9.8	5.88E-01	7.2	9.6	6.99E-01	7.2	9.6	4.13E-01	7.2	9.5	9.33E-01	6.4	9.9
3.00E+01	2.02E+00	7.2	9.3	1.89E+00	7.3	9.3	2.15E+00	7.6	9	2.12E+00	7	8.9	1.91E+00	6.9	9	2.14E+00	6.9	8.8
5.00E+01	9.65E+00	6.2	10.2	8.00E+00	6.8	10.3	1.19E+01	6.7	8.7	1.17E+01	5.4	8.7	1.17E+01	5.3	8.9	1.58E+01	5	7.9
7.50E+01	4.05E+01	5.2	7.9	3.72E+01	4.9	7.9	3.54E+02	9.3	8.4	3.92E+02	10.2	9.5	2.01E+02	9.8	9.5	7.37E+02	10.6	9.4
1.00E+02	1.17E+02	3.7	5.5	2.55E+02	6.5	7.1	1.88E+03	6	5.3	2.13E+03	6	5.3	2.18E+03	6.8	5.9	3.48E+03	6	5.2
1.50E+02	4.83E+03	4.3	4	4.88E+03	4.2	3.9	4.79E+03	3.2	3.1	5.22E+03	3.1	3	5.21E+03	3	2.9	6.08E+03	2.9	2.8
2.00E+02	6.91E+03	2.4	2.6	6.81E+03	2.5	2.4	6.07E+03	2.1	2.2	6.28E+03	2	2.2	6.42E+03	2	2.1	6.43E+03	1.9	2
3.00E+02	5.01E+03	1.4	1.7	5.04E+03	1.5	1.7	5.08E+03	1.5	1.7	5.14E+03	1.5	1.7	5.11E+03	1.4	1.7	5.14E+03	1.4	1.7
5.00E+02	4.04E+03	1.6	1.9	4.36E+03	1.6	1.9	4.23E+03	1.6	1.9	4.31E+03	1.6	1.9	4.08E+03	1.6	1.9	4.31E+03	1.6	1.9
7.00E+02	4.26E+03	1.6	2.1	4.19E+03	1.7	2.1	4.20E+03	1.7	2.1	4.24E+03	1.6	2.1	4.29E+03	1.6	2.1	4.20E+03	1.7	2
1.00E+03	4.58E+03	1.7	2.3	4.50E+03	1.8	2.3	4.46E+03	1.7	2.2	4.47E+03	1.7	2.3	4.37E+03	1.7	2.3	4.22E+03	1.7	2.2
2.00E+03	5.57E+03	1.7	2.4	5.36E+03	1.7	2.4	5.17E+03	1.8	2.3	5.11E+03	1.8	2.3	5.00E+03	1.7	2.3	5.01E+03	1.7	2.2
3.00E+03	5.61E+03	1.7	2.4	5.72E+03	1.8	2.3	5.71E+03	1.7	2.3	5.61E+03	1.7	2.3	5.47E+03	1.8	2.3	5.42E+03	1.8	2.2
5.00E+03	6.29E+03	1.8	2.4	6.40E+03	1.7	2.4	6.18E+03	1.8	2.3	6.23E+03	1.8	2.3	6.08E+03	1.7	2.3	5.59E+03	1.7	2.2
1.00E+04	7.44E+03	1.8	2.3	7.85E+03	1.8	2.3	7.47E+03	1.7	2.3	7.52E+03	1.7	2.3	7.23E+03	1.7	2.2	6.82E+03	1.7	2.2
2.00E+04	8.84E+03	1.6	2.3	7.81E+03	1.6	2.2	8.13E+03	1.6	2.1	7.81E+03	1.6	2.1	7.94E+03	1.5	2.1	7.81E+03	1.6	2.1
5.00E+04	1.29E+04	1.5	2.1	1.17E+04	1.5	2	1.23E+04	1.5	2	1.15E+04	1.6	2	1.08E+04	1.5	2.2	1.10E+04	1.6	2.1
1.00E+05	1.70E+04	1.4	1.9	1.84E+04	1.4	1.9	1.83E+04	1.4	1.9	1.66E+04	1.5	1.9	1.73E+04	1.4	1.9	1.65E+04	1.5	2

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.59E-02	5.8	8.7	0.00E+00	1	1	4.89E+00	8.8	10.6	4.89E+00	8.8	10.6
2.00E+01	4.72E-01	6.4	8.2	0.00E+00	1	1	7.25E+03	21	21.4	7.25E+03	21	21.4
3.00E+01	3.24E+00	5.6	9.1	3.54E+00	5.3	7.5	1.43E+04	10.2	7.9	1.43E+04	10.2	7.9
5.00E+01	5.59E+02	11.8	10.2	4.03E+02	11.7	10.9	9.77E+03	4	3.2	9.77E+03	4	3.2
7.50E+01	3.11E+03	7.4	6.5	2.96E+03	7.8	6.5	8.04E+03	2.5	2.4	8.04E+03	2.5	2.4
1.00E+02	4.86E+03	3.8	3.4	4.06E+03	3.6	3.3	7.72E+03	2.2	2.1	7.72E+03	2.2	2.1
1.50E+02	5.25E+03	2.8	2.9	7.03E+03	3.8	3.4	7.11E+03	1.8	2	7.11E+03	1.8	2

(continued on next page)

Table A.6. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	7.10E+03	1.8	1.9	6.98E+03	1.8	1.9	7.23E+03	1.5	1.5	7.23E+03	1.5	1.5
3.00E+02	5.21E+03	1.4	1.6	5.18E+03	1.4	1.6	5.16E+03	1.4	1.5	5.16E+03	1.4	1.5
5.00E+02	4.33E+03	1.5	1.8	4.36E+03	1.5	1.9	4.48E+03	1.4	1.5	4.48E+03	1.4	1.5
7.00E+02	4.17E+03	1.7	2	4.02E+03	1.8	2	3.86E+03	1.5	1.6	3.86E+03	1.5	1.6
1.00E+03	4.13E+03	1.7	2.2	4.47E+03	1.7	2.1	3.54E+03	1.6	1.6	3.54E+03	1.6	1.6
2.00E+03	4.90E+03	1.7	2.2	5.05E+03	1.7	2.1	4.36E+03	1.6	1.7	4.36E+03	1.6	1.7
3.00E+03	5.26E+03	1.9	2.3	5.24E+03	1.8	2.3	4.52E+03	1.6	1.9	4.52E+03	1.6	1.9
5.00E+03	5.79E+03	1.6	2.1	5.33E+03	1.8	2	4.78E+03	1.6	1.9	4.78E+03	1.6	1.9
1.00E+04	6.22E+03	1.7	2.2	6.39E+03	1.6	2.2	5.40E+03	1.5	1.9	5.40E+03	1.5	1.9
2.00E+04	7.25E+03	1.8	2.1	6.94E+03	1.6	2.1	5.46E+03	1.5	2	5.46E+03	1.5	2
5.00E+04	1.07E+04	1.6	2	1.13E+04	1.6	2.3	6.23E+03	1.4	1.9	6.23E+03	1.4	1.9
1.00E+05	1.35E+04	1.5	1.9	1.49E+04	1.5	2.1	1.04E+04	1.4	1.9	1.04E+04	1.4	1.9

Table A.7. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{9}Be ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.84E+00	23	5.8	6.41E-01	22.6	5.8	2.91E+02	22.5	22.4	2.64E+02	22.6	22.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.01E+00	21.4	5.2	1.09E+00	20.1	5	6.44E+02	22.3	20.6	5.16E+02	22.2	20.4	1.06E-01	7.1	9.6	1.26E-01	7	9.5
2.00E+01	5.22E+00	19.2	4.6	2.24E+00	16.9	4.3	1.50E+03	20.8	18	1.49E+03	20.9	19.1	3.95E-01	7	9.5	6.45E-01	6.9	10.4
3.00E+01	1.75E+01	17	4.1	8.46E+00	15.7	4	6.95E+03	18.7	15.1	4.60E+03	18.2	14.5	2.01E+00	7.9	9.5	2.34E+00	7.3	9.7
5.00E+01	3.17E+02	16.9	4	3.66E+02	17	4	1.50E+04	12.5	8.8	9.59E+03	12.3	8.7	2.21E+01	11.7	11.4	1.12E+01	5.3	8.3
7.50E+01	1.75E+03	11.1	2.7	1.71E+03	11.3	2.7	1.56E+04	6.8	4.4	1.23E+04	8	5.3	3.68E+02	13.2	10.8	5.34E+02	13.7	11.1
1.00E+02	2.97E+03	7.9	2.1	3.15E+03	8.2	2.1	1.37E+04	4.1	2.8	1.20E+04	5.1	3.5	3.01E+03	10.6	7.9	3.12E+03	10.4	7.6
1.50E+02	6.67E+03	5.5	1.7	7.16E+03	5.5	1.7	1.00E+04	1.7	1.7	9.65E+03	2.2	2	7.28E+03	5.2	3.8	7.35E+03	5	3.7
2.00E+02	9.38E+03	3.5	1.4	1.04E+04	3.6	1.4	8.99E+03	1.9	1.8	9.74E+03	2.3	2.1	8.76E+03	3.3	2.7	9.12E+03	3.4	2.7
3.00E+02	8.75E+03	1.6	1.2	8.87E+03	1.5	1.1	9.19E+03	1.6	1.6	9.21E+03	1.5	1.5	8.76E+03	1.7	1.7	8.83E+03	1.6	1.7
5.00E+02	6.47E+03	1.4	1.1	6.56E+03	1.4	1.1	6.62E+03	1.3	1.5	6.68E+03	1.3	1.5	6.60E+03	1.4	1.6	6.54E+03	1.4	1.6
7.00E+02	6.06E+03	1.4	1.2	6.04E+03	1.4	1.2	6.46E+03	1.4	1.6	6.32E+03	1.3	1.6	6.10E+03	1.4	1.7	6.14E+03	1.4	1.7
1.00E+03	6.00E+03	1.5	1.2	6.01E+03	1.5	1.2	5.98E+03	1.3	1.8	6.15E+03	1.4	1.7	5.99E+03	1.5	1.9	6.28E+03	1.5	1.9
2.00E+03	6.57E+03	1.6	1.2	6.39E+03	1.5	1.2	6.27E+03	1.5	1.8	6.14E+03	1.4	1.8	6.51E+03	1.6	2	6.53E+03	1.6	2
3.00E+03	6.86E+03	1.6	1.2	6.83E+03	1.6	1.2	6.52E+03	1.4	1.7	6.47E+03	1.4	1.8	6.95E+03	1.6	2.1	7.05E+03	1.6	2
5.00E+03	7.47E+03	1.6	1.2	7.29E+03	1.6	1.2	6.97E+03	1.4	1.9	6.84E+03	1.5	1.8	7.18E+03	1.6	2	7.28E+03	1.6	2
1.00E+04	8.76E+03	1.6	1.2	8.39E+03	1.6	1.2	7.93E+03	1.5	2	7.63E+03	1.4	1.8	8.90E+03	1.6	2.1	8.66E+03	1.5	2
2.00E+04	9.46E+03	1.5	1.2	8.62E+03	1.5	1.2	8.11E+03	1.4	1.9	7.85E+03	1.4	1.7	1.00E+04	1.5	1.9	8.85E+03	1.5	1.9
5.00E+04	1.37E+04	1.5	1.2	1.30E+04	1.5	1.2	1.15E+04	1.4	1.8	1.09E+04	1.4	1.7	1.40E+04	1.5	1.9	1.32E+04	1.5	1.9
1.00E+05	1.80E+04	1.4	1.2	1.71E+04	1.4	1.2	1.72E+04	1.3	1.7	1.37E+04	1.4	1.7	1.84E+04	1.4	1.8	1.91E+04	1.4	1.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.36E+02	23.1	21.9	0.00E+00	1	1
1.40E+01	1.02E-01	7.5	9.8	1.10E-01	7.3	9.9	9.09E-02	6.6	9.9	1.45E-01	7.5	9.4	3.15E+02	22	19.5	0.00E+00	1	1
2.00E+01	6.48E-01	7.6	9.5	6.72E-01	8.7	10.8	4.32E-01	7.6	10.9	6.65E-01	7	9.8	5.76E+02	19.9	16.6	2.78E-01	5.4	10.4
3.00E+01	1.98E+00	6.8	8.8	1.99E+00	8.2	9.7	2.05E+00	6.8	10.2	1.69E+00	6.4	8.5	1.26E+03	17.8	14.1	1.77E+00	5.4	8.9
5.00E+01	9.57E+00	5.8	9.4	1.04E+01	5.6	9.1	7.80E+00	6.3	9	1.02E+01	6.2	8.1	3.77E+03	13.2	9.5	7.01E+00	6.2	9.9
7.50E+01	2.73E+02	13	11	2.25E+02	11.8	10.3	5.61E+01	5.1	6.1	4.66E+02	14	11.8	7.48E+03	9.2	6.4	1.73E+01	4.7	7.9
1.00E+02	2.13E+03	10.5	7.8	2.88E+03	11.1	8.4	1.71E+03	11.5	8.6	3.52E+03	9.8	7	8.43E+03	6.2	4.3	8.49E+01	3.6	5.2
1.50E+02	9.05E+03	6.1	4.4	1.04E+04	5.4	3.9	5.95E+03	5.9	4.3	7.93E+03	5.3	3.9	7.44E+03	2.7	2.3	2.01E+03	8	7.5
2.00E+02	1.09E+04	3.2	2.6	1.17E+04	3.2	2.6	8.88E+03	3.6	2.9	9.94E+03	3.3	2.7	7.69E+03	3	2.5	9.58E+03	4.3	3.2
3.00E+02	8.95E+03	1.5	1.6	9.00E+03	1.4	1.5	8.96E+03	1.7	1.7	9.03E+03	1.6	1.6	9.13E+03	1.6	1.6	8.47E+03	1.3	1.7
5.00E+02	6.56E+03	1.3	1.6	6.59E+03	1.3	1.5	6.51E+03	1.4	1.6	6.53E+03	1.4	1.6	6.64E+03	1.2	1.6	6.51E+03	1.5	1.6
7.00E+02	6.10E+03	1.4	1.7	6.15E+03	1.4	1.7	6.00E+03	1.5	1.7	6.07E+03	1.5	1.7	5.76E+03	1.4	1.6	6.39E+03	1.4	1.9
1.00E+03	5.94E+03	1.5	1.9	6.10E+03	1.5	1.8	5.90E+03	1.5	1.9	5.94E+03	1.5	1.9	6.25E+03	1.5	1.9	6.32E+03	1.5	1.9
2.00E+03	6.41E+03	1.5	2	6.37E+03	1.5	1.9	6.60E+03	1.6	2.1	6.19E+03	1.5	2	6.79E+03	1.6	1.9	6.62E+03	1.6	2
3.00E+03	6.71E+03	1.5	2	6.71E+03	1.5	1.9	6.84E+03	1.6	2.1	6.90E+03	1.6	2	6.50E+03	1.5	1.9	6.94E+03	1.7	2.1
5.00E+03	7.22E+03	1.6	2	7.05E+03	1.5	1.9	7.51E+03	1.6	2.1	7.45E+03	1.5	2	7.13E+03	1.5	1.9	7.32E+03	1.8	2
1.00E+04	8.57E+03	1.5	2	8.27E+03	1.5	1.9	8.88E+03	1.6	2.1	8.16E+03	1.5	2	8.24E+03	1.6	2	8.46E+03	1.7	2.1
2.00E+04	9.13E+03	1.5	1.8	8.59E+03	1.5	1.8	1.01E+04	1.6	2	8.35E+03	1.4	1.8	9.14E+03	1.5	1.8	9.76E+03	1.6	1.9
5.00E+04	1.29E+04	1.5	1.8	1.21E+04	1.4	1.8	1.46E+04	1.5	1.9	1.38E+04	1.5	1.9	1.35E+04	1.4	2	1.41E+04	1.4	1.7
1.00E+05	1.68E+04	1.4	1.8	1.51E+04	1.4	1.8	1.91E+04	1.4	1.9	1.62E+04	1.4	1.8	2.00E+04	1.5	1.9	2.07E+04	1.4	1.7

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.45E-02	7.5	9.8	1.16E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.7. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	5.89E-01	7.5	9.6	6.92E-01	7.1	9.5	2.72E-01	6.2	9.3	4.47E-01	6.2	9.7	6.29E-01	5.2	7.6	7.60E-01	4.4	7.9
3.00E+01	1.94E+00	6.9	8.8	2.09E+00	6.8	8.7	1.40E+00	6.1	9.1	1.13E+00	7	9	1.86E+00	7.9	6.4	3.71E+00	3.8	6.1
5.00E+01	8.04E+00	6.3	9.5	1.05E+01	6.3	9.2	1.70E+01	10.4	12.3	7.52E+00	6.1	10.4	2.77E+02	18.1	15.6	3.09E+02	19	16.8
7.50E+01	2.45E+02	13.6	11.5	4.30E+02	13.9	11.4	2.40E+02	12.6	10.3	2.91E+02	13.1	11	4.68E+03	12.8	9.7	6.21E+03	12.3	9
1.00E+02	1.71E+03	10.4	7.7	2.77E+03	10.4	7.6	1.56E+03	10.7	8	1.48E+03	10.6	8.2	7.82E+03	8	5	8.40E+03	6.5	4.4
1.50E+02	5.91E+03	5.8	4.3	7.48E+03	5.5	4	4.28E+03	5.6	4.4	6.65E+03	7.2	5.5	7.78E+03	3.3	2.8	7.76E+03	3.9	3
2.00E+02	8.79E+03	3.8	3	9.61E+03	3.5	2.8	1.10E+04	4.2	3.3	1.22E+04	4	2.8	9.97E+03	3	2.4	1.11E+04	3.3	2.5
3.00E+02	8.97E+03	1.7	1.7	9.14E+03	1.6	1.6	8.83E+03	1.4	1.6	8.90E+03	1.4	1.5	9.25E+03	1.4	1.6	9.44E+03	1.4	1.5
5.00E+02	6.51E+03	1.4	1.6	6.50E+03	1.4	1.6	6.55E+03	1.4	1.7	6.94E+03	1.4	1.6	6.17E+03	1.3	1.5	6.85E+03	1.2	1.5
7.00E+02	6.03E+03	1.4	1.8	5.92E+03	1.4	1.7	6.32E+03	1.4	1.7	6.26E+03	1.4	1.7	6.27E+03	1.4	1.7	5.90E+03	1.4	1.7
1.00E+03	6.02E+03	1.5	1.9	6.07E+03	1.5	1.9	6.34E+03	1.5	1.9	6.01E+03	1.5	1.9	5.92E+03	1.4	1.8	6.17E+03	1.4	1.8
2.00E+03	6.57E+03	1.6	2.1	6.41E+03	1.6	2	6.86E+03	1.5	2.1	6.17E+03	1.5	2	6.67E+03	1.6	1.8	6.25E+03	1.4	1.8
3.00E+03	6.95E+03	1.6	2.1	6.92E+03	1.6	2	6.73E+03	1.6	2.1	6.93E+03	1.6	2	6.56E+03	1.5	1.9	6.19E+03	1.6	2
5.00E+03	7.59E+03	1.6	2.1	7.55E+03	1.6	2	7.10E+03	1.6	2	6.74E+03	1.6	2	6.40E+03	1.5	1.9	6.42E+03	1.6	2
1.00E+04	8.90E+03	1.6	2.1	8.60E+03	1.6	2	8.65E+03	1.5	2	8.15E+03	1.5	2	7.82E+03	1.6	2.1	8.01E+03	1.5	1.8
2.00E+04	9.39E+03	1.5	1.9	8.24E+03	1.5	1.9	9.55E+03	1.4	2.1	9.01E+03	1.5	1.9	9.03E+03	1.4	1.9	7.03E+03	1.4	1.9
5.00E+04	1.38E+04	1.5	1.9	1.25E+04	1.5	1.9	1.37E+04	1.6	1.9	1.33E+04	1.4	1.8	1.06E+04	1.4	1.9	1.14E+04	1.4	1.9
1.00E+05	1.83E+04	1.4	1.8	1.72E+04	1.4	1.8	1.69E+04	1.5	1.9	1.59E+04	1.4	1.8	1.52E+04	1.3	1.8	1.73E+04	1.4	1.7

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	5.99E+00	23.1	21.9	1.35E+00	22.8	21.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.00E-02	4.2	8.8	1.06E+01	21.8	19.4	2.30E+00	20.9	18.8	1.18E-01	7.2	10	1.26E-01	7.2	9.6
2.00E+01	3.87E-01	6.4	9.3	5.54E-01	4.9	7.6	1.83E+01	19.7	16.5	4.58E+00	18.1	15.7	6.59E-01	7.3	9.3	4.97E-01	6.8	10.8
3.00E+01	9.54E-01	6.6	8.8	1.86E+00	5	6.8	4.95E+01	17.6	14.5	1.63E+01	16.3	14.4	2.42E+00	6.2	8	2.74E+00	5.7	9.1
5.00E+01	6.37E+00	6.6	10.2	4.76E+02	18.7	16	8.47E+02	16.8	13.6	8.02E+02	17.1	13.9	1.75E+01	6.6	8.8	2.50E+01	7.9	9.7
7.50E+01	3.44E+01	4.4	6.4	3.37E+03	10.7	7.5	4.04E+03	11.2	8	3.70E+03	11.2	8	1.33E+03	14.2	11.2	2.28E+03	13.8	10.6
1.00E+02	1.13E+03	12.6	10.1	4.04E+03	6.5	4.5	7.11E+03	8	5.6	6.72E+03	8.2	5.8	5.47E+03	9.8	7	6.92E+03	9.3	6.6
1.50E+02	4.51E+03	5.1	3.9	6.01E+03	4.3	3.3	1.05E+04	4.5	3.4	1.05E+04	4.6	3.4	1.25E+04	5.3	3.9	1.34E+04	5.1	3.7
2.00E+02	8.15E+03	4	3.2	8.39E+03	3.5	2.9	1.08E+04	2.7	2.3	1.11E+04	2.8	2.3	1.34E+04	2.8	2.3	1.35E+04	2.5	2.1
3.00E+02	8.63E+03	1.8	1.8	8.91E+03	1.5	1.7	8.77E+03	1.5	1.5	8.82E+03	1.4	1.5	8.77E+03	1.3	1.4	9.09E+03	1.3	1.4
5.00E+02	6.42E+03	1.4	1.6	6.86E+03	1.3	1.6	6.65E+03	1.3	1.5	6.66E+03	1.3	1.5	6.87E+03	1.3	1.5	6.84E+03	1.3	1.5
7.00E+02	5.77E+03	1.5	1.7	5.90E+03	1.4	1.7	6.14E+03	1.4	1.6	6.10E+03	1.4	1.6	6.25E+03	1.3	1.6	6.16E+03	1.3	1.6
1.00E+03	6.15E+03	1.6	2	5.97E+03	1.5	1.8	5.99E+03	1.5	1.8	5.98E+03	1.5	1.8	5.92E+03	1.4	1.7	5.96E+03	1.4	1.7
2.00E+03	6.69E+03	1.6	2.1	6.44E+03	1.6	2	6.32E+03	1.5	1.9	6.22E+03	1.5	1.9	6.18E+03	1.4	1.8	6.26E+03	1.5	1.8
3.00E+03	7.08E+03	1.6	2.1	7.00E+03	1.6	2	6.50E+03	1.5	1.9	6.56E+03	1.5	1.9	6.29E+03	1.5	1.8	6.59E+03	1.5	1.8
5.00E+03	7.36E+03	1.6	2.2	6.89E+03	1.6	2.1	6.97E+03	1.5	1.9	6.91E+03	1.5	1.9	6.84E+03	1.5	1.9	6.51E+03	1.5	1.8
1.00E+04	9.33E+03	1.6	2.1	8.50E+03	1.6	1.9	8.13E+03	1.5	1.9	7.83E+03	1.5	1.9	8.27E+03	1.5	1.8	7.49E+03	1.5	1.8
2.00E+04	1.01E+04	1.5	1.8	9.43E+03	1.6	1.9	8.72E+03	1.5	1.8	8.15E+03	1.5	1.8	8.66E+03	1.5	1.7	7.63E+03	1.4	1.7
5.00E+04	1.48E+04	1.5	1.9	1.28E+04	1.6	1.9	1.18E+04	1.4	1.8	1.15E+04	1.4	1.8	1.05E+04	1.5	1.8	1.10E+04	1.4	1.7
1.00E+05	2.02E+04	1.4	1.9	1.79E+04	1.4	1.8	1.56E+04	1.4	1.8	1.54E+04	1.4	1.8	1.33E+04	1.4	1.7	1.34E+04	1.4	1.7

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.43E+03	13.8	12.1	1.74E+03	13.8	12.1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.87E+03	15.5	17.3	3.46E+03	15.5	17.3	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.29E+03	17.2	20.7	5.19E+03	17.2	20.7	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.09E+03	20	23.7	8.59E+03	20	23.7	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.24E+00	22.3	22.6	0.00E+00	1	1	1.38E+04	23.3	21.8	1.66E+04	23.4	21.7	1.97E+01	23.1	21.9	3.12E+00	22.9	21.9
1.40E+01	1.26E+01	21.7	20.8	1.82E-01	4.9	7.2	1.87E+04	22	18.9	2.23E+04	21.9	18.8	2.56E+01	21.9	19.4	4.83E+00	21.2	18.9
2.00E+01	2.83E+01	20.1	18	1.34E+00	4.8	12.7	2.49E+04	19.2	15.2	2.67E+04	18.9	14.3	4.93E+01	19.8	16.5	8.84E+00	19.6	16.7
3.00E+01	7.38E+02	19.9	17.4	3.93E+01	19.3	18.7	2.16E+04	13	8.5	2.19E+04	12.4	7.9	1.50E+02	17.9	14.6	1.85E+01	17.6	14
5.00E+01	5.43E+03	14.7	11	2.33E+03	16.2	12.6	1.55E+04	6.9	4.1	1.54E+04	6.7	3.9	6.22E+02	14.4	10.9	3.45E+02	15.8	12.7
7.50E+01	9.89E+03	9	6.1	7.11E+03	10.4	7.3	1.21E+04	4.4	2.8	1.22E+04	4.4	2.8	1.49E+03	9.9	7	1.14E+03	10.6	7.7
1.00E+02	1.01E+04	5.9	4	8.97E+03	6.8	4.5	1.08E+04	3.4	2.5	1.09E+04	3.4	2.5	2.75E+03	8.1	5.8	2.49E+03	8.6	6.2
1.50E+02	9.82E+03	3.2	2.5	1.02E+04	3.9	3	1.05E+04	2.8	2.3	1.06E+04	2.7	2.3	6.49E+03	5.5	4.1	7.31E+03	5.7	4.2
2.00E+02	1.07E+04	2.8	2.5	1.12E+04	2.7	2.4	1.00E+04	2.1	1.9	1.04E+04	2.2	2	9.41E+03	3.6	2.9	1.05E+04	3.6	2.8
3.00E+02	9.03E+03	1.3	1.5	8.94E+03	1.4	1.5	8.80E+03	1.4	1.5	8.89E+03	1.4	1.5	9.05E+03	1.6	1.7	9.07E+03	1.5	1.6
5.00E+02	6.67E+03	1.3	1.5	6.86E+03	1.3	1.5	6.75E+03	1.3	1.4	6.80E+03	1.2	1.4	6.52E+03	1.4	1.6	6.67E+03	1.3	1.6
7.00E+02	6.25E+03	1.3	1.6	6.01E+03	1.3	1.6	6.12E+03	1.3	1.5	6.14E+03	1.3	1.5	6.08E+03	1.4	1.7	6.01E+03	1.4	1.7
1.00E+03	6.33E+03	1.4	1.7	5.60E+03	1.4	1.7	5.85E+03	1.4	1.6	5.86E+03	1.4	1.6	5.99E+03	1.5	1.9	6.04E+03	1.5	1.9
2.00E+03	6.36E+03	1.5	1.8	6.27E+03	1.5	1.8	6.00E+03	1.4	1.7	5.89E+03	1.4	1.7	6.56E+03	1.6	2	6.33E+03	1.6	2

Table A.7. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	6.48E+03	1.5	1.7	6.40E+03	1.5	1.8	6.21E+03	1.4	1.7	6.17E+03	1.4	1.7	6.87E+03	1.6	2	6.76E+03	1.6	2
5.00E+03	6.97E+03	1.5	1.8	6.33E+03	1.4	1.9	6.51E+03	1.4	1.7	6.46E+03	1.4	1.7	7.41E+03	1.6	2	7.28E+03	1.6	2
1.00E+04	7.99E+03	1.5	1.9	8.13E+03	1.5	1.9	7.46E+03	1.4	1.7	7.20E+03	1.4	1.7	8.76E+03	1.6	2.1	8.54E+03	1.6	2
2.00E+04	8.24E+03	1.4	1.7	8.36E+03	1.5	1.7	7.90E+03	1.4	1.7	7.55E+03	1.4	1.6	9.26E+03	1.5	1.9	8.62E+03	1.5	1.9
5.00E+04	1.03E+04	1.5	1.7	1.20E+04	1.5	1.7	1.06E+04	1.4	1.7	1.01E+04	1.4	1.7	1.34E+04	1.5	1.9	1.29E+04	1.5	1.9
1.00E+05	1.41E+04	1.3	1.7	1.16E+04	1.4	1.6	1.38E+04	1.3	1.7	1.33E+04	1.3	1.6	1.84E+04	1.4	1.8	1.74E+04	1.4	1.8

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.28E+02	23.2	21.9	3.92E+01	23	21.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	2.87E+02	22	19.3	5.97E+01	21.5	19.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.43E-01	4.7	9	2.36E-01	4.8	9.6	5.33E+02	19.9	16.4	9.76E+01	20.3	16.8	3.66E-01	7.7	8.9	3.33E-01	5.6	9.7
3.00E+01	1.06E+00	5.4	9.1	3.37E+00	5.4	9.2	1.35E+03	17.6	14.1	1.39E+02	18.4	13.5	2.08E+00	6.1	9.3	2.08E+00	5.6	9
5.00E+01	8.11E+00	7.3	12.1	9.46E+00	6.9	9.9	3.91E+03	13.6	10	1.98E+03	15.1	11.8	7.26E+00	5	9.2	5.38E+00	5.8	10.4
7.50E+01	3.25E+01	4.6	6.4	2.59E+01	4.6	7.4	6.98E+03	8.7	6	4.01E+03	9.6	6.6	4.22E+01	5.1	7.5	2.14E+01	4.3	7.1
1.00E+02	2.65E+02	9.6	7.5	1.23E+02	3.5	5.1	8.27E+03	6.4	4.4	4.76E+03	6.5	4.9	6.82E+02	9.5	8.1	1.22E+02	3.8	5.1
1.50E+02	5.13E+03	6.4	4.8	3.89E+03	7.1	5.4	1.19E+04	4.7	3.6	1.13E+04	5.4	4	3.79E+03	7.3	5.1	4.90E+03	7.5	5.5
2.00E+02	6.97E+03	3.7	2.9	1.06E+04	4.6	3.2	1.15E+04	2.5	2.2	1.21E+04	2.6	2.5	8.37E+03	3.8	3.3	1.07E+04	4.2	3.6
3.00E+02	8.85E+03	1.8	1.7	9.37E+03	1.7	1.7	9.23E+03	1.4	1.5	9.15E+03	1.4	1.5	9.36E+03	1.9	1.8	9.67E+03	1.5	1.7
5.00E+02	5.67E+03	1.3	1.7	6.84E+03	1.4	1.6	6.95E+03	1.3	1.5	6.97E+03	1.3	1.5	6.74E+03	1.4	1.7	6.81E+03	1.3	1.6
7.00E+02	5.82E+03	1.4	1.8	5.82E+03	1.4	1.7	6.06E+03	1.4	1.7	6.12E+03	1.3	1.7	6.13E+03	1.4	1.7	6.13E+03	1.5	1.8
1.00E+03	5.93E+03	1.5	2	6.25E+03	1.6	2	6.04E+03	1.5	1.7	6.15E+03	1.5	1.8	5.99E+03	1.5	2.1	6.25E+03	1.6	1.8
2.00E+03	6.56E+03	1.6	2.1	6.61E+03	1.6	2	6.27E+03	1.5	1.8	5.69E+03	1.5	1.9	6.78E+03	1.6	2.2	6.31E+03	1.6	2.1
3.00E+03	7.30E+03	1.7	2.2	6.98E+03	1.7	2	6.63E+03	1.5	1.8	6.46E+03	1.6	1.8	7.06E+03	1.7	2.2	6.80E+03	1.6	2.1
5.00E+03	7.60E+03	1.6	2.3	8.17E+03	1.5	2.1	6.89E+03	1.5	1.8	6.27E+03	1.7	1.8	7.87E+03	1.6	2.2	7.96E+03	1.7	2.1
1.00E+04	9.05E+03	1.6	2.1	9.37E+03	1.7	2	8.15E+03	1.6	1.9	8.14E+03	1.5	2	9.34E+03	1.7	2.2	9.23E+03	1.6	2
2.00E+04	9.67E+03	1.5	2	9.04E+03	1.6	1.9	8.01E+03	1.5	1.7	8.48E+03	1.6	1.7	1.01E+04	1.5	2	9.13E+03	1.6	1.9
5.00E+04	1.41E+04	1.5	1.8	1.26E+04	1.5	1.9	1.05E+04	1.4	1.8	1.12E+04	1.5	1.8	1.38E+04	1.6	2	1.39E+04	1.5	2
1.00E+05	2.32E+04	1.4	1.7	2.05E+04	1.4	1.8	1.44E+04	1.4	1.9	1.28E+04	1.5	1.8	1.64E+04	1.4	1.9	1.91E+04	1.4	1.8

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.41E+01	22.2	22.3	0.00E+00	1	1
1.40E+01	9.81E-02	6.9	9.8	0.00E+00	1	1	1.68E-01	6.8	9.8	9.50E-02	7	10.1	2.52E+01	22.1	20.3	1.27E-01	6.1	8.8
2.00E+01	6.56E-01	7.5	9.6	3.92E-01	7.1	9.6	6.39E-01	7.9	9.3	3.84E-01	7.9	9.8	6.53E+01	20.3	17.7	1.08E+00	9.8	12.5
3.00E+01	1.99E+00	7.2	9.1	1.69E+00	7.1	8.9	1.86E+00	7	9.1	1.62E+00	7.2	9.3	4.23E+02	19.2	16.2	9.73E+00	17.9	15.6
5.00E+01	7.99E+00	6	10.1	8.05E+00	6.1	8.3	6.75E+00	6.1	9.5	7.14E+00	5.9	9.5	1.78E+03	13.9	10.1	6.81E+02	17.9	14.5
7.50E+01	6.69E+01	7.8	8.7	1.41E+02	11.7	10.9	2.97E+01	4.5	6.2	3.58E+01	4.4	6.1	3.01E+03	9	6.2	2.55E+03	10.2	7.3
1.00E+02	1.38E+03	11.4	8.7	1.86E+03	10.9	8.1	2.78E+02	8.2	8	3.45E+02	9.1	8.3	3.69E+03	6.6	4.6	3.56E+03	7.1	5.1
1.50E+02	5.53E+03	6	4.5	7.69E+03	6.1	4.5	5.99E+03	6.8	4.9	6.80E+03	7.3	5.2	6.50E+03	4.8	3.7	7.45E+03	5.3	3.9
2.00E+02	1.01E+04	4	3.2	1.15E+04	3.7	2.9	8.33E+03	3.6	2.9	9.87E+03	3.7	2.9	9.45E+03	3.5	2.8	1.08E+04	3.3	2.7
3.00E+02	8.91E+03	1.5	1.6	8.65E+03	1.4	1.5	8.95E+03	1.7	1.8	9.05E+03	1.7	1.7	8.91E+03	1.6	1.7	8.98E+03	1.5	1.6
5.00E+02	6.65E+03	1.4	1.6	6.42E+03	1.4	1.6	6.38E+03	1.4	1.6	6.55E+03	1.4	1.6	6.55E+03	1.3	1.6	6.64E+03	1.4	1.5
7.00E+02	6.01E+03	1.5	1.7	6.05E+03	1.4	1.7	6.07E+03	1.5	1.8	5.87E+03	1.4	1.7	6.14E+03	1.4	1.7	6.09E+03	1.4	1.7
1.00E+03	6.09E+03	1.5	1.9	5.94E+03	1.5	1.9	5.95E+03	1.5	2	6.14E+03	1.5	1.9	6.05E+03	1.5	1.9	6.11E+03	1.6	1.9
2.00E+03	6.52E+03	1.6	2.1	6.41E+03	1.5	2	6.59E+03	1.6	2.1	6.53E+03	1.6	2.1	6.59E+03	1.6	2	6.44E+03	1.6	2
3.00E+03	6.77E+03	1.6	2.1	6.71E+03	1.6	2	6.99E+03	1.6	2.1	6.83E+03	1.6	2.1	6.83E+03	1.5	2	6.77E+03	1.5	1.9
5.00E+03	7.37E+03	1.6	2	7.28E+03	1.6	2	7.72E+03	1.7	2.1	7.44E+03	1.6	2	7.31E+03	1.6	2	7.18E+03	1.6	2
1.00E+04	8.53E+03	1.6	2	8.35E+03	1.5	2	9.15E+03	1.5	2.1	8.96E+03	1.6	2.1	8.79E+03	1.6	2	8.38E+03	1.5	2
2.00E+04	9.31E+03	1.5	1.9	8.30E+03	1.5	1.8	9.62E+03	1.5	1.9	8.70E+03	1.6	2	9.50E+03	1.5	1.9	8.74E+03	1.4	1.9
5.00E+04	1.39E+04	1.5	1.9	1.21E+04	1.5	1.8	1.45E+04	1.5	1.9	1.30E+04	1.5	1.8	1.36E+04	1.5	1.9	1.30E+04	1.5	1.7
1.00E+05	1.78E+04	1.4	1.9	1.68E+04	1.4	1.8	2.04E+04	1.3	1.8	2.05E+04	1.4	1.8	1.81E+04	1.3	1.8	1.71E+04	1.4	1.8

(continued on next page)

Table A.7. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.41E+01	23.1	21.9	1.18E+00	22.9	21.9	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.95E+01	21.9	19.4	1.93E+00	20.6	18.7	1.02E-01	5.6	9.1	9.12E-02	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.74E+01	19.7	16.5	4.61E+00	18.1	16.2	7.27E-01	6.6	9	7.21E+00	20.2	19.8	5.81E-01	6.8	9.7	1.07E+00	7.1	10.1
3.00E+01	1.60E+02	18.6	15.7	2.95E+01	18.8	16.8	3.67E+00	12.2	12.2	4.40E+01	18.7	15.5	1.68E+00	7.1	9.5	2.36E+00	7.1	9.2
5.00E+01	1.57E+03	15.6	12.1	5.70E+02	15.9	12.7	4.72E+02	17.4	14.7	1.01E+03	16.2	13	6.81E+00	6.7	10.6	6.12E+00	6.1	9.8
7.50E+01	4.87E+03	10.7	7.6	3.26E+03	11.9	8.7	1.51E+03	10.2	7.2	2.68E+03	9.9	6.8	1.73E+01	5.4	8.3	2.67E+01	4.2	6.5
1.00E+02	7.80E+03	7.5	5.2	6.61E+03	8.3	5.9	3.73E+03	9.6	7.2	5.27E+03	8.8	6.4	5.92E+01	3.7	5.6	1.51E+02	4.2	5.3
1.50E+02	9.83E+03	4.1	3.1	1.01E+04	4.5	3.4	1.24E+04	5.6	4	1.13E+04	4.7	3.3	1.41E+03	6.6	5.9	6.10E+03	7.5	5.4
2.00E+02	1.02E+04	2.7	2.3	1.07E+04	2.7	2.3	1.18E+04	2.8	2.4	1.10E+04	2.9	2.2	8.75E+03	5.4	4.1	9.76E+03	3.9	3
3.00E+02	8.76E+03	1.5	1.6	8.87E+03	1.5	1.6	9.09E+03	1.3	1.5	8.78E+03	1.4	1.5	9.03E+03	1.8	1.8	9.20E+03	1.7	1.7
5.00E+02	6.66E+03	1.3	1.5	6.67E+03	1.3	1.5	6.74E+03	1.3	1.5	6.82E+03	1.3	1.5	6.30E+03	1.4	1.6	6.47E+03	1.4	1.6
7.00E+02	6.12E+03	1.4	1.6	6.12E+03	1.4	1.6	5.68E+03	1.4	1.6	5.93E+03	1.3	1.7	5.98E+03	1.5	1.8	6.06E+03	1.5	1.8
1.00E+03	5.99E+03	1.5	1.8	6.04E+03	1.5	1.8	5.63E+03	1.5	1.8	5.78E+03	1.4	1.7	6.06E+03	1.6	2	6.05E+03	1.6	1.9
2.00E+03	6.37E+03	1.5	1.9	6.28E+03	1.5	1.9	6.43E+03	1.5	1.8	6.07E+03	1.5	1.9	6.71E+03	1.6	2.1	6.35E+03	1.6	2
3.00E+03	6.64E+03	1.5	1.9	6.65E+03	1.5	1.9	6.52E+03	1.5	1.8	6.13E+03	1.5	2	7.11E+03	1.7	2.1	7.02E+03	1.6	2.1
5.00E+03	7.03E+03	1.5	1.9	6.98E+03	1.5	1.9	7.42E+03	1.4	1.9	6.58E+03	1.5	1.9	7.89E+03	1.6	2.1	7.35E+03	1.6	2.1
1.00E+04	8.22E+03	1.5	1.9	8.06E+03	1.5	1.9	8.09E+03	1.6	1.9	7.69E+03	1.5	1.8	9.40E+03	1.6	2.1	8.94E+03	1.5	2
2.00E+04	8.75E+03	1.5	1.8	8.36E+03	1.5	1.8	8.24E+03	1.5	1.8	8.01E+03	1.4	1.7	9.89E+03	1.5	2	8.31E+03	1.4	1.8
5.00E+04	1.22E+04	1.4	1.8	1.19E+04	1.4	1.8	1.08E+04	1.4	1.9	1.16E+04	1.5	1.8	1.57E+04	1.5	1.9	1.42E+04	1.5	1.9
1.00E+05	1.63E+04	1.4	1.8	1.61E+04	1.4	1.8	1.47E+04	1.4	1.9	1.46E+04	1.4	1.7	1.82E+04	1.4	1.8	1.80E+04	1.4	1.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.10E-01	6.9	10.2	9.97E-02	7.4	9.6	1.15E-01	7.3	9.7	9.17E-02	6.2	10.1	1.20E-01	6.6	9.7
2.00E+01	3.54E-01	5.2	9.4	2.58E-01	6.9	9.8	5.22E-01	7.2	9.6	5.87E-01	7.2	9.6	4.11E-01	7.2	9.5	8.39E-01	6.4	9.9
3.00E+01	1.26E+00	7.2	9.3	1.73E+00	7.3	9.3	1.63E+00	7.8	9	1.98E+00	7	8.9	2.60E+00	6.9	9	2.06E+00	6.9	8.8
5.00E+01	6.17E+00	6.2	10.2	5.83E+00	6.8	10.3	7.54E+00	6.3	8.7	8.20E+00	5.4	8.7	8.54E+00	5.3	8.9	9.16E+00	5	7.9
7.50E+01	2.61E+01	5.2	7.9	2.19E+01	4.9	7.9	1.08E+02	11.4	10.3	6.57E+01	8.2	8.7	4.36E+01	5.1	6.7	7.99E+01	6	6.8
1.00E+02	8.54E+01	3.6	5.5	9.13E+01	4.3	5.7	1.26E+03	11.1	8.4	1.53E+03	11.2	8.6	1.15E+03	11.8	9.1	2.40E+03	11.4	8.5
1.50E+02	2.53E+03	8.7	7	3.41E+03	7.7	5.9	5.46E+03	6	4.4	6.28E+03	6	4.3	6.87E+03	6	4.3	8.35E+03	5.2	3.9
2.00E+02	8.66E+03	4.3	3.3	9.61E+03	4.4	3.3	8.65E+03	3.8	3	9.20E+03	3.8	3	9.14E+03	3.7	2.9	1.01E+04	3.4	2.6
3.00E+02	9.07E+03	1.8	1.8	9.07E+03	1.6	1.7	8.70E+03	1.7	1.8	8.94E+03	1.6	1.7	9.18E+03	1.7	1.7	8.85E+03	1.6	1.6
5.00E+02	6.61E+03	1.5	1.6	6.91E+03	1.3	1.7	6.61E+03	1.4	1.6	6.60E+03	1.4	1.6	6.45E+03	1.4	1.6	6.42E+03	1.3	1.5
7.00E+02	6.13E+03	1.5	1.8	6.26E+03	1.5	1.8	6.08E+03	1.5	1.8	5.92E+03	1.4	1.7	6.32E+03	1.5	1.8	6.10E+03	1.4	1.7
1.00E+03	5.83E+03	1.6	2	5.96E+03	1.5	2	6.07E+03	1.5	1.9	6.09E+03	1.5	1.9	6.02E+03	1.5	1.9	5.72E+03	1.5	1.9
2.00E+03	6.63E+03	1.6	2.1	6.57E+03	1.7	2.1	6.60E+03	1.6	2.1	6.51E+03	1.6	2	6.59E+03	1.6	2.1	6.36E+03	1.5	2
3.00E+03	6.74E+03	1.6	2.2	7.36E+03	1.6	2.1	7.03E+03	1.6	2.1	7.08E+03	1.6	2	7.13E+03	1.6	2.1	6.56E+03	1.5	2
5.00E+03	7.26E+03	1.6	2.2	7.64E+03	1.6	2.1	7.41E+03	1.6	2	7.65E+03	1.6	2.1	7.33E+03	1.6	2.1	7.33E+03	1.6	2
1.00E+04	9.58E+03	1.7	2.2	8.52E+03	1.7	2.1	9.10E+03	1.6	2.1	8.76E+03	1.6	2.1	8.92E+03	1.6	2.1	8.24E+03	1.6	2
2.00E+04	9.33E+03	1.6	2	9.41E+03	1.6	2	1.01E+04	1.5	1.9	9.08E+03	1.5	1.9	8.29E+03	1.5	1.9	8.51E+03	1.5	1.9
5.00E+04	1.54E+04	1.6	1.8	1.39E+04	1.6	2	1.44E+04	1.5	1.9	1.38E+04	1.5	1.9	1.40E+04	1.4	1.9	1.31E+04	1.6	1.9
1.00E+05	2.28E+04	1.5	1.8	1.96E+04	1.4	1.8	2.08E+04	1.4	1.9	1.81E+04	1.4	1.8	1.97E+04	1.4	1.8	1.75E+04	1.4	1.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.63E-02	5.8	8.7	0.00E+00	1	1	2.59E+00	5	6.7	2.59E+00	5	6.7
2.00E+01	4.92E-01	6.4	8.2	0.00E+00	1	1	5.38E+02	17.4	20.6	5.38E+02	17.4	20.6
3.00E+01	3.00E+00	5	8	1.65E+00	5.3	7.5	2.21E+04	19.1	14.8	2.21E+04	19.1	14.8
5.00E+01	3.01E+02	17.5	15.1	1.79E+02	16.7	14.4	1.69E+04	8.4	5	1.69E+04	8.4	5
7.50E+01	2.63E+03	12.7	9.2	1.87E+03	12.7	9.6	1.34E+04	5.2	3.3	1.34E+04	5.2	3.3
1.00E+02	7.05E+03	8.7	6.1	5.55E+03	8.9	6.1	1.25E+04	4.4	3.1	1.25E+04	4.4	3.1
1.50E+02	7.09E+03	3.5	2.8	7.40E+03	4.4	3.4	1.12E+04	2.7	2.1	1.12E+04	2.7	2.1

Table A.7. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	1.04E+04	3.9	3.2	1.03E+04	3.6	2.7	1.16E+04	2	2.3	1.16E+04	2	2.3
3.00E+02	9.56E+03	1.6	1.6	9.33E+03	1.5	1.5	8.86E+03	1.4	1.5	8.86E+03	1.4	1.5
5.00E+02	6.43E+03	1.3	1.6	6.54E+03	1.3	1.5	7.26E+03	1.2	1.5	7.26E+03	1.2	1.5
7.00E+02	6.52E+03	1.4	1.7	5.66E+03	1.3	1.7	6.05E+03	1.3	1.5	6.05E+03	1.3	1.5
1.00E+03	6.26E+03	1.6	1.9	6.01E+03	1.5	1.8	5.29E+03	1.4	1.5	5.29E+03	1.4	1.5
2.00E+03	6.69E+03	1.6	2	6.13E+03	1.5	1.9	6.16E+03	1.4	1.5	6.16E+03	1.4	1.5
3.00E+03	6.52E+03	1.6	1.9	6.50E+03	1.5	1.9	6.30E+03	1.4	1.6	6.30E+03	1.4	1.6
5.00E+03	7.20E+03	1.5	1.9	6.75E+03	1.5	1.9	6.57E+03	1.4	1.7	6.57E+03	1.4	1.7
1.00E+04	7.50E+03	1.5	2.1	8.39E+03	1.5	1.9	7.12E+03	1.4	1.7	7.12E+03	1.4	1.7
2.00E+04	9.53E+03	1.5	1.7	8.04E+03	1.5	1.8	7.38E+03	1.4	1.7	7.38E+03	1.4	1.7
5.00E+04	1.19E+04	1.4	1.8	1.32E+04	1.4	1.8	8.00E+03	1.3	1.7	8.00E+03	1.3	1.7
1.00E+05	1.62E+04	1.4	1.8	1.55E+04	1.5	1.7	1.28E+04	1.3	1.8	1.28E+04	1.3	1.8

Table A.8. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{11}B ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.39E+00	20.2	7.4	7.53E-01	20	7.4	2.76E+02	19.3	27.4	2.65E+02	19.5	27.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.51E+00	21.8	7.9	1.22E+00	20.8	7.5	6.45E+02	21.3	30.1	5.37E+02	21.4	30.5	1.07E-01	7.1	9.6	1.25E-01	7	9.5
2.00E+01	6.05E+00	21.3	7.9	2.46E+00	19.3	7.3	1.42E+03	22.1	31.9	1.18E+03	22.2	32.1	4.01E-01	7	9.5	5.41E-01	6.9	9.7
3.00E+01	1.64E+01	19.4	7.4	6.43E+00	16.5	6.4	6.49E+03	21.9	32	4.78E+03	21.9	32.2	1.65E+00	7.1	9.5	1.57E+00	6.8	9.3
5.00E+01	1.71E+02	18.9	7.2	1.99E+02	19.5	7.5	1.75E+04	17.6	26.6	1.15E+04	17.2	26.1	1.55E+01	12.5	18.3	9.07E+00	5.3	8.2
7.50E+01	1.75E+03	16.5	6.6	1.63E+03	16.1	6.5	2.35E+04	11.8	17.7	1.68E+04	12.5	18.5	1.65E+02	12.4	19	2.03E+02	14.9	21.6
1.00E+02	3.21E+03	11.8	4.9	3.19E+03	12.1	5	2.08E+04	7.6	10.9	1.73E+04	9	13	1.93E+03	15.1	22.3	2.09E+03	14.7	21.8
1.50E+02	6.92E+03	8.5	3.7	7.50E+03	8.5	3.7	1.57E+04	3.9	5.3	1.48E+04	4.7	6.5	8.48E+03	9.1	13	8.99E+03	9.1	13.1
2.00E+02	1.16E+04	6.2	2.9	1.24E+04	6.5	3	1.24E+04	2.5	3.3	1.36E+04	3.3	4.7	1.14E+04	5.8	8.1	1.15E+04	5.7	8
3.00E+02	1.35E+04	3	1.8	1.39E+04	2.7	1.7	1.38E+04	2.7	3.9	1.51E+04	2.6	3.9	1.33E+04	3.1	4.3	1.35E+04	3.2	4.4
5.00E+02	9.75E+03	1.3	1.2	9.84E+03	1.3	1.2	1.11E+04	1.2	1.8	1.04E+04	1.2	1.8	9.86E+03	1.4	1.9	9.85E+03	1.3	1.8
7.00E+02	8.61E+03	1.3	1.2	8.71E+03	1.3	1.2	9.53E+03	1.2	1.7	9.25E+03	1.3	1.7	8.65E+03	1.3	1.8	8.74E+03	1.3	1.8
1.00E+03	8.32E+03	1.4	1.2	8.35E+03	1.4	1.2	8.45E+03	1.3	1.7	8.74E+03	1.3	1.7	8.28E+03	1.4	1.9	8.22E+03	1.4	1.8
2.00E+03	8.65E+03	1.5	1.2	8.66E+03	1.5	1.2	8.96E+03	1.3	1.8	8.59E+03	1.3	1.7	8.81E+03	1.5	2	8.70E+03	1.5	1.9
3.00E+03	9.01E+03	1.5	1.2	8.95E+03	1.5	1.2	8.80E+03	1.4	1.7	8.79E+03	1.3	1.7	9.29E+03	1.5	1.9	9.05E+03	1.5	1.9
5.00E+03	9.73E+03	1.5	1.2	9.49E+03	1.5	1.2	9.88E+03	1.3	1.7	9.39E+03	1.4	1.7	1.02E+04	1.5	2	9.37E+03	1.5	2
1.00E+04	1.12E+04	1.5	1.2	1.10E+04	1.5	1.2	1.07E+04	1.3	1.7	1.01E+04	1.4	1.7	1.13E+04	1.5	2	1.14E+04	1.5	2
2.00E+04	1.25E+04	1.5	1.2	1.17E+04	1.4	1.2	1.15E+04	1.3	1.7	1.07E+04	1.3	1.7	1.24E+04	1.5	1.8	1.25E+04	1.4	1.8
5.00E+04	1.67E+04	1.4	1.2	1.59E+04	1.4	1.2	1.42E+04	1.4	1.7	1.47E+04	1.4	1.7	1.72E+04	1.4	1.8	1.72E+04	1.4	1.8
1.00E+05	2.38E+04	1.4	1.2	2.17E+04	1.4	1.2	1.85E+04	1.4	1.7	2.00E+04	1.3	1.7	2.45E+04	1.4	1.8	2.36E+04	1.4	1.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.69E+02	20.3	29.4	0.00E+00	1	1
1.40E+01	1.04E-01	7.5	9.8	1.11E-01	7.3	9.9	9.36E-02	6.6	9.9	1.43E-01	7.5	9.4	3.68E+02	22.4	32	0.00E+00	1	1
2.00E+01	5.08E-01	7.6	9.5	4.85E-01	7.7	9.7	3.08E-01	7.6	9.7	6.21E-01	7	9.8	6.56E+02	22.7	32.7	2.77E-01	5.4	10.4
3.00E+01	1.77E+00	6.8	8.8	1.77E+00	7.1	9.4	1.12E+00	6.8	9.4	1.61E+00	6.4	8.5	1.38E+03	21.2	31.2	1.72E+00	5.4	8.9
5.00E+01	8.26E+00	5.8	8.7	8.43E+00	5.5	8.5	7.09E+00	5.5	9.2	8.13E+00	5.9	8	3.98E+03	17.6	26.4	5.26E+00	6.2	9.9
7.50E+01	1.17E+02	12.1	16.9	9.37E+01	9	13.1	4.32E+01	4.3	6.1	1.39E+02	12.2	15.5	8.10E+03	13.5	20.2	1.38E+01	4.7	7.9
1.00E+02	1.37E+03	14.3	21.2	1.51E+03	14.3	21.3	7.34E+02	15	22.5	2.83E+03	15.8	23.5	1.09E+04	10.8	15.4	3.78E+01	3.4	5.2
1.50E+02	9.11E+03	10.2	14.8	1.23E+04	10.2	14.8	6.24E+03	9.5	13.7	8.50E+03	8.9	12.9	1.06E+04	5.3	7.3	8.31E+02	2.8	3.7
2.00E+02	1.46E+04	6.2	8.8	1.54E+04	5.7	7.9	1.06E+04	6.4	9	1.23E+04	6	8.3	9.44E+03	3.7	5.4	1.12E+04	9.1	13.9
3.00E+02	1.40E+04	2.5	3.7	1.42E+04	2.3	3.5	1.37E+04	3.4	4.7	1.31E+04	2.8	4	1.33E+04	3.1	4.5	1.47E+04	2.9	4.6
5.00E+02	9.79E+03	1.3	1.8	1.01E+04	1.3	1.8	9.73E+03	1.3	1.9	1.02E+04	1.3	1.8	1.04E+04	1.3	1.8	9.73E+03	1.3	1.9
7.00E+02	8.83E+03	1.3	1.7	8.93E+03	1.3	1.7	8.90E+03	1.3	1.8	8.67E+03	1.3	1.7	8.85E+03	1.3	1.8	8.79E+03	1.4	1.8
1.00E+03	8.29E+03	1.4	1.8	8.45E+03	1.4	1.8	8.18E+03	1.4	1.9	8.37E+03	1.4	1.9	7.88E+03	1.4	1.8	8.41E+03	1.4	2
2.00E+03	8.63E+03	1.5	1.9	8.53E+03	1.4	1.9	8.85E+03	1.5	2	8.40E+03	1.5	1.9	8.84E+03	1.4	1.9	8.58E+03	1.5	2
3.00E+03	9.07E+03	1.5	1.9	8.83E+03	1.4	1.8	9.32E+03	1.5	2	9.14E+03	1.5	1.9	8.94E+03	1.5	1.9	8.99E+03	1.6	2.1
5.00E+03	9.70E+03	1.5	1.9	9.44E+03	1.4	1.8	9.90E+03	1.5	2	9.63E+03	1.5	1.9	8.73E+03	1.5	1.8	1.01E+04	1.7	2
1.00E+04	1.12E+04	1.5	1.9	1.08E+04	1.4	1.9	1.15E+04	1.5	2	1.06E+04	1.5	1.9	1.10E+04	1.5	2	1.17E+04	1.6	1.8
2.00E+04	1.23E+04	1.4	1.7	1.15E+04	1.4	1.7	1.20E+04	1.5	1.8	1.11E+04	1.5	1.8	1.10E+04	1.4	1.8	1.18E+04	1.6	1.8
5.00E+04	1.63E+04	1.4	1.7	1.52E+04	1.4	1.8	1.63E+04	1.5	1.8	1.58E+04	1.4	1.8	1.59E+04	1.4	1.9	1.66E+04	1.5	1.7
1.00E+05	2.17E+04	1.4	1.7	1.99E+04	1.3	1.7	2.61E+04	1.4	1.8	2.37E+04	1.4	1.7	2.23E+04	1.4	1.9	2.36E+04	1.4	1.8

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.65E-02	7.5	9.8	1.17E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	4.87E-01	7.5	9.6	5.06E-01	7.1	9.5	2.76E-01	6.2	9.3	4.46E-01	6.2	9.7	6.22E-01	5.2	7.6	7.58E-01	4.4	7.9
3.00E+01	1.52E+00	6.9	8.8	1.52E+00	6.8	8.7	8.09E-01	6.1	9.1	1.15E+00	7	9	1.96E+00	4.2	6.4	1.77E+00	3.8	6.1
5.00E+01	6.82E+00	5.7	9.2	8.61E+00	5.4	8.5	5.36E+00	6.2	16.9	4.67E+00	6	10.3	3.48E+01	10.7	17.6	3.76E+01	6.2	13.4

Table A.8. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	8.12E+01	11.2	16	1.53E+02	13.3	19.4	1.20E+02	14.5	21.1	9.04E+01	13.2	16.9	3.55E+03	17.8	27	5.53E+03	17.7	26.9
1.00E+02	1.16E+03	14.5	21.6	1.93E+03	14.8	22.1	8.55E+02	14.2	20.8	1.03E+03	12.8	20.3	9.87E+03	13.3	19.6	1.17E+04	12.5	18.3
1.50E+02	6.16E+03	9.5	13.7	8.32E+03	9.3	13.3	4.17E+03	7.9	11.2	4.92E+03	8.8	12.2	1.14E+04	6.2	8.4	9.98E+03	5.7	7.7
2.00E+02	1.01E+04	6.6	9.2	1.26E+04	6.2	8.7	8.61E+03	8	11.7	1.22E+04	8.2	11.2	1.29E+04	5.5	7.4	1.23E+04	5.5	8.4
3.00E+02	1.36E+04	3.2	4.7	1.36E+04	2.9	4.1	1.46E+04	3.1	4.3	1.38E+04	2.6	3.7	1.44E+04	2.8	4.4	1.48E+04	3.1	4
5.00E+02	9.75E+03	1.3	1.9	1.00E+04	1.3	1.8	9.69E+03	1.3	1.9	1.06E+04	1.2	1.9	1.01E+04	1.3	1.7	9.65E+03	1.2	1.7
7.00E+02	8.60E+03	1.3	1.8	8.71E+03	1.3	1.8	8.83E+03	1.3	1.8	8.73E+03	1.4	1.8	9.05E+03	1.2	1.7	9.49E+03	1.4	1.8
1.00E+03	8.27E+03	1.4	1.9	8.40E+03	1.4	1.8	8.64E+03	1.4	2	8.20E+03	1.5	1.8	8.40E+03	1.3	1.9	8.66E+03	1.4	1.7
2.00E+03	8.69E+03	1.5	2	8.68E+03	1.5	1.9	8.98E+03	1.4	2	8.50E+03	1.5	1.9	7.92E+03	1.4	1.9	8.77E+03	1.4	1.7
3.00E+03	9.07E+03	1.5	2	8.97E+03	1.5	1.9	9.08E+03	1.5	1.9	9.32E+03	1.4	2	8.76E+03	1.4	1.8	8.59E+03	1.4	1.8
5.00E+03	9.50E+03	1.5	2	9.45E+03	1.4	1.9	1.01E+04	1.5	2	9.79E+03	1.4	1.9	8.39E+03	1.5	1.8	1.03E+04	1.4	1.9
1.00E+04	1.10E+04	1.5	2	1.12E+04	1.5	1.9	1.09E+04	1.6	1.9	1.06E+04	1.5	2	1.15E+04	1.4	1.8	1.02E+04	1.4	1.8
2.00E+04	1.21E+04	1.5	1.8	1.18E+04	1.4	1.8	1.21E+04	1.5	1.8	1.12E+04	1.4	1.8	1.04E+04	1.4	1.8	1.13E+04	1.4	1.6
5.00E+04	1.68E+04	1.4	1.8	1.59E+04	1.4	1.8	1.55E+04	1.4	1.8	1.52E+04	1.5	1.8	1.49E+04	1.5	1.8	1.35E+04	1.4	1.6
1.00E+05	2.46E+04	1.4	1.8	2.22E+04	1.4	1.8	2.45E+04	1.4	1.8	2.05E+04	1.3	1.7	2.11E+04	1.3	1.8	2.09E+04	1.3	1.7

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	7.45E+00	20.2	29.4	1.60E+00	20	29.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.65E-02	4.2	8.8	1.13E+01	22.1	31.7	2.59E+00	21.5	30.8	1.20E-01	7.2	10	1.29E-01	7.2	9.6
2.00E+01	3.89E-01	6.4	9.3	5.59E-01	4.9	7.6	1.96E+01	22	32	5.03E+00	20.5	29.8	5.00E-01	7.3	9.3	5.05E-01	6.8	9.8
3.00E+01	1.00E+00	6.6	8.8	1.93E+00	5	6.8	4.69E+01	20.1	29.6	9.18E+00	17.6	25.9	1.89E+00	6.2	8	2.60E+00	5.7	9.1
5.00E+01	4.74E+00	6.4	10.1	9.91E+01	16.2	25.4	4.93E+02	19.4	28.6	4.38E+02	19.8	29.2	1.35E+01	5.2	7.9	1.73E+01	4.4	6.5
7.50E+01	2.11E+01	4	6.3	3.64E+03	16.6	24.8	4.01E+03	16.2	24.4	3.60E+03	16.1	24.1	5.55E+02	16.8	24.7	1.13E+03	18	26.6
1.00E+02	2.64E+02	10.5	13.9	5.52E+03	11.3	16.5	7.25E+03	12.1	17.9	7.39E+03	12.3	18.1	4.56E+03	14.6	21.8	6.37E+03	14.2	21.1
1.50E+02	4.77E+03	9.6	13.8	7.55E+03	7.5	10.7	1.34E+04	7.8	11.1	1.34E+04	7.9	11.3	1.40E+04	9.1	13	1.60E+04	8.7	12.5
2.00E+02	8.30E+03	6.8	10.1	9.31E+03	4.7	6.5	1.53E+04	5.1	7.1	1.58E+04	5.3	7.4	1.96E+04	6	8.4	2.04E+04	5.7	7.9
3.00E+02	1.37E+04	3.4	5	1.40E+04	3.2	5	1.37E+04	2.2	3.3	1.38E+04	2.2	3.3	1.44E+04	1.7	2.5	1.41E+04	1.6	2.4
5.00E+02	9.84E+03	1.3	1.8	9.80E+03	1.2	1.9	9.99E+03	1.3	1.8	1.00E+04	1.3	1.8	1.02E+04	1.2	1.7	1.03E+04	1.2	1.7
7.00E+02	8.51E+03	1.4	1.8	8.51E+03	1.3	1.8	8.89E+03	1.3	1.7	8.94E+03	1.3	1.7	8.94E+03	1.3	1.7	9.29E+03	1.2	1.7
1.00E+03	8.71E+03	1.5	1.9	8.20E+03	1.5	1.9	8.43E+03	1.4	1.8	8.46E+03	1.4	1.8	8.46E+03	1.3	1.7	8.60E+03	1.3	1.7
2.00E+03	8.71E+03	1.5	2	9.20E+03	1.5	2	8.52E+03	1.4	1.8	8.51E+03	1.4	1.8	8.26E+03	1.4	1.8	8.52E+03	1.3	1.7
3.00E+03	9.11E+03	1.5	2	9.16E+03	1.5	2	8.85E+03	1.4	1.8	8.81E+03	1.4	1.8	8.98E+03	1.4	1.8	8.68E+03	1.4	1.7
5.00E+03	1.00E+04	1.6	1.9	9.84E+03	1.5	1.9	9.35E+03	1.4	1.8	9.28E+03	1.4	1.8	9.26E+03	1.4	1.7	9.35E+03	1.4	1.7
1.00E+04	1.09E+04	1.4	2.1	1.10E+04	1.6	1.9	1.05E+04	1.4	1.8	1.05E+04	1.4	1.8	1.03E+04	1.4	1.8	1.03E+04	1.4	1.7
2.00E+04	1.23E+04	1.4	1.8	1.22E+04	1.5	1.8	1.15E+04	1.4	1.7	1.12E+04	1.4	1.7	1.15E+04	1.4	1.7	1.10E+04	1.3	1.6
5.00E+04	1.93E+04	1.4	1.8	1.73E+04	1.4	1.8	1.49E+04	1.4	1.8	1.47E+04	1.4	1.7	1.36E+04	1.4	1.7	1.34E+04	1.3	1.7
1.00E+05	2.52E+04	1.4	1.8	2.40E+04	1.4	1.8	2.06E+04	1.3	1.7	1.92E+04	1.3	1.7	1.89E+04	1.3	1.7	1.71E+04	1.3	1.7

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.75E+03	11.8	8.8	2.12E+03	11.8	8.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.50E+03	13	12.3	4.24E+03	13	12.3	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.23E+03	14.3	15.4	6.36E+03	14.3	15.4	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.68E+03	16.4	21.1	1.05E+04	16.4	21.1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.49E+00	18.3	26.5	0.00E+00	1	1	1.70E+04	20.6	30	2.05E+04	20.6	30.1	2.21E+01	20.3	29.4	3.38E+00	20	29.5
1.40E+01	1.17E+01	19.8	29.6	1.84E-01	4.9	7.2	2.33E+04	22.9	32.9	2.78E+04	23	32.9	3.11E+01	22.4	32.1	5.30E+00	22	31.4
2.00E+01	2.86E+01	20.5	30.4	5.00E-01	4.8	8	3.16E+04	22.8	33.4	3.72E+04	22.8	33.5	5.57E+01	22.4	32.6	9.20E+00	21.5	31.4
3.00E+01	5.13E+02	21.9	31.4	1.50E+01	12.6	21.2	3.23E+04	19.3	29.8	3.33E+04	18.8	29.1	1.50E+02	21.1	31.1	1.89E+01	19.5	29.5
5.00E+01	4.88E+03	19.4	29.1	1.81E+03	20.6	30.1	2.38E+04	11.6	17.6	2.37E+04	11.2	16.9	5.80E+02	18.3	27.6	2.48E+02	19.2	28.4
7.50E+01	1.20E+04	14.3	21.3	7.90E+03	15.5	23.1	1.83E+04	7.6	10.6	1.82E+04	7.4	10.4	1.70E+03	14.2	21.3	1.13E+03	15.1	22.8
1.00E+02	1.43E+04	9.9	14.4	1.19E+04	11.4	16.4	1.59E+04	5.9	8	1.60E+04	5.8	8	2.75E+03	11.5	16.8	2.41E+03	12.4	18.3
1.50E+02	1.39E+04	5.6	7.9	1.40E+04	6.6	9.2	1.47E+04	4.5	6.2	1.49E+04	4.5	6.3	6.94E+03	8.6	12.4	7.27E+03	9.2	13.3
2.00E+02	1.43E+04	4.6	6	1.53E+04	5.1	7.2	1.46E+04	3.5	5	1.48E+04	3.5	5	1.16E+04	6.4	9	1.30E+04	6.6	9.3
3.00E+02	1.43E+04	2.2	3.2	1.39E+04	1.9	2.9	1.34E+04	2	3.1	1.36E+04	2	3.1	1.40E+04	3	4.2	1.39E+04	2.8	3.9
5.00E+02	9.73E+03	1.2	1.8	1.05E+04	1.2	1.7	1.03E+04	1.2	1.7	1.03E+04	1.2	1.7	9.98E+03	1.3	1.9	9.87E+03	1.3	1.8
7.00E+02	9.30E+03	1.2	1.7	9.11E+03	1.2	1.7	9.04E+03	1.2	1.6	9.10E+03	1.2	1.6	8.70E+03	1.3	1.8	8.78E+03	1.3	1.8
1.00E+03	8.96E+03	1.3	1.7	8.30E+03	1.3	1.7	8.51E+03	1.3	1.6	8.50E+03	1.3	1.6	8.31E+03	1.4	1.9	8.36E+03	1.4	1.8
2.00E+03	8.19E+03	1.4	1.8	8.75E+03	1.4	1.8	8.42E+03	1.3	1.7	8.43E+03	1.3	1.6	8.67E+03	1.5	1.9	8.77E+03	1.5	1.9
3.00E+03	8.92E+03	1.4	1.7	8.84E+03	1.4	1.8	8.63E+03	1.3	1.6	8.59E+03	1.3	1.6	9.10E+03	1.5	1.9	8.91E+03	1.5	1.9

(continued on next page)

Table A.8. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	9.53E+03	1.4	1.8	8.89E+03	1.4	1.7	9.15E+03	1.3	1.6	8.94E+03	1.3	1.6	9.76E+03	1.5	1.9	9.37E+03	1.5	1.9
1.00E+04	1.01E+04	1.4	1.8	1.02E+04	1.4	1.8	1.01E+04	1.3	1.7	9.87E+03	1.3	1.6	1.12E+04	1.5	1.9	1.08E+04	1.5	1.9
2.00E+04	1.07E+04	1.4	1.6	1.08E+04	1.4	1.7	1.10E+04	1.3	1.6	1.07E+04	1.3	1.5	1.22E+04	1.5	1.8	1.14E+04	1.5	1.8
5.00E+04	1.52E+04	1.3	1.7	1.37E+04	1.3	1.8	1.38E+04	1.3	1.6	1.35E+04	1.3	1.6	1.63E+04	1.4	1.8	1.60E+04	1.4	1.8
1.00E+05	1.71E+04	1.3	1.7	2.01E+04	1.3	1.7	1.83E+04	1.3	1.6	1.75E+04	1.3	1.7	2.34E+04	1.4	1.8	2.25E+04	1.4	1.8

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.54E+02	20.3	29.4	4.24E+01	20.1	29.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	3.52E+02	22.6	32.2	6.56E+01	22.3	32	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.48E-01	4.7	9	2.51E-01	4.8	9.6	6.27E+02	22.5	32.9	1.07E+02	22.4	32.5	3.74E-01	7.7	8.9	3.36E-01	5.6	9.7
3.00E+01	1.07E+00	5.4	9.1	1.09E+00	5.4	9.2	1.43E+03	21.2	31.2	1.73E+02	20.7	31	1.50E+00	6.1	9.3	1.52E+00	5.6	9
5.00E+01	7.04E+00	6.7	11.5	3.32E+00	6.9	9.9	4.08E+03	18	27.2	1.86E+03	19.5	28.6	5.86E+00	5	9.2	4.67E+00	5.8	10.4
7.50E+01	2.76E+01	4.1	7	1.43E+01	4.6	7.4	9.39E+03	13.2	19.8	4.75E+03	14.3	21.8	2.53E+01	4.7	7.4	1.77E+01	4.3	7.1
1.00E+02	1.39E+02	3.5	4.9	6.14E+01	3.5	5.1	9.93E+03	9.8	14.5	5.85E+03	10.3	14.6	3.72E+02	15.7	20.4	7.83E+01	3.8	5.1
1.50E+02	4.90E+03	12.2	17.5	2.71E+03	10.4	16	1.35E+04	6.9	9.7	1.19E+04	9.3	13.4	3.33E+03	8.9	13.3	2.64E+03	10.9	16.1
2.00E+02	8.63E+03	6.3	9	1.16E+04	8.5	12.1	1.84E+04	5.5	7.6	2.05E+04	5.6	7.1	9.41E+03	7.6	10.8	1.24E+04	8.1	11.8
3.00E+02	1.36E+04	4.2	5	1.43E+04	3.1	4.2	1.40E+04	2	2.8	1.38E+04	2.1	3.1	1.39E+04	3.3	4.9	1.29E+04	3.1	4.1
5.00E+02	1.04E+04	1.3	2	9.75E+03	1.3	1.8	9.79E+03	1.2	1.7	9.94E+03	1.3	1.7	9.84E+03	1.4	2	9.73E+03	1.3	1.8
7.00E+02	8.15E+03	1.4	1.8	9.12E+03	1.4	1.9	9.54E+03	1.2	1.7	9.36E+03	1.3	1.7	8.60E+03	1.3	1.9	8.75E+03	1.3	1.7
1.00E+03	8.59E+03	1.4	1.9	8.00E+03	1.5	1.9	8.82E+03	1.3	1.7	8.36E+03	1.4	1.7	8.24E+03	1.4	1.9	8.15E+03	1.4	1.8
2.00E+03	8.79E+03	1.6	2	8.82E+03	1.6	2	8.58E+03	1.4	1.7	8.71E+03	1.4	1.7	8.75E+03	1.5	2	8.57E+03	1.5	2
3.00E+03	9.06E+03	1.4	2	8.32E+03	1.6	1.9	8.65E+03	1.4	1.7	8.69E+03	1.5	1.8	8.94E+03	1.5	2	9.14E+03	1.5	2.1
5.00E+03	1.06E+04	1.6	2	9.47E+03	1.5	2.1	8.72E+03	1.5	1.7	8.69E+03	1.5	1.8	1.03E+04	1.4	2.1	9.87E+03	1.5	2.1
1.00E+04	1.15E+04	1.5	1.9	1.12E+04	1.5	2	1.07E+04	1.4	1.8	9.75E+03	1.5	1.8	1.13E+04	1.5	2	1.11E+04	1.6	2
2.00E+04	1.11E+04	1.5	1.9	1.10E+04	1.5	1.9	1.03E+04	1.5	1.6	1.04E+04	1.4	1.6	1.26E+04	1.5	1.9	1.19E+04	1.7	1.9
5.00E+04	1.81E+04	1.5	1.9	1.65E+04	1.4	1.8	1.45E+04	1.4	1.8	1.44E+04	1.5	1.7	1.69E+04	1.4	1.9	1.68E+04	1.4	2
1.00E+05	2.63E+04	1.4	1.8	2.34E+04	1.4	1.8	2.10E+04	1.3	1.6	1.80E+04	1.4	1.6	2.23E+04	1.4	1.8	2.50E+04	1.5	1.8

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.57E+01	19.3	27.9	0.00E+00	1	1
1.40E+01	9.95E-02	6.9	9.8	0.00E+00	1	1	9.56E-02	6.8	9.8	9.60E-02	7	10.1	2.75E+01	21.3	30.7	1.30E-01	6.1	8.8
2.00E+01	4.90E-01	7.5	9.6	3.96E-01	7.1	9.6	4.21E-01	7.9	9.3	3.90E-01	7.9	9.8	4.94E+01	21.6	31.7	4.10E-01	5	11.8
3.00E+01	1.73E+00	7.2	9.1	1.59E+00	7.1	8.9	1.69E+00	7	9.1	1.32E+00	7.2	9.3	3.70E+02	21.8	31.7	3.51E+00	9.7	24.1
5.00E+01	6.66E+00	6.1	9.8	7.08E+00	5.9	8.3	6.19E+00	6.1	9.5	6.27E+00	5.9	9.5	1.87E+03	18.5	28.1	2.97E+02	19.5	28.8
7.50E+01	3.67E+01	4.7	6.4	5.48E+01	5.1	7.1	2.53E+01	4.4	6.2	2.84E+01	4.2	6.1	3.79E+03	13.7	20.5	3.07E+03	16	24
1.00E+02	6.06E+02	14.3	21.1	9.91E+02	14.6	21.6	1.34E+02	3.9	4.9	1.45E+02	4	5.2	4.59E+03	10	14.4	4.23E+03	10.7	16.3
1.50E+02	5.51E+03	9.5	13.7	7.56E+03	9.9	14.4	4.97E+03	11.4	16.7	5.23E+03	11.4	16.8	7.44E+03	7.4	10.7	7.70E+03	8.2	11.9
2.00E+02	1.02E+04	7.1	10	1.25E+04	6.8	9.6	1.04E+04	6.6	9.4	1.23E+04	7.1	9.8	1.07E+04	6	8.7	1.20E+04	6.5	9
3.00E+02	1.44E+04	3.1	4.5	1.40E+04	2.6	3.9	1.32E+04	3.4	4.8	1.35E+04	3	4.3	1.39E+04	3	4.2	1.40E+04	2.7	3.9
5.00E+02	9.79E+03	1.3	1.9	9.77E+03	1.3	1.8	9.81E+03	1.3	1.9	9.79E+03	1.3	1.8	9.97E+03	1.3	1.8	9.90E+03	1.3	1.8
7.00E+02	9.07E+03	1.3	1.8	8.66E+03	1.3	1.7	8.78E+03	1.3	1.8	8.66E+03	1.4	1.8	8.79E+03	1.3	1.8	8.69E+03	1.3	1.8
1.00E+03	8.27E+03	1.4	1.9	8.43E+03	1.4	1.8	8.21E+03	1.4	1.9	8.14E+03	1.5	1.9	8.38E+03	1.4	1.9	8.44E+03	1.4	1.8
2.00E+03	8.64E+03	1.5	2	8.81E+03	1.5	1.9	8.71E+03	1.5	2	8.66E+03	1.5	2	8.67E+03	1.4	1.9	8.54E+03	1.5	1.9
3.00E+03	9.32E+03	1.5	2	9.06E+03	1.4	1.9	9.09E+03	1.5	2	8.82E+03	1.5	2	9.14E+03	1.5	1.9	8.98E+03	1.5	1.9
5.00E+03	9.80E+03	1.5	1.9	9.50E+03	1.5	1.9	9.73E+03	1.5	2	9.11E+03	1.5	1.9	9.84E+03	1.5	1.9	9.52E+03	1.5	1.9
1.00E+04	1.12E+04	1.5	1.9	1.04E+04	1.4	1.9	1.14E+04	1.5	2	1.12E+04	1.5	2	1.13E+04	1.5	2	1.11E+04	1.5	2
2.00E+04	1.18E+04	1.5	1.8	1.10E+04	1.4	1.8	1.28E+04	1.5	1.8	1.23E+04	1.4	1.8	1.24E+04	1.5	1.7	1.16E+04	1.4	1.7
5.00E+04	1.67E+04	1.5	1.9	1.58E+04	1.4	1.8	1.68E+04	1.4	1.9	1.64E+04	1.4	1.8	1.68E+04	1.4	1.8	1.61E+04	1.4	1.8
1.00E+05	2.39E+04	1.4	1.8	1.98E+04	1.3	1.8	2.51E+04	1.4	1.8	2.33E+04	1.4	1.8	2.38E+04	1.3	1.7	2.19E+04	1.4	1.7

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

Table A.8. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.68E+01	20.3	29.4	1.34E+00	20.2	29.2	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.36E+01	22.3	31.9	2.19E+00	21.2	30.2	1.03E-01	5.6	9.1	9.63E-02	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.29E+01	22.2	32.3	4.14E+00	19.9	28.9	6.65E-01	6.6	9	4.63E+00	16.1	28.3	5.20E-01	6.8	9.7	2.89E-01	7.1	10.1
3.00E+01	1.34E+02	20.9	30.7	1.77E+01	18.7	27	2.17E+00	6	10.7	3.82E+01	19.7	30.5	1.33E+00	7.1	9.5	1.49E+00	7.1	9.2
5.00E+01	1.25E+03	19.4	29	4.14E+02	19.4	28.9	1.79E+02	20.5	29	5.51E+02	19.4	29.4	4.91E+00	6.7	10.6	5.12E+00	6.1	9.8
7.50E+01	5.06E+03	15.3	23	2.76E+03	16.3	24.3	1.67E+03	15.4	22.5	2.51E+03	14.7	22	1.56E+01	5.4	8.3	2.45E+01	4.2	6.5
1.00E+02	8.30E+03	11.8	17.4	6.42E+03	12.9	19.1	3.54E+03	12.1	17.8	5.29E+03	12.6	18.9	4.67E+01	3.8	5.6	1.09E+02	3.5	4.8
1.50E+02	1.31E+04	7.3	10.3	1.30E+04	7.9	11.3	1.35E+04	9.8	14.5	1.31E+04	8.8	13.1	6.11E+02	3.1	3.9	4.08E+03	11.9	17.3
2.00E+02	1.44E+04	4.9	6.9	1.50E+04	5.2	7.3	1.82E+04	5.5	7.4	1.59E+04	5.2	7.2	6.83E+03	9.2	13.6	1.18E+04	7.4	10.5
3.00E+02	1.34E+04	2.4	3.5	1.37E+04	2.3	3.4	1.44E+04	2.3	3	1.47E+04	2.2	3.3	1.39E+04	3.5	4.7	1.34E+04	3	4.1
5.00E+02	9.99E+03	1.3	1.8	1.01E+04	1.3	1.8	1.03E+04	1.3	1.8	1.06E+04	1.2	1.7	9.72E+03	1.4	2	9.65E+03	1.3	1.8
7.00E+02	8.90E+03	1.3	1.7	8.89E+03	1.3	1.7	9.38E+03	1.3	1.7	8.86E+03	1.3	1.7	8.33E+03	1.4	1.8	8.66E+03	1.4	1.8
1.00E+03	8.44E+03	1.4	1.8	8.39E+03	1.4	1.8	8.08E+03	1.3	1.8	8.94E+03	1.3	1.7	8.29E+03	1.5	2	8.41E+03	1.4	1.9
2.00E+03	8.56E+03	1.4	1.8	8.60E+03	1.4	1.8	8.40E+03	1.4	1.8	8.87E+03	1.3	1.8	8.73E+03	1.6	2.1	8.68E+03	1.5	2
3.00E+03	8.92E+03	1.4	1.8	8.88E+03	1.4	1.8	9.54E+03	1.4	1.9	9.13E+03	1.5	1.7	9.37E+03	1.6	2.1	9.35E+03	1.5	2
5.00E+03	9.54E+03	1.4	1.8	9.32E+03	1.4	1.8	1.04E+04	1.4	1.8	8.31E+03	1.4	1.8	9.88E+03	1.5	2	9.72E+03	1.5	1.9
1.00E+04	1.08E+04	1.4	1.9	1.06E+04	1.4	1.8	1.06E+04	1.4	1.8	9.93E+03	1.4	1.8	1.12E+04	1.5	2.1	1.14E+04	1.6	2
2.00E+04	1.18E+04	1.4	1.7	1.15E+04	1.4	1.7	1.11E+04	1.4	1.6	1.01E+04	1.4	1.7	1.42E+04	1.6	1.9	1.13E+04	1.5	1.8
5.00E+04	1.55E+04	1.4	1.7	1.55E+04	1.4	1.7	1.37E+04	1.3	1.8	1.30E+04	1.4	1.6	1.90E+04	1.5	1.9	1.72E+04	1.4	1.8
1.00E+05	2.15E+04	1.3	1.7	2.08E+04	1.3	1.7	1.92E+04	1.3	1.8	2.02E+04	1.3	1.7	2.48E+04	1.4	1.8	2.42E+04	1.4	1.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.10E-01	6.9	10.2	1.01E-01	7.4	9.6	1.15E-01	7.3	9.7	9.53E-02	6.2	10.1	1.21E-01	6.6	9.7
2.00E+01	3.55E-01	5.2	9.4	2.75E-01	6.9	9.8	4.77E-01	7.2	9.6	5.74E-01	7.2	9.6	4.08E-01	7.2	9.5	7.45E-01	6.4	9.9
3.00E+01	1.01E+00	7.2	9.3	1.49E+00	7.3	9.3	1.49E+00	7.4	9	1.38E+00	7	8.9	1.54E+00	6.9	9	1.58E+00	6.9	8.8
5.00E+01	5.97E+00	6.2	10.2	5.56E+00	6.8	10.3	6.93E+00	6	8.7	7.09E+00	5.4	8.7	6.97E+00	5.3	8.9	8.86E+00	5	7.9
7.50E+01	2.09E+01	5.2	7.9	1.84E+01	4.9	7.9	5.16E+01	8.1	11.7	3.92E+01	4.4	6.1	4.24E+01	4	6.1	5.06E+01	4.5	5.6
1.00E+02	5.94E+01	3.8	5.5	7.27E+01	3.8	5.4	6.42E+02	13.8	20.4	6.97E+02	14.4	21	4.13E+02	10.8	16.8	1.27E+03	15.4	22.4
1.50E+02	5.51E+02	4	5.1	1.79E+03	10	14.8	5.55E+03	9.6	13.9	6.43E+03	9.9	14.4	7.25E+03	10.6	15.5	9.63E+03	9.9	14.2
2.00E+02	1.08E+04	10	13.7	9.24E+03	8.7	12.3	9.92E+03	6.8	9.7	1.09E+04	6.5	9.2	1.19E+04	6.3	8.9	1.31E+04	6	8.5
3.00E+02	1.48E+04	3.2	4.9	1.49E+04	3.7	5.2	1.33E+04	3.2	4.6	1.38E+04	3.1	4.4	1.38E+04	3	4.3	1.39E+04	2.8	4.1
5.00E+02	1.02E+04	1.3	1.8	9.78E+03	1.3	1.9	9.68E+03	1.3	1.9	9.68E+03	1.3	1.9	9.80E+03	1.3	1.9	9.34E+03	1.2	1.9
7.00E+02	7.88E+03	1.5	1.8	8.21E+03	1.4	1.8	8.65E+03	1.4	1.8	8.52E+03	1.4	1.8	8.45E+03	1.4	1.8	8.57E+03	1.3	1.8
1.00E+03	8.17E+03	1.4	2	8.32E+03	1.5	1.9	8.26E+03	1.4	1.9	8.38E+03	1.4	1.9	8.25E+03	1.5	1.9	7.93E+03	1.5	1.8
2.00E+03	9.25E+03	1.5	2	9.13E+03	1.5	2	8.70E+03	1.5	2	8.69E+03	1.5	2	8.79E+03	1.5	2	8.50E+03	1.5	1.9
3.00E+03	9.36E+03	1.5	2.1	8.73E+03	1.5	2	9.07E+03	1.5	2	9.12E+03	1.5	2	8.97E+03	1.5	1.9	9.19E+03	1.5	1.9
5.00E+03	8.97E+03	1.6	2	9.82E+03	1.5	2	9.80E+03	1.5	2	9.70E+03	1.5	1.9	9.82E+03	1.4	2	9.92E+03	1.5	1.9
1.00E+04	1.20E+04	1.6	2.1	1.16E+04	1.6	2	1.13E+04	1.5	2	1.13E+04	1.5	2	1.16E+04	1.6	1.9	1.05E+04	1.5	2
2.00E+04	1.41E+04	1.4	2	1.25E+04	1.5	1.8	1.30E+04	1.4	1.8	1.23E+04	1.4	1.8	1.26E+04	1.5	1.8	1.07E+04	1.4	1.8
5.00E+04	1.69E+04	1.3	2	1.83E+04	1.4	1.9	1.76E+04	1.4	1.8	1.71E+04	1.4	1.8	1.55E+04	1.4	1.8	1.59E+04	1.4	1.8
1.00E+05	2.44E+04	1.3	1.8	2.53E+04	1.4	1.8	2.61E+04	1.4	1.8	2.49E+04	1.4	1.8	2.53E+04	1.4	1.8	2.35E+04	1.4	1.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.07E-01	5.8	8.7	0.00E+00	1	1	2.61E+00	4.9	6.6	2.61E+00	4.9	6.6
2.00E+01	5.12E-01	6.4	8.2	0.00E+00	1	1	2.25E+01	8	9.3	2.25E+01	8	9.3
3.00E+01	8.71E-01	4.9	7.9	1.68E+00	5.3	7.5	2.61E+04	22.7	32.8	2.61E+04	22.7	32.8
5.00E+01	9.94E+01	18.7	27.4	4.93E+01	14.5	23	2.65E+04	14.3	22	2.65E+04	14.3	22
7.50E+01	1.91E+03	16.9	24.9	1.39E+03	16.5	25.5	2.01E+04	8.7	12.5	2.01E+04	8.7	12.5
1.00E+02	6.91E+03	14	20.6	6.08E+03	14.4	21.7	1.75E+04	6.5	8.9	1.75E+04	6.5	8.9
1.50E+02	9.94E+03	6.9	9.6	8.78E+03	7	9.1	1.57E+04	4.5	5.2	1.57E+04	4.5	5.2

(*continued on next page*)

Table A.8. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	1.07E+04	4.2	6.6	1.23E+04	6.8	9.8	1.66E+04	3.3	6	1.66E+04	3.3	6
3.00E+02	1.49E+04	2.4	3.7	1.42E+04	2.1	3.4	1.36E+04	2	2.7	1.36E+04	2	2.7
5.00E+02	1.04E+04	1.2	1.9	1.02E+04	1.2	1.8	1.10E+04	1.2	1.8	1.10E+04	1.2	1.8
7.00E+02	8.63E+03	1.3	1.8	9.16E+03	1.4	1.7	8.99E+03	1.2	1.5	8.99E+03	1.2	1.5
1.00E+03	7.97E+03	1.4	1.8	8.73E+03	1.5	1.8	7.75E+03	1.3	1.5	7.75E+03	1.3	1.5
2.00E+03	8.07E+03	1.4	1.9	9.39E+03	1.4	1.8	8.73E+03	1.3	1.6	8.73E+03	1.3	1.6
3.00E+03	8.84E+03	1.5	1.9	8.49E+03	1.5	1.9	8.75E+03	1.3	1.6	8.75E+03	1.3	1.6
5.00E+03	9.43E+03	1.4	1.9	8.85E+03	1.5	2	9.11E+03	1.3	1.6	9.11E+03	1.3	1.6
1.00E+04	1.10E+04	1.4	1.8	1.08E+04	1.4	1.8	9.67E+03	1.3	1.6	9.67E+03	1.3	1.6
2.00E+04	1.08E+04	1.4	1.8	1.19E+04	1.5	1.8	1.04E+04	1.3	1.6	1.04E+04	1.3	1.6
5.00E+04	1.45E+04	1.3	1.8	1.52E+04	1.4	1.8	1.06E+04	1.2	1.6	1.06E+04	1.2	1.6
1.00E+05	2.08E+04	1.3	1.8	2.20E+04	1.4	1.8	1.68E+04	1.3	1.7	1.68E+04	1.3	1.7

Table A.9. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{12}C ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.52E+00	17.1	5.8	8.65E-01	17.2	5.8	2.66E+02	16.3	21.1	2.96E+02	16.7	21.7	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	4.02E+00	18.8	6.7	1.36E+00	18.2	6.5	6.44E+02	18	24.6	5.59E+02	18.3	25.2	1.08E-01	7.1	9.6	1.24E-01	7	9.5
2.00E+01	6.87E+00	20.7	7.3	2.68E+00	19.3	6.9	1.35E+03	20.1	27.9	1.08E+03	20.4	28.2	4.06E-01	7	9.5	3.46E-01	6.9	9.6
3.00E+01	1.50E+01	20.7	7.3	4.88E+00	18.1	6.5	4.89E+03	20.6	28	4.06E+03	21	29.1	1.17E+00	6.3	9.2	1.22E+00	6.8	9.2
5.00E+01	8.10E+01	18.7	6.8	9.46E+01	19.2	6.8	1.86E+04	21	29.3	1.20E+04	20.9	29	6.29E+00	7.9	12	5.98E+00	5.2	8.1
7.50E+01	1.16E+03	19.7	7.2	1.20E+03	19.6	7.1	2.87E+04	16.6	23.4	1.92E+04	16.7	23.3	9.01E+01	12.1	16.9	5.09E+01	5	6.7
1.00E+02	3.24E+03	16.4	6.2	3.16E+03	16.2	6.1	2.95E+04	12.2	16.6	2.23E+04	13.2	18	6.99E+02	14.7	20.3	9.79E+02	16.1	22.3
1.50E+02	7.27E+03	11.4	4.4	7.76E+03	11.5	4.5	2.24E+04	6.9	8.7	2.07E+04	8	10.3	7.89E+03	13.5	18.5	8.27E+03	13.5	18.5
2.00E+02	1.18E+04	9.3	3.7	1.32E+04	9.3	3.7	1.78E+04	4.3	5.1	1.77E+04	5.2	6.3	1.29E+04	9.1	12.2	1.29E+04	9	11.8
3.00E+02	1.75E+04	5.8	2.5	1.87E+04	5.6	2.5	1.60E+04	3.5	4.4	1.79E+04	4.3	5.4	1.59E+04	5.3	6.7	1.69E+04	5.5	7.1
5.00E+02	1.37E+04	1.8	1.4	1.36E+04	1.8	1.3	1.42E+04	1.5	2.4	1.47E+04	1.6	2.2	1.41E+04	2	2.7	1.36E+04	1.9	2.5
7.00E+02	1.16E+04	1.3	1.2	1.16E+04	1.3	1.2	1.25E+04	1.2	1.8	1.24E+04	1.2	1.9	1.16E+04	1.3	1.9	1.16E+04	1.3	1.9
1.00E+03	1.07E+04	1.4	1.2	1.07E+04	1.3	1.2	1.20E+04	1.2	1.7	1.13E+04	1.3	1.8	1.08E+04	1.4	1.9	1.06E+04	1.4	1.9
2.00E+03	1.09E+04	1.4	1.2	1.09E+04	1.4	1.2	1.22E+04	1.3	1.7	1.10E+04	1.3	1.7	1.09E+04	1.4	1.9	1.10E+04	1.4	1.9
3.00E+03	1.13E+04	1.4	1.2	1.14E+04	1.4	1.2	1.13E+04	1.3	1.7	1.15E+04	1.3	1.7	1.14E+04	1.4	1.9	1.14E+04	1.4	1.9
5.00E+03	1.22E+04	1.4	1.2	1.21E+04	1.4	1.2	1.22E+04	1.3	1.6	1.19E+04	1.3	1.7	1.19E+04	1.4	1.9	1.19E+04	1.4	1.9
1.00E+04	1.38E+04	1.4	1.2	1.39E+04	1.4	1.2	1.39E+04	1.3	1.7	1.32E+04	1.3	1.7	1.38E+04	1.5	1.9	1.40E+04	1.5	1.9
2.00E+04	1.52E+04	1.4	1.2	1.43E+04	1.4	1.2	1.44E+04	1.3	1.7	1.41E+04	1.2	1.6	1.55E+04	1.4	1.7	1.51E+04	1.4	1.7
5.00E+04	2.03E+04	1.4	1.2	1.92E+04	1.4	1.2	1.84E+04	1.3	1.7	1.76E+04	1.3	1.6	2.06E+04	1.4	1.8	1.96E+04	1.4	1.7
1.00E+05	2.81E+04	1.3	1.2	2.62E+04	1.3	1.2	2.32E+04	1.3	1.6	2.26E+04	1.3	1.6	2.93E+04	1.3	1.8	2.79E+04	1.3	1.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.97E+02	17.2	23	0.00E+00	1	1
1.40E+01	1.05E-01	7.5	9.8	1.13E-01	7.3	9.9	9.62E-02	6.6	9.9	1.42E-01	7.5	9.4	4.40E+02	19.1	26.8	0.00E+00	1	1
2.00E+01	3.80E-01	7.6	9.5	3.82E-01	7.6	9.7	3.14E-01	7.6	9.7	3.55E-01	7	9.8	7.37E+02	21.4	29.9	2.77E-01	5.4	10.4
3.00E+01	1.16E+00	6.8	8.8	1.24E+00	7.1	9.4	1.15E+00	6.8	9.4	1.30E+00	6.4	8.5	1.51E+03	21.7	29.9	1.01E+00	5.4	8.9
5.00E+01	5.24E+00	5.7	8.6	5.74E+00	5.4	8.4	4.37E+00	5.5	9.2	6.46E+00	4.8	7.9	4.19E+03	20.8	28.7	2.35E+00	6.2	9.9
7.50E+01	4.53E+01	6.9	9	4.83E+01	4.7	6.5	2.60E+01	3.9	5.7	5.58E+01	4.3	5.4	8.72E+03	17.4	23.9	1.06E+01	4.7	7.9
1.00E+02	5.42E+02	14.2	19.4	5.13E+02	11.6	15.6	1.52E+02	4	4.8	9.05E+02	15.6	21.5	1.25E+04	14.6	19.9	3.87E+01	3.4	5.2
1.50E+02	6.55E+03	13.5	18.3	9.44E+03	14.3	19.6	5.00E+03	13.7	18.8	8.62E+03	12.7	17.3	1.44E+04	9.1	12.1	6.36E+02	2.8	3.4
2.00E+02	1.60E+04	10.6	14.2	1.91E+04	9.8	13	1.09E+04	10	13.2	1.38E+04	9.3	12.3	1.25E+04	5.7	7.2	3.42E+03	9.1	13.4
3.00E+02	1.91E+04	5.3	6.7	2.07E+04	5.1	6.3	1.61E+04	5.8	7.8	1.75E+04	5.2	6.9	1.64E+04	5.4	7.1	1.87E+04	7	9.2
5.00E+02	1.40E+04	1.7	2.4	1.41E+04	1.6	2.2	1.36E+04	1.9	2.5	1.36E+04	1.8	2.5	1.56E+04	1.7	2.3	1.43E+04	1.7	2.5
7.00E+02	1.19E+04	1.3	1.9	1.21E+04	1.2	1.9	1.14E+04	1.3	2	1.17E+04	1.3	1.9	1.18E+04	1.3	1.9	1.12E+04	1.3	2
1.00E+03	1.11E+04	1.3	1.9	1.09E+04	1.3	1.9	1.07E+04	1.4	1.9	1.09E+04	1.3	1.9	1.11E+04	1.3	1.8	1.02E+04	1.4	1.9
2.00E+03	1.10E+04	1.4	1.9	1.09E+04	1.4	1.8	1.09E+04	1.4	2	1.08E+04	1.4	1.9	1.10E+04	1.4	1.8	1.06E+04	1.4	1.9
3.00E+03	1.14E+04	1.4	1.9	1.14E+04	1.4	1.8	1.14E+04	1.4	1.9	1.13E+04	1.4	1.9	1.10E+04	1.4	1.9	1.14E+04	1.5	2.1
5.00E+03	1.24E+04	1.4	1.8	1.21E+04	1.4	1.8	1.25E+04	1.4	1.9	1.20E+04	1.4	1.8	1.22E+04	1.4	1.7	1.14E+04	1.6	2
1.00E+04	1.40E+04	1.4	1.9	1.41E+04	1.4	1.8	1.35E+04	1.4	1.9	1.41E+04	1.4	1.8	1.43E+04	1.4	1.8	1.32E+04	1.5	1.9
2.00E+04	1.55E+04	1.3	1.7	1.44E+04	1.3	1.6	1.52E+04	1.4	1.7	1.50E+04	1.3	1.7	1.59E+04	1.4	1.7	1.24E+04	1.4	1.7
5.00E+04	1.95E+04	1.3	1.7	1.84E+04	1.3	1.7	2.02E+04	1.4	1.8	1.94E+04	1.4	1.8	2.05E+04	1.4	1.7	2.10E+04	1.3	1.7
1.00E+05	2.61E+04	1.3	1.8	2.43E+04	1.3	1.7	2.76E+04	1.4	1.7	2.75E+04	1.3	1.7	2.98E+04	1.3	1.7	2.74E+04	1.3	1.8

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.85E-02	7.5	9.8	1.18E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.9. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	2.94E-01	7.5	9.6	3.63E-01	7.1	9.5	2.81E-01	6.2	9.3	4.44E-01	6.2	9.7	6.16E-01	5.2	7.6	7.57E-01	4.4	7.9
3.00E+01	1.07E+00	6.9	8.8	1.13E+00	6.8	8.7	8.66E-01	6.1	9.1	1.18E+00	7	9	2.05E+00	4.2	6.4	1.86E+00	3.8	6.1
5.00E+01	4.90E+00	5.7	9.1	5.71E+00	5.3	8.4	4.82E+00	6.1	9.4	4.84E+00	6	9.6	1.23E+01	5.1	7.2	3.57E+01	5.9	6.9
7.50E+01	3.28E+01	4.4	6	5.29E+01	6	8.3	7.62E+01	13.9	15	2.53E+01	4.1	6.2	1.49E+03	18.9	26.5	2.21E+03	19.3	26.8
1.00E+02	4.76E+02	15.1	20.6	7.77E+02	15.6	21.5	4.77E+02	14.7	21.5	4.32E+02	15.3	21.1	8.60E+03	17.7	25	1.12E+04	17.5	24.8
1.50E+02	5.02E+03	13.2	18.2	7.46E+03	13.3	18.2	4.06E+03	12.4	16.7	4.63E+03	12.2	16.8	1.47E+04	10.1	13.7	1.33E+04	9.3	12.5
2.00E+02	1.06E+04	9.8	13	1.33E+04	9.5	12.6	8.43E+03	8.7	12.4	1.15E+04	10.9	14.8	1.35E+04	6.2	8.5	1.63E+04	7	8.9
3.00E+02	1.71E+04	6	7.7	1.82E+04	5.6	7.2	1.86E+04	6.1	8.4	1.98E+04	5.6	7.4	1.84E+04	5.1	6.4	2.07E+04	4.9	6.3
5.00E+02	1.37E+04	1.9	2.5	1.39E+04	1.8	2.4	1.30E+04	1.7	2.4	1.38E+04	1.6	2.2	1.38E+04	1.7	2.2	1.38E+04	1.5	2.1
7.00E+02	1.16E+04	1.3	2	1.18E+04	1.3	1.9	1.13E+04	1.2	2	1.15E+04	1.3	1.9	1.19E+04	1.3	1.9	1.23E+04	1.3	2
1.00E+03	1.08E+04	1.4	1.9	1.08E+04	1.3	1.9	1.07E+04	1.3	1.9	1.11E+04	1.4	1.8	1.15E+04	1.3	1.9	1.18E+04	1.2	1.8
2.00E+03	1.11E+04	1.4	2	1.08E+04	1.4	1.9	1.08E+04	1.5	1.9	1.08E+04	1.4	1.9	1.09E+04	1.4	1.8	1.13E+04	1.3	1.9
3.00E+03	1.13E+04	1.5	2	1.14E+04	1.4	1.9	1.14E+04	1.4	1.9	1.14E+04	1.4	1.8	1.22E+04	1.3	1.8	1.12E+04	1.3	1.8
5.00E+03	1.20E+04	1.4	1.9	1.22E+04	1.4	1.9	1.23E+04	1.4	1.9	1.17E+04	1.4	1.8	1.12E+04	1.4	1.8	1.22E+04	1.4	1.7
1.00E+04	1.40E+04	1.5	1.9	1.42E+04	1.5	1.9	1.38E+04	1.5	1.9	1.39E+04	1.4	1.9	1.33E+04	1.4	1.8	1.19E+04	1.4	1.8
2.00E+04	1.57E+04	1.4	1.8	1.43E+04	1.4	1.7	1.57E+04	1.4	1.8	1.26E+04	1.3	1.6	1.59E+04	1.3	1.7	1.39E+04	1.4	1.6
5.00E+04	1.99E+04	1.4	1.8	1.92E+04	1.4	1.7	1.88E+04	1.4	1.7	1.69E+04	1.3	1.7	1.86E+04	1.3	1.7	1.56E+04	1.3	1.6
1.00E+05	2.87E+04	1.3	1.8	2.55E+04	1.3	1.7	3.04E+04	1.4	1.7	2.86E+04	1.3	1.8	2.60E+04	1.4	1.7	2.46E+04	1.2	1.7

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	8.35E+00	17.2	23	1.85E+00	17.2	23	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.03E-01	4.2	8.8	1.17E+01	19.1	26.7	2.89E+00	18.6	26.1	1.23E-01	7.2	10	1.32E-01	7.2	9.6
2.00E+01	3.91E-01	6.4	9.3	5.63E-01	4.9	7.6	2.16E+01	21.1	29.2	5.48E+00	20.3	27.8	4.03E-01	7.3	9.3	5.13E-01	6.8	9.7
3.00E+01	1.05E+00	6.6	8.8	2.00E+00	5	6.8	4.24E+01	21.3	29.3	1.02E+01	19	26.4	1.48E+00	6.2	8	1.53E+00	5.7	8.5
5.00E+01	4.89E+00	6.3	10	1.55E+01	6.7	8.4	2.40E+02	19.3	26.8	1.98E+02	19.2	26.4	8.98E+00	5.1	7.6	1.11E+01	4.4	6.5
7.50E+01	2.14E+01	4	6.2	2.43E+03	20.5	28.5	2.83E+03	19.6	27.2	2.67E+03	19.7	27.4	1.38E+02	9.5	12	2.59E+02	13	17.3
1.00E+02	1.15E+02	3.8	4.5	5.94E+03	16.1	22.6	7.39E+03	16.4	22.7	7.09E+03	16.2	22.6	2.46E+03	17.6	24.3	4.08E+03	17.9	24.9
1.50E+02	4.05E+03	14.8	20	8.28E+03	10.4	13.3	1.46E+04	11.5	15.4	1.44E+04	11.6	15.7	1.39E+04	12.9	17.7	1.62E+04	12.6	17.2
2.00E+02	8.71E+03	8.8	11.5	1.15E+04	8.3	10.7	1.87E+04	8.4	10.9	1.88E+04	8.5	11	2.23E+04	9.5	12.6	2.34E+04	9.2	12.1
3.00E+02	1.65E+04	7	8.8	1.62E+04	6	8	1.88E+04	4.6	5.7	1.93E+04	4.5	5.7	2.18E+04	4.3	5.2	2.15E+04	3.9	4.7
5.00E+02	1.31E+04	1.8	2.6	1.37E+04	1.7	2.3	1.41E+04	1.6	2.3	1.41E+04	1.6	2.3	1.47E+04	1.5	2.2	1.41E+04	1.5	2.2
7.00E+02	1.12E+04	1.4	2	1.13E+04	1.3	1.9	1.20E+04	1.2	1.9	1.20E+04	1.2	1.9	1.26E+04	1.2	1.9	1.26E+04	1.2	1.9
1.00E+03	1.11E+04	1.4	2	1.09E+04	1.4	1.9	1.12E+04	1.3	1.8	1.11E+04	1.3	1.8	1.17E+04	1.3	1.8	1.14E+04	1.2	1.8
2.00E+03	1.09E+04	1.5	2	1.12E+04	1.4	1.9	1.10E+04	1.4	1.8	1.10E+04	1.3	1.8	1.13E+04	1.3	1.8	1.13E+04	1.3	1.8
3.00E+03	1.14E+04	1.5	2	1.12E+04	1.4	1.9	1.13E+04	1.4	1.8	1.14E+04	1.4	1.8	1.14E+04	1.3	1.7	1.14E+04	1.3	1.7
5.00E+03	1.20E+04	1.4	2	1.21E+04	1.4	1.9	1.20E+04	1.4	1.8	1.20E+04	1.3	1.8	1.20E+04	1.3	1.7	1.18E+04	1.3	1.7
1.00E+04	1.39E+04	1.6	2	1.34E+04	1.5	1.9	1.33E+04	1.4	1.8	1.34E+04	1.4	1.8	1.30E+04	1.3	1.7	1.25E+04	1.3	1.7
2.00E+04	1.57E+04	1.5	1.8	1.40E+04	1.4	1.8	1.44E+04	1.3	1.7	1.41E+04	1.3	1.7	1.40E+04	1.3	1.6	1.39E+04	1.3	1.6
5.00E+04	2.11E+04	1.4	1.7	2.04E+04	1.4	1.8	1.87E+04	1.3	1.7	1.80E+04	1.3	1.7	1.67E+04	1.3	1.6	1.65E+04	1.3	1.6
1.00E+05	3.11E+04	1.4	1.8	2.63E+04	1.3	1.7	2.51E+04	1.3	1.7	2.37E+04	1.3	1.7	2.11E+04	1.3	1.8	2.32E+04	1.3	1.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.91E+03	10.5	6.9	2.32E+03	10.5	6.9	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.82E+03	11.4	9.3	4.64E+03	11.4	9.3	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.71E+03	12.3	11.4	6.93E+03	12.3	11.4	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.48E+03	14	15.4	1.15E+04	14	15.4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.73E+00	16.4	19.7	0.00E+00	1	1	1.87E+04	17.4	23.5	2.26E+04	17.4	23.5	2.38E+01	17.1	23	3.63E+00	17.1	22.8
1.40E+01	4.23E+00	15.8	23.6	1.86E-01	4.9	7.2	2.56E+04	19.5	27.7	3.09E+04	19.6	27.8	3.65E+01	19.1	26.9	5.77E+00	19	26.6
2.00E+01	2.89E+01	17.9	26.2	5.50E-01	4.8	7.9	3.53E+04	22.3	30.9	4.19E+04	22.4	31	6.35E+01	21.5	29.7	9.83E+00	20.5	29.4
3.00E+01	2.54E+02	17.8	24.3	1.05E+01	11.9	13.6	4.35E+04	23.5	32.4	4.53E+04	23.7	32.6	1.42E+02	21.5	29.2	1.89E+01	20.8	28.7
5.00E+01	3.83E+03	21.4	29.5	7.94E+02	20.5	27.9	3.36E+04	16.9	24	3.35E+04	16.5	23.3	5.23E+02	20.7	28.6	1.26E+02	19.4	27
7.50E+01	1.22E+04	18.5	25.9	6.53E+03	19.2	26.9	2.55E+04	11.3	15.4	2.54E+04	11.1	15	1.61E+03	18.1	25.3	9.28E+02	18.8	26.3
1.00E+02	1.74E+04	14.5	20.1	1.27E+04	15.8	21.8	2.16E+04	8.7	11.2	2.19E+04	8.7	11.1	2.72E+03	14.8	20.4	2.14E+03	15.4	21.2
1.50E+02	1.82E+04	9.1	11.6	1.65E+04	9.9	13.2	1.91E+04	6.5	8.1	1.94E+04	6.5	8.2	6.37E+03	11.6	15.6	6.36E+03	11.6	16
2.00E+02	1.72E+04	6.2	8	1.82E+04	7.5	9.1	1.90E+04	5.6	7	1.92E+04	5.6	7	1.17E+04	9.3	12.3	1.31E+04	9.8	13.1
3.00E+02	2.10E+04	5	6.4	2.12E+04	4.9	6.4	1.80E+04	3.6	4.6	1.85E+04	3.7	4.6	1.78E+04	5.8	7.4	1.87E+04	5.5	7
5.00E+02	1.39E+04	1.6	2.3	1.42E+04	1.5	2.2	1.46E+04	1.6	2.3	1.45E+04	1.5	2.3	1.39E+04	1.9	2.5	1.39E+04	1.7	2.4
7.00E+02	1.32E+04	1.2	1.8	1.24E+04	1.2	1.9	1.26E+04	1.2	1.8	1.26E+04	1.2	1.8	1.16E+04	1.3	2	1.17E+04	1.3	1.9
1.00E+03	1.12E+04	1.3	1.7	1.12E+04	1.3	1.8	1.15E+04	1.2	1.7	1.15E+04	1.2	1.7	1.09E+04	1.4	1.9	1.08E+04	1.3	1.9
2.00E+03	1.13E+04	1.3	1.8	1.14E+04	1.4	1.8	1.12E+04	1.3	1.7	1.12E+04	1.2	1.7	1.08E+04	1.4	1.9	1.11E+04	1.4	1.9

Table A.9. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	1.18E+04	1.3	1.7	1.09E+04	1.3	1.7	1.15E+04	1.3	1.7	1.14E+04	1.3	1.6	1.15E+04	1.4	1.9	1.15E+04	1.4	1.9
5.00E+03	1.23E+04	1.3	1.7	1.11E+04	1.3	1.7	1.20E+04	1.3	1.6	1.19E+04	1.2	1.6	1.19E+04	1.4	1.9	1.21E+04	1.4	1.9
1.00E+04	1.26E+04	1.3	1.8	1.30E+04	1.4	1.7	1.32E+04	1.3	1.7	1.31E+04	1.3	1.6	1.36E+04	1.4	1.9	1.40E+04	1.4	1.9
2.00E+04	1.47E+04	1.3	1.6	1.42E+04	1.3	1.7	1.44E+04	1.2	1.6	1.37E+04	1.2	1.5	1.58E+04	1.4	1.8	1.47E+04	1.4	1.7
5.00E+04	1.74E+04	1.3	1.7	1.83E+04	1.4	1.7	1.75E+04	1.3	1.6	1.70E+04	1.3	1.6	2.00E+04	1.4	1.8	1.96E+04	1.4	1.7
1.00E+05	2.19E+04	1.3	1.6	2.38E+04	1.3	1.6	2.28E+04	1.2	1.6	2.13E+04	1.2	1.6	2.78E+04	1.3	1.7	2.66E+04	1.3	1.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.74E+02	17.2	23	4.56E+01	17.1	22.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	4.16E+02	19.2	27	7.14E+01	19.2	26.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.54E-01	4.7	9	2.66E-01	4.8	9.6	7.21E+02	21.6	30	1.16E+02	21.2	30.1	3.82E-01	7.7	8.9	3.39E-01	5.6	9.7
3.00E+01	1.07E+00	5.4	9.1	1.12E+00	5.4	9.2	1.51E+03	22	29.9	1.91E+02	22.2	30.3	9.59E-01	6.1	9.3	1.52E+00	5.6	9
5.00E+01	4.29E+00	6.6	11.3	3.51E+00	6.9	9.9	4.26E+03	20.7	28.6	9.48E+02	19.9	27.8	2.54E+00	5	9.2	4.54E+00	5.8	10.4
7.50E+01	1.57E+01	4.1	7	1.46E+01	4.6	7.4	9.81E+03	17.5	24.6	4.63E+03	18.5	26.2	1.48E+01	4.7	7.4	1.39E+01	4.3	7.1
1.00E+02	8.86E+01	3.4	4.9	6.16E+01	3.5	5	1.23E+04	14	19.2	7.05E+03	15	20.6	6.84E+01	5	6.8	5.27E+01	3.7	5.1
1.50E+02	1.92E+03	13.5	18.1	8.44E+02	7.7	9.4	1.58E+04	9.8	12.7	1.24E+04	10.4	14.2	2.39E+03	13.1	16.9	9.99E+02	7.9	6.9
2.00E+02	8.69E+03	10.9	15.1	6.59E+03	10.2	13.8	2.10E+04	8.6	11.2	2.15E+04	10.5	13.6	7.01E+03	9.7	12.7	7.30E+03	11.2	16.3
3.00E+02	1.58E+04	7	8.8	1.76E+04	6	8	2.00E+04	3.9	5	2.07E+04	4.2	5.3	1.70E+04	6.7	8.1	1.92E+04	6.7	7.9
5.00E+02	1.42E+04	1.9	2.7	1.33E+04	1.7	2.5	1.50E+04	1.6	2.3	1.52E+04	1.6	2.1	1.35E+04	1.8	2.7	1.35E+04	1.6	2.4
7.00E+02	1.07E+04	1.3	2	1.06E+04	1.3	2	1.25E+04	1.3	1.9	1.23E+04	1.2	1.9	1.13E+04	1.4	2	1.11E+04	1.3	1.9
1.00E+03	1.01E+04	1.5	1.9	1.09E+04	1.3	1.9	1.18E+04	1.2	1.8	1.16E+04	1.3	1.9	1.08E+04	1.4	2	1.06E+04	1.4	1.9
2.00E+03	1.06E+04	1.5	2	1.21E+04	1.4	1.9	1.10E+04	1.3	1.7	1.10E+04	1.3	1.8	1.06E+04	1.5	2	1.06E+04	1.5	2
3.00E+03	1.20E+04	1.5	1.9	1.16E+04	1.5	2	1.13E+04	1.3	1.7	1.12E+04	1.3	1.7	1.13E+04	1.5	2.1	1.13E+04	1.5	1.9
5.00E+03	1.20E+04	1.4	1.9	1.21E+04	1.5	2	1.20E+04	1.3	1.7	1.22E+04	1.3	1.8	1.15E+04	1.4	2.1	1.29E+04	1.5	2.1
1.00E+04	1.36E+04	1.5	2	1.36E+04	1.4	2	1.32E+04	1.4	1.7	1.34E+04	1.4	1.7	1.49E+04	1.4	2	1.44E+04	1.5	2.1
2.00E+04	1.65E+04	1.5	1.8	1.48E+04	1.4	1.9	1.61E+04	1.3	1.7	1.40E+04	1.3	1.7	1.61E+04	1.4	1.9	1.49E+04	1.5	1.8
5.00E+04	2.19E+04	1.5	1.8	2.17E+04	1.4	1.7	1.89E+04	1.2	1.7	1.70E+04	1.4	1.6	1.98E+04	1.5	1.8	2.08E+04	1.4	1.7
1.00E+05	2.97E+04	1.4	1.6	3.10E+04	1.4	1.8	2.35E+04	1.3	1.7	2.40E+04	1.3	1.6	3.04E+04	1.4	1.8	2.66E+04	1.4	1.7

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.73E+01	16.6	21.6	0.00E+00	1	1
1.40E+01	1.01E-01	6.9	9.8	0.00E+00	1	1	9.68E-02	6.8	9.8	9.70E-02	7	10.1	2.97E+01	18.3	25.1	1.32E-01	6.1	8.8
2.00E+01	3.17E-01	7.5	9.6	4.01E-01	7.1	9.6	3.71E-01	7.9	9.3	3.95E-01	7.9	9.8	5.31E+01	20.9	28	4.33E-01	5	8.6
3.00E+01	1.09E+00	7.2	9.1	1.13E+00	7.1	8.9	1.00E+00	7	9.1	1.02E+00	7.2	9.3	2.35E+02	19.3	26.8	2.92E+00	7.8	16.5
5.00E+01	4.49E+00	6.1	9.5	4.92E+00	5.9	8.3	3.91E+00	6.1	9.5	3.73E+00	5.9	9.5	1.67E+03	21.2	29.5	9.65E+01	17.6	25.5
7.50E+01	2.27E+01	4.4	6.4	2.93E+01	4.6	5.9	1.66E+01	4.3	6.2	1.82E+01	4.2	6.1	3.89E+03	17.9	25	2.36E+03	20.1	28
1.00E+02	1.72E+02	6.4	7.7	3.21E+02	10.9	14.2	8.40E+01	3.6	4.7	1.14E+02	3.3	4.5	5.36E+03	14.1	19.6	4.77E+03	15.7	21.6
1.50E+02	4.37E+03	13.6	18.8	5.48E+03	13.1	18.1	2.19E+03	13.5	18.5	2.26E+03	12.1	16.7	7.64E+03	10.2	13.6	8.22E+03	10.5	14.3
2.00E+02	1.04E+04	9.7	13.2	1.35E+04	10.1	13.8	1.09E+04	11.4	15.2	1.20E+04	11.8	15.9	1.20E+04	8.3	11	1.31E+04	9.1	11.8
3.00E+02	1.87E+04	6.3	8.2	2.02E+04	5.7	7.3	1.65E+04	6.1	7.8	1.72E+04	5.5	7.2	1.75E+04	5.7	7.4	1.86E+04	5.4	7
5.00E+02	1.35E+04	1.8	2.5	1.40E+04	1.7	2.3	1.38E+04	2	2.7	1.39E+04	1.8	2.5	1.39E+04	1.9	2.6	1.39E+04	1.8	2.4
7.00E+02	1.15E+04	1.3	2	1.17E+04	1.3	1.9	1.16E+04	1.3	2	1.18E+04	1.3	2	1.17E+04	1.3	1.9	1.18E+04	1.2	1.9
1.00E+03	1.09E+04	1.4	1.9	1.07E+04	1.3	1.9	1.07E+04	1.4	1.9	1.04E+04	1.4	1.9	1.09E+04	1.3	1.9	1.11E+04	1.3	1.9
2.00E+03	1.11E+04	1.4	1.9	1.09E+04	1.4	1.9	1.07E+04	1.5	2	1.09E+04	1.4	2	1.10E+04	1.4	1.9	1.10E+04	1.4	1.9
3.00E+03	1.12E+04	1.5	1.9	1.13E+04	1.4	1.9	1.13E+04	1.5	2	1.16E+04	1.5	1.9	1.15E+04	1.4	1.9	1.14E+04	1.4	1.9
5.00E+03	1.26E+04	1.4	1.9	1.20E+04	1.4	1.8	1.26E+04	1.4	1.9	1.26E+04	1.4	1.9	1.22E+04	1.4	1.9	1.21E+04	1.4	1.9
1.00E+04	1.35E+04	1.5	1.9	1.40E+04	1.5	1.9	1.40E+04	1.5	2	1.44E+04	1.5	1.9	1.39E+04	1.4	1.9	1.39E+04	1.4	1.8
2.00E+04	1.59E+04	1.4	1.7	1.43E+04	1.3	1.7	1.59E+04	1.4	1.8	1.55E+04	1.4	1.8	1.54E+04	1.3	1.7	1.44E+04	1.3	1.7
5.00E+04	2.04E+04	1.4	1.8	1.88E+04	1.4	1.8	2.10E+04	1.4	1.8	2.07E+04	1.4	1.8	1.97E+04	1.4	1.9	1.90E+04	1.4	1.7
1.00E+05	2.64E+04	1.3	1.8	2.53E+04	1.3	1.7	3.22E+04	1.3	1.7	2.72E+04	1.4	1.8	2.76E+04	1.3	1.7	2.58E+04	1.3	1.8

(continued on next page)

Table A.9. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.82E+01	17.2	23	1.38E+00	17.1	22.9	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.78E+01	19.1	26.8	2.46E+00	18.4	25.9	1.04E-01	5.6	9.1	1.01E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.85E+01	21.3	29.5	3.56E+00	19.8	27.3	3.43E-01	6.6	9	4.61E+00	15.4	19.4	2.79E-01	6.8	9.7	3.00E-01	7.1	10.1
3.00E+01	8.82E+01	20.9	28.5	9.49E+00	18.7	25.6	1.73E+00	6	8.9	3.20E+01	19.3	26.1	8.99E-01	7.1	9.5	9.57E-01	7.1	9.2
5.00E+01	7.86E+02	20.5	28.4	2.29E+02	20.1	27.7	3.96E+01	13.6	22.9	3.19E+02	20	27.8	3.45E+00	6.7	10.6	4.03E+00	6.1	9.8
7.50E+01	4.22E+03	19	26.4	1.80E+03	18.9	26.1	1.55E+03	20.1	27.8	2.34E+03	19.2	26.4	1.00E+01	5.4	8.3	1.61E+01	4.2	6.5
1.00E+02	8.79E+03	15.9	22	6.03E+03	16.8	23.2	3.36E+03	14.7	19.9	5.31E+03	14.7	20.2	3.19E+01	3.9	5.6	7.50E+01	3.5	4.8
1.50E+02	1.51E+04	10.9	14.6	1.41E+04	11.7	15.8	1.05E+04	13.2	18	1.34E+04	12.4	17	4.21E+02	2.9	3.6	1.25E+03	7.9	11.2
2.00E+02	1.76E+04	7.8	10	1.80E+04	8.3	10.9	2.32E+04	10.4	13.8	2.05E+04	8.7	11.1	2.29E+03	7.8	9.9	1.11E+04	12.2	16.3
3.00E+02	1.80E+04	4.4	5.6	1.87E+04	4.5	5.7	1.89E+04	4.5	5.7	1.92E+04	4.8	5.7	1.79E+04	7.4	9.8	1.70E+04	6	7.6
5.00E+02	1.41E+04	1.7	2.4	1.40E+04	1.7	2.4	1.35E+04	1.7	2.4	1.38E+04	1.5	2.2	1.35E+04	1.8	2.5	1.33E+04	2	2.7
7.00E+02	1.20E+04	1.3	1.9	1.20E+04	1.2	1.9	1.19E+04	1.2	1.9	1.22E+04	1.2	1.9	1.13E+04	1.3	2	1.17E+04	1.3	1.9
1.00E+03	1.11E+04	1.3	1.8	1.11E+04	1.3	1.8	1.18E+04	1.3	1.8	1.07E+04	1.3	1.8	1.07E+04	1.4	2	1.05E+04	1.4	1.9
2.00E+03	1.10E+04	1.4	1.8	1.11E+04	1.4	1.8	1.06E+04	1.4	1.8	1.11E+04	1.4	1.8	1.08E+04	1.5	2	1.09E+04	1.4	1.9
3.00E+03	1.15E+04	1.4	1.8	1.14E+04	1.4	1.8	1.15E+04	1.4	1.8	1.13E+04	1.3	1.8	1.17E+04	1.5	2	1.13E+04	1.5	2
5.00E+03	1.21E+04	1.3	1.8	1.20E+04	1.3	1.8	1.17E+04	1.4	1.8	1.16E+04	1.3	1.7	1.21E+04	1.5	2	1.16E+04	1.5	1.9
1.00E+04	1.37E+04	1.4	1.8	1.36E+04	1.4	1.8	1.27E+04	1.4	1.8	1.35E+04	1.3	1.7	1.38E+04	1.5	2	1.43E+04	1.5	1.9
2.00E+04	1.49E+04	1.3	1.7	1.42E+04	1.3	1.7	1.51E+04	1.4	1.6	1.41E+04	1.3	1.6	1.66E+04	1.4	1.8	1.43E+04	1.4	1.8
5.00E+04	1.91E+04	1.3	1.7	1.87E+04	1.3	1.7	1.81E+04	1.4	1.6	1.96E+04	1.3	1.6	2.13E+04	1.4	1.8	2.07E+04	1.4	1.8
1.00E+05	2.61E+04	1.3	1.7	2.44E+04	1.3	1.7	2.24E+04	1.4	1.7	2.43E+04	1.3	1.7	3.08E+04	1.4	1.8	2.84E+04	1.3	1.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.09E-01	6.9	10.2	1.02E-01	7.4	9.6	1.15E-01	7.3	9.7	9.88E-02	6.2	10.1	1.22E-01	6.6	9.7
2.00E+01	3.57E-01	5.2	9.4	2.92E-01	6.9	9.8	2.87E-01	7.2	9.6	3.37E-01	7.2	9.6	4.06E-01	7.2	9.5	3.11E-01	6.4	9.9
3.00E+01	8.13E-01	7.2	9.3	8.04E-01	7.3	9.3	1.00E+00	7.2	9	1.06E+00	7	8.9	1.07E+00	6.9	9	1.18E+00	6.9	8.8
5.00E+01	4.43E+00	6.2	10.2	3.61E+00	6.8	10.3	4.52E+00	6.1	8.7	4.53E+00	5.4	8.7	4.31E+00	5.3	8.9	5.10E+00	5	7.9
7.50E+01	1.17E+01	5.2	7.9	1.30E+01	4.9	7.9	2.36E+01	4.6	6.2	2.57E+01	4.3	6.1	2.46E+01	4	6	3.37E+01	4.4	5.5
1.00E+02	3.81E+01	3.8	5.5	4.93E+01	3.8	5.4	2.34E+02	11.4	15.6	1.79E+02	6.3	8	1.58E+02	3.7	4.7	2.42E+02	4.4	5
1.50E+02	5.18E+02	3.1	3.4	6.35E+02	4	5.4	4.36E+03	13.8	18.9	4.87E+03	13.8	18.9	4.50E+03	14.3	19.9	7.52E+03	14.3	19.6
2.00E+02	3.73E+03	9.9	13.6	5.88E+03	11.7	15.6	1.01E+04	10	13.2	1.11E+04	10.1	13.4	1.21E+04	9.9	13.5	1.51E+04	9.7	12.5
3.00E+02	1.76E+04	5.8	7.6	1.77E+04	6.8	8.7	1.65E+04	6.1	7.8	1.72E+04	6.1	7.7	1.76E+04	6	7.6	1.83E+04	5.1	6.7
5.00E+02	1.28E+04	2	2.4	1.32E+04	1.8	2.4	1.39E+04	2	2.7	1.36E+04	1.9	2.6	1.39E+04	1.9	2.4	1.37E+04	1.7	2.4
7.00E+02	1.15E+04	1.4	2.1	1.11E+04	1.3	1.9	1.15E+04	1.3	2	1.17E+04	1.3	1.9	1.14E+04	1.3	1.9	1.19E+04	1.3	1.9
1.00E+03	1.06E+04	1.4	1.9	1.06E+04	1.4	2	1.05E+04	1.4	1.9	1.07E+04	1.4	1.9	1.05E+04	1.4	1.9	1.10E+04	1.4	1.9
2.00E+03	1.07E+04	1.5	2	1.10E+04	1.4	2	1.09E+04	1.5	2	1.09E+04	1.4	1.9	1.08E+04	1.4	2	1.12E+04	1.4	1.9
3.00E+03	1.15E+04	1.5	2	1.17E+04	1.5	2	1.15E+04	1.5	2	1.15E+04	1.4	1.9	1.13E+04	1.5	1.9	1.16E+04	1.4	1.9
5.00E+03	1.22E+04	1.5	1.9	1.15E+04	1.5	2	1.20E+04	1.4	1.9	1.24E+04	1.4	1.9	1.16E+04	1.4	1.9	1.25E+04	1.4	1.8
1.00E+04	1.42E+04	1.5	2	1.47E+04	1.5	2	1.39E+04	1.5	2	1.43E+04	1.5	1.9	1.40E+04	1.4	1.9	1.34E+04	1.5	1.9
2.00E+04	1.65E+04	1.4	1.9	1.43E+04	1.4	1.8	1.59E+04	1.4	1.8	1.56E+04	1.4	1.8	1.51E+04	1.3	1.8	1.51E+04	1.4	1.8
5.00E+04	1.89E+04	1.4	1.8	2.19E+04	1.4	1.8	2.14E+04	1.4	1.8	1.92E+04	1.4	1.8	2.06E+04	1.4	1.8	1.91E+04	1.4	1.8
1.00E+05	2.94E+04	1.4	1.9	2.96E+04	1.4	1.8	3.12E+04	1.3	1.8	2.80E+04	1.3	1.8	2.82E+04	1.3	1.8	2.79E+04	1.3	1.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.17E-01	5.8	8.7	0.00E+00	1	1	2.64E+00	4.9	6.5	2.64E+00	4.9	6.5
2.00E+01	5.32E-01	6.4	8.2	0.00E+00	1	1	1.55E+01	7	8.6	1.55E+01	7	8.6
3.00E+01	1.01E+00	5.8	7.9	1.76E+00	5.3	7.5	1.11E+04	17	22.5	1.11E+04	17	22.5
5.00E+01	2.04E+01	11.9	15.3	1.35E+01	7.3	8.1	3.82E+04	20.8	29.2	3.82E+04	20.8	29.2
7.50E+01	1.33E+03	19.4	26.3	7.66E+02	18.1	25.5	2.78E+04	12.9	17.8	2.78E+04	12.9	17.8
1.00E+02	4.77E+03	17.3	23.7	3.56E+03	17.4	23.9	2.41E+04	9.8	12.8	2.41E+04	9.8	12.8
1.50E+02	1.31E+04	11.7	15.5	1.08E+04	10.8	15.1	2.03E+04	6.8	10	2.03E+04	6.8	10

Table A.9. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	1.29E+04	7.3	8.7	1.42E+04	7.3	10	2.15E+04	5.4	6.8	2.15E+04	5.4	6.8
3.00E+02	1.88E+04	5.7	7.6	2.13E+04	5.4	6.8	1.86E+04	3.6	5.1	1.86E+04	3.6	5.1
5.00E+02	1.52E+04	2	2.5	1.50E+04	1.6	2.3	1.54E+04	1.5	1.9	1.54E+04	1.5	1.9
7.00E+02	1.20E+04	1.2	1.9	1.21E+04	1.2	1.9	1.25E+04	1.2	1.9	1.25E+04	1.2	1.9
1.00E+03	1.16E+04	1.3	1.9	1.05E+04	1.3	1.9	1.06E+04	1.2	1.8	1.06E+04	1.2	1.8
2.00E+03	1.07E+04	1.3	1.9	1.11E+04	1.4	1.9	1.16E+04	1.3	1.7	1.16E+04	1.3	1.7
3.00E+03	1.13E+04	1.4	1.8	1.15E+04	1.4	1.9	1.16E+04	1.3	1.6	1.16E+04	1.3	1.6
5.00E+03	1.01E+04	1.4	1.8	1.20E+04	1.4	1.8	1.20E+04	1.2	1.6	1.20E+04	1.2	1.6
1.00E+04	1.21E+04	1.4	1.8	1.38E+04	1.4	1.9	1.26E+04	1.2	1.5	1.26E+04	1.2	1.5
2.00E+04	1.48E+04	1.4	1.7	1.61E+04	1.3	1.7	1.36E+04	1.2	1.5	1.36E+04	1.2	1.5
5.00E+04	1.82E+04	1.3	1.7	1.72E+04	1.3	1.8	1.35E+04	1.2	1.6	1.35E+04	1.2	1.6
1.00E+05	2.31E+04	1.2	1.7	2.27E+04	1.3	1.7	2.06E+04	1.2	1.7	2.06E+04	1.2	1.7

Table A.10. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{14}N ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.04E+00	14.9	4.5	9.77E-01	15	4.5	2.94E+02	14.3	16.3	3.26E+02	14.5	16.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	4.52E+00	16.3	5.4	1.49E+00	15.3	5.3	5.74E+02	15.8	19.6	5.81E+02	15.9	20.1	1.09E-01	7.1	9.6	1.23E-01	7	9.5
2.00E+01	7.69E+00	17.8	6.2	2.91E+00	17.1	5.9	1.27E+03	17.3	23	1.17E+03	17.7	23.7	4.12E-01	7	9.5	3.57E-01	6.9	9.6
3.00E+01	1.46E+01	19.5	6.7	5.38E+00	16.9	5.9	3.95E+03	19.3	25	3.87E+03	18.9	24.8	1.22E+00	6.3	9.2	1.26E+00	6.7	9.1
5.00E+01	6.94E+01	18.6	6.4	6.58E+01	16.6	5.8	2.02E+04	22.2	29.2	1.35E+04	22.3	29.2	6.01E+00	5.1	8.1	6.23E+00	5.2	8.1
7.50E+01	8.75E+02	19.8	6.8	9.85E+02	20.2	6.9	3.55E+04	20.2	26.5	2.24E+04	20	26.2	7.60E+01	11.3	14.1	4.93E+01	4.2	5.3
1.00E+02	3.28E+03	19.5	6.8	3.14E+03	19.1	6.6	3.74E+04	16.3	21.2	2.72E+04	16.9	21.9	4.83E+02	14	17	6.26E+02	15	19.4
1.50E+02	7.63E+03	14.2	5.1	8.01E+03	14.4	5.2	3.12E+04	10.2	12.6	2.75E+04	11.4	14.2	7.63E+03	16.9	22	8.12E+03	16.7	21.8
2.00E+02	1.27E+04	11.9	4.4	1.39E+04	11.9	4.3	2.47E+04	7	7.8	2.36E+04	7.8	9.1	1.49E+04	12.5	15.9	1.53E+04	12.4	15.8
3.00E+02	2.11E+04	8.1	3.1	2.31E+04	8.3	3.2	2.06E+04	4.5	5.2	2.27E+04	5.6	6.5	1.98E+04	7.6	9.2	2.05E+04	7.7	9.2
5.00E+02	1.80E+04	3.1	1.6	1.81E+04	3	1.6	2.06E+04	3	3.3	1.97E+04	2.7	3.1	1.85E+04	3.3	3.8	1.82E+04	3.2	3.6
7.00E+02	1.51E+04	2	1.3	1.53E+04	1.9	1.3	1.67E+04	1.9	2.3	1.64E+04	1.9	2.2	1.50E+04	2	2.3	1.50E+04	2	2.3
1.00E+03	1.37E+04	1.6	1.3	1.38E+04	1.6	1.3	1.54E+04	1.5	2	1.47E+04	1.6	2	1.37E+04	1.6	2.1	1.39E+04	1.6	2.1
2.00E+03	1.35E+04	1.5	1.2	1.37E+04	1.4	1.2	1.50E+04	1.3	1.8	1.46E+04	1.3	1.9	1.34E+04	1.5	2	1.36E+04	1.5	2
3.00E+03	1.41E+04	1.5	1.2	1.42E+04	1.5	1.2	1.61E+04	1.4	1.8	1.47E+04	1.4	1.8	1.41E+04	1.5	2	1.44E+04	1.5	2
5.00E+03	1.49E+04	1.5	1.2	1.49E+04	1.5	1.2	1.66E+04	1.4	1.7	1.56E+04	1.4	1.8	1.50E+04	1.5	2	1.47E+04	1.5	1.9
1.00E+04	1.67E+04	1.6	1.2	1.68E+04	1.6	1.2	1.59E+04	1.4	1.8	1.71E+04	1.5	1.8	1.68E+04	1.6	1.9	1.71E+04	1.6	1.9
2.00E+04	1.91E+04	1.6	1.2	1.83E+04	1.6	1.2	1.79E+04	1.6	1.8	1.87E+04	1.6	1.7	1.93E+04	1.6	1.8	1.86E+04	1.6	1.8
5.00E+04	2.50E+04	1.6	1.2	2.36E+04	1.6	1.2	2.01E+04	1.6	1.7	2.16E+04	1.7	1.7	2.48E+04	1.6	1.9	2.53E+04	1.6	1.8
1.00E+05	3.31E+04	1.6	1.2	3.15E+04	1.6	1.2	2.79E+04	1.7	1.8	3.14E+04	1.6	1.7	3.24E+04	1.6	1.8	3.24E+04	1.6	1.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.38E+02	14.9	17.8	0.00E+00	1	1
1.40E+01	1.07E-01	7.5	9.8	1.14E-01	7.3	9.9	9.88E-02	6.6	9.9	1.40E-01	7.5	9.4	4.63E+02	16.6	21.6	0.00E+00	1	1
2.00E+01	3.88E-01	7.6	9.5	3.68E-01	7.5	9.7	3.19E-01	7.6	9.7	3.67E-01	7	9.8	8.17E+02	18.7	25.4	2.77E-01	5.4	10.4
3.00E+01	1.20E+00	6.8	8.8	1.27E+00	7	9.3	1.18E+00	6.8	9.3	1.34E+00	6.4	8.5	1.63E+03	21.1	27.9	1.07E+00	5.4	8.9
5.00E+01	5.47E+00	5.7	8.6	6.00E+00	5.4	8.3	4.58E+00	5.5	9.1	6.73E+00	4.8	7.9	4.40E+03	21.6	28.7	2.53E+00	6.2	9.9
7.50E+01	4.14E+01	4.4	6.1	4.67E+01	3.8	5.2	2.65E+01	3.9	5.7	4.61E+01	3.9	5.4	9.34E+03	20.1	26.3	1.10E+01	4.7	7.9
1.00E+02	3.13E+02	11.2	15.1	3.30E+02	9	11.2	1.28E+02	3.5	4.3	5.03E+02	12.3	16.1	1.37E+04	17.7	23.1	3.97E+01	3.4	5.2
1.50E+02	5.51E+03	15.9	20.7	7.67E+03	16.7	21.9	4.65E+03	17	22.2	8.74E+03	16.4	21.3	1.92E+04	12.9	16.3	5.48E+02	2.7	3.4
2.00E+02	1.63E+04	13.8	17.7	2.15E+04	13.6	17.5	1.12E+04	13	16.3	1.56E+04	12.4	15.8	1.74E+04	7.9	10.2	1.97E+03	2.6	3.1
3.00E+02	2.46E+04	7.8	9.4	2.65E+04	7.8	9.4	1.98E+04	8.3	10	2.12E+04	7.7	9.5	1.89E+04	6.4	8.2	2.08E+04	9.7	12.1
5.00E+02	1.85E+04	2.9	3.3	1.88E+04	2.9	3.1	1.84E+04	3.3	3.6	1.91E+04	3.2	3.5	1.75E+04	3.1	3.4	1.73E+04	2.9	3.4
7.00E+02	1.54E+04	1.9	2.3	1.55E+04	1.9	2.3	1.55E+04	2	2.3	1.54E+04	1.9	2.3	1.52E+04	1.9	2.3	1.36E+04	1.9	2.3
1.00E+03	1.41E+04	1.6	2.1	1.43E+04	1.6	2	1.35E+04	1.6	2.1	1.40E+04	1.6	2.1	1.49E+04	1.6	2	1.45E+04	1.6	2.1
2.00E+03	1.37E+04	1.4	2	1.36E+04	1.4	1.9	1.32E+04	1.5	2	1.37E+04	1.4	2	1.42E+04	1.4	2	1.35E+04	1.5	2.1
3.00E+03	1.41E+04	1.4	1.9	1.42E+04	1.4	1.9	1.43E+04	1.5	2	1.47E+04	1.5	2	1.39E+04	1.4	1.9	1.42E+04	1.5	2.1
5.00E+03	1.49E+04	1.5	1.9	1.53E+04	1.5	1.8	1.52E+04	1.5	2	1.52E+04	1.5	1.9	1.48E+04	1.5	1.9	1.46E+04	1.5	1.9
1.00E+04	1.70E+04	1.6	1.9	1.71E+04	1.5	1.8	1.69E+04	1.6	1.9	1.64E+04	1.6	1.9	1.64E+04	1.5	1.9	1.62E+04	1.6	1.9
2.00E+04	1.92E+04	1.6	1.7	1.85E+04	1.6	1.7	1.90E+04	1.7	1.8	1.88E+04	1.6	1.8	1.78E+04	1.6	1.8	2.06E+04	1.6	1.8
5.00E+04	2.47E+04	1.6	1.8	2.25E+04	1.6	1.7	2.52E+04	1.6	1.8	2.31E+04	1.6	1.8	2.47E+04	1.6	1.7	2.47E+04	1.5	1.8
1.00E+05	3.14E+04	1.6	1.7	3.05E+04	1.6	1.7	3.34E+04	1.6	1.8	3.41E+04	1.6	1.7	3.19E+04	1.7	1.8	3.61E+04	1.6	1.8

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.01E-01	7.5	9.8	1.19E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	3.06E-01	7.5	9.6	3.71E-01	7.1	9.5	2.86E-01	6.2	9.3	4.43E-01	6.2	9.7	6.09E-01	5.2	7.6	7.55E-01	4.4	7.9
3.00E+01	1.10E+00	6.9	8.8	1.17E+00	6.8	8.7	9.23E-01	6.1	9.1	1.21E+00	7	9	2.15E+00	4.2	6.4	1.96E+00	3.8	6.1
5.00E+01	5.08E+00	5.7	9	5.94E+00	5.3	8.3	5.01E+00	6.1	9.4	5.01E+00	5.9	9.5	1.81E+01	4.9	5.6	2.66E+01	3.8	5.4

Table A.10. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	2.96E+01	4.2	5.7	3.79E+01	4.5	6	5.85E+01	12.7	15	2.58E+01	4.1	6.1	7.46E+02	15.9	21.6	1.32E+03	17.9	22.3
1.00E+02	2.69E+02	11.5	15.4	4.64E+02	13.6	17.5	2.87E+02	14.3	19.6	3.29E+02	12.4	18.1	7.44E+03	20.3	26.6	9.96E+03	20.3	27
1.50E+02	4.31E+03	16	21	7.01E+03	16.5	21.4	3.95E+03	16.3	21.3	4.42E+03	16.5	20.6	1.92E+04	14.4	18.5	1.79E+04	13.6	16.9
2.00E+02	1.11E+04	12.8	16.3	1.47E+04	12.7	16.1	8.25E+03	10.7	13.6	1.09E+04	11.3	15.5	1.84E+04	9.5	11.4	1.75E+04	8.6	10.5
3.00E+02	2.05E+04	8.5	10.4	2.29E+04	8.1	9.9	2.46E+04	9.8	12.1	2.59E+04	8.4	10.7	2.12E+04	6.9	8.3	2.35E+04	7	8.6
5.00E+02	1.78E+04	3.1	3.6	1.85E+04	3.1	3.4	1.82E+04	3	3.2	1.69E+04	2.9	3.1	1.96E+04	2.8	3.5	1.88E+04	2.8	2.9
7.00E+02	1.51E+04	2	2.3	1.54E+04	1.9	2.3	1.49E+04	2	2.4	1.56E+04	1.9	2.3	1.50E+04	1.9	2.3	1.65E+04	2	2.3
1.00E+03	1.41E+04	1.6	2.1	1.40E+04	1.6	2.1	1.30E+04	1.6	2.1	1.42E+04	1.6	2.1	1.35E+04	1.6	2.1	1.36E+04	1.5	2
2.00E+03	1.34E+04	1.5	2	1.39E+04	1.4	2	1.42E+04	1.5	2	1.35E+04	1.4	1.9	1.47E+04	1.4	2	1.51E+04	1.3	1.9
3.00E+03	1.38E+04	1.5	2	1.41E+04	1.5	2	1.37E+04	1.5	2	1.48E+04	1.4	1.9	1.41E+04	1.4	1.9	1.44E+04	1.4	1.9
5.00E+03	1.51E+04	1.5	2	1.50E+04	1.5	1.9	1.48E+04	1.5	1.9	1.38E+04	1.5	1.8	1.39E+04	1.5	1.8	1.56E+04	1.4	1.9
1.00E+04	1.66E+04	1.6	2	1.67E+04	1.6	1.9	1.69E+04	1.5	2	1.68E+04	1.5	1.9	1.67E+04	1.6	1.9	1.57E+04	1.5	1.9
2.00E+04	1.94E+04	1.6	1.8	1.78E+04	1.6	1.8	2.15E+04	1.6	1.8	1.97E+04	1.5	1.8	2.09E+04	1.6	1.7	1.88E+04	1.5	1.7
5.00E+04	2.45E+04	1.6	1.8	2.25E+04	1.6	1.8	2.48E+04	1.7	1.9	2.09E+04	1.6	1.8	2.46E+04	1.6	1.7	1.89E+04	1.5	1.7
1.00E+05	3.35E+04	1.6	1.8	3.16E+04	1.6	1.9	3.35E+04	1.6	1.9	3.03E+04	1.7	1.7	3.49E+04	1.6	1.8	2.83E+04	1.6	1.8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	9.42E+00	14.9	17.8	2.10E+00	15	17.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.09E-01	4.2	8.8	1.30E+01	16.5	21.5	3.18E+00	16.1	21.1	1.26E-01	7.2	10	1.34E-01	7.2	9.6
2.00E+01	3.93E-01	6.4	9.3	5.67E-01	4.9	7.6	2.23E+01	18.3	24.9	5.94E+00	17.7	23.7	4.18E-01	7.3	9.3	5.21E-01	6.8	9.7
3.00E+01	1.10E+00	6.6	8.8	2.07E+00	5	6.8	4.44E+01	20.3	27	1.12E+01	17.8	23.8	1.53E+00	6.2	8	1.59E+00	5.7	8.4
5.00E+01	5.03E+00	6.2	9.9	1.56E+01	4.6	6.1	1.97E+02	19.3	25.3	1.33E+02	16.7	22.5	9.31E+00	4.8	6.8	1.14E+01	4.3	6.4
7.50E+01	2.17E+01	4	6.2	1.74E+03	19.7	26	2.32E+03	20.3	26.7	2.20E+03	20.4	26.8	9.08E+01	5.2	6.4	1.30E+02	6.2	8
1.00E+02	9.95E+01	3.7	4.4	6.33E+03	19.8	26.1	7.52E+03	19.5	25.5	6.79E+03	19.3	25.2	1.52E+03	17	22.6	2.89E+03	18.9	24.7
1.50E+02	3.15E+03	17.1	22.4	9.86E+03	13.4	17	1.64E+04	14.7	18.9	1.59E+04	14.8	19.1	1.38E+04	16.3	21.2	1.67E+04	16	20.7
2.00E+02	9.11E+03	12	15.7	1.30E+04	10.4	13.1	2.26E+04	11.3	14.2	2.24E+04	11.5	14.3	2.52E+04	12.6	16.1	2.73E+04	12.4	15.6
3.00E+02	1.80E+04	8.9	10.7	1.90E+04	8.2	9.6	2.43E+04	6.8	8	2.51E+04	6.9	8.2	3.02E+04	7.3	8.5	3.04E+04	6.8	7.9
5.00E+02	1.87E+04	3.4	3.8	1.81E+04	3.1	3.4	1.85E+04	2.9	3.2	1.86E+04	2.8	3.2	1.90E+04	2.6	2.9	1.95E+04	2.6	2.9
7.00E+02	1.46E+04	2	2.3	1.47E+04	1.9	2.3	1.59E+04	1.9	2.3	1.59E+04	1.9	2.3	1.61E+04	1.9	2.3	1.65E+04	1.9	2.2
1.00E+03	1.29E+04	1.6	2.1	1.42E+04	1.6	2.1	1.43E+04	1.6	2.1	1.42E+04	1.6	2	1.43E+04	1.6	2	1.49E+04	1.5	2
2.00E+03	1.38E+04	1.4	2	1.33E+04	1.5	2	1.39E+04	1.4	1.9	1.40E+04	1.4	1.9	1.38E+04	1.4	1.9	1.42E+04	1.3	1.9
3.00E+03	1.40E+04	1.5	2.1	1.41E+04	1.5	2	1.44E+04	1.4	1.9	1.45E+04	1.4	1.9	1.47E+04	1.4	1.8	1.44E+04	1.4	1.8
5.00E+03	1.59E+04	1.6	1.9	1.53E+04	1.6	1.9	1.49E+04	1.5	1.8	1.51E+04	1.4	1.8	1.52E+04	1.4	1.8	1.56E+04	1.4	1.8
1.00E+04	1.73E+04	1.6	2	1.65E+04	1.6	1.9	1.66E+04	1.5	1.9	1.64E+04	1.5	1.8	1.64E+04	1.5	1.8	1.70E+04	1.5	1.8
2.00E+04	1.91E+04	1.7	1.8	1.85E+04	1.6	1.8	1.86E+04	1.6	1.7	1.80E+04	1.6	1.7	1.78E+04	1.6	1.7	1.79E+04	1.6	1.7
5.00E+04	2.72E+04	1.7	1.8	2.32E+04	1.7	1.8	2.33E+04	1.6	1.7	2.27E+04	1.6	1.7	2.08E+04	1.7	1.7	2.12E+04	1.7	1.7
1.00E+05	3.38E+04	1.5	1.8	3.57E+04	1.6	1.7	2.96E+04	1.6	1.7	2.93E+04	1.6	1.7	2.79E+04	1.6	1.8	2.57E+04	1.7	1.7

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.23E+03	9.5	5.7	2.71E+03	9.5	5.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.45E+03	10.2	7.4	5.41E+03	10.2	7.4	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.67E+03	10.9	9	8.09E+03	10.9	9	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.11E+04	12.3	11.8	1.34E+04	12.3	11.8	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.98E+00	13.8	15.6	0.00E+00	1	1	2.18E+04	15.1	18.1	2.65E+04	15.1	18.2	2.67E+01	14.9	17.7	3.90E+00	14.7	17.6
1.40E+01	4.89E+00	13.8	18.4	1.89E-01	4.9	7.2	3.02E+04	16.9	22.3	3.62E+04	16.9	22.3	4.20E+01	16.7	21.6	6.24E+00	16	21.5
2.00E+01	2.92E+01	15.7	21.3	5.99E-01	4.8	7.8	4.16E+04	19.2	26.6	4.98E+04	19.3	26.7	7.15E+01	18.7	25.4	1.06E+01	17.6	24.6
3.00E+01	1.33E+02	16.5	20.2	5.82E+00	6.5	9.1	5.62E+04	22.8	30.3	5.94E+04	23.6	31.4	1.44E+02	20.8	27.2	1.93E+01	19.5	26.3
5.00E+01	3.08E+03	20.5	27.4	4.92E+02	17.3	22.7	4.49E+04	21.8	28.4	4.52E+04	21.6	28	5.22E+02	21.3	28.1	1.08E+02	19.4	25.5
7.50E+01	1.27E+04	21.1	27.5	5.95E+03	21.1	27.8	3.44E+04	15.6	20.3	3.41E+04	15.3	19.8	1.57E+03	20.4	26.8	8.38E+02	20.5	26.9
1.00E+02	2.08E+04	18.4	24	1.29E+04	19.1	24.9	2.88E+04	12.1	15.1	2.90E+04	11.9	14.9	2.91E+03	17.9	23.3	2.20E+03	18.5	23.9
1.50E+02	2.26E+04	12.3	15.5	2.08E+04	13.5	17.1	2.48E+04	8.9	10.6	2.50E+04	8.9	10.6	6.65E+03	14.2	18.3	6.49E+03	14.5	18.8
2.00E+02	2.20E+04	9.1	10.7	2.20E+04	9.6	12.3	2.41E+04	7.6	8.9	2.44E+04	7.6	8.9	1.26E+04	12	15.2	1.38E+04	12.6	16
3.00E+02	2.56E+04	7	8.5	2.51E+04	6.8	8.6	2.35E+04	5.4	6.2	2.40E+04	5.5	6.3	2.14E+04	8.3	10.2	2.30E+04	8.2	10
5.00E+02	1.88E+04	2.6	3.1	1.88E+04	2.6	3.2	1.92E+04	2.8	3.1	1.96E+04	2.7	3.1	1.85E+04	3.2	3.5	1.88E+04	3	3.4
7.00E+02	1.63E+04	1.9	2.2	1.71E+04	1.9	2.3	1.66E+04	1.9	2.3	1.68E+04	1.9	2.2	1.51E+04	2	2.3	1.57E+04	1.9	2.3
1.00E+03	1.53E+04	1.5	2	1.47E+04	1.5	2	1.51E+04	1.5	2	1.51E+04	1.5	2	1.36E+04	1.6	2.1	1.40E+04	1.6	2.1
2.00E+03	1.41E+04	1.4	1.9	1.42E+04	1.3	1.9	1.44E+04	1.3	1.8	1.44E+04	1.3	1.8	1.35E+04	1.5	2	1.36E+04	1.4	2
3.00E+03	1.45E+04	1.4	1.8	1.49E+04	1.4	1.8	1.49E+04	1.3	1.8	1.49E+04	1.3	1.7	1.43E+04	1.5	2	1.43E+04	1.4	1.9

(continued on next page)

Table A.10. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	1.54E+04	1.4	1.8	1.47E+04	1.4	1.8	1.53E+04	1.4	1.7	1.56E+04	1.4	1.7	1.54E+04	1.5	1.9	1.52E+04	1.5	1.9
1.00E+04	1.70E+04	1.5	1.8	1.86E+04	1.5	1.8	1.68E+04	1.5	1.7	1.66E+04	1.5	1.7	1.66E+04	1.6	1.9	1.70E+04	1.6	1.9
2.00E+04	1.88E+04	1.5	1.7	1.85E+04	1.5	1.7	1.84E+04	1.6	1.6	1.82E+04	1.6	1.6	1.91E+04	1.6	1.8	1.82E+04	1.6	1.8
5.00E+04	2.23E+04	1.7	1.7	1.96E+04	1.7	1.8	2.22E+04	1.7	1.6	2.18E+04	1.7	1.6	2.48E+04	1.6	1.8	2.35E+04	1.6	1.8
1.00E+05	2.89E+04	1.6	1.6	2.64E+04	1.7	1.7	2.79E+04	1.7	1.6	2.69E+04	1.7	1.6	3.25E+04	1.6	1.8	3.12E+04	1.6	1.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.08E+02	14.9	17.8	4.88E+01	14.8	17.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	4.81E+02	16.7	21.7	7.73E+01	16.1	21.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.59E-01	4.7	9	2.81E-01	4.8	9.6	8.15E+02	18.8	25.6	1.25E+02	18.2	25.2	3.90E-01	7.7	8.9	3.43E-01	5.6	9.7
3.00E+01	1.08E+00	5.4	9.1	1.14E+00	5.4	9.2	1.59E+03	21.2	27.8	2.08E+02	20.7	27.9	9.92E-01	6.1	9.3	1.03E+00	5.6	9
5.00E+01	4.44E+00	6.6	11.2	3.70E+00	6.9	9.9	4.43E+03	21.6	28.5	8.76E+02	20.4	26.8	2.78E+00	5	9.2	4.58E+00	5.8	10.4
7.50E+01	1.55E+01	4.1	6.9	1.49E+01	4.6	7.4	1.02E+04	20.6	27	4.50E+03	21.1	27.6	1.59E+01	4.6	7.3	1.25E+01	4.3	7.1
1.00E+02	8.53E+01	3.4	4.8	6.19E+01	3.5	5	1.42E+04	17.6	22.8	8.58E+03	18.6	23.9	6.85E+01	3.9	4.7	5.37E+01	3.7	5.1
1.50E+02	7.72E+02	7.8	11.4	6.00E+02	2.7	3.4	1.91E+04	12.7	16.1	1.29E+04	12.7	15.9	2.06E+03	14.1	19.6	6.72E+02	3.9	3.9
2.00E+02	8.76E+03	14.5	19	6.30E+03	12.5	16.4	2.40E+04	10.4	13.3	2.25E+04	12.9	16.5	6.61E+03	12.4	15.9	6.40E+03	13.7	17.9
3.00E+02	1.79E+04	8.7	10.2	2.27E+04	9.5	11.6	2.73E+04	6.6	7.8	2.70E+04	7	8.2	1.86E+04	8.8	11.6	2.26E+04	9.5	11.8
5.00E+02	1.72E+04	3.1	3.8	1.99E+04	2.8	3.2	1.88E+04	2.8	3	2.05E+04	2.6	2.9	1.74E+04	3.6	3.6	1.70E+04	3.2	3.6
7.00E+02	1.55E+04	2.1	2.3	1.51E+04	1.9	2.3	1.64E+04	2	2.3	1.52E+04	1.9	2.3	1.49E+04	2	2.3	1.67E+04	2	2.3
1.00E+03	1.20E+04	1.5	2.1	1.31E+04	1.7	2.1	1.51E+04	1.6	2	1.47E+04	1.6	2	1.34E+04	1.6	2.1	1.50E+04	1.6	2.1
2.00E+03	1.32E+04	1.5	2.1	1.36E+04	1.5	2.1	1.44E+04	1.3	1.9	1.33E+04	1.4	1.9	1.35E+04	1.5	2	1.44E+04	1.5	2.1
3.00E+03	1.49E+04	1.5	2.1	1.40E+04	1.6	2	1.54E+04	1.3	1.8	1.43E+04	1.4	1.9	1.31E+04	1.5	2	1.44E+04	1.5	2
5.00E+03	1.60E+04	1.5	1.9	1.57E+04	1.6	1.9	1.56E+04	1.4	1.8	1.59E+04	1.4	1.8	1.58E+04	1.4	2	1.55E+04	1.5	2.2
1.00E+04	1.56E+04	1.6	1.9	1.66E+04	1.7	1.9	1.72E+04	1.5	1.8	1.69E+04	1.5	1.8	1.70E+04	1.5	2.1	1.78E+04	1.6	1.9
2.00E+04	1.88E+04	1.5	1.8	1.80E+04	1.6	1.7	1.82E+04	1.6	1.7	1.59E+04	1.5	1.7	2.10E+04	1.7	1.9	1.79E+04	1.5	1.9
5.00E+04	2.49E+04	1.6	1.8	2.66E+04	1.7	1.8	2.24E+04	1.7	1.7	2.07E+04	1.6	1.7	2.46E+04	1.6	1.9	2.47E+04	1.5	1.8
1.00E+05	3.36E+04	1.6	1.7	3.38E+04	1.5	1.8	2.64E+04	1.7	1.7	2.42E+04	1.6	1.7	3.20E+04	1.7	1.8	3.25E+04	1.5	1.7

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.89E+01	14.7	16.8	0.00E+00	1	1
1.40E+01	1.02E-01	6.9	9.8	0.00E+00	1	1	9.80E-02	6.8	9.8	9.80E-02	7	10.1	3.20E+01	16.2	20.7	1.34E-01	6.1	8.8
2.00E+01	3.26E-01	7.5	9.6	4.06E-01	7.1	9.6	2.86E-01	7.9	9.3	4.00E-01	7.9	9.8	5.68E+01	17.8	23.6	4.56E-01	5	8.6
3.00E+01	1.12E+00	7.2	9.1	1.17E+00	7.1	8.9	1.04E+00	7	9.1	1.05E+00	7.2	9.3	1.82E+02	18.4	24.2	2.96E+00	7.7	10.6
5.00E+01	4.65E+00	6	9.5	5.11E+00	5.8	8.3	4.06E+00	6.1	9.5	3.92E+00	5.9	9.5	1.61E+03	21.5	28.2	6.99E+01	16.1	20.7
7.50E+01	2.32E+01	4.1	6	2.98E+01	3.8	5.8	1.72E+01	4.3	6.2	1.88E+01	4.2	6.1	4.15E+03	20.6	27	1.97E+03	20.7	27.4
1.00E+02	1.25E+02	3.4	4.6	1.77E+02	5.6	7.2	8.28E+01	3.6	4.7	9.68E+01	3.3	4.5	6.38E+03	17.9	23.3	5.18E+03	19.3	25.3
1.50E+02	3.81E+03	16.4	21.5	5.02E+03	16.1	21	1.03E+03	9.1	12.4	1.32E+03	10.1	12.9	8.71E+03	12.7	16.1	8.84E+03	13.4	17.2
2.00E+02	1.05E+04	12.7	16.2	1.44E+04	13.5	17.1	9.58E+03	14.7	19	1.01E+04	14.7	19.1	1.33E+04	10.7	13.7	1.43E+04	11.7	14.5
3.00E+02	2.21E+04	9.1	11.1	2.40E+04	8.5	10.5	1.93E+04	8.5	10.2	2.12E+04	8.3	10.4	2.12E+04	8	9.8	2.29E+04	8	9.7
5.00E+02	1.80E+04	3	3.3	1.84E+04	3	3.2	1.80E+04	3.5	3.9	1.93E+04	3.3	3.8	1.88E+04	3.2	3.6	1.87E+04	3.2	3.3
7.00E+02	1.51E+04	1.9	2.3	1.56E+04	1.9	2.3	1.48E+04	1.9	2.4	1.58E+04	1.9	2.4	1.52E+04	1.9	2.3	1.52E+04	1.9	2.3
1.00E+03	1.37E+04	1.6	2.1	1.39E+04	1.6	2.1	1.28E+04	1.6	2.1	1.35E+04	1.6	2.1	1.38E+04	1.6	2.1	1.42E+04	1.6	2
2.00E+03	1.36E+04	1.5	2	1.36E+04	1.4	2	1.34E+04	1.5	2	1.38E+04	1.5	2	1.36E+04	1.5	2	1.34E+04	1.4	2
3.00E+03	1.44E+04	1.5	2	1.42E+04	1.4	1.9	1.42E+04	1.5	2	1.42E+04	1.5	2	1.42E+04	1.5	2	1.43E+04	1.5	1.9
5.00E+03	1.54E+04	1.5	1.9	1.58E+04	1.5	1.9	1.44E+04	1.5	2	1.51E+04	1.5	1.9	1.54E+04	1.5	1.9	1.51E+04	1.5	1.9
1.00E+04	1.66E+04	1.6	2	1.69E+04	1.6	1.9	1.65E+04	1.6	2	1.69E+04	1.5	2	1.67E+04	1.5	1.9	1.74E+04	1.5	1.9
2.00E+04	1.96E+04	1.6	1.8	1.80E+04	1.6	1.8	1.84E+04	1.6	1.9	1.90E+04	1.6	1.8	1.88E+04	1.5	1.8	1.86E+04	1.6	1.8
5.00E+04	2.48E+04	1.6	1.8	2.23E+04	1.6	1.8	2.35E+04	1.6	1.8	2.52E+04	1.6	1.8	2.44E+04	1.6	1.8	2.40E+04	1.6	1.7
1.00E+05	3.41E+04	1.6	1.8	3.33E+04	1.6	1.7	3.44E+04	1.5	1.8	3.27E+04	1.6	1.8	3.29E+04	1.6	1.7	3.13E+04	1.6	1.8

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

Table A.10. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.05E+01	14.9	17.8	1.68E+00	14.9	17.7	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.19E+01	16.6	21.6	2.72E+00	16.2	20.9	1.05E-01	5.6	9.1	1.07E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	5.40E+01	18.5	25.2	4.49E+00	17.1	23.3	3.57E-01	6.6	9	4.59E+00	10.3	18.7	2.86E-01	6.8	9.7	3.11E-01	7.1	10.1
3.00E+01	9.72E+01	20.3	26.7	1.03E+01	17.5	23.2	1.78E+00	6	8.8	1.93E+01	15.7	20.5	9.37E-01	7.1	9.5	9.88E-01	7.1	9.2
5.00E+01	6.62E+02	20.3	26.9	1.62E+02	18.3	24.4	3.27E+01	14.6	15.2	2.46E+02	19.9	26	3.57E+00	6.7	10.6	4.18E+00	6.1	9.8
7.50E+01	3.99E+03	20.8	27.2	1.52E+03	20	26.3	1.17E+03	20.6	27	2.17E+03	21.1	27.6	1.04E+01	5.4	8.3	1.65E+01	4.2	6.5
1.00E+02	9.29E+03	18.9	24.7	5.63E+03	19.2	25.1	3.18E+03	18.2	23.5	5.33E+03	18.5	23.5	3.28E+01	3.9	5.6	6.48E+01	3.5	4.8
1.50E+02	1.77E+04	14.2	18.3	1.58E+04	15.1	19.5	9.98E+03	15.6	20.1	1.36E+04	15.4	19.8	3.99E+02	2.9	3.5	7.45E+02	4	4.9
2.00E+02	2.17E+04	10.7	13.3	2.17E+04	11.4	14.3	2.47E+04	13.7	17.5	2.64E+04	12.6	15.6	1.45E+03	3.6	4.2	8.62E+03	15.1	19.4
3.00E+02	2.32E+04	6.7	7.8	2.40E+04	6.9	8.1	2.63E+04	6.8	8.5	2.45E+04	6.7	7.6	1.97E+04	11.2	14.1	2.06E+04	8.7	10.8
5.00E+02	1.85E+04	3	3.3	1.87E+04	2.9	3.3	1.99E+04	2.7	3.2	1.96E+04	2.8	3.1	1.84E+04	3.7	3.9	1.79E+04	3.1	3.8
7.00E+02	1.57E+04	1.9	2.3	1.58E+04	1.9	2.3	1.72E+04	1.9	2.3	1.64E+04	1.9	2.3	1.35E+04	1.9	2.4	1.55E+04	1.9	2.3
1.00E+03	1.43E+04	1.6	2	1.44E+04	1.6	2	1.43E+04	1.6	2	1.39E+04	1.6	2	1.36E+04	1.6	2.1	1.39E+04	1.6	2.1
2.00E+03	1.39E+04	1.4	1.9	1.39E+04	1.4	1.9	1.34E+04	1.4	1.9	1.39E+04	1.4	1.9	1.29E+04	1.5	2.1	1.37E+04	1.5	2
3.00E+03	1.44E+04	1.4	1.9	1.45E+04	1.4	1.9	1.51E+04	1.4	1.9	1.46E+04	1.4	1.8	1.42E+04	1.5	2.1	1.39E+04	1.5	2
5.00E+03	1.50E+04	1.5	1.8	1.51E+04	1.5	1.8	1.55E+04	1.5	1.8	1.40E+04	1.4	1.9	1.49E+04	1.5	2	1.42E+04	1.5	1.9
1.00E+04	1.67E+04	1.5	1.9	1.66E+04	1.5	1.9	1.78E+04	1.5	1.8	1.69E+04	1.5	1.9	1.56E+04	1.6	2.1	1.75E+04	1.6	2
2.00E+04	1.88E+04	1.6	1.7	1.82E+04	1.6	1.7	1.92E+04	1.6	1.8	1.58E+04	1.5	1.8	1.94E+04	1.6	1.8	1.94E+04	1.5	1.8
5.00E+04	2.37E+04	1.6	1.7	2.30E+04	1.6	1.7	2.13E+04	1.6	1.7	2.13E+04	1.8	1.7	2.54E+04	1.6	1.9	2.41E+04	1.7	1.8
1.00E+05	3.05E+04	1.6	1.7	2.99E+04	1.6	1.7	2.92E+04	1.7	1.7	2.86E+04	1.8	1.6	3.68E+04	1.5	1.8	3.18E+04	1.6	1.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.08E-01	6.9	10.2	1.03E-01	7.4	9.6	1.15E-01	7.3	9.7	1.02E-01	6.2	10.1	1.23E-01	6.6	9.7
2.00E+01	3.59E-01	5.2	9.4	3.09E-01	6.9	9.8	3.00E-01	7.2	9.6	3.45E-01	7.2	9.6	4.04E-01	7.2	9.5	3.23E-01	6.4	9.9
3.00E+01	8.42E-01	7.2	9.3	8.49E-01	7.3	9.3	1.04E+00	7.2	9	1.10E+00	7	8.9	1.10E+00	6.9	9	1.21E+00	6.9	8.8
5.00E+01	4.49E+00	6.2	10.2	3.73E+00	6.8	10.3	4.68E+00	6	8.7	4.71E+00	5.4	8.7	4.48E+00	5.3	8.9	5.34E+00	5	7.9
7.50E+01	1.21E+01	5.2	7.9	1.34E+01	4.9	7.9	2.40E+01	4.1	5.9	2.61E+01	3.9	5.8	2.49E+01	4	6	3.41E+01	3.7	5.1
1.00E+02	3.89E+01	3.7	5.5	4.56E+01	3.8	5.4	1.69E+02	8.4	10.5	1.33E+02	3.6	4.5	1.35E+02	3.5	4.3	1.91E+02	3.5	4.2
1.50E+02	4.84E+02	3.1	3.4	5.65E+02	3	4	3.42E+03	16.1	21	4.13E+03	16.4	21.5	3.42E+03	16	21	7.00E+03	17	22.1
2.00E+02	1.81E+03	6.9	7.5	4.11E+03	12	16.1	1.03E+04	12.8	16.4	1.15E+04	13.3	17	1.29E+04	14.2	17.7	1.77E+04	13.1	16.7
3.00E+02	1.80E+04	9.1	12.1	2.03E+04	9.3	11.7	1.94E+04	8.6	10.4	2.05E+04	8.4	10.4	2.04E+04	8.4	10.1	2.33E+04	7.9	9.5
5.00E+02	1.96E+04	3	3.6	1.79E+04	3.2	3.4	1.79E+04	3.3	3.9	1.83E+04	3.2	3.6	2.00E+04	3.2	3.6	1.89E+04	2.9	3.3
7.00E+02	1.34E+04	1.9	2.3	1.45E+04	1.9	2.3	1.48E+04	2	2.3	1.49E+04	2	2.3	1.54E+04	1.9	2.3	1.48E+04	1.9	2.3
1.00E+03	1.25E+04	1.6	2.2	1.35E+04	1.6	2.1	1.33E+04	1.6	2.1	1.35E+04	1.6	2.1	1.30E+04	1.6	2.1	1.35E+04	1.6	2.1
2.00E+03	1.35E+04	1.5	2.1	1.30E+04	1.5	2	1.32E+04	1.5	2	1.35E+04	1.5	2	1.32E+04	1.5	2	1.40E+04	1.4	2
3.00E+03	1.35E+04	1.6	2.1	1.39E+04	1.5	2.1	1.41E+04	1.5	2	1.43E+04	1.5	2	1.38E+04	1.5	2	1.45E+04	1.4	1.9
5.00E+03	1.54E+04	1.5	2.2	1.54E+04	1.5	1.9	1.52E+04	1.5	2	1.50E+04	1.5	1.9	1.55E+04	1.5	2	1.47E+04	1.5	1.9
1.00E+04	1.66E+04	1.6	2	1.67E+04	1.6	2.1	1.63E+04	1.6	2	1.72E+04	1.6	1.9	1.73E+04	1.6	1.9	1.62E+04	1.6	1.9
2.00E+04	1.85E+04	1.6	1.8	1.82E+04	1.5	1.9	1.95E+04	1.6	1.8	1.87E+04	1.6	1.8	1.98E+04	1.6	1.8	2.01E+04	1.6	1.7
5.00E+04	2.99E+04	1.8	1.8	2.29E+04	1.6	1.8	2.60E+04	1.6	1.8	2.48E+04	1.6	1.8	2.70E+04	1.6	1.8	2.34E+04	1.6	1.8
1.00E+05	3.51E+04	1.6	1.8	3.38E+04	1.5	1.8	3.40E+04	1.6	1.8	3.40E+04	1.6	1.8	3.25E+04	1.5	1.8	3.04E+04	1.6	1.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.28E-01	5.8	8.7	0.00E+00	1	1	2.66E+00	4.8	6.4	2.66E+00	4.8	6.4
2.00E+01	5.52E-01	6.4	8.2	0.00E+00	1	1	1.32E+01	4.6	5.9	1.32E+01	4.6	5.9
3.00E+01	1.16E+00	5.7	7.8	1.83E+00	5.3	7.5	3.53E+03	13.1	13.8	3.53E+03	13.1	13.8
5.00E+01	1.35E+01	4.4	6.4	1.37E+01	6.5	7.8	5.07E+04	24.1	31.1	5.07E+04	24.1	31.1
7.50E+01	7.89E+02	19.2	24.4	5.71E+02	18.4	23.6	3.76E+04	17.6	23.1	3.76E+04	17.6	23.1
1.00E+02	4.00E+03	19.1	25	3.08E+03	19.3	25.2	3.18E+04	13.4	17	3.18E+04	13.4	17
1.50E+02	1.55E+04	15.7	20.5	1.32E+04	15.6	20.4	2.61E+04	9.5	14.8	2.61E+04	9.5	14.8

(continued on next page)

Table A.10. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	1.80E+04	10	12.5	1.61E+04	10.6	12	2.71E+04	7.6	9.2	2.71E+04	7.6	9.2
3.00E+02	2.44E+04	8.9	11	2.60E+04	8.5	10.4	2.43E+04	5.4	6.7	2.43E+04	5.4	6.7
5.00E+02	1.80E+04	2.9	3	1.88E+04	2.9	3.5	2.05E+04	2.7	2.8	2.05E+04	2.7	2.8
7.00E+02	1.48E+04	1.9	2.2	1.83E+04	1.9	2.2	1.67E+04	1.9	2.2	1.67E+04	1.9	2.2
1.00E+03	1.45E+04	1.6	2.1	1.50E+04	1.6	2.1	1.40E+04	1.5	2.2	1.40E+04	1.5	2.2
2.00E+03	1.36E+04	1.4	2	1.30E+04	1.4	1.9	1.50E+04	1.3	1.9	1.50E+04	1.3	1.9
3.00E+03	1.44E+04	1.6	1.9	1.43E+04	1.4	1.9	1.51E+04	1.3	1.6	1.51E+04	1.3	1.6
5.00E+03	1.57E+04	1.4	1.8	1.62E+04	1.5	1.8	1.54E+04	1.4	1.6	1.54E+04	1.4	1.6
1.00E+04	1.54E+04	1.6	1.9	1.75E+04	1.5	1.9	1.60E+04	1.4	1.7	1.60E+04	1.4	1.7
2.00E+04	1.83E+04	1.6	1.7	1.83E+04	1.6	1.8	1.78E+04	1.5	1.7	1.78E+04	1.5	1.7
5.00E+04	2.51E+04	1.6	1.8	2.25E+04	1.7	1.7	1.73E+04	1.6	1.7	1.73E+04	1.6	1.7
1.00E+05	3.11E+04	1.5	1.7	2.92E+04	1.7	1.8	2.55E+04	1.7	1.7	2.55E+04	1.7	1.7

Table A.11. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{16}O ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.26E+00	13.2	3.5	1.09E+00	13.3	3.5	3.22E+02	12.7	13	3.57E+02	12.9	13.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	5.03E+00	14.4	4.3	1.62E+00	14.3	4.3	6.10E+02	13.9	15.7	6.03E+02	14.1	16.2	1.10E-01	7.1	9.6	1.22E-01	7	9.5
2.00E+01	8.51E+00	16	5.2	3.13E+00	15.4	4.9	1.40E+03	15.4	19	1.20E+03	15.7	19.5	4.18E-01	7	9.5	3.68E-01	6.9	9.6
3.00E+01	1.79E+01	17.7	5.9	5.89E+00	15.9	5.4	3.65E+03	17.6	23	3.52E+03	16.9	21.4	1.26E+00	6.3	9.1	1.29E+00	6.7	9.1
5.00E+01	6.49E+01	18.1	6	4.36E+01	14.4	4.8	2.13E+04	20.7	27	1.45E+04	21.2	27.4	6.31E+00	5	8	6.47E+00	5.1	8
7.50E+01	6.66E+02	18.6	6.2	7.89E+02	18.9	6.3	4.08E+04	22.2	27.7	2.56E+04	22	27.5	5.25E+01	11.2	13.5	4.77E+01	3.7	5.1
1.00E+02	3.31E+03	20.8	6.8	3.12E+03	20.7	6.8	4.68E+04	19.9	24.6	3.29E+04	19.9	24.7	2.44E+02	11.9	15.5	3.75E+02	11.3	14.4
1.50E+02	7.98E+03	16.9	5.7	8.26E+03	17.1	5.8	3.90E+04	13.5	16.1	3.37E+04	14.8	17.9	6.78E+03	18.9	23.6	7.40E+03	18.7	23.4
2.00E+02	1.40E+04	14.4	4.9	1.47E+04	14.4	4.9	3.32E+04	9.5	10.8	3.01E+04	10.8	12.3	1.54E+04	15.5	19.2	1.67E+04	15.8	19.4
3.00E+02	2.44E+04	10.6	3.8	2.75E+04	11	3.9	2.49E+04	6.1	6.2	2.74E+04	7.4	8.2	2.35E+04	10.1	11.9	2.39E+04	9.8	11.6
5.00E+02	2.35E+04	4.8	2	2.37E+04	4.6	1.9	2.70E+04	4.5	4.7	2.60E+04	4.3	4.5	2.31E+04	4.9	5.3	2.40E+04	4.8	5
7.00E+02	1.90E+04	2.9	1.5	1.95E+04	2.9	1.5	2.25E+04	2.9	3	2.18E+04	2.9	2.9	1.96E+04	3	3	1.94E+04	2.9	3
1.00E+03	1.70E+04	2.3	1.3	1.71E+04	2.3	1.3	1.94E+04	2.4	2.4	1.87E+04	2.4	2.4	1.69E+04	2.3	2.4	1.73E+04	2.3	2.4
2.00E+03	1.64E+04	2	1.3	1.64E+04	2	1.3	1.99E+04	2.1	2.1	1.77E+04	2.1	2.1	1.64E+04	2	2.2	1.66E+04	2	2.2
3.00E+03	1.73E+04	2	1.3	1.73E+04	2	1.3	1.81E+04	2.1	2	1.86E+04	2.1	2	1.73E+04	2	2.1	1.74E+04	2	2.1
5.00E+03	1.84E+04	2.1	1.3	1.84E+04	2.1	1.2	1.87E+04	2.1	1.9	1.89E+04	2.2	1.9	1.88E+04	2.1	2.1	1.82E+04	2.1	2
1.00E+04	2.08E+04	2.1	1.2	1.99E+04	2.1	1.2	2.00E+04	2.2	1.9	2.16E+04	2.2	1.9	1.99E+04	2.1	2	2.09E+04	2.1	2
2.00E+04	2.35E+04	2.1	1.2	2.26E+04	2.2	1.2	2.44E+04	2.3	1.8	2.23E+04	2.3	1.8	2.43E+04	2.1	1.9	2.28E+04	2.1	1.9
5.00E+04	2.90E+04	2.1	1.2	2.82E+04	2.1	1.2	2.55E+04	2.3	1.8	2.86E+04	2.3	1.8	2.99E+04	2.1	1.9	2.76E+04	2.1	1.8
1.00E+05	4.05E+04	2	1.2	3.68E+04	2	1.2	3.48E+04	2.3	1.8	3.36E+04	2.3	1.7	4.07E+04	1.9	1.8	3.81E+04	2	1.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.96E+02	13.3	14.1	0.00E+00	1	1
1.40E+01	1.08E-01	7.5	9.8	1.16E-01	7.3	9.9	1.01E-01	6.6	9.9	1.38E-01	7.5	9.4	5.19E+02	14.7	17.4	0.00E+00	1	1
2.00E+01	3.96E-01	7.6	9.5	3.79E-01	7.5	9.6	3.25E-01	7.6	9.7	3.79E-01	7	9.8	8.97E+02	16.6	21.2	2.77E-01	5.4	10.4
3.00E+01	1.24E+00	6.8	8.8	1.31E+00	7	9.3	1.21E+00	6.8	9.3	1.37E+00	6.4	8.5	1.75E+03	18.8	25	1.12E+00	5.4	8.9
5.00E+01	5.70E+00	5.6	8.5	6.27E+00	5.3	8.3	4.78E+00	5.5	9	6.99E+00	4.7	7.8	4.60E+03	21.2	27	2.71E+00	6.2	9.9
7.50E+01	3.54E+01	3.6	5.3	4.10E+01	3.5	5	2.69E+01	3.9	5.7	4.60E+01	3.7	5.1	9.96E+03	21.7	27.3	1.14E+01	4.7	7.9
1.00E+02	2.63E+02	8.8	11	2.54E+02	6.5	7.7	1.06E+02	3.4	4.3	2.47E+02	6.2	9.1	1.55E+04	20.2	25.2	4.06E+01	3.4	5.2
1.50E+02	5.12E+03	17.5	21.9	5.88E+03	17.8	22.4	3.71E+03	18.4	23	8.87E+03	19.4	24.1	2.36E+04	16.4	20	3.32E+02	2.3	3.4
2.00E+02	1.67E+04	16.4	20.2	2.24E+04	16.7	20.7	1.14E+04	15.6	19.4	1.67E+04	15.4	18.8	2.17E+04	11.5	13.6	1.75E+03	2.6	3.1
3.00E+02	2.92E+04	10.5	12.3	3.14E+04	10.3	12	2.28E+04	10.8	12.8	2.69E+04	10.6	11.9	2.07E+04	7.9	8.6	2.37E+04	13	15.8
5.00E+02	2.36E+04	4.6	4.7	2.42E+04	4.3	4.3	2.38E+04	5	5.2	2.32E+04	4.8	5	2.60E+04	4.5	5.3	2.82E+04	4.8	5.8
7.00E+02	1.97E+04	2.9	2.9	1.98E+04	2.9	2.9	1.92E+04	2.9	3	1.94E+04	3	2.9	2.03E+04	2.9	3	2.07E+04	2.9	2.9
1.00E+03	1.73E+04	2.3	2.4	1.76E+04	2.4	2.4	1.62E+04	2.3	2.4	1.80E+04	2.3	2.4	1.79E+04	2.3	2.4	1.76E+04	2.2	2.5
2.00E+03	1.66E+04	2	2.2	1.65E+04	2	2.1	1.64E+04	2	2.2	1.67E+04	2	2.2	1.83E+04	2	2.1	1.71E+04	2	2.2
3.00E+03	1.75E+04	2	2.1	1.76E+04	2	2.1	1.71E+04	2	2.1	1.69E+04	2	2.1	1.80E+04	2.1	2	1.77E+04	2.1	2.1
5.00E+03	1.85E+04	2.1	2	1.87E+04	2.1	2	1.85E+04	2.1	2	1.71E+04	2.1	2	1.86E+04	2	2	1.52E+04	2	2
1.00E+04	2.11E+04	2.1	2	1.99E+04	2.1	2	1.93E+04	2.1	2.1	1.99E+04	2.1	2	2.16E+04	2	2	2.04E+04	1.9	2.1
2.00E+04	2.31E+04	2.2	1.9	2.27E+04	2.2	1.8	2.25E+04	2	1.9	2.22E+04	2.1	1.9	2.20E+04	2.3	1.9	2.12E+04	2	1.9
5.00E+04	2.75E+04	2.2	1.8	2.82E+04	2.2	1.8	2.97E+04	2.1	1.9	2.85E+04	2.1	1.9	2.72E+04	2.2	1.8	2.85E+04	2	1.9
1.00E+05	3.69E+04	2.1	1.8	3.46E+04	2.1	1.8	3.74E+04	1.9	1.8	3.73E+04	2	1.8	3.87E+04	2	1.8	3.81E+04	1.8	1.7

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.03E-01	7.5	9.8	1.20E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.11. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	3.19E-01	7.5	9.6	3.80E-01	7.1	9.5	2.91E-01	6.2	9.3	4.42E-01	6.2	9.7	6.02E-01	5.2	7.6	7.54E-01	4.4	7.9
3.00E+01	1.14E+00	6.9	8.8	1.21E+00	6.8	8.7	9.80E-01	6.1	9.1	1.23E+00	7	9	2.24E+00	4.2	6.4	2.06E+00	3.8	6.1
5.00E+01	5.26E+00	5.6	8.9	6.17E+00	5.3	8.3	5.19E+00	6	9.3	5.18E+00	5.9	9.4	1.84E+01	4.7	5.6	1.77E+01	3.8	5.3
7.50E+01	2.82E+01	4	5.6	3.82E+01	4	5.1	3.66E+01	11.8	12.9	2.63E+01	4.1	6.1	3.76E+02	11.9	15.9	6.18E+02	12.9	15.5
1.00E+02	1.58E+02	7.2	9	2.68E+02	10.3	12.8	2.52E+02	14	17.3	1.84E+02	10.3	7.8	6.15E+03	20	25.4	8.72E+03	20.7	26.2
1.50E+02	3.86E+03	17.9	22.4	6.47E+03	18.5	23.2	3.84E+03	18.1	22.4	3.75E+03	17.1	21.2	2.27E+04	18.4	22.9	2.24E+04	17.6	21.8
2.00E+02	1.15E+04	15.7	19.2	1.57E+04	15.7	19.3	8.06E+03	13.4	15.7	1.02E+04	13.1	17.2	1.98E+04	12	15.1	2.07E+04	11.9	13.6
3.00E+02	2.36E+04	11.1	13	2.60E+04	10.7	12.5	2.63E+04	13	15.7	3.39E+04	12.3	14.5	2.50E+04	8.7	11.2	3.32E+04	10.8	12
5.00E+02	2.38E+04	5.2	5.4	2.46E+04	4.8	5	2.43E+04	4.6	5.1	2.49E+04	4.5	4.7	2.63E+04	5.1	4.7	2.59E+04	4.6	4.5
7.00E+02	1.90E+04	2.9	3	1.93E+04	3	2.9	1.80E+04	2.9	2.9	1.76E+04	2.8	2.9	1.87E+04	2.9	2.8	2.01E+04	2.8	2.8
1.00E+03	1.67E+04	2.3	2.4	1.72E+04	2.3	2.4	1.72E+04	2.3	2.4	1.73E+04	2.3	2.4	1.78E+04	2.4	2.4	1.62E+04	2.3	2.4
2.00E+03	1.63E+04	2	2.2	1.66E+04	2	2.2	1.70E+04	2	2.2	1.63E+04	2	2.2	1.70E+04	2	2.1	1.78E+04	2.1	2.1
3.00E+03	1.68E+04	2	2.1	1.70E+04	2	2.1	1.79E+04	2	2.1	1.66E+04	2	2	1.73E+04	2.1	2	1.76E+04	2.1	2.1
5.00E+03	1.80E+04	2	2.1	1.88E+04	2.1	2	2.07E+04	2	2.1	1.84E+04	2.1	2	1.89E+04	2.2	1.9	1.61E+04	2.1	2
1.00E+04	2.01E+04	2	2.1	1.93E+04	2.1	2	2.13E+04	2	2	1.98E+04	2.1	2.1	2.05E+04	2.1	1.9	2.10E+04	2.2	1.9
2.00E+04	2.33E+04	2.1	1.9	2.26E+04	2.2	1.9	2.38E+04	2.1	1.9	2.33E+04	2.2	1.9	2.12E+04	2.3	1.9	2.33E+04	2.3	1.8
5.00E+04	2.84E+04	2.1	1.9	2.81E+04	2.1	1.8	2.93E+04	2	1.9	2.87E+04	2.2	1.8	3.16E+04	2.2	1.9	2.53E+04	2.2	1.9
1.00E+05	3.85E+04	1.9	1.8	3.91E+04	2	1.8	4.05E+04	2	1.8	3.36E+04	2.1	1.8	3.73E+04	2	1.8	3.20E+04	2.2	1.8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.05E+01	13.2	14.1	2.35E+00	13.3	14	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.16E-01	4.2	8.8	1.56E+01	14.6	17.3	3.47E+00	14.5	17	1.28E-01	7.2	10	1.37E-01	7.2	9.6
2.00E+01	3.95E-01	6.4	9.3	5.71E-01	4.9	7.6	2.45E+01	16.3	20.9	6.39E+00	15.8	20	4.33E-01	7.3	9.3	5.29E-01	6.8	9.6
3.00E+01	1.15E+00	6.6	8.8	2.15E+00	5	6.8	4.86E+01	18.1	24	1.23E+01	16.7	21.8	1.58E+00	6.2	8	1.66E+00	5.7	8.3
5.00E+01	5.18E+00	6.2	9.8	1.57E+01	4.5	6.1	1.94E+02	18.6	23.8	8.68E+01	14.7	18.6	9.65E+00	4.4	6.8	1.18E+01	4.3	6.3
7.50E+01	2.20E+01	4	6.2	8.60E+02	16.3	21.5	1.85E+03	19.1	24.6	1.74E+03	19.1	24.6	6.90E+01	4	5.2	9.11E+01	4.1	5.2
1.00E+02	8.75E+01	3.6	4.4	6.92E+03	21.5	27.2	7.66E+03	20.9	26.3	6.48E+03	20.9	26.2	8.96E+02	14.3	18.2	1.87E+03	17	21.8
1.50E+02	2.02E+03	15.8	20.1	1.15E+04	16.6	20.5	1.80E+04	17.5	21.7	1.72E+04	17.6	21.8	1.37E+04	18.8	23.5	1.69E+04	18.7	23.3
2.00E+02	9.52E+03	16.2	19.3	1.41E+04	13.7	16	2.58E+04	14.3	17.3	2.59E+04	14.4	17.4	2.71E+04	15.6	19.2	3.11E+04	15.4	18.8
3.00E+02	2.00E+04	11.3	13.3	2.03E+04	9.4	10.8	3.03E+04	9.3	10.6	3.15E+04	9.5	11	3.80E+04	10.2	11.9	3.94E+04	9.9	11.4
5.00E+02	2.47E+04	5.3	5.6	2.32E+04	4.8	5.3	2.41E+04	4.4	4.4	2.45E+04	4.3	4.4	2.49E+04	3.9	3.8	2.54E+04	4	3.9
7.00E+02	1.92E+04	3	2.9	1.99E+04	2.9	2.9	2.01E+04	2.9	2.9	2.04E+04	2.9	2.9	2.03E+04	2.9	2.9	2.13E+04	2.9	2.8
1.00E+03	1.65E+04	2.2	2.4	1.73E+04	2.3	2.4	1.80E+04	2.4	2.4	1.79E+04	2.4	2.4	1.86E+04	2.4	2.4	1.88E+04	2.4	2.4
2.00E+03	1.64E+04	2	2.2	1.64E+04	2	2.2	1.70E+04	2.1	2.1	1.71E+04	2.1	2.1	1.72E+04	2.1	2.1	1.80E+04	2.1	2.1
3.00E+03	1.71E+04	2	2.2	1.71E+04	2	2.1	1.78E+04	2.1	2.1	1.77E+04	2.1	2.1	1.80E+04	2.1	2	1.78E+04	2.1	2
5.00E+03	1.97E+04	2	2.1	1.79E+04	2.1	2.1	1.87E+04	2.1	2	1.87E+04	2.1	2	1.92E+04	2.1	1.9	1.92E+04	2.1	1.9
1.00E+04	2.05E+04	2	2.1	2.07E+04	2.1	2	2.05E+04	2.1	2	1.99E+04	2.2	2	1.99E+04	2.2	1.9	1.96E+04	2.2	1.9
2.00E+04	2.29E+04	2	1.9	2.27E+04	2.1	1.8	2.29E+04	2.2	1.9	2.21E+04	2.2	1.8	2.22E+04	2.3	1.8	2.21E+04	2.3	1.8
5.00E+04	3.11E+04	2	1.9	3.09E+04	2.1	1.9	2.80E+04	2.2	1.8	2.67E+04	2.3	1.8	2.72E+04	2.3	1.8	2.60E+04	2.4	1.8
1.00E+05	4.36E+04	1.9	1.9	3.90E+04	2	1.8	3.66E+04	2.1	1.8	3.42E+04	2.2	1.8	3.29E+04	2.3	1.8	3.29E+04	2.3	1.8

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.55E+03	8.8	4.8	3.09E+03	8.8	4.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.10E+03	9.3	6.1	6.18E+03	9.3	6.1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.61E+03	9.9	7.3	9.25E+03	9.9	7.3	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.27E+04	11	9.4	1.54E+04	11	9.4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.23E+00	12.3	12.2	0.00E+00	1	1	2.50E+04	13.4	14.3	3.03E+04	13.4	14.3	2.94E+01	13.3	14	4.15E+00	13.3	14
1.40E+01	5.55E+00	13.6	15	1.91E-01	4.9	7.2	3.46E+04	14.9	17.8	4.16E+04	14.9	17.9	4.75E+01	14.7	17.4	6.71E+00	14.6	17.1
2.00E+01	2.95E+01	15	17.9	6.49E-01	4.8	7.6	4.80E+04	16.9	22.2	5.74E+04	17	22.2	7.95E+01	16.5	21.1	1.14E+01	15.6	20.4
3.00E+01	9.31E+01	16.1	19.7	3.78E+00	3.9	6.7	6.73E+04	19.8	26.7	7.48E+04	20.3	27.7	1.49E+02	18.8	24.8	2.07E+01	17.1	23.6
5.00E+01	2.83E+03	18	23.8	3.24E+02	14.6	18.9	5.79E+04	25.2	30.4	5.85E+04	25.4	30.4	5.25E+02	20.4	26.1	8.22E+01	17.8	24.1
7.50E+01	1.35E+04	21.7	27.3	5.78E+03	20.6	26.3	4.44E+04	20	24.5	4.40E+04	19.7	24.1	1.63E+03	21.1	26.6	7.45E+02	19.5	25.3
1.00E+02	2.38E+04	21	26.1	1.47E+04	21.1	26.4	3.70E+04	15.7	19.1	3.71E+04	15.6	18.9	3.14E+03	20.2	25.2	2.20E+03	20.3	25.4
1.50E+02	2.82E+04	15.8	19.1	2.49E+04	16.8	20.6	3.13E+04	11.6	13.4	3.15E+04	11.6	13.4	7.09E+03	16.6	20.5	6.50E+03	17	21.2
2.00E+02	2.81E+04	11.8	13.7	2.64E+04	13	15.1	2.96E+04	9.8	11.1	3.02E+04	9.9	11.1	1.34E+04	14.5	17.7	1.40E+04	14.9	18.5
3.00E+02	2.96E+04	8.7	9.9	3.27E+04	9.8	11.3	2.93E+04	7.5	8.1	3.00E+04	7.6	8.2	2.50E+04	10.8	12.9	2.73E+04	11	13.1
5.00E+02	2.40E+04	4	4.1	2.57E+04	4.1	4	2.50E+04	4.3	4.3	2.54E+04	4.2	4.3	2.33E+04	4.8	5.2	2.41E+04	4.7	4.8
7.00E+02	2.09E+04	2.9	2.8	2.15E+04	2.9	2.8	2.14E+04	3	2.9	2.17E+04	3	2.9	1.97E+04	3	3	1.97E+04	2.9	2.9
1.00E+03	1.93E+04	2.4	2.4	1.82E+04	2.4	2.4	1.92E+04	2.4	2.4	1.92E+04	2.4	2.4	1.73E+04	2.3	2.4	1.71E+04	2.3	2.4
2.00E+03	1.79E+04	2.1	2.1	1.76E+04	2.1	2.1	1.81E+04	2.1	2.1	1.82E+04	2.1	2.1	1.65E+04	2	2.2	1.64E+04	2	2.2

Table A.11. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	1.94E+04	2	2	1.79E+04	2.1	2	1.87E+04	2.1	2	1.86E+04	2.1	2	1.70E+04	2	2.1	1.71E+04	2	2.1
5.00E+03	1.84E+04	2.1	1.9	1.83E+04	2.1	2	1.94E+04	2.2	1.9	1.94E+04	2.2	1.9	1.85E+04	2.1	2	1.83E+04	2.1	2
1.00E+04	1.99E+04	2.2	1.9	1.99E+04	2.2	2	2.11E+04	2.2	1.9	2.08E+04	2.2	1.9	2.06E+04	2.1	2	2.02E+04	2.1	2
2.00E+04	2.27E+04	2.3	1.8	2.25E+04	2.3	1.8	2.30E+04	2.3	1.8	2.25E+04	2.4	1.8	2.32E+04	2.1	1.9	2.24E+04	2.2	1.9
5.00E+04	2.67E+04	2.3	1.7	2.59E+04	2.4	1.8	2.75E+04	2.4	1.7	2.66E+04	2.4	1.7	2.90E+04	2.1	1.9	2.78E+04	2.1	1.9
1.00E+05	3.40E+04	2.2	1.7	3.29E+04	2.2	1.8	3.46E+04	2.3	1.7	3.21E+04	2.4	1.7	3.95E+04	2	1.8	3.68E+04	2	1.8

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.38E+02	13.2	14.1	5.20E+01	13.3	14	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	5.46E+02	14.8	17.5	8.31E+01	14.8	17.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.64E-01	4.7	9	2.97E-01	4.8	9.6	9.09E+02	16.6	21.3	1.35E+02	16	20.9	3.99E-01	7.7	8.9	3.46E-01	5.6	9.7
3.00E+01	1.08E+00	5.4	9.1	1.17E+00	5.4	9.2	1.67E+03	19	25.2	2.25E+02	18.3	24.6	1.03E+00	6.1	9.3	1.05E+00	5.6	9
5.00E+01	4.59E+00	6.5	11.1	3.89E+00	6.9	9.9	4.61E+03	21.1	26.9	5.96E+02	19.8	25.7	4.03E+00	5	9.2	4.62E+00	5.8	10.4
7.50E+01	1.60E+01	4.1	6.9	1.51E+01	4.6	7.4	1.06E+04	21.6	27.2	4.38E+03	20.7	27	1.65E+01	4.6	7.2	1.31E+01	4.3	7.1
1.00E+02	6.76E+01	3.4	4.8	6.22E+01	3.4	5	1.65E+04	20.2	25.2	8.75E+03	20.7	25.9	6.86E+01	3.3	4.3	5.47E+01	3.6	5
1.50E+02	5.68E+02	3.6	4.4	5.66E+02	2.7	3.4	2.30E+04	15.9	19.3	1.34E+04	15.5	18.9	1.74E+03	15.3	19.4	6.00E+02	2.9	3.5
2.00E+02	8.82E+03	17.4	21.5	4.97E+03	14.3	17.4	2.60E+04	12.7	15.2	2.34E+04	15.3	19.2	6.20E+03	14.5	17.9	4.15E+03	12.5	16.5
3.00E+02	2.00E+04	9.8	12.7	2.64E+04	13.6	16.6	3.46E+04	9.3	10.6	3.30E+04	9.3	10.8	2.21E+04	12.5	15.1	2.44E+04	11.9	14.8
5.00E+02	2.12E+04	5	6	2.17E+04	4.9	5	2.48E+04	4.1	4.1	2.36E+04	4	4.5	2.41E+04	5.2	5.6	2.32E+04	4.7	4.9
7.00E+02	1.95E+04	3.3	3	1.91E+04	2.9	3.1	2.14E+04	2.9	2.8	2.06E+04	2.9	2.8	1.94E+04	2.9	3	1.93E+04	2.9	3
1.00E+03	1.79E+04	2.3	2.5	1.51E+04	2.3	2.4	1.93E+04	2.4	2.4	1.90E+04	2.4	2.4	1.65E+04	2.3	2.5	1.72E+04	2.3	2.4
2.00E+03	1.61E+04	2	2.2	1.65E+04	2	2.3	1.73E+04	2.1	2.2	1.72E+04	2.1	2.1	1.43E+04	2	2.2	1.62E+04	1.9	2.2
3.00E+03	1.60E+04	2	2.1	1.67E+04	2.1	2.1	1.78E+04	2	2	1.66E+04	2	2	1.56E+04	2	2.3	1.71E+04	2	2.2
5.00E+03	1.76E+04	1.9	2.1	1.93E+04	2	2.2	2.07E+04	2.2	2	1.84E+04	2	1.9	1.75E+04	2	2.1	1.84E+04	2	2.1
1.00E+04	2.11E+04	2	2.1	2.31E+04	2	2	1.97E+04	2.3	1.9	1.98E+04	2.1	2	1.92E+04	2.1	2.1	1.91E+04	2.1	2.1
2.00E+04	2.60E+04	2	1.8	2.49E+04	2.1	2	2.19E+04	2.2	1.9	2.25E+04	2.5	1.9	2.12E+04	2	2	2.23E+04	2	1.9
5.00E+04	2.99E+04	1.9	2	2.82E+04	2	1.9	2.46E+04	2.3	1.8	2.34E+04	2.3	1.8	2.94E+04	2	2	2.82E+04	2	1.9
1.00E+05	4.16E+04	1.9	1.7	4.06E+04	1.9	1.8	3.28E+04	2.3	1.7	3.29E+04	2.1	1.8	3.90E+04	2	1.9	3.89E+04	1.9	1.8

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.05E+01	13.3	13.5	0.00E+00	1	1
1.40E+01	1.04E-01	6.9	9.8	0.00E+00	1	1	9.91E-02	6.8	9.8	9.90E-02	7	10.1	3.43E+01	14.1	16.2	1.37E-01	6.1	8.8
2.00E+01	3.35E-01	7.5	9.6	4.11E-01	7.1	9.6	2.98E-01	7.9	9.3	4.05E-01	7.9	9.8	6.06E+01	15.6	19.3	4.79E-01	5	8.5
3.00E+01	1.15E+00	7.2	9.1	1.21E+00	7.1	8.9	1.07E+00	7	9.1	1.08E+00	7.2	9.3	1.45E+02	17.8	23.2	3.00E+00	7.5	7.1
5.00E+01	4.82E+00	6	9.4	5.30E+00	5.8	8.3	4.20E+00	6.1	9.5	4.10E+00	5.9	9.5	1.55E+03	19.7	25.2	5.09E+01	12.9	16.9
7.50E+01	2.37E+01	4.1	5.9	3.03E+01	3.8	5.5	1.77E+01	4.3	6.2	1.93E+01	4.1	6.1	4.88E+03	21.7	27.4	1.44E+03	18.3	24.2
1.00E+02	1.08E+02	3.2	4.3	1.55E+02	3.9	4.7	8.16E+01	3.4	4.5	7.90E+01	3.3	4.5	7.18E+03	20.5	25.5	5.79E+03	21.6	26.8
1.50E+02	2.83E+03	17.1	21.7	3.99E+03	17.6	22.1	6.27E+02	3.9	5.3	8.36E+02	6.2	8	9.87E+03	15.5	19.1	9.63E+03	16.2	20.1
2.00E+02	1.06E+04	15.5	19.3	1.38E+04	15.9	19.8	8.35E+03	16.8	21	8.84E+03	16.3	20.6	1.46E+04	13.2	16	1.54E+04	13.9	16.9
3.00E+02	2.66E+04	11.7	14.1	2.94E+04	11.2	13.5	2.15E+04	10.8	12.9	2.47E+04	11.2	13.4	2.52E+04	10.6	12.4	2.75E+04	10.7	12.7
5.00E+02	2.32E+04	4.7	4.9	2.39E+04	4.5	4.5	2.41E+04	5.3	5.6	2.32E+04	4.9	5.3	2.37E+04	4.9	5.2	2.43E+04	4.6	4.8
7.00E+02	1.91E+04	2.9	2.9	1.98E+04	2.9	2.9	1.96E+04	3	3.1	1.95E+04	3	3	1.94E+04	2.9	2.9	2.02E+04	3	2.9
1.00E+03	1.73E+04	2.3	2.4	1.70E+04	2.3	2.4	1.68E+04	2.3	2.4	1.71E+04	2.3	2.4	1.73E+04	2.3	2.4	1.69E+04	2.3	2.4
2.00E+03	1.64E+04	2	2.2	1.61E+04	2	2.2	1.63E+04	2	2.2	1.61E+04	2	2.2	1.70E+04	2	2.2	1.67E+04	2	2.1
3.00E+03	1.73E+04	2	2.1	1.72E+04	2	2.1	1.69E+04	2	2.2	1.65E+04	2	2.1	1.75E+04	2	2.1	1.75E+04	2	2.1
5.00E+03	1.89E+04	2	2	1.80E+04	2.1	2	1.91E+04	2	2.1	1.87E+04	2.1	2.1	1.91E+04	2	2	1.85E+04	2.1	2
1.00E+04	2.06E+04	2.1	2.1	1.89E+04	2.1	2	2.09E+04	2	2.1	2.07E+04	2.1	2	2.12E+04	2.1	2	2.02E+04	2.1	2
2.00E+04	2.34E+04	2.1	1.9	2.23E+04	2.2	1.9	2.50E+04	2.1	1.9	2.17E+04	2.1	1.9	2.35E+04	2.1	1.9	2.33E+04	2.2	1.9
5.00E+04	2.83E+04	2	1.8	2.67E+04	2.1	1.9	3.08E+04	2	1.9	2.95E+04	2	1.9	2.95E+04	2.1	1.9	2.83E+04	2.2	1.9
1.00E+05	3.67E+04	2	1.8	3.35E+04	2.1	1.8	4.51E+04	1.9	1.8	3.84E+04	1.9	1.8	4.05E+04	2	1.8	3.59E+04	2	1.8

(continued on next page)

Table A.11. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.33E+01	13.3	14.1	1.69E+00	13.2	14	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.60E+01	14.7	17.3	2.98E+00	14.3	17	1.06E-01	5.6	9.1	1.12E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	5.95E+01	16.4	21	4.97E+00	15.4	19.7	3.70E-01	6.6	9	4.57E+00	10	15.1	2.92E-01	6.8	9.7	3.23E-01	7.1	10.1
3.00E+01	1.06E+02	18.3	24.4	1.11E+01	15.9	20.9	1.83E+00	6	8.7	1.92E+01	11.2	18.7	9.75E-01	7.1	9.5	1.02E+00	7.1	9.2
5.00E+01	5.89E+02	18.9	24.3	1.42E+02	16.4	21.3	2.58E+01	12.5	12.3	2.28E+02	17.2	24.6	3.69E+00	6.7	10.6	4.32E+00	6.1	9.8
7.50E+01	3.76E+03	20.6	26.3	1.39E+03	19.7	25.1	1.11E+03	19	24	2.00E+03	20.1	25.3	1.08E+01	5.4	8.3	1.69E+01	4.2	6.5
1.00E+02	9.79E+03	20.8	26	5.24E+03	20.2	25.5	2.99E+03	20.5	25.8	5.35E+03	20.6	25.8	3.36E+01	3.9	5.6	6.55E+01	3.4	4.7
1.50E+02	2.01E+04	17.3	21.3	1.70E+04	18	22.3	9.48E+03	17	21	1.39E+04	17.9	22.3	2.86E+02	2.8	3.5	5.15E+02	2.9	3.6
2.00E+02	2.56E+04	13.7	16.5	2.52E+04	14.4	17.5	2.63E+04	16.2	20	2.81E+04	15	19.1	1.37E+03	2.8	3.2	6.37E+03	15.6	19.8
3.00E+02	2.87E+04	9.1	10.3	3.00E+04	9.4	10.8	3.33E+04	9.7	11.1	3.39E+04	9.5	10.3	1.97E+04	14	17.4	2.54E+04	11.7	14.2
5.00E+02	2.40E+04	4.5	4.6	2.45E+04	4.5	4.6	2.43E+04	4.2	4.3	2.56E+04	4.1	4.2	2.19E+04	5.3	5.7	2.42E+04	5	5.2
7.00E+02	2.03E+04	3	2.9	2.02E+04	2.9	2.9	2.04E+04	2.9	2.9	2.01E+04	2.9	2.8	1.77E+04	2.9	3	1.95E+04	3	3
1.00E+03	1.79E+04	2.4	2.4	1.77E+04	2.4	2.4	1.83E+04	2.4	2.4	1.93E+04	2.4	2.4	1.61E+04	2.3	2.4	1.64E+04	2.3	2.4
2.00E+03	1.71E+04	2.1	2.1	1.70E+04	2	2.1	1.70E+04	2.1	2.1	1.66E+04	2	2.1	1.55E+04	2	2.2	1.67E+04	2	2.2
3.00E+03	1.78E+04	2	2.1	1.77E+04	2	2.1	1.77E+04	2.1	2.1	1.75E+04	2.1	2	1.70E+04	2	2.2	1.69E+04	2	2.1
5.00E+03	1.88E+04	2.1	2	1.87E+04	2.1	2	1.77E+04	2.1	1.9	1.77E+04	2.1	2	1.73E+04	2	2.1	1.73E+04	2	2.1
1.00E+04	2.06E+04	2.1	2	2.03E+04	2.1	2	1.94E+04	2.1	1.9	2.00E+04	2.2	2	1.91E+04	2	2.1	2.03E+04	2	2
2.00E+04	2.28E+04	2.2	1.8	2.21E+04	2.2	1.8	2.32E+04	2.3	1.8	2.08E+04	2.3	1.8	2.19E+04	2	1.9	2.17E+04	2.1	1.9
5.00E+04	2.86E+04	2.2	1.8	2.75E+04	2.2	1.8	2.64E+04	2.4	1.9	2.89E+04	2.3	1.8	3.01E+04	2	1.9	2.74E+04	2	1.9
1.00E+05	3.79E+04	2.1	1.8	3.56E+04	2.1	1.8	3.52E+04	2.2	1.8	3.49E+04	2.2	1.9	4.38E+04	1.9	1.8	4.21E+04	1.9	1.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.07E-01	6.9	10.2	1.04E-01	7.4	9.6	1.14E-01	7.3	9.7	1.06E-01	6.2	10.1	1.25E-01	6.6	9.7
2.00E+01	3.61E-01	5.2	9.4	3.26E-01	6.9	9.8	3.13E-01	7.2	9.6	3.53E-01	7.2	9.6	4.02E-01	7.2	9.5	3.36E-01	6.4	9.9
3.00E+01	8.71E-01	7.2	9.3	8.93E-01	7.3	9.3	1.09E+00	7.2	9	1.14E+00	7	8.9	1.14E+00	6.9	9	1.24E+00	6.9	8.8
5.00E+01	4.55E+00	6.2	10.2	3.86E+00	6.8	10.3	4.85E+00	6	8.7	4.90E+00	5.4	8.7	4.65E+00	5.3	8.9	5.59E+00	5	7.9
7.50E+01	1.24E+01	5.2	7.9	1.39E+01	4.9	7.9	2.44E+01	4	5.9	2.65E+01	3.9	5.8	2.51E+01	4	5.9	3.45E+01	3.6	5.1
1.00E+02	3.98E+01	3.7	5.5	4.64E+01	3.7	5.4	1.17E+02	5.4	7.1	1.06E+02	3.5	4.4	1.04E+02	3.4	4.3	1.43E+02	3.2	4.1
1.50E+02	4.50E+02	2.8	3.4	5.03E+02	2.9	3.5	2.89E+03	16.8	21.1	3.20E+03	17.2	21.8	2.23E+03	15.2	19.2	5.55E+03	18.2	23
2.00E+02	1.68E+03	2.6	4.2	2.79E+03	10.2	13.2	1.05E+04	15.9	19.6	1.20E+04	15.9	19.9	1.37E+04	16.7	21	1.86E+04	16.5	20.4
3.00E+02	2.07E+04	13.2	16.1	2.22E+04	12.8	15.5	2.39E+04	11.1	13.2	2.33E+04	11	13	2.49E+04	10.6	12.6	2.69E+04	10.6	12.4
5.00E+02	2.06E+04	4.5	6.1	2.50E+04	5	5.1	2.30E+04	5.1	5.4	2.36E+04	4.9	5.2	2.35E+04	5	5.7	2.39E+04	4.7	4.9
7.00E+02	2.12E+04	3.3	2.9	1.96E+04	3	3	1.90E+04	3	3	1.94E+04	2.9	3	1.95E+04	2.9	3	1.98E+04	2.9	2.9
1.00E+03	1.65E+04	2.2	2.4	1.64E+04	2.3	2.4	1.67E+04	2.3	2.4	1.66E+04	2.3	2.4	1.65E+04	2.3	2.4	1.72E+04	2.3	2.4
2.00E+03	1.79E+04	2	2.2	1.58E+04	2	2.2	1.63E+04	2	2.2	1.65E+04	2	2.2	1.61E+04	2	2.2	1.69E+04	2	2.2
3.00E+03	1.59E+04	2	2.1	1.66E+04	2	2.2	1.70E+04	2	2.2	1.70E+04	2	2.1	1.72E+04	2	2.1	1.72E+04	2	2.1
5.00E+03	1.85E+04	2	2.1	1.75E+04	2.1	2.1	1.88E+04	2	2.1	1.79E+04	2.1	2.1	1.84E+04	2	2.1	1.89E+04	2.1	2
1.00E+04	2.14E+04	2	2.1	2.05E+04	2.1	2.1	2.04E+04	2	2.1	2.05E+04	2.1	2	2.08E+04	2.1	2.1	1.97E+04	2.1	2.1
2.00E+04	2.31E+04	2	1.9	2.28E+04	2.1	1.9	2.31E+04	2.1	1.9	2.29E+04	2.1	1.9	2.42E+04	2.1	1.9	2.17E+04	2.1	1.9
5.00E+04	3.22E+04	2.1	1.8	3.13E+04	2	1.9	3.05E+04	2	1.9	2.82E+04	2	1.8	2.95E+04	2	1.9	2.65E+04	2.1	1.9
1.00E+05	4.09E+04	1.7	1.9	3.83E+04	1.9	1.9	4.17E+04	1.9	1.8	3.85E+04	1.9	1.8	3.93E+04	1.9	1.8	3.79E+04	2	1.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.38E-01	5.8	8.7	0.00E+00	1	1	2.69E+00	4.7	6.3	2.69E+00	4.7	6.3
2.00E+01	5.72E-01	6.4	8.2	0.00E+00	1	1	1.33E+01	4.6	5.9	1.33E+01	4.6	5.9
3.00E+01	1.30E+00	5.6	7.7	1.91E+00	5.3	7.5	2.73E+02	9.3	8.2	2.73E+02	9.3	8.2
5.00E+01	1.40E+01	3.6	6.2	1.39E+01	5.2	7.7	6.28E+04	21.8	29.1	6.28E+04	21.8	29.1
7.50E+01	6.65E+02	16.3	21.7	2.94E+02	13.6	19.2	4.89E+04	22.4	27.2	4.89E+04	22.4	27.2
1.00E+02	3.77E+03	20.4	25.5	2.70E+03	19.7	24.8	4.06E+04	17.1	20.9	4.06E+04	17.1	20.9
1.50E+02	1.81E+04	18.8	23.3	1.48E+04	19	23.6	3.28E+04	12.7	16.5	3.28E+04	12.7	16.5

Table A.11. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	2.06E+04	13.3	16.1	1.81E+04	12.6	15.7	3.32E+04	10.1	11.7	3.32E+04	10.1	11.7
3.00E+02	2.45E+04	9.9	11.8	2.83E+04	11.9	14.2	3.06E+04	7.3	9.5	3.06E+04	7.3	9.5
5.00E+02	2.39E+04	4.9	4.6	2.72E+04	4.9	4.5	2.66E+04	4.2	3.8	2.66E+04	4.2	3.8
7.00E+02	1.96E+04	2.9	2.9	1.94E+04	2.9	2.8	2.16E+04	3	2.6	2.16E+04	3	2.6
1.00E+03	1.72E+04	2.4	2.4	1.64E+04	2.3	2.4	1.79E+04	2.4	2.2	1.79E+04	2.4	2.2
2.00E+03	1.69E+04	2.1	2.2	1.52E+04	2	2.1	1.88E+04	2.1	2.2	1.88E+04	2.1	2.2
3.00E+03	1.67E+04	2	2.1	1.86E+04	2.1	2.1	1.89E+04	2.1	1.9	1.89E+04	2.1	1.9
5.00E+03	1.80E+04	2.1	2	1.83E+04	2.1	1.9	1.92E+04	2.1	1.8	1.92E+04	2.1	1.8
1.00E+04	2.35E+04	2.2	1.9	1.94E+04	2.1	2	2.00E+04	2.1	1.8	2.00E+04	2.1	1.8
2.00E+04	2.17E+04	1.9	2	2.21E+04	2.2	1.9	2.23E+04	2.3	1.8	2.23E+04	2.3	1.8
5.00E+04	2.68E+04	2.1	1.9	2.70E+04	2.2	1.9	2.15E+04	2.3	1.8	2.15E+04	2.3	1.8
1.00E+05	3.92E+04	2.1	1.8	3.10E+04	2.1	1.8	3.10E+04	2.3	1.8	3.10E+04	2.3	1.8

Table A.12. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, and in units of pGy cm^2, mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{19}F ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.87E+00	12	2.9	1.20E+00	11.9	2.9	3.49E+02	11.6	10.7	3.87E+02	11.7	10.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	5.53E+00	13.1	3.5	1.76E+00	12.8	3.5	6.55E+02	12.5	12.8	6.25E+02	12.8	13.1	1.11E-01	7.1	9.6	1.22E-01	7	9.5
2.00E+01	9.34E+00	14.4	4.3	3.35E+00	13.5	4.1	1.47E+03	13.9	15.6	1.34E+03	14.1	16.1	4.23E-01	7	9.5	3.80E-01	6.9	9.5
3.00E+01	1.83E+01	15.5	5.1	6.39E+00	13.9	4.7	3.49E+03	15.7	19.4	3.14E+03	15.3	18.7	1.30E+00	6.3	9	1.32E+00	6.7	9
5.00E+01	5.94E+01	16.4	5.4	4.22E+01	12.6	4.2	2.59E+04	18.6	24.2	1.68E+04	19	24.8	6.52E+00	5	7.9	6.72E+00	5.1	7.9
7.50E+01	6.42E+02	16.9	5.5	7.65E+02	17	5.6	4.64E+04	22.3	27.3	3.03E+04	22.4	27.3	5.19E+01	8.7	11.4	4.62E+01	3.7	5
1.00E+02	3.13E+03	19.6	6.5	3.09E+03	20.3	6.5	5.66E+04	22.3	26.4	3.98E+04	21.9	26.1	2.37E+02	11.8	14.2	3.15E+02	8.3	9.8
1.50E+02	8.33E+03	19	6.1	8.52E+03	19	6.1	4.72E+04	16.8	19.4	4.30E+04	17.9	20.8	6.71E+03	18.9	23.3	7.23E+03	19.1	23.4
2.00E+02	1.47E+04	16.4	5.3	1.54E+04	16.4	5.3	4.11E+04	12.7	13.5	3.80E+04	13.7	15.2	1.80E+04	17.9	21.3	2.00E+04	17.9	21.3
3.00E+02	2.87E+04	12.7	4.2	3.19E+04	13.1	4.3	3.15E+04	8.3	8.2	3.30E+04	9.3	9.9	2.80E+04	12.2	13.9	2.83E+04	12	13.6
5.00E+02	2.84E+04	6.3	2.3	2.91E+04	6.1	2.3	2.98E+04	6.1	6.6	3.24E+04	5.9	5.8	2.90E+04	6.6	6.7	2.87E+04	6.5	6.6
7.00E+02	2.30E+04	4	1.7	2.35E+04	3.9	1.7	2.60E+04	4.2	3.6	2.58E+04	4.1	3.7	2.32E+04	4	3.7	2.32E+04	4	3.7
1.00E+03	2.04E+04	3.1	1.5	2.08E+04	3.2	1.5	2.34E+04	3.4	2.9	2.36E+04	3.4	2.9	2.04E+04	3.1	2.9	2.03E+04	3.1	2.9
2.00E+03	1.97E+04	2.7	1.4	1.96E+04	2.7	1.4	2.20E+04	3	2.4	2.22E+04	2.9	2.4	1.93E+04	2.6	2.4	1.95E+04	2.7	2.4
3.00E+03	2.03E+04	2.7	1.3	2.04E+04	2.7	1.3	2.35E+04	3	2.3	2.24E+04	2.9	2.3	2.01E+04	2.6	2.3	1.98E+04	2.6	2.3
5.00E+03	2.16E+04	2.7	1.3	2.20E+04	2.8	1.3	2.55E+04	3	2.2	2.23E+04	3	2.2	2.15E+04	2.7	2.3	2.16E+04	2.7	2.2
1.00E+04	2.44E+04	2.7	1.3	2.40E+04	2.7	1.3	2.27E+04	3	2.1	2.50E+04	3	2.1	2.52E+04	2.6	2.2	2.29E+04	2.6	2.2
2.00E+04	2.72E+04	2.7	1.3	2.66E+04	2.8	1.3	2.68E+04	3.1	2	2.76E+04	3.1	2	2.68E+04	2.7	2.1	2.80E+04	2.8	2
5.00E+04	3.55E+04	2.6	1.2	3.43E+04	2.6	1.2	3.67E+04	3.1	2	3.38E+04	3.1	1.9	3.59E+04	2.6	2	3.36E+04	2.6	2
1.00E+05	4.75E+04	2.3	1.2	4.42E+04	2.5	1.2	4.19E+04	2.8	1.9	3.80E+04	2.9	1.9	5.00E+04	2.2	1.9	4.62E+04	2.4	1.9

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.18E+02	11.9	11.5	0.00E+00	1	1
1.40E+01	1.10E-01	7.5	9.8	1.17E-01	7.3	9.9	1.04E-01	6.6	9.9	1.37E-01	7.5	9.4	5.26E+02	13.2	14.1	0.00E+00	1	1
2.00E+01	4.03E-01	7.6	9.5	3.91E-01	7.4	9.6	3.30E-01	7.6	9.7	3.91E-01	7	9.8	9.77E+02	14.7	17.5	2.76E-01	5.4	10.4
3.00E+01	1.28E+00	6.8	8.8	1.35E+00	7	9.2	1.24E+00	6.8	9.3	1.41E+00	6.4	8.5	1.87E+03	16.9	21.5	1.18E+00	5.4	8.9
5.00E+01	5.93E+00	5.6	8.4	6.53E+00	5.3	8.2	4.99E+00	5.5	8.9	7.26E+00	4.7	7.7	4.81E+03	19.2	24.9	2.89E+00	6.2	9.9
7.50E+01	3.58E+01	3.6	5.2	4.15E+01	3.5	4.9	2.74E+01	3.8	5.7	4.60E+01	3.5	4.9	1.06E+04	21.8	26.7	1.18E+01	4.7	7.9
1.00E+02	2.12E+02	6.8	8.7	2.46E+02	5.1	6	1.06E+02	3.4	4.2	2.41E+02	4.7	6.3	1.86E+04	21.7	26	4.16E+01	3.4	5.2
1.50E+02	4.72E+03	17.5	21.6	5.70E+03	17.3	21.4	3.41E+03	16.5	21	8.99E+03	19.8	24.3	2.70E+04	18.9	22.3	3.30E+02	2.3	3.4
2.00E+02	1.70E+04	17.9	21.4	2.47E+04	18.5	22.3	1.17E+04	17.7	21.2	1.87E+04	17.1	20.8	2.82E+04	14.8	16.4	1.61E+03	2.6	3
3.00E+02	3.60E+04	12.9	14.8	3.76E+04	12.4	14	2.68E+04	12.9	14.8	3.07E+04	12.4	14.1	2.44E+04	9.3	10.4	2.63E+04	16	18.2
5.00E+02	2.96E+04	6.1	6.1	2.98E+04	5.8	5.6	2.98E+04	6.7	6.8	2.85E+04	6.3	6.3	3.14E+04	6.4	6.2	2.92E+04	6.4	7.3
7.00E+02	2.34E+04	3.9	3.6	2.37E+04	4	3.6	2.22E+04	3.9	3.7	2.42E+04	4	3.7	2.28E+04	4	3.6	2.13E+04	3.6	3.9
1.00E+03	2.08E+04	3.1	2.9	2.17E+04	3.2	2.9	1.97E+04	3	2.9	2.09E+04	3.1	2.9	2.14E+04	3.3	2.9	2.13E+04	3.1	2.9
2.00E+03	1.99E+04	2.7	2.4	2.00E+04	2.8	2.4	1.92E+04	2.6	2.5	1.92E+04	2.7	2.4	2.08E+04	2.8	2.4	1.78E+04	2.5	2.5
3.00E+03	2.05E+04	2.7	2.3	2.11E+04	2.8	2.3	1.99E+04	2.6	2.3	2.09E+04	2.7	2.3	2.13E+04	2.7	2.3	2.04E+04	2.6	2.3
5.00E+03	2.17E+04	2.8	2.2	2.20E+04	2.8	2.2	2.18E+04	2.7	2.3	2.23E+04	2.7	2.2	2.51E+04	2.8	2.2	2.17E+04	2.6	2.3
1.00E+04	2.47E+04	2.7	2.2	2.47E+04	2.8	2.2	2.35E+04	2.6	2.2	2.34E+04	2.7	2.2	2.56E+04	2.8	2.1	2.19E+04	2.3	2.2
2.00E+04	2.81E+04	2.8	2	2.66E+04	2.9	2	2.46E+04	2.7	2.1	2.70E+04	2.8	2.1	2.64E+04	2.7	2	2.64E+04	2.7	2.1
5.00E+04	3.51E+04	2.7	2	3.40E+04	2.8	1.9	3.41E+04	2.5	2	3.29E+04	2.6	2	3.36E+04	2.6	2	3.15E+04	2.1	1.9
1.00E+05	4.56E+04	2.5	1.9	4.07E+04	2.7	1.9	4.99E+04	2.3	1.9	4.43E+04	2.4	1.9	4.17E+04	2.6	1.8	4.91E+04	2.1	1.9

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.05E-01	7.5	9.8	1.21E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	3.31E-01	7.5	9.6	3.89E-01	7.1	9.5	2.95E-01	6.2	9.3	4.40E-01	6.2	9.7	5.95E-01	5.2	7.6	7.52E-01	4.4	7.9
3.00E+01	1.17E+00	6.9	8.8	1.25E+00	6.8	8.7	1.04E+00	6.1	9.1	1.26E+00	7	9	2.34E+00	4.2	6.4	2.16E+00	3.8	6.1
5.00E+01	5.44E+00	5.6	8.9	6.41E+00	5.2	8.2	5.38E+00	6	9.2	5.35E+00	5.9	9.4	1.88E+01	4.6	5.5	1.88E+01	3.7	5.3

Table A.12. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	2.86E+01	4	5.6	3.85E+01	3.9	5.1	3.62E+01	6.8	9.1	2.68E+01	4.1	6	2.71E+02	11.6	12.3	2.91E+02	8.7	9.9
1.00E+02	1.41E+02	5.3	6.5	2.68E+02	7.9	9.8	2.16E+02	13.6	14.2	1.59E+02	4.6	6.4	5.65E+03	18.9	23.6	7.48E+03	19	24.2
1.50E+02	3.41E+03	18.2	22.2	6.30E+03	18.9	23.1	3.73E+03	17.8	21.9	3.27E+03	16.2	20.4	2.46E+04	20.6	24.6	2.75E+04	20.6	24.4
2.00E+02	1.20E+04	17.4	20.7	1.73E+04	17.8	21.1	7.88E+03	15.1	18.5	9.55E+03	16	18.9	2.76E+04	16	18.3	2.25E+04	14.8	17
3.00E+02	2.64E+04	13	14.9	3.03E+04	12.7	14.5	3.07E+04	14.9	17.8	3.74E+04	14.7	16.9	2.89E+04	11.8	12.8	3.54E+04	12.3	13.4
5.00E+02	2.89E+04	6.7	6.9	2.96E+04	6.3	6.4	3.06E+04	6.2	6.1	3.05E+04	5.8	6.1	3.05E+04	6.3	7	2.92E+04	6.3	6.3
7.00E+02	2.24E+04	3.9	3.7	2.33E+04	4	3.7	2.29E+04	3.9	3.8	2.39E+04	3.9	3.6	2.25E+04	4	3.7	2.44E+04	3.9	3.6
1.00E+03	1.99E+04	3.1	2.9	2.08E+04	3.1	2.9	2.04E+04	3.1	2.9	2.16E+04	3.2	2.9	2.26E+04	3.2	2.9	2.28E+04	3.3	2.9
2.00E+03	1.89E+04	2.6	2.5	1.91E+04	2.7	2.4	2.00E+04	2.7	2.5	1.89E+04	2.7	2.4	2.02E+04	2.8	2.4	2.14E+04	2.8	2.4
3.00E+03	2.02E+04	2.6	2.3	2.06E+04	2.7	2.3	2.02E+04	2.6	2.4	2.03E+04	2.7	2.3	2.09E+04	2.8	2.4	2.30E+04	2.8	2.3
5.00E+03	2.15E+04	2.7	2.2	2.14E+04	2.7	2.2	2.17E+04	2.7	2.2	2.21E+04	2.7	2.2	2.36E+04	2.8	2.2	1.89E+04	3	2.2
1.00E+04	2.39E+04	2.6	2.2	2.40E+04	2.7	2.2	2.35E+04	2.6	2.2	2.23E+04	2.7	2.1	2.42E+04	2.9	2.2	2.17E+04	3	2.1
2.00E+04	2.74E+04	2.6	2.1	2.70E+04	2.8	2	2.44E+04	2.6	2.1	2.40E+04	2.8	2	2.63E+04	2.4	2.1	2.45E+04	2.7	2
5.00E+04	3.59E+04	2.5	2	3.27E+04	2.6	2	3.85E+04	2.6	1.9	3.50E+04	2.6	2	3.61E+04	2.9	1.9	3.19E+04	2.8	1.9
1.00E+05	4.73E+04	2.3	1.9	4.27E+04	2.5	1.9	4.48E+04	2.3	1.9	4.40E+04	2.4	2	4.20E+04	2.6	1.9	3.71E+04	2.5	1.9

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.19E+01	12	11.4	2.60E+00	11.9	11.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.22E-01	4.2	8.8	1.77E+01	13.1	14	3.76E+00	13	13.8	1.31E-01	7.2	10	1.40E-01	7.2	9.6
2.00E+01	3.97E-01	6.4	9.3	5.75E-01	4.9	7.6	2.73E+01	14.6	17.3	6.85E+00	13.9	16.5	4.48E-01	7.3	9.3	5.37E-01	6.8	9.5
3.00E+01	1.20E+00	6.6	8.8	2.22E+00	5	6.8	5.28E+01	16.1	20.7	1.33E+01	14.5	18.8	1.62E+00	6.2	8	1.73E+00	5.7	8.2
5.00E+01	5.32E+00	6.1	9.7	1.59E+01	4.5	6	1.92E+02	17	21.7	8.31E+01	13	16.2	9.98E+00	4.4	6.7	1.22E+01	4.2	6.3
7.50E+01	2.23E+01	4	6.2	6.65E+02	13.9	18	1.81E+03	17.5	22.1	1.68E+03	17.2	21.8	6.90E+01	3.9	4.9	9.06E+01	3.9	4.8
1.00E+02	8.72E+01	3.5	4.4	6.99E+03	20.5	25.9	7.80E+03	20.5	25.4	6.18E+03	20.6	25.5	7.39E+02	11.1	14.2	1.59E+03	14.5	18.3
1.50E+02	1.47E+03	12.1	16.2	1.38E+04	19.4	22.8	2.05E+04	19.6	23.3	1.96E+04	19.5	23.3	1.36E+04	19.8	24	1.71E+04	20	24.2
2.00E+02	9.92E+03	17.9	21.3	1.76E+04	15.3	18.1	3.08E+04	16.7	19.6	3.03E+04	16.8	19.7	3.02E+04	17.9	21.1	3.59E+04	17.7	20.9
3.00E+02	2.14E+04	13.4	15.8	2.29E+04	10.8	12.4	3.66E+04	11.5	12.8	3.80E+04	11.8	13.2	4.77E+04	12.7	14.4	4.69E+04	12.3	13.9
5.00E+02	2.71E+04	6.6	7.1	2.94E+04	6.4	6.6	2.96E+04	5.8	5.7	2.99E+04	5.7	5.6	3.05E+04	5.3	5	3.00E+04	5.4	5.1
7.00E+02	2.25E+04	3.8	3.6	2.36E+04	3.8	3.7	2.46E+04	4	3.7	2.47E+04	4	3.7	2.54E+04	4	3.6	2.51E+04	4	3.6
1.00E+03	1.92E+04	3	2.8	2.08E+04	3.1	2.8	2.19E+04	3.3	2.9	2.16E+04	3.3	2.9	2.24E+04	3.3	2.9	2.30E+04	3.3	2.9
2.00E+03	1.90E+04	2.6	2.4	1.98E+04	2.7	2.4	2.07E+04	2.8	2.4	2.05E+04	2.8	2.5	2.18E+04	2.9	2.4	2.12E+04	2.9	2.4
3.00E+03	1.96E+04	2.6	2.4	2.04E+04	2.7	2.3	2.14E+04	2.8	2.3	2.12E+04	2.8	2.3	2.18E+04	2.9	2.3	2.23E+04	2.9	2.3
5.00E+03	2.07E+04	2.6	2.3	2.16E+04	2.6	2.1	2.23E+04	2.9	2.2	2.26E+04	2.9	2.2	2.27E+04	2.9	2.2	2.45E+04	3	2.2
1.00E+04	2.40E+04	2.6	2.2	2.29E+04	2.6	2.2	2.46E+04	2.9	2.2	2.41E+04	2.9	2.2	2.41E+04	3	2.1	2.31E+04	3	2.1
2.00E+04	2.78E+04	2.6	2	2.71E+04	2.6	2	2.71E+04	3	2	2.69E+04	3	2	2.77E+04	3.1	2	2.56E+04	3.1	2
5.00E+04	3.34E+04	2.4	1.9	3.40E+04	2.6	2	3.39E+04	2.9	2	3.30E+04	2.9	2	3.45E+04	3	1.9	3.17E+04	3.1	1.9
1.00E+05	4.75E+04	2.2	1.9	4.85E+04	2.3	1.9	4.32E+04	2.7	1.9	4.11E+04	2.8	1.9	4.04E+04	2.9	1.9	3.73E+04	3	1.9

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.02E+03	8.2	4.2	3.68E+03	8.2	4.2	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.04E+03	8.6	5.2	7.33E+03	8.6	5.2	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.07E+03	9.1	6.1	1.10E+04	9.1	6.1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.51E+04	10	7.8	1.82E+04	10	7.8	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.47E+00	11.1	10.5	0.00E+00	1	1	2.98E+04	12.1	11.6	3.60E+04	12.1	11.6	3.43E+01	12	11.4	4.44E+00	11.9	11.4
1.40E+01	6.21E+00	11.6	12.3	1.93E-01	4.9	7.2	4.11E+04	13.4	14.5	4.95E+04	13.4	14.5	5.30E+01	13.2	14.1	7.18E+00	13	13.9
2.00E+01	2.98E+01	12.9	14.2	6.98E-01	4.8	7.5	5.72E+04	15.2	18.3	6.86E+04	15.2	18.4	8.74E+01	14.8	17.4	1.21E+01	14.2	17.2
3.00E+01	7.74E+01	14.5	17.5	3.94E+00	3.9	6.7	8.06E+04	17.7	23.3	9.21E+04	18	23.9	1.56E+02	16.8	21.5	2.21E+01	16.1	20.2
5.00E+01	2.58E+03	16.4	20.6	1.74E+02	12.1	14.8	7.24E+04	24.2	30.3	7.33E+04	24.7	30.6	5.32E+02	18.5	23.9	8.68E+01	17.3	22.7
7.50E+01	1.49E+04	20.4	25.8	5.57E+03	18.7	23.9	5.59E+04	24.1	27.5	5.56E+04	23.9	27.2	1.62E+03	20.4	25.4	6.94E+02	18	23.1
1.00E+02	2.73E+04	22.1	26.6	1.56E+04	21.5	26.2	4.65E+04	19.6	22.7	4.65E+04	19.4	22.4	3.57E+03	21.2	25.6	2.34E+03	20.4	25.1
1.50E+02	3.43E+04	18.6	21.8	2.99E+04	19.5	23	3.88E+04	14.5	16.4	3.92E+04	14.5	16.3	7.78E+03	18.4	21.9	6.87E+03	18.5	22.2
2.00E+02	3.57E+04	14.5	16.6	3.52E+04	15.6	17.8	3.67E+04	12.2	13.4	3.72E+04	12.2	13.4	1.48E+04	16.6	19.4	1.46E+04	16.6	19.7
3.00E+02	3.51E+04	10.5	11.4	4.02E+04	11.8	13	3.58E+04	9.4	9.9	3.68E+04	9.5	10	2.87E+04	12.9	14.7	3.20E+04	13.2	15.2
5.00E+02	3.12E+04	5.7	5.3	3.13E+04	5.6	5.5	3.12E+04	5.8	5.5	3.14E+04	5.7	5.4	2.91E+04	6.4	6.5	2.94E+04	6.2	6.2
7.00E+02	2.60E+04	4	3.7	2.70E+04	4	3.6	2.65E+04	4.2	3.7	2.66E+04	4.2	3.7	2.29E+04	3.9	3.7	2.38E+04	3.9	3.6
1.00E+03	2.19E+04	3.3	2.9	2.42E+04	3.3	2.9	2.36E+04	3.5	3	2.38E+04	3.5	3	2.04E+04	3.1	2.9	2.05E+04	3.1	2.9
2.00E+03	2.13E+04	2.9	2.4	2.17E+04	2.9	2.4	2.22E+04	3	2.4	2.22E+04	3	2.4	1.97E+04	2.7	2.5	1.97E+04	2.7	2.4
3.00E+03	2.06E+04	2.9	2.3	2.15E+04	2.9	2.3	2.29E+04	3	2.3	2.28E+04	3	2.3	2.03E+04	2.7	2.3	2.04E+04	2.7	2.3

(continued on next page)

Table A.12. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	2.41E+04	3	2.2	2.31E+04	3	2.2	2.38E+04	3.1	2.2	2.37E+04	3.1	2.2	2.14E+04	2.7	2.2	2.15E+04	2.7	2.2
1.00E+04	2.43E+04	3	2.1	2.38E+04	3	2.1	2.57E+04	3.1	2.1	2.53E+04	3.1	2.1	2.42E+04	2.7	2.2	2.36E+04	2.7	2.2
2.00E+04	2.72E+04	3.1	2	2.76E+04	3.1	2.1	2.80E+04	3.2	2	2.76E+04	3.3	2	2.69E+04	2.7	2	2.73E+04	2.8	2.1
5.00E+04	3.54E+04	3	2	3.14E+04	3.2	2	3.33E+04	3.2	1.9	3.21E+04	3.3	1.9	3.43E+04	2.6	2	3.34E+04	2.6	2
1.00E+05	4.05E+04	2.9	1.9	3.47E+04	2.8	1.9	4.22E+04	3	1.9	3.99E+04	3.2	1.9	4.67E+04	2.4	1.9	4.49E+04	2.4	1.9

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.96E+02	12	11.4	5.52E+01	11.9	11.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	6.11E+02	13.2	14.1	8.90E+01	13.1	14	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.69E-01	4.7	9	3.12E-01	4.8	9.6	1.00E+03	14.9	17.6	1.44E+02	14.5	17.6	4.07E-01	7.7	8.9	3.50E-01	5.6	9.7
3.00E+01	1.09E+00	5.4	9.1	1.19E+00	5.4	9.2	1.75E+03	17	21.9	2.42E+02	17.2	21.2	1.06E+00	6.1	9.3	1.07E+00	5.6	9
5.00E+01	4.75E+00	6.5	10.9	4.08E+00	6.9	9.9	4.78E+03	19.2	24.9	7.01E+02	19.1	25.2	4.17E+00	5	9.2	4.67E+00	5.8	10.4
7.50E+01	1.65E+01	4.1	6.8	1.54E+01	4.6	7.4	1.11E+04	21.2	26.2	4.26E+03	19.2	24.8	1.71E+01	4.5	7.2	1.38E+01	4.3	7.1
1.00E+02	6.76E+01	3.4	4.8	6.25E+01	3.4	5	2.07E+04	22	26.3	1.03E+04	21.6	26.3	6.87E+01	3.2	4.3	5.58E+01	3.6	5
1.50E+02	5.40E+02	3.4	4.2	5.32E+02	2.6	3.4	2.65E+04	18.3	21.6	1.39E+04	18	21.4	1.41E+03	15.2	19.6	5.85E+02	2.6	3.3
2.00E+02	6.45E+03	17.8	21.5	4.71E+03	14.2	16.9	3.25E+04	15.2	17.5	2.44E+04	16.4	19.6	5.79E+03	16.3	18.6	2.94E+03	10.4	14.7
3.00E+02	2.21E+04	13.5	14.4	2.49E+04	15.2	18	4.67E+04	11.9	13.1	4.22E+04	12	13	2.21E+04	14.1	16.8	2.93E+04	14.8	17.2
5.00E+02	2.89E+04	7.1	6.8	2.65E+04	5.8	6.5	3.13E+04	5.6	5.4	3.16E+04	5.7	5.8	3.08E+04	7	7	2.94E+04	7.2	6.7
7.00E+02	2.00E+04	3.8	3.6	2.32E+04	3.9	3.9	2.62E+04	4	3.6	2.67E+04	4.1	3.6	2.19E+04	4	3.8	2.18E+04	3.8	3.6
1.00E+03	2.01E+04	3	2.8	1.98E+04	3	2.8	2.27E+04	3.4	2.9	2.24E+04	3.3	2.9	2.00E+04	3	2.8	1.98E+04	3	2.9
2.00E+03	1.84E+04	2.5	2.5	1.98E+04	2.6	2.5	2.16E+04	2.9	2.4	2.28E+04	2.9	2.4	1.99E+04	2.6	2.5	1.87E+04	2.6	2.5
3.00E+03	1.88E+04	2.5	2.4	2.04E+04	2.7	2.3	2.19E+04	2.9	2.3	2.12E+04	2.9	2.3	2.03E+04	2.6	2.4	1.92E+04	2.6	2.3
5.00E+03	2.02E+04	2.6	2.2	1.98E+04	2.5	2.2	2.31E+04	2.9	2.1	2.30E+04	2.9	2.3	2.02E+04	2.6	2.3	2.23E+04	2.6	2.2
1.00E+04	2.50E+04	2.6	2.3	2.47E+04	2.5	2.3	2.51E+04	3	2.1	2.22E+04	3	2.1	2.25E+04	2.5	2.2	2.38E+04	2.6	2.2
2.00E+04	2.69E+04	2.4	2	2.98E+04	2.8	2.1	2.92E+04	3.1	2	2.59E+04	3	2	2.75E+04	2.5	2	2.89E+04	2.6	2.2
5.00E+04	3.45E+04	2.3	2	3.62E+04	2.4	1.9	3.21E+04	3	2	2.97E+04	3.1	2	3.47E+04	2.4	2	3.17E+04	2.4	1.9
1.00E+05	4.89E+04	2.3	1.9	4.40E+04	2.3	1.9	3.96E+04	2.9	1.9	4.14E+04	2.7	2	4.85E+04	2.2	2	4.53E+04	2.3	1.8

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.21E+01	11.8	10.8	0.00E+00	1	1
1.40E+01	1.05E-01	6.9	9.8	0.00E+00	1	1	1.00E-01	6.8	9.8	1.00E-01	7	10.1	3.65E+01	12.4	13	1.39E-01	6.1	8.8
2.00E+01	3.45E-01	7.5	9.6	4.15E-01	7.1	9.6	3.10E-01	7.9	9.3	4.10E-01	7.9	9.8	6.43E+01	14.1	16	5.01E-01	5	8.4
3.00E+01	1.18E+00	7.2	9.1	1.24E+00	7.1	8.9	1.10E+00	7	9.1	1.11E+00	7.2	9.3	1.52E+02	15.7	19.5	3.03E+00	7.3	7
5.00E+01	4.98E+00	6	9.3	5.49E+00	5.8	8.3	4.35E+00	6.1	9.5	4.29E+00	5.9	9.5	1.50E+03	17.3	22.2	4.21E+01	11.9	15.7
7.50E+01	2.42E+01	4.1	5.9	3.08E+01	3.7	5.5	1.82E+01	4.3	6.2	1.99E+01	4.1	6.1	4.91E+03	21.2	26.4	1.25E+03	16.4	21
1.00E+02	1.04E+02	3.2	4.3	1.33E+02	3.5	4.6	8.03E+01	3.4	4.5	7.93E+01	3.3	4.5	8.33E+03	21.8	26.2	6.76E+03	21	26.2
1.50E+02	2.71E+03	15.8	19.9	3.81E+03	16.9	21.2	5.89E+02	3.9	4.5	7.68E+02	4.4	5.1	1.17E+04	18	21.2	1.16E+04	18.7	22.3
2.00E+02	1.08E+04	17.3	20.7	1.29E+04	17.3	20.9	8.07E+03	16.9	21.1	7.06E+03	16.7	20.1	1.59E+04	15.4	18	1.66E+04	15.8	18.6
3.00E+02	2.71E+04	13.6	15.9	3.42E+04	13.5	15.5	2.56E+04	13.3	15.1	2.97E+04	13.6	15.8	2.78E+04	12.5	14.2	3.29E+04	12.9	14.8
5.00E+02	2.86E+04	6.2	6.4	3.00E+04	5.9	5.9	2.88E+04	6.7	7.1	2.82E+04	6.4	6.6	2.94E+04	6.3	6.5	2.98E+04	6.3	6.2
7.00E+02	2.28E+04	3.9	3.6	2.33E+04	3.9	3.6	2.30E+04	4.1	3.6	2.36E+04	3.9	3.7	2.32E+04	3.9	3.7	2.40E+04	3.9	3.7
1.00E+03	2.09E+04	3.1	2.9	2.12E+04	3.1	2.9	1.99E+04	3	2.9	1.99E+04	3.1	2.9	2.07E+04	3.1	2.9	2.16E+04	3.2	2.9
2.00E+03	1.96E+04	2.7	2.4	1.95E+04	2.7	2.4	1.83E+04	2.6	2.5	1.89E+04	2.6	2.4	1.97E+04	2.7	2.4	1.98E+04	2.7	2.4
3.00E+03	2.00E+04	2.6	2.3	2.03E+04	2.7	2.3	1.99E+04	2.6	2.4	1.97E+04	2.6	2.3	2.06E+04	2.7	2.3	2.08E+04	2.7	2.3
5.00E+03	2.10E+04	2.7	2.2	2.19E+04	2.8	2.2	2.20E+04	2.6	2.2	2.14E+04	2.7	2.2	2.14E+04	2.7	2.2	2.16E+04	2.8	2.2
1.00E+04	2.42E+04	2.6	2.2	2.32E+04	2.7	2.2	2.34E+04	2.5	2.2	2.40E+04	2.6	2.2	2.42E+04	2.6	2.1	2.42E+04	2.8	2.2
2.00E+04	2.62E+04	2.7	2.1	2.56E+04	2.8	2.1	2.54E+04	2.5	2.1	2.86E+04	2.7	2	2.74E+04	2.8	2	2.81E+04	2.9	2.1
5.00E+04	3.61E+04	2.5	2	3.30E+04	2.7	2	3.73E+04	2.4	2	3.43E+04	2.5	1.9	3.51E+04	2.6	2	3.36E+04	2.7	1.9
1.00E+05	4.72E+04	2.3	1.9	4.29E+04	2.5	1.9	4.88E+04	2.2	1.9	4.74E+04	2.4	1.9	4.76E+04	2.3	1.9	4.54E+04	2.5	1.8

Table A.12. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.77E+01	12	11.4	2.10E+00	12	11.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	4.01E+01	13.2	14.1	3.25E+00	12.9	13.8	1.07E-01	5.6	9.1	1.17E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	6.51E+01	14.7	17.4	5.45E+00	13.9	16.4	3.83E-01	6.6	9	4.55E+00	9.8	12.6	2.99E-01	6.8	9.7	3.34E-01	7.1	10.1
3.00E+01	1.15E+02	16.4	21	1.19E+01	14.4	17.9	1.88E+00	5.9	8.6	1.92E+01	10.8	14.6	1.01E+00	7.1	9.5	1.05E+00	7.1	9.2
5.00E+01	5.70E+02	17.1	21.7	1.23E+02	14.7	18.3	1.89E+01	5.7	8.1	2.10E+02	16.5	21.5	3.82E+00	6.7	10.6	4.47E+00	6.1	9.8
7.50E+01	3.53E+03	19.3	24.4	1.26E+03	18.1	23	7.95E+02	16.7	20.7	1.83E+03	18.3	23.2	1.12E+01	5.4	8.3	1.74E+01	4.2	6.5
1.00E+02	1.03E+04	21.1	25.9	4.84E+03	19.9	24.6	2.81E+03	20.7	25.7	5.37E+03	21	25.7	3.44E+01	3.9	5.6	6.62E+01	3.4	4.7
1.50E+02	2.35E+04	19.5	23.2	1.96E+04	19.8	23.8	8.98E+03	17.7	21.5	1.42E+04	19.2	22.9	2.84E+02	2.8	3.5	5.06E+02	2.9	3.6
2.00E+02	3.09E+04	16.2	18.9	2.97E+04	16.9	19.8	2.78E+04	18.2	21.5	3.13E+04	17.5	20.8	1.28E+03	2.4	3.3	5.53E+03	14.4	17.4
3.00E+02	3.47E+04	11.2	12.5	3.61E+04	11.7	13	4.20E+04	12.1	13.4	3.79E+04	11.4	13	1.97E+04	15.4	18.5	3.08E+04	14.3	16.5
5.00E+02	2.96E+04	6	5.9	2.98E+04	5.9	5.8	2.91E+04	5.5	5.4	3.12E+04	5.6	5.5	2.84E+04	6.9	7	2.71E+04	6.6	6.8
7.00E+02	2.46E+04	4.1	3.7	2.46E+04	4	3.7	2.40E+04	4	3.6	2.58E+04	4.1	3.6	2.19E+04	3.8	3.7	2.29E+04	3.9	3.7
1.00E+03	2.18E+04	3.3	2.9	2.16E+04	3.2	2.9	2.29E+04	3.3	2.9	2.30E+04	3.3	2.9	1.94E+04	3	2.8	1.99E+04	3	2.8
2.00E+03	2.07E+04	2.8	2.4	2.06E+04	2.8	2.4	2.17E+04	2.8	2.5	2.11E+04	2.9	2.4	1.91E+04	2.5	2.5	1.92E+04	2.6	2.5
3.00E+03	2.13E+04	2.8	2.3	2.12E+04	2.8	2.3	2.18E+04	2.9	2.3	2.06E+04	2.9	2.3	1.94E+04	2.5	2.4	2.04E+04	2.6	2.3
5.00E+03	2.26E+04	2.9	2.2	2.23E+04	2.9	2.2	2.20E+04	2.9	2.1	2.13E+04	2.9	2.2	1.92E+04	2.5	2.2	2.04E+04	2.7	2.2
1.00E+04	2.48E+04	2.8	2.2	2.41E+04	2.8	2.2	2.54E+04	2.9	2.2	2.50E+04	3	2.1	2.40E+04	2.5	2.2	2.50E+04	2.6	2.2
2.00E+04	2.75E+04	2.9	2	2.69E+04	2.9	2	2.73E+04	2.9	2	2.60E+04	2.9	2.1	2.58E+04	2.5	2.1	2.62E+04	2.6	2.1
5.00E+04	3.38E+04	2.8	1.9	3.29E+04	2.8	2	3.20E+04	2.9	2	3.44E+04	3	2	3.32E+04	2.3	2	3.48E+04	2.5	2
1.00E+05	4.53E+04	2.6	1.9	4.24E+04	2.7	1.9	4.11E+04	2.8	1.9	4.18E+04	2.6	1.9	4.99E+04	2.1	1.9	4.73E+04	2.3	1.9

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.06E-01	6.9	10.2	1.05E-01	7.4	9.6	1.14E-01	7.3	9.7	1.09E-01	6.2	10.1	1.26E-01	6.6	9.7
2.00E+01	3.63E-01	5.2	9.4	3.43E-01	6.9	9.8	3.26E-01	7.2	9.6	3.60E-01	7.2	9.6	4.00E-01	7.2	9.5	3.48E-01	6.4	9.9
3.00E+01	9.01E-01	7.2	9.3	9.37E-01	7.3	9.3	1.13E+00	7.1	9	1.18E+00	7	8.9	1.17E+00	6.9	9	1.28E+00	6.9	8.8
5.00E+01	4.60E+00	6.2	10.2	3.99E+00	6.8	10.3	5.01E+00	5.9	8.7	5.08E+00	5.4	8.7	4.82E+00	5.3	8.9	5.84E+00	5	7.9
7.50E+01	1.28E+01	5.2	7.9	1.43E+01	4.9	7.9	2.47E+01	4	5.9	2.69E+01	3.9	5.7	2.54E+01	3.9	5.9	3.49E+01	3.6	5.1
1.00E+02	4.06E+01	3.7	5.5	4.72E+01	3.7	5.4	1.12E+02	4.2	5.5	1.05E+02	3.4	4.4	1.04E+02	3.3	4.3	1.42E+02	3.2	4
1.50E+02	4.17E+02	2.8	3.4	4.45E+02	2.8	3.5	2.35E+03	16.4	20.1	3.02E+03	16	20	1.89E+03	13.1	16	4.09E+03	17.4	21.8
2.00E+02	1.55E+03	2.6	3.9	2.59E+03	9.3	10.7	1.06E+04	17.5	21.1	1.25E+04	17.7	21.1	1.45E+04	18.4	22.1	2.02E+04	18.3	21.9
3.00E+02	2.62E+04	16.4	19.1	2.68E+04	15.1	17.8	2.48E+04	13.2	15.3	2.73E+04	12.8	15	2.84E+04	12.7	14.6	3.33E+04	12.7	14.4
5.00E+02	2.59E+04	6.8	7.3	2.99E+04	6.6	7	2.82E+04	6.5	6.7	2.87E+04	6.5	6.6	2.89E+04	6.8	7.1	3.01E+04	6.4	6.1
7.00E+02	2.26E+04	3.9	3.6	2.24E+04	3.8	3.7	2.26E+04	3.9	3.8	2.29E+04	3.9	3.7	2.23E+04	3.9	3.6	2.37E+04	4	3.6
1.00E+03	1.84E+04	3	2.9	1.93E+04	2.9	2.9	1.99E+04	3	2.9	2.02E+04	3.1	2.9	1.83E+04	3.1	2.9	2.11E+04	3.1	2.9
2.00E+03	1.91E+04	2.5	2.5	1.77E+04	2.5	2.5	1.93E+04	2.6	2.5	1.91E+04	2.6	2.4	1.92E+04	2.6	2.4	1.94E+04	2.7	2.4
3.00E+03	1.91E+04	2.7	2.4	1.92E+04	2.6	2.3	1.99E+04	2.6	2.3	2.00E+04	2.6	2.3	1.95E+04	2.6	2.3	1.96E+04	2.6	2.3
5.00E+03	2.30E+04	2.6	2.3	1.91E+04	2.5	2.2	2.08E+04	2.6	2.2	2.11E+04	2.7	2.3	2.25E+04	2.7	2.2	2.19E+04	2.7	2.2
1.00E+04	2.27E+04	2.4	2.3	2.14E+04	2.4	2.2	2.44E+04	2.6	2.2	2.38E+04	2.6	2.2	2.38E+04	2.6	2.2	2.27E+04	2.7	2.2
2.00E+04	2.97E+04	2.7	2.1	3.01E+04	2.6	2	2.66E+04	2.6	2.1	2.79E+04	2.6	2	2.55E+04	2.7	2	2.73E+04	2.9	2.1
5.00E+04	3.30E+04	2.5	2	3.34E+04	2.3	2	3.64E+04	2.5	2	3.43E+04	2.5	1.9	3.44E+04	2.4	2	3.08E+04	2.5	1.9
1.00E+05	4.67E+04	2.2	1.9	4.74E+04	2.2	1.9	5.10E+04	2.2	1.9	4.77E+04	2.3	1.9	4.85E+04	2.2	1.9	4.62E+04	2.4	1.9

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.49E-01	5.8	8.7	0.00E+00	1	1	2.72E+00	4.6	6.2	2.72E+00	4.6	6.2
2.00E+01	5.91E-01	6.4	8.2	0.00E+00	1	1	1.34E+01	4.6	5.8	1.34E+01	4.6	5.8
3.00E+01	1.44E+00	5.5	7.6	1.98E+00	5.3	7.5	8.62E+01	6.4	7.6	8.62E+01	6.4	7.6
5.00E+01	1.44E+01	3.6	6.1	1.41E+01	5.1	6.4	7.65E+04	19	25.6	7.65E+04	19	25.6
7.50E+01	5.79E+02	14.3	18	2.37E+02	12.5	16	6.21E+04	25.5	29.3	6.21E+04	25.5	29.3

(continued on next page)

Table A.12. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	3.65E+03	19.3	24.2	2.43E+03	18.3	23.5	5.06E+04	21	24.4	5.06E+04	21	24.4
1.50E+02	2.01E+04	20.3	24.5	1.62E+04	20.2	24.5	4.06E+04	16.3	19.1	4.06E+04	16.3	19.1
2.00E+02	2.66E+04	16.9	19.2	2.00E+04	15.9	18.2	4.08E+04	12.8	14.9	4.08E+04	12.8	14.9
3.00E+02	2.65E+04	10.8	12.2	3.10E+04	13.4	15.6	3.77E+04	9.2	9.6	3.77E+04	9.2	9.6
5.00E+02	3.10E+04	6.5	6.2	2.94E+04	6	5.7	3.29E+04	5.7	5.2	3.29E+04	5.7	5.2
7.00E+02	2.27E+04	3.8	3.6	2.44E+04	3.8	3.5	2.68E+04	4.2	3.5	2.68E+04	4.2	3.5
1.00E+03	2.03E+04	3.1	2.9	1.72E+04	3.1	2.9	2.22E+04	3.4	3.1	2.22E+04	3.4	3.1
2.00E+03	1.94E+04	2.8	2.4	1.95E+04	2.8	2.4	2.31E+04	3.1	2.4	2.31E+04	3.1	2.4
3.00E+03	2.12E+04	2.7	2.3	2.20E+04	2.7	2.3	2.31E+04	3	2.4	2.31E+04	3	2.4
5.00E+03	2.03E+04	2.7	2.2	2.38E+04	2.9	2.2	2.35E+04	3.1	2	2.35E+04	3.1	2
1.00E+04	2.56E+04	2.8	2.2	2.23E+04	2.7	2.2	2.43E+04	3	2.1	2.43E+04	3	2.1
2.00E+04	2.52E+04	2.9	2	2.30E+04	2.8	2	2.75E+04	3.2	2	2.75E+04	3.2	2
5.00E+04	3.41E+04	2.7	1.9	3.46E+04	2.7	2	2.62E+04	3.1	2	2.62E+04	3.1	2
1.00E+05	4.37E+04	2.4	1.9	4.45E+04	2.4	2	3.80E+04	3.1	1.9	3.80E+04	3.1	1.9

Table A.13. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{20}Ne ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.00E+00	10.9	2.4	1.31E+00	10.9	2.4	3.77E+02	10.6	8.9	4.17E+02	10.7	9.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	6.04E+00	11.9	2.9	1.89E+00	11.9	2.9	7.00E+02	11.5	10.6	6.95E+02	11.7	11	1.12E-01	7.1	9.6	1.21E-01	7	9.5
2.00E+01	1.02E+01	13.1	3.6	3.57E+00	12.5	3.5	1.54E+03	12.6	13.1	1.39E+03	12.8	13.4	4.29E-01	7	9.5	3.91E-01	6.9	9.5
3.00E+01	1.86E+01	14.6	4.5	6.90E+00	12.9	4.2	3.64E+03	14.3	16.5	3.27E+03	14.5	16.9	1.34E+00	6.3	9	1.36E+00	6.6	8.9
5.00E+01	6.13E+01	15	4.9	2.52E+01	12	4.1	2.34E+04	16.5	20.8	1.70E+04	17	21.6	6.73E+00	5	7.9	6.96E+00	5.1	7.8
7.50E+01	3.99E+02	15.3	4.8	4.97E+02	15.3	4.9	4.98E+04	20.6	25.9	3.13E+04	20.9	26	5.12E+01	6.8	8.6	4.46E+01	3.7	5
1.00E+02	2.81E+03	18.2	5.8	2.55E+03	18.5	6	6.22E+04	23.1	26.9	4.27E+04	22.7	26.5	2.30E+02	9.2	11.5	1.88E+02	4.2	5.1
1.50E+02	8.69E+03	20.7	6.4	8.77E+03	20.4	6.3	5.78E+04	20.5	22.7	4.93E+04	20.7	23.3	4.17E+03	16.9	20.9	4.94E+03	17.7	21.9
2.00E+02	1.54E+04	18.1	5.7	1.62E+04	18.3	5.7	5.16E+04	15.9	17.2	4.43E+04	16.9	18.5	1.82E+04	19.7	22.9	1.91E+04	19.6	22.8
3.00E+02	2.99E+04	15	4.8	3.26E+04	15.3	4.8	4.10E+04	10.5	10.5	3.75E+04	11.3	11.7	3.04E+04	14.9	16.5	3.08E+04	14.7	16.4
5.00E+02	3.45E+04	8.7	2.9	3.57E+04	8.6	2.9	3.36E+04	8.4	8	3.88E+04	8.4	8.2	3.39E+04	8.6	8.8	3.45E+04	8.8	9
7.00E+02	2.82E+04	5.5	2	2.84E+04	5.4	2	3.34E+04	5.7	5	3.22E+04	5.6	4.8	2.82E+04	5.6	5	2.88E+04	5.5	5
1.00E+03	2.39E+04	4.2	1.6	2.44E+04	4.2	1.6	3.01E+04	4.6	3.6	2.80E+04	4.5	3.7	2.41E+04	4.1	3.5	2.40E+04	4.1	3.5
2.00E+03	2.26E+04	3.5	1.4	2.30E+04	3.6	1.4	2.61E+04	3.9	2.9	2.60E+04	3.9	2.9	2.24E+04	3.5	2.8	2.30E+04	3.5	2.8
3.00E+03	2.36E+04	3.5	1.4	2.36E+04	3.5	1.4	2.84E+04	4	2.7	2.64E+04	3.9	2.7	2.32E+04	3.4	2.6	2.33E+04	3.4	2.6
5.00E+03	2.52E+04	3.5	1.4	2.53E+04	3.6	1.4	2.91E+04	4	2.5	2.61E+04	4	2.5	2.55E+04	3.5	2.5	2.52E+04	3.5	2.5
1.00E+04	2.75E+04	3.4	1.3	2.80E+04	3.5	1.3	3.05E+04	4.2	2.4	2.87E+04	4	2.4	2.74E+04	3.3	2.4	2.77E+04	3.4	2.4
2.00E+04	3.11E+04	3.5	1.3	3.06E+04	3.6	1.3	3.02E+04	4.1	2.3	3.25E+04	4.2	2.3	3.14E+04	3.5	2.2	3.21E+04	3.6	2.3
5.00E+04	4.01E+04	3.2	1.3	3.85E+04	3.4	1.3	4.57E+04	4.3	2.1	3.81E+04	4.1	2.1	4.06E+04	3.2	2.1	3.99E+04	3.2	2.2
1.00E+05	5.06E+04	3	1.2	5.02E+04	3.1	1.2	4.90E+04	3.9	2.1	4.59E+04	3.9	2.1	5.29E+04	2.8	2	4.99E+04	3	2

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.68E+02	11	9.5	0.00E+00	1	1
1.40E+01	1.11E-01	7.5	9.8	1.19E-01	7.3	9.9	1.07E-01	6.6	9.9	1.35E-01	7.5	9.4	6.47E+02	12	11.7	0.00E+00	1	1
2.00E+01	4.11E-01	7.6	9.5	4.02E-01	7.4	9.6	3.36E-01	7.6	9.6	4.03E-01	7	9.8	1.06E+03	13.3	14.6	2.76E-01	5.4	10.4
3.00E+01	1.32E+00	6.8	8.8	1.39E+00	7	9.2	1.27E+00	6.8	9.2	1.45E+00	6.4	8.5	1.99E+03	15.3	18.5	1.23E+00	5.4	8.9
5.00E+01	6.16E+00	5.5	8.3	6.79E+00	5.2	8.1	5.19E+00	5.4	8.9	7.52E+00	4.7	7.7	5.02E+03	17.4	22.1	3.07E+00	6.2	9.9
7.50E+01	3.62E+01	3.6	5.2	4.20E+01	3.4	4.9	2.78E+01	3.8	5.6	4.59E+01	3.5	4.9	1.12E+04	20.4	25.3	1.22E+01	4.7	7.9
1.00E+02	1.62E+02	4.6	5.5	1.91E+02	3.5	4.4	1.05E+02	3.3	4.2	1.89E+02	3.2	4	1.94E+04	22	25.9	4.25E+01	3.4	5.2
1.50E+02	3.29E+03	15.6	19.3	3.33E+03	14.5	17.9	1.33E+03	10.3	13.1	6.34E+03	18	21.8	3.04E+04	20.9	23.9	3.29E+02	2.3	3.3
2.00E+02	1.43E+04	18.6	21.8	2.12E+04	19.3	22.8	1.20E+04	19	22.2	1.89E+04	19.5	22.4	2.99E+04	18	20.1	1.46E+03	2.5	3
3.00E+02	3.88E+04	16	18.1	4.16E+04	15.3	17	2.83E+04	15.5	17.3	3.30E+04	15.1	16.7	2.93E+04	11.4	12.6	2.48E+04	17.5	20.4
5.00E+02	3.61E+04	8.4	8.3	3.80E+04	8.2	8	3.52E+04	9.3	9.5	3.53E+04	8.6	8.6	3.82E+04	9.2	8.9	3.28E+04	9.3	10.2
7.00E+02	2.89E+04	5.4	4.8	2.93E+04	5.4	4.7	2.79E+04	5.4	5	2.94E+04	5.5	4.8	2.71E+04	5.3	4.7	2.60E+04	5.2	4.8
1.00E+03	2.50E+04	4.3	3.5	2.63E+04	4.3	3.6	2.43E+04	4.1	3.5	2.43E+04	4.2	3.5	2.70E+04	4.4	3.6	2.18E+04	4.1	3.4
2.00E+03	2.30E+04	3.6	2.8	2.37E+04	3.7	2.8	2.20E+04	3.4	2.8	2.39E+04	3.6	2.8	2.34E+04	3.7	2.8	2.28E+04	3.2	2.7
3.00E+03	2.42E+04	3.6	2.6	2.40E+04	3.6	2.6	2.32E+04	3.4	2.6	2.47E+04	3.6	2.6	2.57E+04	3.7	2.6	2.06E+04	3.1	2.6
5.00E+03	2.53E+04	3.6	2.5	2.60E+04	3.8	2.5	2.37E+04	3.4	2.5	2.51E+04	3.6	2.5	2.63E+04	3.7	2.5	2.51E+04	3.4	2.5
1.00E+04	2.77E+04	3.6	2.4	2.90E+04	3.7	2.4	2.80E+04	3.3	2.4	2.73E+04	3.4	2.4	2.71E+04	3.7	2.4	2.47E+04	3.3	2.3
2.00E+04	3.16E+04	3.6	2.3	3.13E+04	3.8	2.3	3.00E+04	3.2	2.2	3.24E+04	3.6	2.2	3.42E+04	3.8	2.3	3.16E+04	3.1	2.3
5.00E+04	3.96E+04	3.5	2.1	3.87E+04	3.6	2.1	4.04E+04	3.2	2.1	3.77E+04	3.3	2.1	4.00E+04	3.3	2.1	3.34E+04	3	2.1
1.00E+05	4.94E+04	3.2	2	4.78E+04	3.5	2.1	5.04E+04	2.9	2	4.91E+04	3.1	2	5.03E+04	3.6	2	5.09E+04	2.4	1.9

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.07E-01	7.5	9.8	1.21E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.13. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	3.43E-01	7.5	9.6	3.97E-01	7.1	9.5	3.00E-01	6.2	9.3	4.39E-01	6.2	9.7	5.89E-01	5.2	7.6	7.50E-01	4.4	7.9
3.00E+01	1.21E+00	6.9	8.8	1.28E+00	6.8	8.7	1.09E+00	6.1	9.1	1.29E+00	7	9	2.43E+00	4.2	6.4	2.26E+00	3.8	6.1
5.00E+01	5.62E+00	5.6	8.8	6.64E+00	5.2	8.1	5.57E+00	5.9	9.1	5.52E+00	5.8	9.3	1.91E+01	4.4	5.5	1.98E+01	3.7	5.2
7.50E+01	2.89E+01	3.9	5.6	3.87E+01	3.7	5.1	2.67E+01	6.3	8	2.73E+01	4	6	1.66E+02	4.6	6.1	1.90E+02	5.7	5.7
1.00E+02	1.23E+02	3.4	4.5	1.69E+02	4.4	5.4	1.80E+02	8.7	12.2	9.61E+01	2.9	4.3	3.58E+03	16.1	19.4	6.24E+03	16.3	20.4
1.50E+02	2.96E+03	16.5	20.1	4.55E+03	17.3	21.3	2.23E+03	16	19.5	2.51E+03	15.7	19.5	2.66E+04	21.3	25.2	3.22E+04	21.9	25.6
2.00E+02	1.07E+04	18.6	21.7	1.68E+04	19.3	22.4	7.70E+03	18.1	21.1	8.90E+03	18.4	20.8	3.02E+04	19.2	21.3	3.12E+04	18	20.5
3.00E+02	2.84E+04	15.3	17.3	3.21E+04	15.2	17	2.29E+04	15.3	18.1	3.81E+04	17	19.3	3.28E+04	13.1	14.1	3.77E+04	13.8	15.2
5.00E+02	3.48E+04	9	9.4	3.47E+04	8.8	8.8	3.46E+04	9	9.2	3.87E+04	8.6	8.7	3.41E+04	8.7	8.7	4.14E+04	8.6	8.6
7.00E+02	2.84E+04	5.5	5	2.85E+04	5.4	4.9	2.96E+04	5.6	4.8	2.76E+04	5.3	4.7	3.01E+04	5.5	4.8	2.74E+04	5.6	4.6
1.00E+03	2.41E+04	4.1	3.5	2.43E+04	4.2	3.5	2.32E+04	4	3.5	2.38E+04	4.1	3.6	2.62E+04	4.3	3.5	2.73E+04	4.4	3.5
2.00E+03	2.17E+04	3.4	2.8	2.26E+04	3.5	2.8	2.30E+04	3.5	2.8	2.24E+04	3.5	2.8	2.35E+04	3.6	2.9	2.55E+04	3.8	2.9
3.00E+03	2.23E+04	3.4	2.6	2.41E+04	3.5	2.6	2.31E+04	3.4	2.6	2.41E+04	3.5	2.7	2.35E+04	3.7	2.7	2.48E+04	3.8	2.7
5.00E+03	2.44E+04	3.4	2.5	2.41E+04	3.6	2.5	2.37E+04	3.4	2.5	2.54E+04	3.5	2.5	2.92E+04	3.8	2.5	2.50E+04	3.7	2.6
1.00E+04	2.71E+04	3.3	2.4	2.81E+04	3.4	2.4	2.49E+04	3.4	2.4	2.71E+04	3.5	2.4	2.81E+04	3.6	2.4	2.85E+04	3.8	2.4
2.00E+04	3.18E+04	3.4	2.2	3.13E+04	3.5	2.2	3.16E+04	3.5	2.2	2.85E+04	3.9	2.2	3.13E+04	4	2.3	3.03E+04	4.2	2.2
5.00E+04	3.99E+04	3.1	2.1	3.93E+04	3.3	2.1	3.93E+04	3.1	2.1	3.62E+04	3.2	2.2	4.19E+04	3.7	2.1	3.85E+04	3.8	2.1
1.00E+05	5.13E+04	2.9	2	4.72E+04	3.1	2.1	5.19E+04	2.8	2	5.20E+04	3.5	2	4.93E+04	3.2	2.1	4.50E+04	3.3	2.1

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.28E+01	10.9	9.5	2.85E+00	10.9	9.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.29E-01	4.2	8.8	1.92E+01	12	11.7	4.06E+00	11.9	11.6	1.34E-01	7.2	10	1.42E-01	7.2	9.6
2.00E+01	3.98E-01	6.4	9.3	5.79E-01	4.9	7.6	3.02E+01	13.3	14.5	7.30E+00	12.8	14	4.63E-01	7.3	9.3	5.46E-01	6.8	9.4
3.00E+01	1.24E+00	6.6	8.8	2.29E+00	5	6.8	5.71E+01	14.9	17.9	1.44E+01	13.5	16.6	1.67E+00	6.2	8	1.80E+00	5.7	8.1
5.00E+01	5.47E+00	6.1	9.6	1.60E+01	4.4	6	1.89E+02	15.7	19.7	4.99E+01	12.4	15.7	1.03E+01	4.4	6.7	1.26E+01	4.2	6.2
7.50E+01	2.26E+01	3.9	6.1	2.79E+02	9.6	10.9	1.17E+03	15.9	19.5	1.07E+03	15.4	19	6.91E+01	3.7	4.4	9.00E+01	3.5	4.5
1.00E+02	8.69E+01	3.3	4.4	5.99E+03	17.3	22.5	6.59E+03	18.6	23.3	5.88E+03	18.6	23.4	3.94E+02	6.7	8	6.81E+02	9.8	11.6
1.50E+02	6.84E+02	5.5	6.1	1.55E+04	21.5	24.8	2.10E+04	21.1	24.5	1.99E+04	20.9	24.3	9.73E+03	19	23.2	1.58E+04	19.9	24
2.00E+02	9.13E+03	19.1	22.2	1.90E+04	17.9	20.4	3.21E+04	19	21.7	3.10E+04	19.1	21.8	3.09E+04	19.6	22.7	3.61E+04	19.7	22.7
3.00E+02	2.23E+04	14.6	16.7	2.60E+04	13.5	14.5	4.22E+04	14.4	15.7	4.29E+04	14.5	15.9	5.24E+04	15.7	17.3	5.47E+04	15.3	16.9
5.00E+02	3.48E+04	9.5	9.5	3.51E+04	8.9	9.5	3.64E+04	8	7.8	3.63E+04	7.9	7.7	3.68E+04	7.4	6.9	3.80E+04	7.3	6.8
7.00E+02	2.78E+04	5.4	4.9	2.78E+04	5.3	4.9	3.00E+04	5.5	4.8	2.98E+04	5.5	4.8	3.05E+04	5.5	4.7	3.17E+04	5.5	4.7
1.00E+03	2.26E+04	4	3.4	2.31E+04	4.1	3.5	2.60E+04	4.4	3.6	2.62E+04	4.4	3.6	2.64E+04	4.5	3.6	2.76E+04	4.5	3.7
2.00E+03	2.24E+04	3.3	2.8	2.32E+04	3.5	2.8	2.43E+04	3.8	2.9	2.42E+04	3.8	2.9	2.51E+04	3.8	2.9	2.55E+04	3.9	2.9
3.00E+03	2.31E+04	3.3	2.6	2.37E+04	3.5	2.6	2.50E+04	3.8	2.7	2.50E+04	3.8	2.7	2.53E+04	3.8	2.7	2.51E+04	3.9	2.7
5.00E+03	2.55E+04	3.4	2.5	2.59E+04	3.6	2.5	2.61E+04	3.8	2.5	2.64E+04	3.9	2.5	2.64E+04	3.9	2.5	2.65E+04	4	2.5
1.00E+04	2.62E+04	3.1	2.4	2.76E+04	3.3	2.4	2.82E+04	3.8	2.4	2.86E+04	3.8	2.4	2.88E+04	3.9	2.4	2.96E+04	4	2.4
2.00E+04	3.18E+04	3.3	2.2	3.37E+04	3.5	2.2	3.17E+04	3.9	2.3	3.14E+04	3.9	2.3	3.23E+04	4.1	2.3	3.20E+04	4.1	2.3
5.00E+04	4.14E+04	2.9	2.1	4.25E+04	3.1	2.1	3.87E+04	3.7	2.2	3.75E+04	3.8	2.2	4.01E+04	4	2.2	3.66E+04	4.2	2.2
1.00E+05	5.37E+04	2.8	2	5.05E+04	3.3	2	4.71E+04	3.5	2.1	4.78E+04	3.5	2.1	4.26E+04	3.9	2.1	4.47E+04	3.9	2.1

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.18E+03	7.7	3.7	3.86E+03	7.7	3.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.36E+03	8	4.5	7.72E+03	8	4.5	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.53E+03	8.4	5.3	1.16E+04	8.4	5.3	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.58E+04	9.3	6.6	1.92E+04	9.3	6.6	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.72E+00	10.8	8.5	0.00E+00	1	1	3.14E+04	11	9.6	3.80E+04	11	9.6	3.90E+01	10.9	9.5	4.69E+00	10.9	9.5
1.40E+01	6.87E+00	10.3	9.8	1.95E-01	4.9	7.2	4.35E+04	12.2	12	5.25E+04	12.2	12	5.84E+01	12	11.7	7.65E+00	12	11.7
2.00E+01	3.02E+01	10.8	12.4	7.48E-01	4.8	7.4	6.07E+04	13.7	15.3	7.27E+04	13.7	15.3	9.54E+01	13.4	14.6	1.29E+01	13.3	14.4
3.00E+01	7.84E+01	12.4	15.2	4.09E+00	3.9	6.1	8.65E+04	15.9	19.9	1.02E+05	16	20	1.63E+02	15.2	18.5	2.34E+01	14.3	17.5
5.00E+01	2.33E+03	14.9	18.1	1.51E+02	10.8	10.8	8.71E+04	21.4	28.4	8.90E+04	21.9	29	5.39E+02	17	21.5	8.59E+01	16.3	20.6
7.50E+01	1.25E+04	18.3	23.3	4.51E+03	16.2	20.5	6.84E+04	26.4	29.1	6.79E+04	26.7	29.1	1.58E+03	19	23.6	6.21E+02	16.3	20.7
1.00E+02	2.79E+04	21.4	25.9	1.51E+04	20	24.8	5.66E+04	23.6	25.6	5.66E+04	23.4	25.4	3.62E+03	20.7	25	2.24E+03	19.2	23.8
1.50E+02	4.03E+04	21.4	24.2	3.06E+04	21.4	24.6	4.61E+04	17.7	19.3	4.66E+04	17.6	19.2	7.58E+03	19.7	22.9	6.47E+03	19.3	22.7
2.00E+02	4.01E+04	17.6	19.5	3.60E+04	18.4	20.7	4.31E+04	14.7	15.8	4.32E+04	14.7	15.8	1.44E+04	18.1	20.6	1.41E+04	18	20.9
3.00E+02	3.81E+04	12.8	13.4	4.13E+04	13.6	14.6	4.22E+04	11.7	12.1	4.28E+04	11.7	12.1	2.94E+04	15	16.9	3.37E+04	15.5	17.5
5.00E+02	3.82E+04	7.8	7.4	3.95E+04	8	7.3	3.77E+04	7.8	7.3	3.81E+04	7.7	7.2	3.59E+04	8.8	8.9	3.60E+04	8.6	8.7
7.00E+02	3.09E+04	5.5	4.8	3.23E+04	5.5	4.8	3.25E+04	5.7	4.9	3.23E+04	5.7	4.8	2.85E+04	5.5	4.9	2.87E+04	5.4	4.8
1.00E+03	2.70E+04	4.5	3.7	2.58E+04	4.5	3.6	2.86E+04	4.7	3.7	2.87E+04	4.7	3.7	2.42E+04	4.2	3.5	2.43E+04	4.2	3.5
2.00E+03	2.59E+04	3.9	2.9	2.54E+04	3.9	2.9	2.65E+04	4.1	2.9	2.68E+04	4.1	2.9	2.27E+04	3.5	2.8	2.30E+04	3.6	2.8

Table A.13. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	2.51E+04	3.9	2.7	2.47E+04	3.8	2.7	2.72E+04	4.1	2.7	2.72E+04	4.1	2.7	2.34E+04	3.5	2.6	2.41E+04	3.5	2.6
5.00E+03	2.51E+04	3.9	2.5	2.68E+04	3.9	2.5	2.81E+04	4.2	2.5	2.83E+04	4.2	2.5	2.49E+04	3.5	2.5	2.55E+04	3.6	2.5
1.00E+04	2.91E+04	4.1	2.4	3.06E+04	4	2.4	3.03E+04	4.2	2.4	3.01E+04	4.2	2.4	2.75E+04	3.4	2.4	2.79E+04	3.4	2.4
2.00E+04	3.30E+04	4	2.3	3.26E+04	4	2.3	3.32E+04	4.3	2.3	3.28E+04	4.4	2.3	3.10E+04	3.4	2.2	3.19E+04	3.6	2.3
5.00E+04	3.89E+04	4.1	2.1	3.58E+04	3.9	2.2	3.93E+04	4.3	2.2	3.84E+04	4.4	2.2	4.03E+04	3.3	2.1	3.87E+04	3.4	2.1
1.00E+05	4.89E+04	3.7	2.1	3.67E+04	3.6	2.1	4.71E+04	4.1	2.1	4.61E+04	4.2	2.1	5.09E+04	3	2	5.03E+04	3.1	2

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	4.55E+02	11	9.5	5.85E+01	10.9	9.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	6.75E+02	12.1	11.7	9.48E+01	12.1	11.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.75E-01	4.7	9	3.27E-01	4.8	9.6	1.10E+03	13.5	14.7	1.53E+02	13.6	14.5	4.15E-01	7.7	8.9	3.53E-01	5.6	9.7
3.00E+01	1.09E+00	5.4	9.1	1.22E+00	5.4	9.2	1.83E+03	15.4	18.8	2.59E+02	15	18.1	1.09E+00	6.1	9.3	1.09E+00	5.6	9
5.00E+01	4.90E+00	6.4	10.8	4.27E+00	6.9	9.9	4.96E+03	17.6	22.3	7.39E+02	18.1	22.9	4.32E+00	5	9.2	4.71E+00	5.8	10.4
7.50E+01	1.70E+01	4	6.8	1.56E+01	4.6	7.4	1.15E+04	19.9	24.5	4.14E+03	17.7	22.3	1.77E+01	4.5	7.1	1.44E+01	4.3	7.1
1.00E+02	6.76E+01	3.4	4.8	6.28E+01	3.4	5	2.24E+04	21.9	26.2	1.06E+04	20.8	25.6	6.88E+01	3.2	4.3	5.68E+01	3.6	5
1.50E+02	5.12E+02	3.2	3.9	4.98E+02	2.6	3.4	2.91E+04	20.7	23.5	1.45E+04	20.8	23.8	1.09E+03	10.5	12.4	5.55E+02	2.6	3.3
2.00E+02	4.08E+03	14.2	17.3	2.24E+03	8.8	7.4	3.40E+04	17.9	19.7	2.54E+04	17.7	19.9	5.39E+03	17.1	19.2	2.13E+03	7.1	8.5
3.00E+02	2.42E+04	15.2	17.6	2.34E+04	15.2	18.3	4.80E+04	14.5	16.1	5.13E+04	15.7	16.9	2.14E+04	16.2	18.5	2.77E+04	16.6	19.6
5.00E+02	3.96E+04	10.3	10.1	3.74E+04	8.4	9.7	3.88E+04	7.5	7.2	3.79E+04	7.8	7.3	3.69E+04	9	9.5	3.65E+04	9.3	9.3
7.00E+02	2.67E+04	5.6	5.2	2.73E+04	5.7	4.7	3.13E+04	5.6	4.7	3.16E+04	5.5	4.7	2.55E+04	5.6	4.7	3.01E+04	5.4	5
1.00E+03	2.37E+04	4	3.4	2.13E+04	3.9	3.5	2.68E+04	4.5	3.6	2.67E+04	4.5	3.6	2.24E+04	3.9	3.4	2.26E+04	4.1	3.5
2.00E+03	2.16E+04	3.4	2.8	2.10E+04	3.5	2.8	2.58E+04	3.9	2.9	2.46E+04	3.8	2.9	2.03E+04	3.3	2.8	2.23E+04	3.4	2.7
3.00E+03	2.27E+04	3.3	2.6	2.59E+04	3.4	2.6	2.54E+04	3.8	2.7	2.46E+04	3.8	2.7	2.20E+04	3.3	2.6	2.43E+04	3.4	2.6
5.00E+03	2.45E+04	3.4	2.5	2.33E+04	3.4	2.5	2.70E+04	4	2.5	2.62E+04	4	2.5	2.57E+04	3.3	2.6	2.46E+04	3.5	2.5
1.00E+04	2.77E+04	3.4	2.4	2.75E+04	3	2.4	2.75E+04	4	2.5	3.04E+04	4	2.5	2.72E+04	3.1	2.4	2.79E+04	3.2	2.4
2.00E+04	3.03E+04	3.4	2.1	3.42E+04	3.5	2.3	3.27E+04	4.3	2.3	2.93E+04	3.8	2.3	3.22E+04	3.1	2.2	3.21E+04	3.4	2.3
5.00E+04	4.27E+04	3	2.1	4.06E+04	2.8	2	3.80E+04	4.1	2.1	3.54E+04	4	2.2	4.32E+04	3	2	3.52E+04	2.8	2.1
1.00E+05	5.61E+04	2.9	2.1	5.59E+04	2.6	2	4.47E+04	3.8	2.1	4.24E+04	3.9	2.1	5.39E+04	2.8	2	5.17E+04	2.8	2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.37E+01	10.8	9.3	0.00E+00	1	1
1.40E+01	1.06E-01	6.9	9.8	0.00E+00	1	1	1.01E-01	6.8	9.8	1.01E-01	7	10.1	3.88E+01	11.9	11.1	1.42E-01	6.1	8.8
2.00E+01	3.54E-01	7.5	9.6	4.20E-01	7.1	9.6	3.22E-01	7.9	9.3	4.15E-01	7.9	9.8	6.81E+01	13	13.4	5.24E-01	5	8.4
3.00E+01	1.21E+00	7.2	9.1	1.28E+00	7.1	8.9	1.13E+00	7	9.1	1.14E+00	7.2	9.3	1.58E+02	14.4	17	3.07E+00	7.1	7
5.00E+01	5.14E+00	6	9.2	5.68E+00	5.7	8.3	4.49E+00	6.1	9.5	4.47E+00	5.9	9.5	1.44E+03	15.8	19.9	2.82E+01	10.9	14.4
7.50E+01	2.47E+01	4	5.9	3.13E+01	3.7	5.5	1.87E+01	4.3	6.2	2.05E+01	4.1	6.1	4.93E+03	19.3	24.3	7.91E+02	14.7	17.1
1.00E+02	1.00E+02	3.2	4.3	1.29E+02	3	4	7.91E+01	3.4	4.5	7.97E+01	3.2	4.4	8.73E+03	21.6	25.9	6.00E+03	18.8	23.8
1.50E+02	1.31E+03	11.1	13.9	2.29E+03	13.3	17.1	5.51E+02	3	3.3	6.59E+02	2.8	3.6	1.27E+04	20.5	23.4	1.20E+04	20.8	24
2.00E+02	9.40E+03	18.3	21.7	1.20E+04	18.5	21.8	4.75E+03	13.8	18.1	5.29E+03	14.7	17.2	1.72E+04	17.2	19.7	1.77E+04	17.6	20.3
3.00E+02	2.76E+04	15.3	17.6	3.49E+04	16	18	2.68E+04	16.1	18.3	3.20E+04	16.9	19	3.03E+04	14.4	16	3.38E+04	15.1	16.8
5.00E+02	3.47E+04	9	9.2	3.79E+04	8.6	8.4	3.44E+04	9.3	9.5	3.41E+04	8.6	9	3.57E+04	8.8	8.9	3.56E+04	8.4	8.5
7.00E+02	2.82E+04	5.4	4.8	2.79E+04	5.3	4.7	2.69E+04	5.5	5.1	2.70E+04	5.5	4.9	2.85E+04	5.6	5	2.89E+04	5.4	4.8
1.00E+03	2.35E+04	4.1	3.5	2.55E+04	4.2	3.6	2.35E+04	4	3.5	2.35E+04	4.1	3.5	2.43E+04	4.2	3.5	2.44E+04	4.2	3.5
2.00E+03	2.21E+04	3.5	2.8	2.25E+04	3.5	2.8	2.12E+04	3.4	2.8	2.25E+04	3.4	2.8	2.32E+04	3.5	2.8	2.31E+04	3.6	2.8
3.00E+03	2.34E+04	3.4	2.6	2.43E+04	3.6	2.6	2.28E+04	3.3	2.6	2.38E+04	3.4	2.6	2.39E+04	3.5	2.6	2.42E+04	3.6	2.6
5.00E+03	2.49E+04	3.5	2.5	2.45E+04	3.6	2.5	2.48E+04	3.4	2.5	2.45E+04	3.5	2.5	2.50E+04	3.6	2.5	2.56E+04	3.7	2.5
1.00E+04	2.67E+04	3.4	2.4	2.79E+04	3.5	2.4	2.72E+04	3.2	2.4	2.90E+04	3.4	2.4	2.73E+04	3.4	2.4	2.75E+04	3.5	2.4
2.00E+04	2.96E+04	3.4	2.3	3.35E+04	3.7	2.3	2.89E+04	3.2	2.3	3.22E+04	3.4	2.2	3.05E+04	3.5	2.3	3.14E+04	3.6	2.3
5.00E+04	3.86E+04	3.1	2.1	4.05E+04	3.5	2.1	4.05E+04	3	2.1	3.76E+04	3	2.1	3.97E+04	3.3	2.1	3.82E+04	3.4	2.1
1.00E+05	4.95E+04	3	2	4.80E+04	3.2	2	5.25E+04	2.8	2	4.79E+04	2.8	2	5.17E+04	3.1	2	5.81E+04	2.8	2

(continued on next page)

Table A.13. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	2.84E+01	10.9	9.5	2.26E+00	10.9	9.5	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	4.42E+01	12	11.7	3.51E+00	11.8	11.5	1.09E-01	5.6	9.1	1.22E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	7.06E+01	13.3	14.5	5.93E+00	12.8	13.9	3.96E-01	6.6	9	4.53E+00	9.5	11.7	3.05E-01	6.8	9.7	3.45E-01	7.1	10.1
3.00E+01	1.24E+02	15	18.1	1.26E+01	13.3	16.2	1.93E+00	5.9	8.5	1.82E+01	10.4	13.1	1.05E+00	7.1	9.5	1.08E+00	7.1	9.2
5.00E+01	5.51E+02	16	19.9	1.03E+02	13	15.5	1.20E+01	3.7	6.3	1.93E+02	14.7	17.4	3.94E+00	6.7	10.6	4.61E+00	6.1	9.8
7.50E+01	3.30E+03	17.5	21.9	1.13E+03	16.1	20.3	4.92E+02	13.3	16.1	1.66E+03	16	20.7	1.15E+01	5.4	8.3	1.78E+01	4.2	6.5
1.00E+02	9.52E+03	20	24.6	4.45E+03	18.6	23	2.62E+03	18.4	23.4	5.39E+03	20.1	24.7	3.52E+01	3.9	5.6	6.68E+01	3.4	4.7
1.50E+02	2.49E+04	21.1	24.4	1.91E+04	20.7	24.4	8.48E+03	18.8	21.9	1.45E+04	19.6	23.2	2.83E+02	2.7	3.5	4.98E+02	2.6	3.2
2.00E+02	3.31E+04	18.8	21.3	3.08E+04	19.3	22	2.53E+04	19	22	3.15E+04	18.8	22.2	1.19E+03	2.4	2.8	2.63E+03	8.4	11.7
3.00E+02	3.93E+04	13.8	15	4.10E+04	14.4	15.8	4.71E+04	15.6	17.3	4.18E+04	14.7	16.3	1.23E+04	14.7	17.1	3.10E+04	16.9	19.4
5.00E+02	3.58E+04	8.1	7.9	3.62E+04	8.1	7.9	3.77E+04	7.8	7.2	3.85E+04	8	7.7	3.59E+04	9.1	9.9	3.34E+04	8.9	9.1
7.00E+02	3.00E+04	5.6	4.9	2.98E+04	5.5	4.8	3.34E+04	5.6	4.7	3.00E+04	5.7	4.7	2.88E+04	5.4	4.8	2.91E+04	5.4	4.9
1.00E+03	2.60E+04	4.4	3.6	2.58E+04	4.4	3.6	2.61E+04	4.4	3.6	2.56E+04	4.5	3.6	2.30E+04	3.9	3.4	2.28E+04	4	3.5
2.00E+03	2.42E+04	3.7	2.9	2.40E+04	3.7	2.8	2.50E+04	3.8	2.9	2.47E+04	3.8	2.9	2.06E+04	3.3	2.8	2.36E+04	3.4	2.8
3.00E+03	2.50E+04	3.7	2.7	2.48E+04	3.7	2.7	2.56E+04	3.7	2.7	2.45E+04	3.8	2.7	2.24E+04	3.2	2.6	2.42E+04	3.4	2.6
5.00E+03	2.64E+04	3.8	2.5	2.61E+04	3.8	2.5	2.36E+04	3.8	2.5	3.09E+04	4	2.5	2.39E+04	3.2	2.5	2.52E+04	3.5	2.5
1.00E+04	2.85E+04	3.7	2.4	2.82E+04	3.7	2.4	2.91E+04	3.8	2.4	2.82E+04	3.9	2.4	2.64E+04	3	2.4	2.73E+04	3.3	2.4
2.00E+04	3.17E+04	3.8	2.3	3.14E+04	3.8	2.3	3.13E+04	3.9	2.3	3.13E+04	4	2.2	2.97E+04	3	2.2	3.39E+04	3.5	2.2
5.00E+04	3.92E+04	3.7	2.1	3.81E+04	3.7	2.1	3.75E+04	3.8	2.2	3.99E+04	3.8	2.1	4.14E+04	2.9	2.1	3.91E+04	3.1	2.1
1.00E+05	4.93E+04	3.4	2	4.81E+04	3.5	2.1	4.71E+04	3.6	2	4.74E+04	3.5	2	5.61E+04	2.6	2	5.16E+04	2.9	2

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.05E-01	6.9	10.2	1.06E-01	7.4	9.6	1.14E-01	7.3	9.7	1.13E-01	6.2	10.1	1.27E-01	6.6	9.7
2.00E+01	3.64E-01	5.2	9.4	3.60E-01	6.9	9.8	3.38E-01	7.2	9.6	3.68E-01	7.2	9.6	3.98E-01	7.2	9.5	3.61E-01	6.4	9.9
3.00E+01	9.30E-01	7.2	9.3	9.81E-01	7.3	9.3	1.17E+00	7.1	9	1.21E+00	7	8.9	1.21E+00	6.9	9	1.31E+00	6.9	8.8
5.00E+01	4.66E+00	6.2	10.2	4.12E+00	6.8	10.3	5.17E+00	5.9	8.7	5.27E+00	5.4	8.7	4.99E+00	5.3	8.9	6.09E+00	5	7.9
7.50E+01	1.31E+01	5.2	7.9	1.47E+01	4.9	7.9	2.51E+01	4	5.8	2.73E+01	3.9	5.7	2.57E+01	3.9	5.8	3.53E+01	3.6	5.1
1.00E+02	4.14E+01	3.6	5.5	4.80E+01	3.7	5.3	1.06E+02	3.5	4.5	1.05E+02	3.3	4.2	1.03E+02	3.3	4.2	1.41E+02	3.1	4
1.50E+02	3.83E+02	2.5	3.4	4.01E+02	2.6	3.3	1.82E+03	13.6	16.8	1.51E+03	11.4	14.4	9.89E+02	7.2	9.3	2.64E+03	12.8	15.9
2.00E+02	1.42E+03	2.5	2.8	1.54E+03	3.9	5.5	9.74E+03	18.4	21.6	1.10E+04	18.5	22	9.94E+03	17.8	21.7	1.86E+04	19.2	22.9
3.00E+02	1.91E+04	16.6	19.6	2.32E+04	16.5	18.8	2.57E+04	15.4	17.5	2.85E+04	15.6	17.4	2.99E+04	15.7	17.3	3.56E+04	15.3	16.8
5.00E+02	3.33E+04	9.6	9.9	3.62E+04	10	10.1	3.38E+04	9	9.3	3.45E+04	8.7	9.2	3.52E+04	8.8	9.3	3.45E+04	8.6	8.9
7.00E+02	2.48E+04	5.1	4.9	2.66E+04	5.1	4.9	2.76E+04	5.5	5.1	2.88E+04	5.5	5	2.76E+04	5.4	4.8	2.76E+04	5.4	4.8
1.00E+03	2.49E+04	4.2	3.4	2.40E+04	4	3.5	2.33E+04	4.1	3.5	2.33E+04	4.1	3.5	2.39E+04	4.1	3.5	2.44E+04	4.2	3.5
2.00E+03	2.22E+04	3.4	2.7	2.28E+04	3.3	2.8	2.19E+04	3.4	2.8	2.23E+04	3.4	2.8	2.30E+04	3.5	2.8	2.28E+04	3.5	2.8
3.00E+03	2.02E+04	3.1	2.6	2.19E+04	3.2	2.6	2.28E+04	3.3	2.6	2.36E+04	3.4	2.6	2.37E+04	3.4	2.6	2.38E+04	3.5	2.6
5.00E+03	2.57E+04	3.5	2.4	2.41E+04	3.4	2.5	2.45E+04	3.4	2.5	2.54E+04	3.5	2.5	2.56E+04	3.5	2.5	2.52E+04	3.6	2.5
1.00E+04	2.67E+04	3.3	2.4	2.90E+04	3.2	2.4	2.72E+04	3.2	2.4	2.68E+04	3.3	2.4	2.75E+04	3.3	2.4	2.62E+04	3.4	2.4
2.00E+04	3.43E+04	2.9	2.3	3.28E+04	3.2	2.2	2.98E+04	3.3	2.2	3.08E+04	3.3	2.2	2.85E+04	3.3	2.3	3.26E+04	3.7	2.3
5.00E+04	4.96E+04	3.4	2.1	3.76E+04	3.1	2.1	4.12E+04	3.1	2.1	4.08E+04	3.1	2.1	3.79E+04	3.2	2.1	3.87E+04	3.5	2.1
1.00E+05	5.25E+04	2.8	2	4.85E+04	2.8	2	5.40E+04	2.7	2	5.17E+04	2.9	2	4.93E+04	2.9	2	5.04E+04	3	2

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.59E-01	5.8	8.7	0.00E+00	1	1	2.74E+00	4.6	6.1	2.74E+00	4.6	6.1
2.00E+01	6.11E-01	6.4	8.2	0.00E+00	1	1	1.35E+01	4.5	5.8	1.35E+01	4.5	5.8
3.00E+01	1.59E+00	5.4	7.6	2.05E+00	5.3	7.5	8.29E+01	6.3	7.3	8.29E+01	6.3	7.3
5.00E+01	1.49E+01	3.6	6.1	1.43E+01	4.6	6.4	8.26E+04	16.1	20.3	8.26E+04	16.1	20.3
7.50E+01	2.51E+02	9.3	11.7	1.79E+02	8.3	9.2	7.76E+04	23.8	29.3	7.76E+04	23.8	29.3
1.00E+02	3.16E+03	17.1	21.6	1.95E+03	16.2	20.1	6.17E+04	24.9	27	6.17E+04	24.9	27
1.50E+02	1.65E+04	20.3	24.3	1.50E+04	20.1	24.1	4.81E+04	20.3	21.7	4.81E+04	20.3	21.7

Table A.13. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.13E+04	19.7	22.1	2.19E+04	19.1	22.1	4.73E+04	15.9	18.6	4.73E+04	15.9	18.6
3.00E+02	3.01E+04	13	14	3.37E+04	14	16.2	4.44E+04	11.5	13.9	4.44E+04	11.5	13.9
5.00E+02	3.44E+04	8	8.6	3.55E+04	8.1	7.9	3.97E+04	7.6	6.6	3.97E+04	7.6	6.6
7.00E+02	3.07E+04	5.5	4.8	2.86E+04	5.4	4.7	3.27E+04	5.7	4.6	3.27E+04	5.7	4.6
1.00E+03	2.34E+04	4.2	3.5	2.60E+04	4.4	3.5	2.71E+04	4.6	3.9	2.71E+04	4.6	3.9
2.00E+03	2.39E+04	3.6	2.8	2.32E+04	3.6	2.9	2.76E+04	4.2	3	2.76E+04	4.2	3
3.00E+03	2.44E+04	3.7	2.6	2.38E+04	3.6	2.7	2.74E+04	4.1	2.7	2.74E+04	4.1	2.7
5.00E+03	2.25E+04	3.6	2.5	2.55E+04	3.8	2.5	2.77E+04	4.1	2.3	2.77E+04	4.1	2.3
1.00E+04	2.88E+04	3.6	2.4	2.69E+04	3.4	2.4	2.87E+04	4	2.4	2.87E+04	4	2.4
2.00E+04	3.33E+04	3.7	2.2	2.96E+04	3.5	2.3	3.28E+04	4.3	2.6	3.28E+04	4.3	2.6
5.00E+04	3.46E+04	3.4	2.1	4.15E+04	3.9	2.1	3.13E+04	4.1	2.1	3.13E+04	4.1	2.1
1.00E+05	4.53E+04	3.2	2	5.28E+04	3.6	2	4.30E+04	4.1	2	4.30E+04	4.1	2

Table A.14. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{23}Na ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.44E+00	10.1	2	1.43E+00	10	2	4.05E+02	9.7	7.5	4.48E+02	9.9	7.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	6.54E+00	11	2.5	2.02E+00	10.9	2.5	7.45E+02	10.6	9	7.64E+02	10.7	9.3	1.13E-01	7.1	9.6	1.20E-01	7	9.5
2.00E+01	1.10E+01	12.1	3.1	3.80E+00	11.7	3.1	1.61E+03	11.6	11	1.44E+03	11.8	11.3	4.35E-01	7	9.5	4.02E-01	6.9	9.5
3.00E+01	1.93E+01	12.9	3.8	7.40E+00	12	3.6	3.79E+03	13.1	14	3.41E+03	13.2	14.4	1.39E+00	6.3	8.9	1.39E+00	6.6	8.9
5.00E+01	6.33E+01	14.1	4.4	2.62E+01	11.6	3.8	2.30E+04	15	17.9	1.72E+04	15.4	18.8	6.94E+00	4.9	7.8	7.21E+00	5	7.8
7.50E+01	3.87E+02	14.1	4.4	4.66E+02	14	4.3	5.64E+04	18.8	23.9	3.56E+04	19.1	24.2	5.06E+01	6.5	7.6	4.31E+01	3.6	5
1.00E+02	2.49E+03	16.8	5.2	2.37E+03	16.8	5.4	7.39E+04	22.1	26.3	4.86E+04	22	26	2.23E+02	8.7	10.8	1.65E+02	3.5	4.5
1.50E+02	9.04E+03	21.1	6.4	9.02E+03	20.7	6.3	7.25E+04	23.2	24.8	5.87E+04	22.7	24.9	3.91E+03	15.9	19.6	4.69E+03	16.7	20.7
2.00E+02	1.61E+04	19.8	5.9	1.69E+04	19.8	6	6.18E+04	19.1	20.1	5.59E+04	19.8	21.1	1.85E+04	20.2	23.4	1.82E+04	20.3	23.4
3.00E+02	3.36E+04	17.2	5.2	3.58E+04	17.4	5.3	4.97E+04	13.3	12.9	4.63E+04	13.8	14.1	3.55E+04	17.5	18.8	3.59E+04	17.1	18.7
5.00E+02	4.23E+04	11.1	3.5	4.31E+04	10.8	3.4	4.49E+04	10.2	9.5	4.73E+04	10.5	10.2	4.04E+04	10.8	11	4.38E+04	11.3	11.2
7.00E+02	3.44E+04	7.2	2.3	3.47E+04	7.1	2.3	3.94E+04	7.2	6.3	3.89E+04	7.2	6.1	3.35E+04	7.2	6.4	3.40E+04	7.1	6.3
1.00E+03	2.88E+04	5.4	1.8	2.95E+04	5.5	1.8	3.50E+04	6	4.6	3.36E+04	5.9	4.6	2.95E+04	5.4	4.3	2.94E+04	5.4	4.3
2.00E+03	2.68E+04	4.5	1.6	2.70E+04	4.6	1.6	3.16E+04	5.1	3.5	2.99E+04	5.1	3.5	2.68E+04	4.4	3.3	2.70E+04	4.4	3.3
3.00E+03	2.76E+04	4.5	1.5	2.79E+04	4.5	1.5	3.29E+04	5.1	3.2	3.10E+04	5.1	3.2	2.71E+04	4.4	3	2.71E+04	4.4	3
5.00E+03	2.90E+04	4.5	1.5	2.97E+04	4.7	1.5	3.09E+04	5.2	3	3.22E+04	5.2	3	2.83E+04	4.4	2.8	2.95E+04	4.5	2.9
1.00E+04	3.20E+04	4.3	1.4	3.20E+04	4.4	1.4	3.72E+04	5.2	2.8	3.45E+04	5.1	2.8	3.12E+04	4.2	2.6	3.11E+04	4.2	2.7
2.00E+04	3.66E+04	4.4	1.4	3.71E+04	4.5	1.4	3.43E+04	5.3	2.7	3.98E+04	5.3	2.7	3.68E+04	4.3	2.5	3.81E+04	4.4	2.5
5.00E+04	4.70E+04	4	1.3	4.43E+04	4.2	1.3	5.09E+04	5.2	2.5	4.32E+04	5.2	2.5	4.67E+04	4.1	2.3	4.44E+04	4	2.3
1.00E+05	5.86E+04	3.7	1.3	5.81E+04	3.9	1.3	5.60E+04	4.7	2.3	5.82E+04	4.9	2.3	5.81E+04	3.5	2.2	5.98E+04	3.7	2.2

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	5.17E+02	10.1	8.1	0.00E+00	1	1
1.40E+01	1.12E-01	7.5	9.8	1.20E-01	7.3	9.9	1.09E-01	6.6	9.9	1.33E-01	7.5	9.4	7.16E+02	11.1	9.9	0.00E+00	1	1
2.00E+01	4.19E-01	7.6	9.5	4.14E-01	7.4	9.6	3.41E-01	7.6	9.6	4.15E-01	7	9.8	1.14E+03	12.2	12.3	2.76E-01	5.4	10.4
3.00E+01	1.36E+00	6.8	8.8	1.43E+00	7	9.1	1.30E+00	6.8	9.2	1.48E+00	6.4	8.5	2.12E+03	13.9	15.8	1.29E+00	5.4	8.9
5.00E+01	6.39E+00	5.4	8.3	7.06E+00	5.2	8	5.40E+00	5.4	8.8	7.79E+00	4.7	7.6	5.23E+03	15.9	19.4	3.25E+00	6.2	9.9
7.50E+01	3.66E+01	3.6	5.2	4.26E+01	3.4	4.9	2.83E+01	3.8	5.6	4.58E+01	3.4	4.9	1.18E+04	18.7	23.6	1.25E+01	4.7	7.9
1.00E+02	1.35E+02	3.9	5.1	1.74E+02	3.3	4.1	1.04E+02	3.3	4.2	1.67E+02	3.2	3.9	2.16E+04	20.9	25.2	4.35E+01	3.4	5.2
1.50E+02	3.05E+03	14.6	18.2	2.94E+03	13.2	16.3	9.59E+02	8.1	9.9	5.77E+03	16.3	20.1	3.40E+04	22.1	24.8	3.27E+02	2.3	3.3
2.00E+02	1.33E+04	18.9	22.3	1.96E+04	19.3	22.9	1.23E+04	19.2	22.7	1.91E+04	20.5	23.5	3.88E+04	20.6	22.3	1.32E+03	2.5	3
3.00E+02	4.52E+04	18.4	20.2	4.87E+04	18	19.6	2.99E+04	17.7	19.3	3.78E+04	17.5	19	3.51E+04	14	15	2.27E+04	17.3	20.5
5.00E+02	4.35E+04	10.6	10.6	4.55E+04	10.4	10	4.42E+04	11.8	11.9	4.29E+04	10.7	11	4.66E+04	11.7	11.3	5.10E+04	13.2	12.1
7.00E+02	3.50E+04	7	6.2	3.60E+04	7	6	3.35E+04	7.1	6.3	3.42E+04	7	6.4	3.53E+04	6.9	6.1	3.49E+04	7.7	6.6
1.00E+03	2.97E+04	5.5	4.4	3.14E+04	5.6	4.4	2.92E+04	5.3	4.3	2.93E+04	5.4	4.4	3.37E+04	5.6	4.4	2.89E+04	5.3	4.2
2.00E+03	2.76E+04	4.6	3.3	2.80E+04	4.7	3.4	2.58E+04	4.3	3.2	2.72E+04	4.5	3.3	3.21E+04	4.8	3.3	2.45E+04	4.2	3.2
3.00E+03	2.86E+04	4.6	3.1	2.89E+04	4.7	3.1	2.66E+04	4.2	3	2.70E+04	4.4	3.1	2.76E+04	4.7	3.1	2.60E+04	4.2	3
5.00E+03	2.97E+04	4.7	2.9	3.15E+04	4.9	2.9	2.83E+04	4.3	2.8	3.10E+04	4.7	2.9	3.14E+04	4.9	3	2.79E+04	4.5	2.8
1.00E+04	3.32E+04	4.5	2.7	3.30E+04	4.6	2.7	3.13E+04	4.1	2.7	3.27E+04	4.5	2.7	2.98E+04	4.4	2.8	2.94E+04	3.8	2.6
2.00E+04	3.67E+04	4.7	2.6	3.86E+04	4.9	2.6	3.53E+04	4.3	2.5	3.56E+04	4.5	2.5	3.66E+04	4.5	2.5	3.67E+04	3.7	2.5
5.00E+04	4.47E+04	4.3	2.4	4.42E+04	4.6	2.4	4.65E+04	4	2.3	4.37E+04	4.1	2.4	4.64E+04	4.5	2.3	4.35E+04	3.4	2.3
1.00E+05	5.63E+04	4.1	2.2	5.69E+04	4.3	2.3	6.02E+04	3.6	2.1	5.76E+04	3.7	2.2	5.90E+04	4	2.2	5.79E+04	3.2	2.2

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.09E-01	7.5	9.8	1.22E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	3.56E-01	7.5	9.6	4.06E-01	7.1	9.5	3.05E-01	6.2	9.3	4.37E-01	6.2	9.7	5.82E-01	5.2	7.6	7.49E-01	4.4	7.9
3.00E+01	1.24E+00	6.9	8.8	1.32E+00	6.8	8.7	1.15E+00	6.1	9.1	1.31E+00	7	9	2.53E+00	4.1	6.4	2.36E+00	3.8	6.1
5.00E+01	5.80E+00	5.5	8.7	6.87E+00	5.1	8	5.75E+00	5.9	9.1	5.70E+00	5.8	9.2	1.95E+01	4.2	5.4	2.08E+01	3.7	5.2

Table A.14. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	2.92E+01	3.9	5.5	3.90E+01	3.7	5.1	2.69E+01	5.8	6.1	2.78E+01	4	5.9	1.04E+02	4.3	4.9	1.11E+02	5	5
1.00E+02	1.09E+02	3.4	4.4	1.54E+02	3.6	5.1	1.45E+02	7.6	9.2	9.71E+01	2.9	4.3	3.42E+03	14.1	17.1	4.85E+03	14.5	17.6
1.50E+02	2.51E+03	15.3	18.9	4.21E+03	16	19.9	2.00E+03	15.6	19.3	2.26E+03	15.1	18.5	2.82E+04	20.7	24.9	3.56E+04	21.4	25.4
2.00E+02	1.02E+04	19.2	22.3	1.63E+04	19.9	23.1	7.52E+03	18.8	22.2	7.63E+03	18.8	22.1	4.19E+04	21.8	23.7	4.08E+04	21.6	22.8
3.00E+02	2.92E+04	17.4	19.2	3.80E+04	17.6	19.2	2.26E+04	16.4	18.8	2.84E+04	18.1	20.7	3.67E+04	15.2	16.3	3.99E+04	15.1	16.3
5.00E+02	4.30E+04	11.5	11.6	4.29E+04	11	11.1	4.45E+04	11.6	11.4	4.55E+04	10.6	10.3	4.19E+04	11.1	10.3	4.32E+04	10.1	10.3
7.00E+02	3.38E+04	7.1	6.4	3.39E+04	7.1	6.2	3.27E+04	7	6.2	3.74E+04	7.1	6	3.46E+04	7.2	6.1	3.87E+04	6.9	6
1.00E+03	2.87E+04	5.3	4.3	2.91E+04	5.5	4.4	2.99E+04	5.3	4.4	2.79E+04	5.4	4.4	3.20E+04	5.6	4.5	3.24E+04	5.7	4.5
2.00E+03	2.64E+04	4.3	3.2	2.72E+04	4.5	3.3	2.49E+04	4.4	3.2	2.54E+04	4.5	3.3	2.77E+04	4.9	3.4	3.09E+04	4.9	3.4
3.00E+03	2.75E+04	4.3	3	2.77E+04	4.5	3	2.70E+04	4.4	3	2.76E+04	4.5	3.1	2.93E+04	4.8	3.1	2.94E+04	4.8	3.1
5.00E+03	2.85E+04	4.4	2.8	2.95E+04	4.6	2.9	2.73E+04	4.4	2.9	2.93E+04	4.6	2.9	3.04E+04	4.9	2.9	3.10E+04	5	2.9
1.00E+04	3.22E+04	4.1	2.7	3.32E+04	4.4	2.7	3.12E+04	4.3	2.6	3.38E+04	4.5	2.6	3.20E+04	4.5	2.8	3.19E+04	5	2.8
2.00E+04	3.47E+04	4.2	2.5	3.77E+04	4.4	2.6	3.36E+04	4.3	2.6	3.41E+04	4.4	2.5	3.64E+04	4.8	2.7	3.63E+04	5	2.6
5.00E+04	4.71E+04	4	2.3	4.38E+04	4	2.4	4.18E+04	4.1	2.3	3.99E+04	4.1	2.3	4.76E+04	4.2	2.4	4.51E+04	4.5	2.4
1.00E+05	5.70E+04	3.5	2.2	5.83E+04	3.8	2.2	5.90E+04	3.8	2.2	5.56E+04	3.7	2.2	5.66E+04	4.5	2.2	5.29E+04	4.5	2.4

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.43E+01	10.1	8.1	3.10E+00	10	8.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.35E-01	4.2	8.8	2.15E+01	11	9.8	4.35E+00	10.9	9.8	1.36E-01	7.2	10	1.45E-01	7.2	9.6
2.00E+01	4.00E-01	6.4	9.3	5.83E-01	4.9	7.6	3.30E+01	12.2	12.2	7.75E+00	11.9	12	4.79E-01	7.3	9.3	5.54E-01	6.8	9.4
3.00E+01	1.29E+00	6.6	8.8	2.36E+00	5	6.8	6.13E+01	13.5	15.3	1.54E+01	12.4	14.2	1.72E+00	6.2	8	1.86E+00	5.7	8.1
5.00E+01	5.62E+00	6	9.5	1.61E+01	4.4	5.9	1.87E+02	14.6	17.8	5.17E+01	11.9	14.3	1.06E+01	4.3	6.6	1.30E+01	4.1	6.2
7.50E+01	2.29E+01	3.9	6.1	1.60E+02	8.7	9.2	9.12E+02	14.7	17.7	9.97E+02	14	16.8	6.92E+01	3.4	4.4	8.94E+01	3.3	4.4
1.00E+02	8.66E+01	3.2	4.4	5.00E+03	15.8	19.6	5.99E+03	17.1	21.2	5.58E+03	17	21.3	3.32E+02	5.2	6.2	5.30E+02	7.7	9
1.50E+02	5.24E+02	4.1	4.6	1.69E+04	22.3	25.4	2.16E+04	21.4	24.8	2.02E+04	21.2	24.6	8.77E+03	17.9	22.1	1.44E+04	19.1	23.2
2.00E+02	7.80E+03	18.2	21.7	2.08E+04	20.3	22.1	3.62E+04	20.7	23.1	3.57E+04	20.7	23.1	3.17E+04	20.6	23.6	3.62E+04	20.8	23.7
3.00E+02	2.32E+04	16.3	18.4	2.86E+04	16.1	17.1	5.00E+04	16.9	18.1	5.02E+04	17	18.2	6.24E+04	18	19.5	6.53E+04	17.8	19.2
5.00E+02	3.95E+04	11.5	12	4.31E+04	11.6	11.8	4.43E+04	10.2	9.8	4.44E+04	10.1	9.7	4.54E+04	9.6	8.9	4.67E+04	9.4	8.7
7.00E+02	3.21E+04	7	6.3	3.29E+04	6.8	6.2	3.70E+04	7.2	6.2	3.66E+04	7.2	6.1	3.69E+04	7	6	3.89E+04	7.2	6
1.00E+03	2.55E+04	5	4.2	3.04E+04	5.4	4.4	3.13E+04	5.7	4.5	3.12E+04	5.7	4.5	3.26E+04	5.8	4.5	3.27E+04	5.8	4.6
2.00E+03	2.52E+04	4.2	3.2	2.69E+04	4.4	3.3	2.87E+04	4.8	3.4	2.90E+04	4.9	3.4	2.93E+04	5	3.4	3.00E+04	5	3.5
3.00E+03	2.79E+04	4.3	3	2.73E+04	4.4	3	2.94E+04	4.8	3.1	2.95E+04	4.9	3.1	3.10E+04	5	3.2	3.03E+04	5	3.2
5.00E+03	2.76E+04	4.3	2.8	2.78E+04	4.5	2.9	3.10E+04	5	2.9	3.10E+04	5	2.9	3.23E+04	5.1	3	3.29E+04	5.2	3
1.00E+04	3.09E+04	3.9	2.6	3.23E+04	4.3	2.7	3.29E+04	4.8	2.8	3.27E+04	4.8	2.8	3.44E+04	5.1	2.8	3.23E+04	5.1	2.8
2.00E+04	3.56E+04	3.8	2.5	3.94E+04	4.3	2.5	3.72E+04	5	2.6	3.71E+04	5	2.6	3.55E+04	5.3	2.6	3.53E+04	5.3	2.7
5.00E+04	5.10E+04	3.7	2.3	4.79E+04	3.9	2.3	4.55E+04	4.7	2.4	4.44E+04	4.8	2.4	4.61E+04	4.9	2.5	4.53E+04	5.3	2.5
1.00E+05	6.01E+04	3.3	2.1	6.07E+04	3.5	2.2	5.52E+04	4.5	2.3	5.48E+04	4.5	2.3	5.03E+04	4.8	2.3	5.31E+04	5	2.4

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.66E+03	7.3	3.3	4.45E+03	7.3	3.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.32E+03	7.5	4	8.89E+03	7.5	4	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.10E+04	7.9	4.6	1.33E+04	7.9	4.6	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.82E+04	8.6	5.7	2.21E+04	8.6	5.7	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.96E+00	9.4	7.1	0.00E+00	1	1	3.61E+04	10.1	8.2	4.37E+04	10.2	8.2	4.25E+01	10.1	8	4.96E+00	10	8.1
1.40E+01	7.53E+00	9.3	8.5	1.98E-01	4.9	7.2	5.00E+04	11.2	10.1	6.04E+04	11.2	10.1	6.39E+01	11.1	9.8	8.13E+00	11	9.8
2.00E+01	3.05E+01	10.4	10.5	7.97E-01	4.8	7.2	6.98E+04	12.6	12.8	8.40E+04	12.6	12.9	1.03E+02	12.3	12.3	1.37E+01	11.9	12
3.00E+01	7.94E+01	12.3	12.3	4.25E+00	3.9	5.5	9.99E+04	14.6	17	1.18E+05	14.6	17.1	1.71E+02	14	15.9	2.48E+01	13.3	15
5.00E+01	2.08E+03	13.7	15.5	1.06E+02	9.4	9.1	1.04E+05	19.4	26	1.07E+05	19.8	26.7	5.47E+02	15.6	19	8.60E+01	14.8	18.4
7.50E+01	1.21E+04	16.7	20.8	4.13E+03	14.9	17.7	8.24E+04	24.4	29.3	8.19E+04	24.8	29.5	1.59E+03	17.3	21.8	5.74E+02	15.1	18.4
1.00E+02	2.86E+04	19.8	24.5	1.45E+04	18.3	23.1	6.81E+04	26.7	27.6	6.81E+04	26.7	27.4	3.64E+03	19.6	23.9	2.15E+03	17.7	22.1
1.50E+02	4.61E+04	22.9	25.4	3.54E+04	22.1	25.2	5.54E+04	20.9	22	5.59E+04	20.8	21.9	8.01E+03	20.8	23.7	6.83E+03	19.9	23
2.00E+02	4.90E+04	20.2	21.8	4.37E+04	20.8	22.6	5.09E+04	17.5	18.3	5.20E+04	17.5	18.3	1.45E+04	19.4	21.8	1.44E+04	19.4	22.1
3.00E+02	4.40E+04	14.9	15.5	4.79E+04	15.5	16.8	5.08E+04	14.2	14.4	5.13E+04	14.1	14.4	3.22E+04	17.2	18.8	3.80E+04	17.6	19.4
5.00E+02	4.75E+04	9.9	9.9	4.57E+04	10.2	9.7	4.56E+04	9.8	9.1	4.64E+04	9.8	9.1	4.30E+04	11.1	11.2	4.45E+04	10.9	10.9
7.00E+02	3.70E+04	7.2	6	3.73E+04	7.2	6	3.93E+04	7.4	6.2	3.94E+04	7.3	6.2	3.40E+04	7.1	6.3	3.46E+04	7.1	6.2
1.00E+03	3.20E+04	5.8	4.6	3.37E+04	5.9	4.6	3.42E+04	6.1	4.7	3.47E+04	6.1	4.7	2.92E+04	5.4	4.4	2.98E+04	5.4	4.4
2.00E+03	2.93E+04	5	3.5	2.87E+04	5	3.5	3.16E+04	5.3	3.5	3.18E+04	5.3	3.6	2.69E+04	4.5	3.3	2.71E+04	4.5	3.3
3.00E+03	2.94E+04	5.1	3.2	2.95E+04	5	3.2	3.24E+04	5.3	3.2	3.23E+04	5.3	3.2	2.75E+04	4.4	3	2.78E+04	4.5	3.1

(continued on next page)

Table A.14. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	3.29E+04	5.2	2.9	3.48E+04	5.2	3	3.35E+04	5.4	3	3.41E+04	5.5	3	2.91E+04	4.5	2.9	2.89E+04	4.6	2.9
1.00E+04	3.35E+04	5.1	2.8	3.11E+04	5	2.8	3.55E+04	5.4	2.8	3.59E+04	5.4	2.8	3.15E+04	4.3	2.7	3.20E+04	4.4	2.7
2.00E+04	3.88E+04	5.3	2.7	3.77E+04	5.4	2.7	3.90E+04	5.5	2.7	3.96E+04	5.6	2.7	3.59E+04	4.4	2.5	3.62E+04	4.5	2.6
5.00E+04	4.67E+04	5.1	2.5	4.32E+04	5	2.5	4.60E+04	5.5	2.5	4.52E+04	5.6	2.5	4.57E+04	4.1	2.3	4.43E+04	4.2	2.3
1.00E+05	5.21E+04	4.9	2.3	5.03E+04	4.7	2.3	5.47E+04	5.2	2.3	5.37E+04	5.4	2.4	5.67E+04	3.7	2.2	5.67E+04	3.9	2.2

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	4.94E+02	10.1	8	6.17E+01	10.1	8.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	7.40E+02	11.1	9.9	1.01E+02	11.1	9.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.80E-01	4.7	9	3.42E-01	4.8	9.6	1.19E+03	12.3	12.4	1.62E+02	12.1	12.2	4.23E-01	7.7	8.9	3.57E-01	5.6	9.7
3.00E+01	1.10E+00	5.4	9.1	1.24E+00	5.4	9.2	1.91E+03	14.1	16.1	2.77E+02	14	15.5	1.12E+00	6.1	9.3	1.11E+00	5.6	9
5.00E+01	5.05E+00	6.4	10.7	4.46E+00	6.9	9.9	5.13E+03	16.2	19.8	7.77E+02	16.4	20.3	4.47E+00	5	9.2	4.75E+00	5.8	10.4
7.50E+01	1.75E+01	4	6.7	1.59E+01	4.6	7.4	1.19E+04	18.1	22.8	4.02E+03	16	19.8	1.84E+01	4.4	7.1	1.50E+01	4.3	7.1
1.00E+02	6.77E+01	3.3	4.8	6.31E+01	3.4	4.9	2.32E+04	20.8	25.2	1.09E+04	19	24	6.89E+01	3.2	4.4	5.78E+01	3.5	5
1.50E+02	4.84E+02	3	3.7	4.63E+02	2.6	3.3	3.40E+04	22.3	24.8	2.01E+04	22.2	24.8	7.60E+02	9.4	12	5.09E+02	2.6	3.3
2.00E+02	3.08E+03	11.1	14.4	2.16E+03	4.3	5.7	3.71E+04	19.7	21.7	2.64E+04	19.5	21.5	4.98E+03	18.1	18.8	2.08E+03	5.8	7.3
3.00E+02	2.63E+04	18.6	20.2	2.19E+04	16.7	20.2	5.56E+04	17	18.1	6.48E+04	17.8	19.5	2.08E+04	17.2	19.1	2.68E+04	17.8	20.8
5.00E+02	4.33E+04	12	12.5	4.17E+04	11.1	11.7	4.60E+04	9.7	9.4	4.79E+04	10	9.6	4.37E+04	11.7	11.9	4.26E+04	11.5	11.3
7.00E+02	3.34E+04	6.7	6.5	2.94E+04	6.7	6.3	3.74E+04	7.2	6.1	3.66E+04	7.1	6.1	3.38E+04	7.2	6.5	3.39E+04	7.1	6.1
1.00E+03	2.74E+04	5.1	4.3	3.00E+04	5.4	4.2	3.36E+04	5.9	4.6	3.30E+04	5.8	4.5	2.61E+04	5.2	4.3	2.67E+04	5.2	4.3
2.00E+03	2.63E+04	4.3	3.2	2.60E+04	4.3	3.2	3.08E+04	5	3.5	2.94E+04	5	3.4	2.70E+04	4.2	3.3	2.57E+04	4.4	3.3
3.00E+03	2.68E+04	4.2	3	2.67E+04	4.2	3	3.11E+04	5	3.2	2.85E+04	4.9	3.1	2.79E+04	4.2	2.9	2.81E+04	4.3	3
5.00E+03	2.79E+04	4.2	2.8	2.44E+04	4.1	2.9	2.98E+04	5.2	3	2.75E+04	4.8	3	2.76E+04	4.2	2.8	2.66E+04	4.4	2.9
1.00E+04	3.03E+04	4	2.6	3.02E+04	4.1	2.7	3.21E+04	5	2.8	3.32E+04	5	2.8	3.06E+04	4	2.7	3.05E+04	4.2	2.6
2.00E+04	3.50E+04	4	2.5	3.63E+04	4.3	2.6	3.81E+04	5.5	2.6	3.28E+04	5.1	2.7	3.47E+04	4.1	2.5	3.53E+04	4.2	2.4
5.00E+04	4.54E+04	3.8	2.3	4.88E+04	4.2	2.3	4.91E+04	5.2	2.5	4.09E+04	4.7	2.4	4.47E+04	4	2.3	4.76E+04	3.4	2.2
1.00E+05	6.33E+04	2.9	2.1	6.17E+04	3.5	2.2	5.45E+04	4.6	2.3	5.12E+04	4.7	2.3	5.41E+04	3.1	2.1	5.21E+04	3.4	2.2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.53E+01	10	7.8	0.00E+00	1	1
1.40E+01	1.08E-01	6.9	9.8	0.00E+00	1	1	1.03E-01	6.8	9.8	1.02E-01	7	10.1	4.11E+01	11	9.4	1.44E-01	6.1	8.8
2.00E+01	3.63E-01	7.5	9.6	4.25E-01	7.1	9.6	3.34E-01	7.9	9.3	4.20E-01	7.9	9.8	7.18E+01	11.8	11.5	5.47E-01	5	8.3
3.00E+01	1.24E+00	7.2	9.1	1.32E+00	7.1	8.9	1.16E+00	7	9.1	1.18E+00	7.2	9.3	1.65E+02	13.1	14.4	3.11E+00	6.9	6.9
5.00E+01	5.31E+00	5.9	9.2	5.87E+00	5.7	8.3	4.63E+00	6.1	9.5	4.66E+00	5.9	9.5	1.38E+03	14.4	17.2	2.75E+01	9.9	11.4
7.50E+01	2.52E+01	4	5.9	3.17E+01	3.7	5.4	1.93E+01	4.2	6.2	2.11E+01	4.1	6.1	4.96E+03	17.5	22.2	6.50E+02	14	16.3
1.00E+02	9.62E+01	3.2	4.3	1.22E+02	3	4	7.78E+01	3.3	4.5	8.00E+01	3.2	4.4	9.13E+03	20.5	24.9	5.23E+03	17.2	21.4
1.50E+02	1.09E+03	9.3	11.7	2.08E+03	12.5	15.3	5.14E+02	2.6	3.3	5.76E+02	2.8	3.6	1.50E+04	22.1	24.7	1.40E+04	21.9	25
2.00E+02	8.53E+03	18.4	21.8	1.10E+04	18.9	22.3	4.15E+03	12.9	15.9	4.18E+03	12.8	16.3	1.86E+04	19.3	21.4	1.89E+04	19.8	21.8
3.00E+02	2.81E+04	17.5	19.4	3.90E+04	18.3	20.1	2.92E+04	18.5	20.5	3.71E+04	18.9	21	3.29E+04	16.6	18	3.77E+04	17.1	18.7
5.00E+02	4.40E+04	11.6	11.7	4.59E+04	11.1	10.8	4.11E+04	11.7	11.7	4.29E+04	11.2	11.2	4.35E+04	11.2	11	4.40E+04	10.7	10.7
7.00E+02	3.39E+04	7.1	6.2	3.50E+04	7	6.1	3.29E+04	7.2	6.6	3.30E+04	6.9	6.3	3.46E+04	7.2	6.4	3.52E+04	7.1	6.2
1.00E+03	2.88E+04	5.3	4.3	2.96E+04	5.4	4.4	2.78E+04	5.2	4.3	2.96E+04	5.3	4.3	2.99E+04	5.4	4.4	3.02E+04	5.5	4.4
2.00E+03	2.60E+04	4.4	3.3	2.73E+04	4.6	3.3	2.60E+04	4.3	3.2	2.62E+04	4.4	3.3	2.70E+04	4.5	3.3	2.73E+04	4.6	3.3
3.00E+03	2.69E+04	4.3	3	2.88E+04	4.6	3.1	2.73E+04	4.2	3	2.60E+04	4.3	3	2.74E+04	4.5	3	2.83E+04	4.6	3.1
5.00E+03	2.82E+04	4.4	2.9	2.99E+04	4.7	2.9	2.89E+04	4.3	2.8	2.86E+04	4.4	2.8	2.92E+04	4.5	2.9	3.00E+04	4.7	2.9
1.00E+04	3.06E+04	4.2	2.7	3.18E+04	4.4	2.7	3.21E+04	4.1	2.6	3.14E+04	4.2	2.7	3.20E+04	4.3	2.7	3.11E+04	4.4	2.7
2.00E+04	3.56E+04	4.4	2.5	3.73E+04	4.6	2.6	3.56E+04	4.1	2.5	3.77E+04	4.4	2.5	3.64E+04	4.4	2.6	3.68E+04	4.5	2.5
5.00E+04	4.40E+04	4	2.3	4.23E+04	4.4	2.3	4.69E+04	3.8	2.3	4.17E+04	3.8	2.3	4.64E+04	4.1	2.3	4.50E+04	4.3	2.4
1.00E+05	5.44E+04	3.7	2.1	5.82E+04	3.8	2.2	5.62E+04	3.5	2.1	5.89E+04	3.5	2.3	5.82E+04	3.8	2.2	6.18E+04	3.9	2.2

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

Table A.14. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.27E+01	10.1	8.1	2.55E+00	10.1	8	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	4.83E+01	11.1	9.9	3.77E+00	10.9	9.8	1.10E-01	5.6	9.1	1.27E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	7.62E+01	12.2	12.3	6.41E+00	11.8	11.8	4.09E-01	6.6	9	4.51E+00	9.2	9.3	3.12E-01	6.8	9.7	3.56E-01	7.1	10.1
3.00E+01	1.33E+02	13.7	15.5	1.34E+01	12.2	14	1.98E+00	5.9	8.4	1.75E+01	10	12	1.09E+00	7.1	9.5	1.11E+00	7.1	9.2
5.00E+01	5.32E+02	14.6	17.6	8.33E+01	12	13.7	1.18E+01	3.7	6.3	1.75E+02	12.7	16.3	4.06E+00	6.7	10.6	4.76E+00	6.1	9.8
7.50E+01	3.07E+03	16.1	19.7	1.00E+03	14.7	18	4.55E+02	12.5	13.7	1.49E+03	15.6	18.6	1.19E+01	5.4	8.3	1.83E+01	4.2	6.5
1.00E+02	9.30E+03	18.5	23	4.05E+03	17.2	21.4	2.44E+03	16.6	21.2	5.41E+03	18.6	22.8	3.60E+01	3.9	5.6	6.75E+01	3.4	4.6
1.50E+02	2.58E+04	21.6	24.8	1.87E+04	20.6	24.3	7.98E+03	20.5	22.6	1.47E+04	20	23.1	2.82E+02	2.7	3.4	4.89E+02	2.6	3.1
2.00E+02	3.85E+04	20.8	23	3.56E+04	20.9	23.3	2.42E+04	19.5	22.6	3.16E+04	20.9	23.2	1.11E+03	2.3	2.8	2.18E+03	7.1	8.6
3.00E+02	4.67E+04	16.4	17.4	4.85E+04	16.9	18.1	5.92E+04	18.2	20	5.53E+04	17.4	18.5	1.04E+04	14.1	16.9	3.21E+04	18.7	21.1
5.00E+02	4.35E+04	10.2	9.9	4.42E+04	10.2	9.9	4.40E+04	9.8	9.5	4.79E+04	10.3	9.8	4.30E+04	12.1	12.2	4.32E+04	10.9	11.5
7.00E+02	3.64E+04	7.2	6.3	3.64E+04	7.1	6.2	3.60E+04	7.4	6.1	3.84E+04	7.1	6	3.21E+04	7.1	6.3	3.30E+04	7.2	6.5
1.00E+03	3.12E+04	5.7	4.5	3.12E+04	5.7	4.5	3.02E+04	5.8	4.5	3.31E+04	5.7	4.5	2.67E+04	5	4.2	2.90E+04	5.2	4.3
2.00E+03	2.88E+04	4.8	3.4	2.86E+04	4.8	3.4	2.86E+04	4.8	3.4	2.84E+04	4.9	3.4	2.43E+04	4.1	3.1	2.51E+04	4.3	3.2
3.00E+03	2.94E+04	4.8	3.1	2.92E+04	4.8	3.1	2.85E+04	4.8	3.1	2.72E+04	4.9	3.2	2.58E+04	4	2.9	2.71E+04	4.3	3
5.00E+03	3.13E+04	4.9	2.9	3.11E+04	4.9	2.9	3.06E+04	5	3	3.25E+04	5.1	3	2.76E+04	4	2.8	2.68E+04	4.3	2.8
1.00E+04	3.31E+04	4.7	2.7	3.29E+04	4.7	2.7	3.29E+04	4.9	2.8	3.31E+04	5	2.8	3.03E+04	3.8	2.6	3.18E+04	4.1	2.7
2.00E+04	3.75E+04	4.9	2.6	3.79E+04	4.9	2.6	3.53E+04	5.2	2.6	3.65E+04	5	2.6	3.36E+04	3.6	2.5	3.47E+04	4.1	2.5
5.00E+04	4.61E+04	4.6	2.4	4.46E+04	4.7	2.4	4.30E+04	4.8	2.4	4.55E+04	5.2	2.4	4.60E+04	3.4	2.2	4.20E+04	3.6	2.3
1.00E+05	5.61E+04	4.3	2.2	5.60E+04	4.3	2.3	5.30E+04	4.2	2.3	5.30E+04	5.2	2.3	6.00E+04	3.3	2.2	5.54E+04	3.6	2.3

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.04E-01	6.9	10.2	1.07E-01	7.4	9.6	1.14E-01	7.3	9.7	1.16E-01	6.2	10.1	1.28E-01	6.6	9.7
2.00E+01	3.66E-01	5.2	9.4	3.78E-01	6.9	9.8	3.51E-01	7.2	9.6	3.76E-01	7.2	9.6	3.96E-01	7.2	9.5	3.73E-01	6.4	9.9
3.00E+01	9.59E-01	7.2	9.3	1.02E+00	7.3	9.3	1.21E+00	7.1	9	1.25E+00	7	8.9	1.24E+00	6.9	9	1.34E+00	6.9	8.8
5.00E+01	4.72E+00	6.2	10.2	4.24E+00	6.8	10.3	5.34E+00	5.9	8.7	5.46E+00	5.4	8.7	5.16E+00	5.3	8.9	6.34E+00	5	7.9
7.50E+01	1.35E+01	5.2	7.9	1.52E+01	4.9	7.9	2.55E+01	4	5.8	2.76E+01	3.9	5.7	2.60E+01	3.9	5.8	3.57E+01	3.6	5
1.00E+02	4.22E+01	3.6	5.5	4.88E+01	3.7	5.3	1.01E+02	3.4	4.4	1.04E+02	3.2	4.1	1.03E+02	3.2	4.2	1.40E+02	3.1	4
1.50E+02	3.49E+02	2.5	3.4	3.80E+02	2.6	3.3	1.29E+03	12.2	15.4	1.23E+03	9.9	12.4	7.84E+02	5.8	7	1.81E+03	10.4	12.6
2.00E+02	1.29E+03	2.5	2.8	1.44E+03	3.7	5.4	7.74E+03	18.2	21.8	1.09E+04	18.8	22.1	6.70E+03	17.7	21.3	1.70E+04	19.7	22.9
3.00E+02	1.57E+04	16.8	19.8	2.20E+04	17.7	20.3	2.66E+04	17.6	19.4	3.13E+04	17.7	19.5	3.41E+04	17.7	19.8	4.12E+04	17.5	19.2
5.00E+02	3.84E+04	12	12.3	4.76E+04	12.2	12.3	4.06E+04	11.4	11.5	4.37E+04	11.3	11.4	4.09E+04	10.8	11.2	4.38E+04	10.8	10.9
7.00E+02	3.11E+04	7.2	6.2	3.20E+04	7.1	6.3	3.38E+04	7.2	6.6	3.33E+04	7.1	6.4	3.29E+04	7.1	6.3	3.49E+04	7.1	6.1
1.00E+03	2.79E+04	5.2	4.2	2.76E+04	5	4.2	2.81E+04	5.2	4.3	2.87E+04	5.3	4.3	2.95E+04	5.4	4.4	3.00E+04	5.5	4.4
2.00E+03	2.37E+04	4.1	3.2	2.69E+04	4.2	3.2	2.57E+04	4.2	3.2	2.61E+04	4.3	3.2	2.55E+04	4.3	3.2	2.79E+04	4.5	3.3
3.00E+03	2.49E+04	4.2	3	2.52E+04	4	3	2.66E+04	4.2	3	2.70E+04	4.3	3	2.82E+04	4.3	3	2.92E+04	4.5	3
5.00E+03	3.06E+04	4.5	2.8	2.96E+04	4.3	2.8	2.92E+04	4.3	2.8	2.85E+04	4.4	2.8	2.93E+04	4.5	2.8	3.02E+04	4.7	2.9
1.00E+04	3.06E+04	3.6	2.6	3.33E+04	3.9	2.7	3.15E+04	4	2.6	3.15E+04	4.2	2.7	3.07E+04	4.2	2.7	2.96E+04	4.2	2.7
2.00E+04	3.54E+04	4.2	2.5	3.62E+04	3.7	2.4	3.60E+04	4	2.5	3.79E+04	4.2	2.5	3.33E+04	4.3	2.5	3.87E+04	4.6	2.6
5.00E+04	5.08E+04	3.8	2.3	4.25E+04	3.2	2.3	4.68E+04	3.8	2.3	4.51E+04	3.9	2.3	4.31E+04	3.8	2.4	4.35E+04	4.5	2.4
1.00E+05	5.83E+04	3.2	2.2	5.96E+04	3.3	2.1	6.03E+04	3.5	2.1	5.86E+04	3.5	2.2	5.57E+04	3.7	2.2	5.60E+04	4.1	2.2

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.69E-01	5.8	8.7	0.00E+00	1	1	2.77E+00	4.5	6	2.77E+00	4.5	6
2.00E+01	6.31E-01	6.4	8.2	0.00E+00	1	1	1.35E+01	4.5	5.7	1.35E+01	4.5	5.7
3.00E+01	1.73E+00	5.4	7.5	2.13E+00	5.3	7.5	7.41E+01	5.8	6.9	7.41E+01	5.8	6.9
5.00E+01	1.53E+01	3.6	6	1.45E+01	4.5	6.3	9.46E+04	14.3	16.5	9.46E+04	14.3	16.5
7.50E+01	1.93E+02	8.8	9.9	1.22E+02	5.5	8.3	9.37E+04	21.5	28	9.37E+04	21.5	28
1.00E+02	2.68E+03	16	19.5	1.67E+03	14.7	18.3	7.42E+04	26.1	28.3	7.42E+04	26.1	28.3
1.50E+02	1.59E+04	19.8	24.1	1.38E+04	19.4	23.2	5.75E+04	24.8	23.4	5.75E+04	24.8	23.4

(*continued on next page*)

Table A.14. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.25E+04	21.6	23.8	2.39E+04	21.2	23.8	5.60E+04	19.4	20.5	5.60E+04	19.4	20.5
3.00E+02	3.29E+04	15.5	16.4	3.64E+04	16.2	17.6	5.37E+04	13.8	16.3	5.37E+04	13.8	16.3
5.00E+02	4.67E+04	10.4	10.9	4.34E+04	10.8	10.4	4.80E+04	9.6	10.2	4.80E+04	9.6	10.2
7.00E+02	3.38E+04	6.8	6.4	3.91E+04	7.1	6.1	4.00E+04	7.4	5.6	4.00E+04	7.4	5.6
1.00E+03	3.20E+04	5.6	4.4	2.93E+04	5.5	4.4	3.28E+04	6	4.5	3.28E+04	6	4.5
2.00E+03	2.96E+04	4.8	3.4	2.67E+04	4.6	3.4	3.29E+04	5.4	3.6	3.29E+04	5.4	3.6
3.00E+03	2.73E+04	4.6	3.1	3.00E+04	4.8	3.1	3.26E+04	5.3	3.3	3.26E+04	5.3	3.3
5.00E+03	2.77E+04	4.8	2.9	2.99E+04	4.7	2.9	3.31E+04	5.4	2.9	3.31E+04	5.4	2.9
1.00E+04	3.22E+04	4.6	2.7	3.52E+04	4.7	2.7	3.37E+04	5.2	2.6	3.37E+04	5.2	2.6
2.00E+04	4.03E+04	4.7	2.6	3.23E+04	4.5	2.6	3.94E+04	5.5	2.8	3.94E+04	5.5	2.8
5.00E+04	4.18E+04	4.2	2.4	4.67E+04	4.8	2.4	3.70E+04	5.2	2.7	3.70E+04	5.2	2.7
1.00E+05	5.31E+04	4.3	2.2	5.42E+04	4.4	2.3	4.98E+04	5.3	2.2	4.98E+04	5.3	2.2

Table A.15. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{24}Mg ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.11E+00	9.4	1.8	1.54E+00	9.4	1.8	4.33E+02	9.2	6.5	4.78E+02	9.2	6.7	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	7.05E+00	10.2	2.1	2.15E+00	10	2.2	7.90E+02	9.8	7.8	7.70E+02	10	8	1.13E-01	7.1	9.6	1.19E-01	7	9.5
2.00E+01	1.18E+01	11.2	2.6	4.02E+00	10.9	2.7	1.68E+03	10.7	9.4	1.49E+03	10.9	9.8	4.41E-01	7	9.5	4.14E-01	6.9	9.5
3.00E+01	1.96E+01	12.4	3.3	7.91E+00	10.8	3.2	3.94E+03	11.9	12.1	3.54E+03	12.3	12.4	1.43E+00	6.3	8.9	1.42E+00	6.5	8.8
5.00E+01	6.52E+01	12.9	4	2.71E+01	10.4	3.6	2.27E+04	13.6	15.1	1.74E+04	14	16	7.15E+00	4.9	7.7	7.46E+00	5	7.7
7.50E+01	2.57E+02	13.2	4.1	3.42E+02	12.4	3.7	5.67E+04	17.1	21.5	3.69E+04	17.4	21.9	4.99E+01	6	6.2	4.15E+01	3.6	4.9
1.00E+02	2.17E+03	15.4	4.6	2.19E+03	15	4.7	8.18E+04	20.1	24.8	5.13E+04	20.1	24.8	2.16E+02	7.6	8.8	1.38E+02	3.1	4
1.50E+02	9.39E+03	19.8	6.1	9.28E+03	19.6	6	8.42E+04	24.4	26.1	6.59E+04	23.4	25.5	2.50E+03	13.6	16.4	3.27E+03	14.4	17.9
2.00E+02	1.67E+04	20.6	6.1	1.76E+04	20.5	6	6.95E+04	22.2	22.6	6.29E+04	22.3	23.2	1.52E+04	18.8	22.5	1.74E+04	19.2	22.7
3.00E+02	3.50E+04	18.7	5.5	3.73E+04	18.8	5.5	5.07E+04	16.1	15.7	5.30E+04	16.8	16.6	3.67E+04	19.4	20.7	3.79E+04	19.5	20.7
5.00E+02	4.91E+04	13.8	4	5.11E+04	13.6	4	5.02E+04	11.8	11.3	5.52E+04	12.6	12	4.64E+04	13.3	13.3	4.77E+04	13.5	13.4
7.00E+02	4.02E+04	9.2	2.8	4.09E+04	9.1	2.7	4.68E+04	9.7	8.3	4.64E+04	9.2	7.9	3.93E+04	9.1	8.4	4.12E+04	9.3	8.4
1.00E+03	3.31E+04	6.8	2.1	3.38E+04	6.9	2.1	4.13E+04	7.4	5.7	3.97E+04	7.4	5.7	3.34E+04	6.7	5.4	3.36E+04	6.8	5.4
2.00E+03	3.02E+04	5.6	1.7	3.04E+04	5.7	1.7	3.92E+04	6.5	4.2	3.58E+04	6.4	4.2	2.95E+04	5.4	3.8	2.91E+04	5.5	3.9
3.00E+03	3.07E+04	5.5	1.6	3.14E+04	5.6	1.6	3.76E+04	6.5	3.8	3.67E+04	6.4	3.8	3.13E+04	5.4	3.5	3.06E+04	5.5	3.5
5.00E+03	3.38E+04	5.6	1.6	3.40E+04	5.8	1.6	3.89E+04	6.7	3.5	3.90E+04	6.4	3.5	3.38E+04	5.6	3.3	3.32E+04	5.7	3.3
1.00E+04	3.57E+04	5.3	1.5	3.47E+04	5.4	1.5	3.80E+04	6.4	3.3	3.96E+04	6.5	3.3	3.53E+04	5.1	3	3.50E+04	5.2	3
2.00E+04	4.10E+04	5.4	1.5	4.08E+04	5.7	1.5	4.28E+04	6.6	3.2	4.36E+04	6.6	3.1	4.18E+04	5.3	2.9	3.96E+04	5.4	2.9
5.00E+04	5.16E+04	4.9	1.4	5.03E+04	5.2	1.4	5.25E+04	6.6	2.9	5.01E+04	6.4	2.9	5.28E+04	4.8	2.6	5.13E+04	5.1	2.6
1.00E+05	6.62E+04	4.4	1.3	6.24E+04	4.8	1.4	6.31E+04	5.7	2.6	6.16E+04	6.2	2.7	6.81E+04	4.4	2.4	6.51E+04	4.6	2.4

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	5.67E+02	9.4	7	0.00E+00	1	1
1.40E+01	1.14E-01	7.5	9.8	1.21E-01	7.3	9.9	1.12E-01	6.6	9.9	1.32E-01	7.5	9.4	7.85E+02	10.3	8.5	0.00E+00	1	1
2.00E+01	4.27E-01	7.6	9.5	4.25E-01	7.4	9.6	3.46E-01	7.6	9.6	4.27E-01	7	9.8	1.22E+03	11.4	10.5	2.75E-01	5.4	10.4
3.00E+01	1.40E+00	6.8	8.8	1.46E+00	6.9	9	1.33E+00	6.8	9.1	1.52E+00	6.4	8.5	2.24E+03	12.9	13.6	1.34E+00	5.4	8.9
5.00E+01	6.62E+00	5.4	8.2	7.32E+00	5.1	7.9	5.60E+00	5.4	8.7	8.05E+00	4.7	7.5	5.44E+03	14.7	17.3	3.43E+00	6.2	9.9
7.50E+01	3.70E+01	3.5	5.1	4.31E+01	3.4	4.8	2.87E+01	3.8	5.6	4.58E+01	3.4	4.8	1.24E+04	17.2	21.4	1.29E+01	4.7	7.9
1.00E+02	1.35E+02	3.2	4.1	1.58E+02	3	3.8	1.04E+02	3.1	4.2	1.63E+02	3.2	3.9	2.20E+04	19.3	23.9	4.44E+01	3.4	5.2
1.50E+02	1.99E+03	11.9	14.6	1.80E+03	10.3	12.6	6.12E+02	4.3	5.6	3.28E+03	13.6	16.5	3.71E+04	22.2	24.9	3.26E+02	2.3	3.3
2.00E+02	1.23E+04	17.7	21.2	1.58E+04	17.7	21.3	9.81E+03	17.3	20.8	1.93E+04	19.6	23.5	4.27E+04	22.1	23.9	1.03E+03	2.4	2.9
3.00E+02	4.66E+04	19.8	21.7	5.41E+04	20.3	21.7	3.11E+04	19.1	20.6	3.93E+04	19.2	20.6	3.89E+04	17.2	17.3	8.59E+03	12.1	13.2
5.00E+02	5.21E+04	13.4	13.2	5.37E+04	13	12.7	4.68E+04	13.9	14.2	5.01E+04	13.3	13.2	5.80E+04	14.1	13.7	5.62E+04	15	15.1
7.00E+02	4.19E+04	9.1	8	4.17E+04	9	7.8	4.04E+04	9.4	8.4	3.87E+04	9	8.1	4.59E+04	9.7	7.8	4.04E+04	9.3	8.3
1.00E+03	3.44E+04	6.9	5.4	3.53E+04	7	5.5	3.21E+04	6.7	5.3	3.35E+04	6.7	5.5	3.51E+04	6.9	5.4	3.18E+04	6.5	5.2
2.00E+03	3.08E+04	5.7	3.9	3.17E+04	5.9	4	2.99E+04	5.4	3.8	3.12E+04	5.7	3.9	3.27E+04	5.9	4	2.93E+04	5.2	3.8
3.00E+03	3.16E+04	5.7	3.6	3.23E+04	5.9	3.7	3.07E+04	5.3	3.5	3.15E+04	5.6	3.6	3.26E+04	5.9	3.6	3.01E+04	5.2	3.4
5.00E+03	3.44E+04	5.9	3.4	3.58E+04	6.1	3.4	3.13E+04	5.4	3.3	3.55E+04	5.7	3.3	3.70E+04	5.9	3.4	3.01E+04	4.9	3.2
1.00E+04	3.65E+04	5.6	3.1	3.70E+04	5.9	3.2	3.47E+04	5.1	3	3.43E+04	5.4	3.1	3.65E+04	5.5	3.1	3.40E+04	4.4	3
2.00E+04	4.23E+04	5.7	2.9	4.17E+04	6	3	4.06E+04	5.1	2.9	4.18E+04	5.6	2.9	4.25E+04	6.1	3	4.19E+04	5	2.9
5.00E+04	5.16E+04	5.4	2.7	5.05E+04	5.9	2.8	5.44E+04	4.9	2.6	4.98E+04	5.3	2.7	5.28E+04	5.6	2.6	4.71E+04	4.4	2.4
1.00E+05	6.73E+04	5	2.5	6.09E+04	5.3	2.5	6.51E+04	4.1	2.4	6.15E+04	5.1	2.4	6.77E+04	4.2	2.4	6.14E+04	4	2.3

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.11E-01	7.5	9.8	1.23E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.15. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	3.68E-01	7.5	9.6	4.14E-01	7.1	9.5	3.10E-01	6.2	9.3	4.36E-01	6.2	9.7	5.75E-01	5.2	7.6	7.47E-01	4.4	7.9
3.00E+01	1.28E+00	6.9	8.8	1.36E+00	6.8	8.7	1.21E+00	6.1	9.1	1.34E+00	7	9	2.62E+00	4.1	6.4	2.46E+00	3.8	6.1
5.00E+01	5.98E+00	5.5	8.7	7.10E+00	5.1	8	5.94E+00	5.8	9	5.87E+00	5.7	9.1	1.98E+01	4	5.4	2.18E+01	3.6	5.2
7.50E+01	2.96E+01	3.9	5.5	3.93E+01	3.5	5	2.70E+01	5.3	5.7	2.83E+01	4	5.9	1.03E+02	4	4.1	1.10E+02	3.2	4.3
1.00E+02	1.06E+02	3.1	4.2	1.30E+02	3.4	4.3	1.09E+02	6.6	5.7	9.81E+01	2.9	4.2	1.37E+03	11.4	13.3	2.43E+03	12	13.3
1.50E+02	2.06E+03	12.4	15.2	2.69E+03	13.4	16.6	1.77E+03	13.2	17.4	1.80E+03	11.6	13.8	2.81E+04	18.9	23.2	3.40E+04	19.4	23.9
2.00E+02	9.57E+03	18	21.4	1.58E+04	18.8	22.3	7.33E+03	17	21.4	7.21E+03	16.8	20.5	4.43E+04	22.5	24.6	4.42E+04	23.3	24.6
3.00E+02	3.01E+04	19	20.6	3.95E+04	19.3	20.8	2.22E+04	16.7	18.9	2.84E+04	18.3	20.4	4.05E+04	18	18.2	4.50E+04	17.3	18
5.00E+02	4.98E+04	14.1	14	4.92E+04	13.5	13.4	5.29E+04	14.1	14.3	5.45E+04	13.8	13.8	4.92E+04	12.7	13.2	5.00E+04	12.9	12.7
7.00E+02	3.97E+04	9.2	8.3	4.07E+04	9.2	8.1	4.08E+04	8.9	8.2	3.96E+04	8.7	7.7	4.42E+04	9.4	8	4.86E+04	9.3	7.8
1.00E+03	3.18E+04	6.6	5.3	3.48E+04	6.9	5.4	3.01E+04	6.5	5.3	3.54E+04	7	5.4	3.48E+04	7.1	5.5	3.72E+04	7.3	5.5
2.00E+03	2.96E+04	5.4	3.8	3.03E+04	5.6	3.9	2.96E+04	5.4	3.8	3.18E+04	5.6	3.9	3.47E+04	6.1	4	3.46E+04	6	4.1
3.00E+03	3.08E+04	5.3	3.5	3.11E+04	5.6	3.6	2.88E+04	5.4	3.5	3.24E+04	5.6	3.5	3.32E+04	6	3.7	3.58E+04	6.1	3.7
5.00E+03	3.32E+04	5.5	3.3	3.36E+04	5.7	3.3	3.20E+04	5.6	3.3	3.40E+04	5.9	3.4	3.34E+04	5.8	3.4	3.70E+04	6.4	3.3
1.00E+04	3.49E+04	5	3	3.60E+04	5.5	3.1	3.39E+04	5.1	3	3.41E+04	5.2	3.1	3.59E+04	5.8	3.2	3.87E+04	6.3	3.1
2.00E+04	4.01E+04	5.2	2.9	3.92E+04	5.5	2.9	3.73E+04	5.6	2.8	3.98E+04	5.4	2.9	4.14E+04	6.3	3.1	4.23E+04	5.8	2.8
5.00E+04	4.85E+04	4.7	2.6	5.18E+04	5.1	2.6	4.90E+04	4.6	2.5	5.14E+04	5.3	2.7	5.34E+04	5.8	2.7	5.17E+04	5.8	2.8
1.00E+05	6.50E+04	4.1	2.4	6.12E+04	4.5	2.4	6.60E+04	4.1	2.3	6.13E+04	4.8	2.5	6.39E+04	4.9	2.6	6.08E+04	5.7	2.5

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.55E+01	9.4	7	3.35E+00	9.4	6.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.42E-01	4.2	8.8	2.23E+01	10.2	8.5	4.64E+00	10.2	8.4	1.39E-01	7.2	10	1.48E-01	7.2	9.6
2.00E+01	4.02E-01	6.4	9.3	5.87E-01	4.9	7.6	3.59E+01	11.3	10.5	8.21E+00	11	10.3	4.94E-01	7.3	9.3	5.62E-01	6.8	9.3
3.00E+01	1.34E+00	6.6	8.8	2.43E+00	5	6.8	6.55E+01	12.6	13.3	1.64E+01	11.2	12.4	1.77E+00	6.2	8	1.93E+00	5.7	8
5.00E+01	5.76E+00	5.9	9.4	1.63E+01	4.3	5.9	1.84E+02	13.5	16	5.35E+01	10.8	13.3	1.10E+01	4.3	6.5	1.33E+01	4.1	6.1
7.50E+01	2.32E+01	3.9	6.1	9.43E+01	4.6	6	8.71E+02	13.8	16.4	7.22E+02	12.5	14.2	6.92E+01	3.1	4.3	8.89E+01	3.2	4.1
1.00E+02	8.63E+01	3.2	4.4	4.00E+03	13.9	16	5.38E+03	15.4	18.6	5.27E+03	15.2	18.4	2.54E+02	3.8	4.5	3.27E+02	4.6	5.4
1.50E+02	4.74E+02	3.6	3.7	1.77E+04	21	24.7	2.22E+04	20.3	24	2.05E+04	20.1	23.9	7.82E+03	15.7	19.4	1.31E+04	16.8	20.9
2.00E+02	6.47E+03	15.1	18.7	2.17E+04	22	23.5	3.78E+04	21.5	23.7	3.58E+04	21.3	23.7	3.04E+04	20.2	23.3	3.64E+04	20.8	23.7
3.00E+02	2.42E+04	18.7	20.1	3.27E+04	18.4	19.1	5.42E+04	19.1	20.1	5.43E+04	19.2	20.2	6.38E+04	19.9	21.2	6.77E+04	19.8	21.1
5.00E+02	4.42E+04	14.1	14.4	5.04E+04	14.6	14.3	5.22E+04	12.8	12.2	5.30E+04	12.7	12.2	5.56E+04	12.5	11.7	5.44E+04	12.2	11.4
7.00E+02	3.80E+04	9.1	8.3	4.16E+04	9.4	8.3	4.27E+04	9.1	7.8	4.29E+04	9.1	7.8	4.29E+04	8.9	7.5	4.54E+04	8.9	7.5
1.00E+03	3.07E+04	6.5	5.4	3.10E+04	6.7	5.5	3.64E+04	7.2	5.6	3.62E+04	7.2	5.6	3.77E+04	7.3	5.6	3.86E+04	7.3	5.6
2.00E+03	2.84E+04	5.3	3.7	2.93E+04	5.5	3.9	3.26E+04	6.1	4.1	3.25E+04	6.1	4.1	3.41E+04	6.2	4.1	3.53E+04	6.4	4.2
3.00E+03	2.83E+04	5.1	3.5	3.18E+04	5.5	3.5	3.33E+04	6	3.7	3.39E+04	6.1	3.7	3.35E+04	6.2	3.8	3.59E+04	6.3	3.8
5.00E+03	3.34E+04	5.2	3.2	3.21E+04	5.7	3.2	3.64E+04	6.2	3.5	3.55E+04	6.2	3.5	3.77E+04	6.4	3.5	3.63E+04	6.5	3.5
1.00E+04	3.49E+04	4.9	2.9	3.36E+04	5	3	3.75E+04	6	3.2	3.66E+04	6	3.2	3.64E+04	6.2	3.2	3.61E+04	6.4	3.3
2.00E+04	4.26E+04	5	2.9	4.17E+04	5.3	2.9	4.26E+04	6.2	3	4.21E+04	6.3	3	4.26E+04	6.6	3.1	4.17E+04	6.6	3.1
5.00E+04	5.50E+04	4.4	2.5	4.82E+04	5	2.6	5.10E+04	5.9	2.8	4.95E+04	6	2.8	4.70E+04	6.2	2.8	5.14E+04	6.8	2.9
1.00E+05	6.60E+04	4.3	2.3	6.16E+04	4.6	2.3	6.33E+04	5.4	2.5	6.04E+04	5.7	2.6	6.28E+04	5.7	2.6	5.68E+04	6.4	2.7

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.82E+03	7	3	4.63E+03	6.9	3	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.63E+03	7.1	3.6	9.27E+03	7.1	3.6	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.14E+04	7.4	4.1	1.39E+04	7.4	4.1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.90E+04	8.1	5	2.31E+04	8.1	5	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.21E+00	8.9	6.2	0.00E+00	1	1	3.78E+04	9.4	7	4.57E+04	9.4	7.1	4.58E+01	9.4	6.9	5.23E+00	9.3	6.9
1.40E+01	8.19E+00	9.1	7.5	2.00E-01	4.9	7.2	5.23E+04	10.4	8.6	6.32E+04	10.4	8.6	6.94E+01	10.3	8.4	8.60E+00	10.2	8.5
2.00E+01	3.08E+01	10.1	8.8	8.47E-01	4.8	7.1	7.33E+04	11.6	10.9	8.81E+04	11.6	11	1.11E+02	11.3	10.6	1.44E+01	11.1	10.4
3.00E+01	8.04E+01	11.3	11.2	4.41E+00	3.9	5.4	1.06E+05	13.4	14.6	1.25E+05	13.4	14.7	1.78E+02	12.8	13.6	2.62E+01	12.3	13
5.00E+01	1.83E+03	12.2	12.5	6.48E+01	8	7.2	1.21E+05	17.6	22.9	1.24E+05	18	23.6	5.55E+02	14.2	16.6	8.60E+01	13.1	16
7.50E+01	1.18E+04	15.1	18.1	3.04E+03	13.2	14.6	9.68E+04	22.1	28.3	9.65E+04	22.6	28.8	1.59E+03	16.1	19.8	5.15E+02	14.3	16.4
1.00E+02	2.92E+04	18	22.4	1.40E+04	16.4	20.5	8.03E+04	25.6	28.5	7.99E+04	25.9	28.5	3.67E+03	17.8	22	2.02E+03	16	19.5
1.50E+02	5.05E+04	22.7	25.6	3.78E+04	21.3	24.8	6.44E+04	24.3	24.3	6.47E+04	24.2	24.2	8.15E+03	20.7	23.6	6.65E+03	19.4	22.8
2.00E+02	5.07E+04	22.3	23.6	4.55E+04	22.2	24	5.83E+04	20.3	20.6	5.93E+04	20.3	20.5	1.48E+04	20.1	22.3	1.40E+04	19.8	22.3
3.00E+02	4.79E+04	17.5	17.8	5.43E+04	18.3	18.9	5.76E+04	16.4	16.4	5.83E+04	16.4	16.4	3.36E+04	18.6	20.2	3.78E+04	19.1	20.7
5.00E+02	5.54E+04	13.5	12.4	5.64E+04	12.8	12.4	5.28E+04	12	11.1	5.39E+04	12	11.2	5.03E+04	13.9	13.8	5.20E+04	13.7	13.4
7.00E+02	4.41E+04	9	7.8	4.37E+04	9	7.6	4.61E+04	9.3	7.8	4.66E+04	9.3	7.8	4.01E+04	9.1	8.2	4.04E+04	9.1	8
1.00E+03	3.84E+04	7.4	5.6	3.90E+04	7.3	5.6	4.02E+04	7.6	5.8	4.06E+04	7.6	5.8	3.34E+04	6.8	5.4	3.46E+04	6.9	5.4
2.00E+03	3.49E+04	6.3	4.2	3.62E+04	6.3	4.2	3.66E+04	6.6	4.3	3.68E+04	6.7	4.3	3.03E+04	5.5	3.9	3.06E+04	5.6	3.9

Table A.15. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	3.57E+04	6.4	3.8	3.79E+04	6.4	3.8	3.73E+04	6.6	3.9	3.78E+04	6.7	3.9	3.11E+04	5.5	3.5	3.14E+04	5.6	3.6
5.00E+03	3.72E+04	6.4	3.5	3.74E+04	6.5	3.5	3.99E+04	6.8	3.6	3.92E+04	6.8	3.6	3.36E+04	5.6	3.3	3.41E+04	5.8	3.3
1.00E+04	3.88E+04	6.4	3.3	3.65E+04	6.3	3.3	4.12E+04	6.7	3.4	4.11E+04	6.8	3.4	3.55E+04	5.2	3	3.56E+04	5.4	3.1
2.00E+04	4.47E+04	6.8	3.1	4.52E+04	6.6	3.1	4.52E+04	6.9	3.2	4.46E+04	7.1	3.2	4.06E+04	5.4	2.9	4.00E+04	5.6	2.9
5.00E+04	5.40E+04	6.4	2.9	5.10E+04	6.3	2.8	5.33E+04	6.8	2.9	5.17E+04	7	2.9	5.20E+04	5	2.6	4.99E+04	5.2	2.7
1.00E+05	6.73E+04	5.6	2.6	5.67E+04	5.8	2.7	6.35E+04	6.5	2.7	6.13E+04	6.8	2.7	6.52E+04	4.4	2.4	6.24E+04	4.8	2.4

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	5.34E+02	9.4	7	6.49E+01	9.3	6.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	8.05E+02	10.3	8.5	1.06E+02	10.3	8.5	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.85E-01	4.7	9	3.57E-01	4.8	9.6	1.29E+03	11.4	10.7	1.72E+02	11.3	10.5	4.31E-01	7.7	8.9	3.60E-01	5.6	9.7
3.00E+01	1.11E+00	5.4	9.1	1.27E+00	5.4	9.2	1.99E+03	12.9	13.7	2.94E+02	12.8	13.4	1.16E+00	6.1	9.3	1.13E+00	5.6	9
5.00E+01	5.20E+00	6.4	10.6	4.66E+00	6.9	9.9	5.31E+03	14.7	17.4	8.15E+02	14.1	17.6	4.61E+00	5	9.2	4.79E+00	5.8	10.4
7.50E+01	1.80E+01	4	6.7	1.62E+01	4.6	7.4	1.23E+04	16.8	20.8	3.89E+03	15.6	17.9	1.90E+01	4.4	7	1.57E+01	4.3	7.1
1.00E+02	6.77E+01	3.3	4.8	6.33E+01	3.3	4.9	2.41E+04	18.7	23.3	1.12E+04	17.3	21.4	6.90E+01	3.2	4.4	5.88E+01	3.5	4.9
1.50E+02	4.57E+02	2.8	3.5	4.29E+02	2.5	3.3	3.62E+04	22.6	25.1	2.14E+04	21.9	25	3.82E+02	4.7	5.3	3.91E+02	2.6	3.3
2.00E+02	1.99E+03	8.2	9	1.41E+03	3.7	4.6	4.50E+04	21.8	23.3	2.74E+04	21.2	22.6	4.57E+03	14.7	18.3	1.28E+03	3.8	5.3
3.00E+02	2.84E+04	19.4	21.7	2.04E+04	18.3	20.6	6.06E+04	18.6	19.8	6.63E+04	19.7	21.2	2.01E+04	17.1	19.6	2.21E+04	17.8	21.1
5.00E+02	4.69E+04	14.5	15.3	4.81E+04	14.2	14.4	5.25E+04	12.4	11.7	5.91E+04	13	12.2	5.10E+04	14.8	14.7	5.05E+04	14.4	14
7.00E+02	4.02E+04	8.9	8.6	3.78E+04	8.7	8.2	4.51E+04	9.1	7.6	4.25E+04	9.2	7.6	3.79E+04	9.2	8.6	3.60E+04	8.7	8.1
1.00E+03	2.80E+04	6.7	5.3	3.35E+04	6.7	5.3	3.90E+04	7.4	5.6	4.01E+04	7.3	5.6	2.95E+04	6.4	5.2	3.28E+04	6.8	5.3
2.00E+03	2.77E+04	5.2	3.8	2.83E+04	5.3	3.8	3.53E+04	6.4	4.2	3.37E+04	6.2	4.1	2.99E+04	5.3	3.8	2.91E+04	5.2	3.7
3.00E+03	3.07E+04	5.1	3.5	2.76E+04	5.1	3.4	3.43E+04	6.3	3.8	3.49E+04	6.2	3.8	3.21E+04	5.4	3.5	2.96E+04	5.3	3.4
5.00E+03	3.13E+04	4.8	3.2	3.16E+04	5.3	3.2	3.76E+04	6.4	3.6	3.58E+04	6.3	3.4	3.44E+04	5.2	3.3	3.56E+04	5.6	3.3
1.00E+04	3.30E+04	4.5	3	3.49E+04	5.1	3.1	3.69E+04	6.2	3.3	3.75E+04	6	3.2	3.43E+04	4.7	3	3.52E+04	4.9	3.1
2.00E+04	3.98E+04	4.8	2.8	3.93E+04	5.3	2.9	4.35E+04	6.7	3.1	3.58E+04	6.2	3.1	3.67E+04	4.5	2.9	3.85E+04	5.1	2.9
5.00E+04	4.95E+04	4.8	2.5	5.11E+04	4.9	2.6	5.21E+04	6.2	2.9	4.63E+04	6	2.8	5.03E+04	4.6	2.5	5.29E+04	4.3	2.6
1.00E+05	7.05E+04	3.9	2.3	6.51E+04	4.3	2.4	6.08E+04	5.9	2.6	6.00E+04	5.9	2.6	6.25E+04	3.9	2.4	5.94E+04	3.8	2.4

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.69E+01	9.3	6.8	0.00E+00	1	1
1.40E+01	1.09E-01	6.9	9.8	0.00E+00	1	1	1.04E-01	6.8	9.8	1.03E-01	7	10.1	4.33E+01	10.1	8.1	1.46E-01	6.1	8.8
2.00E+01	3.73E-01	7.5	9.6	4.30E-01	7.1	9.6	3.45E-01	7.9	9.3	4.25E-01	7.9	9.8	7.55E+01	10.8	9.7	5.70E-01	5	8.2
3.00E+01	1.27E+00	7.2	9.1	1.36E+00	7.1	8.9	1.19E+00	7	9.1	1.21E+00	7.2	9.3	1.72E+02	12.2	12.2	3.14E+00	6.7	6.9
5.00E+01	5.47E+00	5.9	9.1	6.07E+00	5.6	8.3	4.78E+00	6.1	9.5	4.84E+00	5.9	9.5	1.33E+03	13.1	14.2	2.69E+01	8.9	8.1
7.50E+01	2.57E+01	4	5.8	3.22E+01	3.7	5.4	1.98E+01	4.2	6.2	2.16E+01	4.1	6.1	4.99E+03	16	19.5	4.80E+02	12.2	13.9
1.00E+02	9.21E+01	3.1	4.3	1.12E+02	3	4	7.66E+01	3.1	4.5	8.04E+01	3.2	4.4	9.53E+03	18.7	23.3	4.47E+03	15	18
1.50E+02	6.72E+02	5.6	6.8	1.24E+03	8.8	10.5	4.76E+02	2.6	3.3	5.29E+02	2.6	3.1	1.62E+04	22.2	25	1.43E+04	20.8	24.5
2.00E+02	7.67E+03	16.4	20	1.01E+04	17.7	20.8	2.06E+03	8.1	9.4	2.66E+03	9	10.9	1.98E+04	21	22.6	1.95E+04	21.1	22.8
3.00E+02	2.86E+04	18.7	20.6	3.93E+04	19.4	21.2	3.00E+04	19.3	21.6	3.50E+04	19.2	21.7	3.40E+04	18.2	19.2	3.79E+04	18.7	19.9
5.00E+02	5.05E+04	14.3	14.4	5.28E+04	13.7	13.6	4.48E+04	13.8	13.9	4.60E+04	13.6	13.7	5.02E+04	13.8	13.8	5.11E+04	13.6	13.3
7.00E+02	4.04E+04	9.1	8.1	4.20E+04	9	7.8	3.77E+04	9	8.4	3.98E+04	9.1	8.2	4.03E+04	9.1	8.2	4.17E+04	9.1	8
1.00E+03	3.28E+04	6.8	5.3	3.49E+04	6.9	5.4	3.07E+04	6.6	5.3	3.30E+04	6.6	5.3	3.38E+04	6.8	5.4	3.48E+04	7	5.4
2.00E+03	2.91E+04	5.4	3.8	3.11E+04	5.7	3.9	2.88E+04	5.2	3.7	2.99E+04	5.4	3.8	3.08E+04	5.6	3.9	3.12E+04	5.7	3.9
3.00E+03	3.05E+04	5.4	3.5	3.07E+04	5.6	3.6	3.01E+04	5.2	3.5	3.02E+04	5.4	3.5	3.15E+04	5.6	3.6	3.18E+04	5.7	3.6
5.00E+03	3.14E+04	5.5	3.3	3.51E+04	5.9	3.3	3.23E+04	5.3	3.2	3.41E+04	5.6	3.3	3.43E+04	5.7	3.3	3.54E+04	5.8	3.4
1.00E+04	3.52E+04	5.2	3	3.63E+04	5.6	3.1	3.43E+04	4.9	3	3.37E+04	5	3	3.55E+04	5.3	3.1	3.58E+04	5.6	3.1
2.00E+04	4.10E+04	5.4	2.9	4.00E+04	5.6	2.9	3.97E+04	4.8	2.8	3.93E+04	5.3	2.9	4.22E+04	5.5	2.9	4.01E+04	5.7	2.9
5.00E+04	5.27E+04	4.9	2.6	4.90E+04	5.4	2.7	5.44E+04	4.6	2.5	5.13E+04	4.9	2.6	5.37E+04	5.1	2.6	5.17E+04	5.5	2.6
1.00E+05	6.88E+04	4.2	2.4	6.10E+04	4.9	2.5	6.70E+04	3.9	2.3	6.30E+04	4.3	2.4	6.61E+04	4.6	2.4	6.55E+04	4.9	2.4

(continued on next page)

Table A.15. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.42E+01	9.4	7	2.72E+00	9.4	7	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	5.24E+01	10.3	8.5	4.04E+00	10.1	8.4	1.11E-01	5.6	9.1	1.32E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	8.17E+01	11.3	10.5	6.89E+00	10.9	10.2	4.23E-01	6.6	9	4.49E+00	8.9	8.3	3.19E-01	6.8	9.7	3.68E-01	7.1	10.1
3.00E+01	1.42E+02	12.7	13.4	1.42E+01	11.3	12.2	2.04E+00	5.9	8.3	1.68E+01	9.6	9	1.13E+00	7.1	9.5	1.14E+00	7.1	9.2
5.00E+01	5.13E+02	13.6	15.5	6.15E+01	11.1	12.4	1.21E+01	3.7	6.3	1.57E+02	12.1	13	4.18E+00	6.7	10.6	4.90E+00	6.1	9.8
7.50E+01	2.83E+03	14.7	17.5	7.59E+02	13.2	15.3	2.51E+02	10.4	10.5	1.32E+03	13.6	16.2	1.23E+01	5.4	8.3	1.87E+01	4.2	6.5
1.00E+02	9.07E+03	16.8	20.8	3.66E+03	15.7	19.2	2.26E+03	14.7	17.7	5.11E+03	16.6	20	3.68E+01	3.8	5.6	6.82E+01	3.3	4.6
1.50E+02	2.67E+04	20.8	24.3	1.83E+04	19.3	23.1	7.48E+03	20.1	22.9	1.50E+04	20.8	23.6	2.80E+02	2.7	3.4	4.80E+02	2.6	3.1
2.00E+02	4.14E+04	21.8	23.9	3.65E+04	21.4	23.8	2.10E+04	19.3	21.8	3.17E+04	20.3	23.4	1.02E+03	2.2	2.8	1.46E+03	4.1	5.5
3.00E+02	5.16E+04	18.8	19.5	5.24E+04	19.2	20.1	6.15E+04	20	21.9	5.71E+04	19.8	20.9	8.57E+03	10.1	12.7	2.97E+04	19	21.6
5.00E+02	4.99E+04	12.6	12.1	5.15E+04	12.7	12.3	5.69E+04	13.2	12.2	5.75E+04	13	12.4	4.80E+04	15	15.4	5.30E+04	14.2	14
7.00E+02	4.27E+04	9.2	8	4.23E+04	9.1	7.9	4.43E+04	9.4	7.9	4.10E+04	8.9	7.8	3.95E+04	9.4	8.8	3.81E+04	9.1	8.4
1.00E+03	3.61E+04	7.2	5.6	3.62E+04	7.1	5.5	3.93E+04	7.2	5.6	3.97E+04	7.2	5.6	3.10E+04	6.3	5.2	3.16E+04	6.5	5.4
2.00E+03	3.27E+04	6	4.1	3.24E+04	6	4.1	3.51E+04	6.2	4.1	3.30E+04	6.2	4.1	2.75E+04	4.9	3.7	2.96E+04	5.4	3.8
3.00E+03	3.35E+04	6	3.7	3.34E+04	6	3.7	3.27E+04	6	3.7	3.24E+04	6	3.7	2.68E+04	4.8	3.4	3.04E+04	5.4	3.5
5.00E+03	3.64E+04	6.1	3.4	3.52E+04	6.2	3.4	3.59E+04	6.3	3.5	3.60E+04	6.2	3.5	3.24E+04	5	3.1	3.18E+04	5.3	3.3
1.00E+04	3.75E+04	5.9	3.2	3.69E+04	5.9	3.2	4.05E+04	6.2	3.2	3.74E+04	6.2	3.2	3.44E+04	4.4	2.8	3.29E+04	5	3
2.00E+04	4.26E+04	6.1	3	4.13E+04	6.1	3	3.94E+04	6.4	3	4.18E+04	6.5	3.1	3.81E+04	4.6	2.8	4.28E+04	5.3	2.9
5.00E+04	5.25E+04	5.7	2.7	5.06E+04	5.8	2.7	4.96E+04	5.6	2.8	5.10E+04	6.1	2.8	5.13E+04	4.3	2.5	4.96E+04	4.8	2.6
1.00E+05	6.47E+04	5.2	2.5	6.08E+04	5.4	2.5	6.03E+04	5.7	2.5	5.80E+04	5.8	2.6	6.93E+04	4	2.3	6.32E+04	4.6	2.4

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.03E-01	6.9	10.2	1.08E-01	7.4	9.6	1.14E-01	7.3	9.7	1.20E-01	6.2	10.1	1.29E-01	6.6	9.7
2.00E+01	3.68E-01	5.2	9.4	3.95E-01	6.9	9.8	3.64E-01	7.2	9.6	3.84E-01	7.2	9.6	3.94E-01	7.2	9.5	3.86E-01	6.4	9.9
3.00E+01	9.89E-01	7.2	9.3	1.07E+00	7.3	9.3	1.25E+00	7.1	9	1.29E+00	7	8.9	1.28E+00	6.9	9	1.38E+00	6.9	8.8
5.00E+01	4.78E+00	6.2	10.2	4.37E+00	6.8	10.3	5.50E+00	5.8	8.7	5.64E+00	5.4	8.7	5.33E+00	5.3	8.9	6.59E+00	5	7.9
7.50E+01	1.38E+01	5.2	7.9	1.56E+01	4.9	7.9	2.58E+01	4	5.8	2.80E+01	3.8	5.6	2.63E+01	3.9	5.8	3.61E+01	3.6	5
1.00E+02	4.31E+01	3.6	5.5	4.96E+01	3.7	5.3	9.53E+01	3.2	4.2	1.04E+02	3.1	4.1	1.02E+02	3.1	4.2	1.39E+02	3.1	4
1.50E+02	3.16E+02	2.5	3.3	3.57E+02	2.6	3.3	9.13E+02	9.3	11.6	7.17E+02	5.9	7.2	6.02E+02	3.5	4.4	8.07E+02	4.9	6.6
2.00E+02	1.16E+03	2.5	2.7	1.26E+03	3.4	4	7.08E+03	16.4	20	8.09E+03	16.6	20.5	5.94E+03	14.7	18.4	1.54E+04	18.1	21.5
3.00E+02	1.23E+04	13.2	16.6	1.85E+04	17.3	19.3	2.75E+04	18.8	20.6	3.22E+04	19.2	21	3.51E+04	19.6	21.4	4.19E+04	19.8	21.3
5.00E+02	4.83E+04	14.7	15.2	5.00E+04	15.1	14.9	4.80E+04	13.9	14.1	4.87E+04	14	13.9	4.82E+04	13.8	13.8	5.43E+04	13.5	13.2
7.00E+02	3.65E+04	8.7	7.9	4.10E+04	9.3	8.2	3.87E+04	9.2	8.4	3.97E+04	9.2	8.3	3.91E+04	9.4	8.1	3.89E+04	9	8
1.00E+03	3.23E+04	6.7	5.1	3.28E+04	6.6	5.2	3.20E+04	6.6	5.3	3.24E+04	6.7	5.3	3.22E+04	6.6	5.5	3.40E+04	6.8	5.4
2.00E+03	2.76E+04	4.9	3.6	2.72E+04	5.1	3.7	2.87E+04	5.2	3.8	2.92E+04	5.4	3.8	2.89E+04	5.4	3.8	3.05E+04	5.7	3.9
3.00E+03	2.71E+04	4.8	3.4	2.94E+04	5.2	3.4	2.95E+04	5.2	3.5	3.01E+04	5.3	3.5	3.07E+04	5.4	3.5	3.26E+04	5.6	3.6
5.00E+03	3.17E+04	4.8	3.1	3.00E+04	5.2	3.2	3.32E+04	5.3	3.2	3.24E+04	5.5	3.3	3.28E+04	5.5	3.3	3.57E+04	5.9	3.4
1.00E+04	3.38E+04	4.6	2.9	3.42E+04	4.8	3	3.41E+04	4.8	3	3.44E+04	5.1	3	3.69E+04	5.3	3	3.55E+04	5.5	3.1
2.00E+04	4.05E+04	4.5	2.8	3.80E+04	4.6	2.8	4.09E+04	5	2.8	3.98E+04	5.2	2.8	4.03E+04	5.3	2.8	4.09E+04	5.9	2.9
5.00E+04	5.39E+04	4.7	2.5	4.62E+04	4.6	2.5	5.34E+04	4.5	2.5	5.08E+04	5	2.6	5.01E+04	5.1	2.6	4.93E+04	5.2	2.7
1.00E+05	6.09E+04	3.4	2.3	6.87E+04	4.2	2.3	6.72E+04	4	2.3	6.37E+04	4.5	2.4	6.87E+04	4.3	2.3	6.39E+04	4.9	2.4

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.80E-01	5.8	8.7	0.00E+00	1	1	2.79E+00	4.4	5.9	2.79E+00	4.4	5.9
2.00E+01	6.51E-01	6.4	8.2	0.00E+00	1	1	1.36E+01	4.4	5.6	1.36E+01	4.4	5.6
3.00E+01	1.87E+00	5.3	7.4	2.20E+00	5.3	7.5	6.84E+01	4.8	5.8	6.84E+01	4.8	5.8
5.00E+01	1.57E+01	3.6	6	1.47E+01	4.5	6.2	9.09E+04	12.2	12.1	9.09E+04	12.2	12.1
7.50E+01	1.38E+02	5.1	5.7	6.43E+01	5	5.5	1.11E+05	19	25.1	1.11E+05	19	25.1
1.00E+02	2.20E+03	14.3	15.8	1.17E+03	12.6	14.4	8.80E+04	23.8	28.6	8.80E+04	23.8	28.6
1.50E+02	1.53E+04	19.1	22.5	1.25E+04	17.9	22	6.65E+04	24.8	24.6	6.65E+04	24.8	24.6

Table A.15. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.38E+04	21.7	24.1	2.58E+04	21.7	24.1	6.37E+04	22.1	21.8	6.37E+04	22.1	21.8
3.00E+02	3.80E+04	17.9	18.9	3.90E+04	17.9	18.7	6.13E+04	16	17	6.13E+04	16	17
5.00E+02	5.82E+04	14.5	13.3	5.39E+04	13	13.2	5.55E+04	11.8	11	5.55E+04	11.8	11
7.00E+02	3.90E+04	8.8	8	4.48E+04	9.5	8.2	4.72E+04	9.3	7.5	4.72E+04	9.3	7.5
1.00E+03	3.80E+04	7.1	5.5	3.36E+04	6.9	5.6	3.87E+04	7.6	6	3.87E+04	7.6	6
2.00E+03	3.16E+04	5.9	4	3.24E+04	5.7	4	3.80E+04	6.8	4.4	3.80E+04	6.8	4.4
3.00E+03	3.44E+04	6	3.6	3.48E+04	5.7	3.7	3.78E+04	6.7	3.9	3.78E+04	6.7	3.9
5.00E+03	3.30E+04	6	3.3	3.42E+04	6.1	3.4	3.85E+04	6.7	3.5	3.85E+04	6.7	3.5
1.00E+04	3.52E+04	5.8	3.1	3.77E+04	5.8	3.1	3.87E+04	6.5	3.3	3.87E+04	6.5	3.3
2.00E+04	4.31E+04	6.1	3	4.24E+04	6.4	2.9	4.53E+04	6.9	3.5	4.53E+04	6.9	3.5
5.00E+04	5.32E+04	5.5	2.7	4.89E+04	5.5	2.8	4.29E+04	6.5	3	4.29E+04	6.5	3
1.00E+05	6.11E+04	4.9	2.5	5.90E+04	5.4	2.4	5.71E+04	6.6	2.9	5.71E+04	6.6	2.9

Table A.16. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{27}Al ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.60E+00	8.8	1.5	1.65E+00	8.8	1.5	4.61E+02	8.6	5.8	5.09E+02	8.7	5.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	7.55E+00	9.6	1.9	2.29E+00	9.5	1.9	8.35E+02	9.3	6.8	8.48E+02	9.3	7	1.14E-01	7.1	9.6	1.19E-01	7	9.5
2.00E+01	1.26E+01	10.5	2.3	4.24E+00	10.2	2.4	1.75E+03	10	8.3	1.54E+03	10.2	8.5	4.46E-01	7	9.5	4.25E-01	6.9	9.4
3.00E+01	2.13E+01	11.4	2.9	8.42E+00	10.4	2.9	4.09E+03	11.2	10.4	3.67E+03	11.4	10.7	1.47E+00	6.3	8.8	1.46E+00	6.5	8.7
5.00E+01	6.72E+01	12	3.5	2.80E+01	9.6	3.2	2.23E+04	12.6	13.2	1.75E+04	13	13.9	7.36E+00	4.9	7.7	7.70E+00	4.9	7.6
7.50E+01	2.55E+02	12.4	3.8	3.26E+02	11.4	3.2	6.00E+04	15.8	19.2	4.03E+04	16	19.7	4.92E+01	5.4	5.6	4.00E+01	3.6	4.9
1.00E+02	1.85E+03	14	4.1	2.01E+03	13.8	4.1	9.23E+04	18.5	23.1	5.84E+04	18.6	23.2	2.09E+02	6.8	8.2	1.37E+02	3.1	4
1.50E+02	9.74E+03	18.5	5.8	9.53E+03	18.3	5.8	9.87E+04	23.9	26.4	7.54E+04	22.8	25.6	2.26E+03	12.5	15.1	2.98E+03	13.1	16
2.00E+02	1.74E+04	20.9	6.1	1.82E+04	20.6	6	8.26E+04	24.6	24.3	7.44E+04	24	24.5	1.42E+04	17.8	21.4	1.65E+04	18	21.8
3.00E+02	3.65E+04	20	5.7	3.88E+04	20	5.7	5.87E+04	18.8	18	6.34E+04	19.6	19	4.12E+04	20.8	22	4.31E+04	20.9	22
5.00E+02	5.67E+04	15.9	4.5	5.92E+04	15.9	4.5	5.10E+04	14.5	12.6	6.43E+04	14.8	13.8	5.33E+04	15.3	15.2	5.66E+04	15.7	15.3
7.00E+02	4.70E+04	11.1	3.2	4.79E+04	11	3.1	5.23E+04	11.3	10	5.57E+04	11.2	9.5	4.63E+04	11	10	4.64E+04	11.1	9.9
1.00E+03	3.94E+04	8.3	2.4	3.99E+04	8.5	2.4	4.74E+04	9.2	6.9	4.54E+04	9	6.9	3.90E+04	8.2	6.5	3.96E+04	8.3	6.5
2.00E+03	3.46E+04	6.7	1.9	3.46E+04	6.9	1.9	4.28E+04	7.9	5	4.11E+04	7.8	5	3.45E+04	6.6	4.5	3.48E+04	6.8	4.5
3.00E+03	3.58E+04	6.7	1.8	3.59E+04	6.8	1.8	4.14E+04	7.9	4.6	4.28E+04	7.8	4.6	3.64E+04	6.6	4.1	3.50E+04	6.6	4.1
5.00E+03	3.87E+04	6.8	1.7	3.81E+04	7	1.7	4.44E+04	8	4.2	4.24E+04	7.8	4.2	3.92E+04	6.7	3.8	3.82E+04	6.7	3.8
1.00E+04	4.05E+04	6.4	1.6	4.04E+04	6.6	1.6	4.41E+04	7.9	3.9	4.47E+04	7.8	3.8	4.13E+04	6.3	3.4	4.06E+04	6.3	3.5
2.00E+04	4.59E+04	6.4	1.6	4.52E+04	6.7	1.6	5.13E+04	7.6	3.7	5.44E+04	8.2	3.6	5.01E+04	6.5	3.2	4.64E+04	6.4	3.3
5.00E+04	5.99E+04	5.9	1.5	5.80E+04	6.3	1.5	6.23E+04	7.9	3.2	6.08E+04	7.9	3.3	6.22E+04	6	2.9	5.64E+04	6.1	3
1.00E+05	7.52E+04	5.3	1.4	7.00E+04	5.6	1.4	8.38E+04	7.2	3.1	7.10E+04	7.4	3	7.73E+04	5.2	2.6	7.27E+04	5.3	2.7

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	6.16E+02	8.8	6.1	0.00E+00	1	1
1.40E+01	1.15E-01	7.5	9.8	1.23E-01	7.3	9.9	1.15E-01	6.6	9.9	1.30E-01	7.5	9.4	8.53E+02	9.6	7.4	0.00E+00	1	1
2.00E+01	4.34E-01	7.6	9.5	4.37E-01	7.3	9.5	3.52E-01	7.6	9.6	4.39E-01	7	9.8	1.30E+03	10.6	9.1	2.75E-01	5.4	10.4
3.00E+01	1.43E+00	6.8	8.8	1.50E+00	6.9	9	1.36E+00	6.8	9.1	1.55E+00	6.4	8.5	2.36E+03	11.9	11.9	1.40E+00	5.4	8.9
5.00E+01	6.85E+00	5.3	8.1	7.58E+00	5.1	7.8	5.81E+00	5.4	8.6	8.32E+00	4.7	7.5	5.64E+03	13.7	15.1	3.61E+00	6.2	9.9
7.50E+01	3.74E+01	3.5	5.1	4.36E+01	3.4	4.8	2.91E+01	3.8	5.6	4.57E+01	3.4	4.8	1.31E+04	15.8	19.3	1.33E+01	4.7	7.9
1.00E+02	1.34E+02	3.1	4	1.58E+02	2.9	3.7	1.03E+02	3.1	4.2	1.46E+02	3.1	3.9	2.32E+04	17.9	22.3	4.54E+01	3.4	5.2
1.50E+02	1.80E+03	10.7	12.9	1.59E+03	9.1	11.1	5.68E+02	3.9	4.3	2.94E+03	12.4	14.7	3.92E+04	21.3	24.6	3.24E+02	2.3	3.3
2.00E+02	1.13E+04	16.8	20.4	1.54E+04	16.6	20.2	9.50E+03	15.8	19.7	1.95E+04	18.6	22.4	4.85E+04	23	24.5	1.02E+03	2.4	2.9
3.00E+02	4.80E+04	20.6	22.4	6.16E+04	21.3	22.8	3.23E+04	20.1	21.7	4.57E+04	20.7	21.9	4.43E+04	20	19.5	7.36E+03	8	12.8
5.00E+02	6.01E+04	15.8	15.2	6.39E+04	15.6	14.9	5.53E+04	15.9	15.9	5.79E+04	15.7	15.4	5.83E+04	15.1	15	6.01E+04	17	16.7
7.00E+02	4.82E+04	10.9	9.7	4.99E+04	10.9	9.4	4.81E+04	11.2	10	4.64E+04	11	9.8	4.92E+04	11.3	9.8	5.29E+04	10.9	10.1
1.00E+03	4.08E+04	8.4	6.6	4.17E+04	8.6	6.7	3.86E+04	8.2	6.4	4.01E+04	8.4	6.6	3.72E+04	8.5	6.7	3.94E+04	8.2	6.3
2.00E+03	3.57E+04	6.9	4.6	3.71E+04	7.2	4.8	3.38E+04	6.5	4.5	3.37E+04	6.8	4.6	3.63E+04	7.3	4.7	3.38E+04	6.4	4.3
3.00E+03	3.66E+04	6.9	4.2	3.80E+04	7.1	4.3	3.54E+04	6.4	4.1	3.51E+04	6.7	4.2	3.76E+04	6.8	4.3	3.06E+04	6.2	4.1
5.00E+03	4.05E+04	7.1	3.9	4.02E+04	7.4	4	3.63E+04	6.5	3.7	3.86E+04	7	3.8	4.19E+04	7.5	3.9	3.29E+04	6.4	3.6
1.00E+04	4.17E+04	6.8	3.6	4.29E+04	7.1	3.7	3.90E+04	6	3.4	3.93E+04	6.6	3.5	4.10E+04	7.2	3.6	3.87E+04	5.8	3.4
2.00E+04	4.74E+04	6.9	3.4	4.69E+04	7.4	3.5	4.60E+04	6.3	3.2	4.39E+04	6.6	3.4	4.83E+04	7.1	3.4	4.71E+04	6.2	3.1
5.00E+04	6.01E+04	6.4	3	6.16E+04	7	3.1	6.22E+04	6.1	2.8	5.58E+04	5.8	3	5.92E+04	6.6	3	5.22E+04	5.6	2.9
1.00E+05	7.43E+04	5.9	2.8	6.70E+04	6.5	2.9	7.38E+04	4.9	2.6	7.41E+04	5.7	2.7	7.63E+04	6.2	2.8	6.48E+04	4.8	2.6

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.13E-01	7.5	9.8	1.24E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	3.81E-01	7.5	9.6	4.23E-01	7.1	9.5	3.14E-01	6.2	9.3	4.35E-01	6.2	9.7	5.69E-01	5.2	7.6	7.45E-01	4.4	7.9
3.00E+01	1.31E+00	6.9	8.8	1.40E+00	6.8	8.7	1.26E+00	6.1	9.1	1.37E+00	7	9	2.72E+00	4.1	6.4	2.55E+00	3.8	6.1
5.00E+01	6.16E+00	5.5	8.6	7.34E+00	5.1	7.9	6.13E+00	5.7	8.9	6.04E+00	5.7	9	2.02E+01	3.4	5.3	2.29E+01	3.6	5.1

Table A.16. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	2.99E+01	3.8	5.5	3.95E+01	3.4	5	2.72E+01	4.8	5.7	2.88E+01	4	5.8	1.02E+02	3.8	4.1	1.09E+02	3.1	4.3
1.00E+02	9.66E+01	3	4	1.30E+02	3.2	4.1	8.84E+01	5.6	5.6	9.90E+01	2.9	4.2	1.07E+03	10	11.1	1.90E+03	10.6	11.1
1.50E+02	1.62E+03	11.2	13.4	2.45E+03	12.3	14.8	1.54E+03	12.3	16.5	1.36E+03	10.4	13.6	2.74E+04	17.7	21.6	3.25E+04	17.9	22.3
2.00E+02	8.98E+03	17.1	20.7	1.53E+04	17.9	21.5	7.15E+03	15.8	20.2	6.79E+03	14.8	19.6	4.66E+04	22	24.8	4.54E+04	23	25.3
3.00E+02	3.10E+04	20.1	21.6	4.10E+04	20.6	21.9	2.18E+04	18.7	19.9	2.84E+04	18.4	20.7	4.44E+04	19.9	20.3	4.58E+04	20.1	19.8
5.00E+02	5.42E+04	16	15.9	5.92E+04	15.8	15.6	5.46E+04	16.5	16.7	6.41E+04	16	16.1	5.65E+04	14.3	14.6	5.65E+04	14.7	14.5
7.00E+02	4.61E+04	11.2	10.1	4.82E+04	11	9.8	4.75E+04	11.1	10	4.91E+04	11	9.6	4.82E+04	11	9.7	4.93E+04	11	9.4
1.00E+03	3.83E+04	8.1	6.5	3.97E+04	8.3	6.6	3.59E+04	7.9	6.5	3.96E+04	8.5	6.5	4.18E+04	8.6	6.7	4.30E+04	8.8	6.6
2.00E+03	3.38E+04	6.5	4.5	3.51E+04	6.8	4.6	3.19E+04	6.4	4.5	3.72E+04	6.9	4.6	3.52E+04	7.1	4.8	3.49E+04	7.5	4.9
3.00E+03	3.46E+04	6.4	4	3.55E+04	6.8	4.2	3.59E+04	6.6	4.1	3.73E+04	6.7	4.2	3.66E+04	7.2	4.3	3.85E+04	7.4	4.4
5.00E+03	3.79E+04	6.6	3.8	3.63E+04	6.9	3.9	3.79E+04	7	3.8	3.69E+04	6.7	3.9	3.49E+04	7.5	4	4.30E+04	7.4	4.1
1.00E+04	3.91E+04	6.1	3.4	3.94E+04	6.5	3.5	3.99E+04	6.2	3.4	3.95E+04	6.5	3.5	3.98E+04	6.6	3.7	4.35E+04	7.3	3.7
2.00E+04	4.73E+04	6.3	3.2	4.50E+04	6.7	3.3	4.29E+04	6	3.3	4.55E+04	7.2	3.3	4.64E+04	6.7	3.5	4.83E+04	7.7	3.5
5.00E+04	5.93E+04	5.7	2.9	5.76E+04	6	3	5.63E+04	5.8	2.9	5.77E+04	6.6	3	5.92E+04	6.9	3	5.83E+04	7.2	3.3
1.00E+05	7.63E+04	5.2	2.6	6.80E+04	5.5	2.7	6.81E+04	5.4	2.6	6.46E+04	5.7	2.7	7.12E+04	5.6	2.7	6.86E+04	6.1	2.9

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.71E+01	8.8	6.1	3.60E+00	8.8	6.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.48E-01	4.2	8.8	2.39E+01	9.6	7.4	4.93E+00	9.5	7.4	1.41E-01	7.2	10	1.50E-01	7.2	9.6
2.00E+01	4.04E-01	6.4	9.3	5.92E-01	4.9	7.6	3.88E+01	10.5	9.1	8.66E+00	10.3	9	5.09E-01	7.3	9.3	5.70E-01	6.8	9.2
3.00E+01	1.39E+00	6.6	8.8	2.50E+00	5	6.8	6.98E+01	11.6	11.5	1.75E+01	10.6	10.9	1.82E+00	6.2	8	2.00E+00	5.7	7.9
5.00E+01	5.91E+00	5.9	9.3	1.64E+01	4.3	5.8	1.82E+02	12.6	14.2	5.53E+01	9.9	12	1.13E+01	4.2	6.5	1.37E+01	4	6
7.50E+01	2.35E+01	3.9	6	8.63E+01	3.8	4.6	8.30E+02	13	15	6.79E+02	11.5	12.4	6.93E+01	3.1	4.3	8.83E+01	3.2	4.1
1.00E+02	8.59E+01	3.2	4.3	3.00E+03	12.6	13.7	4.77E+03	14.3	16.6	4.97E+03	14	16.3	2.42E+02	3.3	4.2	3.04E+02	4.1	4.7
1.50E+02	4.19E+02	2.7	3.7	1.99E+04	19.2	23.8	2.27E+04	18.8	23	2.07E+04	18.8	22.8	6.86E+03	14.5	17.4	1.18E+04	15.6	19.1
2.00E+02	5.14E+03	13.1	16.9	2.54E+04	22.6	24.4	3.95E+04	21.5	23.9	3.83E+04	21.3	23.8	2.93E+04	19.1	22.7	3.66E+04	19.9	23.3
3.00E+02	2.51E+04	19.7	21.1	3.28E+04	19.6	20.5	6.14E+04	20.9	21.6	6.17E+04	20.9	21.6	7.16E+04	21.2	22.4	7.73E+04	21.3	22.3
5.00E+02	5.25E+04	16.2	16.5	5.61E+04	16	16	6.13E+04	15	14.3	6.10E+04	15.1	14.3	6.69E+04	15.1	14.1	6.66E+04	14.7	13.7
7.00E+02	4.43E+04	11.1	10.3	4.69E+04	11.6	10.2	5.00E+04	11	9.5	5.01E+04	11	9.4	5.10E+04	10.8	9.1	5.31E+04	10.8	9.1
1.00E+03	3.65E+04	7.7	6.3	3.97E+04	8.3	6.5	4.28E+04	8.7	6.8	4.27E+04	8.8	6.8	4.43E+04	8.8	6.8	4.45E+04	9	6.9
2.00E+03	3.21E+04	6.2	4.3	3.33E+04	6.7	4.6	3.78E+04	7.4	4.9	3.78E+04	7.4	4.9	3.92E+04	7.5	4.9	4.00E+04	7.8	5
3.00E+03	3.26E+04	6.3	3.9	3.69E+04	6.7	4.1	3.89E+04	7.4	4.4	3.90E+04	7.4	4.4	4.12E+04	7.6	4.5	4.10E+04	7.6	4.5
5.00E+03	3.75E+04	6.4	3.7	3.56E+04	6.6	3.8	4.12E+04	7.5	4.1	4.12E+04	7.6	4.1	4.39E+04	7.8	4.1	4.10E+04	7.9	4.2
1.00E+04	3.91E+04	6	3.3	4.23E+04	6.6	3.4	4.31E+04	7.3	3.7	4.27E+04	7.3	3.7	4.35E+04	7.5	3.8	4.40E+04	7.8	3.9
2.00E+04	4.82E+04	5.9	3.1	4.78E+04	6.7	3.3	4.76E+04	7.4	3.5	4.74E+04	7.5	3.5	4.88E+04	7.8	3.6	4.95E+04	8.1	3.7
5.00E+04	5.91E+04	5.6	2.8	5.60E+04	5.8	2.9	5.97E+04	7.1	3.2	5.76E+04	7.2	3.2	5.51E+04	7.7	3.3	5.60E+04	8	3.3
1.00E+05	7.41E+04	4.7	2.5	7.63E+04	5.4	2.6	7.04E+04	6.6	2.9	6.98E+04	6.7	2.9	6.68E+04	7.2	3	6.78E+04	7.6	3.1

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.29E+03	6.7	2.8	5.22E+03	6.7	2.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.59E+03	6.8	3.3	1.04E+04	6.8	3.3	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.29E+04	7.1	3.7	1.56E+04	7.1	3.7	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.14E+04	7.6	4.4	2.60E+04	7.6	4.4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.45E+00	8.5	5.7	0.00E+00	1	1	4.25E+04	8.8	6.2	5.15E+04	8.8	6.2	4.93E+01	8.8	6.1	5.48E+00	8.7	6.1
1.40E+01	8.85E+00	8.9	6.3	2.02E-01	4.9	7.2	5.90E+04	9.7	7.5	7.11E+04	9.7	7.5	7.48E+01	9.6	7.4	9.07E+00	9.7	7.4
2.00E+01	3.11E+01	9.7	7.7	8.96E-01	4.8	7	8.29E+04	10.8	9.4	9.93E+04	10.8	9.5	1.19E+02	10.6	9.2	1.52E+01	10.5	9.1
3.00E+01	8.13E+01	10.1	9.4	4.57E+00	3.9	5.4	1.19E+05	12.4	12.6	1.41E+05	12.5	12.7	1.86E+02	11.9	11.8	2.75E+01	11.5	11.2
5.00E+01	1.58E+03	11.3	10.7	5.47E+01	5.7	6.5	1.40E+05	16.2	20.2	1.45E+05	16.6	21	5.63E+02	13.3	14.5	8.76E+01	12.8	14.4
7.50E+01	1.14E+04	14	16	2.83E+03	11.8	12.6	1.13E+05	20.4	26.8	1.13E+05	20.8	27.4	1.60E+03	15.1	17.8	3.96E+02	12.9	14.8
1.00E+02	2.98E+04	16.6	20.4	1.34E+04	15.2	18.3	9.40E+04	23.6	28.5	9.34E+04	23.9	28.6	3.70E+03	16.5	20.1	1.91E+03	14.5	17.5
1.50E+02	5.95E+04	21.4	25.1	4.14E+04	19.8	23.9	7.49E+04	27.1	25.9	7.55E+04	27.1	25.8	8.56E+03	19.7	23.3	6.77E+03	18.3	22.1
2.00E+02	6.15E+04	23.6	24.6	5.72E+04	22.9	24.7	6.85E+04	23.2	22.6	6.88E+04	23.1	22.5	1.51E+04	20.5	22.6	1.44E+04	19.6	22.3
3.00E+02	5.89E+04	20.1	19.8	6.44E+04	20.5	20.6	6.62E+04	18.8	18.4	6.68E+04	18.8	18.3	3.61E+04	19.9	21.3	3.98E+04	20.2	21.6
5.00E+02	6.74E+04	15.6	14.7	6.52E+04	15.8	14.7	6.12E+04	14.2	13	6.35E+04	14.3	13.1	5.75E+04	16	15.7	6.07E+04	15.9	15.6
7.00E+02	5.13E+04	10.9	9.3	5.37E+04	11.2	9.2	5.39E+04	11.3	9.5	5.49E+04	11.2	9.4	4.75E+04	11.2	9.9	4.77E+04	11.1	9.7
1.00E+03	4.37E+04	8.9	7	4.40E+04	8.7	6.8	4.72E+04	9.3	7	4.74E+04	9.3	7	3.93E+04	8.3	6.5	3.97E+04	8.4	6.6
2.00E+03	3.84E+04	7.6	5	3.75E+04	7.6	5	4.26E+04	8.1	5.2	4.29E+04	8.2	5.2	3.48E+04	6.7	4.6	3.51E+04	6.8	4.6
3.00E+03	4.24E+04	7.8	4.5	4.02E+04	7.6	4.5	4.35E+04	8.1	4.7	4.37E+04	8.2	4.7	3.61E+04	6.7	4.1	3.61E+04	6.8	4.2

(continued on next page)

Table A.16. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	4.27E+04	7.9	4.2	4.39E+04	7.8	4.1	4.57E+04	8.3	4.3	4.54E+04	8.3	4.3	3.81E+04	6.8	3.9	3.80E+04	7	3.9
1.00E+04	4.69E+04	7.7	3.9	4.13E+04	7.6	3.8	4.72E+04	8.2	4	4.77E+04	8.3	4	4.05E+04	6.4	3.5	4.07E+04	6.6	3.5
2.00E+04	5.05E+04	8	3.6	4.54E+04	7.7	3.6	5.20E+04	8.4	3.7	5.19E+04	8.6	3.8	4.59E+04	6.4	3.3	4.47E+04	6.8	3.3
5.00E+04	6.12E+04	7.6	3.2	5.53E+04	7.7	3.3	6.18E+04	8.3	3.4	6.07E+04	8.5	3.5	5.77E+04	6.1	2.9	5.67E+04	6.2	3
1.00E+05	7.02E+04	7.5	3	6.77E+04	6.8	3	7.25E+04	7.9	3.1	7.10E+04	8.2	3.2	7.32E+04	5.3	2.7	6.94E+04	5.6	2.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	5.74E+02	8.8	6.1	6.81E+01	8.8	6.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	8.70E+02	9.6	7.4	1.12E+02	9.7	7.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.90E-01	4.7	9	3.73E-01	4.8	9.6	1.38E+03	10.7	9.2	1.81E+02	10.6	9.1	4.39E-01	7.7	8.9	3.63E-01	5.6	9.7
3.00E+01	1.11E+00	5.4	9.1	1.29E+00	5.4	9.2	2.07E+03	12	12	3.11E+02	11.9	11.6	1.19E+00	6.1	9.3	1.15E+00	5.6	9
5.00E+01	5.35E+00	6.3	10.4	4.85E+00	6.9	9.9	5.48E+03	13.7	15.3	8.53E+02	13.9	15.8	4.76E+00	5	9.2	4.84E+00	5.8	10.4
7.50E+01	1.85E+01	4	6.6	1.64E+01	4.6	7.4	1.27E+04	15.8	18.8	2.64E+03	14.1	16.1	1.96E+01	4.3	7	1.63E+01	4.3	7.1
1.00E+02	6.78E+01	3.3	4.7	6.36E+01	3.3	4.9	2.49E+04	17.4	21.4	1.15E+04	15.7	19.2	6.91E+01	3.2	4.4	5.99E+01	3.5	4.9
1.50E+02	4.29E+02	2.3	3.1	3.80E+02	2.5	3.3	3.91E+04	21.7	25	2.39E+04	20.5	24.4	3.78E+02	2.9	3.5	3.89E+02	2.5	3.2
2.00E+02	1.84E+03	6.9	6.5	1.35E+03	3.1	3.8	4.71E+04	23	24	2.84E+04	22.4	23.6	4.17E+03	14.1	17.2	1.25E+03	2.6	3
3.00E+02	3.05E+04	20.3	22.2	1.89E+04	17.6	20.2	6.88E+04	20	20.9	6.79E+04	20.5	22.1	1.94E+04	18.5	20	2.10E+04	17.4	20.6
5.00E+02	5.05E+04	16.7	16.4	5.78E+04	16	16.9	6.44E+04	14.6	13.6	6.76E+04	15.5	14	5.33E+04	16.2	16.6	6.41E+04	16.9	16.8
7.00E+02	4.69E+04	11.6	10.4	4.75E+04	11.5	9.7	5.31E+04	10.9	9.2	5.14E+04	11	9.3	4.70E+04	11.1	10.6	4.53E+04	11.2	9.8
1.00E+03	3.47E+04	8.2	6.3	3.70E+04	8.1	6.4	4.62E+04	9.1	6.9	4.31E+04	8.9	6.8	3.70E+04	7.9	6.5	4.06E+04	8.4	6.3
2.00E+03	3.43E+04	6.3	4.4	3.26E+04	6	4.5	3.76E+04	7.6	5	3.83E+04	7.6	4.9	3.28E+04	6.2	4.3	3.25E+04	6.4	4.5
3.00E+03	3.45E+04	6.3	3.9	3.33E+04	6.3	4.1	4.01E+04	7.6	4.5	3.86E+04	7.4	4.4	3.47E+04	6.2	3.9	3.29E+04	6.3	4
5.00E+03	3.47E+04	6.4	3.8	3.63E+04	6.5	3.8	4.21E+04	8	4.2	4.19E+04	7.7	4.2	3.59E+04	6.2	3.7	3.62E+04	6.8	3.7
1.00E+04	3.57E+04	5.7	3.4	3.96E+04	5.4	3.4	4.60E+04	7.9	3.8	4.69E+04	7.9	3.8	3.91E+04	5.9	3.3	3.99E+04	6	3.5
2.00E+04	4.45E+04	5.9	3	4.06E+04	5.6	3.1	4.89E+04	7.9	3.7	4.96E+04	8	3.6	4.20E+04	5.4	3.1	4.17E+04	6.6	3.2
5.00E+04	5.69E+04	5.6	2.7	5.85E+04	5.5	2.8	5.52E+04	7.4	3.2	5.40E+04	7.4	3.2	5.26E+04	5	2.8	5.56E+04	5.2	2.8
1.00E+05	7.78E+04	4.7	2.5	7.11E+04	5.1	2.5	6.71E+04	7.2	3	6.87E+04	7.1	3	7.46E+04	4.8	2.5	6.66E+04	4.9	2.5

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	2.85E+01	8.7	6	0.00E+00	1	1
1.40E+01	1.10E-01	6.9	9.8	0.00E+00	1	1	1.05E-01	6.8	9.8	1.04E-01	7	10.1	4.56E+01	9.4	7	1.49E-01	6.1	8.8
2.00E+01	3.82E-01	7.5	9.6	4.35E-01	7.1	9.6	3.57E-01	7.9	9.3	4.30E-01	7.9	9.8	7.93E+01	9.9	8.4	5.93E-01	4.9	8.2
3.00E+01	1.31E+00	7.2	9.1	1.39E+00	7.1	8.9	1.22E+00	7	9.1	1.24E+00	7.2	9.3	1.78E+02	11.4	10.8	3.18E+00	6.6	6.9
5.00E+01	5.64E+00	5.9	9	6.26E+00	5.6	8.3	4.92E+00	6.1	9.5	5.03E+00	5.9	9.5	1.27E+03	12.2	12.2	2.62E+01	7.9	7.7
7.50E+01	2.62E+01	4	5.8	3.27E+01	3.7	5.4	2.03E+01	4.2	6.2	2.22E+01	4	6.1	5.02E+03	14.8	17.4	3.96E+02	11.4	12.4
1.00E+02	8.80E+01	3.1	4.2	1.12E+02	3	3.9	7.54E+01	3.1	4.4	8.08E+01	3.2	4.4	9.94E+03	17.2	21.4	3.70E+03	13.6	15.7
1.50E+02	5.92E+02	4.4	5.6	1.03E+03	7.5	9.2	4.38E+02	2.6	3.3	4.83E+02	2.5	3.1	1.77E+04	21.2	24.7	1.51E+04	19.4	23.7
2.00E+02	6.80E+03	15.2	18.8	9.11E+03	15.9	19.7	1.60E+03	5.5	7.4	2.20E+03	8	9.5	2.20E+04	22.3	23.5	2.12E+04	22	23.7
3.00E+02	2.91E+04	19.8	21.4	3.97E+04	20.3	22	3.09E+04	19.7	22	3.28E+04	19.3	22	3.63E+04	19.7	20.6	4.07E+04	20.1	21.1
5.00E+02	5.79E+04	16.4	16.3	6.25E+04	16.1	15.6	5.40E+04	16.3	15.9	5.44E+04	16	15.7	5.57E+04	15.8	15.5	5.95E+04	15.7	15.3
7.00E+02	4.69E+04	11	9.7	4.78E+04	10.9	9.4	4.67E+04	11.4	10.3	4.52E+04	10.8	10	4.80E+04	11.1	9.9	4.82E+04	11	9.8
1.00E+03	3.85E+04	8.2	6.5	3.96E+04	8.3	6.6	3.75E+04	8	6.5	3.87E+04	8.3	6.5	3.94E+04	8.3	6.6	4.11E+04	8.5	6.6
2.00E+03	3.36E+04	6.6	4.5	3.60E+04	7	4.6	3.29E+04	6.3	4.4	3.38E+04	6.6	4.5	3.54E+04	6.8	4.6	3.54E+04	6.9	4.6
3.00E+03	3.53E+04	6.5	4.1	3.70E+04	6.8	4.2	3.47E+04	6.2	4	3.50E+04	6.5	4.1	3.61E+04	6.7	4.2	3.73E+04	6.9	4.2
5.00E+03	3.94E+04	6.8	3.8	4.03E+04	7.1	3.9	3.67E+04	6.4	3.7	3.67E+04	6.6	3.7	3.87E+04	6.8	3.8	3.90E+04	7.1	3.9
1.00E+04	3.95E+04	6.3	3.4	4.06E+04	6.7	3.5	4.06E+04	5.9	3.3	3.86E+04	6	3.4	4.19E+04	6.6	3.5	4.11E+04	6.6	3.6
2.00E+04	4.47E+04	6.1	3.2	4.83E+04	7.1	3.3	4.47E+04	6	3.2	4.44E+04	6.4	3.2	4.91E+04	6.7	3.3	4.45E+04	6.8	3.3
5.00E+04	5.96E+04	5.8	2.9	5.99E+04	6.4	3	5.98E+04	5.7	2.8	5.78E+04	5.7	2.9	5.95E+04	6	2.9	5.87E+04	6.5	3
1.00E+05	7.31E+04	5	2.6	6.83E+04	5.9	2.7	7.29E+04	4.7	2.5	6.91E+04	5	2.6	7.57E+04	5.5	2.7	6.92E+04	5.7	2.7

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1

Table A.16. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	3.81E+01	8.8	6.1	2.78E+00	8.8	6.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	5.66E+01	9.6	7.4	4.30E+00	9.5	7.4	1.12E-01	5.6	9.1	1.37E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	8.72E+01	10.6	9.1	7.37E+00	10.2	9	4.36E-01	6.6	9	4.47E+00	8.6	5.5	3.25E-01	6.8	9.7	3.79E-01	7.1	10.1
3.00E+01	1.51E+02	11.8	11.6	1.50E+01	10.6	10.8	2.09E+00	5.9	8.2	1.60E+01	9.2	8.4	1.17E+00	7.1	9.5	1.17E+00	7.1	9.2
5.00E+01	4.94E+02	12.6	13.6	6.21E+01	10.4	11.4	1.24E+01	3.7	6.2	1.40E+02	11.5	12.2	4.31E+00	6.7	10.6	5.05E+00	6.1	9.8
7.50E+01	2.60E+03	13.7	15.6	7.13E+02	12.3	13.5	1.86E+02	9.1	8.8	1.15E+03	13.3	15	1.27E+01	5.4	8.3	1.91E+01	4.2	6.5
1.00E+02	8.84E+03	15.6	18.8	3.26E+03	14.5	17.4	2.07E+03	13.5	15.4	4.90E+03	14.7	18	3.76E+01	3.8	5.6	6.89E+01	3.3	4.6
1.50E+02	2.75E+04	19.5	23.4	1.78E+04	18.1	21.9	8.44E+03	18.6	22.6	1.53E+04	19.4	23.3	2.79E+02	2.6	3.4	4.71E+02	2.6	3.1
2.00E+02	4.40E+04	22	24.2	3.74E+04	21.1	23.8	1.99E+04	19.1	21.7	3.19E+04	20.1	23	9.37E+02	2.2	2.8	1.37E+03	3.3	4.5
3.00E+02	5.89E+04	20.8	21.2	5.95E+04	20.9	21.6	7.19E+04	21	22.7	7.10E+04	21.7	22.3	6.69E+03	9.2	11.1	2.73E+04	18.7	21.5
5.00E+02	5.88E+04	14.9	14.1	6.01E+04	15	14.3	6.81E+04	15.4	14.4	6.27E+04	15	14.7	5.79E+04	17.9	17.6	5.68E+04	15.9	16.5
7.00E+02	4.97E+04	11.1	9.6	4.98E+04	11	9.5	4.89E+04	11	9.4	5.16E+04	11.2	9.5	4.46E+04	11.2	10.4	4.62E+04	11	10
1.00E+03	4.24E+04	8.7	6.7	4.18E+04	8.7	6.7	4.30E+04	8.8	6.7	4.39E+04	8.8	6.7	3.42E+04	7.4	6.2	3.93E+04	8.2	6.4
2.00E+03	3.76E+04	7.3	4.8	3.73E+04	7.3	4.8	4.07E+04	7.5	4.9	3.75E+04	7.5	4.9	3.26E+04	6	4.2	3.22E+04	6.4	4.4
3.00E+03	3.87E+04	7.3	4.4	3.84E+04	7.3	4.4	4.15E+04	7.4	4.4	3.98E+04	7.4	4.5	3.37E+04	5.9	3.9	3.28E+04	6.4	4
5.00E+03	4.16E+04	7.4	4	4.05E+04	7.4	4	4.01E+04	7.6	4.1	4.16E+04	7.6	4.1	3.77E+04	6.2	3.6	3.34E+04	6.6	3.7
1.00E+04	4.30E+04	7.2	3.7	4.26E+04	7.2	3.7	4.29E+04	7.3	3.7	4.04E+04	7.4	3.8	3.85E+04	5.6	3.3	4.02E+04	6.1	3.4
2.00E+04	4.87E+04	7.4	3.5	4.70E+04	7.3	3.5	4.59E+04	8	3.6	4.71E+04	7.9	3.6	4.46E+04	5.3	3	4.64E+04	6.4	3.2
5.00E+04	6.04E+04	6.9	3.1	5.82E+04	7.1	3.1	5.35E+04	7.3	3.2	5.66E+04	8.1	3.1	5.69E+04	5.1	2.7	5.60E+04	5.7	2.9
1.00E+05	7.27E+04	6.4	2.8	7.04E+04	6.5	2.9	6.90E+04	6.4	2.9	6.36E+04	6.6	3.1	7.50E+04	4.1	2.5	7.10E+04	4.8	2.6

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.02E-01	6.9	10.2	1.09E-01	7.4	9.6	1.14E-01	7.3	9.7	1.24E-01	6.2	10.1	1.30E-01	6.6	9.7
2.00E+01	3.70E-01	5.2	9.4	4.12E-01	6.9	9.8	3.77E-01	7.2	9.6	3.92E-01	7.2	9.6	3.92E-01	7.2	9.5	3.98E-01	6.4	9.9
3.00E+01	1.02E+00	7.2	9.3	1.11E+00	7.3	9.3	1.29E+00	7.1	9	1.33E+00	7	8.9	1.31E+00	6.9	9	1.41E+00	6.9	8.8
5.00E+01	4.84E+00	6.2	10.2	4.50E+00	6.8	10.3	5.66E+00	5.8	8.7	5.83E+00	5.4	8.7	5.50E+00	5.3	8.9	6.84E+00	5	7.9
7.50E+01	1.42E+01	5.2	7.9	1.61E+01	4.9	7.9	2.62E+01	3.9	5.8	2.84E+01	3.8	5.6	2.66E+01	3.8	5.7	3.64E+01	3.6	5
1.00E+02	4.39E+01	3.6	5.5	5.05E+01	3.6	5.3	8.98E+01	3.1	4.2	1.03E+02	3	4.1	1.02E+02	3	4.2	1.38E+02	3	3.9
1.50E+02	3.07E+02	2.5	3.3	3.47E+02	2.6	3.2	8.81E+02	8.5	10	6.13E+02	4.6	5.6	5.07E+02	3.2	4	7.52E+02	4	5.1
2.00E+02	1.03E+03	2.4	2.7	1.22E+03	3.2	3.7	6.41E+03	15.7	19.1	7.21E+03	15.5	19.1	5.17E+03	14	16.7	1.31E+04	16.2	20.1
3.00E+02	8.97E+03	13	14.6	1.74E+04	16.8	19	2.84E+04	19.9	21.5	3.32E+04	20.1	21.8	3.62E+04	20.4	22.5	4.65E+04	21.3	22.3
5.00E+02	5.29E+04	15.6	16.8	5.47E+04	16.9	17	5.33E+04	16	15.9	5.75E+04	16.1	15.9	5.59E+04	15.9	15.7	5.86E+04	15.5	15.3
7.00E+02	4.01E+04	10.4	10.2	4.73E+04	11.3	10.1	4.54E+04	11.3	10.1	4.65E+04	11.1	10	4.81E+04	11.2	9.8	4.54E+04	11	9.7
1.00E+03	3.70E+04	8.2	6.5	3.82E+04	8.1	6.3	3.77E+04	8.1	6.4	3.74E+04	8.2	6.5	3.93E+04	8.2	6.5	4.05E+04	8.3	6.5
2.00E+03	3.15E+04	6.4	4.3	3.24E+04	6.3	4.3	3.29E+04	6.4	4.4	3.38E+04	6.6	4.5	3.50E+04	6.7	4.5	3.66E+04	6.9	4.6
3.00E+03	3.30E+04	6.5	3.9	3.34E+04	6.1	4	3.38E+04	6.2	4	3.53E+04	6.5	4.1	3.75E+04	6.6	4.1	3.61E+04	6.8	4.2
5.00E+03	3.48E+04	6.1	3.7	3.26E+04	6.1	3.6	3.66E+04	6.3	3.7	3.63E+04	6.6	3.8	3.52E+04	6.5	3.8	4.07E+04	7.1	3.8
1.00E+04	4.12E+04	5.8	3.3	3.83E+04	5.7	3.3	3.88E+04	5.9	3.4	3.93E+04	6.1	3.4	4.15E+04	6.2	3.4	4.16E+04	6.8	3.6
2.00E+04	4.55E+04	5.7	3.2	4.25E+04	5.9	3.1	4.69E+04	6	3.2	4.43E+04	6.2	3.3	4.66E+04	6.2	3.3	4.16E+04	6.8	3.2
5.00E+04	5.95E+04	5	2.9	5.33E+04	5.2	2.8	6.13E+04	5.5	2.8	5.65E+04	5.7	2.9	6.02E+04	6.1	2.8	5.57E+04	6.4	3
1.00E+05	7.39E+04	4.2	2.5	7.19E+04	4.5	2.5	7.88E+04	4.8	2.5	7.31E+04	5.1	2.6	7.23E+04	5	2.6	7.10E+04	5.5	2.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.90E-01	5.8	8.7	0.00E+00	1	1	2.82E+00	4.3	5.8	2.82E+00	4.3	5.8
2.00E+01	6.71E-01	6.4	8.2	0.00E+00	1	1	1.37E+01	4.4	5.6	1.37E+01	4.4	5.6
3.00E+01	2.01E+00	5.2	7.3	2.27E+00	5.3	7.5	6.73E+01	4.7	5.7	6.73E+01	4.7	5.7
5.00E+01	1.62E+01	3.6	5.9	1.49E+01	4.4	6.1	9.46E+04	11	9.9	9.46E+04	11	9.9
7.50E+01	8.69E+01	3.9	4.2	6.33E+01	3	4.7	1.30E+05	17.4	22.5	1.30E+05	17.4	22.5
1.00E+02	1.72E+03	12.5	13.6	8.07E+02	10.5	13.4	1.03E+05	21.9	27.9	1.03E+05	21.9	27.9
1.50E+02	1.47E+04	17.6	21.3	1.13E+04	16.7	20.6	7.71E+04	24.5	26.8	7.71E+04	24.5	26.8

(continued on next page)

Table A.16. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.50E+04	20.7	23.9	3.21E+04	20.2	23.9	7.39E+04	23.1	23.6	7.39E+04	23.1	23.6
3.00E+02	4.27E+04	20.5	20.8	4.17E+04	20.2	20.5	7.09E+04	18.3	19	7.09E+04	18.3	19
5.00E+02	6.47E+04	16.1	15.5	7.30E+04	16	15.3	6.46E+04	14	14.3	6.46E+04	14	14.3
7.00E+02	5.25E+04	11.8	9.6	4.73E+04	11	9.6	5.56E+04	11.2	8.8	5.56E+04	11.2	8.8
1.00E+03	4.41E+04	8.5	6.6	3.56E+04	8.3	6.8	4.57E+04	9.2	7.2	4.57E+04	9.2	7.2
2.00E+03	3.49E+04	7.1	4.7	3.81E+04	7.2	4.7	4.43E+04	8.3	5.2	4.43E+04	8.3	5.2
3.00E+03	3.64E+04	7	4.3	3.95E+04	7.2	4.3	4.38E+04	8.2	4.8	4.38E+04	8.2	4.8
5.00E+03	4.12E+04	7.1	4	3.85E+04	7.1	4	4.41E+04	8.2	4.3	4.41E+04	8.2	4.3
1.00E+04	3.79E+04	6.7	3.6	3.98E+04	7	3.6	4.45E+04	7.9	4	4.45E+04	7.9	4
2.00E+04	4.51E+04	6.9	3.4	4.32E+04	7.2	3.4	5.27E+04	8.4	4	5.27E+04	8.4	4
5.00E+04	5.42E+04	7.6	3	5.58E+04	6.3	3.1	5.04E+04	8	3.6	5.04E+04	8	3.6
1.00E+05	6.93E+04	6.1	2.8	6.82E+04	6.2	2.8	6.55E+04	8	3.4	6.55E+04	8	3.4

Table A.17. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{28}Si ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.94E+00	8.3	1.4	1.76E+00	8.3	1.4	4.88E+02	8.1	5.1	5.39E+02	8.2	5.2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.06E+00	9	1.6	2.42E+00	8.9	1.7	8.80E+02	8.6	6	8.57E+02	8.8	6.2	1.15E-01	7.1	9.6	1.18E-01	7	9.5
2.00E+01	1.34E+01	9.9	2	4.46E+00	9.6	2.1	1.82E+03	9.4	7.3	1.63E+03	9.6	7.4	4.52E-01	7	9.5	4.37E-01	6.9	9.4
3.00E+01	2.30E+01	10.8	2.6	8.92E+00	9.9	2.5	4.25E+03	10.5	9.2	3.80E+03	10.7	9.4	1.52E+00	6.3	8.8	1.49E+00	6.5	8.7
5.00E+01	6.91E+01	11.4	3.2	2.89E+01	9.3	3	2.20E+04	11.7	11.2	1.77E+04	12	11.9	7.57E+00	4.8	7.6	7.95E+00	4.9	7.5
7.50E+01	2.53E+02	11.7	3.4	2.46E+02	10.2	2.8	6.49E+04	14.6	16.9	4.09E+04	14.8	17.4	4.86E+01	3.6	4.7	3.84E+01	3.5	4.9
1.00E+02	1.53E+03	12.6	3.6	1.83E+03	12.7	3.6	9.43E+04	16.9	21.1	5.96E+04	17.2	21.3	2.02E+02	6.7	7.3	1.37E+02	2.9	3.9
1.50E+02	1.01E+04	16.9	5.3	9.79E+03	16.9	5.3	1.09E+05	21.8	25.8	8.19E+04	21.1	24.9	1.51E+03	10.9	13	2.07E+03	11.3	12.7
2.00E+02	1.81E+04	19.9	6	1.88E+04	19.6	5.9	9.50E+04	25.4	25.5	8.36E+04	24.1	25.2	1.33E+04	16	19.5	1.51E+04	16.4	19.8
3.00E+02	3.79E+04	20.5	5.8	4.03E+04	20.6	5.8	7.56E+04	22.2	20.5	7.09E+04	22.3	21.1	4.27E+04	21.2	22.6	4.38E+04	21.3	22.7
5.00E+02	6.29E+04	18	4.9	6.68E+04	18.3	4.9	6.08E+04	15.6	14.1	6.72E+04	16.3	15.3	5.68E+04	17.5	16.9	5.92E+04	17.5	16.9
7.00E+02	5.39E+04	13.5	3.6	5.51E+04	13.4	3.6	6.35E+04	14	11.8	6.22E+04	13.6	11.7	5.28E+04	13.5	11.9	5.54E+04	13.5	11.9
1.00E+03	4.42E+04	10	2.7	4.46E+04	10.1	2.7	5.17E+04	11	8.3	5.11E+04	10.8	8.3	4.34E+04	9.9	7.8	4.39E+04	10	7.9
2.00E+03	3.83E+04	8	2.1	3.97E+04	8.3	2.1	4.79E+04	9.5	6	4.80E+04	9.4	6	3.82E+04	8	5.3	3.88E+04	8	5.4
3.00E+03	3.94E+04	8	1.9	3.98E+04	8.2	2	4.61E+04	9.4	5.5	4.61E+04	9.3	5.4	3.87E+04	7.8	4.8	3.92E+04	8	4.8
5.00E+03	4.37E+04	8.2	1.8	4.39E+04	8.4	1.9	5.17E+04	9.7	5	5.05E+04	9.6	5	4.40E+04	8.1	4.4	4.09E+04	8	4.5
1.00E+04	4.48E+04	7.5	1.7	4.44E+04	7.9	1.8	5.42E+04	9.5	4.5	5.04E+04	9.4	4.6	4.54E+04	7.5	3.9	4.46E+04	7.6	4
2.00E+04	5.05E+04	7.6	1.7	5.23E+04	8.1	1.7	5.98E+04	9.6	4.3	5.88E+04	9.9	4.3	5.43E+04	7.6	3.7	5.23E+04	7.7	3.8
5.00E+04	6.46E+04	7	1.6	6.21E+04	7.6	1.6	6.70E+04	10	3.9	6.73E+04	9.6	3.8	6.29E+04	6.7	3.3	6.21E+04	7.2	3.3
1.00E+05	8.42E+04	6.2	1.5	7.68E+04	6.8	1.5	9.08E+04	9.2	3.4	7.43E+04	8.7	3.5	8.43E+04	6	3	8.03E+04	6.5	3

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	6.66E+02	8.3	5.4	0.00E+00	1	1
1.40E+01	1.17E-01	7.5	9.8	1.24E-01	7.3	9.9	1.17E-01	6.6	9.9	1.29E-01	7.5	9.4	9.22E+02	9	6.5	0.00E+00	1	1
2.00E+01	4.42E-01	7.6	9.5	4.48E-01	7.3	9.5	3.57E-01	7.6	9.6	4.50E-01	7	9.8	1.38E+03	9.9	8	2.75E-01	5.4	10.4
3.00E+01	1.47E+00	6.8	8.8	1.54E+00	6.9	8.9	1.39E+00	6.8	9	1.59E+00	6.4	8.5	2.48E+03	11.2	10.4	1.45E+00	5.4	8.9
5.00E+01	7.08E+00	5.3	8.1	7.85E+00	5	7.7	6.01E+00	5.4	8.5	8.58E+00	4.7	7.4	5.85E+03	12.8	13.6	3.79E+00	6.2	9.9
7.50E+01	3.78E+01	3.5	5.1	4.42E+01	3.3	4.8	2.96E+01	3.8	5.5	4.57E+01	3.4	4.8	1.37E+04	14.8	17.2	1.37E+01	4.7	7.9
1.00E+02	1.33E+02	2.9	3.7	1.57E+02	2.8	3.6	1.02E+02	3	4.1	1.45E+02	3.1	3.9	2.34E+04	16.5	20.4	4.63E+01	3.4	5.2
1.50E+02	1.24E+03	8.7	9.9	1.18E+03	7	8.1	4.85E+02	3.6	4	1.73E+03	9.8	11.3	4.33E+04	19.9	23.7	3.22E+02	2.3	3.3
2.00E+02	1.02E+04	15.4	18.5	1.13E+04	14.8	17.9	7.45E+03	13.7	15.6	1.89E+04	16.5	20.4	5.17E+04	22.5	24.6	1.01E+03	2.4	2.9
3.00E+02	4.94E+04	20.1	22.3	6.31E+04	20.9	23	3.35E+04	19.9	22	4.72E+04	21.1	22.5	5.05E+04	22.6	21.5	4.40E+03	7.3	9.3
5.00E+02	6.78E+04	18.1	17.3	7.36E+04	18.2	17.3	5.65E+04	17.6	17.5	6.15E+04	17.9	17.2	6.17E+04	16.9	16.2	6.39E+04	18.5	18.8
7.00E+02	5.59E+04	13.4	11.7	5.69E+04	13.2	11.5	5.35E+04	13.6	12.3	5.55E+04	13.5	11.9	6.36E+04	13.8	12.3	5.72E+04	13.6	12.6
1.00E+03	4.56E+04	10.2	8	4.67E+04	10.3	8	4.13E+04	9.6	7.8	4.57E+04	10.2	7.9	4.58E+04	10.4	8	4.25E+04	9.4	7.7
2.00E+03	3.98E+04	8.3	5.5	4.14E+04	8.6	5.6	3.66E+04	7.8	5.2	3.82E+04	8.2	5.4	4.10E+04	8.8	5.7	3.49E+04	7.6	5
3.00E+03	4.08E+04	8.3	5	4.22E+04	8.6	5.1	3.80E+04	7.6	4.7	4.03E+04	8.1	4.9	4.25E+04	8.5	5.1	3.53E+04	7.1	4.6
5.00E+03	4.32E+04	8.4	4.6	4.56E+04	8.8	4.7	4.26E+04	7.8	4.4	4.17E+04	8.4	4.5	4.68E+04	8.5	4.8	3.76E+04	8.1	4.3
1.00E+04	4.63E+04	8	4.1	4.67E+04	8.5	4.2	4.17E+04	7.2	3.9	4.59E+04	8	4.1	4.66E+04	8.5	4.3	4.33E+04	7.2	3.7
2.00E+04	5.24E+04	8.4	3.9	5.80E+04	9.1	4	5.13E+04	7.5	3.7	5.27E+04	8	3.8	5.42E+04	8.1	3.8	5.23E+04	7.4	3.5
5.00E+04	6.26E+04	7.8	3.5	6.47E+04	8.4	3.6	6.33E+04	7	3.3	6.10E+04	7.4	3.3	6.56E+04	7.5	3.4	5.88E+04	6.4	2.9
1.00E+05	8.09E+04	7.1	3.1	7.71E+04	7.7	3.2	7.64E+04	6.1	2.9	8.24E+04	6.2	3	8.50E+04	6.8	3.3	8.19E+04	5.5	2.9

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.15E-01	7.5	9.8	1.25E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.17. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	3.93E-01	7.5	9.6	4.31E-01	7.1	9.5	3.19E-01	6.2	9.3	4.33E-01	6.2	9.7	5.62E-01	5.2	7.6	7.44E-01	4.4	7.9
3.00E+01	1.35E+00	6.9	8.8	1.44E+00	6.8	8.7	1.32E+00	6.1	9.1	1.39E+00	7	9	2.82E+00	4.1	6.4	2.65E+00	3.8	6.1
5.00E+01	6.34E+00	5.4	8.5	7.57E+00	5	7.8	6.31E+00	5.7	8.9	6.21E+00	5.7	8.9	2.05E+01	3.4	5.3	2.39E+01	3.5	5.1
7.50E+01	3.02E+01	3.8	5.5	3.98E+01	3.4	5	2.73E+01	3.9	5.7	2.93E+01	3.9	5.8	1.01E+02	3.5	4.1	1.08E+02	3.1	3.9
1.00E+02	9.62E+01	3	4	1.30E+02	2.9	3.8	8.83E+01	4.6	5.5	1.00E+02	2.9	4.2	8.10E+02	8	7.9	8.81E+02	8.5	7.3
1.50E+02	1.17E+03	8.7	9.8	1.42E+03	10.3	11.7	1.31E+03	11.1	13.9	9.92E+02	8.3	9.1	2.10E+04	15.6	18.9	3.10E+04	16.3	19.7
2.00E+02	8.40E+03	15.4	18.7	1.18E+04	16.1	19.6	6.97E+03	15.1	17.8	6.37E+03	14.1	16.9	4.90E+04	20.3	23.8	5.81E+04	20.9	24.7
3.00E+02	3.19E+04	20.1	21.9	4.24E+04	20.8	22.4	2.14E+04	18.7	20.6	2.83E+04	19.3	20.6	5.28E+04	22.7	22.1	4.97E+04	22.3	21.6
5.00E+02	5.84E+04	18	17.7	6.65E+04	18.1	17.4	7.16E+04	19	18.8	7.06E+04	18.7	18.1	6.38E+04	17.4	16.5	7.10E+04	17.8	17.1
7.00E+02	5.45E+04	13.7	12.2	5.55E+04	13.6	12	5.63E+04	13.8	11.9	5.39E+04	13.5	11.4	5.78E+04	13	12.1	5.77E+04	13.3	11.6
1.00E+03	4.24E+04	9.7	7.8	4.43E+04	10.1	7.9	4.25E+04	9.7	8	4.51E+04	10.2	7.9	4.65E+04	10.3	8.2	4.77E+04	10.5	8
2.00E+03	3.62E+04	7.8	5.2	3.86E+04	8.1	5.4	3.69E+04	7.8	5.3	3.75E+04	8	5.4	3.95E+04	8.6	5.7	4.05E+04	8.8	5.8
3.00E+03	3.76E+04	7.7	4.7	3.93E+04	8.1	4.9	3.74E+04	7.8	4.8	3.85E+04	8.1	4.9	4.39E+04	8.7	5.1	4.19E+04	8.6	5.1
5.00E+03	4.20E+04	8	4.4	4.26E+04	8.2	4.5	4.39E+04	8	4.4	4.37E+04	8.3	4.6	4.21E+04	9.1	4.7	4.90E+04	8.6	4.7
1.00E+04	4.29E+04	7.2	3.9	4.41E+04	7.7	4	4.34E+04	7.5	3.9	4.38E+04	7.7	4.1	4.37E+04	8.3	4.3	4.37E+04	8.6	4.3
2.00E+04	4.80E+04	7.3	3.7	5.04E+04	8	3.8	4.85E+04	7.3	3.7	5.11E+04	8.2	3.9	4.95E+04	8.6	3.9	5.43E+04	8.9	4.1
5.00E+04	5.96E+04	6.8	3.2	6.28E+04	7.5	3.3	6.35E+04	7.4	3.4	6.49E+04	7.9	3.3	6.50E+04	8.1	3.6	6.49E+04	9.1	3.7
1.00E+05	8.33E+04	6.1	2.9	7.55E+04	6.5	3	7.63E+04	6.1	2.9	7.51E+04	6.9	3.1	7.85E+04	7.2	3.2	7.65E+04	6.9	3.2

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.85E+01	8.3	5.4	3.85E+00	8.3	5.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.54E-01	4.2	8.8	2.60E+01	9	6.5	5.22E+00	9	6.5	1.44E-01	7.2	10	1.53E-01	7.2	9.6
2.00E+01	4.06E-01	6.4	9.3	5.96E-01	4.9	7.6	4.16E+01	9.9	8	9.11E+00	9.7	7.9	5.24E-01	7.3	9.3	5.78E-01	6.8	9.2
3.00E+01	1.44E+00	6.6	8.8	2.57E+00	5	6.8	7.40E+01	11	10.1	1.85E+01	10.2	9.6	1.87E+00	6.2	8	2.06E+00	5.7	7.8
5.00E+01	6.05E+00	5.8	9.3	1.65E+01	4.2	5.8	1.79E+02	11.9	12.8	5.71E+01	9.5	11	1.17E+01	4.2	6.4	1.41E+01	4	6
7.50E+01	2.37E+01	3.9	6	7.28E+01	3.5	4.6	7.88E+02	12.2	13.6	4.73E+02	10.3	10.6	6.94E+01	3.1	4.3	8.78E+01	3.1	4.1
1.00E+02	8.56E+01	3.1	4.3	2.01E+03	11	11.1	4.17E+03	13.1	14.6	3.61E+03	12.9	14.2	2.16E+02	2.9	3.8	2.83E+02	3.2	3.9
1.50E+02	4.14E+02	2.7	3.6	2.06E+04	17.5	21.9	2.33E+04	17.3	21.2	2.10E+04	17.3	21.1	5.91E+03	12.5	14.5	1.04E+04	13.8	16.3
2.00E+02	3.81E+03	9.9	12.1	2.76E+04	21.3	24.4	4.11E+04	20.4	23.5	3.97E+04	20.1	23.3	2.82E+04	17.5	21.2	3.68E+04	18.2	22
3.00E+02	2.61E+04	19.9	21.7	4.05E+04	21.3	21.6	6.52E+04	22	22.6	6.50E+04	21.9	22.6	7.46E+04	21.6	22.9	7.82E+04	21.9	23
5.00E+02	5.61E+04	17.8	17.7	5.93E+04	17.4	17	6.91E+04	17.5	16.4	7.07E+04	17.7	16.5	8.02E+04	18.2	16.9	7.96E+04	17.9	16.4
7.00E+02	5.19E+04	13.7	12.3	5.55E+04	13.6	12.3	5.75E+04	13.3	11.4	5.80E+04	13.3	11.4	5.96E+04	13	11	6.12E+04	13	11
1.00E+03	4.07E+04	9.5	7.6	4.60E+04	10.1	7.8	4.83E+04	10.5	8.1	4.82E+04	10.6	8.2	4.99E+04	10.7	8.2	5.17E+04	10.7	8.3
2.00E+03	3.68E+04	7.5	5.1	3.91E+04	8	5.4	4.26E+04	8.9	5.8	4.25E+04	8.9	5.8	4.45E+04	9.1	5.9	4.50E+04	9.2	5.9
3.00E+03	3.85E+04	7.5	4.6	4.09E+04	8	4.8	4.35E+04	8.8	5.2	4.37E+04	8.9	5.2	4.50E+04	9.1	5.3	4.56E+04	9.3	5.4
5.00E+03	4.33E+04	7.8	4.3	4.38E+04	8.3	4.5	4.71E+04	9	4.8	4.72E+04	9.1	4.8	4.73E+04	9.3	4.9	4.96E+04	9.5	4.9
1.00E+04	4.33E+04	6.4	3.7	4.50E+04	7.6	4	4.78E+04	8.7	4.3	4.74E+04	8.8	4.4	4.84E+04	9	4.4	4.70E+04	9.4	4.5
2.00E+04	4.87E+04	6.6	3.6	5.08E+04	7.6	3.8	5.36E+04	8.9	4.1	5.44E+04	9	4.1	5.14E+04	9.5	4.2	5.84E+04	9.6	4.3
5.00E+04	6.32E+04	5.7	3.1	5.81E+04	7.2	3.3	6.58E+04	8.5	3.6	6.46E+04	8.8	3.7	6.42E+04	9.4	3.8	6.49E+04	9.5	3.8
1.00E+05	8.23E+04	5	2.7	7.76E+04	6.2	3	8.12E+04	7.7	3.3	7.60E+04	8.1	3.4	7.74E+04	9	3.4	7.03E+04	9.2	3.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.47E+03	6.4	2.6	5.41E+03	6.4	2.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.91E+03	6.5	3	1.08E+04	6.5	3	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.34E+04	6.7	3.3	1.62E+04	6.7	3.3	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.23E+04	7.2	4	2.69E+04	7.2	4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.70E+00	8	4.8	0.00E+00	1	1	4.41E+04	8.3	5.5	5.34E+04	8.3	5.5	5.26E+01	8.3	5.4	5.73E+00	8.2	5.4
1.40E+01	9.51E+00	8.3	5.7	2.04E-01	4.9	7.2	6.12E+04	9.1	6.6	7.39E+04	9.1	6.6	8.03E+01	9	6.5	9.54E+00	8.8	6.5
2.00E+01	3.14E+01	8.8	6.9	9.46E-01	4.8	6.9	8.60E+04	10.1	8.3	1.03E+05	10.1	8.3	1.27E+02	10	8	1.59E+01	9.6	8
3.00E+01	8.23E+01	9.3	8.4	4.73E+00	3.9	5.4	1.24E+05	11.6	11	1.48E+05	11.6	11	1.93E+02	11.2	10.4	2.89E+01	10.8	9.9
5.00E+01	1.33E+03	10.2	9.1	4.88E+01	5.1	5.9	1.59E+05	14.8	17.4	1.64E+05	15.2	18.2	5.71E+02	12.4	12.8	8.93E+01	12.1	12.4
7.50E+01	1.10E+04	12.9	13.8	2.14E+03	10.9	10.1	1.30E+05	18.8	24.6	1.30E+05	19.2	25.3	1.61E+03	14	16	3.60E+02	12.5	13.5
1.00E+02	3.04E+04	15.3	18.1	1.29E+04	14	15.9	1.08E+05	21.8	27.6	1.07E+05	22.1	27.9	3.72E+03	15.3	18.4	1.69E+03	13.4	15.3
1.50E+02	6.17E+04	19.6	23.8	4.24E+04	18.4	22.4	8.56E+04	25.9	27	8.58E+04	26	26.9	8.95E+03	18.4	22.2	6.79E+03	17.1	20.8
2.00E+02	6.86E+04	23.2	25.1	5.88E+04	21.6	24.5	7.66E+04	26.1	24.2	7.74E+04	26	24.1	1.56E+04	19.9	22.3	1.43E+04	18.6	21.6
3.00E+02	6.65E+04	22.2	21.6	6.81E+04	22.3	22	7.31E+04	21.1	20	7.45E+04	21.1	20	3.69E+04	20.3	21.6	4.03E+04	20.2	21.8
5.00E+02	7.27E+04	17.4	16.5	7.98E+04	17.8	16.8	6.95E+04	16.5	14.9	7.15E+04	16.6	15	6.31E+04	18.1	17.6	6.72E+04	18.2	17.7
7.00E+02	5.97E+04	13.2	11.2	5.92E+04	13.2	11.2	6.23E+04	13.5	11.3	6.31E+04	13.5	11.3	5.49E+04	13.5	11.9	5.61E+04	13.4	11.8
1.00E+03	5.06E+04	10.8	8.2	4.98E+04	10.7	8.2	5.42E+04	11.2	8.5	5.44E+04	11.2	8.5	4.39E+04	9.9	7.9	4.49E+04	10.1	7.9
2.00E+03	4.68E+04	9.4	5.9	4.51E+04	9.2	5.9	4.83E+04	9.7	6.2	4.90E+04	9.8	6.2	3.80E+04	8	5.4	3.93E+04	8.2	5.4

Table A.17. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	4.75E+04	9.3	5.3	4.62E+04	9.1	5.3	4.92E+04	9.7	5.6	4.94E+04	9.8	5.6	4.00E+04	8	4.8	4.01E+04	8.1	4.9
5.00E+03	4.81E+04	9.6	4.9	4.55E+04	9.3	4.9	5.21E+04	9.9	5.1	5.18E+04	10	5.1	4.33E+04	8.3	4.5	4.25E+04	8.3	4.5
1.00E+04	4.96E+04	9.3	4.5	4.70E+04	9.2	4.5	5.37E+04	9.9	4.7	5.38E+04	10	4.7	4.45E+04	7.6	4	4.49E+04	7.9	4
2.00E+04	5.63E+04	9.6	4.3	5.55E+04	9.5	4.2	5.91E+04	10.1	4.4	5.89E+04	10.3	4.4	5.15E+04	7.7	3.8	5.04E+04	8	3.8
5.00E+04	6.85E+04	9.5	3.7	6.32E+04	8.9	3.8	6.90E+04	10	4	6.80E+04	10.3	4	6.29E+04	7.1	3.3	6.20E+04	7.5	3.4
1.00E+05	8.11E+04	8.7	3.4	7.68E+04	8.6	3.5	8.18E+04	9.3	3.6	7.88E+04	9.8	3.7	8.10E+04	6.3	3	7.64E+04	6.6	3.1

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	6.14E+02	8.3	5.4	7.13E+01	8.2	5.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	9.34E+02	9	6.5	1.18E+02	8.9	6.5	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	3.95E-01	4.7	9	3.88E-01	4.8	9.6	1.47E+03	10	8.1	1.90E+02	9.7	8	4.48E-01	7.7	8.9	3.67E-01	5.6	9.7
3.00E+01	1.12E+00	5.4	9.1	1.32E+00	5.4	9.2	2.15E+03	11.3	10.5	3.28E+02	11.1	10.1	1.22E+00	6.1	9.3	1.17E+00	5.6	9
5.00E+01	5.50E+00	6.3	10.3	5.04E+00	6.9	9.9	5.66E+03	12.8	13.5	8.92E+02	13.1	13.6	4.91E+00	5	9.2	4.88E+00	5.8	10.4
7.50E+01	1.90E+01	3.9	6.6	1.67E+01	4.6	7.4	1.31E+04	14.6	17	2.63E+03	13.9	15.1	2.03E+01	4.3	6.9	1.70E+01	4.3	7.1
1.00E+02	6.78E+01	3.3	4.7	6.39E+01	3.3	4.9	2.58E+04	16.1	19.6	1.01E+04	14.6	16.9	6.92E+01	3.2	4.4	6.09E+01	3.4	4.9
1.50E+02	4.01E+02	2.3	3.1	3.76E+02	2.5	3.3	4.28E+04	20.2	24.1	2.53E+04	19	23	3.75E+02	2.9	3.5	3.87E+02	2.5	3.2
2.00E+02	1.09E+03	2.7	5.4	1.29E+03	2.6	2.9	5.33E+04	22.9	24.4	2.94E+04	21.9	24	3.76E+03	13.5	14	1.23E+03	2.6	2.9
3.00E+02	3.27E+04	18.4	21.4	1.74E+04	16.1	19.3	6.97E+04	21.3	21.6	6.94E+04	20.7	22.1	1.88E+04	17.8	20.3	1.95E+04	16	17.9
5.00E+02	5.41E+04	17	17.2	7.04E+04	19.2	19	7.55E+04	17.7	16.5	7.10E+04	17.6	16.7	5.78E+04	18.3	18	6.95E+04	18.5	19.1
7.00E+02	5.36E+04	13.6	12.5	4.93E+04	12.9	12.4	5.95E+04	13	11.2	6.34E+04	13.3	11.6	5.55E+04	13.7	12.3	4.99E+04	13.7	12
1.00E+03	4.14E+04	9.4	7.8	4.05E+04	9.3	7.8	5.08E+04	10.8	8.3	4.88E+04	10.6	8	4.25E+04	9.5	7.9	4.32E+04	9.9	7.6
2.00E+03	3.50E+04	7.5	5	3.68E+04	7.8	5.3	4.46E+04	9.2	6	4.41E+04	9.1	5.9	3.35E+04	7.3	5.1	3.77E+04	7.8	5.2
3.00E+03	3.78E+04	7.5	4.6	3.79E+04	7.5	4.7	4.92E+04	9.3	5.4	4.51E+04	9.1	5.2	3.84E+04	7.5	4.6	3.70E+04	7.6	4.6
5.00E+03	3.81E+04	7.6	4.2	3.70E+04	7.6	4.3	4.93E+04	9.6	5	4.48E+04	9.1	4.9	4.33E+04	7.8	4.3	4.06E+04	7.9	4.4
1.00E+04	4.20E+04	6.9	3.8	4.43E+04	7.1	3.6	5.20E+04	9.4	4.5	4.95E+04	9	4.5	4.25E+04	6.8	3.7	4.46E+04	7.4	3.7
2.00E+04	4.92E+04	6.6	3.5	5.05E+04	7.2	3.4	5.67E+04	9.5	4.2	5.26E+04	9.1	4.2	5.06E+04	7	3.6	4.94E+04	6.7	3.7
5.00E+04	6.33E+04	6.2	3.1	6.36E+04	6.5	3.1	6.51E+04	9.4	3.8	5.66E+04	9.1	3.8	5.57E+04	6	3.2	6.23E+04	6.2	3.3
1.00E+05	8.50E+04	5.6	2.9	7.64E+04	5.9	3	7.34E+04	8.5	3.5	7.75E+04	8.6	3.5	8.04E+04	6	2.7	7.38E+04	5.2	3

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.01E+01	8.2	5.3	0.00E+00	1	1
1.40E+01	1.12E-01	6.9	9.8	0.00E+00	1	1	1.06E-01	6.8	9.8	1.05E-01	7	10.1	4.79E+01	8.8	6.3	1.51E-01	6.1	8.8
2.00E+01	3.91E-01	7.5	9.6	4.39E-01	7.1	9.6	3.69E-01	7.9	9.3	4.35E-01	7.9	9.8	8.30E+01	9.6	7.4	6.16E-01	4.9	8.1
3.00E+01	1.34E+00	7.2	9.1	1.43E+00	7.1	8.9	1.25E+00	7	9.1	1.27E+00	7.2	9.3	1.85E+02	10.6	9.4	3.22E+00	6.4	6.8
5.00E+01	5.80E+00	5.9	8.9	6.45E+00	5.5	8.3	5.06E+00	6.1	9.5	5.21E+00	5.9	9.5	1.22E+03	11.2	10.5	2.56E+01	4.7	6.2
7.50E+01	2.67E+01	3.9	5.8	3.32E+01	3.6	5.3	2.08E+01	4.2	6.2	2.28E+01	4	6.1	5.04E+03	13.7	15.1	2.08E+02	10	10.7
1.00E+02	8.97E+01	3.1	4.2	1.12E+02	2.9	3.9	6.76E+01	3.1	4.4	8.11E+01	3.2	4.3	1.03E+04	15.9	19.3	2.93E+03	12.3	13.3
1.50E+02	4.61E+02	3.2	4	7.29E+02	4.8	6.1	4.01E+02	2.4	3.2	4.59E+02	2.4	3.1	1.89E+04	19.5	23.6	1.60E+04	17.8	22.1
2.00E+02	5.93E+03	13.1	15.8	8.16E+03	14.3	17.1	1.20E+03	4.4	5.7	1.52E+03	4.9	6.2	2.35E+04	22.2	23.9	2.29E+04	21	23.5
3.00E+02	2.96E+04	19.7	21.6	4.01E+04	19.9	21.9	3.00E+04	18.2	21.3	3.06E+04	18	20.9	3.85E+04	20.7	21.3	4.19E+04	20.6	21.6
5.00E+02	6.28E+04	18.3	18.2	6.77E+04	18.5	17.9	5.73E+04	17.7	17.7	6.24E+04	18.4	17.7	6.23E+04	17.8	17.4	6.86E+04	18.1	17.5
7.00E+02	5.45E+04	13.6	11.9	5.55E+04	13.2	11.5	5.38E+04	13.7	12.3	5.41E+04	13.7	12.1	5.56E+04	13.5	11.9	5.61E+04	13.4	11.7
1.00E+03	4.32E+04	9.8	7.8	4.33E+04	10	8	4.20E+04	9.6	7.8	4.32E+04	9.9	7.9	4.43E+04	10	7.9	4.43E+04	10.1	7.9
2.00E+03	3.70E+04	7.8	5.3	3.88E+04	8.2	5.4	3.70E+04	7.7	5.2	3.71E+04	7.8	5.2	3.93E+04	8.2	5.4	3.95E+04	8.3	5.5
3.00E+03	3.85E+04	7.8	4.8	4.11E+04	8.2	4.9	3.70E+04	7.5	4.6	3.85E+04	7.8	4.7	3.97E+04	8	4.9	4.07E+04	8.3	5
5.00E+03	4.16E+04	7.9	4.4	4.24E+04	8.3	4.5	4.38E+04	7.8	4.3	4.43E+04	8.1	4.4	4.50E+04	8.3	4.5	4.35E+04	8.4	4.5
1.00E+04	4.34E+04	7.5	3.9	4.31E+04	8	4.1	4.23E+04	6.8	3.8	4.41E+04	7.4	3.9	4.52E+04	7.7	4	4.53E+04	8	4.1
2.00E+04	4.96E+04	7.5	3.7	4.91E+04	8.3	3.9	4.95E+04	6.8	3.6	4.75E+04	7.5	3.7	5.09E+04	7.7	3.8	5.11E+04	8.2	3.9
5.00E+04	6.25E+04	7.1	3.3	6.48E+04	8	3.4	6.53E+04	6.1	3.1	5.96E+04	6.7	3.2	6.48E+04	7.3	3.3	6.30E+04	7.7	3.4
1.00E+05	7.70E+04	6	2.9	7.78E+04	6.8	3.1	8.38E+04	5.4	2.8	8.03E+04	6.5	2.9	8.59E+04	6.6	3	7.29E+04	7	3.1

(continued on next page)

Table A.17. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.01E+01	8.3	5.4	2.86E+00	8.2	5.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	6.07E+01	9	6.5	4.57E+00	8.9	6.5	1.13E-01	5.6	9.1	1.42E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	9.28E+01	9.9	8	7.86E+00	9.6	7.9	4.49E-01	6.6	9	4.45E+00	8.3	5.3	3.32E-01	6.8	9.7	3.90E-01	7.1	10.1
3.00E+01	1.60E+02	11.1	10.2	1.58E+01	10	9.6	2.14E+00	5.9	8.1	1.53E+01	8.8	7.9	1.20E+00	7.1	9.5	1.21E+00	7.1	9.2
5.00E+01	4.75E+02	11.9	12.2	6.26E+01	9.7	10.2	1.27E+01	3.8	6.2	1.22E+02	10.9	9.8	4.43E+00	6.7	10.6	5.19E+00	6.1	9.8
7.50E+01	2.37E+03	12.9	14.2	6.66E+02	11.1	11.6	1.05E+02	8.3	7.1	9.13E+02	12.5	13	1.30E+01	5.4	8.3	1.96E+01	4.2	6.5
1.00E+02	8.62E+03	14.4	16.7	2.89E+03	13.4	15.3	1.89E+03	11.8	12.6	4.69E+03	13.5	15.4	3.84E+01	3.8	5.6	6.96E+01	3.3	4.5
1.50E+02	2.84E+04	18	22	1.74E+04	16.7	20.2	8.78E+03	17.7	21.3	1.56E+04	18.2	22.4	2.78E+02	2.6	3.4	4.62E+02	2.5	3.1
2.00E+02	4.66E+04	21	23.9	3.83E+04	19.7	23.1	1.88E+04	18	21.3	3.20E+04	19.3	22.1	8.68E+02	2.2	2.8	1.30E+03	2.5	3.8
3.00E+02	6.36E+04	22.2	22.4	6.34E+04	22	22.6	7.39E+04	20.7	22.6	7.26E+04	21.6	23.1	4.82E+03	6	7.8	2.49E+04	16.8	20
5.00E+02	6.59E+04	17.3	16.1	6.82E+04	17.5	16.4	7.53E+04	18	16.6	7.07E+04	17.4	16.6	6.23E+04	19	19.5	6.10E+04	18.6	18.3
7.00E+02	5.73E+04	13.3	11.5	5.75E+04	13.3	11.5	6.00E+04	13.3	11.3	5.99E+04	13.4	11.5	5.17E+04	13.6	12.5	5.42E+04	13.5	12
1.00E+03	4.82E+04	10.5	8.1	4.77E+04	10.5	8.1	4.53E+04	10.6	8.2	4.90E+04	10.6	8.1	4.15E+04	9.4	7.6	4.32E+04	9.8	7.7
2.00E+03	4.24E+04	8.8	5.7	4.19E+04	8.8	5.7	4.32E+04	8.8	5.8	4.43E+04	9.1	5.8	3.38E+04	7.1	4.9	3.57E+04	7.7	5.2
3.00E+03	4.33E+04	8.8	5.2	4.30E+04	8.7	5.1	4.21E+04	8.9	5.2	4.25E+04	8.9	5.2	3.62E+04	7	4.4	3.74E+04	7.6	4.7
5.00E+03	4.69E+04	9	4.7	4.57E+04	8.9	4.7	4.42E+04	9.4	4.9	4.67E+04	9.3	4.8	4.25E+04	7.3	4.1	4.05E+04	7.8	4.3
1.00E+04	4.81E+04	8.6	4.3	4.71E+04	8.6	4.3	4.65E+04	8.8	4.4	4.69E+04	8.9	4.4	4.25E+04	6.4	3.6	4.06E+04	7.1	3.9
2.00E+04	5.47E+04	8.8	4	5.37E+04	8.8	4	5.29E+04	8.6	4.2	5.23E+04	8.9	4.2	5.05E+04	6.9	3.5	4.79E+04	7.3	3.6
5.00E+04	6.59E+04	8.3	3.6	6.37E+04	8.4	3.6	6.22E+04	8.6	3.6	6.21E+04	8.9	3.8	5.78E+04	6.1	3	6.08E+04	6.7	3.2
1.00E+05	8.28E+04	7.4	3.2	7.81E+04	7.7	3.3	7.70E+04	8.7	3.4	6.92E+04	7.6	3.4	7.96E+04	5.3	2.7	7.88E+04	5.8	2.9

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.01E-01	6.9	10.2	1.11E-01	7.4	9.6	1.13E-01	7.3	9.7	1.27E-01	6.2	10.1	1.31E-01	6.6	9.7
2.00E+01	3.72E-01	5.2	9.4	4.29E-01	6.9	9.8	3.89E-01	7.2	9.6	3.99E-01	7.2	9.6	3.89E-01	7.2	9.5	4.11E-01	6.4	9.9
3.00E+01	1.05E+00	7.2	9.3	1.16E+00	7.3	9.3	1.33E+00	7	9	1.37E+00	7	8.9	1.35E+00	6.9	9	1.44E+00	6.9	8.8
5.00E+01	4.90E+00	6.2	10.2	4.63E+00	6.8	10.3	5.83E+00	5.7	8.7	6.01E+00	5.4	8.7	5.67E+00	5.3	8.9	7.09E+00	5	7.9
7.50E+01	1.45E+01	5.2	7.9	1.65E+01	4.9	7.9	2.66E+01	3.9	5.7	2.88E+01	3.8	5.6	2.69E+01	3.8	5.7	3.68E+01	3.5	5
1.00E+02	4.47E+01	3.5	5.5	5.13E+01	3.6	5.2	8.43E+01	3	4.1	1.03E+02	3	4.1	1.01E+02	3	4.2	1.37E+02	3	3.9
1.50E+02	3.05E+02	2.5	3.3	3.27E+02	2.6	3.2	6.36E+02	6.2	7.3	4.95E+02	3.4	4.2	5.00E+02	2.7	3.8	6.99E+02	3.4	4.4
2.00E+02	9.03E+02	2.4	2.7	1.18E+03	3	3.2	5.75E+03	13.7	16.6	6.33E+03	13.2	16	4.41E+03	11.2	13.4	9.96E+03	14.2	17.3
3.00E+02	5.61E+03	8.4	11	1.22E+04	13.7	16.5	2.94E+04	19.8	21.8	3.41E+04	20	21.9	3.73E+04	19.9	22.2	5.29E+04	21.2	22.9
5.00E+02	5.74E+04	19.2	19	5.93E+04	18.3	18.5	5.73E+04	17.9	17.7	5.99E+04	18	17.8	6.18E+04	18.2	17.6	6.53E+04	18.2	17.1
7.00E+02	5.02E+04	13.8	12.7	5.79E+04	13.8	12.4	5.18E+04	13.5	12.1	5.35E+04	13.4	12	5.47E+04	13.7	12	5.65E+04	13.6	11.9
1.00E+03	4.16E+04	9.5	7.4	4.25E+04	9.6	7.5	4.16E+04	9.7	7.8	4.25E+04	9.9	7.8	4.24E+04	9.7	7.8	4.61E+04	10.2	8
2.00E+03	3.54E+04	6.9	5.1	3.56E+04	7.4	5.1	3.65E+04	7.6	5.1	3.76E+04	7.8	5.2	3.63E+04	7.8	5.3	4.10E+04	8.4	5.4
3.00E+03	3.73E+04	7.2	4.6	3.75E+04	7.4	4.5	3.76E+04	7.5	4.6	3.86E+04	7.8	4.7	4.08E+04	7.9	4.8	4.20E+04	8.2	4.9
5.00E+03	3.80E+04	7.4	4.3	3.91E+04	7.6	4.2	4.29E+04	7.8	4.3	4.05E+04	7.8	4.4	4.28E+04	8.3	4.4	4.43E+04	8.7	4.5
1.00E+04	4.25E+04	6.5	3.7	4.07E+04	6.8	3.8	4.29E+04	7	3.8	4.44E+04	7.4	3.9	4.36E+04	7.2	3.9	4.46E+04	7.8	4.1
2.00E+04	5.06E+04	7	3.4	4.90E+04	7.1	3.6	5.19E+04	7	3.6	5.16E+04	7.4	3.7	5.23E+04	7.7	3.7	4.96E+04	8.1	3.8
5.00E+04	6.61E+04	5.4	3	6.05E+04	6.2	3.1	6.39E+04	6.4	3.2	6.33E+04	7	3.2	6.23E+04	6.9	3.3	6.33E+04	7.6	3.3
1.00E+05	8.26E+04	5	2.7	7.53E+04	5.7	2.9	8.38E+04	5.6	2.8	7.93E+04	6.1	2.9	8.38E+04	6.1	3	7.80E+04	6.5	3

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.01E-01	5.8	8.7	0.00E+00	1	1	2.85E+00	4.2	5.7	2.85E+00	4.2	5.7
2.00E+01	6.91E-01	6.4	8.2	0.00E+00	1	1	1.37E+01	4.3	5.5	1.37E+01	4.3	5.5
3.00E+01	2.16E+00	5.1	7.3	2.35E+00	5.3	7.5	6.63E+01	4.7	5.7	6.63E+01	4.7	5.7
5.00E+01	1.66E+01	3.6	5.8	1.51E+01	4.4	6.1	6.68E+04	9.8	7.9	6.68E+04	9.8	7.9
7.50E+01	5.82E+01	3.7	4.2	6.35E+01	3	4.2	1.47E+05	15.7	19.2	1.47E+05	15.7	19.2
1.00E+02	1.24E+03	10.6	11.4	7.15E+02	10.2	10.5	1.20E+05	19.9	26	1.20E+05	19.9	26
1.50E+02	1.41E+04	16.2	19.7	1.01E+04	15.7	18.7	8.75E+04	23.4	26.6	8.75E+04	23.4	26.6

Table A.17. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.62E+04	19.1	22.4	3.26E+04	18.5	22.3	8.23E+04	24.7	24.5	8.23E+04	24.7	24.5
3.00E+02	4.58E+04	22.6	22.4	4.44E+04	21.7	22.4	7.92E+04	20.6	20.8	7.92E+04	20.6	20.8
5.00E+02	7.02E+04	18.5	17.6	7.92E+04	18.2	17.8	7.28E+04	16.3	15.9	7.28E+04	16.3	15.9
7.00E+02	5.55E+04	13.2	11.2	6.11E+04	13.6	11.5	6.44E+04	13.5	12.2	6.44E+04	13.5	12.2
1.00E+03	4.60E+04	10.2	8	4.96E+04	10.4	8	5.28E+04	11.1	8.2	5.28E+04	11.1	8.2
2.00E+03	4.02E+04	8.5	5.6	4.11E+04	8.5	5.6	5.04E+04	10	5.9	5.04E+04	10	5.9
3.00E+03	4.26E+04	8.6	5	4.03E+04	8.4	5	4.95E+04	9.8	5.8	4.95E+04	9.8	5.8
5.00E+03	4.52E+04	8.7	4.6	4.28E+04	8.5	4.7	5.00E+04	9.9	5.3	5.00E+04	9.9	5.3
1.00E+04	4.46E+04	8.3	4.1	4.83E+04	8.5	4.2	5.02E+04	9.5	4.8	5.02E+04	9.5	4.8
2.00E+04	4.97E+04	8.3	3.9	5.03E+04	8.8	4	6.03E+04	10.1	4.6	6.03E+04	10.1	4.6
5.00E+04	6.27E+04	8.3	3.5	6.26E+04	9	3.5	5.68E+04	9.6	3.9	5.68E+04	9.6	3.9
1.00E+05	7.81E+04	6.7	3.2	7.52E+04	6.8	3.1	7.30E+04	9.5	3.6	7.30E+04	9.5	3.6

Table A.18. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{31}P ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.29E+00	7.8	1.2	1.87E+00	7.8	1.2	5.16E+02	7.6	4.6	5.70E+02	7.7	4.7	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.57E+00	8.5	1.5	2.55E+00	8.4	1.5	9.26E+02	8.1	5.4	9.64E+02	8.3	5.5	1.16E-01	7.1	9.6	1.17E-01	7	9.5
2.00E+01	1.43E+01	9.2	1.8	4.69E+00	9.1	1.9	1.89E+03	9	6.4	1.68E+03	9.1	6.6	4.58E-01	7	9.5	4.48E-01	6.9	9.4
3.00E+01	2.47E+01	10.1	2.3	9.43E+00	9.6	2.3	4.40E+03	9.9	8.1	3.93E+03	10.1	8.3	1.56E+00	6.3	8.7	1.52E+00	6.4	8.6
5.00E+01	7.11E+01	10.8	2.9	2.99E+01	9	2.8	2.17E+04	10.9	9.9	1.79E+04	11.2	10.4	7.78E+00	4.8	7.5	8.19E+00	4.9	7.5
7.50E+01	2.52E+02	11	3.1	2.25E+02	9.5	2.5	6.66E+04	13.6	15	4.41E+04	13.8	15.5	4.79E+01	3.6	4.7	3.69E+01	3.5	4.9
1.00E+02	1.21E+03	11.2	3.2	1.65E+03	11.8	3.2	1.04E+05	15.9	19.2	6.62E+04	16	19.5	1.95E+02	5.8	6.4	1.36E+02	2.9	3.9
1.50E+02	1.05E+04	15.7	4.8	1.00E+04	15.8	4.9	1.26E+05	20.5	25	9.06E+04	19.7	24	1.44E+03	10	11.6	1.92E+03	10.2	11.1
2.00E+02	1.88E+04	18.7	5.8	1.94E+04	18.5	5.7	1.18E+05	24.4	26.2	9.88E+04	22.9	25.3	1.23E+04	14.8	17.9	1.37E+04	15.4	18.6
3.00E+02	3.93E+04	20.8	5.8	4.18E+04	20.8	5.8	8.54E+04	25	22.3	8.07E+04	24.5	22.7	4.63E+04	20.7	22.8	4.88E+04	20.8	22.9
5.00E+02	6.97E+04	19.6	5.2	7.52E+04	19.9	5.3	7.05E+04	17.8	15.6	7.70E+04	18.6	16.8	6.52E+04	19.4	18.4	6.52E+04	19.3	18.5
7.00E+02	6.08E+04	15.6	4.1	6.38E+04	15.5	4	7.02E+04	15.9	13.2	7.21E+04	15.8	13.4	5.92E+04	15.4	13.6	6.32E+04	15.7	13.7
1.00E+03	4.99E+04	11.8	3	5.03E+04	11.8	3	5.76E+04	13.1	9.7	5.99E+04	12.7	9.7	4.99E+04	11.6	9.2	5.02E+04	11.7	9.2
2.00E+03	4.32E+04	9.4	2.3	4.43E+04	9.7	2.3	5.21E+04	11.3	7.2	5.34E+04	11	7	4.24E+04	9.3	6.1	4.27E+04	9.4	6.1
3.00E+03	4.42E+04	9.3	2.1	4.48E+04	9.6	2.1	5.28E+04	10.9	6.4	5.30E+04	10.9	6.3	4.34E+04	9.1	5.5	4.46E+04	9.3	5.6
5.00E+03	4.88E+04	9.6	2	4.88E+04	9.8	2	5.48E+04	11.2	5.7	5.57E+04	11.1	5.8	4.78E+04	9.3	5.1	4.95E+04	9.6	5.1
1.00E+04	4.92E+04	8.9	1.9	5.05E+04	9.2	1.9	6.07E+04	11.4	5.3	5.53E+04	11	5.3	4.99E+04	8.8	4.5	4.94E+04	8.9	4.6
2.00E+04	5.68E+04	9	1.8	5.60E+04	9.5	1.8	6.83E+04	11.3	5	6.16E+04	11.3	4.9	5.87E+04	8.8	4.2	5.86E+04	9.4	4.3
5.00E+04	7.15E+04	8.4	1.7	7.08E+04	8.9	1.7	7.20E+04	11.3	4.5	7.50E+04	11.1	4.4	7.35E+04	7.9	3.7	7.08E+04	8.2	3.8
1.00E+05	8.58E+04	7.5	1.6	8.44E+04	8.2	1.6	9.14E+04	10.5	4	8.90E+04	10.3	4	8.60E+04	7.1	3.2	8.79E+04	7.5	3.3

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	7.16E+02	7.8	4.8	0.00E+00	1	1
1.40E+01	1.18E-01	7.5	9.8	1.26E-01	7.3	9.9	1.20E-01	6.6	9.9	1.27E-01	7.5	9.4	9.91E+02	8.5	5.8	0.00E+00	1	1
2.00E+01	4.50E-01	7.6	9.5	4.60E-01	7.3	9.5	3.63E-01	7.6	9.5	4.62E-01	7	9.8	1.46E+03	9.4	7.1	2.74E-01	5.4	10.4
3.00E+01	1.51E+00	6.8	8.8	1.58E+00	6.9	8.9	1.42E+00	6.8	9	1.62E+00	6.4	8.5	2.60E+03	10.6	9.1	1.51E+00	5.4	8.9
5.00E+01	7.30E+00	5.2	8	8.11E+00	5	7.6	6.22E+00	5.4	8.5	8.84E+00	4.6	7.3	6.06E+03	11.9	11.9	3.97E+00	6.2	9.9
7.50E+01	3.82E+01	3.5	5	4.47E+01	3.3	4.7	3.00E+01	3.7	5.5	4.56E+01	3.4	4.8	1.43E+04	13.8	15.5	1.41E+01	4.7	7.9
1.00E+02	1.33E+02	2.8	3.7	1.57E+02	2.7	3.6	1.02E+02	3	4.1	1.44E+02	3	3.8	2.40E+04	15.5	18.7	4.73E+01	3.4	5.2
1.50E+02	1.11E+03	7.6	8.6	1.06E+03	6.3	7	4.70E+02	3.4	3.8	1.43E+03	8.6	9.6	4.76E+04	18.7	22.5	3.21E+02	2.3	3.2
2.00E+02	9.22E+03	14.2	17	1.08E+04	13.9	16.3	6.27E+03	11.9	13.8	1.72E+04	15.4	18.4	6.25E+04	21	24	1.00E+03	2.3	2.8
3.00E+02	5.08E+04	19.5	22	6.49E+04	20	22.7	3.47E+04	19.4	22.1	4.87E+04	20.9	22.7	5.59E+04	24.1	22.9	4.21E+03	6.6	8.6
5.00E+02	7.75E+04	20	18.9	8.45E+04	20.1	18.9	6.39E+04	19.5	18.8	7.13E+04	19.6	18.7	6.72E+04	18.3	17.5	6.88E+04	20.5	19.3
7.00E+02	6.34E+04	15.5	13.4	6.65E+04	15.4	13.2	6.08E+04	15.8	14	6.33E+04	15.5	13.5	6.86E+04	15.7	13.6	6.50E+04	16.2	14
1.00E+03	5.21E+04	11.9	9.2	5.40E+04	12.1	9.3	5.16E+04	11.5	9	5.15E+04	12	9.2	5.03E+04	12.1	9.2	4.90E+04	11.3	8.9
2.00E+03	4.60E+04	9.8	6.4	4.66E+04	10.1	6.5	4.39E+04	9.2	6	4.20E+04	9.5	6.3	4.27E+04	9.8	6.5	4.12E+04	8.8	5.7
3.00E+03	4.59E+04	9.7	5.7	4.78E+04	10.1	5.9	4.46E+04	9.1	5.4	4.51E+04	9.5	5.6	4.75E+04	10.1	5.9	4.00E+04	8.3	5.1
5.00E+03	4.98E+04	9.9	5.3	5.11E+04	10.3	5.4	4.85E+04	9.1	5	4.73E+04	9.7	5.2	5.17E+04	10.2	5.4	4.24E+04	8.5	4.9
1.00E+04	5.07E+04	9.4	4.7	5.52E+04	10	4.9	4.65E+04	8.4	4.4	5.14E+04	9.2	4.6	5.22E+04	10	4.8	4.80E+04	8.8	4.2
2.00E+04	5.96E+04	10	4.5	6.10E+04	10.5	4.6	5.66E+04	8.7	4.1	5.64E+04	9.3	4.5	6.00E+04	9.5	4.5	5.74E+04	8.5	4.2
5.00E+04	7.14E+04	9.3	3.9	6.78E+04	9.7	4.1	7.31E+04	8.2	3.6	6.48E+04	8	3.9	7.20E+04	8.9	3.9	6.54E+04	7.2	3.5
1.00E+05	8.54E+04	8.4	3.5	8.12E+04	8.9	3.6	8.53E+04	6.9	3.1	8.80E+04	7.7	3.4	9.37E+04	8	3.5	8.82E+04	6.3	3.1

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.17E-01	7.5	9.8	1.26E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	4.06E-01	7.5	9.6	4.40E-01	7.1	9.5	3.24E-01	6.2	9.3	4.32E-01	6.2	9.7	5.55E-01	5.2	7.6	7.42E-01	4.4	7.9
3.00E+01	1.38E+00	6.9	8.8	1.48E+00	6.8	8.7	1.38E+00	6.1	9.1	1.42E+00	7	9	2.91E+00	4.1	6.4	2.75E+00	3.8	6.1
5.00E+01	6.52E+00	5.4	8.4	7.80E+00	5	7.7	6.50E+00	5.6	8.8	6.38E+00	5.6	8.9	2.08E+01	3.4	5.2	2.49E+01	3.5	5.1

Table A.18. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.06E+01	3.8	5.4	4.01E+01	3.4	4.9	2.74E+01	3.9	5.7	2.98E+01	3.9	5.7	1.00E+02	3.2	4.1	1.07E+02	3.1	3.9
1.00E+02	9.63E+01	3	4	1.29E+02	2.9	3.8	8.81E+01	3.5	5.4	1.01E+02	2.9	4.2	6.76E+02	7	7.4	4.01E+02	6.4	6.8
1.50E+02	7.18E+02	7.6	8.3	1.30E+03	9.3	10.3	1.08E+03	10.2	12	7.36E+02	7.1	8.2	1.99E+04	14.8	17.1	2.94E+04	15.1	17.8
2.00E+02	7.81E+03	14.4	17.4	1.11E+04	15.1	18.2	6.79E+03	14.3	17	5.95E+03	13.3	16.6	5.13E+04	18.9	22.8	6.06E+04	19.6	23.5
3.00E+02	3.28E+04	19.6	21.9	4.39E+04	20.4	22.5	2.11E+04	18.7	20.8	2.83E+04	18.3	20.7	6.06E+04	24	23.2	5.60E+04	23.9	22.8
5.00E+02	6.78E+04	19.5	19	7.29E+04	19.6	19	7.66E+04	20.3	19.8	8.22E+04	20.7	19.6	7.11E+04	19.4	17.9	7.86E+04	19.4	18.1
7.00E+02	6.01E+04	15.8	14	6.42E+04	15.6	13.6	6.04E+04	15.6	13.7	7.21E+04	15.9	13.5	6.31E+04	15.4	13.8	6.03E+04	15.1	13.6
1.00E+03	4.98E+04	11.6	9.1	5.06E+04	11.7	9.3	4.78E+04	11.6	9.1	5.18E+04	11.8	9.2	5.43E+04	12.1	9.4	5.39E+04	12.3	9.5
2.00E+03	4.33E+04	9.2	6	4.28E+04	9.4	6.2	4.30E+04	9.1	6.1	4.65E+04	9.8	6.3	4.66E+04	10.2	6.6	4.73E+04	10.6	6.7
3.00E+03	4.29E+04	9	5.4	4.41E+04	9.4	5.6	4.09E+04	8.9	5.5	4.48E+04	9.6	5.7	4.59E+04	10.2	5.9	4.80E+04	10.4	6.1
5.00E+03	4.76E+04	9.2	5	4.70E+04	9.5	5.2	4.98E+04	9.5	5.1	5.01E+04	9.8	5.2	4.93E+04	9.9	5.5	5.51E+04	10.8	5.5
1.00E+04	4.95E+04	8.5	4.4	5.19E+04	9.2	4.6	4.57E+04	8.8	4.4	4.89E+04	9.4	4.7	4.76E+04	10	4.8	5.09E+04	10.3	4.8
2.00E+04	5.66E+04	8.7	4.1	5.54E+04	9.2	4.4	5.40E+04	8.6	4.2	5.68E+04	9.7	4.4	5.26E+04	10.5	4.6	6.03E+04	11.4	4.7
5.00E+04	7.26E+04	8	3.7	6.95E+04	8.9	3.8	7.07E+04	8.7	3.6	6.51E+04	8.6	3.7	7.08E+04	10	4	7.15E+04	10.2	4.2
1.00E+05	8.41E+04	7.3	3.2	8.26E+04	7.9	3.3	8.44E+04	7.1	3.2	8.26E+04	8.1	3.4	8.57E+04	9	3.4	8.44E+04	10.4	3.9

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.99E+01	7.8	4.8	4.09E+00	7.8	4.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.61E-01	4.2	8.8	2.80E+01	8.5	5.8	6.09E+00	8.4	5.8	1.47E-01	7.2	10	1.55E-01	7.2	9.6
2.00E+01	4.08E-01	6.4	9.3	6.00E-01	4.9	7.6	4.45E+01	9.3	7.1	1.10E+01	9.1	7.1	5.39E-01	7.3	9.3	5.86E-01	6.8	9.1
3.00E+01	1.48E+00	6.6	8.8	2.64E+00	5	6.8	7.82E+01	10.3	9	1.95E+01	9.7	8.6	1.92E+00	6.2	8	2.13E+00	5.7	7.7
5.00E+01	6.20E+00	5.8	9.2	1.67E+01	4.1	5.7	1.94E+02	11.3	11.5	5.89E+01	9.1	10	1.20E+01	4.2	6.3	1.45E+01	3.9	5.9
7.50E+01	2.40E+01	3.9	6	7.25E+01	3.4	4.5	7.47E+02	11.5	12.4	4.72E+02	9.6	9.4	6.94E+01	3.1	4.3	8.72E+01	3	4
1.00E+02	8.53E+01	3.1	4.3	1.01E+03	10.2	9.5	3.56E+03	12.3	13.1	3.32E+03	12	12.7	2.14E+02	2.8	3.7	2.66E+02	2.8	3.7
1.50E+02	4.08E+02	2.6	3.6	2.12E+04	16.4	19.8	2.39E+04	16.1	19.5	2.13E+04	16.1	19.6	4.95E+03	11.6	12.7	9.12E+03	12.8	14.4
2.00E+02	2.48E+03	9.2	11	3.05E+04	20.2	24	4.27E+04	19.2	22.8	4.10E+04	19	22.5	2.70E+04	16.3	19.8	3.70E+04	17.1	20.7
3.00E+02	2.70E+04	19	21.9	4.27E+04	21.8	22.3	7.27E+04	22.4	23.1	7.19E+04	22.2	23.1	7.77E+04	21.2	23.1	8.81E+04	21.7	23.3
5.00E+02	6.24E+04	18.9	19.3	6.22E+04	18.4	17.8	7.85E+04	19.6	18.1	7.97E+04	19.8	18.2	8.92E+04	20.4	18.7	9.20E+04	20.3	18.4
7.00E+02	6.13E+04	15.7	14.2	6.29E+04	15.9	14	6.47E+04	15.4	13.1	6.59E+04	15.4	13.1	6.64E+04	15.2	12.7	6.84E+04	15.2	12.7
1.00E+03	4.45E+04	11	9	4.95E+04	11.7	9.2	5.51E+04	12.4	9.5	5.44E+04	12.3	9.5	5.82E+04	12.6	9.6	5.82E+04	12.6	9.6
2.00E+03	4.17E+04	8.9	5.9	4.29E+04	9.4	6.1	4.77E+04	10.4	6.7	4.86E+04	10.5	6.7	4.92E+04	10.6	6.9	5.11E+04	10.8	6.9
3.00E+03	4.13E+04	8.6	5.2	4.55E+04	9.4	5.5	4.90E+04	10.4	6	4.89E+04	10.4	6.1	4.99E+04	10.7	6.1	5.11E+04	10.8	6.2
5.00E+03	4.69E+04	8.6	4.9	4.54E+04	9.6	5.1	5.25E+04	10.6	5.5	5.28E+04	10.7	5.6	5.35E+04	10.9	5.7	5.49E+04	11.2	5.8
1.00E+04	4.75E+04	7.5	4.2	5.22E+04	9.1	4.6	5.32E+04	10.2	5	5.36E+04	10.3	5	5.30E+04	10.7	5.1	5.45E+04	10.7	5.2
2.00E+04	5.77E+04	8.2	4.1	6.17E+04	9	4.2	6.05E+04	10.5	4.7	5.91E+04	10.6	4.7	6.16E+04	11.1	4.8	5.95E+04	11.2	5
5.00E+04	6.73E+04	7.2	3.6	6.81E+04	8.1	3.8	7.34E+04	10.1	4.2	7.19E+04	10.2	4.2	7.21E+04	10.9	4.4	7.36E+04	11.4	4.4
1.00E+05	9.04E+04	7	3	9.41E+04	8.1	3.5	8.49E+04	9.3	3.7	8.31E+04	9.7	3.8	7.97E+04	10.2	3.9	8.38E+04	10.6	4

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.94E+03	6.2	2.4	5.99E+03	6.2	2.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.88E+03	6.2	2.8	1.20E+04	6.2	2.8	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.48E+04	6.4	3.1	1.79E+04	6.4	3.1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.46E+04	6.9	3.6	2.98E+04	6.9	3.6	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.95E+00	7.6	4.4	0.00E+00	1	1	4.88E+04	7.9	4.9	5.90E+04	7.9	4.9	5.61E+01	7.8	4.8	6.02E+00	7.8	4.8
1.40E+01	1.02E+01	7.5	5	2.07E-01	4.9	7.2	6.78E+04	8.6	5.9	8.20E+04	8.6	5.9	8.58E+01	8.5	5.8	1.00E+01	8.5	5.8
2.00E+01	3.17E+01	8.4	6.3	9.95E-01	4.8	6.7	9.53E+04	9.5	7.3	1.15E+05	9.5	7.3	1.35E+02	9.4	7.1	1.67E+01	9.3	7.1
3.00E+01	8.33E+01	8.8	7.5	4.89E+00	3.9	5.4	1.38E+05	10.9	9.7	1.65E+05	10.9	9.7	2.14E+02	10.5	9.1	3.55E+01	9.9	9
5.00E+01	1.22E+03	9.5	7.9	3.95E+01	4.1	5	1.80E+05	13.8	15.3	1.87E+05	14.2	16	5.78E+02	11.7	11.3	9.04E+01	11.3	10.8
7.50E+01	1.06E+04	12	12.2	1.62E+03	10	9	1.48E+05	17.5	22.5	1.49E+05	17.9	23.2	1.62E+03	13.2	14.5	3.53E+02	11.8	12.2
1.00E+02	3.10E+04	14.2	16.2	1.23E+04	12.9	14	1.23E+05	20.3	26.4	1.23E+05	20.6	26.7	3.76E+03	14.4	16.7	1.62E+03	12.6	13.8
1.50E+02	6.75E+04	18.2	22.4	4.35E+04	17.1	20.9	9.78E+04	24.2	27.3	9.81E+04	24.3	27.3	9.44E+03	17.2	21	6.82E+03	16	19.5
2.00E+02	7.57E+04	21.7	24.9	6.59E+04	20.4	23.9	8.73E+04	26.5	25.4	8.84E+04	26.6	25.3	1.60E+04	18.8	21.9	1.48E+04	17.8	20.9
3.00E+02	7.42E+04	23.9	22.9	7.18E+04	23.4	23	8.24E+04	23.4	21.6	8.34E+04	23.4	21.5	3.78E+04	20.5	21.9	4.15E+04	20	21.8
5.00E+02	8.64E+04	19.5	17.9	8.68E+04	19.9	18.3	7.94E+04	18.8	16.7	8.14E+04	18.8	16.8	7.13E+04	19.6	19	7.52E+04	20	19.1
7.00E+02	6.48E+04	15.5	13.1	6.76E+04	15.7	13	7.12E+04	15.7	13	7.22E+04	15.6	13	6.10E+04	15.7	13.6	6.45E+04	15.6	13.6
1.00E+03	5.59E+04	12.7	9.7	5.68E+04	12.7	9.6	6.19E+04	13.1	9.9	6.23E+04	13.2	9.9	5.10E+04	11.7	9.2	5.18E+04	11.8	9.2
2.00E+03	4.91E+04	10.7	7	5.21E+04	10.8	6.9	5.51E+04	11.5	7.3	5.55E+04	11.5	7.3	4.34E+04	9.4	6.2	4.42E+04	9.7	6.3
3.00E+03	5.31E+04	10.8	6.3	4.88E+04	10.5	6.2	5.63E+04	11.5	6.5	5.66E+04	11.5	6.6	4.45E+04	9.3	5.6	4.48E+04	9.5	5.7

(continued on next page)

Table A.18. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	5.17E+04	11	5.7	5.12E+04	10.9	5.7	5.89E+04	11.6	6	5.91E+04	11.8	6	4.77E+04	9.5	5.1	4.85E+04	9.8	5.2
1.00E+04	5.26E+04	10.8	5.2	5.62E+04	10.5	5.2	6.11E+04	11.6	5.4	6.08E+04	11.7	5.5	4.89E+04	8.9	4.6	5.08E+04	9.2	4.6
2.00E+04	6.22E+04	11.1	5	6.03E+04	10.9	4.8	6.71E+04	11.9	5.1	6.66E+04	12.1	5.2	5.78E+04	9.3	4.3	5.59E+04	9.5	4.4
5.00E+04	7.57E+04	10.7	4.4	7.12E+04	11.2	4.3	7.82E+04	11.8	4.6	7.65E+04	12	4.7	7.03E+04	8.4	3.7	6.90E+04	8.7	3.9
1.00E+05	8.67E+04	9.9	4	7.80E+04	10.7	4	8.92E+04	11.2	4.2	8.88E+04	11.6	4.3	8.72E+04	7.5	3.2	8.40E+04	8	3.4

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	6.53E+02	7.8	4.8	7.45E+01	7.8	4.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	9.99E+02	8.5	5.8	1.24E+02	8.6	5.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.01E-01	4.7	9	4.03E-01	4.8	9.6	1.57E+03	9.4	7.1	2.00E+02	9.4	7.1	4.56E-01	7.7	8.9	3.70E-01	5.6	9.7
3.00E+01	1.12E+00	5.4	9.1	1.34E+00	5.4	9.2	2.41E+03	10.6	9.2	4.13E+02	10.1	9.1	1.26E+00	6.1	9.3	1.19E+00	5.6	9
5.00E+01	5.65E+00	6.2	10.2	5.23E+00	6.9	9.9	5.83E+03	12	11.8	9.30E+02	12.1	11.8	5.06E+00	5	9.2	4.92E+00	5.8	10.4
7.50E+01	1.95E+01	3.9	6.5	1.70E+01	4.6	7.4	1.35E+04	13.8	15.4	2.63E+03	13.1	13.8	2.09E+01	4.2	6.8	1.76E+01	4.3	7.1
1.00E+02	6.79E+01	3.3	4.7	6.42E+01	3.3	4.9	2.66E+04	15.1	17.8	9.81E+03	13.9	15.2	6.93E+01	3.1	4.5	6.19E+01	3.4	4.8
1.50E+02	3.73E+02	2.3	3.1	3.73E+02	2.4	3.2	4.65E+04	18.7	22.9	2.58E+04	17.6	21.6	3.71E+02	2.8	3.5	3.85E+02	2.5	3.2
2.00E+02	1.07E+03	2.7	4.3	1.23E+03	2.1	2.9	5.79E+04	21.3	24.1	3.66E+04	20.8	24.1	2.47E+03	9.6	13.8	1.20E+03	2.5	2.9
3.00E+02	2.50E+04	16.9	20.3	1.59E+04	15.6	18.2	7.71E+04	22.7	22.5	7.10E+04	20.3	22.2	1.81E+04	17.6	20.4	1.62E+04	14.5	17.2
5.00E+02	5.78E+04	19.2	18.6	8.19E+04	21.3	20.1	8.96E+04	19.9	17.9	8.04E+04	20.1	18.5	6.22E+04	19.9	19.9	7.49E+04	20.9	19.9
7.00E+02	6.03E+04	16.8	13.9	6.52E+04	16	14.1	6.67E+04	15.4	12.9	7.17E+04	15.6	13.1	5.63E+04	15.4	14.1	6.55E+04	16.1	14.2
1.00E+03	4.81E+04	11.3	9	4.50E+04	11.1	9.1	6.37E+04	12.9	9.6	5.69E+04	12.5	9.6	4.82E+04	11.2	9.1	5.05E+04	11.8	9.1
2.00E+03	3.84E+04	8.6	5.9	4.11E+04	9.5	6	5.13E+04	10.7	7	5.09E+04	10.7	6.9	3.91E+04	8.5	5.9	4.16E+04	8.8	5.8
3.00E+03	4.15E+04	8.7	5.2	4.45E+04	9.1	5.3	5.29E+04	10.8	6.3	4.70E+04	10.3	6.1	4.20E+04	8.5	5.2	3.91E+04	8.7	5.4
5.00E+03	4.16E+04	8.8	4.7	4.25E+04	9	5.1	5.46E+04	11.1	5.7	5.23E+04	11.3	5.6	4.92E+04	9.1	4.8	4.69E+04	8.7	5
1.00E+04	4.72E+04	7.2	4.3	4.90E+04	8.1	4.4	5.31E+04	10.9	5.2	5.67E+04	10.5	5.2	4.98E+04	8.4	4.2	4.93E+04	8.6	4.4
2.00E+04	5.39E+04	8.6	4	5.50E+04	8.8	4.3	6.44E+04	11.1	4.9	5.97E+04	11.3	4.9	5.77E+04	8.8	4.1	5.51E+04	8.8	4.4
5.00E+04	7.04E+04	7.6	3.8	6.74E+04	7.5	3.7	7.47E+04	10.8	4.4	6.90E+04	10.7	4.5	6.27E+04	6.3	3.3	6.90E+04	8.6	3.6
1.00E+05	9.22E+04	6.1	2.9	8.33E+04	6.7	3.1	7.97E+04	9.8	3.9	8.62E+04	10.6	3.8	8.86E+04	6.3	2.9	8.10E+04	6.9	3.1

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.17E+01	7.8	4.7	0.00E+00	1	1
1.40E+01	1.13E-01	6.9	9.8	0.00E+00	1	1	1.07E-01	6.8	9.8	1.06E-01	7	10.1	5.01E+01	8.4	5.6	1.53E-01	6.1	8.8
2.00E+01	4.00E-01	7.5	9.6	4.44E-01	7.1	9.6	3.81E-01	7.9	9.3	4.40E-01	7.9	9.8	8.67E+01	9	6.6	6.38E-01	4.9	8
3.00E+01	1.37E+00	7.2	9.1	1.47E+00	7.1	8.9	1.28E+00	7	9.1	1.30E+00	7.2	9.3	1.91E+02	10.1	8.3	3.25E+00	6.2	6.8
5.00E+01	5.96E+00	5.8	8.9	6.64E+00	5.5	8.3	5.21E+00	6.1	9.5	5.40E+00	5.9	9.5	1.16E+03	10.5	9.4	2.50E+01	4.7	6.1
7.50E+01	2.72E+01	3.9	5.8	3.37E+01	3.6	5.3	2.14E+01	4.2	6.2	2.34E+01	4	6.1	5.07E+03	12.7	13.5	1.98E+02	9.1	9
1.00E+02	9.01E+01	3.1	4.2	1.12E+02	2.9	3.9	6.87E+01	3.1	4.4	8.15E+01	3.1	4.3	1.07E+04	14.8	17.4	2.62E+03	11.4	11.7
1.50E+02	4.56E+02	2.7	3.9	6.80E+02	4.5	4.9	4.00E+02	2.4	3.2	4.53E+02	2.4	3.1	2.11E+04	18.3	22.5	1.75E+04	16.6	20.4
2.00E+02	5.06E+03	11.7	14	7.21E+03	13.2	15.6	1.17E+03	3.8	4.8	1.36E+03	4.2	5.3	2.57E+04	21.3	23.9	2.46E+04	19.9	23.4
3.00E+02	3.01E+04	19	21.6	4.05E+04	19.3	21.7	2.79E+04	17.4	20.5	2.84E+04	17	20.2	4.07E+04	21.4	21.9	4.41E+04	21.1	21.9
5.00E+02	7.43E+04	19.9	19.6	8.07E+04	20.2	19.4	6.60E+04	19.4	19	6.78E+04	19.8	19.4	6.98E+04	19.5	18.7	7.52E+04	19.6	18.9
7.00E+02	6.02E+04	15.6	13.7	6.46E+04	15.5	13.4	6.29E+04	15.9	14	5.94E+04	15.3	13.7	6.22E+04	15.6	13.6	6.43E+04	15.6	13.5
1.00E+03	5.13E+04	11.6	9	5.18E+04	11.8	9.3	4.66E+04	11.2	9.1	5.07E+04	11.6	9.1	5.14E+04	11.8	9.2	5.19E+04	11.8	9.2
2.00E+03	4.26E+04	9.2	6.1	4.46E+04	9.7	6.3	4.23E+04	8.8	5.9	4.31E+04	9.2	6.1	4.55E+04	9.6	6.3	4.45E+04	9.7	6.3
3.00E+03	4.35E+04	9.1	5.5	4.47E+04	9.6	5.7	4.23E+04	8.7	5.3	4.36E+04	9.2	5.5	4.55E+04	9.5	5.6	4.58E+04	9.7	5.7
5.00E+03	4.80E+04	9.2	5.1	4.97E+04	9.8	5.2	4.59E+04	8.8	4.9	4.74E+04	9.4	5.1	5.01E+04	9.6	5.2	4.87E+04	9.8	5.2
1.00E+04	4.66E+04	8.6	4.5	5.39E+04	9.3	4.6	4.87E+04	8.3	4.3	4.88E+04	8.7	4.4	4.97E+04	9.1	4.5	5.14E+04	9.4	4.7
2.00E+04	5.45E+04	9.3	4.2	5.55E+04	9.6	4.4	5.79E+04	8.6	4.1	5.75E+04	8.7	4.2	5.84E+04	9.2	4.3	5.49E+04	9.4	4.4
5.00E+04	6.73E+04	8.3	3.7	6.97E+04	8.9	3.8	7.07E+04	7.5	3.6	6.76E+04	8.4	3.6	7.31E+04	8.7	3.8	7.13E+04	9.2	4
1.00E+05	8.57E+04	7.8	3.3	8.14E+04	7.6	3.4	8.92E+04	6.5	3	8.39E+04	7.3	3.2	8.63E+04	8	3.4	8.67E+04	8.2	3.4

Table A.18. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.41E+01	7.9	4.8	3.33E+00	7.8	4.8	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	6.48E+01	8.5	5.8	4.83E+00	8.5	5.8	1.14E-01	5.6	9.1	1.47E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	9.83E+01	9.3	7.1	8.34E+00	9.1	7.1	4.62E-01	6.6	9	4.43E+00	8.1	5.1	3.38E-01	6.8	9.7	4.01E-01	7.1	10.1
3.00E+01	1.69E+02	10.4	9	1.66E+01	9.6	8.6	2.19E+00	5.9	8	1.45E+01	8.4	7.4	1.24E+00	7.1	9.5	1.24E+00	7.1	9.2
5.00E+01	4.56E+02	11.2	10.9	6.32E+01	9.2	9.3	1.29E+01	3.8	6.2	9.63E+01	10.3	8.2	4.55E+00	6.7	10.6	5.34E+00	6.1	9.8
7.50E+01	2.14E+03	12.1	12.7	6.19E+02	10.4	10.2	9.62E+01	5.3	6.8	8.80E+02	11.6	11.8	1.34E+01	5.4	8.3	2.00E+01	4.2	6.5
1.00E+02	8.39E+03	13.5	15	2.78E+03	12.5	13.7	1.70E+03	11	11.3	4.48E+03	12.7	14.1	3.92E+01	3.8	5.6	7.03E+01	3.3	4.5
1.50E+02	2.93E+04	16.9	20.5	1.70E+04	15.6	18.7	9.12E+03	15.9	20.3	1.58E+04	17	21.3	2.76E+02	2.5	3.4	4.53E+02	2.5	3.1
2.00E+02	4.92E+04	19.7	23.2	3.93E+04	18.5	22.1	1.76E+04	17.6	20.6	3.21E+04	18.3	21.3	8.61E+02	2.1	2.7	1.16E+03	2.5	3.6
3.00E+02	7.15E+04	22.8	23.2	7.04E+04	22.3	23.2	7.59E+04	20.2	22.5	8.40E+04	21.3	23	2.94E+03	4.9	6.7	2.25E+04	15.9	18.9
5.00E+02	7.55E+04	19.4	17.8	7.70E+04	19.6	18.1	9.24E+04	19.9	18.2	8.45E+04	19.6	18.4	6.67E+04	19.9	20.3	6.73E+04	19.6	19.6
7.00E+02	6.53E+04	15.4	13.2	6.60E+04	15.4	13.2	6.18E+04	15.5	13.1	6.78E+04	15.5	13.3	5.53E+04	15.9	14	6.17E+04	15.3	14
1.00E+03	5.47E+04	12.3	9.5	5.45E+04	12.3	9.4	5.41E+04	12.4	9.4	5.81E+04	12.4	9.4	4.68E+04	11.1	8.8	4.98E+04	11.6	8.9
2.00E+03	4.78E+04	10.3	6.7	4.77E+04	10.3	6.6	4.69E+04	10.4	6.8	5.05E+04	10.8	6.8	3.86E+04	8.4	5.6	4.26E+04	9	6
3.00E+03	4.88E+04	10.3	6	4.86E+04	10.2	6	4.84E+04	10.4	6	4.91E+04	10.5	6.2	3.94E+04	8.2	5	4.33E+04	9	5.3
5.00E+03	5.24E+04	10.5	5.5	5.19E+04	10.5	5.5	5.12E+04	10.8	5.5	5.41E+04	11.3	5.6	4.56E+04	8.4	4.7	4.35E+04	8.8	4.9
1.00E+04	5.40E+04	10.1	4.9	5.32E+04	10.1	4.9	5.35E+04	10.5	5.1	5.43E+04	10.8	5.1	4.66E+04	8.3	4.1	4.82E+04	8.4	4.4
2.00E+04	6.06E+04	10.3	4.7	5.96E+04	10.4	4.7	5.99E+04	10.1	4.8	5.76E+04	11	4.7	5.55E+04	8.2	3.9	5.19E+04	8.8	4.1
5.00E+04	7.37E+04	9.8	4.1	7.11E+04	9.9	4.1	7.09E+04	11.3	4.4	6.76E+04	10.4	4.2	6.45E+04	7	3.3	6.56E+04	7.1	3.8
1.00E+05	8.73E+04	9	3.6	8.52E+04	9.2	3.7	8.50E+04	9.3	3.6	7.47E+04	8.6	3.9	8.76E+04	6.3	2.8	8.66E+04	7.4	3.2

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.00E-01	6.9	10.2	1.12E-01	7.4	9.6	1.13E-01	7.3	9.7	1.31E-01	6.2	10.1	1.33E-01	6.6	9.7
2.00E+01	3.73E-01	5.2	9.4	4.46E-01	6.9	9.8	4.02E-01	7.2	9.6	4.07E-01	7.2	9.6	3.87E-01	7.2	9.5	4.23E-01	6.4	9.9
3.00E+01	1.08E+00	7.2	9.3	1.20E+00	7.3	9.3	1.37E+00	7	9	1.41E+00	7	8.9	1.38E+00	6.9	9	1.48E+00	6.9	8.8
5.00E+01	4.95E+00	6.2	10.2	4.75E+00	6.8	10.3	5.99E+00	5.7	8.7	6.20E+00	5.4	8.7	5.84E+00	5.3	8.9	7.33E+00	5	7.9
7.50E+01	1.49E+01	5.2	7.9	1.69E+01	4.9	7.9	2.70E+01	3.9	5.7	2.92E+01	3.8	5.6	2.72E+01	3.8	5.6	3.72E+01	3.5	5
1.00E+02	4.55E+01	3.5	5.5	5.21E+01	3.6	5.2	7.87E+01	3	4.1	1.02E+02	3	4.1	1.01E+02	3	4.1	1.36E+02	3	3.9
1.50E+02	3.02E+02	2.5	3.3	3.25E+02	2.5	3.2	5.84E+02	5.4	6.1	4.88E+02	3	3.7	4.93E+02	2.5	3.3	6.10E+02	3.3	3.8
2.00E+02	8.95E+02	2.4	2.7	1.15E+03	2.8	3	5.08E+03	12.9	15.1	5.44E+03	12.3	14.3	3.64E+03	9.9	11.9	8.56E+03	13	15.3
3.00E+02	4.40E+03	6.5	8.9	1.09E+04	12.6	15.5	3.03E+04	19.2	21.7	3.51E+04	19.2	21.8	3.83E+04	18.8	21.9	5.37E+04	20.2	22.8
5.00E+02	6.20E+04	20.3	20.3	6.40E+04	19.6	19.4	6.51E+04	19.5	19	6.68E+04	19.5	19.2	6.95E+04	19.4	19	7.18E+04	19.6	18.6
7.00E+02	5.76E+04	16.1	14	6.08E+04	15.6	14.2	5.96E+04	15.5	13.8	6.13E+04	15.5	13.8	6.20E+04	15.9	13.8	6.26E+04	15.6	13.6
1.00E+03	4.63E+04	11	8.9	4.68E+04	11.1	8.8	4.75E+04	11.3	9.1	4.93E+04	11.6	9	4.83E+04	11.4	9.2	5.21E+04	11.7	9.2
2.00E+03	3.93E+04	8.7	5.7	3.93E+04	8.9	5.9	4.13E+04	8.9	5.9	4.25E+04	9.2	6.1	4.17E+04	9.1	6.1	4.16E+04	9.6	6.2
3.00E+03	4.16E+04	7.7	5.3	3.89E+04	8.5	5.2	4.18E+04	8.8	5.3	4.43E+04	9.1	5.4	4.38E+04	9.1	5.5	4.55E+04	9.6	5.7
5.00E+03	4.11E+04	8.7	4.8	4.73E+04	9	4.7	4.58E+04	8.8	4.9	4.74E+04	9.3	5	4.74E+04	9.5	5.1	4.87E+04	9.7	5.2
1.00E+04	4.32E+04	6.8	4.2	4.39E+04	7.6	4.2	4.76E+04	8.2	4.3	4.98E+04	8.7	4.4	4.42E+04	8.3	4.5	4.71E+04	9.4	4.7
2.00E+04	5.57E+04	8.3	4	5.60E+04	8.1	3.9	5.63E+04	8.3	4.1	5.45E+04	8.6	4.2	5.95E+04	9.6	4.2	5.34E+04	9.2	4.4
5.00E+04	7.27E+04	6	3.1	6.77E+04	7.1	3.6	7.26E+04	7.6	3.5	7.08E+04	7.9	3.7	6.92E+04	8.5	3.6	7.10E+04	8.2	3.9
1.00E+05	9.13E+04	5.8	2.9	8.39E+04	6	3.1	8.88E+04	7	3	9.01E+04	7.4	3.2	8.55E+04	6.6	3.3	8.51E+04	8.3	3.3

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.11E-01	5.8	8.7	0.00E+00	1	1	2.87E+00	4.2	5.6	2.87E+00	4.2	5.6
2.00E+01	7.10E-01	6.4	8.2	0.00E+00	1	1	1.38E+01	4.3	5.5	1.38E+01	4.3	5.5
3.00E+01	2.30E+00	5	7.2	2.42E+00	5.3	7.5	6.53E+01	4.6	5.6	6.53E+01	4.6	5.6
5.00E+01	1.71E+01	3.6	5.8	1.53E+01	4.4	6	6.36E+04	9.1	6.8	6.36E+04	9.1	6.8
7.50E+01	5.94E+01	3.3	4.2	6.36E+01	3	4.2	1.67E+05	14.5	16.8	1.67E+05	14.5	16.8

(continued on next page)

Table A.18. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	9.35E+02	9.7	9.6	6.22E+02	8.6	8.7	1.37E+05	18.6	24.1	1.37E+05	18.6	24.1
1.50E+02	1.35E+04	15.1	18.1	8.83E+03	14.8	16.8	9.96E+04	21.8	26.5	9.96E+04	21.8	26.5
2.00E+02	3.75E+04	17.5	21.4	3.31E+04	17.3	20.9	9.33E+04	25.1	25.2	9.33E+04	25.1	25.2
3.00E+02	4.95E+04	23.3	23.5	4.70E+04	23.3	22.9	8.96E+04	22.9	22.6	8.96E+04	22.9	22.6
5.00E+02	7.56E+04	19	19.2	8.54E+04	20.4	18.8	8.27E+04	18.5	17	8.27E+04	18.5	17
7.00E+02	6.22E+04	15.6	13.4	6.72E+04	15.4	13.5	7.39E+04	15.7	12.4	7.39E+04	15.7	12.4
1.00E+03	5.61E+04	12.3	9.2	5.65E+04	12	9.4	6.08E+04	13	9.9	6.08E+04	13	9.9
2.00E+03	4.96E+04	10.2	6.5	4.46E+04	10.5	6.5	5.74E+04	11.7	7.2	5.74E+04	11.7	7.2
3.00E+03	4.64E+04	9.7	5.8	4.78E+04	10.1	5.9	5.66E+04	11.6	6.6	5.66E+04	11.6	6.6
5.00E+03	4.76E+04	10.2	5.4	5.08E+04	10.2	5.4	5.65E+04	11.6	6.1	5.65E+04	11.6	6.1
1.00E+04	5.22E+04	9.6	4.8	5.49E+04	9.9	4.6	5.67E+04	11.2	5.6	5.67E+04	11.2	5.6
2.00E+04	5.68E+04	9.8	4.6	5.54E+04	10.6	4.7	6.87E+04	11.9	5.1	6.87E+04	11.9	5.1
5.00E+04	7.13E+04	8.8	4	6.95E+04	9.2	4.1	6.46E+04	11.3	5.1	6.46E+04	11.3	5.1
1.00E+05	8.69E+04	9.1	3.6	8.40E+04	9.4	3.7	8.07E+04	11.4	4.2	8.07E+04	11.4	4.2

Table A.19. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{32}S ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.63E+00	7.5	1.1	1.99E+00	7.4	1.1	5.44E+02	7.3	4.2	6.00E+02	7.4	4.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.07E+00	8.1	1.3	3.07E+00	8	1.4	9.71E+02	7.8	4.8	9.80E+02	7.9	5	1.17E-01	7.1	9.6	1.16E-01	7	9.5
2.00E+01	1.51E+01	8.8	1.6	5.37E+00	8.7	1.7	1.97E+03	8.5	5.8	1.79E+03	8.6	5.9	4.63E-01	7	9.5	4.59E-01	6.9	9.3
3.00E+01	2.64E+01	9.6	2.1	9.93E+00	9	2.1	4.55E+03	9.4	7.2	4.06E+03	9.5	7.4	1.60E+00	6.3	8.6	1.56E+00	6.4	8.5
5.00E+01	7.30E+01	10.3	2.6	3.08E+01	8.4	2.5	2.13E+04	10.4	8.9	1.80E+04	10.5	9.2	7.99E+00	4.7	7.5	8.44E+00	4.8	7.4
7.50E+01	2.50E+02	10.4	2.9	2.04E+02	8.7	2.2	6.83E+04	12.6	13.2	4.42E+04	12.9	13.7	4.73E+01	3.5	4.7	4.19E+01	3.5	4.8
1.00E+02	9.50E+02	11	2.9	1.47E+03	11	2.9	1.10E+05	14.8	17.2	6.79E+04	15	17.6	1.88E+02	5.2	5.6	1.36E+02	2.8	3.7
1.50E+02	1.08E+04	14.4	4.3	1.03E+04	14.7	4.4	1.39E+05	18.9	23.4	9.68E+04	18.4	22.6	1.15E+03	8.8	10	1.28E+03	8	8.7
2.00E+02	1.94E+04	17.6	5.5	2.00E+04	17.3	5.4	1.27E+05	22.3	25.8	1.05E+05	21.4	24.8	1.14E+04	13.7	15.9	1.24E+04	14	16.6
3.00E+02	4.07E+04	20.1	5.8	4.33E+04	20.2	5.8	9.44E+04	26.3	23.8	9.32E+04	25.6	23.9	4.70E+04	19.4	22.4	4.92E+04	19.5	22.3
5.00E+02	7.51E+04	20.8	5.4	8.12E+04	21	5.5	8.02E+04	20.6	17.5	8.49E+04	20.7	18.2	7.20E+04	20.9	19.7	6.88E+04	20.7	19.6
7.00E+02	7.01E+04	17.9	4.5	7.16E+04	17.9	4.5	8.63E+04	17.7	15.1	7.96E+04	18.1	15.2	6.80E+04	17.6	15.3	7.00E+04	17.8	15.5
1.00E+03	5.58E+04	13.8	3.4	5.76E+04	13.9	3.4	6.81E+04	15.1	11.4	6.79E+04	14.9	11.2	5.47E+04	13.7	10.7	5.56E+04	13.7	10.6
2.00E+03	4.69E+04	11	2.5	4.85E+04	11.3	2.5	6.02E+04	13.1	8.3	6.06E+04	12.9	8.2	4.66E+04	10.8	7	4.55E+04	11	7.2
3.00E+03	4.81E+04	10.8	2.3	5.00E+04	11.2	2.4	6.07E+04	13.1	7.4	6.04E+04	12.8	7.3	4.83E+04	10.7	6.3	4.77E+04	10.7	6.4
5.00E+03	5.37E+04	11.1	2.2	5.40E+04	11.4	2.2	5.75E+04	13.3	6.7	5.90E+04	12.9	6.7	5.28E+04	10.8	5.8	5.21E+04	11	5.8
1.00E+04	5.38E+04	10.3	2	5.58E+04	10.9	2	6.56E+04	13.2	6	6.22E+04	12.8	6.1	5.47E+04	10.2	5.1	5.36E+04	10.4	5.2
2.00E+04	6.17E+04	10.6	1.9	6.22E+04	10.9	2	7.68E+04	13.2	5.8	6.71E+04	12.9	5.7	6.19E+04	10.2	4.8	6.29E+04	10.6	4.9
5.00E+04	7.67E+04	9.9	1.8	7.36E+04	10.5	1.8	8.35E+04	13.1	5.1	8.32E+04	13.1	5.1	7.65E+04	9.3	4.1	7.48E+04	9.7	4.2
1.00E+05	9.53E+04	8.8	1.6	8.80E+04	9.5	1.7	1.03E+05	12.9	4.6	9.41E+04	12.3	4.5	9.55E+04	8.7	3.6	9.40E+04	8.7	3.7

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	7.65E+02	7.5	4.4	0.00E+00	1	1
1.40E+01	1.20E-01	7.5	9.8	1.27E-01	7.3	9.9	1.23E-01	6.6	9.9	1.25E-01	7.5	9.4	1.06E+03	8.1	5.2	0.00E+00	1	1
2.00E+01	4.57E-01	7.6	9.5	4.71E-01	7.2	9.5	3.68E-01	7.6	9.5	4.74E-01	7	9.8	1.54E+03	8.9	6.3	2.74E-01	5.4	10.4
3.00E+01	1.55E+00	6.8	8.8	1.62E+00	6.8	8.8	1.45E+00	6.8	8.9	1.66E+00	6.4	8.5	2.73E+03	10	8.1	1.57E+00	5.4	8.9
5.00E+01	7.53E+00	5.2	7.9	8.37E+00	4.9	7.6	6.43E+00	5.3	8.4	9.11E+00	4.6	7.3	6.27E+03	11.4	10.9	4.15E+00	6.2	9.9
7.50E+01	3.86E+01	3.4	5	4.53E+01	3.3	4.7	3.05E+01	3.7	5.5	4.55E+01	3.4	4.7	1.49E+04	12.9	13.9	1.45E+01	4.7	7.9
1.00E+02	1.32E+02	2.8	3.7	1.56E+02	2.7	3.5	1.01E+02	3	4.1	1.43E+02	3	3.8	2.63E+04	14.6	16.9	4.83E+01	3.4	5.2
1.50E+02	8.25E+02	5.9	6.4	8.61E+02	4.4	5.3	4.64E+02	2.9	3.6	9.39E+02	6.1	7.4	4.86E+04	17.3	21.2	3.19E+02	2.3	3.2
2.00E+02	6.96E+03	12.7	14.8	9.29E+03	12.3	14	3.53E+03	10	10.7	1.56E+04	13.8	16	6.72E+04	19.8	23.2	9.89E+02	2.3	2.8
3.00E+02	5.04E+04	18.2	21.2	6.73E+04	18.6	21.8	3.59E+04	18.4	21.4	5.02E+04	19.8	22.3	6.58E+04	24.7	23.8	4.03E+03	5.9	7.2
5.00E+02	8.55E+04	21.7	20.2	9.18E+04	21.5	20.1	6.95E+04	20.7	19.9	7.92E+04	21.1	19.9	7.28E+04	19.9	18	7.89E+04	20.4	21
7.00E+02	7.24E+04	17.9	15.3	7.44E+04	17.9	15.1	7.00E+04	17.9	15.9	7.02E+04	18	15.3	7.61E+04	18.2	15.5	6.90E+04	17.7	16.3
1.00E+03	5.86E+04	13.9	10.7	5.97E+04	14.1	10.8	5.50E+04	13.6	10.5	5.88E+04	13.8	10.7	5.64E+04	14	10.8	5.42E+04	13.1	10
2.00E+03	4.82E+04	11.4	7.4	5.22E+04	11.8	7.6	4.53E+04	10.7	6.9	4.96E+04	11.1	7.3	5.41E+04	11.9	7.6	4.45E+04	10.2	6.7
3.00E+03	5.10E+04	11.2	6.6	5.21E+04	11.7	6.8	4.57E+04	10.4	6.2	4.95E+04	11	6.5	5.24E+04	11.9	6.8	4.46E+04	9.8	6
5.00E+03	5.61E+04	11.6	6	5.66E+04	12	6.2	5.17E+04	10.6	5.8	5.41E+04	11.3	5.9	5.78E+04	11.8	6.3	4.71E+04	10.4	5.7
1.00E+04	5.65E+04	11	5.3	5.89E+04	11.6	5.5	5.10E+04	9.9	4.9	5.39E+04	10.6	5.3	5.78E+04	11.3	5.5	5.26E+04	9.1	4.8
2.00E+04	6.35E+04	11.2	5.1	6.55E+04	11.8	5.2	5.94E+04	10.1	4.7	6.38E+04	10.8	4.9	6.58E+04	11.9	5.3	6.26E+04	9.7	4.7
5.00E+04	8.12E+04	10.6	4.5	7.46E+04	11.5	4.7	7.37E+04	9.3	4.1	7.87E+04	10.5	4.3	7.84E+04	11.5	4.5	7.19E+04	8.1	3.9
1.00E+05	8.90E+04	9.8	4	8.60E+04	11.1	4.1	9.43E+04	8.2	3.6	9.42E+04	9.5	3.8	1.02E+05	10.6	3.9	9.45E+04	7.1	3.3

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.19E-01	7.5	9.8	1.26E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.19. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	4.18E-01	7.5	9.6	4.48E-01	7.1	9.5	3.28E-01	6.2	9.3	4.30E-01	6.2	9.7	5.49E-01	5.2	7.6	7.41E-01	4.4	7.9
3.00E+01	1.42E+00	6.9	8.8	1.52E+00	6.8	8.7	1.43E+00	6.1	9.1	1.45E+00	7	9	3.01E+00	4.1	6.4	2.85E+00	3.8	6.1
5.00E+01	6.70E+00	5.4	8.4	8.04E+00	5	7.6	6.69E+00	5.6	8.7	6.56E+00	5.6	8.8	2.12E+01	3.4	5.2	2.60E+01	3.5	5
7.50E+01	3.09E+01	3.8	5.4	4.03E+01	3.4	4.9	2.76E+01	4	5.7	3.03E+01	3.9	5.7	9.95E+01	3	4.1	1.05E+02	3	3.9
1.00E+02	9.63E+01	3	4	1.29E+02	2.9	3.8	8.79E+01	2.9	5.2	1.02E+02	2.9	4.1	4.10E+02	6	4.4	3.77E+02	5.1	5.9
1.50E+02	5.72E+02	5.2	5.9	1.18E+03	7.6	7.8	9.08E+02	7.8	10.7	7.00E+02	4.8	4.7	1.88E+04	13.5	15.2	2.79E+04	13.8	15.5
2.00E+02	7.23E+03	13	15.2	1.04E+04	13.7	16.1	6.60E+03	13.6	15.3	5.53E+03	12.5	15	5.37E+04	16.8	21	6.30E+04	17.5	21.8
3.00E+02	3.36E+04	18.3	21.2	4.54E+04	19.1	22	2.07E+04	18.4	21.2	2.83E+04	18.2	20.7	6.84E+04	23.5	24.1	6.02E+04	23.3	24.1
5.00E+02	7.03E+04	20.7	19.9	7.91E+04	20.9	20.1	8.16E+04	20.5	20.9	9.35E+04	21.9	20.9	7.84E+04	20.6	19.4	9.29E+04	20.8	19.3
7.00E+02	6.68E+04	17.7	15.6	7.20E+04	18	15.4	7.05E+04	18.1	15.5	7.54E+04	18	15.5	7.53E+04	17.5	15.3	8.51E+04	18.4	15.4
1.00E+03	5.51E+04	13.5	10.5	5.69E+04	13.9	10.7	5.77E+04	13.7	10.6	5.99E+04	14	10.6	5.91E+04	14	11	6.95E+04	14.6	10.9
2.00E+03	4.53E+04	10.6	6.9	4.82E+04	11.1	7.2	4.59E+04	10.7	7.1	5.17E+04	11.5	7.3	5.19E+04	11.9	7.6	5.12E+04	11.9	7.8
3.00E+03	4.73E+04	10.5	6.2	4.91E+04	11	6.5	4.65E+04	10.6	6.3	5.02E+04	11.1	6.6	5.19E+04	11.6	6.9	5.18E+04	12	6.8
5.00E+03	5.18E+04	10.5	5.7	5.24E+04	11.5	5.9	5.58E+04	11	5.9	5.26E+04	11.3	6	5.65E+04	11.7	6.2	6.11E+04	12.6	6.3
1.00E+04	5.35E+04	10	5	5.28E+04	10.6	5.2	5.14E+04	9.5	5	5.41E+04	10.3	5.3	5.15E+04	11.7	5.4	5.75E+04	11.9	5.7
2.00E+04	6.01E+04	10	4.7	5.99E+04	10.5	4.9	5.96E+04	9.8	4.8	6.24E+04	11.1	5	5.57E+04	12.3	5.2	6.63E+04	12.2	5.4
5.00E+04	7.72E+04	9.3	4	7.88E+04	10.1	4.3	7.79E+04	9.4	4.2	6.78E+04	10.1	4.4	7.66E+04	11.5	4.8	7.81E+04	11.2	4.8
1.00E+05	9.35E+04	8.2	3.6	8.94E+04	9.4	3.8	9.26E+04	9	3.6	8.85E+04	9.6	3.7	9.28E+04	10.4	4	9.23E+04	10.8	4.1

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.12E+01	7.5	4.4	4.43E+00	7.5	4.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.67E-01	4.2	8.8	3.01E+01	8.1	5.2	6.57E+00	8	5.2	1.49E-01	7.2	10	1.58E-01	7.2	9.6
2.00E+01	4.09E-01	6.4	9.3	6.04E-01	4.9	7.6	4.73E+01	8.8	6.3	1.14E+01	8.8	6.4	5.54E-01	7.3	9.3	5.94E-01	6.8	9
3.00E+01	1.53E+00	6.6	8.8	2.71E+00	5	6.8	8.25E+01	9.8	8	2.06E+01	9.1	7.8	1.97E+00	6.2	8	2.20E+00	5.7	7.7
5.00E+01	6.34E+00	5.7	9.1	1.68E+01	4.1	5.7	2.02E+02	10.7	10.3	6.07E+01	8.6	8.8	1.23E+01	4.1	6.3	1.49E+01	3.9	5.8
7.50E+01	2.43E+01	3.8	6	7.22E+01	3.4	4.5	7.06E+02	10.9	11.3	3.15E+02	8.8	8.2	6.95E+01	3.1	4.2	8.66E+01	3	4
1.00E+02	8.50E+01	3.1	4.3	9.48E+02	8.6	7.4	2.96E+03	11.5	11.8	3.03E+03	11.2	11.3	2.13E+02	2.7	3.5	2.51E+02	2.7	3.4
1.50E+02	4.02E+02	2.6	3.5	2.18E+04	14.8	17.3	2.45E+04	14.9	17.5	2.16E+04	14.9	17.6	4.00E+03	9.8	10.3	7.79E+03	11.3	12
2.00E+02	1.26E+03	4.6	7.4	3.24E+04	18.8	22.6	4.43E+04	17.9	21.6	4.23E+04	17.7	21.4	2.59E+04	15	17.8	3.72E+04	15.7	18.9
3.00E+02	2.80E+04	18	21.1	4.54E+04	21.7	22.5	7.85E+04	21.6	23.2	7.54E+04	21.5	23.2	8.07E+04	20	22.7	9.00E+04	20.5	23
5.00E+02	6.49E+04	20.2	19.7	6.88E+04	20.2	18.9	8.69E+04	21.6	19.6	8.98E+04	21.6	19.8	1.06E+05	22.3	20.4	1.06E+05	22.4	20.2
7.00E+02	7.15E+04	18	16	7.36E+04	18.2	15.7	7.48E+04	17.9	15	7.44E+04	17.8	15	7.92E+04	17.9	14.8	7.90E+04	17.8	14.6
1.00E+03	5.30E+04	13.5	10.4	5.71E+04	14	10.6	6.15E+04	14.5	11.1	6.19E+04	14.4	11	6.50E+04	14.5	11.1	6.44E+04	14.6	11.2
2.00E+03	4.40E+04	10.2	6.8	4.76E+04	11.2	7.2	5.28E+04	12.1	7.8	5.36E+04	12.2	7.8	5.62E+04	12.4	7.9	5.95E+04	12.7	8.1
3.00E+03	4.40E+04	9.7	6	5.06E+04	11	6.5	5.35E+04	12	7	5.42E+04	12.1	7	5.50E+04	12.4	7.1	5.82E+04	12.6	7.2
5.00E+03	4.88E+04	10.2	5.6	5.19E+04	10.9	5.8	5.86E+04	12.3	6.4	5.81E+04	12.4	6.4	6.16E+04	12.7	6.6	6.07E+04	12.8	6.6
1.00E+04	5.17E+04	9.4	4.8	5.25E+04	10.5	5.2	5.87E+04	11.9	5.7	5.94E+04	12.1	5.8	6.09E+04	12.5	5.9	6.38E+04	13	6
2.00E+04	6.22E+04	9.9	4.5	6.52E+04	10.2	4.8	6.59E+04	12.3	5.4	6.58E+04	12.4	5.4	6.92E+04	13	5.5	6.70E+04	13.2	5.7
5.00E+04	7.74E+04	8.4	3.9	8.16E+04	11	4.2	7.96E+04	11.8	4.8	7.76E+04	12	4.8	7.65E+04	12.5	4.9	8.26E+04	13.2	5.1
1.00E+05	9.86E+04	7.5	3.3	9.44E+04	9.4	3.6	9.29E+04	10.9	4.2	8.94E+04	11.3	4.3	9.46E+04	12.3	4.4	8.82E+04	12.4	4.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.09E+03	6	2.3	6.19E+03	6	2.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.02E+04	6	2.6	1.24E+04	6	2.6	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.52E+04	6.2	2.8	1.85E+04	6.2	2.8	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.54E+04	6.6	3.3	3.08E+04	6.6	3.3	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.19E+00	7.2	4	0.00E+00	1	1	5.05E+04	7.5	4.4	6.12E+04	7.5	4.4	5.94E+01	7.4	4.3	7.51E+00	7.4	4.3
1.40E+01	1.08E+01	7.4	4.6	2.09E-01	4.9	7.2	7.02E+04	8.1	5.3	8.46E+04	8.1	5.3	9.13E+01	8.1	5.2	1.05E+01	8	5.2
2.00E+01	3.20E+01	8.2	5.5	1.04E+00	4.8	6.6	9.87E+04	9	6.5	1.19E+05	9	6.5	1.43E+02	8.8	6.4	1.74E+01	8.7	6.2
3.00E+01	8.43E+01	8.1	6.5	5.05E+00	3.9	5.3	1.43E+05	10.3	8.6	1.71E+05	10.3	8.6	2.28E+02	10	8.1	3.68E+01	9.6	8
5.00E+01	1.07E+03	8.7	6.9	3.95E+01	4	5	1.99E+05	12.8	13.2	2.08E+05	13.2	14	5.68E+02	11.1	10.5	9.32E+01	10.7	10.4
7.50E+01	1.02E+04	11.1	10.4	1.36E+03	8.7	7.4	1.67E+05	16.3	20.2	1.68E+05	16.6	20.9	1.65E+03	12.4	12.9	3.45E+02	10.8	11.4
1.00E+02	3.17E+04	13.2	14.3	1.17E+04	11.8	12.1	1.40E+05	19	24.6	1.39E+05	19.3	25.1	3.83E+03	13.4	15.2	1.54E+03	11.8	12.3
1.50E+02	7.00E+04	16.9	20.6	4.45E+04	15.8	19	1.10E+05	22.7	27.2	1.10E+05	22.8	27.2	9.79E+03	16.2	19.5	6.96E+03	15	17.7
2.00E+02	8.27E+04	20.4	24.1	6.99E+04	18.8	22.8	9.72E+04	25	26.1	9.78E+04	25	26.1	1.66E+04	17.8	21.3	1.50E+04	16.6	19.7
3.00E+02	8.33E+04	24.2	23.7	7.91E+04	23.1	23.6	9.04E+04	25.7	22.8	9.22E+04	25.7	22.8	3.90E+04	19.8	21.8	4.15E+04	19.2	21.4
5.00E+02	9.84E+04	20.7	18.8	9.49E+04	21.3	19.8	8.82E+04	21	18.3	9.04E+04	21	18.4	7.60E+04	20.8	20	8.34E+04	21.1	20.3
7.00E+02	7.70E+04	18.3	14.9	7.83E+04	18	15.1	8.02E+04	18	14.8	8.17E+04	18	14.8	7.18E+04	18	15.6	7.37E+04	18	15.4
1.00E+03	6.25E+04	14.8	11.2	6.27E+04	14.5	11.1	6.98E+04	15.3	11.5	7.05E+04	15.3	11.5	5.64E+04	13.7	10.6	5.82E+04	13.9	10.7
2.00E+03	5.75E+04	12.7	8	5.83E+04	12.7	8.1	6.17E+04	13.4	8.4	6.25E+04	13.5	8.5	4.77E+04	11	7.2	4.85E+04	11.1	7.3

Table A.19. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	5.92E+04	12.8	7.2	5.67E+04	12.5	7.3	6.32E+04	13.4	7.6	6.29E+04	13.4	7.6	4.91E+04	10.9	6.4	5.03E+04	11.2	6.5
5.00E+03	6.06E+04	13.1	6.6	5.99E+04	12.7	6.6	6.61E+04	13.6	6.9	6.57E+04	13.7	7	5.30E+04	11.1	5.9	5.39E+04	11.4	6
1.00E+04	6.55E+04	12.5	6.1	6.00E+04	12.5	5.9	6.73E+04	13.5	6.3	6.82E+04	13.7	6.4	5.34E+04	10.4	5.2	5.54E+04	10.7	5.3
2.00E+04	6.80E+04	12.9	5.6	6.45E+04	12.7	5.7	7.48E+04	13.9	5.9	7.35E+04	14.1	6	6.26E+04	10.7	4.8	6.26E+04	10.8	4.9
5.00E+04	8.30E+04	13.5	5	7.92E+04	12.6	5.1	8.62E+04	13.8	5.3	8.53E+04	14.1	5.4	7.66E+04	9.8	4.2	7.58E+04	10.6	4.4
1.00E+05	9.34E+04	12	4.5	8.86E+04	11	4.4	9.85E+04	13.2	4.8	9.52E+04	13.8	4.9	9.50E+04	8.6	3.7	9.16E+04	9.3	3.8

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	6.93E+02	7.4	4.3	9.38E+01	7.4	4.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.06E+03	8.1	5.2	1.30E+02	8.1	5.2	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.06E-01	4.7	9	4.18E-01	4.8	9.6	1.66E+03	8.9	6.4	2.09E+02	8.8	6.2	4.64E-01	7.7	8.9	3.74E-01	5.6	9.7
3.00E+01	1.13E+00	5.4	9.1	1.37E+00	5.4	9.2	2.58E+03	10.1	8.2	4.31E+02	9.8	8	1.29E+00	6.1	9.3	1.21E+00	5.6	9
5.00E+01	5.80E+00	6.2	10.1	5.42E+00	6.9	9.9	6.01E+03	11.4	10.9	9.68E+02	11.4	11.2	5.20E+00	5	9.2	4.97E+00	5.8	10.4
7.50E+01	2.00E+01	3.9	6.5	1.72E+01	4.6	7.4	1.39E+04	12.9	13.7	2.62E+03	12	13	2.15E+01	4.2	6.8	1.82E+01	4.3	7.1
1.00E+02	6.79E+01	3.2	4.7	6.45E+01	3.2	4.8	2.75E+04	14.1	16.1	9.57E+03	12.8	13.4	6.94E+01	3.1	4.5	6.29E+01	3.3	4.8
1.50E+02	3.50E+02	2.3	3.1	3.69E+02	2.4	3.2	5.02E+04	17.5	21.5	2.80E+04	16.5	19.6	3.67E+02	2.8	3.4	3.82E+02	2.5	3.2
2.00E+02	1.05E+03	2.6	3.7	1.18E+03	2.1	2.9	6.31E+04	20.1	23.8	3.92E+04	19.2	22.9	2.30E+03	9	9.1	1.17E+03	2.4	2.9
3.00E+02	2.31E+04	15.5	18.4	1.44E+04	14	15.7	7.87E+04	23.4	23.2	7.25E+04	20.3	21.4	1.75E+04	16.3	18.8	1.29E+04	12.7	15
5.00E+02	6.14E+04	20.5	19.4	8.68E+04	20.6	21.2	9.26E+04	21.6	19.6	9.14E+04	21.8	20	6.66E+04	20.9	20.2	8.03E+04	21	20.6
7.00E+02	6.70E+04	18.2	16.1	7.40E+04	17.9	15.7	8.03E+04	18.1	14.6	7.83E+04	18	14.8	6.54E+04	17.6	15.5	7.97E+04	18.4	15.8
1.00E+03	5.48E+04	13	10.2	4.96E+04	13.5	10.7	6.71E+04	14.8	11.2	6.59E+04	14.6	11	5.45E+04	13	10.4	5.79E+04	13.4	10.5
2.00E+03	4.33E+04	10.2	6.6	4.53E+04	10.1	6.9	5.66E+04	12.4	8.1	5.37E+04	12.3	7.9	4.30E+04	10.2	6.7	4.52E+04	10.3	7.1
3.00E+03	4.61E+04	10.5	6.1	4.93E+04	10.6	6.3	5.94E+04	12.6	7.3	5.60E+04	12.5	7.1	4.49E+04	10	6	4.79E+04	10.7	6.1
5.00E+03	5.14E+04	10.4	5.4	4.80E+04	10.2	5.6	6.14E+04	13.1	6.6	6.72E+04	12.9	6.5	5.05E+04	10	5.5	5.10E+04	11	5.7
1.00E+04	5.23E+04	9.6	4.9	5.37E+04	8.8	4.9	5.85E+04	12.7	6.1	6.27E+04	12.5	5.9	5.03E+04	9.5	4.7	5.39E+04	9.7	4.7
2.00E+04	5.87E+04	9.8	4.4	5.96E+04	10.4	4.6	7.20E+04	13	5.6	6.69E+04	12.6	5.4	5.89E+04	9.9	4.4	6.07E+04	9	4.5
5.00E+04	7.74E+04	9	3.9	7.79E+04	10.6	4.1	7.86E+04	12.7	5.1	8.00E+04	12.4	5	6.76E+04	8	3.9	7.57E+04	10.2	3.8
1.00E+05	9.95E+04	7.6	3.4	9.02E+04	8.5	3.2	9.35E+04	12.3	4.6	9.50E+04	11.3	4.3	9.69E+04	6.9	3.6	8.83E+04	7.6	3.6

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.33E+01	7.4	4.2	0.00E+00	1	1
1.40E+01	1.14E-01	6.9	9.8	0.00E+00	1	1	1.09E-01	6.8	9.8	1.07E-01	7	10.1	5.24E+01	7.9	5	1.56E-01	6.1	8.8
2.00E+01	4.10E-01	7.5	9.6	4.49E-01	7.1	9.6	3.93E-01	7.9	9.3	4.45E-01	7.9	9.8	9.05E+01	8.6	5.9	6.61E-01	4.9	8
3.00E+01	1.40E+00	7.2	9.1	1.50E+00	7.1	8.9	1.31E+00	7	9.1	1.33E+00	7.2	9.3	1.98E+02	9.3	7.6	3.29E+00	6	6.7
5.00E+01	6.13E+00	5.8	8.8	6.83E+00	5.4	8.3	5.35E+00	6.1	9.5	5.58E+00	5.9	9.5	8.59E+02	9.8	8.2	2.43E+01	4.6	6
7.50E+01	2.77E+01	3.9	5.7	3.41E+01	3.6	5.3	2.19E+01	4.1	6.2	2.40E+01	4	6.1	5.10E+03	11.9	11.8	1.88E+02	7.9	7.7
1.00E+02	9.04E+01	3	4.2	1.12E+02	2.9	3.9	6.97E+01	3.1	4.4	8.18E+01	3.1	4.3	1.11E+04	13.8	15.6	2.27E+03	11	10.2
1.50E+02	4.51E+02	2.7	3.4	5.68E+02	3.1	3.9	3.96E+02	2.4	3.2	4.47E+02	2.4	3.1	2.16E+04	17.1	20.9	1.77E+04	15.2	18.2
2.00E+02	4.19E+03	10.2	10.9	6.26E+03	11.6	13.1	1.15E+03	3.3	4.4	1.21E+03	3.5	4	2.73E+04	19.8	23.4	2.63E+04	18.7	22.4
3.00E+02	3.06E+04	17.8	21	4.09E+04	18.1	21	2.57E+04	15.7	18.8	2.62E+04	15.3	18.4	4.30E+04	21.4	22.3	4.57E+04	20.7	22
5.00E+02	7.72E+04	20.5	20.3	8.79E+04	21.2	20.5	6.91E+04	20.6	20	7.50E+04	21	20.4	7.66E+04	20.6	19.7	8.18E+04	20.9	19.9
7.00E+02	6.82E+04	18.2	15.9	7.16E+04	17.9	15.4	6.79E+04	17.9	15.7	6.63E+04	17.6	15.7	7.03E+04	17.9	15.5	7.34E+04	17.9	15.3
1.00E+03	5.54E+04	13.4	10.5	5.64E+04	13.8	10.6	5.41E+04	13.6	10.6	5.46E+04	13.6	10.6	5.67E+04	13.8	10.8	5.77E+04	14	10.7
2.00E+03	4.57E+04	10.8	7	5.01E+04	11.4	7.3	4.40E+04	10.2	6.8	4.50E+04	10.6	7	4.80E+04	11.1	7.2	4.91E+04	11.3	7.4
3.00E+03	4.76E+04	10.6	6.3	5.30E+04	11.3	6.6	4.52E+04	10.1	6	4.67E+04	10.6	6.3	4.95E+04	11	6.5	4.95E+04	11.2	6.6
5.00E+03	5.00E+04	10.6	5.8	5.23E+04	11.4	6	4.92E+04	10.4	5.6	4.96E+04	11	5.7	5.39E+04	11.2	6	5.38E+04	11.5	6
1.00E+04	5.28E+04	10.2	5	5.43E+04	11	5.3	5.09E+04	9.1	4.8	5.15E+04	9.9	5.1	5.54E+04	10.6	5.2	5.65E+04	11	5.3
2.00E+04	6.06E+04	10.2	4.7	6.18E+04	10.6	5.1	6.10E+04	9.9	4.5	6.05E+04	10.3	4.6	6.34E+04	10.6	5	6.39E+04	11.2	5.1
5.00E+04	7.94E+04	9.9	4.2	7.15E+04	10.5	4.4	7.61E+04	8.8	3.9	7.93E+04	9.6	4.1	7.94E+04	10.3	4.3	7.45E+04	10.6	4.4
1.00E+05	8.91E+04	8.4	3.6	8.90E+04	9.9	3.8	9.62E+04	7.6	3.5	9.22E+04	8.4	3.6	9.32E+04	8.9	3.7	9.36E+04	9.8	3.9

(continued on next page)

Table A.19. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.62E+01	7.5	4.4	3.41E+00	7.5	4.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	6.89E+01	8.1	5.2	5.09E+00	8	5.2	1.15E-01	5.6	9.1	1.52E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.04E+02	8.8	6.3	8.82E+00	8.6	6.4	4.75E-01	6.6	9	4.41E+00	7.8	4.9	3.45E-01	6.8	9.7	4.13E-01	7.1	10.1
3.00E+01	1.78E+02	9.8	8.1	1.74E+01	9	7.8	2.24E+00	5.8	7.8	1.38E+01	8	6.9	1.28E+00	7.1	9.5	1.27E+00	7.1	9.2
5.00E+01	4.37E+02	10.7	10	6.38E+01	8.7	8.4	1.32E+01	3.8	6.1	9.33E+01	9.7	8.1	4.67E+00	6.7	10.6	5.48E+00	6.1	9.8
7.50E+01	2.04E+03	11.4	11.3	5.72E+02	9.6	9	8.78E+01	4.8	5.1	8.48E+02	10.5	10.7	1.38E+01	5.4	8.3	2.04E+01	4.2	6.5
1.00E+02	8.17E+03	12.6	13.4	2.67E+03	11.6	12.1	1.52E+03	9.7	9.1	4.27E+03	11.9	12.4	4.00E+01	3.8	5.6	7.10E+01	3.2	4.5
1.50E+02	3.02E+04	15.7	18.8	1.66E+04	14.6	17	9.46E+03	15.2	17.8	1.61E+04	15.9	19.1	2.75E+02	2.6	3.4	4.44E+02	2.5	3.1
2.00E+02	5.19E+04	18.4	22.1	4.02E+04	17.2	20.7	1.65E+04	17.3	20.5	3.23E+04	17.3	20	8.55E+02	2.1	2.7	1.14E+03	2.5	3.1
3.00E+02	7.55E+04	22.2	23.4	7.34E+04	21.4	23.2	7.79E+04	19.2	22	8.61E+04	20.6	22.6	3.03E+03	4.4	5.7	2.01E+04	13.9	16.5
5.00E+02	8.32E+04	21.4	19.4	8.59E+04	21.5	19.6	1.04E+05	22.2	19.9	9.67E+04	21.8	19.8	7.10E+04	19.4	20.9	7.60E+04	21.4	20.5
7.00E+02	7.35E+04	17.8	15	7.40E+04	17.8	15	8.01E+04	18.3	14.7	7.83E+04	18.2	15	6.64E+04	18	16	6.97E+04	17.9	15.4
1.00E+03	6.14E+04	14.4	11	6.12E+04	14.3	11	6.14E+04	14.3	11	6.91E+04	14.7	11.2	4.89E+04	12.9	10.2	5.64E+04	13.8	10.4
2.00E+03	5.29E+04	12.1	7.7	5.25E+04	12	7.7	5.54E+04	12.2	7.8	5.61E+04	12.4	7.9	4.35E+04	9.7	6.5	4.55E+04	10.4	6.9
3.00E+03	5.42E+04	12	6.9	5.33E+04	11.9	6.9	5.51E+04	12.1	7.1	5.88E+04	12.6	7.1	4.43E+04	9.8	5.8	4.59E+04	10.4	6.2
5.00E+03	5.88E+04	12.2	6.3	5.73E+04	12.2	6.3	5.83E+04	12.5	6.5	6.16E+04	12.6	6.5	4.97E+04	9.5	5.3	4.99E+04	10.6	5.6
1.00E+04	5.89E+04	11.7	5.7	5.80E+04	11.8	5.7	6.02E+04	12	5.9	6.05E+04	12.5	5.9	5.07E+04	8.8	4.6	5.59E+04	10.1	4.9
2.00E+04	6.65E+04	12	5.3	6.51E+04	12.1	5.3	6.69E+04	12.3	5.5	6.87E+04	13.1	5.5	6.05E+04	8.9	4.1	5.81E+04	9.6	4.6
5.00E+04	8.07E+04	11.5	4.7	7.82E+04	11.7	4.7	7.95E+04	12.3	4.7	7.32E+04	12.2	4.9	7.22E+04	7.7	3.7	7.03E+04	9	4
1.00E+05	9.46E+04	10.6	4.1	9.00E+04	10.9	4.2	9.29E+04	10.9	4.3	8.68E+04	9.7	4.4	9.56E+04	7	3.4	9.45E+04	8.1	3.7

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.94E-02	6.9	10.2	1.13E-01	7.4	9.6	1.13E-01	7.3	9.7	1.34E-01	6.2	10.1	1.34E-01	6.6	9.7
2.00E+01	3.75E-01	5.2	9.4	4.63E-01	6.9	9.8	4.15E-01	7.2	9.6	4.15E-01	7.2	9.6	3.85E-01	7.2	9.5	4.36E-01	6.4	9.9
3.00E+01	1.11E+00	7.2	9.3	1.25E+00	7.3	9.3	1.41E+00	7	9	1.44E+00	7	8.9	1.42E+00	6.9	9	1.51E+00	6.9	8.8
5.00E+01	5.01E+00	6.2	10.2	4.88E+00	6.8	10.3	6.15E+00	5.6	8.7	6.38E+00	5.4	8.7	6.02E+00	5.3	8.9	7.58E+00	5	7.9
7.50E+01	1.52E+01	5.2	7.9	1.74E+01	4.9	7.9	2.73E+01	3.9	5.7	2.96E+01	3.8	5.5	2.75E+01	3.8	5.6	3.76E+01	3.5	4.9
1.00E+02	4.64E+01	3.5	5.5	5.29E+01	3.6	5.2	8.81E+01	3	4.1	1.02E+02	2.9	4	1.01E+02	3	4.1	1.35E+02	2.9	3.8
1.50E+02	3.00E+02	2.5	3.3	3.24E+02	2.5	3.2	4.77E+02	4	4.6	4.81E+02	2.7	3.5	4.85E+02	2.5	3.1	6.01E+02	2.9	3.4
2.00E+02	8.88E+02	2.3	2.7	1.11E+03	2.3	2.9	4.42E+03	11.2	13	4.56E+03	10.3	11.6	2.88E+03	7.6	8.5	7.06E+03	11.3	12.2
3.00E+02	4.09E+03	6.3	7.4	7.05E+03	9.8	12.3	3.12E+04	17.9	20.9	3.61E+04	18	20.9	3.94E+04	17.4	20.8	5.45E+04	18.6	21.9
5.00E+02	6.66E+04	20.7	20.9	7.22E+04	20.6	20.8	6.79E+04	20.5	19.9	7.41E+04	20.6	20	7.15E+04	20.9	20.1	8.40E+04	21.2	19.9
7.00E+02	7.50E+04	18.1	16.2	7.24E+04	18.7	16.1	6.58E+04	17.7	15.5	7.14E+04	18	15.6	6.82E+04	17.5	15.8	7.01E+04	17.6	15.5
1.00E+03	4.98E+04	12.7	10.4	5.42E+04	13.3	10.4	5.29E+04	13.3	10.6	5.55E+04	13.7	10.5	5.58E+04	13.4	10.4	5.83E+04	13.6	10.6
2.00E+03	4.32E+04	9.7	6.7	4.40E+04	10.1	6.6	4.43E+04	10.3	6.8	4.50E+04	10.6	7	4.56E+04	10.7	7	4.87E+04	11.1	7.2
3.00E+03	4.59E+04	10	5.9	4.46E+04	9.7	6	4.66E+04	10.3	6.1	4.63E+04	10.5	6.2	4.76E+04	10.7	6.3	5.02E+04	11.3	6.6
5.00E+03	4.65E+04	10	5.5	4.95E+04	10.3	5.4	5.21E+04	10.4	5.6	5.12E+04	10.8	5.7	5.41E+04	11	5.8	5.22E+04	11.3	6
1.00E+04	4.55E+04	8.5	4.5	4.77E+04	9.2	4.7	5.13E+04	9.4	4.9	5.24E+04	10.1	5	5.32E+04	10.6	5.1	5.34E+04	10.6	5.2
2.00E+04	6.07E+04	9.6	4.4	6.15E+04	8.6	4.5	5.98E+04	9.6	4.6	6.21E+04	10.1	4.7	6.03E+04	10.4	4.7	6.12E+04	10.9	4.9
5.00E+04	7.92E+04	7.4	4	7.48E+04	9.2	3.9	7.54E+04	9	4	7.56E+04	9.6	4.1	7.02E+04	9.3	4.1	7.86E+04	10.5	4.4
1.00E+05	1.00E+05	6.7	3.3	9.26E+04	7.7	3.3	9.38E+04	7.9	3.5	9.14E+04	8.4	3.6	9.43E+04	7.9	3.6	9.41E+04	10	3.9

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.22E-01	5.8	8.7	0.00E+00	1	1	2.90E+00	4.1	5.5	2.90E+00	4.1	5.5
2.00E+01	7.30E-01	6.4	8.2	0.00E+00	1	1	1.39E+01	4.3	5.4	1.39E+01	4.3	5.4
3.00E+01	2.44E+00	4.9	7.1	2.50E+00	5.3	7.5	6.43E+01	4.5	5.5	6.43E+01	4.5	5.5
5.00E+01	1.75E+01	3.6	5.7	1.55E+01	4.3	5.9	3.86E+04	8.2	5.4	3.86E+04	8.2	5.4
7.50E+01	6.06E+01	3	4.1	6.37E+01	3	4.2	1.83E+05	13.3	14.2	1.83E+05	13.3	14.2
1.00E+02	8.89E+02	8	7.8	5.30E+02	8.3	6.4	1.57E+05	17	21.5	1.57E+05	17	21.5
1.50E+02	1.28E+04	14.2	16	8.49E+03	13.7	15	1.11E+05	20.4	25.5	1.11E+05	20.4	25.5

Table A.19. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.87E+04	16.4	20	3.36E+04	16.1	18.9	1.03E+05	23.6	26.2	1.03E+05	23.6	26.2
3.00E+02	5.67E+04	21.7	23.8	4.94E+04	21.9	23.4	9.94E+04	25.1	23.6	9.94E+04	25.1	23.6
5.00E+02	8.11E+04	19.7	19.7	9.16E+04	20.9	20.8	9.15E+04	20.7	18.3	9.15E+04	20.7	18.3
7.00E+02	8.48E+04	18.3	15.8	7.84E+04	18.5	15.1	8.37E+04	18	14.8	8.37E+04	18	14.8
1.00E+03	6.12E+04	14.8	10.8	6.00E+04	14.1	10.8	6.93E+04	15.1	11.5	6.93E+04	15.1	11.5
2.00E+03	5.43E+04	11.9	7.5	5.07E+04	11.3	7.6	6.44E+04	13.7	8.5	6.44E+04	13.7	8.5
3.00E+03	5.21E+04	11.4	6.8	5.22E+04	12.1	6.8	6.31E+04	13.5	7.5	6.31E+04	13.5	7.5
5.00E+03	5.38E+04	11.8	6.2	5.72E+04	11.5	6.1	6.28E+04	13.5	6.8	6.28E+04	13.5	6.8
1.00E+04	5.42E+04	11.5	5.6	6.02E+04	11.6	5.5	6.28E+04	13.1	5.7	6.28E+04	13.1	5.7
2.00E+04	6.39E+04	11.5	5.1	6.36E+04	11.5	5.1	7.68E+04	13.9	5.6	7.68E+04	13.9	5.6
5.00E+04	7.98E+04	10.6	4.4	7.63E+04	11.5	4.5	7.21E+04	13.2	5.4	7.21E+04	13.2	5.4
1.00E+05	9.57E+04	9.5	4.1	9.28E+04	10.7	4.2	8.75E+04	13.4	4.8	8.75E+04	13.4	4.8

Table A.20. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{35}Cl ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.97E+00	7.1	1	2.10E+00	7.1	1	5.72E+02	7	3.8	6.30E+02	7	3.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.58E+00	7.7	1.2	3.29E+00	7.6	1.2	1.02E+03	7.5	4.4	1.09E+03	7.5	4.5	1.18E-01	7.1	9.6	1.16E-01	7	9.5
2.00E+01	1.59E+01	8.4	1.5	5.58E+00	8.3	1.6	2.04E+03	8.1	5.3	1.93E+03	8.2	5.4	4.69E-01	7	9.5	4.71E-01	6.9	9.3
3.00E+01	2.81E+01	9.2	1.9	1.04E+01	8.7	2	4.70E+03	8.9	6.5	4.19E+03	9	6.7	1.64E+00	6.3	8.6	1.59E+00	6.4	8.5
5.00E+01	7.50E+01	9.8	2.4	3.17E+01	8.2	2.4	2.10E+04	9.7	8.1	1.82E+04	9.9	8.2	8.20E+00	4.7	7.4	8.68E+00	4.8	7.3
7.50E+01	2.48E+02	9.8	2.6	1.82E+02	8.2	2.1	7.00E+04	11.9	11.7	4.79E+04	12.2	12.2	4.66E+01	3.5	4.7	4.24E+01	3.4	4.8
1.00E+02	9.18E+02	10.4	2.7	1.29E+03	10.4	2.6	1.15E+05	13.9	15.6	7.48E+04	14.1	15.9	1.82E+02	4.9	4.8	1.35E+02	2.8	3.7
1.50E+02	1.12E+04	13.6	3.9	1.05E+04	13.8	4	1.58E+05	17.7	22	1.09E+05	17.3	21.2	1.11E+03	8.3	9.2	1.12E+03	7.4	7.1
2.00E+02	2.01E+04	16.6	5.2	2.06E+04	16.3	5.1	1.42E+05	21.2	25.4	1.13E+05	20.1	24.1	1.05E+04	12.8	14.4	1.15E+04	13.2	15.3
3.00E+02	4.22E+04	19.3	5.7	4.48E+04	19.3	5.7	1.17E+05	25.9	24.8	1.03E+05	24.5	24.6	4.96E+04	18.5	21.7	5.30E+04	18.5	21.7
5.00E+02	8.33E+04	21.5	5.6	8.95E+04	21.6	5.7	9.00E+04	23.1	19.2	8.98E+04	22.9	19.5	7.80E+04	21.8	20.5	8.08E+04	21.8	20.6
7.00E+02	7.74E+04	19.7	4.8	7.96E+04	19.9	4.8	9.15E+04	20	16.4	9.46E+04	20.2	16.7	7.22E+04	19.1	16.7	7.61E+04	19.5	16.9
1.00E+03	6.23E+04	15.6	3.7	6.29E+04	15.7	3.7	7.86E+04	17.1	12.8	7.55E+04	16.9	12.6	6.21E+04	15.6	12	6.10E+04	15.4	12
2.00E+03	5.20E+04	12.6	2.7	5.34E+04	12.9	2.8	6.83E+04	14.8	9.4	6.61E+04	14.7	9.3	5.09E+04	12.4	7.9	5.10E+04	12.4	8
3.00E+03	5.31E+04	12.3	2.5	5.43E+04	12.7	2.6	7.33E+04	15.1	8.5	6.70E+04	14.6	8.4	5.03E+04	12	7.1	5.38E+04	12.3	7.2
5.00E+03	5.73E+04	12.5	2.4	5.91E+04	12.8	2.4	6.67E+04	15.2	7.8	6.81E+04	14.7	7.6	5.78E+04	12.3	6.5	6.01E+04	12.6	6.6
1.00E+04	6.02E+04	11.7	2.2	5.88E+04	12.2	2.2	7.23E+04	14.7	7	7.07E+04	14.7	6.9	5.69E+04	11.1	5.6	5.96E+04	11.8	5.8
2.00E+04	6.66E+04	11.9	2.1	6.73E+04	12.4	2.1	8.53E+04	14.6	6.5	8.19E+04	15.1	6.5	6.36E+04	11.1	5.3	6.95E+04	12.3	5.5
5.00E+04	8.47E+04	11.1	1.9	8.22E+04	11.8	1.9	9.47E+04	13.8	5.9	8.95E+04	14.8	5.7	8.79E+04	10.4	4.6	8.23E+04	10.9	4.6
1.00E+05	1.07E+05	9.9	1.7	9.86E+04	10.3	1.8	1.15E+05	14.7	5.3	1.05E+05	14	5.2	1.03E+05	9.2	4	1.08E+05	10.1	4.1

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	8.15E+02	7.1	4	0.00E+00	1	1
1.40E+01	1.21E-01	7.5	9.8	1.28E-01	7.3	9.9	1.25E-01	6.6	9.9	1.24E-01	7.5	9.4	1.13E+03	7.7	4.7	0.00E+00	1	1
2.00E+01	4.65E-01	7.6	9.5	4.82E-01	7.2	9.5	3.73E-01	7.6	9.5	4.86E-01	7	9.8	1.62E+03	8.4	5.7	2.74E-01	5.4	10.4
3.00E+01	1.59E+00	6.8	8.8	1.65E+00	6.8	8.8	1.48E+00	6.8	8.9	1.70E+00	6.4	8.5	2.85E+03	9.4	7.3	1.62E+00	5.4	8.9
5.00E+01	7.76E+00	5.1	7.8	8.64E+00	4.9	7.5	6.63E+00	5.3	8.3	9.37E+00	4.6	7.2	6.48E+03	10.8	9.7	4.33E+00	6.2	9.9
7.50E+01	3.90E+01	3.4	5	4.58E+01	3.3	4.7	3.09E+01	3.7	5.5	4.55E+01	3.3	4.7	1.55E+04	12.2	12.3	1.49E+01	4.7	7.9
1.00E+02	1.32E+02	2.8	3.7	1.56E+02	2.7	3.5	1.00E+02	3	4.1	1.42E+02	3	3.8	2.86E+04	13.8	15.4	4.92E+01	3.4	5.2
1.50E+02	7.94E+02	5.3	5.8	8.24E+02	4.3	4.7	4.58E+02	2.7	3.4	9.16E+02	5.4	5.8	5.37E+04	16.4	19.8	3.18E+02	2.3	3.2
2.00E+02	6.52E+03	12	13.7	7.82E+03	11.3	12.6	2.54E+03	8.4	8.9	1.39E+04	12.9	14.4	7.19E+04	18.6	22.4	9.78E+02	2.2	2.8
3.00E+02	4.92E+04	17.4	20.4	6.78E+04	17.6	20.9	3.71E+04	17.5	20.6	5.17E+04	18.8	21.9	7.20E+04	23.3	24.3	3.85E+03	5.2	5.6
5.00E+02	9.51E+04	22.4	21.1	1.01E+05	22.5	21	7.60E+04	21.2	20.7	8.38E+04	21.7	20.8	7.83E+04	21.3	19.3	8.42E+04	20.2	21.4
7.00E+02	8.11E+04	19.8	16.7	8.44E+04	20.1	16.6	7.37E+04	19.7	16.9	7.81E+04	19.6	16.9	8.76E+04	19.6	16.9	7.13E+04	19.1	17.3
1.00E+03	6.46E+04	15.9	12.1	6.73E+04	16	12.2	5.89E+04	15.3	11.8	6.32E+04	15.7	12.1	6.39E+04	15.9	12.1	5.95E+04	14.2	11.6
2.00E+03	5.49E+04	12.9	8.3	5.71E+04	13.5	8.6	5.26E+04	12.2	7.8	5.20E+04	12.8	8.2	5.94E+04	13.5	8.7	4.77E+04	11.7	7.5
3.00E+03	5.62E+04	12.9	7.5	5.82E+04	13.2	7.7	5.13E+04	12.1	7	5.31E+04	12.5	7.3	5.74E+04	13.1	7.7	4.93E+04	10.7	6.7
5.00E+03	6.08E+04	13.1	6.8	6.36E+04	13.4	7	5.33E+04	11.9	6.4	6.02E+04	12.8	6.7	6.16E+04	13	7	5.18E+04	11	6.4
1.00E+04	6.50E+04	12.6	6	6.47E+04	13.2	6.3	5.52E+04	10.7	5.5	5.84E+04	11.9	5.8	6.35E+04	11.8	6.3	5.73E+04	10.1	5.2
2.00E+04	6.82E+04	12.7	5.7	7.15E+04	13.7	6	6.58E+04	11	5.2	6.70E+04	12.2	5.6	7.17E+04	13.5	5.9	6.78E+04	12	5.1
5.00E+04	8.78E+04	12	5	8.27E+04	13	5.3	8.69E+04	10.5	4.5	8.30E+04	11.5	4.7	9.53E+04	13.5	4.7	7.85E+04	8.9	4.2
1.00E+05	1.06E+05	10.4	4.3	9.67E+04	11.7	4.6	1.03E+05	9.4	3.9	1.01E+05	10.6	4.3	1.03E+05	12.2	4.5	1.01E+05	8.7	3.5

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.21E-01	7.5	9.8	1.27E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	4.31E-01	7.5	9.6	4.57E-01	7.1	9.5	3.33E-01	6.2	9.3	4.29E-01	6.2	9.7	5.42E-01	5.2	7.6	7.39E-01	4.4	7.9
3.00E+01	1.45E+00	6.9	8.8	1.56E+00	6.8	8.7	1.49E+00	6.1	9.1	1.47E+00	7	9	3.10E+00	4	6.4	2.95E+00	3.8	6.1
5.00E+01	6.88E+00	5.3	8.3	8.27E+00	4.9	7.6	6.87E+00	5.5	8.7	6.73E+00	5.6	8.7	2.15E+01	3.4	5.1	2.70E+01	3.4	5

Table A.20. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.13E+01	3.7	5.4	4.06E+01	3.4	4.9	2.77E+01	4	5.7	3.08E+01	3.9	5.6	9.87E+01	2.6	4	1.04E+02	3	3.9
1.00E+02	9.64E+01	3	4	1.29E+02	2.9	3.8	8.78E+01	3	5.1	1.03E+02	2.9	4.1	3.17E+02	5	4.3	3.53E+02	4.3	4.9
1.50E+02	5.54E+02	4.9	5.2	1.06E+03	6.7	6.7	8.70E+02	7.5	8.6	6.63E+02	4.4	4.7	1.78E+04	12.6	13.4	2.63E+04	12.8	13.9
2.00E+02	6.64E+03	12.1	13.7	9.71E+03	12.8	14.6	5.81E+03	12.8	14.3	5.11E+03	11.8	13.1	5.60E+04	16.1	19.1	6.55E+04	17	20.2
3.00E+02	3.45E+04	17.4	20.6	4.69E+04	18.2	21.3	2.20E+04	18	20.5	2.83E+04	17.2	20.5	7.63E+04	22.3	24.1	6.69E+04	22.5	24.5
5.00E+02	7.89E+04	20.9	20.6	8.43E+04	21.7	20.8	8.66E+04	20.4	21.2	1.04E+05	22.1	21.3	8.57E+04	21.8	20.7	9.97E+04	22.2	20.6
7.00E+02	7.67E+04	19.5	17	8.12E+04	19.8	16.9	7.56E+04	20	17.1	8.23E+04	20.1	16.8	8.79E+04	19.9	16.6	8.96E+04	20.5	16.9
1.00E+03	6.10E+04	15.4	11.8	6.27E+04	15.8	12	5.93E+04	15.4	11.9	6.08E+04	15.2	11.8	6.67E+04	16.5	12.4	7.42E+04	16.4	12.2
2.00E+03	5.10E+04	12.1	7.8	5.34E+04	12.8	8.2	5.07E+04	12.1	8	5.20E+04	12.6	8.2	5.67E+04	13.6	8.6	6.16E+04	14.2	8.8
3.00E+03	5.26E+04	12	7	5.41E+04	12.5	7.3	5.21E+04	12.1	7.1	5.68E+04	13	7.3	5.79E+04	13.8	7.9	5.78E+04	13.5	7.8
5.00E+03	5.67E+04	12.3	6.4	5.99E+04	12.7	6.6	6.18E+04	12.3	6.4	6.55E+04	12.8	6.7	6.37E+04	14.3	7.1	6.71E+04	13.4	7.1
1.00E+04	5.83E+04	11.2	5.6	5.90E+04	11.9	5.8	5.72E+04	11.3	5.6	5.92E+04	12.3	5.9	6.28E+04	12.7	6.2	6.41E+04	13.4	6.3
2.00E+04	6.85E+04	11.5	5.2	6.37E+04	12.2	5.6	6.52E+04	11.5	5.2	6.81E+04	12.7	5.6	6.55E+04	13	6	7.23E+04	14	5.9
5.00E+04	8.39E+04	10.6	4.5	7.96E+04	11.4	4.7	8.52E+04	10.8	4.5	7.93E+04	11.6	4.9	8.19E+04	13.3	5.1	8.47E+04	12.5	5.3
1.00E+05	1.05E+05	8.8	3.9	1.01E+05	10	4.2	1.01E+05	9.5	4	9.80E+04	10.8	4.3	9.73E+04	12.2	4.8	1.00E+05	12.9	4.9

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.26E+01	7.1	4	4.78E+00	7.1	4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.74E-01	4.2	8.8	3.21E+01	7.7	4.7	7.06E+00	7.6	4.8	1.52E-01	7.2	10	1.61E-01	7.2	9.6
2.00E+01	4.11E-01	6.4	9.3	6.08E-01	4.9	7.6	5.02E+01	8.4	5.7	1.18E+01	8.3	5.8	5.69E-01	7.3	9.3	6.02E-01	6.8	8.9
3.00E+01	1.58E+00	6.6	8.8	2.78E+00	5	6.8	8.67E+01	9.2	7.2	2.16E+01	8.8	7.1	2.01E+00	6.2	8	2.27E+00	5.7	7.6
5.00E+01	6.49E+00	5.7	9	1.69E+01	4	5.6	2.09E+02	10.1	9.4	6.25E+01	8.4	8.2	1.27E+01	4.1	6.2	1.52E+01	3.8	5.8
7.50E+01	2.46E+01	3.8	5.9	7.19E+01	3.3	4.4	6.64E+02	10.4	10.2	3.05E+02	8.4	7.5	6.95E+01	3	4.2	8.61E+01	2.9	4
1.00E+02	8.47E+01	3.1	4.3	8.13E+02	7.4	6.1	2.60E+03	10.9	10.7	2.73E+03	10.5	10	2.11E+02	2.7	3.4	2.49E+02	2.7	3.4
1.50E+02	3.97E+02	2.6	3.4	2.24E+04	13.9	15.7	2.50E+04	14	15.9	2.19E+04	14.1	16	3.04E+03	9	9	6.46E+03	10.5	10.6
2.00E+02	1.22E+03	4.4	6.7	3.72E+04	17.8	21.3	4.60E+04	16.9	20.4	4.37E+04	16.7	20.2	2.48E+04	14.1	16.3	3.74E+04	14.8	17.4
3.00E+02	2.89E+04	16.7	20.2	4.82E+04	20.6	22.7	8.34E+04	20.6	23.1	8.19E+04	20.4	22.9	8.38E+04	19	22.1	9.54E+04	19.5	22.5
5.00E+02	7.46E+04	20.2	20.5	7.40E+04	21.2	19.8	9.71E+04	23	20.7	1.00E+05	22.9	20.9	1.20E+05	23.2	21.5	1.17E+05	23.6	21.4
7.00E+02	7.35E+04	19.4	17.1	8.21E+04	19.8	17.1	8.33E+04	20	16.5	8.41E+04	20.1	16.5	8.53E+04	20.2	16.4	8.88E+04	20.3	16.1
1.00E+03	5.66E+04	15.1	11.7	6.77E+04	15.7	12.1	6.89E+04	16.4	12.4	6.84E+04	16.4	12.4	7.30E+04	16.6	12.5	7.45E+04	16.8	12.6
2.00E+03	4.70E+04	11.5	7.5	5.07E+04	12.3	8.1	5.89E+04	13.9	8.8	5.93E+04	14	8.8	5.87E+04	14.1	9	6.31E+04	14.4	9.2
3.00E+03	5.06E+04	11.4	6.7	5.30E+04	12.3	7.2	5.98E+04	13.8	7.9	5.99E+04	13.8	8	6.19E+04	14.1	8.1	6.56E+04	14.4	8.2
5.00E+03	5.41E+04	11.7	6.1	5.83E+04	12.3	6.7	6.40E+04	14	7.2	6.45E+04	14	7.3	6.59E+04	14.4	7.4	6.53E+04	14.5	7.5
1.00E+04	5.59E+04	10.5	5.3	6.24E+04	11.8	5.8	6.53E+04	13.6	6.5	6.39E+04	13.7	6.5	6.90E+04	14.3	6.6	6.47E+04	14.4	6.8
2.00E+04	6.43E+04	10.8	5	6.68E+04	11.8	5.6	7.26E+04	13.9	6.1	6.99E+04	13.9	6.2	7.59E+04	14.6	6.2	7.19E+04	15.1	6.5
5.00E+04	8.45E+04	9.8	4.2	8.46E+04	11.6	4.7	8.66E+04	13.4	5.3	8.48E+04	13.6	5.4	8.14E+04	14.5	5.5	9.09E+04	14.6	5.7
1.00E+05	1.07E+05	7.9	3.6	1.04E+05	10	4.1	1.02E+05	12.4	4.7	1.00E+05	12.3	4.8	9.65E+04	13.7	4.9	9.78E+04	14.3	5.2

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	5.58E+03	5.8	2.1	6.77E+03	5.8	2.1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.11E+04	5.8	2.4	1.35E+04	5.8	2.4	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.67E+04	6	2.6	2.03E+04	6	2.6	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.78E+04	6.3	3	3.37E+04	6.3	3	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.44E+00	6.7	3.5	0.00E+00	1	1	5.51E+04	7.2	4	6.68E+04	7.2	4	6.29E+01	7.1	4	8.42E+00	7.1	4
1.40E+01	1.15E+01	7.2	4.3	2.11E-01	4.9	7.2	7.66E+04	7.7	4.8	9.27E+04	7.7	4.8	9.67E+01	7.7	4.7	1.10E+01	7.7	4.7
2.00E+01	3.23E+01	7.4	5	1.09E+00	4.8	6.5	1.08E+05	8.5	5.9	1.30E+05	8.5	5.9	1.51E+02	8.4	5.7	2.36E+01	8.2	5.7
3.00E+01	8.53E+01	7.9	6.1	5.21E+00	3.9	5.3	1.57E+05	9.7	7.7	1.87E+05	9.7	7.7	2.43E+02	9.4	7.3	3.81E+01	9.1	7.3
5.00E+01	9.33E+02	8.3	6.4	3.95E+01	4	4.9	2.22E+05	12	11.7	2.32E+05	12.4	12.4	5.83E+02	10.6	9.4	9.60E+01	10.3	9.3
7.50E+01	9.85E+03	10.5	9.4	1.11E+03	8.5	6.9	1.87E+05	15.3	18.2	1.90E+05	15.6	18.9	1.68E+03	11.7	11.6	3.38E+02	10.5	10.3
1.00E+02	3.23E+04	12.4	12.9	1.12E+04	11.3	10.8	1.57E+05	17.8	22.9	1.56E+05	18.1	23.4	3.88E+03	12.7	13.7	1.46E+03	11.1	11.2
1.50E+02	7.60E+04	15.9	19.1	4.55E+04	14.9	17.4	1.23E+05	21.4	26.6	1.24E+05	21.5	26.7	1.03E+04	15.2	18.2	7.17E+03	14.1	16.3
2.00E+02	8.98E+04	19	23.2	7.38E+04	17.9	21.6	1.09E+05	23.6	26.4	1.10E+05	23.6	26.4	1.74E+04	17	20.4	1.52E+04	15.8	19
3.00E+02	9.33E+04	23.4	24.2	8.74E+04	22.1	23.9	1.01E+05	26	23.8	1.03E+05	25.9	23.8	4.06E+04	19	21.4	4.24E+04	18.4	21
5.00E+02	1.07E+05	22.6	20.2	1.02E+05	23	20.7	9.80E+04	23.1	19.7	1.01E+05	23.1	19.8	8.25E+04	21.4	20.8	8.91E+04	21.7	21
7.00E+02	8.67E+04	20.3	16.5	8.98E+04	20.5	16.6	8.98E+04	20.2	16.3	9.13E+04	20.3	16.4	7.84E+04	19.7	16.8	8.26E+04	19.9	16.8
1.00E+03	7.44E+04	16.9	12.8	7.39E+04	16.7	12.6	7.78E+04	17.4	13	7.88E+04	17.5	13	6.24E+04	15.6	11.9	6.33E+04	15.6	12
2.00E+03	6.12E+04	14.5	9.2	6.24E+04	14.3	9.1	6.92E+04	15.3	9.6	6.94E+04	15.4	9.7	5.29E+04	12.5	8	5.34E+04	12.8	8.2
3.00E+03	6.72E+04	14.6	8.2	6.09E+04	14.1	8.2	6.99E+04	15.3	8.7	7.06E+04	15.4	8.7	5.35E+04	12.3	7.2	5.46E+04	12.6	7.3

(continued on next page)

Table A.20. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	6.60E+04	14.7	7.6	6.85E+04	14.7	7.5	7.27E+04	15.5	7.9	7.43E+04	15.6	7.9	5.75E+04	12.4	6.6	5.95E+04	12.9	6.8
1.00E+04	6.99E+04	14.6	6.8	6.33E+04	13.8	6.8	7.55E+04	15.5	7.2	7.52E+04	15.7	7.3	5.99E+04	11.8	5.8	6.01E+04	12.1	5.9
2.00E+04	7.38E+04	14.3	6.4	7.02E+04	14.2	6.4	8.21E+04	15.9	6.7	8.15E+04	16.1	6.8	6.85E+04	12	5.4	6.92E+04	12.7	5.7
5.00E+04	9.02E+04	14.4	5.5	8.72E+04	14.5	5.6	9.45E+04	15.7	6	9.47E+04	16.2	6.1	8.44E+04	11	4.7	8.27E+04	11.8	4.8
1.00E+05	1.02E+05	13.2	5.1	9.93E+04	14.4	5.1	1.09E+05	15	5.4	1.07E+05	15.5	5.6	1.04E+05	9.8	4	1.01E+05	10.3	4.3

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	7.33E+02	7.1	4	1.05E+02	7.1	4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.13E+03	7.7	4.7	1.36E+02	7.7	4.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.11E-01	4.7	9	4.33E-01	4.8	9.6	1.76E+03	8.5	5.7	2.88E+02	8.2	5.7	4.72E-01	7.7	8.9	3.77E-01	5.6	9.7
3.00E+01	1.13E+00	5.4	9.1	1.40E+00	5.4	9.2	2.75E+03	9.5	7.3	4.48E+02	9.3	7.3	1.32E+00	6.1	9.3	1.24E+00	5.6	9
5.00E+01	5.95E+00	6.2	9.9	5.61E+00	6.9	9.9	6.18E+03	10.8	9.7	1.01E+03	11.1	9.9	5.35E+00	5	9.2	5.01E+00	5.8	10.4
7.50E+01	2.05E+01	3.9	6.4	1.75E+01	4.6	7.4	1.44E+04	12.1	12.4	2.61E+03	11.8	11.4	2.21E+01	4.1	6.7	1.89E+01	4.3	7.1
1.00E+02	6.79E+01	3.2	4.7	6.48E+01	3.2	4.8	2.83E+04	13.3	14.6	9.33E+03	12.2	12.4	6.96E+01	3.1	4.5	6.39E+01	3.3	4.8
1.50E+02	3.49E+02	2.3	3.1	3.66E+02	2.4	3.2	5.39E+04	16.5	20.2	3.09E+04	15.3	18.1	3.64E+02	2.7	3.4	3.80E+02	2.4	3.2
2.00E+02	1.04E+03	2.6	3.3	1.02E+03	2.1	2.9	6.88E+04	19.2	23.1	4.17E+04	18.3	22.7	2.12E+03	8.2	8.8	1.14E+03	2.4	2.9
3.00E+02	2.12E+04	14.1	16.9	1.29E+04	12.4	13.8	8.13E+04	22	23.5	7.41E+04	19.6	21.4	1.68E+04	16.1	18.7	9.63E+03	11.7	13.8
5.00E+02	6.50E+04	21	20.3	8.90E+04	19.9	21.4	1.09E+05	23.1	20.9	9.58E+04	23.4	20.8	7.11E+04	20.7	21	8.57E+04	20.4	21.5
7.00E+02	7.38E+04	19.3	16.7	8.29E+04	19.5	17.2	8.31E+04	20.3	16.5	9.33E+04	19.8	16.7	7.44E+04	20	17.1	8.04E+04	19.8	17.1
1.00E+03	6.15E+04	14.8	11.5	5.42E+04	14.4	11.7	7.44E+04	16.9	12.6	6.91E+04	16.4	12.5	5.84E+04	15.2	11.7	6.52E+04	15.3	11.7
2.00E+03	4.81E+04	11	7.5	4.96E+04	12.1	7.7	6.36E+04	14.4	9.2	5.98E+04	14.1	8.9	4.81E+04	11.6	7.4	5.03E+04	12.1	7.6
3.00E+03	5.08E+04	11.3	6.8	5.40E+04	12.1	6.8	6.44E+04	14.4	8.3	5.89E+04	13.9	8.1	4.93E+04	11.1	6.8	5.14E+04	11.8	6.9
5.00E+03	5.72E+04	11.9	6.3	5.35E+04	11.6	6.6	6.67E+04	14.9	7.5	7.00E+04	14.9	7.4	5.48E+04	11.3	6.2	5.48E+04	12.1	6
1.00E+04	5.75E+04	11.5	5.3	5.83E+04	11.8	5.1	6.90E+04	14.3	6.7	6.87E+04	14.5	6.7	5.57E+04	10.7	5.4	5.86E+04	9.8	5.6
2.00E+04	6.34E+04	10	5.2	6.42E+04	12.6	5.2	7.97E+04	15.2	6.4	7.40E+04	14.5	6.3	7.10E+04	10.6	5.1	6.64E+04	10.6	5.4
5.00E+04	8.45E+04	10.1	4.3	8.86E+04	11.2	4.3	8.28E+04	14.9	5.8	8.14E+04	13.7	5.3	8.12E+04	9.1	4.3	8.24E+04	10.8	4.5
1.00E+05	1.07E+05	8.4	3.6	9.71E+04	9.1	3.7	1.04E+05	13.9	4.9	1.04E+05	12.5	5.1	1.05E+05	7.9	3.9	9.55E+04	8.9	4.2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.49E+01	7	3.9	0.00E+00	1	1
1.40E+01	1.16E-01	6.9	9.8	0.00E+00	1	1	1.10E-01	6.8	9.8	1.08E-01	7	10.1	5.47E+01	7.6	4.5	1.58E-01	6.1	8.8
2.00E+01	4.19E-01	7.5	9.6	4.54E-01	7.1	9.6	4.04E-01	7.9	9.3	4.50E-01	7.9	9.8	9.42E+01	8	5.4	6.84E-01	4.9	7.9
3.00E+01	1.43E+00	7.2	9.1	1.54E+00	7.1	8.9	1.34E+00	7	9.1	1.37E+00	7.2	9.3	2.05E+02	9	6.8	3.33E+00	5.8	6.7
5.00E+01	6.29E+00	5.8	8.7	7.02E+00	5.4	8.3	5.49E+00	6.1	9.5	5.77E+00	5.9	9.5	8.53E+02	9.6	7.7	2.37E+01	4.5	5.9
7.50E+01	2.82E+01	3.8	5.7	3.46E+01	3.6	5.2	2.24E+01	4.1	6.2	2.45E+01	3.9	6.1	5.13E+03	11.2	10.4	1.78E+02	7.8	7.1
1.00E+02	9.08E+01	3	4.2	1.12E+02	2.9	3.9	7.07E+01	3.1	4.4	8.22E+01	3.1	4.3	1.15E+04	13	14.1	1.92E+03	10	9.3
1.50E+02	4.46E+02	2.6	3.2	5.59E+02	2.7	3.4	3.93E+02	2.4	3.2	4.42E+02	2.4	3	2.36E+04	16.1	19.4	1.80E+04	14.4	16.7
2.00E+02	3.33E+03	8.9	9.4	5.31E+03	10.6	11.5	1.13E+03	2.9	3.8	1.19E+03	2.9	3.8	2.99E+04	19	22.7	2.80E+04	17.5	21.4
3.00E+02	3.11E+04	17.1	20.2	4.16E+04	17.1	20.3	2.36E+04	14.8	17.5	2.40E+04	14.7	17.3	4.52E+04	20.5	22.2	4.76E+04	20	22
5.00E+02	8.62E+04	20.8	20.9	9.39E+04	21.5	21.2	7.37E+04	20.9	20.6	8.19E+04	21.5	21.1	8.21E+04	21.3	20.5	8.88E+04	21.8	20.8
7.00E+02	7.70E+04	19.7	17.2	7.98E+04	19.9	16.9	7.37E+04	19.2	16.9	7.91E+04	19.7	16.8	7.77E+04	19.6	16.9	8.01E+04	20	16.7
1.00E+03	6.05E+04	15.2	11.8	6.27E+04	15.5	12	6.00E+04	15.2	11.8	5.95E+04	15.4	12	6.42E+04	15.8	12.1	6.42E+04	15.8	12.1
2.00E+03	5.19E+04	12.2	7.8	5.27E+04	12.7	8.2	5.21E+04	11.9	7.5	4.92E+04	12.1	7.8	5.29E+04	12.6	8.1	5.44E+04	12.9	8.3
3.00E+03	5.25E+04	12	7.1	5.45E+04	12.6	7.3	4.84E+04	11.4	6.8	5.24E+04	12.1	7	5.40E+04	12.5	7.3	5.50E+04	12.8	7.4
5.00E+03	5.68E+04	12.3	6.5	5.82E+04	12.6	6.8	5.53E+04	11.3	6.2	5.69E+04	12.1	6.4	5.86E+04	12.8	6.7	6.04E+04	13	6.8
1.00E+04	6.05E+04	11.3	5.6	5.86E+04	12.3	5.9	5.53E+04	10.6	5.4	5.73E+04	11.1	5.5	6.33E+04	12.1	5.9	5.84E+04	12.2	6
2.00E+04	6.67E+04	11.3	5.2	6.82E+04	12.6	5.7	6.64E+04	10.6	5	6.50E+04	11.4	5.3	6.51E+04	11.9	5.4	6.98E+04	12.8	5.7
5.00E+04	8.45E+04	10.7	4.6	8.04E+04	11.7	5	8.84E+04	9.8	4.3	8.09E+04	11.4	4.5	8.56E+04	11.4	4.8	8.05E+04	11.5	5
1.00E+05	1.01E+05	9.4	3.9	9.91E+04	10.9	4.2	1.05E+05	8.3	3.7	1.03E+05	9.9	3.9	1.02E+05	9.9	4.1	9.99E+04	10.5	4.3

Table A.20. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	4.95E+01	7.1	4	3.64E+00	7.1	4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	7.30E+01	7.7	4.7	5.86E+00	7.7	4.8	1.16E-01	5.6	9.1	1.58E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.09E+02	8.4	5.7	9.30E+00	8.2	5.8	4.89E-01	6.6	9	4.39E+00	7.5	4.7	3.52E-01	6.8	9.7	4.24E-01	7.1	10.1
3.00E+01	1.87E+02	9.3	7.2	1.82E+01	8.7	7.1	2.29E+00	5.8	7.7	1.31E+01	6.7	4.8	1.32E+00	7.1	9.5	1.30E+00	7.1	9.2
5.00E+01	4.65E+02	10.2	9.1	6.43E+01	8.2	7.8	1.35E+01	3.8	6.1	9.04E+01	9.1	6.5	4.80E+00	6.7	10.6	5.63E+00	6.1	9.8
7.50E+01	2.01E+03	10.8	10.2	5.26E+02	9	8.1	7.94E+01	4.5	5	8.16E+02	9.9	10.1	1.41E+01	5.4	8.3	2.09E+01	4.2	6.5
1.00E+02	7.94E+03	11.9	12	2.57E+03	11	10.8	1.34E+03	9	8.1	4.06E+03	11.1	11	4.09E+01	3.8	5.6	7.17E+01	3.2	4.4
1.50E+02	3.10E+04	14.8	17.3	1.63E+04	13.7	15.5	9.80E+03	14.1	16.3	1.64E+04	14.8	17.5	2.74E+02	2.6	3.4	4.35E+02	2.5	3.1
2.00E+02	5.45E+04	17.3	20.9	4.11E+04	16.2	19.4	1.84E+04	16	19.2	3.24E+04	16.2	19	8.48E+02	2.1	2.7	1.13E+03	2.4	3
3.00E+02	8.47E+04	21.2	23.4	8.01E+04	20.4	23	7.99E+04	18.2	21.3	8.83E+04	19.4	22.3	3.12E+03	3.9	5.4	1.78E+04	13.1	15.1
5.00E+02	9.26E+04	22.8	20.5	9.53E+04	22.8	20.7	1.08E+05	23.7	21.4	1.04E+05	23.2	20.7	7.54E+04	18.5	20.9	8.24E+04	21.1	21.5
7.00E+02	8.18E+04	19.8	16.5	8.31E+04	19.9	16.5	8.29E+04	20.1	16.5	9.53E+04	20.3	16.6	7.49E+04	19.7	17.1	7.81E+04	19.6	16.8
1.00E+03	6.91E+04	16.4	12.4	6.77E+04	16.3	12.3	6.83E+04	16.5	12.5	7.17E+04	16.5	12.5	5.52E+04	14.5	11.4	6.16E+04	15.5	11.8
2.00E+03	5.87E+04	13.8	8.8	5.78E+04	13.7	8.7	5.92E+04	14	8.7	6.12E+04	14.1	8.9	4.70E+04	11	7.1	4.96E+04	11.9	7.8
3.00E+03	5.99E+04	13.7	7.9	5.94E+04	13.6	7.8	6.17E+04	13.9	8	6.17E+04	14	8.1	4.50E+04	10.5	6.3	5.04E+04	11.6	6.9
5.00E+03	6.38E+04	13.9	7.2	6.42E+04	13.8	7.1	6.53E+04	14	7.3	6.90E+04	14.7	7.5	5.19E+04	10.8	5.9	5.50E+04	11.8	6.3
1.00E+04	6.55E+04	13.4	6.4	6.37E+04	13.3	6.4	6.70E+04	14	6.6	6.66E+04	13.8	6.7	5.48E+04	9.6	5.2	5.64E+04	10.9	5.6
2.00E+04	7.28E+04	13.7	6	7.19E+04	13.7	6	7.40E+04	14.7	6.2	7.59E+04	14.3	6.3	6.54E+04	9.5	4.8	6.44E+04	11.6	5.2
5.00E+04	8.79E+04	13.1	5.2	8.61E+04	13.2	5.3	8.82E+04	13.2	5.4	7.98E+04	14.5	5.5	8.00E+04	9.6	4.2	8.16E+04	9.3	4.5
1.00E+05	1.05E+05	12	4.6	1.02E+05	11.9	4.7	1.01E+05	13.1	4.6	9.71E+04	12.4	4.9	1.04E+05	7.8	3.6	1.02E+05	9.1	3.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.84E-02	6.9	10.2	1.14E-01	7.4	9.6	1.13E-01	7.3	9.7	1.38E-01	6.2	10.1	1.35E-01	6.6	9.7
2.00E+01	3.77E-01	5.2	9.4	4.80E-01	6.9	9.8	4.28E-01	7.2	9.6	4.23E-01	7.2	9.6	3.83E-01	7.2	9.5	4.48E-01	6.4	9.9
3.00E+01	1.14E+00	7.2	9.3	1.29E+00	7.3	9.3	1.45E+00	7	9	1.48E+00	7	8.9	1.45E+00	6.9	9	1.54E+00	6.9	8.8
5.00E+01	5.07E+00	6.2	10.2	5.01E+00	6.8	10.3	6.32E+00	5.6	8.7	6.57E+00	5.4	8.7	6.19E+00	5.3	8.9	7.83E+00	5	7.9
7.50E+01	1.56E+01	5.2	7.9	1.78E+01	4.9	7.9	2.77E+01	3.8	5.7	3.00E+01	3.8	5.5	2.77E+01	3.7	5.5	3.80E+01	3.5	4.9
1.00E+02	4.72E+01	3.4	5.5	5.37E+01	3.6	5.2	8.84E+01	3	4.1	1.01E+02	2.9	4	1.00E+02	2.9	4.1	1.34E+02	2.9	3.8
1.50E+02	2.98E+02	2.5	3.3	3.23E+02	2.5	3.2	4.66E+02	3.8	4.2	4.73E+02	2.6	3.3	4.78E+02	2.5	3.1	5.92E+02	2.7	3.3
2.00E+02	8.80E+02	2.3	2.7	1.07E+03	2.3	2.9	3.75E+03	10.4	11.6	3.68E+03	9	10.1	2.11E+03	6.5	7.6	5.56E+03	10	10.6
3.00E+02	3.78E+03	6.1	6.3	6.31E+03	9.5	10.6	3.21E+04	16.9	20.1	3.70E+04	17.1	20.2	4.05E+04	16.4	19.6	5.54E+04	17.6	20.9
5.00E+02	7.11E+04	20.5	21.2	7.79E+04	20	21.1	7.44E+04	21	20.7	7.78E+04	21.1	20.7	7.73E+04	21.4	20.8	8.79E+04	22.3	20.9
7.00E+02	8.26E+04	19.5	17.5	8.39E+04	20	17.4	7.25E+04	19.3	17	7.64E+04	19.5	16.8	7.75E+04	19.4	16.8	8.01E+04	19.8	16.7
1.00E+03	5.35E+04	14.6	11.4	5.83E+04	14.5	11.5	5.99E+04	15.1	11.8	5.92E+04	15.3	11.8	6.32E+04	15.5	11.9	6.26E+04	15.5	12.1
2.00E+03	4.72E+04	10.9	7.3	4.88E+04	11.5	7.5	4.84E+04	11.7	7.6	4.96E+04	12.1	7.8	5.06E+04	12.3	7.9	5.43E+04	12.9	8.3
3.00E+03	5.02E+04	10.6	6.4	5.08E+04	11.4	6.6	4.94E+04	11.5	6.8	5.16E+04	11.9	7	5.33E+04	12.2	7.1	5.16E+04	12.4	7.3
5.00E+03	5.14E+04	10.7	6	5.59E+04	11.7	6.1	5.45E+04	11.7	6.2	5.65E+04	12	6.4	5.50E+04	12.1	6.5	5.54E+04	12.7	6.8
1.00E+04	5.10E+04	8.9	5.2	5.28E+04	10.5	5.5	5.72E+04	10.6	5.4	5.70E+04	11.2	5.5	5.86E+04	11.5	5.7	5.97E+04	11.9	5.8
2.00E+04	6.58E+04	10.9	5.1	6.70E+04	12.2	5.1	6.40E+04	10.9	5.1	6.81E+04	11.6	5.3	6.58E+04	11.6	5.3	7.30E+04	12.9	5.7
5.00E+04	8.58E+04	8.7	4.1	8.20E+04	9.9	4.2	7.95E+04	9.6	4.4	8.25E+04	10.9	4.5	8.08E+04	9.9	4.5	8.63E+04	12.2	4.8
1.00E+05	1.09E+05	7.5	3.5	1.01E+05	8.1	3.8	1.03E+05	8.6	3.8	1.02E+05	8.9	4	1.03E+05	8.4	3.9	1.03E+05	10.2	4.3

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.32E-01	5.8	8.7	0.00E+00	1	1	2.92E+00	4	5.3	2.92E+00	4	5.3
2.00E+01	7.50E-01	6.4	8.2	0.00E+00	1	1	1.39E+01	4.2	5.3	1.39E+01	4.2	5.3
3.00E+01	2.59E+00	4.8	7	2.57E+00	5.3	7.5	6.32E+01	4.5	5.4	6.32E+01	4.5	5.4
5.00E+01	1.79E+01	3.6	5.7	1.57E+01	4.3	5.8	3.47E+04	7.7	4.7	3.47E+04	7.7	4.7
7.50E+01	6.18E+01	3	4.1	6.39E+01	3	4.2	2.03E+05	12.4	12.5	2.03E+05	12.4	12.5

(continued on next page)

Table A.20. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	8.43E+02	7.7	6.3	4.37E+02	7.1	5.9	1.78E+05	16	19.5	1.78E+05	16	19.5
1.50E+02	1.22E+04	13	14.7	8.02E+03	12.6	13.5	1.32E+05	20.3	25.6	1.32E+05	20.3	25.6
2.00E+02	3.99E+04	15.6	18.4	3.41E+04	15.3	17.9	1.14E+05	22.1	24.2	1.14E+05	22.1	24.2
3.00E+02	6.39E+04	21.2	23.6	5.61E+04	21.1	23.6	1.12E+05	25.3	24	1.12E+05	25.3	24
5.00E+02	8.66E+04	20.4	20.1	9.78E+04	22	21.2	1.02E+05	22.7	20	1.02E+05	22.7	20
7.00E+02	8.71E+04	20.4	16.7	8.10E+04	20.3	16.6	9.41E+04	20.3	16.1	9.41E+04	20.3	16.1
1.00E+03	6.30E+04	16.2	12.1	6.64E+04	15.7	12.2	7.79E+04	17.3	12.9	7.79E+04	17.3	12.9
2.00E+03	6.01E+04	13.4	8.3	5.68E+04	13.2	8.5	7.18E+04	15.7	9.5	7.18E+04	15.7	9.5
3.00E+03	5.70E+04	13	7.6	5.81E+04	12.9	7.5	7.02E+04	15.5	8.6	7.02E+04	15.5	8.6
5.00E+03	5.58E+04	12.4	6.9	6.36E+04	13.7	7	6.97E+04	15.4	7.7	6.97E+04	15.4	7.7
1.00E+04	6.37E+04	12.6	6.3	6.54E+04	13.3	6.3	6.96E+04	15	7	6.96E+04	15	7
2.00E+04	7.10E+04	13.3	5.7	7.17E+04	13.4	6.2	8.52E+04	15.8	6.1	8.52E+04	15.8	6.1
5.00E+04	8.83E+04	12.1	4.8	8.32E+04	12.9	5.4	8.01E+04	15.1	5.9	8.01E+04	15.1	5.9
1.00E+05	1.04E+05	12.5	4.4	1.02E+05	11	4.5	9.75E+04	15.2	5.3	9.75E+04	15.2	5.3

Table A.21. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{40}Ar ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.32E+00	6.8	0.9	2.21E+00	6.8	0.9	6.00E+02	6.7	3.5	6.93E+02	6.7	3.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.01E+01	7.3	1.1	3.51E+00	7.4	1.2	1.06E+03	7.2	4	1.14E+03	7.2	4.1	1.19E-01	7.1	9.6	1.15E-01	7	9.5
2.00E+01	1.67E+01	8	1.4	5.79E+00	8.1	1.5	2.11E+03	7.7	4.7	2.00E+03	7.8	4.9	4.75E-01	7	9.5	4.82E-01	6.9	9.3
3.00E+01	2.98E+01	8.8	1.7	1.09E+01	8.3	1.9	4.85E+03	8.5	5.8	4.33E+03	8.6	6	1.69E+00	6.3	8.5	1.63E+00	6.3	8.4
5.00E+01	7.69E+01	9.4	2.2	3.27E+01	7.8	2.3	2.06E+04	9.3	7.2	1.86E+04	9.4	7.4	8.41E+00	4.7	7.4	8.93E+00	4.7	7.2
7.50E+01	2.47E+02	9.5	2.4	1.61E+02	7.8	2	7.17E+04	11.3	10.6	5.18E+04	11.5	11	4.59E+01	3.5	4.7	4.29E+01	3.4	4.8
1.00E+02	8.85E+02	10	2.4	1.11E+03	10	2.4	1.21E+05	13.2	14.1	7.82E+04	13.3	14.5	1.75E+02	4.2	4.7	1.34E+02	2.8	3.7
1.50E+02	1.11E+04	12.9	3.6	1.08E+04	13.2	3.7	1.76E+05	16.7	20.5	1.17E+05	16.4	19.8	1.06E+03	7.7	8.8	9.59E+02	7.1	7
2.00E+02	2.08E+04	15.8	4.9	2.12E+04	15.6	4.8	1.58E+05	20	24.8	1.27E+05	19.1	23.2	9.53E+03	12.3	13.3	1.06E+04	12.8	14.1
3.00E+02	4.36E+04	18.5	5.6	4.63E+04	18.5	5.6	1.20E+05	24.8	25.4	1.16E+05	23.4	25	5.11E+04	17.8	21.1	5.62E+04	17.8	21
5.00E+02	8.87E+04	21.8	5.7	1.03E+05	21.9	5.8	9.97E+04	25.9	20.6	1.02E+05	24.7	20.9	8.40E+04	22.1	21.3	8.60E+04	22.1	21.4
7.00E+02	8.89E+04	21.5	5.1	9.20E+04	21.8	5.1	1.01E+05	22.1	17.8	1.05E+05	22.2	18.1	8.74E+04	21.2	18.1	8.92E+04	21.3	18.1
1.00E+03	7.03E+04	17.7	4	7.27E+04	17.9	4	8.92E+04	19.5	14.1	8.61E+04	19.2	14.2	6.95E+04	17.5	13.2	7.10E+04	17.7	13.3
2.00E+03	5.78E+04	14.2	2.9	5.92E+04	14.5	3	7.64E+04	17	10.6	7.44E+04	16.7	10.4	5.63E+04	13.8	8.8	5.95E+04	14.2	9
3.00E+03	5.99E+04	14.1	2.7	6.10E+04	14.5	2.8	7.44E+04	16.6	9.5	7.54E+04	16.8	9.4	5.78E+04	13.7	7.9	5.90E+04	14	8.1
5.00E+03	6.57E+04	14.4	2.6	6.82E+04	14.7	2.6	7.60E+04	17.4	8.7	8.19E+04	17	8.6	6.60E+04	14.2	7.3	6.74E+04	14.4	7.4
1.00E+04	6.67E+04	13.1	2.3	6.76E+04	13.7	2.4	8.16E+04	17.2	7.8	7.79E+04	16.4	7.7	6.56E+04	12.8	6.3	6.61E+04	12.8	6.3
2.00E+04	7.70E+04	13.5	2.2	7.74E+04	14.1	2.3	9.38E+04	17.9	7.4	8.78E+04	17.1	7.3	7.48E+04	12.9	5.9	7.89E+04	13.5	6.1
5.00E+04	9.77E+04	12.5	2	9.59E+04	13.2	2.1	1.06E+05	16.4	6.5	1.06E+05	16.8	6.5	9.37E+04	11.7	5.1	9.57E+04	13.2	5.2
1.00E+05	1.13E+05	10.9	1.8	1.16E+05	11.7	1.9	1.27E+05	16.5	5.9	1.17E+05	15.6	5.7	1.18E+05	10.5	4.2	1.16E+05	10.7	4.4

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	8.64E+02	6.8	3.6	0.00E+00	1	1
1.40E+01	1.23E-01	7.5	9.8	1.30E-01	7.3	9.9	1.28E-01	6.6	9.9	1.22E-01	7.5	9.4	1.20E+03	7.3	4.3	0.00E+00	1	1
2.00E+01	4.73E-01	7.6	9.5	4.94E-01	7.2	9.4	3.79E-01	7.6	9.5	4.98E-01	7	9.8	1.70E+03	8	5.2	2.73E-01	5.4	10.4
3.00E+01	1.63E+00	6.8	8.8	1.69E+00	6.8	8.7	1.51E+00	6.8	8.9	1.73E+00	6.4	8.5	2.97E+03	9	6.6	1.68E+00	5.4	8.9
5.00E+01	7.99E+00	5.1	7.8	8.90E+00	4.8	7.4	6.84E+00	5.3	8.2	9.64E+00	4.6	7.1	6.68E+03	10.2	8.7	4.51E+00	6.2	9.9
7.50E+01	3.95E+01	3.4	4.9	4.63E+01	3.2	4.6	3.14E+01	3.7	5.4	4.54E+01	3.3	4.7	1.62E+04	11.5	11.2	1.53E+01	4.7	7.9
1.00E+02	1.31E+02	2.8	3.7	1.55E+02	2.6	3.5	9.97E+01	3	4.1	1.42E+02	2.9	3.7	2.95E+04	13.1	14	5.02E+01	3.4	5.2
1.50E+02	7.64E+02	4.8	5.2	7.87E+02	4.1	4.6	4.52E+02	2.7	3.3	8.82E+02	5.1	5.5	5.61E+04	15.5	18.3	3.16E+02	2.3	3.2
2.00E+02	6.08E+03	11.6	12.8	6.34E+03	11.2	11.8	2.15E+03	7.3	8.7	1.22E+04	12.4	13.3	7.66E+04	17.7	21.4	9.67E+02	2.2	2.7
3.00E+02	4.79E+04	16.7	19.7	6.79E+04	16.9	20.1	3.83E+04	17	19.9	5.32E+04	18.2	21.3	7.90E+04	22.2	24.5	3.66E+03	4.5	5.3
5.00E+02	1.08E+05	22.3	22	1.16E+05	22.6	21.9	8.11E+04	21.3	21.4	9.44E+04	22.2	21.6	8.38E+04	22.8	20.5	1.08E+05	19.3	21.5
7.00E+02	9.52E+04	21.9	18.2	9.58E+04	22.2	18.1	8.98E+04	21.3	18.3	9.30E+04	21.6	18.3	9.59E+04	21.7	18.8	8.16E+04	20.9	18.7
1.00E+03	7.36E+04	17.9	13.4	7.75E+04	18.4	13.6	6.84E+04	17.3	13.1	7.57E+04	18	13.4	7.78E+04	18.7	13.8	6.47E+04	17.2	12.6
2.00E+03	6.18E+04	14.8	9.3	6.36E+04	15.1	9.6	5.67E+04	13.7	8.6	6.00E+04	14.5	9.1	6.11E+04	15.2	9.7	5.23E+04	12.1	8
3.00E+03	6.24E+04	14.6	8.4	6.48E+04	15.2	8.6	5.69E+04	13.5	7.8	6.05E+04	14.2	8.2	6.24E+04	15	8.7	5.40E+04	12.7	7.3
5.00E+03	6.77E+04	14.9	7.8	7.27E+04	15.5	8	6.23E+04	13.8	7.1	6.54E+04	14.6	7.7	7.17E+04	15.1	7.8	5.65E+04	12.9	7.3
1.00E+04	6.92E+04	13.8	6.7	7.11E+04	14.8	7	6.05E+04	11.6	6.1	6.71E+04	13.6	6.6	6.91E+04	14.2	7	6.19E+04	11.3	6
2.00E+04	8.20E+04	14.5	6.4	7.95E+04	15.2	6.7	7.22E+04	12.9	5.7	7.40E+04	13.9	6.2	7.75E+04	15.1	6.4	7.30E+04	12.8	5.9
5.00E+04	9.83E+04	13.4	5.6	9.87E+04	14.5	5.8	8.85E+04	12	5	9.35E+04	12.9	5.4	1.03E+05	14.5	5.8	8.50E+04	9.8	5
1.00E+05	1.13E+05	12.2	4.8	1.15E+05	13.5	5.1	1.12E+05	9.9	4.3	1.08E+05	11.5	4.7	1.14E+05	13.3	5.2	1.07E+05	9	3.7

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.23E-01	7.5	9.8	1.28E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

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Table A.21. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	4.43E-01	7.5	9.6	4.66E-01	7.1	9.5	3.38E-01	6.2	9.3	4.27E-01	6.2	9.7	5.35E-01	5.2	7.6	7.37E-01	4.4	7.9
3.00E+01	1.49E+00	6.9	8.8	1.60E+00	6.8	8.7	1.55E+00	6.1	9.1	1.50E+00	7	9	3.20E+00	4	6.4	3.05E+00	3.8	6.1
5.00E+01	7.06E+00	5.3	8.2	8.50E+00	4.9	7.5	7.06E+00	5.5	8.6	6.90E+00	5.5	8.6	2.19E+01	3.4	5.1	2.80E+01	3.4	4.9
7.50E+01	3.16E+01	3.7	5.4	4.09E+01	3.4	4.9	2.78E+01	4	5.7	3.13E+01	3.9	5.5	9.79E+01	2.6	4	1.03E+02	2.9	3.9
1.00E+02	9.65E+01	3	4	1.28E+02	2.8	3.7	8.76E+01	3	5	1.04E+02	2.9	4.1	3.06E+02	4	4.2	3.28E+02	3.6	4.9
1.50E+02	5.35E+02	4.1	5.1	9.42E+02	5.8	6.5	8.31E+02	7.1	8.2	6.26E+02	3.9	4.1	1.67E+04	11.9	12.3	2.48E+04	12.3	12.6
2.00E+02	6.06E+03	11.7	13	9.01E+03	12.4	13.6	5.52E+03	12.1	12.1	4.69E+03	11	12.7	5.84E+04	15.2	18.1	6.80E+04	16	18.8
3.00E+02	3.54E+04	16.8	20	4.84E+04	17.5	20.8	2.29E+04	17.3	20.5	2.83E+04	16.2	20.3	8.41E+04	20.9	24	6.87E+04	21.4	24.4
5.00E+02	8.30E+04	21.2	21.3	9.53E+04	22	21.6	9.16E+04	20.3	21.7	1.09E+05	21.2	22.2	9.30E+04	22.7	21.5	1.06E+05	23.3	21.6
7.00E+02	8.80E+04	21.2	18.4	9.37E+04	21.6	18.2	9.30E+04	21.9	18.7	9.57E+04	22.3	18.3	9.99E+04	22.3	18.2	1.04E+05	22	18.5
1.00E+03	6.83E+04	17.4	13.2	7.22E+04	17.8	13.3	6.89E+04	17.4	13.1	7.60E+04	18.4	13.4	7.66E+04	18.5	13.8	8.25E+04	18.8	13.6
2.00E+03	5.54E+04	13.6	8.7	5.89E+04	14.3	9.1	5.25E+04	14.2	8.8	5.97E+04	14.6	9	6.58E+04	15.7	9.7	6.33E+04	15.6	9.8
3.00E+03	5.80E+04	13.5	7.8	5.90E+04	14.2	8.2	6.02E+04	13.7	7.8	6.28E+04	14.6	8.3	6.39E+04	15.2	8.7	6.00E+04	15.5	9
5.00E+03	6.54E+04	13.7	7.3	6.54E+04	14.5	7.5	6.77E+04	14.2	7.5	6.95E+04	14.9	7.6	7.09E+04	15.1	7.8	7.31E+04	16.3	8.1
1.00E+04	6.50E+04	12.1	6.1	6.95E+04	13.6	6.6	6.29E+04	13.1	6.2	6.31E+04	13.6	6.5	7.03E+04	14.7	7.2	7.06E+04	14.4	7.3
2.00E+04	7.77E+04	12.8	5.9	7.21E+04	13.2	6.1	7.08E+04	13.6	5.9	7.38E+04	14.7	6.2	7.35E+04	13.6	6.5	7.83E+04	14.1	7
5.00E+04	9.41E+04	12.1	4.9	9.48E+04	13	5.3	9.24E+04	12.2	5.3	9.07E+04	13	5.4	9.19E+04	13.9	5.9	9.13E+04	16.2	6
1.00E+05	1.12E+05	10	4.2	1.13E+05	11	4.6	1.09E+05	11.6	4.5	1.08E+05	12.5	4.8	1.02E+05	13.9	4.8	1.08E+05	14.8	5.3

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.40E+01	6.8	3.6	5.12E+00	6.8	3.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.80E-01	4.2	8.8	3.41E+01	7.3	4.3	7.55E+00	7.3	4.4	1.55E-01	7.2	10	1.63E-01	7.2	9.6
2.00E+01	4.13E-01	6.4	9.3	6.12E-01	4.9	7.6	5.31E+01	8	5.2	1.23E+01	8	5.4	5.85E-01	7.3	9.3	6.10E-01	6.8	8.9
3.00E+01	1.63E+00	6.6	8.8	2.85E+00	5	6.8	9.09E+01	8.8	6.5	2.26E+01	8.3	6.6	2.06E+00	6.2	8	2.33E+00	5.7	7.5
5.00E+01	6.63E+00	5.6	8.9	1.71E+01	4	5.6	2.17E+02	9.7	8.6	6.43E+01	7.9	7.8	1.30E+01	4.1	6.2	1.56E+01	3.8	5.7
7.50E+01	2.49E+01	3.8	5.9	7.16E+01	3.3	4.4	6.23E+02	10	9.4	2.96E+02	8.2	7	6.96E+01	3	4.2	8.55E+01	2.9	4
1.00E+02	8.44E+01	3	4.3	6.06E+02	7.1	5.9	2.51E+03	10.4	9.7	2.44E+03	10.1	9.1	2.10E+02	2.7	3.4	2.47E+02	2.7	3.4
1.50E+02	3.91E+02	2.5	3.4	2.36E+04	13.1	14.3	2.56E+04	13.3	14.6	2.21E+04	13.4	14.7	2.08E+03	8.8	8.4	5.13E+03	10.2	9.7
2.00E+02	1.18E+03	4.2	6	3.86E+04	16.5	20.3	5.14E+04	16.1	19.3	4.50E+04	16	19	2.36E+04	13.5	15.2	3.76E+04	14.2	16.2
3.00E+02	2.98E+04	16.5	19.9	5.10E+04	20.1	22.4	8.83E+04	19.7	22.7	8.97E+04	19.6	22.6	8.68E+04	18.2	21.5	1.06E+05	18.7	21.9
5.00E+02	7.64E+04	20.4	21.2	7.85E+04	21.7	20.9	1.11E+05	23.8	21.7	1.14E+05	23.6	21.8	1.33E+05	23.7	22.4	1.33E+05	24	22.4
7.00E+02	8.67E+04	20.9	18.4	8.72E+04	21.1	18.5	9.50E+04	22.2	17.9	9.47E+04	22.2	17.9	9.83E+04	22.8	17.8	1.01E+05	22.8	17.7
1.00E+03	6.49E+04	16.7	13.1	7.40E+04	17.9	13.2	7.80E+04	18.6	13.8	7.81E+04	18.7	13.8	8.23E+04	18.8	13.8	8.32E+04	19	14
2.00E+03	5.32E+04	12.8	8.3	6.19E+04	14.4	9	6.49E+04	15.7	9.9	6.58E+04	15.8	9.9	6.71E+04	16.2	10.1	7.10E+04	16.4	10.3
3.00E+03	5.49E+04	13	7.5	5.87E+04	14	8.1	6.74E+04	15.7	8.9	6.70E+04	15.8	9	6.93E+04	16	9.1	7.08E+04	16.4	9.2
5.00E+03	6.01E+04	13.6	7	6.48E+04	14.1	7.6	7.15E+04	16	8.2	7.53E+04	16.1	8.3	7.38E+04	16.4	8.4	7.79E+04	16.8	8.6
1.00E+04	6.01E+04	12.3	5.7	6.54E+04	12.9	6.5	7.30E+04	15.2	7.2	7.29E+04	15.3	7.3	7.78E+04	16	7.4	7.71E+04	16.4	7.6
2.00E+04	7.91E+04	12.9	5.6	8.11E+04	13.1	6.2	8.21E+04	15.8	6.8	8.26E+04	15.9	6.9	8.44E+04	16.7	7.1	7.99E+04	16.9	7.3
5.00E+04	9.42E+04	10.2	4.6	9.36E+04	12.3	5.3	9.85E+04	15.2	6	9.92E+04	15.3	6	9.26E+04	16.2	6.2	9.75E+04	16.6	6.3
1.00E+05	1.15E+05	9.2	4	1.09E+05	10.2	4.3	1.15E+05	13.8	5.2	1.12E+05	14.2	5.3	1.10E+05	15.2	5.6	1.08E+05	16.2	5.7

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.37E+03	5.6	2	7.73E+03	5.6	2	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.27E+04	5.6	2.2	1.55E+04	5.6	2.2	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.91E+04	5.8	2.4	2.31E+04	5.8	2.4	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.17E+04	6.1	2.8	3.85E+04	6.1	2.8	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.68E+00	6.3	3.4	0.00E+00	1	1	6.30E+04	6.8	3.7	7.62E+04	6.8	3.7	6.63E+01	6.8	3.6	9.35E+00	6.9	3.6
1.40E+01	1.22E+01	7	3.7	2.13E-01	4.9	7.2	8.76E+04	7.4	4.3	1.06E+05	7.4	4.3	1.02E+02	7.3	4.3	1.15E+01	7.3	4.3
2.00E+01	3.26E+01	7.2	4.6	1.14E+00	4.8	6.3	1.23E+05	8.1	5.3	1.48E+05	8.1	5.3	1.59E+02	8	5.2	2.43E+01	7.9	5.3
3.00E+01	8.62E+01	7.7	5.5	5.37E+00	3.9	5.3	1.80E+05	9.2	6.9	2.13E+05	9.2	6.9	2.57E+02	8.9	6.6	3.95E+01	8.7	6.4
5.00E+01	7.92E+02	8	5.7	3.96E+01	3.9	4.8	2.50E+05	11.4	10.6	2.61E+05	11.7	11.2	5.97E+02	10	8.4	9.88E+01	9.8	8.2
7.50E+01	9.46E+03	10	8.5	8.46E+02	7.9	6.1	2.10E+05	14.5	16.6	2.13E+05	14.8	17.1	1.71E+03	11	10.5	3.31E+02	10.1	9.5
1.00E+02	3.29E+04	11.8	11.6	1.06E+04	10.7	9.6	1.77E+05	16.9	21.2	1.75E+05	17.1	21.7	3.94E+03	12.2	12.4	1.38E+03	10.6	10.1
1.50E+02	7.96E+04	15	17.6	4.66E+04	14.1	16	1.38E+05	20.2	25.6	1.39E+05	20.3	25.8	1.07E+04	14.5	16.9	7.20E+03	13.3	15
2.00E+02	1.03E+05	18.1	22.3	7.78E+04	16.8	20.6	1.22E+05	22.3	26.2	1.23E+05	22.3	26.2	1.80E+04	16.3	19.3	1.54E+04	15.3	17.9
3.00E+02	1.03E+05	22.1	24.4	9.74E+04	21.1	23.8	1.14E+05	24.6	24.5	1.16E+05	24.6	24.5	4.25E+04	18.4	21.1	4.34E+04	17.7	20.5
5.00E+02	1.12E+05	23.8	21.2	1.17E+05	23.5	21.6	1.10E+05	25.1	21	1.15E+05	25	21.1	8.84E+04	21.5	21.4	9.92E+04	21.8	21.8
7.00E+02	1.01E+05	22.7	18.1	1.05E+05	22.9	17.9	1.02E+05	22.6	17.9	1.04E+05	22.7	17.9	8.97E+04	21.6	18.2	9.19E+04	21.7	18.3
1.00E+03	8.01E+04	18.9	14	8.48E+04	19.1	14.1	8.81E+04	19.8	14.4	8.87E+04	19.8	14.4	6.99E+04	17.6	13.3	7.30E+04	17.9	13.3
2.00E+03	6.94E+04	16.4	10.3	6.78E+04	16.4	10.2	7.68E+04	17.4	10.8	7.81E+04	17.5	10.9	5.80E+04	14.1	9	5.93E+04	14.6	9.2

Table A.21. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	7.15E+04	16.4	9.3	7.26E+04	16.2	9.3	7.82E+04	17.4	9.8	7.88E+04	17.5	9.8	5.95E+04	14.1	8.1	6.12E+04	14.4	8.3
5.00E+03	7.55E+04	17	8.6	7.41E+04	16.3	8.4	8.27E+04	17.7	8.9	8.43E+04	17.8	9	6.43E+04	14.3	7.5	6.69E+04	14.9	7.7
1.00E+04	7.90E+04	16.5	7.7	7.37E+04	16	7.5	8.45E+04	17.5	8.1	8.48E+04	17.7	8.2	6.55E+04	13	6.4	6.66E+04	13.8	6.5
2.00E+04	8.09E+04	16.7	7.3	8.57E+04	17.3	7.1	9.24E+04	18	7.6	9.38E+04	18.2	7.7	7.55E+04	13.6	6.1	7.60E+04	14.1	6.2
5.00E+04	9.75E+04	16.1	6.2	9.51E+04	15.9	6.4	1.08E+05	17.8	6.7	1.05E+05	18.2	6.9	9.41E+04	12.5	5.2	9.17E+04	13.2	5.4
1.00E+05	1.07E+05	16.3	5.6	1.10E+05	15	5.8	1.22E+05	17	6	1.20E+05	17.5	6.2	1.14E+05	10.9	4.5	1.10E+05	11.4	4.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	7.73E+02	6.8	3.6	1.17E+02	6.9	3.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.19E+03	7.4	4.3	1.42E+02	7.3	4.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.16E-01	4.7	9	4.49E-01	4.8	9.6	1.85E+03	8	5.2	2.97E+02	7.9	5.2	4.80E-01	7.7	8.9	3.81E-01	5.6	9.7
3.00E+01	1.14E+00	5.4	9.1	1.42E+00	5.4	9.2	2.92E+03	9	6.6	4.65E+02	8.9	6.4	1.36E+00	6.1	9.3	1.26E+00	5.6	9
5.00E+01	6.10E+00	6.1	9.8	5.80E+00	6.9	9.9	6.36E+03	10.3	8.7	1.04E+03	10.4	8.5	5.50E+00	5	9.2	5.05E+00	5.8	10.4
7.50E+01	2.10E+01	3.8	6.4	1.77E+01	4.6	7.4	1.48E+04	11.4	11.1	2.61E+03	11.3	10.6	2.28E+01	4.1	6.7	1.95E+01	4.3	7.1
1.00E+02	6.80E+01	3.2	4.7	6.50E+01	3.2	4.8	2.91E+04	12.8	13.3	9.09E+03	11.5	11.2	6.97E+01	3.1	4.5	6.50E+01	3.3	4.8
1.50E+02	3.49E+02	2.3	3.1	3.62E+02	2.3	3.2	5.76E+04	15.6	18.7	3.15E+04	14.3	16.8	3.60E+02	2.6	3.3	3.78E+02	2.4	3.1
2.00E+02	1.02E+03	2.6	3.3	1.01E+03	2.1	2.9	7.54E+04	18.1	21.9	4.42E+04	17.9	21.6	1.95E+03	7.4	8.6	1.12E+03	2.3	2.8
3.00E+02	1.93E+04	13.6	16.3	1.14E+04	10.8	13.3	9.08E+04	21.3	23.5	7.57E+04	18.3	21	1.61E+04	15.1	18.3	8.85E+03	10.6	13.1
5.00E+02	6.86E+04	19.6	21.2	9.12E+04	19.2	22.6	1.17E+05	24	21.8	1.27E+05	23.9	22	7.55E+04	20.5	21.5	9.11E+04	20.4	21.9
7.00E+02	8.05E+04	20.7	18.8	9.17E+04	21.9	18.5	1.03E+05	22.8	17.8	9.84E+04	22.3	18.3	8.34E+04	20.8	18.3	8.45E+04	21.1	18.5
1.00E+03	6.82E+04	16.9	12.7	6.41E+04	17	12.9	8.36E+04	19	14.1	8.22E+04	18.6	14.1	6.68E+04	17.4	13	6.81E+04	17.7	12.9
2.00E+03	5.30E+04	12.6	8.3	5.38E+04	13.9	8.7	6.75E+04	16.5	10.3	6.57E+04	16.1	10.2	5.38E+04	13.1	8.3	5.79E+04	14	8.6
3.00E+03	5.55E+04	13.2	7.6	5.68E+04	14	7.6	7.22E+04	16.3	9.3	6.78E+04	15.7	9.1	5.60E+04	13.1	7.3	5.80E+04	13.5	7.8
5.00E+03	6.30E+04	12.3	6.9	5.90E+04	14.2	7.2	7.53E+04	16.7	8.6	7.59E+04	16.6	8.6	6.19E+04	13.2	7.2	5.86E+04	13.5	7.3
1.00E+04	6.26E+04	12	5.9	6.30E+04	13	5.8	7.39E+04	15.9	7.7	7.46E+04	15.9	7.4	6.11E+04	11	5.9	6.33E+04	11.9	6
2.00E+04	6.81E+04	10.5	5.8	6.87E+04	13.4	5.3	8.73E+04	16.7	7.2	8.11E+04	16.5	7	7.51E+04	13.2	5.6	7.21E+04	12.7	5.8
5.00E+04	9.15E+04	11.3	4.9	9.53E+04	13	4.6	9.64E+04	16.4	6.4	9.19E+04	16.5	6.2	8.75E+04	10.8	4.6	8.91E+04	11.9	4.8
1.00E+05	1.14E+05	9.4	3.7	1.04E+05	9.7	4	1.14E+05	15.3	5.8	1.13E+05	14.4	5.9	1.13E+05	9.2	3.9	1.03E+05	9.6	4.2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.65E+01	6.7	3.6	0.00E+00	1	1
1.40E+01	1.17E-01	6.9	9.8	0.00E+00	1	1	1.11E-01	6.8	9.8	1.09E-01	7	10.1	5.69E+01	7.2	4.1	1.61E-01	6.1	8.8
2.00E+01	4.28E-01	7.5	9.6	4.58E-01	7.1	9.6	4.16E-01	7.9	9.3	4.55E-01	7.9	9.8	9.80E+01	7.8	4.9	7.07E-01	4.9	7.8
3.00E+01	1.46E+00	7.2	9.1	1.58E+00	7.1	8.9	1.37E+00	7	9.1	1.40E+00	7.2	9.3	2.11E+02	8.5	6	3.36E+00	5.7	6.6
5.00E+01	6.45E+00	5.8	8.6	7.21E+00	5.3	8.3	5.64E+00	6.1	9.5	5.95E+00	5.9	9.5	8.48E+02	9.1	6.8	2.30E+01	4.4	5.8
7.50E+01	2.87E+01	3.8	5.7	3.51E+01	3.6	5.2	2.29E+01	4.1	6.2	2.51E+01	3.9	6.1	5.15E+03	10.6	9.5	1.68E+02	7.3	6
1.00E+02	9.11E+01	3	4.1	1.12E+02	2.9	3.8	7.17E+01	3.1	4.3	8.25E+01	3.1	4.2	1.18E+04	12.3	12.7	1.56E+03	9.5	8.3
1.50E+02	4.41E+02	2.5	3.2	5.49E+02	2.6	3.3	3.90E+02	2.4	3.1	4.36E+02	2.4	3	2.49E+04	15.2	18	1.83E+04	13.6	15.1
2.00E+02	2.46E+03	8.8	9.1	4.37E+03	10.4	11.1	1.11E+03	2.7	3.5	1.16E+03	2.8	3.5	3.34E+04	17.9	21.8	2.97E+04	16.8	20.2
3.00E+02	3.16E+04	16.6	19.7	4.05E+04	16.6	19.6	2.15E+04	14.3	16.7	2.14E+04	14.3	16.5	4.75E+04	19.9	22.2	4.95E+04	19.1	21.8
5.00E+02	9.35E+04	20.9	21.4	1.09E+05	21.6	21.9	7.82E+04	21	21.4	9.48E+04	21.2	21.7	9.05E+04	21.9	21.2	1.02E+05	22.2	21.6
7.00E+02	9.22E+04	21.7	18.5	9.41E+04	21.9	18.3	8.36E+04	20.6	18.3	8.86E+04	21.4	18.3	9.14E+04	21.5	18.2	9.36E+04	21.8	18.2
1.00E+03	6.78E+04	17.4	13.1	7.39E+04	17.9	13.4	6.53E+04	17.2	12.9	7.17E+04	17.4	13.1	7.32E+04	17.9	13.4	7.42E+04	17.9	13.5
2.00E+03	5.79E+04	13.9	8.7	5.82E+04	14.2	9.2	5.52E+04	13	8.5	5.58E+04	13.7	8.8	6.09E+04	14.4	9.1	5.97E+04	14.7	9.2
3.00E+03	5.76E+04	13.7	7.9	6.36E+04	14.8	8.3	5.33E+04	12.7	7.6	5.76E+04	13.4	7.9	6.05E+04	14.1	8.2	6.13E+04	14.6	8.4
5.00E+03	6.33E+04	14.1	7.3	6.90E+04	14.8	7.7	6.14E+04	13.2	7	6.80E+04	14.1	7.2	6.75E+04	14.7	7.6	6.97E+04	14.9	7.7
1.00E+04	6.63E+04	12.6	6.3	6.66E+04	13.8	6.6	6.16E+04	11.8	5.8	6.51E+04	12.8	6.1	6.78E+04	13.3	6.5	6.73E+04	13.6	6.6
2.00E+04	7.28E+04	13.7	5.9	7.45E+04	14.1	6.4	7.19E+04	12.2	5.7	7.32E+04	12.9	5.9	7.92E+04	13.9	6.1	7.84E+04	14.3	6.4
5.00E+04	9.14E+04	11.8	5.1	9.16E+04	13.3	5.4	9.74E+04	11.4	4.8	9.01E+04	12.4	5.3	9.64E+04	12.8	5.2	9.29E+04	13.4	5.5
1.00E+05	1.11E+05	10.9	4.4	1.09E+05	11.6	4.7	1.16E+05	9.2	4	1.08E+05	10.2	4.2	1.15E+05	10.8	4.5	1.10E+05	12.2	4.7

(continued on next page)

Table A.21. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.28E+01	6.8	3.6	4.17E+00	6.8	3.7	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	7.71E+01	7.3	4.3	6.19E+00	7.3	4.4	1.17E-01	5.6	9.1	1.63E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.15E+02	8	5.2	9.78E+00	7.9	5.4	5.02E-01	6.6	9	4.37E+00	7.2	4.5	3.58E-01	6.8	9.7	4.35E-01	7.1	10.1
3.00E+01	1.96E+02	8.9	6.5	1.90E+01	8.2	6.6	2.34E+00	5.8	7.6	1.23E+01	6.5	4.7	1.36E+00	7.1	9.5	1.33E+00	7.1	9.2
5.00E+01	4.77E+02	9.6	8.2	6.49E+01	8	7.3	1.38E+01	3.9	6.1	8.74E+01	8.5	6.2	4.92E+00	6.7	10.6	5.78E+00	6.1	9.8
7.50E+01	1.99E+03	10.3	9.2	4.79E+02	8.8	7.5	7.10E+01	3.4	4.8	7.83E+02	9.5	9.2	1.45E+01	5.4	8.3	2.13E+01	4.2	6.5
1.00E+02	7.72E+03	11.3	10.9	2.46E+03	10.5	9.9	1.15E+03	8.8	7.3	3.85E+03	10.6	9.9	4.17E+01	3.8	5.6	7.24E+01	3.2	4.4
1.50E+02	3.19E+04	14.1	15.9	1.60E+04	13.1	14.2	1.01E+04	13.5	15.2	1.66E+04	14.1	16.3	2.72E+02	2.5	3.4	4.26E+02	2.4	3
2.00E+02	5.71E+04	16.5	19.8	4.21E+04	15.4	18.2	1.86E+04	15.1	18.4	3.25E+04	15.5	18	8.41E+02	2.1	2.7	1.11E+03	2.4	3
3.00E+02	9.07E+04	20.3	23.2	8.87E+04	19.5	22.6	8.20E+04	17.6	20.4	9.05E+04	18.2	21.5	3.04E+03	3.5	4.9	1.54E+04	12.5	14.6
5.00E+02	1.05E+05	23.8	21.6	1.09E+05	23.6	21.7	1.11E+05	23.3	22.1	1.13E+05	23.5	21.5	7.68E+04	17.8	20.6	8.88E+04	20.9	21.7
7.00E+02	9.39E+04	22	17.9	9.51E+04	22.1	17.9	9.59E+04	23	17.9	9.95E+04	22.1	18.2	8.02E+04	20.5	18.8	8.88E+04	21.3	18.1
1.00E+03	7.75E+04	18.6	13.8	7.73E+04	18.5	13.7	7.66E+04	18.4	13.8	8.27E+04	19	13.8	6.19E+04	16.4	12.7	6.82E+04	17.2	12.9
2.00E+03	6.56E+04	15.6	9.8	6.51E+04	15.6	9.8	6.58E+04	15.7	10	6.50E+04	15.9	10.2	4.95E+04	12.1	7.8	5.50E+04	13.5	8.7
3.00E+03	6.72E+04	15.6	8.8	6.63E+04	15.5	8.8	6.83E+04	15.7	8.9	6.86E+04	15.7	9.3	5.05E+04	11.9	7.1	5.83E+04	13.5	7.8
5.00E+03	7.25E+04	15.9	8.1	7.25E+04	15.8	8.1	7.24E+04	15.9	8.2	7.54E+04	16.1	8.4	5.51E+04	12.6	6.7	6.37E+04	14.4	7.2
1.00E+04	7.33E+04	15	7.1	7.30E+04	15.1	7.1	7.37E+04	15.3	7.3	7.28E+04	15.9	7.3	5.75E+04	11	5.6	6.13E+04	12.1	6.1
2.00E+04	8.20E+04	15.4	6.8	8.22E+04	15.4	6.7	8.10E+04	16.3	7	8.31E+04	16.8	7.1	7.04E+04	11.1	5.2	7.07E+04	12.6	5.7
5.00E+04	1.01E+05	14.7	5.8	9.70E+04	14.8	5.9	9.69E+04	16.2	6	9.10E+04	16	6.3	8.77E+04	9.8	4.3	8.87E+04	10.3	5.1
1.00E+05	1.20E+05	13.5	5.1	1.15E+05	13.6	5.1	1.09E+05	13.6	5.4	1.07E+05	15.6	5.6	1.12E+05	8.7	4.1	1.10E+05	10.1	4.3

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.75E-02	6.9	10.2	1.15E-01	7.4	9.6	1.13E-01	7.3	9.7	1.41E-01	6.2	10.1	1.36E-01	6.6	9.7
2.00E+01	3.79E-01	5.2	9.4	4.97E-01	6.9	9.8	4.41E-01	7.2	9.6	4.31E-01	7.2	9.6	3.81E-01	7.2	9.5	4.60E-01	6.4	9.9
3.00E+01	1.16E+00	7.2	9.3	1.33E+00	7.3	9.3	1.49E+00	7	9	1.52E+00	7	8.9	1.49E+00	6.9	9	1.58E+00	6.9	8.8
5.00E+01	5.13E+00	6.2	10.2	5.14E+00	6.8	10.3	6.48E+00	5.5	8.7	6.76E+00	5.4	8.7	6.36E+00	5.3	8.9	8.08E+00	5	7.9
7.50E+01	1.59E+01	5.2	7.9	1.83E+01	4.9	7.9	2.81E+01	3.8	5.6	3.04E+01	3.7	5.5	2.80E+01	3.7	5.5	3.84E+01	3.5	4.9
1.00E+02	4.80E+01	3.4	5.5	5.45E+01	3.5	5.1	8.87E+01	3	4.1	1.01E+02	2.9	4	9.97E+01	2.9	4.1	1.33E+02	2.9	3.8
1.50E+02	2.95E+02	2.5	3.3	3.21E+02	2.5	3.2	4.56E+02	3.6	4.2	4.66E+02	2.5	3.2	4.70E+02	2.4	3.1	5.82E+02	2.6	3.2
2.00E+02	8.72E+02	2.3	2.7	1.03E+03	2.3	2.9	3.09E+03	10.1	10.9	2.79E+03	9	9.5	1.34E+03	6.3	7.3	4.05E+03	9.8	9.8
3.00E+02	3.47E+03	3.9	5	5.58E+03	9	10.4	3.41E+04	16.3	19.6	3.80E+04	16.5	19.5	4.15E+04	15.9	18.9	5.62E+04	17	20.3
5.00E+02	7.57E+04	19	21.9	7.80E+04	19.7	21.6	8.24E+04	21.1	21.3	8.63E+04	21.3	21.4	8.30E+04	21.4	21.2	9.54E+04	22	21.8
7.00E+02	9.05E+04	21.3	18.2	8.76E+04	21.1	18.9	8.57E+04	21	18.2	8.91E+04	21.3	18.2	8.88E+04	21.4	18.2	9.44E+04	21.8	18.2
1.00E+03	6.37E+04	16.7	13	6.62E+04	17.1	12.7	6.66E+04	17.1	13.1	6.94E+04	17.4	13.1	6.53E+04	17.4	13.2	7.18E+04	17.8	13.3
2.00E+03	5.11E+04	12.6	8.4	5.35E+04	13.1	8.2	5.46E+04	13.2	8.4	5.76E+04	13.8	8.7	5.40E+04	13.6	8.8	6.12E+04	14.6	9.3
3.00E+03	5.44E+04	13.2	7.4	5.62E+04	12.8	7.4	5.54E+04	13.1	7.6	5.61E+04	13.4	7.8	5.74E+04	13.8	7.9	6.10E+04	14.6	8.4
5.00E+03	5.64E+04	12.5	6.7	5.80E+04	13.2	7	6.42E+04	13.7	7.1	6.75E+04	14.2	7.2	6.20E+04	13.9	7.3	6.31E+04	14.7	7.8
1.00E+04	5.66E+04	9.9	5.5	5.65E+04	12.1	5.8	6.22E+04	12	6	6.59E+04	12.4	6.1	6.40E+04	12.6	6.3	6.60E+04	14.1	6.6
2.00E+04	7.08E+04	12.2	5.4	7.24E+04	12.4	5.7	7.18E+04	12.1	5.6	7.73E+04	13	5.9	7.32E+04	12.6	6	7.46E+04	13.9	6.1
5.00E+04	9.24E+04	9.1	4.1	8.91E+04	11.3	4.7	9.43E+04	11.3	4.8	9.10E+04	12.2	5.1	9.41E+04	12.2	5	9.40E+04	13.3	5.5
1.00E+05	1.17E+05	8.3	3.8	1.10E+05	8.6	4.3	1.17E+05	9.3	4.1	1.14E+05	9.9	4.2	1.12E+05	10.3	4.6	1.13E+05	11.1	4.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.42E-01	5.8	8.7	0.00E+00	1	1	2.95E+00	3.9	5.2	2.95E+00	3.9	5.2
2.00E+01	7.70E-01	6.4	8.2	0.00E+00	1	1	1.40E+01	4.2	5.3	1.40E+01	4.2	5.3
3.00E+01	2.73E+00	4.7	7	2.64E+00	5.3	7.5	6.22E+01	4.4	5.3	6.22E+01	4.4	5.3
5.00E+01	1.84E+01	3.6	5.6	1.59E+01	4.2	5.8	4.65E+04	7.4	4.4	4.65E+04	7.4	4.4
7.50E+01	6.29E+01	2.9	4.1	6.40E+01	3	4.2	2.30E+05	11.8	11.3	2.30E+05	11.8	11.3
1.00E+02	7.97E+02	7.6	6.3	3.45E+02	5.9	5.4	1.99E+05	15.1	17.9	1.99E+05	15.1	17.9
1.50E+02	1.16E+04	12.5	13.4	7.56E+03	11.8	12.6	1.49E+05	19.2	24.4	1.49E+05	19.2	24.4

Table A.21. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.72E+04	14.6	16.9	3.46E+04	14.3	16.6	1.28E+05	20.9	24.1	1.28E+05	20.9	24.1
3.00E+02	7.11E+04	19.9	23.5	6.27E+04	20.3	23.5	1.27E+05	24	24.3	1.27E+05	24	24.3
5.00E+02	9.21E+04	22.1	20.9	1.04E+05	22	21.9	1.15E+05	24.7	20.9	1.15E+05	24.7	20.9
7.00E+02	9.80E+04	22.5	18	8.99E+04	22.3	18.2	1.07E+05	22.7	17.9	1.07E+05	22.7	17.9
1.00E+03	7.26E+04	17.4	13.4	7.87E+04	18.3	13.3	8.86E+04	19.6	14.5	8.86E+04	19.6	14.5
2.00E+03	6.49E+04	15.2	9.6	6.29E+04	15.4	9.5	8.03E+04	17.8	10.8	8.03E+04	17.8	10.8
3.00E+03	6.47E+04	15.2	8.6	6.39E+04	14.8	8.5	7.84E+04	17.6	9.6	7.84E+04	17.6	9.6
5.00E+03	6.16E+04	15.4	8	7.01E+04	15.8	8.1	7.88E+04	17.6	9.2	7.88E+04	17.6	9.2
1.00E+04	7.06E+04	14.5	6.9	7.07E+04	15.1	7	7.79E+04	16.9	7.8	7.79E+04	16.9	7.8
2.00E+04	7.81E+04	14.9	6.4	7.98E+04	14.5	6.6	9.76E+04	17.9	6.7	9.76E+04	17.9	6.7
5.00E+04	9.69E+04	13.8	5.9	9.01E+04	13	5.8	9.09E+04	17	7.5	9.09E+04	17	7.5
1.00E+05	1.13E+05	13.6	5	1.10E+05	11.7	5	1.09E+05	17.2	5.9	1.09E+05	17.2	5.9

Table A.22. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{39}K ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.66E+00	6.5	0.9	2.31E+00	6.6	0.9	6.28E+02	6.4	3.2	7.31E+02	6.5	3.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.08E+01	7	1	3.73E+00	7	1	1.11E+03	6.9	3.7	1.20E+03	6.9	3.8	1.20E-01	7.1	9.6	1.14E-01	7	9.5
2.00E+01	1.76E+01	7.6	1.2	6.01E+00	7.6	1.3	2.18E+03	7.4	4.3	2.09E+03	7.5	4.5	4.80E-01	7	9.5	4.94E-01	6.9	9.3
3.00E+01	3.15E+01	8.3	1.6	1.14E+01	8.1	1.7	5.00E+03	8.1	5.3	4.46E+03	8.2	5.5	1.73E+00	6.3	8.5	1.66E+00	6.3	8.3
5.00E+01	7.89E+01	8.9	2	3.36E+01	7.7	2.1	2.03E+04	9.1	6.9	1.84E+04	9	6.7	8.62E+00	4.6	7.3	9.17E+00	4.7	7.2
7.50E+01	2.45E+02	8.9	2.3	1.39E+02	7.5	2	7.35E+04	10.6	9.3	5.31E+04	10.9	9.8	4.53E+01	3.4	4.7	4.33E+01	3.3	4.7
1.00E+02	8.53E+02	9.3	2.3	1.01E+03	9.2	2.1	1.26E+05	12.4	12.6	8.16E+04	12.6	13	1.68E+02	4	4.6	1.34E+02	2.8	3.7
1.50E+02	1.06E+04	12	3.1	1.02E+04	12.2	3.2	1.81E+05	15.7	18.6	1.25E+05	15.4	18.2	1.02E+03	7.3	7.2	7.99E+02	4.6	4.9
2.00E+02	2.15E+04	14.7	4.4	2.18E+04	14.6	4.3	1.75E+05	18.7	23.2	1.37E+05	17.9	21.9	6.74E+03	11.1	11.8	9.71E+03	11.6	12.2
3.00E+02	4.50E+04	17.7	5.3	4.77E+04	17.5	5.3	1.32E+05	23.1	25.4	1.23E+05	22.1	24.8	5.25E+04	16.4	19.4	5.72E+04	16.4	19.6
5.00E+02	9.41E+04	20.9	5.7	1.03E+05	20.9	5.8	1.09E+05	26.4	22.1	1.09E+05	25	21.8	9.00E+04	21.1	21.7	9.13E+04	21.2	21.7
7.00E+02	9.60E+04	22.3	5.3	9.87E+04	22.7	5.4	1.11E+05	24.2	18.8	1.09E+05	23.9	19.2	9.05E+04	22.1	19.2	9.54E+04	22.1	19.1
1.00E+03	7.70E+04	20	4.3	7.80E+04	20.2	4.3	9.97E+04	22	15.7	9.15E+04	21.7	15.6	7.67E+04	19.8	14.7	7.82E+04	19.9	14.8
2.00E+03	6.29E+04	16.2	3.2	6.34E+04	16.5	3.3	8.45E+04	19.1	11.7	8.03E+04	19	11.7	6.12E+04	15.8	9.9	6.18E+04	16.1	10
3.00E+03	6.39E+04	15.9	3	6.48E+04	16.4	3	8.13E+04	19.1	10.7	8.20E+04	18.9	10.5	6.26E+04	15.6	8.9	6.33E+04	15.8	9.1
5.00E+03	6.78E+04	16	2.8	7.12E+04	16.7	2.8	8.52E+04	19.2	9.7	8.70E+04	19.1	9.6	6.93E+04	15.8	8.1	6.92E+04	16.4	8.3
1.00E+04	6.94E+04	15	2.5	7.13E+04	15.8	2.5	9.08E+04	18	8.8	8.51E+04	18.9	8.7	6.70E+04	14.4	7	6.74E+04	15.1	7.1
2.00E+04	8.17E+04	15.1	2.4	8.12E+04	16	2.4	1.02E+05	19.6	8	8.88E+04	19.3	8.2	7.86E+04	14.5	6.6	8.00E+04	14.9	6.6
5.00E+04	1.01E+05	14	2.2	9.88E+04	15.2	2.2	1.17E+05	18.6	7.5	1.13E+05	19.5	7.2	9.60E+04	13.4	5.7	9.98E+04	13.9	5.8
1.00E+05	1.20E+05	13.1	1.9	1.18E+05	13.8	2	1.39E+05	18.3	6.5	1.25E+05	18.8	6.5	1.21E+05	12.5	4.8	1.19E+05	12.6	5

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	9.14E+02	6.6	3.4	0.00E+00	1	1
1.40E+01	1.24E-01	7.5	9.8	1.31E-01	7.3	9.9	1.31E-01	6.6	9.9	1.20E-01	7.5	9.4	1.27E+03	7	3.9	0.00E+00	1	1
2.00E+01	4.81E-01	7.6	9.5	5.05E-01	7.2	9.4	3.84E-01	7.6	9.5	5.10E-01	7	9.8	1.78E+03	7.7	4.7	2.73E-01	5.4	10.4
3.00E+01	1.67E+00	6.8	8.8	1.73E+00	6.8	8.7	1.54E+00	6.8	8.8	1.77E+00	6.4	8.5	3.09E+03	8.6	6	1.73E+00	5.4	8.9
5.00E+01	8.22E+00	5	7.7	9.16E+00	4.8	7.3	7.04E+00	5.3	8.2	9.90E+00	4.6	7.1	6.89E+03	9.9	8.2	4.69E+00	6.2	9.9
7.50E+01	3.99E+01	3.4	4.9	4.69E+01	3.2	4.6	3.18E+01	3.7	5.4	4.53E+01	3.3	4.7	1.68E+04	11	10.1	1.56E+01	4.7	7.9
1.00E+02	1.30E+02	2.7	3.7	1.55E+02	2.6	3.5	9.91E+01	3	4	1.41E+02	2.9	3.7	3.03E+04	12.4	12.6	5.11E+01	3.4	5.2
1.50E+02	7.33E+02	4.3	4.6	7.50E+02	3.1	3.6	4.46E+02	2.6	3.1	6.49E+02	3.5	4	5.84E+04	14.6	16.9	3.15E+02	2.2	3.2
2.00E+02	5.64E+03	10.1	10.7	4.87E+03	9.6	9.9	1.75E+03	6.3	6.1	1.06E+04	11	11.3	8.14E+04	16.6	20.1	9.56E+02	2.2	2.7
3.00E+02	4.67E+04	15.6	18.3	6.71E+04	15.7	18.3	3.71E+04	15.2	18.3	5.48E+04	16.9	19.9	8.81E+04	21.1	24.1	3.48E+03	3.3	4.2
5.00E+02	1.09E+05	21.2	22.2	1.18E+05	21.7	22.2	8.55E+04	20.2	21.3	9.72E+04	21.2	21.8	8.93E+04	23.3	21.4	1.03E+05	18.2	20.6
7.00E+02	1.05E+05	23	19.5	1.03E+05	23.5	19.4	9.75E+04	21.6	19.4	9.69E+04	22.6	19.3	1.04E+05	22.5	19.3	9.18E+04	20.9	19.3
1.00E+03	8.01E+04	20.2	14.9	8.20E+04	20.6	15	7.28E+04	19.6	14.7	7.88E+04	20.3	14.9	7.90E+04	20.4	15.1	7.00E+04	19.6	14.2
2.00E+03	6.50E+04	16.7	10.5	6.86E+04	17.3	10.8	6.01E+04	15.6	9.8	6.69E+04	16.6	10.2	6.33E+04	16.9	10.9	5.70E+04	14.4	9.3
3.00E+03	6.77E+04	16.6	9.4	7.09E+04	17.3	9.7	6.32E+04	15.6	8.7	6.43E+04	16.3	9.2	7.40E+04	17.8	9.6	5.87E+04	12.7	8.4
5.00E+03	7.23E+04	16.6	8.6	7.59E+04	17.5	8.8	6.90E+04	15.6	8	6.72E+04	16.1	8.5	7.28E+04	18	8.9	6.12E+04	14.3	7.5
1.00E+04	7.27E+04	15.9	7.5	7.60E+04	16.9	7.9	6.56E+04	14.1	6.8	6.99E+04	15.6	7.4	7.47E+04	17.6	7.6	6.66E+04	13.9	6.6
2.00E+04	8.41E+04	16.3	7.1	8.60E+04	17.5	7.4	7.86E+04	14.4	6.6	8.21E+04	16.6	6.8	8.89E+04	16.7	7.2	7.82E+04	14.9	5.9
5.00E+04	1.01E+05	15.8	6.1	1.02E+05	17	6.5	9.70E+04	12.8	5.5	9.85E+04	15	5.9	1.11E+05	15.6	6.4	9.16E+04	10.6	5.3
1.00E+05	1.20E+05	14.9	5.4	1.19E+05	16	5.8	1.21E+05	12.1	4.6	1.11E+05	13.1	5.1	1.25E+05	14.4	5.7	1.13E+05	9.2	3.9

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.25E-01	7.5	9.8	1.29E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	4.55E-01	7.5	9.6	4.74E-01	7.1	9.5	3.43E-01	6.2	9.3	4.26E-01	6.2	9.7	5.28E-01	5.2	7.6	7.36E-01	4.4	7.9
3.00E+01	1.52E+00	6.9	8.8	1.64E+00	6.8	8.7	1.61E+00	6.1	9.1	1.53E+00	7	9	3.29E+00	4	6.4	3.15E+00	3.8	6.1
5.00E+01	7.24E+00	5.3	8.2	8.73E+00	4.8	7.4	7.24E+00	5.4	8.5	7.07E+00	5.5	8.5	2.22E+01	3.4	5	2.91E+01	3.3	4.9

Table A.22. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.19E+01	3.7	5.3	4.11E+01	3.4	4.8	2.80E+01	4	5.8	3.18E+01	3.8	5.5	9.71E+01	2.7	4	1.02E+02	2.9	3.9
1.00E+02	9.65E+01	2.9	4	1.28E+02	2.8	3.7	8.75E+01	3	4.9	1.05E+02	2.9	4	2.95E+02	2.6	4	3.04E+02	3	3.5
1.50E+02	5.16E+02	3.3	3.7	8.23E+02	4.8	4.8	7.93E+02	6.8	5.7	5.89E+02	3.5	3.4	1.57E+04	11.2	10.6	2.33E+04	11.2	10.6
2.00E+02	4.79E+03	10.2	10.8	8.31E+03	10.9	11.5	5.23E+03	11.3	11.5	4.27E+03	10.2	10.7	6.07E+04	14.1	15.8	7.04E+04	14.5	16.8
3.00E+02	3.63E+04	15.6	18.5	4.98E+04	16.3	19.3	2.39E+04	15.7	19	2.82E+04	15.8	18.9	9.19E+04	19.6	23.5	7.96E+04	20.1	24.1
5.00E+02	8.70E+04	20.2	21.2	1.00E+05	20.9	21.7	9.66E+04	19.3	21.2	1.14E+05	19.9	21.9	1.00E+05	21.8	21.6	1.13E+05	22.7	21.7
7.00E+02	9.57E+04	21.9	19.3	9.65E+04	22.4	19.4	1.03E+05	22.4	19.6	1.03E+05	22.8	19.7	1.01E+05	22.7	19.4	1.17E+05	22.8	19.8
1.00E+03	7.50E+04	19.5	14.7	7.67E+04	20.1	14.9	7.53E+04	19.8	14.6	7.91E+04	20.3	14.9	7.90E+04	20.5	15.2	8.39E+04	21.1	14.9
2.00E+03	5.98E+04	15.6	9.8	6.33E+04	16.4	10.2	5.84E+04	15.4	9.8	6.19E+04	15.9	10.3	7.16E+04	16.9	10.8	7.06E+04	17.7	10.9
3.00E+03	6.15E+04	15.3	8.8	6.52E+04	16.1	9.2	6.08E+04	15.2	8.8	6.71E+04	16.4	9.2	6.99E+04	17.4	9.9	7.74E+04	18	9.8
5.00E+03	6.70E+04	15.4	7.9	6.81E+04	16.3	8.4	7.37E+04	15.7	8.1	7.03E+04	17	8.2	7.81E+04	17.9	8.9	7.91E+04	17.7	9.1
1.00E+04	6.62E+04	14	6.9	7.36E+04	15.8	7.3	6.87E+04	15.1	7.1	7.39E+04	16.1	7.4	7.77E+04	17.2	8.1	7.72E+04	17.1	8.1
2.00E+04	7.85E+04	14.2	6.5	8.21E+04	16.1	6.9	7.63E+04	14	6.8	7.94E+04	15.6	7.1	8.15E+04	15.6	7.2	8.43E+04	18.1	7.7
5.00E+04	9.51E+04	13.3	5.6	9.55E+04	15	5.9	9.96E+04	13.7	5.9	9.83E+04	14.7	6	1.02E+05	15.6	6.2	9.79E+04	17.5	6.6
1.00E+05	1.20E+05	12.3	4.7	1.15E+05	13.2	5.2	1.17E+05	12.5	5	1.17E+05	13.9	5.4	1.06E+05	15.7	5.7	1.16E+05	15.9	5.6

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.54E+01	6.5	3.4	5.46E+00	6.6	3.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.87E-01	4.2	8.8	3.62E+01	7	3.9	8.04E+00	7	4	1.57E-01	7.2	10	1.66E-01	7.2	9.6
2.00E+01	4.15E-01	6.4	9.3	6.16E-01	4.9	7.6	5.59E+01	7.6	4.7	1.27E+01	7.6	4.8	6.00E-01	7.3	9.3	6.18E-01	6.8	8.8
3.00E+01	1.68E+00	6.6	8.8	2.92E+00	5	6.8	9.52E+01	8.4	5.9	2.37E+01	8.1	5.9	2.11E+00	6.2	8	2.40E+00	5.7	7.4
5.00E+01	6.78E+00	5.5	8.8	1.72E+01	3.9	5.5	2.25E+02	9.2	7.8	6.61E+01	7.7	7.1	1.33E+01	4	6.1	1.60E+01	3.7	5.6
7.50E+01	2.52E+01	3.8	5.9	7.13E+01	3.2	4.3	6.45E+02	9.5	8.7	2.87E+02	7.1	6.7	6.97E+01	3	4.1	8.49E+01	2.9	3.9
1.00E+02	8.41E+01	3	4.2	3.00E+02	5.6	4.9	2.42E+03	9.8	9.2	2.14E+03	9.3	8.1	2.08E+02	2.7	3.4	2.45E+02	2.6	3.3
1.50E+02	3.86E+02	2.5	3.3	2.27E+04	11.9	11.9	2.40E+04	12.4	12.9	2.24E+04	12.4	12.9	1.66E+03	6.5	6.4	3.58E+03	8.3	7.8
2.00E+02	1.13E+03	4	4.4	4.00E+04	15.3	18.2	5.21E+04	15	17.6	4.63E+04	15	17.5	2.25E+04	12.3	13.1	3.44E+04	13	14.2
3.00E+02	2.91E+04	14.9	17.5	5.37E+04	19	22.1	9.32E+04	18.6	21.8	9.37E+04	18.4	21.6	8.99E+04	17	20.2	1.08E+05	17.5	20.7
5.00E+02	7.82E+04	19.6	21.2	8.30E+04	21.8	20.9	1.16E+05	22.9	22.4	1.19E+05	22.7	22.3	1.49E+05	22.2	22.7	1.48E+05	22.6	22.8
7.00E+02	9.47E+04	21.3	19.3	9.59E+04	21.6	19.4	1.04E+05	23.9	19.4	1.03E+05	23.9	19.4	1.12E+05	24.7	19.5	1.13E+05	25	19.5
1.00E+03	7.33E+04	19	14.4	7.92E+04	20.5	14.9	8.56E+04	21.1	15.3	8.53E+04	21.1	15.3	8.67E+04	21.3	15.3	9.03E+04	21.3	15.4
2.00E+03	5.66E+04	15	9.3	6.23E+04	16.3	10.2	7.17E+04	17.9	11.1	7.12E+04	18	11.1	7.43E+04	18.3	11.4	7.61E+04	18.6	11.5
3.00E+03	5.89E+04	14.5	8.4	6.33E+04	16.1	9	7.22E+04	17.8	10	7.17E+04	17.8	10	7.40E+04	18.1	10.2	7.71E+04	18.5	10.4
5.00E+03	6.61E+04	14.7	7.9	7.12E+04	15.6	8.4	7.70E+04	18	9.1	7.76E+04	18.1	9.2	8.11E+04	18.3	9.3	8.14E+04	18.6	9.5
1.00E+04	6.43E+04	13.5	6.4	7.10E+04	15.3	7.1	7.75E+04	17.5	8.1	7.83E+04	17.7	8.2	8.09E+04	18.3	8.3	8.10E+04	18.7	8.5
2.00E+04	8.12E+04	13.4	6.1	8.61E+04	16.3	6.9	8.77E+04	17.9	7.6	8.73E+04	18.1	7.7	8.84E+04	18.8	7.9	8.74E+04	19	8
5.00E+04	1.02E+05	11.8	5.2	9.53E+04	14	5.8	1.06E+05	17.3	6.7	1.04E+05	17.6	6.8	9.96E+04	18.2	7	1.05E+05	19.4	7.3
1.00E+05	1.23E+05	10.6	4.7	1.22E+05	12	5	1.21E+05	16.2	5.9	1.22E+05	16.8	6	1.19E+05	18	6.2	1.21E+05	18.5	6.4

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.21E+03	5.5	1.9	7.55E+03	5.5	1.9	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.24E+04	5.5	2.1	1.51E+04	5.5	2.1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.86E+04	5.6	2.3	2.25E+04	5.6	2.3	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.10E+04	5.9	2.6	3.76E+04	5.9	2.6	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.93E+00	6	3.1	0.00E+00	1	1	6.14E+04	6.6	3.4	7.44E+04	6.6	3.4	7.34E+01	6.5	3.3	1.03E+01	6.6	3.3
1.40E+01	1.28E+01	6.7	3.6	2.16E-01	4.9	7.2	8.57E+04	7.1	4	1.04E+05	7.1	4	1.08E+02	7	3.9	1.19E+01	6.9	4
2.00E+01	3.29E+01	7	4.2	1.19E+00	4.8	6.2	1.20E+05	7.8	4.8	1.46E+05	7.8	4.8	1.67E+02	7.7	4.7	2.51E+01	7.7	4.8
3.00E+01	8.72E+01	7.4	5	5.53E+00	3.9	5.3	1.76E+05	8.8	6.3	2.11E+05	8.8	6.3	2.71E+02	8.5	6	4.08E+01	8.4	5.9
5.00E+01	6.51E+02	7.7	5.5	3.96E+01	3.8	4.7	2.65E+05	10.6	9.2	2.81E+05	11	9.7	6.11E+02	9.7	8	1.02E+02	9	7.5
7.50E+01	9.08E+03	9.3	7.6	5.89E+02	6.9	5.3	2.30E+05	13.6	14.7	2.34E+05	13.8	15.2	1.74E+03	10.6	9.6	3.22E+02	9.6	9.2
1.00E+02	3.10E+04	11.1	10.3	9.00E+03	9.8	8.3	1.95E+05	15.8	19.2	1.94E+05	16.1	19.8	3.89E+03	11.6	11.4	1.31E+03	9.9	9.2
1.50E+02	8.31E+04	14.1	15.8	4.76E+04	13.1	14.2	1.52E+05	19.1	24.4	1.52E+05	19.3	24.6	1.11E+04	13.7	15.3	7.22E+03	12.4	13.5
2.00E+02	1.11E+05	16.9	20.6	8.17E+04	15.8	18.8	1.33E+05	21.2	25.8	1.34E+05	21.2	25.8	1.85E+04	15.4	18.3	1.53E+04	14.3	16.7
3.00E+02	1.13E+05	20.8	24.1	1.03E+05	19.9	23.2	1.22E+05	23.6	24.9	1.24E+05	23.5	24.9	4.28E+04	17.4	20.2	4.33E+04	16.9	19.8
5.00E+02	1.21E+05	23.9	22	1.20E+05	23.1	22	1.19E+05	25.9	22	1.21E+05	25.9	22	9.40E+04	20.7	21.5	1.05E+05	20.7	21.6
7.00E+02	1.16E+05	24.2	19.6	1.14E+05	24.2	19.7	1.11E+05	24.7	19.2	1.13E+05	24.8	19.3	9.71E+04	22.3	19.4	9.97E+04	22.6	19.4
1.00E+03	9.48E+04	21.7	15.6	8.77E+04	21.5	15.5	9.69E+04	22.3	15.9	9.83E+04	22.4	15.9	7.80E+04	19.9	14.9	7.84E+04	20.1	14.8
2.00E+03	7.42E+04	18.6	11.6	7.48E+04	18.3	11.4	8.43E+04	19.8	12.1	8.52E+04	19.9	12.2	6.31E+04	16.2	10.1	6.43E+04	16.4	10.3
3.00E+03	7.75E+04	18.8	10.4	7.64E+04	18.3	10.4	8.56E+04	19.7	10.9	8.67E+04	19.9	11	6.49E+04	15.9	9	6.46E+04	16.2	9.2

(continued on next page)

Table A.22. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	7.99E+04	18.8	9.6	8.13E+04	19.1	9.5	8.93E+04	20	10	9.08E+04	20.2	10	6.96E+04	15.9	8.3	7.16E+04	16.5	8.5
1.00E+04	8.70E+04	18.8	8.7	7.74E+04	17.9	8.5	9.18E+04	20	9.1	9.15E+04	20.2	9.2	7.07E+04	15.2	7.2	7.12E+04	15.9	7.3
2.00E+04	9.45E+04	19.2	7.9	9.06E+04	19	8.1	9.91E+04	20.4	8.5	9.99E+04	20.7	8.6	8.11E+04	15.2	6.8	8.14E+04	16	6.9
5.00E+04	1.05E+05	18.1	7.1	1.03E+05	18.7	7.2	1.17E+05	20.3	7.6	1.13E+05	20.8	7.7	1.01E+05	13.9	5.8	9.89E+04	15.2	6
1.00E+05	1.21E+05	17.9	6.6	1.21E+05	17.8	6.3	1.31E+05	19.7	6.8	1.29E+05	20.3	7	1.21E+05	13	4.9	1.18E+05	13.3	5.3

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	8.60E+02	6.5	3.3	1.29E+02	6.6	3.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.26E+03	7.1	3.9	1.47E+02	6.9	4	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.22E-01	4.7	9	4.64E-01	4.8	9.6	1.94E+03	7.7	4.7	3.06E+02	7.7	4.8	4.88E-01	7.7	8.9	3.84E-01	5.6	9.7
3.00E+01	1.15E+00	5.4	9.1	1.45E+00	5.4	9.2	3.09E+03	8.6	6	4.82E+02	8.5	5.9	1.39E+00	6.1	9.3	1.28E+00	5.6	9
5.00E+01	6.25E+00	6.1	9.7	6.00E+00	6.9	9.9	6.53E+03	9.9	8.2	1.08E+03	9.5	7.7	5.64E+00	5	9.2	5.09E+00	5.8	10.4
7.50E+01	2.15E+01	3.8	6.3	1.80E+01	4.6	7.4	1.52E+04	11	10.2	2.60E+03	10.8	10.4	2.34E+01	4	6.6	2.02E+01	4.3	7.1
1.00E+02	6.80E+01	3.2	4.6	6.53E+01	3.2	4.8	3.00E+04	12.1	12.2	8.85E+03	10.6	10.2	6.98E+01	3.1	4.6	6.60E+01	3.2	4.7
1.50E+02	3.48E+02	2.3	3.1	3.59E+02	2.3	3.1	6.13E+04	14.9	16.9	3.22E+04	13.6	15.1	3.57E+02	2.6	3.3	3.76E+02	2.4	3.1
2.00E+02	9.99E+02	2.6	2.9	1.01E+03	2.1	2.9	7.95E+04	17	20.7	4.67E+04	16	19.6	1.77E+03	7.3	5.5	1.09E+03	2.2	2.8
3.00E+02	1.74E+04	12.1	13.8	6.49E+03	9.2	10.5	9.86E+04	20.1	23.1	7.72E+04	18.3	20.9	1.58E+04	14.6	16.2	7.50E+03	9.6	10.4
5.00E+02	7.22E+04	19.4	21.9	9.34E+04	18.5	20.7	1.35E+05	23.3	22.4	1.35E+05	22.6	22.3	8.00E+04	19.1	20.8	9.66E+04	18.5	21.3
7.00E+02	8.72E+04	21.2	19.2	1.01E+05	21.9	19.4	1.11E+05	24.6	19.3	1.04E+05	24.5	19.4	9.25E+04	21.6	19.2	1.03E+05	22.4	19.8
1.00E+03	7.49E+04	18.6	14.5	7.13E+04	19.4	14.6	8.54E+04	21.5	15.6	8.89E+04	21.2	15.4	7.53E+04	19	14.8	7.16E+04	19.1	14.3
2.00E+03	5.78E+04	14.6	9.7	5.81E+04	14.8	9.7	7.48E+04	18.7	11.6	7.23E+04	18.1	11.3	5.90E+04	15.7	9.2	5.88E+04	15.5	9.5
3.00E+03	6.02E+04	14.2	8.1	6.13E+04	14.9	8.5	8.14E+04	18.7	10.4	7.26E+04	18.2	10.1	5.96E+04	14.8	8.2	6.02E+04	15	8.7
5.00E+03	6.88E+04	15	7.8	6.45E+04	15.3	7.8	8.40E+04	19.1	9.5	8.48E+04	18.8	9.5	6.30E+04	14.6	7.8	6.24E+04	13.9	7.9
1.00E+04	6.78E+04	13.9	6.4	6.77E+04	14.2	6.5	8.12E+04	18.8	8.5	8.06E+04	18.3	8.3	6.65E+04	13.2	6.6	6.80E+04	14.9	6.8
2.00E+04	7.28E+04	11.9	6.2	7.33E+04	14.3	5.8	9.50E+04	18.6	8.1	8.82E+04	18.5	7.8	8.00E+04	13.9	5.9	7.78E+04	14.5	6.4
5.00E+04	9.86E+04	12.7	5	9.83E+04	14	4.9	1.01E+05	17.9	7.2	1.02E+05	19.1	7.2	9.38E+04	11.1	5	9.57E+04	12.4	5.3
1.00E+05	1.21E+05	10.5	4.4	1.11E+05	10.3	4.8	1.25E+05	17.9	6.5	1.21E+05	18	6.3	1.22E+05	11.8	4.4	1.10E+05	10	4.5

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.81E+01	6.5	3.3	0.00E+00	1	1
1.40E+01	1.18E-01	6.9	9.8	0.00E+00	1	1	1.12E-01	6.8	9.8	1.10E-01	7	10.1	5.92E+01	6.9	3.8	1.63E-01	6.1	8.8
2.00E+01	4.37E-01	7.5	9.6	4.63E-01	7.1	9.6	4.28E-01	7.9	9.3	4.60E-01	7.9	9.8	1.02E+02	7.5	4.5	7.30E-01	4.9	7.8
3.00E+01	1.49E+00	7.2	9.1	1.62E+00	7.1	8.9	1.40E+00	7	9.1	1.43E+00	7.2	9.3	2.18E+02	8.1	5.6	3.40E+00	5.5	6.6
5.00E+01	6.62E+00	5.7	8.6	7.40E+00	5.3	8.3	5.78E+00	6.1	9.5	6.14E+00	5.9	9.5	8.42E+02	8.9	6.8	2.24E+01	4.4	5.8
7.50E+01	2.92E+01	3.8	5.7	3.56E+01	3.5	5.2	2.35E+01	4.1	6.2	2.57E+01	3.9	6.1	5.18E+03	10	8.5	1.59E+02	6.6	5.8
1.00E+02	9.15E+01	3	4.1	1.12E+02	2.8	3.8	7.27E+01	3.1	4.3	8.29E+01	3	4.2	1.21E+04	11.6	11.3	1.21E+03	9.1	7.9
1.50E+02	4.36E+02	2.4	3.2	5.39E+02	2.6	3.3	3.87E+02	2.4	3.1	4.30E+02	2.4	3	2.62E+04	14.2	16.3	1.86E+04	12.4	12.9
2.00E+02	1.59E+03	6	6.5	3.19E+03	8	8.8	1.09E+03	2.5	3.3	1.14E+03	2.5	3.2	3.46E+04	16.8	20.3	3.14E+04	15.6	18.4
3.00E+02	3.21E+04	15.3	17.8	3.95E+04	15.6	18.2	1.93E+04	12.7	14.2	1.84E+04	12.8	14.3	4.97E+04	18.9	21.6	5.14E+04	18.3	21.3
5.00E+02	9.58E+04	19.8	21.1	1.14E+05	20.5	21.7	8.27E+04	20	21.5	1.00E+05	20.1	21.6	9.53E+04	21.3	21.3	1.07E+05	21.1	21.6
7.00E+02	9.91E+04	21.8	19.7	9.97E+04	22.4	19.5	8.92E+04	21.5	19.3	9.08E+04	22	19.3	9.78E+04	22.2	19.4	1.02E+05	22.6	19.4
1.00E+03	7.53E+04	19.6	14.5	7.82E+04	20.1	14.8	7.35E+04	19.2	14.5	7.37E+04	19.3	14.5	7.94E+04	20.1	14.9	8.09E+04	20.4	14.9
2.00E+03	6.07E+04	15.7	9.8	6.52E+04	16.6	10.3	5.75E+04	15	9.6	5.80E+04	15.4	9.8	6.24E+04	16.3	10.3	6.69E+04	16.8	10.4
3.00E+03	6.35E+04	15.7	8.8	6.59E+04	16.3	9.3	5.88E+04	14.8	8.4	5.88E+04	15.3	8.8	6.51E+04	16.1	9.2	6.67E+04	16.6	9.4
5.00E+03	6.81E+04	15.6	8.1	7.16E+04	16.5	8.4	6.75E+04	14.5	7.8	6.84E+04	15.5	8.1	6.85E+04	16.2	8.4	7.28E+04	16.8	8.6
1.00E+04	6.93E+04	14.5	7	7.07E+04	16	7.3	6.69E+04	13.6	6.6	6.89E+04	14.8	6.9	7.02E+04	15.3	7.2	7.22E+04	16	7.5
2.00E+04	7.89E+04	15.1	6.6	8.09E+04	16.2	7	7.73E+04	13.5	6.3	7.92E+04	14.8	6.6	8.33E+04	15.6	6.9	8.01E+04	16.1	7
5.00E+04	9.76E+04	13.5	5.6	1.02E+05	15.6	6.2	1.01E+05	12.3	5.2	9.41E+04	13.3	5.4	1.00E+05	14.3	5.9	1.01E+05	15.5	6.1
1.00E+05	1.20E+05	12.6	4.7	1.18E+05	13.2	5.3	1.25E+05	11.2	4.4	1.17E+05	11.9	4.6	1.17E+05	13.2	5.1	1.20E+05	14.1	5.3

Table A.22. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.61E+01	6.6	3.4	4.43E+00	6.6	3.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.12E+01	7	3.9	6.52E+00	7	4	1.18E-01	5.6	9.1	1.68E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.20E+02	7.7	4.7	1.03E+01	7.5	4.9	5.15E-01	6.6	9	4.35E+00	6.9	4.3	3.65E-01	6.8	9.7	4.46E-01	7.1	10.1
3.00E+01	2.06E+02	8.5	6	1.98E+01	8	5.9	2.39E+00	5.8	7.5	1.16E+01	6.3	4.6	1.39E+00	7.1	9.5	1.36E+00	7.1	9.2
5.00E+01	4.89E+02	9.4	7.8	6.55E+01	7.6	6.7	1.41E+01	3.9	6	8.44E+01	7.9	6.2	5.04E+00	6.7	10.6	5.92E+00	6.1	9.8
7.50E+01	1.96E+03	9.8	8.5	4.09E+02	8.1	6.8	6.71E+01	3.1	4.7	7.51E+02	9.1	8.1	1.49E+01	5.4	8.3	2.17E+01	4.2	6.5
1.00E+02	6.96E+03	10.7	9.9	2.35E+03	9.7	8.7	5.66E+02	7.3	6.3	3.65E+03	10.3	8.8	4.25E+01	3.8	5.6	7.30E+01	3.2	4.4
1.50E+02	3.28E+04	13.2	14.3	1.57E+04	12.3	12.9	1.05E+04	12.3	13.1	1.69E+04	13.2	14.4	2.71E+02	2.5	3.3	4.17E+02	2.4	3
2.00E+02	5.97E+04	15.5	18.2	4.30E+04	14.4	16.6	1.88E+04	14.6	17.6	3.27E+04	14.9	17.7	8.35E+02	2.1	2.7	1.09E+03	2.3	2.9
3.00E+02	9.67E+04	19.1	22.4	9.27E+04	18.3	21.6	7.53E+04	16.8	19.1	9.26E+04	17.4	20.7	2.97E+03	2.7	3.9	9.74E+03	10.5	11.6
5.00E+02	1.10E+05	23.1	22.2	1.13E+05	22.7	22.3	1.25E+05	22	22.8	1.25E+05	23.1	22.3	7.36E+04	16.8	19.1	9.51E+04	19.8	21.5
7.00E+02	1.01E+05	23.6	19.2	1.02E+05	23.6	19.3	1.09E+05	24.7	19.4	1.07E+05	24.2	19.6	8.92E+04	20.9	19.7	9.02E+04	21.8	19.3
1.00E+03	8.49E+04	20.9	15.3	8.49E+04	20.9	15.2	8.87E+04	21.3	15.4	8.32E+04	21.1	15.3	7.36E+04	19.1	14.4	7.25E+04	19.3	14.6
2.00E+03	7.07E+04	17.8	11	7.02E+04	17.7	11	7.17E+04	17.9	11.1	7.09E+04	18.2	11.2	5.78E+04	14.4	8.9	6.21E+04	15.6	9.7
3.00E+03	7.21E+04	17.6	9.9	7.13E+04	17.6	9.9	7.49E+04	17.6	10	7.28E+04	18	10.1	5.59E+04	13.9	7.9	5.94E+04	14.7	8.7
5.00E+03	7.62E+04	17.8	9.1	7.66E+04	17.8	9	7.94E+04	18	9	8.31E+04	18.5	9.4	6.32E+04	14	7.4	6.98E+04	15.9	7.9
1.00E+04	7.80E+04	17.3	8	7.73E+04	17.3	8	8.04E+04	17.8	8.1	7.89E+04	17.6	8.3	6.24E+04	11.7	6.4	6.45E+04	14.7	6.7
2.00E+04	8.75E+04	17.6	7.5	8.68E+04	17.6	7.6	8.80E+04	17.9	7.8	9.02E+04	18.7	7.9	7.54E+04	12.8	5.7	7.69E+04	13.7	6.5
5.00E+04	1.07E+05	16.8	6.6	1.02E+05	16.9	6.6	1.06E+05	17.6	7	1.02E+05	18.4	7.2	9.55E+04	10.3	4.9	9.57E+04	14.1	5.3
1.00E+05	1.23E+05	15.8	5.8	1.21E+05	15.9	5.8	1.17E+05	17.1	5.9	1.18E+05	16.9	6.7	1.20E+05	9	4.1	1.18E+05	11.1	4.9

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.66E-02	6.9	10.2	1.16E-01	7.4	9.6	1.13E-01	7.3	9.7	1.45E-01	6.2	10.1	1.37E-01	6.6	9.7
2.00E+01	3.80E-01	5.2	9.4	5.14E-01	6.9	9.8	4.53E-01	7.2	9.6	4.38E-01	7.2	9.6	3.79E-01	7.2	9.5	4.73E-01	6.4	9.9
3.00E+01	1.19E+00	7.2	9.3	1.38E+00	7.3	9.3	1.53E+00	7	9	1.56E+00	7	8.9	1.52E+00	6.9	9	1.61E+00	6.9	8.8
5.00E+01	5.19E+00	6.2	10.2	5.26E+00	6.8	10.3	6.64E+00	5.5	8.7	6.94E+00	5.4	8.7	6.53E+00	5.3	8.9	8.33E+00	5	7.9
7.50E+01	1.63E+01	5.2	7.9	1.87E+01	4.9	7.9	2.84E+01	3.8	5.6	3.08E+01	3.7	5.4	2.83E+01	3.7	5.5	3.88E+01	3.4	4.9
1.00E+02	4.89E+01	3.4	5.5	5.53E+01	3.5	5.1	8.90E+01	3	4.1	1.00E+02	2.9	4	9.93E+01	2.9	4	1.32E+02	2.8	3.7
1.50E+02	2.93E+02	2.5	3.3	3.20E+02	2.5	3.2	4.45E+02	2.7	3.3	4.59E+02	2.5	3.2	4.63E+02	2.4	3.1	5.73E+02	2.6	3.2
2.00E+02	8.64E+02	2.2	2.7	9.36E+02	2.2	2.9	2.43E+03	8.6	8.8	1.91E+03	6.4	7.1	1.30E+03	4.5	5.5	2.55E+03	7.2	7.3
3.00E+02	2.98E+03	3.7	4.7	4.84E+03	7	7.9	3.27E+04	15	17.7	3.61E+04	15.2	17.9	3.49E+04	14.6	16.8	5.70E+04	15.6	18.4
5.00E+02	8.03E+04	18.2	20.4	8.17E+04	18.1	20.2	8.56E+04	19.9	21.2	9.03E+04	20.2	21.5	8.87E+04	20.2	21.7	1.03E+05	21.2	21.9
7.00E+02	9.76E+04	20.9	19.4	1.04E+05	20.7	19.6	9.00E+04	21.6	19.3	9.15E+04	21.8	19.4	8.96E+04	21.9	19.4	9.53E+04	22.6	19.2
1.00E+03	7.23E+04	18.9	14.7	7.65E+04	19.4	14.4	7.27E+04	19.3	14.5	7.46E+04	19.6	14.5	7.58E+04	19.8	14.9	7.74E+04	19.9	14.7
2.00E+03	5.50E+04	14.4	9.1	5.82E+04	14.2	9.4	5.84E+04	15.1	9.5	5.93E+04	15.6	9.8	6.35E+04	15.8	9.9	6.66E+04	16.7	10.3
3.00E+03	5.87E+04	13.9	7.9	5.85E+04	14.6	8.2	6.13E+04	15	8.5	6.04E+04	15.3	8.8	6.18E+04	15.6	8.8	6.24E+04	16.4	9.3
5.00E+03	6.14E+04	12.7	7.8	6.17E+04	14.7	7.6	6.48E+04	15	7.9	6.78E+04	15.7	8	6.90E+04	15.7	8.1	7.07E+04	16.2	8.5
1.00E+04	6.21E+04	14.6	6	6.20E+04	13.7	6.5	6.81E+04	13.8	6.7	6.68E+04	14.6	7	6.93E+04	14.4	7.1	7.23E+04	16.2	7.3
2.00E+04	7.59E+04	13.5	6.2	7.79E+04	14.1	5.9	7.75E+04	13.8	6.3	7.75E+04	14.6	6.5	7.73E+04	14.5	6.7	8.15E+04	16.5	6.8
5.00E+04	9.90E+04	11.3	5.1	9.63E+04	12.9	5.3	1.01E+05	12.6	5.4	9.77E+04	13.4	5.6	1.01E+05	14	5.8	1.02E+05	14.9	6.1
1.00E+05	1.26E+05	9.1	4	1.18E+05	9	4.4	1.19E+05	11.3	4.4	1.17E+05	12	4.8	1.21E+05	13.1	4.9	1.22E+05	13.6	5.2

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.53E-01	5.8	8.7	0.00E+00	1	1	2.98E+00	3.9	5.1	2.98E+00	3.9	5.1
2.00E+01	7.90E-01	6.4	8.2	0.00E+00	1	1	1.41E+01	4.1	5.2	1.41E+01	4.1	5.2
3.00E+01	2.87E+00	4.7	6.9	2.72E+00	5.3	7.5	6.12E+01	4.3	5.2	6.12E+01	4.3	5.2
5.00E+01	1.88E+01	3.6	5.6	1.61E+01	4.2	5.7	1.31E+04	6.5	3.4	1.31E+04	6.5	3.4
7.50E+01	6.41E+01	2.9	4.1	6.42E+01	3	4.2	2.37E+05	10.7	9.4	2.37E+05	10.7	9.4

(continued on next page)

Table A.22. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	3.16E+02	4.5	4.8	2.66E+02	4.7	4.9	2.22E+05	13.9	15.4	2.22E+05	13.9	15.4
1.50E+02	1.10E+04	11.5	11.8	7.10E+03	10.9	11.1	1.63E+05	18	22.9	1.63E+05	18	22.9
2.00E+02	3.65E+04	14	15.5	3.17E+04	13.7	15.1	1.38E+05	19.8	23.1	1.38E+05	19.8	23.1
3.00E+02	7.82E+04	18.5	22.4	6.94E+04	18.4	22.5	1.36E+05	23	25.5	1.36E+05	23	25.5
5.00E+02	9.76E+04	22	21.1	1.10E+05	20.7	21.5	1.22E+05	25.5	22.2	1.22E+05	25.5	22.2
7.00E+02	1.10E+05	22.8	19.5	1.06E+05	22.9	19.6	1.17E+05	24.8	19.4	1.17E+05	24.8	19.4
1.00E+03	8.23E+04	20.1	15.1	8.58E+04	21	15.2	9.85E+04	22.1	16.2	9.85E+04	22.1	16.2
2.00E+03	7.10E+04	17.7	10.8	6.90E+04	17.1	10.7	8.79E+04	20.2	12.5	8.79E+04	20.2	12.5
3.00E+03	7.02E+04	17.1	9.5	6.98E+04	17	9.6	8.59E+04	19.9	11	8.59E+04	19.9	11
5.00E+03	7.04E+04	17.1	8.9	7.65E+04	17.3	8.8	8.45E+04	19.9	10.1	8.45E+04	19.9	10.1
1.00E+04	7.75E+04	16.1	8	7.59E+04	16.9	7.5	8.40E+04	19.3	8.5	8.40E+04	19.3	8.5
2.00E+04	8.52E+04	17.1	7.3	8.80E+04	17.1	7.3	1.05E+05	20.4	7.2	1.05E+05	20.4	7.2
5.00E+04	1.05E+05	15.5	6.4	9.69E+04	17.3	6.1	9.88E+04	19.4	7.8	9.88E+04	19.4	7.8
1.00E+05	1.22E+05	16.4	5.7	1.19E+05	15.9	5.6	1.16E+05	20	6.5	1.16E+05	20	6.5

Table A.23. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{40}Ca ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.00E+00	6.3	0.8	2.41E+00	6.3	0.8	6.55E+02	6.2	3	7.68E+02	6.2	3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.14E+01	6.7	0.9	3.95E+00	6.8	1	1.15E+03	6.6	3.4	1.26E+03	6.7	3.5	1.21E-01	7.1	9.6	1.13E-01	7	9.5
2.00E+01	1.84E+01	7.4	1.1	6.22E+00	7.3	1.2	2.25E+03	7.1	4	2.17E+03	7.2	4.1	4.86E-01	7	9.5	5.05E-01	6.9	9.2
3.00E+01	3.32E+01	8	1.4	1.20E+01	7.7	1.5	5.15E+03	7.8	4.9	4.59E+03	7.9	5	1.77E+00	6.3	8.4	1.69E+00	6.2	8.3
5.00E+01	8.08E+01	8.6	1.9	3.45E+01	7.3	1.9	1.99E+04	9	6.6	1.81E+04	8.6	6.2	8.83E+00	4.6	7.2	9.42E+00	4.7	7.1
7.50E+01	2.43E+02	8.6	2.1	1.19E+02	7.2	2	7.52E+04	10	8.4	5.44E+04	10.3	8.8	4.46E+01	3.4	4.7	4.38E+01	3.3	4.7
1.00E+02	8.21E+02	9.1	2.2	9.54E+02	8.4	1.9	1.32E+05	11.7	11.4	8.50E+04	11.9	11.7	1.61E+02	3.7	4.4	1.33E+02	2.8	3.7
1.50E+02	1.01E+04	11.2	2.8	9.87E+03	11.4	2.9	1.89E+05	14.7	16.9	1.26E+05	14.6	16.7	9.77E+02	6.9	6.5	6.40E+02	3.4	3.9
2.00E+02	2.22E+04	13.8	4	2.25E+04	13.7	4	1.91E+05	17.7	21.8	1.44E+05	16.9	20.5	6.25E+03	10.2	10.7	8.80E+03	10.7	10.8
3.00E+02	4.64E+04	16.8	5.1	4.92E+04	16.7	5.1	1.46E+05	21.9	25.3	1.39E+05	20.8	24.4	5.39E+04	15.4	18.1	5.83E+04	15.3	18.1
5.00E+02	9.95E+04	20.1	5.7	1.05E+05	20	5.7	1.19E+05	25.5	23.1	1.22E+05	24.3	22.6	9.60E+04	20.4	21.8	9.66E+04	20.6	22
7.00E+02	1.03E+05	22	5.5	1.08E+05	22.3	5.6	1.21E+05	25.7	20	1.21E+05	24.9	20.2	9.56E+04	21.7	19.9	9.93E+04	21.9	20
1.00E+03	8.30E+04	21.9	4.6	8.51E+04	22.3	4.6	1.10E+05	24	17.1	1.02E+05	24.1	17	8.39E+04	21.6	16	8.29E+04	21.6	15.9
2.00E+03	6.71E+04	18.1	3.4	6.94E+04	18.6	3.5	9.27E+04	21.9	13.1	8.57E+04	21.2	12.8	6.73E+04	17.9	10.9	6.61E+04	18.1	11.1
3.00E+03	6.87E+04	18	3.2	6.94E+04	18.4	3.2	9.32E+04	21.5	11.8	8.69E+04	21.3	11.7	6.71E+04	17.7	9.8	6.63E+04	17.7	10
5.00E+03	7.42E+04	18.1	3	7.60E+04	18.4	3	9.44E+04	21.8	10.8	9.49E+04	21.5	10.6	7.49E+04	17.9	9	7.50E+04	18.1	9.2
1.00E+04	7.46E+04	16.9	2.7	7.61E+04	17.7	2.7	1.00E+05	22.4	9.8	9.47E+04	21.6	9.7	7.31E+04	16.6	7.7	7.66E+04	17.4	7.8
2.00E+04	8.52E+04	17.1	2.5	8.54E+04	18	2.6	1.11E+05	22.9	9	9.75E+04	21.4	9.1	8.40E+04	16.8	7.3	8.26E+04	17.2	7.5
5.00E+04	1.05E+05	16.1	2.3	1.03E+05	17.1	2.3	1.28E+05	21.7	8	1.14E+05	21	8	1.04E+05	15.8	6.2	1.03E+05	16.2	6.5
1.00E+05	1.26E+05	13.6	2.1	1.22E+05	14.6	2.1	1.51E+05	20.1	7.2	1.37E+05	19	7	1.28E+05	13.3	5.2	1.24E+05	13.2	5.6

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	9.64E+02	6.3	3.1	0.00E+00	1	1
1.40E+01	1.26E-01	7.5	9.8	1.33E-01	7.3	9.9	1.33E-01	6.6	9.9	1.19E-01	7.5	9.4	1.33E+03	6.8	3.6	0.00E+00	1	1
2.00E+01	4.88E-01	7.6	9.5	5.17E-01	7.1	9.4	3.90E-01	7.6	9.4	5.22E-01	7	9.8	1.86E+03	7.4	4.3	2.73E-01	5.4	10.4
3.00E+01	1.71E+00	6.8	8.8	1.77E+00	6.7	8.6	1.57E+00	6.8	8.8	1.80E+00	6.4	8.5	3.22E+03	8.2	5.5	1.79E+00	5.4	8.9
5.00E+01	8.45E+00	5	7.6	9.43E+00	4.7	7.2	7.25E+00	5.3	8.1	1.02E+01	4.6	7	7.10E+03	9.5	7.5	4.87E+00	6.2	9.9
7.50E+01	4.03E+01	3.4	4.8	4.74E+01	3.2	4.6	3.22E+01	3.7	5.4	4.53E+01	3.3	4.7	1.74E+04	10.4	9.1	1.60E+01	4.7	7.9
1.00E+02	1.30E+02	2.7	3.7	1.54E+02	2.6	3.5	9.84E+01	2.9	4	1.40E+02	2.8	3.7	3.12E+04	11.8	11.5	5.21E+01	3.4	5.2
1.50E+02	7.02E+02	3.8	4.1	7.13E+02	2.7	3.2	4.40E+02	2.6	3.1	5.87E+02	3.2	4	6.08E+04	14	15.7	3.13E+02	2.2	3.1
2.00E+02	5.20E+03	9.1	9.3	3.80E+03	8.4	8.8	1.35E+03	5.3	5.3	8.76E+03	10.3	10.1	8.61E+04	15.7	18.8	9.46E+02	2.1	2.7
3.00E+02	4.55E+04	14.8	17.1	6.63E+04	14.7	16.8	3.62E+04	14.2	16.8	5.63E+04	15.8	18.7	9.83E+04	19.6	23.2	3.00E+03	3.2	4.1
5.00E+02	1.16E+05	20.2	22.1	1.21E+05	20.8	22.4	8.98E+04	19.4	21.3	1.02E+05	20.2	21.9	9.48E+04	22.7	22.4	9.88E+04	16.8	19.7
7.00E+02	1.13E+05	22.6	20.4	1.12E+05	23	20.6	1.05E+05	21.3	20	1.07E+05	22.4	20.1	1.13E+05	23.2	19.7	1.02E+05	20.7	20.4
1.00E+03	8.80E+04	22.5	16.3	8.84E+04	22.7	16.3	8.14E+04	21.4	16	8.25E+04	21.9	16.1	9.42E+04	23	16.5	7.52E+04	19.8	15
2.00E+03	7.18E+04	18.8	11.5	7.30E+04	19.3	11.8	6.25E+04	17.4	10.8	6.74E+04	18.3	11.2	7.70E+04	19.5	12.1	6.16E+04	16.3	10.2
3.00E+03	7.29E+04	18.7	10.3	7.29E+04	19.2	10.7	6.71E+04	17.4	9.5	7.12E+04	18.5	10.1	7.44E+04	19	10.8	6.34E+04	16.6	8.6
5.00E+03	7.77E+04	18.9	9.5	8.35E+04	19.4	9.8	7.31E+04	17.2	8.7	7.29E+04	18.2	9.3	8.65E+04	19.3	9.6	6.59E+04	16	8.4
1.00E+04	7.86E+04	18.1	8.3	8.45E+04	19.2	8.7	7.18E+04	16.4	7.6	7.12E+04	16.5	8.1	8.33E+04	19.1	8.6	7.12E+04	14.8	7.5
2.00E+04	9.13E+04	18.3	7.8	9.01E+04	19	8.1	8.51E+04	16.9	6.9	8.76E+04	17.8	7.7	9.25E+04	18.3	8.4	8.33E+04	15.6	6.5
5.00E+04	1.09E+05	17.4	6.9	1.10E+05	18.9	7.1	1.06E+05	15.3	6.1	1.06E+05	16.6	6.8	1.19E+05	19.2	7.2	9.81E+04	15.6	5.6
1.00E+05	1.23E+05	15.4	5.9	1.26E+05	16.9	6.3	1.30E+05	12.6	5.2	1.27E+05	14.1	5.8	1.35E+05	15.5	5.9	1.20E+05	9.4	4.5

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.27E-01	7.5	9.8	1.30E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.23. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	4.68E-01	7.5	9.6	4.83E-01	7.1	9.5	3.47E-01	6.2	9.3	4.25E-01	6.2	9.7	5.22E-01	5.2	7.6	7.34E-01	4.4	7.9
3.00E+01	1.56E+00	6.9	8.8	1.68E+00	6.8	8.7	1.66E+00	6.1	9.1	1.55E+00	7	9	3.39E+00	4	6.4	3.24E+00	3.8	6.1
5.00E+01	7.42E+00	5.2	8.1	8.97E+00	4.8	7.3	7.43E+00	5.3	8.4	7.24E+00	5.4	8.4	2.26E+01	3.4	5	3.01E+01	3.3	4.9
7.50E+01	3.23E+01	3.7	5.3	4.14E+01	3.3	4.8	2.81E+01	4	5.8	3.23E+01	3.8	5.4	9.63E+01	2.7	4	1.01E+02	2.9	3.9
1.00E+02	9.66E+01	2.9	4	1.28E+02	2.8	3.7	8.73E+01	3	4.8	1.06E+02	2.9	4	2.84E+02	2.6	3.9	2.81E+02	2.6	3.5
1.50E+02	4.98E+02	2.8	3.4	6.25E+02	3.5	4	7.54E+02	6.4	5.5	5.53E+02	3	3.1	1.46E+04	10.2	9.3	2.17E+04	10.5	9.3
2.00E+02	4.42E+03	9.3	9.2	7.61E+03	9.9	10.1	4.94E+03	10.5	10.7	3.85E+03	9.4	8.4	6.30E+04	13.4	14.2	7.29E+04	13.8	15
3.00E+02	3.52E+04	14.7	17.2	5.13E+04	15.3	17.9	2.48E+04	14.5	17.5	2.82E+04	15.2	17.1	9.97E+04	18.2	22.1	1.02E+05	19	23.2
5.00E+02	9.11E+04	19.4	21.2	1.02E+05	20	21.7	1.02E+05	17.8	20.3	1.19E+05	18.9	21.2	1.08E+05	21	21.7	1.20E+05	22.4	22.2
7.00E+02	1.00E+05	21.2	20.1	1.08E+05	22.2	20.2	1.13E+05	21.5	20.6	1.14E+05	22.2	20.7	1.12E+05	23.1	20.2	1.19E+05	23.8	20.6
1.00E+03	8.12E+04	21.4	15.9	8.43E+04	22	16	8.44E+04	21.2	15.8	8.87E+04	22.5	16	8.61E+04	22.5	16.7	9.76E+04	23.6	16.6
2.00E+03	6.36E+04	17.4	10.7	6.72E+04	18.2	11.2	6.44E+04	17.5	10.8	6.26E+04	18.1	11.1	7.74E+04	19.3	12.1	7.78E+04	19.4	11.9
3.00E+03	6.64E+04	17.2	9.7	6.93E+04	18.2	10.1	6.58E+04	17.2	9.7	6.72E+04	18.4	10.1	7.59E+04	19.1	10.7	8.03E+04	20.2	11.1
5.00E+03	7.20E+04	17.3	8.8	7.29E+04	17.9	9.3	7.96E+04	18	9	7.63E+04	18.2	9.3	8.53E+04	20.2	10	8.51E+04	20.1	10.2
1.00E+04	7.10E+04	15.9	7.5	7.41E+04	17.4	8	7.44E+04	15.8	7.5	7.59E+04	17.4	8.1	8.52E+04	19.2	8.5	8.37E+04	20.8	8.8
2.00E+04	8.46E+04	16.2	7.1	8.86E+04	17.3	7.4	8.19E+04	15.9	7.2	8.51E+04	17.8	7.7	8.95E+04	18.3	7.9	9.03E+04	20.9	8.3
5.00E+04	1.03E+05	15.2	6	1.05E+05	16.8	6.6	1.07E+05	15.4	6	1.06E+05	17.5	6.8	1.12E+05	18.7	7.4	1.05E+05	17.7	7.2
1.00E+05	1.27E+05	12.5	5	1.24E+05	13.9	5.4	1.25E+05	13.4	5.1	1.27E+05	15.3	5.9	1.20E+05	15.8	6	1.24E+05	17.7	6.6

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.67E+01	6.3	3.1	5.81E+00	6.3	3.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.93E-01	4.2	8.8	3.82E+01	6.8	3.6	8.53E+00	6.8	3.7	1.60E-01	7.2	10	1.69E-01	7.2	9.6
2.00E+01	4.17E-01	6.4	9.3	6.21E-01	4.9	7.6	5.88E+01	7.4	4.4	1.31E+01	7.3	4.4	6.15E-01	7.3	9.3	6.26E-01	6.8	8.7
3.00E+01	1.73E+00	6.6	8.8	2.99E+00	5	6.8	9.94E+01	8.1	5.5	2.47E+01	7.7	5.5	2.16E+00	6.2	8	2.47E+00	5.7	7.4
5.00E+01	6.92E+00	5.5	8.7	1.73E+01	3.9	5.5	2.33E+02	8.8	7.1	6.79E+01	7.5	6.4	1.37E+01	4	6	1.64E+01	3.7	5.6
7.50E+01	2.55E+01	3.8	5.8	7.10E+01	3.2	4.3	6.49E+02	9	8.1	2.77E+02	7.1	6.6	6.97E+01	3	4.1	8.44E+01	2.9	3.9
1.00E+02	8.38E+01	3	4.2	2.11E+02	4.7	4.4	2.33E+03	9.6	8.7	1.89E+03	8.6	7.3	2.07E+02	2.6	3.4	2.43E+02	2.6	3.3
1.50E+02	3.80E+02	2.5	3.3	2.19E+04	11.2	10.2	2.32E+04	11.6	11.5	2.18E+04	11.6	11.5	1.50E+03	5.5	5.4	2.51E+03	7.7	6.6
2.00E+02	1.09E+03	3.7	4.2	4.14E+04	14.4	16.5	5.29E+04	14.2	16.1	4.77E+04	14.1	16	1.95E+04	11.4	11.5	3.24E+04	12.1	12.6
3.00E+02	2.88E+04	13.6	15.4	5.65E+04	18.1	21.7	9.80E+04	17.6	20.8	9.78E+04	17.4	20.6	9.29E+04	16.1	18.9	1.10E+05	16.5	19.5
5.00E+02	8.00E+04	18.8	20.5	8.74E+04	20.8	21.6	1.24E+05	21.9	22.7	1.29E+05	21.7	22.6	1.51E+05	21.2	22.6	1.57E+05	21.6	22.8
7.00E+02	1.05E+05	20.7	20.2	9.86E+04	21.4	19.9	1.14E+05	23.9	20.4	1.14E+05	23.9	20.4	1.25E+05	24.3	20.8	1.21E+05	24.8	20.7
1.00E+03	8.16E+04	20.8	16	8.43E+04	21.3	16.1	9.22E+04	23.3	16.6	9.41E+04	23.4	16.6	9.74E+04	23.9	16.7	1.01E+05	24.1	16.8
2.00E+03	6.01E+04	16.4	10.4	6.63E+04	18	11.1	7.68E+04	20.1	12.2	7.73E+04	20.1	12.3	8.09E+04	20.5	12.5	8.27E+04	21	12.6
3.00E+03	6.16E+04	16.3	9.3	7.20E+04	18.1	10	7.85E+04	20	11	7.75E+04	20	11.1	8.32E+04	20.6	11.3	8.28E+04	20.9	11.4
5.00E+03	7.21E+04	16.6	8.4	7.77E+04	18.5	9.1	8.40E+04	20.2	10.1	8.61E+04	20.4	10.1	8.84E+04	21	10.4	9.11E+04	21.2	10.5
1.00E+04	7.22E+04	15.2	7.2	7.76E+04	18.1	7.8	8.34E+04	19.7	9	8.39E+04	19.9	9	9.03E+04	20.6	9.3	9.15E+04	21	9.4
2.00E+04	8.39E+04	16.2	6.9	9.24E+04	18.2	7.5	9.30E+04	20	8.4	9.33E+04	20.5	8.5	9.28E+04	20.5	8.8	9.99E+04	21.8	8.9
5.00E+04	1.09E+05	14.3	5.5	1.13E+05	16.5	6.7	1.13E+05	19.5	7.4	1.08E+05	19.8	7.5	1.11E+05	20.5	7.8	1.12E+05	21.6	8
1.00E+05	1.31E+05	10.6	5	1.33E+05	13.9	5.2	1.28E+05	17.1	6.5	1.26E+05	17.4	6.6	1.24E+05	18.5	6.9	1.26E+05	19.4	7.1

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	6.36E+03	5.3	1.8	7.73E+03	5.3	1.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.27E+04	5.3	2	1.54E+04	5.3	2	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.91E+04	5.4	2.2	2.32E+04	5.4	2.2	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.17E+04	5.7	2.4	3.85E+04	5.7	2.4	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.17E+00	5.9	2.9	0.00E+00	1	1	6.32E+04	6.3	3.1	7.66E+04	6.3	3.1	7.93E+01	6.3	3.1	1.12E+01	6.3	3.1
1.40E+01	1.35E+01	6.5	3.4	2.18E-01	4.9	7.2	8.78E+04	6.8	3.6	1.06E+05	6.8	3.7	1.13E+02	6.8	3.6	1.24E+01	6.7	3.6
2.00E+01	3.32E+01	6.6	3.9	1.24E+00	4.8	6.1	1.24E+05	7.4	4.4	1.49E+05	7.5	4.4	1.75E+02	7.4	4.3	2.58E+01	7.3	4.3
3.00E+01	8.82E+01	7.2	4.6	5.69E+00	3.9	5.2	1.81E+05	8.4	5.7	2.17E+05	8.4	5.7	2.86E+02	8.2	5.5	4.22E+01	8.1	5.4
5.00E+01	4.07E+02	7.6	5.4	3.96E+01	3.7	4.7	2.79E+05	10	8.3	3.04E+05	10.3	8.7	6.25E+02	9.4	7.5	1.04E+02	8.7	7.1
7.50E+01	8.70E+03	9	7	5.45E+02	6.6	4.7	2.52E+05	12.8	13.2	2.56E+05	13.1	13.7	1.75E+03	10.1	8.8	3.18E+02	9.1	8.1
1.00E+02	3.06E+04	10.4	9.2	8.38E+03	9.2	7.4	2.14E+05	15	17.5	2.14E+05	15.2	18	3.96E+03	11	10.4	1.24E+03	9.5	8.4
1.50E+02	8.66E+04	13.3	14.3	4.87E+04	12.4	12.7	1.67E+05	18.1	23	1.67E+05	18.3	23.3	1.18E+04	12.9	13.9	7.25E+03	11.8	12.1
2.00E+02	1.18E+05	16	19	8.57E+04	14.9	17.2	1.45E+05	20.2	25.1	1.47E+05	20.2	25.1	1.90E+04	14.7	17.2	1.54E+04	13.8	15.7
3.00E+02	1.23E+05	19.9	23.5	1.12E+05	19	22.4	1.31E+05	22.5	25.1	1.33E+05	22.5	25	4.39E+04	16.5	19.5	4.38E+04	16.1	18.9
5.00E+02	1.31E+05	22.9	22.3	1.32E+05	21.7	22	1.29E+05	24.9	22.8	1.32E+05	24.8	22.7	9.94E+04	19.9	21.4	1.11E+05	19.8	21.5
7.00E+02	1.25E+05	24.6	20.5	1.21E+05	24.2	20.6	1.21E+05	26.3	20.3	1.24E+05	26.3	20.4	1.06E+05	22	20.1	1.09E+05	22.2	20.3
1.00E+03	1.01E+05	23.9	16.8	9.86E+04	23.9	16.9	1.06E+05	24.7	17.3	1.07E+05	24.8	17.3	8.52E+04	21.8	16.2	8.62E+04	22.1	16.1
2.00E+03	8.54E+04	21.3	12.7	8.27E+04	20.9	12.6	9.24E+04	22.2	13.3	9.28E+04	22.3	13.4	6.82E+04	18	11.1	6.92E+04	18.4	11.2

Table A.23. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	8.38E+04	20.9	11.5	8.15E+04	20.7	11.4	9.40E+04	22.1	12.1	9.42E+04	22.3	12.2	6.96E+04	17.9	10	7.08E+04	18.3	10.2
5.00E+03	8.90E+04	20.9	10.5	9.13E+04	21.2	10.4	9.77E+04	22.4	11	9.98E+04	22.6	11.1	7.60E+04	17.8	9.2	7.81E+04	18.5	9.3
1.00E+04	9.50E+04	21.1	9.6	9.37E+04	21.3	9.4	9.98E+04	22.5	10.1	1.01E+05	22.7	10.2	7.63E+04	16.8	8	7.65E+04	17.5	8.1
2.00E+04	1.01E+05	21.5	8.8	9.90E+04	21	8.9	1.09E+05	23	9.4	1.11E+05	23.4	9.5	8.69E+04	16.8	7.4	8.73E+04	17.6	7.7
5.00E+04	1.24E+05	20.3	8	1.11E+05	21	7.8	1.24E+05	22.9	8.4	1.24E+05	23.6	8.6	1.07E+05	15.8	6.4	1.06E+05	16.8	6.7
1.00E+05	1.34E+05	18.7	6.9	1.31E+05	18.5	6.9	1.41E+05	20.7	7.5	1.42E+05	21.5	7.7	1.30E+05	13.7	5.4	1.27E+05	14.3	5.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	9.31E+02	6.3	3.1	1.40E+02	6.3	3.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.32E+03	6.8	3.6	1.53E+02	6.7	3.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.27E-01	4.7	9	4.79E-01	4.8	9.6	2.04E+03	7.4	4.3	3.15E+02	7.3	4.3	4.97E-01	7.7	8.9	3.88E-01	5.6	9.7
3.00E+01	1.15E+00	5.4	9.1	1.47E+00	5.4	9.2	3.26E+03	8.2	5.5	4.99E+02	8.2	5.3	1.42E+00	6.1	9.3	1.30E+00	5.6	9
5.00E+01	6.41E+00	6	9.6	6.19E+00	6.9	9.9	6.71E+03	9.5	7.7	1.12E+03	9.2	7.4	5.79E+00	5	9.2	5.14E+00	5.8	10.4
7.50E+01	2.20E+01	3.8	6.3	1.83E+01	4.6	7.4	1.56E+04	10.5	9.2	2.59E+03	10.2	9.1	2.40E+01	4	6.5	2.08E+01	4.3	7.1
1.00E+02	6.81E+01	3.2	4.6	6.56E+01	3.1	4.8	3.08E+04	11.5	11.1	8.62E+03	10.4	9.3	6.99E+01	3	4.6	6.70E+01	3.2	4.7
1.50E+02	3.47E+02	2.3	3.1	3.55E+02	2.3	3.1	6.91E+04	13.9	15.5	3.28E+04	13.1	13.7	3.53E+02	2.5	3.2	3.74E+02	2.4	3.1
2.00E+02	9.82E+02	2.5	2.9	1.00E+03	2.1	2.9	8.36E+04	16.3	19.5	4.92E+04	15.4	18.1	9.59E+02	2.4	4.1	1.06E+03	2.2	2.8
3.00E+02	1.55E+04	11.6	11.8	4.85E+03	7.6	9	1.06E+05	19.1	22.6	7.88E+04	18.2	20.7	1.54E+04	13.5	14.6	6.14E+03	8.1	9.2
5.00E+02	7.59E+04	19.2	21.4	9.55E+04	17.8	19.6	1.49E+05	22.4	22.5	1.36E+05	21.7	23	8.44E+04	17.9	19.8	1.02E+05	18.4	20.5
7.00E+02	9.39E+04	20.8	19.6	1.09E+05	20.7	20.9	1.24E+05	24.8	20.3	1.08E+05	24	20.5	1.02E+05	20.9	20.2	1.05E+05	21.5	20.3
1.00E+03	8.16E+04	20	15.9	8.55E+04	21.9	16	9.78E+04	24	17	9.99E+04	23.7	16.6	8.38E+04	20.6	15.8	8.09E+04	21.5	15.8
2.00E+03	6.27E+04	17.1	10.5	6.23E+04	16.5	10.5	8.66E+04	20.9	12.7	8.13E+04	20.4	12.4	6.41E+04	16.5	10.3	6.41E+04	17.2	10.5
3.00E+03	6.49E+04	16.1	9.2	6.58E+04	16.5	9.6	8.48E+04	21.1	11.5	8.33E+04	20.6	11.2	6.46E+04	16.8	9.3	6.48E+04	17	9.3
5.00E+03	7.46E+04	16.1	8.7	7.00E+04	16.4	9.2	9.27E+04	21	10.6	8.84E+04	20.6	10.2	6.97E+04	15.4	8.7	7.23E+04	16.7	8.8
1.00E+04	7.29E+04	14.4	7.1	7.24E+04	15.4	7.4	9.05E+04	21.3	9.6	9.01E+04	20.9	9.1	7.19E+04	13.9	7.3	7.27E+04	15.3	7.6
2.00E+04	7.76E+04	13	6.6	7.78E+04	15.1	7.2	1.03E+05	21.6	9	9.54E+04	20.3	8.7	8.50E+04	14.7	6.4	8.34E+04	15.6	6.9
5.00E+04	1.06E+05	13.1	5.8	1.03E+05	13.9	6.4	1.15E+05	21.7	7.8	1.13E+05	19.6	7.5	1.00E+05	13.8	5.5	1.02E+05	12.8	5.9
1.00E+05	1.28E+05	10.7	4.5	1.18E+05	10.8	5.1	1.35E+05	20.5	7	1.30E+05	18.5	6.8	1.30E+05	11.7	4.6	1.17E+05	11.9	5.2

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.97E+01	6.3	3	0.00E+00	1	1
1.40E+01	1.20E-01	6.9	9.8	0.00E+00	1	1	1.13E-01	6.8	9.8	1.11E-01	7	10.1	6.15E+01	6.7	3.5	1.65E-01	6.1	8.8
2.00E+01	4.47E-01	7.5	9.6	4.68E-01	7.1	9.6	4.40E-01	7.9	9.3	4.65E-01	7.9	9.8	1.05E+02	7.1	4.1	7.53E-01	4.9	7.7
3.00E+01	1.52E+00	7.2	9.1	1.65E+00	7.1	8.9	1.43E+00	7	9.1	1.46E+00	7.2	9.3	2.25E+02	7.8	5	3.44E+00	5.3	6.5
5.00E+01	6.78E+00	5.7	8.5	7.60E+00	5.2	8.3	5.93E+00	6.1	9.5	6.32E+00	5.9	9.5	8.36E+02	8.8	6.5	2.17E+01	4.3	5.7
7.50E+01	2.97E+01	3.8	5.6	3.61E+01	3.5	5.1	2.40E+01	4.1	6.2	2.63E+01	3.9	6.1	4.93E+03	9.6	7.7	1.49E+02	6.4	5.5
1.00E+02	9.18E+01	3	4.1	1.12E+02	2.8	3.8	7.38E+01	3	4.3	8.32E+01	3	4.2	1.24E+04	11	10.2	9.09E+02	8.2	7
1.50E+02	4.31E+02	2.4	3.1	5.30E+02	2.5	3.2	3.84E+02	2.4	3.1	4.25E+02	2.3	3	2.76E+04	13.6	14.9	1.89E+04	11.6	11.3
2.00E+02	1.44E+03	5	5.3	2.90E+03	7.3	7.2	1.07E+03	2.4	3.1	1.12E+03	2.4	3.1	3.71E+04	15.7	18.9	3.30E+04	14.6	16.9
3.00E+02	3.14E+04	14.1	16.2	3.84E+04	14.5	16.9	1.72E+04	11.7	12.3	1.54E+04	11.6	12.8	5.23E+04	18.2	21.2	5.33E+04	17.4	20.7
5.00E+02	9.81E+04	18.8	20.9	1.19E+05	19.4	21.5	8.73E+04	19.2	21.2	1.05E+05	19.2	21.3	1.00E+05	20.4	21.5	1.13E+05	20.3	21.4
7.00E+02	1.11E+05	21.4	20.1	1.10E+05	22.2	20.4	9.14E+04	20.9	19.7	1.08E+05	21.6	20.1	1.07E+05	22.1	20.2	1.07E+05	22.4	20.3
1.00E+03	8.25E+04	21.7	16	8.54E+04	22.2	16.1	8.17E+04	21	15.6	8.23E+04	21.2	15.9	8.60E+04	22	16.3	8.51E+04	22.2	16.2
2.00E+03	6.66E+04	17.8	10.8	6.92E+04	18.4	11.3	6.14E+04	16.7	10.3	6.28E+04	17.3	10.7	6.92E+04	18.5	11.3	6.94E+04	18.6	11.4
3.00E+03	6.60E+04	17.3	9.7	7.25E+04	18.7	10.2	6.32E+04	16.4	9.2	6.67E+04	17.3	9.7	7.16E+04	18.3	10.1	7.03E+04	18.6	10.3
5.00E+03	7.04E+04	17.4	9	7.88E+04	18.7	9.2	7.36E+04	17	8.5	7.42E+04	17.4	8.8	7.47E+04	18.1	9.3	8.06E+04	18.9	9.5
1.00E+04	7.21E+04	16.3	7.6	7.36E+04	17.3	8.2	7.21E+04	14.7	7.3	6.89E+04	15.8	7.8	7.67E+04	17.4	8	7.78E+04	18.2	8.3
2.00E+04	8.50E+04	16.6	7.1	8.72E+04	17.6	7.6	8.27E+04	14.4	7	8.48E+04	15.9	7.4	8.70E+04	17.5	7.6	8.37E+04	17.9	7.7
5.00E+04	1.03E+05	15.4	6.2	1.04E+05	18	6.7	1.03E+05	14.2	6	1.02E+05	14.5	6.2	1.07E+05	17	6.5	1.07E+05	17.8	6.8
1.00E+05	1.29E+05	13.4	5.2	1.28E+05	14.8	5.8	1.33E+05	11.7	5	1.27E+05	12.2	5.3	1.28E+05	13.7	5.6	1.30E+05	14.5	5.7

(continued on next page)

Table A.23. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	5.94E+01	6.3	3.1	4.68E+00	6.3	3.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.53E+01	6.8	3.6	6.84E+00	6.7	3.7	1.19E-01	5.6	9.1	1.73E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.26E+02	7.3	4.3	1.07E+01	7.2	4.5	5.28E-01	6.6	9	4.33E+00	6.7	4.2	3.72E-01	6.8	9.7	4.58E-01	7.1	10.1
3.00E+01	2.15E+02	8.1	5.5	2.05E+01	7.7	5.5	2.45E+00	5.8	7.4	1.08E+01	6.1	4.5	1.43E+00	7.1	9.5	1.39E+00	7.1	9.2
5.00E+01	5.01E+02	9.1	7.3	6.60E+01	7.4	6.3	1.44E+01	3.9	6	8.14E+01	7.2	5.5	5.16E+00	6.7	10.6	6.07E+00	6.1	9.8
7.50E+01	1.94E+03	9.4	8	3.94E+02	7.5	6.2	6.62E+01	3.1	4.2	7.18E+02	9	7.4	1.53E+01	5.4	8.3	2.22E+01	4.2	6.5
1.00E+02	6.79E+03	10.2	9	2.24E+03	9.1	7.8	5.30E+02	6.6	5.2	3.44E+03	9.8	8.3	4.33E+01	3.8	5.6	7.37E+01	3.1	4.4
1.50E+02	3.27E+04	12.5	13	1.54E+04	11.6	11.8	1.08E+04	11.4	11.5	1.72E+04	12.1	12.9	2.69E+02	2.5	3.3	4.08E+02	2.4	3
2.00E+02	6.24E+04	14.6	16.8	4.39E+04	13.6	15.2	1.90E+04	14.4	16.3	3.28E+04	14.8	17	8.28E+02	2.1	2.7	1.07E+03	2.3	2.9
3.00E+02	1.03E+05	18.1	21.5	9.66E+04	17.4	20.6	7.40E+04	15.5	18.3	9.48E+04	16.4	19.4	2.90E+03	2.6	3.5	8.46E+03	9.2	10.8
5.00E+02	1.18E+05	22.2	22.5	1.22E+05	21.7	22.5	1.39E+05	21.8	22.9	1.37E+05	21.6	22.8	7.05E+04	15.7	18.1	1.02E+05	18.6	21.1
7.00E+02	1.10E+05	23.9	20.2	1.11E+05	23.7	20.3	1.22E+05	24	20.4	1.17E+05	23.9	20.6	9.69E+04	20.3	20.3	1.03E+05	21.7	20
1.00E+03	9.25E+04	23.2	16.6	9.20E+04	23.1	16.5	9.52E+04	23.2	16.8	9.85E+04	23.6	16.6	7.43E+04	20.3	15.4	7.94E+04	21	15.8
2.00E+03	7.71E+04	20	12.2	7.61E+04	19.8	12.1	7.53E+04	19.6	12.3	8.12E+04	20.8	12.3	5.86E+04	15.8	9.8	6.32E+04	17.4	10.5
3.00E+03	7.88E+04	19.9	10.9	7.65E+04	19.7	10.9	8.15E+04	20.1	11.1	7.84E+04	20.1	11.3	5.93E+04	15.4	8.8	6.41E+04	16.7	9.4
5.00E+03	8.43E+04	20.1	10	8.32E+04	19.9	9.9	8.65E+04	19.8	10.2	9.09E+04	20.9	10.2	7.06E+04	15.5	8	7.59E+04	16.7	8.8
1.00E+04	8.43E+04	19.5	8.9	8.26E+04	19.4	8.8	8.72E+04	18.7	9.2	8.51E+04	20.2	9.1	6.74E+04	14.5	6.8	7.10E+04	15.5	7.4
2.00E+04	9.44E+04	19.8	8.3	9.41E+04	19.9	8.3	9.50E+04	18.5	8.2	9.74E+04	20.4	8.7	8.03E+04	13.4	6.6	8.32E+04	15.2	7
5.00E+04	1.13E+05	19.2	7.3	1.09E+05	19.3	7.3	1.14E+05	17.8	7.7	1.13E+05	20.4	7.8	1.03E+05	12.9	5.2	1.03E+05	14.8	6.2
1.00E+05	1.32E+05	16.8	6.3	1.27E+05	17	6.3	1.25E+05	17.4	6.7	1.28E+05	18.3	6.9	1.28E+05	9.4	4.5	1.26E+05	12.2	5

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.57E-02	6.9	10.2	1.17E-01	7.4	9.6	1.12E-01	7.3	9.7	1.48E-01	6.2	10.1	1.38E-01	6.6	9.7
2.00E+01	3.82E-01	5.2	9.4	5.31E-01	6.9	9.8	4.66E-01	7.2	9.6	4.46E-01	7.2	9.6	3.77E-01	7.2	9.5	4.85E-01	6.4	9.9
3.00E+01	1.22E+00	7.2	9.3	1.42E+00	7.3	9.3	1.57E+00	6.9	9	1.60E+00	7	8.9	1.56E+00	6.9	9	1.64E+00	6.9	8.8
5.00E+01	5.24E+00	6.2	10.2	5.39E+00	6.8	10.3	6.81E+00	5.5	8.7	7.13E+00	5.4	8.7	6.70E+00	5.3	8.9	8.58E+00	5	7.9
7.50E+01	1.66E+01	5.2	7.9	1.91E+01	4.9	7.9	2.88E+01	3.8	5.6	3.12E+01	3.7	5.4	2.86E+01	3.7	5.4	3.92E+01	3.4	4.8
1.00E+02	4.97E+01	3.4	5.5	5.61E+01	3.5	5.1	8.93E+01	3	4.1	9.96E+01	2.9	4	9.88E+01	2.9	4	1.32E+02	2.8	3.7
1.50E+02	2.90E+02	2.5	3.2	3.19E+02	2.5	3.2	4.35E+02	2.7	3.3	4.52E+02	2.5	3.2	4.56E+02	2.4	3	5.63E+02	2.5	3.1
2.00E+02	8.57E+02	2.2	2.7	9.26E+02	2.2	2.8	2.23E+03	7.7	7.4	1.48E+03	5.4	5.5	1.26E+03	3.5	3.8	1.85E+03	6.1	6.6
3.00E+02	2.92E+03	3.6	4.5	4.10E+03	4.9	6.5	3.14E+04	14	16	3.47E+04	14.1	16.3	3.36E+04	13.5	15.2	5.74E+04	14.7	16.9
5.00E+02	8.48E+04	17.1	19.6	8.53E+04	17.1	19.5	8.88E+04	19.1	21.1	9.43E+04	19.5	21.3	9.43E+04	19.8	21.5	1.10E+05	20	22
7.00E+02	1.05E+05	20.6	19.4	1.11E+05	20.3	19.7	9.47E+04	21	19.9	1.00E+05	21.3	20.1	1.00E+05	21.4	20.1	1.07E+05	22.1	20.2
1.00E+03	7.65E+04	20.3	16.1	7.65E+04	20.6	15.4	7.94E+04	21.1	15.8	8.01E+04	21.2	15.8	8.51E+04	21.7	16.2	8.71E+04	22.3	16.1
2.00E+03	5.89E+04	15.1	10.2	6.29E+04	16.7	10.1	6.35E+04	17.1	10.5	6.50E+04	17.5	10.7	6.59E+04	17.5	10.7	6.71E+04	18.1	11.1
3.00E+03	6.30E+04	15.3	9.3	6.48E+04	16.5	9.3	6.50E+04	16.8	9.4	6.62E+04	17.4	9.7	6.62E+04	17.2	9.6	7.07E+04	18.5	10.1
5.00E+03	6.63E+04	15.9	8.2	6.54E+04	16	8.5	6.98E+04	16.7	8.6	7.48E+04	17.7	8.9	7.61E+04	17.7	9.1	7.84E+04	18.6	9.4
1.00E+04	6.76E+04	15	7.2	6.95E+04	15.5	7.1	7.06E+04	15.8	7.4	7.07E+04	16.2	7.5	7.47E+04	15.9	7.5	7.86E+04	17.1	8.3
2.00E+04	8.10E+04	14.5	6.4	8.34E+04	16.4	6.8	8.32E+04	15.8	7	8.06E+04	16.1	7.1	8.40E+04	16.6	6.9	8.82E+04	17.3	7.5
5.00E+04	1.06E+05	13	5.5	1.03E+05	14.5	5.9	1.04E+05	14.8	5.9	1.01E+05	15.5	6.2	1.09E+05	14.4	6.1	1.09E+05	17	6.5
1.00E+05	1.35E+05	12	4.3	1.27E+05	12.2	4.6	1.26E+05	11.8	4.9	1.29E+05	12.6	5.3	1.29E+05	13.4	5.2	1.32E+05	15.1	5.9

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.63E-01	5.8	8.7	0.00E+00	1	1	3.00E+00	3.8	5	3.00E+00	3.8	5
2.00E+01	8.10E-01	6.4	8.2	0.00E+00	1	1	1.41E+01	4.1	5.2	1.41E+01	4.1	5.2
3.00E+01	3.02E+00	4.6	6.8	2.79E+00	5.3	7.5	6.02E+01	4.3	5.1	6.02E+01	4.3	5.1
5.00E+01	1.93E+01	3.6	5.5	1.63E+01	4.1	5.6	3.56E+03	5.9	2.9	3.56E+03	5.9	2.9
7.50E+01	6.53E+01	2.9	4.1	6.43E+01	3	4.2	2.45E+05	9.9	8.1	2.45E+05	9.9	8.1
1.00E+02	2.97E+02	4.4	3.8	1.98E+02	2.8	4.1	2.45E+05	13	13.6	2.45E+05	13	13.6
1.50E+02	9.75E+03	10.8	10.3	6.64E+03	10.2	9.4	1.86E+05	16.9	21	1.86E+05	16.9	21

Table A.23. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.57E+04	13.1	14.5	3.03E+04	13.1	14.2	1.50E+05	18.7	22.9	1.50E+05	18.7	22.9
3.00E+02	8.54E+04	17.4	21	7.61E+04	17.5	20.7	1.48E+05	22	24.6	1.48E+05	22	24.6
5.00E+02	1.03E+05	20.9	21.5	1.16E+05	19.8	21.2	1.32E+05	24.5	22.7	1.32E+05	24.5	22.7
7.00E+02	1.22E+05	22.4	20.8	1.22E+05	22.9	20	1.28E+05	26.3	20.3	1.28E+05	26.3	20.3
1.00E+03	9.19E+04	23.4	16.7	8.72E+04	22.5	16.3	1.08E+05	24.5	17.9	1.08E+05	24.5	17.9
2.00E+03	7.71E+04	19.2	11.8	7.51E+04	19.3	11.6	9.60E+04	22.6	13.1	9.60E+04	22.6	13.1
3.00E+03	7.57E+04	19.3	10.5	7.57E+04	19.1	10.7	9.37E+04	22.4	12.4	9.37E+04	22.4	12.4
5.00E+03	7.92E+04	18.9	9.6	8.29E+04	19.6	9.6	9.23E+04	22.3	11.4	9.23E+04	22.3	11.4
1.00E+04	8.43E+04	18.7	8.8	8.11E+04	18.3	8.6	9.14E+04	21.7	10.6	9.14E+04	21.7	10.6
2.00E+04	9.23E+04	19.3	7.6	9.61E+04	19.6	8.1	1.17E+05	23	7.7	1.17E+05	23	7.7
5.00E+04	1.14E+05	17.1	7	1.04E+05	18.8	7.2	1.08E+05	22	9.5	1.08E+05	22	9.5
1.00E+05	1.31E+05	16	6.1	1.28E+05	15.8	6.4	1.26E+05	21	8.5	1.26E+05	21	8.5

Table A.24. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{45}Sc ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.35E+00	6.1	0.7	2.61E+00	6.1	0.7	6.83E+02	6	2.8	8.05E+02	6	2.8	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.21E+01	6.5	0.9	4.17E+00	6.6	0.9	1.20E+03	6.3	3.2	1.31E+03	6.4	3.2	1.22E-01	7.1	9.6	1.12E-01	7	9.5
2.00E+01	1.92E+01	7	1.1	6.43E+00	7.1	1.2	2.32E+03	6.8	3.7	2.25E+03	6.9	3.8	4.92E-01	7	9.5	5.16E-01	6.9	9.2
3.00E+01	3.49E+01	7.7	1.3	1.25E+01	7.5	1.5	5.30E+03	7.5	4.5	4.72E+03	7.6	4.6	1.81E+00	6.2	8.3	1.73E+00	6.2	8.2
5.00E+01	8.28E+01	8.3	1.8	3.54E+01	7.2	1.9	1.96E+04	8.4	6	1.79E+04	8.2	5.6	9.04E+00	4.6	7.2	9.66E+00	4.6	7
7.50E+01	2.41E+02	8.3	2	1.19E+02	6.9	1.9	7.69E+04	9.6	7.7	5.57E+04	9.8	8	4.40E+01	3.4	4.7	4.43E+01	3.3	4.7
1.00E+02	7.88E+02	8.7	2.1	9.01E+02	8.2	1.8	1.37E+05	11.2	10.4	8.84E+04	11.4	10.7	1.54E+02	3.5	4.3	1.33E+02	2.7	3.7
1.50E+02	9.63E+03	10.7	2.6	9.57E+03	10.9	2.7	2.20E+05	14	15.7	1.41E+05	13.9	15.5	9.33E+02	6.5	6.2	5.89E+02	3.3	3.8
2.00E+02	2.28E+04	13.3	3.7	2.31E+04	13.2	3.7	2.07E+05	16.9	20.8	1.66E+05	16.1	19.4	5.76E+03	9.8	9.7	7.90E+03	10.3	9.9
3.00E+02	4.78E+04	16.1	4.9	5.07E+04	16.1	4.9	1.66E+05	20.8	24.9	1.53E+05	20	23.9	5.54E+04	14.9	17.1	5.94E+04	14.9	17.1
5.00E+02	1.05E+05	19.6	5.7	1.19E+05	19.4	5.6	1.29E+05	24.9	23.6	1.28E+05	23.5	23.1	1.02E+05	19.8	21.8	1.02E+05	19.9	22
7.00E+02	1.14E+05	21.7	5.6	1.21E+05	22	5.7	1.31E+05	24.9	20.7	1.37E+05	24.1	21	1.11E+05	21.6	20.5	1.15E+05	21.6	20.7
1.00E+03	9.56E+04	22.5	4.8	9.51E+04	22.9	4.9	1.21E+05	26	18.2	1.12E+05	25.5	18.2	9.18E+04	22.2	16.9	9.23E+04	22.3	17.1
2.00E+03	7.42E+04	20.1	3.6	7.63E+04	20.6	3.7	1.01E+05	23.9	13.8	9.96E+04	23.7	13.9	7.31E+04	19.8	11.8	7.27E+04	20	11.9
3.00E+03	7.47E+04	19.8	3.4	7.72E+04	20.4	3.4	1.05E+05	24.1	12.9	9.84E+04	23.7	12.6	7.35E+04	19.5	10.6	7.59E+04	19.7	10.7
5.00E+03	8.49E+04	20.3	3.2	8.61E+04	20.9	3.2	1.04E+05	24.3	11.7	1.06E+05	23.9	11.6	7.99E+04	19.5	9.8	8.72E+04	20.3	10
1.00E+04	8.25E+04	18.7	2.8	8.45E+04	19.4	2.9	1.09E+05	24	10.7	1.07E+05	23.9	10.5	8.19E+04	17.7	8.4	8.10E+04	18.4	8.5
2.00E+04	9.54E+04	18.1	2.7	9.46E+04	18.9	2.7	1.19E+05	23.2	10.1	1.08E+05	23.3	9.9	9.58E+04	17.3	7.8	9.12E+04	17.8	8.1
5.00E+04	1.21E+05	15.9	2.4	1.17E+05	16.6	2.5	1.39E+05	21.5	8.7	1.30E+05	21.1	8.8	1.18E+05	15.6	6.8	1.17E+05	15.9	6.9
1.00E+05	1.42E+05	13.4	2.1	1.33E+05	14.6	2.2	1.63E+05	18.8	7.5	1.37E+05	18.6	7.6	1.45E+05	12.7	5.6	1.41E+05	13.6	6

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.01E+03	6.1	2.9	0.00E+00	1	1
1.40E+01	1.27E-01	7.5	9.8	1.34E-01	7.3	9.9	1.36E-01	6.6	9.9	1.17E-01	7.5	9.4	1.40E+03	6.5	3.3	0.00E+00	1	1
2.00E+01	4.96E-01	7.6	9.5	5.28E-01	7.1	9.4	3.95E-01	7.6	9.4	5.34E-01	7	9.8	2.14E+03	7.1	4	2.72E-01	5.4	10.4
3.00E+01	1.75E+00	6.8	8.8	1.81E+00	6.7	8.5	1.60E+00	6.8	8.7	1.84E+00	6.4	8.5	3.34E+03	7.9	5	1.84E+00	5.4	8.9
5.00E+01	8.68E+00	4.9	7.6	9.69E+00	4.7	7.1	7.45E+00	5.2	8	1.04E+01	4.5	6.9	7.31E+03	9.1	6.8	5.05E+00	6.2	9.9
7.50E+01	4.07E+01	3.3	4.8	4.79E+01	3.2	4.5	3.27E+01	3.6	5.4	4.52E+01	3.3	4.6	1.80E+04	10	8.4	1.64E+01	4.7	7.9
1.00E+02	1.29E+02	2.7	3.7	1.54E+02	2.6	3.5	9.77E+01	2.9	4	1.39E+02	2.8	3.6	3.20E+04	11.2	10.5	5.30E+01	3.4	5.2
1.50E+02	6.71E+02	3.3	3.5	6.76E+02	2.6	3.2	4.34E+02	2.5	3.1	5.70E+02	3.1	3.5	6.31E+04	13.3	14.4	3.12E+02	2.2	3.1
2.00E+02	4.75E+03	8.9	8.6	3.59E+03	8.3	8.1	1.16E+03	3.4	4.5	7.86E+03	10.2	9.2	9.08E+04	15.1	17.7	9.35E+02	2.1	2.6
3.00E+02	4.43E+04	14.1	16.1	6.56E+04	14.1	15.9	3.54E+04	13.9	15.9	5.78E+04	15.3	17.8	1.05E+05	19.2	22.5	2.94E+03	3	3.9
5.00E+02	1.31E+05	19.7	22.2	1.37E+05	20.2	22.4	9.42E+04	19	21.3	1.17E+05	19.7	22	1.00E+05	22.3	22.5	9.43E+04	16.3	19.6
7.00E+02	1.23E+05	22.3	21.2	1.28E+05	22.8	21.3	1.13E+05	21.2	20.5	1.19E+05	21.9	20.9	1.21E+05	22.1	20.2	1.12E+05	20.2	20.8
1.00E+03	9.73E+04	23	17.2	1.01E+05	23.6	17.3	9.18E+04	21.6	16.7	9.73E+04	22.8	17.1	9.77E+04	23.6	17.5	8.04E+04	20.7	16.6
2.00E+03	8.07E+04	20.9	12.4	8.19E+04	21.4	12.8	6.98E+04	19.3	11.5	7.31E+04	20.2	12.1	7.71E+04	21.3	12.9	6.62E+04	18.7	10.6
3.00E+03	7.72E+04	20.5	11.2	8.21E+04	21.3	11.5	7.22E+04	19.2	10.4	7.61E+04	20.3	10.9	8.16E+04	21.1	11.6	6.81E+04	18.2	10.1
5.00E+03	8.53E+04	20.8	10.4	9.33E+04	21.9	10.7	8.25E+04	19.2	9.6	7.87E+04	20.1	10	8.85E+04	20.6	10.5	7.07E+04	17.1	9.4
1.00E+04	8.71E+04	19.8	9	9.02E+04	20.9	9.4	7.42E+04	16.6	8	8.20E+04	19.1	8.6	8.55E+04	20.2	9.2	7.59E+04	15.8	7.8
2.00E+04	9.80E+04	19.4	8.4	1.02E+05	20.7	8.8	9.15E+04	17	7.6	9.64E+04	18.6	7.9	1.03E+05	19.9	8.5	8.85E+04	15.7	7
5.00E+04	1.22E+05	17.2	7.4	1.19E+05	18.4	7.7	1.14E+05	15.4	6.7	1.13E+05	16.8	7.2	1.26E+05	18.6	7.6	1.05E+05	15.3	6.9
1.00E+05	1.36E+05	14.7	6.3	1.32E+05	16.3	6.6	1.39E+05	12.6	5.4	1.34E+05	14	6	1.46E+05	15.1	6.4	1.26E+05	9.6	5

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.29E-01	7.5	9.8	1.30E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	4.80E-01	7.5	9.6	4.91E-01	7.1	9.5	3.52E-01	6.2	9.3	4.23E-01	6.2	9.7	5.15E-01	5.2	7.6	7.33E-01	4.4	7.9
3.00E+01	1.59E+00	6.9	8.8	1.72E+00	6.8	8.7	1.72E+00	6.1	9.1	1.58E+00	7	9	3.48E+00	4	6.4	3.34E+00	3.8	6.1
5.00E+01	7.60E+00	5.2	8	9.20E+00	4.8	7.2	7.62E+00	5.3	8.4	7.41E+00	5.4	8.4	2.29E+01	3.4	4.9	3.11E+01	3.3	4.8

Table A.24. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.26E+01	3.6	5.3	4.17E+01	3.3	4.8	2.83E+01	4	5.8	3.28E+01	3.8	5.4	9.54E+01	2.7	3.9	1.00E+02	2.8	3.9
1.00E+02	9.67E+01	2.9	4	1.27E+02	2.8	3.7	8.71E+01	3	4.6	1.07E+02	2.9	4	2.73E+02	2.6	3.8	2.81E+02	2.6	3.4
1.50E+02	4.79E+02	2.7	3.4	5.91E+02	3.3	3.9	7.16E+02	6.1	5.4	5.16E+02	2.5	3.1	1.36E+04	9.7	8.6	2.02E+04	9.9	8.6
2.00E+02	4.04E+03	8.7	8.7	6.91E+03	9.7	9.4	4.65E+03	10	9.9	3.44E+03	8.7	8.4	6.54E+04	12.6	13.4	8.15E+04	13.2	13.9
3.00E+02	3.45E+04	14.2	16.3	5.28E+04	14.8	17.1	2.58E+04	13.9	16.8	2.82E+04	14.2	16.8	1.08E+05	17.6	21.7	1.07E+05	18.6	22.3
5.00E+02	9.52E+04	18.9	21.1	1.12E+05	19.5	21.7	1.07E+05	17.8	19.5	1.38E+05	18.1	21.1	1.13E+05	20.9	21.7	1.27E+05	21	21.9
7.00E+02	1.12E+05	21	20.7	1.21E+05	21.8	20.9	1.23E+05	21	21.2	1.30E+05	21.8	21.1	1.23E+05	22.4	21.1	1.21E+05	22.4	21.4
1.00E+03	9.09E+04	21.8	16.9	9.65E+04	22.7	17.2	9.34E+04	22.1	16.7	9.85E+04	22.7	17.2	1.03E+05	23.7	17.9	1.05E+05	24.3	17.6
2.00E+03	7.04E+04	19.2	11.5	7.36E+04	20.1	12	7.03E+04	18.6	11.6	7.96E+04	20.4	12.1	8.32E+04	21.7	12.9	8.51E+04	22.4	13
3.00E+03	7.24E+04	19.1	10.5	7.46E+04	20	10.8	7.18E+04	19.4	10.4	7.73E+04	19.8	11.1	8.19E+04	21.1	11.7	8.90E+04	22.3	12.1
5.00E+03	8.07E+04	19.5	9.7	8.63E+04	20.6	10.1	8.56E+04	19.9	9.6	8.58E+04	20.6	10.2	9.25E+04	21.8	10.6	9.12E+04	21.4	11.2
1.00E+04	8.03E+04	17.5	8.1	7.98E+04	18.9	8.7	8.02E+04	17.3	8.3	7.73E+04	18.6	8.9	9.27E+04	20.7	9.2	9.03E+04	21.4	9.6
2.00E+04	8.74E+04	16.8	7.6	9.51E+04	18.7	8.2	8.75E+04	17	7.7	9.08E+04	18.8	8.1	9.75E+04	20.3	9.1	9.63E+04	20.6	9.3
5.00E+04	1.15E+05	15.1	6.5	1.17E+05	16.6	7.1	1.14E+05	15.5	6.9	1.13E+05	17.2	7	1.22E+05	18.3	7.8	1.11E+05	18.3	7.7
1.00E+05	1.33E+05	12.3	5.5	1.29E+05	14.3	6	1.34E+05	12.4	5.7	1.36E+05	14.6	6.5	1.31E+05	15.7	6.6	1.32E+05	17.1	7.4

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.81E+01	6.1	2.9	6.15E+00	6.1	2.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	1.99E-01	4.2	8.8	4.03E+01	6.5	3.4	9.02E+00	6.5	3.4	1.63E-01	7.2	10	1.71E-01	7.2	9.6
2.00E+01	4.19E-01	6.4	9.3	6.25E-01	4.9	7.6	6.16E+01	7.1	4	1.35E+01	7	4.2	6.30E-01	7.3	9.3	6.35E-01	6.8	8.6
3.00E+01	1.77E+00	6.6	8.8	3.07E+00	5	6.8	1.04E+02	7.7	5	2.57E+01	7.5	5.2	2.21E+00	6.2	8	2.54E+00	5.7	7.3
5.00E+01	7.07E+00	5.4	8.6	1.75E+01	3.8	5.4	2.41E+02	8.5	6.6	6.97E+01	7.3	6.3	1.40E+01	4	6	1.67E+01	3.6	5.5
7.50E+01	2.58E+01	3.8	5.8	7.07E+01	3.1	4.2	6.53E+02	8.8	7.5	2.68E+02	7	6.2	6.98E+01	2.9	4.1	8.38E+01	2.8	3.9
1.00E+02	8.35E+01	3	4.2	2.04E+02	3.5	4.4	2.24E+03	9.2	8	1.79E+03	8.4	6.7	2.05E+02	2.6	3.3	2.41E+02	2.6	3.3
1.50E+02	3.74E+02	2.4	3.2	2.10E+04	10.6	9.5	2.24E+04	11.1	10.6	2.11E+04	11.1	10.6	1.35E+03	5.4	5.1	2.40E+03	7	6.1
2.00E+02	1.05E+03	3.5	4	4.28E+04	14	15.4	5.37E+04	13.6	15	4.90E+04	13.5	14.9	1.81E+04	11	10.7	3.04E+04	11.6	11.6
3.00E+02	2.85E+04	13.4	14.8	5.92E+04	17.4	21.2	1.03E+05	16.9	20	1.02E+05	16.7	19.8	9.60E+04	15.4	18	1.12E+05	15.8	18.6
5.00E+02	8.18E+04	18.1	20.3	9.19E+04	20.5	21.9	1.40E+05	21.3	22.8	1.45E+05	21.1	22.7	1.72E+05	20.6	22.6	1.83E+05	21	23
7.00E+02	1.12E+05	20.6	20.7	1.23E+05	21	20.5	1.26E+05	23.4	21.2	1.28E+05	23.4	21.3	1.39E+05	23.9	21.7	1.35E+05	24.3	21.7
1.00E+03	9.00E+04	21	16.8	9.64E+04	22.6	16.9	1.04E+05	24.3	17.7	1.04E+05	24.4	17.7	1.08E+05	24.7	17.8	1.10E+05	25	17.9
2.00E+03	6.89E+04	18.7	11.1	7.53E+04	20.2	12	8.57E+04	22.3	13.2	8.53E+04	22.3	13.2	9.07E+04	22.8	13.5	9.18E+04	23.2	13.7
3.00E+03	6.58E+04	17.8	10	7.88E+04	20	10.7	8.63E+04	22.2	12	8.68E+04	22.3	12	8.74E+04	22.7	12.2	9.37E+04	23.1	12.4
5.00E+03	7.81E+04	18.3	9.3	8.41E+04	20.2	9.9	9.40E+04	22.6	11	9.31E+04	22.6	11.1	9.57E+04	23.2	11.4	9.78E+04	23.4	11.5
1.00E+04	7.63E+04	16.5	7.4	8.35E+04	18.8	8.4	9.27E+04	21.8	9.7	9.25E+04	21.9	9.8	9.75E+04	22.6	10.1	9.79E+04	23.1	10.3
2.00E+04	8.47E+04	16.1	7.3	9.29E+04	17.8	7.9	1.02E+05	21.1	9.1	1.02E+05	21.4	9.2	1.06E+05	22.1	9.5	1.06E+05	23	9.7
5.00E+04	1.17E+05	14.2	6.2	1.15E+05	16.2	6.7	1.24E+05	19	8	1.22E+05	19.2	8.1	1.29E+05	20.5	8.4	1.19E+05	21.3	8.7
1.00E+05	1.39E+05	10.6	5.1	1.44E+05	13.7	5.6	1.44E+05	16.5	7	1.39E+05	17.3	7.1	1.37E+05	18.1	7	1.36E+05	18.9	7.8

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.16E+03	5.2	1.8	8.70E+03	5.2	1.8	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.43E+04	5.2	1.9	1.74E+04	5.2	1.9	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.15E+04	5.3	2	2.60E+04	5.3	2	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.57E+04	5.5	2.3	4.33E+04	5.5	2.3	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.42E+00	5.8	2.7	0.00E+00	1	1	7.10E+04	6.1	2.9	8.61E+04	6.1	2.9	8.51E+01	6.1	2.9	1.21E+01	6.1	2.9
1.40E+01	1.41E+01	6.3	3.2	2.20E-01	4.9	7.2	9.88E+04	6.5	3.4	1.20E+05	6.6	3.4	1.19E+02	6.5	3.3	2.04E+01	6.5	3.4
2.00E+01	3.35E+01	6.5	3.7	1.29E+00	4.8	5.9	1.39E+05	7.2	4.1	1.68E+05	7.2	4.1	1.83E+02	7.1	4	2.66E+01	7	4.1
3.00E+01	8.92E+01	7	4.3	5.85E+00	3.9	5.2	2.04E+05	8	5.2	2.44E+05	8.1	5.2	3.00E+02	7.9	5	4.35E+01	7.6	5.1
5.00E+01	4.22E+02	7.4	5.2	3.96E+01	3.7	4.6	3.11E+05	9.6	7.6	3.36E+05	9.9	8	6.39E+02	8.9	6.8	1.07E+02	8.6	6.5
7.50E+01	8.32E+03	8.6	6.3	5.02E+02	6.3	4.4	2.78E+05	12.2	12.1	2.83E+05	12.5	12.5	1.78E+03	9.6	8	3.13E+02	8.9	7.4
1.00E+02	3.02E+04	10	8.4	7.76E+03	8.7	6.7	2.36E+05	14.3	16.1	2.36E+05	14.6	16.6	4.12E+03	10.5	9.5	1.19E+03	9	7.7
1.50E+02	9.02E+04	12.7	13.2	4.97E+04	11.8	11.8	1.84E+05	17.3	21.7	1.84E+05	17.4	21.9	1.21E+04	12.4	12.9	7.26E+03	11.3	11.3
2.00E+02	1.34E+05	15.2	17.9	8.96E+04	14.3	16.1	1.61E+05	19.2	24.1	1.63E+05	19.3	24.2	1.97E+04	14	16.1	1.57E+04	13.3	14.7
3.00E+02	1.33E+05	19	22.9	1.23E+05	18.4	21.8	1.46E+05	21.5	24.8	1.48E+05	21.5	24.8	4.49E+04	15.9	18.6	4.40E+04	15.6	18.2
5.00E+02	1.40E+05	22.5	22.9	1.42E+05	21.3	22.4	1.43E+05	23.9	23.3	1.46E+05	23.8	23.3	1.05E+05	19.3	21.4	1.18E+05	19.3	21.5
7.00E+02	1.39E+05	23.8	21.5	1.42E+05	24.1	21.7	1.35E+05	25.4	21.3	1.38E+05	25.4	21.4	1.18E+05	21.6	20.8	1.23E+05	21.9	21.1
1.00E+03	1.11E+05	25	17.9	1.17E+05	24.8	17.8	1.18E+05	26.4	18.4	1.19E+05	26.6	18.5	9.46E+04	22.5	17.1	9.57E+04	22.8	17.1
2.00E+03	8.89E+04	23.1	13.7	8.64E+04	23	13.7	1.02E+05	24.6	14.4	1.03E+05	24.7	14.5	7.47E+04	20.1	11.9	7.46E+04	20.2	12.2
3.00E+03	9.61E+04	23.2	12.4	9.21E+04	23	12.2	1.03E+05	24.6	13.1	1.04E+05	24.7	13.2	7.50E+04	19.7	10.8	7.73E+04	20.3	11

(continued on next page)

Table A.24. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	9.87E+04	23.7	11.6	1.02E+05	23.5	11.4	1.08E+05	24.9	12	1.09E+05	25.1	12.1	8.34E+04	19.9	10	8.47E+04	20.4	10.1
1.00E+04	1.03E+05	23.6	10.3	1.00E+05	23.1	10.2	1.11E+05	24.9	11	1.11E+05	25.2	11.1	8.30E+04	18.5	8.6	8.25E+04	19.1	8.8
2.00E+04	1.11E+05	23	9.6	1.07E+05	22.5	9.7	1.20E+05	24.3	10.2	1.21E+05	24.7	10.4	9.39E+04	17.9	8	9.46E+04	18.9	8.2
5.00E+04	1.33E+05	21.3	8.5	1.22E+05	20.5	8.2	1.39E+05	22.1	9.1	1.39E+05	22.7	9.3	1.16E+05	16.1	7	1.15E+05	16.8	7.2
1.00E+05	1.47E+05	18.5	7.6	1.42E+05	18.2	7.4	1.56E+05	19.8	8.2	1.55E+05	20.7	8.4	1.40E+05	13.4	5.8	1.35E+05	14.3	6.1

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.00E+03	6.1	2.9	1.52E+02	6.1	2.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.39E+03	6.5	3.3	2.57E+02	6.5	3.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.32E-01	4.7	9	4.94E-01	4.8	9.6	2.13E+03	7.1	4	3.24E+02	7	4	5.05E-01	7.7	8.9	3.91E-01	5.6	9.7
3.00E+01	1.16E+00	5.4	9.1	1.50E+00	5.4	9.2	3.43E+03	7.9	5	5.16E+02	7.7	5	1.45E+00	6.1	9.3	1.32E+00	5.6	9
5.00E+01	6.56E+00	6	9.4	6.38E+00	6.9	9.9	6.88E+03	9	6.9	1.16E+03	9.1	6.7	5.94E+00	5	9.2	5.18E+00	5.8	10.4
7.50E+01	2.25E+01	3.8	6.2	1.85E+01	4.6	7.4	1.60E+04	9.9	8.4	2.59E+03	10	8.3	2.47E+01	3.9	6.5	2.15E+01	4.3	7.1
1.00E+02	6.81E+01	3.1	4.6	6.59E+01	3.1	4.8	3.29E+04	11	10.2	8.38E+03	9.7	8.5	7.00E+01	3	4.6	6.80E+01	3.2	4.7
1.50E+02	3.47E+02	2.3	3.1	3.52E+02	2.2	3.1	7.19E+04	13.2	14.3	3.35E+04	12.4	12.7	3.50E+02	2.5	3.2	3.72E+02	2.4	3.1
2.00E+02	9.64E+02	2.5	2.8	1.00E+03	2	2.8	8.77E+04	15.4	18.3	5.18E+04	14.8	16.9	9.57E+02	2.4	3.8	1.03E+03	2.1	2.7
3.00E+02	1.36E+04	11.5	11.3	4.60E+03	6.9	8.8	1.13E+05	18.3	21.8	8.03E+04	17	20	1.50E+04	12.9	14.2	4.09E+03	6.3	8.5
5.00E+02	7.95E+04	18.5	21.2	9.77E+04	17.1	19.1	1.62E+05	21.4	22.9	1.55E+05	21.3	23	8.88E+04	17.1	19.8	1.07E+05	17.8	20.4
7.00E+02	1.01E+05	20.2	19.9	1.18E+05	20.4	20.9	1.37E+05	24.1	21.4	1.33E+05	24	21.7	1.12E+05	20.6	20.4	1.21E+05	21	21.1
1.00E+03	8.83E+04	21.3	16.3	8.82E+04	21.6	16.6	1.10E+05	25.1	18.1	1.08E+05	24.8	17.6	9.23E+04	21.2	16.7	9.30E+04	21.8	16.6
2.00E+03	6.75E+04	18.5	11.3	6.66E+04	17.4	11.1	9.13E+04	23.1	13.7	8.60E+04	22.4	13.5	6.93E+04	18.7	11	6.52E+04	18.3	11.2
3.00E+03	6.96E+04	18.3	9.9	7.03E+04	17.6	10.1	8.88E+04	22.9	12.5	9.01E+04	22.6	12.2	6.97E+04	17.6	9.8	6.95E+04	19	10.3
5.00E+03	8.04E+04	17.5	9	7.55E+04	17.5	9.5	1.01E+05	23.5	11.6	1.00E+05	22.5	11.2	7.63E+04	18.4	9.2	7.94E+04	18.8	9.4
1.00E+04	7.81E+04	16.1	8	7.71E+04	17.8	8	9.65E+04	23.7	10.3	9.13E+04	22.8	9.9	7.74E+04	14.8	7.9	7.74E+04	18	8.4
2.00E+04	8.23E+04	13.8	7.3	8.24E+04	15.4	7.3	1.10E+05	22.5	9.8	1.02E+05	21.8	9.3	9.00E+04	15.5	7.2	8.91E+04	16.9	7.7
5.00E+04	1.13E+05	16.3	6.5	1.08E+05	13.8	6.6	1.27E+05	20.6	8.6	1.23E+05	21.4	8.5	1.06E+05	13.7	6	1.09E+05	13.2	6.5
1.00E+05	1.36E+05	10.6	5.2	1.25E+05	11.4	5.4	1.46E+05	18.9	7.4	1.39E+05	18.9	7.5	1.38E+05	11.6	5.3	1.24E+05	12	5.5

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.13E+01	6.1	2.8	0.00E+00	1	1
1.40E+01	1.21E-01	6.9	9.8	0.00E+00	1	1	1.14E-01	6.8	9.8	1.12E-01	7	10.1	6.37E+01	6.4	3.3	1.68E-01	6.1	8.8
2.00E+01	4.56E-01	7.5	9.6	4.73E-01	7.1	9.6	4.52E-01	7.9	9.3	4.70E-01	7.9	9.8	1.09E+02	6.9	3.8	7.76E-01	4.9	7.6
3.00E+01	1.55E+00	7.2	9.1	1.69E+00	7.1	8.9	1.46E+00	7	9.1	1.49E+00	7.2	9.3	2.31E+02	7.5	4.7	3.47E+00	5.1	6.5
5.00E+01	6.94E+00	5.7	8.4	7.79E+00	5.2	8.3	6.07E+00	6.1	9.5	6.51E+00	5.9	9.5	8.30E+02	8.4	6.1	2.11E+01	4.2	5.6
7.50E+01	3.02E+01	3.7	5.6	3.65E+01	3.5	5.1	2.45E+01	4	6.2	2.68E+01	3.9	6.1	4.91E+03	9.2	7.1	1.39E+02	6	5.3
1.00E+02	9.22E+01	2.9	4.1	1.12E+02	2.8	3.8	7.48E+01	3	4.3	8.36E+01	3	4.2	1.27E+04	10.4	9.2	8.78E+02	7.9	6.4
1.50E+02	4.26E+02	2.3	3.1	5.20E+02	2.5	3.2	3.81E+02	2.4	3.1	4.19E+02	2.3	3	2.89E+04	12.9	13.9	1.92E+04	11	10.6
2.00E+02	1.38E+03	4.6	5.1	2.61E+03	7	6.8	1.04E+03	2.4	3.1	1.09E+03	2.3	3	3.96E+04	15	17.6	3.47E+04	14	15.9
3.00E+02	3.03E+04	13.5	15.3	3.74E+04	14	16	1.51E+04	11.2	11.6	1.23E+04	11.1	12	5.50E+04	17.3	20.5	5.52E+04	16.9	19.9
5.00E+02	1.00E+05	18.4	20.6	1.25E+05	19	21.5	9.18E+04	18.7	21.1	1.11E+05	18.7	21.3	1.05E+05	19.9	21.5	1.19E+05	19.7	21.5
7.00E+02	1.22E+05	21.4	20.9	1.23E+05	21.8	21.2	1.06E+05	20.8	20.6	1.12E+05	21.4	20.7	1.17E+05	21.9	20.9	1.23E+05	22.2	21.1
1.00E+03	9.08E+04	22	16.9	9.63E+04	22.8	16.9	8.98E+04	21.4	16.6	8.89E+04	21.8	16.9	9.37E+04	22.6	17.1	9.79E+04	23	17.2
2.00E+03	7.13E+04	19.5	11.5	7.60E+04	20.2	12.2	6.99E+04	19	11.2	6.87E+04	19	11.5	7.71E+04	20.4	12.1	7.62E+04	20.7	12.4
3.00E+03	7.10E+04	19.2	10.4	7.83E+04	20.5	11	7.16E+04	18.6	10	7.12E+04	19.1	10.4	7.84E+04	20.3	10.9	7.82E+04	20.5	11.1
5.00E+03	8.20E+04	19.6	9.9	8.50E+04	20.8	10.2	7.97E+04	18.6	9.5	7.97E+04	19.6	9.5	8.34E+04	20	10.2	8.17E+04	20.5	10.3
1.00E+04	8.14E+04	18.4	8.2	8.34E+04	19.3	8.9	7.74E+04	16.9	7.8	7.26E+04	17	8.3	8.48E+04	18.9	8.6	8.51E+04	19.6	9
2.00E+04	9.11E+04	17.5	7.8	9.36E+04	19.5	8.4	8.81E+04	15.7	7.2	9.04E+04	17	7.4	9.38E+04	18.3	8.1	9.63E+04	19.6	8.3
5.00E+04	1.16E+05	15.5	6.7	1.16E+05	17.6	7.3	1.07E+05	14.1	6.2	1.11E+05	15.5	6.9	1.19E+05	16	7.1	1.22E+05	17.4	7.3
1.00E+05	1.38E+05	13.2	5.7	1.37E+05	14.6	6.1	1.42E+05	11.5	5.2	1.36E+05	12.5	5.5	1.41E+05	13.5	5.9	1.41E+05	14.9	6.2

Table A.24. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.27E+01	6.1	2.9	4.93E+00	6.1	2.9	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	8.95E+01	6.5	3.4	7.17E+00	6.5	3.5	1.20E-01	5.6	9.1	1.78E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.32E+02	7.1	4	1.12E+01	7	4.2	5.42E-01	6.6	9	4.31E+00	6.4	4	3.78E-01	6.8	9.7	4.69E-01	7.1	10.1
3.00E+01	2.24E+02	7.8	5	2.13E+01	7.4	5.2	2.50E+00	5.8	7.3	1.01E+01	5.9	4.4	1.47E+00	7.1	9.5	1.42E+00	7.1	9.2
5.00E+01	5.13E+02	8.7	6.6	6.66E+01	7.1	5.9	1.47E+01	3.9	6	7.84E+01	6.9	4.6	5.29E+00	6.7	10.6	6.21E+00	6.1	9.8
7.50E+01	1.92E+03	9.1	7.2	3.79E+02	7.4	5.8	6.54E+01	3	4.2	6.86E+02	8.7	6.6	1.56E+01	5.4	8.3	2.26E+01	4.2	6.5
1.00E+02	6.61E+03	9.7	8.2	2.14E+03	8.8	7.2	4.95E+02	6.2	5	3.23E+03	9.2	7.6	4.41E+01	3.7	5.6	7.44E+01	3.1	4.3
1.50E+02	3.26E+04	11.9	11.9	1.48E+04	11.1	10.8	1.12E+04	11.1	10.7	1.75E+04	11.8	12	2.68E+02	2.5	3.3	3.99E+02	2.4	3
2.00E+02	6.50E+04	14	15.7	4.48E+04	13.1	14.1	1.92E+04	13.5	15.1	3.29E+04	14.3	16.1	8.21E+02	2.1	2.7	1.06E+03	2.3	2.8
3.00E+02	1.09E+05	17.4	20.7	1.01E+05	16.6	19.7	7.27E+04	15	17	9.70E+04	15.8	18.6	2.82E+03	2.6	3.5	7.17E+03	8.6	9.6
5.00E+02	1.32E+05	21.5	22.8	1.37E+05	21.1	22.7	1.52E+05	20.6	23.2	1.49E+05	21.2	23.4	6.74E+04	15.5	17.4	1.08E+05	18.1	20.9
7.00E+02	1.23E+05	23.4	21.1	1.25E+05	23.2	21.1	1.35E+05	23.4	21.4	1.43E+05	23.4	21.5	1.14E+05	20.1	20.8	1.16E+05	21.1	20.8
1.00E+03	1.03E+05	24.1	17.6	1.04E+05	24.1	17.6	1.05E+05	24.1	17.7	1.06E+05	24.9	17.9	8.47E+04	20.4	16.5	8.99E+04	21.7	16.7
2.00E+03	8.46E+04	22.1	13.1	8.38E+04	22	13	8.55E+04	22	13.1	8.58E+04	22.5	13.3	6.56E+04	17.5	10.3	6.70E+04	18.3	11.4
3.00E+03	8.58E+04	22	11.9	8.48E+04	21.9	11.8	8.82E+04	21.9	11.9	9.14E+04	22.7	12	6.32E+04	16.8	9.5	6.71E+04	18.4	10.2
5.00E+03	9.32E+04	22.3	10.9	9.24E+04	22.2	10.9	9.35E+04	22.6	11	9.87E+04	22.7	11.2	7.39E+04	16.5	8.9	8.20E+04	19.5	9.6
1.00E+04	9.31E+04	21.5	9.6	9.07E+04	21.3	9.6	9.39E+04	22.5	9.9	9.12E+04	21.8	10.2	7.23E+04	14.7	7.3	7.75E+04	17.4	8.1
2.00E+04	1.03E+05	20.8	9	1.02E+05	20.8	9	1.02E+05	20.9	9.1	1.05E+05	22	9.8	8.53E+04	15.8	6.7	8.94E+04	16.6	7.5
5.00E+04	1.26E+05	18.6	7.8	1.22E+05	18.7	7.9	1.23E+05	19.6	8.4	1.24E+05	20.1	8.1	1.11E+05	13.1	6.1	1.10E+05	15	6.3
1.00E+05	1.46E+05	16	6.8	1.40E+05	16.6	6.8	1.33E+05	17.7	7.3	1.38E+05	18	7.6	1.36E+05	9.7	4.6	1.34E+05	12.1	5.4

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.47E-02	6.9	10.2	1.18E-01	7.4	9.6	1.12E-01	7.3	9.7	1.52E-01	6.2	10.1	1.39E-01	6.6	9.7
2.00E+01	3.84E-01	5.2	9.4	5.48E-01	6.9	9.8	4.79E-01	7.2	9.6	4.54E-01	7.2	9.6	3.75E-01	7.2	9.5	4.98E-01	6.4	9.9
3.00E+01	1.25E+00	7.2	9.3	1.47E+00	7.3	9.3	1.61E+00	6.9	9	1.64E+00	7	8.9	1.59E+00	6.9	9	1.68E+00	6.9	8.8
5.00E+01	5.30E+00	6.2	10.2	5.52E+00	6.8	10.3	6.97E+00	5.4	8.7	7.31E+00	5.4	8.7	6.87E+00	5.3	8.9	8.83E+00	5	7.9
7.50E+01	1.70E+01	5.2	7.9	1.96E+01	4.9	7.9	2.92E+01	3.7	5.6	3.16E+01	3.7	5.4	2.89E+01	3.7	5.4	3.96E+01	3.4	4.8
1.00E+02	5.05E+01	3.3	5.5	5.70E+01	3.5	5.1	8.97E+01	2.9	4.1	9.90E+01	2.9	4	9.84E+01	2.9	4	1.31E+02	2.7	3.7
1.50E+02	2.88E+02	2.5	3.2	3.18E+02	2.4	3.2	4.24E+02	2.6	3.2	4.45E+02	2.4	3.1	4.48E+02	2.4	3	5.54E+02	2.5	3.1
2.00E+02	8.49E+02	2.1	2.7	9.15E+02	2.2	2.8	2.09E+03	7.2	7	1.41E+03	4.9	5.2	1.22E+03	3.2	3.7	1.53E+03	6	5.5
3.00E+02	2.87E+03	3.5	4.3	3.74E+03	4.5	6.3	3.00E+04	13.6	15.3	3.34E+04	13.7	15.4	3.23E+04	12.9	14.4	5.54E+04	14	16.1
5.00E+02	8.94E+04	16.5	19.4	8.89E+04	16.7	19.4	9.20E+04	18.7	21	9.84E+04	19.1	21.2	1.00E+05	19.3	21.5	1.18E+05	19.5	21.9
7.00E+02	1.12E+05	19.3	20.1	1.17E+05	20.2	20.7	1.08E+05	20.9	20.6	1.14E+05	21	20.8	1.17E+05	21.2	20.7	1.21E+05	22.1	20.9
1.00E+03	8.51E+04	21	16.7	8.56E+04	21.2	16.4	9.11E+04	21.6	16.7	8.98E+04	21.9	16.9	9.43E+04	22.4	16.8	9.86E+04	22.8	17.1
2.00E+03	6.28E+04	18.7	10.7	6.76E+04	17.8	10.8	6.92E+04	18.8	11.2	7.03E+04	19.3	11.6	7.36E+04	19.6	11.7	7.52E+04	20.7	12.3
3.00E+03	6.73E+04	17.3	9.8	6.84E+04	17.8	10	7.01E+04	18.5	10.1	7.40E+04	19.2	10.4	7.07E+04	19.2	10.4	8.05E+04	20.6	10.9
5.00E+03	7.13E+04	17	9.3	7.35E+04	18.5	9.5	7.75E+04	18.7	9.4	7.71E+04	19.4	9.7	8.31E+04	19.5	9.9	8.61E+04	20.7	10.1
1.00E+04	7.32E+04	15.3	7.3	7.55E+04	16.5	7.8	7.94E+04	17	7.9	7.95E+04	17.7	8.2	8.01E+04	17	8.4	8.49E+04	19	8.6
2.00E+04	8.60E+04	14.5	6.6	8.89E+04	16.7	7	9.46E+04	16.8	7.5	9.11E+04	17.5	7.7	9.52E+04	18.1	7.4	9.49E+04	19.1	8.2
5.00E+04	1.12E+05	12.9	6.1	1.11E+05	14.3	6.1	1.13E+05	14.6	6.3	1.14E+05	15.3	6.5	1.17E+05	15.4	6.9	1.17E+05	16.1	6.9
1.00E+05	1.44E+05	11.7	4.7	1.36E+05	12	4.8	1.39E+05	11.3	5.1	1.34E+05	12.5	5.4	1.38E+05	13	5.7	1.41E+05	14.7	6.1

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.74E-01	5.8	8.7	0.00E+00	1	1	3.03E+00	3.7	4.9	3.03E+00	3.7	4.9
2.00E+01	8.29E-01	6.4	8.2	0.00E+00	1	1	1.42E+01	4	5.1	1.42E+01	4	5.1
3.00E+01	3.16E+00	4.5	6.7	2.87E+00	5.3	7.5	5.91E+01	4.2	5	5.91E+01	4.2	5
5.00E+01	1.97E+01	3.6	5.4	1.65E+01	4.1	5.5	6.76E+03	5.8	2.8	6.76E+03	5.8	2.8
7.50E+01	6.65E+01	2.9	4.1	6.44E+01	3	4.2	2.76E+05	9.6	7.5	2.76E+05	9.6	7.5

(continued on next page)

Table A.24. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	2.78E+02	4.2	3.8	1.95E+02	2.8	4	2.70E+05	12.5	12.5	2.70E+05	12.5	12.5
1.50E+02	9.39E+03	10.3	9.6	6.17E+03	10.1	9.3	2.06E+05	16.2	19.6	2.06E+05	16.2	19.6
2.00E+02	3.50E+04	12.5	13.4	2.88E+04	12.5	12.9	1.65E+05	17.8	21.7	1.65E+05	17.8	21.7
3.00E+02	9.26E+04	16.5	20.3	8.02E+04	16.9	20.3	1.66E+05	21	23.5	1.66E+05	21	23.5
5.00E+02	1.08E+05	20.3	21.7	1.23E+05	19.6	21	1.45E+05	23.5	23.1	1.45E+05	23.5	23.1
7.00E+02	1.34E+05	22.2	21.4	1.34E+05	22.3	21.4	1.44E+05	25.4	21.5	1.44E+05	25.4	21.5
1.00E+03	1.01E+05	23.4	17.5	9.83E+04	23.4	17.4	1.22E+05	26.2	18.7	1.22E+05	26.2	18.7
2.00E+03	8.32E+04	21.1	12.7	8.12E+04	21.7	12.6	1.06E+05	25.1	14.9	1.06E+05	25.1	14.9
3.00E+03	8.12E+04	20.9	11.4	8.15E+04	21.6	11.5	1.03E+05	24.9	13.3	1.03E+05	24.9	13.3
5.00E+03	8.79E+04	21.4	10.6	8.94E+04	20.6	10.4	1.01E+05	24.7	12.9	1.01E+05	24.7	12.9
1.00E+04	9.12E+04	20.4	9.4	8.64E+04	18.5	9	1.01E+05	24.1	11	1.01E+05	24.1	11
2.00E+04	9.94E+04	19.5	8.7	1.04E+05	20.7	8.3	1.29E+05	24.3	10.3	1.29E+05	24.3	10.3
5.00E+04	1.22E+05	17.9	7.8	1.11E+05	18.4	8	1.21E+05	21.2	9.7	1.21E+05	21.2	9.7
1.00E+05	1.40E+05	15.6	6.4	1.37E+05	15.6	6.9	1.38E+05	20.2	8.9	1.38E+05	20.2	8.9

Table A.25. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{48}Ti ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.69E+00	5.9	0.7	2.81E+00	5.9	0.7	7.11E+02	5.8	2.6	8.42E+02	5.8	2.6	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.28E+01	6.3	0.8	4.39E+00	6.3	0.9	1.24E+03	6.1	3	1.41E+03	6.2	3	1.23E-01	7.1	9.6	1.12E-01	7	9.5
2.00E+01	2.00E+01	6.8	1	6.65E+00	6.8	1.1	2.39E+03	6.6	3.4	2.34E+03	6.6	3.5	4.98E-01	7	9.5	5.28E-01	6.9	9.2
3.00E+01	3.66E+01	7.4	1.2	1.30E+01	7.2	1.4	5.45E+03	7.1	4.2	4.85E+03	7.3	4.3	1.86E+00	6.2	8.3	1.76E+00	6.2	8.2
5.00E+01	8.47E+01	8	1.7	3.64E+01	7.2	1.8	1.92E+04	8.2	5.6	1.76E+04	7.9	5.2	9.26E+00	4.5	7.1	9.91E+00	4.6	6.9
7.50E+01	2.40E+02	8.2	1.8	1.19E+02	6.6	1.9	7.86E+04	9.2	7	5.70E+04	9.4	7.3	4.33E+01	3.3	4.7	4.48E+01	3.2	4.6
1.00E+02	7.56E+02	8.4	1.9	8.47E+02	7.9	1.7	1.43E+05	10.7	9.5	9.49E+04	10.8	9.8	1.47E+02	3.4	4.1	1.32E+02	2.7	3.7
1.50E+02	9.14E+03	10.2	2.3	9.27E+03	10.4	2.4	2.35E+05	13.4	14.4	1.51E+05	13.3	14.2	8.89E+02	6.1	5.7	5.69E+02	3.1	3.6
2.00E+02	2.35E+04	12.7	3.4	2.37E+04	12.6	3.4	2.24E+05	16.1	19.3	1.80E+05	15.4	18	5.27E+03	9.4	9	7.31E+03	9.8	9.1
3.00E+02	4.93E+04	15.5	4.6	5.22E+04	15.4	4.6	1.78E+05	19.8	24.3	1.68E+05	19	23.1	5.68E+04	14.1	15.8	6.05E+04	14.1	15.9
5.00E+02	1.10E+05	18.9	5.5	1.27E+05	18.7	5.5	1.39E+05	23.8	24.2	1.41E+05	22.5	23.5	1.08E+05	19.2	21.5	1.15E+05	19.3	21.6
7.00E+02	1.27E+05	21.1	5.7	1.34E+05	21.5	5.8	1.41E+05	24.3	21.4	1.47E+05	23.4	21.6	1.22E+05	21.2	21	1.26E+05	21.1	21.1
1.00E+03	1.02E+05	22.1	5.1	1.05E+05	22.5	5.1	1.31E+05	25.1	19.4	1.27E+05	24.8	19.2	1.01E+05	21.9	17.9	1.02E+05	22.1	18
2.00E+03	7.95E+04	21.3	3.8	8.23E+04	21.8	3.9	1.09E+05	25.3	15.1	1.03E+05	25	14.9	7.82E+04	21	12.6	7.94E+04	21.2	12.7
3.00E+03	8.14E+04	21.2	3.5	8.31E+04	21.7	3.6	1.14E+05	25.8	13.8	1.04E+05	24.9	13.6	8.01E+04	20.8	11.4	8.01E+04	21.1	11.5
5.00E+03	9.17E+04	21.1	3.4	9.24E+04	21.7	3.4	1.13E+05	24.6	12.9	1.12E+05	24.8	12.5	8.82E+04	20.7	10.7	9.23E+04	21.5	10.7
1.00E+04	8.88E+04	18.5	3	8.91E+04	19.2	3	1.19E+05	24.2	11.3	1.08E+05	23.2	11.3	8.81E+04	18.1	9.1	8.65E+04	18.4	9.1
2.00E+04	1.01E+05	17.8	2.8	1.02E+05	18.5	2.9	1.28E+05	22.5	10.5	1.20E+05	22.4	10.7	9.93E+04	17.3	8.4	9.81E+04	17.5	8.6
5.00E+04	1.26E+05	15.6	2.5	1.25E+05	16.4	2.6	1.50E+05	20.7	9.4	1.45E+05	20.6	9.5	1.27E+05	15.3	7.2	1.25E+05	15.7	7.4
1.00E+05	1.55E+05	12.7	2.2	1.49E+05	13.9	2.3	1.75E+05	18.4	8.4	1.63E+05	18.2	8.3	1.53E+05	12.5	6.2	1.50E+05	13.4	6.4

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.06E+03	5.9	2.7	0.00E+00	1	1
1.40E+01	1.29E-01	7.5	9.8	1.35E-01	7.3	9.9	1.39E-01	6.6	9.9	1.15E-01	7.5	9.4	1.47E+03	6.3	3.1	0.00E+00	1	1
2.00E+01	5.04E-01	7.6	9.5	5.40E-01	7.1	9.4	4.01E-01	7.6	9.4	5.46E-01	7	9.8	2.26E+03	6.8	3.7	2.72E-01	5.4	10.4
3.00E+01	1.79E+00	6.8	8.8	1.85E+00	6.7	8.5	1.63E+00	6.8	8.7	1.88E+00	6.4	8.5	3.46E+03	7.6	4.6	1.90E+00	5.4	8.9
5.00E+01	8.91E+00	4.9	7.5	9.95E+00	4.6	7	7.66E+00	5.2	7.9	1.07E+01	4.5	6.9	7.52E+03	8.8	6.3	5.23E+00	6.2	9.9
7.50E+01	4.11E+01	3.3	4.8	4.85E+01	3.1	4.5	3.31E+01	3.6	5.3	4.52E+01	3.3	4.6	1.86E+04	9.6	7.6	1.68E+01	4.7	7.9
1.00E+02	1.28E+02	2.7	3.6	1.53E+02	2.6	3.5	9.70E+01	2.9	4	1.38E+02	2.8	3.6	3.29E+04	10.7	9.6	5.40E+01	3.4	5.2
1.50E+02	6.40E+02	3.1	3.4	6.38E+02	2.5	3.1	4.28E+02	2.5	3.1	5.54E+02	2.8	3.4	6.54E+04	12.7	13.3	3.10E+02	2.2	3.1
2.00E+02	4.31E+03	8.3	7.8	3.38E+03	7.6	7.4	1.14E+03	3.2	4.3	6.97E+03	9.2	8.1	9.55E+04	14.5	16.4	9.24E+02	2	2.6
3.00E+02	4.31E+04	13.5	15	6.48E+04	13.4	14.7	3.45E+04	13.2	14.7	6.58E+04	14.5	16.7	1.14E+05	17.9	21.6	2.88E+03	2.8	3.7
5.00E+02	1.41E+05	19	21.7	1.48E+05	19.5	22.2	9.86E+04	18.2	21.1	1.29E+05	19.3	21.8	1.06E+05	21.6	23.2	8.98E+04	14.4	17.7
7.00E+02	1.37E+05	21.7	21.6	1.42E+05	22.2	22	1.21E+05	20.7	20.8	1.25E+05	21.2	21.4	1.29E+05	21.8	21.3	1.23E+05	19.9	20.9
1.00E+03	1.10E+05	22.8	18.3	1.13E+05	23.3	18.4	1.01E+05	21.9	17.9	1.05E+05	22.3	18.2	1.18E+05	23.4	18.6	9.73E+04	21.5	17.7
2.00E+03	8.39E+04	22.1	13.2	8.82E+04	22.8	13.7	7.52E+04	20.3	12.3	8.07E+04	21.5	13	8.36E+04	23.1	13.6	7.08E+04	19.5	11.5
3.00E+03	8.57E+04	22	12	8.92E+04	22.7	12.4	7.71E+04	20.3	11	8.49E+04	21.6	11.8	9.13E+04	23	12.4	7.28E+04	19.1	10.8
5.00E+03	9.88E+04	22.1	11.3	1.02E+05	22.9	11.6	8.98E+04	20.4	10.4	8.83E+04	21.4	11.1	9.56E+04	21.8	11.6	7.54E+04	19.8	9.8
1.00E+04	9.30E+04	19.8	9.7	9.87E+04	20.7	10.2	7.79E+04	16.9	8.7	9.11E+04	19	9.4	9.51E+04	20.4	10.1	8.05E+04	16.7	8.2
2.00E+04	1.07E+05	19.4	9.1	1.10E+05	20	9.6	9.79E+04	17.4	8.2	1.02E+05	18.3	9	1.13E+05	20.4	9.4	9.37E+04	15.7	7.9
5.00E+04	1.33E+05	17.1	7.9	1.36E+05	18.4	8.5	1.23E+05	15	7.1	1.21E+05	16.4	7.5	1.34E+05	18	8.3	1.11E+05	14.9	7.1
1.00E+05	1.56E+05	14.6	6.8	1.49E+05	16	7.3	1.48E+05	12.4	5.9	1.43E+05	13.8	6.6	1.57E+05	14.7	6.9	1.32E+05	9.9	5.3

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.31E-01	7.5	9.8	1.31E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.25. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	4.93E-01	7.5	9.6	5.00E-01	7.1	9.5	3.57E-01	6.2	9.3	4.22E-01	6.2	9.7	5.08E-01	5.2	7.6	7.31E-01	4.4	7.9
3.00E+01	1.63E+00	6.9	8.8	1.76E+00	6.8	8.7	1.78E+00	6.1	9.1	1.61E+00	7	9	3.58E+00	4	6.4	3.44E+00	3.8	6.1
5.00E+01	7.78E+00	5.2	7.9	9.43E+00	4.7	7.2	7.80E+00	5.2	8.3	7.59E+00	5.4	8.3	2.33E+01	3.4	4.9	3.22E+01	3.2	4.8
7.50E+01	3.29E+01	3.6	5.3	4.19E+01	3.3	4.8	2.84E+01	4.1	5.8	3.33E+01	3.8	5.3	9.46E+01	2.7	3.9	9.94E+01	2.8	3.8
1.00E+02	9.67E+01	2.9	4	1.27E+02	2.8	3.7	8.70E+01	3	4.5	1.08E+02	2.9	4	2.62E+02	2.6	3.6	2.81E+02	2.6	3.4
1.50E+02	4.61E+02	2.6	3.3	5.57E+02	3.2	3.6	6.77E+02	5.8	5.2	4.79E+02	2.3	3	1.25E+04	9.2	7.7	1.86E+04	9.3	7.8
2.00E+02	3.67E+03	8.1	7.8	6.21E+03	9.2	8.5	4.36E+03	9.5	9.6	3.02E+03	7.9	7.8	6.77E+04	11.9	12.3	8.00E+04	12.3	12.7
3.00E+02	3.39E+04	13.5	15.2	5.64E+04	14	15.8	2.67E+04	13.8	15.6	2.82E+04	13.5	15.1	1.15E+05	16.3	20.4	1.11E+05	17.4	21.4
5.00E+02	9.93E+04	18.2	20.7	1.26E+05	18.9	21.4	1.12E+05	17.2	18.6	1.52E+05	17.5	20.5	1.23E+05	20.4	22.3	1.34E+05	19.9	21.9
7.00E+02	1.24E+05	20.5	21	1.30E+05	21.3	21.3	1.34E+05	20.9	21.3	1.38E+05	21.2	21.9	1.34E+05	22.3	21.2	1.55E+05	22.3	21.5
1.00E+03	9.93E+04	21.7	17.8	1.06E+05	22.3	18.1	1.02E+05	21.6	17.9	1.03E+05	22.2	18.1	1.13E+05	23.6	18.8	1.11E+05	23.6	18.9
2.00E+03	7.49E+04	20.5	12.3	7.81E+04	21.2	13	7.63E+04	20.2	12.6	8.46E+04	21.9	13	8.90E+04	22.6	13.8	9.23E+04	23.6	14
3.00E+03	7.92E+04	20.3	11.1	8.04E+04	21.2	11.7	7.47E+04	20.5	11.2	8.34E+04	21.8	11.7	8.79E+04	22.5	12.4	9.15E+04	23.2	12.8
5.00E+03	9.00E+04	20.6	10.5	8.93E+04	21.4	11	9.16E+04	20.5	10.5	8.94E+04	21	11.1	9.97E+04	23.4	11.4	9.72E+04	23	11.9
1.00E+04	8.53E+04	17.9	8.7	9.12E+04	19.1	9.4	8.59E+04	18.2	9.1	8.44E+04	18.8	9.4	1.00E+05	20.4	10.2	9.68E+04	21.6	10.3
2.00E+04	9.88E+04	17.3	8.2	1.02E+05	18.3	9	9.31E+04	16.9	8.3	9.64E+04	18.9	8.9	1.05E+05	20	9.4	1.02E+05	20.2	10.4
5.00E+04	1.24E+05	14.9	7.1	1.26E+05	16.3	7.6	1.21E+05	15.5	7.2	1.21E+05	16.8	7.6	1.32E+05	18	8.4	1.18E+05	18	8.6
1.00E+05	1.49E+05	12.2	5.9	1.52E+05	13.8	6.4	1.42E+05	12.3	6.2	1.46E+05	14.4	7.1	1.42E+05	15.5	7.3	1.40E+05	16.6	7.6

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	2.95E+01	5.9	2.7	6.49E+00	5.9	2.7	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.06E-01	4.2	8.8	4.23E+01	6.3	3.1	9.51E+00	6.3	3.2	1.65E-01	7.2	10	1.74E-01	7.2	9.6
2.00E+01	4.20E-01	6.4	9.3	6.29E-01	4.9	7.6	6.45E+01	6.8	3.7	1.40E+01	6.7	3.9	6.45E-01	7.3	9.3	6.43E-01	6.8	8.6
3.00E+01	1.82E+00	6.6	8.8	3.14E+00	5	6.8	1.08E+02	7.5	4.7	2.68E+01	7.2	4.8	2.26E+00	6.2	8	2.60E+00	5.7	7.2
5.00E+01	7.21E+00	5.4	8.5	1.76E+01	3.7	5.4	2.49E+02	8.2	6.1	7.15E+01	7.2	6	1.43E+01	3.9	5.9	1.71E+01	3.6	5.4
7.50E+01	2.61E+01	3.7	5.8	7.04E+01	3	4.2	6.56E+02	8.5	6.9	2.59E+02	7	6	6.99E+01	2.9	4	8.32E+01	2.8	3.9
1.00E+02	8.32E+01	2.9	4.2	1.97E+02	3.3	4.2	2.15E+03	8.9	7.4	1.68E+03	8	6.2	2.04E+02	2.6	3.3	2.39E+02	2.5	3.3
1.50E+02	3.69E+02	2.4	3.1	2.02E+04	10	8.5	2.17E+04	10.6	9.6	2.04E+04	10.6	9.6	1.19E+03	5	4.5	2.28E+03	6.7	5.5
2.00E+02	1.01E+03	3.3	3.8	4.71E+04	13.1	14	5.45E+04	12.9	13.8	5.03E+04	12.9	13.7	1.66E+04	10.4	9.7	2.84E+04	11	10.5
3.00E+02	2.82E+04	12.6	13.3	6.33E+04	16.6	20.1	1.08E+05	16.1	18.9	1.06E+05	16	18.7	9.90E+04	14.7	16.8	1.15E+05	15.1	17.4
5.00E+02	8.37E+04	17.5	19.6	9.64E+04	20.1	21.9	1.51E+05	20.5	22.7	1.58E+05	20.2	22.6	1.86E+05	19.8	22.3	1.95E+05	20.1	22.6
7.00E+02	1.24E+05	20.2	20.7	1.31E+05	20.7	20.6	1.40E+05	22.7	21.8	1.42E+05	22.8	21.9	1.50E+05	23.2	22.4	1.55E+05	23.6	22.4
1.00E+03	9.84E+04	21.1	17.7	1.04E+05	22.2	18	1.14E+05	23.7	18.7	1.13E+05	23.7	18.7	1.16E+05	24.1	18.8	1.22E+05	24.5	18.8
2.00E+03	7.37E+04	19.6	11.8	8.08E+04	20.8	12.7	9.29E+04	23.7	14.1	9.26E+04	23.7	14.1	9.78E+04	24	14.4	9.63E+04	24.5	14.5
3.00E+03	7.34E+04	19.2	10.6	8.45E+04	21.3	11.5	9.33E+04	23.6	12.9	9.41E+04	23.7	12.9	9.57E+04	24	13.1	1.01E+05	24.6	13.4
5.00E+03	8.41E+04	18.9	10.4	9.06E+04	20.3	10.9	1.03E+05	23.3	12	1.03E+05	23.6	12	1.03E+05	24	12.3	1.11E+05	24.5	12.4
1.00E+04	8.22E+04	16.3	8.4	8.95E+04	19.3	9.2	1.01E+05	21.5	10.5	9.75E+04	21.6	10.6	1.07E+05	22.4	10.8	1.02E+05	23.1	11.1
2.00E+04	9.50E+04	15.9	7.6	9.96E+04	17.5	8.7	1.11E+05	20.7	9.8	1.10E+05	20.7	9.9	1.17E+05	21.7	10.1	1.08E+05	22.3	10.5
5.00E+04	1.24E+05	13.9	6.6	1.27E+05	16	7.1	1.34E+05	18.7	8.7	1.32E+05	18.8	8.8	1.39E+05	20	9.2	1.37E+05	20.5	9.3
1.00E+05	1.47E+05	10.6	5.5	1.54E+05	13.5	6.3	1.56E+05	16	7.5	1.53E+05	16.6	7.7	1.57E+05	17.7	8.1	1.46E+05	18.5	8.4

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	7.64E+03	5.1	1.7	9.27E+03	5.1	1.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.53E+04	5	1.8	1.85E+04	5	1.8	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.29E+04	5.1	1.9	2.78E+04	5.1	1.9	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	3.80E+04	5.3	2.2	4.63E+04	5.3	2.2	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.66E+00	5.6	2.6	0.00E+00	1	1	7.57E+04	5.9	2.7	9.18E+04	5.9	2.7	9.09E+01	5.9	2.7	1.30E+01	5.9	2.7
1.40E+01	1.48E+01	6.1	3	2.22E-01	4.9	7.2	1.05E+05	6.3	3.1	1.27E+05	6.3	3.1	1.24E+02	6.3	3.1	2.10E+01	6.3	3.2
2.00E+01	3.38E+01	6.3	3.5	1.34E+00	4.8	5.8	1.49E+05	6.9	3.8	1.79E+05	6.9	3.8	1.91E+02	6.8	3.7	2.73E+01	6.8	3.8
3.00E+01	9.01E+01	6.7	4	6.01E+00	3.9	5.2	2.17E+05	7.7	4.8	2.61E+05	7.7	4.8	3.15E+02	7.6	4.6	4.49E+01	7.4	4.7
5.00E+01	4.36E+02	7.3	5.1	3.96E+01	3.6	4.5	3.34E+05	9.2	6.9	3.64E+05	9.4	7.2	6.53E+02	8.7	6.3	1.10E+02	8.1	6
7.50E+01	7.93E+03	8.4	5.8	4.59E+02	5.9	4.3	3.03E+05	11.7	11	3.09E+05	11.9	11.4	1.81E+03	9.3	7.4	3.09E+02	8.7	7.2
1.00E+02	2.98E+04	9.5	7.7	7.15E+03	8.4	6.1	2.59E+05	13.6	14.7	2.58E+05	13.9	15.2	4.15E+03	10.1	8.7	1.15E+03	8.7	7.3
1.50E+02	9.37E+04	12.1	12	5.07E+04	11.3	10.7	2.02E+05	16.5	20.3	2.02E+05	16.6	20.5	1.24E+04	11.8	11.8	7.39E+03	10.8	10.4
2.00E+02	1.37E+05	14.6	16.5	9.36E+04	13.7	14.9	1.76E+05	18.3	23.1	1.78E+05	18.4	23.1	2.05E+04	13.5	15	1.61E+04	12.7	13.8
3.00E+02	1.43E+05	18	22.1	1.34E+05	17.6	20.8	1.59E+05	20.6	24.5	1.61E+05	20.5	24.4	4.60E+04	15.3	17.8	4.45E+04	14.9	17.2
5.00E+02	1.49E+05	21.6	23	1.58E+05	20.6	22.5	1.56E+05	22.9	23.7	1.60E+05	22.9	23.6	1.11E+05	18.7	21	1.26E+05	18.7	21.1
7.00E+02	1.52E+05	23	22	1.55E+05	23.2	22.1	1.48E+05	24.4	22.1	1.51E+05	24.4	22.1	1.28E+05	21.1	21.3	1.36E+05	21.3	21.4
1.00E+03	1.22E+05	24.6	19	1.24E+05	24.5	19.2	1.30E+05	25.6	19.5	1.31E+05	25.7	19.5	1.04E+05	22.2	18.1	1.06E+05	22.4	18.1
2.00E+03	1.04E+05	25.2	14.8	1.02E+05	24.6	14.7	1.11E+05	26.2	15.5	1.12E+05	26.3	15.6	7.93E+04	21.3	12.8	8.08E+04	21.5	13

Table A.25. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	1.06E+05	24.7	13.5	1.01E+05	24.7	13.4	1.13E+05	26.1	14.1	1.13E+05	26.2	14.2	8.07E+04	20.8	11.5	8.25E+04	21.5	11.8
5.00E+03	1.08E+05	24.5	12.4	1.15E+05	24.4	12.5	1.20E+05	25.7	13	1.21E+05	25.9	13.1	9.14E+04	21.1	10.9	9.25E+04	21.6	11.1
1.00E+04	1.11E+05	23.2	11.1	1.07E+05	22.6	11.1	1.20E+05	24.4	11.9	1.20E+05	24.6	12	8.96E+04	18.6	9.2	8.93E+04	19.3	9.5
2.00E+04	1.20E+05	22.1	10.3	1.16E+05	22.6	10.3	1.29E+05	23.4	11.1	1.32E+05	23.7	11.2	1.00E+05	17.9	8.5	1.01E+05	18.4	8.9
5.00E+04	1.42E+05	20.9	9.6	1.32E+05	20.1	9.1	1.51E+05	21.4	9.9	1.51E+05	21.9	10.1	1.25E+05	16	7.6	1.24E+05	16.5	7.7
1.00E+05	1.60E+05	17.2	8.7	1.52E+05	17.9	7.9	1.71E+05	19.1	8.8	1.67E+05	20	9.1	1.49E+05	13.2	6.2	1.45E+05	14.1	6.7

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.07E+03	5.9	2.7	1.63E+02	5.9	2.7	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.45E+03	6.3	3.1	2.64E+02	6.3	3.1	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.37E-01	4.7	9	5.10E-01	4.8	9.6	2.23E+03	6.8	3.7	3.33E+02	6.8	3.7	5.13E-01	7.7	8.9	3.94E-01	5.6	9.7
3.00E+01	1.16E+00	5.4	9.1	1.52E+00	5.4	9.2	3.60E+03	7.6	4.6	5.33E+02	7.5	4.6	1.49E+00	6.1	9.3	1.34E+00	5.6	9
5.00E+01	6.71E+00	6	9.3	6.57E+00	6.9	9.9	7.06E+03	8.8	6.3	1.20E+03	8.5	6.1	6.08E+00	5	9.2	5.22E+00	5.8	10.4
7.50E+01	2.30E+01	3.7	6.2	1.88E+01	4.6	7.4	1.64E+04	9.6	7.8	2.58E+03	9.8	8	2.53E+01	3.9	6.4	2.21E+01	4.3	7.1
1.00E+02	6.81E+01	3.1	4.6	6.62E+01	3.1	4.7	3.32E+04	10.5	9.2	8.14E+03	9.4	8.1	7.01E+01	3	4.6	6.90E+01	3.1	4.7
1.50E+02	3.46E+02	2.3	3.1	3.48E+02	2.2	3.1	7.47E+04	12.6	13.1	3.41E+04	11.8	11.7	3.46E+02	2.4	3.1	3.69E+02	2.3	3.1
2.00E+02	9.46E+02	2.5	2.8	9.95E+02	2	2.8	9.18E+04	14.7	16.8	5.43E+04	13.9	15.9	9.56E+02	2.4	3.7	1.01E+03	2	2.7
3.00E+02	1.17E+04	10.4	10.2	4.36E+03	6.2	6.2	1.20E+05	17.3	21.3	8.19E+04	16.5	19.5	1.46E+04	12.3	13.8	3.89E+03	5.4	7.7
5.00E+02	8.31E+04	17.9	20.2	9.99E+04	16.5	19	1.76E+05	20.8	22.8	1.68E+05	20.6	22.7	9.21E+04	16.8	19.3	1.13E+05	17.1	19.2
7.00E+02	1.07E+05	20.1	20.6	1.27E+05	19.9	21	1.51E+05	23.4	22.1	1.56E+05	23	21.9	1.19E+05	20.3	20.9	1.33E+05	20.8	21.4
1.00E+03	9.50E+04	21.1	17.8	1.02E+05	21.4	17.5	1.23E+05	24.4	19	1.18E+05	23.7	18.9	1.01E+05	21	17.5	9.93E+04	21.6	18
2.00E+03	7.23E+04	19.8	12	7.08E+04	18.8	12.3	9.63E+04	24.6	14.7	9.11E+04	23.8	14.2	7.44E+04	19.3	11.8	7.43E+04	20.1	12.2
3.00E+03	7.44E+04	18.5	10.9	7.49E+04	19.7	11	1.00E+05	24.5	13.3	9.76E+04	24.2	13.1	7.47E+04	19.2	10.6	7.41E+04	19.2	10.9
5.00E+03	8.62E+04	20.2	9.9	8.10E+04	18.6	10.7	1.10E+05	24.3	12.6	1.07E+05	23.6	12	8.30E+04	19.5	9.9	8.64E+04	19.8	10.7
1.00E+04	8.32E+04	16.2	8.5	8.18E+04	17.4	9.1	1.16E+05	22.9	11.1	9.97E+04	22.2	10.7	8.28E+04	16.9	8.1	8.21E+04	17.6	8.6
2.00E+04	8.70E+04	14.7	7.3	8.70E+04	15.2	7.4	1.18E+05	21.7	10.4	1.10E+05	21.2	10.3	9.49E+04	16.3	7.9	9.48E+04	16.7	8.4
5.00E+04	1.20E+05	16	6.9	1.13E+05	13.6	6.8	1.38E+05	20.2	9.4	1.34E+05	20.7	8.6	1.13E+05	13.5	7.2	1.16E+05	13.6	7.2
1.00E+05	1.43E+05	10.6	5.8	1.32E+05	11.1	5.8	1.56E+05	18.4	7.9	1.48E+05	18.4	7.9	1.46E+05	11.4	5.6	1.32E+05	11.9	5.9

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.29E+01	5.8	2.6	0.00E+00	1	1
1.40E+01	1.22E-01	6.9	9.8	0.00E+00	1	1	1.16E-01	6.8	9.8	1.13E-01	7	10.1	6.60E+01	6.2	3	1.70E-01	6.1	8.8
2.00E+01	4.65E-01	7.5	9.6	4.77E-01	7.1	9.6	4.63E-01	7.9	9.3	4.75E-01	7.9	9.8	1.13E+02	6.6	3.5	7.98E-01	4.9	7.6
3.00E+01	1.58E+00	7.2	9.1	1.73E+00	7.1	8.9	1.49E+00	7	9.1	1.52E+00	7.2	9.3	2.38E+02	7.3	4.3	3.51E+00	4.9	6.4
5.00E+01	7.11E+00	5.6	8.3	7.98E+00	5.1	8.3	6.21E+00	6.1	9.5	6.69E+00	5.9	9.5	8.24E+02	8.1	5.8	2.04E+01	4.1	5.5
7.50E+01	3.07E+01	3.7	5.6	3.70E+01	3.5	5.1	2.50E+01	4	6.2	2.74E+01	3.8	6.1	4.89E+03	8.7	6.5	1.29E+02	5.6	5.1
1.00E+02	9.25E+01	2.9	4.1	1.13E+02	2.8	3.8	7.58E+01	3	4.3	8.39E+01	3	4.1	1.30E+04	10	8.4	8.46E+02	7.9	6
1.50E+02	4.21E+02	2.3	3.1	5.10E+02	2.4	3.1	3.78E+02	2.3	3	4.13E+02	2.3	3	3.02E+04	12.4	12.6	2.09E+04	10.6	9.6
2.00E+02	1.32E+03	4.2	4.5	2.32E+03	6.2	6.1	1.02E+03	2.4	3	1.07E+03	2.3	2.9	4.20E+04	14.5	16.5	3.86E+04	13.4	14.8
3.00E+02	2.91E+04	12.9	14.2	3.63E+04	13.3	14.9	1.34E+04	10	10.3	1.16E+04	10.3	10.9	5.78E+04	16.7	19.9	5.71E+04	16.2	19.2
5.00E+02	1.03E+05	17.7	20.3	1.30E+05	18.3	21	9.63E+04	17.9	20.7	1.16E+05	17.9	20.8	1.10E+05	19.2	21.3	1.24E+05	19.1	21.3
7.00E+02	1.32E+05	20.7	21.2	1.41E+05	21.5	21.6	1.13E+05	20.1	20.9	1.31E+05	20.9	21.2	1.29E+05	21.2	21.2	1.33E+05	21.7	21.4
1.00E+03	1.04E+05	22.1	18	1.05E+05	22.5	18.1	9.80E+04	21.1	17.6	1.04E+05	21.7	17.8	1.05E+05	22.4	18.1	1.09E+05	22.6	18.2
2.00E+03	7.75E+04	20.6	12.3	8.26E+04	21.6	13.1	7.32E+04	19.8	12	7.84E+04	20.6	12.4	8.04E+04	21.6	13	8.09E+04	21.8	13.2
3.00E+03	8.05E+04	20.8	11.2	8.34E+04	21.5	11.8	7.26E+04	19	10.6	7.51E+04	20.1	11.1	8.13E+04	21.3	11.7	8.44E+04	21.8	11.9
5.00E+03	9.40E+04	21	10.7	9.39E+04	21.9	11.2	8.58E+04	20	10.2	8.65E+04	20.1	10.6	9.43E+04	21.3	11	9.32E+04	21.7	11.2
1.00E+04	8.71E+04	18.1	8.9	8.93E+04	19.4	9.4	8.27E+04	16.7	8.4	8.63E+04	17.7	8.9	8.88E+04	18.9	9.3	9.26E+04	19.7	9.6
2.00E+04	9.72E+04	17.8	8.4	1.00E+05	18.4	8.9	9.35E+04	16.1	7.8	9.60E+04	16.7	8	1.05E+05	18.6	8.8	1.01E+05	18.8	9.2
5.00E+04	1.26E+05	15.7	7.3	1.30E+05	17.3	7.7	1.27E+05	13.9	6.8	1.19E+05	15.2	7.1	1.28E+05	15.9	7.6	1.32E+05	17.1	7.9
1.00E+05	1.47E+05	12.9	6	1.46E+05	14.4	6.6	1.51E+05	11.4	5.6	1.45E+05	12.2	6.3	1.53E+05	13.3	6.4	1.51E+05	14.6	6.8

(continued on next page)

Table A.25. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.60E+01	5.9	2.7	5.19E+00	5.9	2.7	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.36E+01	6.3	3.1	7.50E+00	6.3	3.3	1.21E-01	5.6	9.1	1.83E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.37E+02	6.8	3.7	1.17E+01	6.7	4	5.55E-01	6.6	9	4.29E+00	6.1	3.8	3.85E-01	6.8	9.7	4.80E-01	7.1	10.1
3.00E+01	2.33E+02	7.5	4.6	2.21E+01	7.1	4.9	2.55E+00	5.7	7.2	9.37E+00	5.7	4.2	1.51E+00	7.1	9.5	1.45E+00	7.1	9.2
5.00E+01	5.26E+02	8.4	6.2	6.72E+01	7	5.7	1.50E+01	4	5.9	7.54E+01	6.7	4.5	5.41E+00	6.7	10.6	6.36E+00	6.1	9.8
7.50E+01	1.89E+03	8.7	6.7	3.64E+02	7.2	5.4	6.46E+01	3	4.2	6.53E+02	8.3	6.3	1.60E+01	5.4	8.3	2.30E+01	4.2	6.5
1.00E+02	6.44E+03	9.3	7.6	2.03E+03	8.4	6.6	4.60E+02	5.9	4.6	3.02E+03	8.6	7	4.49E+01	3.7	5.6	7.51E+01	3.1	4.3
1.50E+02	3.25E+04	11.4	10.9	1.43E+04	10.6	9.9	1.15E+04	10.6	9.7	1.77E+04	11.1	11	2.67E+02	2.5	3.3	3.90E+02	2.3	3
2.00E+02	7.06E+04	13.3	14.5	4.58E+04	12.4	12.9	1.94E+04	13.2	14.2	3.31E+04	13.7	15.1	8.14E+02	2.1	2.7	1.04E+03	2.2	2.8
3.00E+02	1.15E+05	16.6	19.7	1.05E+05	15.9	18.6	7.15E+04	14.4	16.2	9.92E+04	15.4	17.3	2.75E+03	2.5	3.4	5.89E+03	8.2	8.5
5.00E+02	1.44E+05	20.7	22.7	1.50E+05	20.3	22.6	1.66E+05	20.4	22.8	1.61E+05	20.6	23	6.43E+04	14.4	16.6	1.23E+05	17.5	20.1
7.00E+02	1.35E+05	22.7	21.7	1.37E+05	22.5	21.7	1.48E+05	22.5	22.2	1.55E+05	22.1	22	1.24E+05	19.4	20.9	1.23E+05	20.7	21.2
1.00E+03	1.13E+05	23.6	18.6	1.13E+05	23.5	18.6	1.15E+05	24	18.8	1.17E+05	24.1	19	9.51E+04	20.4	17.3	1.00E+05	21.3	17.8
2.00E+03	9.18E+04	23.5	14	9.04E+04	23.3	13.9	9.27E+04	23.8	14.1	9.33E+04	24.2	14.3	6.64E+04	18.3	10.8	7.26E+04	19.9	12.1
3.00E+03	9.29E+04	23.4	12.7	9.19E+04	23.3	12.7	9.48E+04	22.7	12.8	9.37E+04	23.9	13	6.98E+04	17.8	9.9	7.95E+04	20.2	11
5.00E+03	1.03E+05	23.2	11.9	1.01E+05	23.2	11.8	1.01E+05	23.9	12.2	1.06E+05	24	12.2	7.97E+04	18.2	9.6	8.80E+04	19.9	10.6
1.00E+04	1.01E+05	21.2	10.4	9.81E+04	21.1	10.3	1.01E+05	22	10.8	9.74E+04	22.1	10.9	7.72E+04	15	7.7	8.39E+04	18	8.9
2.00E+04	1.11E+05	20.3	9.7	1.10E+05	20.3	9.7	1.09E+05	20.5	9.8	1.12E+05	21.5	10.3	9.02E+04	15.4	7.3	9.57E+04	16.5	8.2
5.00E+04	1.35E+05	18.2	8.5	1.33E+05	18.3	8.5	1.32E+05	19.4	9.1	1.36E+05	19.7	8.8	1.19E+05	13	6.1	1.17E+05	14.9	7.3
1.00E+05	1.58E+05	15.5	7.3	1.50E+05	16	7.4	1.41E+05	17.1	7.6	1.48E+05	17.6	8.1	1.44E+05	10	4.8	1.41E+05	11.9	6

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.38E-02	6.9	10.2	1.19E-01	7.4	9.6	1.12E-01	7.3	9.7	1.55E-01	6.2	10.1	1.41E-01	6.6	9.7
2.00E+01	3.86E-01	5.2	9.4	5.65E-01	6.9	9.8	4.92E-01	7.2	9.6	4.62E-01	7.2	9.6	3.73E-01	7.2	9.5	5.10E-01	6.4	9.9
3.00E+01	1.28E+00	7.2	9.3	1.51E+00	7.3	9.3	1.65E+00	6.9	9	1.67E+00	7	8.9	1.62E+00	6.9	9	1.71E+00	6.9	8.8
5.00E+01	5.36E+00	6.2	10.2	5.65E+00	6.8	10.3	7.13E+00	5.4	8.7	7.50E+00	5.4	8.7	7.04E+00	5.3	8.9	9.08E+00	5	7.9
7.50E+01	1.73E+01	5.2	7.9	2.00E+01	4.9	7.9	2.95E+01	3.7	5.5	3.20E+01	3.7	5.4	2.92E+01	3.6	5.3	4.00E+01	3.4	4.8
1.00E+02	5.13E+01	3.3	5.5	5.78E+01	3.5	5	9.00E+01	2.9	4.1	9.85E+01	2.9	4	9.79E+01	2.9	4	1.30E+02	2.7	3.6
1.50E+02	2.86E+02	2.5	3.2	3.16E+02	2.4	3.2	4.14E+02	2.6	3.2	4.38E+02	2.4	3.1	4.41E+02	2.3	3	5.45E+02	2.4	3
2.00E+02	8.41E+02	2.1	2.7	9.04E+02	2.2	2.8	1.94E+03	6.7	6.7	1.35E+03	4.6	4.7	1.17E+03	3.1	3.5	1.45E+03	3.5	5.3
3.00E+02	2.81E+03	3.3	4	3.55E+03	4.2	5.7	2.86E+04	13	14.1	3.20E+04	13	14.4	3.09E+04	12.4	13	5.34E+04	13.3	14.7
5.00E+02	1.02E+05	14.9	17.8	9.25E+04	16.1	18.7	9.52E+04	18.1	20.5	1.02E+05	18.4	20.9	1.06E+05	18.6	21.3	1.25E+05	18.9	21.6
7.00E+02	1.19E+05	19.3	20.7	1.24E+05	19.5	20.6	1.19E+05	20.4	20.9	1.29E+05	20.7	21	1.22E+05	20.9	20.9	1.28E+05	21.2	21.4
1.00E+03	9.37E+04	21.1	17.5	9.62E+04	21.1	17.6	9.69E+04	21.2	17.6	1.01E+05	21.7	17.8	1.03E+05	21.8	17.9	1.00E+05	22.2	18
2.00E+03	6.67E+04	19.4	11.4	7.24E+04	19.2	11.5	7.32E+04	19.8	12	7.49E+04	20.4	12.3	7.62E+04	20.5	12.5	8.22E+04	21.7	13.1
3.00E+03	7.16E+04	17.6	10	7.17E+04	18.6	10.6	7.50E+04	19.6	10.8	7.67E+04	20.3	11.1	7.51E+04	20.4	11.1	8.24E+04	21.5	11.8
5.00E+03	7.62E+04	17	9.9	8.05E+04	19.3	10	8.85E+04	19.9	10.2	8.82E+04	20.5	10.6	9.01E+04	20.9	10.9	9.37E+04	22.2	10.9
1.00E+04	7.87E+04	15.7	7.5	8.20E+04	16.6	8.1	8.39E+04	17	8.5	8.52E+04	17.9	8.8	8.55E+04	17.3	9.1	9.12E+04	18.8	9.4
2.00E+04	9.11E+04	14.5	7.6	9.44E+04	16.3	7.7	9.62E+04	16.7	7.9	9.35E+04	16.7	8.2	1.02E+05	17.3	8.3	1.02E+05	18.7	8.8
5.00E+04	1.19E+05	12.9	6.4	1.18E+05	14.1	6.5	1.21E+05	14.4	6.9	1.23E+05	15.1	7.2	1.24E+05	15.5	7.4	1.25E+05	15.9	7.9
1.00E+05	1.52E+05	11.4	4.9	1.44E+05	11.7	5.7	1.55E+05	11.2	5.6	1.51E+05	12.4	6	1.47E+05	12.7	6.1	1.50E+05	14.3	6.7

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.84E-01	5.8	8.7	0.00E+00	1	1	3.06E+00	3.6	4.8	3.06E+00	3.6	4.8
2.00E+01	8.49E-01	6.4	8.2	0.00E+00	1	1	1.43E+01	4	5.1	1.43E+01	4	5.1
3.00E+01	3.30E+00	4.4	6.7	2.94E+00	5.3	7.5	5.81E+01	4.1	5	5.81E+01	4.1	5
5.00E+01	2.02E+01	3.5	5.4	1.68E+01	4	5.5	4.45E+03	5.5	2.5	4.45E+03	5.5	2.5
7.50E+01	6.77E+01	2.9	4	6.46E+01	3	4.2	2.94E+05	9.1	6.7	2.94E+05	9.1	6.7
1.00E+02	2.59E+02	4	3.7	1.91E+02	2.7	3.9	2.96E+05	11.8	11.3	2.96E+05	11.8	11.3
1.50E+02	9.03E+03	10.1	8.6	5.71E+03	9.3	8.2	2.26E+05	15.4	18.2	2.26E+05	15.4	18.2

Table A.25. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.42E+04	12	12.5	2.74E+04	11.8	12	1.79E+05	16.9	20.9	1.79E+05	16.9	20.9
3.00E+02	9.98E+04	15.8	18.6	8.46E+04	15.8	19.2	1.81E+05	20.1	23	1.81E+05	20.1	23
5.00E+02	1.12E+05	20.1	22.1	1.29E+05	18.7	20.6	1.58E+05	22.6	23.5	1.58E+05	22.6	23.5
7.00E+02	1.46E+05	21.9	21.8	1.47E+05	21.8	21.6	1.58E+05	24.4	21.9	1.58E+05	24.4	21.9
1.00E+03	1.11E+05	23.4	18.7	1.17E+05	23.3	17.9	1.34E+05	25.4	19	1.34E+05	25.4	19
2.00E+03	8.94E+04	22.8	13.5	8.73E+04	22.4	13.5	1.16E+05	26.7	15.7	1.16E+05	26.7	15.7
3.00E+03	8.67E+04	22.3	12.5	8.74E+04	23	12.2	1.12E+05	26.4	13.6	1.12E+05	26.4	13.6
5.00E+03	9.67E+04	22.7	11.4	9.58E+04	23.4	11.6	1.11E+05	25.5	13.2	1.11E+05	25.5	13.2
1.00E+04	9.81E+04	20.3	10.1	9.16E+04	20.7	10.4	1.09E+05	23.5	12.1	1.09E+05	23.5	12.1
2.00E+04	1.07E+05	20.3	9	1.12E+05	20.2	9.6	1.40E+05	23.4	11.6	1.40E+05	23.4	11.6
5.00E+04	1.31E+05	17.6	8.2	1.17E+05	18	8.3	1.33E+05	20.5	10.1	1.33E+05	20.5	10.1
1.00E+05	1.48E+05	15.2	7.1	1.46E+05	15.5	7.6	1.49E+05	19.5	9.5	1.49E+05	19.5	9.5

Table A.26. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{51}V ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.02E+01	5.7	0.7	3.01E+00	5.7	0.7	7.39E+02	5.6	2.4	8.79E+02	5.7	2.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.35E+01	6.1	0.8	4.62E+00	6.1	0.8	1.29E+03	5.9	2.8	1.43E+03	6	2.8	1.24E-01	7.1	9.6	1.11E-01	7	9.5
2.00E+01	2.08E+01	6.6	0.9	6.86E+00	6.5	1.1	2.46E+03	6.3	3.2	2.42E+03	6.4	3.3	5.03E-01	7	9.5	5.39E-01	6.9	9.1
3.00E+01	3.83E+01	7.2	1.2	1.35E+01	7	1.4	5.60E+03	6.9	3.9	4.98E+03	7	4	1.90E+00	6.2	8.2	1.79E+00	6.1	8.1
5.00E+01	8.67E+01	7.8	1.6	3.73E+01	6.9	1.8	1.89E+04	7.9	5.2	1.74E+04	7.7	4.9	9.47E+00	4.5	7	1.02E+01	4.5	6.9
7.50E+01	2.38E+02	7.9	1.7	1.19E+02	6.3	1.8	8.03E+04	8.8	6.4	5.83E+04	9	6.7	4.26E+01	3.3	4.7	4.53E+01	3.2	4.6
1.00E+02	7.24E+02	8.2	1.8	7.94E+02	7.7	1.5	1.48E+05	10.2	8.6	1.02E+05	10.4	8.9	1.40E+02	3.2	4	1.32E+02	2.7	3.7
1.50E+02	8.65E+03	9.8	2.1	8.97E+03	10	2.2	2.45E+05	12.8	13.2	1.61E+05	12.7	13.1	8.46E+02	5.8	5.6	5.49E+02	2.9	3.5
2.00E+02	2.42E+04	12.1	3.1	2.51E+04	12	3.1	2.40E+05	15.4	17.9	1.88E+05	14.7	16.8	4.78E+03	9	8.2	6.71E+03	9.3	8.2
3.00E+02	5.07E+04	14.9	4.4	5.69E+04	14.8	4.4	1.91E+05	19.4	23.4	1.88E+05	18.2	22.1	6.33E+04	13.4	14.6	6.15E+04	13.4	14.8
5.00E+02	1.16E+05	18.2	5.4	1.34E+05	18.1	5.4	1.48E+05	23.1	24.4	1.56E+05	21.8	23.7	1.14E+05	18.5	21	1.19E+05	18.6	21.4
7.00E+02	1.40E+05	20.5	5.7	1.46E+05	20.9	5.8	1.51E+05	23.7	22.2	1.65E+05	22.6	22.1	1.31E+05	20.6	21.4	1.35E+05	20.5	21.3
1.00E+03	1.13E+05	21.8	5.2	1.17E+05	22.2	5.3	1.42E+05	24.1	20.4	1.39E+05	24.1	20.1	1.09E+05	21.5	18.8	1.13E+05	21.8	19
2.00E+03	8.67E+04	21.2	4	8.86E+04	21.6	4.1	1.17E+05	24.8	16.2	1.14E+05	24.4	15.9	8.46E+04	20.6	13.4	8.65E+04	21.2	13.5
3.00E+03	8.82E+04	20.9	3.7	8.92E+04	21.4	3.8	1.23E+05	24.5	14.8	1.17E+05	24.5	14.5	8.65E+04	20.5	12.2	8.53E+04	20.8	12.3
5.00E+03	9.91E+04	21.1	3.6	1.01E+05	21.5	3.6	1.22E+05	24.3	13.8	1.21E+05	24.1	13.5	1.01E+05	20.8	11.5	9.55E+04	21.1	11.6
1.00E+04	9.81E+04	18.3	3.1	9.82E+04	18.9	3.2	1.28E+05	22.9	12.3	1.28E+05	22.6	12.2	9.66E+04	18.1	9.7	9.85E+04	18.5	9.8
2.00E+04	1.06E+05	17.4	2.9	1.12E+05	17.9	3	1.36E+05	22	11.4	1.36E+05	21.9	11.3	1.02E+05	17	8.9	1.11E+05	17.3	9.3
5.00E+04	1.37E+05	15.4	2.6	1.35E+05	16.2	2.8	1.61E+05	20.2	10.1	1.53E+05	20.3	10.1	1.38E+05	15.1	7.7	1.31E+05	15.5	8
1.00E+05	1.67E+05	12.5	2.3	1.59E+05	13.8	2.5	1.87E+05	18	8.9	1.82E+05	17.9	9.1	1.62E+05	12.3	6.4	1.69E+05	13.1	6.8

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.11E+03	5.7	2.5	0.00E+00	1	1
1.40E+01	1.30E-01	7.5	9.8	1.37E-01	7.3	9.9	1.41E-01	6.6	9.9	1.14E-01	7.5	9.4	1.54E+03	6.1	2.9	0.00E+00	1	1
2.00E+01	5.11E-01	7.6	9.5	5.51E-01	7.1	9.3	4.06E-01	7.6	9.4	5.58E-01	7	9.8	2.37E+03	6.6	3.4	2.72E-01	5.4	10.4
3.00E+01	1.83E+00	6.8	8.8	1.88E+00	6.7	8.4	1.66E+00	6.8	8.6	1.91E+00	6.4	8.5	3.58E+03	7.3	4.3	1.95E+00	5.4	8.9
5.00E+01	9.14E+00	4.8	7.4	1.02E+01	4.6	6.9	7.86E+00	5.2	7.9	1.10E+01	4.5	6.8	7.72E+03	8.4	5.8	5.41E+00	6.2	9.9
7.50E+01	4.15E+01	3.3	4.7	4.90E+01	3.1	4.4	3.36E+01	3.6	5.3	4.51E+01	3.2	4.6	1.93E+04	9.2	7.1	1.72E+01	4.7	7.9
1.00E+02	1.28E+02	2.7	3.6	1.53E+02	2.6	3.5	9.64E+01	2.9	3.9	1.37E+02	2.7	3.6	3.37E+04	10.3	8.8	5.49E+01	3.4	5.2
1.50E+02	6.09E+02	3	3.3	6.09E+02	2.5	3	4.22E+02	2.4	3	5.37E+02	2.4	3.4	6.78E+04	12.1	12.2	3.09E+02	2.2	3.1
2.00E+02	3.87E+03	7.9	7.2	3.17E+03	7.1	6.8	1.12E+03	3.1	3.9	6.07E+03	8.4	7.4	1.00E+05	13.8	15	9.13E+02	2	2.6
3.00E+02	4.19E+04	12.9	14	6.41E+04	12.7	13.5	3.37E+04	12.7	13.5	6.55E+04	13.9	15.6	1.23E+05	17.1	20.6	2.81E+03	2.7	3.6
5.00E+02	1.56E+05	18.3	21.2	1.66E+05	18.9	21.8	1.03E+05	17.6	20.3	1.34E+05	18.4	21.3	1.11E+05	21.1	23	8.53E+04	13.8	16.7
7.00E+02	1.52E+05	21.1	22	1.58E+05	21.6	22.3	1.28E+05	20.2	21.1	1.45E+05	20.9	21.7	1.38E+05	21.2	21.3	1.49E+05	18.8	20.8
1.00E+03	1.18E+05	22.4	19.2	1.23E+05	22.9	19.4	1.09E+05	21.3	18.7	1.20E+05	22.1	19	1.22E+05	23	19.4	1.06E+05	20.8	18.7
2.00E+03	9.19E+04	21.8	14.1	9.73E+04	22.5	14.6	7.90E+04	20.1	13	8.52E+04	21.3	13.9	9.02E+04	22.4	14.7	7.55E+04	18.9	12.4
3.00E+03	9.02E+04	21.5	12.8	9.49E+04	22.4	13.2	8.34E+04	19.9	12	9.04E+04	21.3	12.6	9.62E+04	22.4	13.3	7.74E+04	18.9	11.1
5.00E+03	1.07E+05	22	12.2	1.09E+05	22.5	12.5	9.71E+04	20.1	11.4	1.03E+05	21.6	11.9	1.03E+05	23.1	12.6	8.01E+04	19.6	10.7
1.00E+04	1.05E+05	19.6	10.4	1.09E+05	20.4	10.9	9.15E+04	17.2	9.3	9.95E+04	18.9	10.1	1.05E+05	20.5	10.7	8.51E+04	16.7	8.7
2.00E+04	1.15E+05	18.7	9.8	1.22E+05	19.8	10.3	1.04E+05	17.4	8.8	1.08E+05	17.9	9.5	1.24E+05	20.1	10.3	9.89E+04	15.6	8.4
5.00E+04	1.39E+05	16.8	8.5	1.39E+05	18	9	1.31E+05	14.7	7.5	1.28E+05	16	8.6	1.42E+05	17.4	8.4	1.18E+05	14.6	7.3
1.00E+05	1.65E+05	14.3	7.3	1.62E+05	15.7	7.9	1.57E+05	12.2	6.1	1.69E+05	13.7	7.2	1.67E+05	14.4	7.3	1.39E+05	10.1	5.7

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.32E-01	7.5	9.8	1.32E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	5.05E-01	7.5	9.6	5.08E-01	7.1	9.5	3.62E-01	6.2	9.3	4.20E-01	6.2	9.7	5.02E-01	5.2	7.6	7.29E-01	4.4	7.9
3.00E+01	1.67E+00	6.9	8.8	1.80E+00	6.8	8.7	1.83E+00	6.1	9.1	1.64E+00	7	9	3.68E+00	3.9	6.4	3.54E+00	3.8	6.1
5.00E+01	7.96E+00	5.1	7.9	9.66E+00	4.7	7.1	7.99E+00	5.2	8.2	7.76E+00	5.3	8.2	2.36E+01	3.4	4.8	3.32E+01	3.2	4.7

Table A.26. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.33E+01	3.6	5.2	4.22E+01	3.3	4.7	2.85E+01	4.1	5.8	3.38E+01	3.7	5.3	9.38E+01	2.7	3.9	9.84E+01	2.7	3.8
1.00E+02	9.68E+01	2.9	4	1.27E+02	2.7	3.7	8.68E+01	3	4.4	1.09E+02	2.9	3.9	2.51E+02	2.6	3.5	2.80E+02	2.5	3.3
1.50E+02	4.42E+02	2.6	3.3	5.24E+02	3	3.6	6.39E+02	5.2	4.7	4.75E+02	2.3	3	1.15E+04	9	6.9	1.71E+04	8.9	6.9
2.00E+02	3.29E+03	7.5	7	5.51E+03	8.7	7.8	4.07E+03	9.1	8.4	2.60E+03	7.1	6.8	7.01E+04	11.4	10.8	7.86E+04	12	11.6
3.00E+02	3.32E+04	12.9	14.1	5.46E+04	13.4	14.7	2.92E+04	12.9	14.5	2.81E+04	13.2	14	1.23E+05	16	18.9	1.21E+05	16.1	20
5.00E+02	1.03E+05	17.6	20.3	1.30E+05	18.1	21	1.17E+05	16.3	18.4	1.54E+05	16.7	19.2	1.32E+05	19.7	22.1	1.40E+05	19.2	21.6
7.00E+02	1.31E+05	20.1	21.2	1.44E+05	20.6	21.6	1.44E+05	19.9	21.4	1.64E+05	20.7	22	1.44E+05	21.1	21.9	1.66E+05	21.4	22.2
1.00E+03	1.10E+05	21.4	18.8	1.14E+05	22	19	1.11E+05	21.4	19	1.05E+05	21.9	18.9	1.19E+05	23.1	19.7	1.23E+05	23.1	19.6
2.00E+03	8.53E+04	20.4	13.2	8.83E+04	21.4	13.9	8.22E+04	20.5	13.1	9.28E+04	22	13.9	9.48E+04	22.5	14.9	9.95E+04	23.3	15.2
3.00E+03	8.33E+04	19.9	11.9	8.62E+04	21	12.5	7.94E+04	19.9	11.9	8.52E+04	21	12.6	9.39E+04	22.7	13.5	1.01E+05	23.6	13.6
5.00E+03	9.71E+04	20.3	11.4	9.91E+04	21.4	11.9	9.75E+04	20.9	11.3	9.77E+04	21.1	11.8	1.07E+05	22.4	12.3	1.03E+05	22.7	13.1
1.00E+04	9.51E+04	17.4	9.4	9.90E+04	18.8	10.1	9.17E+04	17.9	9.6	9.15E+04	18.6	10.3	1.08E+05	20.1	11	1.03E+05	21	11.4
2.00E+04	1.03E+05	16.7	8.7	1.08E+05	17.9	9.3	9.86E+04	16.8	8.9	1.02E+05	18.4	9.5	1.13E+05	19.6	9.6	1.08E+05	19.7	10.4
5.00E+04	1.29E+05	14.7	7.6	1.38E+05	16	8.1	1.29E+05	15.5	7.6	1.29E+05	16.5	7.9	1.42E+05	17.6	8.9	1.24E+05	17.8	8.8
1.00E+05	1.62E+05	12.1	6.3	1.55E+05	13.5	6.9	1.50E+05	12.1	6.3	1.55E+05	14.2	7.2	1.54E+05	15.3	7.5	1.47E+05	16	8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.08E+01	5.7	2.5	6.83E+00	5.7	2.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.12E-01	4.2	8.8	4.43E+01	6.1	2.9	1.00E+01	6.1	3	1.68E-01	7.2	10	1.77E-01	7.2	9.6
2.00E+01	4.22E-01	6.4	9.3	6.33E-01	4.9	7.6	6.74E+01	6.6	3.5	1.44E+01	6.6	3.7	6.60E-01	7.3	9.3	6.51E-01	6.8	8.5
3.00E+01	1.87E+00	6.6	8.8	3.21E+00	5	6.8	1.12E+02	7.2	4.3	2.78E+01	6.9	4.6	2.31E+00	6.2	8	2.67E+00	5.7	7.1
5.00E+01	7.36E+00	5.3	8.4	1.78E+01	3.7	5.3	2.57E+02	7.9	5.7	7.33E+01	7	5.7	1.47E+01	3.9	5.8	1.75E+01	3.6	5.4
7.50E+01	2.64E+01	3.7	5.8	7.01E+01	3	4.1	6.60E+02	8.3	6.5	2.49E+02	6.6	5.7	6.99E+01	2.9	4	8.27E+01	2.8	3.8
1.00E+02	8.28E+01	2.9	4.2	1.90E+02	3.1	4	2.06E+03	8.6	6.9	1.58E+03	7.8	5.7	2.02E+02	2.5	3.3	2.37E+02	2.5	3.2
1.50E+02	3.63E+02	2.4	3.1	1.94E+04	9.5	7.5	2.09E+04	10.1	8.8	1.98E+04	10.1	8.8	1.03E+03	4.5	4.2	2.16E+03	6.1	4.9
2.00E+02	9.65E+02	3	3.6	5.00E+04	12.6	12.9	5.53E+04	12.3	12.7	5.37E+04	12.3	12.6	1.52E+04	9.8	8.8	2.64E+04	10.4	9.5
3.00E+02	2.80E+04	11.7	12	6.83E+04	16	19.3	1.13E+05	15.4	17.9	1.18E+05	15.3	17.6	1.03E+05	14	15.6	1.17E+05	14.4	16.3
5.00E+02	8.55E+04	16.6	18.9	1.01E+05	19.5	21.7	1.64E+05	19.7	22.4	1.67E+05	19.6	22.2	2.06E+05	19	21.8	2.12E+05	19.3	22.2
7.00E+02	1.29E+05	19.4	20.8	1.37E+05	20.1	20.9	1.52E+05	22	22.3	1.56E+05	22.2	22.3	1.69E+05	22.5	22.9	1.68E+05	22.8	23
1.00E+03	1.07E+05	20.9	18.5	1.14E+05	22	18.9	1.24E+05	23.2	19.6	1.26E+05	23.3	19.6	1.27E+05	23.6	19.7	1.30E+05	23.9	19.9
2.00E+03	7.85E+04	19.3	12.5	8.62E+04	21.1	13.6	1.01E+05	23.3	15.1	9.91E+04	23.2	15.1	1.03E+05	23.7	15.3	1.07E+05	24.1	15.6
3.00E+03	7.91E+04	19.2	11.3	8.95E+04	21.3	12.5	1.02E+05	23.1	13.8	1.01E+05	23.2	13.8	1.05E+05	23.5	14.1	1.08E+05	23.9	14.3
5.00E+03	9.01E+04	19.4	11	9.70E+04	20.7	11.7	1.11E+05	23.1	12.9	1.10E+05	23.1	12.9	1.17E+05	23.6	13.1	1.20E+05	24.1	13.4
1.00E+04	8.81E+04	16.2	8.8	9.55E+04	18.6	9.8	1.10E+05	21.1	11.3	1.08E+05	21.1	11.3	1.14E+05	22.1	11.6	1.16E+05	22.1	12
2.00E+04	1.07E+05	15.7	8.6	1.06E+05	17.2	9.2	1.18E+05	20.2	10.5	1.20E+05	20.1	10.6	1.21E+05	21.4	10.9	1.31E+05	21.6	11.4
5.00E+04	1.32E+05	13.7	7	1.36E+05	15.7	7.7	1.47E+05	18.4	9.4	1.42E+05	18.6	9.4	1.50E+05	19.4	9.8	1.44E+05	20.1	10
1.00E+05	1.56E+05	10.6	5.7	1.64E+05	13.3	6.4	1.67E+05	15.7	8.1	1.65E+05	16.3	8.3	1.60E+05	17.3	8.5	1.61E+05	18.3	8.8

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.12E+03	5	1.6	9.88E+03	5	1.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.62E+04	4.9	1.7	1.97E+04	4.9	1.7	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.44E+04	5	1.8	2.95E+04	5	1.8	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.05E+04	5.2	2	4.91E+04	5.2	2	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.91E+00	5.5	2.3	0.00E+00	1	1	8.03E+04	5.7	2.5	9.73E+04	5.7	2.5	9.67E+01	5.7	2.5	1.39E+01	5.7	2.5
1.40E+01	1.55E+01	5.8	2.7	2.25E-01	4.9	7.2	1.12E+05	6.1	2.9	1.35E+05	6.1	2.9	1.30E+02	6.1	2.9	2.16E+01	6.1	2.9
2.00E+01	3.41E+01	6.1	3.2	1.39E+00	4.8	5.7	1.58E+05	6.6	3.5	1.91E+05	6.6	3.5	1.99E+02	6.6	3.5	2.80E+01	6.6	3.5
3.00E+01	9.11E+01	6.5	3.7	6.17E+00	4	5.2	2.31E+05	7.4	4.5	2.77E+05	7.4	4.5	3.29E+02	7.3	4.3	4.62E+01	7.2	4.4
5.00E+01	4.51E+02	7.1	4.9	3.97E+01	3.5	4.4	3.58E+05	8.8	6.3	3.94E+05	9	6.6	6.67E+02	8.3	5.9	1.13E+02	7.7	5.8
7.50E+01	7.55E+03	8	5.4	4.15E+02	5.6	4	3.29E+05	11.1	10	3.37E+05	11.4	10.4	1.84E+03	8.9	6.8	3.04E+02	8.1	6.5
1.00E+02	2.94E+04	9.1	7	6.53E+03	8	5.4	2.81E+05	13	13.5	2.82E+05	13.2	13.9	4.18E+03	9.8	8.1	1.10E+03	8.3	6.6
1.50E+02	1.01E+05	11.5	10.9	5.47E+04	10.8	9.7	2.20E+05	15.8	18.9	2.20E+05	15.9	19.1	1.27E+04	11.3	10.9	7.49E+03	10.4	9.4
2.00E+02	1.47E+05	13.8	15.2	1.02E+05	12.8	13.6	1.89E+05	17.6	21.9	1.92E+05	17.6	22	2.14E+04	12.9	13.9	1.63E+04	12.1	12.7
3.00E+02	1.53E+05	17.4	21.1	1.37E+05	16.6	19.8	1.71E+05	19.7	23.9	1.74E+05	19.7	23.9	4.71E+04	14.8	16.8	4.53E+04	14.3	16.3
5.00E+02	1.58E+05	20.7	22.7	1.76E+05	19.9	22.4	1.70E+05	22	23.7	1.73E+05	22	23.7	1.16E+05	18.1	20.6	1.32E+05	17.9	20.6
7.00E+02	1.65E+05	22.6	22.4	1.79E+05	22.3	22.3	1.61E+05	23.6	22.6	1.65E+05	23.6	22.7	1.39E+05	20.5	21.5	1.47E+05	20.8	21.7
1.00E+03	1.34E+05	23.8	20.1	1.25E+05	23.7	19.9	1.41E+05	24.8	20.4	1.43E+05	24.9	20.5	1.13E+05	21.8	19	1.17E+05	22.1	19
2.00E+03	1.10E+05	24.3	15.6	1.05E+05	23.7	15.6	1.21E+05	25.4	16.5	1.21E+05	25.5	16.6	8.59E+04	21.1	13.6	8.84E+04	21.6	13.9
3.00E+03	1.13E+05	24.1	14.3	1.07E+05	23.8	14.2	1.22E+05	25.2	15.1	1.24E+05	25.4	15.2	8.77E+04	20.9	12.4	8.93E+04	21.4	12.6

(continued on next page)

Table A.26. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	1.18E+05	24.3	13.5	1.23E+05	23.6	13.3	1.31E+05	24.9	14	1.31E+05	25.1	14.1	9.81E+04	21.2	11.8	9.99E+04	21.6	11.9
1.00E+04	1.19E+05	22.6	11.8	1.14E+05	22	11.7	1.31E+05	23.6	12.7	1.32E+05	23.9	12.8	9.64E+04	18.5	9.8	9.65E+04	18.9	10.2
2.00E+04	1.30E+05	21.2	11	1.24E+05	22.1	11	1.42E+05	22.7	11.9	1.41E+05	23	12	1.06E+05	17.5	9.2	1.08E+05	18	9.4
5.00E+04	1.51E+05	20.1	9.9	1.43E+05	19.6	9.9	1.64E+05	20.8	10.6	1.61E+05	21.3	10.8	1.34E+05	15.7	8.1	1.32E+05	16.3	8.3
1.00E+05	1.73E+05	17	8.7	1.63E+05	17.6	8.9	1.83E+05	18.7	9.5	1.83E+05	19.3	9.7	1.58E+05	13	6.7	1.54E+05	13.8	7.1

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.14E+03	5.7	2.5	1.75E+02	5.7	2.5	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.52E+03	6.1	2.9	2.72E+02	6.1	2.9	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.43E-01	4.7	9	5.25E-01	4.8	9.6	2.32E+03	6.6	3.4	3.43E+02	6.6	3.4	5.21E-01	7.7	8.9	3.98E-01	5.6	9.7
3.00E+01	1.17E+00	5.4	9.1	1.55E+00	5.4	9.2	3.77E+03	7.3	4.3	5.50E+02	7.3	4.2	1.52E+00	6.1	9.3	1.36E+00	5.6	9
5.00E+01	6.86E+00	5.9	9.2	6.76E+00	6.9	9.9	7.23E+03	8.4	5.9	1.23E+03	8	5.9	6.23E+00	5	9.2	5.26E+00	5.8	10.4
7.50E+01	2.35E+01	3.7	6.1	1.90E+01	4.6	7.4	1.68E+04	9.2	7.2	2.57E+03	9	7.2	2.59E+01	3.8	6.4	2.27E+01	4.3	7.1
1.00E+02	6.82E+01	3.1	4.6	6.65E+01	3.1	4.7	3.35E+04	10.2	8.6	7.90E+03	9.1	7.2	7.02E+01	3	4.6	7.01E+01	3.1	4.6
1.50E+02	3.45E+02	2.3	3.1	3.45E+02	2.2	3	7.75E+04	12	12.1	3.47E+04	11.3	10.7	3.42E+02	2.4	3.1	3.67E+02	2.3	3.1
2.00E+02	9.28E+02	2.5	2.7	9.91E+02	2	2.8	1.01E+05	13.9	15.6	5.68E+04	13.5	14.8	9.54E+02	2.3	3.6	9.78E+02	1.9	2.7
3.00E+02	9.83E+03	9.3	9.3	4.12E+03	5.5	4.9	1.28E+05	17.1	20	8.34E+04	15.9	18.5	1.42E+04	11.7	12.5	3.69E+03	4.8	7.6
5.00E+02	8.67E+04	17.8	20	1.02E+05	16	17.4	1.89E+05	19.9	22.4	1.74E+05	19.5	22.4	9.19E+04	16.3	18.4	1.24E+05	15.9	18.7
7.00E+02	1.14E+05	19.5	20.4	1.37E+05	19.4	21.3	1.64E+05	22.8	22.8	1.67E+05	22.4	22.5	1.26E+05	19.4	21.2	1.43E+05	20.3	21.5
1.00E+03	1.02E+05	20.8	18.5	1.13E+05	21.2	18.7	1.35E+05	24.1	20.1	1.29E+05	23.5	19.5	1.09E+05	20.8	18.6	1.12E+05	21.2	18.4
2.00E+03	7.72E+04	19.8	12.7	7.50E+04	20.2	12.8	1.07E+05	24.2	15.6	1.07E+05	24	15.3	7.96E+04	19.2	12.7	8.18E+04	20.3	13.2
3.00E+03	7.91E+04	19.3	11.6	7.94E+04	20.6	11.5	1.13E+05	24.2	14.2	1.04E+05	23.2	14.1	7.97E+04	19.3	11.5	7.88E+04	19.9	11.7
5.00E+03	9.20E+04	20.4	11.3	8.65E+04	20.8	11.2	1.19E+05	24.2	13.4	1.15E+05	23.7	12.9	8.96E+04	19.5	11.2	9.35E+04	20.3	11.2
1.00E+04	8.84E+04	17.1	8.9	8.65E+04	17	9.5	1.22E+05	22.6	11.9	1.08E+05	21.7	11.4	8.82E+04	16.6	9	8.68E+04	17.2	9.5
2.00E+04	9.17E+04	15.5	7.8	9.15E+04	14.9	8.5	1.26E+05	21.6	11.2	1.17E+05	20.7	10.6	9.99E+04	14.9	8.3	1.00E+05	16.4	8.5
5.00E+04	1.27E+05	15.3	7.3	1.18E+05	13.4	7.6	1.50E+05	19.8	10.2	1.44E+05	20	9.8	1.19E+05	13.3	7.4	1.22E+05	14.1	7.5
1.00E+05	1.50E+05	10.5	6.1	1.39E+05	10.9	6.2	1.67E+05	18	8.8	1.56E+05	18	8.3	1.55E+05	11.3	6	1.39E+05	11.7	6.3

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.46E+01	5.7	2.5	0.00E+00	1	1
1.40E+01	1.24E-01	6.9	9.8	0.00E+00	1	1	1.17E-01	6.8	9.8	1.14E-01	7	10.1	6.82E+01	6	2.8	1.72E-01	6.1	8.8
2.00E+01	4.75E-01	7.5	9.6	4.82E-01	7.1	9.6	4.75E-01	7.9	9.3	4.80E-01	7.9	9.8	1.17E+02	6.5	3.3	8.21E-01	4.9	7.5
3.00E+01	1.61E+00	7.2	9.1	1.77E+00	7.1	8.9	1.52E+00	7	9.1	1.56E+00	7.2	9.3	2.45E+02	7	4	3.54E+00	4.8	6.4
5.00E+01	7.27E+00	5.6	8.3	8.17E+00	5.1	8.3	6.36E+00	6.1	9.5	6.88E+00	5.9	9.5	8.18E+02	8	5.4	1.98E+01	4.1	5.4
7.50E+01	3.12E+01	3.7	5.5	3.75E+01	3.5	5.1	2.56E+01	4	6.2	2.80E+01	3.8	6.1	4.87E+03	8.4	5.9	1.19E+02	5.3	4.8
1.00E+02	9.29E+01	2.9	4	1.13E+02	2.7	3.8	7.68E+01	3	4.2	8.43E+01	2.9	4.1	1.33E+04	9.6	7.8	8.15E+02	7.5	5.5
1.50E+02	4.16E+02	2.3	3	5.00E+02	2.4	3	3.74E+02	2.3	3	4.07E+02	2.3	2.9	3.16E+04	11.8	11.6	1.97E+04	10.1	8.6
2.00E+02	1.27E+03	3.8	4.2	2.12E+03	5.4	5.4	1.00E+03	2.3	3	1.04E+03	2.2	2.9	4.45E+04	13.6	15.1	3.95E+04	12.6	13.3
3.00E+02	2.79E+04	12.4	13	3.52E+04	12.6	13.7	1.25E+04	9.7	9.2	1.05E+04	9.9	9.9	6.05E+04	16.2	18.9	6.25E+04	15.5	18.1
5.00E+02	1.05E+05	16.9	19.7	1.35E+05	17.6	20.4	1.01E+05	17.2	20.2	1.21E+05	17.3	20	1.14E+05	18.5	20.7	1.30E+05	18.2	20.9
7.00E+02	1.45E+05	20.1	21.4	1.58E+05	20.9	21.9	1.22E+05	19.8	20.9	1.35E+05	20.3	21.5	1.42E+05	20.7	21.4	1.46E+05	20.8	21.7
1.00E+03	1.12E+05	21.5	18.8	1.14E+05	22.3	19.1	1.06E+05	21	18.6	1.14E+05	21.4	18.9	1.12E+05	21.9	19.2	1.17E+05	22.2	19.1
2.00E+03	8.63E+04	20.5	13.2	8.99E+04	21.5	14	7.92E+04	19.6	12.8	7.90E+04	20.2	13.2	8.82E+04	21.2	13.7	8.99E+04	21.7	14.1
3.00E+03	8.19E+04	20.1	12.1	9.12E+04	21.7	12.6	8.07E+04	19.6	11.4	8.40E+04	20	11.8	9.19E+04	21.3	12.5	9.25E+04	21.7	12.7
5.00E+03	9.93E+04	20.7	11.6	1.02E+05	21.5	12.1	9.19E+04	19.8	11.1	9.33E+04	20.6	11.5	1.00E+05	21.3	11.8	1.02E+05	21.6	12.2
1.00E+04	9.28E+04	17.8	9.4	1.02E+05	19.1	10.2	8.80E+04	16.6	9	8.98E+04	17.5	9.5	1.01E+05	18.9	10	1.02E+05	19.4	10.4
2.00E+04	1.03E+05	17.2	9.1	1.06E+05	18.2	9.5	9.89E+04	15.9	8.4	1.02E+05	16.5	8.8	1.11E+05	17.8	9.4	1.12E+05	18.3	9.6
5.00E+04	1.33E+05	15.4	7.9	1.38E+05	16.9	8.2	1.34E+05	13.8	7.3	1.27E+05	14.9	7.5	1.38E+05	15.6	8	1.39E+05	16.7	8.5
1.00E+05	1.56E+05	12.6	6.2	1.55E+05	14.3	7.2	1.60E+05	11.3	5.8	1.54E+05	12	6.4	1.65E+05	13.1	6.8	1.61E+05	14.4	7.4

Table A.26. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	6.93E+01	5.7	2.5	5.44E+00	5.7	2.5	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	9.77E+01	6.1	2.9	7.82E+00	6.1	3.1	1.22E-01	5.6	9.1	1.88E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.43E+02	6.6	3.5	1.22E+01	6.5	3.7	5.68E-01	6.6	9	4.27E+00	5.8	3.6	3.91E-01	6.8	9.7	4.92E-01	7.1	10.1
3.00E+01	2.42E+02	7.2	4.3	2.29E+01	6.9	4.6	2.60E+00	5.7	7.1	8.63E+00	5.5	4.1	1.55E+00	7.1	9.5	1.49E+00	7.1	9.2
5.00E+01	5.38E+02	8.1	5.7	6.78E+01	6.7	5.4	1.53E+01	4	5.9	7.25E+01	6.5	4.3	5.53E+00	6.7	10.6	6.50E+00	6.1	9.8
7.50E+01	1.87E+03	8.4	6.3	3.49E+02	7	5.1	6.37E+01	2.9	4.2	6.21E+02	8	5.9	1.64E+01	5.4	8.3	2.35E+01	4.2	6.5
1.00E+02	6.27E+03	9	7	1.92E+03	8.1	6.1	4.24E+02	5.6	4.3	2.81E+03	8.4	6.4	4.57E+01	3.7	5.6	7.58E+01	3.1	4.3
1.50E+02	3.24E+04	10.9	10	1.38E+04	10.2	9.1	1.23E+04	10.1	8.6	2.05E+04	10.8	9.9	2.65E+02	2.5	3.3	3.81E+02	2.3	3
2.00E+02	7.09E+04	12.7	13.4	4.67E+04	11.9	11.9	1.96E+04	12.6	13.1	3.32E+04	12.8	13.9	8.08E+02	2.1	2.7	1.02E+03	2.2	2.7
3.00E+02	1.21E+05	15.9	18.6	1.08E+05	15.2	17.5	7.02E+04	13.8	15	1.01E+05	14.6	16.6	2.68E+03	2.4	3.3	4.66E+03	6.5	8.1
5.00E+02	1.56E+05	20	22.5	1.61E+05	19.6	22.2	1.80E+05	19.1	22.4	1.73E+05	19.3	22.6	6.11E+04	13.7	15.4	1.22E+05	16.8	19.6
7.00E+02	1.47E+05	22.1	22.2	1.51E+05	21.9	22.2	1.61E+05	22.1	22.5	1.67E+05	22	22.3	1.34E+05	18.5	20.9	1.39E+05	20.1	21.4
1.00E+03	1.23E+05	23.1	19.6	1.24E+05	23.1	19.5	1.25E+05	23.3	19.8	1.27E+05	23.4	19.6	1.05E+05	20.1	18.2	1.12E+05	21	18.8
2.00E+03	9.98E+04	23	15	9.84E+04	22.9	14.9	9.77E+04	23.4	15	1.06E+05	23.7	15.1	7.00E+04	18.6	11.8	7.99E+04	20.6	13.3
3.00E+03	1.01E+05	22.9	13.6	9.96E+04	22.8	13.5	1.01E+05	23.6	13.6	1.04E+05	23.4	13.8	7.59E+04	18	10.7	8.14E+04	19.9	11.8
5.00E+03	1.12E+05	22.8	12.8	1.11E+05	22.8	12.7	1.08E+05	23.3	13	1.14E+05	23.8	12.9	8.55E+04	18.2	10.6	9.41E+04	20.6	11.1
1.00E+04	1.10E+05	20.8	11.1	1.08E+05	20.8	11.1	1.07E+05	21.5	11.5	1.04E+05	20.7	11.7	8.21E+04	15	8.5	9.04E+04	17.7	9.4
2.00E+04	1.20E+05	19.8	10.4	1.19E+05	19.9	10.4	1.16E+05	20.1	10.6	1.19E+05	20.9	10.9	9.52E+04	14.4	7.6	1.02E+05	16.4	8.7
5.00E+04	1.47E+05	17.9	9.2	1.40E+05	18.1	9.2	1.40E+05	19	9.4	1.47E+05	19.4	9.7	1.26E+05	12.8	6.7	1.24E+05	14.7	7.5
1.00E+05	1.68E+05	15.4	7.9	1.66E+05	15.6	8	1.49E+05	16.6	8.3	1.59E+05	17.2	8.8	1.52E+05	10.3	5.5	1.49E+05	11.8	6.7

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.29E-02	6.9	10.2	1.20E-01	7.4	9.6	1.12E-01	7.3	9.7	1.59E-01	6.2	10.1	1.42E-01	6.6	9.7
2.00E+01	3.88E-01	5.2	9.4	5.82E-01	6.9	9.8	5.04E-01	7.2	9.6	4.70E-01	7.2	9.6	3.70E-01	7.2	9.5	5.23E-01	6.4	9.9
3.00E+01	1.31E+00	7.2	9.3	1.55E+00	7.3	9.3	1.69E+00	6.9	9	1.71E+00	7	8.9	1.66E+00	6.9	9	1.74E+00	6.9	8.8
5.00E+01	5.42E+00	6.2	10.2	5.77E+00	6.8	10.3	7.30E+00	5.3	8.7	7.68E+00	5.4	8.7	7.21E+00	5.3	8.9	9.32E+00	5	7.9
7.50E+01	1.77E+01	5.2	7.9	2.05E+01	4.9	7.9	2.99E+01	3.7	5.5	3.24E+01	3.7	5.3	2.95E+01	3.6	5.3	4.04E+01	3.4	4.8
1.00E+02	5.22E+01	3.3	5.5	5.86E+01	3.4	5	9.03E+01	2.9	4	9.80E+01	2.8	4	9.75E+01	2.8	4	1.29E+02	2.7	3.6
1.50E+02	2.83E+02	2.5	3.2	3.15E+02	2.4	3.2	4.03E+02	2.5	3.1	4.31E+02	2.4	3	4.33E+02	2.3	2.9	5.35E+02	2.4	3
2.00E+02	8.34E+02	2.1	2.7	8.94E+02	2.1	2.7	1.80E+03	6.7	5.9	1.28E+03	3.7	4.3	1.13E+03	3	3.4	1.38E+03	3	4.5
3.00E+02	2.76E+03	3.2	3.8	3.36E+03	3.9	5.2	2.73E+04	12.2	13	3.06E+04	12.4	13.2	2.96E+04	11.8	12.1	5.14E+04	12.8	13.4
5.00E+02	1.00E+05	14.7	16.4	9.42E+04	15.7	17.6	9.84E+04	17.3	20	1.15E+05	17.6	20.4	1.11E+05	17.9	20.6	1.33E+05	18.6	21.3
7.00E+02	1.26E+05	19.2	20.9	1.31E+05	19.1	20.5	1.29E+05	20	21	1.36E+05	20.1	21.3	1.36E+05	20.2	21.2	1.47E+05	20.9	21.9
1.00E+03	1.02E+05	20.5	18.4	1.08E+05	21	18.6	1.08E+05	21.1	18.6	1.12E+05	21.3	18.7	1.13E+05	21.6	18.6	1.19E+05	22.1	19.1
2.00E+03	7.06E+04	19.1	12.2	7.71E+04	19.5	12.4	7.97E+04	19.7	12.8	8.19E+04	20.5	13.2	8.65E+04	20.9	13.3	9.03E+04	21.5	13.8
3.00E+03	7.58E+04	18.1	11.1	7.87E+04	19	11.3	8.07E+04	19.4	11.6	8.57E+04	20.3	11.9	8.61E+04	20.5	12.2	8.89E+04	21.8	12.6
5.00E+03	8.12E+04	19.7	10.7	8.74E+04	19.2	10.9	9.47E+04	20.1	11.1	9.70E+04	20.4	11.3	9.71E+04	21	11.5	1.01E+05	21.8	12
1.00E+04	8.43E+04	16	8.4	8.84E+04	16.9	8.5	9.21E+04	17.4	9	9.41E+04	17.7	9.5	9.09E+04	17.4	9.4	9.75E+04	18.6	10.2
2.00E+04	9.62E+04	14.5	8.1	9.99E+04	15.9	8.2	1.03E+05	16.3	8.5	1.04E+05	16.4	8.9	1.09E+05	17.3	9	1.08E+05	18.2	9.3
5.00E+04	1.25E+05	12.9	6.7	1.25E+05	13.9	7.5	1.35E+05	14.1	7.3	1.32E+05	14.9	7.6	1.32E+05	15.8	7.8	1.32E+05	15.8	8.4
1.00E+05	1.61E+05	11.1	5.2	1.53E+05	11.4	5.9	1.59E+05	11.1	6	1.63E+05	12.3	6.5	1.55E+05	12.3	6.3	1.60E+05	14	6.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	2.95E-01	5.8	8.7	0.00E+00	1	1	3.08E+00	3.5	4.7	3.08E+00	3.5	4.7
2.00E+01	8.69E-01	6.4	8.2	0.00E+00	1	1	1.44E+01	4	5	1.44E+01	4	5
3.00E+01	3.45E+00	4.3	6.6	3.01E+00	5.3	7.5	5.71E+01	4	4.9	5.71E+01	4	4.9
5.00E+01	2.06E+01	3.5	5.3	1.70E+01	4	5.4	2.66E+03	5.2	2.4	2.66E+03	5.2	2.4
7.50E+01	6.89E+01	2.9	4	6.47E+01	3	4.2	3.11E+05	8.6	6	3.11E+05	8.6	6

(continued on next page)

Table A.26. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	2.40E+02	3.8	3.7	1.88E+02	2.7	3.8	3.21E+05	11.2	10.2	3.21E+05	11.2	10.2
1.50E+02	8.67E+03	9.3	8	5.25E+03	9	7.4	2.46E+05	14.7	16.8	2.46E+05	14.7	16.8
2.00E+02	3.35E+04	11.6	11.4	2.59E+04	11.1	10.8	1.92E+05	16.1	19.2	1.92E+05	16.1	19.2
3.00E+02	1.07E+05	15.2	17.6	8.91E+04	14.8	17.6	1.97E+05	19.2	22.5	1.97E+05	19.2	22.5
5.00E+02	1.17E+05	19.9	22.2	1.35E+05	18.1	20.5	1.71E+05	21.7	24	1.71E+05	21.7	24
7.00E+02	1.58E+05	21	21.9	1.59E+05	21	22.1	1.74E+05	23.6	22.3	1.74E+05	23.6	22.3
1.00E+03	1.21E+05	22.3	19.4	1.25E+05	22.9	19.5	1.48E+05	24.6	20.4	1.48E+05	24.6	20.4
2.00E+03	9.55E+04	22.4	14.2	9.34E+04	22	14.1	1.25E+05	25.9	16.4	1.25E+05	25.9	16.4
3.00E+03	9.23E+04	21.8	12.9	9.33E+04	22.1	13	1.22E+05	25.5	15.4	1.22E+05	25.5	15.4
5.00E+03	1.05E+05	22.5	12.4	1.02E+05	22.8	12.3	1.20E+05	24.7	14.4	1.20E+05	24.7	14.4
1.00E+04	1.05E+05	19.9	10.3	9.69E+04	20.3	10.5	1.19E+05	22.8	12.7	1.19E+05	22.8	12.7
2.00E+04	1.14E+05	19.7	9.7	1.21E+05	19.7	10.1	1.54E+05	22.6	12.7	1.54E+05	22.6	12.7
5.00E+04	1.39E+05	17.3	8.7	1.24E+05	17.5	9	1.44E+05	19.9	10.7	1.44E+05	19.9	10.7
1.00E+05	1.57E+05	14.8	7.3	1.55E+05	15.3	8	1.61E+05	18.9	10	1.61E+05	18.9	10

Table A.27. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{52}Cr ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.03E+01	5.5	0.6	3.20E+00	5.5	0.6	7.67E+02	5.4	2.3	9.16E+02	5.5	2.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.41E+01	5.9	0.7	4.84E+00	5.9	0.8	1.33E+03	5.7	2.6	1.46E+03	5.8	2.6	1.24E-01	7.1	9.6	1.10E-01	7	9.5
2.00E+01	2.17E+01	6.4	0.9	7.08E+00	6.5	1	2.53E+03	6.1	3	2.50E+03	6.2	3.1	5.09E-01	7	9.5	5.51E-01	6.9	9.1
3.00E+01	4.00E+01	6.9	1.1	1.40E+01	6.9	1.2	5.75E+03	6.6	3.6	5.11E+03	6.8	3.7	1.94E+00	6.2	8.2	1.83E+00	6.1	8
5.00E+01	8.86E+01	7.6	1.5	3.82E+01	6.9	1.7	1.86E+04	7.7	4.8	1.71E+04	7.5	4.6	9.68E+00	4.5	7	1.04E+01	4.5	6.8
7.50E+01	2.36E+02	7.6	1.6	1.19E+02	6	1.7	8.20E+04	8.4	5.8	5.95E+04	8.6	6.1	4.20E+01	3.3	4.7	4.58E+01	3.2	4.6
1.00E+02	6.91E+02	7.8	1.7	7.40E+02	7.2	1.4	1.54E+05	9.8	7.9	1.03E+05	9.9	8.2	1.33E+02	3.1	3.8	1.31E+02	2.7	3.6
1.50E+02	8.16E+03	9.3	1.9	8.67E+03	9.4	2	2.53E+05	12.1	12	1.65E+05	12.1	12.1	8.02E+02	5.4	5.1	5.29E+02	2.8	3.2
2.00E+02	2.49E+04	11.5	2.8	2.47E+04	11.5	2.9	2.57E+05	14.4	16.5	1.96E+05	14	15.6	4.29E+03	8.1	7.7	6.12E+03	8.5	7.3
3.00E+02	5.21E+04	14.3	4.2	5.72E+04	14.2	4.1	2.12E+05	18.3	22.5	1.97E+05	17.3	21	6.01E+04	12.7	13.3	6.33E+04	12.8	13.6
5.00E+02	1.21E+05	17.4	5.2	1.36E+05	17.4	5.2	1.58E+05	21.7	24.7	1.64E+05	21.1	23.8	1.20E+05	17.7	20.5	1.25E+05	17.8	20.9
7.00E+02	1.46E+05	19.9	5.6	1.58E+05	20.1	5.7	1.60E+05	22.5	22.6	1.67E+05	21.9	22.3	1.37E+05	20	21.4	1.42E+05	19.9	21.3
1.00E+03	1.23E+05	21.4	5.4	1.26E+05	21.6	5.4	1.52E+05	23.7	21.1	1.49E+05	23.4	20.8	1.20E+05	21.2	19.4	1.23E+05	21.3	19.6
2.00E+03	9.17E+04	20.7	4.2	9.56E+04	21.2	4.3	1.25E+05	24.1	17	1.18E+05	23.7	16.7	9.00E+04	20.3	14.2	9.10E+04	20.6	14.4
3.00E+03	9.13E+04	20.4	3.9	9.47E+04	21	3.9	1.32E+05	24	15.5	1.26E+05	23.7	15.4	9.18E+04	20.2	12.9	9.37E+04	20.6	13
5.00E+03	1.07E+05	20.8	3.7	1.06E+05	21.2	3.8	1.31E+05	23.5	14.5	1.31E+05	23.5	14.4	1.02E+05	20.4	12.1	1.06E+05	20.7	12.3
1.00E+04	1.01E+05	18.1	3.3	1.05E+05	18.8	3.3	1.37E+05	21.6	13	1.38E+05	22.3	12.9	9.87E+04	17.6	10.3	1.04E+05	18	10.6
2.00E+04	1.12E+05	17	3.1	1.14E+05	17.6	3.2	1.45E+05	21.4	12.2	1.42E+05	21	12	1.10E+05	16.6	9.6	1.20E+05	17	9.7
5.00E+04	1.46E+05	15.1	2.8	1.46E+05	16	2.9	1.72E+05	19.6	11	1.66E+05	19.7	10.7	1.45E+05	14.8	8.2	1.49E+05	15.3	8.6
1.00E+05	1.71E+05	12.4	2.4	1.60E+05	13.7	2.6	1.99E+05	17.6	9.5	1.88E+05	17.5	9.6	1.65E+05	12.1	6.9	1.71E+05	12.9	7.2

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.16E+03	5.5	2.4	0.00E+00	1	1
1.40E+01	1.31E-01	7.5	9.8	1.38E-01	7.3	9.9	1.44E-01	6.6	9.9	1.12E-01	7.5	9.4	1.61E+03	5.9	2.7	0.00E+00	1	1
2.00E+01	5.19E-01	7.6	9.5	5.63E-01	7	9.3	4.11E-01	7.6	9.4	5.70E-01	7	9.8	2.49E+03	6.4	3.2	2.71E-01	5.4	10.4
3.00E+01	1.86E+00	6.8	8.8	1.92E+00	6.7	8.4	1.70E+00	6.8	8.6	1.95E+00	6.4	8.5	3.70E+03	7	4	2.01E+00	5.4	8.9
5.00E+01	9.37E+00	4.8	7.4	1.05E+01	4.5	6.9	8.07E+00	5.2	7.8	1.12E+01	4.5	6.7	7.93E+03	8	5.4	5.59E+00	6.2	9.9
7.50E+01	4.19E+01	3.3	4.7	4.95E+01	3.1	4.4	3.40E+01	3.6	5.3	4.50E+01	3.2	4.6	1.99E+04	8.9	6.5	1.76E+01	4.7	7.9
1.00E+02	1.27E+02	2.7	3.6	1.52E+02	2.6	3.5	9.57E+01	2.9	3.9	1.37E+02	2.7	3.5	3.46E+04	9.9	8.1	5.59E+01	3.4	5.2
1.50E+02	5.78E+02	2.8	3.2	6.01E+02	2.4	3	4.15E+02	2.4	3	5.20E+02	2.3	3.3	7.01E+04	11.7	11.3	3.07E+02	2.2	3.1
2.00E+02	3.43E+03	7.1	6.3	2.97E+03	6.6	5.8	1.09E+03	2.9	3.9	4.65E+03	7.9	6.6	1.05E+05	13.2	14.2	9.02E+02	2	2.5
3.00E+02	4.06E+04	12.3	12.8	6.02E+04	12.1	12.4	3.28E+04	11.8	12.1	6.51E+04	13.2	14.3	1.32E+05	16.1	19.3	2.75E+03	2.5	3.4
5.00E+02	1.58E+05	17.3	20.1	1.72E+05	18.1	21.1	1.07E+05	17	19.5	1.38E+05	17.8	20.4	1.17E+05	20	23	8.09E+04	13.3	15.7
7.00E+02	1.59E+05	20.3	21.9	1.69E+05	20.7	22.2	1.36E+05	19.2	20.9	1.50E+05	20.1	21.6	1.46E+05	20.9	21.3	1.50E+05	18.4	20.2
1.00E+03	1.32E+05	21.9	19.9	1.35E+05	22.3	20.1	1.14E+05	20.7	19.4	1.31E+05	21.5	19.6	1.32E+05	22.1	20.4	1.16E+05	20.4	19.3
2.00E+03	9.70E+04	21.4	14.9	1.04E+05	22	15.4	8.81E+04	20	13.9	9.49E+04	21.2	14.6	9.84E+04	22	15.6	8.01E+04	18.8	13.3
3.00E+03	9.79E+04	21.3	13.6	1.03E+05	22	14	8.67E+04	19.6	12.6	9.63E+04	20.9	13.2	1.03E+05	21.8	14.2	8.21E+04	18.7	11.8
5.00E+03	1.14E+05	21.5	12.9	1.14E+05	22	13.3	9.86E+04	19.9	12.1	1.06E+05	21.3	12.6	1.10E+05	22.3	13.4	8.48E+04	19.4	11.3
1.00E+04	1.08E+05	19.2	11.1	1.16E+05	20.1	11.6	9.55E+04	17.2	9.9	1.05E+05	18.6	11.1	1.14E+05	19.4	11.6	8.98E+04	16.7	9.2
2.00E+04	1.22E+05	18.5	10.3	1.26E+05	19.1	10.8	1.11E+05	16.4	9.3	1.13E+05	17.6	9.8	1.34E+05	19.6	11.1	1.04E+05	15.5	8.8
5.00E+04	1.46E+05	16.5	9.1	1.48E+05	17.3	9.7	1.40E+05	14.5	8	1.46E+05	15.6	8.9	1.50E+05	16.8	9	1.24E+05	14.3	7.6
1.00E+05	1.76E+05	14	7.4	1.72E+05	15.4	8.4	1.66E+05	12.1	6.9	1.77E+05	13.6	7.4	1.78E+05	14.1	8.1	1.45E+05	11.4	6

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.34E-01	7.5	9.8	1.33E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.27. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	5.18E-01	7.5	9.6	5.17E-01	7.1	9.5	3.66E-01	6.2	9.3	4.19E-01	6.2	9.7	4.95E-01	5.2	7.6	7.28E-01	4.4	7.9
3.00E+01	1.70E+00	6.9	8.8	1.84E+00	6.8	8.7	1.89E+00	6.1	9.1	1.66E+00	7	9	3.77E+00	3.9	6.4	3.64E+00	3.8	6.1
5.00E+01	8.14E+00	5.1	7.8	9.90E+00	4.7	7	8.18E+00	5.1	8.2	7.93E+00	5.3	8.1	2.39E+01	3.3	4.8	3.42E+01	3.1	4.7
7.50E+01	3.36E+01	3.6	5.2	4.25E+01	3.3	4.7	2.87E+01	4.1	5.8	3.43E+01	3.7	5.2	9.30E+01	2.7	3.9	9.74E+01	2.7	3.8
1.00E+02	9.69E+01	2.8	4	1.26E+02	2.7	3.7	8.66E+01	3	4.3	1.10E+02	2.9	3.9	2.40E+02	2.6	3.4	2.80E+02	2.5	3.3
1.50E+02	4.23E+02	2.5	3.2	4.90E+02	2.9	3.2	6.01E+02	4.7	4.5	4.68E+02	2.3	3	9.34E+03	8.3	6.1	1.47E+04	8.5	6.2
2.00E+02	2.92E+03	7	6	4.81E+03	8	6.8	3.78E+03	8.6	7.3	1.74E+03	4.7	6.4	6.62E+04	10.7	10.1	7.71E+04	11.1	10.3
3.00E+02	3.25E+04	12.3	13	5.28E+04	12.6	13.5	3.16E+04	12.1	13.1	2.81E+04	12.4	12.6	1.31E+05	15.1	17.8	1.27E+05	15.7	18.9
5.00E+02	1.07E+05	16.9	19.5	1.38E+05	17.4	20.3	1.15E+05	15.8	17.5	1.59E+05	16.3	18.1	1.41E+05	18.9	21.8	1.47E+05	19	21.3
7.00E+02	1.39E+05	19.4	21	1.50E+05	19.9	21.5	1.54E+05	19.5	21.1	1.78E+05	19.9	22	1.55E+05	20.9	22.2	1.77E+05	20.7	22
1.00E+03	1.20E+05	20.8	19.4	1.25E+05	21.5	19.6	1.20E+05	21.1	19.6	1.17E+05	21.8	19.7	1.34E+05	22	20.5	1.27E+05	22.6	20.4
2.00E+03	9.08E+04	20.1	13.9	9.61E+04	21	14.6	8.82E+04	20.5	14.1	9.42E+04	20.9	14.8	1.01E+05	22	15.6	1.07E+05	22.8	16.1
3.00E+03	8.83E+04	19.8	12.7	9.52E+04	20.8	13.2	8.46E+04	19.6	12.6	9.26E+04	21	13.3	9.99E+04	21.8	14.1	1.09E+05	22.8	14.6
5.00E+03	9.92E+04	20.1	12.1	1.07E+05	21.1	12.7	1.03E+05	20.6	12.4	1.07E+05	21.3	12.7	1.14E+05	22	13.4	1.09E+05	22.3	13.8
1.00E+04	9.58E+04	17.1	10.1	1.03E+05	18.5	10.8	9.75E+04	17.6	10.2	9.87E+04	18.4	10.7	1.15E+05	19.7	11.5	1.10E+05	20.2	11.7
2.00E+04	1.07E+05	16.3	9.3	1.15E+05	17.5	9.8	1.04E+05	16.6	9.5	1.08E+05	17.9	10.3	1.21E+05	19.3	11.2	1.14E+05	19.3	11.6
5.00E+04	1.39E+05	14.5	8.3	1.45E+05	15.7	8.8	1.36E+05	15.1	8.3	1.36E+05	16.2	9	1.52E+05	17.3	9.4	1.31E+05	17.6	9.7
1.00E+05	1.67E+05	12	6.7	1.63E+05	13.3	7.5	1.58E+05	12	7.4	1.65E+05	14	7.8	1.65E+05	15.1	8.3	1.55E+05	15.5	8.8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.22E+01	5.5	2.4	7.18E+00	5.5	2.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.19E-01	4.2	8.8	4.64E+01	5.9	2.7	1.05E+01	5.9	2.8	1.70E-01	7.2	10	1.79E-01	7.2	9.6
2.00E+01	4.24E-01	6.4	9.3	6.37E-01	4.9	7.6	7.02E+01	6.4	3.3	1.48E+01	6.4	3.4	6.75E-01	7.3	9.3	6.59E-01	6.8	8.4
3.00E+01	1.92E+00	6.6	8.8	3.28E+00	5	6.8	1.16E+02	7	4	2.88E+01	6.8	4.2	2.36E+00	6.2	8	2.74E+00	5.7	7
5.00E+01	7.51E+00	5.2	8.3	1.79E+01	3.6	5.3	2.65E+02	7.7	5.3	7.51E+01	6.9	5.2	1.50E+01	3.8	5.8	1.79E+01	3.5	5.3
7.50E+01	2.67E+01	3.7	5.7	6.99E+01	2.9	4.1	6.64E+02	8	6.1	2.40E+02	6.4	5.4	7.00E+01	2.9	4	8.21E+01	2.8	3.8
1.00E+02	8.25E+01	2.9	4.2	1.83E+02	3	3.9	1.97E+03	8.3	6.5	1.47E+03	7.3	5.3	2.01E+02	2.5	3.3	2.34E+02	2.5	3.2
1.50E+02	3.58E+02	2.3	3	1.85E+04	8.9	6.7	2.01E+04	9.6	8	1.91E+04	9.6	7.9	8.75E+02	3.6	3.6	1.41E+03	4.9	4.3
2.00E+02	9.22E+02	2.8	3.4	5.01E+04	11.8	11.8	5.61E+04	11.7	11.6	5.32E+04	11.7	11.6	1.38E+04	9.2	7.8	2.45E+04	9.8	8.5
3.00E+02	2.77E+04	10.7	10.4	7.14E+04	15.5	18.1	1.18E+05	14.7	16.8	1.19E+05	14.6	16.5	1.01E+05	13.3	14.4	1.19E+05	13.7	15.1
5.00E+02	8.73E+04	16.5	18.6	1.05E+05	18.1	21.6	1.73E+05	18.9	21.8	1.78E+05	18.8	21.6	2.16E+05	18.2	21	2.26E+05	18.4	21.4
7.00E+02	1.40E+05	18.5	20.3	1.42E+05	19.5	20.9	1.64E+05	21.3	22.4	1.69E+05	21.3	22.5	1.83E+05	21.6	23	1.87E+05	22.1	23.2
1.00E+03	1.15E+05	20.4	19.2	1.23E+05	21.1	19.6	1.35E+05	22.7	20.4	1.35E+05	22.6	20.4	1.43E+05	23	20.5	1.47E+05	23.2	20.6
2.00E+03	8.33E+04	19.1	13.4	9.17E+04	21	14.4	1.07E+05	22.6	15.9	1.08E+05	22.7	16	1.14E+05	23.2	16.2	1.13E+05	23.3	16.4
3.00E+03	8.56E+04	19.1	12	9.42E+04	20.4	13.4	1.07E+05	22.5	14.6	1.07E+05	22.6	14.6	1.14E+05	23.1	14.8	1.17E+05	23.4	15.1
5.00E+03	9.61E+04	19.4	11.5	1.03E+05	20.4	12.3	1.20E+05	22.5	13.6	1.18E+05	22.7	13.7	1.24E+05	23.2	14	1.27E+05	23.3	14.1
1.00E+04	9.39E+04	16	9.2	1.01E+05	17.8	10.5	1.15E+05	20.5	12	1.15E+05	20.7	12.1	1.20E+05	21.3	12.4	1.28E+05	21.8	12.6
2.00E+04	1.09E+05	15.6	8.9	1.13E+05	16.9	9.7	1.26E+05	19.7	11.2	1.29E+05	19.9	11.3	1.30E+05	20.8	11.6	1.33E+05	21	11.9
5.00E+04	1.39E+05	13.4	7.3	1.44E+05	15.4	8.4	1.55E+05	17.9	9.9	1.51E+05	18.1	10	1.56E+05	18.8	10.3	1.52E+05	19.4	10.8
1.00E+05	1.64E+05	10.6	6.3	1.74E+05	13.1	7.2	1.74E+05	15.4	8.6	1.69E+05	16.1	8.8	1.73E+05	17	9.2	1.76E+05	17.8	9.6

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.28E+03	4.9	1.6	1.00E+04	4.9	1.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.66E+04	4.8	1.7	2.01E+04	4.8	1.7	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.49E+04	4.9	1.8	3.01E+04	4.9	1.8	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.12E+04	5.1	1.9	5.01E+04	5.1	1.9	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.16E+00	5.4	2.3	0.00E+00	1	1	8.21E+04	5.6	2.4	9.94E+04	5.6	2.4	1.03E+02	5.5	2.4	1.48E+01	5.5	2.4
1.40E+01	1.61E+01	5.6	2.7	2.27E-01	4.9	7.2	1.14E+05	5.9	2.7	1.39E+05	5.9	2.7	1.35E+02	5.9	2.7	2.22E+01	5.9	2.7
2.00E+01	3.44E+01	6	3	1.44E+00	4.8	5.5	1.62E+05	6.4	3.3	1.95E+05	6.4	3.3	2.07E+02	6.3	3.2	2.88E+01	6.4	3.3
3.00E+01	9.21E+01	6.3	3.6	6.33E+00	4	5.1	2.37E+05	7.2	4.1	2.84E+05	7.2	4.1	3.43E+02	7	4	4.76E+01	6.9	4
5.00E+01	4.66E+02	6.9	4.5	3.97E+01	3.4	4.3	3.68E+05	8.5	5.9	4.17E+05	8.6	6	6.81E+02	8	5.4	1.16E+02	7.7	5.4
7.50E+01	7.17E+03	7.8	5.1	3.72E+02	5.3	3.5	3.54E+05	10.6	9.1	3.63E+05	10.9	9.5	1.87E+03	8.5	6.4	2.99E+02	7.8	6.3
1.00E+02	2.89E+04	8.7	6.4	5.91E+03	7.7	5.1	3.05E+05	12.4	12.3	3.06E+05	12.6	12.7	4.22E+03	9.4	7.5	1.06E+03	8.1	6.2
1.50E+02	1.02E+05	11	10	5.29E+04	10.3	8.8	2.38E+05	15.1	17.5	2.37E+05	15.2	17.8	1.29E+04	10.8	10	7.31E+03	9.9	8.6
2.00E+02	1.53E+05	13	13.9	1.03E+05	12.2	12.6	2.06E+05	16.8	20.7	2.08E+05	16.9	20.8	2.21E+04	12.5	13	1.63E+04	11.5	11.8
3.00E+02	1.63E+05	16.6	19.9	1.52E+05	15.7	18.6	1.83E+05	19	23.2	1.87E+05	18.9	23.2	4.84E+04	14.1	16.1	4.59E+04	13.7	15.3
5.00E+02	1.67E+05	19.9	22.6	1.82E+05	19.3	22.1	1.81E+05	21.2	23.6	1.84E+05	21.2	23.6	1.21E+05	17.3	20	1.37E+05	17.3	19.8
7.00E+02	1.78E+05	21.3	22.3	1.93E+05	21.4	22.4	1.72E+05	22.7	23	1.78E+05	22.7	23	1.48E+05	19.7	21.3	1.57E+05	20	21.7
1.00E+03	1.46E+05	23.2	20.9	1.37E+05	23	20.6	1.53E+05	24	21.1	1.55E+05	24	21.2	1.21E+05	21.3	19.7	1.27E+05	21.5	19.8
2.00E+03	1.21E+05	23.7	16.5	1.12E+05	23.3	16	1.30E+05	24.6	17.4	1.32E+05	24.7	17.5	9.13E+04	20.5	14.4	9.41E+04	21.1	14.7

Table A.27. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	1.20E+05	23.5	15.2	1.14E+05	23.2	15	1.32E+05	24.5	16	1.33E+05	24.6	16.1	9.31E+04	20.5	13.1	9.41E+04	20.9	13.3
5.00E+03	1.28E+05	23.2	14.2	1.30E+05	22.9	14.1	1.40E+05	24.2	14.8	1.40E+05	24.3	14.9	1.05E+05	21	12.5	1.06E+05	21.2	12.7
1.00E+04	1.27E+05	21.5	12.6	1.20E+05	21.5	12.7	1.41E+05	22.9	13.5	1.42E+05	23.1	13.7	1.02E+05	18.1	10.6	1.02E+05	18.6	10.8
2.00E+04	1.39E+05	20.7	11.6	1.32E+05	20.4	12	1.51E+05	22	12.6	1.54E+05	22.3	12.8	1.13E+05	17.3	9.7	1.14E+05	17.7	10
5.00E+04	1.60E+05	18.9	10.5	1.54E+05	19.2	10.6	1.73E+05	20.2	11.3	1.75E+05	20.6	11.5	1.42E+05	15.4	8.5	1.40E+05	16.1	8.9
1.00E+05	1.86E+05	16.9	9.3	1.74E+05	17.2	9.3	1.99E+05	18.2	10.1	1.91E+05	18.9	10.4	1.67E+05	12.8	7.2	1.62E+05	13.6	7.5

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.21E+03	5.5	2.4	1.86E+02	5.5	2.4	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.58E+03	5.9	2.7	2.79E+02	5.9	2.7	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.48E-01	4.7	9	5.40E-01	4.8	9.6	2.42E+03	6.4	3.2	3.52E+02	6.4	3.2	5.29E-01	7.7	8.9	4.01E-01	5.6	9.7
3.00E+01	1.17E+00	5.4	9.1	1.57E+00	5.4	9.2	3.94E+03	7	4	5.67E+02	7	3.9	1.55E+00	6.1	9.3	1.38E+00	5.6	9
5.00E+01	7.01E+00	5.9	9.1	6.95E+00	6.9	9.9	7.41E+03	8.1	5.4	1.27E+03	8	5.4	6.38E+00	5	9.2	5.31E+00	5.8	10.4
7.50E+01	2.40E+01	3.7	6.1	1.93E+01	4.6	7.4	1.73E+04	8.8	6.6	2.57E+03	8.7	6.6	2.65E+01	3.8	6.3	2.34E+01	4.3	7.1
1.00E+02	6.82E+01	3.1	4.6	6.67E+01	3	4.7	3.38E+04	9.8	8	7.66E+03	8.9	6.8	7.03E+01	3	4.7	7.11E+01	3	4.6
1.50E+02	3.44E+02	2.3	3.1	3.41E+02	2.2	3	8.02E+04	11.4	10.9	3.54E+04	10.8	9.6	3.39E+02	2.3	3.1	3.65E+02	2.3	3
2.00E+02	9.10E+02	2.4	2.7	9.86E+02	2	2.8	1.08E+05	13.5	14.6	5.93E+04	12.6	13.3	9.52E+02	2.3	3.4	9.51E+02	1.9	2.6
3.00E+02	8.24E+03	8.2	8	3.87E+03	4.8	4.7	1.35E+05	16.2	19.1	8.73E+04	15.4	18.1	1.38E+04	11.1	11.6	3.49E+03	4.5	6
5.00E+02	9.04E+04	17	19.3	1.10E+05	15.4	16.9	2.03E+05	18.4	21.4	1.88E+05	18.9	21.9	9.16E+04	15.3	18	1.15E+05	14.7	17.2
7.00E+02	1.21E+05	18.2	20.2	1.47E+05	18.8	21.2	1.78E+05	21.9	23	1.79E+05	21.5	22.9	1.32E+05	18.8	20.7	1.53E+05	19.1	20.9
1.00E+03	1.08E+05	20.5	19.2	1.25E+05	20.7	19.6	1.48E+05	23.2	20.7	1.39E+05	22.8	20.5	1.18E+05	20.4	19.3	1.21E+05	20.9	19.3
2.00E+03	8.20E+04	18.7	13.3	8.49E+04	19.8	13.3	1.17E+05	23.3	16.6	1.13E+05	22.9	16.2	8.48E+04	19	13.4	8.19E+04	19.6	13.4
3.00E+03	8.38E+04	19.3	12.1	8.39E+04	19.9	12.1	1.20E+05	23.6	15.1	1.11E+05	23	14.7	8.48E+04	18.3	12	8.34E+04	19.5	12.1
5.00E+03	9.78E+04	20.5	11.9	9.20E+04	20.3	12.2	1.28E+05	23.4	14.4	1.22E+05	22.4	13.7	9.63E+04	19.5	11.7	1.01E+05	20.1	11.9
1.00E+04	9.35E+04	16.7	9.4	9.12E+04	16.6	9.6	1.29E+05	21.4	12.6	1.17E+05	21.2	12.1	9.36E+04	16.3	9.5	9.15E+04	16.9	9.6
2.00E+04	9.65E+04	16.5	8.3	9.61E+04	14.7	9	1.33E+05	21.1	11.8	1.24E+05	20.1	11.4	1.05E+05	14.8	8.7	1.06E+05	16.2	8.7
5.00E+04	1.34E+05	14.5	7.6	1.23E+05	13.3	7.9	1.62E+05	19.4	10.4	1.55E+05	19.3	10.5	1.25E+05	13	7.7	1.29E+05	15	8.1
1.00E+05	1.57E+05	10.5	6.3	1.46E+05	10.6	6.5	1.77E+05	17.5	9.5	1.65E+05	17.5	9.2	1.63E+05	11.2	6.3	1.46E+05	11.6	6.7

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.62E+01	5.5	2.3	0.00E+00	1	1
1.40E+01	1.25E-01	6.9	9.8	0.00E+00	1	1	1.18E-01	6.8	9.8	1.15E-01	7	10.1	7.05E+01	5.8	2.7	1.75E-01	6.1	8.8
2.00E+01	4.84E-01	7.5	9.6	4.87E-01	7.1	9.6	4.87E-01	7.9	9.3	4.85E-01	7.9	9.8	1.20E+02	6.2	3.1	8.44E-01	4.9	7.4
3.00E+01	1.64E+00	7.2	9.1	1.80E+00	7.1	8.9	1.55E+00	7	9.1	1.59E+00	7.2	9.3	2.51E+02	6.7	3.8	3.58E+00	4.6	6.3
5.00E+01	7.43E+00	5.6	8.2	8.36E+00	5	8.3	6.50E+00	6.1	9.5	7.06E+00	5.9	9.5	8.12E+02	7.7	4.9	1.92E+01	4	5.3
7.50E+01	3.17E+01	3.7	5.5	3.80E+01	3.4	5	2.61E+01	4	6.2	2.86E+01	3.8	6.1	4.85E+03	8.2	5.6	1.10E+02	4.9	4.6
1.00E+02	9.32E+01	2.9	4	1.13E+02	2.7	3.7	7.78E+01	3	4.2	8.46E+01	2.9	4.1	1.38E+04	9.1	7.1	7.83E+02	7.1	5.2
1.50E+02	4.11E+02	2.3	3	4.91E+02	2.3	3	3.71E+02	2.3	3	4.02E+02	2.3	2.9	3.29E+04	11.3	10.7	1.86E+04	9.5	7.7
2.00E+02	1.21E+03	3.4	3.6	1.78E+03	4.7	4.6	9.79E+02	2.3	2.9	1.02E+03	2.2	2.8	4.69E+04	13.2	14.1	4.04E+04	12.1	12.3
3.00E+02	2.67E+04	11.6	11.7	3.42E+04	11.9	12.4	8.77E+03	8.6	8.3	9.30E+03	9	8.8	6.33E+04	15.4	18.3	6.33E+04	15	17.3
5.00E+02	1.07E+05	16.4	18.9	1.41E+05	17.1	19.6	1.05E+05	16.4	19.1	1.26E+05	16.4	19.1	1.19E+05	17.8	20.4	1.36E+05	17.5	20
7.00E+02	1.55E+05	19.2	21	1.65E+05	20	21.7	1.34E+05	19	20.7	1.46E+05	19.6	21.5	1.52E+05	20	21.3	1.55E+05	20.4	21.7
1.00E+03	1.17E+05	21.2	19.6	1.28E+05	21.8	19.8	1.14E+05	20.7	19.2	1.21E+05	21	19.3	1.21E+05	21.5	19.7	1.27E+05	21.7	19.7
2.00E+03	8.90E+04	20.1	14.1	9.52E+04	21.2	14.8	8.26E+04	19.3	13.3	8.60E+04	20.1	14.2	9.32E+04	20.9	14.6	9.66E+04	21.4	14.9
3.00E+03	8.97E+04	20	12.8	9.66E+04	20.9	13.4	8.93E+04	19.7	12.3	8.51E+04	19.7	12.6	9.45E+04	20.7	13.3	9.49E+04	21	13.5
5.00E+03	1.02E+05	20.5	12.2	1.08E+05	21.3	12.6	9.80E+04	19.6	11.7	1.00E+05	20.2	12.1	1.10E+05	21	12.6	1.10E+05	21.4	12.8
1.00E+04	9.85E+04	17.6	10.2	1.07E+05	19	10.9	9.33E+04	16.4	9.6	9.33E+04	17.3	10.2	1.02E+05	18.5	10.7	1.07E+05	18.9	11
2.00E+04	1.09E+05	16.9	9.6	1.13E+05	17.7	10.2	1.04E+05	15.8	8.7	1.07E+05	16.2	9.2	1.19E+05	17.8	10	1.19E+05	18	10.1
5.00E+04	1.40E+05	15.1	8.3	1.45E+05	16.6	9.1	1.40E+05	13.6	7.7	1.35E+05	14.6	7.9	1.43E+05	15.4	8.7	1.47E+05	16.4	9
1.00E+05	1.64E+05	12.4	7	1.65E+05	14.1	7.7	1.69E+05	11.1	6.2	1.63E+05	11.8	7	1.75E+05	13	7.4	1.71E+05	14.2	7.7

(continued on next page)

Table A.27. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.26E+01	5.5	2.4	5.70E+00	5.5	2.4	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.02E+02	5.9	2.7	8.15E+00	5.9	2.9	1.23E-01	5.6	9.1	1.93E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.48E+02	6.4	3.2	1.27E+01	6.3	3.5	5.81E-01	6.6	9	4.25E+00	5.5	3.4	3.98E-01	6.8	9.7	5.03E-01	7.1	10.1
3.00E+01	2.51E+02	7	4	2.37E+01	6.7	4.3	2.65E+00	5.7	7	7.90E+00	5.3	4	1.58E+00	7.1	9.5	1.52E+00	7.1	9.2
5.00E+01	5.50E+02	7.8	5.3	6.83E+01	6.5	5.2	1.56E+01	4	5.9	6.95E+01	6.2	4.1	5.65E+00	6.7	10.6	6.65E+00	6.1	9.8
7.50E+01	1.84E+03	8.2	5.9	3.34E+02	6.6	4.8	6.29E+01	2.9	4.1	5.88E+02	7.7	5.8	1.68E+01	5.4	8.3	2.39E+01	4.2	6.5
1.00E+02	6.10E+03	8.7	6.5	1.81E+03	7.7	5.6	3.89E+02	5.3	4.2	2.60E+03	8.2	6	4.65E+01	3.7	5.6	7.65E+01	3	4.2
1.50E+02	3.23E+04	10.4	9.1	1.34E+04	9.8	8.4	1.16E+04	9.4	7.7	2.01E+04	10.4	8.9	2.64E+02	2.4	3.3	3.72E+02	2.3	3
2.00E+02	7.12E+04	12.1	12.3	4.54E+04	11.3	10.9	1.98E+04	12.3	12.2	3.33E+04	12.2	13.1	8.01E+02	2.1	2.6	1.00E+03	2.2	2.7
3.00E+02	1.27E+05	15.1	17.5	1.12E+05	14.5	16.3	6.89E+04	13.3	14.4	1.04E+05	14.1	15.4	2.60E+03	2.3	3.2	4.37E+03	5.6	6.7
5.00E+02	1.64E+05	19.2	22.1	1.69E+05	18.7	21.7	1.93E+05	18.3	21.4	1.85E+05	19	21.7	5.44E+04	12.9	14.3	1.22E+05	15.9	18.3
7.00E+02	1.58E+05	21.3	22.3	1.62E+05	21.2	22.3	1.74E+05	21.4	22.6	1.79E+05	21.1	22.5	1.41E+05	18	20.2	1.50E+05	19.5	21.2
1.00E+03	1.34E+05	22.5	20.3	1.34E+05	22.4	20.2	1.35E+05	22.5	20.3	1.38E+05	22.5	20.3	1.11E+05	20	18.8	1.22E+05	20.6	19.3
2.00E+03	1.07E+05	22.5	15.8	1.05E+05	22.4	15.7	1.04E+05	22.1	15.9	1.11E+05	23.2	16.1	7.80E+04	18.2	12.5	8.52E+04	19.7	13.6
3.00E+03	1.07E+05	22.4	14.4	1.05E+05	22.3	14.4	1.08E+05	22.9	14.5	1.11E+05	22.6	14.8	7.96E+04	18.2	11.3	8.69E+04	19.5	12.5
5.00E+03	1.20E+05	22.4	13.5	1.17E+05	22.4	13.5	1.15E+05	22.8	13.8	1.22E+05	23.1	13.8	9.13E+04	19.5	11.2	1.00E+05	20.3	12
1.00E+04	1.17E+05	20.4	11.9	1.14E+05	20.3	11.9	1.14E+05	21	12.2	1.10E+05	20.6	12.1	8.71E+04	14.9	8.7	9.69E+04	17.4	10.1
2.00E+04	1.27E+05	19.4	11.1	1.26E+05	19.4	11.1	1.23E+05	19.7	11	1.26E+05	20.4	11.4	1.00E+05	14.2	7.8	1.08E+05	16.2	9
5.00E+04	1.55E+05	17.5	9.7	1.52E+05	17.7	9.8	1.49E+05	18.5	10	1.58E+05	19	10.6	1.34E+05	12.6	7.1	1.31E+05	14	8.1
1.00E+05	1.79E+05	15.1	8.4	1.67E+05	15.5	8.5	1.57E+05	16.1	8.8	1.69E+05	16.9	9.2	1.60E+05	10.4	5.7	1.57E+05	11.7	6.8

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.20E-02	6.9	10.2	1.21E-01	7.4	9.6	1.12E-01	7.3	9.7	1.63E-01	6.2	10.1	1.43E-01	6.6	9.7
2.00E+01	3.89E-01	5.2	9.4	5.99E-01	6.9	9.8	5.17E-01	7.2	9.6	4.78E-01	7.2	9.6	3.68E-01	7.2	9.5	5.35E-01	6.4	9.9
3.00E+01	1.34E+00	7.2	9.3	1.60E+00	7.3	9.3	1.73E+00	6.9	9	1.75E+00	7	8.9	1.69E+00	6.9	9	1.78E+00	6.9	8.8
5.00E+01	5.48E+00	6.2	10.2	5.90E+00	6.8	10.3	7.46E+00	5.3	8.7	7.87E+00	5.4	8.7	7.38E+00	5.3	8.9	9.57E+00	5	7.9
7.50E+01	1.80E+01	5.2	7.9	2.09E+01	4.9	7.9	3.03E+01	3.7	5.5	3.28E+01	3.6	5.3	2.98E+01	3.6	5.2	4.08E+01	3.4	4.8
1.00E+02	5.30E+01	3.2	5.5	5.94E+01	3.4	5	9.06E+01	2.9	4	9.75E+01	2.8	4	9.71E+01	2.8	3.9	1.28E+02	2.6	3.6
1.50E+02	2.81E+02	2.5	3.2	3.14E+02	2.4	3.2	3.92E+02	2.4	3.1	4.23E+02	2.3	3	4.26E+02	2.3	2.9	5.26E+02	2.3	2.9
2.00E+02	8.26E+02	2	2.7	8.83E+02	2.1	2.7	1.66E+03	5.2	5.1	1.22E+03	2.9	3.8	1.09E+03	2.8	3.3	1.31E+03	2.9	4.3
3.00E+02	2.70E+03	3	3.6	3.17E+03	3.6	4.3	2.59E+04	11.5	11.8	2.92E+04	11.7	12	2.83E+04	10.9	10.8	4.94E+04	12.1	12.4
5.00E+02	9.84E+04	14.3	15.3	9.00E+04	14.8	16.8	1.02E+05	16.6	19.3	1.17E+05	17	19.5	1.17E+05	17.1	20	1.37E+05	17.8	20.4
7.00E+02	1.34E+05	18.8	20.4	1.37E+05	18.3	20.4	1.35E+05	19.1	20.8	1.45E+05	19.4	21	1.44E+05	19.4	21.1	1.50E+05	20.2	21.7
1.00E+03	1.11E+05	20.1	19.2	1.17E+05	20.3	19.4	1.15E+05	20.6	19.1	1.21E+05	20.9	19.4	1.16E+05	20.8	19.5	1.23E+05	21.6	19.7
2.00E+03	7.45E+04	18.6	12.5	8.18E+04	19.3	13	8.32E+04	19.4	13.6	8.88E+04	20.3	14	9.08E+04	20.2	14.1	9.37E+04	21.3	14.6
3.00E+03	8.01E+04	18.5	11.8	8.44E+04	18.6	11.9	8.43E+04	19.1	12.3	8.68E+04	19.8	12.6	9.19E+04	20.2	12.7	9.45E+04	20.8	13.4
5.00E+03	8.61E+04	19.3	11.2	9.44E+04	19.1	11.7	1.01E+05	19.8	11.9	9.93E+04	20.3	12.1	1.04E+05	20.5	12.4	1.09E+05	21.3	12.7
1.00E+04	8.98E+04	15.3	9.2	9.29E+04	16.5	9.4	9.76E+04	16.6	9.8	1.02E+05	17.4	10.2	9.63E+04	17.3	10.3	1.04E+05	18.5	10.9
2.00E+04	1.01E+05	14.5	8.5	1.05E+05	15.5	9	1.12E+05	15.9	9.1	1.06E+05	16.1	9.3	1.16E+05	17	9.5	1.15E+05	17.8	10.1
5.00E+04	1.32E+05	12.8	7	1.32E+05	13.7	7.6	1.41E+05	13.9	7.8	1.39E+05	14.8	8.1	1.40E+05	15.2	8.2	1.40E+05	15.6	8.7
1.00E+05	1.70E+05	10.9	5.7	1.62E+05	11.1	6.3	1.65E+05	11	6.4	1.68E+05	12.2	6.9	1.64E+05	11.9	6.8	1.69E+05	13.6	7.1

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.05E-01	5.8	8.7	0.00E+00	1	1	3.11E+00	3.5	4.6	3.11E+00	3.5	4.6
2.00E+01	8.89E-01	6.4	8.2	0.00E+00	1	1	1.44E+01	3.9	4.9	1.44E+01	3.9	4.9
3.00E+01	3.59E+00	4.2	6.5	3.09E+00	5.3	7.5	5.61E+01	4	4.8	5.61E+01	4	4.8
5.00E+01	2.10E+01	3.5	5.3	1.72E+01	4	5.3	3.94E+02	4.5	3.5	3.94E+02	4.5	3.5
7.50E+01	7.01E+01	2.8	4	6.49E+01	3	4.2	3.18E+05	8.1	5.3	3.18E+05	8.1	5.3
1.00E+02	2.20E+02	3.5	3.6	1.84E+02	2.7	3.7	3.46E+05	10.6	9.1	3.46E+05	10.6	9.1
1.50E+02	8.31E+03	8.9	7	4.41E+03	8.3	6.7	2.65E+05	14	15.4	2.65E+05	14	15.4

Table A.27. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.27E+04	11	10.7	2.45E+04	10.7	9.8	2.07E+05	15.4	17.4	2.07E+05	15.4	17.4
3.00E+02	1.19E+05	14.1	16.3	9.35E+04	14.1	16.2	2.13E+05	18.5	21.4	2.13E+05	18.5	21.4
5.00E+02	1.21E+05	19	22.1	1.41E+05	17.7	19.9	1.82E+05	20.8	23.7	1.82E+05	20.8	23.7
7.00E+02	1.70E+05	20	21.6	1.71E+05	20.4	21.8	1.87E+05	22.7	22.7	1.87E+05	22.7	22.7
1.00E+03	1.30E+05	21.8	20	1.32E+05	22.2	20.1	1.62E+05	23.7	21.5	1.62E+05	23.7	21.5
2.00E+03	1.02E+05	21.9	15.4	9.95E+04	21.6	15.2	1.36E+05	25.1	17.6	1.36E+05	25.1	17.6
3.00E+03	9.78E+04	21.4	14.1	9.91E+04	21.7	13.8	1.31E+05	24.7	15.8	1.31E+05	24.7	15.8
5.00E+03	1.14E+05	22.2	13.1	1.09E+05	22.2	13.3	1.28E+05	24	14.6	1.28E+05	24	14.6
1.00E+04	1.12E+05	19.6	11.4	1.02E+05	19.8	11.4	1.27E+05	22.1	13.3	1.27E+05	22.1	13.3
2.00E+04	1.21E+05	19	11	1.29E+05	19.3	10.7	1.66E+05	21.9	13.8	1.66E+05	21.9	13.8
5.00E+04	1.48E+05	17	9.1	1.31E+05	17.1	9.6	1.55E+05	19.3	11.3	1.55E+05	19.3	11.3
1.00E+05	1.66E+05	14.4	8.4	1.63E+05	15.2	8.3	1.72E+05	18.5	10.6	1.72E+05	18.5	10.6

Table A.28. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{55}Mn ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.03E+01	5.4	0.6	3.40E+00	5.4	0.6	7.94E+02	5.3	2.2	9.54E+02	5.3	2.2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.48E+01	5.7	0.7	5.06E+00	5.7	0.7	1.38E+03	5.6	2.4	1.53E+03	5.6	2.5	1.25E-01	7.1	9.6	1.09E-01	7	9.5
2.00E+01	2.25E+01	6.2	0.8	7.29E+00	6.2	0.9	2.60E+03	6	2.8	2.59E+03	6	2.9	5.15E-01	7	9.5	5.62E-01	6.9	9.1
3.00E+01	4.17E+01	6.7	1	1.45E+01	6.7	1.2	5.90E+03	6.5	3.4	5.24E+03	6.6	3.5	1.99E+00	6.2	8.1	1.86E+00	6.1	8
5.00E+01	9.06E+01	7.3	1.4	3.91E+01	6.6	1.6	1.82E+04	7.4	4.4	1.69E+04	7.2	4.3	9.89E+00	4.4	6.9	1.06E+01	4.5	6.7
7.50E+01	2.35E+02	7.3	1.6	1.19E+02	6	1.6	8.37E+04	8.1	5.4	6.08E+04	8.3	5.7	4.13E+01	3.2	4.7	4.63E+01	3.1	4.5
1.00E+02	6.59E+02	7.6	1.6	6.87E+02	6.9	1.4	1.59E+05	9.4	7.3	1.09E+05	9.5	7.5	1.26E+02	3	3.7	1.30E+02	2.7	3.6
1.50E+02	7.68E+03	8.9	1.8	8.37E+03	9	1.8	2.72E+05	11.6	11.1	1.76E+05	11.6	11.1	7.58E+02	5	4.8	5.09E+02	2.6	3.1
2.00E+02	2.55E+04	11	2.6	2.44E+04	11	2.6	2.73E+05	13.9	15.5	2.10E+05	13.4	14.5	3.80E+03	7.9	7	5.10E+03	8.2	6.6
3.00E+02	5.35E+04	13.8	3.9	5.75E+04	13.7	3.8	2.40E+05	17.2	21.4	2.06E+05	16.6	19.9	5.69E+04	12	12.2	6.01E+04	12.2	12.6
5.00E+02	1.26E+05	16.8	5	1.41E+05	16.7	5	1.68E+05	21.2	24.4	1.74E+05	20.4	23.6	1.26E+05	17.1	20	1.30E+05	17.1	20.2
7.00E+02	1.57E+05	19.2	5.6	1.69E+05	19.5	5.6	1.70E+05	21.6	23	1.77E+05	21.2	22.5	1.42E+05	19.4	21.3	1.53E+05	19.4	21.3
1.00E+03	1.33E+05	21	5.5	1.34E+05	21.3	5.5	1.63E+05	23.2	21.4	1.60E+05	22.7	21.3	1.33E+05	20.8	19.9	1.35E+05	20.9	20
2.00E+03	9.81E+04	20.3	4.3	1.00E+05	20.7	4.4	1.33E+05	23	17.6	1.28E+05	22.9	17.5	9.79E+04	20	14.9	9.86E+04	20.3	15.1
3.00E+03	1.00E+05	20.1	4	1.02E+05	20.5	4.1	1.41E+05	23.3	16.3	1.33E+05	23	16.2	9.98E+04	19.9	13.5	1.01E+05	20.1	13.7
5.00E+03	1.15E+05	20.4	3.9	1.18E+05	21	3.9	1.41E+05	22.8	15.1	1.41E+05	22.8	14.9	1.15E+05	20.1	12.8	1.20E+05	20.3	13.1
1.00E+04	1.09E+05	17.7	3.4	1.10E+05	18.4	3.5	1.46E+05	21.5	13.8	1.49E+05	21.5	13.6	1.09E+05	17.6	10.8	1.07E+05	17.7	11.1
2.00E+04	1.25E+05	16.6	3.2	1.22E+05	17.4	3.3	1.53E+05	20.8	12.5	1.46E+05	20.3	12.8	1.24E+05	16.3	10	1.24E+05	16.8	10.2
5.00E+04	1.56E+05	14.9	2.9	1.50E+05	15.8	3	1.83E+05	19.1	11.1	1.79E+05	19	11.4	1.54E+05	14.5	8.7	1.49E+05	15	9
1.00E+05	1.84E+05	12.3	2.5	1.81E+05	13.2	2.6	2.11E+05	17.2	9.9	1.94E+05	17.2	10.2	1.80E+05	11.9	7.3	1.77E+05	12.6	7.5

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.21E+03	5.4	2.2	0.00E+00	1	1
1.40E+01	1.33E-01	7.5	9.8	1.40E-01	7.3	9.9	1.46E-01	6.6	9.9	1.11E-01	7.5	9.4	1.68E+03	5.7	2.6	0.00E+00	1	1
2.00E+01	5.27E-01	7.6	9.5	5.74E-01	7	9.3	4.17E-01	7.6	9.4	5.82E-01	7	9.8	2.61E+03	6.2	3	2.71E-01	5.4	10.4
3.00E+01	1.90E+00	6.8	8.8	1.96E+00	6.6	8.3	1.73E+00	6.8	8.5	1.98E+00	6.4	8.5	3.83E+03	6.8	3.7	2.06E+00	5.4	8.9
5.00E+01	9.60E+00	4.7	7.3	1.07E+01	4.5	6.8	8.27E+00	5.2	7.7	1.15E+01	4.5	6.7	8.14E+03	7.8	5	5.77E+00	6.2	9.9
7.50E+01	4.23E+01	3.2	4.7	5.01E+01	3.1	4.4	3.44E+01	3.6	5.2	4.50E+01	3.2	4.5	2.05E+04	8.5	6	1.80E+01	4.7	7.9
1.00E+02	1.26E+02	2.7	3.6	1.52E+02	2.6	3.4	9.50E+01	2.9	3.9	1.36E+02	2.6	3.5	3.55E+04	9.5	7.4	5.68E+01	3.4	5.2
1.50E+02	5.47E+02	2.6	3.1	5.94E+02	2.3	2.9	4.09E+02	2.3	3	5.04E+02	2.3	3.1	7.25E+04	11.2	10.5	3.06E+02	2.2	3
2.00E+02	2.99E+03	6.5	5.8	2.76E+03	6.2	5.4	1.07E+03	2.8	3.8	4.22E+03	7.5	6.2	1.10E+05	12.8	13.2	8.91E+02	1.9	2.5
3.00E+02	3.94E+04	11.8	11.9	5.74E+04	11.6	11.4	3.20E+04	11.3	11	6.47E+04	12.6	13.3	1.42E+05	15.5	18.1	2.68E+03	2.3	3.2
5.00E+02	1.71E+05	16.6	19.4	1.82E+05	17.4	20.3	1.12E+05	16.2	18.9	1.43E+05	17.2	19.6	1.22E+05	19.4	22.9	7.64E+04	12.8	13.7
7.00E+02	1.71E+05	19.8	21.8	1.84E+05	20.1	22.1	1.44E+05	19	20.8	1.66E+05	19.4	21.4	1.55E+05	19.5	21.3	1.51E+05	17.9	19.9
1.00E+03	1.37E+05	21.4	20.4	1.41E+05	21.8	20.6	1.28E+05	20.6	19.8	1.33E+05	21.1	20.2	1.42E+05	21.6	20.5	1.25E+05	20	19.3
2.00E+03	1.04E+05	21	15.5	1.07E+05	21.4	16	9.01E+04	19.4	14.4	1.01E+05	20.6	15.4	1.10E+05	21.5	16.2	8.47E+04	18.6	13.6
3.00E+03	1.05E+05	20.8	14.3	1.10E+05	21.5	14.7	9.24E+04	19.3	13.2	1.01E+05	20.4	14.1	1.09E+05	21.3	14.8	8.68E+04	18.4	12.6
5.00E+03	1.19E+05	21.2	13.5	1.27E+05	21.8	14	1.06E+05	19.6	12.6	1.16E+05	20.6	13.3	1.17E+05	21.6	14	8.95E+04	19.2	12.1
1.00E+04	1.20E+05	18.8	11.8	1.25E+05	19.8	12.2	1.01E+05	17	10.4	1.07E+05	17.9	11.5	1.24E+05	19.2	12.5	9.44E+04	16.6	9.6
2.00E+04	1.30E+05	17.9	10.8	1.30E+05	18.6	11.5	1.17E+05	15.6	9.8	1.23E+05	17.3	10.5	1.45E+05	19.1	11.2	1.09E+05	15.5	9.1
5.00E+04	1.56E+05	16.2	9.5	1.54E+05	17.1	10.1	1.48E+05	14.3	8.7	1.57E+05	15.2	9	1.57E+05	16.2	9.8	1.31E+05	14	7.8
1.00E+05	1.87E+05	13.8	8.3	1.79E+05	15.1	8.9	1.75E+05	11.9	7	1.84E+05	13.4	7.9	1.88E+05	13.7	8.2	1.51E+05	10.7	6.4

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.36E-01	7.5	9.8	1.34E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	5.30E-01	7.5	9.6	5.25E-01	7.1	9.5	3.71E-01	6.2	9.3	4.18E-01	6.2	9.7	4.88E-01	5.2	7.6	7.26E-01	4.4	7.9
3.00E+01	1.74E+00	6.9	8.8	1.88E+00	6.8	8.7	1.95E+00	6.1	9.1	1.69E+00	7	9	3.87E+00	3.9	6.4	3.74E+00	3.8	6.1
5.00E+01	8.32E+00	5.1	7.7	1.01E+01	4.6	6.9	8.36E+00	5.1	8.1	8.10E+00	5.2	8	2.43E+01	3.3	4.7	3.53E+01	3.1	4.7

Table A.28. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.39E+01	3.5	5.2	4.27E+01	3.3	4.7	2.88E+01	4.1	5.9	3.49E+01	3.7	5.2	9.22E+01	2.8	3.9	9.64E+01	2.7	3.8
1.00E+02	9.69E+01	2.8	4	1.26E+02	2.7	3.7	8.65E+01	3	4.2	1.11E+02	2.9	3.9	2.29E+02	2.6	3.3	2.80E+02	2.5	3.2
1.50E+02	4.05E+02	2.4	3.1	4.56E+02	2.7	3.2	5.62E+02	4.2	4.2	4.61E+02	2.3	3	7.90E+03	7.8	5.5	1.25E+04	7.8	5.6
2.00E+02	2.54E+03	6.4	5.5	4.11E+03	7.7	6.3	3.49E+03	8.1	7	1.66E+03	4.5	5.4	6.11E+04	10	9	7.56E+04	10.7	9.5
3.00E+02	3.18E+04	11.7	12	5.10E+04	12.2	12.5	2.94E+04	11.2	11.7	2.81E+04	11.7	11.7	1.39E+05	14.6	16.7	1.39E+05	14.9	17.5
5.00E+02	1.12E+05	16.3	18.9	1.40E+05	16.8	19.6	1.05E+05	15.4	16.9	1.68E+05	15.3	17.7	1.51E+05	18.8	21.4	1.54E+05	18.6	20.9
7.00E+02	1.46E+05	18.8	20.7	1.60E+05	19.3	21.4	1.65E+05	18.7	20.7	1.81E+05	19.4	21.9	1.66E+05	19.9	21.9	1.88E+05	19.7	21.9
1.00E+03	1.31E+05	20.6	19.9	1.32E+05	21	20.1	1.29E+05	20.8	20.1	1.31E+05	21.3	20.4	1.43E+05	21.6	20.7	1.56E+05	22.1	20.7
2.00E+03	9.23E+04	19.7	14.6	9.91E+04	20.4	15.1	9.41E+04	20	14.6	9.61E+04	20.4	15.1	1.06E+05	21.2	16.1	1.14E+05	22.1	16.6
3.00E+03	9.32E+04	19.3	13.2	9.64E+04	20.3	13.9	9.17E+04	19.4	13.4	1.02E+05	20.5	14.1	1.06E+05	21.5	15.1	1.14E+05	22.1	15.1
5.00E+03	1.07E+05	19.9	12.8	1.14E+05	20.7	13.2	1.09E+05	20.5	12.7	1.10E+05	21	13.5	1.21E+05	21.7	13.6	1.15E+05	21.8	14.4
1.00E+04	1.06E+05	17	10.7	1.14E+05	18.1	11.2	1.03E+05	17.3	10.9	1.06E+05	18.2	11.6	1.23E+05	19.4	12.3	1.17E+05	19.6	12.8
2.00E+04	1.22E+05	15.7	9.5	1.21E+05	17.2	10.5	1.10E+05	16.5	10	1.13E+05	17.4	10.6	1.29E+05	18.9	11.4	1.20E+05	18.9	11.7
5.00E+04	1.53E+05	14.3	8.5	1.55E+05	15.5	9.2	1.43E+05	14.7	8.8	1.44E+05	15.8	9.1	1.62E+05	17	9.8	1.38E+05	17.3	10.4
1.00E+05	1.77E+05	11.9	6.8	1.82E+05	13.1	7.9	1.66E+05	11.8	7.6	1.74E+05	13.8	8.2	1.76E+05	15	8.7	1.63E+05	15	9.3

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.36E+01	5.4	2.3	7.52E+00	5.4	2.3	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.25E-01	4.2	8.8	4.84E+01	5.7	2.6	1.10E+01	5.7	2.7	1.73E-01	7.2	10	1.82E-01	7.2	9.6
2.00E+01	4.26E-01	6.4	9.3	6.41E-01	4.9	7.6	7.31E+01	6.2	3.1	1.53E+01	6.1	3.3	6.90E-01	7.3	9.3	6.67E-01	6.8	8.4
3.00E+01	1.97E+00	6.6	8.8	3.35E+00	5	6.8	1.21E+02	6.8	3.8	2.99E+01	6.6	4	2.40E+00	6.2	8	2.80E+00	5.7	7
5.00E+01	7.65E+00	5.2	8.2	1.80E+01	3.6	5.2	2.73E+02	7.4	5	7.69E+01	6.7	5	1.53E+01	3.8	5.7	1.83E+01	3.5	5.2
7.50E+01	2.70E+01	3.7	5.7	6.96E+01	2.9	4	6.68E+02	7.7	5.7	2.31E+02	6.1	5.1	7.00E+01	2.8	3.9	8.15E+01	2.7	3.8
1.00E+02	8.22E+01	2.9	4.1	1.76E+02	2.8	3.7	1.88E+03	8.1	6	1.37E+03	7	4.8	1.99E+02	2.5	3.3	2.32E+02	2.4	3.2
1.50E+02	3.52E+02	2.3	3	1.70E+04	8.4	6.2	1.93E+04	9.2	7.4	1.84E+04	9.2	7.2	8.27E+02	3.3	3.4	1.26E+03	4.5	3.9
2.00E+02	8.80E+02	2.6	3.2	5.02E+04	11.4	11	5.69E+04	11.2	10.6	5.27E+04	11.2	10.7	1.24E+04	8.7	7.2	2.25E+04	9.4	7.8
3.00E+02	2.21E+04	10.4	9.7	7.44E+04	14.7	17.1	1.22E+05	14.1	15.7	1.21E+05	14	15.5	9.93E+04	12.8	13.4	1.21E+05	13.1	14
5.00E+02	8.91E+04	15.8	17.9	1.10E+05	18	20.7	1.87E+05	18.2	21.2	1.88E+05	18	21	2.29E+05	17.4	20.3	2.45E+05	17.8	20.7
7.00E+02	1.43E+05	18.1	19.9	1.48E+05	18.8	20.8	1.78E+05	20.6	22.4	1.81E+05	20.7	22.4	2.01E+05	21.1	23	1.97E+05	21.2	23.2
1.00E+03	1.23E+05	20.4	19.5	1.33E+05	20.6	20.1	1.47E+05	22.2	20.9	1.45E+05	22.2	20.9	1.59E+05	22.6	21.1	1.57E+05	22.8	21.2
2.00E+03	8.81E+04	19	13.9	9.72E+04	20.2	14.9	1.14E+05	22	16.6	1.15E+05	22.1	16.7	1.16E+05	22.5	16.9	1.23E+05	22.9	17.2
3.00E+03	9.12E+04	18.8	12.9	9.88E+04	19.6	13.5	1.17E+05	21.9	15.3	1.17E+05	22.1	15.3	1.20E+05	22.4	15.5	1.23E+05	22.7	15.8
5.00E+03	1.02E+05	19	12.3	1.10E+05	20.1	13.1	1.30E+05	22	14.3	1.33E+05	22.3	14.4	1.35E+05	22.6	14.6	1.37E+05	23	14.9
1.00E+04	9.98E+04	15.9	9.7	1.07E+05	17.7	10.9	1.23E+05	20	12.7	1.24E+05	20.2	12.7	1.31E+05	20.6	13.1	1.31E+05	21.4	13.4
2.00E+04	1.12E+05	15.4	9.1	1.20E+05	16.5	10.6	1.39E+05	19.1	11.8	1.35E+05	19.4	11.9	1.39E+05	19.6	12.4	1.40E+05	20.3	12.5
5.00E+04	1.47E+05	13.2	8	1.52E+05	15.1	9.1	1.65E+05	17.5	10.4	1.61E+05	17.7	10.6	1.69E+05	18.4	11	1.64E+05	19.1	11.2
1.00E+05	1.72E+05	10.6	6.4	1.84E+05	12.9	7.5	1.92E+05	15.3	9.1	1.83E+05	15.6	9.3	1.86E+05	16.6	9.6	1.79E+05	17.6	10.1

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.77E+03	4.8	1.5	1.06E+04	4.8	1.5	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.75E+04	4.7	1.6	2.12E+04	4.7	1.6	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.62E+04	4.8	1.7	3.18E+04	4.8	1.7	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.36E+04	4.9	1.8	5.30E+04	4.9	1.8	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.40E+00	5.3	2.1	0.00E+00	1	1	8.66E+04	5.4	2.3	1.05E+05	5.4	2.3	1.08E+02	5.4	2.2	1.57E+01	5.4	2.2
1.40E+01	1.68E+01	5.4	2.4	2.29E-01	4.9	7.2	1.21E+05	5.7	2.6	1.46E+05	5.7	2.6	1.41E+02	5.7	2.6	2.28E+01	5.7	2.6
2.00E+01	3.47E+01	5.8	2.9	1.49E+00	4.8	5.4	1.71E+05	6.2	3.1	2.06E+05	6.2	3.1	2.15E+02	6.2	3	2.95E+01	6.2	3.1
3.00E+01	9.31E+01	6.1	3.4	6.48E+00	4	5.1	2.51E+05	6.9	3.9	2.99E+05	6.9	3.9	3.58E+02	6.8	3.8	4.89E+01	6.8	3.9
5.00E+01	4.80E+02	6.8	4.4	3.97E+01	3.3	4.3	3.89E+05	8.2	5.4	4.46E+05	8.3	5.6	6.96E+02	7.8	5.1	1.19E+02	7.6	5
7.50E+01	6.78E+03	7.4	4.7	3.29E+02	4.9	3.5	3.81E+05	10.2	8.4	3.93E+05	10.4	8.7	1.90E+03	8.3	5.9	2.95E+02	7.6	5.9
1.00E+02	2.85E+04	8.4	5.9	5.29E+03	7.3	4.7	3.29E+05	11.9	11.4	3.30E+05	12.1	11.7	4.21E+03	9	6.9	1.01E+03	7.8	5.9
1.50E+02	1.03E+05	10.5	9.2	5.10E+04	9.8	8.1	2.58E+05	14.5	16.3	2.57E+05	14.6	16.6	1.32E+04	10.4	9.2	7.19E+03	9.4	7.9
2.00E+02	1.59E+05	12.5	12.9	1.04E+05	11.8	11.5	2.22E+05	16.2	19.5	2.23E+05	16.2	19.6	2.28E+04	11.9	12	1.63E+04	11.1	10.8
3.00E+02	1.77E+05	15.8	18.8	1.65E+05	15.2	17.5	1.98E+05	18.2	22.4	2.02E+05	18.2	22.4	4.90E+04	13.7	15.1	4.64E+04	13.1	14.4
5.00E+02	1.76E+05	19.2	22.2	1.88E+05	18.4	21.6	1.95E+05	20.4	23.4	1.96E+05	20.4	23.4	1.24E+05	16.7	19.3	1.40E+05	16.6	19.2
7.00E+02	1.92E+05	20.4	22.2	2.04E+05	20.7	22.6	1.86E+05	22	23.1	1.92E+05	22	23.2	1.58E+05	19.2	21.2	1.69E+05	19.4	21.4
1.00E+03	1.57E+05	22.7	21.3	1.48E+05	22.5	21.1	1.66E+05	23.2	21.7	1.67E+05	23.3	21.7	1.33E+05	21	20.1	1.36E+05	21.2	20.2
2.00E+03	1.24E+05	22.7	17.4	1.26E+05	23	17.1	1.41E+05	23.7	18.1	1.41E+05	23.9	18.2	9.77E+04	20.2	15	9.98E+04	20.6	15.3
3.00E+03	1.27E+05	23	16	1.24E+05	22.8	15.6	1.42E+05	23.6	16.8	1.44E+05	23.8	16.8	9.95E+04	20.1	13.7	1.00E+05	20.4	14

(continued on next page)

Table A.28. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	1.37E+05	22.9	14.9	1.37E+05	22.7	14.6	1.53E+05	23.4	15.6	1.54E+05	23.6	15.7	1.11E+05	20.5	13.1	1.14E+05	20.8	13.3
1.00E+04	1.35E+05	21.2	13.5	1.27E+05	21	13.2	1.53E+05	22.2	14.2	1.53E+05	22.4	14.4	1.08E+05	17.8	11	1.08E+05	18.3	11.4
2.00E+04	1.48E+05	20.2	12.5	1.41E+05	19.9	12.5	1.66E+05	21.2	13.3	1.65E+05	21.6	13.4	1.20E+05	16.9	10.3	1.21E+05	17.3	10.6
5.00E+04	1.68E+05	18.4	11.2	1.65E+05	18.8	11.1	1.89E+05	19.5	11.9	1.89E+05	20.1	12.1	1.51E+05	15.1	8.9	1.48E+05	15.8	9.3
1.00E+05	1.99E+05	16.7	10	1.84E+05	16.9	10.1	2.12E+05	17.9	10.6	2.08E+05	18.2	10.9	1.76E+05	12.5	7.6	1.71E+05	13.3	8

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.29E+03	5.4	2.2	1.98E+02	5.4	2.2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.65E+03	5.7	2.6	2.86E+02	5.7	2.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.53E-01	4.7	9	5.55E-01	4.8	9.6	2.51E+03	6.2	3	3.61E+02	6.2	3	5.37E-01	7.7	8.9	4.05E-01	5.6	9.7
3.00E+01	1.18E+00	5.4	9.1	1.60E+00	5.4	9.2	4.11E+03	6.8	3.7	5.84E+02	6.9	3.7	1.59E+00	6.1	9.3	1.40E+00	5.6	9
5.00E+01	7.16E+00	5.8	8.9	7.14E+00	6.9	9.9	7.58E+03	7.8	5.1	1.31E+03	7.9	4.8	6.52E+00	5	9.2	5.35E+00	5.8	10.4
7.50E+01	2.45E+01	3.7	6	1.96E+01	4.6	7.4	1.77E+04	8.6	6.2	2.56E+03	8.4	6.4	2.72E+01	3.7	6.3	2.40E+01	4.3	7.1
1.00E+02	6.83E+01	3	4.5	6.70E+01	3	4.7	3.41E+04	9.3	7.3	7.42E+03	8.5	6.5	7.04E+01	3	4.7	7.21E+01	3	4.6
1.50E+02	3.44E+02	2.2	3.1	3.38E+02	2.1	3	8.30E+04	11	10.1	3.60E+04	10.3	8.8	3.35E+02	2.2	3	3.63E+02	2.3	3
2.00E+02	8.92E+02	2.4	2.6	9.82E+02	2	2.8	1.15E+05	12.8	13.4	6.18E+04	12.2	12.2	9.50E+02	2.3	3.3	9.23E+02	1.8	2.6
3.00E+02	6.17E+03	7.1	7.9	3.63E+03	4.1	4.5	1.42E+05	15.7	18	8.79E+04	14.8	17.2	1.34E+04	10.5	10.6	3.29E+03	4.1	4.9
5.00E+02	9.40E+04	15.7	19	9.93E+04	14.8	16.8	2.16E+05	18	21.2	2.00E+05	17.7	20.7	9.14E+04	14.9	16.2	1.06E+05	14.4	16.2
7.00E+02	1.28E+05	17.9	20.1	1.57E+05	18.1	20.8	1.91E+05	21.1	22.8	1.91E+05	20.7	22.6	1.39E+05	18.5	20.6	1.63E+05	18.3	20.5
1.00E+03	1.15E+05	19.8	19.5	1.36E+05	20.7	19.7	1.60E+05	22.8	21.2	1.49E+05	22.4	21	1.26E+05	20.1	19.9	1.27E+05	20.2	19.6
2.00E+03	8.69E+04	18.6	14.2	9.01E+04	19.4	14.5	1.26E+05	23	17.2	1.20E+05	22.5	16.9	8.99E+04	18.8	13.8	8.88E+04	18.9	14.2
3.00E+03	8.85E+04	18.9	12.5	8.84E+04	19.3	12.3	1.26E+05	22.9	15.8	1.18E+05	22.4	15.6	8.98E+04	19	12.5	8.80E+04	19	12.6
5.00E+03	1.04E+05	19.6	12.2	9.75E+04	19.8	12.3	1.36E+05	23.3	14.9	1.30E+05	22.3	14.6	1.03E+05	19.4	12.5	1.08E+05	19.9	12.4
1.00E+04	9.87E+04	16.3	9.9	9.58E+04	16.2	9.9	1.36E+05	21.3	13.3	1.25E+05	20.7	12.9	9.90E+04	16	9.8	9.62E+04	16.5	10.1
2.00E+04	1.01E+05	15.6	8.8	1.01E+05	14.5	9.4	1.41E+05	20.5	12.6	1.31E+05	19.6	12.4	1.10E+05	14.6	9.1	1.12E+05	16	8.9
5.00E+04	1.41E+05	13.8	8	1.27E+05	13.1	8.2	1.73E+05	19	11.3	1.65E+05	18.6	10.9	1.32E+05	12.8	7.9	1.36E+05	14.4	8.3
1.00E+05	1.65E+05	10.4	6.6	1.52E+05	10.4	6.8	1.87E+05	17.1	9.8	1.74E+05	17.1	9.8	1.71E+05	11.1	6.5	1.53E+05	11.4	7.3

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.78E+01	5.4	2.2	0.00E+00	1	1
1.40E+01	1.27E-01	6.9	9.8	0.00E+00	1	1	1.19E-01	6.8	9.8	1.16E-01	7	10.1	7.28E+01	5.7	2.5	1.77E-01	6.1	8.8
2.00E+01	4.93E-01	7.5	9.6	4.92E-01	7.1	9.6	4.99E-01	7.9	9.3	4.90E-01	7.9	9.8	1.24E+02	6.1	2.9	8.67E-01	4.9	7.4
3.00E+01	1.67E+00	7.2	9.1	1.84E+00	7.1	8.9	1.58E+00	7	9.1	1.62E+00	7.2	9.3	2.58E+02	6.6	3.5	3.62E+00	4.4	6.3
5.00E+01	7.60E+00	5.6	8.1	8.55E+00	5	8.3	6.64E+00	6.1	9.5	7.25E+00	5.9	9.5	8.06E+02	7.4	4.6	1.85E+01	3.9	5.3
7.50E+01	3.22E+01	3.6	5.5	3.85E+01	3.4	5	2.66E+01	4	6.2	2.91E+01	3.8	6.1	4.83E+03	7.8	5.1	9.99E+01	4.6	4.4
1.00E+02	9.36E+01	2.8	4	1.13E+02	2.7	3.7	7.89E+01	3	4.2	8.50E+01	2.9	4.1	1.35E+04	8.8	6.5	7.52E+02	6.9	4.7
1.50E+02	4.06E+02	2.3	3	4.81E+02	2.2	2.9	3.68E+02	2.3	3	3.96E+02	2.3	2.9	3.50E+04	10.8	9.9	1.74E+04	9	7.1
2.00E+02	1.15E+03	3	3.5	1.66E+03	4.3	3.9	9.57E+02	2.2	2.9	9.96E+02	2.1	2.7	4.94E+04	12.6	13	4.13E+04	11.5	11.1
3.00E+02	2.56E+04	11	10.7	3.31E+04	11.3	11.5	6.93E+03	7.5	7.7	8.13E+03	8	8.1	6.61E+04	15	17.3	6.52E+04	14.4	16.3
5.00E+02	1.10E+05	15.9	18.3	1.46E+05	16.4	18.8	1.10E+05	15.9	18.3	1.31E+05	15.7	18	1.24E+05	17.2	19.9	1.42E+05	17	19.4
7.00E+02	1.66E+05	18.7	20.8	1.76E+05	19.4	21.5	1.43E+05	18.5	20.6	1.62E+05	19	21.2	1.61E+05	19.4	21.1	1.72E+05	19.7	21.5
1.00E+03	1.29E+05	20.8	20	1.35E+05	21.4	20.4	1.23E+05	20.2	19.5	1.32E+05	20.7	19.7	1.37E+05	21.1	20.2	1.35E+05	21.3	20.4
2.00E+03	9.56E+04	19.8	14.6	1.00E+05	20.4	15.3	8.60E+04	18.7	14	8.79E+04	19.4	14.5	1.01E+05	20.5	15.3	1.04E+05	20.9	15.6
3.00E+03	9.82E+04	19.8	13.5	1.02E+05	20.6	14	9.35E+04	19	12.8	9.38E+04	19.4	13.2	1.03E+05	20.3	14	1.04E+05	20.6	14.2
5.00E+03	1.10E+05	20.2	12.6	1.14E+05	21	13.3	1.04E+05	19.3	12.1	1.07E+05	19.9	12.8	1.15E+05	20.5	13.3	1.19E+05	20.9	13.5
1.00E+04	1.04E+05	17.3	10.8	1.12E+05	18.3	11.5	9.86E+04	16.2	9.9	1.01E+05	17	10.6	1.13E+05	18.1	11.3	1.15E+05	18.8	11.6
2.00E+04	1.16E+05	16.2	9.9	1.19E+05	17.4	10.9	1.10E+05	15.2	9.4	1.13E+05	16	9.9	1.30E+05	17.1	10.3	1.31E+05	17.6	10.7
5.00E+04	1.47E+05	14.8	8.7	1.53E+05	16.2	9.3	1.47E+05	13.5	8.2	1.44E+05	14.4	8.7	1.54E+05	15.1	9.1	1.55E+05	16	9.5
1.00E+05	1.73E+05	12.1	7.6	1.74E+05	13.9	8.4	1.78E+05	11	6.4	1.73E+05	11.5	7	1.84E+05	12.8	7.7	1.81E+05	13.9	8

Table A.28. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.59E+01	5.4	2.2	5.95E+00	5.4	2.3	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.06E+02	5.7	2.6	8.48E+00	5.7	2.7	1.24E-01	5.6	9.1	1.98E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.54E+02	6.2	3	1.31E+01	6.2	3.3	5.94E-01	6.6	9	4.23E+00	5.3	3.2	4.05E-01	6.8	9.7	5.14E-01	7.1	10.1
3.00E+01	2.60E+02	6.8	3.8	2.45E+01	6.5	4.1	2.70E+00	5.7	6.9	7.16E+00	5	3.9	1.62E+00	7.1	9.5	1.55E+00	7.1	9.2
5.00E+01	5.62E+02	7.6	5	6.89E+01	6.4	4.9	1.58E+01	4	5.8	6.65E+01	6	4	5.78E+00	6.7	10.6	6.79E+00	6.1	9.8
7.50E+01	1.82E+03	7.9	5.5	3.19E+02	6.4	4.6	6.21E+01	2.8	4.1	5.56E+02	7.3	4.7	1.71E+01	5.4	8.3	2.43E+01	4.2	6.5
1.00E+02	5.93E+03	8.4	6.1	1.71E+03	7.4	5.2	3.54E+02	5	4	2.39E+03	7.9	5.4	4.73E+01	3.7	5.6	7.72E+01	3	4.2
1.50E+02	3.22E+04	9.9	8.4	1.29E+04	9.4	7.7	1.09E+04	8.9	6.8	1.97E+04	9.5	8.2	2.63E+02	2.4	3.3	3.63E+02	2.3	2.9
2.00E+02	7.15E+04	11.7	11.4	4.38E+04	10.9	10.1	2.00E+04	11.4	11.8	3.34E+04	12	12.2	7.94E+02	2.1	2.6	9.84E+02	2.1	2.6
3.00E+02	1.33E+05	14.5	16.4	1.16E+05	13.9	15.3	6.76E+04	12.7	13.5	1.06E+05	13.2	14.4	2.53E+03	2.3	3.1	4.07E+03	5.4	5.8
5.00E+02	1.75E+05	18.5	21.5	1.80E+05	18.1	21.1	2.07E+05	17.2	20.8	1.97E+05	17.8	20.9	4.78E+04	12	13.6	1.21E+05	15.2	17.4
7.00E+02	1.71E+05	20.7	22.4	1.76E+05	20.6	22.3	1.87E+05	20.6	22.4	1.90E+05	20.3	22.3	1.47E+05	17.6	19.7	1.57E+05	18.6	20.8
1.00E+03	1.45E+05	22	20.8	1.44E+05	22	20.7	1.53E+05	22	20.8	1.49E+05	22.4	21	1.26E+05	19.7	19.1	1.29E+05	20.3	19.7
2.00E+03	1.14E+05	21.9	16.5	1.12E+05	21.9	16.4	1.13E+05	22	16.5	1.20E+05	22.2	16.7	8.24E+04	18	13.1	9.06E+04	19.4	14.4
3.00E+03	1.16E+05	21.8	15.2	1.13E+05	21.7	15.1	1.15E+05	22.1	15.1	1.19E+05	22.3	15.4	8.75E+04	18	11.7	9.29E+04	19.2	13.1
5.00E+03	1.29E+05	21.8	14.2	1.28E+05	21.9	14.2	1.22E+05	22.2	14.3	1.30E+05	22.4	14.4	9.71E+04	18.2	11.7	1.06E+05	19.9	12.6
1.00E+04	1.24E+05	19.9	12.5	1.23E+05	19.9	12.5	1.21E+05	20.5	12.8	1.16E+05	20.6	13.1	9.20E+04	14.8	9.1	1.03E+05	17.1	10.5
2.00E+04	1.39E+05	18.8	11.7	1.35E+05	18.9	11.6	1.30E+05	19.3	12	1.33E+05	19.9	12.4	1.05E+05	14	8.1	1.14E+05	16.1	9.8
5.00E+04	1.68E+05	17.1	10.2	1.64E+05	17.6	10.3	1.58E+05	18	11	1.69E+05	18.6	11	1.42E+05	12.4	7.1	1.38E+05	13.9	8.4
1.00E+05	1.89E+05	15	8.9	1.84E+05	14.9	9	1.64E+05	15.5	9.3	1.79E+05	16.5	9.6	1.68E+05	10.3	6	1.65E+05	11.6	7.1

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.10E-02	6.9	10.2	1.23E-01	7.4	9.6	1.12E-01	7.3	9.7	1.66E-01	6.2	10.1	1.44E-01	6.6	9.7
2.00E+01	3.91E-01	5.2	9.4	6.16E-01	6.9	9.8	5.30E-01	7.2	9.6	4.85E-01	7.2	9.6	3.66E-01	7.2	9.5	5.48E-01	6.4	9.9
3.00E+01	1.37E+00	7.2	9.3	1.64E+00	7.3	9.3	1.77E+00	6.8	9	1.79E+00	7	8.9	1.73E+00	6.9	9	1.81E+00	6.9	8.8
5.00E+01	5.54E+00	6.2	10.2	6.03E+00	6.8	10.3	7.62E+00	5.2	8.7	8.06E+00	5.4	8.7	7.55E+00	5.3	8.9	9.82E+00	5	7.9
7.50E+01	1.84E+01	5.2	7.9	2.13E+01	4.9	7.9	3.06E+01	3.6	5.5	3.32E+01	3.6	5.3	3.01E+01	3.6	5.2	4.12E+01	3.3	4.7
1.00E+02	5.38E+01	3.2	5.5	6.02E+01	3.4	5	9.09E+01	2.9	4	9.70E+01	2.8	3.9	9.66E+01	2.8	3.9	1.27E+02	2.6	3.5
1.50E+02	2.79E+02	2.5	3.2	3.12E+02	2.4	3.2	3.82E+02	2.4	3.1	4.16E+02	2.3	3	4.19E+02	2.3	2.9	5.16E+02	2.3	2.9
2.00E+02	8.18E+02	2	2.7	8.72E+02	2.1	2.7	1.52E+03	4.5	4.7	1.15E+03	2.8	3.7	1.05E+03	2.7	3.1	1.23E+03	2.8	4.2
3.00E+02	2.64E+03	2.9	3.3	2.97E+03	3.2	4.3	2.45E+04	11.1	11	2.78E+04	11.1	10.9	2.70E+04	10.6	10	4.74E+04	11.6	11.3
5.00E+02	8.24E+04	13.5	14.5	8.57E+04	14.3	15.6	1.05E+05	16	18.5	1.18E+05	16.4	18.8	1.23E+05	16.5	19.2	1.43E+05	17	20.2
7.00E+02	1.41E+05	18.5	20.2	1.44E+05	18.2	20.3	1.42E+05	18.7	20.6	1.60E+05	18.9	20.8	1.50E+05	18.9	21.1	1.64E+05	19.7	21.6
1.00E+03	1.20E+05	19.9	19.4	1.26E+05	19.9	19.7	1.27E+05	20.4	19.7	1.30E+05	20.5	19.8	1.33E+05	20.8	20.2	1.31E+05	21	20.2
2.00E+03	7.84E+04	18.5	13.3	8.65E+04	18.9	13.7	9.33E+04	19.3	14.1	9.29E+04	19.6	14.5	9.52E+04	19.9	14.5	9.89E+04	20.8	15.4
3.00E+03	8.44E+04	18.1	12.5	8.70E+04	18.3	12.4	9.35E+04	19	12.9	9.46E+04	19.4	13.2	9.41E+04	19.5	13.2	1.00E+05	20.1	14
5.00E+03	9.11E+04	18.9	11.8	1.01E+05	19	12	1.04E+05	19.4	12.3	1.12E+05	20	12.7	1.11E+05	20	12.7	1.17E+05	20.9	13.4
1.00E+04	9.53E+04	15.3	9.4	9.75E+04	16.1	9.6	1.03E+05	16.4	10.2	1.05E+05	17.2	10.7	1.02E+05	17.1	10.7	1.10E+05	18.3	11.4
2.00E+04	1.06E+05	14.5	8.9	1.11E+05	15	9.2	1.21E+05	15.5	9.3	1.20E+05	15.9	9.9	1.23E+05	16.8	9.9	1.22E+05	17.3	10.3
5.00E+04	1.38E+05	12.8	7.3	1.39E+05	13.6	7.9	1.54E+05	13.7	8.1	1.49E+05	14.6	8.6	1.47E+05	14.7	8.6	1.48E+05	15.5	9.2
1.00E+05	1.78E+05	10.6	6.5	1.70E+05	10.9	6.5	1.76E+05	10.9	6.8	1.73E+05	12	7.2	1.73E+05	11.6	7.5	1.79E+05	13.2	7.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.16E-01	5.8	8.7	0.00E+00	1	1	3.13E+00	3.4	4.5	3.13E+00	3.4	4.5
2.00E+01	9.09E-01	6.4	8.2	0.00E+00	1	1	1.45E+01	3.9	4.9	1.45E+01	3.9	4.9
3.00E+01	3.73E+00	4.1	6.4	3.16E+00	5.3	7.5	5.50E+01	3.9	4.7	5.50E+01	3.9	4.7
5.00E+01	2.15E+01	3.5	5.2	1.74E+01	3.9	5.2	2.44E+02	4.2	4.6	2.44E+02	4.2	4.6
7.50E+01	7.12E+01	2.8	4	6.50E+01	3	4.2	3.34E+05	7.7	4.8	3.34E+05	7.7	4.8

(*continued on next page*)

Table A.28. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	2.01E+02	3.3	3.5	1.81E+02	2.6	3.6	3.73E+05	10.1	8.3	3.73E+05	10.1	8.3
1.50E+02	7.96E+03	8.5	6.3	4.26E+03	8	6.1	2.87E+05	13.4	14.3	2.87E+05	13.4	14.3
2.00E+02	3.20E+04	10.7	9.8	2.30E+04	10.2	8.9	2.22E+05	14.7	16.9	2.22E+05	14.7	16.9
3.00E+02	1.19E+05	13.5	14.8	9.80E+04	13.6	15	2.32E+05	17.8	20.1	2.32E+05	17.8	20.1
5.00E+02	1.26E+05	18.5	21.1	1.47E+05	17.4	19.9	1.94E+05	20.1	23	1.94E+05	20.1	23
7.00E+02	1.82E+05	19	21.5	1.83E+05	19.7	21.8	2.02E+05	22	23.1	2.02E+05	22	23.1
1.00E+03	1.40E+05	21.7	20.5	1.40E+05	21.8	20.8	1.76E+05	23	21.9	1.76E+05	23	21.9
2.00E+03	1.08E+05	21.3	15.9	1.06E+05	21.3	15.9	1.46E+05	24.2	18.5	1.46E+05	24.2	18.5
3.00E+03	1.03E+05	20.9	14.7	1.05E+05	21.2	15	1.41E+05	23.9	17.2	1.41E+05	23.9	17.2
5.00E+03	1.23E+05	22.1	13.9	1.15E+05	21.6	13.7	1.40E+05	23.3	16	1.40E+05	23.3	16
1.00E+04	1.19E+05	19.2	11.9	1.07E+05	19.4	12.1	1.37E+05	21.4	13.9	1.37E+05	21.4	13.9
2.00E+04	1.28E+05	18.4	11.5	1.37E+05	18.9	11	1.82E+05	21.2	13.9	1.82E+05	21.2	13.9
5.00E+04	1.57E+05	16.8	9.5	1.38E+05	16.7	9.9	1.70E+05	18.7	11.9	1.70E+05	18.7	11.9
1.00E+05	1.75E+05	14	8.7	1.72E+05	15	8.7	1.84E+05	18	11.1	1.84E+05	18	11.1

Table A.29. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{56}Fe ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.04E+01	5.2	0.5	3.60E+00	5.3	0.6	8.22E+02	5.2	2.1	9.91E+02	5.2	2.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.55E+01	5.6	0.6	5.28E+00	5.6	0.7	1.42E+03	5.4	2.3	1.55E+03	5.5	2.3	1.26E-01	7.1	9.6	1.09E-01	7	9.5
2.00E+01	2.33E+01	6	0.8	7.50E+00	6	0.9	2.67E+03	5.8	2.6	2.67E+03	5.8	2.7	5.20E-01	7	9.5	5.73E-01	6.9	9.1
3.00E+01	4.34E+01	6.5	1	1.50E+01	6.3	1.1	6.05E+03	6.2	3.2	5.38E+03	6.4	3.3	2.03E+00	6.2	8.1	1.90E+00	6	7.9
5.00E+01	9.25E+01	7	1.3	4.01E+01	6.2	1.5	1.79E+04	7.1	4.2	1.66E+04	7.1	4.2	1.01E+01	4.4	6.8	1.09E+01	4.4	6.6
7.50E+01	2.33E+02	7.1	1.5	1.19E+02	5.9	1.6	8.54E+04	7.8	5	6.21E+04	8	5.2	4.07E+01	3.2	4.7	4.68E+01	3.1	4.5
1.00E+02	6.27E+02	7.4	1.6	6.33E+02	6.5	1.3	1.65E+05	9	6.7	1.09E+05	9.1	6.9	1.19E+02	2.8	3.5	1.30E+02	2.7	3.6
1.50E+02	7.19E+03	8.5	1.7	8.07E+03	8.6	1.7	2.83E+05	11.1	10.2	1.79E+05	11.1	10.3	7.15E+02	4.6	4.4	4.89E+02	2.4	3
2.00E+02	2.62E+04	10.4	2.4	2.40E+04	10.5	2.4	2.89E+05	13.4	14	2.18E+05	12.9	13.4	3.31E+03	7.7	6.5	4.11E+03	7.3	5.9
3.00E+02	5.49E+04	13.3	3.7	5.78E+04	13.1	3.6	2.57E+05	16.6	20.3	2.31E+05	15.9	18.8	5.37E+04	11.5	11.3	5.70E+04	11.7	11.5
5.00E+02	1.32E+05	16.2	4.8	1.41E+05	16.2	4.8	1.78E+05	20.4	24.1	1.86E+05	19.7	23.2	1.32E+05	16.4	19.2	1.36E+05	16.6	19.3
7.00E+02	1.64E+05	18.6	5.5	1.77E+05	18.8	5.5	1.80E+05	21.2	22.8	1.92E+05	20.6	22.5	1.60E+05	18.8	21	1.56E+05	18.8	21
1.00E+03	1.42E+05	20.4	5.5	1.44E+05	20.7	5.5	1.73E+05	21.9	21.8	1.70E+05	21.9	21.7	1.34E+05	20.3	20.3	1.40E+05	20.4	20.2
2.00E+03	1.03E+05	19.8	4.5	1.05E+05	20.2	4.5	1.41E+05	22.6	18.4	1.34E+05	22.3	18.1	1.03E+05	19.5	15.4	1.03E+05	19.7	15.6
3.00E+03	1.04E+05	19.6	4.1	1.07E+05	20.1	4.2	1.51E+05	22.2	16.9	1.39E+05	22.3	16.8	1.04E+05	19.2	14	1.01E+05	19.5	14.3
5.00E+03	1.19E+05	20	4	1.23E+05	20.4	4.1	1.50E+05	21.8	15.8	1.48E+05	22.2	15.8	1.16E+05	19.7	13.3	1.22E+05	20	13.7
1.00E+04	1.16E+05	17.4	3.5	1.16E+05	18.1	3.6	1.56E+05	21	14.5	1.50E+05	20.8	14.2	1.18E+05	17.3	11.2	1.12E+05	17.4	11.6
2.00E+04	1.25E+05	16.1	3.3	1.31E+05	16.9	3.4	1.62E+05	20.3	13.5	1.66E+05	19.9	13.3	1.29E+05	16	10.5	1.32E+05	16.5	10.5
5.00E+04	1.64E+05	14.6	2.9	1.62E+05	15.6	3	1.94E+05	18.6	11.9	1.97E+05	18.4	11.9	1.64E+05	14.3	9.1	1.64E+05	14.8	9.6
1.00E+05	1.92E+05	12.2	2.6	1.90E+05	13.1	2.7	2.23E+05	16.9	10.7	2.10E+05	16.8	10.5	1.86E+05	11.7	7.8	1.82E+05	12.4	7.9

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.26E+03	5.2	2.1	0.00E+00	1	1
1.40E+01	1.34E-01	7.5	9.8	1.41E-01	7.3	9.9	1.49E-01	6.6	9.9	1.09E-01	7.5	9.4	1.75E+03	5.6	2.4	0.00E+00	1	1
2.00E+01	5.35E-01	7.6	9.5	5.85E-01	7	9.3	4.22E-01	7.6	9.3	5.94E-01	7	9.8	2.73E+03	6	2.8	2.71E-01	5.4	10.4
3.00E+01	1.94E+00	6.8	8.8	2.00E+00	6.6	8.3	1.76E+00	6.8	8.5	2.02E+00	6.4	8.5	3.95E+03	6.6	3.5	2.12E+00	5.4	8.9
5.00E+01	9.83E+00	4.7	7.2	1.10E+01	4.4	6.7	8.48E+00	5.1	7.6	1.18E+01	4.5	6.6	8.35E+03	7.5	4.7	5.95E+00	6.2	9.9
7.50E+01	4.27E+01	3.2	4.6	5.06E+01	3	4.3	3.49E+01	3.6	5.2	4.49E+01	3.2	4.5	2.11E+04	8.2	5.7	1.83E+01	4.7	7.9
1.00E+02	1.26E+02	2.6	3.6	1.51E+02	2.5	3.4	9.44E+01	2.8	3.9	1.35E+02	2.6	3.5	3.63E+04	9.2	7	5.78E+01	3.4	5.2
1.50E+02	5.16E+02	2.4	2.9	5.86E+02	2.2	2.8	4.03E+02	2.3	3	4.87E+02	2.2	3	7.48E+04	10.7	9.7	3.04E+02	2.2	3
2.00E+02	2.55E+03	5.7	5.1	2.22E+03	5.2	4.6	1.04E+03	2.6	3.6	2.93E+03	6.2	5.5	1.14E+05	12.2	12.2	8.80E+02	1.9	2.5
3.00E+02	3.82E+04	11.2	11	5.15E+04	11	10.5	3.11E+04	10.6	9.9	6.44E+04	12	12.1	1.51E+05	14.7	17	2.62E+03	2.2	3.1
5.00E+02	1.74E+05	15.8	18.3	1.91E+05	16.5	19.3	1.16E+05	15.6	18.2	1.47E+05	16.3	19.1	1.28E+05	19.1	22.3	7.19E+04	12.3	12.3
7.00E+02	1.87E+05	19.1	21.4	2.00E+05	19.4	21.7	1.51E+05	18.3	20.5	1.74E+05	18.9	21	1.63E+05	19.3	21.3	1.52E+05	17.5	19.3
1.00E+03	1.47E+05	20.8	20.7	1.52E+05	21.3	21	1.42E+05	20.1	20.1	1.45E+05	20.6	20.6	1.53E+05	21.3	20.9	1.34E+05	19.6	19.6
2.00E+03	1.08E+05	20.4	16.1	1.14E+05	20.9	16.6	9.78E+04	19.2	15.1	1.08E+05	20	15.8	1.15E+05	21	16.8	8.94E+04	18.5	14.1
3.00E+03	1.11E+05	20.3	14.7	1.17E+05	20.9	15.3	9.77E+04	18.9	13.6	1.02E+05	19.6	14.5	1.15E+05	20.7	15.8	9.15E+04	18.2	12.6
5.00E+03	1.27E+05	20.8	14.1	1.33E+05	21.3	14.5	1.13E+05	19.3	13.1	1.26E+05	20.5	13.8	1.24E+05	20.9	14.7	9.42E+04	19	13
1.00E+04	1.25E+05	18.4	12.2	1.28E+05	19.3	12.8	1.11E+05	16.8	11	1.12E+05	17.7	11.9	1.34E+05	19	12.6	9.91E+04	16.6	10.1
2.00E+04	1.38E+05	17.3	11.4	1.42E+05	18.4	12	1.23E+05	15.5	10.2	1.35E+05	16.9	10.8	1.55E+05	18.6	11.8	1.14E+05	15.4	9.6
5.00E+04	1.69E+05	15.9	10.1	1.68E+05	16.9	10.6	1.57E+05	14.1	8.7	1.59E+05	14.8	9.7	1.65E+05	15.6	10	1.37E+05	13.7	8
1.00E+05	1.90E+05	13.6	8.7	1.93E+05	14.8	9.2	1.84E+05	11.8	7.7	1.91E+05	13.3	8.2	1.99E+05	13.4	8.5	1.57E+05	10	6.8

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.38E-01	7.5	9.8	1.35E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3

(continued on next page)

Table A.29. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+01	5.43E-01	7.5	9.6	5.34E-01	7.1	9.5	3.76E-01	6.2	9.3	4.16E-01	6.2	9.7	4.82E-01	5.2	7.6	7.24E-01	4.4	7.9
3.00E+01	1.77E+00	6.9	8.8	1.92E+00	6.8	8.7	2.00E+00	6.1	9.1	1.72E+00	7	9	3.96E+00	3.9	6.4	3.84E+00	3.8	6.1
5.00E+01	8.50E+00	5	7.7	1.04E+01	4.6	6.8	8.55E+00	5	8	8.27E+00	5.2	7.9	2.46E+01	3.3	4.7	3.63E+01	3	4.6
7.50E+01	3.43E+01	3.5	5.2	4.30E+01	3.3	4.7	2.89E+01	4.1	5.9	3.54E+01	3.7	5.1	9.13E+01	2.8	3.8	9.54E+01	2.6	3.8
1.00E+02	9.70E+01	2.8	3.9	1.26E+02	2.7	3.7	8.63E+01	3	4.1	1.12E+02	2.9	3.9	2.18E+02	2.6	3.1	2.80E+02	2.4	3.2
1.50E+02	3.86E+02	2.4	3.1	4.96E+02	2.6	3	5.24E+02	3.6	3.9	4.53E+02	2.2	3	6.45E+03	7.5	5.1	1.04E+04	7.2	5
2.00E+02	2.17E+03	5.8	4.9	3.41E+03	6.8	5.6	3.19E+03	7.6	6.2	1.59E+03	4.2	4.6	5.59E+04	9.8	8.3	7.42E+04	9.8	8.6
3.00E+02	3.12E+04	11.2	11	4.92E+04	11.5	11.5	2.73E+04	10.9	10.7	2.81E+04	11.1	10.2	1.47E+05	13.7	15.3	1.55E+05	14.5	16.1
5.00E+02	1.16E+05	15.8	17.9	1.42E+05	16.2	18.8	9.61E+04	14.5	16.7	1.58E+05	14.6	16.3	1.60E+05	18.1	21	1.61E+05	17.8	20.6
7.00E+02	1.54E+05	18.1	20.4	1.75E+05	18.7	21	1.75E+05	17.9	20.4	1.93E+05	19.2	21	1.77E+05	19.4	21.4	1.99E+05	19.6	21.6
1.00E+03	1.41E+05	20	20.2	1.43E+05	20.5	20.5	1.38E+05	20.3	20.2	1.39E+05	20.6	20.6	1.51E+05	21	21	1.64E+05	21.5	21.1
2.00E+03	9.77E+04	19.2	15.2	1.05E+05	20	15.9	1.00E+05	19.5	15.3	1.06E+05	20.2	15.7	1.12E+05	20.8	16.7	1.21E+05	21.4	17.2
3.00E+03	9.80E+04	18.9	13.8	1.06E+05	19.9	14.5	9.89E+04	19.1	13.7	1.06E+05	20	14.9	1.12E+05	21.2	15.1	1.20E+05	21.4	15.4
5.00E+03	1.14E+05	19.4	13.3	1.18E+05	20.4	13.7	1.15E+05	19.6	13.1	1.23E+05	20.6	14.2	1.28E+05	20.8	14.4	1.21E+05	21.4	14.7
1.00E+04	1.13E+05	16.8	11.1	1.15E+05	17.8	11.8	1.09E+05	17.2	11.1	1.13E+05	18	12.2	1.30E+05	19.1	13.1	1.23E+05	18.9	13.2
2.00E+04	1.25E+05	15.6	10	1.28E+05	16.8	11	1.15E+05	16.3	10.4	1.19E+05	16.8	11.2	1.37E+05	18.6	11.9	1.26E+05	18.4	12.6
5.00E+04	1.59E+05	14.2	8.8	1.59E+05	15.2	9.5	1.50E+05	14.3	8.9	1.51E+05	15.5	9.8	1.72E+05	16.6	10.3	1.44E+05	17.1	10.8
1.00E+05	1.89E+05	11.8	7.4	1.86E+05	13	8.1	1.74E+05	11.7	7.9	1.84E+05	13.5	8.4	1.88E+05	14.8	9.1	1.71E+05	14.4	9.8

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.50E+01	5.2	2.1	7.86E+00	5.2	2.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.32E-01	4.2	8.8	5.04E+01	5.6	2.4	1.15E+01	5.6	2.5	1.76E-01	7.2	10	1.84E-01	7.2	9.6
2.00E+01	4.28E-01	6.4	9.3	6.45E-01	4.9	7.6	7.60E+01	6	2.9	1.57E+01	5.9	3	7.06E-01	7.3	9.3	6.75E-01	6.8	8.3
3.00E+01	2.01E+00	6.6	8.8	3.42E+00	5	6.8	1.25E+02	6.5	3.5	3.09E+01	6.3	3.8	2.45E+00	6.2	8	2.87E+00	5.7	6.9
5.00E+01	7.80E+00	5.1	8.1	1.82E+01	3.5	5.2	2.81E+02	7.1	4.6	7.87E+01	6.3	4.8	1.57E+01	3.8	5.7	1.86E+01	3.4	5.2
7.50E+01	2.73E+01	3.7	5.7	6.93E+01	2.8	4	6.72E+02	7.5	5.4	2.21E+02	6.1	4.8	7.01E+01	2.8	3.9	8.10E+01	2.7	3.7
1.00E+02	8.19E+01	2.8	4.1	1.69E+02	2.7	3.6	1.79E+03	7.8	5.7	1.27E+03	6.7	4.5	1.98E+02	2.5	3.2	2.30E+02	2.4	3.1
1.50E+02	3.47E+02	2.3	2.9	1.41E+04	7.9	5.6	1.86E+04	8.8	6.8	1.77E+04	8.7	6.6	7.87E+02	2.9	3.2	1.03E+03	3.5	3.5
2.00E+02	8.38E+02	2.4	3	5.03E+04	11	9.7	5.77E+04	10.7	9.7	5.22E+04	10.7	9.8	1.09E+04	8.2	6.4	2.05E+04	8.8	7
3.00E+02	1.93E+04	9.7	8.5	7.73E+04	14.1	16.1	1.27E+05	13.5	14.8	1.22E+05	13.4	14.5	9.75E+04	12.2	12.4	1.23E+05	12.5	13
5.00E+02	9.09E+04	15.4	17.9	1.14E+05	17.6	20.1	1.96E+05	17.5	20.4	1.98E+05	17.4	20.2	2.45E+05	16.7	19.3	2.47E+05	17	19.7
7.00E+02	1.47E+05	17.4	19.7	1.53E+05	18.5	20.5	1.90E+05	20	22.2	1.92E+05	19.9	22.2	2.17E+05	20.1	22.5	2.18E+05	20.5	22.9
1.00E+03	1.32E+05	20	19.8	1.44E+05	20.4	20.4	1.57E+05	21.5	21.2	1.56E+05	21.6	21.2	1.66E+05	22	21.5	1.63E+05	22.1	21.6
2.00E+03	9.29E+04	18.6	14.5	1.03E+05	19.8	15.7	1.21E+05	21.5	17.2	1.22E+05	21.6	17.3	1.27E+05	21.8	17.5	1.32E+05	22.2	17.8
3.00E+03	9.56E+04	18.5	12.9	1.03E+05	19.5	14.3	1.22E+05	21.4	15.9	1.22E+05	21.4	15.9	1.27E+05	21.7	16.2	1.35E+05	22.1	16.4
5.00E+03	1.08E+05	18.9	12.7	1.16E+05	19.8	13.7	1.36E+05	21.5	14.9	1.37E+05	21.6	15	1.45E+05	22	15.2	1.46E+05	22.4	15.6
1.00E+04	1.06E+05	15.7	10.7	1.13E+05	17.2	11.7	1.32E+05	19.6	13.3	1.30E+05	19.7	13.3	1.37E+05	20.2	13.7	1.40E+05	20.8	14
2.00E+04	1.15E+05	15.2	9.4	1.27E+05	16.2	10.7	1.43E+05	18.6	12.3	1.45E+05	18.8	12.4	1.46E+05	19.5	12.8	1.44E+05	19.8	13
5.00E+04	1.55E+05	13	8	1.60E+05	14.8	9.2	1.77E+05	17	10.9	1.71E+05	17.4	11.1	1.76E+05	18.3	11.5	1.71E+05	18.7	11.9
1.00E+05	1.80E+05	10.6	6.9	1.95E+05	12.7	8	2.03E+05	14.6	9.5	1.97E+05	15.1	9.7	1.99E+05	16.2	10.3	1.88E+05	17	10.4

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	8.91E+03	4.7	1.5	1.08E+04	4.7	1.5	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.78E+04	4.6	1.5	2.16E+04	4.6	1.5	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.67E+04	4.7	1.6	3.24E+04	4.7	1.6	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.44E+04	4.8	1.8	5.40E+04	4.8	1.8	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.65E+00	5.1	2.1	0.00E+00	1	1	8.85E+04	5.3	2.1	1.07E+05	5.3	2.1	1.14E+02	5.2	2.1	1.66E+01	5.2	2.1
1.40E+01	1.74E+01	5.3	2.4	2.31E-01	4.9	7.2	1.23E+05	5.6	2.4	1.49E+05	5.6	2.4	1.46E+02	5.5	2.4	2.34E+01	5.6	2.4
2.00E+01	3.50E+01	4.7	2.6	1.54E+00	4.8	5.3	1.74E+05	6	2.9	2.10E+05	6	2.9	2.23E+02	6	2.8	3.03E+01	5.8	2.9
3.00E+01	9.41E+01	5.8	3.1	6.64E+00	4	5.1	2.55E+05	6.7	3.6	3.07E+05	6.7	3.6	3.72E+02	6.6	3.5	5.02E+01	6.5	3.6
5.00E+01	4.95E+02	6.6	4	3.97E+01	3.3	4.2	3.99E+05	7.9	5	4.67E+05	7.9	5.1	7.10E+02	7.5	4.8	1.21E+02	7.2	4.7
7.50E+01	6.40E+03	7	4.3	2.86E+02	4.6	3.4	4.07E+05	9.8	7.7	4.20E+05	10	8	1.93E+03	8	5.5	2.90E+02	7.3	5.6
1.00E+02	2.81E+04	8.1	5.4	4.68E+03	6.8	4.1	3.54E+05	11.4	10.4	3.54E+05	11.6	10.8	4.20E+03	8.7	6.5	9.66E+02	7.7	5.7
1.50E+02	1.04E+05	10.1	8.5	4.91E+04	9.3	7.4	2.78E+05	13.9	15.1	2.77E+05	14	15.4	1.33E+04	9.9	8.6	7.06E+03	9	7.2
2.00E+02	1.65E+05	11.9	11.7	1.05E+05	11.2	10.6	2.38E+05	15.5	18.4	2.40E+05	15.6	18.5	2.34E+04	11.5	11.2	1.63E+04	10.7	10
3.00E+02	1.81E+05	15.3	17.7	1.71E+05	14.4	16.3	2.11E+05	17.6	21.5	2.13E+05	17.6	21.5	4.91E+04	13.2	14.4	4.69E+04	12.7	13.5
5.00E+02	1.86E+05	18.8	21.9	1.94E+05	18	21.1	2.07E+05	19.6	22.9	2.11E+05	19.7	22.9	1.28E+05	16.2	18.5	1.44E+05	16.1	18.3
7.00E+02	2.05E+05	20	21.9	2.12E+05	19.9	21.9	1.99E+05	21.2	23.1	2.04E+05	21.2	23.1	1.66E+05	18.4	20.8	1.77E+05	18.8	21.1
1.00E+03	1.69E+05	22.1	21.7	1.59E+05	21.7	21.6	1.78E+05	22.5	22.1	1.80E+05	22.5	22.1	1.42E+05	20.4	20.4	1.43E+05	20.7	20.6
2.00E+03	1.36E+05	22.1	17.9	1.34E+05	22.3	17.7	1.50E+05	23	18.8	1.51E+05	23.1	18.9	1.03E+05	19.8	15.5	1.06E+05	20.2	15.9

Table A.29. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
3.00E+03	1.34E+05	22.2	16.7	1.30E+05	22	16.3	1.50E+05	22.9	17.4	1.52E+05	23	17.5	1.04E+05	19.6	14.3	1.05E+05	20	14.5
5.00E+03	1.47E+05	22.1	15.4	1.44E+05	22.5	15.3	1.62E+05	22.8	16.2	1.63E+05	22.9	16.3	1.18E+05	20.1	13.7	1.21E+05	20.4	13.9
1.00E+04	1.43E+05	20.6	13.9	1.33E+05	20.4	13.9	1.63E+05	21.5	14.9	1.64E+05	21.8	15	1.14E+05	17.5	11.6	1.14E+05	17.9	12
2.00E+04	1.58E+05	19.7	13.1	1.49E+05	19.8	12.9	1.75E+05	20.6	13.9	1.76E+05	20.9	14	1.26E+05	16.4	10.8	1.27E+05	17	11
5.00E+04	1.77E+05	17.9	11.5	1.75E+05	18.3	11.7	2.04E+05	19.1	12.4	2.00E+05	19.4	12.7	1.59E+05	14.8	9.3	1.56E+05	15.4	9.7
1.00E+05	2.12E+05	16.5	10.3	1.95E+05	16.6	10.4	2.27E+05	17.2	11.1	2.20E+05	17.8	11.4	1.85E+05	12.3	7.9	1.81E+05	13.1	8.3

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.36E+03	5.2	2.1	2.09E+02	5.2	2.1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.71E+03	5.5	2.4	2.93E+02	5.6	2.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.58E-01	4.7	9	5.70E-01	4.8	9.6	2.60E+03	6	2.8	3.70E+02	5.8	2.8	5.46E-01	7.7	8.9	4.08E-01	5.6	9.7
3.00E+01	1.19E+00	5.4	9.1	1.62E+00	5.4	9.2	4.28E+03	6.6	3.5	6.01E+02	6.5	3.5	1.62E+00	6.1	9.3	1.42E+00	5.6	9
5.00E+01	7.31E+00	5.8	8.8	7.34E+00	6.9	9.9	7.76E+03	7.6	4.8	1.35E+03	7.5	4.6	6.67E+00	5	9.2	5.39E+00	5.8	10.4
7.50E+01	2.50E+01	3.6	6	1.98E+01	4.6	7.4	1.81E+04	8.3	5.8	2.55E+03	8.1	6	2.78E+01	3.7	6.2	2.47E+01	4.3	7.1
1.00E+02	6.83E+01	3	4.5	6.73E+01	3	4.7	3.44E+04	9.1	6.8	7.18E+03	8.4	6.4	7.05E+01	2.9	4.7	7.31E+01	3	4.5
1.50E+02	3.43E+02	2.2	3.1	3.34E+02	2.1	3	8.58E+04	10.5	9.4	3.66E+04	9.8	7.9	3.32E+02	2.2	3	3.61E+02	2.3	3
2.00E+02	8.74E+02	2.4	2.6	9.77E+02	2	2.8	1.22E+05	12.3	12.5	6.44E+04	11.6	11.1	9.49E+02	2.2	3.1	8.96E+02	1.7	2.6
3.00E+02	4.09E+03	5.1	7.4	3.38E+03	3.4	4.2	1.49E+05	15	17.2	8.85E+04	14.5	16.7	1.30E+04	9.9	9.9	3.09E+03	3.8	4.7
5.00E+02	9.76E+04	15.2	17	8.87E+04	14.2	15.3	2.30E+05	17.8	20.1	2.22E+05	17.4	19.5	9.11E+04	14.5	15.7	9.72E+04	14	15
7.00E+02	1.34E+05	17.4	19.8	1.68E+05	18	20	2.04E+05	20.6	22.7	2.02E+05	19.8	22.2	1.46E+05	17.6	20	1.73E+05	17.9	20.4
1.00E+03	1.22E+05	19.3	20.1	1.47E+05	20.3	19.8	1.72E+05	22.1	21.6	1.60E+05	21.9	21.6	1.35E+05	19.7	20	1.33E+05	19.7	20
2.00E+03	9.17E+04	18.5	14.4	9.54E+04	19	14.5	1.36E+05	22.3	18	1.26E+05	21.9	17.3	9.51E+04	18.6	14	9.66E+04	18.9	14.9
3.00E+03	9.32E+04	18.4	13	9.29E+04	18.6	13.2	1.33E+05	22.3	16.5	1.24E+05	21.7	16.1	9.49E+04	18.3	13.1	9.27E+04	18.6	13.5
5.00E+03	1.09E+05	18.9	13	1.03E+05	19.3	12.6	1.45E+05	22.2	15.6	1.38E+05	22.1	15	1.10E+05	19	12.7	1.15E+05	19.7	13.3
1.00E+04	1.04E+05	16	10.4	1.01E+05	15.8	10.1	1.42E+05	20.7	14	1.34E+05	20.2	13.6	1.04E+05	15.7	10.2	1.01E+05	16.1	10.8
2.00E+04	1.06E+05	14.8	9.4	1.05E+05	14.3	10.2	1.49E+05	19.9	13.1	1.38E+05	19	12.8	1.15E+05	14.5	9.4	1.18E+05	15.7	9.4
5.00E+04	1.48E+05	13.1	8.4	1.32E+05	13	8.6	1.85E+05	18.4	11.4	1.76E+05	17.9	11.1	1.38E+05	12.5	8.2	1.43E+05	13.8	8.9
1.00E+05	1.72E+05	10.4	6.8	1.59E+05	10.2	7.2	1.98E+05	16.6	10.3	1.83E+05	16.7	10.2	1.79E+05	11	6.7	1.61E+05	11.3	7.4

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	4.94E+01	5.2	2.1	0.00E+00	1	1
1.40E+01	1.28E-01	6.9	9.8	0.00E+00	1	1	1.20E-01	6.8	9.8	1.17E-01	7	10.1	7.50E+01	5.5	2.4	1.79E-01	6.1	8.8
2.00E+01	5.02E-01	7.5	9.6	4.97E-01	7.1	9.6	5.11E-01	7.9	9.3	4.95E-01	7.9	9.8	1.28E+02	5.8	2.8	8.90E-01	4.8	7.3
3.00E+01	1.71E+00	7.2	9.1	1.88E+00	7.1	8.9	1.61E+00	7	9.1	1.65E+00	7.2	9.3	2.64E+02	6.3	3.3	3.65E+00	4.2	6.2
5.00E+01	7.76E+00	5.5	8	8.74E+00	5	8.3	6.79E+00	6.1	9.5	7.43E+00	5.9	9.5	8.00E+02	7.2	4.3	1.79E+01	3.8	5.2
7.50E+01	3.27E+01	3.6	5.5	3.89E+01	3.4	5	2.72E+01	3.9	6.2	2.97E+01	3.7	6.1	4.81E+03	7.5	4.7	9.01E+01	4.3	4.1
1.00E+02	9.39E+01	2.8	4	1.13E+02	2.7	3.7	7.99E+01	3	4.2	8.53E+01	2.9	4	1.33E+04	8.5	6	7.21E+02	6.6	4.6
1.50E+02	4.01E+02	2.3	2.9	4.71E+02	2.2	2.9	3.65E+02	2.3	2.9	3.90E+02	2.2	2.9	3.47E+04	10.4	9.1	1.62E+04	8.6	6.3
2.00E+02	1.09E+03	2.7	3.1	1.35E+03	3.8	3.8	9.35E+02	2.2	2.8	9.72E+02	2.1	2.6	5.18E+04	12	12.1	4.22E+04	11	10.2
3.00E+02	2.44E+04	10.3	9.7	3.21E+04	10.7	10.4	5.40E+03	6.8	6.9	6.96E+03	7.3	7	6.88E+04	14.5	16.6	6.64E+04	13.9	15.5
5.00E+02	1.12E+05	15.3	17.6	1.51E+05	15.7	17.9	1.14E+05	15.2	17	1.37E+05	14.8	16.5	1.29E+05	16.7	19.2	1.47E+05	16.3	19
7.00E+02	1.72E+05	18	20.4	1.89E+05	18.8	21.1	1.50E+05	18	20.1	1.65E+05	18.6	20.7	1.66E+05	18.7	20.9	1.77E+05	18.8	21.1
1.00E+03	1.40E+05	20.3	20.4	1.42E+05	20.8	20.7	1.31E+05	19.6	20.1	1.34E+05	20.1	20.1	1.45E+05	20.5	20.5	1.41E+05	20.8	20.7
2.00E+03	9.85E+04	19.3	15.2	1.05E+05	20.2	15.8	9.40E+04	18.7	14.4	9.77E+04	19.1	15.1	1.05E+05	20	15.9	1.07E+05	20.3	16.1
3.00E+03	1.02E+05	19.3	13.8	1.08E+05	20.2	14.7	9.56E+04	18.6	13.2	9.52E+04	19.1	13.7	1.07E+05	19.8	14.5	1.07E+05	20.1	14.7
5.00E+03	1.17E+05	19.8	13.3	1.20E+05	20.6	14	1.10E+05	19.1	13.2	1.14E+05	19.5	13.2	1.24E+05	20.2	13.8	1.23E+05	20.4	13.9
1.00E+04	1.10E+05	17	11.2	1.17E+05	18.2	12.1	1.04E+05	16.1	10.5	1.09E+05	16.8	11.4	1.20E+05	17.8	11.7	1.21E+05	18.4	12.1
2.00E+04	1.22E+05	15.8	10.4	1.25E+05	17	11.1	1.15E+05	14.7	9.8	1.18E+05	15.7	10.6	1.33E+05	16.5	11	1.35E+05	17.3	11.2
5.00E+04	1.54E+05	14.5	9	1.60E+05	15.9	9.7	1.54E+05	13.4	8.5	1.52E+05	14.1	9.1	1.73E+05	14.9	9.5	1.63E+05	15.7	10.1
1.00E+05	1.82E+05	11.8	7.9	1.83E+05	13.8	8.5	1.86E+05	10.9	7.1	1.82E+05	11.3	7.4	1.93E+05	12.6	8.2	1.91E+05	13.7	8.5

(continued on next page)

Table A.29. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	7.92E+01	5.2	2.1	6.21E+00	5.2	2.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.10E+02	5.6	2.4	8.80E+00	5.6	2.5	1.25E-01	5.6	9.1	2.03E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.59E+02	6	2.9	1.36E+01	6	3.1	6.08E-01	6.6	9	4.21E+00	5	3	4.11E-01	6.8	9.7	5.25E-01	7.1	10.1
3.00E+01	2.69E+02	6.5	3.5	2.53E+01	6.3	3.8	2.75E+00	5.7	6.8	6.42E+00	4.8	3.7	1.66E+00	7.1	9.5	1.58E+00	7.1	9.2
5.00E+01	5.74E+02	7.3	4.7	6.95E+01	6.2	4.7	1.61E+01	4	5.8	6.35E+01	5.7	3.8	5.90E+00	6.7	10.6	6.94E+00	6.1	9.8
7.50E+01	1.80E+03	7.6	5.1	3.04E+02	6.1	4.4	6.12E+01	2.8	4.1	5.23E+02	7	4.3	1.75E+01	5.4	8.3	2.48E+01	4.2	6.5
1.00E+02	5.76E+03	8.1	5.7	1.60E+03	7.1	4.8	3.18E+02	4.7	3.7	2.18E+03	7.8	5.3	4.81E+01	3.7	5.6	7.79E+01	3	4.2
1.50E+02	3.21E+04	9.5	7.7	1.24E+04	9	7.1	1.02E+04	8.3	6	1.93E+04	9.2	7.4	2.61E+02	2.4	3.3	3.54E+02	2.2	2.9
2.00E+02	7.18E+04	11.2	10.5	4.21E+04	10.4	9.3	2.02E+04	11.1	10.3	3.36E+04	11.4	10.9	7.88E+02	2.1	2.6	9.67E+02	2.1	2.6
3.00E+02	1.39E+05	13.9	15.4	1.20E+05	13.3	14.2	6.63E+04	12.4	12.7	1.08E+05	12.9	13.7	2.46E+03	2.2	3	3.78E+03	5.2	5.5
5.00E+02	1.84E+05	17.8	20.9	1.89E+05	17.4	20.3	2.21E+05	16.7	19.4	2.09E+05	17.3	20.2	4.13E+04	11.9	12.9	1.20E+05	14.5	16.2
7.00E+02	1.81E+05	20	22.2	1.85E+05	19.9	22.1	2.00E+05	19.6	22.3	2.02E+05	20	22.3	1.55E+05	16.4	18.8	1.65E+05	18.2	20.4
1.00E+03	1.55E+05	21.4	21.1	1.54E+05	21.4	21.1	1.65E+05	21.5	21.2	1.60E+05	21.6	21.5	1.32E+05	19.2	19.6	1.35E+05	19.9	20.1
2.00E+03	1.21E+05	21.4	17.1	1.19E+05	21.3	17	1.22E+05	21.1	17	1.28E+05	21.8	17.4	8.72E+04	17.7	13.3	9.59E+04	19.1	14.9
3.00E+03	1.21E+05	21.2	15.8	1.20E+05	21.2	15.6	1.21E+05	21.6	16.1	1.26E+05	21.9	16.1	9.10E+04	17.3	11.8	9.70E+04	18.9	13.5
5.00E+03	1.37E+05	21.4	14.8	1.36E+05	21.4	14.8	1.29E+05	21.6	15.2	1.38E+05	21.7	15.2	1.03E+05	17.9	12.2	1.12E+05	19.6	13.1
1.00E+04	1.33E+05	19.4	13.1	1.28E+05	19.4	13	1.28E+05	20	13.4	1.22E+05	20.2	13.7	9.69E+04	14.7	9.5	1.10E+05	16.8	10.8
2.00E+04	1.47E+05	18.4	12.2	1.43E+05	18.4	12.2	1.37E+05	18.9	12.6	1.40E+05	19.4	12.5	1.10E+05	13.9	8.3	1.21E+05	16	10.4
5.00E+04	1.77E+05	16.6	10.7	1.72E+05	16.7	10.8	1.66E+05	17.5	11.1	1.80E+05	18.3	11.4	1.50E+05	12.3	7.7	1.45E+05	13.9	8.7
1.00E+05	2.07E+05	14.3	9.3	1.98E+05	14.8	9.4	1.72E+05	15	9.7	1.89E+05	16.2	10	1.76E+05	10.2	6.3	1.73E+05	11.5	7.2

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	9.01E-02	6.9	10.2	1.24E-01	7.4	9.6	1.11E-01	7.3	9.7	1.70E-01	6.2	10.1	1.45E-01	6.6	9.7
2.00E+01	3.93E-01	5.2	9.4	6.34E-01	6.9	9.8	5.43E-01	7.2	9.6	4.93E-01	7.2	9.6	3.64E-01	7.2	9.5	5.60E-01	6.4	9.9
3.00E+01	1.40E+00	7.2	9.3	1.69E+00	7.3	9.3	1.81E+00	6.8	9	1.83E+00	7	8.9	1.76E+00	6.9	9	1.84E+00	6.9	8.8
5.00E+01	5.59E+00	6.2	10.2	6.16E+00	6.8	10.3	7.78E+00	5.2	8.7	8.24E+00	5.4	8.7	7.72E+00	5.3	8.9	1.01E+01	5	7.9
7.50E+01	1.87E+01	5.2	7.9	2.18E+01	4.9	7.9	3.10E+01	3.6	5.4	3.36E+01	3.6	5.2	3.03E+01	3.5	5.2	4.16E+01	3.3	4.7
1.00E+02	5.46E+01	3.2	5.5	6.10E+01	3.4	4.9	9.13E+01	2.9	4	9.65E+01	2.8	3.9	9.62E+01	2.8	3.9	1.26E+02	2.6	3.5
1.50E+02	2.76E+02	2.5	3.2	3.11E+02	2.4	3.2	3.71E+02	2.3	3	4.09E+02	2.3	2.9	4.11E+02	2.2	2.9	5.07E+02	2.3	2.8
2.00E+02	8.11E+02	2	2.7	8.62E+02	2	2.7	1.38E+03	4.3	4.2	1.09E+03	2.7	3.4	1.00E+03	2.6	3	1.16E+03	2.7	3.6
3.00E+02	2.59E+03	2.7	3.1	2.78E+03	2.9	4.1	2.32E+04	10.5	10	2.64E+04	10.5	9.9	1.99E+04	9.7	9	4.54E+04	10.9	10.3
5.00E+02	7.32E+04	12	13.4	8.15E+04	13.4	14.9	1.08E+05	15.5	17.6	1.20E+05	15.7	18	1.28E+05	15.6	18.1	1.49E+05	16.3	19.3
7.00E+02	1.48E+05	17.2	19.9	1.51E+05	17.8	19.5	1.53E+05	18	20.2	1.63E+05	18.2	20.4	1.61E+05	18.1	20.6	1.73E+05	18.9	21.2
1.00E+03	1.28E+05	19.5	19.5	1.35E+05	19.7	19.9	1.32E+05	19.8	19.9	1.38E+05	20	20.1	1.38E+05	20.3	20.2	1.40E+05	20.7	20.7
2.00E+03	8.23E+04	18.1	13.3	9.12E+04	18.7	14.4	9.47E+04	18.8	14.7	1.00E+05	19.3	15.1	9.95E+04	19.3	15.2	1.10E+05	20.2	15.9
3.00E+03	8.87E+04	17.9	12.8	8.97E+04	18	12.8	9.63E+04	18.6	13.5	9.76E+04	18.9	13.7	1.03E+05	19.3	13.8	1.06E+05	20	14.7
5.00E+03	9.61E+04	18.5	12.3	1.08E+05	18.8	12.6	1.11E+05	19	12.9	1.19E+05	19.7	13.3	1.18E+05	19.8	13.4	1.24E+05	20.5	14
1.00E+04	1.01E+05	15.3	9.7	1.02E+05	15.7	10.4	1.09E+05	16.3	10.7	1.10E+05	16.8	11.1	1.07E+05	17	11.5	1.16E+05	18.1	11.9
2.00E+04	1.11E+05	14.5	9.3	1.16E+05	14.6	9.5	1.23E+05	15.2	9.9	1.23E+05	15.7	10.4	1.30E+05	16.3	10.5	1.28E+05	16.9	10.6
5.00E+04	1.45E+05	12.8	7.6	1.46E+05	13.4	8.2	1.62E+05	13.4	8.5	1.59E+05	14.4	9.1	1.55E+05	14.2	8.9	1.55E+05	15.3	10.1
1.00E+05	1.87E+05	10.3	6.6	1.79E+05	10.6	6.9	1.81E+05	10.8	7.1	1.83E+05	11.9	7.6	1.82E+05	11.2	7.6	1.88E+05	12.8	7.9

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.26E-01	5.8	8.7	0.00E+00	1	1	3.16E+00	3.3	4.4	3.16E+00	3.3	4.4
2.00E+01	9.29E-01	6.4	8.2	0.00E+00	1	1	1.46E+01	3.8	4.8	1.46E+01	3.8	4.8
3.00E+01	3.87E+00	4.1	6.4	3.24E+00	5.3	7.5	5.40E+01	3.8	4.6	5.40E+01	3.8	4.6
5.00E+01	2.19E+01	3.5	5.2	1.76E+01	3.9	5.2	2.17E+02	3.7	4.2	2.17E+02	3.7	4.2
7.50E+01	7.24E+01	2.8	4	6.52E+01	2.9	4.2	3.33E+05	7.2	4.2	3.33E+05	7.2	4.2
1.00E+02	1.82E+02	3.1	3.5	1.77E+02	2.6	3.4	3.97E+05	9.6	7.5	3.97E+05	9.6	7.5
1.50E+02	7.60E+03	8.1	5.9	4.10E+03	7.7	5.5	3.04E+05	12.9	13.2	3.04E+05	12.9	13.2

Table A.29. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
2.00E+02	3.12E+04	10.3	8.8	2.16E+04	9.7	8.6	2.37E+05	14.1	16.9	2.37E+05	14.1	16.9
3.00E+02	1.20E+05	13.1	13.8	1.02E+05	13.1	13.4	2.47E+05	17.1	19.6	2.47E+05	17.1	19.6
5.00E+02	1.31E+05	18.2	20.7	1.54E+05	17	19.6	2.06E+05	19.4	22.2	2.06E+05	19.4	22.2
7.00E+02	1.94E+05	18.7	20.9	1.95E+05	19.2	21.6	2.16E+05	21.2	23.5	2.16E+05	21.2	23.5
1.00E+03	1.50E+05	21.1	21.1	1.47E+05	21	20.8	1.90E+05	22.3	22.8	1.90E+05	22.3	22.8
2.00E+03	1.14E+05	20.8	16.5	1.12E+05	20.9	16.4	1.56E+05	23.5	18.7	1.56E+05	23.5	18.7
3.00E+03	1.09E+05	20.4	15.3	1.11E+05	21	15.2	1.49E+05	23.1	17.6	1.49E+05	23.1	17.6
5.00E+03	1.32E+05	21.6	14.3	1.22E+05	21	14.7	1.47E+05	22.6	16.3	1.47E+05	22.6	16.3
1.00E+04	1.26E+05	18.9	12.2	1.13E+05	18.9	12.9	1.45E+05	20.8	14.5	1.45E+05	20.8	14.5
2.00E+04	1.35E+05	17.8	12	1.45E+05	18.5	11.7	1.94E+05	20.6	14	1.94E+05	20.6	14
5.00E+04	1.65E+05	16.5	10	1.45E+05	16.3	10.3	1.82E+05	18.2	12.5	1.82E+05	18.2	12.5
1.00E+05	1.84E+05	13.6	9	1.81E+05	14.9	9.1	1.95E+05	17.4	11.7	1.95E+05	17.4	11.7

Table A.30. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{59}Co ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.04E+01	5.1	0.5	3.80E+00	5.1	0.5	8.50E+02	5	2	1.03E+03	5.1	2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.62E+01	5.4	0.6	5.50E+00	5.4	0.7	1.47E+03	5.3	2.2	1.60E+03	5.3	2.2	1.27E-01	7.1	9.6	1.08E-01	7	9.5
2.00E+01	2.41E+01	5.8	0.7	7.72E+00	5.8	0.9	2.74E+03	5.6	2.5	2.75E+03	5.7	2.6	5.26E-01	7	9.5	5.85E-01	6.9	9
3.00E+01	4.51E+01	6.4	0.9	1.55E+01	6.2	1.1	6.20E+03	6	3	5.51E+03	6.2	3.1	2.07E+00	6.2	8	1.93E+00	6	7.8
5.00E+01	9.45E+01	6.8	1.2	4.10E+01	6.1	1.5	1.75E+04	6.9	3.9	1.64E+04	6.9	3.9	1.03E+01	4.4	6.8	1.11E+01	4.4	6.6
7.50E+01	2.31E+02	6.8	1.4	1.19E+02	5.9	1.6	8.72E+04	7.5	4.6	6.34E+04	7.7	4.9	4.00E+01	3.2	4.7	4.73E+01	3.1	4.5
1.00E+02	5.94E+02	7.1	1.5	5.80E+02	6.2	1.2	1.70E+05	8.6	6.2	1.09E+05	8.8	6.4	1.12E+02	2.7	3.4	1.29E+02	2.6	3.6
1.50E+02	6.70E+03	8.2	1.6	7.77E+03	8.3	1.6	2.88E+05	10.7	9.4	1.89E+05	10.7	9.5	6.71E+02	4.3	4.2	4.68E+02	2.3	3
2.00E+02	2.69E+04	10	2.2	2.36E+04	10.2	2.3	3.06E+05	12.7	13.1	2.32E+05	12.4	12.5	2.83E+03	7.1	6.1	3.56E+03	6.6	5.5
3.00E+02	5.64E+04	12.8	3.5	5.81E+04	12.7	3.4	2.65E+05	16.1	19.3	2.44E+05	15.3	17.7	5.05E+04	11.1	10.4	5.39E+04	11.1	10.7
5.00E+02	1.37E+05	15.6	4.6	1.41E+05	15.6	4.6	1.87E+05	19.6	23.5	2.01E+05	19	22.8	1.38E+05	15.8	18.4	1.41E+05	16	18.4
7.00E+02	1.75E+05	18.1	5.3	1.91E+05	18.2	5.4	1.90E+05	20.7	23	2.10E+05	20	22.4	1.61E+05	18.3	20.7	1.65E+05	18.3	20.6
1.00E+03	1.52E+05	20	5.5	1.55E+05	20.3	5.6	1.84E+05	21.3	22	1.91E+05	21.4	21.9	1.46E+05	19.8	20.4	1.58E+05	20.1	20.5
2.00E+03	1.12E+05	19.5	4.6	1.13E+05	19.8	4.6	1.49E+05	22.1	19	1.50E+05	21.8	18.7	1.08E+05	19.3	16	1.09E+05	19.3	16.1
3.00E+03	1.11E+05	19.3	4.2	1.14E+05	19.7	4.3	1.60E+05	21.8	17.5	1.49E+05	21.6	17.3	1.09E+05	19.1	14.7	1.11E+05	19.1	14.7
5.00E+03	1.29E+05	19.7	4.1	1.33E+05	20	4.1	1.59E+05	21.8	16.4	1.69E+05	21.7	16.3	1.24E+05	19.3	13.9	1.25E+05	19.6	14
1.00E+04	1.24E+05	17.2	3.6	1.24E+05	17.6	3.7	1.65E+05	20.5	15	1.66E+05	20.2	14.7	1.25E+05	17.2	11.9	1.18E+05	17.1	11.9
2.00E+04	1.33E+05	15.8	3.4	1.43E+05	16.9	3.5	1.70E+05	19.7	13.8	1.87E+05	19.4	13.7	1.34E+05	15.7	10.6	1.33E+05	16.3	11.1
5.00E+04	1.75E+05	14.4	3	1.69E+05	15.3	3.1	2.06E+05	18.1	12.6	2.03E+05	18.2	12.4	1.66E+05	14	9.5	1.65E+05	14.6	9.7
1.00E+05	2.00E+05	12.1	2.6	1.92E+05	13	2.8	2.35E+05	16.5	11.3	2.26E+05	16.4	10.8	1.92E+05	11.6	7.9	1.94E+05	12.1	8.2

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.31E+03	5.1	2	0.00E+00	1	1
1.40E+01	1.36E-01	7.5	9.8	1.42E-01	7.3	9.9	1.52E-01	6.6	9.9	1.07E-01	7.5	9.4	1.82E+03	5.4	2.3	0.00E+00	1	1
2.00E+01	5.42E-01	7.6	9.5	5.97E-01	6.9	9.3	4.28E-01	7.6	9.3	6.06E-01	7	9.8	2.84E+03	5.8	2.7	2.70E-01	5.4	10.4
3.00E+01	1.98E+00	6.8	8.8	2.04E+00	6.6	8.2	1.79E+00	6.8	8.5	2.05E+00	6.4	8.5	4.07E+03	6.4	3.3	2.17E+00	5.4	8.9
5.00E+01	1.01E+01	4.6	7.1	1.13E+01	4.4	6.6	8.69E+00	5.1	7.5	1.20E+01	4.5	6.5	8.56E+03	7.3	4.4	6.13E+00	6.2	9.9
7.50E+01	4.31E+01	3.2	4.6	5.12E+01	3	4.3	3.53E+01	3.5	5.2	4.48E+01	3.2	4.5	2.18E+04	7.9	5.3	1.87E+01	4.7	7.9
1.00E+02	1.25E+02	2.6	3.6	1.51E+02	2.5	3.4	9.37E+01	2.8	3.9	1.34E+02	2.6	3.4	3.72E+04	8.8	6.5	5.88E+01	3.4	5.2
1.50E+02	4.85E+02	2.2	2.8	5.79E+02	2.1	2.8	3.97E+02	2.2	2.9	4.70E+02	2.2	2.9	7.72E+04	10.4	9	3.03E+02	2.2	3
2.00E+02	2.11E+03	5.5	4.8	2.00E+03	4.7	4.3	1.02E+03	2.4	3.5	2.64E+03	6.1	5.1	1.19E+05	11.8	11.4	8.69E+02	1.9	2.4
3.00E+02	3.70E+04	10.8	10.3	4.87E+04	10.5	9.8	3.03E+04	10.1	9.1	6.40E+04	11.6	11.2	1.60E+05	14.4	16	2.56E+03	2	2.9
5.00E+02	1.77E+05	15.3	17.4	1.97E+05	15.9	18.5	1.20E+05	15	17.1	1.51E+05	15.8	18.3	1.33E+05	18.2	21.9	6.75E+04	11.8	12.2
7.00E+02	1.93E+05	18.5	21	2.16E+05	18.7	21.2	1.59E+05	17.8	20	1.80E+05	18.2	20.6	1.71E+05	18.8	21.3	1.53E+05	17	18.4
1.00E+03	1.57E+05	20.4	21	1.66E+05	20.8	21.2	1.51E+05	19.7	20.4	1.52E+05	20.3	20.7	1.63E+05	20.7	21.1	1.43E+05	19.2	20
2.00E+03	1.19E+05	20	16.6	1.20E+05	20.5	17.1	1.05E+05	19	15.7	1.13E+05	19.7	16.3	1.20E+05	20.5	17.3	9.40E+04	18.3	14.3
3.00E+03	1.18E+05	20	15.3	1.25E+05	20.5	15.9	1.04E+05	18.7	14.2	1.14E+05	19.6	15	1.22E+05	20.2	15.8	9.62E+04	18	13.5
5.00E+03	1.35E+05	20.3	14.7	1.42E+05	20.7	15	1.21E+05	19	13.9	1.33E+05	20.1	14.5	1.32E+05	20.2	15.3	9.90E+04	18.8	13.2
1.00E+04	1.31E+05	18.3	12.6	1.36E+05	18.5	13.4	1.16E+05	16.5	11.4	1.20E+05	17.5	12	1.43E+05	18.8	13.4	1.04E+05	16.5	10.5
2.00E+04	1.43E+05	17	11.8	1.50E+05	17.8	12.4	1.30E+05	15.5	10.7	1.38E+05	16.6	11.4	1.66E+05	18.2	12.6	1.20E+05	15.3	10.1
5.00E+04	1.79E+05	15.6	10.3	1.79E+05	16.7	11.1	1.65E+05	13.8	8.8	1.61E+05	14.4	10.2	1.73E+05	15	10.3	1.44E+05	13.4	8.3
1.00E+05	2.02E+05	13.4	8.8	2.04E+05	14.5	9.7	1.93E+05	11.6	7.7	1.98E+05	13.1	8.3	2.10E+05	13	8.9	1.64E+05	9.4	7.1

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.40E-01	7.5	9.8	1.35E-01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E-01	3.5	7.3
2.00E+01	5.55E-01	7.5	9.6	5.43E-01	7.1	9.5	3.81E-01	6.2	9.3	4.15E-01	6.2	9.7	4.75E-01	5.2	7.6	7.23E-01	4.4	7.9
3.00E+01	1.81E+00	6.9	8.8	1.96E+00	6.8	8.7	2.06E+00	6.1	9.1	1.74E+00	7	9	4.06E+00	3.9	6.4	3.93E+00	3.8	6.1
5.00E+01	8.68E+00	5	7.6	1.06E+01	4.5	6.8	8.74E+00	5	7.9	8.45E+00	5.2	7.9	2.50E+01	3.3	4.7	3.73E+01	3	4.6

Table A.30. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
7.50E+01	3.46E+01	3.5	5.1	4.33E+01	3.3	4.6	2.91E+01	4.2	5.9	3.59E+01	3.6	5.1	9.05E+01	2.8	3.8	9.44E+01	2.6	3.8
1.00E+02	9.70E+01	2.8	3.9	1.25E+02	2.6	3.6	8.61E+01	3	3.9	1.13E+02	2.9	3.8	2.07E+02	2.6	3	2.80E+02	2.4	3.1
1.50E+02	3.67E+02	2.3	3	4.87E+02	2.4	3	4.85E+02	3.1	3.6	4.46E+02	2.2	2.9	5.01E+03	7.2	4.6	8.25E+03	7	4.6
2.00E+02	1.79E+03	5.2	4.5	2.71E+03	6.3	5.2	2.90E+03	7.1	5.4	1.51E+03	4	3.8	5.08E+04	9.3	7.4	7.27E+04	9.4	7.8
3.00E+02	3.05E+04	10.7	10.3	4.74E+04	11.1	10.6	2.51E+04	10.5	9.7	2.80E+04	10.3	9.8	1.55E+05	13.3	14.1	1.60E+05	13.6	15.1
5.00E+02	1.20E+05	15.1	17.2	1.43E+05	15.6	18	8.69E+04	14.1	16.2	1.47E+05	14.2	15.8	1.70E+05	17.4	20.5	1.67E+05	17.3	19.8
7.00E+02	1.61E+05	17.7	20	1.82E+05	18.2	20.6	1.85E+05	17	19.5	2.00E+05	17.9	20.7	1.88E+05	18.9	21.1	2.11E+05	18.8	21.3
1.00E+03	1.47E+05	19.6	20.3	1.52E+05	20.1	20.7	1.47E+05	19.7	20.6	1.49E+05	20.3	20.9	1.59E+05	20.5	21.4	1.72E+05	20.5	21.4
2.00E+03	1.08E+05	19.1	15.5	1.14E+05	19.7	16.2	1.06E+05	19.2	15.5	1.15E+05	20	16.4	1.18E+05	20.6	17.4	1.28E+05	20.7	17.5
3.00E+03	1.06E+05	18.7	14.2	1.09E+05	19.3	14.9	1.06E+05	18.9	14.4	1.10E+05	19.4	15.1	1.18E+05	20.1	15.9	1.25E+05	20.6	16.6
5.00E+03	1.22E+05	19	13.8	1.33E+05	20	14.3	1.21E+05	19.5	14.3	1.30E+05	20.2	14.5	1.36E+05	20.3	15.2	1.27E+05	20.9	15.7
1.00E+04	1.22E+05	16.7	11.4	1.21E+05	17.5	12.1	1.15E+05	16.9	11.7	1.20E+05	17.8	12.3	1.38E+05	18.7	13.4	1.30E+05	18.8	13.8
2.00E+04	1.29E+05	15.4	10.8	1.34E+05	16.4	11.3	1.21E+05	16.2	10.7	1.25E+05	16.3	12	1.45E+05	18.2	12.6	1.32E+05	18	12.6
5.00E+04	1.65E+05	14	9.2	1.63E+05	14.9	9.8	1.57E+05	13.9	9.1	1.59E+05	15.2	9.8	1.82E+05	16.3	11.1	1.51E+05	16.9	11.2
1.00E+05	1.94E+05	11.7	7.6	1.87E+05	12.5	8.5	1.83E+05	11.5	8.4	1.93E+05	13.3	8.8	1.99E+05	14.6	9.5	1.79E+05	13.9	10.2

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.63E+01	5.1	2	8.20E+00	5.1	2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.38E-01	4.2	8.8	5.25E+01	5.4	2.3	1.20E+01	5.4	2.4	1.78E-01	7.2	10	1.87E-01	7.2	9.6
2.00E+01	4.30E-01	6.4	9.3	6.49E-01	4.9	7.6	7.88E+01	5.8	2.7	1.61E+01	5.8	2.9	7.21E-01	7.3	9.3	6.83E-01	6.8	8.2
3.00E+01	2.06E+00	6.6	8.8	3.49E+00	5	6.8	1.29E+02	6.3	3.3	3.19E+01	6.2	3.6	2.50E+00	6.2	8	2.94E+00	5.7	6.8
5.00E+01	7.94E+00	5.1	8	1.83E+01	3.5	5.1	2.88E+02	6.9	4.4	8.05E+01	6.1	4.5	1.60E+01	3.7	5.6	1.90E+01	3.4	5.1
7.50E+01	2.75E+01	3.7	5.7	6.90E+01	2.8	4	6.75E+02	7.2	5.1	2.12E+02	6	4.6	7.02E+01	2.8	3.9	8.04E+01	2.7	3.7
1.00E+02	8.16E+01	2.8	4.1	1.62E+02	2.5	3.4	1.70E+03	7.5	5.4	1.16E+03	6.3	4.3	1.96E+02	2.4	3.2	2.28E+02	2.4	3.1
1.50E+02	3.41E+02	2.2	2.8	1.13E+04	7.7	5.1	1.78E+04	8.5	6.3	1.70E+04	8.4	6.1	7.72E+02	2.7	3	9.35E+02	3.2	3.3
2.00E+02	7.96E+02	2.1	2.8	5.04E+04	10.4	8.8	5.85E+04	10.3	9	5.17E+04	10.3	9.1	9.51E+03	7.8	5.9	1.85E+04	8.4	6.4
3.00E+02	1.65E+04	8.7	7.9	8.03E+04	13.7	15.1	1.32E+05	13.1	13.9	1.23E+05	12.9	13.6	9.57E+04	11.7	11.5	1.25E+05	12.1	12.1
5.00E+02	9.27E+04	14.9	16.9	1.19E+05	16.7	19.5	2.05E+05	16.8	19.7	2.09E+05	16.7	19.5	2.46E+05	16.1	18.5	2.56E+05	16.4	18.9
7.00E+02	1.51E+05	17	19.1	1.59E+05	18.3	19.8	2.01E+05	19.3	21.9	2.06E+05	19.3	21.9	2.39E+05	19.5	22.2	2.34E+05	19.8	22.6
1.00E+03	1.40E+05	19.5	20.2	1.55E+05	20.2	20.6	1.68E+05	21	21.5	1.68E+05	21.1	21.5	1.73E+05	21.5	21.8	1.77E+05	21.6	21.9
2.00E+03	9.77E+04	18.3	15	1.08E+05	19.4	16.2	1.31E+05	21	17.7	1.30E+05	21	17.7	1.36E+05	21.4	18	1.42E+05	21.6	18.3
3.00E+03	9.99E+04	18.1	13.6	1.08E+05	19.2	14.6	1.32E+05	20.9	16.4	1.30E+05	20.9	16.5	1.37E+05	21.4	16.6	1.41E+05	21.6	16.9
5.00E+03	1.14E+05	18.8	13.4	1.23E+05	19.5	14.1	1.48E+05	21	15.5	1.45E+05	21.1	15.6	1.56E+05	21.5	15.8	1.54E+05	21.6	16.1
1.00E+04	1.12E+05	15.6	11	1.19E+05	17	11.9	1.44E+05	19.2	13.7	1.39E+05	19.3	13.8	1.44E+05	20	14.2	1.51E+05	20.2	14.4
2.00E+04	1.18E+05	14.2	10	1.33E+05	15.9	10.7	1.51E+05	18.1	12.8	1.59E+05	18.4	12.9	1.53E+05	18.7	13.1	1.67E+05	19.4	13.4
5.00E+04	1.62E+05	12.7	8.5	1.68E+05	14.5	9.4	1.88E+05	16.8	11.3	1.84E+05	17.1	11.4	1.83E+05	17.5	11.8	1.83E+05	18.4	12.3
1.00E+05	1.88E+05	10.6	7.1	2.05E+05	12.5	8.1	2.11E+05	14.5	9.9	2.00E+05	15.1	10.1	2.12E+05	15.8	10.5	1.95E+05	16.7	11.2

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.38E+03	4.6	1.4	1.14E+04	4.6	1.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.88E+04	4.5	1.5	2.28E+04	4.5	1.5	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.81E+04	4.6	1.5	3.41E+04	4.6	1.5	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.68E+04	4.7	1.7	5.67E+04	4.7	1.7	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.89E+00	5	1.9	0.00E+00	1	1	9.31E+04	5.1	2	1.13E+05	5.1	2	1.20E+02	5.1	2	1.76E+01	5.1	2
1.40E+01	1.81E+01	5.1	2.2	2.34E-01	4.9	7.2	1.30E+05	5.4	2.3	1.57E+05	5.4	2.3	1.51E+02	5.4	2.3	2.39E+01	5.4	2.3
2.00E+01	3.53E+01	5.4	2.6	1.59E+00	4.8	5.1	1.83E+05	5.9	2.7	2.21E+05	5.9	2.7	2.31E+02	5.8	2.7	3.10E+01	5.8	2.8
3.00E+01	9.50E+01	5.6	3.1	6.80E+00	4	5.1	2.70E+05	6.5	3.4	3.23E+05	6.5	3.4	3.86E+02	6.4	3.3	5.16E+01	6.3	3.4
5.00E+01	5.10E+02	6.4	3.8	3.97E+01	3.2	4.1	4.22E+05	7.6	4.7	4.94E+05	7.7	4.8	7.24E+02	7.3	4.5	1.24E+02	7.1	4.4
7.50E+01	6.02E+03	6.8	4	2.42E+02	4.3	3.4	4.35E+05	9.4	7.1	4.51E+05	9.6	7.4	1.96E+03	7.7	5.1	2.86E+02	7.1	5.2
1.00E+02	2.77E+04	7.8	5	4.06E+03	6.6	3.8	3.80E+05	11	9.7	3.83E+05	11.2	10	4.18E+03	8.5	6	9.21E+02	7.3	5.3
1.50E+02	1.05E+05	9.7	7.8	4.73E+04	8.9	6.8	2.98E+05	13.4	14.1	2.98E+05	13.5	14.3	1.34E+04	9.6	7.9	6.93E+03	8.6	6.7
2.00E+02	1.71E+05	11.4	11	1.06E+05	10.9	9.9	2.57E+05	15	17.3	2.57E+05	15	17.4	2.42E+04	11.1	10.4	1.63E+04	10.4	9.3
3.00E+02	1.97E+05	14.5	16.7	1.78E+05	13.9	15.2	2.26E+05	16.9	20.6	2.28E+05	16.9	20.6	4.97E+04	12.8	13.5	4.75E+04	12.2	12.8
5.00E+02	1.95E+05	18.1	21.5	2.01E+05	17.3	20.6	2.21E+05	18.9	22.4	2.25E+05	19	22.4	1.32E+05	15.6	17.8	1.48E+05	15.6	17.6
7.00E+02	2.18E+05	19.4	21.5	2.39E+05	19.1	21.6	2.13E+05	20.5	23	2.18E+05	20.5	23	1.74E+05	18	20.3	1.87E+05	18.2	20.6
1.00E+03	1.81E+05	21.4	22.1	1.70E+05	21.3	22	1.92E+05	21.8	22.3	1.95E+05	21.9	22.3	1.53E+05	20.1	20.6	1.54E+05	20.3	20.8
2.00E+03	1.45E+05	21.6	18.6	1.44E+05	21.6	18.2	1.61E+05	22.3	19.3	1.62E+05	22.4	19.4	1.10E+05	19.5	16.1	1.13E+05	19.8	16.4
3.00E+03	1.41E+05	21.5	17.1	1.40E+05	21.4	17	1.63E+05	22.2	18	1.64E+05	22.3	18.1	1.09E+05	19.2	14.7	1.11E+05	19.6	15.1

(continued on next page)

Table A.30. (*continued*)

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
5.00E+03	1.56E+05	21.3	16.3	1.50E+05	21.6	15.9	1.74E+05	22.1	16.8	1.75E+05	22.2	16.9	1.26E+05	19.7	14.2	1.28E+05	20	14.4
1.00E+04	1.51E+05	20.1	14.6	1.40E+05	19.9	14.4	1.74E+05	20.9	15.4	1.74E+05	21.1	15.5	1.20E+05	17.2	12	1.21E+05	17.5	12.4
2.00E+04	1.67E+05	19.3	13.6	1.57E+05	18.9	13.3	1.83E+05	19.9	14.3	1.92E+05	20.2	14.5	1.32E+05	16.1	11.1	1.34E+05	16.6	11.4
5.00E+04	1.86E+05	17.4	12.1	1.86E+05	17.9	12.2	2.15E+05	18.6	12.9	2.14E+05	18.9	13.2	1.66E+05	14.5	9.6	1.64E+05	15.1	10.1
1.00E+05	2.26E+05	16.4	10.6	2.05E+05	16.3	10.7	2.50E+05	16.5	11.5	2.38E+05	17.4	11.9	1.93E+05	12	8.2	1.90E+05	12.9	8.6

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.43E+03	5.1	2	2.21E+02	5.1	2	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.78E+03	5.4	2.3	3.01E+02	5.4	2.3	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.63E-01	4.7	9	5.86E-01	4.8	9.6	2.70E+03	5.8	2.7	3.79E+02	5.8	2.7	5.54E-01	7.7	8.9	4.12E-01	5.6	9.7
3.00E+01	1.19E+00	5.4	9.1	1.65E+00	5.4	9.2	4.45E+03	6.4	3.3	6.18E+02	6.3	3.2	1.65E+00	6.1	9.3	1.44E+00	5.6	9
5.00E+01	7.46E+00	5.7	8.7	7.53E+00	6.9	9.9	7.93E+03	7.4	4.5	1.39E+03	7.3	4.3	6.82E+00	5	9.2	5.44E+00	5.8	10.4
7.50E+01	2.55E+01	3.6	5.9	2.01E+01	4.6	7.4	1.85E+04	8	5.4	2.55E+03	7.8	5.5	2.84E+01	3.6	6.1	2.53E+01	4.3	7.1
1.00E+02	6.84E+01	3	4.5	6.76E+01	3	4.6	3.47E+04	8.8	6.4	6.94E+03	8.2	5.9	7.06E+01	2.9	4.7	7.41E+01	2.9	4.5
1.50E+02	3.42E+02	2.2	3	3.31E+02	2.1	2.9	8.86E+04	10.1	8.7	3.73E+04	9.4	7.4	3.28E+02	2.1	2.9	3.58E+02	2.2	3
2.00E+02	8.56E+02	2.4	2.5	9.73E+02	1.9	2.8	1.29E+05	12	11.5	6.69E+04	11.5	10.5	9.47E+02	2.2	3	8.68E+02	1.7	2.5
3.00E+02	4.06E+03	4.8	6.3	3.14E+03	2.7	4	1.56E+05	14.3	16.2	8.92E+04	13.9	15.9	1.27E+04	9.3	8.4	2.89E+03	3.5	4.6
5.00E+02	1.01E+05	15	16.4	7.82E+04	13.6	14.2	2.43E+05	16.7	19.1	2.45E+05	16.5	19	9.09E+04	14	15.4	8.82E+04	13.9	14.9
7.00E+02	1.41E+05	17	19	1.78E+05	17	19.7	2.18E+05	19.6	22.5	2.14E+05	19.3	21.9	1.52E+05	17.1	19.7	1.83E+05	17.3	19.7
1.00E+03	1.28E+05	19.1	19.9	1.58E+05	19.6	19.9	1.85E+05	21.5	21.9	1.70E+05	21.3	21.8	1.43E+05	19.3	20.2	1.40E+05	19.2	20.6
2.00E+03	9.65E+04	18.4	14.7	1.01E+05	18.6	15.3	1.46E+05	21.5	18.5	1.32E+05	21.5	18.1	1.00E+05	18.4	14.9	1.07E+05	18.9	15.4
3.00E+03	9.79E+04	18	13.8	9.74E+04	18	13.6	1.40E+05	21.4	17	1.31E+05	21.1	16.8	9.99E+04	18	13.6	9.73E+04	18.1	13.9
5.00E+03	1.15E+05	18.8	13.3	1.09E+05	18.8	13.9	1.54E+05	21.9	16	1.45E+05	21.6	15.8	1.16E+05	18.9	13	1.22E+05	19.5	13.5
1.00E+04	1.09E+05	15.6	10.9	1.05E+05	15.3	10.5	1.49E+05	20.2	14.5	1.42E+05	19.7	14.2	1.10E+05	15.4	10.9	1.06E+05	15.7	11
2.00E+04	1.11E+05	13.9	9.9	1.10E+05	14.1	10.4	1.56E+05	19.2	13.5	1.45E+05	18.5	12.8	1.20E+05	14.4	9.8	1.23E+05	15.5	10
5.00E+04	1.55E+05	12.3	8.7	1.37E+05	12.8	8.9	1.96E+05	18	12.5	1.86E+05	17.2	12.2	1.44E+05	12.3	8.4	1.49E+05	13.2	9.3
1.00E+05	1.79E+05	10.4	7.1	1.66E+05	10	7.5	2.08E+05	16.2	10.8	1.91E+05	16.2	10.5	1.87E+05	10.9	6.9	1.68E+05	11.2	7.4

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	5.10E+01	5.1	2	0.00E+00	1	1
1.40E+01	1.29E-01	6.9	9.8	0.00E+00	1	1	1.22E-01	6.8	9.8	1.18E-01	7	10.1	7.73E+01	5.4	2.2	1.82E-01	6.1	8.8
2.00E+01	5.12E-01	7.5	9.6	5.01E-01	7.1	9.6	5.22E-01	7.9	9.3	5.00E-01	7.9	9.8	1.32E+02	5.7	2.6	9.13E-01	4.8	7.2
3.00E+01	1.74E+00	7.2	9.1	1.91E+00	7.1	8.9	1.64E+00	7	9.1	1.68E+00	7.2	9.3	2.71E+02	6.1	3.1	3.69E+00	4	6.2
5.00E+01	7.93E+00	5.5	8	8.94E+00	4.9	8.3	6.93E+00	6.1	9.5	7.62E+00	5.9	9.5	7.94E+02	7	4.1	1.72E+01	3.8	5.1
7.50E+01	3.32E+01	3.6	5.4	3.94E+01	3.4	4.9	2.77E+01	3.9	6.2	3.03E+01	3.7	6.1	4.79E+03	7.2	4.4	8.03E+01	3.9	3.9
1.00E+02	9.43E+01	2.8	3.9	1.13E+02	2.7	3.7	8.09E+01	3	4.2	8.57E+01	2.8	4	1.30E+04	8.1	5.6	6.89E+02	6.3	4.3
1.50E+02	3.96E+02	2.3	2.9	4.62E+02	2.1	2.8	3.62E+02	2.3	2.9	3.85E+02	2.2	2.9	3.43E+04	9.9	8.4	1.50E+04	8.3	5.9
2.00E+02	1.03E+03	2.5	3.1	1.26E+03	3.3	3.5	9.14E+02	2.2	2.8	9.48E+02	2	2.6	5.43E+04	11.6	11.3	4.31E+04	10.8	9.3
3.00E+02	2.32E+04	10	8.9	3.10E+04	10.2	9.7	4.43E+03	5.8	6.4	5.79E+03	7	6.7	7.16E+04	13.9	15.6	7.01E+04	13.5	14.7
5.00E+02	1.14E+05	14.8	16.7	1.57E+05	15.2	17	1.19E+05	14.3	16.2	1.42E+05	14.2	15.9	1.34E+05	16.1	18.6	1.53E+05	15.9	18.3
7.00E+02	1.78E+05	17.5	19.7	2.04E+05	18.2	20.5	1.56E+05	17.6	19.8	1.71E+05	17.7	20.1	1.75E+05	18.2	20.3	1.89E+05	18.3	20.8
1.00E+03	1.51E+05	20	20.5	1.55E+05	20.5	20.9	1.39E+05	19.5	20.1	1.48E+05	19.9	20.4	1.58E+05	20.3	20.7	1.60E+05	20.2	20.8
2.00E+03	1.10E+05	19.3	15.7	1.10E+05	19.7	16.4	9.98E+04	18.5	15	1.03E+05	18.8	15.5	1.12E+05	19.6	16.3	1.16E+05	20	16.5
3.00E+03	1.05E+05	18.9	14.3	1.13E+05	19.7	15.1	1.00E+05	18.2	13.7	1.05E+05	18.8	14.1	1.14E+05	19.4	15	1.16E+05	19.9	15.3
5.00E+03	1.24E+05	19.3	13.8	1.26E+05	19.9	14.6	1.16E+05	18.8	13.3	1.20E+05	19.1	13.5	1.27E+05	19.6	14.3	1.33E+05	20.2	14.6
1.00E+04	1.16E+05	16.8	11.5	1.22E+05	17.6	12.6	1.09E+05	15.9	10.9	1.16E+05	16.6	11.5	1.26E+05	17.5	12.3	1.30E+05	18.1	12.8
2.00E+04	1.28E+05	15.6	10.6	1.32E+05	16.7	11.7	1.21E+05	14	10	1.24E+05	15.5	10.6	1.41E+05	16.4	11.2	1.42E+05	16.8	11.6
5.00E+04	1.61E+05	14.2	9.3	1.68E+05	15.5	10	1.60E+05	13.2	8.8	1.60E+05	13.8	9.4	1.74E+05	14.7	9.9	1.71E+05	15.3	10.2
1.00E+05	1.91E+05	11.6	8.1	1.93E+05	13.6	8.8	1.95E+05	10.7	7.2	1.91E+05	11	7.9	2.02E+05	12.5	8.4	2.01E+05	13.5	8.9

Table A.30. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.26E+01	5.1	2	6.46E+00	5.1	2	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.14E+02	5.4	2.3	9.13E+00	5.4	2.4	1.26E-01	5.6	9.1	2.09E-01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.65E+02	5.8	2.7	1.41E+01	5.8	3	6.21E-01	6.6	9	4.19E+00	4.7	2.9	4.18E-01	6.8	9.7	5.37E-01	7.1	10.1
3.00E+01	2.78E+02	6.3	3.3	2.61E+01	6.2	3.6	2.81E+00	5.7	6.7	5.68E+00	4.6	3.6	1.70E+00	7.1	9.5	1.61E+00	7.1	9.2
5.00E+01	5.86E+02	7.1	4.4	7.00E+01	6	4.5	1.64E+01	4.1	5.8	6.05E+01	5.5	3.6	6.02E+00	6.7	10.6	7.08E+00	6.1	9.8
7.50E+01	1.77E+03	7.4	4.8	2.89E+02	6	4.3	6.04E+01	2.8	4.1	4.91E+02	6.6	4.2	1.79E+01	5.4	8.3	2.52E+01	4.2	6.5
1.00E+02	5.59E+03	7.8	5.4	1.49E+03	6.8	4.5	2.83E+02	4.4	3.5	1.98E+03	7	5	4.90E+01	3.7	5.6	7.85E+01	3	4.1
1.50E+02	3.20E+04	9.2	7.2	1.19E+04	8.7	6.6	9.47E+03	8.1	5.8	1.89E+04	8.6	6.8	2.60E+02	2.4	3.2	3.45E+02	2.2	2.9
2.00E+02	7.21E+04	10.7	9.7	4.05E+04	10	8.7	2.04E+04	10.7	9.7	3.37E+04	10.8	10.1	7.81E+02	2.1	2.6	9.49E+02	2	2.6
3.00E+02	1.45E+05	13.4	14.4	1.24E+05	12.8	13.3	6.51E+04	11.9	12.1	1.10E+05	12.4	12.7	2.38E+03	2.1	2.9	3.49E+03	5	5.5
5.00E+02	1.95E+05	17.2	20.2	2.00E+05	16.8	19.6	2.35E+05	16.5	18.5	2.21E+05	17	19.6	3.47E+04	11.4	11.9	1.20E+05	14.1	15.2
7.00E+02	1.95E+05	19.4	21.9	1.99E+05	19.3	21.8	2.13E+05	19.4	21.9	2.14E+05	19.5	21.6	1.56E+05	16.1	18.1	1.76E+05	17.6	20
1.00E+03	1.67E+05	20.9	21.4	1.67E+05	20.9	21.3	1.77E+05	21.3	21.7	1.71E+05	21.2	21.6	1.40E+05	18.9	19.7	1.40E+05	19.5	20.3
2.00E+03	1.30E+05	20.9	17.6	1.27E+05	20.8	17.5	1.31E+05	21.1	17.6	1.37E+05	21.4	18.1	9.07E+04	17.7	13.8	1.01E+05	18.8	15.4
3.00E+03	1.30E+05	20.7	16.3	1.27E+05	20.7	16.2	1.28E+05	21.1	16.2	1.34E+05	21.1	16.7	9.45E+04	17.3	12.7	1.01E+05	18.5	14
5.00E+03	1.47E+05	20.9	15.4	1.44E+05	20.9	15.3	1.36E+05	21.2	15.6	1.45E+05	21	15.6	1.09E+05	17.7	12.5	1.18E+05	19.3	13.8
1.00E+04	1.42E+05	19	13.6	1.37E+05	19	13.5	1.34E+05	19.5	13.9	1.28E+05	19.5	13.8	1.02E+05	14.6	9.9	1.16E+05	16.5	11.3
2.00E+04	1.54E+05	17.9	12.6	1.53E+05	17.9	12.6	1.44E+05	18.5	12.9	1.48E+05	18.8	13	1.15E+05	13.7	9.4	1.27E+05	15.9	10.5
5.00E+04	1.86E+05	16.4	11.2	1.82E+05	16.7	11.2	1.75E+05	17	11.4	1.91E+05	17.9	11.7	1.57E+05	12.1	8	1.52E+05	13	9
1.00E+05	2.13E+05	14.3	9.6	2.10E+05	14.5	9.8	1.80E+05	14.4	10.2	2.00E+05	15.8	10.3	1.84E+05	10.1	6.5	1.80E+05	11.3	7.4

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	8.92E-02	6.9	10.2	1.25E-01	7.4	9.6	1.11E-01	7.3	9.7	1.73E-01	6.2	10.1	1.46E-01	6.6	9.7
2.00E+01	3.95E-01	5.2	9.4	6.51E-01	6.9	9.8	5.55E-01	7.2	9.6	5.01E-01	7.2	9.6	3.62E-01	7.2	9.5	5.73E-01	6.4	9.9
3.00E+01	1.43E+00	7.2	9.3	1.73E+00	7.3	9.3	1.85E+00	6.8	9	1.87E+00	7	8.9	1.80E+00	6.9	9	1.88E+00	6.9	8.8
5.00E+01	5.65E+00	6.2	10.2	6.28E+00	6.8	10.3	7.95E+00	5.1	8.7	8.43E+00	5.4	8.7	7.89E+00	5.3	8.9	1.03E+01	5	7.9
7.50E+01	1.91E+01	5.2	7.9	2.22E+01	4.9	7.9	3.14E+01	3.6	5.4	3.40E+01	3.6	5.2	3.06E+01	3.5	5.1	4.20E+01	3.3	4.7
1.00E+02	5.55E+01	3.2	5.5	6.18E+01	3.4	4.9	9.16E+01	2.9	4	9.60E+01	2.8	3.9	9.57E+01	2.8	3.9	1.25E+02	2.5	3.5
1.50E+02	2.74E+02	2.5	3.2	3.10E+02	2.3	3.2	3.61E+02	2.3	3	4.02E+02	2.2	2.9	4.04E+02	2.2	2.8	4.97E+02	2.2	2.8
2.00E+02	8.03E+02	1.9	2.7	8.51E+02	2	2.6	1.24E+03	3.9	3.7	1.02E+03	2.6	3	9.60E+02	2.5	2.9	1.09E+03	2.6	3.4
3.00E+02	2.53E+03	2.6	2.8	2.59E+03	2.6	3.8	2.18E+04	10.1	9.3	2.50E+04	9.9	9.1	1.67E+04	9.6	8.3	4.34E+04	10.4	9.3
5.00E+02	6.39E+04	11.6	12.1	7.73E+04	12.6	13.7	1.11E+05	14.9	16.9	1.22E+05	15.2	17.2	1.34E+05	15.2	17.4	1.55E+05	15.7	18.2
7.00E+02	1.55E+05	16.9	19	1.57E+05	17.3	19	1.58E+05	17.6	19.9	1.65E+05	17.7	20	1.62E+05	17.9	20.4	1.78E+05	18.5	20.7
1.00E+03	1.37E+05	19	20.1	1.44E+05	19.5	20.2	1.40E+05	19.6	20.1	1.46E+05	19.8	20.4	1.60E+05	19.8	20.2	1.48E+05	20.3	20.8
2.00E+03	8.62E+04	17.2	14	9.60E+04	18.2	14.5	1.01E+05	18.7	15.2	1.06E+05	18.9	15.6	1.04E+05	19.3	15.8	1.16E+05	19.8	16.5
3.00E+03	9.30E+04	17.8	12.9	9.24E+04	17.7	13.4	1.01E+05	18.2	13.9	1.06E+05	18.8	14.4	1.05E+05	18.8	14.2	1.11E+05	19.7	15.2
5.00E+03	1.01E+05	18.1	12.9	1.15E+05	18.7	12.9	1.22E+05	18.8	13.4	1.25E+05	19.4	13.7	1.25E+05	19.4	13.9	1.32E+05	20.1	14.4
1.00E+04	1.06E+05	15.3	10	1.07E+05	15.4	10.4	1.14E+05	16.2	11.2	1.19E+05	16.7	11.5	1.12E+05	16.9	11.6	1.23E+05	17.9	12.3
2.00E+04	1.16E+05	14.5	9.7	1.22E+05	14.2	9.8	1.26E+05	14.8	10.1	1.28E+05	15.5	10.8	1.37E+05	16.2	10.5	1.35E+05	16.4	11.6
5.00E+04	1.52E+05	12.7	7.9	1.54E+05	13.2	8.5	1.65E+05	13.2	8.9	1.69E+05	14.2	9.2	1.62E+05	13.7	9.3	1.63E+05	15.2	10.4
1.00E+05	1.96E+05	10	6.7	1.88E+05	10.3	7.4	1.92E+05	10.8	7.4	1.92E+05	11.8	8	1.90E+05	10.9	7.8	1.97E+05	12.5	8.5

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.36E-01	5.8	8.7	0.00E+00	1	1	3.19E+00	3.2	4.3	3.19E+00	3.2	4.3
2.00E+01	9.48E-01	6.4	8.2	0.00E+00	1	1	1.46E+01	3.8	4.8	1.46E+01	3.8	4.8
3.00E+01	4.02E+00	4	6.3	3.31E+00	5.3	7.5	5.30E+01	3.8	4.5	5.30E+01	3.8	4.5
5.00E+01	2.24E+01	3.5	5.1	1.78E+01	3.8	5.1	2.18E+02	3.9	4.5	2.18E+02	3.9	4.5
7.50E+01	7.36E+01	2.8	3.9	6.53E+01	2.9	4.2	3.45E+05	6.9	3.8	3.45E+05	6.9	3.8

(continued on next page)

Table A.30. (*continued*)

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	1.63E+02	2.8	3.4	1.74E+02	2.5	3.3	4.24E+05	9.2	6.9	4.24E+05	9.2	6.9
1.50E+02	7.24E+03	7.7	5.6	3.94E+03	7.4	5.5	3.25E+05	12.4	12.3	3.25E+05	12.4	12.3
2.00E+02	3.05E+04	9.7	8.1	2.01E+04	9.3	7.8	2.52E+05	13.5	14.7	2.52E+05	13.5	14.7
3.00E+02	1.21E+05	12.6	12.8	1.07E+05	12.4	12.7	2.67E+05	16.5	19.1	2.67E+05	16.5	19.1
5.00E+02	1.35E+05	17.2	20.2	1.60E+05	16.7	19	2.19E+05	18.7	21.4	2.19E+05	18.7	21.4
7.00E+02	2.06E+05	17.9	20.1	2.08E+05	18.6	21.2	2.33E+05	20.5	23.5	2.33E+05	20.5	23.5
1.00E+03	1.59E+05	20.6	21.2	1.54E+05	20.9	21.3	2.07E+05	21.6	22.6	2.07E+05	21.6	22.6
2.00E+03	1.20E+05	20.3	17.1	1.18E+05	20.5	16.9	1.67E+05	22.8	19.2	1.67E+05	22.8	19.2
3.00E+03	1.14E+05	19.9	15.5	1.17E+05	20.6	15.7	1.61E+05	22.5	17.9	1.61E+05	22.5	17.9
5.00E+03	1.41E+05	20.3	15.1	1.28E+05	20.4	15	1.57E+05	21.9	16.8	1.57E+05	21.9	16.8
1.00E+04	1.32E+05	18.5	12.9	1.18E+05	18.5	13.4	1.54E+05	20.2	15.1	1.54E+05	20.2	15.1
2.00E+04	1.42E+05	17.1	12	1.53E+05	18.1	12.3	2.09E+05	19.9	14.2	2.09E+05	19.9	14.2
5.00E+04	1.74E+05	16.2	10.4	1.52E+05	15.9	10.4	1.95E+05	17.7	13.1	1.95E+05	17.7	13.1
1.00E+05	1.92E+05	13.2	9.1	1.90E+05	14.7	9.5	2.13E+05	16.8	12.2	2.13E+05	16.8	12.2

Table A.31. Particle fluence to organ absorbed dose conversion coefficients, D_T/Φ, in units of pGy cm^2, and mean quality factors [Q_{ICRP60} based on $Q(L)$ and Q_{NASA} based on $Q(Z,E)$] for the organs and tissues of the male and female reference phantoms for isotropic exposure by ^{59}Ni ions.

	Red bone marrow						Breast						Colon					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	1.05E+01	5	0.5	3.99E+00	5	0.5	8.78E+02	4.9	1.9	1.07E+03	5	1.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.69E+01	5.3	0.6	5.72E+00	5.3	0.6	1.51E+03	5.2	2.1	1.65E+03	5.2	2.1	1.28E−01	7.1	9.6	1.07E−01	7	9.5
2.00E+01	2.50E+01	5.6	0.7	7.93E+00	5.8	0.8	2.81E+03	5.5	2.4	2.84E+03	5.5	2.4	5.32E−01	7	9.5	5.96E−01	6.9	9
3.00E+01	4.68E+01	6.1	0.9	1.60E+01	6	1	6.35E+03	5.9	2.8	5.64E+03	6	2.9	2.11E+00	6.2	7.9	1.96E+00	5.9	7.8
5.00E+01	9.64E+01	6.6	1.2	4.19E+01	6	1.4	1.72E+04	6.6	3.7	1.61E+04	6.8	3.8	1.05E+01	4.3	6.7	1.14E+01	4.3	6.5
7.50E+01	2.29E+02	6.7	1.4	1.18E+02	5.4	1.5	8.89E+04	7.2	4.3	6.47E+04	7.4	4.5	3.94E+01	3.1	4.7	4.78E+01	3	4.5
1.00E+02	5.62E+02	6.8	1.4	5.26E+02	5.8	1.2	1.76E+05	8.3	5.7	1.09E+05	8.5	6	1.05E+02	2.5	3.3	1.29E+02	2.6	3.6
1.50E+02	6.21E+03	7.8	1.5	7.47E+03	7.8	1.5	2.90E+05	10.3	8.7	1.90E+05	10.3	8.8	6.27E+02	3.9	3.7	4.48E+02	2.1	2.8
2.00E+02	2.76E+04	9.5	2	2.33E+04	9.6	2.1	3.22E+05	12.2	12.1	2.37E+05	11.9	11.6	2.34E+03	6.2	5.6	2.85E+03	6	4.7
3.00E+02	5.78E+04	12.4	3.3	5.84E+04	12.2	3.2	2.73E+05	15.3	18	2.49E+05	14.7	16.6	4.73E+04	10.5	9.6	5.07E+04	10.6	9.9
5.00E+02	1.43E+05	15.1	4.4	1.49E+05	15.1	4.4	1.97E+05	18.8	22.7	2.11E+05	18.4	22.1	1.44E+05	15.3	17.5	1.47E+05	15.4	17.6
7.00E+02	1.79E+05	17.5	5.2	1.94E+05	17.5	5.2	2.00E+05	20	22.8	2.13E+05	19.5	22.2	1.69E+05	17.8	20.1	1.67E+05	17.8	20.2
1.00E+03	1.59E+05	19.5	5.5	1.64E+05	19.8	5.5	1.94E+05	20.7	21.8	2.09E+05	20.8	21.9	1.52E+05	19.3	20.4	1.59E+05	19.4	20.5
2.00E+03	1.16E+05	19.1	4.6	1.20E+05	19.6	4.7	1.58E+05	21.4	19.2	1.62E+05	21.3	19.1	1.13E+05	18.9	16.2	1.17E+05	19.2	16.5
3.00E+03	1.16E+05	18.9	4.3	1.20E+05	19.3	4.4	1.69E+05	21.4	18	1.62E+05	21.2	17.9	1.13E+05	18.7	15	1.12E+05	18.7	15.1
5.00E+03	1.35E+05	19.3	4.2	1.35E+05	19.6	4.2	1.68E+05	21.2	16.9	1.69E+05	21	16.6	1.34E+05	18.9	14.3	1.28E+05	19.2	14.5
1.00E+04	1.25E+05	16.8	3.7	1.30E+05	17.5	3.8	1.74E+05	20.1	15.3	1.67E+05	19.8	15.2	1.29E+05	16.8	12.3	1.28E+05	16.8	12.3
2.00E+04	1.41E+05	15.8	3.4	1.45E+05	16.4	3.5	1.79E+05	19.2	14.5	1.97E+05	19	14.3	1.39E+05	15.4	11.1	1.49E+05	16	11.5
5.00E+04	1.79E+05	14.1	3.1	1.75E+05	15.1	3.2	2.17E+05	17.5	12.8	2.09E+05	17.7	12.7	1.74E+05	13.8	9.6	1.81E+05	14.4	10.1
1.00E+05	2.08E+05	12	2.7	2.04E+05	12.7	2.8	2.47E+05	16.1	11.5	2.39E+05	16.1	11.4	2.00E+05	11.4	8.3	1.98E+05	11.8	8.6

	Lungs						Stomach wall						Gonads					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	1.36E+03	5	1.9	0.00E+00	1	1
1.40E+01	1.37E−01	7.5	9.8	1.44E−01	7.3	9.9	1.54E−01	6.6	9.9	1.06E−01	7.5	9.4	1.88E+03	5.3	2.2	0.00E+00	1	1
2.00E+01	5.50E−01	7.6	9.5	6.08E−01	6.9	9.2	4.33E−01	7.6	9.3	6.18E−01	7	9.8	2.96E+03	5.6	2.5	2.70E−01	5.4	10.4
3.00E+01	2.02E+00	6.8	8.8	2.07E+00	6.6	8.2	1.82E+00	6.8	8.4	2.09E+00	6.4	8.5	4.19E+03	6.2	3.1	2.23E+00	5.4	8.9
5.00E+01	1.03E+01	4.5	7.1	1.15E+01	4.3	6.5	8.89E+00	5.1	7.5	1.23E+01	4.4	6.5	8.76E+03	7.1	4.1	6.31E+00	6.2	9.9
7.50E+01	4.35E+01	3.2	4.6	5.17E+01	3	4.3	3.58E+01	3.5	5.2	4.48E+01	3.2	4.5	2.24E+04	7.8	4.9	1.91E+01	4.7	7.9
1.00E+02	1.24E+02	2.6	3.6	1.50E+02	2.5	3.4	9.30E+01	2.8	3.8	1.33E+02	2.5	3.4	3.80E+04	8.4	6.1	5.97E+01	3.4	5.2
1.50E+02	4.55E+02	2	2.7	5.71E+02	2.1	2.7	3.91E+02	2.2	2.9	4.54E+02	2.1	2.8	7.95E+04	10	8.4	3.01E+02	2.2	3
2.00E+02	1.67E+03	4.9	4.2	1.75E+03	4	3.6	9.93E+02	2.3	3.4	2.34E+03	5.4	4.2	1.24E+05	11.3	10.6	8.58E+02	1.8	2.4
3.00E+02	3.58E+04	10.2	9.5	4.05E+04	10.1	9.1	2.94E+04	9.3	8.1	6.37E+04	10.8	10	1.69E+05	13.5	14.8	2.49E+03	1.9	2.7
5.00E+02	1.80E+05	14.6	16.2	2.02E+05	15.2	17.2	1.25E+05	14.7	16.3	1.55E+05	15.3	17.2	1.39E+05	17	21.1	6.30E+04	11.3	11.8
7.00E+02	2.01E+05	17.9	20.3	2.24E+05	18	20.5	1.67E+05	17.1	19.4	1.88E+05	17.8	20.1	1.80E+05	18.8	21.3	1.54E+05	16.5	18.2
1.00E+03	1.66E+05	20	21	1.75E+05	20.3	21.3	1.53E+05	19.1	20.2	1.60E+05	19.6	20.7	1.73E+05	20.1	21.2	1.52E+05	18.8	20
2.00E+03	1.24E+05	19.7	17.1	1.31E+05	20.2	17.6	1.09E+05	18.6	15.8	1.27E+05	19.6	16.8	1.25E+05	20.1	17.9	9.86E+04	18.2	14.8
3.00E+03	1.22E+05	19.4	15.8	1.29E+05	20	16.3	1.16E+05	18.4	14.5	1.19E+05	19.3	15.7	1.28E+05	19.6	16.5	1.01E+05	17.8	14.2
5.00E+03	1.45E+05	20	15.1	1.47E+05	20.2	15.5	1.28E+05	18.7	14	1.43E+05	19.7	14.6	1.39E+05	19.5	15.4	1.04E+05	18.6	13.5
1.00E+04	1.36E+05	17.7	13	1.41E+05	18.5	13.7	1.28E+05	16.3	12	1.29E+05	17.2	12.7	1.53E+05	18.6	14	1.08E+05	16.5	10.7
2.00E+04	1.55E+05	17	12.1	1.55E+05	17.4	12.8	1.36E+05	15.4	10.7	1.47E+05	16.3	11.6	1.76E+05	17.7	12.8	1.25E+05	15.2	10.3
5.00E+04	1.81E+05	15.3	10.9	1.85E+05	16.4	11.3	1.74E+05	13.6	9.6	1.62E+05	13.9	10.3	1.81E+05	14.4	11.5	1.51E+05	13.1	8.5
1.00E+05	2.06E+05	13.1	9.2	2.06E+05	14.2	10	2.02E+05	11.5	7.9	2.06E+05	13	8.8	2.20E+05	12.7	9.9	1.70E+05	8.7	7.5

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.42E−01	7.5	9.8	1.36E−01	7.4	10.1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	3.16E−01	3.5	7.3
2.00E+01	5.67E−01	7.5	9.6	5.51E−01	7.1	9.5	3.85E−01	6.2	9.3	4.13E−01	6.2	9.7	4.68E−01	5.2	7.6	7.21E−01	4.4	7.9
3.00E+01	1.84E+00	6.9	8.8	2.00E+00	6.8	8.7	2.12E+00	6.1	9.1	1.77E+00	7	9	4.15E+00	3.9	6.4	4.03E+00	3.8	6.1
5.00E+01	8.86E+00	5	7.5	1.08E+01	4.5	6.7	8.92E+00	4.9	7.9	8.62E+00	5.1	7.8	2.53E+01	3.3	4.6	3.84E+01	3	4.6
7.50E+01	3.50E+01	3.5	5.1	4.35E+01	3.2	4.6	2.92E+01	4.2	5.9	3.64E+01	3.6	5	8.97E+01	2.8	3.8	9.34E+01	2.5	3.8

(continued on next page)

Table A.31. (*continued*)

	Liver						Oesophagus						Thyroid					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+02	9.71E+01	2.8	3.9	1.25E+02	2.6	3.6	8.60E+01	3	3.8	1.14E+02	2.9	3.8	1.96E+02	2.6	2.9	2.80E+02	2.4	3.1
1.50E+02	3.49E+02	2.2	2.9	4.79E+02	2.3	2.8	4.47E+02	2.6	3.3	4.39E+02	2.2	2.9	3.57E+03	6.9	4.1	6.11E+03	6.8	4
2.00E+02	1.42E+03	4.6	3.9	2.01E+03	5.4	4.7	2.61E+03	6.7	4.6	1.44E+03	3.7	3.2	4.56E+04	8.7	6.9	7.12E+04	9.3	7.1
3.00E+02	2.98E+04	10.2	9.5	4.56E+04	10.6	9.7	2.30E+04	10.2	9	2.80E+04	10.1	8.8	1.62E+05	12.2	12.8	1.79E+05	12.8	13.5
5.00E+02	1.24E+05	14.5	16.3	1.45E+05	15.1	17	7.76E+04	13.8	15.7	1.37E+05	13.6	14.9	1.79E+05	16.8	20.1	1.74E+05	16.8	19.1
7.00E+02	1.69E+05	17.2	19.4	1.89E+05	17.5	19.9	1.95E+05	16.6	18.4	2.16E+05	17.3	19.8	1.99E+05	18.3	21.1	2.22E+05	18.5	21
1.00E+03	1.53E+05	19.1	20.3	1.64E+05	19.6	20.7	1.56E+05	19.3	20.6	1.64E+05	19.8	20.9	1.67E+05	20.1	21.3	1.92E+05	20.1	21.7
2.00E+03	1.10E+05	18.7	16	1.16E+05	19.3	16.7	1.12E+05	18.9	16.1	1.21E+05	19.5	16.5	1.24E+05	19.9	17.9	1.36E+05	20.1	17.7
3.00E+03	1.08E+05	18.2	14.7	1.17E+05	19.1	15.4	1.13E+05	18.6	14.9	1.15E+05	19.3	15.6	1.24E+05	19.7	16.7	1.31E+05	19.9	16.7
5.00E+03	1.29E+05	19	14.1	1.37E+05	19.7	14.7	1.27E+05	19.2	14.4	1.36E+05	19.8	15	1.43E+05	20.2	15.6	1.33E+05	20.5	16.1
1.00E+04	1.22E+05	16.5	11.8	1.28E+05	17.2	12.6	1.20E+05	16.3	11.9	1.27E+05	17.6	12.3	1.45E+05	18.4	13.9	1.36E+05	18.8	14.1
2.00E+04	1.32E+05	15.2	11	1.41E+05	16	11.7	1.27E+05	16	10.7	1.30E+05	15.8	12.1	1.53E+05	17.9	12.7	1.38E+05	17.5	13
5.00E+04	1.67E+05	13.8	9.5	1.67E+05	14.6	10.3	1.65E+05	13.5	9.6	1.67E+05	14.8	10.3	1.92E+05	15.9	11.7	1.57E+05	16.6	11.7
1.00E+05	1.99E+05	11.6	7.9	2.00E+05	12.4	8.8	1.91E+05	11.4	8.5	2.03E+05	13.1	9.3	2.10E+05	14.4	9.9	1.87E+05	13.3	10.7

	Urinary bladder wall						Endosteum (bone surface)						Brain					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	3.77E+01	5	1.9	8.55E+00	5	1.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	2.44E−01	4.2	8.8	5.45E+01	5.3	2.2	1.24E+01	5.3	2.2	1.81E−01	7.2	10	1.90E−01	7.2	9.6
2.00E+01	4.31E−01	6.4	9.3	6.54E−01	4.9	7.6	8.17E+01	5.6	2.6	1.66E+01	5.7	2.7	7.36E−01	7.3	9.3	6.91E−01	6.8	8.1
3.00E+01	2.11E+00	6.6	8.8	3.56E+00	5	6.8	1.33E+02	6.1	3.2	3.30E+01	5.9	3.4	2.55E+00	6.2	8	3.01E+00	5.7	6.7
5.00E+01	8.09E+00	5	7.9	1.84E+01	3.4	5.1	2.96E+02	6.7	4.1	8.23E+01	6	4.3	1.63E+01	3.7	5.5	1.94E+01	3.3	5.1
7.50E+01	2.78E+01	3.6	5.6	6.87E+01	2.7	3.9	6.79E+02	7.1	4.8	2.03E+02	5.5	4.4	7.02E+01	2.8	3.8	7.98E+01	2.7	3.7
1.00E+02	8.13E+01	2.8	4.1	1.55E+02	2.4	3.3	1.61E+03	7.3	5.2	1.06E+03	6	4	1.95E+02	2.4	3.2	2.26E+02	2.3	3.1
1.50E+02	3.35E+02	2.2	2.8	8.46E+03	7.2	4.6	1.70E+04	8.1	5.9	1.64E+04	8	5.7	7.38E+02	2.5	2.8	8.55E+02	2.8	3
2.00E+02	7.54E+02	1.9	2.6	5.05E+04	9.6	8.1	5.93E+04	9.8	8.2	5.11E+04	9.8	8.3	8.08E+03	7.1	5.3	1.65E+04	7.9	5.8
3.00E+02	1.37E+04	8.6	7.1	8.32E+04	13	14.1	1.37E+05	12.6	13	1.24E+05	12.5	12.8	9.39E+04	11.2	10.6	1.27E+05	11.5	11.2
5.00E+02	9.46E+04	14.3	16.5	1.23E+05	16.1	18.5	2.13E+05	16.2	18.8	2.11E+05	16.1	18.6	2.51E+05	15.5	17.6	2.73E+05	15.7	18
7.00E+02	1.54E+05	16.4	18.9	1.64E+05	17.5	19.6	2.13E+05	18.7	21.4	2.18E+05	18.6	21.4	2.55E+05	18.5	21.4	2.56E+05	18.9	21.8
1.00E+03	1.48E+05	18.7	19.9	1.65E+05	19.2	20.5	1.79E+05	20.4	21.5	1.79E+05	20.5	21.5	1.88E+05	20.8	21.9	1.89E+05	21	22
2.00E+03	1.02E+05	18	15.3	1.14E+05	18.9	16.5	1.40E+05	20.6	18.2	1.38E+05	20.6	18.2	1.48E+05	20.9	18.4	1.46E+05	21.1	18.6
3.00E+03	1.04E+05	17.8	14.2	1.13E+05	18.7	15.2	1.39E+05	20.4	16.9	1.37E+05	20.4	16.9	1.38E+05	20.6	17.2	1.46E+05	21	17.5
5.00E+03	1.20E+05	18.5	13.8	1.29E+05	19.3	14.7	1.59E+05	20.6	15.9	1.54E+05	20.6	16	1.66E+05	21.1	16.3	1.63E+05	21.3	16.5
1.00E+04	1.17E+05	15.4	11	1.25E+05	16.6	12.4	1.48E+05	18.8	14.2	1.46E+05	18.9	14.3	1.51E+05	19.3	14.7	1.61E+05	19.7	15
2.00E+04	1.20E+05	14	10.2	1.40E+05	15.6	11.7	1.60E+05	17.8	13.2	1.62E+05	18.1	13.3	1.60E+05	18.3	13.6	1.72E+05	18.9	13.8
5.00E+04	1.70E+05	12.5	8.9	1.77E+05	14.3	10.4	1.93E+05	16.3	11.7	1.92E+05	16.7	11.9	1.90E+05	17.1	12.4	2.09E+05	18	12.7
1.00E+05	1.96E+05	10.6	7.6	2.15E+05	12.3	8.8	2.17E+05	14.5	10.2	2.16E+05	14.7	10.4	2.25E+05	15.4	11	2.11E+05	16.4	11.3

	Salivary glands						Skin						Remainder tissues					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	9.39E+03	4.5	1.4	1.14E+04	4.5	1.4	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	1.88E+04	4.4	1.4	2.28E+04	4.4	1.4	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	2.81E+04	4.5	1.5	3.42E+04	4.5	1.5	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	4.68E+04	4.6	1.6	5.68E+04	4.6	1.6	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	9.14E+00	4.9	1.8	0.00E+00	1	1	9.33E+04	5	1.9	1.13E+05	5	1.9	1.26E+02	5	1.9	1.85E+01	5	1.9
1.40E+01	1.88E+01	5	2	2.36E−01	4.9	7.2	1.30E+05	5.3	2.2	1.57E+05	5.3	2.2	1.57E+02	5.3	2.2	2.45E+01	5.3	2.2
2.00E+01	3.56E+01	5.2	2.4	1.64E+00	4.8	5	1.84E+05	5.7	2.6	2.22E+05	5.7	2.6	2.39E+02	5.7	2.5	3.18E+01	5.6	2.6
3.00E+01	9.60E+01	5.4	2.8	6.96E+00	4	5	2.70E+05	6.3	3.2	3.25E+05	6.3	3.2	4.01E+02	6.2	3.1	5.29E+01	6.2	3.2
5.00E+01	5.24E+02	6.3	3.6	3.98E+01	3.1	4	4.26E+05	7.4	4.4	5.02E+05	7.4	4.4	7.38E+02	7	4.2	1.27E+02	6.6	4.2
7.50E+01	5.64E+03	6.5	3.6	1.99E+02	3.9	3.3	4.59E+05	9	6.6	4.76E+05	9.2	6.8	1.98E+03	7.5	4.8	2.81E+02	7	4.9
1.00E+02	2.73E+04	7.5	4.6	3.44E+03	6	3.6	4.04E+05	10.5	8.9	4.08E+05	10.7	9.2	4.17E+03	8.1	5.7	8.76E+02	7.1	5.1
1.50E+02	1.06E+05	9.3	7.2	4.54E+04	8.6	6.3	3.19E+05	12.8	13.1	3.18E+05	13	13.3	1.35E+04	9.2	7.4	6.81E+03	8.2	6.1
2.00E+02	1.77E+05	11.1	10.1	1.06E+05	10.4	9	2.75E+05	14.4	16.2	2.74E+05	14.5	16.3	2.46E+04	10.6	9.6	1.63E+04	9.9	8.6
3.00E+02	2.06E+05	14.1	15.6	1.84E+05	13.4	14.3	2.36E+05	16.4	19.7	2.40E+05	16.4	19.7	5.03E+04	12.3	12.9	4.82E+04	11.7	11.9
5.00E+02	2.04E+05	17.5	20.9	2.07E+05	16.6	19.9	2.33E+05	18.3	21.8	2.36E+05	18.4	21.9	1.35E+05	15	17.1	1.51E+05	14.9	16.7
7.00E+02	2.32E+05	18.6	21	2.44E+05	18.8	21.4	2.25E+05	19.9	22.7	2.30E+05	19.9	22.6	1.81E+05	17.3	19.8	1.97E+05	17.5	20
1.00E+03	1.92E+05	20.8	22	1.82E+05	20.9	21.8	2.04E+05	21.1	22.4	2.08E+05	21.2	22.4	1.61E+05	19.5	20.5	1.63E+05	19.7	20.7
2.00E+03	1.51E+05	21	18.9	1.57E+05	21.2	18.8	1.73E+05	21.7	19.7	1.74E+05	21.8	19.8	1.16E+05	19.1	16.6	1.19E+05	19.4	16.8
3.00E+03	1.48E+05	20.8	17.7	1.44E+05	20.7	17.4	1.74E+05	21.6	18.4	1.74E+05	21.7	18.5	1.15E+05	18.8	15.2	1.17E+05	19.1	15.5
5.00E+03	1.66E+05	21.1	16.5	1.57E+05	20.8	16.4	1.87E+05	21.5	17.2	1.87E+05	21.6	17.3	1.33E+05	19.2	14.7	1.34E+05	19.5	14.8
1.00E+04	1.59E+05	19.8	14.7	1.47E+05	19.4	15	1.85E+05	20.3	15.9	1.86E+05	20.5	16	1.26E+05	16.9	12.4	1.26E+05	17.2	13
2.00E+04	1.77E+05	18.8	13.8	1.66E+05	18.3	13.9	1.99E+05	19.5	14.8	2.00E+05	19.7	15	1.37E+05	15.7	11.5	1.40E+05	16.3	11.9
5.00E+04	1.95E+05	16.9	12.7	1.91E+05	17.4	12.2	2.27E+05	18.1	13.4	2.26E+05	18.5	13.6	1.74E+05	14.1	10	1.72E+05	14.7	10.5
1.00E+05	2.39E+05	16.2	11.1	2.16E+05	16	10.9	2.53E+05	16	12	2.52E+05	16.9	12.3	2.02E+05	11.8	8.5	1.98E+05	12.6	8.9

Table A.31. (*continued*)

	Adrenals						Extrathoracic region						Gallbladder wall					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	1.50E+03	5	1.9	2.33E+02	5	1.9	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	0.00E+00	1	1	1.84E+03	5.3	2.2	3.08E+02	5.3	2.2	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	4.69E−01	4.7	9	6.01E−01	4.8	9.6	2.79E+03	5.7	2.5	3.88E+02	5.6	2.5	5.62E−01	7.7	8.9	4.15E−01	5.6	9.7
3.00E+01	1.20E+00	5.4	9.1	1.68E+00	5.4	9.2	4.62E+03	6.2	3.1	6.35E+02	6.3	3.1	1.69E+00	6.1	9.3	1.46E+00	5.6	9
5.00E+01	7.61E+00	5.7	8.6	7.72E+00	6.9	9.9	8.11E+03	7.1	4.2	1.43E+03	6.7	4.1	6.97E+00	5	9.2	5.48E+00	5.8	10.4
7.50E+01	2.60E+01	3.6	5.9	2.03E+01	4.6	7.4	1.89E+04	7.7	5	2.54E+03	7.8	5.3	2.91E+01	3.6	6.1	2.59E+01	4.3	7.1
1.00E+02	6.84E+01	3	4.5	6.79E+01	2.9	4.6	3.50E+04	8.4	6.1	6.70E+03	8	5.6	7.07E+01	2.9	4.8	7.52E+01	2.9	4.5
1.50E+02	3.42E+02	2.2	3	3.27E+02	2	2.9	9.14E+04	9.7	8	3.79E+04	8.9	6.8	3.24E+02	2.1	2.9	3.56E+02	2.2	3
2.00E+02	8.38E+02	2.3	2.5	9.68E+02	1.9	2.8	1.33E+05	11.4	10.8	6.94E+04	10.6	9.8	9.45E+02	2.1	2.9	8.41E+02	1.6	2.5
3.00E+02	3.24E+03	4.6	5.8	2.89E+03	2	3.8	1.64E+05	13.7	15.2	8.98E+04	13.5	15.1	1.23E+04	8.7	8	2.69E+03	3.1	4.5
5.00E+02	1.05E+05	13.7	15.9	6.76E+04	13	13.7	2.57E+05	16.4	19.1	2.67E+05	15.1	17.5	9.06E+04	13.8	15	7.93E+04	12.6	13.5
7.00E+02	1.48E+05	16.9	19	1.88E+05	16.3	18.7	2.31E+05	18.8	21.7	2.26E+05	18.8	21.3	1.59E+05	16.5	18.8	1.93E+05	16.6	19.2
1.00E+03	1.35E+05	18.3	19.5	1.69E+05	19.2	20	1.97E+05	20.9	21.9	1.81E+05	20.7	21.6	1.52E+05	19	19.8	1.46E+05	18.8	19.9
2.00E+03	1.01E+05	18.3	15.3	1.06E+05	18.2	15.6	1.56E+05	21.2	18.9	1.39E+05	20.9	18.5	1.05E+05	18.3	15.4	1.12E+05	18.4	15.7
3.00E+03	1.03E+05	17.7	13.8	1.02E+05	17.3	13.9	1.46E+05	20.7	17.7	1.38E+05	20.5	17	1.05E+05	17.8	13.9	1.02E+05	17.7	14.5
5.00E+03	1.21E+05	17.6	13.7	1.14E+05	18.3	14	1.62E+05	21.1	16.7	1.53E+05	20.5	16.3	1.23E+05	18.7	13.8	1.29E+05	19.3	14
1.00E+04	1.14E+05	15.2	11.3	1.10E+05	14.9	12	1.55E+05	19.3	14.8	1.50E+05	19.2	14.9	1.15E+05	15.1	11.1	1.10E+05	15.4	12
2.00E+04	1.15E+05	13.1	10.4	1.14E+05	13.9	11.3	1.64E+05	18.9	13.9	1.52E+05	17.9	13.6	1.25E+05	14.3	10.2	1.29E+05	15.3	10.3
5.00E+04	1.62E+05	11.6	9.1	1.42E+05	12.6	9.2	2.08E+05	17.4	12.7	1.97E+05	16.5	12.4	1.51E+05	12	8.7	1.56E+05	12.6	10.2
1.00E+05	1.86E+05	10.3	7.4	1.73E+05	9.8	7.8	2.19E+05	15.7	11	2.00E+05	15.8	10.9	1.96E+05	10.7	7.1	1.75E+05	11	7.5

	Heart wall						Kidneys						Lymphatic nodes					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	5.26E+01	4.9	1.9	0.00E+00	1	1
1.40E+01	1.31E−01	6.9	9.8	0.00E+00	1	1	1.23E−01	6.8	9.8	1.19E−01	7	10.1	7.96E+01	5.2	2.1	1.84E−01	6.1	8.8
2.00E+01	5.21E−01	7.5	9.6	5.06E−01	7.1	9.6	5.34E−01	7.9	9.3	5.06E−01	7.9	9.8	1.35E+02	5.6	2.5	9.35E−01	4.8	7.2
3.00E+01	1.77E+00	7.2	9.1	1.95E+00	7.1	8.9	1.67E+00	7	9.1	1.71E+00	7.2	9.3	2.78E+02	6	2.9	3.73E+00	3.9	6.1
5.00E+01	8.09E+00	5.5	7.9	9.13E+00	4.9	8.3	7.08E+00	6.1	9.5	7.80E+00	5.9	9.5	7.88E+02	6.7	3.8	1.66E+01	3.7	5
7.50E+01	3.36E+01	3.5	5.4	3.99E+01	3.4	4.9	2.82E+01	3.9	6.2	3.09E+01	3.7	6.1	4.77E+03	7	4.1	7.05E+01	3.6	3.7
1.00E+02	9.46E+01	2.8	3.9	1.13E+02	2.6	3.7	8.19E+01	3	4.1	8.61E+01	2.8	4	1.28E+04	7.8	5.2	6.58E+02	5.8	3.8
1.50E+02	3.91E+02	2.3	2.9	4.52E+02	2.1	2.7	3.59E+02	2.3	2.9	3.79E+02	2.2	2.8	3.40E+04	9.6	7.7	1.38E+04	7.8	5.3
2.00E+02	9.77E+02	2.2	3	1.18E+03	2.8	3.2	8.92E+02	2.1	2.7	9.24E+02	1.9	2.5	5.67E+04	10.9	10.4	4.41E+04	10.1	8.4
3.00E+02	2.20E+04	9.2	8.1	2.99E+04	9.8	8.8	3.63E+03	5.4	5.8	4.62E+03	5.7	5.7	7.43E+04	13.6	14.9	7.47E+04	12.8	13.8
5.00E+02	1.17E+05	14.5	16	1.62E+05	14.7	16.3	1.24E+05	13.6	15	1.47E+05	13.6	14.6	1.38E+05	15.9	18	1.59E+05	15.5	17.6
7.00E+02	1.83E+05	17	19.1	2.07E+05	17.4	19.8	1.63E+05	16.8	19.2	1.86E+05	17.2	19.5	1.79E+05	17.5	19.9	1.96E+05	17.6	20.2
1.00E+03	1.61E+05	19.5	20.3	1.67E+05	19.9	20.9	1.47E+05	18.8	19.9	1.61E+05	19.1	20.2	1.61E+05	19.6	20.7	1.67E+05	19.8	20.8
2.00E+03	1.13E+05	18.8	16.1	1.15E+05	19.4	16.9	1.08E+05	18.5	15.4	1.06E+05	18.5	16.1	1.21E+05	19.3	16.9	1.24E+05	19.6	16.9
3.00E+03	1.09E+05	18.3	14.8	1.19E+05	19.4	15.7	1.06E+05	17.9	14.2	1.13E+05	18.5	14.7	1.18E+05	18.9	15.5	1.18E+05	19.2	15.8
5.00E+03	1.32E+05	19.1	14.4	1.32E+05	19.4	14.8	1.22E+05	18.3	13.6	1.27E+05	18.7	13.9	1.39E+05	19.5	14.8	1.35E+05	19.6	14.9
1.00E+04	1.21E+05	16.5	12	1.27E+05	17.6	12.7	1.14E+05	15.7	11.2	1.24E+05	16.4	12.1	1.29E+05	17.1	12.7	1.33E+05	17.5	13.1
2.00E+04	1.34E+05	15.3	11.2	1.38E+05	16.3	11.7	1.26E+05	13.6	10.7	1.30E+05	15.3	10.9	1.48E+05	16.2	11.7	1.52E+05	16.7	12.2
5.00E+04	1.68E+05	13.9	9.6	1.75E+05	15.2	10.4	1.67E+05	13.1	9	1.68E+05	13.5	9.8	1.80E+05	14.3	10.3	1.79E+05	15	10.8
1.00E+05	2.00E+05	11.3	8.3	2.02E+05	13.4	9.2	2.04E+05	10.6	7.6	2.00E+05	10.8	8.2	2.11E+05	12.3	8.7	2.12E+05	13.2	9.3

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	8.59E+01	5	1.9	6.72E+00	5	1.9	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	1.18E+02	5.3	2.2	9.46E+00	5.3	2.3	1.27E−01	5.6	9.1	2.14E−01	4	5.6	0.00E+00	1	1	0.00E+00	1	1
2.00E+01	1.70E+02	5.6	2.5	1.46E+01	5.6	2.7	6.34E−01	6.6	9	4.17E+00	4.4	2.7	4.24E−01	6.8	9.7	5.48E−01	7.1	10.1
3.00E+01	2.87E+02	6.2	3.1	2.69E+01	5.9	3.4	2.86E+00	5.7	6.5	4.94E+00	4.4	3.5	1.74E+00	7.1	9.5	1.64E+00	7.1	9.2
5.00E+01	5.98E+02	6.9	4.1	7.06E+01	5.9	4.2	1.67E+01	4.1	5.7	5.75E+01	5.2	3.5	6.14E+00	6.7	10.6	7.23E+00	6.1	9.8
7.50E+01	1.75E+03	7.1	4.5	2.74E+02	5.7	4.1	5.96E+01	2.7	4	4.59E+02	6.3	4	1.83E+01	5.4	8.3	2.56E+01	4.2	6.5
1.00E+02	5.42E+03	7.6	5	1.38E+03	6.4	4.2	2.48E+02	4.1	3.2	1.77E+03	6.6	4.9	4.98E+01	3.7	5.6	7.92E+01	2.9	4.1

(continued on next page)

Table A.31. (*continued*)

	Muscle						Oral mucosa						Pancreas					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.50E+02	3.20E+04	8.8	6.6	1.14E+04	8.3	6.1	8.75E+03	7.6	5.3	1.85E+04	8.4	6	2.59E+02	2.4	3.2	3.36E+02	2.2	2.9
2.00E+02	7.24E+04	10.3	9	3.89E+04	9.7	8.1	2.06E+04	10	8.5	3.38E+04	10.5	9.1	7.74E+02	2.1	2.6	9.32E+02	2	2.5
3.00E+02	1.51E+05	12.9	13.5	1.28E+05	12.2	12.4	6.38E+04	11.8	11.8	1.12E+05	11.8	12.1	2.31E+03	2	2.9	3.19E+03	4.8	5.3
5.00E+02	2.01E+05	16.6	19.3	2.04E+05	16.1	18.7	2.48E+05	15	16.8	2.33E+05	15.9	18.8	2.81E+04	10.7	11.7	1.19E+05	13.5	14
7.00E+02	2.04E+05	18.8	21.4	2.07E+05	18.6	21.3	2.26E+05	18.7	21.6	2.26E+05	19	21.1	1.57E+05	15	16.8	1.86E+05	16.7	19.3
1.00E+03	1.77E+05	20.3	21.4	1.78E+05	20.3	21.3	1.90E+05	20.5	21.7	1.82E+05	20.6	21.8	1.48E+05	18.3	19.3	1.46E+05	19.2	20.3
2.00E+03	1.37E+05	20.4	18.1	1.34E+05	20.4	17.9	1.40E+05	20.8	18.3	1.46E+05	20.7	18.3	9.79E+04	17.5	14.1	1.07E+05	18.5	15.8
3.00E+03	1.38E+05	20.3	16.8	1.34E+05	20.2	16.7	1.34E+05	20.6	16.9	1.41E+05	20.6	16.9	9.80E+04	17	12.8	1.05E+05	18.2	14.6
5.00E+03	1.55E+05	20.4	15.8	1.52E+05	20.4	15.7	1.43E+05	20.9	16.1	1.53E+05	20.2	16.1	1.14E+05	17.2	12.8	1.24E+05	19	13.8
1.00E+04	1.48E+05	18.6	14	1.44E+05	18.6	14	1.41E+05	19	14	1.34E+05	19	14.9	1.07E+05	14.6	10.3	1.23E+05	16.2	11.5
2.00E+04	1.61E+05	17.6	13.1	1.61E+05	17.7	13	1.51E+05	18.1	13.3	1.55E+05	18.3	13.6	1.20E+05	13.5	9.8	1.33E+05	15.8	10.6
5.00E+04	1.95E+05	16.2	11.6	1.87E+05	16.4	11.6	1.84E+05	16.5	11.9	2.02E+05	17.6	12.1	1.65E+05	11.9	8	1.59E+05	12.6	9.3
1.00E+05	2.24E+05	14.1	10	2.12E+05	14.1	10.1	1.88E+05	13.9	10.7	2.10E+05	15.4	10.7	1.92E+05	10	6.8	1.88E+05	11.2	7.9

	Prostate (male)/uterus (female)						Small intestine wall						Spleen					
E	Male			Female			Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	0.00E+00	1	1	8.82E−02	6.9	10.2	1.26E−01	7.4	9.6	1.11E−01	7.3	9.7	1.77E−01	6.2	10.1	1.47E−01	6.6	9.7
2.00E+01	3.97E−01	5.2	9.4	6.68E−01	6.9	9.8	5.68E−01	7.2	9.6	5.09E−01	7.2	9.6	3.60E−01	7.2	9.5	5.85E−01	6.4	9.9
3.00E+01	1.46E+00	7.2	9.3	1.77E+00	7.3	9.3	1.89E+00	6.8	9	1.90E+00	7	8.9	1.83E+00	6.9	9	1.91E+00	6.9	8.8
5.00E+01	5.71E+00	6.2	10.2	6.41E+00	6.8	10.3	8.11E+00	5.1	8.7	8.61E+00	5.4	8.7	8.06E+00	5.3	8.9	1.06E+01	5	7.9
7.50E+01	1.94E+01	5.2	7.9	2.27E+01	4.9	7.9	3.17E+01	3.6	5.4	3.44E+01	3.6	5.2	3.09E+01	3.5	5.1	4.24E+01	3.3	4.7
1.00E+02	5.63E+01	3.1	5.5	6.27E+01	3.3	4.9	9.19E+01	2.9	4	9.55E+01	2.8	3.9	9.53E+01	2.8	3.8	1.24E+02	2.5	3.4
1.50E+02	2.72E+02	2.5	3.1	3.09E+02	2.3	3.2	3.50E+02	2.2	2.9	3.95E+02	2.2	2.8	3.96E+02	2.2	2.8	4.88E+02	2.2	2.7
2.00E+02	7.95E+02	1.9	2.7	8.41E+02	2	2.6	1.10E+03	3	3.3	9.59E+02	2.6	2.9	9.17E+02	2.4	2.8	1.01E+03	2.6	2.9
3.00E+02	2.48E+03	2.5	2.6	2.40E+03	2.2	3.5	2.04E+04	9.6	8.7	2.37E+04	9.3	8.3	1.35E+04	8.3	7.8	4.14E+04	9.9	8.6
5.00E+02	5.46E+04	10.8	11.5	7.30E+04	12.4	13	1.14E+05	14.4	16.1	1.24E+05	14.6	16.3	1.40E+05	14.6	16.2	1.61E+05	15.1	17.4
7.00E+02	1.62E+05	16.1	18.3	1.64E+05	16.4	18.4	1.60E+05	17.1	19.2	1.68E+05	17.2	19.4	1.63E+05	17.3	19.6	1.89E+05	17.6	20.4
1.00E+03	1.45E+05	18.8	19.8	1.53E+05	18.7	20	1.49E+05	19	20	1.54E+05	19.2	20.2	1.65E+05	19.1	20.2	1.56E+05	19.7	20.7
2.00E+03	9.02E+04	16.5	14.4	1.01E+05	18.1	15.1	1.06E+05	18.3	15.5	1.11E+05	18.7	16	1.08E+05	18.5	16.2	1.22E+05	19.7	16.9
3.00E+03	9.73E+04	17.6	13.2	9.51E+04	17.3	14	1.09E+05	18.1	14.2	1.09E+05	18.2	14.8	1.12E+05	18.5	14.8	1.17E+05	19.1	15.7
5.00E+03	1.06E+05	17.8	13.5	1.22E+05	18.6	13.5	1.29E+05	18.7	13.8	1.30E+05	19	14.1	1.32E+05	19.1	14.1	1.40E+05	19.6	14.8
1.00E+04	1.12E+05	15.3	10.2	1.11E+05	15	11.2	1.19E+05	16	11.4	1.23E+05	16.6	11.9	1.18E+05	16.7	12.2	1.29E+05	17.7	13
2.00E+04	1.22E+05	14.5	10.1	1.27E+05	13.8	10.2	1.27E+05	14.4	10.5	1.30E+05	15.3	11.1	1.44E+05	15.6	10.6	1.42E+05	16	11.8
5.00E+04	1.58E+05	12.7	8.2	1.61E+05	13	8.8	1.73E+05	13	9.2	1.79E+05	14	9.7	1.70E+05	13.1	9.6	1.70E+05	15	10.5
1.00E+05	2.04E+05	9.8	6.8	1.96E+05	10	7.4	1.99E+05	10.7	7.6	2.02E+05	11.7	8.1	1.99E+05	10.5	8	2.07E+05	12.1	8.8

	Thymus						Lens of the eye					
E	Male			Female			Male			Female		
MeV/u	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}	D_T/Φ	Q_{ICRP60}	Q_{NASA}
1.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
2.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
3.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
5.00E+00	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.00E+01	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1	0.00E+00	1	1
1.40E+01	3.47E−01	5.8	8.7	0.00E+00	1	1	3.21E+00	3.2	4.2	3.21E+00	3.2	4.2
2.00E+01	9.68E−01	6.4	8.2	0.00E+00	1	1	1.47E+01	3.7	4.7	1.47E+01	3.7	4.7
3.00E+01	4.16E+00	3.9	6.2	3.38E+00	5.3	7.5	5.20E+01	3.7	4.4	5.20E+01	3.7	4.4
5.00E+01	2.28E+01	3.5	5	1.80E+01	3.8	5	2.00E+02	3.4	4	2.00E+02	3.4	4
7.50E+01	7.48E+01	2.8	3.9	6.54E+01	2.9	4.2	3.11E+05	6.4	3.3	3.11E+05	6.4	3.3
1.00E+02	1.44E+02	2.6	3.4	1.70E+02	2.5	3.2	4.43E+05	8.7	6.2	4.43E+05	8.7	6.2
1.50E+02	6.88E+03	7.2	4.9	3.78E+03	7.1	4.8	3.47E+05	11.9	11.4	3.47E+05	11.9	11.4
2.00E+02	2.97E+04	9.2	7.5	1.87E+04	8.7	7.3	2.68E+05	13	13.3	2.68E+05	13	13.3
3.00E+02	1.21E+05	11.9	11.8	1.11E+05	11.6	11.2	2.82E+05	16	18.4	2.82E+05	16	18.4
5.00E+02	1.40E+05	16.4	19.6	1.66E+05	16.3	18.4	2.29E+05	18.1	20.7	2.29E+05	18.1	20.7
7.00E+02	2.18E+05	17.4	19.9	2.20E+05	17.6	20.8	2.47E+05	19.9	22.9	2.47E+05	19.9	22.9
1.00E+03	1.69E+05	20	21	1.62E+05	20	21	2.22E+05	20.9	22.6	2.22E+05	20.9	22.6
2.00E+03	1.26E+05	19.7	17.4	1.24E+05	20.2	17.5	1.80E+05	22.1	19.4	1.80E+05	22.1	19.4
3.00E+03	1.20E+05	19.5	16.4	1.23E+05	19.8	16.2	1.71E+05	21.8	18.1	1.71E+05	21.8	18.1
5.00E+03	1.49E+05	19.7	15.4	1.34E+05	19.7	15.2	1.68E+05	21.3	17.9	1.68E+05	21.3	17.9
1.00E+04	1.39E+05	18.1	13.7	1.23E+05	18.1	13.6	1.64E+05	19.6	15.7	1.64E+05	19.6	15.7
2.00E+04	1.49E+05	16.5	12.3	1.61E+05	17.7	13	2.24E+05	19.4	14.3	2.24E+05	19.4	14.3
5.00E+04	1.82E+05	16	10.9	1.59E+05	15.5	11.1	2.08E+05	17.3	13.6	2.08E+05	17.3	13.6
1.00E+05	2.01E+05	12.8	9.5	1.99E+05	14.5	9.9	2.19E+05	16.4	12.8	2.19E+05	16.4	12.8

APPENDIX. SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.icrp.2013.05.004.