

JAERI - M
87-186

THE VADMAP CODE TO CALCULATE THE SAF OF PHOTON
— CODE DESCRIPTION AND THE PERFORMANCE —

November 1987

Yukichi YAMAGUCHI, Orihiko TOGAWA and Toshimitsu HONMA

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Department of Technical Information, Japan Atomic Energy Research Institute, Tokai-
mura, Naka-gun, Ibaraki-ken 319-11, Japan.

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編集兼発行 日本原子力研究所
印 刷 いばらき印刷(株)

The VADMAP Code to Calculate the SAF of Photon
- Code Description and the Performance -

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(Received October 19, 1987)

A computer code VADMAP has been developed to calculate the Specific Absorbed Fraction, SAF, of photon. The development of the code is aimed at efficient and systematic preparation of the SAF data files for several different human phantoms in a suitable form as a direct input data file to DOSimetric Data Calculation system, DOSDAC, which is being developed at Japan Atomic Energy Research Institute, JAERI.

This document describes the methodology used in the code, the code structure, user's information including the way of implementing the code on FACOM/M-380, and the performance through calculation and preparation of the SAF data file.

In order to show the performance of the code, a set of the SAF values for an adult human phantom was calculated and was organized to prepare the SAF file. Comparing the calculated SAF values with those tabulated in ORNL-5000, the quality of the code was examined.

Keywords: ICRP, Specific Absorbed Fraction, DOSDAC System, ALI, DAC,
Human Phantom, Computer Code, ORNL-5000

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光子の比吸収割合計算用コード VADMAP

— 計算コードとその使用 —

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(1987年10月19日受理)

光子の比吸収割合, SAF, の算出を目的とする計算コード VADMAPを開発した。本計算コードの開発は, 種々の異なる人体ファントムについて, SAF・データ・ファイルの効率的かつ系統的な作成を意図している。本コードを通じて作成されるデータ・ファイルは, 現在, 日本原子力研究所で開発を進めている被曝線量基礎データ計算システム, DOSDAC, に直接使用可能な形式となっている。

本報告書では, 計算コードに用いられている計算手法, コードの構成, 本コードの FACOM/M-380 での使用方法, さらには, SAF・データ・ファイルの計算と作成を通じてのコード性能について記述している。

コードの性能テストとして, 成人・人体ファントムに対する SAF 値の算出および算出値のデータ・ファイル化を行い, 作成したデータ・ファイルを, ORNL-5000 に示された値と比較した。

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1. Introduction

Since International Commission on Radiological Protection, ICRP, recommended a new concept of radiological protection in 1977/1/, its committees have been exemplifying practical ways to adopt the recommendation for actual activities associated with use of radioactive materials by means of publications. The way of assessing internal exposure doses resulting from intake of radioactive material by a worker was shown in the Publication 30/2/. Using the assessment way, the committee calculated the Annual Limit on Intake, ALI, and the Derived Air Concentration, DAC, of some 300 radioactive isotopes and published these calculated values as a supplement to the publication.

The newly recommended way is as in the followings/1/:

The committed dose equivalent, $H_{50,T}$, in a target tissue, T is defined as:

$$H_{50,T} = \sum_S U_S \cdot SEE(T \leftarrow S) \quad (1)$$

where, U_S is the number of transformation of the radioactive nuclide over the 50 years in each source organ S and $SEE(T \leftarrow S)$ is the specific effective energy absorbed in a target organ, T , per nuclear transformation in S . Amongst the terms in equation (1), specific effective energy, $SEE(T \leftarrow S)$ is defined as:

$$SEE(T \leftarrow S) = \sum_i Y_i E_i Q_i \frac{AF(T \leftarrow S)_i}{M_T} \quad (2)$$

where, for each type of radiation i emitted by a radioactive nuclide, Y_i is the yield of the radiation, E_i is the average or unique energy, $AF(T \leftarrow S)_i$ is the absorbed energy fraction of radiation i , and M_T is the mass of the target organ.

For the ICRP's calculation, the specific absorbed fraction, SAF, for photon, $AF(T \leftarrow S)_{\text{photon}}/M_T$, in equation (2) was taken from the calculation by Snyder/3/. The calculation was performed using anatomical data such as organ geometries, relative position of each organ, and organ masses of reference man, or standard man, which is based on European adult man/4/.

As the SAF values for photon depend on anatomical data, special attention for use of ALI/DAC values given in ICRP Publication-30 should be paid on whether the human phantom of reference man represents that of the exposure group to be assessed. Although an effect of deviations in anatomical configuration of the exposure group from that of reference man is one of the most important problem for adopting the ALI/DAC to the regulation in non-European countries/5/ or to the case where the most potentially hazardous exposure is expected, i.e., for so called critical group, the provision of the SAF values to those groups have not been sufficiently made. One of the reason of this is the fact that the calculation is needed to perform in Monte-Carlo way, and hence enormous computation time is required. Extensive progress has, however, been achieved in computer technology and it makes us possible to calculate those values some times faster than when values used for calculating ALI/DAC by the ICRP were evaluated.

In order to implement the way recommended by the ICRP of estimating an internal exposure dose to environmental dose assessment works at Japan Atomic Energy Research Institute, JAERI, the authors have been developing a calculation system called DOSimetric Data Calculation system, DOSDAC/6/. The system is designed to calculate necessary dosimetric data for environmental dose assessment works from up-to-date fundamental data such as nuclear decay data, metabolic data, and so on. As one of the modules consisting of the calculation system, a computer code VADMAP has been developed to calculate the SAF values from the anatomical data. With an inclusion of the VADMAP code to the system, the code system enable us to calculate dose factors even for those whose organ geometries have considerable differences from the reference man.

The VADMAP code is based on the computer code ALGAM/7/ which was originated at Oak Ridge National Laboratory and was used in estimating the SAF values used for calculating the ALI/DAC values published in ICRP Publication 30. The VADMAP code is designed to perform efficient calculation of the SAF values for several exposure groups whose organ geometries have considerable differences. In order to do so, the following improvements are introduced:

- Parameters relating to anatomical data such as organ geometries and relative positions of each organ are inputted from an independent data file, so that user can easily change these anatomical parameters. And also, user can check the input data using a graphical checking tool of this code.
- The mathematical human phantom due to Cristy's work/8/ is implemented in the VADMAP code, in which geometrical configuration of the phantom were improved in comparison with that used in the Snyder's calculation.
- Function of calculating the SAF values using a buildup factor method is added to the code. This part of the code is independent of the code except common variables representing geometries of human phantom.
- The SAF values required for exposure dose calculations are outputted in a machine readable form. From this output, user can efficiently prepare the SAF file which is directly used as input data file of the DOSDAC system.

This document describes the methodology used in the code and user information including the way of implementing the code. In addition to these code description, results of the calculation of the SAF values of an adult are presented to show the performance of the code. As a part of the performance examination, a comparison between the present values and those calculated by Snyder is also made.

2. Models used in the code

2.1 Mathematical phantom

The mathematical phantom implemented in this code is taken from the work of Cristy/8/ instead of that given in the ORNL-5000/3/. In the Cristy's work, following revisions had been made from that of the ORNL-5000.

- 1) Facial skeleton and breasts were newly added
- 2) Geometries of some organs such as lungs, heart and adrenal had been revised and treated more precisely.

Detailed geometries of each organ and the parameters representing its shape are shown in Section 3.1 as a part of input data description.

2.2 Computation of energy deposition through photon collision

Energy deposition by a collision of photon with organ tissue is estimated through two ways in this code, that is, 1) Monte-Carlo method and 2) Buildup-factor method. The Monte-Carlo method is expected to simulate photon transportation close to real one especially for complicate geometries such as human organs of interest in this report. However, in the case where a volume of target organ is small or a distance between source and target organ is extensively large compared with a mean-free-path of photon, sufficient accuracy can be hardly achieved because of poor statistics. Buildup-factor method is to be used in order to fill up this disadvantage as a complementary mean. Detailed description of these methods is given in the following sections.

2.2.1 Monte-Carlo calculation

Monte-Carlo calculation method used in the code for simulating photon transportation is the same as used in the ALGAM code.

The photon cross section for elements of human tissue has been taken from NDL-78/9/ for the range of photon energy from 1×10^{-4} to 4 MeV. The macroscopic cross section required is generated in the code using a fractional mass density of elements at each medium from the microscopic cross section. The macroscopic cross section table to be generated are for total, Compton(incoherent) scattering, and pair-production. Amongst those cross sections, the Compton cross section is computed in the code with the well-known Klein-Nishina formula. Photo-electric cross section is assumed to be the difference between the total cross section and the sum of Compton and pair production cross section. Although, because of the procedure used to estimate photo-electric cross section, coherent scattering is treated as a part of photo-electric interaction, the contribution from this is assumed to be negligibly small.

The photon transportation for each history is simulated in the following steps;

1. Distance to be traveled from the point of photon emission or interaction to a site where next possible interaction may potentially occur is estimated as

$$d = \frac{(-\ln r)}{\mu_0} \quad (3)$$

where, r is a random number uniformly distributed between 0 and 1

μ_0 is a maximum total cross section among those of media.

2. Potential collision site predicted in previous step is checked on whether the potential collision point is inside of exterior of phantom or not. If the point is the outer side, the photon history is terminated.
3. Test on the site where collision takes place, that is, on whether the collision is real or not. The test is carried out by a game of Russian Roulette for a probability which is defined as a ratio of total cross section of medium at the collision site to the maximum one.

4. Energy deposition, E_{dep} , in the collision site is estimated as;

$$E_{dep} = W_{n-1} \times \left[(E_{n-1} - m_0 c^2) \times \frac{\Sigma_{pp}}{\Sigma_T} + E_{n-1} \times \frac{\Sigma_{pe}}{\Sigma_T} + (E_{n-1} - E_n) \times \frac{\Sigma_c}{\Sigma_t} \right] \quad (4)$$

where,

E_{n-1} and E_n ; energies of photon before and after scattering, respectively. Photon energy after collision is estimated together with a new direction of the photon path using Klein-Nishina differential cross section.

Σ_T , Σ_{pe} , Σ_{pp} , and Σ_c ; macroscopic cross section at the photon energy, E_{n-1} , for total, photo-electric, pair production, and Compton scattering, respectively.

W_n ; is a weight which represents a survival rate of n-th collided photon. The weight W_n is calculated as

$$W_n = W_{n-1} \times \frac{\Sigma_c}{\Sigma_T} \quad (5)$$

When the incoming photon has an energy greater than 1.02 MeV, pair production process takes place. In this case, energy deposition to the collision site is a sum of kinetic energies of electron and positron created in the process. Two photons, each of which has an energy of 0.51 MeV, are created following annihilation of positron. The created photons are assumed to have the same behavior and are treated as a single photon with an energy of 0.51 MeV and the weight of $2W_n$. The photon transportation will be simulated as an emission of independent photon from the collision point.

5. The photon history is terminated if either of following two conditions are satisfied;

- (1) The weight W_n is less than 10^{-5} .
- (2) The energy of collided photon E_n is below cut-off energy (given as input data).

In the case where the condition (1) is satisfied, further check using a Russian Roulette is carried out. That is, if uniformly distributed random number between 0 and 1 is less than 10^{-5} , W_n is changed to $10^5 \times W_n$ and further simulation is made. The procedure is to compensate missing of energy deposition due to the termination by the weight criterion.

In the case where the condition (2) is satisfied, the energy of collided photon E_n is assumed to be absorbed in the collision site.

After the all photon histories are completed, standard deviation of averaged energy deposition to each organ region is calculated. Each of the standard deviations will be used to check the appropriateness for the inclusion of each value to final SAF table.

2.2.2 Buildup-factor calculation

In an infinite homogeneous medium, absorbed dose $D^0(r)$ due to uncollided photon at a distance r from a point source of mono-energetic photon is given by the formula:

$$D^0(r) = \frac{\mu_{en}/\rho \cdot E_0}{4\pi r^2} \cdot \exp(-\mu \cdot r) \quad (6)$$

where,

μ/ρ ; mass attenuation coefficient for photon of source energy E_0 , (cm^2/g)

μ_{en}/ρ ; energy absorption coefficient for the photon, (cm^2/g)

ρ ; mass density of a medium, (gcm^{-3})

Total absorbed dose, $D(r)$ (rad), including the contribution from collided photon can be obtained using the dose buildup factor $B(r)$ as follows;

$$D(r) = B(r) \cdot D^0(r) \quad (7)$$

By extending the above point-to-point relation to region-to-region one, the absorbed dose in target region due to mono-energetic photon emitted from the source region is written as;

$$\int_{V_2} \int_{V_1} D(|\vec{r}_1 - \vec{r}_2|) d\vec{r}_1 d\vec{r}_2$$

Thus, specific absorbed fraction, SAF, for photon from source region V_1 to target region V_2 is:

$$SAF(V_1 \longrightarrow V_2) = const \cdot \frac{1}{E_0} \cdot \int_{V_2} \int_{V_1} D(|\vec{r}_1 - \vec{r}_2|) \cdot d\vec{r}_1 \cdot d\vec{r}_2 \quad (8)$$

In the actual cases treated in the code, the geometries of both source and target regions are rather complicated, so analytical integration appeared in Eq.(8) is, in general, not practical. Following approximation is used in the code, instead;

$$SAF(V_1 \longrightarrow V_2) \sim \frac{const}{NE_0} \cdot \sum_{j=1}^N D(|\vec{r}_{1j}' - \vec{r}_{2j}'|) \quad (9)$$

where,

\vec{r}_{1j}' , \vec{r}_{2j}' ; randomly sampled point within regions V_1 and V_2 , respectively.

N ; number of sampling points.

In the case where source and target regions are identical or have an intersected region each other, the function $D(r_1-r_2)$ could diverge when r_1-r_2 becomes zero. In order to avoid the difficulty, following approximation is introduced for the case where the r_1-r_2 is less than certain distance, $l/3$:

$$D(r_1-r_2) = \int_0^l \mu_{ab} \exp(-\mu\tau) / \frac{4\pi r^3}{3} d\tau = \frac{3\mu_{ab}(1-\exp(-\mu l))}{4\mu r^3} \quad (10)$$

where, a value of l is fixed at 0.1(cm) in the code.

When the Buildup-factor method is used for filling up a weakness of the Monte-Carlo method especially for the situation in which deep penetration of photon is expected, i.e. large distance from the source compared with a mean-free-path, accurate attenuation and buildup factor at low energy are essential for the calculation. Taking the requirement into consideration, recently evaluated and/or compiled data are adopted to the code.

Mass attenuation coefficients for water medium and energy absorbed coefficients for media of human soft tissue, lung, and skeletal tissue have been taken from the compilation made by Hubel/10/. Those of data implemented to the code are given in Table 1.

The estimation of buildup factor is performed using a fitting function called G-P method by which a buildup factor can be extrapolated even for deep penetration above 40 mean-free-path successfully/11/. The fitting function implemented to the code is as follows;

For a source-target distance below 40 mfp

$$\begin{aligned}
 B(X) &= 1 + (B_0 - 1) \frac{K^X - 1}{K - 1} & K \neq 1 \text{ and } K \geq 0 \\
 B(X) &= 1 + (B_0 - 1) & K = 1 \\
 B(X) &= 1 & K < 0
 \end{aligned}
 \tag{11}$$

$$K(X) = cX^a + d \cdot \frac{\tanh(X/X_h - 2) - \tanh(-2)}{1 - \tanh(-2)}
 \tag{12}$$

where,

X ; source-target distance in mean-free-path

B_0 ; a value of buildup factor at a distance of 1 mfp

$a, c, d,$ and X_h ; fitting parameters

For a distance above 40 mfp, the function $K(X)$ is replaced as follows;

$$K(X) = 1 + (K(X_i) - 1) \exp\left\{ \frac{1 - (X/X_i)^{0.1}}{1 - (X_j/X_i)^{0.1}} \ln \frac{K(X_j) - 1}{K(X_i) - 1} \right\} \quad (13)$$

where, $X_i=35$ mfp and $X_j=40$ mfp.

3. Computer code

3.1 Code description

The VADMAP code has following three independent functions, each of which is a different program(entry) name and is prepared for;

- (1) calculation of the SAF values using the Monte-Carlo method
(entry name: VADMAP)
- (2) calculation of the SAF values using the Buildup-factor method
(entry name: BUILD)
- (3) printout of cross sectional view of human phantom
(entry name: OGNPRT).

While the functions of (1) and (2) are those explained in section 2.2., the function of (3) helps user to check parameters describing organ geometries. The programs for these three different functions are separated in the code and are called VADMAP/Monte-Carlo, VADMAP/BUILD, and VADMAP/OGNPRT, respectively, while the routines related with organ geometries are commonly used.

(1) VADMAP/Monte-Carlo

The tree structure of the VADMAP/Monte-Carlo is shown in Figure 1. The program is divided broadly into three parts, each of which is enclosed with a dashed line and is called Block-A, Block-B, and Block-C, respectively.

In the Block-A, subroutine GEOMPM reads parameters of describing a human phantom from a logical unit 10 and stores them on common areas of /GP001/ -- /GP005/. Subroutines WGHT1, WGHT2, --- , WGHT5 calculate volume and weight of each organ using the parameters stored. The weight is estimated simply as a product of density of organ and its volume calculated. In subroutine RATIO, weight of marrow at each portion of skeletal tissue is set using the fractional amount of marrow at each the portion and total marrow weight inputted. The routines included in this

block are used not only in this program but also in the VADMAP/BUILD and VADMAP/OGNPRT.

In the Block-B, a macro-scopic cross section table is prepared and, using the cross section table, a photon transportation is simulated following the way described in Section 2.2.

Subroutine GTSIGW is a control routine for processing a macro-scopic photon cross section table, in which the cross section table is generated and stored on a variable XSECT, and also necessary cross section data are picked up referring a photon energy. The generated cross section table is also outputted on a file in a binary format. The file may be used for the calculation using the same elemental configuration of medium.

For a user supplied routine of 'SOURCE', initial physical quantities such as energy and direction and photon emission points are set. The physical quantities of photon emission are stored on a common area of /GAMB/. The routine of 'SOURCE' is standardized to enable user to provide any geometrical shape and photon energy of source. The standardized structure of the routine 'SOURCE' is given in Figure 2. Of parts of the routine mentioned in the figure, those required to calculate SAF values for internal exposure dose assessment are available in a form of include file. Given in Table 2 are module names of the include file and its corresponding function. Routines such as GEOSKL, MEDSKL...., which are mentioned in Figure 2 as those called by the 'SOURCE', are all used through the modules in the include file.

Subroutine COLLIS is a control routine which simulates a photon collision inside a human phantom.

The functions of key routines included in the Block-B is outlined as follows;

GENSIG: calculates macro-scopic cross sections for total, Compton scattering, and pair-production for each medium of human tissue, and stores them on variable XSECT. The Compton cross section is

calculated by a function SIGMAS.

FINDX1 : reads micro-sscopic photon cross section data
 INDEX : calculates an address of the photon cross section table
 corresponding to an photon energy.
 GEOM : checks a predicted collision point on whether it is inside of
 an exterior of a human phantom or not.
 MEDIUM: identifies an organ and its medium which includes a predicted
 collision point. The organ is identified through subroutine BXN.
 KLEIN, AZI and ROT: determine physical quantities of collided photon
 such as energy and direction. The physical quantities determined
 are stored on common /GAMA/.

Routines included in the Block-C sum up energy deposition on each target organ estimated for each collision and, after a completion of all photon histories, calculates specific absorbed fraction together with standard deviation of the value estimated. The results are outputted both on a line-printer and on a machine readable file. In the case where an exterior of phantom based for the calculation is the one of the reference man, absorbed fractions for particular sectors defined by fixed parameter in the program can be obtained as well as those for each organ.

Subroutine DCOMP controls the routines included in this block and calculates the SAF values regarding to the sectors. Through subroutine SPECI\$, the SAF values for each organ are calculated. By subroutine SAFOUT, the SAF values and its standard deviations are outputted on a file of logical unit 20. The file will be processed by a small program included in Appendix 4 of this report for preparing a final SAF-file to be used in one of the modules consisting the DOSDAC system.

(2) VADMAP/BUILD

The tree structure of the VADMAP/BUILD is shown in Figure 3. The routines included in the part called Block-A are commonly used among three programs of the VADMAP code as mentioned above.

After setting organ geometries, subroutines ATTEN and ATNFCT set

attenuation and energy absorbed coefficients on a common area /ATNF00/. Although the coefficients for water and human tissues media are all set on the common area, only those for water medium are used in this version of the code.

Through subroutines SOURCE and TARGET, points included in the regions of each source and target organs are randomly sampled and then an absorbed dose corresponding to a distance between the two points are calculated in subroutine ABSENG. The calculation is repeated for each pair of sampling points until either the conditions that the averaged value converged or number of repetition reached maximum number are satisfied. Convergence condition is examined in the following way:

$$\frac{SAF'(:N) - SAF'(:N+I)}{SAF'(:N)} < \epsilon \quad (14)$$

where,

- SAF'(:N) : an estimated SAF value with N sampling points
- I : number of sampling of an interval, at each interval convergence condition is examined
- ϵ : convergence criteria

The calculated absorbed energy is converted to a specific absorbed fraction and then the results are outputted both on line-printer and a file of logical I/O unit 30. The output file is used for preparing final SAF-table(See also Appendix 4 of this report).

(3) VADMAP/OGNPRT

A tree structure of the VADMAP/OGNPRT is shown in Figure 4. Routines except for subroutines XZPLOT, XYPLOT, and YZPLOT are those used in the VADMAP/Monte-Carlo. The program may printout three kinds of cross section view regarding (x-z)-, (x-y)-, and (y-z)-planes to which subroutines XZPLOT, XYPLOT, and YZPLOT are correspond, respectively.

Using subroutine GEOM, meshed points on a plane specified by the input data are scanned for identifying an organ corresponding to these. Each

organ is represented by a particular character when printing out a cross section view.

3.2 Input data

3.2.1 Input data for describing a human phantom

All the necessary data for describing a human phantom are read from a logical I/O unit 10 in a format: `FORMAT(5E10.4)`. The sequence of the variables to be inputted and their definition are given as follows:

Card 1. Densities of medium (g/cm^3)

DEN(1) - for tissue of lung

DEN(2) - for tissue of neither lung nor skelton

DEN(3) - for skeltal tissue

Card 2. Total weights of marrows (g)

TMW(1) - total weight of red marrows

TMW(2) - total weight of yellow marrows

Card 3. Fraction of either red or yellow marrows at each protion of skelatal tissues in percent. The data are read in a sequence of $((MW(I,J),I=1,15),J=1,2)$

where,

J = 1 for red marrows

2 for yellow marrows

I = 1 for the portion at cranium

2 -- scapulae

3 -- clavicles

4 -- ribs

5 -- upper spine

6 -- mid spine

7 -- lower spine

8 -- pelvis

9 -- upper legs

10 -- mid legs

11 -- lower legs

12	--	upper arms
13	--	mid arms
14	--	lower arms
15	--	facial

The Geometries of human phantom are described by inequation formula to be given in following description of Card 4 - 35 All the variables appeared in the description are in unit of cm. A coordinate system assumed in this description is shown in Figure 5.

Exterior of phantom is described with the cards of CARD 3-4.

Card 4. Exterior of trunk:

Parameters to be inputted : A_T , B_T , C_T

Expression of area :

$$\left(\frac{x}{A_T}\right)^2 + \left(\frac{y}{B_T}\right)^2 \leq 1 \text{ and } 0 \leq z \leq C_T$$

Card 5. Exterior of head:

Parameter to be inputted : A_H , B_H , C_H , C_{H1} , C_{H2}

Expression of area :

$$\left(\frac{x}{A_H}\right)^2 + \left(\frac{y}{B_H}\right)^2 \leq 1 \text{ and } C_T \leq z \leq C_T + C_{H1}$$

or

$$\left(\frac{x}{A_H}\right)^2 + \left(\frac{y}{B_H}\right)^2 + \left(\frac{z - (C_T + C_{H1})}{C_{H2}}\right)^2 \leq 1 \text{ and } z > C_T + C_{H1}$$

Card 6. Exterior of legs:

Parameters to be inputted : C_L , C_L'

Expression of area :

$$x^2 + y^2 \leq \pm x \left(A_T + \frac{A_T}{C_L'}\right) \text{ and } -C_L \leq z \leq 0$$

Skeletal system

Amongst skeletal system, leg bones are described using parameters defined in Cards 4-6. The area of leg bones is expressed by the following inequations:

$$(x \pm (\frac{A_T}{2} + \frac{kz}{C_L - S}))^2 + y^2 \leq (R_1 + (\frac{R_1 - R_2}{C_L - S})z)^2$$

and

$$-(C_L - S) \leq z \leq 0$$

where,

$$k = \frac{A_T}{2} (1 - \frac{C_L' - C_L}{C_L}), \quad R_1 = 0.175 A_T \quad \text{and} \quad R_2 = \frac{A_T}{4} (\frac{C_L' - C_L}{C_L'})$$

Card 7. Arm bones:

Parameter to be inputted : a, b, z_2, x_0

Expression of area :

$$(\frac{(a/(2z_2))(z-z_2) + (x-x_0)}{a})^2 + (\frac{y}{b})^2 \leq (\frac{2z_2 + (z-z_2)}{2z_2})^2$$

and

$$0 \leq z \leq z_2$$

Card 8. Pelvis:

Parameter to be inputted : $a_1, a_2, b_1, b_2, y_{01},$

y_{02}, z_1, z_2, y_1

Expression of area :

$$(\frac{x}{a_2})^2 + (\frac{y-y_{02}}{b_2})^2 \leq 1, \quad (\frac{x}{a_1})^2 + (\frac{y-y_{01}}{b_1})^2 \geq 1,$$

$$y \geq y_{02}, \quad 0 \leq z \leq z_2 \quad \text{and} \quad y \leq y_1 \quad \text{if} \quad z \leq z_1$$

Card 9. Spine:

Parameter to be inputted : $a, b, z_1, z_2, z_3,$

z_4, y_0

Expression of area :

$$(\frac{x}{a})^2 + (\frac{y-y_0}{b})^2 \leq 1 \quad \text{and} \quad z_1 \leq z \leq z_4$$

Parameters z_2 and z_3 represent positions by which spine is divided into three portions.

Card 10. Skull:

Parameter to be inputted : a, b, c, d

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z - (C_T + C_{H1})}{c}\right)^2 \geq 1$$

and

$$\left(\frac{x}{a+d}\right)^2 + \left(\frac{y}{b+d}\right)^2 + \left(\frac{z - (C_T + C_{H1})}{c+d}\right)^2 \leq 1$$

Card 11. Facial skelton

Parameter to be inputted : a_1, b_1, c_1, d

Expression of area :

$$\left(\frac{x}{a_1}\right)^2 + \left(\frac{y}{b_1}\right)^2 \leq 1, \quad \left(\frac{x}{a_1-d}\right)^2 + \left(\frac{y}{b_1-d}\right)^2 \geq 1,$$

$$y \leq 0, \quad C_T + z_1 \leq z \leq C_T + z_5$$

and

$$\left(\frac{x}{a_2}\right)^2 + \left(\frac{y}{b_2}\right)^2 + \left(\frac{z - (C_T + C_{H1})}{c_2}\right)^2 > 1$$

Amongst the parameters used in above expression, four parameters, i.e. a_2, b_2, c_2, z_5 are derived from those of Card 10 as follows;

$$a_2 = a + d, \quad b_2 = b + d,$$

$$c_2 = c + d, \quad z_5 = C_{H1} - c_2 \sqrt{1 - (b_1/b_2)^2}$$

Card 12. Rib cage:

Parameter to be inputted : a, b, c, d, z_1, z_2

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 \leq 1, \quad \left(\frac{x}{a-d}\right)^2 + \left(\frac{y}{b-d}\right)^2 \geq 1,$$

$$z_1 \leq z \leq z_2$$

and Integer($z - z_1/c$) is even

Card 13. Clavicles:

Parameter to be inputted : $y_0, z_1, R, r,$

$$\cot\theta_1, \cot\theta_2$$

Expression of area :

$$(z-z_1)^2 + (R - \sqrt{x^2 + (y-y_0)^2})^2 \leq r^2,$$

$$\cot \theta_2 \leq \frac{y_0 - y}{|x|} \leq \cot \theta_1 \quad \text{and} \quad y < 0$$

Card 14. Scaplae:

Parameter to be inputted : a_2, z_1, z_2, m_1, m_2

Expression of area :

$$\left(\frac{x}{a_2}\right)^2 + \left(\frac{y}{b}\right)^2 \leq 1, \quad \left(\frac{x}{a_1}\right)^2 + \left(\frac{y}{b}\right)^2 > 1,$$

$$z_1 \leq z \leq z_2, \quad y > 0 \quad \text{and} \quad m_1 < \frac{y}{|x|} < m_2$$

Amongst the parameters used in above expression, two parameters, i.e. a, b , are the same as those defined in Card 10.

GI-tract

Card 15. Stomach:

Parameter to be inputted : $a, b, c, d, x_0, y_0, z_0$

Expression of area :

wall;

$$\left(\frac{x-x_0}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1$$

and

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 + \left(\frac{z-z_0}{c-d}\right)^2 \geq 1$$

contents;

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 + \left(\frac{z-z_0}{c-d}\right)^2 < 1$$

Card 16. Small Intetine:

Parameter to be inputted : a, b, y_0, y_1, y_2

z_1, z_2

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 < 1,$$

$$y_1 \leq y \leq y_2 \quad \text{and} \quad z_1 \leq z \leq z_2$$

Of the area expressed above inequations, the region overlapped with ULI and LLI are excluded.

Card 17. Upper Large Intestine:

Parameter to be inputted : $a, b, d, x_0, y_0, z_1, z_2,$
 $b_{tc}, c_{tc}, d_{tc}, y_{0tc}, z_{0tc}, x_{1tc}$

Expression of area :

(ascending colon)

wall;

$$\left(\frac{x-x_0}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 \leq 1,$$

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 \leq 1, \quad \text{and} \quad z_1 \leq z \leq z_2$$

contents;

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 \leq 1, \quad \text{and} \quad z_1 \leq z \leq z_2$$

(transverse colon)

wall:

$$\left(\frac{y-y_{0tc}}{b_{tc}}\right)^2 + \left(\frac{z-z_{0tc}}{c_{tc}}\right)^2 \leq 1,$$

$$\left(\frac{y-y_{0tc}}{b_{tc}-d_{tc}}\right)^2 + \left(\frac{z-z_{0tc}}{b_{tc}-d_{tc}}\right)^2 \leq 1, \quad \text{and} \quad -x_{1tc} \leq x \leq x_{1tc}$$

contents:

$$\left(\frac{y-y_{0tc}}{b_{tc}-d_{tc}}\right)^2 + \left(\frac{z-z_{0tc}}{b_{tc}-d_{tc}}\right)^2 < 1, \quad \text{and} \quad -x_{1tc} \leq x \leq x_{1tc}$$

Card 18. Lower Large Intestine:

Parameter to be inputted : $a, b, d, z_1, z_2,$

$x_1, m_x, m_y, a_{sc}, b_{sc},$

$d_{sc}, x_{0sc}, z_{0sc}, R_1, R_2$

Expression of area :

(descending colon)

wall;

$$\left(\frac{x-x_0}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 \leq 1,$$

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 \geq 1, \quad \text{and} \quad z_1 \leq z \leq z_2$$

where,

$$x_0 = x_1 + \frac{m_x(z-z_2)}{z_2-z_1} \quad \text{and} \quad y_0 = \frac{m_y(z_1-z)}{z_2-z_1}$$

content;

$$\left(\frac{x-x_0}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 < 1, \quad \text{and} \quad z_1 \leq z \leq z_2$$

(sigmoid colon)

wall:

- upper portion -

$$\left(\frac{\sqrt{(x-x_0)^2 + (z-z_0)^2} - R_1}{a}\right)^2 + \left(\frac{y}{b}\right)^2 \leq 1,$$

$$\left(\frac{\sqrt{(x-x_0)^2 + (z-z_0)^2} - R_1}{a-d}\right)^2 + \left(\frac{y}{b-d}\right)^2 \geq 1,$$

$$x \geq x_0 \quad \text{and} \quad z \leq z_0$$

- lower portion -

$$\left(\frac{\sqrt{(x-x_1)^2 + z^2} - R_2}{a}\right)^2 + \left(\frac{y}{b}\right)^2 \leq 1,$$

$$\left(\frac{\sqrt{(x-x_0)^2 + z^2} - R_2}{a-d}\right)^2 + \left(\frac{y}{b-d}\right)^2 \geq 1,$$

$$x \leq x_0 \quad \text{and} \quad z \geq z_0$$

content:

- upper portion -

$$\left(\frac{\sqrt{(x-x_0)^2 + (z-z_0)^2} - R_1}{a-d}\right)^2 + \left(\frac{y}{b-d}\right)^2 < 1,$$

$$x \geq x_0 \quad \text{and} \quad z \leq z_0$$

- lower portion -

$$\left(\frac{\sqrt{(x-x_1)^2 + z^2} - R_2}{a-d}\right)^2 + \left(\frac{y}{b-d}\right)^2 < 1,$$

$$x \leq x_0 \quad \text{and} \quad z \geq z_0$$

Other organs

Card 19. Adrenal glands

Parameter to be inputted : $a, b, c, \theta, x_0, y_0, z_0$

Expression of area :

$$\left(\frac{x_1}{a}\right)^2 + \left(\frac{y_1}{b}\right)^2 + \left(\frac{z_1}{c}\right)^2 \leq 1 \quad \text{and} \quad z_1 \geq 0$$

where,

$$\begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x-x_0 \\ y-y_0 \\ z-z_0 \end{bmatrix}$$

for left, sign of x_0, θ is positive, otherwise negative.

Card 20. Brain

Parameter to be inputted : a, b, c

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z-(C_T+C_{H1})}{c}\right)^2 \leq 1$$

Card 21. Breasts

Parameter to be inputted : a, b, c, x_0, z_0

Expression of area :

$$\left(\frac{x-x_0}{a-S}\right)^2 + \left(\frac{y-y_0}{b-S}\right)^2 + \left(\frac{z-z_0}{c-S}\right)^2 \leq 1 \quad \text{and} \quad \left(\frac{x}{A_T}\right)^2 + \left(\frac{y}{B_T}\right)^2 > 1$$

where,

$$y_0 = -B_T \sqrt{1 - (x_0/A_T)^2}$$

for left breast, positive value of x_0 , otherwise negative.

Parameter S is a skin thickness read from Card 28.

Card 22. Gal. Bladder and content

Parameter to be inputted : a_1, b_1, c_1, a_2, b_2
 $c_2, a_3, b_3, c_3, x_0,$
 $y_0, z_0, r_1, r_2, s,$
 h

Expression of area :

wall ;

(hemispherical part)

$$x_1^2 + y_1^2 + z_1^2 \leq r_2^2,$$

$$x_1^2 + y_1^2 + z_1^2 \leq r_1^2 \text{ and } z_1 < 0$$

(conical part)

$$x_1^2 + y_1^2 \leq (r_2 - sz_1)^2,$$

$$x_1^2 + y_1^2 \leq (r_1 - sz_2)^2, \text{ and } 0 \leq z_1 \leq h$$

contents

(hemispherical part)

$$x_1^2 + y_1^2 + z_1^2 < r_1^2 \text{ and } z_1 < 0$$

(conical part)

$$x_1^2 + y_1^2 \leq (r_2 - sz_1)^2,$$

$$x_1^2 + y_1^2 < (r_1 - sz_2)^2, \text{ and } 0 \leq z_1 \leq h$$

where,

$$\begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix} = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} x-x_0 \\ y-y_0 \\ z-z_0 \end{bmatrix}$$

Card 23. Kidneys

Parameter to be inputted : $a, b, c, x_0, y_0, z_0, x_1$

Expression of area :

$$\left(\frac{x \pm x_0}{a}\right)^2 + \left(\frac{y - y_0}{b}\right)^2 + \left(\frac{z - z_0}{c}\right)^2 \leq 1$$

and

$$|x| \leq x_1$$

for the right kidney positive sign, otherwise minus.

Card 24. Liver

Parameter to be inputted : $a, b, x_m, y_m, z_m,$

$$z_1, z_2, k$$

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 \leq 1, \quad \frac{x-k}{x_m} + \frac{y}{y_m} - \frac{z}{z_m} \leq -1$$

and

$$z_1 \leq z \leq z_2$$

Card 25. Lungs

Parameter to be inputted : $a, b, x_0, z_0, z_{1R},$
 $z_{2R}, y_{1R}, x_{1R}, y_{1L},$
 z_{2L}, x_{1L}

Expression of area :

(right lung)

$$\left(\frac{x+x_0}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1$$

and

$$z \geq z_0, \quad \text{if } z_{1R} \leq z \leq z_{2R} \quad \text{and} \quad y < y_{2R} \quad \text{then} \quad x \leq x_{1R}$$

(left lung)

Geometry of left lung can be expressed by following change for the inequation of right lung:

$$(x+x_0) \quad \text{---->} \quad (x-x_0)$$

$$z_{1R}, z_{2R}, y_{2R} \quad \text{---->} \quad z_{1L}, z_{2L}, y_{2L}$$

$$(x \leq x_{1R}) \quad \text{---->} \quad (x \geq x_{1L})$$

Card 26. Ovaries

Parameter to be inputted : a, b, c, x_0, z_0

Expression of area :

$$\left(\frac{x \pm x_0}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1$$

for right ovarie, plus sign is assumed, otherwise negative.

Card 27. Pancreas

Parameter to be inputted : a, b, c, x_0, z_0, x_1

Expression of area :

$$\left(\frac{x-x_0}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1, \quad x \geq x_0$$

and

$$z \geq z_0, \quad \text{if } x > x_1$$

Card 28. Skin

Parameter to be inputted : S

Skin is assumed to cover exterior of phantom with uniform thickness S (cm).

Card 29. SpleenParameter to be inputted : a, b, c, x_0, y_0, z_0

Expression of area :

$$\left(\frac{x-x_0}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1,$$

Card 30. TestesParameter to be inputted : a, b, c, y_0

Expression of area :

$$\left(\frac{x \pm a}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z+c}{c}\right)^2 \leq 1$$

where, plus sign is for right testes and minus for right.

Card 31. ThymusParameter to be inputted : a, b, c, y_0, z_0

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1$$

Card 32. ThyroidParameter to be inputted : y_0, R, c, r

Expression of area :

$$x^2 + (y-y_0)^2 \leq R^2$$

$$x^2 + (y-y_0)^2 \geq r^2$$

$$y \leq y_0, C_T \leq z \leq C_T + c,$$

and

$$((y-y_0)-|x|)^2 \geq 2(x^2 + (y-y_0)^2)r^2$$

where,

$$r = \left(\frac{\sqrt{2}-2}{2}\right)\left(\frac{z-C_T}{0.25c}\right) + 1 \quad \text{for } 0 \leq z-C_T \leq 0.25c$$

$$r = \left(\frac{2-\sqrt{2}}{2}\right)\left(\frac{z-C_T}{0.75c}\right) + \frac{2\sqrt{2}-1}{3} \quad \text{for } 0.25c \leq z-C_T \leq c$$

Card 33. UterusParameter to be inputted : a, b, c, y_0, z_0, y_1

Expression of area :

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1,$$

$$y \geq y_1$$

Card 34. Hert

Parameter to be inputted : $a_1, b_1, c_1, a_2, b_2,$
 $c_2, a_3, b_3, c_3, x_0,$
 $y_0, z_0, VX, AVY, LAVZ,$
 $RAVZ, TLVW, AX, TAW, TRVW$

Expression of area :

left ventricle

-wall-

$$\left(\frac{x_1}{VX}\right)^2 + \left(\frac{y_1}{AVY}\right)^2 + \left(\frac{z_1}{LAVZ}\right)^2 \leq 1,$$

$$\left(\frac{x_1}{VX-TLVW}\right)^2 + \left(\frac{y_1}{AVY-TLVW}\right)^2 + \left(\frac{z_1}{LAVZ-TLVW}\right)^2 \leq 1,$$

and

$$x_1 \geq 0$$

-content-

$$\left(\frac{x_1}{VX-TLVW}\right)^2 + \left(\frac{y_1}{AVY-TLVW}\right)^2 + \left(\frac{z_1}{LAVZ-TLVW}\right)^2 < 1,$$

and

$$x_1 \geq 0$$

right ventricle

-wall-

$$\left(\frac{x_1}{VX}\right)^2 + \left(\frac{y_1}{AVY}\right)^2 + \left(\frac{z_1}{RAVZ}\right)^2 \leq 1,$$

$$\left(\frac{x_1}{VX-TRVW}\right)^2 + \left(\frac{y_1}{AVY-TRVW}\right)^2 + \left(\frac{z_1}{LAVZ-TRVW}\right)^2 \leq 1,$$

and

$$x_1 \geq 0, \text{ and } z_1 < 0$$

-content-

$$\left(\frac{x_1}{VX-TRVW}\right)^2 + \left(\frac{y_1}{AVY-TRVW}\right)^2 + \left(\frac{z_1}{LAVZ-TRVW}\right)^2 < 1,$$

and

$$x_1 \geq 0, \text{ and } z_1 < 0$$

left atrium

-wall(part1)-

$$\left(\frac{x_1}{AX}\right)^2 + \left(\frac{y_1}{AVY}\right)^2 + \left(\frac{z_1}{LAVZ}\right)^2 \leq 1,$$

$$\left(\frac{x_1}{AX-TAW}\right)^2 + \left(\frac{y_1}{AVY-TAW}\right)^2 + \left(\frac{z_1}{LAVZ-TAW}\right)^2 \leq 1,$$

and

$$x_1 < 0, \text{ and } z_1 \geq 0$$

-wall(part2)-

$$\left(\frac{x_1}{AX}\right)^2 + \left(\frac{y_1}{AVY}\right)^2 + \left(\frac{z_1}{LAVZ-TLVW+TAW}\right)^2 \leq 1,$$

$$\left(\frac{x_1}{AX-TAW}\right)^2 + \left(\frac{y_1}{AVY-TAW}\right)^2 + \left(\frac{z_1}{LAVZ-TAW}\right)^2 \leq 1,$$

and

$$x_1 < 0, \text{ and } z_1 < 0$$

-content(part1)-

$$\left(\frac{x_1}{AX-TAW}\right)^2 + \left(\frac{y_1}{AVY-TAW}\right)^2 + \left(\frac{z_1}{LAVZ-TAW}\right)^2 < 1,$$

and

$$x_1 < 0, \text{ and } z_1 \geq 0$$

-content(part2)-

$$\left(\frac{x_1}{VX-TAW}\right)^2 + \left(\frac{y_1}{AVY-TAW}\right)^2 + \left(\frac{z_1}{LAVZ-TLVW}\right)^2 < 1,$$

and

$$x_1 < 0, \text{ and } z_1 < 0$$

right atrium

-wall-

$$\left(\frac{x_1}{AX}\right)^2 + \left(\frac{y_1}{AVY}\right)^2 + \left(\frac{z_1}{RAVZ}\right)^2 \leq 1,$$

and

$$x_1 < 0, \text{ and } z_1 < 0$$

-content-

$$\left(\frac{x_1}{AX-TAW}\right)^2 + \left(\frac{y_1}{AVY-TAW}\right)^2 + \left(\frac{z_1}{RAVZ-TAW}\right)^2 < 1,$$

and

$$x_1 < 0, \text{ and } z_1 < 0$$

where,

$$\begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix} = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} x-x_0 \\ y-y_0 \\ z-z_0 \end{bmatrix}$$

Card 35. Urinary bladder and content

Parameter to be inputted : a, b, c, d, y_0, z_0

Expression of area :

wall;

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y-y_0}{b}\right)^2 + \left(\frac{z-z_0}{c}\right)^2 \leq 1$$

and

$$\left(\frac{x}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 + \left(\frac{z-z_0}{c-d}\right)^2 \geq 1$$

contents;

$$\left(\frac{x}{a-d}\right)^2 + \left(\frac{y-y_0}{b-d}\right)^2 + \left(\frac{z-z_0}{c-d}\right)^2 < 1$$

3.2.2 Input data for controlling programs

(1) VADMAP/Monte-Carlo

Card 1. Title

FORMAT (10A8)

(IDENT(I), I = 1, 10) - Title of run.

Card 2. Control data for running the program.

FORMAT (I10, 2E10.0, 2I5, 3x, I4)

NGAMA - Number of histories to be simulated.

ECT - Gamma-ray cut off energy(MeV)

EZERO - Gamma-ray initial energy(MeV)

IOP - Option to generate photon cross section table for each medium

; if IOP=1, cross section table is produced.

2, cross section table has already been produced, read from binary data file.

NMED - Numbers of medium which have different elemental composition.

$NMED \leq 3$

IRNO - Initial value for random number generator

Card 3. I/O unit concerning cross section table

FORMAT (2I4)

NTAPE - Logical I/O unit of macro-scopic cross section table.

MX - Logical I/O unit of micro-scopic cross section table of element.

In the case where macro-scopic cross section table has already produced, the value of MX is 0.

Following input data (Cards 4-6) are required only if macro-scopic cross section table is produced(i.e. $MX \neq 0$)

Card 4. Control data for producing macro-scopic cross section

FORMAT(4I4)

NMED - Numbers of medium.
NMED \leq 3.
NINT - Numbers of energy point in each energy groupe is
defined as $2^{**}NINT$.
ILOW - The lowest photon energy of the cross section
table is defined as $2^{**}ILOW$.
IHIGH - The highest photon energy of the cross section
table is defined as $2^{**}IHIGH$.

Subsequent blocks are repeated NMED times.

Card 5. Index of photon cross section table.

FORMAT(I4, E9.3)
NELE - Numbers of element contained in each medium.
TITL - Title of photon cross section table for each
medium.

Card 6. Fractional density of element

FORMAT(I4, E9.3)
LEMNO - Atomic number of element.
DENSTY- Elemental density of medium (gram/cm³).

(2) VADMAP/BUILD

Card 1. Selection of calculation mode

FORMAT(15)
IMOD - calculation mode
=1:Mode for making SAF table

Calculations for 23 target organs with 12 energy
points are carried out and the results are outputted
to machine readable file as well as printed output.

=2:Mode for calculating te SAF of particular
source-target pair.

In the case of IMOD=1

Routine of SOURCE is expected to be supplied by user in this

case. 23 routines of describing target organ are called following sequence:

- | | |
|-------------------------------|-------------------------------|
| 1. Urinary bladder wall | 2. Stomach wall |
| 3. Small Intestine | 4. Upper Large Intestine wall |
| 5. Lower Large Intestine wall | 6. Kidneys |
| 7. Liver | 8. Lungs |
| 9. Breasts | 10. Ovaries |
| 11. Pancreas | 12. Red Marrows |
| 13. Yellow Marrows | 14. Bone |
| 15. Skin | 16. Spleen |
| 17. Testes | 18. Thymus |
| 19. Thyroid | 20. Uterus |
| 21. Muscle | 22. Adrenals |
| 23. Brain | |

Following two cards are repeated 23 times, each step is correspond to the calculation with target organs mentioned.

Card 2. Title card.

```
FORMAT( 10A8 )
( IDENT(I), I=1,10) - Title
```

Card 3. Calculation conditions

```
FORMAT( I10, 2I5, F10.5 )
RANDO - Initial number for random number generator
NGAMA - Maximum sampling number
ICLK - Interval of sampling number at each of which
        convergence condition is examined
Gain - Convergence condition
```

In the case of IMOD=2

Routines of both SOURCE and TARGET are expected to be supplied by user in this case.

Card 2' Title card.

```
FORMAT( 10A8 )
```

(IDENT(I),I=1,10) - Title

Card 3' Calculation conditions

FORMAT(I5, I10, 2I5, F10.5)

INRG - Number of initial photon energy (INRG \leq 12)

IRNO - Initial number of random number generator

MAXSMP- Maximum number of sampling

ICLK - Interval of sampling number at each of which
convergence condition is examined

GAIN - Convergence condition

Card 4' Initial photon energies

FORMAT(5F10.5)

(ENER(I),I=1,INRG) - Photon energies (MeV)

(3) VADMAP/OGNPRT

A plane on which cross section view is outputted and the intercepted point of the plane with an axis are defined as follows:

FORMAT(I4, F10.0)

IS - Selection of the plane

= 1 : (x-z)-plane

= 2 : (x-y)-plane

= 3 : (y-z)-plane

= 0 : termination of run

SP - Intercepted point of axis

The input data can be repeated for the planes user desire to examine. The last card should be IS=0.

4. Performance through the calculation of the SAF values

A set of the SAF values for photon was calculated using the VADMAP code, which is required for the dose estimation by the DOSDAC system. The calculation was performed with both Monte-Carlo and Buildup-factor methods for 22×23 source-target organ pairs and at twelve energy points which cover the photon energy in a range of 0.01 to 4.0 MeV. From the calculated results, the SAF data file, which can be used as an input data file for DOSDAC system, was prepared. The preparation was made considering statistical accuracies of the values calculated with the Monte-Carlo method. The SAF values prepared for the DOSDAC system are tabulated in Appendix 5 in which the values accompanied by letter b were estimated with the Buildup factor method, otherwise with the Monte-Carlo method.

In this section, showing the calculation conditions and procedure used to prepare the SAF values, performance of the VADMAP code is presented. Further, the calculated results are compared with the values tabulated in ORNL-5000/3/ in order to assure the quality of the code.

4.1 Calculation of the SAF values using the VADMAP code

Calculation condition

Anatomical data, or mathematical human phantom used in the present calculation is taken from that proposed by Cristy for an adult. Parameters describing a human phantom used in this work are given in Appendix 3 in a form of input data to the VADMAP code, the definition of which is described in Section 2.3.

Calculation condition particular to the Monte-Carlo method is the same as used in the work of ORNL-5000. They are:

- Number of histories : 60000
- Cut-off photon energy : 4 keV
- Elemental composition of different tissues are summarized in Table 3, which were used to generate macro-scopic photon cross section.

The conditions for the calculation by the Buildup-factor method are:

- Convergence criterion : 10^{-3}
- Number of sampling points for one interval: 100
- Maximum sampling numbers : 6000
- Attenuation coefficients, mass energy absorbed coefficients and buildup factor used in the calculation are all for water medium. The differences in the coefficients among lung, skeletal tissue and other soft tissue are not taken into account for the present calculation.

The definition of the first three items of the conditions described above are given in Equation (13) of Section 2.

Procedure used to prepare the SAF data file

Calculation results obtained with both the Monte-Carlo and the Buildup-factor methods were organized to a form suitable as an input data file of the DOSDAC system. The preparation of the file was made using a small program which is given in Appendix 4 of this report together with the job control instruction.

As explained in Section 2, the Buildup factor method is used for filling up a weakness of the Monte-Carlo method in the case that statistical accuracy is hardly achieved. The selection on which value should be taken to the SAF data file was made referring to the coefficients of variance, CV . The CV value is obtained in the calculation of the Monte-Carlo method together with the value of specific effective energy, and it is defined as:

$$CV = 100 \cdot \sigma / E \quad (15)$$

where, σ is the standard deviation of the mean energy absorption E at each target organ.

In the present work, if the CV value is in excess of 30 %, the SAF value estimated by the Buildup-factor method is taken to the SAF data file which

is to be used as an input data of the DOSDAC system.

4.2 Comparison of the calculated SAF values with those tabulated in ORNL-5000

In order to examine the SAF values calculated by the VADMAP code, the comparison study between the SAF values calculated by the VADMAP code and those tabulated in ORNL-5000 was carried out. The comparison was made with following three steps:

- The differences in calculation condition used to calculate the two SAF data files were identified.
- The specific effective energies of photon, SEE_{photon} , for three radioactive nuclides, ^{132}Eu , ^{129}Cs , and ^{239}Pu , were calculated from the SAF values of both present and ORNL-5000. Comparing the values of the SEE_{photon} for each nuclide, the tendency of the difference between the two SAF files was examined.
- Detailed examination was performed on the differences in the SAF for the particular source-target pairs for which typical tendency was observed in the examination at the preceding step.

Differences in the calculation condition

The differences observed in calculation conditions between present calculation and that of ORNL-5000 are summarized as follows:

- Differences of anatomical data used
Although both the SAF files examined were prepared using an adult human phantom, some differences in anatomical data were observed. The differences between the human phantoms used in the present calculation and that of ORNL-5000 are:
 - (1) Organs such as breasts and facial skeleton are newly added.
 - (2) For the organs of lungs and heart, the geometrical expression used in the present calculation are more precise than used in ORNL-5000.
 - (3) Small modification has been introduced, which is expressed with

the same inequality formula to describe the region of each organ, but with different parameter. The differences of the parameters used to calculate the SAF values are summarized in Table 4.

(4) Marrow weights and its fraction at each portion of skeletal tissue are different, which are summarized in Table 5.

- Differences in buildup factor used and photon attenuation coefficients

For the present calculation with the Buildup factor method, inter-/extra-polation of buildup factor was made using recently developed way called G-P method, while Berger's fitting procedure was used for ORNL-5000. As use of a buildup factor obtained by the Berger's procedure is limited to the case where source-target distance is less than 40 mean-free-path and photon energy is greater than 15 keV, the values of SAF(source \neq target) of ORNL-5000 at photon energy of 10-20 keV were obtained by extrapolating the values at upper photon energies. As for the values at the low photon energy region, no particular treatment was made, considering the capability of the G-P method which is expected to be rigorous for deep penetration of photon.

- Difference of the criterion on the statistical accuracy applied to the SAF values estimated by the Monte-Carlo calculation

The SAF values estimated by the Buildup factor method was taken instead of those by Monte-Carlo method in the present calculation, in such a case that the coefficient of variance is in excess of 30 %, while 50 % in the work of ORNL-5000.

Comparison of the SEE_{photon} values

The SEE_{photon} values of three radioactive nuclides, ^{152}Eu , ^{129}Cs , and ^{239}Pu , were derived from either of the SAF files, and, then compared each other. The SEE_{photon} values were calculated with the following definition:

$$SEE(T \leftarrow S)_{photon} = \sum_i I_i \cdot E_i \cdot SAF(T \leftarrow S; E_i) \quad (16)$$

where, the $SEE(T \leftarrow S)_{photon}$ is the specific effective energy for photon of a source organ S and a target organ T, I_i is a yield of i -th photon

per disintegration, and the $SAF(T \leftarrow S; E_i)$ is the specific absorbed fraction at a photon energy of E_i . The values of the $SAF(T \leftarrow S; E_i)$ were calculated by linearly inter-/extra-polating two energetically adjacent calculated values.

The discrepancies in the SEE_{photon} for each source-target organ pair are shown in Figures 6-8. The discrepancies shown in the figures were quantified as:

$$\frac{\max.(SAF_{present}, SAF_{ORNL-5000})}{\min.(SAF_{present}, SAF_{ORNL-5000})} - 1.$$

where, $SAF_{present}$ and $SAF_{ORNL5000}$ are SAF_{photon} value of a source-target organ pair of present work and that of ORNL-5000, respectively. In these figures, the asterisk(*) attached to the source or target organ names for which the organ geometries are different between the present work and ORNL-5000. The photon spectra used to calculate the SAF values are given in Figures 9-11, together with energy weighted spectra. (Amongst the comparisons made for each the source-target organ pair shown in these figures 6-8, the case in which target organ is specified as 'breasts' is a comparison between the $SAF_{photon}(\text{breasts} \leftarrow x)$ calculated by the VADMAP and $SAF_{photon}(\text{muscle} \leftarrow x)$ of ORNL-5000. This is because the $SAF_{photon}(\text{breasts} \leftarrow x)$ was not estimated in ORNL-5000 but the $SAF_{photon}(\text{muscle} \leftarrow x)$ was used for a calculation of the ALI/DAC values by ICRP instead.)

As can be seen in Figures 6-8, large discrepancies in SAF_{photon} concentrate on the cases where either organ geometry of source or of target is different between present calculation and ORNL-5000. And the extent of the discrepancies for the SEE_{photon} of ^{239}Pu are larger than that of the other two radioactive nuclides.

Systematic discrepancies are observed in the cases where target organ is breasts, thymus, or adrenal, and where source organ is adrenal. The discrepancies in the $SEE_{photon}(\text{breasts} \leftarrow x)$ are significant except for the cases where the source organ is total body. It indicates that the $SEE_{photon}(\text{muscle} \leftarrow x)$ can not be used as an alternative of the $SEE_{photon}(\text{breasts} \leftarrow x)$, as assumed in ICRP's calculation of the ALI/DAC values.

As to the cases where neither the organ geometry of source nor of target is different, the discrepancies are within 20 % for ^{152}Eu and ^{129}Cs , although a few exceptions are observed. This indicates that the $\text{SAF}_{\text{photon}}$ of ORNL-5000 were reproduced correctly in the present calculation for photon energies greater than 100 keV, since photon spectra of these nuclides cover a photon energy in a range of 100 keV to 2 MeV. In the comparison for ^{239}Pu , however, considerable number of source-target organ pairs show large discrepancies. Among those discrepancies appeared in the $\text{SAF}_{\text{photon}}$ of ^{239}Pu , the cases in which source organ is muscle or skin are remarkable.

Detailed examination of the $\text{SAF}_{\text{photon}}$ values

Taking into account the trend of the discrepancies in $\text{SEE}_{\text{photon}}$ values observed in the preceding section, the values of $\text{SAF}_{\text{photon}}$ for some source-target organ pairs were examined for each characteristic feature appeared.

- The cases in which the $\text{SEE}_{\text{photon}}$ are in a good agreement for all the three nuclides examined;

In the case that the volume of a target organ is large and the distance between source and target organs is small, the comparison of the $\text{SEE}_{\text{photon}}$ show a good agreement because of sufficient number of photon collisions taking place in the target organ. As an example, the $\text{SAF}_{\text{photon}}$ (Liver <--- Kidneys) is shown in Figure 12. As can be seen in this figure, the present values at photon energies greater than 15 keV is in an excellent agreement with those of ORNL-5000. The discrepancy observed at the photon energy of 10 keV is due to a special treatment made in the work of ORNL-5000, in which some $\text{SAF}_{\text{photon}}$ -values at photon energies of 10-20 keV were obtained by extrapolating the values for the upper photon energy points.

In the opposite case where the volume of a target organ is small, there are also some source-target organ pairs which show a good agreement in the $\text{SEE}_{\text{photon}}$ such as an organ pair of kidneys-testes. Shown in

Figure 13 is the SAF_{photon} (testes <--- kidneys) in which all the values adopted to the final SAF table are those calculated by the Buildup factor method. The good agreement assures a correct implementation of the Buildup factor method into the VADMAP code.

- The cases in which the same organ geometries are used but considerable differences observed in the SEE_{photon}

Although the organ geometries used in the present calculation are the same as those in ORNL-5000, considerable discrepancies were observed in Figs 6 through 8. Such discrepancies are, as examples, pointed out in the SEE_{photon} (stomach wall <--- liver) of ^{239}Pu , the SEE_{photon} (bladder wall <--- stomach wall) of ^{152}Eu and ^{129}Cs , and the SEE_{photon} (stomach wall <--- muscle) of ^{239}Pu .

As for the SEE_{photon} (stomach wall <--- liver) of ^{239}Pu , the discrepancy in the SEE is in excess of 40 %, while those of ^{152}Eu and ^{129}Cs are within 10 %. As can be seen in Figure 14, the SAF_{photon} values of this source-target organ pair show a good agreement at photon energies greater than 30 keV. The discrepancies observed in the SEE_{photon} of ^{239}Pu can be explained with the differences at photon energy below 30 keV, which is due to the same reason mentioned in the first case of this section.

Shown in Figure 15 is the SAF_{photon} (bladder wall <--- stomach wall) in which differences in the SAF_{photon} appears at photon energies greater than 500 keV due to poor statistics. As can be seen in photon energy spectra of ^{129}Cs and ^{152}Eu , dominant contribution to the SEE_{photon} are expected in a photon energy region of 200 to 1000 keV. Considering these facts, the discrepancies in the SEE_{photon} (bladder wall <--- stomach wall) is explained by the poor statistics observed in the SAF.

Shown in Figure 16 is the SAF_{photon} (stomach wall <--- muscle). In this figure, apparent discrepancies are observed at the photon energies less than 30 keV in spite of sufficient statistical accuracy reached for the values. The SAF_{photon} reflects to those in the SEE_{photon} of

^{239}Pu . The same trends have been found in the other source-target organ pairs for which the source organ is muscle, such as those whose target organ is bladder wall, ULI wall, LLI wall, testes or uterus, and source organ is muscle. The reason of these discrepancies are not clear, so far.

- The cases in which either organ geometry of source or of target is different;

Shown in Figure 17 is the SAF_{photon} (liver <--- adrenal) in which the discrepancies are observed in the values for all the calculated energy points. The discrepancies can be explained with the difference in the organ geometry of adrenal between present calculation and ORNL-5000. The SAF_{photon} of this source-target organ pairs represents the most typical example of the discrepancies due to the change of organ geometry.

As mentioned before, the SEE_{photon} (breasts <--- x) of the present calculation is compared with the SEE_{photon} (muscle <--- x) of ORNL-5000. The differences between the SEE_{photon} values for each radioisotopes examined indicate that the SEE_{photon} (breast <--- x) cannot be replaced by the SEE_{photon} (muscle <--- x) as in ORNL-5000. In order to show the differences in the SAF_{photon} , which resulted in the differences observed in SEE_{photon} values, the case in which source organ is lungs is presented in Figure 18 as an example.

Acknowledgement

The authors would like to express their thanks to Mr. A.Kohsaka, Div. of Reactor Safety Research, JAERI, for his encouragement : through this work and critical reading of this manuscript, to Dr. J.Katakura and Dr.Y.Sakamoto of Div. of Nuclear Fuel Safety Research for their useful discussion on the simulation method of photon transportation, and to Mr. Iwai of Mitsubishi Atomic Power Industry for his offer of the list of the ALGAM code. And the authors would like also to acknowledge the contribution of Dr. Ryufuku of VIC (who died on August, 1987) for his help to implement a mathematical human phantom proposed by Cristy into the code.

^{239}Pu . The same trends have been found in the other source-target organ pairs for which the source organ is muscle, such as those whose target organ is bladder wall, ULI wall, LLI wall, testes or uterus, and source organ is muscle. The reason of these discrepancies are not clear, so far.

- The cases in which either organ geometry of source or of target is different;

Shown in Figure 17 is the SAF_{photon} (liver <--- adrenal) in which the discrepancies are observed in the values for all the calculated energy points. The discrepancies can be explained with the difference in the organ geometry of adrenal between present calculation and ORNL-5000. The SAF_{photon} of this source-target organ pairs represents the most typical example of the discrepancies due to the change of organ geometry.

As mentioned before, the SEE_{photon} (breasts <--- x) of the present calculation is compared with the SEE_{photon} (muscle <--- x) of ORNL-5000. The differences between the SEE_{photon} values for each radioisotopes examined indicate that the SEE_{photon} (breast <--- x) cannot be replaced by the SEE_{photon} (muscle <--- x) as in ORNL-5000. In order to show the differences in the SAF_{photon} , which resulted in the differences observed in SEE_{photon} values, the case in which source organ is lungs is presented in Figure 18 as an example.

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Table 1 Photon mass attenuation coefficients and mass energy absorbed coefficients used in the VADMAP code

Energy (MeV)	Mass attenuation coefficients (cm ² /g)			Energy absorbed coefficients (cm ² /g)			
	Water	Lung	Bone	Water	Lung	Bone	Muscle
0.010	5.2230	5.3590	26.9000	4.8400	4.9580	25.2400	4.8950
0.015	1.6390	1.6910	8.5240	1.3400	1.3910	7.8970	1.3710
0.020	0.7958	0.8194	3.7820	0.5367	0.5615	3.3890	0.5531
0.030	0.3718	0.3781	1.2670	0.1520	0.1604	1.0090	0.1579
0.040	0.2668	0.2685	0.6400	0.0680	0.0717	0.4250	0.0707
0.050	0.2262	0.2262	0.4121	0.0416	0.0434	0.2207	0.0429
0.060	0.2055	0.2048	0.3087	0.0315	0.0325	0.1327	0.0322
0.080	0.1835	0.1823	0.2215	0.0258	0.0261	0.0662	0.0260
0.100	0.1707	0.1693	0.1857	0.0254	0.0254	0.0447	0.0254
0.150	0.1504	0.1491	0.1492	0.0276	0.0274	0.0318	0.0274
0.200	0.1370	0.1357	0.1322	0.0297	0.0294	0.0302	0.0294
0.300	0.1187	0.1175	0.1126	0.0319	0.0316	0.0307	0.0316
0.400	0.1061	0.1051	0.1003	0.0328	0.0325	0.0311	0.0325
0.500	0.0969	0.0959	0.0913	0.0330	0.0327	0.0311	0.0327
0.600	0.0896	0.0887	0.0844	0.0328	0.0325	0.0309	0.0325
0.800	0.0787	0.0779	0.0740	0.0320	0.0317	0.0301	0.0318
1.000	0.0707	0.0700	0.0665	0.0310	0.0307	0.0291	0.0307
1.500	0.0575	0.0570	0.0541	0.0283	0.0280	0.0265	0.0280
2.000	0.0494	0.0489	0.0466	0.0260	0.0258	0.0245	0.0258
3.000	0.0397	0.0393	0.0379	0.0228	0.0226	0.0217	0.0226
4.000	0.0340	0.0337	0.0329	0.0206	0.0204	0.0199	0.0204
5.000	0.0303	0.0300	0.0297	0.0191	0.0189	0.0188	0.0189
6.000	0.0277	0.0274	0.0275	0.0180	0.0178	0.0180	0.0178
8.000	0.0243	0.0240	0.0248	0.0166	0.0164	0.0170	0.0164
10.000	0.0222	0.0220	0.0232	0.0157	0.0155	0.0164	0.0155

Table 2 List of module names contained in INCLUDE file and their functions

Module name	Function
(1) COMMON blocks	
DIMCOM	COMMON blocks in which anatomical data are stored
SRCCOM	COMMON blocks to be used in the user supplied routine of 'SOURCE'
TRGCOM	COMMON blocks to be used in the user supplied routine of 'TARGET'
(2) Positioning the points included in each organ	
ADRENALS	adrenal glands
BRAIN	brain
BREASTS	breasts
GBLCNTS	gal. bladder contents
GBLWALL	gal. bladder wall
KIDNEY	kidneys
LIVER	liver
LLICNTS	lower large intestine contents
LLIWALL	lower large intestine wall
LUNGS	lungs
OVARIES	ovaries
PANCREAS	pancreas
RMARROW	red marrows equivalent to the region of skeletal tissue but the differences of the density of the the marrow among skeletal portions are taken into account
SICNTS	small intestine wall and contents
SKELETON	skeletal tissue
SKIN	skin
SPLEEN	spleen
STCNTS	stomach contents
STWALL	stomach wall
TESTES	testes
THYMUS	thymus
THYROID	thyroid
TTISSUE	muscle (separable fat)
ULICNTS	upper large intestine contents
ULIWALL	upper large intestine wall
URBLCNTS	urinary bladder contents
UTERUS	uterus
YMARROW	yellow marrows equivalent to the region of skeletal tissue but the differences of the density among skeletal portions are taken into account

Table 3 Elemental composition of different tissues used for preparing a macroscopic photon cross section

Element	Skeletal tissue ^{a)}	Lung tissue ^{b)}	Remainders ^{c)}
H	7.04	10.21	10.47
C	22.79	10.01	23.02
N	3.87	2.80	2.34
O	48.56	75.96	63.21
Na	0.32	0.19	0.13
Mg	0.11	0.0074	0.015
P	6.94	0.081	0.24
S	0.17	0.23	0.22
Cl	0.14	0.27	0.14
K	0.15	0.20	0.21
Ca	9.91	0.0070	0.0
Fe	0.008	0.037	0.0063
Zn	0.0048	0.0011	0.0032
Rb	0.0	0.00037	0.00057
Sr	0.0032	5.9E-06	3.4E-05
Zr	0.0	0.0	0.0008
Pb	0.0011	4.1E-05	1.6E-05

a) Density 1.4682 g/cm³b) Density 0.2958 g/cm³c) Density 0.9869 g/cm³

Table 4 Difference of parameters representing a human phantom used in the present calculation from those in ORNL-5000

Parameter ^{a)}	Values used in calculation	
	Present	ORNL-5000
Exterior of phantom		
A_H	8.0	7.0
C_H	16.85	15.5
Skeletal system		
z_4 for spine	80.54	78.5
c for skull	5.75	6.5
Brain		
a	6.6	6.0
b	8.6	9.0
c	5.75	6.5
L.L.I.		
m	0.78	0.28
d^x	0.54	0.3-0.79
Pancreas		
x_0	-1.0	0.0
a	16.0	15.0
b	1.2	1.0
c	3.3	3.0
Thymus		
a	3.0	1.50
b	0.8	0.5
x_0	0.0	-2.0
y_0	-6.0	-7.30
z_0	57.5	60.5
Thyroid		
y_0	-4.0	-6.0
Adrenal		
x_0	3.5	4.5
y_0	5.0	6.5
θ	52.0	0.0

Table 5 Distribution of marrows used for present calculation and in ORNL-5000

Portion of skeletal system	Red marrows		Yellow marrows	
	Present	ORNL-5000	Present	ORNL-5000
Cranium	5.57	11.9	4.26	4.0
Scapulae	2.85	4.8	2.17	1.6
Clavicles	0.79	1.6	0.75	0.5
Ribs	19.22	10.2	3.86	13.4
Upper spine	2.66	3.4	0.53	1.1
Mid spine	17.41	14.1	3.50	4.7
Lower spine	9.79	10.9	1.97	3.6
Pelvis	33.31	36.2	16.07	12.0
Upper legs	3.35	3.8	4.70	1.2
Mid legs	0.0	----	12.35	----
Lower legs	0.0	0.0	32.5	30.7
Upper arms	2.29	1.9	3.21	6.3
Mid arms	0.0	----	4.29	----
Lower arms	0.0	0.0	8.02	25.9
Facial	2.75	1.2	2.09	0.4
Total weights(g)	1120.0	1500.0	2380.0	1500.0

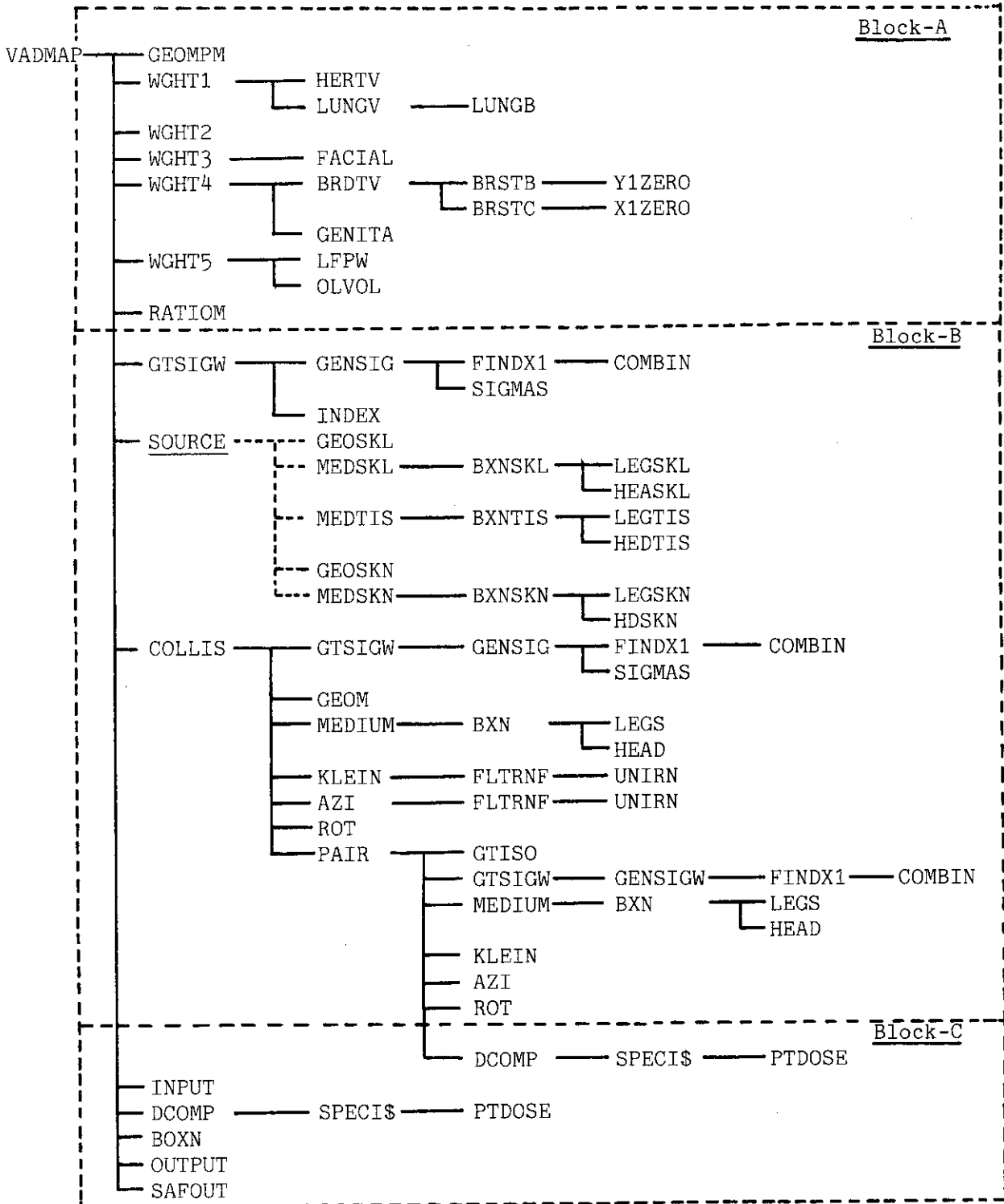


Fig.1 The tree structure of the VADMAP/Monte-Carlo code

```

C
      SUBROUTINE SOURCE
C
C----- COMMON BLOCKS WHERE ANATOMICAL DATA ARE STORED
C
      INCLUDE ( DIMCOM )
C
C----- COMMON BLOCKS PARTICULAR FOR ROUTINE SOURCE
C
      INCLUDE ( SRCCOM )
C
C----- PART OF SAMPLING THE POINTS OF SOURCE REGION
C

      In the case where photon source region is specified as organ,
      user can use INCLUDE file. The definition of each module of
      the file is described in Table 2.

      ex. INCLUDE ( KIDNEYS )

      Otherwise, an appropriate routine to sample the the point
      of photon source region is required.

              X =
              Y =      ←----- sampled point
              Z =

C----- FOLLOWING PART CAN BE SUPRESSED IN CASE OF VADMAP/BUILD
C---
C--- SET PHYSICAL QUANTITIES OF PHOTON
C--- AND INITIALIZE VARIABLES WGT, NRG
C
      CALL GTISO( ALP, BET, GAM ) ; Samples photon dirction
C
      ENER = EZERO                ; Sets initial photon energy
                                the value of EZERO is input
C
      WGT = 1.                    ; Initialize counter
      NRG = 1.
C
      RETURN
      END

C
      SUBROUTINE TARGET
C
C----- COMMON BLOCKS WHERE ANATOMICAL DATA ARE STORED
C
      INCLUDE ( DIMCOM )
C
C----- COMMON BLOCKS PARTICULAR FOR THE ROUTINE TARGET
C
      INCLUDE ( TRGCOM )
C
C----- PART OF SAMPLING THE POINTS OF TARGET ORGAN
C
      INCLUDE ( module name correspond to organ )
C
      RETURN
      END

```

Fig.2 The standardized structure of the user supplied routine 'SOURCE'

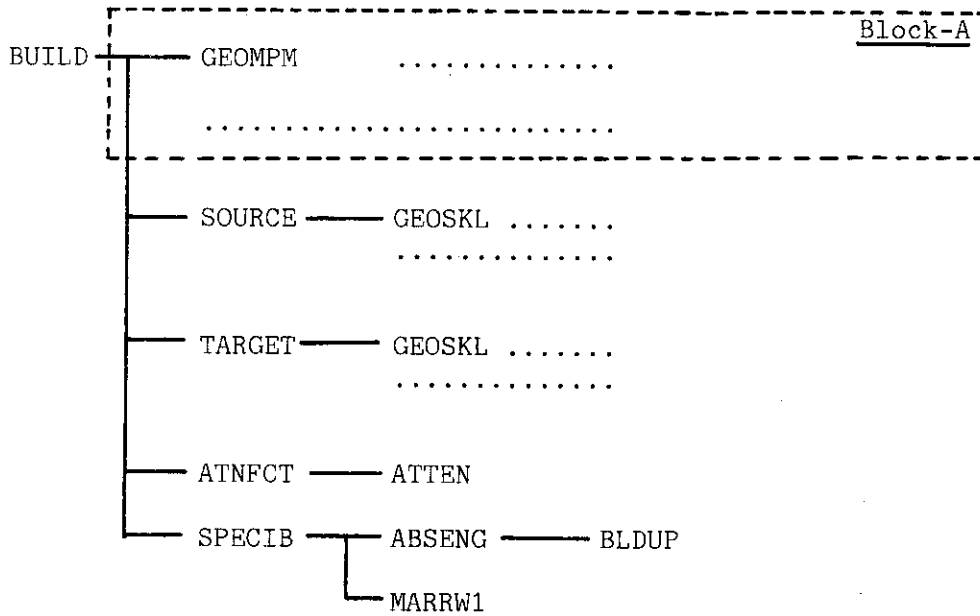


Fig.3 The tree structure of the VADMAP/BUILD code

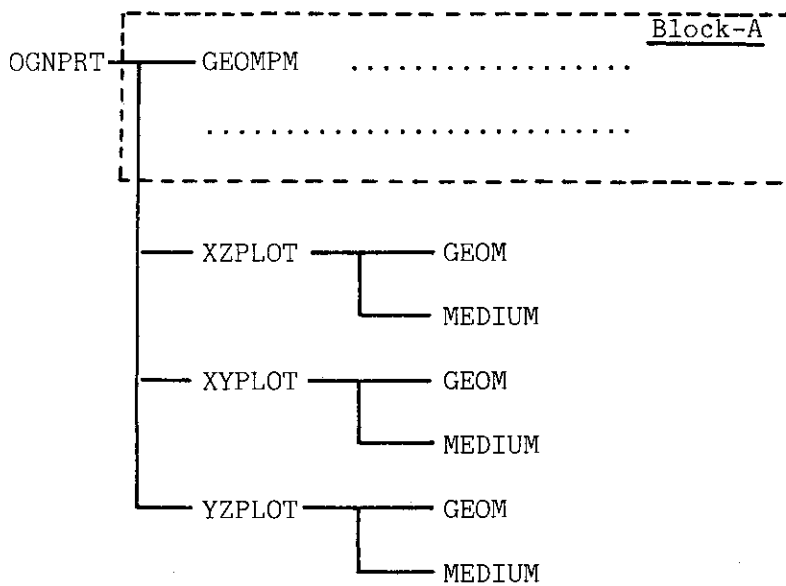


Fig.4 The tree structure of the VADMAP/OGNPRT code

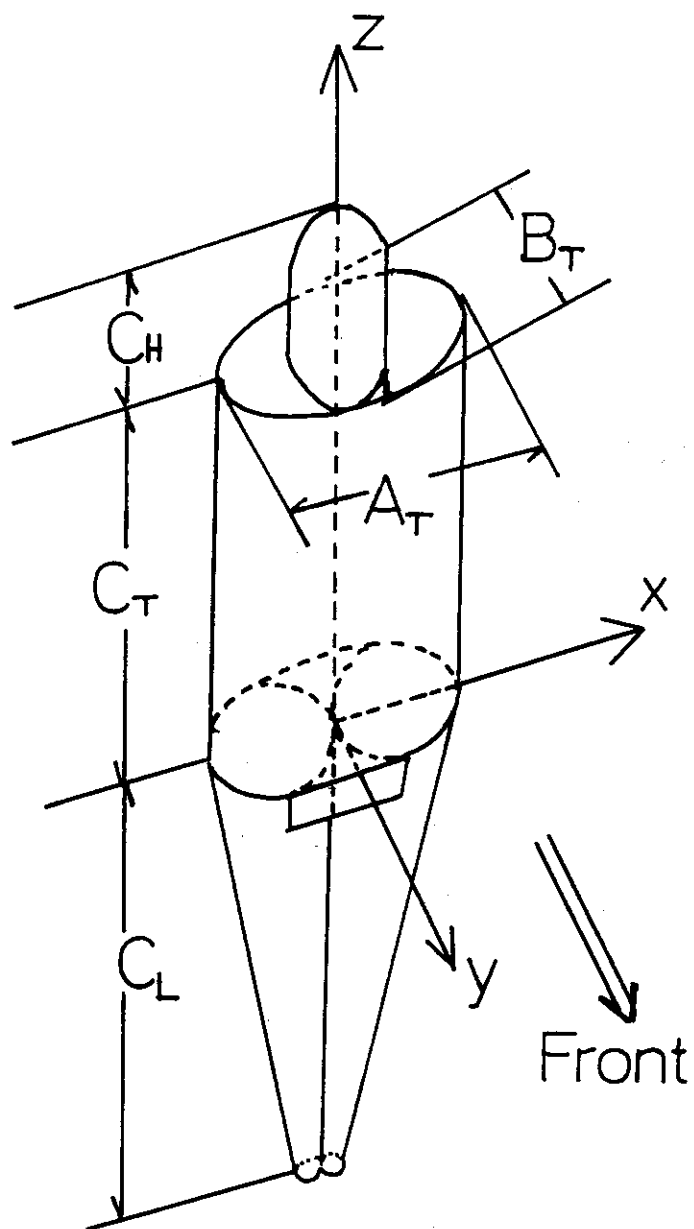


Fig.5 A coordinate system to describe a mathematical human phantom

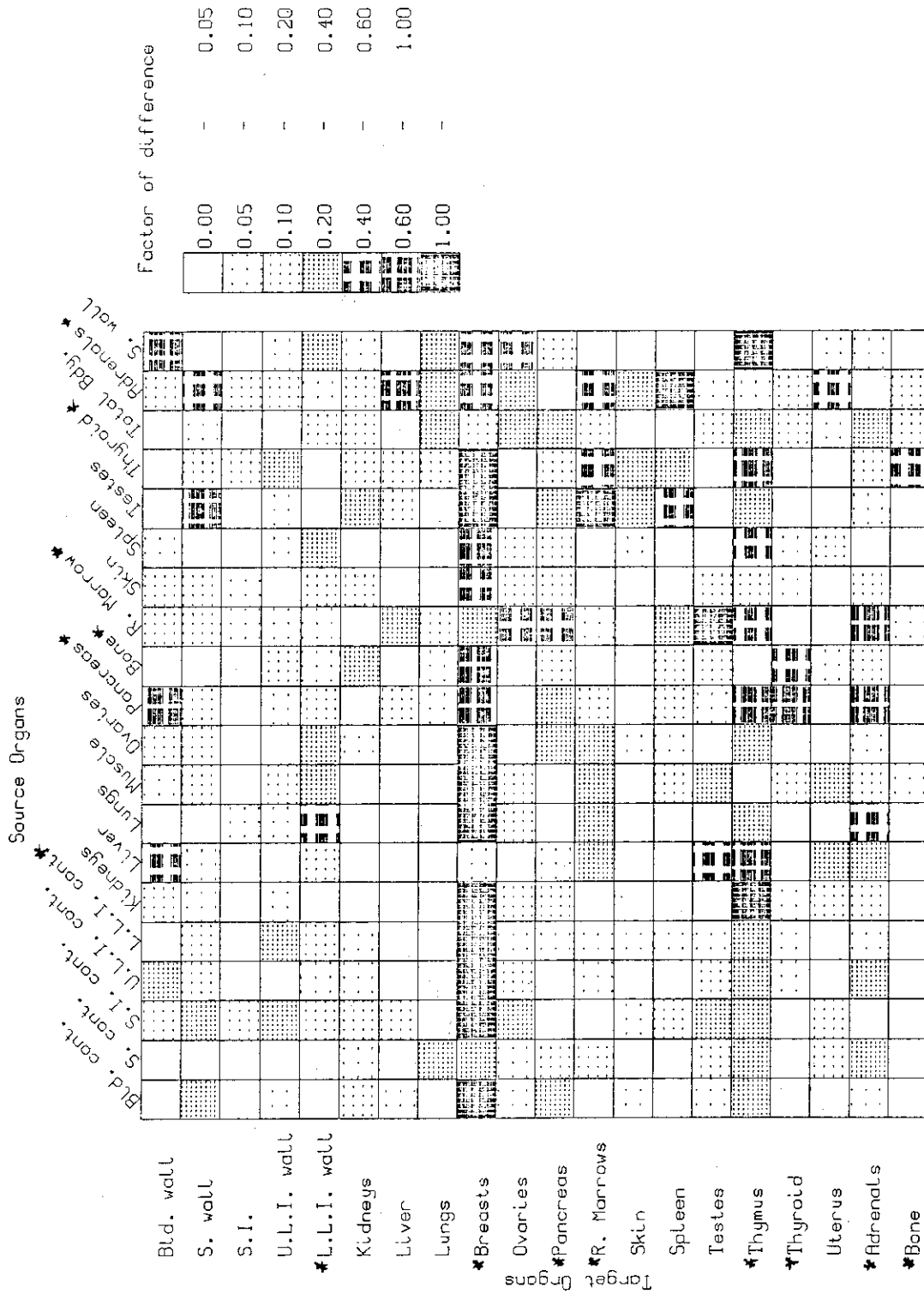


Fig.6 The discrepancies in the SEE_{photon} of ^{152}Eu for each source-target organ pair

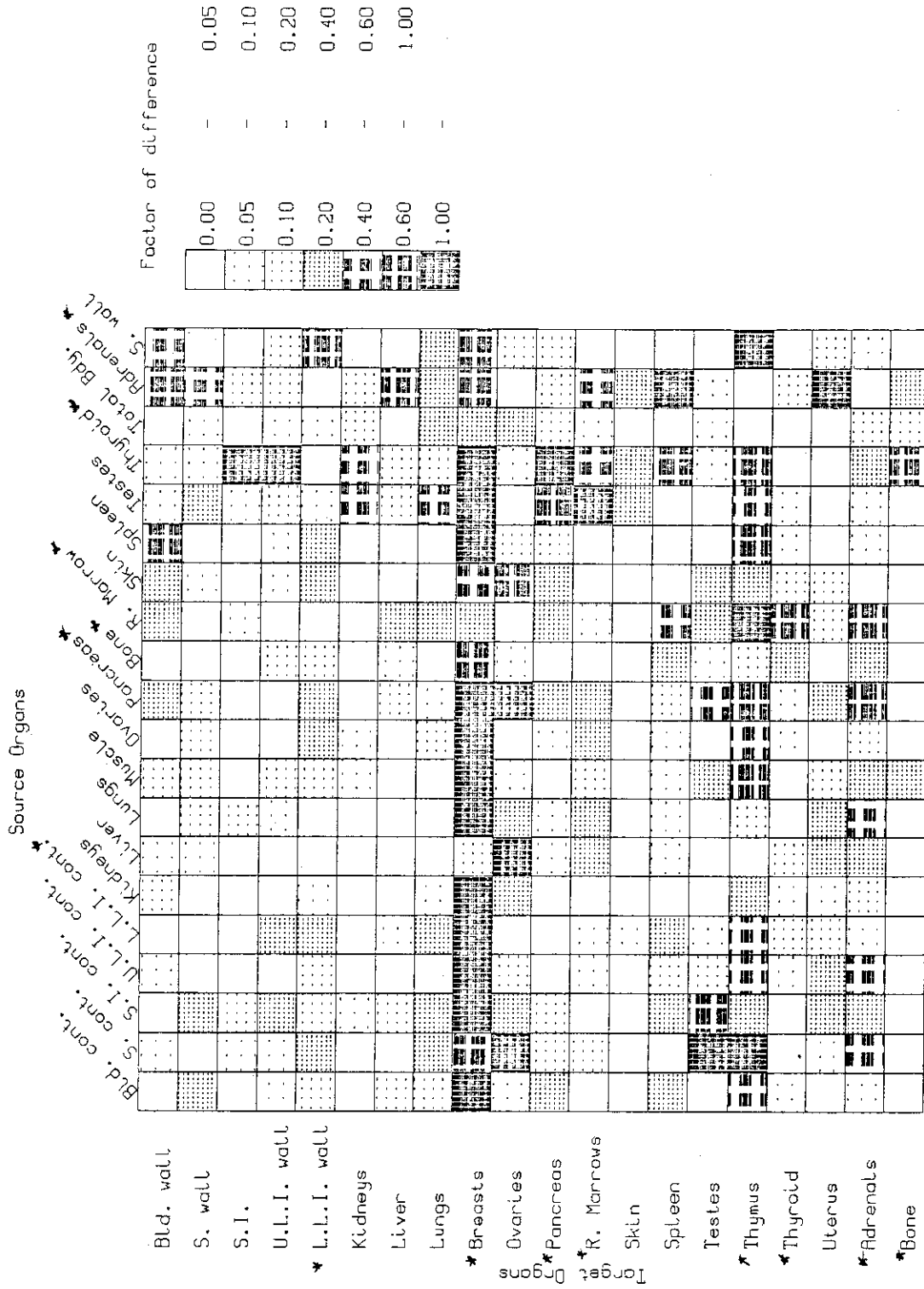


Fig.7 The discrepancies in the SEE_{photon} of ^{129}Cs for each source-target organ pair

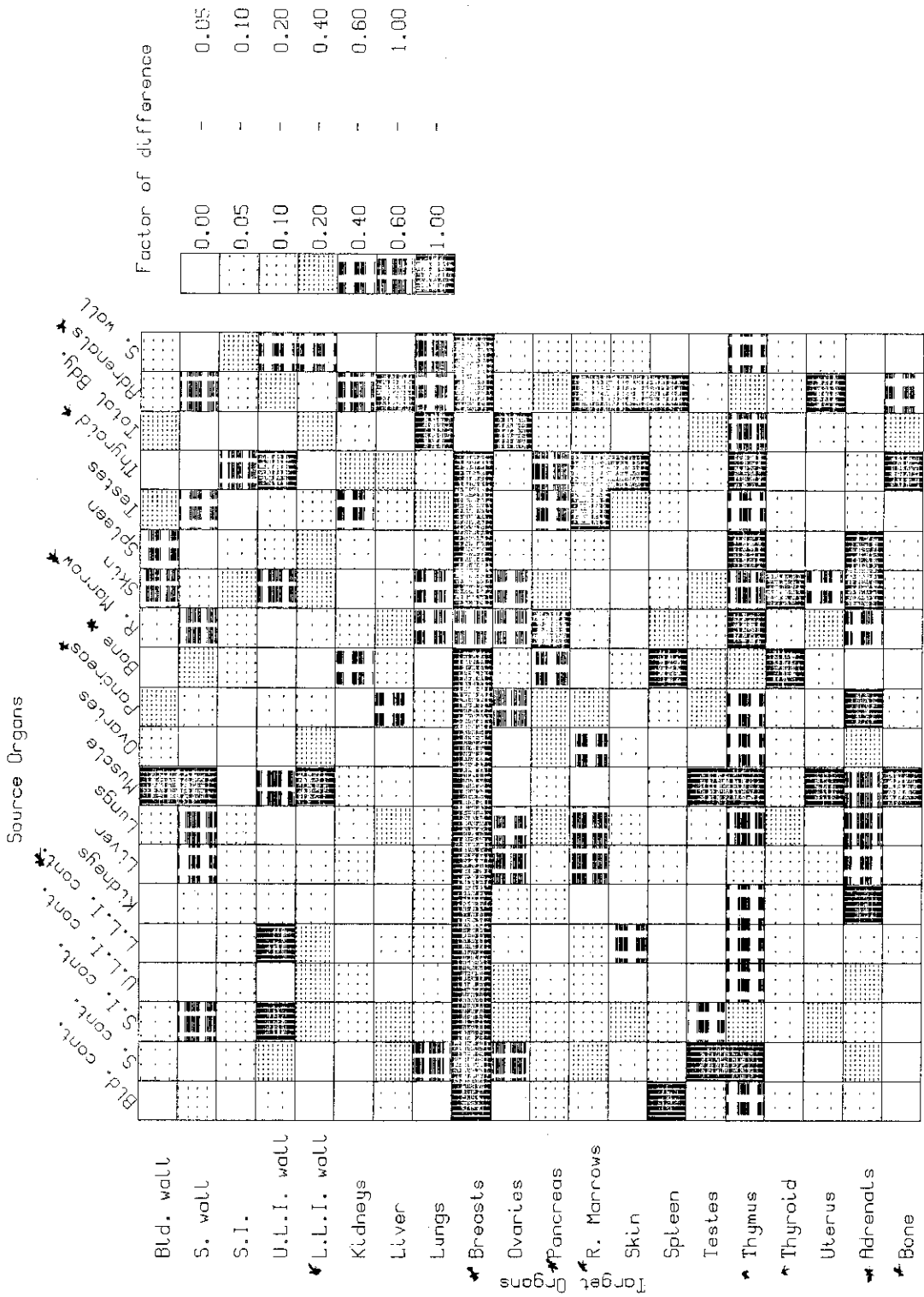


Fig.8 The discrepancies in the SEE_{photon} of ^{239}Pu for each source-target organ pair

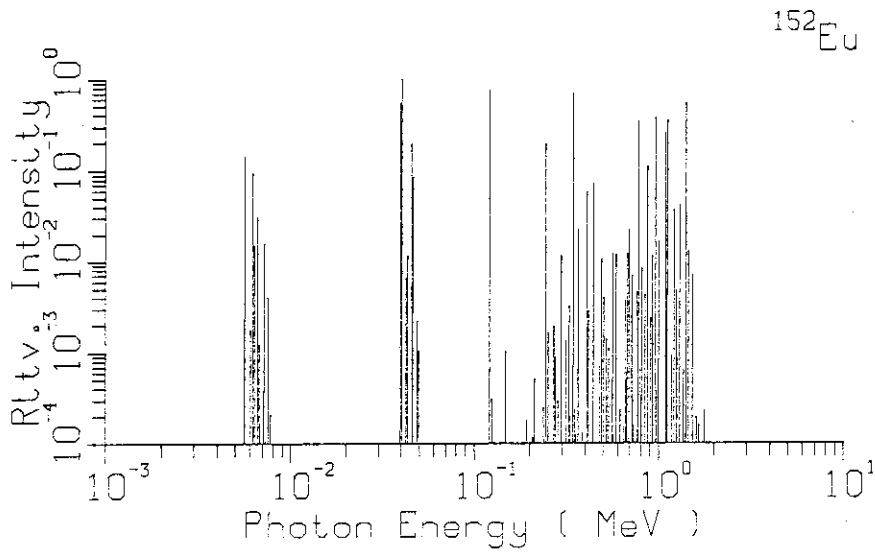
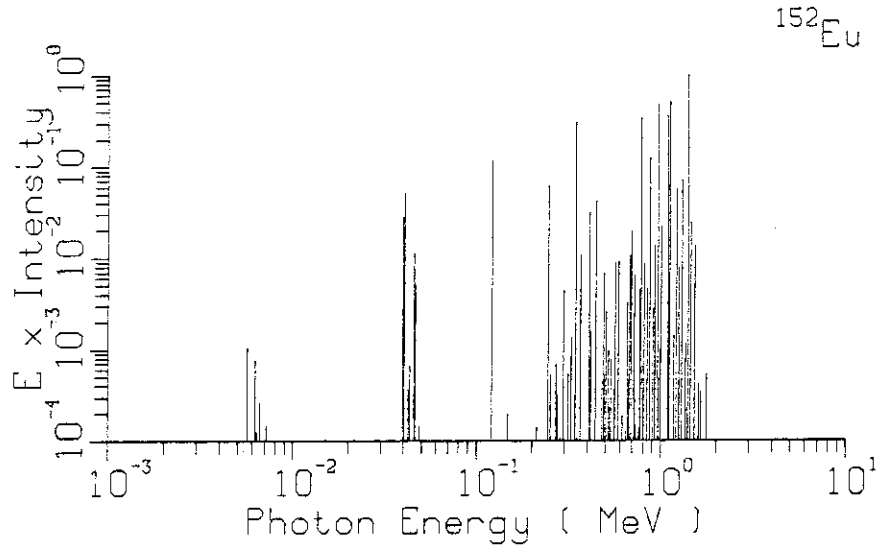


Fig.9 The photon spectra of ^{152}Eu used to calculate the SEE_{photon}

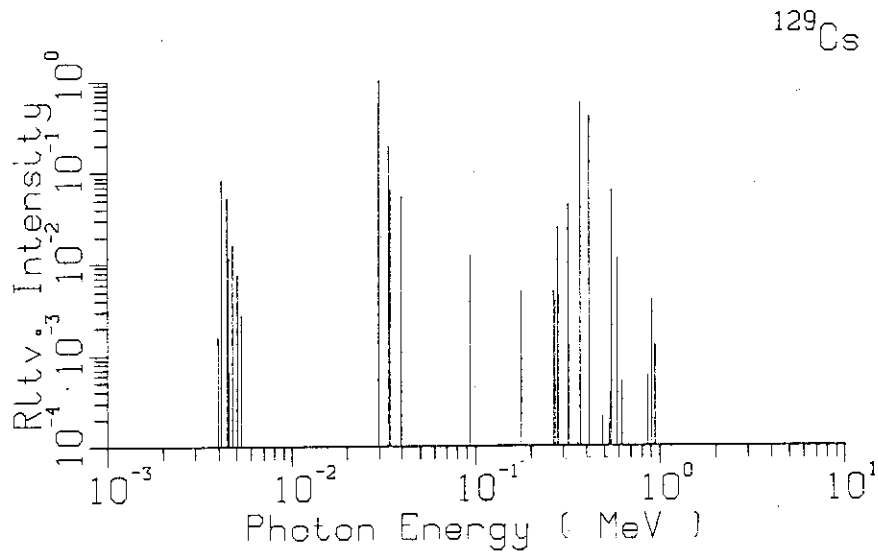
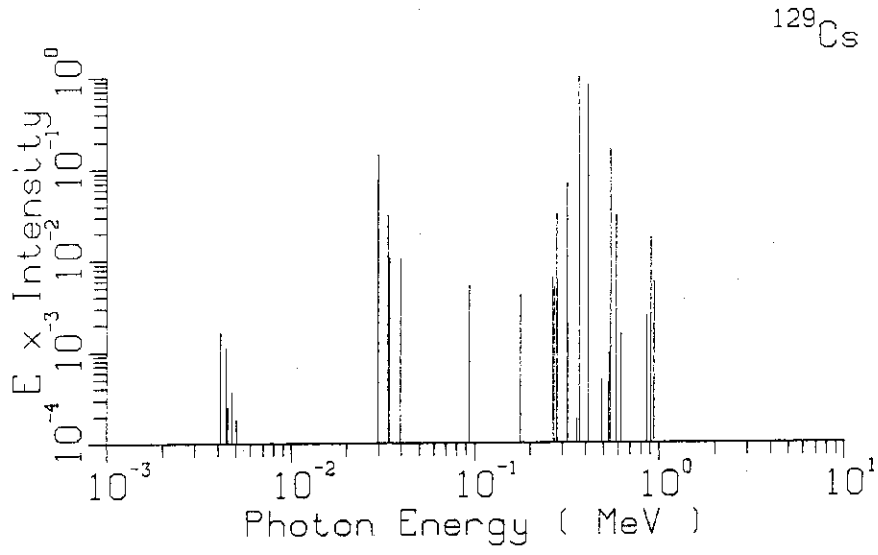


Fig.10 The photon spectra of ^{129}Cs used to calculate the SEE_{photon}

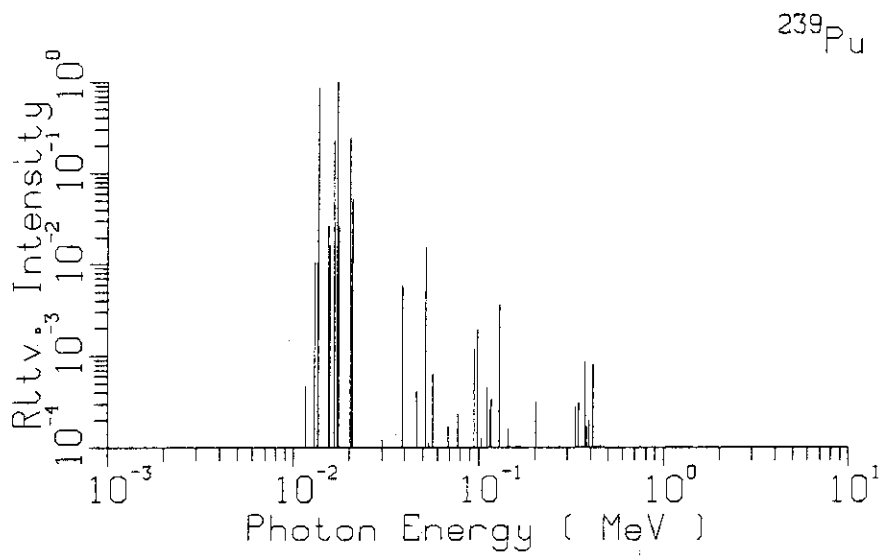
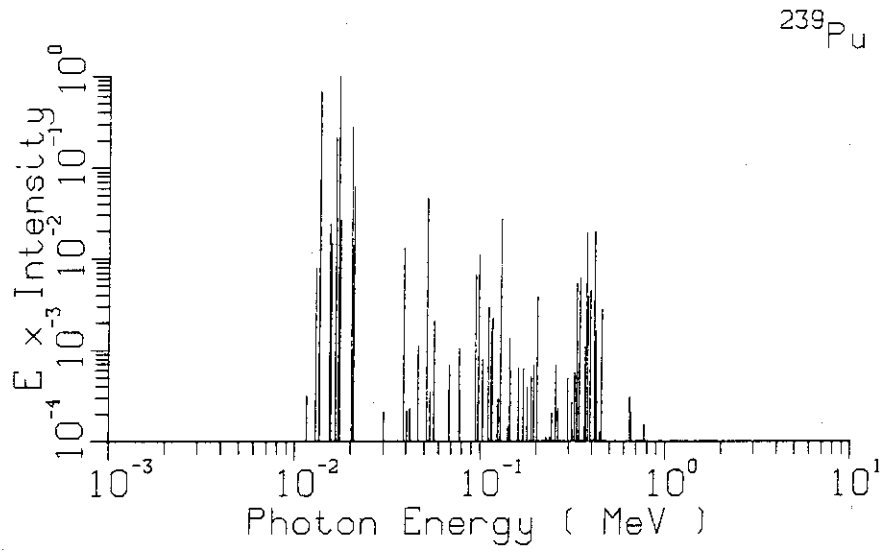


Fig.11 The photon spectra of ^{239}Pu used to calculate the SEE_{photon}

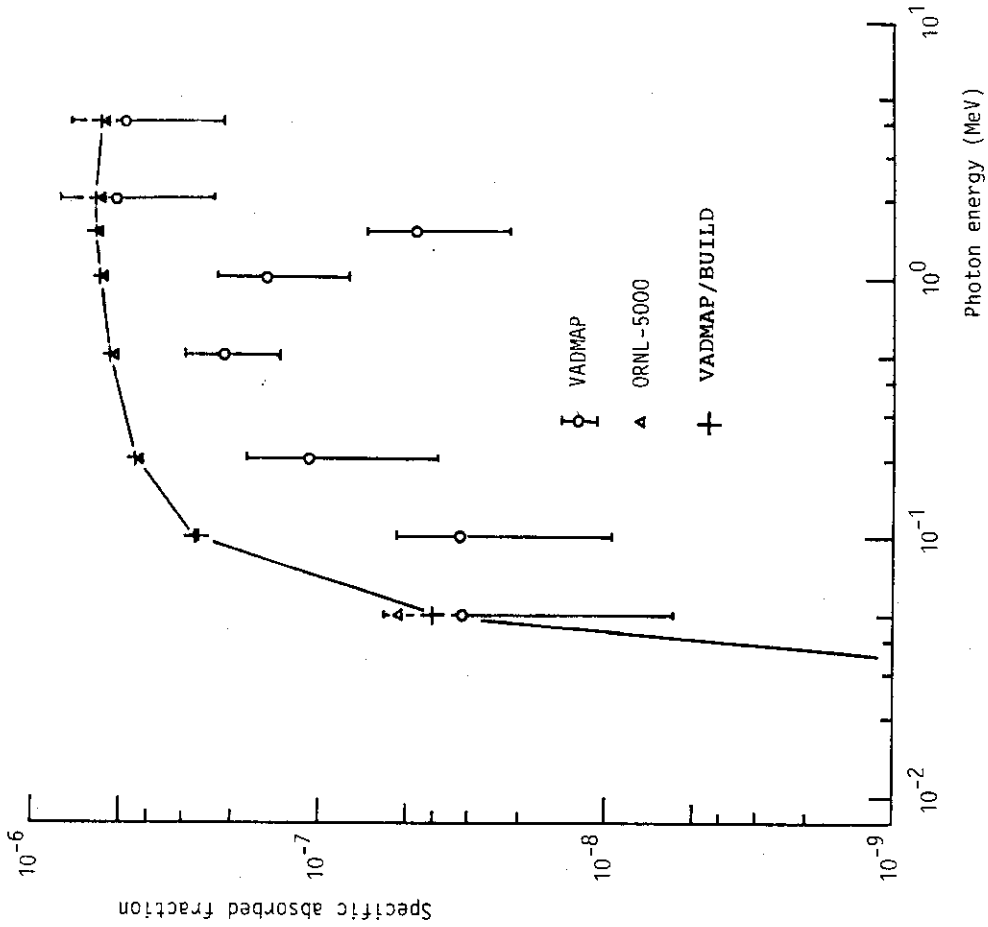


Fig.13 The SAF_{photon} (testes (---- kidneys)

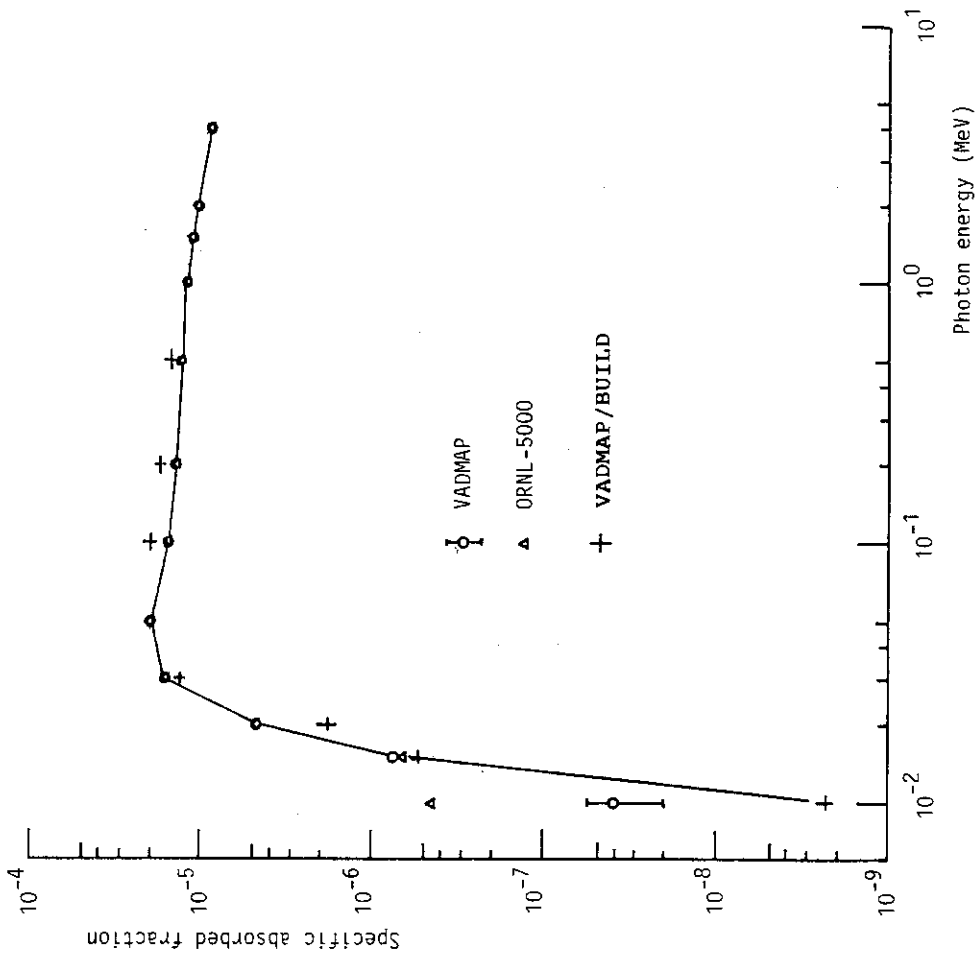


Fig.12 The SAF_{photon} (liver (---- kidneys)

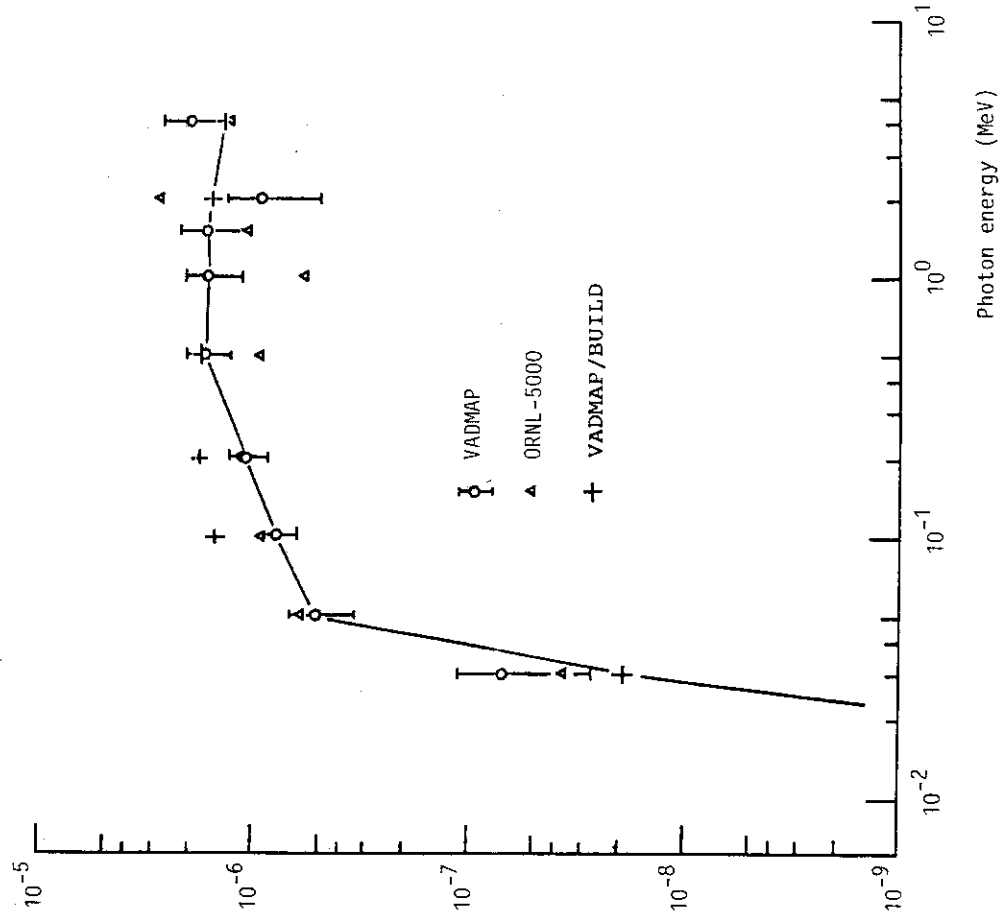


Fig.15 The SAF_{photon} (bladder wall <--- stomach wall)

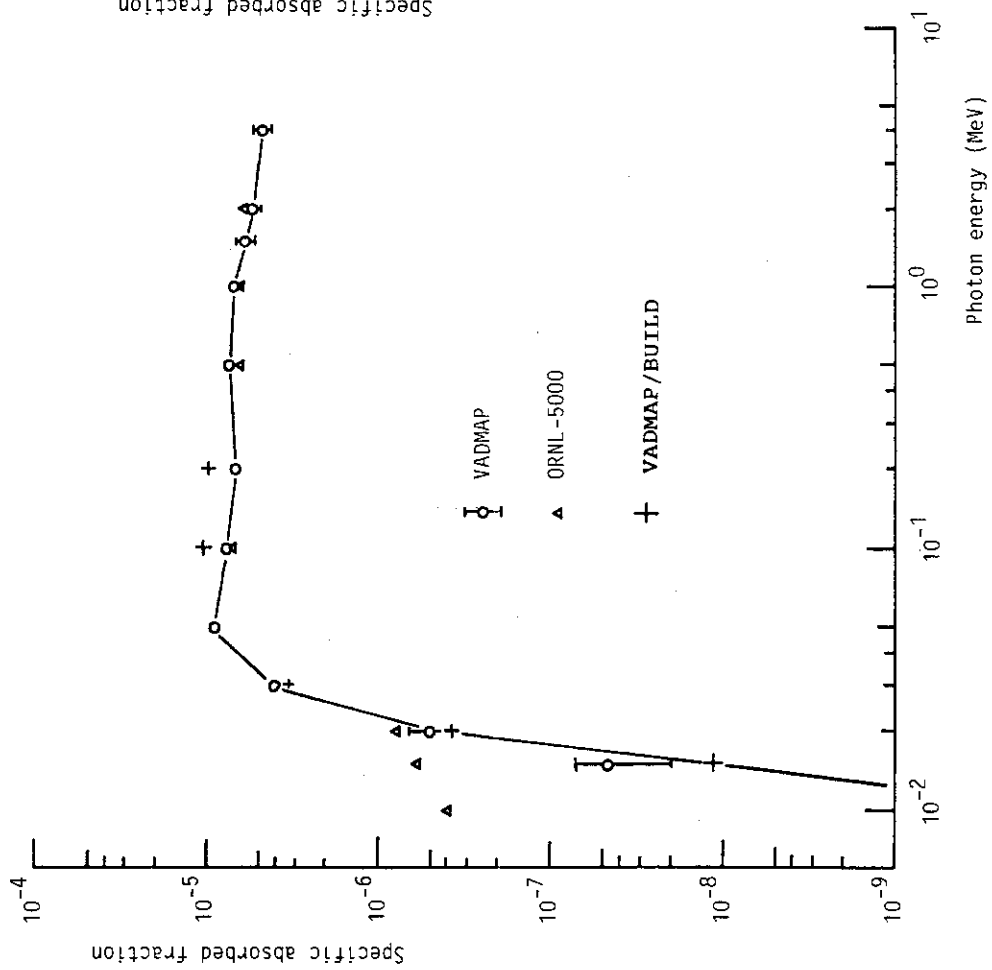


Fig.14 The SAF_{photon} (liver <--- stomach wall)

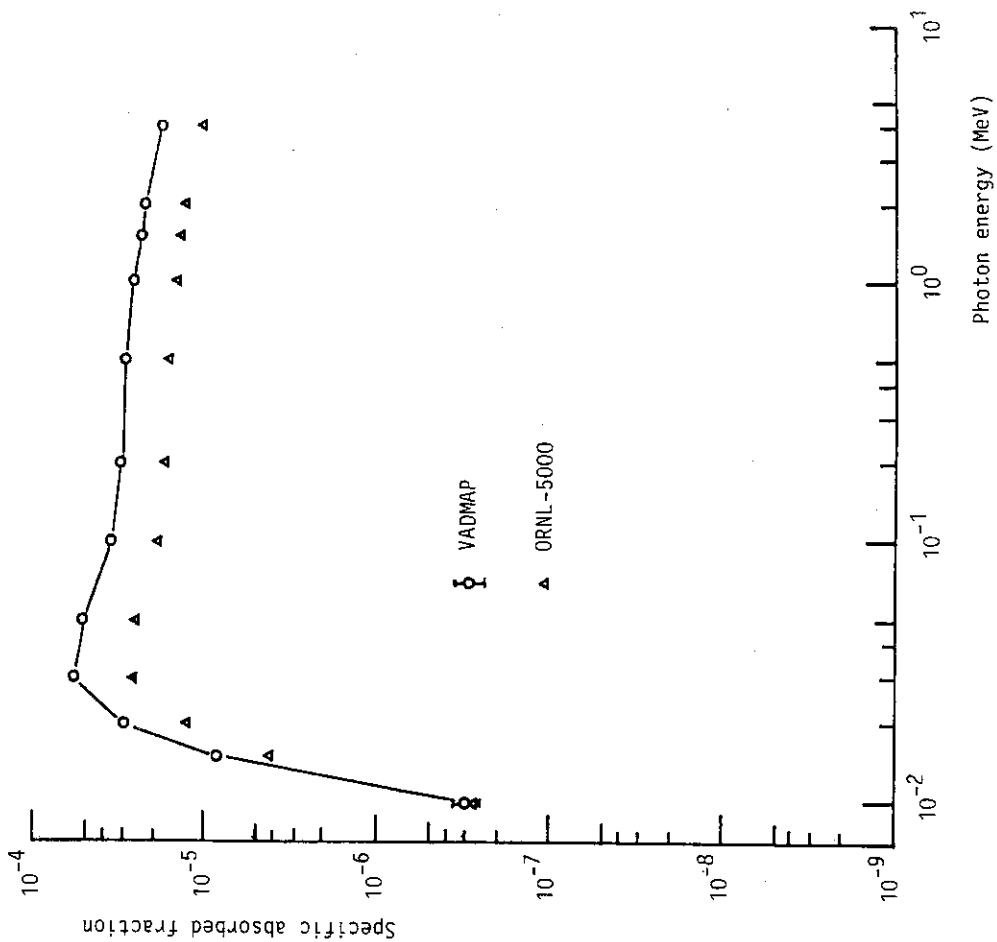


Fig.17 The SAF_{photon} (liver (--- adrenal glands)

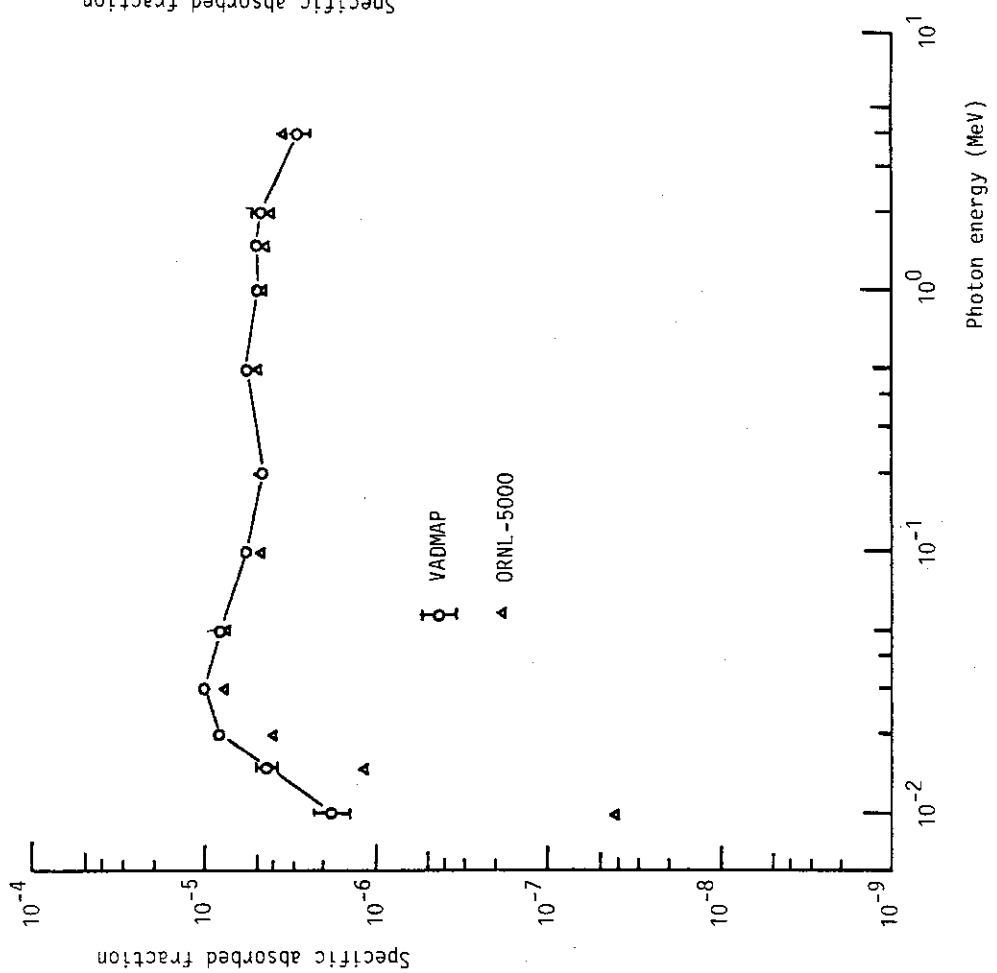


Fig.16 The SAF_{photon} (stomach wall (--- muscle)

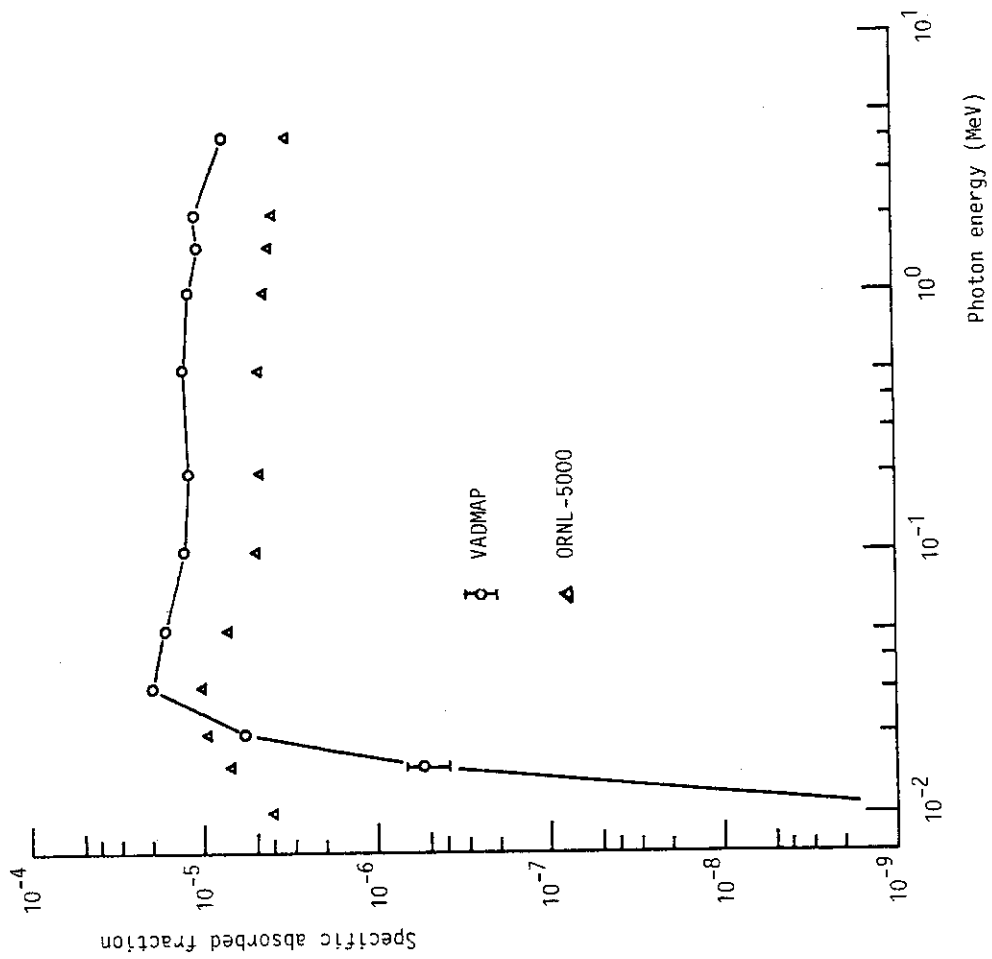


Fig.18 The SAF_{photon} (muscle <--- lungs)

Appendix 1 Job control instruction for implementing and running the code on FACOM-M/380

Data sets required for implementing the VADMAP code are as follows :

File No.	Contents	Data Set Name (assumed in JCL)
1.	VADMAP fortran source program	JXXXX.VADMAP.SOURCE
2.	Include file in UPDTE format	JXXXX.VADMAP.UPDTE
3.	Photon cross section data file	JXXXX.PHOTCRS.DATA
4.	Anatomical data of adults human phantom	JXXXX.PHANTOM.DATA

Step 1. Creation of INCLUDE file

Before compiling the fortran source program, a user must prepare PO-file of INCLUDE. Creation of the file is made using the following job control instruction.

```
//STEP1 EXEC PGM=JESUPDTE,REGION=200K,PARM=NEW
//SYSPRINT DD SYSOUT=*
//SYSUT1 DD DUMMY
//SYSUT2 DD DSN=JXXXX.VADMAP.INCSRC,DISP=(NEW,CATLG,DELETE),
// UNIT=DDDD,VOL=SER=VVVVV,SPACE=(TRK,(10,10,2)),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//SYSIN DD DSN=JXXXX.VADMAP.UPDTE,DISP=OLD
```

Step 2. Compiling and linking the program

```
//STEP2 EXEC FORTCL
//FORT.SYSINC DD DSN=JXXXX.VADMAP.INCSRC,DISP=OLD
//FORT.SYSIN DD DSN=JXXXX.VADMAP.SOURCE,DISP=OLD
//LKED.SYSLMOD DD DSN=JXXXX.VADMAP.LOAD,DISP=(NEW,CATLG,DELETE),
//          SPACE=(TRK,(10,10,2),RLSE),UNIT=DDDD,VOL=SER=VVVVV
//LKED.SYSIN DD *
    ALIAS BUILD,OGNPRT
    ENTRY VADMAP
    NAME VADMAP
/*
```

Step 3. Job control instruction for running the code

(1) For running the VADMAP/Monte-Carlo

```
//VADMAP EXEC FORTCLG
//FORT.SYSINC DD DSN=JXXXX.VADMAP.INCSRC,DISP=SHR
//FORT.SYSIN DD *
    <----- Source of a user supplied routine is placed here.
             The standard structure of the routine is given in Figure 2
             of this report.
/*
//LKED.VADLRD DD DSN=JXXXX.VADMAP.LOAD,DISP=SHR
//LKED.SYSIN DD *
    INCLUDE VADLRD(VADMAP)
    ENTRY VADMAP
/*
//GO.FT01F001 DD DSN=JXXXX.PHOTCRS.DATA,DISP=OLD
//GO.FT02F001 DD DSN=&PHTCRS,DISP=(NEW,CATLG,DELETE),
//          DCB=(RECFM=VBS,LRECL=6208,BLKSIZE=6212),
//          SPACE=(TRK,(10,10,2),RLSE),UNIT=SYSDA
//GO.FT10F001 DD DSN=JXXXX.PHANTOM.DATA,DISP=SHR
//GO.FT20F001 DD DSN=JXXXX.SAFOUT.DATA,DISP=(NEW,CATLG,DELETE),
```

```
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),UNIT=DDDD,
//          VOL=SER=VVVVV
//GO.SYSIN   DD *
  <----- Input data for controlling the program is placed here.
             The input data description is given in section 3.2.2
             in this report.
/*
```

(2) For running the VADMAP/BUILD

```
//BUILD   EXEC   FORTCLG
//FORT.SYSINC DD DSN=JXXXX.VADMAP.INCSRC,DISP=SHR
//FORT.SYSIN  DD *
  <----- Source of a user supplied routine is placed here.
             The standard structure of the routine is given in Figure 2
             of this report.
             Sample input and output are given in Appendix 3.
/*
//LKED.VADLRD DD DSN=JXXXX.VADMAP.LOAD,DISP=SHR
//LKED.SYSIN  DD *
  INCLUDE VADLRD(VADMAP)
  ENTRY   BUILD
/*
//GO.FT10F001 DD DSN=JXXXX.PHANTOM.DATA,DISP=SHR
//GO.FT30F001 DD DSN=JXXXX.BLDOUT.DATA,DISP=(NEW,CATLG,DELETE),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),UNIT=DDDD,
//          VOL=SER=VVVVV,SPACE=(TRK,(1,1))
//GO.SYSIN   DD *
  <----- Input data for controlling the program is placed here.
             The input data description is given in section 3.2.2
             in this report.
             Sample input and output are given in Appendix 3.
/*
```

(3) For running the VADMAP/OGNPRT

```
//OGNPRT EXEC FORTCLG
//FORT.SYSINC DD DSN=JXXXX.VADMAP.INCSRC,DISP=SHR
//FORT.SYSIN DD *
    <----- Source of a user supplied routine is placed here.
                The standard structure of the routine is given in Figure 2
                of this report.

/*
//LKED.VADLRD DD DSN=JXXXX.VADMAP.LOAD,DISP=SHR
//LKED.SYSIN DD *
    INCLUDE VADLRD(VADMAP)
    ENTRY  OGNPRT
/*
//GO.FT10F001 DD DSN=JXXXX.PHANTOM.DATA,DISP=SHR
//GO.SYSIN DD *
    <----- Input data for controlling the program is placed here.
                The input data description is given in section 3.2.2
                in this report.
                Sample input and output are given in Appendix 3.

/*
```

Cataloged procedure used in the above job control instructions, FORTCL and FORTCLG are as follows :

(A) FORTCL ;

```
//FORTCL PROC
//FORT EXEC PGM=JZK@FORT,REGION=1024K,
// PARM='OPTIMIZE(3),SOURCE,NOMAP'
//SYSLIN DD DSN=&&OBJ,DISP=(NEW,PASS),UNIT=SYSDA,
// SPACE=(TRK,(50,20)),DCB=BLKSIZE=3200
//SYSUT2 DD DSN=&&OUTSRC,DISP=(NEW,DELETE),UNIT=SYSDA,
// SPACE=(TRK,(30,10)),DCB=BLKSIZE=3200
```



```

//SYSPRINT DD SYSOUT=&SYSOUT,
//          DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//SYSTEM   DD SYSOUT=&SYSOUT,
//          DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//LKED     EXEC PGM=JQAL,REGION=1024K,COND=(4,LT),
//          PARM='NOMAP,LIST,LET'
//SYSLIB   DD DSN=SYS9.JSSL.LOAD,DISP=SHR SCIENTIFIC ROUTINE
//          DD DSN=SYS9.SSL.LOAD,DISP=SHR SCIENTIFIC ROUTINE
//          DD DSN=SYS9.SSL2.LOAD,DISP=SHR SCIENTIFIC ROUTINE
//          DD DSN=SYS1.FORTLIB,DISP=SHR
//SYSLIN   DD DSN=&&OBJ,DISP=(OLD,DELETE)
//          DD DDNAME=SYSIN
//SYSLMOD  DD DSN=&&LM,UNIT=SYSDA,DISP=(NEW,PASS,DELETE),
//          SPACE=(TRK,(30,20,1))
//SYSPRINT DD SYSOUT=*,DCB=(BLKSIZE=4840)
//SYSTEM   DD SYSOUT=*
//SYSUT1   DD UNIT=VIO,SPACE=(TRK,(50,30))

```

(B) FORTCLG

```

//FORTCLG PROC
//FORT     EXEC PGM=JZK@FORT,REGION=1024K,
//          PARM='OPTIMIZE(3),SOURCE,NOMAP'
//SYSLIN   DD DSN=&&OBJ,DISP=(NEW,PASS),UNIT=SYSDA,
//          SPACE=(TRK,(50,20)),DCB=BLKSIZE=3200
//SYSUT2   DD DSN=&&OUTSRC,DISP=(NEW,DELETE),UNIT=SYSDA,
//          SPACE=(TRK,(30,10)),DCB=BLKSIZE=3200
//SYSPRINT DD SYSOUT=&SYSOUT,
//          DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//SYSTEM   DD SYSOUT=&SYSOUT,
//          DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//LKED     EXEC PGM=JQAL,REGION=1024K,COND=(4,LT),
//          PARM='NOMAP,LIST,LET'
//SYSLIB   DD DSN=SYS9.JSSL.LOAD,DISP=SHR SCIENTIFIC ROUTINE
//          DD DSN=SYS9.SSL.LOAD,DISP=SHR SCIENTIFIC ROUTINE

```

```
//          DD   DSN=SYS9.SSL2.LOAD,DISP=SHR SCIENTIFIC ROUTINE
//          DD   DSN=SYS1.FORTLIB,DISP=SHR
//SYSLIN    DD   DSN=&&OBJ,DISP=(OLD,DELETE)
//          DD   DDNAME=SYSIN
//SYSLMOD   DD   DSN=&&LM(MAIN),UNIT=SYSDA,
//          DD   DISP=(NEW,PASS,DELETE),SPACE=(TRK,(30,20,1))
//SYSRINT   DD   SYSOUT=*,DCB=(BLKSIZE=4840)
//SYSTEM    DD   SYSOUT=*
//SYSUT1    DD   UNIT=VIO,SPACE=(TRK,(50,30))
//GO        EXEC PGM=*.LKED.SYSLMOD,REGION=650K
//SYSRINT   DD   SYSOUT=*,DCB=(BLKSIZE=4840)
//FT05F001  DD   DDNAME=SYSIN
//FT06F001  DD   SYSOUT=*
```

Appendix 2 Sample input data and output

1. Sample run for VADMAP/Monte-Carlo

Computer resources required to execute
the sample case:

Region size ; 460 K bytes

Executuion time ; 43.45 CPU seconds

No. of I/O times; 20 times

```

*****
* INPUT DATA LIST *
*
*****

```

```

.....1.....2.....3.....4.....5.....6.....7.....8
---- TEST RUN ---- SOURCE ORGAN: KIDNEYS
60000 4.E-03 4.0 1 3 1853
2 -1
3 6 -7 3
15 1. SKELTAL TISSUE
1 0.104628
6 3.387E-1
7 5.752E-2
8 7.217E-1
9 4.756E-3
10 1.635E-3
11 1.031E-1
12 2.527E-3
13 1.72081E-3
14 2.229E-3
15 2.01473E-1
16 1.189E-4
17 3.07134E-5
18 4.756E-5
19 8.21635E-5
20 1.635E-1
21 16 2. TOTAL BODY EXCEPT SKELTON AND LUNG
22 1 1.033E-1
23 6 2.272E-1
24 7 2.309E-2
25 8 6.238E-1
26 11 1.283E-3
27 12 1.480E-4
28 15 2.369E-3
29 16 2.171E-3
30 17 1.382E-3
31 19 2.072E-3
32 26 6.217E-5
33 30 3.158E-5
34 37 5.625E-6
35 38 3.355E-7
36 40 7.895E-6
37 82 1.579E-7
38 16 3. LUNG TISSUE
39 1 3.020E-2
40 6 2.961E-2
41 7 8.282E-3
42 8 2.247E-1
43 11 5.620E-4
44 12 2.189E-5
45 15 2.396E-4
46 16 6.803E-4
47 17 7.987E-4
48 19 5.916E-4
49 20 2.071E-5
50 26 1.094E-4
.....1.....2.....3.....4.....5.....6.....7.....8

```

*** CONTINUE ***

B

PAGL-0002

```

*****
* INPUT DATA LIST *
*****
.....1.....2.....3.....4.....5.....6.....7.....8
51 30 3.254E-6
52 37 1.094E-6
53 38 1.745E-8
54 82 1.213E-7
.....1.....2.....3.....4.....5.....6.....7.....8

```

*** INPUT DATA END ***

- 1. SKELTAL TISSUE
- 2. TOTAL BODY EXCEPT SKELTON AND LUNG
- 3. LUNG TISSUE

```

----- TEST RUN ----- SOURCE ORGAN: KIDNEYS
NO. OF GAMMAS  INITIAL ENERGY  CUT-OFF ENERGY  TOTAL NO. OF COLLISIONS
# 60000          4.000E+00      4.000E-03          171535

```

```

DATE RUN, 87-06-12
INITIAL RANDOM NO. 1853          FINAL RANDOM NO. 1054298889

```

REGION	TOTAL XSECT	SCAT PROB	PAIR PROB
1	0.4920E-01	0.9324E+00	0.6753E-01
2	0.3325E-01	0.9470E+00	0.5299E-01
3	0.9966E-02	0.9449E+00	0.5504E-01

```

TERMINATION
1. ENERGY 0.0      2. WEIGHT 4.020E+02
3. ESCAPE 5.960E+04 4. ABSORBED 0.0

```

---ABSORBED FRACTION FOR EACH ORGAN REGION---

ORGAN	AV. DOSE (RADS)	DOSE STD.	COEF. VAR.	COLLISIONS	MASS	E (G-RADS)	VAR. OF E	ABSD. FRAC.
1 LEFT ADRENAL	1.213E-12	3.393E-13	2.799E-01	79	7.775E+00	9.428E-12	6.962E-24	0.1489E-03
2 RIGHT ADRENAL	1.015E-12	2.880E-13	2.838E-01	105	7.775E+00	7.888E-12	5.013E-24	0.1245E-03
3 ADRENALS	1.114E-12	2.825E-13	1.998E-01	184	1.555E+01	1.732E-11	1.197E-23	0.2734E-03
4 GALL BLADDER	3.572E-13	1.434E-13	4.015E-01	83	1.004E+01	3.585E-12	2.072E-24	0.5661E-04
5 CONTENTS	6.077E-13	9.054E-14	1.490E-01	448	5.302E+01	3.282E-11	2.504E-23	0.5087E-03
6 BRAIN	9.548E-15	2.278E-15	2.385E-01	131	1.353E+03	1.922E-11	9.501E-24	0.2040E-03
7 G.I. STOMACH	5.307E-13	4.993E-14	9.409E-02	968	1.504E+02	7.983E-11	5.642E-23	0.1260E-02
8 G.I. U.L.I.	3.652E-13	3.574E-14	9.787E-02	1200	2.099E+02	7.663E-11	5.625E-23	0.1210E-02
9 G.I. L.L.I.	1.759E-13	2.776E-14	1.579E-01	459	1.588E+02	2.792E-11	1.943E-23	0.4409E-03
10 CONTENTS	4.427E-13	2.323E-14	5.247E-02	3380	6.049E+02	2.675E-10	1.975E-22	0.4228E-02
11 SM.INT.+CONTS	3.900E-13	1.652E-14	4.235E-02	6376	1.045E+03	4.075E-10	2.980E-22	0.6435E-02
12 HEART	1.835E-13	1.344E-14	7.326E-02	2186	7.330E+02	1.345E-10	9.708E-23	0.2123E-02
13 LEFT KIDNEY	1.021E-11	2.346E-13	2.298E-02	6448	1.425E+02	1.455E-09	1.118E-21	0.2297E-01
14 RIGHT KIDNEY	9.837E-12	2.302E-13	2.340E-02	6080	1.423E+02	1.402E-09	1.077E-21	0.2214E-01
15 KIDNEYS	1.002E-11	1.618E-13	1.616E-02	12528	2.851E+02	2.856E-09	2.129E-21	0.4509E-01
16 LIVER	5.522E-13	1.507E-14	2.714E-02	11616	1.815E+03	1.008E-09	7.480E-22	0.1591E-01
17 LEFT LUNG	1.822E-13	1.631E-14	8.952E-02	1130	4.841E+02	8.820E-11	6.235E-23	0.1393E-02
18 RIGHT LUNG	1.692E-13	1.471E-14	8.695E-02	1267	5.000E+02	9.306E-11	6.547E-23	0.1469E-02
19 LUNGS	1.753E-13	1.093E-14	6.234E-02	2397	1.034E+03	1.812E-10	1.277E-22	0.2862E-02
20 RM UP,L.ARM	5.320E-14	1.157E-14	2.175E-01	158	1.283E+01	6.823E-13	2.202E-26	0.1077E-04
21 RM UP,R.ARM	3.807E-14	9.290E-15	2.440E-01	156	1.283E+01	4.883E-13	1.420E-26	0.7709E-05
22 RM CLAVICLES	2.195E-14	1.290E-14	5.877E-01	32	8.849E+00	1.942E-13	1.503E-26	0.3067E-05
23 RM UP,L.LEG	3.861E-14	6.333E-15	1.630E-01	440	1.876E+01	7.243E-13	1.412E-26	0.1144E-04
24 RM UP,R.LEG	3.616E-14	6.641E-15	1.847E-01	341	1.876E+01	6.784E-13	1.553E-26	0.1037E-04
25 RM PELVIS	1.758E-13	1.175E-14	6.684E-02	2993	3.731E+02	6.558E-11	1.921E-23	0.1033E-02
26 RM RIBS	2.482E-13	1.313E-14	5.289E-02	2585	2.153E+02	5.344E-11	7.990E-24	0.8437E-03
27 RM SCAPULAE	8.120E-14	1.599E-14	1.723E-01	263	3.192E+01	2.592E-12	1.995E-25	0.4093E-04
28 RM CRANIUM	1.019E-14	2.814E-15	2.762E-01	114	6.239E+01	6.356E-13	3.082E-26	0.1004E-04
29 RM FACIAL SK	2.342E-14	6.168E-15	2.634E-01	4798	3.080E+01	7.213E-13	3.609E-26	0.1139E-04
30 RM LOW SPINE	1.722E-12	6.550E-14	3.804E-02	4329	1.950E+02	1.888E-10	5.159E-23	0.2981E-02
31 RM MID SPINE	4.550E-13	2.054E-14	4.513E-02	108	2.979E+01	8.873E-11	1.604E-23	0.1401E-02
32 RM UP SPINE	2.013E-14	7.391E-15	3.672E-01	7855	4.767E+02	1.480E-10	2.436E-23	0.9467E-05
33 RM MID REGION	3.105E-13	1.035E-14	3.334E-02	10323	5.203E+02	2.557E-10	7.067E-23	0.2337E-02
34 RM LOW REGION	4.915E-13	1.616E-14	3.287E-02	16424	1.230E+02	1.957E-12	1.189E-25	0.3089E-04
35 RM HEAD	1.591E-14	2.804E-15	1.763E-01	332	1.120E+03	4.037E-10	9.421E-23	0.6375E-02
36 RED MARROW	3.605E-13	8.666E-15	2.404E-02	158	3.810E+01	2.027E-12	1.943E-25	0.3200E-04
37 YM UP,L.ARM	5.320E-14	1.157E-14	2.175E-01	398	9.518E+01	1.449E-11	3.974E-24	0.2288E-03
38 YM LO,L.ARM	1.822E-13	2.094E-14	1.376E-01	156	3.810E+01	1.450E-12	1.253E-25	0.2290E-04
39 YM UP,R.ARM	3.807E-14	9.290E-15	2.440E-01	459	9.518E+01	1.707E-11	4.803E-24	0.2694E-03
40 YM LO,R.ARM	1.793E-13	2.303E-14	1.284E-01	32	1.780E+01	3.908E-13	5.274E-26	0.6170E-05
41 YM CLAVICLES	2.195E-14	1.290E-14	5.877E-01	440	5.578E+01	2.153E-12	1.248E-25	0.3400E-04
42 YM UP,L.LEG	3.861E-14	6.333E-15	1.640E-01	1	3.857E+02	6.589E-13	2.252E-25	0.1040E-04
43 YM LO,L.LEG	1.708E-15	1.230E-15	7.203E-01	341	5.578E+01	2.017E-12	1.372E-25	0.3183E-04
44 YM UP,R.LEG	3.616E-14	6.641E-15	1.837E-01	2	3.857E+02	9.501E-13	3.671E-25	0.1563E-04
45 YM LO,R.LEG	2.567E-15	1.571E-15	6.119E-01	2993	3.814E+02	6.704E-11	2.008E-23	0.1059E-02
46 YM PELVIS	1.758E-13	1.175E-14	6.684E-02	2585	9.162E+01	2.274E-11	1.447E-24	0.3590E-03
47 YM RIBS	2.482E-13	1.313E-14	5.290E-02	263	5.151E+01	4.182E-12	5.194E-25	0.6603E-04
48 YM SCAPULAE	8.120E-14	1.599E-14	1.723E-01	114	1.011E+02	1.030E-12	8.094E-26	0.1626E-04
49 YM CRANIUM	1.019E-14	2.814E-15	2.762E-01	4798	4.676E+01	1.162E-12	9.3361E-26	0.1834E-02
50 YM FACIAL SK	2.342E-14	6.168E-15	2.634E-01	4329	8.308E+01	8.051E-11	9.380E-24	0.1271E-02
51 YM LOW SPINE	1.722E-12	6.550E-14	3.804E-02	108	1.258E+01	3.781E-11	2.910E-24	0.5969E-03
52 YM MID SPINE	4.550E-13	2.054E-14	4.513E-02	7855	1.425E+03	2.532E-13	6.644E-27	0.3997E-05
53 YM UP SPINE	2.013E-14	7.391E-15	3.672E-01	10323	1.041E+03	7.104E-11	5.430E-24	0.112E-02
54 YM MID REGION	6.827E-14	2.239E-15	3.672E-01	16424	1.648E+03	2.030E-10	4.177E-23	0.3205E-02
55 YM LOW REGION	1.232E-13	3.920E-15	3.183E-02	332	1.633E+02	2.445E-12	1.880E-25	0.5860E-04
56 YM HED	1.497E-14	2.655E-15	1.773E-01					

57	YELLOW MARROW	1.151E-13	2.876E-15	2.498E-02	18178	2.380E+03	2.740E-10	4.684E-23	0.45261E-02
58		0.0			0	0.0	0.0		0.0
59		0.0			0	0.0	0.0		0.0
60		0.0			0	0.0	0.0		0.0
61	LEFT OVARY	2.776E-14	2.641E-14	9.513E-01	11	4.147E+00	1.151E-13	1.199E-26	0.1817E-05
62	RIGHT OVARY	6.766E-15	3.294E-15	4.869E-01	12	4.147E+00	2.806E-14	1.866E-28	0.4430E-06
63	OVARIES	1.726E-14	1.331E-14	7.708E-01	23	8.294E+00	1.432E-13	1.218E-26	0.2260E-05
64	PANCREAS	1.012E-12	9.363E-14	9.253E-02	974	8.981E+01	9.088E-11	7.070E-23	0.1635E-02
65	LEFT ARM	1.468E-13	1.045E-14	9.102E-02	927	7.108E+02	8.162E-11	5.520E-23	0.1289E-02
66	RIGHT ARM	1.257E-13	1.095E-14	9.102E-02	1022	7.108E+02	8.937E-11	6.056E-23	0.1411E-02
67	CLAVICLES	2.195E-14	1.890E-14	5.877E-01	32	8.125E+01	1.099E-24	0.2816E-04	
68	LEFT LEG	1.125E-14	1.800E-15	1.599E-01	443	2.081E+03	2.362E-11	1.603E-23	0.3698E-03
69	RIGHT LEG	1.456E-14	2.235E-15	1.535E-01	454	2.081E+03	3.031E-11	2.165E-23	0.4786E-03
70	PELVIS	1.757E-13	1.175E-14	6.685E-02	2993	9.013E+02	1.584E-10	1.121E-22	0.2501E-02
71	RIBS	2.482E-13	1.313E-14	2.290E-02	2585	1.032E+03	2.561E-10	1.836E-22	0.4044E-02
72	SCAPULAE	8.120E-14	1.399E-14	1.723E-01	263	3.004E+02	2.439E-11	1.767E-23	0.3851E-03
73		0.0			0	0.0	0.0		0.0
74	SPINE	6.602E-13	1.911E-14	2.894E-02	9235	1.367E+03	9.028E-10	6.826E-22	0.1425E-01
75	SKELETON	1.492E-13	3.183E-15	2.134E-02	18178	1.064E+04	1.587E-09	1.147E-21	0.2506E-01
76	TRUNK SKIN	2.429E-13	1.110E-14	4.569E-02	2412	1.392E+03	3.381E-10	2.387E-22	0.5338E-02
77	LEG SKIN	6.535E-15	1.793E-15	2.736E-01	109	1.202E+03	7.874E-12	4.642E-24	0.1243E-03
78	HEAD SKIN	7.123E-15	3.980E-15	5.587E-01	34	2.710E+02	1.931E-12	1.164E-24	0.3048E-04
79	TOTAL SKIN	1.214E-13	5.458E-15	4.494E-02	2555	2.865E+03	3.479E-10	2.445E-22	0.5493E-02
80	SPLEEN	1.203E-12	7.280E-14	6.053E-02	1766	1.742E+02	2.095E-10	1.608E-22	0.3307E-02
81	LEFT TESTIS	6.602E-15	5.314E-15	8.050E-01	12	1.860E+01	1.282E-13	9.769E-27	0.1939E-05
82	RIGHT TESTIS	5.430E-14	3.200E-14	6.114E-01	10	1.860E+01	1.010E-12	3.813E-25	0.1595E-04
83	TESTES	3.045E-14	1.681E-14	5.521E-01	22	3.720E+01	1.133E-12	3.911E-25	0.1788E-04
84	THYROID	1.052E-13	5.728E-14	5.446E-01	18	1.991E+01	2.094E-12	1.300E-24	0.3306E-04
85	THYROID	6.972E-14	5.212E-14	7.476E-01	18	1.970E+01	1.373E-12	1.054E-24	0.2168E-04
86	TRUNK TISSUE	3.486E-13	2.747E-15	7.879E-03	101437	2.982E+04	1.040E-08	6.711E-21	0.1641E+00
87	LEG TISSUE	1.336E-14	7.506E-16	5.618E-02	2803	1.673E+04	2.235E-10	1.577E-22	0.3529E-02
88	HEAD TISSUE	2.106E-14	2.355E-15	1.118E-01	798	2.657E+03	5.596E-11	3.916E-23	0.8836E-03
89	TOTAL TISSUE	2.170E-13	1.884E-15	7.764E-03	105038	4.921E+04	1.068E-08	6.870E-21	0.1686E+00
90	UTERUS	1.535E-13	4.210E-14	2.743E-01	240	6.561E+01	1.007E-11	7.629E-24	0.1590E-03
91	TRUNK	4.107E-13	2.357E-15	5.739E-03	166391	4.310E+04	1.770E-08	1.032E-20	0.2795E+00
92	LEGS	1.293E-14	6.502E-16	5.027E-02	3831	2.213E+04	2.862E-10	2.070E-22	0.6519E-02
93	HEAD	1.641E-14	1.437E-15	8.759E-02	1313	5.919E+03	9.712E-11	7.237E-23	0.1533E-02
94	TOTALBODY	2.541E-13	1.440E-15	5.666E-03	171535	7.115E+04	1.808E-08	1.049E-20	0.2854E+00
102	LEFT BREAST	6.389E-14	1.660E-14	2.598E-01	169	1.554E+02	9.929E-12	6.654E-24	0.1568E-03
103	RIGHT BREAST	9.365E-14	1.998E-14	2.133E-01	300	1.554E+02	1.455E-11	9.638E-24	0.2298E-03
104	BREAST	7.877E-14	1.299E-14	1.649E-01	369	3.108E+02	2.448E-11	1.629E-23	0.3866E-03
105	RM MID.L.ARM	0.0			371	0.0	0.0		0.0
106	RM MID.R.ARM	0.0			407	0.0	0.0		0.0
107	RM LOW.L.ARM	0.0			398	0.0	0.0		0.0
108	RM LOW.R.ARM	0.0			459	0.0	0.0		0.0
109	RM MID.L.LEG	0.0			0	0.0	0.0		0.0
110	RM MID.R.LEG	0.0			0	0.0	0.0		0.0
111	RM LOW.L.LEG	0.0			104	0.0	0.0		0.0
112	RM LOW.R.LEG	0.0			3	0.0	0.0		0.0
113	YM MID.L.ARM	1.521E-13	2.204E-14	1.449E-01	371	5.091E+01	7.745E-12	1.259E-24	0.1223E-03
114	YM MID.R.ARM	1.783E-13	2.410E-14	1.351E-01	407	5.091E+01	9.079E-12	1.505E-24	0.1433E-03
115	YM MID.L.LEG	0.0			0	1.466E+02	0.0		0.0
116	CRANIUM	1.019E-14	2.814E-15	2.762E-01	114	9.184E+02	9.356E-12	6.677E-24	0.1477E-03
117	FACIAL SKELETON	2.342E-14	6.168E-15	2.634E-01	110	4.537E+02	1.062E-11	7.832E-24	0.1678E-03
118	UPPER SPINE*	0.0			0	2.462E+02	0.0		0.0
119	MIDDLE SPINE*	0.0			0	8.152E+02	0.0		0.0
120	LOWER SPINE*	0.0			0	3.060E+02	0.0		0.0
121	UP.L.ARM*	0.0			0	2.681E+02	0.0		0.0
122	UP.R.ARM*	0.0			0	2.681E+02	0.0		0.0
123	MID.L.ARM*	0.0			0	2.015E+02	0.0		0.0
124	MID.R.ARM*	0.0			0	2.015E+02	0.0		0.0
125	LOW.L.ARM*	0.0			0	2.411E+02	0.0		0.0

AUSSURSED IRRADIATION AT EACH ORGAN REGION

ORGAN	AV. DOSE (GRADS)	DOES STD.	COEF. VAR.	COLLISIONS	MASS	E(G-GADS)	VAR. OF E	ABSD. FRAC
(OGARN)								
BRAIN	9.548E-15	2.278E-15	2.385E-01	131	1.353E+03	1.292E-11	9.501E-24	0.2040E-03
LEFT ADRENAL	1.213E-12	3.393E-13	2.799E-01	79	7.775E+00	9.428E-12	6.962E-24	0.1489E-03
RIGHT ADRENAL	1.015E-12	2.880E-13	2.838E-01	105	7.775E+00	7.888E-12	5.013E-24	0.1245E-03
ADRENALS	1.114E-12	2.225E-13	1.998E-01	184	1.555E+01	1.732E-11	1.197E-23	0.2734E-03
GALL BLADDER	3.572E-13	1.434E-13	4.015E-01	83	1.004E+01	3.585E-11	2.072E-24	0.5661E-04
CONTENTS	6.077E-13	9.054E-14	1.490E-01	4.8	5.302E+01	3.222E-11	2.304E-23	0.5087E-03
UR. BLADDER	8.569E-14	3.482E-14	4.084E-01	81	4.527E+01	3.879E-12	2.485E-24	0.6125E-04
UR. BL. CONTENTS	1.147E-13	1.899E-14	1.655E-01	297	2.006E+02	2.301E-11	1.450E-23	0.3632E-03
G. I. STOMACH	5.307E-13	4.993E-14	9.499E-02	9.8	1.504E+02	7.983E-11	5.642E-23	0.1260E-02
G. I. U.L.I.	3.652E-13	3.574E-14	9.787E-02	1200	2.099E+02	7.663E-11	5.625E-23	0.1210E-02
G. I. L.L.I.	1.759E-13	2.776E-14	1.579E-01	4.59	1.588E+02	2.792E-11	1.943E-23	0.4409E-03
CONTENTS	4.427E-13	2.323E-14	5.247E-02	3380	6.049E+02	2.678E-10	1.975E-22	0.4228E-02
SM. INT.+CONTS	3.900E-13	1.652E-14	4.235E-02	6376	1.045E+03	4.075E-10	2.980E-22	0.6435E-02
HEART	1.835E-13	1.344E-14	7.368E-02	2186	7.303E+02	1.345E-10	9.708E-23	0.2123E-02
LEFT KIDNEY	1.021E-11	2.346E-13	2.298E-02	64.8	1.425E+02	1.455E-09	1.118E-21	0.2297E-01
RIGHT KIDNEY	9.837E-12	2.302E-13	2.340E-02	60.8	1.425E+02	1.402E-09	1.077E-21	0.2214E-01
KIDNEYS	1.002E-11	1.618E-13	1.616E-02	125.8	2.851E+02	2.856E-09	2.129E-21	0.4509E-01
LIVER	5.552E-13	1.507E-14	2.714E-02	116.6	1.815E+03	1.008E-09	7.480E-22	0.1591E-01
LEFT LUNG	1.822E-13	1.631E-14	8.952E-02	1130	4.841E+02	8.820E-11	6.235E-23	0.1393E-02
RIGHT LUNG	1.692E-13	1.471E-14	8.695E-02	1267	5.500E+02	9.306E-11	6.547E-23	0.1469E-02
LUNGS	1.753E-13	1.093E-14	6.236E-02	2397	1.034E+03	1.812E-10	1.277E-22	0.2862E-02
LEFT OVARY	2.776E-14	2.644E-14	9.513E-01	11	4.147E+00	1.151E-13	1.199E-26	0.1817E-05
RIGHT OVARY	6.766E-15	3.294E-15	4.869E-01	12	4.147E+00	2.806E-14	1.866E-28	0.4430E-06
OVARIES	1.726E-14	1.331E-14	7.708E-01	23	8.294E+01	1.432E-13	1.218E-26	0.2260E-05
PANCREAS	1.012E-12	9.363E-14	9.253E-02	974	8.981E+01	9.088E-11	7.070E-23	0.1435E-02
SPLEEN	1.203E-12	7.280E-14	6.053E-02	1766	1.742E+02	2.095E-10	1.608E-22	0.3307E-02
LEFT TESTIS	6.602E-15	5.314E-15	8.050E-01	12	1.860E+01	1.228E-13	9.769E-05	0.1939E-05
RIGHT TESTIS	5.430E-14	3.320E-14	6.114E-01	10	1.860E+01	1.010E-12	3.813E-27	0.1595E-04
TESTES	3.045E-14	1.681E-14	5.524E-01	22	3.720E+01	1.133E-12	3.911E-25	0.1788E-04
THYMUS	1.052E-13	5.728E-14	5.446E-01	18	1.970E+01	2.094E-12	1.300E-24	0.3306E-04
THYROID	6.972E-14	5.212E-14	7.474E-01	18	1.970E+01	1.373E-12	1.054E-24	0.2168E-04
UTERUS	1.535E-13	4.210E-14	2.743E-01	240	6.554E+02	1.007E-11	7.629E-24	0.1590E-03
LEFT BREAST	6.389E-14	1.660E-14	2.598E-01	169	1.554E+02	9.929E-12	6.654E-24	0.1568E-03
RIGHT BREAST	9.365E-14	1.998E-14	2.133E-01	200	1.554E+02	1.455E-11	9.638E-24	0.2298E-03
BREAST	7.877E-14	1.299E-14	1.649E-01	369	3.108E+02	2.448E-11	1.629E-23	0.3866E-03
(SKELETON)								
CRANIUM	1.019E-14	2.814E-15	2.762E-01	114	9.184E+02	9.356E-12	6.677E-24	0.1477E-03
FACIAL SKEL	2.342E-14	6.168E-15	2.634E-01	110	4.537E+02	1.062E-11	7.832E-24	0.1678E-03
SPINE	6.602E-13	1.911E-14	2.894E-02	9235	1.367E+03	9.028E-10	6.826E-22	0.1425E-01
LEFT ARM	1.148E-13	1.045E-14	9.102E-02	927	7.108E+02	8.162E-11	5.520E-23	0.1289E-02
RIGHT ARM	1.257E-13	1.095E-14	8.708E-02	1022	7.108E+02	8.937E-11	6.056E-23	0.1411E-02
CLAVICLES	2.195E-14	1.290E-14	5.877E-01	32	8.125E+01	1.783E-12	1.099E-24	0.2816E-04
SCAPULAE	8.120E-14	1.399E-14	1.723E-01	263	3.004E+02	2.439E-11	1.767E-23	0.3851E-03
RIBS	2.482E-13	1.313E-14	5.290E-02	2585	1.032E+03	2.561E-10	1.836E-22	0.4044E-02
PELVIS	1.757E-13	1.173E-14	6.683E-02	2995	9.013E+02	1.584E-10	1.121E-22	0.2501E-02
LEFT LEG	1.125E-14	1.800E-15	1.599E-01	443	2.081E+03	2.342E-11	1.403E-23	0.3698E-03
RIGHT LEG	1.456E-14	2.235E-15	1.535E-01	454	2.081E+03	3.031E-11	2.165E-23	0.4786E-03
SKELETON	1.492E-13	3.183E-15	2.134E-02	18178	1.064E+04	1.587E-09	1.147E-21	0.2506E-01
(RED MARROW)								
RM CRANIUM	1.019E-14	2.814E-15	2.762E-01	114	6.239E+01	6.356E-13	3.082E-26	0.1004E-04
RM FACIAL SK	2.342E-14	6.168E-15	2.634E-01	110	3.080E+01	7.213E-13	3.609E-26	0.1139E-04
RM UPP.SPINE	2.013E-14	7.391E-15	3.672E-01	108	2.979E+01	5.996E-13	4.849E-26	0.9467E-05

RM MID. SPINE	6.550E-13	2.054E-14	4.513E-02	4.329	1.950E+02	8.875E-11	1.604E-23	0.1601E-02
RM LOW. SPINE	1.725E-12	6.550E-14	3.804E-02	4.798	1.097E+02	1.888E-10	5.159E-23	0.2981E-02
RM UP. L. ARM	5.320E-14	1.157E-14	2.175E-01	158	1.283E+01	6.823E-13	2.202E-26	0.1077E-04
RM UP. R. ARM	3.807E-14	9.290E-15	2.440E-01	156	1.283E+01	4.883E-13	1.420E-26	0.7709E-05
RM MID. L. ARM	0.0			371	0.0	0.0	0.0	0.0
RM MID. R. ARM	0.0			407	0.0	0.0	0.0	0.0
RM LOW. L. ARM	0.0			398	0.0	0.0	0.0	0.0
RM LOW. R. ARM	0.0			459	0.0	0.0	0.0	0.0
RM CLAVICLES	2.195E-14	1.290E-14	5.877E-01	32	8.849E+00	1.942E-13	1.303E-26	0.3067E-05
RM SCAPULAE	1.720E-14	1.399E-14	1.723E-01	263	3.192E+01	5.992E-12	1.995E-25	0.4093E-04
RM RIBS	2.482E-13	1.313E-14	5.289E-02	2385	2.153E+02	5.344E-11	7.990E-24	0.8437E-03
RM PELVIS	1.750E-13	1.175E-14	6.684E-02	2993	3.731E+02	6.558E-11	1.921E-23	0.1035E-02
RM UP. L. LEG	3.861E-14	6.333E-15	1.640E-01	440	1.876E+01	7.243E-13	1.412E-26	0.1144E-04
RM UP. R. LEG	3.616E-14	6.641E-15	1.837E-01	341	1.876E+01	6.784E-13	1.553E-26	0.1071E-04
RM MID. L. LEG	0.0			0	0.0	0.0	0.0	0.0
RM MID. R. LEG	0.0			104	0.0	0.0	0.0	0.0
RM LOW. L. LEG	0.0			3	0.0	0.0	0.0	0.0
RM LOW. R. LEG	0.0			9	0.0	0.0	0.0	0.0
RM HEAD	1.591E-14	2.804E-15	1.763E-01	332	1.230E+02	1.957E-12	1.189E-25	0.3089E-04
RM MID. REGION	3.105E-13	1.035E-14	3.334E-02	7855	4.767E+02	1.480E-10	2.436E-23	0.2337E-02
RM LOW REGION	4.915E-13	1.616E-14	3.287E-02	10323	5.203E+02	2.557E-10	7.067E-23	0.4038E-02
RED MARROW	3.605E-13	8.666E-15	2.404E-02	16424	1.120E+03	4.037E-10	9.421E-23	0.6375E-02
(VERROW MARROW)								
YM CRANIUM	1.019E-14	2.814E-15	2.762E-01	114	1.011E+02	1.030E-12	8.094E-26	0.1626E-04
YM FACIAL SK	2.342E-14	6.168E-15	3.634E-01	110	1.258E+01	1.162E-12	9.361E-26	0.1834E-04
YM UP. SPINE	2.013E-14	7.391E-15	3.672E-01	108	1.258E+01	2.532E-13	8.644E-27	0.3997E-05
YM MID. SPINE	4.551E-13	2.054E-14	4.513E-02	4329	8.308E+01	3.781E-11	2.910E-24	0.5969E-03
YM LOW. SPINE	1.722E-12	6.550E-14	3.804E-02	4798	4.876E+01	8.051E-11	9.380E-24	0.1271E-02
YM UP. L. ARM	5.320E-14	1.157E-14	2.175E-01	158	3.810E+01	2.027E-12	1.943E-25	0.3200E-04
YM UP. R. ARM	3.807E-14	9.290E-15	2.440E-01	156	3.810E+01	1.450E-12	1.253E-25	0.2290E-04
YM MID. L. ARM	1.521E-13	2.204E-14	1.449E-01	371	5.091E+01	7.745E-12	1.259E-24	0.1233E-03
YM MID. R. ARM	1.783E-13	2.410E-14	1.531E-01	407	5.091E+01	9.079E-12	1.505E-24	0.1433E-03
YM LO. L. ARM	1.522E-13	2.094E-14	1.376E-01	398	9.518E+01	1.449E-11	3.974E-24	0.2288E-03
YM LO. R. ARM	1.793E-13	2.303E-14	1.284E-01	459	9.518E+01	1.707E-11	4.803E-24	0.2694E-03
YM CLAVICLES	2.195E-14	1.290E-14	5.877E-01	32	1.780E+01	3.908E-13	5.274E-26	0.6170E-05
YM SCAPULAE	8.120E-14	1.399E-14	1.723E-01	263	5.151E+01	4.182E-12	5.194E-25	0.6603E-04
YM RIBS	2.482E-13	1.313E-14	5.290E-02	2385	9.162E+01	2.274E-11	1.447E-24	0.3590E-03
YM PELVIS	1.750E-13	1.175E-14	6.684E-02	2993	3.814E+02	6.704E-11	2.008E-23	0.1059E-02
YM UP. L. LEG	3.861E-14	6.333E-15	1.640E-01	440	5.578E+01	2.153E-12	1.248E-25	0.3400E-04
YM UP. R. LEG	3.616E-14	6.641E-15	1.837E-01	341	5.578E+01	2.017E-12	1.372E-25	0.3185E-04
YM MID. L. LEG	0.0			0	1.466E+02	0.0	0.0	0.0
YM MID. R. LEG	9.161E-15	2.665E-15	2.909E-01	104	1.466E+02	1.343E-12	1.525E-25	0.2120E-04
YM LO. L. LEG	1.708E-15	1.230E-15	7.203E-01	1	3.857E+02	6.589E-13	2.52E-25	0.1040E-04
YM LO. R. LEG	2.567E-15	1.571E-15	6.119E-01	2	3.857E+02	9.901E-13	3.671E-25	0.1563E-04
YM HED	1.497E-14	2.655E-15	1.773E-01	332	1.633E+02	2.445E-12	1.880E-25	0.3860E-04
YM MID. REGION	6.827E-14	2.239E-15	3.280E-02	7855	1.041E+03	7.104E-11	5.430E-24	0.1122E-02
YM LOW. REGION	1.232E-13	3.920E-15	3.183E-02	10323	1.648E+03	2.030E-10	4.177E-23	0.3205E-02
YELLOW MARROW	1.151E-13	2.876E-15	2.498E-02	18178	2.380E+03	2.740E-10	4.684E-23	0.4326E-02
(SKIN)								
HEAD SKIN	7.123E-15	3.980E-15	5.587E-01	34	2.710E+02	1.931E-12	1.164E-24	0.3048E-04
TRUNK SKIN	2.429E-13	1.110E-14	4.509E-02	2412	1.392E+03	3.381E-10	2.387E-22	0.5338E-02
LEG SKIN	6.538E-15	1.793E-15	2.736E-01	109	1.202E+03	7.874E-12	4.642E-24	0.1243E-03
TOTAL SKIN	1.214E-13	5.458E-15	4.494E-02	2555	2.865E+03	3.479E-10	2.445E-22	0.5493E-02
(TISSUE)								
HEAD TISSUE	2.106E-14	2.355E-15	1.118E-01	798	2.657E+03	5.596E-11	3.916E-23	0.8836E-03
TRUNK TISSUE	3.486E-13	2.747E-15	7.879E-03	101437	2.982E+04	1.040E-08	6.711E-21	0.1641E+00
LEG TISSUE	1.338E-14	7.506E-16	5.618E-02	2803	1.673E+04	2.235E-10	1.577E-22	0.3529E-02
TOTAL TISSUE	2.170E-13	1.684E-15	7.764E-03	105038	4.921E+04	1.068E-08	6.870E-21	0.1686E+00

(TOTAL)													
HEAD	1.641E-14	1.437E-15	8.759E-02	1313	5.919E+03	9.712E-11	7.237E-23	0.1533E-02					
TRUNK	4.107E-13	2.357E-15	5.739E-03	166391	4.310E+04	1.770E-08	1.038E-20	0.2795E+00					
LEGS	1.293E-14	6.502E-16	5.027E-02	3831	2.213E+04	2.862E-10	2.070E-22	0.4519E-02					
■ TOTALBODY	2.541E-13	1.440E-15	5.666E-03	171535	7.115E+04	1.808E-08	1.049E-20	0.2854E+00					

---- ABSORBED FRACTION FOR SECTOR DIVIDED REGION ----
 THE CALCULATION IS VALID ONLY FOR THE CASE OF REFERENCE MAN

- SECTOR DEFINITION DATA -

85 BOXES IN BODY, 8 BOXES IN HEAD, 4 BOXES IN LEGS.

MAJOR AXES OF BODY, 4.0 8.0 12.0 16.0 20.0
 MINOR AXES OF BODY, 2.0 4.0 6.0 8.0 10.0
 LAYERS IN BODY AT 14.0 28.0 42.0 56.0 70.0
 SECTORS IN BODY AT -45.000 DEG. 45.000 DEG. 135.000 DEG. 225.000 DEG.

MAJOR AXIS OF HEAD, 7.0
 MINOR AXIS OF HEAD, 10.0
 LAYERS IN HEAD AT 82.0 94.0
 SECTORS IN HEAD AT -45.000 DEG. 45.000 DEG. 135.000 DEG. 225.000 DEG.

LAYERS IN LEGS AT -20.0 -40.0 -60.0 -80.0

VERTEX AT -100.0

-- ABSORBED FRACTION AT EACH OF THE SECTOR --

BOX NO.	AV. DOSE (RADS)	DOSE STD.	COEFF. VAR.	COLLISIONS	MASS	E (G-RADS)	VAR. OF E	ABS'D FRAC.
1	1.094E-13	1.533E-14	1.401E-01	638	3.472E+02	3.798E-11	2.832E-23	0.3034E-03
2	3.555E-14	1.169E-14	3.289E-01	127	1.537E+02	5.465E-12	3.230E-24	0.6365E-04
3	1.222E-13	1.530E-14	1.252E-01	837	3.671E+02	4.487E-11	3.156E-23	0.3584E-03
4	3.534E-14	1.230E-14	3.482E-01	132	1.537E+02	5.435E-12	3.578E-24	0.4340E-04
5	1.430E-13	1.630E-14	1.140E-01	822	3.671E+02	5.249E-11	3.581E-23	0.4193E-03
6	3.283E-14	8.641E-15	2.632E-01	177	2.562E+02	8.413E-12	4.903E-24	0.6720E-04
7	1.057E-13	1.058E-14	1.001E-01	1221	6.558E+02	6.934E-11	4.818E-23	0.5539E-03
8	5.424E-14	1.285E-14	2.369E-01	193	2.562E+02	1.390E-11	1.084E-23	0.1110E-03
9	1.070E-13	1.040E-14	9.716E-02	1213	6.543E+02	7.004E-11	4.631E-23	0.5595E-03
10	3.483E-14	7.889E-15	2.265E-01	222	3.587E+02	1.249E-11	8.008E-24	0.9980E-04
11	9.101E-14	8.231E-15	9.044E-02	1254	8.785E+02	7.995E-11	5.228E-23	0.6386E-03
12	5.009E-14	9.732E-15	1.943E-01	236	3.587E+02	1.797E-11	1.219E-23	0.1435E-03
13	9.705E-14	8.872E-15	9.142E-02	1177	8.759E+02	8.501E-11	6.040E-23	0.6791E-03
14	3.750E-14	7.532E-15	2.008E-01	206	4.612E+02	1.730E-11	1.207E-23	0.1382E-03
15	8.480E-14	7.399E-15	8.726E-02	1010	1.126E+03	9.548E-11	6.941E-23	0.7627E-03
16	3.942E-14	7.600E-15	1.877E-01	247	4.612E+02	1.818E-11	1.165E-23	0.1452E-03
17	6.871E-14	6.457E-15	9.397E-02	1049	1.128E+03	7.747E-11	5.300E-23	0.6188E-03
18	4.076E-13	2.928E-14	7.183E-02	2478	3.472E+02	1.415E-10	1.034E-22	0.1131E-02
19	1.480E-13	2.460E-14	1.663E-01	456	1.537E+02	2.275E-11	1.831E-23	0.1817E-03
20	6.294E-13	3.536E-14	5.618E-02	3059	3.671E+02	2.311E-10	1.685E-22	0.1846E-02
21	3.076E-13	3.780E-14	1.229E-01	568	1.596E+02	4.909E-11	3.640E-23	0.3921E-03
22	5.559E-13	3.356E-14	6.037E-02	2819	3.671E+02	2.041E-10	1.518E-22	0.1630E-02
23	1.583E-13	2.048E-14	1.294E-01	637	2.562E+02	4.057E-11	2.755E-23	0.3241E-03
24	5.856E-13	2.604E-14	4.446E-02	4833	6.381E+02	3.737E-10	2.761E-22	0.2985E-02
25	3.924E-13	3.234E-14	8.242E-02	1183	2.797E+02	1.098E-10	8.185E-23	0.8767E-03
26	5.028E-13	2.408E-14	4.789E-02	4149	6.372E+02	3.204E-10	2.354E-22	0.2559E-02
27	1.228E-13	1.500E-14	1.221E-01	712	3.587E+02	4.405E-11	2.895E-23	0.3519E-03
28	5.478E-13	2.153E-14	3.930E-02	5348	8.768E+02	4.803E-10	3.563E-22	0.3836E-02
29	3.718E-13	2.609E-14	7.017E-02	1567	4.197E+02	1.561E-10	1.199E-22	0.1247E-02
30	4.100E-13	1.864E-14	4.546E-02	4306	8.796E+02	3.806E-10	2.687E-22	0.2880E-02

31	8.926E-14	1.161E-14	1.296E-01	6.612E+02	4.131E-11	2.867E-25	0.3299E-05
32	3.799E-13	1.545E-14	4.066E-02	1.136E+03	4.316E-10	3.080E-22	0.3447E-02
33	3.583E-13	2.361E-14	6.589E-02	4.926E+02	1.765E-10	1.352E-22	0.1410E-02
34	2.814E-13	1.330E-14	4.727E-02	1.136E+03	3.196E-10	2.282E-22	0.2953E-02
35	1.057E-12	4.766E-14	4.510E-02	3.672E+02	3.669E-10	2.738E-22	0.2931E-02
36	2.761E-13	3.523E-14	1.277E-01	1.537E+02	4.244E-11	2.937E-22	0.3590E-03
37	1.576E-12	5.689E-14	3.611E-02	3.671E+02	5.784E-10	4.362E-22	0.4620E-02
38	8.508E-13	6.135E-14	7.211E-02	1.666E+02	1.417E-10	1.045E-22	0.1132E-02
39	1.228E-12	4.946E-14	4.026E-02	3.671E+02	4.509E-10	3.297E-22	0.3602E-02
40	2.586E-13	2.698E-14	1.043E-01	2.562E+02	6.626E-11	4.780E-22	0.5293E-03
41	2.263E-12	5.306E-14	2.343E-02	6.119E+02	1.384E-09	1.054E-21	0.1106E-01
42	1.502E-12	4.019E-14	3.139E+02	3.139E+02	4.716E-10	3.570E-22	0.3767E-02
43	1.534E-12	4.368E-14	2.848E-02	6.119E+02	9.386E-10	7.144E-22	0.7497E-02
44	1.830E-12	1.926E-14	1.053E-01	3.587E+02	5.635E-11	4.776E-23	0.5242E-03
45	2.500E-12	4.708E-14	1.883E-02	8.566E+02	1.626E-21	1.626E-21	0.1711E-01
46	2.138E-12	6.383E-14	2.985E-02	8.566E+02	8.572E-10	6.548E-22	0.6847E-02
47	1.514E-12	3.654E-14	2.414E-02	8.566E+02	1.297E-09	9.799E-22	0.1036E-01
48	1.377E-13	1.390E-14	1.010E-01	4.810E+02	6.621E-11	4.472E-23	0.5289E-03
49	1.090E-12	2.628E-14	2.410E-02	1.175E+03	1.281E-09	9.539E-22	0.1024E-01
50	1.144E-12	2.029E-14	3.729E-02	4.765E+02	5.451E-10	4.131E-22	0.4354E-02
51	6.521E-13	2.413E-14	8.601E-02	1.174E+03	7.658E-10	5.635E-22	0.6117E-02
52	2.803E-13	2.099E-14	2.092E-01	3.449E+02	9.676E-11	6.927E-23	0.7729E-03
53	1.003E-13	3.324E-14	8.192E-02	1.537E+02	1.542E-11	1.041E-23	0.1232E-03
54	4.057E-13	1.863E-14	2.014E-01	1.672E+02	1.102E-10	8.151E-23	0.8803E-03
55	9.246E-14	1.863E-14	1.006E-01	2.716E+02	1.546E-11	9.693E-24	0.5654E-03
56	2.600E-13	2.610E-14	1.793E-01	2.722E+02	7.078E-11	1.183E-23	0.1531E-03
57	7.488E-14	1.344E-14	7.520E-02	2.559E+02	1.916E-11	1.83E-23	0.9783E-03
58	4.598E-13	3.308E-14	1.206E-01	3.111E+02	4.818E-11	8.484E-23	0.3849E-03
59	1.549E-13	1.868E-14	8.853E-02	2.840E+02	9.319E-11	6.807E-23	0.7444E-03
60	3.282E-13	2.905E-14	1.493E-01	3.529E+02	3.182E-11	2.258E-23	0.2542E-03
61	9.018E-14	1.347E-14	6.326E-02	5.154E+02	1.814E-10	1.317E-22	0.1449E-02
62	3.520E-13	2.227E-14	1.102E-01	3.922E+02	1.028E-22	4.510E-23	0.4869E-03
63	1.554E-13	1.712E-14	7.211E-02	4.915E+02	4.066E-10	1.028E-22	0.1123E-02
64	8.179E-14	1.054E-14	1.288E-01	5.125E+02	4.016E-11	1.509E-22	0.3208E-03
65	1.784E-13	1.027E-14	1.020E-01	4.898E+02	2.134E-10	2.676E-23	0.1704E-02
66	1.438E-13	1.467E-14	5.766E-02	4.910E+02	2.134E-10	5.163E-23	0.5628E-03
67	1.790E-13	1.032E-14	1.309E-01	1.196E+03	7.046E-11	1.518E-22	0.1707E-02
68	8.295E-14	1.309E-14	1.578E-01	3.472E+02	2.880E-11	2.067E-23	0.2301E-03
69	3.068E-14	1.157E-14	3.771E-01	1.537E+02	4.716E-12	3.183E-24	0.3767E-03
70	8.781E-14	1.400E-14	1.595E-01	3.098E+02	2.720E-11	1.881E-23	0.4543E-04
71	3.235E-14	1.143E-14	3.539E-01	1.681E+02	5.437E-12	3.703E-24	0.1969E-03
72	8.137E-14	1.327E-14	1.631E-01	3.029E+02	2.465E-11	1.615E-23	0.6098E-04
73	2.980E-14	9.145E-15	3.069E-01	2.562E+02	7.635E-12	5.490E-24	0.2302E-03
74	7.405E-14	1.091E-14	1.473E-01	3.893E+02	2.883E-11	1.802E-23	0.5654E-04
75	2.284E-14	6.239E-15	2.731E-01	3.099E+02	3.479E-12	2.422E-23	0.2795E-03
76	8.906E-14	1.253E-14	1.407E-01	3.929E+02	3.499E-11	4.785E-24	0.6458E-04
77	2.254E-14	7.861E-15	2.706E-01	3.587E+02	8.085E-12	3.789E-23	0.4519E-03
78	3.244E-14	7.553E-15	1.088E-01	5.657E-11	9.112E-24	9.112E-24	0.1035E-03
79	7.372E-14	5.129E-15	2.329E-01	7.831E+02	1.296E-11	4.070E-23	0.4621E-03
80	2.542E-14	8.126E-15	1.103E-01	3.996E+02	5.786E-11	8.154E-24	0.9881E-04
81	7.225E-14	5.868E-15	2.308E-01	4.866E+02	8.674E-11	6.386E-23	0.6929E-03
82	6.996E-14	6.445E-15	9.212E-02	1.240E+03	1.237E-11	8.586E-23	0.1044E-03
83	2.720E-14	5.759E-15	9.211E-02	4.807E+02	1.307E-11	7.662E-24	0.5692E-03
84	5.711E-14	5.601E-15	2.117E-01	1.248E+03	7.125E-11	4.884E-23	0.1217E-03
85	1.784E-14	3.773E-15	9.808E-02	8.538E+02	1.523E-11	1.038E-23	0.1895E-03
86	4.351E-14	7.607E-15	2.115E-01	5.453E+02	2.373E-11	1.721E-23	0.7827E-04
87	1.069E-14	2.814E-15	1.748E-01	9.169E+02	9.798E-12	6.656E-24	0.2021E-03
88	4.666E-14	7.859E-15	2.633E-01	5.422E+02	2.530E-11	1.816E-23	0.5155E-04
89	7.449E-14	2.561E-15	1.684E-01	8.663E+02	6.454E-12	4.923E-24	0.5323E-04
90	1.202E-14	3.859E-15	3.211E-01	5.545E+02	6.664E-12	4.578E-24	0.5323E-04
91	3.672E-15	1.748E-15	4.761E-01	8.645E+02	3.174E-12	2.284E-24	0.2536E-04
92							

93	1.221E-14	3.595E-15	2.943E-01	98	5.549E+02	6.777E-12	5.979E-24	0.5414E-04
94	2.231E-14	1.211E-15	5.430E-02	3401	1.073E+04	2.393E-10	1.688E-22	0.1911E-02
95	5.750E-15	7.689E-16	1.337E-01	387	6.532E+03	3.756E-11	2.522E-23	0.3000E-03
96	2.122E-15	6.546E-16	3.085E-01	40	3.377E+03	7.166E-12	4.887E-24	0.5724E-04
97	1.761E-15	1.018E-15	5.781E-01	3	1.264E+03	2.227E-12	1.657E-24	0.1779E-04
98	4.146E-13	2.379E-15	5.739E-03	166391	4.269E+04	1.770E-08	1.032E-20	0.1414E+00
99	1.704E-14	1.493E-15	8.759E-02	1313	5.698E+03	9.712E-11	7.237E-23	0.7758E-03
100	1.307E-14	6.570E-16	5.027E-02	3831	2.190E+04	2.862E-10	2.070E-22	0.2286E-02
101	2.572E-13	1.457E-15	5.666E-03	171535	7.029E+04	1.808E-08	1.049E-20	0.1444E+00

冊

Output file of VADMAP/Monte-Carlo
(Logical unit 20)

.4000E+01	.13529E-05	.40635E+00	.83783E-05	.94089E-01
.61574E-05	.42354E-01	.57653E-05	.97871E-01	
.27767E-05	.15786E+00	.15815E-03	.16158E-01	
.87659E-05	.27142E-01	.27672E-05	.62343E-01	
.0	.0	.0	.0	
.0	.0	.27672E-05	.62343E-01	
.12437E-05	.16485E+00	.27255E-06	.77079E+00	
.15976E-04	.92526E-01	.0	.0	
.0	.0	.0	.0	
.56916E-05	.24040E-01	.18175E-05	.24981E-01	
.0	.0	.0	.0	
.0	.0	.23553E-05	.21340E-01	
.19175E-05	.44942E-01	.18988E-04	.60535E-01	
.48078E-06	.55209E+00	.16606E-05	.54458E+00	
.11008E-05	.74758E+00	.24229E-05	.27434E+00	
.40120E-05	.56658E-02	.17581E-04	.19982E+00	
.23553E-05	.21340E-01	.15074E-06	.23854E+00	

2. Sample run for VADMAP/BUILD

- Sample case-1

Computer resources required to execute
the sample case:

Region size ; 452 K bytes

Execution time ; 170.5 CPU seconds

No. of I/O ; 11 times

 *
 * INPUT DATA LIST *
 *

```

1 .....1.....2.....3.....4.....5.....6.....7.....8
2 1
3 TEST CASE-1 FOR VADMAP/BUILD SOURCE ORGAN: KIDNEYS
19875 6000 100 1.0E-02
.....1.....2.....3.....4.....5.....6.....7.....8

*** INPUT DATA END ***
  
```

TEST CASE-1 FOR VADMAP/BUILD SOURCE ORGAN: KIDNEYS

TARGET ORGAN = BLD. WALL

ENERGY(MEV)	MASS(GRAM)	ABS.FRC.	SAF
1.000E-02	4.527E+01	5.266E-49	1.163E-50
1.500E-02	4.527E+01	1.476E-18	3.260E-20
2.000E-02	4.527E+01	6.707E-11	1.482E-12
3.000E-02	4.527E+01	6.306E-07	1.393E-08
5.000E-02	4.527E+01	2.472E-05	5.460E-07
1.000E-01	4.527E+01	7.037E-05	1.554E-06
2.000E-01	4.527E+01	8.698E-05	1.921E-06
5.000E-01	4.527E+01	8.316E-05	1.837E-06
1.000E+00	4.527E+01	8.105E-05	1.790E-06
1.500E+00	4.527E+01	7.689E-05	1.698E-06
2.000E+00	4.527E+01	7.497E-05	1.656E-06
4.000E+00	4.527E+01	6.532E-05	1.443E-06

ENERGY(MEV)	MASS(GRAM)	ABS.FRC.	SAF
1.000E-02	1.504E+02	3.530E-18	2.346E-20
1.500E-02	1.504E+02	5.222E-08	3.471E-10
2.000E-02	1.504E+02	3.443E-05	2.289E-07
3.000E-02	1.504E+02	9.444E-04	6.277E-06
5.000E-02	1.504E+02	2.602E-03	1.729E-05
1.000E-01	1.504E+02	2.480E-03	1.648E-05
2.000E-01	1.504E+02	2.354E-03	1.565E-05
5.000E-01	1.504E+02	1.874E-03	1.246E-05
1.000E+00	1.504E+02	1.719E-03	1.143E-05
1.500E+00	1.504E+02	1.499E-03	9.963E-06
2.000E+00	1.504E+02	1.501E-03	9.980E-06
4.000E+00	1.504E+02	1.128E-03	7.498E-06

The outputs followed were omitted.

Output data file on logical unit 30

RID. WALL						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
1.163E-50	3.260E-20	1.482E-12	1.393E-08	5.460E-07	1.554E-06	
1.921E-06	1.837E-06	1.790E-06	1.698E-06	1.656E-06	1.443E-06	
ST. WALL						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
2.346E-20	3.471E-10	2.289E-07	6.277E-06	1.729E-05	1.648E-05	
1.565E-05	1.246E-05	1.143E-05	9.963E-06	9.980E-06	7.498E-06	
SMALL INT.						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
3.724E-16	6.977E-09	4.810E-07	5.392E-06	1.442E-05	1.555E-05	
1.357E-05	1.127E-05	1.001E-05	9.052E-06	8.487E-06	6.834E-06	
U.L.I. WALL						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
7.365E-20	4.924E-10	1.496E-07	4.319E-06	1.251E-05	1.370E-05	
1.216E-05	1.053E-05	8.946E-06	8.468E-06	7.598E-06	6.406E-06	
L.L.I. WALL						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
3.063E-26	4.913E-12	5.099E-09	4.307E-07	2.436E-06	3.788E-06	
3.872E-06	3.422E-06	3.100E-06	2.925E-06	2.954E-06	2.334E-06	
KIDNEYS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
2.058E-03	3.238E-03	2.978E-03	1.856E-03	8.696E-04	4.192E-04	
4.155E-04	4.180E-04	3.852E-04	3.514E-04	3.231E-04	2.565E-04	
LIVER						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
8.924E-13	2.206E-07	1.386E-06	1.175E-05	1.992E-05	1.605E-05	
1.680E-05	1.222E-05	1.245E-05	9.806E-06	1.050E-05	7.381E-06	
LUNGS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
1.024E-35	8.449E-16	5.273E-11	6.316E-08	1.029E-06	2.380E-06	
2.652E-06	2.451E-06	2.295E-06	2.173E-06	2.076E-06	1.783E-06	
BREASTS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
1.543E-49	8.481E-20	2.465E-12	2.387E-08	7.501E-07	2.050E-06	
2.365E-06	2.252E-06	2.122E-06	2.030E-06	1.938E-06	1.684E-06	
OVARIES						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
8.227E-34	2.799E-14	1.656E-09	5.814E-07	4.755E-06	7.336E-06	
7.201E-06	6.164E-06	5.471E-06	5.064E-06	4.727E-06	3.926E-06	
PANCREAS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
4.179E-16	1.529E-08	1.613E-06	2.011E-05	3.868E-05	3.150E-05	
2.860E-05	2.307E-05	2.087E-05	1.834E-05	1.748E-05	1.359E-05	
RED MARROWS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	
2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00	
6.582E-12	6.227E-07	3.480E-06	1.600E-05	1.439E-05	1.112E-05	
1.104E-05	8.672E-06	8.506E-06	7.060E-06	7.218E-06	5.332E-06	
Y. MARROWS						
1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01	

	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	5.223E-10	1.448E-07	7.521E-07	3.482E-06	4.277E-06	4.652E-06
	3.653E-06	3.852E-06	2.497E-06	2.510E-06	2.167E-06	2.450E-06
BONE						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	4.984E-13	1.314E-07	1.141E-06	4.201E-06	4.182E-06	4.217E-06
	4.628E-06	3.496E-06	3.640E-06	2.930E-06	3.132E-06	2.274E-06
SKIN						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	5.114E-13	2.987E-08	2.004E-07	4.344E-06	3.389E-06	3.761E-06
	3.226E-06	3.124E-06	3.144E-06	2.619E-06	2.229E-06	2.038E-06
SPLEEN						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	1.145E-08	5.772E-07	2.492E-05	5.305E-05	5.766E-05	3.503E-05
	3.732E-05	2.669E-05	2.798E-05	2.147E-05	2.344E-05	1.587E-05
TETES						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	0.0	1.378E-28	1.103E-16	1.692E-10	4.321E-08	2.877E-07
	4.581E-07	5.584E-07	6.089E-07	6.281E-07	6.293E-07	5.997E-07
THYMUS						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	1.468E-58	2.028E-22	1.331E-13	5.852E-09	3.396E-07	1.190E-06
	1.515E-06	1.528E-06	1.493E-06	1.452E-06	1.404E-06	1.246E-06
THYROID						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	0.0	1.721E-31	4.359E-18	3.606E-11	1.700E-08	1.507E-07
	2.687E-07	3.605E-07	4.163E-07	4.426E-07	4.422E-07	4.475E-07
UTERUS						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	1.655E-39	4.280E-16	1.986E-10	1.861E-07	2.545E-06	4.776E-06
	4.955E-06	4.347E-06	3.934E-06	3.663E-06	3.453E-06	2.898E-06
MUSCLE						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	1.132E-08	5.913E-08	4.295E-06	5.064E-06	5.021E-06	6.041E-06
	6.268E-06	4.907E-06	5.021E-06	4.060E-06	4.303E-06	3.115E-06
ADRENALS						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	4.471E-09	8.173E-06	1.595E-05	7.085E-05	6.144E-05	4.785E-05
	3.978E-05	3.679E-05	3.016E-05	2.961E-05	2.523E-05	2.181E-05
BRAIN						
	1.000E-02	1.500E-02	2.000E-02	3.000E-02	5.000E-02	1.000E-01
	2.000E-01	5.000E-01	1.000E+00	1.500E+00	2.000E+00	4.000E+00
	0.0	1.779E-38	5.010E-22	3.484E-13	9.494E-10	1.949E-08
	5.008E-08	9.249E-08	1.311E-07	1.542E-07	1.684E-07	1.880E-07

Sample case 2

Computer resources required to execute
the sample case:

Region size ; 450 K bytes

Execution time ; 1.28 CPU seconds

PAGE 0001

```
*****
*
* INPUT DATA LIST *
*
*****
```

```
.....1.....*.....2.....*.....3.....*.....4.....*.....5.....*.....6.....*.....7.....*.....8
1      2
2 TEST CASE-2 FOR VADMAP/BUILD SOURCE ORGAN: KIDNEYS TARGET ORGAN: LIVER
3      5 2371982 6000 100 1.0E-02
4      0.01 0.04 0.5 0.7 1.0
.....1.....*.....2.....*.....3.....*.....4.....*.....5.....*.....6.....*.....7.....*.....8
*** INPUT DATA END ***
```

TEST CASE-2 FOR VADMAP/BUILD SOURCE ORGAN: KIDNEYS TARGET ORGAN: LIVER

ENERGY(MEV)	MASS(GRAM)	ABS.FRC.	SAF
1.000E-02	1.815E+03	1.667E-09	9.186E-13
4.000E-02	1.815E+03	3.493E-02	1.925E-05
5.000E-01	1.815E+03	2.899E-02	1.597E-05
7.000E-01	1.815E+03	2.526E-02	1.392E-05
1.000E+00	1.815E+03	2.548E-02	1.404E-05

3. Sample case for VADMAP/OGNPRT

Computer resources required for the sample case:

Region size ; 440 K bytes

Execution time ; 1.07 CPU seconds

NO. of I/O ; 15 times

PAGE-0001

*
* INPUT DATA LIST *
*

	.....1.....*.....2.....*.....3.....*.....4.....*.....5.....*.....6.....*.....7.....*.....8	
1	1 0.	00345604 1
2	2 30.	
3	0	00345704 3
	.....*.....1.....*.....2.....*.....3.....*.....4.....*.....5.....*.....6.....*.....7.....*.....8	

*** INPUT DATA END ***

NOTATION OF ORGAN REGION

1	A	3	ADRENAL
2	G	4	GALL BLADDER
3	G	5	G.B.CONTENTS
4	N	6	BRAIN
5	M	7	STOMACH
6	C	8	UPP.LG.INT.
7	C	9	LOW.LG.INT
8	*	10	G.I.CONTENTS
9	F	11	SM.INT.+CONT.
10	H	12	HEART
11	K	15	KIDNEY
12	V	16	LIVER
13	L	19	LUNG
14	O	63	OVERY
15	P	64	PANCREAS
16	E	75	SKELETON
17	S	79	SKIN
18	X	80	SPLEEN
19	T	83	TESTIS
20	Y	84	THYMUS
21	I	85	THYROID
22	.	89	TISSUE
23	U	90	UTERUS
24	B	104	BREAST
25	R	144	URINARY BLADDER
26	R	145	U.B.CONTENTS

Appendix 3 Input parameters of describing an adult human phantom used to calculate the SAF values

CARD NO.	.....1.....	.....2.....	.....3.....	.....4.....	.....5.....	.....6.....	.....7.....	.....8
1	1.487	0.99	0.3					DENSITY OF MEDIUM
2	1120.	2380.						WEIGHTS OF MARROW
3	5.57	2.85	0.79	19.22	2.66			FRACTION OF MARROW
4	17.41	9.79	33.31	3.35	0.0			-
5	0.0	2.29	0.0	0.0	2.75			-
6	4.26	2.17	0.75	3.86	0.53			-
7	3.50	1.97	16.07	4.70	12.35			-
8	32.5	3.21	4.29	8.02	2.09			-
9	20.	10.	70.					OUTER DIM. TRUNK
10	8.	16.85	7.15					HEAD
11	100.	80.						LEG
12	1.4	2.7	69.	18.4				SKELTAL
13	11.3	12.	11.3	12.	-3.8			ARM BDN
14	-3.	14.	22.	5.				PELVIS
15	2.	2.5	22.	35.1	70.			PELVIS2
16	80.54	5.5						SPINE
17	6.6	8.6	5.75	0.9				SPINE2
18	7.	9.	4.	1.4				CRANIUM
19	17.	9.8	1.4	0.5	35.1			FACIAL
20	67.3							RIB CGE
21	11.1	68.25	20.	0.7883	7.0342			RIB CG2
22	0.89475							CLAVIC.
23	19.	50.9	67.3	0.25	0.80			CLAVIC2
24	4.	3.	8.	0.613	8.0			SCAPULA
25	-4.	35.						GI-TRACT
26	11.3	11.3	-3.8	-4.86	2.2			STOMACH
27	17.	27.						STOMAC2
28	2.5	2.5	0.7085	-8.5	-2.36			SI
29	14.45	24.	2.5	1.5	0.527			SI2
30	-2.36	25.5	10.5					ULI
31	1.88	2.13	0.54	8.72	24.			ULI2
32	9.25	0.78	2.5	1.57	1.57			ULI3
33	0.66	3.0	8.72	5.72	3.			LLI
34	1.5	0.5	5.	0.9076	3.5			LLI2
35	5.	38.						LLI3
36	4.83	4.26	4.06	10.	52.			OTHER
37	0.9615	0.	-0.2748	-0.0574	0.9779			ADRENAL
38	-0.2008	0.2687	0.2090	0.9403	-4.5			ADRENA2
39	-3.2	30.	2.	2.12	0.2275			BREAST
40	8.							BLD CNT
41	4.5	1.5	5.5	6.	6.			BLDCNT2
42	32.5	3.						BLDCNT3
43	16.5	8.	35.	45.	43.			BLDCNT4
44	27.	43.	0.					KIDNEY
45	5.	7.5	24.	8.5	43.5			KIDNEY2
46	46.	54.	1.5	-5.4	1.			LIVER
47	55.	8.						LIVER2
48	1.	0.5	2.	6.	15.			LUNG
49	16.	1.2	3.3	-1.	37.			LUNG2
50	3.							LUNG3
51	0.2							OVARIES
52	3.5	2.	6.	11.	3.			PANCREA
53	37.							PANCRE2
54	1.3	1.5	2.3	-8.				SKIN
55	1.5	0.8	4.	-7.3	57.			SPLEEN
56	-4.	2.2	5.	1.				SPLEEN2
57	2.5	5.	1.5	-2.	14.			TESTES
58	-4.5							THYMUS
59	0.6715	-0.4727	-0.5664	-0.464	0.3249			THYROID
60	-0.8241	0.5736	0.8191	0.	1.			UTERUS
61	-1.8	50.	8.6	5.	3.1			UTERUS2
62	7.	1.3	5.4	0.3	0.6			HEART
63	4.958	3.458	3.458	0.252	-4.50			HEART2
64	8.00							HEART3
								HEART4
								URINBRD
								URINBR2

Appendix 4 Job control instruction and a list of a computer program to prepare the SAF data file

1. Job control instruction used for preparing the SAF data file used in the present calculation

```
//      EXEC FORTCLG
//FORT.SYSIN DD *

      Source program shown in this appendix is placed here
/*
//GO.FT20F001 DD DSN=JXXXX.....,DISP=SHR,LABEL=(,,IN)
//          DD DSN=JXXXX..
//          DD .....      --- The data files outputted from
//          DD .....      the VADMAP/Monte-Carlo
//          DD .....
//GO.FT35F001 DD DSN=JXXX.....,DISP=SHR,LABEL=(,,IN)
//          DD DSN=JXXXX..
//          DD .....      --- The data files outputted from
//          DD .....      the VADMAP/BUILD
//          DD .....
//GO.FT40F001 DD DSN=JXXXX.VADMAP.SAFDT,DISP=(NEW,CATLG,DELETE),
//          SPACE=(TRK,(5,5),RLSE),UNIT=DDDD,VOL=SER=VVVV,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//*          --- Organized file
//GO.SYSIN   DD *
Bladder cont.
Stomach cont.
SI + content.          ; Souce organ names to be outputted
ULI contents          in SAF data table
LLI contents
Kidneys
Liver
Lungs
Lungs
Lungs
Muscle
Ovaries
Pancreas
Bone
Red marrow
Yel.marrow
Skin
Spleen
Testes
Thyroid
Total body
Adrenals
St. wall
Brain
/*
```

Cataloged procedure FORTCLG used in this job control instruction is the same as defined in appendix 1.

2. The data file to be processed in the job control instruction

a. The data file from VADMAP/Monte-Carlo

The data file created from the VADMAP/Monte-Carlo consists of three items of data such as photon energy, specific absorbed fraction, and coefficients of variance. The data format is as follows;

Record no.	Variable and FORMAT	Comment
1	ENER FORMAT(E10.4)	Photon energy
2 - 18	(SAF(I),CV(I),I=1,34) FORMAT(2E10.4)	SAF and coefficient of variance

The index, I, corresponds to target organs as follows:

I = 1	Urinary bladder wall	I = 2	Stomach wall
3	SI + contents	4	U.L.I. wall
5	L.L.I. wall	6	Kidneys
7	Liver	8	Lungs
9	blank	10	blank
11	blank	12	Lungs
13	Breasts	14	Ovaries
15	Pancreas	16	blank
17	blank	18	blank
19	Red marrows	20	Yellow marrows
21	blank	22	blank
23	blank	24	Bone
25	Skin	26	Spleen
27	Testes	28	Thymus
29	Thyroid	30	Uterus
31	Total body	32	Gal. bladder
33	Bone	34	Brain

A single run of the VADMAP/Monte-Carlo outputs one block of data shown above. The data blocks calculated at twelve different photon energies, i.e. 0.01, ..., 4.0 MeV, are arranged to make the sub-SAF file for each of source organs. The sub-SAF files are concatenated in the sequence of source organs shown in the SYSIN data of the job control instruction, so as to form input data to logical unit 20.

b. The data file from the VADMAP/BUILD

The data file is outputted in the calculation mode of IMOD=1. The data items are target organ name, photon energy, and specific absorbed fraction. The data format is as follows:

Record No.	Variable and FORMAT	Comments
1	TRGORG FORMAT(A12)	Target organ names
2 - 3	(ENER(I), I=1, 12) FORMAT(6(3X,1PE9.3))	Photon energies
4 - 6	(SAF(I), I=1, 12)	Specific absorbed fraction

From a single running the code, the data file consisting of 23 data blocks is created, each data block of which corresponds to those of target organs given in section 3.2.2. of main text. The data file are concatenated to form the input data to the logical unit 35. The sequence of the data to be concatenated follows the order of source organs shown in the SYSIN data of the job control instruction.

2. List of FORTRAN source program used to prepare the SAF data file in this work

```

CARD NO.  .....1.....2.....3.....4.....5.....6.....7.....8
1         C
2         C
3         C
4         DIMENSION  SAFAR( 12, 34, 3 ), E( 12 ), G( 12 )
5         DIMENSION  IBLD(23)
6         CHARACTER*4 IND, INDO
7         CHARACTER*72 BLKCD
8         COMMON  /ARD / SAFAR, E
9         C
10        DATA IBLD/  1, 2, 3, 4, 5, 6, 7, 8,
11        1          13, 14, 15, 19, 20, 24, 25, 26,
12        2          27, 28, 29, 30, 31, 32, 34/
13        DATA BLKCD/' '/
14        C
15        C ---- INITIALIZE ARRAY OF SAFAR( I, J, K )
16        C           I : ENERGY      1---12
17        C           J : TARGET ORGAN 1---34
18        C           K :   =1  MONTE CARLO CALCULATION
19        C                   =2  RELATIVE STATISTICAL ERROR
20        C                   =3  BUILD-UP CALCULATION
21        C
22        DO 5000 IJK= 1, 27
23        C
24        DO 1000 J= 1, 12
25        DO 1000 K= 1, 34
26        DO 1000 L= 1, 3
27        SAFAR( J, K, L ) = 0.0
28        1000 CONTINUE
29        IF( IJK.EQ.8 .OR. IJK.EQ.24 ) THEN
30        DO 440 K= 1, 34
31        WRITE(40, 430) BLKCD
32        WRITE(40, 430) BLKCD
33        430  FORMAT( A72 )
34        440  CONTINUE
35        GO TO 5000
36        END IF
37        C
38        C ---- READ THE VALUES OBTAINED FROM MONTE CARLO CALCULATION
39        C           AND STORE THEM INTO ARRAY SAFAR(-----)
40        C
41        K = 0
42        10  K = K + 1
43        IF ( K .GE. 13 ) GO TO 400
44        READ ( 20, 200 ) E(K)
45        200  FORMAT( 8E10.0 )
46        DO 300 I= 1, 17
47        L = 2*I
48        READ( 20, 200 ) SAFAR( K, L-1, 1), SAFAR( K, L-1, 2),
49        1          SAFAR( K, L, 1), SAFAR( K, L, 2)
50        300 CONTINUE
.....1.....2.....3.....4.....5.....6.....7.....8

```



```

CARD NO. ....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
51 C
52 GO TO 10
53 400 CONTINUE
54 C
55 C -----READ THE VALUES CALCULATED FROM BUILD-UP WAY
56 C
57 DO 30 K= 1, 23
58 READ( 35, 420 ) DUM
59 READ( 35, 420 ) DUM
60 READ( 35, 420 ) DUM
61 420 FORMAT( A4 )
62 READ( 35, 410 ) (G(J), J=1, 12)
63 410 FORMAT( 6E12.0 )
64 DO 30 J = 1, 12
65 SAFAR( J, IBLD(K), 3 ) = G(J)
66 30 CONTINUE
67 DO 35 J= 1, 12
68 SAFAR( J, 12, 3) = SAFAR( J, 8, 3)
69 SAFAR( J, 33, 3) = SAFAR( J, 24, 3)
70 35 CONTINUE
71 IF(IJK .EQ. 13 ) THEN
72 DO 45 K= 1, 3
73 DO 45 J=1,12
74 SAFAR( J, 27, K ) = 0.0
75 45 CONTINUE
76 ELSE IF(IJK .EQ. 21) THEN
77 DO 55 K= 1, 3
78 DO 55 J= 1, 12
79 SAFAR( J, 13, K) = 0.0
80 SAFAR( J, 14, K) = 0.0
81 SAFAR( J, 30, K) = 0.0
82 55 CONTINUE
83 END IF
84 C
85 C ----- MERGE THE VALUES OF MONTECARLO AND BUILD-UP
86 C
87 CALL MERGE
88 C
89 5000 CONTINUE
90 STOP
91 END
92 C
93 C
94 C
95 SUBROUTINE MERGE
96 C
97 COMMON /ARD/ SAFAR( 12, 34, 3 ), E(12)
98 DIMENSION IZERO(9), SAFOUT( 12, 34)
99 DIMENSION G(12)
100 CHARACTER*15 TORGNM(34)
.....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

```

CARD NO.

```

.....+.....1.....+.....2.....+.....3.....+.....4.....+.....5.....+.....6.....+.....7.....+.....8
101 CHARACTER*1 INDXB( 12, 34 ), BLNK, LTRB
102 CHARACTER*10 SORGNM
103 DATA IZERO/ 9, 10, 11, 16, 17, 18, 21, 22, 23 /
104 C-----
105 C IF THE CV VALUE OF THE SAF FROM VADMAP/MONTE-CARLO IS IN EXCESS
106 C OF A VALUE OF CRIT, SAF VALUES FROM VADMAP/BUILD IS TAKEN.
107 C-----
108 DATA CRIT / 0.3 /, BLNK/' ', LTRB/'b'/
109 DATA (TORGNM(I), I= 1, 34)/
110 . ' Bladder ' ' Stomach '
111 . ' Sm. Int. ' ' U.L.I. '
112 . ' L.L.I. ' ' Kidneys '
113 . ' Liver ' ' Lungs '
114 . ' ' ' ' ' Breasts ' ' Ovaries '
115 . ' Pancreas '
116 . ' ' ' ' ' Red Marrow ' ' Yellow Marrow '
117 . ' ' ' ' ' Skelton '
118 . ' Skin ' ' Spleen '
119 . ' Testes ' ' Thymus '
120 . ' Thyroid ' ' Uterus '
121 . ' Total body ' ' Adrenals '
122 . ' ' ' ' ' Brain '
123 C
124 C
125 DO 100 K = 1, 34
126 DO 150 I = 1, 9
127 IF( K .NE. IZERO(I) ) GO TO 150
128 WRITE( 40, 400 ) (SAFAR(J, K, 1 ), J=1, 12)
129 400 FORMAT( 7( 1X, 1PE9.3 ) )
130 GO TO 100
131 150 CONTINUE
132 DO 170 J= 1, 12
133 IF ( SAFAR(J,K,2).LT.CRIT.AND.SAFAR(J,K,1).NE.0.) THEN
134 G(J) = SAFAR(J,K,1)
135 SAFOUT( J, K ) = SAFAR( J, K, 1)
136 INDXB ( J, K ) = BLNK
137 ELSE
138 G(J) = SAFAR(J,K,4)
139 SAFOUT( J, K ) = SAFAR( J, K, 3)
140 INDXB ( J, K ) = LTRB
141 ENDF
142 170 CONTINUE
143 WRITE( 40, 400 ) (G(J),J=1,12)
144 100 CONTINUE
145 ISTR = 0
146 READ ( 5, 500 ) SORGNM
147 500 FORMAT( A10 )
148 1000 CONTINUE
149 WRITE( 6, 6001 ) SORGNM
150 6001 FORMAT(1H1,////,46X, 'Specific absorbed fraction for photon',/,
151 1 46X, ' from source of ', A10,/,
152 2 46X, '-----',/,
153 3 4X, 120(' '),/,
154 4 56X, 'Initial photon energy (MeV)', /,
155 5 18X, 106(' '))
156 IF ( ISTR .EQ. 0 ) THEN
157 ISTR = 1
158 ELSE
159 ISTR = 7
160 END IF
161 WRITE( 6, 6002 ) (E(I), I=ISTR, ISTR+5)
162 6002 FORMAT(' Organ', 5X, 6( 7X, F5.3, 6X ) /
163 1 ,4X, 120(' '))
164 DO 1100 K = 1, 34
165 IF( TORGNM( K ) .EQ. ' ' ) GO TO 1100
166 WRITE( 6, 6003 ) TORGNM(K),
167 1 ( SAFOUT( J, K ), INDXB( J, K ), J=ISTR, ISTR+5)
168 6003 FORMAT( 2X, A15, 6(3X, 1PE10.3, 1X, A1, 3X) )
169 1100 CONTINUE
170 WRITE( 6, 6004 )
171 6004 FORMAT( 4X, 120(' ')),/,
172 1 10X, 'The values accompanied by letter b are estimated by bu
173 2ild-up factor method' )
174 IF ( ISTR .EQ. 7 ) RETURN
175 GO TO 1000
176 END
.....+.....1.....+.....2.....+.....3.....+.....4.....+.....5.....+.....6.....+.....7.....+.....8

```

Appendix 5 The specific absorbed fraction for an adult human phantom

Specific absorbed fraction for photon
from source of Blad.cont.

Organ	Initial photon energy (MeV)					
	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	8.305E-04	1.385E-03	1.412E-03	9.633E-04	4.362E-04	2.483E-04
Stomach	1.119E-47 b	2.322E-19 b	2.517E-12 b	1.579E-08 b	4.425E-07	9.839E-07
Sm. Int.	1.053E-22 b	5.348E-11 b	1.792E-07	5.034E-06	1.279E-05	1.188E-05
U.L.I.	3.371E-20 b	1.564E-10 b	5.343E-08 b	3.212E-06	7.810E-06	8.929E-06
L.L.I.	4.587E-12 b	1.878E-07 b	7.518E-06 b	3.681E-05	4.468E-05	3.278E-05
Kidneys	2.860E-52 b	1.235E-20 b	7.575E-13 b	1.174E-08 b	4.692E-07	9.899E-07
Liver	8.247E-52 b	9.314E-21 b	3.590E-13 b	5.336E-09 b	2.772E-07	5.911E-07
Lungs	0.0	4.452E-31 b	3.232E-18 b	2.322E-11 b	1.039E-08 b	6.219E-08
Breasts	0.0	1.470E-34 b	9.913E-20 b	6.575E-12 b	6.585E-09 b	7.805E-08 b
Ovaries	2.486E-18 b	3.716E-09 b	9.794E-07 b	2.786E-05	4.215E-05	3.523E-05
Pancreas	3.533E-60 b	3.225E-23 b	3.875E-14 b	3.038E-09 b	4.813E-07	6.492E-07
Red Marrow	2.062E-23 b	1.081E-11 b	7.143E-08	3.691E-06	1.161E-05	9.665E-06
Yellow Marrow	7.844E-25 b	1.364E-12 b	3.532E-08	1.857E-06	6.076E-06	5.233E-06
Skeleton	2.032E-25 b	2.587E-12 b	2.127E-08	1.179E-06	4.259E-06	4.061E-06
Skin	5.842E-13 b	3.197E-08 b	4.229E-07	1.633E-06	2.109E-06	1.784E-06
Spleen	8.835E-61 b	1.263E-23 b	2.122E-14 b	2.047E-09 b	1.734E-07 b	3.561E-07
Testes	1.066E-19 b	9.407E-10 b	4.434E-07 b	1.403E-05	2.575E-05	1.936E-05
Thymus	0.0	2.856E-38 b	2.477E-21 b	1.431E-12 b	2.769E-09 b	4.411E-08 b
Thyroid	0.0	1.168E-48 b	1.454E-26 b	4.205E-15 b	8.649E-11 b	3.937E-09 b
Uterus	2.456E-10 b	3.701E-06	4.165E-05	1.188E-04	1.008E-04	6.347E-05
Total body	1.406E-05	1.405E-05	1.393E-05	1.286E-05	9.821E-06	7.133E-06
Adrenals	2.661E-71 b	1.456E-26 b	1.330E-15 b	7.275E-10 b	1.026E-07 b	5.314E-07 b
Brain	0.0	5.296E-57 b	5.894E-31 b	2.619E-17 b	3.956E-12 b	4.177E-10 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Blad.cont.

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	2.441E-04	2.550E-04	2.289E-04	2.089E-04	2.086E-04	1.468E-04
Stomach	1.131E-06	1.487E-06	1.212E-06	1.066E-06	1.291E-06	1.211E-06
Sm. Int.	1.011E-05	9.570E-06	8.662E-06	8.510E-06	8.115E-06	5.827E-06
U.L.I.	8.089E-06	7.409E-06	7.172E-06	6.656E-06	6.274E-06	5.467E-06
L.L.I.	2.804E-05	2.798E-05	2.194E-05	2.103E-05	1.923E-05	1.692E-05
Kidneys	9.473E-07	1.270E-06	1.730E-06	1.559E-06	1.483E-06	1.913E-06
Liver	6.839E-07	8.675E-07	9.149E-07	9.996E-07	1.107E-06	9.167E-07
Lungs	8.045E-08	2.026E-07	2.695E-07	3.012E-07	4.081E-07	4.296E-07
Breasts	1.573E-07 b	2.340E-07 b	2.880E-07 b	3.078E-07	3.755E-07	5.385E-07
Ovaries	2.437E-05	2.006E-05	2.001E-05	1.851E-05	2.178E-05	1.410E-05 b
Pancreas	6.393E-07	8.113E-07	1.232E-06	1.241E-06 b	9.949E-07	1.083E-06 b
Red Marrow	5.647E-06	4.328E-06	3.760E-06	3.323E-06	3.301E-06	2.600E-06
Yellow Marrow	3.150E-06	2.454E-06	2.185E-06	1.976E-06	1.970E-06	1.572E-06
Skelton	2.592E-06	2.035E-06	1.859E-06	1.715E-06	1.734E-06	1.399E-06
Skin	1.872E-06	2.170E-06	2.075E-06	2.083E-06	2.048E-06	1.620E-06
Spleen	6.008E-07	5.358E-07	9.009E-07	8.664E-07	7.331E-07	7.379E-07
Testes	1.934E-05	1.636E-05	1.716E-05	1.378E-05	1.464E-05	1.365E-05
Thymus	9.936E-08 b	1.625E-07 b	2.118E-07 b	2.390E-07 b	2.535E-07 b	2.687E-07 b
Thyroid	1.406E-08 b	3.488E-08 b	5.897E-08 b	7.591E-08 b	8.747E-08 b	1.083E-07 b
Uterus	5.515E-05	5.126E-05	4.794E-05	4.586E-05	4.177E-05	3.301E-05
Total body	6.490E-06	6.328E-06	5.894E-06	5.570E-06	5.239E-06	4.338E-06
Adrenals	7.672E-07 b	8.606E-07 b	8.920E-07 b	8.966E-07 b	8.834E-07 b	8.155E-07 b
Brain	2.299E-09 b	8.591E-09 b	1.885E-08 b	2.771E-08 b	3.471E-08 b	5.024E-08 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Stom.cont.

Organ	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	4.216E-48 b	1.502E-19 b	1.697E-12 b	1.318E-08 b	4.831E-07 b	1.148E-06
Stomach	3.240E-04	7.474E-04	8.958E-04	6.867E-04	3.220E-04	1.909E-04
Sm. Int.	3.175E-13 b	1.830E-07 b	1.312E-06	6.410E-06	1.198E-05	1.043E-05
U.L.I.	1.860E-10 b	5.640E-07 b	5.243E-06	1.389E-05	1.601E-05	1.289E-05
L.L.I.	9.117E-18 b	1.319E-09 b	7.808E-08 b	2.772E-06	5.333E-06	5.305E-06
Kidneys	9.376E-22 b	1.807E-10 b	5.000E-07	7.642E-06	1.570E-05	1.328E-05
Liver	1.214E-15 b	4.542E-09 b	4.070E-07	3.986E-06	8.199E-06	7.728E-06
Lungs	4.982E-14 b	1.201E-08 b	1.322E-06	5.348E-06	7.157E-06	5.865E-06
Breasts	1.012E-25 b	1.014E-12 b	3.806E-09 b	1.120E-06	2.965E-06	2.931E-06
Ovaries	3.607E-34 b	4.261E-15 b	3.201E-10 b	1.713E-07 b	1.974E-06 b	3.694E-06
Pancreas	9.768E-09 b	1.285E-05	5.598E-05	1.185E-04	9.942E-05	6.310E-05
Red Marrow	6.872E-13 b	1.145E-07	1.185E-06	5.802E-06	1.097E-05	8.202E-06
Yellow Marrow	7.738E-17 b	2.292E-08	2.421E-07	1.552E-06	3.766E-06	3.029E-06
Skeleton	2.449E-13 b	5.776E-08	5.940E-07	2.946E-06	5.487E-06	3.930E-06
Skin	3.040E-15 b	1.418E-08 b	4.274E-07	1.561E-06	1.916E-06	1.712E-06
Spleen	6.099E-14 b	8.366E-08 b	8.603E-06	5.116E-05	6.069E-05	4.068E-05
Testes	3.151E-73 b	7.006E-28 b	1.663E-16 b	1.830E-10 b	3.984E-08 b	2.668E-07 b
Thymus	2.866E-43 b	1.410E-17 b	3.093E-11 b	7.230E-08 b	1.451E-06	2.164E-06
Thyroid	1.438E-72 b	1.939E-27 b	2.372E-16 b	2.062E-10 b	4.419E-08 b	2.840E-07 b
Uterus	1.128E-39 b	1.311E-16 b	7.813E-11 b	1.100E-07 b	2.043E-06	2.792E-06
Total body	1.406E-05	1.405E-05	1.395E-05	1.281E-05	9.561E-06	6.712E-06
Adrenals	5.100E-31 b	1.982E-13 b	6.226E-09 b	8.444E-06	1.524E-05	1.239E-05
Brain	0.0	5.324E-36 b	8.568E-21 b	1.243E-12 b	1.892E-09 b	3.125E-08 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Stom.cont.

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.404E-06	1.450E-06	1.659E-06 b	1.605E-06 b	1.543E-06 b	1.359E-06 b
Stomach	1.806E-04	1.811E-04	1.611E-04	1.518E-04	1.491E-04	1.151E-04
Sm. Int.	8.752E-06	8.654E-06	8.248E-06	7.475E-06	6.850E-06	5.890E-06
U.L.I.	1.128E-05	1.107E-05	1.096E-05	8.546E-06	9.130E-06	7.011E-06
L.L.I.	5.737E-06	5.181E-06	4.004E-06	4.643E-06	4.208E-06	3.195E-06
Kidneys	1.150E-05	1.125E-05	9.990E-06	9.002E-06	8.082E-06	7.586E-06
Liver	7.200E-06	6.912E-06	6.396E-06	6.132E-06	5.816E-06	4.842E-06
Lungs	5.651E-06	4.646E-06	4.811E-06	4.472E-06	4.356E-06	3.957E-06
Breasts	3.188E-06	3.003E-06	3.858E-06	2.974E-06	3.204E-06	2.508E-06
Ovaries	6.253E-06	3.601E-06 b	3.274E-06 b	3.080E-06 b	2.900E-06 b	2.459E-06 b
Pancreas	5.743E-05	5.330E-05	4.771E-05	4.578E-05	4.543E-05	3.197E-05
Red Marrow	5.196E-06	3.966E-06	3.641E-06	3.636E-06	3.228E-06	2.868E-06
Yellow Marrow	1.980E-06	1.594E-06	1.471E-06	1.455E-06	1.328E-06	1.204E-06
Skeleton	2.507E-06	2.012E-06	1.885E-06	1.836E-06	1.683E-06	1.506E-06
Skin	1.842E-06	1.998E-06	1.982E-06	2.130E-06	2.054E-06	1.685E-06
Spleen	3.507E-05	3.146E-05	2.960E-05	2.731E-05	2.383E-05	1.892E-05
Testes	4.270E-07 b	5.249E-07 b	5.766E-07 b	5.957E-07 b	5.991E-07 b	5.731E-07 b
Thymus	3.688E-06	3.080E-06 b	2.844E-06 b	2.687E-06 b	2.543E-06 b	2.173E-06 b
Thyroid	4.476E-07 b	5.440E-07 b	5.935E-07 b	6.127E-07 b	6.142E-07 b	5.925E-07 b
Uterus	2.909E-06	2.723E-06	3.525E-06	1.814E-06	2.084E-06	3.599E-06
Total body	6.131E-06	6.005E-06	5.663E-06	5.291E-06	5.007E-06	4.171E-06
Adrenals	1.130E-05	1.100E-05	1.269E-05	7.311E-06	9.244E-06	1.027E-05
Brain	3.583E-08	9.404E-08	1.041E-07	1.520E-07	1.606E-07	2.082E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of SI+cont

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	7.645E-20 b	3.100E-10 b	1.125E-07 b	6.615E-06	1.277E-05
Stomach	1.932E-10 b	1.802E-06	2.651E-06	8.369E-06	1.303E-05
Sm. Int.	8.869E-04	7.829E-04	6.526E-04	4.108E-04	2.015E-04
U.L.I.	8.064E-05	1.592E-04	2.023E-04	1.817E-04	1.108E-04
L.L.I.	4.739E-05	6.543E-05	7.463E-05	6.970E-05	4.917E-05
Kidneys	1.854E-15 b	2.812E-09 b	5.934E-07	7.170E-06	1.282E-05
Liver	1.213E-07	3.928E-07	8.752E-07	3.173E-06	6.138E-06
Lungs	5.289E-46 b	4.891E-19 b	1.545E-12 b	7.379E-09 b	4.232E-07
Breasts	2.069E-58 b	1.153E-23 b	1.322E-14 b	1.126E-09 b	1.669E-07
Ovaries	1.901E-07 b	2.706E-05	6.144E-05	7.956E-05	7.997E-05
Pancreas	4.144E-22 b	2.896E-11 b	2.720E-08 b	1.773E-06	6.895E-06
Red Marrow	8.686E-07	2.636E-06	6.408E-06	2.021E-05	2.969E-05
Yellow Marrow	4.179E-07	1.222E-06	2.798E-06	8.608E-06	1.276E-05
Skeleton	2.209E-07	6.770E-07	1.674E-06	5.460E-06	8.494E-06
Skin	6.232E-19 b	2.786E-10 b	9.683E-08	8.153E-07	1.438E-06
Spleen	4.996E-20 b	1.257E-10 b	2.913E-08 b	1.574E-06	4.568E-06
Testes	5.553E-48 b	3.449E-19 b	4.290E-12 b	2.926E-08 b	8.281E-07 b
Thymus	1.086E-73 b	1.446E-27 b	3.057E-16 b	2.844E-10 b	5.678E-08 b
Thyroid	0.0	1.188E-37 b	2.228E-21 b	9.789E-13 b	1.967E-09 b
Uterus	2.543E-10 b	2.894E-06	2.616E-05	6.657E-05	6.560E-05
Total body	1.406E-05	1.405E-05	1.403E-05	1.339E-05	1.068E-05
Adrenals	5.512E-33 b	1.418E-14 b	6.426E-10 b	2.823E-07 b	2.282E-06
Brain	0.0	2.182E-45 b	1.868E-25 b	6.926E-15 b	9.235E-11 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of SI+cont

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.194E-05	9.723E-06	6.966E-06	7.027E-06	9.208E-06	7.217E-06
Stomach	9.764E-06	1.030E-05	8.176E-06	8.134E-06	8.167E-06	5.646E-06
Sm. Int.	1.174E-04	1.173E-04	1.058E-04	9.835E-05	9.166E-05	7.359E-05
U.L.I.	6.342E-05	6.309E-05	5.339E-05	5.178E-05	4.872E-05	3.926E-05
L.L.I.	3.011E-05	2.863E-05	2.564E-05	2.364E-05	2.306E-05	1.690E-05
Kidneys	1.013E-05	9.890E-06	8.968E-06	8.041E-06	8.307E-06	6.345E-06
Liver	5.757E-06	5.636E-06	5.283E-06	5.100E-06	5.011E-06	4.237E-06
Lungs	7.992E-07	9.209E-07	1.124E-06	1.098E-06	1.166E-06	9.756E-07
Breasts	3.171E-07	5.883E-07	4.837E-07	6.467E-07	9.391E-07	7.231E-07
Ovaries	4.821E-05	3.692E-05	4.201E-05	3.196E-05	3.388E-05	1.762E-05
Pancreas	6.614E-06	6.060E-06	6.399E-06	5.218E-06	6.209E-06	4.452E-06
Red Marrow	1.114E-05	8.483E-06	7.304E-06	7.314E-06	6.441E-06	5.109E-06
Yellow Marrow	4.875E-06	3.727E-06	3.259E-06	3.254E-06	2.905E-06	2.388E-06
Skeleton	3.529E-06	2.796E-06	2.465E-06	2.478E-06	2.204E-06	1.865E-06
Skin	1.547E-06	1.819E-06	1.735E-06	1.785E-06	1.857E-06	1.588E-06
Spleen	4.525E-06	4.590E-06	5.028E-06	4.017E-06	4.715E-06	2.989E-06
Testes	1.482E-06	2.477E-06	2.529E-06	2.113E-06	2.012E-06	1.745E-06
Thymus	5.290E-07	6.294E-07	6.762E-07	6.923E-07	6.903E-07	6.518E-07
Thyroid	7.847E-08	1.335E-07	1.787E-07	2.047E-07	2.191E-07	2.364E-07
Uterus	3.796E-05	3.825E-05	2.872E-05	2.975E-05	2.773E-05	2.048E-05
Total body	6.901E-06	6.682E-06	6.131E-06	5.839E-06	5.490E-06	4.543E-06
Adrenals	3.420E-06	3.847E-06	4.150E-06	3.870E-06	3.631E-06	3.048E-06
Brain	1.311E-08	3.246E-08	5.514E-08	7.125E-08	8.235E-08	1.034E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of ULI cont.

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	2.053E-21 b	1.039E-10 b	5.377E-08 b	3.234E-06	8.610E-06
Stomach	7.651E-10 b	2.031E-06	1.406E-05	2.124E-05	2.036E-05
Sm. Int.	3.192E-06	4.726E-05	1.135E-04	1.496E-04	1.020E-04
U.L.I.	3.507E-04	7.661E-04	8.365E-04	5.481E-04	2.540E-04
L.L.I.	2.607E-08 b	4.561E-06 b	1.549E-05	2.156E-05	1.726E-05
Kidneys	2.093E-21 b	1.548E-10 b	1.340E-07 b	5.608E-06	1.186E-05
Liver	8.739E-10 b	2.097E-07	1.771E-06	7.630E-06	1.211E-05
Lungs	9.440E-47 b	4.615E-19 b	2.912E-12 b	5.076E-08	5.028E-07
Breasts	2.930E-59 b	4.235E-23 b	4.529E-14 b	2.172E-09 b	3.096E-07
Ovaries	5.581E-08 b	1.276E-05 b	6.401E-05	8.281E-05	5.583E-05
Pancreas	1.159E-24 b	1.731E-11 b	3.533E-08 b	3.058E-06	1.026E-05
Red Marrow	1.529E-11 b	8.618E-07	5.257E-06	1.810E-05	2.465E-05
Yellow Marrow	4.151E-11 b	4.146E-07	2.493E-06	8.350E-06	1.115E-05
Skelton	1.223E-12 b	2.192E-07	1.350E-06	4.876E-06	7.297E-06
Skin	1.005E-18 b	2.903E-10 b	1.103E-07	8.315E-07	1.553E-06
Spleen	4.202E-22 b	3.618E-11 b	2.641E-08 b	2.195E-06	5.153E-06
Testes	1.874E-45 b	1.135E-18 b	6.385E-12 b	2.801E-08 b	6.293E-07 b
Thymus	1.371E-74 b	3.756E-27 b	8.722E-16 b	5.600E-10 b	8.414E-08 b
Thyroid	0.0	1.935E-37 b	5.681E-21 b	1.836E-12 b	2.958E-09 b
Uterus	6.711E-18 b	2.008E-09 b	5.323E-07 b	1.564E-05	2.779E-05
Total body	1.406E-05	1.406E-05	1.402E-05	1.326E-05	1.037E-05
Adrenals	1.074E-36 b	3.386E-15 b	7.405E-10 b	3.832E-07 b	3.018E-06
Brain	0.0	1.225E-45 b	2.396E-25 b	1.037E-14 b	1.237E-10 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of ULI cont.

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	8.405E-06	7.238E-06	8.070E-06	9.178E-06	5.921E-06
Stomach	1.243E-05	1.231E-05	1.313E-05	1.129E-05	9.938E-06
Sm. Int.	5.741E-05	5.385E-05	4.931E-05	4.592E-05	4.146E-05
U.L.I.	1.449E-04	1.477E-04	1.354E-04	1.220E-04	1.125E-04
L.L.I.	1.207E-05	1.141E-05	1.142E-05	9.141E-06	9.754E-06
Kidneys	9.495E-06	9.483E-06	8.351E-06	8.418E-06	8.238E-06
Liver	9.036E-06	8.595E-06	8.098E-06	7.882E-06	7.164E-06
Lungs	9.381E-07	1.122E-06	1.410E-06	1.318E-06	1.373E-06
Breasts	4.094E-07	7.210E-07	6.434E-07	8.163E-07	1.002E-06
Ovaries	4.330E-05	2.947E-05	3.173E-05	2.599E-05	2.312E-05
Pancreas	7.557E-06	6.885E-06	6.797E-06	5.675E-06	5.828E-06
Red Marrow	9.648E-06	6.870E-06	6.111E-06	5.685E-06	5.243E-06
Yellow Marrow	4.362E-06	3.218E-06	2.909E-06	2.719E-06	2.533E-06
Skeleton	3.160E-06	2.389E-06	2.171E-06	2.076E-06	1.952E-06
Skin	1.674E-06	1.845E-06	1.914E-06	1.750E-06	1.746E-06
Spleen	5.152E-06	5.102E-06	5.035E-06	4.020E-06	3.966E-06
Testes	1.106E-06	2.060E-06 b	1.926E-06 b	1.872E-06 b	1.770E-06 b
Thymus	6.605E-07 b	7.501E-07 b	7.904E-07 b	7.996E-07 b	7.912E-07 b
Thyroid	9.805E-08 b	1.591E-07 b	2.069E-07 b	2.334E-07 b	2.476E-07 b
Uterus	1.864E-05	2.001E-05	1.547E-05	1.395E-05	1.289E-05
Total body	6.672E-06	6.450E-06	6.031E-06	5.692E-06	5.315E-06
Adrenals	5.162E-06	5.463E-06	4.656E-06 b	4.319E-06 b	4.042E-06 b
Brain	1.570E-08 b	3.854E-08 b	6.335E-08 b	8.050E-08 b	9.210E-08 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of LLI cont.

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	2.766E-13 b	1.435E-07 b	6.597E-06	2.838E-05	3.541E-05
Stomach	3.184E-15 b	8.113E-09 b	9.173E-07	5.002E-06	7.223E-06
Sm. Int.	1.503E-06	2.503E-05	5.896E-05	7.515E-05	5.305E-05
U.L.I.	1.403E-06	5.681E-06	1.356E-05	1.851E-05	1.817E-05
L.L.I.	1.104E-03	1.553E-03	1.459E-03	8.457E-04	3.542E-04
Kidneys	3.070E-27 b	1.695E-12 b	5.084E-09 b	9.413E-07	3.211E-06
Liver	1.278E-42 b	3.904E-18 b	3.588E-12 b	3.373E-08	5.637E-07
Lungs	1.227E-52 b	2.296E-21 b	9.088E-14 b	1.194E-09 b	1.314E-07
Breasts	6.180E-66 b	4.366E-25 b	1.256E-15 b	2.733E-10 b	3.659E-08 b
Ovaries	2.975E-07 b	5.299E-05	1.649E-04	1.871E-04	1.079E-04
Pancreas	2.776E-34 b	3.483E-15 b	3.443E-10 b	1.788E-07 b	1.805E-06
Red Marrow	4.321E-09 b	4.466E-06	2.062E-05	4.623E-05	4.323E-05
Yellow Marrow	4.300E-11 b	2.149E-06	9.933E-06	2.253E-05	2.172E-05
Skeleton	2.192E-11 b	1.137E-06	5.283E-06	1.235E-05	1.284E-05
Skin	7.280E-19 b	9.290E-08	2.937E-07	9.859E-07	1.601E-06
Spleen	3.073E-27 b	6.745E-13 b	3.652E-09 b	4.709E-07	3.031E-06
Testes	9.381E-21 b	2.395E-10 b	1.225E-07 b	6.013E-06	9.719E-06
Thymus	0.0	3.183E-30 b	1.370E-17 b	4.666E-11 b	1.540E-08 b
Thyroid	0.0	2.456E-40 b	9.369E-23 b	1.558E-13 b	5.558E-10 b
Uterus	5.427E-18 b	3.419E-09 b	2.227E-06	2.492E-05	3.689E-05
Total body	1.406E-05	1.405E-05	1.403E-05	1.345E-05	1.054E-05
Adrenals	3.149E-51 b	3.554E-20 b	1.345E-12 b	1.269E-08 b	4.382E-07 b
Brain	0.0	6.993E-48 b	6.792E-27 b	1.122E-15 b	2.663E-11 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of LLI cont.

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	2.316E-05	2.098E-05	1.851E-05	1.577E-05	1.826E-05	1.534E-05
Stomach	5.933E-06	6.273E-06	6.101E-06	5.512E-06	5.198E-06	3.488E-06
Sm. Int.	3.160E-05	3.086E-05	2.779E-05	2.612E-05	2.342E-05	1.899E-05
U.L.I.	1.146E-05	1.139E-05	9.895E-06	9.150E-06	1.004E-05	7.069E-06
L.L.I.	2.098E-04	2.164E-04	1.919E-04	1.806E-04	1.637E-04	1.343E-04
Kidneys	3.380E-06	2.999E-06	3.790E-06	2.762E-06	3.125E-06	2.346E-06
Liver	1.103E-06	1.286E-06	1.285E-06	1.253E-06	1.155E-06	1.246E-06
Lungs	3.041E-07	5.265E-07	5.517E-07	5.231E-07	6.777E-07	4.056E-07
Breasts	2.756E-07	2.957E-07	3.135E-07	4.948E-07	4.576E-07	6.179E-07
Ovaries	7.016E-05	5.424E-05	6.185E-05	5.262E-05	3.086E-05	3.516E-05
Pancreas	2.448E-06	2.573E-06	2.640E-06	2.130E-06	2.266E-06	1.713E-06
Red Marrow	1.294E-05	9.922E-06	9.044E-06	8.036E-06	7.676E-06	6.527E-06
Yellow Marrow	6.696E-06	5.186E-06	4.781E-06	4.285E-06	4.051E-06	3.532E-06
Skeleton	4.490E-06	3.530E-06	3.244E-06	2.972E-06	2.861E-06	2.474E-06
Skin	1.690E-06	2.009E-06	1.977E-06	1.946E-06	1.883E-06	1.644E-06
Spleen	3.007E-06	4.184E-06	3.688E-06	3.050E-06	2.644E-06	2.396E-06
Testes	6.864E-06	5.954E-06	5.741E-06	4.890E-06	5.348E-06	4.809E-06
Thymus	2.266E-07	2.970E-07	3.475E-07	3.723E-07	3.824E-07	3.824E-07
Thyroid	3.461E-08	7.005E-08	1.023E-07	1.187E-07	1.315E-07	1.515E-07
Uterus	2.620E-05	2.226E-05	1.947E-05	1.490E-05	1.600E-05	1.497E-05
Total body	6.652E-06	6.482E-06	6.057E-06	5.619E-06	5.356E-06	4.394E-06
Adrenals	1.582E-06	1.566E-06	1.513E-06	1.468E-06	1.414E-06	1.251E-06
Brain	5.911E-09	1.674E-08	3.189E-08	4.352E-08	5.244E-08	6.991E-08

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Kidneys

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	2.089E-50 b	3.098E-20 b	1.099E-12 b	1.324E-08 b	5.456E-07
Stomach	3.963E-20 b	6.939E-10 b	2.496E-07 b	9.732E-06	1.555E-05
Sm. Int.	7.980E-17 b	8.520E-09 b	7.493E-07	6.881E-06	1.241E-05
U.L.I.	3.932E-20 b	3.313E-10 b	1.618E-07 b	5.448E-06	1.215E-05
L.L.I.	3.936E-25 b	1.502E-12 b	5.414E-09 b	9.589E-07	2.500E-06
Kidneys	3.274E-03	2.722E-03	2.029E-03	1.009E-03	3.849E-04
Liver	2.332E-09 b	7.595E-07 b	4.696E-06	1.611E-05	1.949E-05
Lungs	1.137E-36 b	7.565E-16 b	8.725E-11 b	1.297E-06	3.259E-06
Breasts	1.887E-49 b	7.084E-20 b	2.006E-12 b	2.102E-08 b	6.055E-07
Ovaries	8.572E-34 b	1.476E-14 b	1.099E-09 b	4.890E-07 b	4.322E-06 b
Pancreas	7.551E-16 b	1.601E-08 b	3.008E-06	2.816E-05	3.353E-05
Red Marrow	8.751E-11 b	1.059E-06	5.796E-06	2.058E-05	2.834E-05
Yellow Marrow	6.405E-12 b	2.123E-07	1.176E-06	4.511E-06	7.185E-06
Skeleton	1.291E-09 b	3.748E-07	2.089E-06	7.352E-06	1.020E-05
Skin	1.128E-10 b	1.977E-07	1.292E-06	2.578E-06	2.160E-06
Spleen	5.715E-09 b	9.162E-06	3.770E-05	7.012E-05	4.819E-05
Testes	0.0	9.251E-29 b	7.945E-17 b	1.530E-10 b	4.015E-08 b
Thymus	2.862E-59 b	1.817E-22 b	1.411E-13 b	6.276E-09 b	3.712E-07 b
Thyroid	0.0	2.527E-31 b	3.932E-18 b	3.557E-11 b	1.680E-08 b
Uterus	5.127E-39 b	2.880E-16 b	1.412E-10 b	1.730E-07 b	3.011E-06
Total body	1.406E-05	1.404E-05	1.372E-05	1.207E-05	8.841E-06
Adrenals	2.821E-07 b	1.015E-05	4.854E-05	6.475E-05	5.549E-05
Brain	0.0	1.438E-38 b	5.222E-22 b	3.485E-13 b	1.018E-09 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Kidneys

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	8.514E-07	1.696E-06	1.739E-06 b	1.675E-06 b	2.073E-06
Stomach	1.221E-05	1.137E-05	1.132E-05	1.034E-05	9.988E-06
Sm. Int.	1.036E-05	9.793E-06	8.875E-06	8.777E-06	8.122E-06
U.L.I.	9.850E-06	9.504E-06	8.635E-06	8.361E-06	7.676E-06
L.L.I.	2.524E-06	3.001E-06	3.208E-06	2.888E-06	3.287E-06
Kidneys	2.385E-04	2.480E-04	2.270E-04	2.154E-04	1.940E-04
Liver	1.404E-05	1.292E-05	1.214E-05	1.128E-05	1.055E-05
Lungs	3.383E-06	3.379E-06	3.363E-06	2.904E-06	2.981E-06
Breasts	1.126E-06	1.618E-06	1.672E-06	1.500E-06	1.212E-06
Ovaries	4.902E-06	5.880E-06 b	5.229E-06 b	4.845E-06 b	4.526E-06 b
Pancreas	2.207E-05	2.219E-05	1.969E-05	1.650E-05	1.700E-05
Red Marrow	1.074E-05	8.703E-06	7.927E-06	7.424E-06	6.615E-06
Yellow Marrow	3.116E-06	2.531E-06	2.381E-06	2.336E-06	2.069E-06
Skeleton	4.010E-06	3.300E-06	3.058E-06	2.912E-06	2.638E-06
Skin	1.942E-06	2.270E-06	2.278E-06	2.266E-06	2.164E-06
Spleen	3.066E-05	3.071E-05	2.645E-05	2.423E-05	2.386E-05
Testes	4.401E-07 b	5.404E-07 b	5.918E-07 b	6.119E-07 b	6.139E-07 b
Thymus	1.552E-06 b	1.563E-06 b	1.522E-06 b	1.481E-06 b	1.430E-06 b
Thyroid	2.672E-07 b	3.584E-07 b	4.137E-07 b	4.404E-07 b	4.491E-07 b
Uterus	3.798E-06	3.301E-06	3.737E-06	3.480E-06	2.710E-06
Total body	5.783E-06	5.744E-06	5.398E-06	5.124E-06	4.792E-06
Adrenals	3.541E-05	3.711E-05	3.171E-05	3.822E-05	1.591E-05
Brain	5.247E-08 b	8.056E-08	1.356E-07 b	1.282E-07	1.231E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Liver

Organ	Initial photon energy (MeV)					
	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	1.521E-47 b	8.303E-20 b	7.918E-13 b	6.735E-09 b	2.864E-07 b	4.195E-07
Stomach	3.273E-14 b	1.146E-08 b	3.588E-07 b	3.976E-06	9.083E-06	7.760E-06
Sm. Int.	2.153E-16 b	2.924E-07	6.469E-07	3.079E-06	6.179E-06	6.222E-06
U.L.I.	4.937E-11 b	2.236E-07 b	2.041E-06	8.010E-06	1.180E-05	1.053E-05
L.L.I.	2.687E-43 b	2.014E-18 b	3.571E-12 b	1.083E-08 b	5.952E-07	8.304E-07
Kidneys	6.681E-11 b	9.002E-07	4.166E-06	1.463E-05	1.854E-05	1.481E-05
Liver	5.344E-04	4.936E-04	4.334E-04	2.939E-04	1.496E-04	9.079E-05
Lungs	2.220E-07	3.805E-06	1.071E-05	1.764E-05	1.433E-05	1.014E-05
Breasts	5.422E-23 b	1.227E-11 b	9.122E-09 b	1.586E-06	3.727E-06	3.679E-06
Ovaries	9.863E-35 b	3.175E-15 b	1.754E-10 b	1.008E-07 b	1.281E-06 b	2.746E-06 b
Pancreas	2.271E-11 b	3.774E-07 b	4.462E-06	1.984E-05	2.661E-05	2.020E-05
Red Marrow	9.039E-08	1.053E-06	3.583E-06	9.656E-06	1.334E-05	9.005E-06
Yellow Marrow	1.810E-08	2.477E-07	1.077E-06	3.695E-06	5.574E-06	3.667E-06
Skeleton	4.562E-08	5.542E-07	2.042E-06	5.877E-06	7.888E-06	4.885E-06
Skin	5.343E-12 b	5.623E-08	4.345E-07	1.644E-06	2.089E-06	1.775E-06
Spleen	1.887E-28 b	2.310E-13 b	2.365E-09 b	6.483E-07	2.864E-06	4.101E-06
Testes	7.128E-74 b	8.431E-28 b	9.041E-17 b	9.404E-11 b	2.457E-08 b	1.849E-07 b
Thymus	3.893E-37 b	1.336E-15 b	2.515E-10 b	1.744E-07 b	1.802E-06	4.029E-06
Thyroid	6.511E-69 b	4.686E-26 b	1.446E-15 b	5.009E-10 b	6.901E-08 b	3.874E-07 b
Uterus	2.377E-41 b	1.772E-17 b	1.989E-11 b	4.486E-08 b	7.498E-07	2.006E-06
Total body	1.406E-05	1.405E-05	1.392E-05	1.268E-05	9.253E-06	6.415E-06
Adrenals	1.905E-07 b	6.637E-06 b	1.981E-05	2.839E-05	2.943E-05	2.199E-05
Brain	0.0	4.072E-34 b	7.203E-20 b	3.065E-12 b	3.143E-09 b	4.330E-08

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Liver

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	8.219E-07	9.515E-07	1.270E-06 b	1.246E-06 b	1.208E-06 b
Stomach	6.897E-06	7.493E-06	7.071E-06	5.950E-06	5.439E-06
Sm. Int.	5.419E-06	5.565E-06	5.513E-06	5.429E-06	4.518E-06
U.L.I.	9.362E-06	8.846E-06	7.462E-06	7.407E-06	6.442E-06
L.L.I.	9.032E-07	1.029E-06	1.331E-06	1.173E-06	1.662E-06
Kidneys	1.325E-05	1.319E-05	1.189E-05	1.142E-05	9.870E-06
Liver	8.718E-05	8.809E-05	8.082E-05	7.354E-05	6.873E-05
Lungs	9.101E-06	8.655E-06	7.804E-06	7.784E-06	7.049E-06
Breasts	3.549E-06	4.001E-06	4.149E-06	4.183E-06	3.618E-06
Ovaries	2.888E-06 b	2.727E-06 b	2.476E-06 b	2.405E-06 b	2.231E-06 b
Pancreas	1.704E-05	1.565E-05	1.415E-05	1.311E-05	1.187E-05
Red Marrow	5.686E-06	4.534E-06	4.206E-06	3.793E-06	3.722E-06
Yellow Marrow	2.317E-06	1.943E-06	1.807E-06	1.693E-06	1.658E-06
Skelton	3.061E-06	2.524E-06	2.360E-06	2.171E-06	2.164E-06
Skin	1.876E-06	2.088E-06	2.109E-06	2.159E-06	1.970E-06
Spleen	3.799E-06	3.637E-06	3.239E-06	3.952E-06	3.331E-06
Testes	3.102E-07 b	4.009E-07 b	4.537E-07 b	4.778E-07 b	4.848E-07 b
Thymus	3.597E-06	3.584E-06 b	7.543E-06	3.062E-06 b	2.887E-06 b
Thyroid	5.753E-07 b	6.661E-07 b	7.061E-07 b	7.187E-07 b	7.140E-07 b
Uterus	1.741E-06	1.871E-06	2.754E-06	1.467E-06	1.596E-06
Total body	5.828E-06	5.779E-06	5.428E-06	5.106E-06	4.780E-06
Adrenals	2.224E-05	2.512E-05	1.955E-05	1.686E-05	1.358E-05
Brain	6.067E-08	1.079E-07	1.615E-07	1.657E-07	2.475E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Lungs

Organ	Initial photon energy (MeV)						
	0.0	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	0.0	1.862E-30 b	5.810E-18 b	2.497E-11 b	1.054E-08 b	9.720E-08 b	
Stomach	2.047E-10 b	2.236E-07 b	2.002E-06	7.281E-06	8.348E-06	6.686E-06	
Sm. Int.	2.986E-47 b	2.556E-19 b	1.573E-12 b	4.350E-08	4.153E-07	7.226E-07	
U.L.I.	2.319E-46 b	6.323E-19 b	3.300E-12 b	1.463E-08 b	5.723E-07	7.900E-07	
L.L.I.	1.637E-52 b	2.411E-21 b	8.223E-14 b	1.114E-09 b	5.678E-08 b	2.456E-07 b	
Kidneys	2.143E-35 b	9.190E-16 b	9.040E-11 b	1.440E-06	3.103E-06	3.045E-06	
Liver	1.022E-07	3.172E-06	8.752E-06	1.568E-05	1.303E-05	9.900E-06	
Lungs	8.826E-04	6.985E-04	4.912E-04	2.317E-04	8.901E-05	5.056E-05	
Breasts	1.980E-37 b	5.302E-07	5.708E-06	1.943E-05	1.640E-05	1.272E-05	
Ovaries	4.794E-73 b	9.491E-28 b	1.743E-16 b	1.574E-10 b	3.344E-08 b	2.218E-07 b	
Pancreas	1.498E-16 b	2.700E-09 b	1.368E-07 b	7.358E-06	1.038E-05	9.013E-06	
Red Marrow	4.340E-08	1.252E-06	6.789E-06	1.900E-05	2.054E-05	1.096E-05	
Yellow Marrow	8.692E-09	2.618E-07	1.591E-06	5.416E-06	6.506E-06	3.631E-06	
Skelton	2.190E-08	6.398E-07	3.598E-06	1.090E-05	1.226E-05	6.605E-06	
Skin	1.660E-14 b	4.950E-08	5.289E-07	1.971E-06	2.305E-06	2.059E-06	
Spleen	5.042E-12 b	9.510E-07	4.690E-06	1.234E-05	1.214E-05	8.287E-06	
Testes	0.0	5.099E-39 b	4.210E-22 b	3.246E-13 b	8.693E-10 b	1.768E-08 b	
Thymus	2.636E-18 b	1.669E-09 b	3.083E-07 b	1.350E-05	2.106E-05	1.554E-05	
Thyroid	1.672E-25 b	1.992E-12 b	4.833E-09 b	6.520E-07 b	3.952E-06	4.011E-06	
Uterus	2.194E-73 b	2.356E-27 b	3.446E-16 b	2.318E-10 b	4.090E-08 b	2.592E-07 b	
Total body	1.406E-05	1.405E-05	1.390E-05	1.249E-05	8.709E-06	5.722E-06	
Adrenals	1.285E-12 b	4.244E-08 b	1.236E-06 b	1.484E-05	1.689E-05	1.133E-05	
Brain	3.566E-40 b	8.247E-18 b	2.675E-12 b	6.279E-09 b	1.572E-07	3.137E-07	

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Lungs

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.803E-07 b	2.536E-07 b	3.034E-07 b	3.288E-07 b	3.374E-07 b	3.451E-07 b
Stomach	5.687E-06	5.755E-06	6.240E-06	6.055E-06	5.713E-06	3.887E-06
Sm. Int.	8.296E-07	1.102E-06	1.167E-06	1.141E-06	1.047E-06	1.019E-06
U.L.I.	8.789E-07	1.210E-06	1.518E-06	1.520E-06	1.194E-06	1.381E-06
L.L.I.	2.239E-07	3.601E-07	4.718E-07 b	4.864E-07 b	5.467E-07	4.713E-07 b
Kidneys	3.526E-06	3.379E-06	3.523E-06	3.452E-06	2.757E-06	2.797E-06
Liver	8.514E-06	8.451E-06	7.811E-06	7.577E-06	6.711E-06	5.550E-06
Lungs	4.948E-05	4.984E-05	4.551E-05	4.207E-05	3.873E-05	3.042E-05
Breasts	1.199E-05	1.275E-05	1.191E-05	1.040E-05	1.090E-05	7.430E-06
Ovaries	3.589E-07 b	4.474E-07 b	4.997E-07 b	5.216E-07 b	5.251E-07 b	5.083E-07 b
Pancreas	8.907E-06	8.561E-06	7.907E-06	6.003E-06	6.930E-06	4.960E-06
Red Marrow	6.986E-06	5.730E-06	5.129E-06	4.809E-06	4.457E-06	3.711E-06
Yellow Marrow	2.362E-06	1.980E-06	1.848E-06	1.758E-06	1.642E-06	1.419E-06
Skelton	4.234E-06	3.515E-06	3.192E-06	3.025E-06	2.812E-06	2.400E-06
Skin	2.081E-06	2.386E-06	2.294E-06	2.210E-06	2.024E-06	1.771E-06
Spleen	9.392E-06	8.258E-06	6.113E-06	7.144E-06	6.506E-06	4.555E-06
Testes	4.495E-08 b	8.412E-08 b	1.195E-07 b	1.420E-07 b	1.533E-07 b	1.736E-07 b
Thymus	1.226E-05	1.206E-05	1.029E-05	1.080E-05	4.881E-06	9.131E-06
Thyroid	6.726E-06	2.288E-06	4.237E-06	3.980E-06 b	3.618E-06 b	3.118E-06 b
Uterus	4.049E-07 b	4.949E-07 b	5.406E-07 b	5.610E-07 b	5.627E-07 b	5.407E-07 b
Total body	5.110E-06	4.974E-06	4.649E-06	4.313E-06	4.082E-06	3.363E-06
Adrenals	1.427E-05	9.992E-06	1.250E-05	1.011E-05	8.007E-06	6.598E-06 b
Brain	4.507E-07	6.636E-07	8.263E-07	9.076E-07	8.950E-07	8.012E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Muscle

Organ	Initial photon energy (MeV)					
	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	1.710E-09 b	8.778E-06	1.097E-05	1.316E-05	1.124E-05	6.933E-06
Stomach	1.824E-06	4.327E-06	8.240E-06	1.013E-05	8.186E-06	5.836E-06
Sm. Int.	6.727E-07	2.081E-06	3.937E-06	6.793E-06	7.441E-06	5.892E-06
U.L.I.	6.392E-12 b	2.020E-06	4.285E-06	7.140E-06	7.134E-06	5.272E-06
L.L.I.	1.937E-06	5.432E-06	7.310E-06	1.146E-05	9.652E-06	7.586E-06
Kidneys	9.770E-07	3.768E-06	7.046E-06	8.844E-06	5.916E-06	4.657E-06
Liver	5.589E-07	1.704E-06	3.313E-06	5.505E-06	5.035E-06	4.062E-06
Lungs	2.055E-06	6.305E-06	9.824E-06	9.920E-06	7.087E-06	4.787E-06
Breasts	6.753E-08 b	1.418E-06	1.926E-06	2.445E-06	3.005E-06	2.259E-06
Ovaries	1.898E-06 b	5.819E-06 b	1.654E-05 b	1.121E-05	8.083E-06	9.203E-06
Pancreas	1.968E-06	5.153E-06	9.326E-06	1.133E-05	8.393E-06	6.458E-06
Red Marrow	1.389E-06	4.589E-06	9.248E-06	1.700E-05	1.864E-05	1.091E-05
Yellow Marrow	1.069E-06	2.796E-06	5.497E-06	9.724E-06	9.619E-06	5.057E-06
Skeleton	1.099E-06	3.428E-06	6.762E-06	1.196E-05	1.245E-05	6.962E-06
Skin	4.322E-06	6.167E-06	6.708E-06	5.468E-06	3.443E-06	2.737E-06
Spleen	8.832E-11 b	4.237E-06	7.382E-06	8.781E-06	8.546E-06	5.554E-06
Testes	3.514E-09 b	8.343E-06	1.152E-05	1.023E-05	5.934E-06	4.500E-06
Thymus	1.466E-08 b	8.811E-06	1.076E-05	7.499E-06	9.013E-06	6.165E-06
Thyroid	1.485E-09 b	9.402E-06	1.617E-05	1.142E-05	7.661E-06	6.067E-06
Uterus	2.302E-08 b	4.997E-06	9.148E-06	1.311E-05	1.167E-05	7.581E-06
Total body	1.400E-05	1.364E-05	1.293E-05	1.097E-05	7.730E-06	5.261E-06
Adrenals	3.157E-08 b	2.645E-06 b	1.072E-05	8.853E-06	8.029E-06	5.161E-06
Brain	3.838E-13 b	2.803E-08 b	5.580E-07 b	5.870E-07	9.977E-07	1.149E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Muscle

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	7.321E-06	6.251E-06	7.907E-06	3.234E-06	3.489E-06	3.987E-06
Stomach	4.620E-06	5.718E-06	4.868E-06	5.016E-06	4.749E-06	2.887E-06
Sm. Int.	5.092E-06	5.245E-06	5.063E-06	4.555E-06	4.231E-06	3.719E-06
U.L.I.	4.776E-06	4.821E-06	5.035E-06	4.079E-06	4.057E-06	3.732E-06
L.L.I.	6.363E-06	6.666E-06	7.873E-06	6.359E-06	5.410E-06	4.832E-06
Kidneys	4.985E-06	4.313E-06	5.100E-06	4.456E-06	4.348E-06	3.615E-06
Liver	3.658E-06	3.688E-06	3.473E-06	3.413E-06	3.110E-06	2.675E-06
Lungs	4.526E-06	4.385E-06	4.193E-06	3.887E-06	3.472E-06	2.833E-06
Breasts	2.499E-06	2.483E-06	2.503E-06	2.274E-06	2.228E-06	1.995E-06
Ovaries	1.081E-05	5.781E-06 b	5.211E-06 b	4.749E-06 b	4.458E-06 b	3.622E-06 b
Pancreas	5.145E-06	7.262E-06	6.753E-06	4.129E-06	5.229E-06	4.129E-06
Red Marrow	7.095E-06	5.895E-06	5.406E-06	5.049E-06	4.934E-06	4.185E-06
Yellow Marrow	3.367E-06	3.039E-06	2.651E-06	2.682E-06	2.321E-06	2.141E-06
Skelton	4.588E-06	3.946E-06	3.607E-06	3.458E-06	3.212E-06	2.802E-06
Skin	2.943E-06	3.111E-06	3.150E-06	2.979E-06	2.947E-06	2.244E-06
Spleen	4.421E-06	5.097E-06	4.813E-06	2.890E-06	4.133E-06	2.600E-06
Testes	4.772E-06	5.690E-06	3.723E-06	6.452E-06	4.728E-06	3.621E-06 b
Thymus	4.175E-06	4.440E-06	7.729E-06	4.996E-06 b	4.492E-06 b	3.660E-06 b
Thyroid	3.335E-06	5.394E-06	4.776E-06	5.191E-06 b	4.797E-06 b	3.879E-06 b
Uterus	7.242E-06	5.605E-06	5.782E-06	5.674E-06	5.060E-06	4.591E-06
Total body	4.864E-06	4.885E-06	4.597E-06	4.293E-06	4.101E-06	3.403E-06
Adrenals	4.831E-06	3.175E-06	7.023E-06	4.537E-06 b	4.216E-06 b	3.456E-06 b
Brain	1.176E-06	1.225E-06	1.151E-06	1.229E-06	1.153E-06	1.098E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Ovaries

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	3.908E-17 b	1.175E-08 b	4.567E-06	3.033E-05	4.091E-05
Stomach	8.464E-33 b	2.528E-14 b	8.252E-10 b	4.797E-07	2.405E-06
Sm. Int.	2.861E-06	2.318E-05	5.812E-05	9.251E-05	7.203E-05
U.L.I.	1.037E-05	6.636E-05	1.129E-04	1.032E-04	6.527E-05
L.L.I.	2.037E-05	1.208E-04	1.955E-04	1.848E-04	1.037E-04
Kidneys	5.019E-34 b	1.565E-14 b	1.169E-09 b	4.549E-07	2.549E-06
Liver	1.105E-35 b	2.217E-15 b	1.590E-10 b	2.550E-07	1.354E-06
Lungs	1.269E-73 b	7.503E-28 b	1.826E-16 b	1.580E-10 b	7.356E-08
Breasts	0.0	4.932E-30 b	2.216E-17 b	9.545E-11 b	3.159E-08 b
Ovaries	9.627E-02	5.870E-02	3.211E-02	1.130E-02	3.466E-03
Pancreas	7.087E-47 b	6.554E-19 b	8.634E-12 b	4.624E-08 b	1.278E-05
Red Marrow	4.999E-15 b	7.868E-08	3.736E-06	2.270E-05	2.975E-05
Yellow Marrow	6.106E-17 b	6.539E-09	3.105E-07	2.016E-06	3.716E-06
Skelton	5.008E-15 b	2.827E-08	1.343E-06	8.212E-06	1.110E-05
Skin	1.766E-26 b	3.437E-12 b	9.129E-09 b	4.857E-07	1.254E-06
Spleen	1.660E-42 b	1.057E-17 b	2.068E-11 b	4.820E-08 b	1.044E-06
Testes	0.0	0.0	0.0	0.0	0.0
Thymus	0.0	2.021E-34 b	2.516E-19 b	1.405E-11 b	1.076E-08 b
Thyroid	0.0	1.566E-44 b	2.123E-24 b	4.685E-14 b	3.699E-10 b
Uterus	2.249E-12 b	2.324E-06	4.782E-05	1.490E-04	1.241E-04
Total body	1.406E-05	1.406E-05	1.405E-05	1.365E-05	1.105E-05
Adrenals	4.170E-56 b	1.726E-21 b	5.205E-13 b	1.329E-08 b	5.689E-07 b
Brain	0.0	1.765E-52 b	1.202E-28 b	3.399E-16 b	1.801E-11 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Ovaries

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	2.482E-05	2.316E-05	2.082E-05	1.592E-05	2.033E-05	1.172E-05
Stomach	2.532E-06	3.520E-06	3.574E-06	3.186E-06	2.459E-06	2.326E-06
Sm. Int.	4.235E-05	4.026E-05	3.599E-05	3.310E-05	3.111E-05	2.515E-05
U.L.I.	3.781E-05	3.841E-05	3.161E-05	3.142E-05	3.006E-05	2.255E-05
L.L.I.	5.991E-05	5.913E-05	5.233E-05	5.161E-05	4.807E-05	3.530E-05
Kidneys	3.666E-06	3.469E-06	3.859E-06	3.766E-06	2.905E-06	2.942E-06
Liver	1.987E-06	2.071E-06	2.068E-06	2.266E-06	2.196E-06	1.922E-06
Lungs	2.702E-07	3.093E-07	5.117E-07	6.385E-07	5.826E-07	6.130E-07
Breasts	2.180E-07	2.681E-07	5.353E-07	3.793E-07	4.241E-07	3.675E-07
Ovaries	2.436E-03	2.652E-03	2.448E-03	2.242E-03	2.062E-03	1.636E-03
Pancreas	2.258E-06	1.938E-06	1.769E-06	1.625E-06	1.710E-06	1.765E-06
Red Marrow	1.041E-05	7.794E-06	6.988E-06	6.703E-06	6.170E-06	5.141E-06
Yellow Marrow	1.847E-06	1.450E-06	1.459E-06	1.232E-06	1.301E-06	1.199E-06
Skelton	4.136E-06	3.140E-06	2.861E-06	2.735E-06	2.568E-06	2.193E-06
Skin	1.572E-06	1.764E-06	1.735E-06	1.709E-06	1.827E-06	1.502E-06
Spleen	1.804E-06	2.183E-06	2.088E-06	2.210E-06	1.780E-06	1.617E-06
Testes	0.0	0.0	0.0	0.0	0.0	0.0
Thymus	2.159E-07	3.036E-07	3.610E-07	3.883E-07	4.003E-07	4.004E-07
Thyroid	3.178E-08	6.645E-08	1.003E-07	1.220E-07	1.355E-07	1.568E-07
Uterus	6.968E-05	6.523E-05	5.597E-05	4.991E-05	4.395E-05	3.738E-05
Total body	7.024E-06	6.805E-06	6.281E-06	5.835E-06	5.573E-06	4.603E-06
Adrenals	2.071E-06	2.014E-06	1.915E-06	1.845E-06	1.765E-06	1.545E-06
Brain	5.519E-09	1.683E-08	3.245E-08	4.469E-08	5.371E-08	7.201E-08

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Pancreas

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	3.873E-59 b	7.329E-23 b	5.697E-14 b	3.206E-09 b	2.316E-07 b
Stomach	3.174E-06	3.945E-05	9.435E-05	1.361E-04	1.026E-04
Sm. Int.	1.619E-23 b	1.303E-11 b	1.662E-08 b	2.055E-06	6.774E-06
U.L.I.	5.753E-23 b	3.140E-11 b	3.905E-08 b	3.354E-06	9.639E-06
L.L.I.	3.557E-36 b	7.374E-16 b	2.175E-10 b	3.583E-07	1.852E-06
Kidneys	1.886E-15 b	1.144E-08 b	3.498E-06	2.811E-05	3.390E-05
Liver	3.972E-12 b	6.121E-07	5.922E-06	2.117E-05	2.662E-05
Lungs	1.431E-17 b	1.311E-09 b	1.016E-06	7.308E-06	1.156E-05
Breasts	2.587E-36 b	1.886E-15 b	2.524E-10 b	6.368E-07	2.403E-06
Ovaries	2.365E-47 b	7.906E-19 b	8.231E-12 b	4.600E-08 b	1.144E-06 b
Pancreas	1.006E-02	7.774E-03	5.365E-03	2.434E-03	8.770E-04
Red Marrow	5.810E-13 b	1.693E-07	2.120E-06	1.232E-05	2.182E-05
Yellow Marrow	1.508E-15 b	3.420E-08	4.385E-07	2.781E-06	5.628E-06
Skelton	4.919E-13 b	7.259E-08	8.820E-07	5.290E-06	9.665E-06
Skin	2.958E-29 b	1.028E-10 b	2.171E-08	5.054E-07	1.327E-06
Spleen	2.504E-06	4.120E-05	1.099E-04	1.501E-04	1.033E-04
Testes	0.0	1.650E-31 b	3.679E-18 b	3.842E-11 b	1.865E-08 b
Thymus	6.665E-46 b	4.835E-18 b	3.029E-11 b	1.007E-07 b	2.284E-06
Thyroid	1.149E-75 b	6.177E-28 b	2.580E-16 b	3.258E-10 b	6.507E-08 b
Uterus	7.420E-49 b	2.504E-19 b	5.364E-12 b	3.687E-08 b	1.178E-06
Total body	1.406E-05	1.406E-05	1.405E-05	1.361E-05	1.094E-05
Adrenals	2.700E-14 b	1.223E-07 b	2.458E-05	9.860E-05	8.131E-05
Brain	0.0	7.842E-36 b	1.423E-20 b	2.118E-12 b	3.016E-09 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Pancreas

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	9.960E-07	8.000E-07	1.247E-06 b	1.227E-06 b	1.192E-06 b	1.072E-06 b
Stomach	5.719E-05	5.406E-05	4.868E-05	4.288E-05	4.063E-05	3.387E-05
Sm. Int.	6.799E-06	6.204E-06	6.061E-06	5.935E-06	5.313E-06	4.285E-06
U.L.I.	8.162E-06	6.917E-06	6.411E-06	5.928E-06	6.328E-06	4.898E-06
L.L.I.	2.118E-06	2.456E-06	2.327E-06	2.447E-06	2.407E-06	3.403E-06
Kidneys	2.370E-05	2.169E-05	1.944E-05	1.827E-05	1.581E-05	1.232E-05
Liver	1.770E-05	1.635E-05	1.430E-05	1.404E-05	1.289E-05	1.047E-05
Lungs	8.181E-06	7.668E-06	6.717E-06	6.472E-06	6.107E-06	4.926E-06
Breasts	3.411E-06	3.003E-06	3.845E-06	3.618E-06	2.928E-06	3.104E-06
Ovaries	3.077E-06 b	2.832E-06 b	2.634E-06 b	2.488E-06 b	2.369E-06 b	2.027E-06 b
Pancreas	5.451E-04	5.681E-04	5.357E-04	4.904E-04	4.587E-04	3.649E-04
Red Marrow	9.289E-06	7.119E-06	6.261E-06	5.743E-06	5.718E-06	4.635E-06
Yellow Marrow	2.731E-06	2.179E-06	1.945E-06	1.809E-06	1.842E-06	1.584E-06
Skelton	4.139E-06	3.271E-06	2.893E-06	2.685E-06	2.668E-06	2.215E-06
Skin	1.537E-06	1.705E-06	1.813E-06	1.876E-06	1.804E-06	1.402E-06
Spleen	5.907E-05	5.376E-05	5.385E-05	4.497E-05	4.342E-05	3.299E-05
Testes	2.897E-07 b	3.845E-07 b	4.412E-07 b	4.670E-07 b	4.755E-07 b	4.671E-07 b
Thymus	3.517E-06	3.774E-06 b	3.433E-06 b	3.218E-06 b	3.033E-06 b	2.570E-06 b
Thyroid	5.908E-07 b	6.920E-07 b	7.359E-07 b	7.495E-07 b	7.447E-07 b	6.984E-07 b
Uterus	1.596E-06	1.776E-06	2.061E-06	2.083E-06	2.623E-06	1.936E-06 b
Total body	6.947E-06	6.656E-06	6.204E-06	5.770E-06	5.463E-06	4.491E-06
Adrenals	4.610E-05	4.819E-05	4.485E-05	4.322E-05	3.725E-05	3.204E-05
Brain	9.975E-08 b	7.227E-08	1.394E-07	1.426E-07	2.032E-07	2.569E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Bone

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.100
Bladder	5.859E-24 b	9.820E-12 b	9.619E-09 b	4.809E-07 b	1.670E-06
Stomach	1.784E-10 b	1.680E-07 b	6.996E-07 b	5.099E-07	1.764E-06
Sm. Int.	7.996E-11 b	1.747E-07	3.924E-07	1.626E-06	2.817E-06
U.L.I.	4.234E-10 b	2.269E-07 b	8.373E-07	1.540E-06	2.475E-06
L.L.I.	2.389E-09 b	8.818E-07 b	1.931E-06	3.240E-06	4.799E-06
Kidneys	8.970E-11 b	2.256E-07 b	1.880E-06 b	1.738E-06	3.226E-06
Liver	4.488E-13 b	1.032E-07	4.674E-07	1.523E-06	2.534E-06
Lungs	3.951E-14 b	2.762E-07	1.059E-06	3.102E-06	3.371E-06
Breasts	1.367E-09 b	5.678E-08 b	1.375E-06	2.143E-06	1.744E-06
Ovaries	2.321E-15 b	1.923E-08 b	5.514E-07 b	3.404E-06 b	3.372E-06
Pancreas	1.869E-13 b	4.349E-08 b	8.369E-07 b	1.240E-06	3.348E-06
Red Marrow	9.546E-05	8.973E-05	8.230E-05	6.414E-05	3.279E-06
Yellow Marrow	8.533E-05	8.226E-05	7.656E-05	6.127E-05	1.662E-05
Skelton	9.229E-05	8.885E-05	8.272E-05	6.729E-05	3.485E-05
Skin	3.715E-07	9.622E-07	1.492E-06	2.081E-06	3.991E-05
Spleen	5.672E-16 b	3.666E-09 b	1.745E-07 b	1.534E-06	2.381E-06
Testes	8.294E-24 b	4.884E-12 b	7.907E-09 b	6.141E-07 b	2.309E-06
Thymus	2.134E-11 b	1.962E-07 b	1.246E-06 b	2.584E-06 b	1.237E-06
Thyroid	7.919E-11 b	2.294E-07 b	1.763E-06 b	5.174E-06 b	3.256E-06
Uterus	7.710E-21 b	9.293E-11 b	3.510E-08 b	1.044E-06 b	3.343E-06
Total body	1.405E-05	1.398E-05	1.373E-05	1.258E-05	1.912E-06
Adrenals	8.137E-11 b	3.880E-07 b	4.324E-06 b	5.116E-06	9.127E-06
Brain	8.233E-07	2.276E-06	5.264E-06	8.459E-06	6.568E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Bone

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	2.017E-06	1.999E-06	1.687E-06	2.018E-06 b	1.900E-06 b	1.609E-06 b
Stomach	1.595E-06	2.257E-06	1.608E-06	2.477E-06	1.766E-06	1.186E-06
Sm. Int.	2.881E-06	2.662E-06	2.802E-06	2.347E-06	2.253E-06	2.091E-06
U.L.I.	2.339E-06	2.164E-06	2.144E-06	1.969E-06	2.385E-06	1.927E-06
L.L.I.	3.433E-06	4.097E-06	3.971E-06	3.163E-06	3.336E-06	2.711E-06
Kidneys	3.468E-06	3.249E-06	2.448E-06	2.626E-06	2.348E-06	1.680E-06
Liver	2.525E-06	2.623E-06	2.238E-06	2.352E-06	2.089E-06	2.022E-06
Lungs	3.334E-06	3.411E-06	2.970E-06	2.889E-06	2.397E-06	2.243E-06
Breasts	1.899E-06	2.061E-06	1.795E-06	2.041E-06	1.504E-06	1.600E-06
Ovaries	3.864E-06 b	3.447E-06 b	2.975E-06 b	2.885E-06 b	2.580E-06 b	1.743E-06 b
Pancreas	3.363E-06	3.457E-06	3.219E-06	2.155E-06	1.996E-06	2.800E-06
Red Marrow	1.163E-05	1.062E-05	9.839E-06	9.242E-06	8.649E-06	7.185E-06
Yellow Marrow	1.043E-05	9.779E-06	9.101E-06	8.656E-06	8.028E-06	6.723E-06
Skelton	1.241E-05	1.148E-05	1.071E-05	1.005E-05	9.368E-06	7.880E-06
Skin	2.602E-06	2.846E-06	2.867E-06	2.734E-06	2.656E-06	2.257E-06
Spleen	2.263E-06	2.246E-06	2.637E-06	1.884E-06	2.228E-06	2.491E-06
Testes	1.667E-06	2.141E-06	1.946E-06	2.197E-06 b	2.076E-06 b	1.753E-06 b
Thymus	1.868E-06	2.561E-06 b	2.310E-06 b	2.154E-06 b	2.060E-06 b	1.730E-06 b
Thyroid	3.666E-06	4.530E-06	4.033E-06 b	3.705E-06 b	3.437E-06 b	2.812E-06 b
Uterus	2.546E-06	2.024E-06	2.333E-06	2.403E-06	2.161E-06 b	1.884E-06
Total body	4.935E-06	4.862E-06	4.588E-06	4.360E-06	4.099E-06	3.463E-06
Adrenals	8.435E-06	5.136E-06	8.908E-06	5.063E-06 b	4.693E-06 b	3.823E-06 b
Brain	6.586E-06	6.714E-06	6.203E-06	5.801E-06	5.505E-06	4.313E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Red marrow

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	3.287E-06	3.373E-06	3.917E-06	5.265E-06	4.619E-06	2.780E-06
Stomach	3.563E-06	3.457E-06	2.945E-06	3.863E-06	3.601E-06	3.220E-06
Sm. Int.	8.693E-06	8.361E-06	7.659E-06	7.759E-06	6.962E-06	6.159E-06
U.L.I.	7.320E-06	7.420E-06	6.875E-06	6.506E-06	5.596E-06	5.502E-06
L.L.I.	1.125E-05	1.072E-05	1.072E-05	9.206E-06	8.531E-06	7.264E-06
Kidneys	8.097E-06	8.521E-06	7.817E-06	7.266E-06	7.122E-06	5.317E-06
Liver	4.221E-06	4.384E-06	4.111E-06	3.797E-06	3.757E-06	2.943E-06
Lungs	5.531E-06	5.204E-06	4.709E-06	4.440E-06	4.481E-06	3.844E-06
Breasts	2.866E-06	3.476E-06	3.647E-06	3.378E-06	3.327E-06	2.422E-06
Ovaries	1.202E-05	9.510E-06	1.718E-05	1.209E-05	6.295E-06 b	5.336E-06 b
Pancreas	7.959E-06	7.334E-06	6.073E-06	6.071E-06	6.936E-06	4.825E-06
Red Marrow	2.557E-05	2.369E-05	2.128E-05	1.962E-05	1.857E-05	1.555E-05
Yellow Marrow	9.799E-06	9.136E-06	8.235E-06	7.578E-06	7.167E-06	6.054E-06
Skeleton	1.096E-05	1.018E-05	9.211E-06	8.523E-06	8.036E-06	6.820E-06
Skin	2.315E-06	2.509E-06	2.656E-06	2.718E-06	2.363E-06	2.079E-06
Spleen	4.264E-06	4.851E-06	4.850E-06	3.892E-06	2.773E-06	2.822E-06
Testes	1.608E-06	1.698E-06	1.950E-06	4.007E-06 b	3.609E-06 b	3.081E-06 b
Thymus	3.961E-06	5.406E-06	3.596E-06 b	3.328E-06 b	3.103E-06 b	2.569E-06 b
Thyroid	5.066E-06	5.498E-06	2.162E-06 b	2.012E-06 b	1.886E-06 b	1.513E-06 b
Uterus	7.362E-06	5.429E-06	5.758E-06	5.530E-06	5.829E-06	5.280E-06
Total body	5.504E-06	5.453E-06	5.121E-06	4.802E-06	4.542E-06	3.857E-06
Adrenals	1.338E-05	1.378E-05	1.440E-05	1.467E-05	1.801E-05	6.964E-06 b
Brain	4.060E-06	4.209E-06	4.148E-06	3.828E-06	3.717E-06	3.310E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Red marrow

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	1.167E-22 b	3.391E-11 b	3.032E-08 b	1.273E-06	3.848E-06
Stomach	2.753E-10 b	2.765E-07 b	1.127E-06 b	1.772E-06	3.965E-06
Sm. Int.	3.225E-07	7.903E-07	1.946E-06	5.787E-06	9.312E-06
U.L.I.	1.632E-09 b	1.029E-06	2.341E-06	6.099E-06	8.053E-06
L.L.I.	3.939E-08 b	2.970E-06	7.054E-06	1.330E-05	1.303E-05
Kidneys	2.923E-09 b	7.784E-07 b	1.493E-06	5.288E-06	8.425E-06
Liver	3.710E-12 b	1.961E-07	8.563E-07	2.672E-06	4.087E-06
Lungs	3.382E-10 b	4.901E-07	2.120E-06	5.303E-06	6.835E-06
Breasts	4.957E-11 b	6.311E-07	1.953E-06	3.638E-06	3.273E-06
Ovaries	3.096E-15 b	4.323E-08 b	1.636E-06 b	1.092E-05	1.353E-05
Pancreas	2.615E-12 b	1.252E-07 b	2.561E-06 b	2.813E-06	6.647E-06
Red Marrow	2.373E-04	2.231E-04	2.036E-04	1.563E-04	8.717E-05
Yellow Marrow	8.875E-05	8.374E-05	7.667E-05	5.889E-05	3.306E-05
Skeleton	9.176E-05	8.686E-05	7.922E-05	6.202E-05	3.581E-05
Skin	3.384E-07	9.244E-07	1.567E-06	2.041E-06	2.036E-06
Spleen	6.815E-14 b	2.019E-08 b	9.781E-07	2.097E-06	3.752E-06
Testes	1.085E-23 b	2.452E-11 b	2.343E-08 b	1.441E-06 b	1.153E-06
Thymus	2.826E-10 b	5.358E-07 b	2.701E-06 b	4.705E-06 b	5.061E-06
Thyroid	1.040E-16 b	1.184E-09 b	8.274E-08 b	1.015E-06 b	3.875E-06
Uterus	9.237E-20 b	2.262E-10 b	8.722E-08 b	2.446E-06	6.922E-06
Total body	1.405E-05	1.398E-05	1.374E-05	1.267E-05	9.516E-06
Adrenals	3.375E-09 b	1.728E-06 b	9.348E-06 b	9.110E-06	1.249E-05
Brain	3.278E-07	1.266E-06	2.843E-06	5.125E-06	4.728E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Yel.marrow

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	2.378E-25 b	1.376E-12 b	1.873E-09 b	9.481E-08 b	6.759E-07 b
Stomach	1.601E-22 b	3.512E-11 b	2.275E-08 b	7.162E-07 b	1.185E-06
Sm. Int.	6.280E-14 b	9.592E-09 b	1.583E-07 b	3.128E-07	9.576E-07
U.L.I.	4.386E-15 b	3.201E-09 b	8.128E-08 b	6.299E-07	1.151E-06
L.L.I.	1.741E-11 b	3.335E-11 b	1.517E-08 b	1.037E-06	1.730E-06
Kidneys	1.444E-13 b	1.393E-08 b	1.694E-07 b	3.729E-07	1.411E-06
Liver	1.372E-11 b	1.196E-07 b	2.624E-07	1.236E-06	2.255E-06
Lungs	8.181E-14 b	2.657E-08 b	9.126E-07	3.926E-06	5.094E-06
Breasts	4.997E-08 b	3.011E-10 b	2.314E-06 b	5.059E-07	1.061E-06
Ovaries	2.002E-16 b	7.137E-09 b	1.035E-07 b	1.040E-06 b	1.502E-06 b
Pancreas	2.476E-12 b	5.592E-08 b	4.511E-07 b	1.308E-06 b	1.763E-06
Red Marrow	7.415E-05	7.175E-05	6.835E-05	5.723E-05	3.603E-05
Yellow Marrow	2.810E-04	2.643E-04	2.372E-04	1.685E-04	7.841E-05
Skeleton	9.244E-05	8.908E-05	8.316E-05	6.649E-05	3.779E-05
Skin	6.279E-07	1.449E-06	2.173E-06	2.866E-06	2.782E-06
Spleen	9.240E-16 b	1.296E-09 b	1.068E-07 b	8.839E-07	1.789E-06
Testes	1.144E-24 b	3.701E-12 b	4.988E-09 b	3.380E-07 b	1.490E-06 b
Thymus	5.530E-11 b	1.224E-07 b	5.869E-07 b	1.162E-06 b	2.029E-06
Thyroid	2.297E-12 b	4.990E-08 b	3.088E-07 b	2.059E-06 b	2.676E-06
Uterus	7.058E-21 b	1.202E-10 b	6.320E-08 b	1.693E-06 b	1.025E-06
Total body	1.405E-05	1.392E-05	1.357E-05	1.212E-05	8.419E-06
Adrenals	3.140E-09 b	6.752E-07 b	2.643E-06 b	4.558E-06 b	2.668E-06
Brain	1.209E-06 b	3.442E-07	8.014E-07	1.600E-06	1.620E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Yel. marrow

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.461E-06 b	1.367E-06 b	1.279E-06 b	1.229E-06 b	1.177E-06 b	1.033E-06 b
Stomach	1.457E-06	1.352E-06	1.920E-06	2.036E-06	1.827E-06	1.421E-06
Sm. Int.	1.457E-06	1.374E-06	1.454E-06	1.440E-06	1.292E-06	1.165E-06
U.L.I.	1.459E-06	1.511E-06	1.777E-06	1.302E-06	1.176E-06	1.221E-06
L.L.I.	1.791E-06	1.857E-06	1.788E-06	2.023E-06	2.517E-06	2.269E-06
Kidneys	1.431E-06	1.515E-06	1.698E-06	1.351E-06	1.272E-06	1.229E-06
Liver	2.363E-06	2.481E-06	2.389E-06	2.311E-06	2.291E-06	1.889E-06
Lungs	4.070E-06	4.127E-06	3.933E-06	3.654E-06	3.454E-06	2.893E-06
Breasts	1.088E-06	1.542E-06	1.846E-06	1.680E-06	1.757E-06	1.359E-06
Ovaries	2.016E-06 b	1.943E-06 b	1.686E-06 b	1.740E-06 b	1.514E-06 b	1.404E-06 b
Pancreas	1.787E-06	1.434E-06	1.031E-06	2.404E-06	1.031E-06	1.590E-06
Red Marrow	1.203E-05	1.082E-05	1.014E-05	9.459E-06	8.671E-06	7.528E-06
Yellow Marrow	2.081E-05	2.041E-05	1.904E-05	1.733E-05	1.607E-05	1.335E-05
Skeleton	1.154E-05	1.079E-05	1.002E-05	9.280E-06	8.548E-06	7.275E-06
Skin	2.875E-06	3.173E-06	3.280E-06	3.012E-06	2.982E-06	2.415E-06
Spleen	1.720E-06	1.768E-06	2.206E-06	2.212E-06	2.243E-06	1.951E-06
Testes	1.412E-06	2.029E-06 b	1.830E-06 b	1.748E-06 b	1.632E-06 b	1.412E-06 b
Thymus	2.374E-06	1.528E-06 b	1.122E-06 b	1.309E-06 b	1.300E-06 b	1.100E-06 b
Thyroid	2.868E-06	2.235E-06 b	1.994E-06 b	1.840E-06 b	1.712E-06 b	1.414E-06 b
Uterus	1.251E-06	1.378E-06	3.383E-06 b	1.359E-06	3.058E-06 b	2.530E-06 b
Total body	4.448E-06	4.459E-06	4.272E-06	4.033E-06	3.804E-06	3.198E-06
Adrenals	3.765E-06 b	3.758E-06 b	3.402E-06 b	3.142E-06 b	2.924E-06 b	2.404E-06 b
Brain	1.465E-06	1.659E-06	1.810E-06	1.642E-06	1.631E-06	1.326E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Skin

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	6.148E-14 b	1.074E-08 b	3.170E-07 b	1.591E-06	2.451E-06
Stomach	1.017E-10 b	1.900E-07 b	6.675E-07	1.376E-06	2.298E-06
Sm. Int.	3.713E-14 b	7.893E-09 b	1.374E-07	7.711E-07	1.815E-06
U.L.I.	4.169E-16 b	2.502E-09 b	1.223E-07 b	1.072E-06	1.685E-06
L.L.I.	4.615E-12 b	3.787E-08 b	2.746E-07 b	1.191E-06	2.023E-06
Kidneys	1.667E-11 b	1.591E-07 b	1.353E-06	2.776E-06	2.708E-06
Liver	1.869E-12 b	9.943E-08 b	5.592E-07	1.801E-06	2.251E-06
Lungs	2.256E-12 b	4.515E-08 b	4.443E-07	2.200E-06	2.690E-06
Breasts	1.254E-05	2.109E-05	1.951E-05	1.227E-05	5.843E-06
Ovaries	3.098E-26 b	3.306E-12 b	9.123E-09 b	5.322E-07 b	2.134E-06 b
Pancreas	1.835E-21 b	3.333E-11 b	1.453E-08 b	8.201E-07	1.485E-06
Red Marrow	1.100E-06	3.831E-06	6.044E-06	8.264E-06	7.487E-06
Yellow Marrow	1.088E-06	2.932E-06	5.159E-06	8.710E-06	8.172E-06
Skeleton	1.258E-06	3.730E-06	6.031E-06	8.815E-06	4.159E-06
Skin	2.077E-04	1.050E-04	5.813E-05	2.286E-05	4.398E-06
Spleen	6.463E-13 b	3.584E-08 b	5.326E-07 b	1.577E-06	8.186E-06
Testes	5.584E-09 b	8.548E-06	1.187E-05	1.239E-05	1.877E-06
Thymus	1.438E-10 b	1.114E-07 b	1.157E-06 b	4.847E-06 b	5.172E-06
Thyroid	3.557E-15 b	1.229E-08 b	4.269E-07 b	2.239E-06 b	3.865E-06
Uterus	2.238E-19 b	9.240E-11 b	1.863E-08 b	5.907E-07 b	2.203E-06
Total body	1.132E-05	9.241E-06	8.008E-06	6.311E-06	1.818E-06
Adrenals	4.593E-16 b	3.322E-09 b	1.844E-07 b	1.480E-06 b	4.280E-06
Brain	8.061E-09 b	1.219E-06 b	1.286E-07	1.488E-06	2.917E-06 b
					2.304E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Skin

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.874E-06	1.613E-06	2.498E-06 b	2.329E-06 b	2.940E-06	1.834E-06 b
Stomach	2.140E-06	2.648E-06	1.638E-06	1.954E-06	1.932E-06	2.391E-06
Sm. Int.	1.643E-06	1.932E-06	1.894E-06	1.700E-06	1.795E-06	1.714E-06
U.L.I.	1.840E-06	1.632E-06	2.466E-06	1.586E-06	1.457E-06	1.516E-06
L.L.I.	2.361E-06	2.407E-06	2.573E-06	2.413E-06	1.677E-06	2.215E-06
Kidneys	2.535E-06	2.499E-06	2.108E-06	2.243E-06	2.538E-06	1.837E-06
Liver	1.983E-06	2.213E-06	2.175E-06	2.286E-06	1.900E-06	1.847E-06
Lungs	2.089E-06	2.347E-06	2.338E-06	2.461E-06	2.322E-06	1.891E-06
Breasts	4.117E-06	4.367E-06	4.814E-06	4.390E-06	4.376E-06	3.488E-06
Ovaries	2.661E-06 b	2.306E-06 b	2.116E-06 b	1.963E-06 b	1.884E-06 b	1.568E-06 b
Pancreas	1.868E-06	1.306E-06	1.545E-06	1.723E-06	1.251E-06	1.860E-06
Red Marrow	2.822E-06	2.826E-06	2.774E-06	2.570E-06	2.420E-06	2.086E-06
Yellow Marrow	2.967E-06	2.884E-06	2.790E-06	2.759E-06	2.478E-06	2.144E-06
Skelton	3.099E-06	3.054E-06	2.905E-06	2.838E-06	2.640E-06	2.269E-06
Skin	6.271E-06	7.091E-06	6.753E-06	6.383E-06	6.074E-06	5.164E-06
Spleen	2.387E-06	2.190E-06	2.527E-06	2.403E-06	2.610E-06	1.970E-06
Testes	4.098E-06	4.317E-06	3.451E-06	3.754E-06 b	3.545E-06	2.870E-06 b
Thymus	3.373E-06 b	2.962E-06 b	2.665E-06 b	2.470E-06 b	2.306E-06 b	1.916E-06 b
Thyroid	3.018E-06 b	2.617E-06 b	2.342E-06 b	2.166E-06 b	2.069E-06 b	1.714E-06 b
Uterus	1.669E-06	1.514E-06	2.165E-06 b	2.626E-06	2.296E-06	2.202E-06
Total body	2.959E-06	3.227E-06	3.132E-06	3.033E-06	2.856E-06	2.461E-06
Adrenals	2.853E-06	2.570E-06 b	2.324E-06 b	2.233E-06 b	2.095E-06 b	1.757E-06 b
Brain	2.125E-06	2.279E-06	2.180E-06	2.366E-06	2.171E-06	1.670E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Spleen

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	2.374E-59 b	3.328E-23 b	3.152E-14 b	2.162E-09 b	1.757E-07 b
Stomach	6.138E-12 b	9.168E-07	1.495E-05	5.520E-05	6.035E-05
Sm. Int.	2.607E-21 b	5.437E-11 b	2.629E-08 b	1.561E-06	4.897E-06
U.L.I.	5.192E-22 b	3.988E-11 b	2.848E-08 b	1.851E-06	5.033E-06
L.L.I.	8.325E-27 b	4.183E-13 b	2.886E-09 b	6.081E-07	2.155E-06
Kidneys	2.089E-08 b	9.721E-06 b	3.612E-05	6.810E-05	5.113E-05
Liver	4.733E-29 b	2.314E-13 b	1.956E-09 b	6.343E-07	3.019E-06
Lungs	2.881E-14 b	1.191E-06 b	5.496E-06	1.213E-05	8.326E-06
Breasts	1.851E-36 b	1.142E-15 b	1.741E-10 b	5.336E-07	2.121E-06
Ovaries	5.324E-42 b	1.157E-17 b	1.994E-11 b	4.669E-08 b	2.463E-06
Pancreas	3.014E-07 b	4.227E-05	1.123E-04	1.498E-04	9.557E-07 b
Red Marrow	4.903E-12 b	3.311E-07	2.350E-06	8.269E-06	1.078E-04
Yellow Marrow	3.274E-15 b	2.680E-08	3.304E-07	3.083E-06	1.157E-05
Skelton	6.152E-14 b	2.127E-07	1.545E-06	5.781E-06	6.326E-06
Skin	3.986E-15 b	1.076E-08 b	3.102E-07	1.565E-06	8.138E-06
Spleen	5.427E-03	4.643E-03	3.550E-03	1.835E-03	1.979E-06
Testes	0.0	1.168E-31 b	2.619E-18 b	2.810E-11 b	7.184E-04
Thymus	1.617E-50 b	8.389E-20 b	3.018E-12 b	2.885E-08 b	1.457E-08 b
Thyroid	0.0	3.999E-28 b	1.256E-16 b	1.817E-10 b	1.193E-06
Uterus	3.707E-50 b	6.341E-20 b	2.165E-12 b	2.138E-08 b	4.265E-08 b
Total body	1.406E-05	1.405E-05	1.396E-05	1.277E-05	8.747E-07
Adrenals	6.397E-30 b	5.906E-13 b	1.018E-08 b	3.214E-05	9.299E-06
Brain	0.0	1.156E-35 b	1.305E-20 b	1.630E-12 b	3.251E-05

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Spleen

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	8.694E-07	1.070E-06 b	1.080E-06 b	1.071E-06 b	1.046E-06 b	9.501E-07 b
Stomach	3.623E-05	3.380E-05	2.907E-05	2.786E-05	2.422E-05	1.789E-05
Sm. Int.	5.001E-06	4.695E-06	4.543E-06	4.813E-06	4.220E-06	3.409E-06
U.L.I.	4.144E-06	4.336E-06	4.222E-06	4.563E-06	4.075E-06	3.469E-06
L.L.I.	3.120E-06	2.926E-06	2.456E-06	2.992E-06	2.761E-06	2.356E-06
Kidneys	2.995E-05	2.869E-05	2.669E-05	2.513E-05	2.184E-05	1.867E-05
Liver	3.710E-06	3.634E-06	3.790E-06	3.473E-06	3.228E-06	2.872E-06
Lungs	7.493E-06	7.256E-06	6.419E-06	6.112E-06	5.772E-06	4.777E-06
Breasts	2.506E-06	2.612E-06	3.031E-06	2.391E-06	2.787E-06	2.804E-06
Ovaries	2.637E-06 b	2.588E-06 b	2.305E-06 b	2.290E-06 b	2.096E-06 b	1.875E-06 b
Pancreas	6.137E-05	5.797E-05	5.240E-05	4.583E-05	4.524E-05	3.418E-05
Red Marrow	4.814E-06	3.809E-06	3.529E-06	3.408E-06	3.056E-06	2.754E-06
Yellow Marrow	2.669E-06	2.319E-06	2.156E-06	2.064E-06	2.072E-06	1.922E-06
Skeleton	3.183E-06	2.594E-06	2.389E-06	2.322E-06	2.133E-06	1.925E-06
Skin	1.837E-06	2.016E-06	2.058E-06	1.945E-06	1.997E-06	1.678E-06
Spleen	4.231E-04	4.487E-04	4.144E-04	3.784E-04	3.491E-04	2.800E-04
Testes	2.465E-07 b	3.360E-07 b	3.929E-07 b	4.185E-07 b	4.294E-07 b	4.262E-07 b
Thymus	3.039E-06	2.453E-06 b	2.297E-06 b	2.190E-06 b	2.086E-06 b	1.804E-06 b
Thyroid	4.495E-07 b	5.508E-07 b	6.013E-07 b	6.207E-07 b	6.221E-07 b	5.934E-07 b
Uterus	1.510E-06	1.574E-06	1.639E-06	2.350E-06	2.683E-06	1.647E-06 b
Total body	5.845E-06	5.771E-06	5.393E-06	5.095E-06	4.800E-06	3.939E-06
Adrenals	1.791E-05	2.705E-05	2.106E-05	2.205E-05	1.260E-05	1.318E-05
Brain	6.716E-08	9.363E-08	1.890E-07	1.884E-07	2.422E-07	2.737E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Testes

Initial photon energy (MeV)

Organ	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	9.467E-19 b	3.099E-09 b	7.190E-07 b	2.026E-05	2.625E-05	2.001E-05
Stomach	3.476E-72 b	3.786E-27 b	3.772E-16 b	2.355E-10 b	4.494E-08 b	2.836E-07 b
Sm. Int.	3.320E-48 b	2.242E-19 b	4.029E-12 b	1.001E-07	7.527E-07	1.393E-06
U.L.I.	1.130E-44 b	1.194E-18 b	6.443E-12 b	2.571E-08 b	3.848E-07	9.007E-07
L.L.I.	6.595E-20 b	6.916E-10 b	3.413E-07	7.875E-06	1.330E-05	1.066E-05
Kidneys	0.0 b	9.035E-29 b	8.010E-17 b	1.552E-10 b	3.949E-08 b	9.469E-08
Liver	0.0 b	3.200E-28 b	8.560E-17 b	9.152E-11 b	2.438E-08 b	6.652E-08
Lungs	0.0 b	3.855E-39 b	3.869E-22 b	3.467E-13 b	8.527E-10 b	1.743E-08 b
Breasts	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Ovaries	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Pancreas	0.0 b	1.714E-31 b	3.667E-18 b	4.008E-11 b	1.879E-08 b	1.645E-07 b
Red Marrow	3.985E-24 b	2.039E-11 b	6.173E-08	2.566E-06	9.809E-06	8.597E-06
Yellow Marrow	7.216E-26 b	1.320E-12 b	3.870E-09	2.493E-07	1.288E-06	1.384E-06
Skelton	7.968E-25 b	7.030E-12 b	2.622E-08	1.114E-06	4.379E-06	3.930E-06
Skin	1.567E-06 b	7.373E-06	1.135E-05	9.949E-06	5.442E-06	3.756E-06
Spleen	0.0 b	1.203E-31 b	2.656E-18 b	2.919E-11 b	1.509E-08 b	1.389E-07 b
Testes	2.413E-02	1.840E-02	1.237E-02	5.365E-03	1.798E-03	1.053E-03
Thymus	0.0 b	5.667E-46 b	4.411E-25 b	2.466E-14 b	2.595E-10 b	8.521E-09 b
Thyroid	0.0 b	1.821E-56 b	2.514E-30 b	7.448E-17 b	8.116E-12 b	7.334E-10 b
Uterus	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Total body	1.404E-05	1.359E-05	1.242E-05	9.790E-06	6.715E-06	4.917E-06
Adrenals	0.0 b	8.312E-35 b	1.337E-19 b	9.047E-12 b	8.113E-09 b	9.296E-08 b
Brain	0.0 b	7.261E-65 b	1.021E-34 b	4.558E-19 b	3.595E-13 b	7.621E-11 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Testes

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	1.850E-05	1.843E-05	1.414E-05	1.672E-05	1.642E-05
Stomach	2.115E-07	5.418E-07 b	5.900E-07 b	6.095E-07 b	7.118E-07
Sm. Int.	1.302E-06	1.710E-06	1.771E-06	1.670E-06	1.843E-06
U.L.I.	9.408E-07	1.702E-06	1.274E-06	1.613E-06	1.461E-06
L.L.I.	9.749E-06	8.627E-06	8.209E-06	8.347E-06	9.206E-06
Kidneys	1.123E-07	2.364E-07	4.782E-07	4.148E-07	3.672E-07
Liver	1.264E-07	1.656E-07	3.161E-07	3.662E-07	4.556E-07
Lungs	4.550E-08 b	8.497E-08 b	1.203E-07 b	1.123E-07	1.412E-07
Breasts	0.0	0.0	0.0	0.0	0.0
Ovaries	0.0	0.0	0.0	0.0	0.0
Pancreas	2.900E-07 b	3.852E-07 b	4.413E-07 b	4.675E-07 b	4.755E-07 b
Red Marrow	5.750E-06	4.827E-06	4.196E-06	4.181E-06	3.766E-06
Yellow Marrow	1.005E-06	8.577E-07	8.912E-07	9.056E-07	8.650E-07
Skelton	2.666E-06	2.249E-06	2.017E-06	2.014E-06	1.840E-06
Skin	4.053E-06	4.216E-06	4.257E-06	3.972E-06	3.385E-06
Spleen	2.330E-07 b	3.394E-07 b	3.952E-07 b	4.218E-07 b	4.317E-07 b
Testes	1.148E-03	1.228E-03	1.145E-03	1.033E-03	9.792E-04
Thymus	2.632E-08 b	5.699E-08 b	8.845E-08 b	1.090E-07 b	1.222E-07 b
Thyroid	3.699E-09 b	1.249E-08 b	2.561E-08 b	3.634E-08 b	4.450E-08 b
Uterus	0.0	0.0	0.0	0.0	0.0
Total body	4.722E-06	4.836E-06	4.620E-06	4.350E-06	4.159E-06
Adrenals	1.824E-07 b	2.646E-07 b	3.203E-07 b	3.483E-07 b	3.607E-07 b
Brain	5.911E-10 b	3.071E-09 b	8.300E-09 b	1.355E-08 b	1.812E-08 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Thyroid

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.100
Bladder	0.0	3.441E-48 b	2.184E-26 b	4.684E-15 b	8.988E-11 b
Stomach	4.843E-71 b	7.093E-27 b	4.728E-16 b	2.703E-10 b	4.729E-08 b
Sm. Int.	0.0	1.105E-37 b	2.026E-21 b	8.969E-13 b	1.949E-09 b
U.L.I.	0.0	4.165E-37 b	6.819E-21 b	1.811E-12 b	2.794E-09 b
L.L.I.	0.0	2.131E-40 b	7.587E-23 b	1.163E-13 b	4.082E-10 b
Kidneys	0.0	2.816E-31 b	4.061E-18 b	3.628E-11 b	1.683E-08 b
Liver	9.576E-69 b	5.207E-26 b	1.551E-15 b	5.223E-10 b	1.625E-07
Lungs	4.088E-27 b	1.400E-12 b	6.216E-09 b	2.021E-06	4.360E-07
Breasts	1.373E-45 b	1.545E-18 b	1.086E-11 b	5.103E-06	4.588E-06
Ovaries	0.0	1.672E-44 b	1.980E-24 b	4.728E-14 b	1.614E-06
Pancreas	1.168E-75 b	6.282E-28 b	2.686E-16 b	3.199E-10 b	3.686E-10 b
Red Marrow	7.347E-18 b	1.044E-07	1.481E-06	7.817E-06	6.467E-08 b
Yellow Marrow	1.851E-13 b	7.917E-08	1.084E-06	5.096E-06	1.215E-05
Skeleton	2.037E-10 b	1.602E-07	2.145E-06	1.003E-05	3.844E-06
Skin	2.360E-15 b	8.118E-09 b	6.187E-07	2.238E-06	7.894E-06
Spleen	0.0	3.472E-28 b	1.321E-16 b	1.797E-10 b	2.572E-06
Testes	0.0	2.061E-56 b	2.539E-30 b	7.501E-17 b	1.501E-07
Thymus	7.267E-34 b	6.889E-14 b	4.364E-09 b	8.236E-12 b	2.144E-07
Thyroid	4.278E-02	2.933E-02	1.816E-02	1.530E-06	7.408E-10 b
Uterus	0.0	4.229E-45 b	1.072E-24 b	7.289E-03	8.945E-06
Total body	1.406E-05	1.405E-05	1.392E-05	3.667E-14 b	1.417E-03
Adrenals	5.355E-73 b	4.365E-27 b	7.657E-16 b	1.260E-05	3.195E-10 b
Brain	9.361E-21 b	1.054E-10 b	6.850E-08 b	5.502E-10 b	9.039E-06
				1.059E-06	8.946E-08 b
					5.406E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Thyroid

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	1.408E-08 b	3.485E-08 b	5.887E-08 b	7.576E-08 b	8.729E-08 b	1.082E-07 b
Stomach	2.685E-07	4.192E-07	6.229E-07	6.153E-07 b	6.165E-07 b	5.917E-07 b
Sm. Int.	7.721E-08 b	8.862E-08	1.775E-07	1.416E-07	2.051E-07	1.296E-07
U.L.I.	9.553E-08 b	1.555E-07 b	2.018E-07 b	2.281E-07 b	2.423E-07 b	2.577E-07 b
L.L.I.	2.547E-08 b	5.231E-08 b	7.988E-08 b	9.818E-08 b	1.101E-07 b	1.299E-07 b
Kidneys	1.155E-07	3.204E-07	3.613E-07	4.878E-07	5.602E-07	4.443E-07 b
Liver	5.496E-07	6.261E-07	7.766E-07	8.126E-07	7.347E-07	8.166E-07
Lungs	4.236E-06	4.057E-06	4.010E-06	3.857E-06	4.022E-06	3.162E-06
Breasts	1.718E-06	1.911E-06	2.007E-06	2.346E-06	1.854E-06	2.241E-06
Ovaries	3.201E-08 b	6.637E-08 b	1.002E-07 b	1.219E-07 b	1.354E-07 b	1.567E-07 b
Pancreas	4.412E-07	6.903E-07 b	7.344E-07 b	7.481E-07 b	7.433E-07 b	6.973E-07 b
Red Marrow	4.861E-06	3.978E-06	3.657E-06	3.342E-06	3.331E-06	2.763E-06
Yellow Marrow	2.389E-06	2.031E-06	1.873E-06	1.704E-06	1.699E-06	1.420E-06
Skelton	4.881E-06	4.082E-06	3.742E-06	3.406E-06	3.384E-06	2.796E-06
Skin	2.350E-06	2.604E-06	2.518E-06	2.485E-06	2.283E-06	1.998E-06
Spleen	2.799E-07	9.521E-07	7.056E-07	9.920E-07	8.887E-07	1.041E-06
Testes	3.691E-09 b	1.247E-08 b	2.558E-08 b	3.630E-08 b	4.447E-08 b	6.170E-08 b
Thymus	1.063E-05	8.210E-06	7.946E-06	4.838E-06	6.286E-06	5.502E-06 b
Thyroid	1.556E-03	1.686E-03	1.540E-03	1.421E-03	1.298E-03	1.085E-03
Uterus	2.942E-08 b	6.206E-08 b	9.469E-08 b	1.158E-07 b	1.292E-07 b	1.506E-07 b
Total body	5.362E-06	5.277E-06	4.911E-06	4.566E-06	4.333E-06	3.599E-06
Adrenals	7.116E-07 b	8.234E-07 b	8.582E-07 b	8.650E-07 b	8.538E-07 b	7.908E-07 b
Brain	6.596E-06	7.022E-06	6.775E-06	6.378E-06	6.661E-06	5.250E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Total body

Organ	Initial photon energy (MeV)					
	0.010	0.015	0.020	0.030	0.050	0.100
Bladder	1.023E-05	1.141E-05	1.537E-05	1.020E-05	1.035E-05	6.596E-06
Stomach	1.589E-05	1.416E-05	1.417E-05	1.208E-05	9.178E-06	6.129E-06
Sm. Int.	1.390E-05	1.353E-05	1.374E-05	1.295E-05	9.907E-06	7.175E-06
U.L.I.	1.375E-05	1.388E-05	1.465E-05	1.244E-05	9.903E-06	6.982E-06
L.L.I.	1.575E-05	1.529E-05	1.601E-05	1.341E-05	1.055E-05	7.767E-06
Kidneys	1.351E-05	1.292E-05	1.270E-05	1.195E-05	7.201E-06	5.676E-06
Liver	1.483E-05	1.500E-05	1.393E-05	1.310E-05	8.741E-06	6.487E-06
Lungs	4.456E-05	3.950E-05	3.043E-05	1.987E-05	1.101E-05	6.823E-06
Breasts	1.496E-05	1.406E-05	1.214E-05	9.081E-06	5.374E-06	4.091E-06
Ovaries	1.516E-08 b	9.021E-06 b	7.355E-06 b	1.248E-05	6.714E-06	7.875E-06
Pancreas	1.279E-05	1.439E-05	1.234E-05	1.518E-05	9.496E-06	7.006E-06
Red Marrow	1.265E-05	1.417E-05	1.753E-05	2.271E-05	2.107E-05	1.180E-05
Yellow Marrow	8.184E-06	1.020E-05	1.127E-05	1.359E-05	1.131E-05	5.712E-06
Skelton	1.017E-05	1.162E-05	1.390E-05	1.703E-05	1.496E-05	7.906E-06
Skin	1.159E-05	9.199E-06	7.512E-06	5.318E-06	3.274E-06	2.613E-06
Spleen	1.406E-05	1.457E-05	1.512E-05	1.236E-05	8.729E-06	6.623E-06
Testes	1.583E-05	1.374E-05	1.577E-05	1.136E-05	6.450E-06	5.046E-06
Thymus	1.532E-05	2.963E-06 b	1.871E-05	1.075E-05	8.558E-06	7.097E-06
Thyroid	1.981E-05	1.417E-05	1.366E-05	9.298E-06	7.241E-06	6.195E-06
Uterus	1.337E-05	1.479E-05	1.616E-05	1.259E-05	9.495E-06	7.961E-06
Total body	1.390E-05	1.356E-05	1.296E-05	1.121E-05	7.934E-06	5.354E-06
Adrenals	8.698E-08 b	1.859E-05	1.319E-05	1.272E-05	6.981E-06	6.497E-06
Brain	1.363E-05	1.290E-05	1.195E-05	8.661E-06	5.317E-06	3.867E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Total body

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500	2.000	4.000
Bladder	6.640E-06	6.348E-06	5.726E-06	6.748E-06	6.474E-06	5.197E-06
Stomach	5.276E-06	7.562E-06	5.058E-06	5.820E-06	4.890E-06	4.940E-06
Sm. Int.	6.585E-06	6.691E-06	6.492E-06	6.247E-06	5.500E-06	4.491E-06
U.L.I.	6.588E-06	6.170E-06	6.122E-06	5.461E-06	4.571E-06	3.691E-06
L.L.I.	6.656E-06	7.477E-06	7.100E-06	7.150E-06	5.839E-06	4.404E-06
Kidneys	4.999E-06	5.054E-06	5.174E-06	4.991E-06	4.420E-06	3.880E-06
Liver	6.365E-06	6.016E-06	5.713E-06	5.430E-06	4.863E-06	4.048E-06
Lungs	6.619E-06	6.395E-06	6.050E-06	5.427E-06	5.273E-06	3.979E-06
Breasts	3.678E-06	3.893E-06	3.990E-06	4.035E-06	3.978E-06	3.705E-06
Ovaries	9.980E-06	7.280E-06 b	6.246E-06 b	5.610E-06 b	5.324E-06 b	4.250E-06 b
Pancreas	6.456E-06	7.602E-06	7.342E-06	5.121E-06	4.573E-06	4.471E-06
Red Marrow	7.555E-06	6.563E-06	6.001E-06	5.419E-06	5.430E-06	4.454E-06
Yellow Marrow	3.768E-06	3.377E-06	3.002E-06	3.058E-06	2.902E-06	2.402E-06
Skeleton	5.204E-06	4.575E-06	4.115E-06	3.892E-06	3.777E-06	3.142E-06
Skin	2.774E-06	3.166E-06	3.163E-06	2.874E-06	2.872E-06	2.436E-06
Spleen	6.869E-06	6.151E-06	5.293E-06	4.984E-06	5.775E-06	4.063E-06
Testes	4.887E-06	4.948E-06	4.056E-06	5.708E-06	4.828E-06	3.583E-06
Thymus	5.878E-06	6.738E-06	7.952E-06	4.794E-06 b	4.447E-06 b	7.578E-06
Thyroid	5.751E-06	3.785E-06	5.676E-06	6.447E-06	7.063E-06	3.299E-06 b
Uterus	7.290E-06	6.438E-06	4.944E-06	7.875E-06	4.844E-06	3.557E-06
Total body	4.913E-06	4.874E-06	4.611E-06	4.348E-06	4.072E-06	3.411E-06
Adrenals	5.975E-06	6.137E-06	5.909E-06 b	5.434E-06 b	4.805E-06 b	3.932E-06 b
Brain	3.747E-06	3.778E-06	3.695E-06	3.618E-06	3.354E-06	2.527E-06

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Adrenals

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	3.628E-70 b	4.407E-26 b	2.080E-15 b	8.001E-10 b	1.072E-07 b
Stomach	3.692E-29 b	9.307E-13 b	1.166E-08 b	1.703E-06	7.268E-06
Sm. Int.	9.149E-34 b	1.007E-14 b	6.878E-10 b	5.278E-07	2.736E-06
U.L.I.	9.893E-35 b	7.763E-15 b	8.965E-10 b	8.761E-07	3.883E-06
L.L.I.	2.164E-50 b	4.365E-20 b	1.059E-12 b	9.180E-09 b	2.990E-07
Kidneys	4.703E-07 b	1.361E-05	4.515E-05	6.673E-05	5.213E-05
Liver	3.002E-07	8.398E-06	2.923E-05	5.802E-05	5.178E-05
Lungs	1.996E-11 b	5.724E-07	5.163E-06	1.597E-05	1.651E-05
Breasts	3.201E-43 b	9.446E-18 b	3.179E-11 b	9.109E-07	2.952E-06
Ovaries	3.627E-56 b	2.127E-21 b	5.109E-13 b	1.358E-08 b	5.696E-07 b
Pancreas	6.364E-14 b	1.023E-07 b	1.060E-05	4.583E-05	4.829E-05
Red Marrow	5.947E-08	3.687E-06	1.633E-05	3.998E-05	2.379E-05
Yellow Marrow	1.192E-08	7.390E-07	3.278E-06	8.126E-06	5.522E-06
Skeleton	2.617E-08	1.625E-06	7.247E-06	1.776E-05	1.953E-05
Skin	1.438E-15 b	5.395E-09 b	2.215E-07	1.144E-06	1.651E-06
Spleen	3.192E-30 b	5.438E-13 b	9.715E-09 b	4.736E-07	4.794E-06
Testes	0.0	9.740E-35 b	1.328E-19 b	9.123E-12 b	8.154E-09 b
Thymus	2.466E-47 b	2.175E-18 b	2.374E-11 b	9.626E-08 b	1.547E-06
Thyroid	2.980E-73 b	5.251E-27 b	7.868E-16 b	5.582E-10 b	8.976E-08 b
Uterus	2.906E-59 b	2.735E-22 b	2.378E-13 b	9.582E-09 b	4.792E-07 b
Total body	1.406E-05	1.405E-05	1.399E-05	1.311E-05	1.026E-05
Adrenals	5.187E-02	3.256E-02	1.875E-02	6.992E-03	2.189E-03
Brain	0.0	3.883E-34 b	1.107E-19 b	5.375E-12 b	5.321E-09 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Adrenals

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	2.417E-07	8.670E-07 b	8.970E-07 b	9.010E-07 b	8.873E-07 b
Stomach	8.139E-06	6.862E-06	6.226E-06	5.143E-06	6.023E-06
Sm. Int.	3.681E-06	3.692E-06	3.599E-06	3.890E-06	3.663E-06
U.L.I.	4.207E-06	4.045E-06	3.382E-06	4.098E-06	4.443E-06
L.L.I.	8.890E-07	1.149E-06	1.035E-06	1.148E-06	1.046E-06
Kidneys	3.477E-05	3.562E-05	3.154E-05	2.854E-05	2.550E-05
Liver	3.175E-05	3.018E-05	2.739E-05	2.458E-05	2.359E-05
Lungs	1.129E-05	1.049E-05	9.669E-06	9.195E-06	8.255E-06
Breasts	3.403E-06	3.685E-06	3.582E-06	2.851E-06	3.286E-06
Ovaries	2.071E-06 b	2.017E-06 b	1.915E-06 b	1.847E-06 b	1.765E-06 b
Pancreas	3.346E-05	3.366E-05	2.708E-05	2.678E-05	2.273E-05
Red Marrow	1.506E-05	1.254E-05	1.133E-05	1.022E-05	9.890E-06
Yellow Marrow	3.656E-06	3.067E-06	2.830E-06	2.563E-06	2.523E-06
Skelton	6.720E-06	5.602E-06	5.131E-06	4.635E-06	4.543E-06
Skin	1.709E-06	2.015E-06	2.017E-06	1.865E-06	1.919E-06
Spleen	7.555E-06	7.106E-06	6.645E-06	6.897E-06	6.751E-06
Testes	1.827E-07 b	2.648E-07 b	3.205E-07 b	3.484E-07 b	3.609E-07 b
Thymus	2.790E-06	2.624E-06	1.491E-06	3.240E-06 b	3.054E-06 b
Thyroid	7.123E-07 b	8.092E-07 b	8.450E-07 b	8.526E-07 b	8.420E-07 b
Uterus	1.324E-06	1.366E-06	1.445E-06	1.509E-06	1.793E-06
Total body	6.375E-06	6.204E-06	5.799E-06	5.400E-06	5.147E-06
Adrenals	1.483E-03	1.606E-03	1.530E-03	1.380E-03	1.275E-03
Brain	4.304E-08	7.013E-08	1.263E-07	1.685E-07	1.924E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of St wall

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	4.436E-46 b	7.784E-19 b	4.199E-12 b	1.891E-08 b	5.306E-07 b
Stomach	5.424E-03	3.53E-03	2.258E-03	1.059E-03	4.183E-04
Sm. Int.	3.651E-07	1.118E-06	2.696E-06	8.926E-06	1.317E-05
U.L.I.	3.608E-07 b	3.958E-06	1.073E-05	1.964E-05	1.829E-05
L.L.I.	1.123E-15 b	5.037E-09 b	8.246E-07	4.079E-06	6.361E-06
Kidneys	8.616E-20 b	5.628E-10 b	5.816E-07	8.783E-06	1.589E-05
Liver	8.234E-15 b	9.565E-09 b	7.859E-07	4.761E-06	8.648E-06
Lungs	1.465E-14 b	7.184E-07	2.817E-06	7.165E-06	7.776E-06
Breasts	1.972E-24 b	4.120E-12 b	7.889E-09 b	1.252E-06	3.261E-06
Ovaries	1.519E-32 b	2.250E-14 b	7.271E-10 b	2.405E-07 b	2.235E-06 b
Pancreas	2.317E-06	3.825E-05	9.297E-05	1.400E-04	1.017E-04
Red Marrow	2.396E-13 b	2.719E-07	1.684E-06	5.378E-06	8.998E-06
Yellow Marrow	8.068E-16 b	2.187E-08	1.717E-07	1.293E-06	3.973E-06
Skelton	3.568E-12 b	1.746E-07	1.082E-06	3.473E-06	5.694E-06
Skin	3.788E-14 b	7.493E-08	5.534E-07	1.724E-06	1.926E-06
Spleen	2.935E-12 b	3.546E-07 b	1.410E-05	5.380E-05	5.979E-05
Testes	7.527E-72 b	4.280E-27 b	3.540E-16 b	2.351E-10 b	4.479E-08 b
Thymus	1.288E-41 b	5.815E-17 b	6.151E-11 b	9.526E-08 b	1.577E-06
Thyroid	3.481E-71 b	7.219E-27 b	5.157E-16 b	2.783E-10 b	4.785E-08 b
Uterus	3.122E-38 b	5.617E-16 b	1.661E-10 b	1.483E-07 b	2.468E-06
Total body	1.406E-05	1.405E-05	1.390E-05	1.266E-05	9.382E-06
Adrenals	2.407E-29 b	8.777E-13 b	1.140E-08 b	1.031E-05	1.608E-05
Brain	0.0	5.245E-35 b	2.158E-20 b	1.484E-12 b	2.050E-09 b

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of St wall

Organ	Initial photon energy (MeV)					
	0.200	0.500	1.000	1.500		
					2.000	4.000
Bladder	1.077E-06	1.677E-06	1.634E-06	1.635E-06 b	1.571E-06 b	1.381E-06 b
Stomach	2.552E-04	2.685E-04	2.500E-04	2.291E-04	2.080E-04	1.685E-04
Sm. Int.	9.584E-06	9.347E-06	9.128E-06	7.919E-06	7.878E-06	6.456E-06
U.L.I.	1.273E-05	1.145E-05	1.073E-05	1.104E-05	9.411E-06	7.390E-06
L.L.I.	5.589E-06	5.498E-06	4.749E-06	4.951E-06	4.895E-06	4.820E-06
Kidneys	1.176E-05	1.096E-05	1.088E-05	8.971E-06	8.936E-06	6.213E-06
Liver	7.036E-06	6.596E-06	6.482E-06	6.123E-06	5.737E-06	5.021E-06
Lungs	5.459E-06	5.421E-06	5.066E-06	4.867E-06	4.424E-06	3.559E-06
Breasts	2.972E-06	3.797E-06	3.093E-06	3.744E-06	4.175E-06	3.072E-06
Ovaries	1.609E-06	3.763E-06 b	3.389E-06 b	3.203E-06 b	2.994E-06 b	2.552E-06 b
Pancreas	5.686E-05	5.081E-05	5.032E-05	4.506E-05	4.250E-05	3.499E-05
Red Marrow	4.393E-06	3.391E-06	3.110E-06	2.981E-06	2.929E-06	2.472E-06
Yellow Marrow	2.001E-06	1.697E-06	1.602E-06	1.519E-06	1.633E-06	1.348E-06
Skeleton	2.622E-06	2.106E-06	1.963E-06	1.898E-06	1.865E-06	1.583E-06
Skin	1.892E-06	2.122E-06	2.082E-06	2.059E-06	1.964E-06	1.594E-06
Spleen	3.459E-05	3.414E-05	3.178E-05	2.726E-05	2.518E-05	2.122E-05
Testes	4.469E-07 b	5.381E-07 b	5.911E-07 b	6.059E-07 b	6.114E-07 b	5.799E-07 b
Thymus	1.561E-06	3.107E-06 b	2.855E-06 b	2.696E-06 b	2.550E-06 b	2.178E-06 b
Thyroid	4.345E-07 b	5.290E-07 b	5.978E-07 b	5.980E-07 b	6.173E-07 b	5.883E-07 b
Uterus	2.356E-06	2.897E-06	2.946E-06	3.283E-06	2.520E-06	2.206E-06
Total body	6.029E-06	5.934E-06	5.586E-06	5.242E-06	4.953E-06	4.134E-06
Adrenals	1.406E-05	1.045E-05	1.185E-05	5.638E-06	1.150E-05	5.521E-06 b
Brain	7.400E-08 b	6.682E-08	1.426E-07	1.263E-07	1.254E-07	2.479E-07

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Brain

Organ	Initial photon energy (MeV)				
	0.010	0.015	0.020	0.030	0.050
Bladder	0.0	3.750E-57 b	4.725E-31 b	2.229E-17 b	3.532E-12 b
Stomach	0.0	1.226E-35 b	8.560E-21 b	1.129E-12 b	1.821E-09 b
Sm. Int.	0.0	4.254E-46 b	7.921E-26 b	5.019E-15 b	7.993E-11 b
U.L.I.	0.0	5.805E-46 b	1.812E-25 b	9.219E-15 b	1.163E-10 b
L.L.I.	0.0	4.004E-49 b	2.247E-27 b	5.510E-16 b	1.646E-11 b
Kidneys	0.0	3.919E-39 b	2.463E-22 b	2.748E-13 b	8.840E-10 b
Liver	0.0	8.528E-35 b	3.664E-20 b	2.412E-12 b	2.882E-09 b
Lungs	5.097E-46 b	1.767E-19 b	1.048E-12 b	4.568E-09 b	2.036E-07
Breasts	2.830E-72 b	1.609E-27 b	2.091E-16 b	1.881E-10 b	4.172E-08 b
Ovaries	0.0	3.372E-53 b	5.451E-29 b	2.519E-16 b	1.550E-11 b
Pancreas	0.0	1.246E-36 b	7.922E-21 b	1.606E-12 b	2.639E-09 b
Red Marrow	1.543E-06	5.469E-06	1.212E-05	2.169E-05	1.756E-05
Yellow Marrow	1.177E-06	4.172E-06	9.217E-06	1.641E-05	1.289E-05
Skeleton	2.392E-06	8.477E-06	1.877E-05	3.340E-05	2.651E-05
Skin	7.708E-09 b	1.489E-06 b	1.291E-07	1.180E-06	2.076E-06
Spleen	0.0	3.951E-36 b	7.653E-21 b	1.159E-12 b	2.092E-09 b
Testes	0.0	1.764E-65 b	4.580E-35 b	3.348E-19 b	3.087E-13 b
Thymus	1.191E-61 b	1.439E-23 b	3.125E-14 b	2.616E-09 b	2.040E-07 b
Thyroid	2.527E-23 b	1.721E-11 b	2.224E-08 b	1.965E-06 b	6.330E-06
Uterus	0.0	7.055E-54 b	2.854E-29 b	1.875E-16 b	1.309E-11 b
Total body	1.406E-05	1.406E-05	1.402E-05	1.288E-05	8.414E-06
Adrenals	0.0	5.822E-35 b	4.573E-20 b	3.799E-12 b	4.545E-09 b
Brain	7.206E-04	6.726E-04	5.901E-04	3.942E-04	1.911E-04

The values accompanied by letter b are estimated by build-up factor method

Specific absorbed fraction for photon
from source of Brain

Organ	Initial photon energy (MeV)				
	0.200	0.500	1.000	1.500	2.000
Bladder	2.179E-09 b	8.249E-09 b	1.834E-08 b	2.705E-08 b	3.395E-08 b
Stomach	7.004E-08 b	1.186E-07 b	1.608E-07 b	1.854E-07 b	1.855E-07 b
Sm. Int.	1.240E-08 b	3.119E-08 b	5.345E-08 b	6.935E-08 b	8.034E-08 b
U.L.I.	1.519E-08 b	3.632E-08 b	6.034E-08 b	7.713E-08 b	8.853E-08 b
L.L.I.	4.056E-09 b	1.238E-08 b	2.455E-08 b	3.446E-08 b	4.203E-08 b
Kidneys	4.903E-08 b	9.171E-08 b	1.301E-07 b	1.537E-07 b	1.676E-07 b
Liver	4.272E-08	1.496E-07	1.606E-07	2.224E-07	2.841E-07
Lungs	4.213E-07	5.948E-07	7.865E-07	9.484E-07	7.849E-07
Breasts	4.376E-07 b	4.070E-07	3.613E-07	5.189E-07	5.497E-07
Ovaries	5.161E-09 b	1.600E-08 b	3.120E-08 b	4.318E-08 b	5.208E-08 b
Pancreas	9.236E-08 b	1.521E-07 b	1.995E-07 b	2.261E-07 b	2.404E-07 b
Red Marrow	5.116E-06	4.496E-06	4.188E-06	3.891E-06	3.706E-06
Yellow Marrow	3.529E-06	3.098E-06	2.856E-06	2.656E-06	2.505E-06
Skeleton	7.351E-06	6.430E-06	5.912E-06	5.482E-06	4.252E-06
Skin	2.029E-06	2.398E-06	2.417E-06	2.342E-06	5.166E-06
Spleen	7.849E-08 b	1.329E-07 b	1.777E-07 b	2.045E-07 b	2.125E-06
Testes	5.514E-10 b	2.925E-09 b	7.998E-09 b	1.312E-08 b	2.188E-07 b
Thymus	1.098E-06 b	1.161E-06 b	1.162E-06 b	1.148E-06 b	1.761E-08 b
Thyroid	5.933E-06	7.405E-06	8.249E-06	7.274E-06	1.012E-06 b
Uterus	4.691E-09 b	1.489E-08 b	2.943E-08 b	4.101E-08 b	5.528E-06 b
Total body	4.158E-06	4.142E-06	3.893E-06	3.648E-06	6.735E-06 b
Adrenals	1.273E-07 b	1.967E-07 b	2.481E-07 b	2.755E-07 b	4.968E-08 b
Brain	1.149E-04	1.172E-04	1.073E-04	9.959E-05	2.822E-06
					3.011E-07 b
					7.331E-05

The values accompanied by letter b are estimated by build-up factor method