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Monte Carlo Photon Codes: MCG and MCP

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ABSTRACT

A description of the Monte Carlo photon codes, MCG and MCP, is given. Since these codes contain many features in common with the Monte Carlo neutron code MCN, which is described in LA-4751, we concentrate on the details peculiar to processing photons in each of these programs. This report leans heavily on LA-4751 and is intended to be used in conjunction with it when dealing with a photon problem. The parts of the photon codes which are the same as in MCN are clearly indicated.

In Part I, an account is given of MCG. This code is suitable for solving a wide variety of gamma transport problems. The physical processes treated are pair production, Compton scattering, and photoelectric absorption. The collision routine assumes photons with energies between 1 keV and 100 MeV. The possible sources, geometry, and output available to the user are described, together with the Monte Carlo methods and cross section data employed.

Part II describes MCP, which has a more sophisticated Monte Carlo collision routine for photons of energy 1 keV to 15 MeV colliding with atoms of $Z = 1, 2, \dots, 94$ at rest. The routine takes account of incoherent and coherent scattering factors, and of the possibility of fluorescent emission following photo-electric absorption, as well as absorption in pair production with local emission of annihilation radiation.

In Part III, a sample problem is set up and run using both MCG and MCP, with the complete computer listing displayed in each case.

PART I

MCG: A MONTE CARLO GAMMA CODE FOR HIGH ENERGY PHOTON TRANSPORT

A. INTRODUCTION

The Monte Carlo gamma code MCG has many features in common with the neutron code MCN, which is described in LA-4751.¹ In the interests of brevity, we will not describe in detail the features which are the same in the two codes but merely point out

that they are identical, and we refer the reader to LA-4751 for the details.

Setting up a problem for MCG is quite similar to setting up one for MCN, with only a few differences resulting from the altered collision routine

for photons as well as from the slight modifications of the output tallies.

The units used in MCG are the same as those used in MCN and are as follows:

1. Lengths in centimeters.
2. Times in shakes (10^{-8} sec).
3. Energies in MeV.
4. Atomic densities in units of 10^{24} atoms/cm³.
5. Cross sections in barns (10^{-24} cm²).

B. GEOMETRY

The three-dimensional geometry package in MCG is identical to that in MCN. The code will handle spatial cells bounded by first- and second-degree surfaces, as well as some fourth-degree surfaces (elliptical tori). The reader is strongly urged to read the description of the geometry in LA-4751, since the most common errors made in setting up a problem occur in specifying the geometry.

C. COLLISION ROUTINE

The physical processes treated are photoelectric effect, pair production, and Compton scattering on free electrons (alternatively, the code provides for Thomson scattering in place of Compton scattering, at the option of the user). These are more fully described in the following.

Since the code is intended primarily for higher energy photons, the photoelectric effect is regarded as an absorption (without fluorescence), scattering (Compton) is on free electrons (without use of form factors), and the highly forward coherent scattering is ignored. Thus the total cross section σ_t is regarded as the sum of three components.

$$\sigma_t = \sigma_{pe} + \sigma_{pp} + \sigma_s$$

(An alternative code, MCP, designed to incorporate low energy effects, is another of our family of Monte Carlo codes. This code deals with fluorescent re-emission, in addition to coherent and incoherent scattering as influenced by the appropriate form factors cf. Part II.)

1. Cross Sections. The Howerton Photon Interaction Library in ENDF/B format (Ref: UCRL-50400, Vol. VI) was the source of cross sections used in the code. The latter yields tables of values of

$\sigma_{pe}^1(Z)$, $\sigma_{pp}^1(Z)$, $\sigma_s^1(Z)$, and $\sigma_t^1(Z)$ for elements with the atomic numbers $Z = 1, 2, \dots, 83, 86, 90, 92$, and 94 at a common sequence of 166 energies E_i , $i = 1, 2, \dots, 166$. These energies include the photoelectric edges above 10 keV of all elements provided for and were otherwise so chosen that linear interpolation yields good accuracy at intermediate points. Always consecutive energy values are spaced so that the change in energy is 10% or less.

An initiation code prepares, for each material region in the problem, a single list of macroscopic total cross sections Σ_t^1 and required probabilities. This is a simplification allowed by the use of an energy mesh common to all elements Z , and it allows considerable saving in machine time for problems involving highly composite media.

2. Photoelectric Effect. This is treated as an absorption, with a corresponding reduction in the photon weight W , and hence does not result in the loss of a particle history. On every collision, the weight $W \sigma_{pe}/\sigma_t$ and energy $EW \sigma_{pe}/\sigma_t$ are tallied in the appropriate bins. The non-captured weight $W(1 - \sigma_{pe}/\sigma_t)$ is then forced to suffer either pair production or Compton scattering with the proper dependent probabilities.

3. Pair Production. In a collision resulting in pair production (probability $\sigma_{pp}/(\sigma_t - \sigma_{pe})$), it is assumed that the kinetic energy $W(E - 1.022)$ MeV of the electron-positron pair produced is deposited as thermal energy at the time and point, with isotropic production of one gamma of energy 0.511 MeV, and weight $2W$, which is followed further.

4. Compton Scattering. The alternative to pair production (when both are possible) is Compton scattering on a free electron, with probability $\sigma_s/(\sigma_t - \sigma_{pe})$. In the event of such a collision, the objective is to determine the energy E' of the scattered photon, and $\mu = \cos \theta$ for the angle θ of deflection from the line of flight. This yields at once the energy $W(E - E')$ deposited at the point of collision and the new direction of the scattered photon.

The differential cross section for the process is given by the Klein-Nishina formula

$$K(\alpha, \mu) d\mu = \pi r_0^2 (\alpha'/\alpha)^2 (\alpha'/\alpha + \alpha/\alpha' + \mu^2 - 1) d\mu,$$

where r_0 is the classical electron radius, α and α' are the incident and final photon energies in units of 0.511 MeV ($\alpha = E/(mc^2)$, where m is the mass of the electron and c is the speed of light), and

$$\alpha' = \alpha/[1 + \alpha(1 - \mu)]$$

Changing variables from μ to $x = 1/[1 + \alpha(1 - \mu)]$ on $\xi \equiv (1 + 2\alpha)^{-1} < x < 1$, one finds the probability density function for x to be

$$p(x) = g(x)/G(\xi)$$

$$\text{where } g(x) = x + x^{-1} + \mu^2 - 1$$

$$\mu = 1 + \alpha^{-1} - (\alpha x)^{-1}$$

$$\text{and } G(x) = \int_x^1 g(x)dx$$

Thus, a random number r determines x by the implicit relation

$$r = G(x)/G(\xi)$$

and consequently the required $\mu = 1 + \alpha^{-1} - (\alpha x)^{-1}$ and $\alpha' = \alpha x$, $E' = 0.511 \alpha'$.

An accurate approximation^{2,3} for the inverse $x = H(y)$ of the function $y = G(x)$ allows rapid determination of $x = H[rG(\xi)]$, and this is now used in place of earlier methods.

5. Thomson Scattering. One may optionally choose Thomson scattering in place of the Klein-Nishina scattering function. Here the photon scatters with the probability density function in μ given by

$$p(\mu)d\mu = \frac{3}{8} (1 + \mu^2)d\mu$$

with no loss in energy. If a table of values for μ_1 is stored, where

$$\frac{1}{N} = \frac{3}{8} \int_{\mu_1}^1 (1 + \mu^2)d\mu, \quad i = 0, 1, \dots, N$$

then by choosing the integer i randomly on its range yields N equally likely discrete scattering cosines μ_1 . In the present code $N = 128$ (a power of two is used because of the ease of selecting i on a binary machine). One may, if more accuracy is desired, linearly interpolate between these equally likely values of μ_1 but the present code does not include this feature.

D. ESTIMATION OF ERRORS

The error analysis in MCG is identical to that in MCN, and we refer the reader to Sec. IV of LA-4751. In brief, for the tallies printed out, the code gives the relative error in the quantity scored, defined as the ratio of one standard deviation to the sample mean.

E. SAMPLING TECHNIQUES

The discussion in MCN carries over verbatim to MCG, with the same options available in the latter code.

Standard Tallies. Same as in MCN, with the same definitions used for currents and fluxes as in the neutron code. (The reader accustomed to the use of other terms such as flux and mean intensity for what we call current and flux, respectively, should take careful note of the fact that we are using terminology commonly used in neutron transport theory.)

F. EXECUTION OF MONTE CARLO PROGRAMS

(In the following, much of the description for MCG is the same as for MCN--simply substitute MCG for MCN, and MCGI, the initiation code, for the corresponding neutron initiation code, MCNI.) We shall list below the photon programs corresponding to those listed in LA-4751. When they are identical, except for the obvious changes mentioned above, we shall simply indicate by the words "same as in MCN".

1. Initiation. Same as in MCN.

2. Running. Same as in MCN, except that the run card has a different format. Now the 2nd entry on the run card is weight WR , and the 8th entry (the run card in MCN has only 7 entries) is a weight $WC < WR$. (Both WR and WC are set by the user, subject to the condition $WR > WC$). When the weight W of a photon has $W < [WC \cdot I(\text{source})]/I(n)$ -- where $I(\text{source})$ is the importance of the source region and $I(n)$ is the importance of cell n where the photon

is located -- then if a random number $r < W/[WR \cdot I(\text{source})/I(n)]$, the weight of the photon is taken to be $[WR \cdot I(\text{source})]/I(n)$; otherwise the photon history is terminated.

3. File Manipulation. Same as in MCN.

4. Card Format. Same as in MCN.

5. Problem ID Card. Same as in MCN.

6. Cell Cards. Same as in MCN.

7. Surface Cards. Same as in MCN.

8. Data Cards.

a. Cell Specification Cards. Cards IO and Y6 apply to MCG in exactly the same manner as in MCN. The thermal specification cards R0, R1, ..., Rn do not apply. The Y7 card in MCG specifies the energy cutoff for each cell, below which energy the photon is dropped and not followed further.

b. Source Cards. Same as in MCN.

c. L Card. Does not apply to MCG.

d. Function Cards. The description in LA-4751 of these cards carries over to MCG, with a couple of exceptions.

(1) The first exception is for $n = 5$: Flux tally at points. In addition to the F5, E5, and T5 cards, an additional card, called the A card, has been added. This card contains the list of

cells which contribute to the fluxes at the point detectors; that is, collisions in these cells, and only these cells, are allowed to contribute to the flux at each of the designated points. If the A card is missing, collisions in all cells contribute to the fluxes at the point detectors.

(2) The second exception occurs for $n = 6$: Capture tally in cells. Here MCG departs from MCN. MCG automatically (without any action on the part of the user) gives for each cell in the problem the number (i.e., the weight) and energy of photons captured (from the photoelectric effect), the number and energy of photons lost to energy cutoff, the number of photons creating a pair and the energy lost in the process, and the energy lost in Compton scattering collisions.

e. DO Card. This section does not apply. A DO card in MCG means that Thomson scattering replaces Compton scattering. The energy cutoff in MCG is given per cell and, as described above, appears on the Y7 card.

f. Material Cards. The section applies to MCG if the nuclide cross section ID is replaced by the Z (atomic number) of the element.

APPENDIX A CONTROL CARD DECKS

Same as in MCN.

APPENDIX B SOURCE SUBROUTINES

Same as in MCN, except for Sec. V - Random Number Generators. The function FRNS (KRN) is replaced by $2*FRN(KRN) - 1$.

PART II

MCP: A GENERAL MONTE CARLO PHOTON CODE

A. INTRODUCTION

The general photon code MCP has many features in common with the gamma code MCG, namely, the variety of sources, the output, the variance reducing techniques, and the general geometry routine. In fact, the two codes are virtually identical to use. However, the collision subroutine in MCG was intended only for photons of relatively high energy, with fluorescence and coherent scattering ignored, and incoherent scattering subject to the unmodified Klein-Nishina cross section for free electrons.⁴

The code MCP, for photons of energies 1 keV to 15 MeV, contains a new collision routine, described below, providing for fluorescent emission, and the modification of Thomson and Klein-Nishina differential cross sections by appropriate form factors which take binding effects into account.

A library tape (LT) has been prepared, incorporating all constants required by the collision code, for elements $Z = 1, \dots, 94$, in a form designed to expedite computation.

B. FREE PATH

The LT contains, for each Z , a table of the logarithms $L_1(Z) = \ln E_1(Z)$ of suitable energies, including the photoelectric edges, and a matrix $L_1^j(Z) = \ln \sigma_1^j(Z)$, listing for $j = 1, 2, 3, 4$, the logs of corresponding cross sections (when the latter are nonzero) for incoherent scattering, coherent scattering, photoelectric effect, and pair production, respectively. The recent compilation of data by Storm and Israel⁵ was used, for all listed energies $E_1 \leq 15$ MeV. In the case of scattering ($j = 1, 2$) the cited total cross sections were obtained by numerical integration, based on the same form factors used in the Monte Carlo treatment of such collisions, and referred to below.

In the collision code, a photon of energy E , starting from a point of a particular medium, has a free path

$$\lambda = 1 / \left[\sum_Z N(Z) \sum_1^4 \sigma^j(Z) \right] ,$$

where Z runs over all elements present in the medium, $N(Z)$ is the corresponding numerical density, and $\sigma^j(Z)$ is the cross section for process j , each log-log interpolated to energy E . A random number r on $(0, 1)$ then determines the (infinite medium) distance to collision, $d = -\lambda \ln r$; and the eventuality of escape from, or collision within, the current region, follows from the geometry routine of MCP.

In the event of collision, two random numbers, r_1 and r_2 , serve to designate the element Z hit, and the process j responsible. The former results from a comparison of r_1/λ with the partial Z -sums obtained above, and present in the memory. The latter process j is determined by a similar comparison of $r_2 \sum_1^4 \sigma^j(Z)$ with the partial sums involved, the individual $\sigma^j(Z)$ being also retained from the λ computation.

Note on Interpolation. Log-log interpolation for the partial cross sections σ^j , at an energy E between tabulated energies $E_{i-1} < E_i$, leads to the result

$$\sigma^j = (\sigma_{i-1}^j)^a (\sigma_i^j)^b ,$$

where $a = (\ln E_i - \ln E) / (\ln E_i - \ln E_{i-1})$, $a + b = 1$, $a, b > 0$. It is expedient to regard as the total cross section, and as the probability of process j at energy E , the values of σ and σ^j/σ , where σ is the sum $\sum_1^4 \sigma^j$ of the σ^j so found, and not the log-log interpolated value σ' of the total cross section. For, the relation

$$\begin{aligned} \sigma &= \sum_j \sigma^j = \sum_j (\sigma_{i-1}^j)^a (\sigma_i^j)^b < \left(\sum_j \sigma_{i-1}^j \right)^a \\ &\quad \times \left(\sum_j \sigma_i^j \right)^b = \sigma' \end{aligned}$$

is an obvious consequence of Hölder's inequality,

$$\sum x_j y_j < \left(\sum x_j^{1/a} \right)^a \left(\sum y_j^{1/b} \right)^b ,$$

strict unless $y_j^{1/b} \equiv kx_j^{1/a}$.

Hence, in practice one has $\sigma < \sigma'$, and use of σ' in place of σ may lead to absurdities; e.g., pair production, determined above by default (after the other three processes are tested), would occur at all energies $E \geq 1$ keV.

This shows that adoption of log-log interpolated partial cross sections is inconsistent with a log-log interpolated total cross section.

C. INCOHERENT SCATTERING

The objective, in the event of such a process ($j = 1$), is to determine the angle θ of scattering from the incident line of flight (and thus the new direction via the general code), the new energy E' of the photon, and the local energy deposition $E - E'$ (the recoil k.e. of the electron).

Incoherent scattering is assumed to have the differential cross section $\sigma^1(Z, \alpha, \mu) d\mu = I(Z, v) \times K(\alpha, \mu) d\mu$, where $I(Z, v)$ is an appropriate scattering factor, modifying the Klein-Nishina (K-N) cross section

$$K(\alpha, \mu) d\mu = \pi r_0^2 \left(\frac{\alpha'}{\alpha} \right)^2 \left| \frac{\alpha'}{\alpha} + \frac{\alpha}{\alpha'} + \mu^2 - 1 \right| d\mu.$$

As is customary, α and α' denote the incident and scattered photon energies, respectively, in units of electron rest energy mc^2 , $\alpha' = \alpha/[1 + \alpha(1 - \mu)]$, $\mu = \cos \theta$, and $r_0 = e^2/mc^2 = 2.81776 \times 10^{-13}$ cm, the "classical electron radius".

Qualitatively, the effect of $I(Z, v)/Z$ is to decrease the K-N cross section (per electron) more extremely in the forward direction, for low E and for high Z independently. For any Z , $I(Z, v)$ increases from $I(Z, 0) = 0$ to $I(Z, \infty) = 2$. The parameter $v = v(\alpha, \mu)$ is a given function of α and μ which, for a particular incident energy α , increases from $v(\alpha, 1) = 0$ at $\mu = 1$ to a maximum value $\tilde{v} = v(\alpha, -1)$ at $\mu = -1$. The essential features of $I(Z, v)$ are indicated in Fig. 1.

The complete tabulations of Cromer and Mann^{6,7} (and of Brown⁸ for a few low Z) are used for all $Z \geq 2$, $v \leq 8$, and we set $I(Z, v) \equiv Z$ for $v > 8$. These tables, for $v_1 = 0, \dots, v_{21} = 8$, are recorded without change on the LT, and those required form

Fig. 1. Incoherent scattering factor.

part of problem storage. Linear interpolation is used as necessary. The parameter v is here the inverse length $v = \sin \frac{1}{2} \theta / \lambda (A) = K\alpha\sqrt{1 - \mu}$, $K = 10^{-8} mc/(\sqrt{2} h) = 29.1445 \text{ cm}^{-1}$, with maximal value $\tilde{v} = \sqrt{2} K\alpha$ for given α .

For $Z = 1$, we use the exact formula⁹ $I(1, v) = 1 - (1 + v^2)^{-4}$, with the dimensionless parameter $v = a m c \alpha \sqrt{2(1 - \mu)} / 2h = K' \alpha \sqrt{1 - \mu}$, $K' = hc/\sqrt{2} e^2 = 96.9014$, $\tilde{v} = \sqrt{2} K' \alpha$. Here $a = h^2/me^2$ is the first "Bohr radius".

The method of sampling for $\mu = \cos \theta$, in both coherent and incoherent scattering, is based on the following:

Principle. Let $P(y) = C_0 F(y) Q(y)$ on (a, b) , where $P(y)$ and $Q(y)$ are probability densities, $0 < F(y) \leq 1$, and $C_0 > 1$ is a constant. If a particle is tentatively assigned to $(y, y + dy)$ with probability $Q(y)dy$, but the assignment is ratified only with probability $F(y)$, the process being iterated with probability $1 - \int_a^b F(y)Q(y)dy$, then the probability of the particle being definitely assigned to $(y, y + dy)$ is $P(y)dy$. (The value of C_0 is irrelevant for the process). For, $\int_a^b F(y)Q(y)dy = C_0^{-1} < 1$, and the probability in question is seen to be

$$\sum_{k=0}^{\infty} F(y)Q(y)dy (1 - C_0^{-1})^k = C_0 F(y)Q(y)dy = P(y)dy.$$

To apply this to incoherent scattering, we write $\sigma_t^1(Z, \alpha)$ and $\sigma_t(\alpha)$ for the total incoherent and

K-N cross sections, and express the probability density for scattering into $(\mu, \mu + d\mu)$ in the form

$$P(\mu) \equiv p^1(\mu) \equiv \sigma^1(Z, \alpha, \mu) / \sigma^1(Z, \alpha) = \frac{I(Z, \bar{v}) \sigma^1_t(\alpha)}{\sigma^1_t(Z, \alpha)}$$

$$\times \frac{I(Z, \bar{v})}{I(Z, \bar{v})} \times \frac{K(\alpha, \mu)}{\sigma^1_t(\alpha)} = C_0 \times F(\mu) \times Q(\mu)$$

We therefore assign μ tentatively with K-N probability $Q(\mu)d\mu$, ratifying with probability $F(\mu) = I[Z, v(\alpha, \mu)] / I(Z, \bar{v}) \leq 1$.

The tentative choice of μ is effected indirectly as follows. Taking in place of μ the variable $x = 1/[1 + \alpha(1 - \mu)]$ on the interval $\xi \equiv 1/(1 + 2\alpha) < x < 1$, and defining $p(x)dx = Q(\mu)d\mu$, one finds that $p(x) = g(x)/G(\xi)$, where $g(x) = x + x^{-1} + \mu^2 - 1$, $\mu \equiv 1 + \alpha^{-1} - (\alpha x)^{-1}$, and in general,

$$G(x) \equiv \int_x^1 g(x)dx$$

Thus we may determine x by $r = G(x)/G(\xi)$, where r is random on $(0, 1)$, and so obtain μ with the required density $Q(\mu)$. A recently obtained approximation^{2,3} for the inverse $x = H(y)$ of the function $y = G(x)$ allows rapid and accurate determination of $x = H[rG(\xi)]$.

Having obtained μ , and $\alpha' = \alpha x$, the final energy of the photon is $E' = mc^2 \alpha'$, and one deposits the energy $E - E'$ locally. If $E' < 1$ keV, E' is tallied in a cut-off bin and one returns to the source subroutine of the general code. Otherwise the new direction is found from μ , and one returns to the free path routine.

For the point detector routine of the general code, one requires, for a given μ (determined by the detector position), the probability of (incoherent) scattering to the angular range $(\mu, \mu + d\mu)$, $p^1(\mu)d\mu = I(Z, v)K(\alpha, \mu)d\mu / \sigma^1_t(Z, \alpha)$. The values of πr_0^2 and of $\alpha'/\alpha = 1/[1 + \alpha(1 - \mu)]$ are needed in $K(\alpha, \mu)$; $I(Z, v)$ is obtained by linear interpolation at the computed value of $v = v(\alpha, \mu)$; and $\sigma^1_t(Z, \alpha) = \sigma^1_t(Z)$, at the incident energy E , is recoverable from the free path routine.

Note on Momentum Transfer to the Electrons.

The parameter v above is, except for constants, the

momentum $q = \alpha\sqrt{2(1 - \mu)}$ (units of mc). The latter seems to be used exclusively in theoretical computation of incoherent scattering factors. The following comparison of q with the relativistic momentum transfer q' to the electron in Compton (elastic) scattering of photons on free electrons at rest may therefore be of interest. In this connection, see the SORS¹⁰ and Union Carbide¹¹ reports.

Since $\alpha' = \alpha/[1 + \alpha(1 - \mu)]$, we have $k = \alpha - \alpha' = \alpha \alpha'(1 - \mu)$ for the k.e. of the recoil electron, and $E = k + 1$ for its energy (units of mc^2). Thus $E^2 - 1 = k(k + 2) = (\alpha - \alpha')^2 + 2\alpha\alpha'(1 - \mu) = \alpha^2 + \alpha'^2 - 2\alpha\alpha'\mu$, and the electron momentum is

$$q = (E^2 - 1)^{1/2} = \alpha[1 + (\alpha'/\alpha)^2 - 2(\alpha'/\alpha)\mu]^{1/2},$$

(units of mc)

as compared with $q = \alpha\sqrt{2(1 - \mu)}$. To say $q' \approx q$ for $\alpha' \approx \alpha$ is not very revealing, since μ is a function of α' such that $\mu \rightarrow 1$ as $\alpha' \rightarrow \alpha$. Clearly, however, $q = 0 = q'$ exactly for $\mu = 1$.

Fixing $\alpha > 0$, and setting $x = 1 - \mu$, $0 < x \leq 2$, one finds that $F(x) \equiv q^2/q'^2 = (1 + \alpha x)^2/D$, $D = 1 + \frac{1}{2}(\alpha^2 + 2\alpha)x > 1$. Thus $F(0^+) = 1$ and $F(2) = (1 + 2\alpha)^2/(1 + \alpha)^2 > 1$. Differentiation yields $\alpha^{-1}(1 + \alpha x)^{-1}D^2 F'(x) = (1 - \frac{\alpha}{2}) + (\frac{\alpha}{2} + \alpha)x$.

Case I. ($\alpha \leq 2$). Since $F'(x) > 0$, q/q' increases from 1 to $(1 + 2\alpha)/(1 + \alpha) > 1$, and the "relative error" $t(x) = q/q' - 1$ rises from 0 to its maximum value $\alpha/(1 + \alpha)$ at $\mu = -1$. For $\alpha = 2$, this amounts to 67%, while even for $\alpha = 0.2$ ($E \sim 100$ keV) it is already 17%.

Case II. ($\alpha > 2$). Here, the maximum positive error is $\epsilon(2) = \alpha/(1 + \alpha) + 1$ as $\alpha \rightarrow \infty$. Since $F'(x_0) = 0$ at $x_0 = (\alpha - 2)/(\alpha^2 + 2\alpha)$, and $F(x_0) = 8\alpha/(\alpha + 2)^2$, we conclude that the worst negative error (at $\mu_0 = 1 - x_0$) is $\epsilon(x_0) = (2\sqrt{2\alpha})/(\alpha + 2) - 1 \rightarrow -1$.

D. COHERENT SCATTERING

This process ($j = 2$) involves no energy loss, only the scattering angle θ being required before returning the photon to the free path routine with its new direction, obtained from the general code.

The differential cross section is now $\sigma^2(Z, \alpha, \mu)d\mu = C^2(Z, v)T(\mu)d\mu$, where $C(Z, v)$ is a form factor modifying the (energy independent!) Thomson

cross section $T(\mu) = \pi r_0^2 (1 + \mu^2) d\mu$. (Superscripts on σ 's denote process number j , not an exponent).

The general effect of $C^2(Z, v)/Z^2$ is to decrease the Thomson cross section, more extremely for backward scattering, high E , and low Z , being opposite in these respects to the effect of $I(Z, v)/Z$ on $K(\alpha, \mu)$ in Section C above. For a given Z , $C(Z, v)$ decreases from $C(Z, 0) = Z$ to $C(Z, \infty) = 0$. The parameter is here the $v = K\alpha\sqrt{1 - \mu}$ of that section, with maximum $\bar{v} = \sqrt{2} K\alpha$ for given α . The qualitative features of $C(Z, v)$ are shown in Fig. 2.

The required tables of $C(Z, v)$, for $Z \geq 1$, $v \leq 6$, were compiled from various sources, (12,13,14) with values listed for $v_1 = 0, \dots, v_{55} = 6$. (For details, see Storm and Israel⁵). We define $C(Z, v) \equiv 0$ for $v > 6$.

To improve efficiency in applying the Principle of Sec. C, we follow a device of the SORS report,¹⁰ and reverse the roles of the coherent cross section components. Denoting by $p^2(\mu) = \sigma^2(Z, \alpha, \mu)/\sigma_t^2(Z, \alpha)$ the probability density for μ , we have

$$P(v^2) dv^2 = p^2(\mu) \left| \frac{d\mu}{dv^2} \right| dv^2,$$

where μ is replaced by the variable $v^2 = (K\alpha)^2(1 - \mu)$, $0 \leq v^2 \leq \bar{v}^2$. Since $\mu = 1 - v^2/(K\alpha)^2$, $d\mu/dv^2 = -1/(K\alpha)^2$, and we may write

$$P(v^2) dv^2 = \frac{2\pi r_0^2 Z^2 A(Z, \bar{v}^2)}{(K\alpha)^2 \sigma_t^2(Z, \alpha)} \cdot \frac{1 + \mu^2}{2} \cdot Q(v^2) dv^2 \\ \equiv C_0 F(v^2) \cdot Q(v^2) dv^2,$$

where

$$Q(v^2) = C^2(Z, v^2) Z^{-2} / A(Z, \bar{v}^2),$$

$$\text{and } A(Z, \bar{v}^2) = \int_0^{\bar{v}^2} C^2(Z, v^2) Z^{-2} dv^2,$$

for arbitrary v^2 .

A random number r on $(0,1)$ may therefore be used to tentatively assign v^2 with density $Q(v^2)$, by the relation $r = A(Z, v^2)/A(Z, \bar{v}^2)$, v^2 being

Fig. 2. Coherent scattering factor.

ratified with probability $F(v^2) = \frac{1}{2}(1 + \mu^2) \leq 1$, where μ is the above function of v^2 .

The required values of $A(Z, \bar{v}^2)$ and of v^2 are obtained by linear interpolation, using tables of $A(Z, v_1^2)$, $v_1^2 = 0, \dots, v_{55}^2 = 36$, obtained by numerical integration of the data cited, and stored on the LT.

For the point detector program, one must evaluate the density $p^2(\mu) = \pi r_0^2 (1 + \mu^2) C^2(Z, v)/\sigma_t^2(Z, \alpha)$ for given μ . Although $\sigma_t^2(Z, \alpha) = \sigma_t^2(Z)$ is recoverable from the λ routine, the value of $C^2(Z, v)$ at $v = K\alpha\sqrt{1 - \mu}$ must be interpolated in the original $C^2(Z, v_1)$ tables, separately stored on the LT for this purpose.

E. PHOTOELECTRIC EFFECT

A collision of this type ($j = 3$) involves the disappearance of the incident photon of energy E , the ejection from some (positively written) energy level $e < E$ of an orbital electron with k.e. $E - e$, and the transition of a second electron from a level $e' < e$ to the e -level vacancy. There are two possibilities.

(1) A (fluorescence) photon of energy $E' = e - e'$ may be emitted. In such a case, the photon energy difference $E - E' = (E - e) + e'$ consists of the k.e. of the first ejected electron, plus a residual excitation energy e' which is ultimately dissipated by further processes, with additional fluorescence of still lower energy. This we ignore, depositing all of $E - E'$ locally, and returning to the λ routine with the (isotropically emitted) fluorescence photon of energy E' , provided of course that $E' > 1$ keV.

Otherwise the event is "terminal", by which is meant that the incident photon's history terminates, its energy E being locally deposited, and the code returns to the source routine of MCP.

(2) The electron transition $e' \rightarrow e$ may not be accompanied by $E' = e - e'$ fluorescence, but by the ejection of an "Auger electron", resulting from "internal conversion". In this event, the entire incident energy E is tallied as energy deposition, and the collision is terminal.

The energy levels e are called "edge energies" because, regarded as a function of increasing E , the photoelectric cross section $\sigma(E)$, elsewhere decreasing continuously, shows a sharp discontinuity (edge) at each $E = e$, jumping from its lower, limiting value $\sigma(e^-)$ to its value $\sigma(e) > \sigma(e^-)$ as the photon energy E becomes sufficient to activate the e -level.

A photoelectric event is regarded as terminal for elements $Z < 12$, the possible fluorescence energy being below 1 keV.

For elements $Z \geq 12$, fluorescent emission above 1 keV is possible and allowed for to the extent indicated below, using basic data from a Union Carbide report¹¹ which provides, for each Z , a table of the form

(UC)	e_1	σ_1	Y_1	F_1
$\vee$	.	.	.	.
.	.	.	.	.
.	.	.	.	.
$\vee$	.	.	.	.
	e_{f-1}	σ_{f-1}	Y_{f-1}	F_{f-1}
	e_f''	σ_f	$Y_f = 0$	$F_f = 0$

where the energies are in decreasing order. These tables have been prepared in a rather involved way, referred to in a later note. For our immediate objective, which is simply the determination of the energy of the fluorescence photons emitted, if any, the following remarks suffice.

Define in terms of the e_1, σ_1 above the numbers

$$\phi_1 = \sigma_1 e_1^3 - \sigma_2 e_2^3$$

.

.

.

$$\phi_{f-1} = \sigma_{f-1} e_{f-1}^3 - \sigma_f e_f^3$$

$$\phi_f = \sigma_f e_f^3$$

If $E < e_{f-1}$, the event is terminal. Otherwise, define i as the least index $i < f - 1$ for which $e_i < E$. Then the ratio $Y_i \phi_i / (\phi_f + \dots + \phi_i)$, $i = f - 1, \dots, i$ represents the probability of the event resulting in a fluorescence photon of energy F_i .

The data in this form is very inconvenient for our purposes, and the LT contains instead the tables

(LT)	$\frac{1}{e_1}$	$\frac{D_1}{\sigma_1}$	$\frac{N_1}{Y_1 \phi_1}$	$\frac{E_1'}{F_1}$
1	e_f	ϕ_f	$Y_f \phi_f = 0$	$F_f = 0$
2	e_{f-1}	$\phi_f + \phi_{f-1}$	$Y_f \phi_f + Y_{f-1} \phi_{f-1}$	F_{f-1}
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
f	e_1	$\phi_f + \dots + \phi_1$	$Y_f \phi_f + \dots + Y_1 \phi_1$	F_1

Accordingly, our method in the event $j = 3$, $Z \geq 12$, $E \geq E_2$ begins with determination of the greatest index k for which $E_k < E$, and formation of the product rD_k , where r is a random number on $(0,1)$. If $rD_k > N_k$, the event is terminal. Otherwise, the greatest index i (≥ 2) for which $rD_k > N_{i-1}$ determines the energy E_i' of the fluorescent photon emitted.

Note on the Tables. For simplicity, we describe first a table of the form (UC) above, of the following nature: (1) e_1 is the energy level of the K-shell and any further e_i , $1 \leq i \leq f - 1$, are average energies for the composite shells L, M, N, ... in that order, $e_{f-1} = e_f$ being that of the outermost shell allowed for; (2) $\sigma_1 = \sigma(e_1)$ is the peak K-edge $\sigma(E)$ and for further $i \leq f - 1$, σ_i is an average of the peak $\sigma(E)$ values for the shell in question, the final σ_f being the lower limit of $\sigma(E)$ for shell $f - 1$; (3) Y_i is the probability of emission of a fluorescent photon if the i -shell is activated;

(4) F_1 is an average value for the fluorescent energies resulting from transitions to the i -shell vacancy from outer shells.

The basic assumption is made that $G(E)$ is of the form $\sigma_1 e_1^3/E^3$ on the intervals of continuity $E \in e_i = e_{i-1}^3; e_i \leq E < e_{i+1}^3, i = f-1, \dots, 2$; and $e_1 \leq E$. If these continuous functions are extrapolated to an energy E for which e_i is the greatest listed $e_i \leq E$, their values are $\sigma_i e_i^3/E^3, \dots, \sigma_f e_f^3/E^3$, and the differences $\delta_1, \dots, \delta_f$, as defined above, times $1/E^3$, are regarded as the "contributions" of shells $i, \dots, f-1$, and of all outer shells, to the total cross section $\sigma_1 e_1^3/E^3$ at energy E . Under this second assumption, the chance of i -shell activation is $\delta_1/\delta_f + \dots + \delta_i$, $i = f-1, \dots, 2$, and the product of this ratio with Y_i may be regarded as the probability of emission of a fluorescence photon of energy F_i .

It was indeed in this form that the original (MC) tables appeared. For $Z \geq 30$, the updated version¹¹ attempts to replace the average F_1 for the K-shell (only!) by the individual fluorescent energies. In order to preserve the original format of the tables and the computational method, the old tables were modified in the following way.

The first row is replaced by a number of rows $i = 1, 2, \dots, k$, one for each K-shell fluorescence considered, the renumbered remaining rows $k+1, \dots$ following without change. The new rows $i \leq k$ all list for e_i and Y_i the original energy e_1 and (total) yield Y_1 for the K-shell, and for F_i the fluorescent energy referred to. Also, σ_i is the original $G(e_1)$, for the K-peak.

Since, for an energy $E \geq e_1$, the total probability of K-shell fluorescence is

$$P = Y_1(\sigma_1 e_1^3 - \sigma_{k+1} e_{k+1}^3)/\sigma_1 e_1^3$$

in terms of the new numbering, it is required to invent fictitious numbers $\sigma_2, \dots, \sigma_k$ in such a way that

$$(\sigma_1 e_1^3 - \sigma_{i+1} e_{i+1}^3)/(\sigma_1 e_1^3 - \sigma_{k+1} e_{k+1}^3) = P_i,$$

$$i = 1, 2, \dots, k-1$$

where P_i is the dependent probability of K-fluorescence of energy F_i . The P_i being known in the form of relative intensities of the "lines" F_i , it is easy to compute the desired $\sigma_2, \dots, \sigma_k$ from these equations.

The probability of F_i emission is then

$$P = p_i = Y_i(\sigma_1 e_1^3 - \sigma_{i+1} e_{i+1}^3)/\sigma_1 e_1^3, i = 1, \dots, k$$

for $E \geq e_1 = \dots = e_k$, and the method is unchanged if one computes the P_i as before, for all $i \leq f-1$, f being the total number of rows in the new table. For details of the fine structure considered, one should consult the U.C. report.¹¹

F. PAIR PRODUCTION

We consider this process ($j = 4$) only in the field of a nucleus. Although the threshold is technically $2mc^2[1 + (m/M)] \approx 1.022$ MeV, M being the nuclear mass, $\sigma_p(Z)$ becomes positive only for $E \geq 1.5$ MeV in the tables used.⁵

In the event of such a collision, the incident photon, of energy E , vanishes; the k.e. of the created positron-electron pair, assumed to be $E - 2mc^2$, is deposited locally; the positron is considered to be annihilated with an electron at the point of collision; and a single photon of weight twice that of the incoming photon and energy mc^2 is given an isotropically distributed new direction and is transported further.

G. ENERGY RANGE

If all other effects (bremsstrahlung, etc.) are ignored, nothing prevents extension of the code to the limit (100 MeV) of the Storm-Israel tables,⁵ the approximation for the inverse to the Klein-Nishina scattering distribution³ remaining good to that energy.

H. MECHANICS OF THE CODE MCP

Apart from the collision routine which has been described in some detail above, the codes MCP and MCG have few differences. As mentioned in the introduction to Part II, they are virtually identical to use and have almost identical outputs. (Both of these codes are quite similar in problem set up and output to the Monte Carlo neutron code MCN.¹) To

avoid duplication, let us refer the reader to Sections D, E, F, Appendix A and Appendix B of Part I, and below we list the exceptions to this discussion which apply to the use of MCP.

Exceptions. (1) The second item on the run card for MCP is the energy cut-off ECF (not weight cut-off WC) and this is the same for all cells. There are no weight cut-offs WC and WR used in MCP since capture is not treated by weights (i.e., estimating the capture per collision by reducing the particle weight). Thus the run card will have only 7 entries with entry 2 modified as above.

(2) The Y7 card is not used in MCP since we do not have energy cut-offs as a function of cell.

REFERENCES

1. E. D. Cashwell, J. R. Neergaard, W. M. Taylor, and G. D. Turner, "MCN: A Neutron Monte Carlo Code," Los Alamos Scientific Laboratory report LA-4751 (January 1972).
2. C. J. Everett and E. D. Cashwell, "Approximation for the Inverse of the Klein-Nishina Probability Distribution," Los Alamos Scientific Laboratory report LA-4448 (June 1970).
3. C. J. Everett, E. D. Cashwell, and G. D. Turner, "A New Method of Sampling the Klein-Nishina Probability Distribution for All Incident Energies Above 1 keV," Los Alamos Scientific Laboratory report LA-4663 (April 1971).
4. C. J. Everett, "A Relativity Notebook for Monte Carlo Practice," Los Alamos Scientific Laboratory report LA-3839, p. 120 (1968).
5. E. Storm and H. I. Israel, "Photon Cross Sections from 1 keV to 100 MeV for Elements $Z = 1$ to $Z = 100$," Nuclear Data Tables 7, 565-681 (1970).
6. D. T. Cromer and J. B. Mann, "Compton Scattering Factors for Spherically Symmetric Free Atoms," Jour. Chem. Phys. 47, 1892-1893 (1967).
7. D. T. Cromer, "Compton Scattering Factors for Aspherical Free Atoms," Jour. Chem. Phys. 50, 4857-4859 (1969).
8. R. T. Brown, EG&G, Inc., report L-958 (1969) and unpublished data.
9. G. W. Grodstein, "X-ray Attenuation Coefficients from 10 keV to 100 MeV," N.B.S. Circular 583 (1957).
10. J. W. Kimlinger, E. F. Plechaty, and J. R. Terrall, "SORS Monte Carlo Photon-Transport Code," Lawrence Radiation Laboratory report UCRL-50358.
11. C. R. Marotta, "Updated Master Library Tape for PHOTRAN," Union Carbide Corp. report AFWL-TR-67-11 (1967).
12. P. A. Doyle and P. S. Turner, "Relativistic Hartree-Fock X-ray Electron Scattering Factors," Acta Cryst. 24, 390-397 (1968).
13. D. T. Cromer and J. T. Waber (to appear in supplement to Vol. III of International Tables for X-ray Crystallography).
14. H. P. Hanson, F. Herman, J. D. Lea, and S. Skillman, "HFS Atomic Scattering Factors," Acta Cryst. 17, 1040-1044 (1964).

PART III
SAMPLE PROBLEM

In order to illustrate the steps in setting up a typical problem for the codes MCG and MCP, as well as to portray the output features of these codes, we shall set up and run the same problem with these codes. We will use the geometry shown in Figs. C-1 and C-2 in Appendix C of LA-4751 with the exception that Surface 18, the left bounding plane, is not taken to be a reflecting plane. (The reflecting plane upsets the estimation of the flux at the point detector in the present codes, including MCN.)

While the geometry is quite similar to that in LA-4751, the source is different. Also the tally bins are specified anew, to a large extent a reflection of the differences between processing neutrons and photons. In the following we shall specify completely the input to the problem, with the exception of the geometry, independently of the sample problem for MCN given in LA-4751.

A. Source. The source is assumed to be uniformly distributed in volume throughout Cell 1 and isotropic in direction. Because we are tallying mainly along the positive y direction, we biased the directional distribution, sending three-fourths of the particles isotropically with positive v (v is the y-direction cosine) and one-fourth of the particles isotropically with negative v, correcting the weights of the source particles so that one-half of the expected weight has positive v and one-half has negative v.

In addition, the energy distribution of the source has been biased in order to emphasize the source particles of higher energies. The information is displayed in Table I, with the source energy bins (W0 card), the actual fractions of the particles in each source group (V0 card), and the fictitious (biased) fractions in each source group (U0 card). The procedure follows exactly the description of the Source Cards on pp. 10-11 of LA-4751.

If the problem has a time cut-off of 100 shakes (essentially infinite time cut-off for this problem), we ask for the following information.

TABLE I

SOURCE			
Group	Energy in MeV (W0)	Fractions in Group (V0)	Track Fractions in Group (U0)
1	0.001	0.0	0.0
2	0.01	0.1	0.02
3	0.1	0.2	0.08
4	0.5	0.3	0.2
5	1.0	0.3	0.3
6	5.0	0.05	0.2
7	10.0	0.03	0.15
8	14.0	0.02	0.05

B. Currents. Tally currents across surfaces 1, 10, 11, and 14 for

energies: 0-0.005, 0.005-0.01, 0.01-1.0,
1.0-5.0, 5.0-14.0 (MeV)

times: 0-100 (shakes)

angles: 1.0-0.8, 0.8-0.6, 0.6-0.4,
0.4-0.2, 0.2-0 (values are for the
cosine of the angle with the normal
to the surface).

C. Flux Across Surfaces. Tally the flux integrated over surface 17 for

energies: 0-0.005, 0.005-0.01, 0.01-1.0,
1.0-5.0, 5.0-14.0 (MeV)

times: 0-0.01, 0.01-0.1, 0.1-1.0,
1.0-10.0 (shakes)

D. Flux in a Cell. Tally the average flux in Cell 3 for

energies: 0-0.1, 0.1-0.5, 0.5-1.0, 1.0-5.0,
5.0-14.0 (MeV)

times: 0-0.01, 0.01-0.1, 0.1-1.0,
1.0-10.0 (shakes)

cell volumes: 245.52 (cm³)

E. Flux at a Point. Tally the flux at the point (0, 10, 25) for
energies: 0-0.005, 0.005-0.01, 0.01-1.0,
1.0-5.0, 5.0-14.0 (MeV)
times: 0-0.01, 0.01-0.1, 0.1-1.0,
1.0-10.0 (shakes)
cells contributing to point detector: all
cells

TABLE II
CELL QUANTITIES

Cell	Importance	Energy Cut-off
1	1.0	0.001 (MeV)
2	1.0	0.001
3	2.0	0.001
4	2.0	0.001
5	1.0	0.001
6	4.0	0.001
7	4.0	0.001
8	8.0	0.001
9	8.0	0.001
10	16.0	0.001
11	8.0	0.001
12	32.0	0.001
13	16.0	0.001
14	32.0	0.001
15	1.0	0.001
16	1.0	0.001
17	1.0	0.001
18	1.0	0.001
19	1.0	0.001
20	1.0	0.001
21	1.0	0.001
22	4.0	0.001
23	4.0	0.001
24	8.0	0.001
25	8.0	0.001
26	1.0	0.001
27	1.0	0.001
28	2.0	0.001
29	2.0	0.001
30	4.0	0.001
31	1.0	0.001
32	0.0	0.001

TABLE III
MATERIAL DENSITIES

Material	Atomic Density [(atoms/cm ³ × 10 ⁻²⁴)]
Al	0.0603
Normal Li	0.0463
Be	0.123
CH	0.00926
CH ₂	0.1173
Fe	0.0847

time cut-off = 100 shakes

WC = 10⁻³

WR = 10⁻⁴

TABLE IV
SAMPLE RUN -- MCG

```

SUBROUTINE SOURCE
COMMON MRA,MRAJ,MRS,MREN,MRL,MRE,MRF,MIFM,MXLC,LC3,MRE2,MRA7,MRR,MRC
1  C 111,112,J11,J12,K11,K12,111,LL1,111,KL1,121,122,J21,J22,12,101
  C 102,J01,J02,114,151,152,J31,J32,115,MDET,LCD,SCP,SRG(10),F9(120)
  C 15M(120),SEQ(120),ID(131),ID(181),ID(171),LDF(16),RMD(120),VOL(120),MCT
  C 1201,NC(120),F10(120),ECF(120),LCA(121),LCS(120),LJA(180),LCAJ
  C 400,LAJ(190),NST(120),LSC(121),SCF(150),LCB(190),LFD(16),LPR(16),I
  C 1001,IFP(100),P(100),CDET(125,3),R3(125),FR3(125),EC5(16),F75(124
  C 50),MDC,DC(120),G4(120),SRL(7),GBL(10),GF(14),WTMIN,WTMAX,NPFR,NFI
  C M,NPE,J1,NST,104,105,106,NPS,NRN,NRN,T05,T05,NPS,NTR,NCT,T09,E*4(16),M
  C 1 1M(1),WTM(1),F(15000)
  C 1 1COMMON/01/ STU,OLS,PL,OPL,PMF,DEQ,CSJA,CSA,1AP,ME,
  C 1 1NCP,RDB,A,T02,U,V,W,ERG,WT,THE,
  C 1 1VL,DEL,1A,JA,NP,USQ,VSQ,W50,1AF,11F,12F,15F,16F
  C 1 1COMMON/DSCOM/NIR,DETA,CSOX,CS,DEETA,DAFAC,AMFP,AMFP2,90,54V(12),
  C 1 1LV2,LV3,LV4,LV5,LV6,LV7,PSC,DMU0A,4V,U0LO,V0LD,*CLD,
  C 1 1XNU,0,W1,AK,DCAP,NCAP,NV,CTH,STH,CEP,SEP
  C 1 1COMMON/G2/J0(12),CSN(120),TP(125),JSF(120),SG1(120),SG2(120),
  C 1 1C 1 1RMR(12,100)
  C 1 1UNIFORMLY DISTRIBUTED IN VOLUME IN SPECIFIED SPHERICAL CELL.
  C 1 1STARTING DIRECTION ISOTROPIC, BUT BIASED IN POSITIVE V-DIRECTION.
  C 1 1ENERGY DISTRIBUTION.
  C 1 1ST CARD REQUIRED IN PROBLEM DECK.
  C 1 1SRC(1)=CELL NUMBER.
  C 1 1SRC(2)=RADIUS OF CELL IN CM.
  C 1 1SRC(3)=FRACTION OF NEUTRONS WHOSE STARTING DIRECTION HAS
  C 1 1POSITIVE V.
  C 1 1
  C 1 1DISTANCE FROM ORIGIN SAMPLED FROM THE INTERVAL (0,SRC(2))
  C 1 1DISTRIBUTED ACCORDING TO THE DISTANCE CURVED.
  C 1 1R=SRC(2)*F69N(KRN1)*.33333333
  C 1 1SAMPLE UNIFORMLY FROM POINTS INSIDE THE UNIT CIRCLE.
  C 1 10 TP(1)=2.*FRN(KRN1)-1.
  C 1 19 TP(2)=2.*FRN(KRN1)-1.
  C 1 22 TP(3)=TP(1)**2+TP(2)**2
  C 1 24 IF (TP(3).GT.1.) GO TO 10
  C 1 1TP(3) DISTRIBUTED UNIFORMLY ON THE INTERVAL (0,1). TP(4) IS
  C 1 1THE COSINE OF THE POLAR ANGLE OF THE STARTING POINT.
  C 1 30 TP(4)=2.*TP(3)-1.
  C 1 31 TP(5)=R*SQRT(1.-TP(4)**2)/TP(3)
  C 1 37 R=0*TP(4)
  C 1 40 TP(1)=TP(5)
  C 1 41 Z=TP(2)*TP(5)
  C 1 43 IF (FRN(KRN1).GT.SRC(3)) GO TO 30
  C 1 51 SET V POSITIVE SRC(3) OF THE TIME.
  C 1 52 V=ABS(V)
  C 1 53 15 1A=SRC(1)
  C 1 54 JA=1
  C 1 55 THE=0
  C 1 56 DEL=0
  C 1 60 R=FRN(KRN1)
  C 1 63 DO 20 I=2,8
  C 1 64 IF (R.LT. SPB(I)) GO TO 25
  C 1 67 20 CONTINUE
  C 1 72 25 ERG=SEQ(1-1)+(SEQ(1)-SEQ(I-1))*(R-SPB(I-1))/
  C 1 1 (SPB(I)-SPB(I-1))
  C 1 100 WTWTSUM(I)
  C 1 102 RETURN
  C 1 103 SET V NEGATIVE 1-SRC(3) OF THE TIME.
  C 1 105 V=-ABS(V)
  C 1 106 WTWTSUM(I)=SRC(3)
  C 1 110 GO TO 15
  C 1 111 END

```

SUBPROGRAM LENGTH - SOURCE
144

STATEMENT ASSIGNMENTS			STMT NO# LOCATION			STMT NO# LOCATION			STMT NO# LOCATION		
10	#	11	15	#	53	20	#	72	30	#	104
BLOCK NAMES AND LENGTHS			01 # 42			DIXON # 91			02 # 9235		
# 100131											
VARIABLE ASSIGNMENTS			NAME # LOCATION			NAME # LOCATION			NAME # LOCATION		
NAME	#	LOCATION	NAME	#	LOCATION	NAME	#	LOCATION	NAME	#	LOCATION
BHR	#R	1085C04	COETA	#R	11320C01	CRS	#R	11771C01	CSW	#R	22C0
DEL	#R	24C02	ECF	#R	1354C01	EC5	#R	11923C01	CR0	#R	22C0
ETH	#R	42057C01	F	#R	42701C01	F10	#R	1164C01	FR0	#R	11472C0
GBL	#R	42023C01	I	#R	162	I4	#R	217C02	ID	#R	177C0
IDV	#R	172C01	IPF	#R	11155C01	IJP	#R	1077C01	JA	#R	30C0
JDC	#R	42234C01	JQ	#R	0520	JSP	#R	233C04	KRN	#R	42047C0
KST	#R	5725C01	LAJ	#R	4025C01	LCA	#R	1544C01	LCAJ	#R	3845C0
LC0	#R	7054C01	LCS	#R	1735C01	LCF	#R	216C01	LFD	#R	10758C0
LJA	#R	2125C01	LFR	#R	10764C01	LSC	#R	0111C01	MA7	#R	406C0
NCL	#R	774C01	NIF	#R	207C01	MYM	#R	42063C01	RHO	#R	1182C0
OBLSAV	#R	10C03	QA	#R	42024C01	R	#R	163	RHO	#R	224C0
NO	#R	11441C01	SL	#R	42014C01	SCF	#R	0300C01	SE0	#R	142C0
SO1	#R	425C06	SG2	#R	019C06	SPB	#R	02C01	SR0	#R	520C0
SWH	#R	112C01	TNE	#R	24C02	TP	#R	204C04	SE0	#R	20C0
VDL	#R	014C01	WT	#R	22C02	W7M	#R	42073C01	X	#R	14C0
V	#R	15C02	Z	#R	10C02						

EXTERNAL ASSIGNMENTS
PRH

REBARX

SGRT

START OF - CONSTANTS TEMPORARIES INDIRECTS - UNUSED COMPILER SPACE
113 117 141 77800

CORE MAP ***** DATE- 72/12/80 TIME- 17:50:00 ***** NORMAL LOAD *****
FNA LNA BLK COM LENGTH
CODE 000000 147155 007025 199131
LOADER 103602 150071
TABLES 103601 141724

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LCN BLOCK	ADDRESS
CODETP	IMCGRS	032007	011	000100		
SYSLIB	ACCOER	037625				
	BUFFED	037637				
	ENDFIL	037721				
	INPUTM	037735				
	INPUTC	040112				
	INPUTS	040200				
	IOCMEN	040354				
	LOCF	040400				
	OUTPTC	040412				
	OUTPTS	040550				
	NEWINH	040641				
	SYSTEM	040676				
	ISAIEX	041732				
	MS0020	041763				
	CA020	042543				
	GETHA	042637				
	IOUTIL	042673				
	MONER	044164				
	KHAKER	045001				
	MEMORV	046322				
	SKJPR	046702				
	BD1	046734				
	PSCALE	047920				

UNSATISFIED
EXTERNALS

REFERENCED
BY

AT
LOCATION

MCB TEST PROBLEM

```

1 45 .00026 -1.2
2 43 .0003 1.1 -2.4,3.3
3 44 .121 2.2 -4.0 -3.6
4 46 .1173 2.2 4.3 15.5 -3.6
5 46 .1173 2.2 -15.4 -3.15
6 41 .0003 3.4,3 -5.7 -7.8
7 43 .0003 5.6 15.16 -6.22 -7.9
8 41 .0003 -5.9 7.6 -8.13
9 43 .0003 5.8 7.7 -5.23 -8.11
10 41 .0003 -5.17 8.8 -9.12
11 43 .0003 5.10 8.9 -6.24 -9.13
12 44 .123 -5.13 9.10 -10.14
13 43 .0003 5.12,14 9.11 -4.25 -11.32
14 43 .0003 -5.13 10.12 -11.32
15 45 .00926 3.5 16.17 -5.16
16 43 .0003 5.15 16.18 -6.21 -15.7
17 45 .00926 -5.16 17.19 -16.15
18 43 .0003 5.17,19 18.32 -6.20 -10.10
19 43 .0003 -5.18 18.32 -17.17
20 46 .1173 6.18 18.32 -12.26 -16.21
21 46 .1173 6.16 16.28 -12.27 -15.22
22 46 .1173 6.7 15.21 -12.28 -7.23
23 46 .1173 6.9 7.22 -12.29 -8.29
24 46 .1173 6.11 8.23 -12.30 -9.25
25 46 .1173 6.13 9.24 -12.30 -11.32
26 42 .0847 12.20 18.32 -13.31 -16.27
27 42 .0847 12.21 16.26 -13.31 -15.28
28 42 .0847 12.22 15.27 -13.31 -7.28
29 42 .0847 12.23 7.28 -13.31 -8.30
30 42 .0847 12.24,25 8.29 -13.31 -11.32
31 0 13.26,27,28,29,30 18.32 -14.32 -11.32
32 0 14.31 -14.19,18.20,26,31 11.14,13,25,30,31

```

```

1 50 3.0
2 50 5.0
3 50 10.0
4 KY 0 .3333333333
5 CY 10.
6 CY 11.
7 PY 15.
8 PY 20.
9 PY 25.
10 PY 30.
11 PY 31.
12 CY 14.
13 CY 15.
14 CY 20.
15 PY 0
16 PY -12.
17 PY -10.
18 PY -18.

```

```

10 1. 1. 2. 2. 1. 4. 4. 8. 8. 16. 8. 32. 16. 32. 1. 64 6. 4. 8. 8.
1. 1. 2. 2. 4. 1. 0

```

```

S7 1 3.0 .75
F1 1 10 11 14
E1 .005 .01 1. 5. 14.
T1 100.
C1 .8 .6 .4 .2 0
F2 17

```

```

E2 .005 .01 1. 5. 14.
T2 .01 .1 1. 10.

```

```

F4 3
E4 .1 .5 1.0 5.0 14.0
T4 .01 .1 1. 10.

```

```

P4 24552
F5 0 10. 25. 0

```

```

E5 .005 .01 1. 5. 14.
T5 .01 .1 1. 10.
U0 0. .02 .08 .2 .3 .2 .15 .05
V0 0. .1 .2 .3 .3 .05 .03 .02
W0 .001 .01 .1 .5 1. 5. 10. 14.
Y7 .001 312

```

```

M41 3 1.
M4P 20 1.
M43 13 1.
M44 4 1.
M45 1 .5 6 .5
M46 1 2. 6 1.

```

NO. CELLS= 32			NO. SURFACES= 18		
PROGRAM NAME	CELLS PROBLEM NAME	TALLY FORMULA	PROGRAM NAME	SURFACES PROBLEM NAME	TALLY FORMULA
1	1		1	1	1
2	2		2	2	
3	3		3	3	
4	4		4	4	
5	5		5	5	
6	6		6	6	
7	7		7	7	
8	8		8	8	
9	9		9	9	
10	10		10	10	1
11	11		11	11	1
12	12		12	12	
13	13		13	13	
14	14		14	14	1
15	15		15	15	
16	16		16	16	
17	17		17	17	2
18	18		18	18	
19	19				
20	20				
21	21				
22	22				
23	23				
24	24				
25	25				
26	26				
27	27				
28	28				
29	29				
30	30				
31	31				
32	32				

CELL	AMB. SURF.	MATERIAL	DENSITY	IO	Y7
1		45	9.2600E-03	1.0000E+00	1.0000E+03
2		43	6.0300E-02	1.0000E+00	1.0000E+03
3		44	1.2300E-01	2.0000E+00	1.0000E+03
4		46	1.1730E-01	2.0000E+00	1.0000E+03
5		46	1.1730E-01	1.0000E+00	1.0000E+03
6		41	4.6300E-02	4.0000E+00	1.0000E+03
7		43	6.0300E-02	4.0000E+00	1.0000E+03
8		41	4.6300E-02	8.0000E+00	1.0000E+03
9		43	6.0300E-02	8.0000E+00	1.0000E+03
10		41	4.6300E-02	1.0000E+01	1.0000E+03
11		43	6.0300E-02	8.0000E+00	1.0000E+03
12		44	1.2300E-01	3.0000E+01	1.0000E+03
13		43	6.0300E-02	1.0000E+01	1.0000E+03
14		43	6.0300E-02	3.0000E+01	1.0000E+03
15		45	9.2600E-03	1.0000E+00	1.0000E+03
16		43	6.0300E-02	1.0000E+00	1.0000E+03
17		45	9.2600E-03	1.0000E+00	1.0000E+03
18		43	6.0300E-02	1.0000E+00	1.0000E+03
19		43	6.0300E-02	1.0000E+00	1.0000E+03
20		46	1.1730E-01	1.0000E+00	1.0000E+03
21		46	1.1730E-01	1.0000E+00	1.0000E+03
22		46	1.1730E-01	4.0000E+00	1.0000E+03
23		46	1.1730E-01	4.0000E+00	1.0000E+03
24		46	1.1730E-01	8.0000E+00	1.0000E+03
25		46	1.1730E-01	8.0000E+00	1.0000E+03
26		42	8.4700E-02	1.0000E+00	1.0000E+03
27		42	8.4700E-02	1.0000E+00	1.0000E+03
28		42	8.4700E-02	2.0000E+00	1.0000E+03
29		42	8.4700E-02	2.0000E+00	1.0000E+03
30		42	8.4700E-02	4.0000E+00	1.0000E+03
31		0	0.	1.0000E+00	1.0000E+03
32		0	0.	0.	1.0000E+03

FORMULA 1 -- PHOTONS CROSSING SURFACE

SURFACE	1	10	11	14
ENERGY	5.0000E+03	1.0000E-02	1.0000E+00	5.0000E+00
TIME	1.0000E+00			1.0000E-01
COSINE	8.0000E-01	6.0000E-01	4.0000E-01	2.0000E-01

FORMULA 2 -- FLUX INTEGRATED OVER SURFACE

SURFACE	17
ENERGY	5.0000E+03
TIME	1.0000E-02

FORMULA 4 -- PATH LENGTH/VOLUME

CELL	3
ENERGY	1.0000E+01
TIME	1.0000E-02
VOLUME	2.552E+02

FORMULA 5 -- FLUX AT DETECTOR

DETECTOR	1	0.	1.0000E+01	2.5000E+01	NEIGHBORHOOD
CELL	ALL				
ENERGY	5.0000E+03	1.0000E-02	1.0000E+00	5.0000E+00	1.0000E+01
TIME	1.0000E-02	1.0000E-01	1.0000E+00	1.0000E+01	

SOURCE 7

	SRC(1) 1.0000E+00	SRC(2) 3.0000E+00	SRC(3) 7.5000E+01
N	ENERGY	CUM. PROB.	WT. MULT.
1	1.0000E+03	0.	0.
2	1.0000E+02	2.0000E-02	3.0000E+00
3	1.0000E+01	1.0000E-01	2.5000E+00
4	5.0000E-01	3.0000E-01	1.5000E+00
5	1.0000E+00	6.0000E-01	1.0000E+00
6	5.0000E+00	8.0000E-01	2.5000E-01
7	1.0000E+01	9.5000E-01	2.0000E-01
8	1.4000E+01	1.0000E+00	4.0000E-01

MATERIAL DATA

MAT. NO.	ELEM. NO.	FRACTION
41	3	1.00000
MAT. NO.	ELEM. NO.	FRACTION
42	26	1.00000
MAT. NO.	ELEM. NO.	FRACTION
43	12	1.00000
MAT. NO.	ELEM. NO.	FRACTION
44	4	1.00000
MAT. NO.	ELEM. NO.	FRACTION
45	1 6	.50000 .50000
MAT. NO.	ELEM. NO.	FRACTION
46	1 6	.66667 .33333

INITIATION COMPLETED

CORE MAP ***** DATE- 72/12/88 TIME- 17.56.10 ***** NORMAL LOAD *****

	FMA	LWA	BLNK COM	LENGTH
CODE	000100	130373	030243	100131
LOADER	143602	190071		
TABLES	143601	140057		

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LC BLOCK	ADDRESS
*****	*****	*****	*****	*****	*****	*****
RUNTP	SOURCE	005453	G1	000100		
			DxCOM	000142		
			G2	000216		
	MCGRS	005622	G1	000100		
			G3	005617		
			DxCOM	000142		
			G2	000216		
	DBPNT	010104	G1	000100		
			G3	005617		
			DxCOM	000142		
			G2	000216		
	FRM	016533	G1	000100		
			G3	005617		
			DxCOM	000142		
			G2	000216		
	IRN	016561	G1	000100		
			G3	005617		
			DxCOM	000142		
			G2	000216		

SYSLIB

ACGDER	016007
BACKSP	016021
BUFFEI	016550
BUFFED	016771
CLOCKF	017053
DNPRX	017156
EMGFI	017150
INPUTC	017736
IOCHK	020110
LENGTH	020174
LOCF	020154
OUTPTC	020166
PACKAGE	020324
SETQ	020411
SSWTCM	020632
SYSTEM	020720
XJT	021756
ALNLOG	022075
EXP	022164
IOATER	022237
RRATER	022270
RRAREX	022321
SORT	022400
ABOHT	022456
BS4020	022527
C4020	023307
ENTR	023403
GETRA	023437
IOUTIL	023473
KODER	024764
KRAKER	026281
LSHUT	027322
MEMORY	027430
OUTPTS	027610
REMARK	027701
RETN	027734
SFIPR	027764
SHIFT	030036
BOI	030053
PSCALE	030117
N2035R	030124

UNSATISFIED
EXTERNALS

SRCOR

REFERENCED
BY

MCGRS

A
LOCATION

000024

MCB TEST PROBLEM

SOURCE NO.	TIME CUTOFF	WT. CUTOFF 1	RUN TIME	D.P. CYCLE	DUMP CYCLE	DUMP NO.	CUTOFF CYCLE	WT. CUTOFF 2
7	1.0000E+02	1.0000E-03	0.0000E+00	25000	25000	-0	-0	1.0000E-06
NPS	X	Y	Z	IA	JA	U	V	W
1	1.8000E+00	-1.1700E+00	-1.9410E+00	1	1	7.8852E-01	6.0253E-01	1.2328E-01
2	7.9061E-01	-2.8099E+00	6.3319E-01	1	1	2.9024E-01	8.9063E-02	-9.5157E-01
3	-1.8176E+00	1.5956E+00	7.5075E-01	1	1	-7.4973E-01	5.6121E-01	-1.5064E-01
4	-1.5899E+00	3.0203E+01	9.9150E-01	1	1	9.0218E-01	3.8224E-01	1.9993E-01
5	9.8692E-01	6.5240E-01	2.5618E+00	1	1	3.0760E-01	6.8151E-01	6.6403E-01
6	1.0094E+00	-6.8009E-01	1.2487E+00	1	1	-3.4625E-01	5.4972E-01	7.6023E-01
7	1.5817E+00	1.5320E+00	1.6454E+00	1	1	5.8842E-01	1.7994E-01	7.6828E-01
8	8.7802E-01	-8.8799E-01	-1.6466E+00	1	1	5.8019E-01	-5.3230E-01	6.1647E-01
9	-4.8758E-02	-1.4527E+00	-1.6107E+00	1	1	-4.6880E-01	3.2439E-01	-8.2273E-01
10	-1.6290E+00	6.8720E-01	2.2839E+00	1	1	-4.2532E-02	4.0882E-01	-9.1162E-01
11	-1.8184E+00	-8.7101E-01	1.2774E+00	1	1	-2.1312E-01	-7.7967E-01	-5.6881E-01
12	1.2789E+00	-5.9198E-01	1.6113E+00	1	1	2.5608E-01	9.3871E-01	2.6115E-01
13	-1.9050E+00	3.5257E-01	1.2992E+00	1	1	-8.6814E-01	4.7129E-01	2.0369E-01
14	-5.6906E-01	-1.8980E+00	1.6013E+00	1	1	4.0615E-01	8.6279E-01	-3.0104E-01
15	1.4359E-01	2.3181E+00	-1.3090E+00	1	1	5.5106E-01	-2.9001E-01	7.6245E-01
16	2.8122E-01	-1.8005E+00	1.4064E+00	1	1	5.1308E-01	4.6818E-01	7.1942E-01
17	1.3147E+00	2.5053E+00	-9.4498E-01	1	1	-8.0674E-01	4.4657E-01	3.8795E-01
18	-1.7895E+00	1.0723E+00	3.2450E-01	1	1	-1.7847E-01	3.4990E-01	9.2039E-01
19	9.3469E-01	5.8619E-01	8.8899E-01	1	1	7.0919E-01	-8.0076E-01	-3.7467E-01
20	-4.4311E-01	6.5555E-01	2.0903E+00	1	1	5.6842E-01	3.2999E-01	7.5517E-01
21	5.6261E-01	-2.7617E-01	-2.0090E+00	1	1	7.1946E-01	4.8708E-01	1.0161E-01
22	1.8855E+00	1.5924E+00	6.2927E-01	1	1	2.1473E-01	-4.8953E-01	8.4513E-01
23	1.3925E+00	-0.4947E-01	1.9876E+00	1	1	-4.4512E-01	6.6503E-01	-5.6829E-01
24	8.3328E-01	4.3827E-01	1.0312E+00	1	1	2.6656E-01	9.1718E-01	-2.9826E-01
25	-1.8806E-01	1.9109E+00	1.2670E+00	1	1	-8.8971E-01	-4.4307E-01	1.1004E-01
26	-1.5025E-01	5.6974E-01	6.5121E-01	1	1	6.9655E-01	6.4540E-01	-2.1203E-01
27	1.0248E+00	-2.5649E+00	2.9510E-01	1	1	-7.0189E-01	6.4350E-01	-7.3714E-02
28	7.4240E-01	3.0754E-02	2.3344E+00	1	1	-7.2178E-01	-5.4654E-01	-3.6734E-01
29	-8.3918E-01	7.7705E-01	-9.1937E-01	1	1	3.3282E-02	6.3031E-01	-7.7503E-01
30	-1.7052E+00	-8.3155E-01	4.8474E-01	1	1	9.7468E-01	1.6780E-01	-1.4299E-01
31	-1.5052E+00	2.0510E+00	1.4549E-01	1	1	5.5239E-01	-5.9143E-01	5.9738E-01
32	5.3233E-01	-1.5705E+00	1.5310E-01	1	1	-5.0435E-02	-9.5567E-02	-9.9413E-01
33	1.0504E+00	-6.2248E-01	2.5024E+00	1	1	-4.4993E-01	7.5555E-01	4.3543E-01
34	9.0440E-01	-1.4094E-01	2.7427E+00	1	1	1.7474E-01	8.4772E-01	-4.2591E-01
35	-3.7305E-01	1.3200E+00	-1.9929E+00	1	1	6.7543E-01	2.8355E-01	6.8857E-01
36	6.1254E-01	-5.3557E-02	2.7926E+00	1	1	-9.6888E-01	2.3505E-01	-7.7609E-02
37	-2.0957E+00	1.3958E-01	1.0714E+00	1	1	6.4676E-01	4.7922E-01	5.9332E-01
38	-1.8794E+00	9.2181E-01	-9.5096E-01	1	1	9.1000E-01	1.6180E-01	3.8180E-01
39	1.9181E+00	-9.0274E-02	1.0938E-01	1	1	1.8084E-01	1.8167E-01	9.6868E-01
40	2.4017E+00	1.0240E+00	1.8979E-02	1	1	5.3823E-01	7.7522E-01	7.9659E-01
41	7.3849E-01	2.0218E+00	1.5797E+00	1	1	-7.5351E-01	9.6575E-02	-6.9029E-01
42	3.8772E-01	-1.9195E+00	1.5532E+00	1	1	-1.5493E-01	1.5881E-02	-4.8760E-01
43	-1.5251E+00	5.2232E-01	5.1127E-01	1	1	-8.4717E-01	9.4135E-01	7.5659E-01
44	1.6763E-01	1.2883E-01	1.3853E-01	1	1	7.8063E-01	-4.9750E-01	-3.7768E-01
45	1.2854E+00	-4.3399E-01	2.0153E-01	1	1	8.7371E-01	-4.6380E-01	-1.4669E-01
46	7.2839E-01	6.6969E-01	2.1071E+00	1	1	-4.3991E-01	-8.7673E-01	1.9009E-01
47	2.5047E+00	-1.2434E-01	1.7365E+00	1	1	-6.4271E-01	8.6087E-02	-7.6117E-01
48	1.3589E+00	-8.3716E-01	1.6405E+00	1	1	6.8931E-01	-5.3775E-01	-4.6970E-01
49	-1.7942E+00	-4.2251E-01	1.9093E+00	1	1	-7.7610E-01	4.7190E-01	4.1818E-01
50	1.1096E+00	-8.0901E-01	-1.9184E+00	1	1	8.2028E-01	2.6719E-01	-5.0572E-01

MCB TEST PROBLEM

TIME= 4.671 MINUTES

NUMBER OF PHOTONS STARTED	TOTAL NUMBER OF COLLISIONS	RANDOM NUMBERS GENERATED	TOTAL WEIGHT STARTED	TOTAL ENERGY STARTED	COLLISION PER PHOTON STARTED	TRACKS PER PHOTON STARTED	PHOTONS PROCESSED PER MINUTE
15232	270746	185194	1.5242E+04	1.4459E+04	1.7775E-01	6.2508E+00	3.2600E+03
TOTAL TRACKS STARTED	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO WEIGHT CUTOFF	LOSS TO ESCAPE	LOSS TO SPLITTING	TOTAL TRACKS LOST	
95303	0	0	14816	21670	58817	95303	
WEIGHT STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	WEIGHT LOST PER PHOTON	PAIR PRODUCTION PER PHOTON	
1.0007E+00	0.	0.	3.2892E-01	6.8201E-01	1.0109E+00	1.0015E-02	
ENERGY STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	LOSS TO PAIR PRODUCTION	LOSS TO COMPTON	ENERGY LOST PER PHOTON
9.4927E-01	0.	0.	4.5810E-01	4.6079E-02	7.5179E-02	3.6976E-01	9.4952E-01

TOTAL CELL DEPOSITION DATA

CELL	NO. OF PHOTONS CAPTURED	RELATIVE ERROR	PHOTONS LOST TO C. C.	RELATIVE ERROR	PHOTONS CREATING A PAIR	RELATIVE ERROR
1	0.1522E-02	.07515	0.	0.00000	3.2826E-05	.99997
2	2.2121E-01	.02873	0.	0.00000	2.0091E-03	.00011
3	1.0329E-04	.11911	0.	0.00000	0.0745E-03	.28984
4	3.0107E-03	.00009	0.	0.00000	0.0923E-04	.16216
5	4.1135E-03	.00293	0.	0.00000	2.1853E-04	.34452
6	1.0000E-04	.00009	0.	0.00000	5.1427E-03	.24845
7	4.4541E-02	.02894	0.	0.00000	4.4231E-04	.69592
8	3.7840E-05	.00150	0.	0.00000	9.5701E-04	.33062
9	0.0745E-03	.04684	0.	0.00000	4.0783E-05	.21245
10	2.7522E-05	.07454	0.	0.00000	1.1762E-05	.26150
11	4.5043E-03	.05042	0.	0.00000	4.4039E-03	.20254
12	2.0430E-04	.00276	0.	0.00000	2.3935E-05	.10453
13	2.9408E-03	.04972	0.	0.00000	2.0870E-03	.20258
14	1.9177E-03	.04724	0.	0.00000	1.5033E-05	.22117
15	1.3922E-04	.29524	0.	0.00000	0.	0.00000
16	3.9808E-02	.05115	0.	0.00000	0.8093E-04	.23412
17	7.4677E-05	.17035	0.	0.00000	0.	0.00000
18	6.9864E-03	.12282	0.	0.00000	7.6779E-05	.74531
19	9.0503E-03	.07991	0.	0.00000	1.1188E-04	.75252
20	2.0554E-04	.17003	0.	0.00000	9.7521E-05	.75786
21	1.1877E-03	.07303	0.	0.00000	1.1754E-04	.52694
22	1.5082E-03	.04141	0.	0.00000	1.0741E-04	.13545
23	2.0537E-04	.00392	0.	0.00000	1.5319E-05	.01224
24	1.3110E-04	.07505	0.	0.00000	9.8477E-04	.83026
25	9.5131E-05	.00870	0.	0.00000	1.5542E-05	.37496
26	2.0029E-02	.07540	0.	0.00000	2.8289E-04	.34007
27	9.0121E-02	.03379	0.	0.00000	1.0403E-03	.15177
28	1.1117E-01	.02791	0.	0.00000	1.7479E-02	.00704
29	1.4275E-02	.04805	0.	0.00000	3.0821E-04	.17391
30	1.3968E-02	.03459	0.	0.00000	2.7832E-04	.13103
31	0.	0.00000	0.	0.00000	0.	0.00000
32	0.	0.00000	0.	0.00000	0.	0.00000

CELL	ENERGY LOST TO CAPTURE	RELATIVE ERROR	ENERGY LOST TO ENERGY CUTOFF	RELATIVE ERROR	ENERGY LOST TO PAIR PRODUCTION	RELATIVE ERROR	ENERGY LOST TO COMPTON	RELATIVE ERROR	TOTAL ENERGY DEPOSITED
1	4.3689E-04	.07805	0.	0.00000	0.2325E-05	.99997	0.3903E-03	.15586	4.9155E-03
2	1.0590E-02	.02900	0.	0.00000	2.2190E-02	.10595	1.0578E-01	.02728	1.3657E-01
3	1.4850E-05	.00762	0.	0.00000	1.9546E-04	.37726	0.7041E-03	.05674	9.1149E-03
4	2.0721E-04	.04570	0.	0.00000	1.2145E-03	.16079	3.4981E-02	.02088	3.0382E-02
5	2.2009E-04	.00546	0.	0.00000	1.2986E-03	.30800	4.1312E-02	.03329	4.2400E-02
6	5.1039E-06	.04096	0.	0.00000	4.2433E-04	.27651	7.4594E-03	.04040	0.2074E-03
7	2.7939E-03	.02537	0.	0.00000	3.3970E-03	.11234	1.7818E-02	.02757	2.3094E-02
8	1.7223E-06	.00305	0.	0.00000	5.0400E-03	.52603	1.0098E-03	.05997	2.0519E-03
9	3.9568E-04	.06202	0.	0.00000	3.2247E-04	.20287	1.0410E-03	.00240	1.3322E-03
10	1.1950E-04	.05940	0.	0.00000	9.0118E-05	.30704	1.2319E-03	.06087	1.0245E-03
11	2.0366E-04	.04532	0.	0.00000	3.3534E-04	.21001	1.2255E-03	.07806	2.7001E-03
12	1.1540E-05	.09026	0.	0.00000	1.8206E-04	.19477	2.5122E-03	.04520	1.2240E-03
13	1.0894E-04	.04470	0.	0.00000	2.2817E-04	.23491	0.2779E-04	.07849	7.2426E-04
14	1.0444E-04	.06301	0.	0.00001	1.1713E-04	.20156	5.0208E-04	.06035	9.2041E-04
15	0.3743E-06	.22727	0.	0.00001	0.	0.00000	9.1204E-04	.21854	2.3250E-02
16	2.4905E-03	.05663	0.	0.00000	5.1666E-03	.27279	1.5602E-02	.09110	9.2603E-04
17	4.6010E-06	.15346	0.	0.00000	0.	0.00000	9.1833E-04	.07083	4.3444E-03
18	4.4009E-04	.10714	0.	0.00000	0.0449E-04	.03582	3.1199E-03	.10197	5.0069E-03
19	0.6286E-04	.00573	0.	0.00000	4.1202E-04	.52570	4.3922E-03	.16176	3.7402E-03
20	1.2555E-05	.14099	0.	0.00000	1.1355E-04	.70760	3.6141E-03	.22077	1.0680E-02
21	7.5406E-05	.06291	0.	0.00000	1.4675E-03	.55960	1.3137E-02	.09301	1.5085E-02
22	9.2902E-05	.03269	0.	0.00000	1.3969E-03	.16100	1.7095E-02	.02758	2.4945E-03
23	1.2647E-05	.00389	0.	0.00000	5.4778E-05	.43355	2.2271E-03	.07823	1.3088E-03
24	0.9020E-06	.00193	0.	0.00000	8.5077E-05	.47527	1.1770E-03	.10710	1.0720E-02
25	5.7691E-06	.07468	0.	0.00000	1.2375E-06	.45343	2.9907E-02	.07208	5.2490E-02
26	2.2901E-03	.07404	0.	0.00000	1.0213E-03	.41076	0.6010E-03	.12097	0.3605E-03
27	0.9032E-03	.03303	0.	0.00000	1.2950E-02	.18094	2.9907E-02	.07208	0.2231E-03
28	1.1812E-02	.02172	0.	0.00000	1.3738E-02	.08013	2.9907E-02	.07208	0.
29	1.5087E-03	.05761	0.	0.00000	2.4425E-03	.20137	4.3753E-03	.08005	0.
30	1.4310E-03	.03859	0.	0.00000	2.2340E-03	.15985	4.3582E-03	.06400	0.
31	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.
32	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.

NUMBER OF PHOTONS CROSSING SURFACE

TIME 0. 1.0000E+02

COSINE 1.0000E+00 0.0000E+01

SURFACE 1			SURFACE 10		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	6.58248E-04	.00382	0.	0.00000	0.
1.0000E+02	9.08870E-03	.26335	0.	0.00000	0.
1.0000E+00	4.18458E-01	.01857	7.30967E-03	.03723	.07181
5.0000E+00	2.55867E-02	.02838	7.72283E-04	.03810	0.00000
1.0000E+01	2.46588E-02	.03074	0.23694E-04	.11990	0.00000
SURFACE 11			SURFACE 14		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	0.	0.00000	0.	0.00000	0.
1.0000E+00	1.118778E-02	.04299	1.43652E-01	.02505	0.00000
5.0000E+00	2.33315E-03	.06362	1.69052E-02	.02610	0.00000
1.0000E+01	2.27043E-03	.07842	1.48841E-02	.04058	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 1			SURFACE 10		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	4.37712E-04	.70700	0.	0.00000	0.
1.0000E+02	6.76838E-03	.26497	0.	0.00000	0.
1.0000E+00	2.97057E-01	.02147	2.31611E-03	.04133	3.42202E-04
5.0000E+00	1.45638E-02	.03798	3.38513E-05	.12660	0.00000
1.0000E+01	1.50082E-02	.00015	0.	0.00000	0.
SURFACE 11			SURFACE 14		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	0.	0.00000	0.	0.00000	0.
1.0000E+00	4.38217E-03	.07033	2.31599E-02	.05276	0.00000
5.0000E+00	4.57340E-04	.13805	2.0762E-03	.08110	0.00000
1.0000E+01	2.98958E-04	.20642	2.0395E-03	.09913	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 1			SURFACE 10		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	2.18838E-04	.99997	0.	0.00000	0.
1.0000E+02	6.42234E-03	.26165	0.	0.00000	0.
1.0000E+00	1.36099E-01	.03098	1.28625E-03	.04833	2.75049E-04
5.0000E+00	7.52881E-03	.05224	1.98310E-05	.37022	0.00000
1.0000E+01	7.57178E-03	.05554	0.	0.00000	0.
SURFACE 11			SURFACE 14		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	0.	0.00000	0.	0.00000	0.
1.0000E+00	1.08032E-03	.08302	0.30755E-03	.13895	0.00000
5.0000E+00	5.15018E-05	.39674	1.2824E-04	.31433	0.00000
1.0000E+01	0.	0.00000	0.	0.00000	0.

COSINE 0.0000E+01 2.0000E+01

SURFACE 1			SURFACE 10		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	2.87588E-03	.38863	0.	0.00000	0.
1.0000E+00	5.91457E-02	.04659	5.03030E-04	.06723	2.33925E-04
5.0000E+00	2.56048E-03	.09269	0.	0.00000	0.
1.0000E+01	2.70483E-03	.09723	0.	0.00000	0.
SURFACE 11			SURFACE 14		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	0.	0.00000	0.	0.00000	0.
1.0000E+00	9.23317E-04	.13678	2.44848E-04	.63292	0.00000
5.0000E+00	0.	0.00000	0.	0.00000	0.
1.0000E+01	0.	0.00000	0.	0.00000	0.

COSINE 2.0000E+01 0.

SURFACE 1			SURFACE 10		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	8.78629E-04	.78930	0.	0.00000	0.
1.0000E+00	1.18269E-02	.10349	1.632 2E-04	.10073	1.87165E-04
5.0000E+00	4.33288E-04	.21197	0.	0.00000	0.
1.0000E+01	3.93008E-04	.24431	0.	0.00000	0.
SURFACE 11			SURFACE 14		
ENERGY	- TO -	REL. ERROR	ENERGY	- TO -	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.
1.0000E+02	0.	0.00000	0.	0.00000	0.
1.0000E+00	2.62914E-04	.24313	0.	0.00000	0.
5.0000E+00	0.	0.00000	0.	0.00000	0.
1.0000E+01	0.	0.00000	0.	0.00000	0.

NUMBER FLUX INTEGRATED OVER SURFACE

TIME	0.	1.0000E-02	RELATIVE
ENERGY		SURFACE	ERROR
5.0000E-03	0.	17	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	0.		0.00000
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

TIME	1.0000E-02	1.0000E-01	RELATIVE
ENERGY		SURFACE	ERROR
5.0000E-03	0.	17	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	7.13023E-02		.01941
5.0000E-00	3.16100E-03		.11021
1.0000E-01	2.79103E-03		.11943

TIME	1.0000E-01	1.0000E-00	RELATIVE
ENERGY		SURFACE	ERROR
5.0000E-03	0.	17	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	3.32510E-02		.13947
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

TIME	1.0000E-00	1.0000E-01	RELATIVE
ENERGY		SURFACE	ERROR
5.0000E-03	0.	17	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	0.		0.00000
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

PATH LENGTH/VOLUME

TIME	0.	1.0000E-02	RELATIVE
ENERGY		CELL	ERROR
1.0000E-01	6.50472E-07	3	.02893
5.0000E-01	1.96240E-06		.24000
1.0000E-00	2.10509E-06		.20131
5.0000E-00	3.07135E-07		.24633
1.0000E-01	6.00107E-07		.19024

TIME	1.0000E-02	1.0000E-01	RELATIVE
ENERGY		CELL	ERROR
1.0000E-01	3.49732E-04	3	.06933
5.0000E-01	7.41861E-04		.03800
1.0000E-00	2.74035E-04		.05033
5.0000E-00	5.95909E-05		.05718
1.0000E-01	5.85952E-05		.06339

TIME	1.0000E-01	1.0000E-00	RELATIVE
ENERGY		CELL	ERROR
1.0000E-01	1.02643E-04	3	.08204
5.0000E-01	2.90410E-05		.14224
1.0000E-00	3.61612E-07		.63191
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

TIME	1.0000E-00	1.0000E-01	RELATIVE
ENERGY		CELL	ERROR
1.0000E-01	0.	3	.00000
5.0000E-01	0.		.00000
1.0000E-00	0.		.00000
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

NUMBER FLUX AT DETECTOR

TIME	0.	1.0000E-02	RELATIVE
ENERGY		DETECTOR	ERROR
5.0000E-03	0.	1	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	0.		0.00000
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

TIME	1.0000E-02	1.0000E-01	RELATIVE
ENERGY		DETECTOR	ERROR
5.0000E-03	0.	1	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	1.04450E-05		.03104
5.0000E-00	3.37327E-06		.03669
1.0000E-01	3.07740E-06		.03512

TIME	1.0000E-01	1.0000E-00	RELATIVE
ENERGY		DETECTOR	ERROR
5.0000E-03	0.	1	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	1.41405E-05		.03793
5.0000E-00	1.43145E-07		.21320
1.0000E-01	0.		0.00000

TIME	1.0000E-00	1.0000E-01	RELATIVE
ENERGY		DETECTOR	ERROR
5.0000E-03	0.	1	0.00000
1.0000E-02	0.		0.00000
1.0000E-00	0.		0.00000
5.0000E-00	0.		0.00000
1.0000E-01	0.		0.00000

TAPE DUMP NO. 2 NPS= 15232

FILE COMPLETE SCHRANDIDA 1

CORE MAP ***** DATE= 72/12/88 TIME= 20.26.31 ***** NORMAL LOAD *****

	PWA	LWA	BLNK CBN	LENOMN
CODE	000100	130373	030243	100131
LOADER	143602	150071		
TABLES	143601	140007		

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LCN BLOCK	ADDRESS
-----	-----	-----	-----	-----	-----	-----
RUNTP	SOURCE	005453	G1	000100		
			DICOM	000142		
			G2	000216		
	MCBPRS	005622	G1	000100		
			G3	005617		
			DICOM	000142		
			G2	000216		
	OBPHI	010106	G1	000100		
			G3	005617		
			DICOM	000142		
			G2	000216		
	FRII	010533	G1	000100		
			G3	005617		
			DICOM	000142		
			G2	000216		
	IRH	010561	G1	000100		
			G3	005617		
			DICOM	000142		
			G2	000216		

SYSLIB				
ACGOER	010607	RBAREX	022321	
BACKSP	010621	SDRT	022400	
BUFFET	010650	ABORT	022450	
BUFFEO	010771	BS4020	022527	
CLOCKP	017053	C4020	022307	
OKPAX	017150	ENTR	023003	
ENDFIL	017720	GETBA	023037	
INPUTC	017734	IDUTIL	023073	
IOCMER	020110	KODER	020706	
LENGTH	020134	KRAKER	020261	
LOC	020154	LABRT	027322	
OUTP7C	020160	MEMORY	027430	
PACKAGE	020324	CUTPTS	027610	
SETO	020411	REMARK	027701	
SSWCH	020632	RETN	027734	
SYSTEM	020720	SKIPR	027766	
HTT	021756	SHIFT	030036	
ALNLOG	022075	NOI	030053	
EXP	022104	PSCALE	030117	
IRATER	022237	M2035R	030124	
IRATER	022270			

UNSATISFIED EXTERNALS	REFERENCED BY	AT LOCATION
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SACON	MCBPRS	000124

MCB TEST PROBLEM

SOURCE NO.	TIME CUTOFF	WT. CUTOFF 1	RUN TIME	D.P. CYCLE	DUMP CYCLE	DUMP NO.	CUTOFF CYCLE	WT. CUTOFF 2
7	1.0000E+02	1.0000E+03	4.9880E+00	4000	5000	0	0	1.0000E+04

TIME= 9.375 MINUTES

NUMBER OF PHOTONS STARTED	TOTAL NUMBER OF COLLISIONS	RANDOM NUMBERS GENERATED	TOTAL WEIGHT STARTED	TOTAL ENERGY STARTED	COLLISIONS PER PHOTON STARTED	TRACKS PER PHOTON STARTED	PHOTONS PROCESSED PER MINUTE
30100	543978	3710003	3.0103E+06	2.8040E+06	1.8072E+01	6.3290E+00	3.2097E+03
TOTAL TRACKS STARTED	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO WEIGHT CUTOFF	LOSS TO ESCAPE	LOSS TO SPLITTING	TOTAL TRACKS LOST	
100504	0	0	20762	42723	116019	100504	
WEIGHT STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	WEIGHT LOST PER PHOTON	PAIR PRODUCTION PER PHOTON	
1.0022E+00	0.	0.	3.2723E-01	6.0512E-01	1.0124E+00	9.3670E-03	
ENERGY STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	LOSS TO PAIR PRODUCTION	LOSS TO COMPTON	ENERGY LOST PER PHOTON
9.3157E-01	0.	0.	6.4510E-01	6.0409E-02	6.9519E-02	3.6607E-01	9.2718E-01

TOTAL CELL DEPOSITION DATA

CELL	NO. OF PHOTONS CAPTURED	RELATIVE ERROR	PHOTONS LOST TO E. C.	RELATIVE ERROR	PHOTONS CREATING A PAIR	RELATIVE ERROR
1	7.8183E-02	.05366	0.	0.00000	2.1641E-05	.01704
2	2.2149E-01	.02055	0.	0.00000	2.5757E-03	.06946
3	2.8466E-04	.07844	0.	0.00000	7.6412E-05	.20564
4	3.8581E-03	.04000	0.	0.00000	4.0919E-04	.09983
5	3.9917E-03	.05428	0.	0.00000	3.9646E-04	.21014
6	1.0429E-04	.04376	0.	0.00000	4.8173E-05	.18000
7	4.6101E-02	.02003	0.	0.00000	5.0330E-04	.06464
8	3.8055E-05	.05156	0.	0.00000	1.1351E-05	.25978
9	6.7975E-03	.03187	0.	0.00000	5.8929E-05	.13387
10	2.8444E-05	.05220	0.	0.00000	1.8244E-05	.20262
11	4.5461E-03	.03527	0.	0.00000	4.0834E-05	.15915
12	2.9120E-04	.04158	0.	0.00000	2.5855E-05	.11182
13	3.0126E-03	.03606	0.	0.00000	2.6784E-05	.14495
14	2.0223E-03	.03231	0.	0.00000	1.5641E-05	.14486
15	1.6314E-04	.15233	0.	0.00000	0.	0.00000
16	3.6722E-02	.03548	0.	0.00000	5.2378E-04	.18458
17	6.4943E-05	.15092	0.	0.00000	0.	0.00000
18	6.7529E-03	.08250	0.	0.00000	7.9731E-05	.52702
19	1.1120E-02	.06267	0.	0.00000	1.1295E-04	.39236
20	2.2071E-04	.11248	0.	0.00000	2.6578E-05	.73708
21	1.1918E-03	.07268	0.	0.00000	1.7276E-04	.32984
22	1.5921E-03	.03125	0.	0.00000	2.8570E-04	.09292
23	2.1881E-04	.05449	0.	0.00000	1.7719E-05	.28885
24	1.4552E-04	.05384	0.	0.00000	1.4258E-05	.23515
25	9.8885E-05	.06044	0.	0.00000	1.5781E-05	.26045
26	2.0615E-02	.05354	0.	0.00000	3.8938E-04	.23966
27	9.1620E-02	.02417	0.	0.00000	1.3689E-03	.11498
28	1.1305E-01	.01628	0.	0.00000	1.7424E-03	.09748
29	1.9467E-02	.03408	0.	0.00000	2.4793E-04	.12457
30	1.4945E-02	.02819	0.	0.00000	3.1489E-04	.09144
31	0.	0.00000	0.	0.00000	0.	0.00000
32	0.	0.00000	0.	0.00000	0.	0.00000

CELL	ENERGY LOST TO CAPTURE	RELATIVE ERROR	ENERGY LOST TO ENERGY CUTOFF	RELATIVE ERROR	ENERGY LOST TO PAIR PRODUCTION	RELATIVE ERROR	ENERGY LOST TO COMPTON	RELATIVE ERROR	TOTAL ENERGY DEPOSITED
1	4.2208E-04	.05686	0.	0.00000	6.5809E-05	.73169	4.7357E-03	.10552	5.2236E-03
2	1.0616E-02	.01771	0.	0.00000	1.8657E-02	.08208	1.8549E-01	.01935	1.3449E-01
3	1.4331E-05	.05880	0.	0.00000	5.8800E-04	.24369	9.8162E-03	.03930	9.8112E-03
4	2.1204E-04	.02987	0.	0.00000	3.1944E-03	.11663	3.4943E-02	.01984	3.8349E-02
5	2.2404E-04	.04305	0.	0.00000	2.7433E-03	.25993	3.9725E-02	.03676	4.2693E-02
6	5.1738E-03	.03260	0.	0.00000	3.7013E-04	.20577	8.1212E-03	.02757	8.4965E-03
7	2.8905E-06	.01769	0.	0.00000	3.9728E-03	.07544	1.7692E-02	.01958	2.4555E-02
8	1.7740E-06	.04036	0.	0.00000	6.6915E-05	.33980	2.8854E-03	.03881	2.1541E-03
9	4.0679E-04	.02869	0.	0.00000	4.2738E-04	.16198	2.8170E-03	.04527	2.8512E-03
10	1.2618E-06	.03929	0.	0.00000	0.3645E-05	.23643	1.2501E-03	.04109	1.3344E-03
11	2.6778E-04	.03192	0.	0.00000	3.1820E-04	.18209	1.2510E-03	.05536	1.8370E-03
12	1.1949E-05	.03379	0.	0.00000	1.8774E-04	.13523	2.5207E-03	.03286	2.7204E-03
13	1.7283E-04	.03293	0.	0.00000	2.1832E-04	.17757	8.7424E-04	.05765	1.2654E-03
14	1.0958E-04	.02991	0.	0.00000	1.1002E-04	.18706	5.8618E-04	.04989	7.2578E-04
15	9.8412E-06	.12954	0.	0.00000	0.	0.00000	1.5300E-03	.23254	1.5300E-03
16	2.3638E-03	.03215	0.	0.00000	3.8886E-03	.21063	1.5295E-02	.05922	2.1547E-02
17	3.9638E-06	.13077	0.	0.00000	0.	0.00000	7.3275E-04	.43925	7.3671E-04
18	4.3623E-04	.07267	0.	0.00000	8.2566E-04	.57931	2.7975E-03	.12303	4.0594E-03
19	7.4526E-04	.05793	0.	0.00000	7.3522E-04	.46095	4.8733E-03	.11355	6.3538E-03
20	1.4195E-05	.09103	0.	0.00000	1.5467E-04	.70762	3.2290E-03	.13984	3.4019E-03
21	7.5153E-05	.05320	0.	0.00000	1.4879E-03	.37905	1.3484E-02	.06490	1.5047E-02
22	9.7362E-05	.02365	0.	0.00000	1.8565E-03	.10521	1.7187E-02	.02026	1.8941E-02
23	1.3461E-05	.04315	0.	0.00000	9.8396E-05	.38408	2.3105E-03	.05499	2.4223E-03
24	8.7663E-06	.04289	0.	0.00000	1.0464E-04	.27328	1.3509E-03	.05052	1.4643E-03
25	5.5294E-06	.04984	0.	0.00000	1.2901E-04	.29927	1.2022E-03	.06820	1.3368E-03
26	2.2970E-03	.05281	0.	0.00000	1.8435E-03	.20797	6.7110E-03	.09631	1.0852E-02
27	9.9816E-03	.02419	0.	0.00000	1.8143E-02	.13621	2.4050E-02	.04896	4.6195E-02
28	1.1920E-02	.01559	0.	0.00000	1.3004E-02	.05565	3.8174E-02	.02334	5.5098E-02
29	1.6104E-03	.03312	0.	0.00000	1.9485E-03	.15517	4.4189E-03	.06153	7.0777E-03
30	1.5502E-03	.02755	0.	0.00000	2.4796E-03	.14956	4.2915E-03	.04448	8.3214E-03
31	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.
32	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.

NUMBER OF PHOTONS CROSSING SURFACE

TIME 0. 1.0000E-02

COSINE 1.0000E+00 0.0000E-01

SURFACE 1				SURFACE 10			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.444356E-04	.78808	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	1.01770E-02	.14102	3.96398E-06	.64402	0.00000	0.	0.00000
1.0000E+00	4.13039E-01	.03178	2.84863E-02	.64491	7.27895E-03	3.44461E-06	.04985
5.0000E+00	2.52348E-02	.02031	0.	0.00000	7.59681E-04	.06270	0.00000
1.4000E+01	2.39380E-02	.02192	0.	0.00000	6.01329E-04	.08670	0.00000

SURFACE 11				SURFACE 14			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E+00	1.21601E-02	.03073	0.	0.00000	1.41524E-01	.01771	0.00000
5.0000E+00	2.31345E-03	.04527	0.	0.00000	1.85479E-02	.02594	0.00000
1.4000E+01	2.1n381E-03	.05529	0.	0.00000	1.63763E-02	.02891	0.00000

COSINE 0.0000E-01 0.0000E-01

SURFACE 1				SURFACE 10			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	3.32498E-04	.57665	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	7.36345E-03	.18029	3.23957E-06	.76957	0.00000	0.	0.00000
1.0000E+00	2.59763E-01	.01549	2.54493E-02	.04770	2.37388E-03	.02916	3.38284E-04
5.0000E+00	1.42663E-02	.02740	0.	0.00000	3.12497E-05	.09437	0.00000
1.4000E+01	1.46489E-02	.02852	0.	0.00000	0.	0.00000	0.00000

SURFACE 11				SURFACE 14			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E+00	4.80514E-03	.05014	0.	0.00000	2.47377E-02	.03742	0.00000
5.0000E+00	5.35681E-04	.10091	0.	0.00000	2.38669E-03	.05806	0.00000
1.4000E+01	3.33328E-04	.13738	0.	0.00000	1.90032E-03	.06855	0.00000

COSINE 0.0000E-01 0.0000E-01

SURFACE 1				SURFACE 10			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	5.53710E-04	.66330	7.45146E-09	.99598	0.	0.00000	0.00000
1.0000E-02	4.93303E-03	.20075	1.49250E-06	.50285	0.	0.00000	0.00000
1.0000E+00	1.4nT44E-01	.02174	1.77135E-02	.05290	1.30905E-03	.03398	2.84708E-04
5.0000E+00	7.31340E-03	.03798	0.	0.00000	2.66471E-06	.25870	0.00000
1.4000E+01	7.07663E-03	.03918	0.	0.00000	0.	0.00000	0.00000

SURFACE 11				SURFACE 14			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E+00	1.00318E-03	.05927	0.	0.00000	4.32093E-03	.08878	0.00000
5.0000E+00	7.21865E-05	.26763	0.	0.00000	1.02905E-04	.24634	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000	0.00000

COSINE 0.0000E-01 2.0000E-01

SURFACE 1				SURFACE 10			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	2.23821E-03	.32818	1.70251E-07	.92897	0.	0.00000	0.00000
1.0000E+00	6.07369E-02	.03338	1.29940E-02	.06746	6.16135E-04	.04398	2.39784E-04
5.0000E+00	2.74640E-03	.06386	3.65432E-05	.75269	1.38427E-07	.99998	0.00000
1.4000E+01	2.35592E-03	.06827	0.	0.00000	0.	0.00000	0.00000

SURFACE 11				SURFACE 14			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E+00	8.50837E-04	.09367	0.	0.00000	3.04798E-04	.42215	0.00000
5.0000E+00	5.51576E-06	.99998	0.	0.00000	0.	0.00000	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000	0.00000

COSINE 2.0000E-01 0.

SURFACE 1				SURFACE 10			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	1.10742E-04	.99998	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	4.45192E-04	.78661	6.47021E-07	.59275	0.	0.00000	0.00000
1.0000E+00	1.14033E-02	.07299	4.78145E-03	.10457	1.90695E-04	.07209	1.05521E-04
5.0000E+00	4.35216E-04	.15n19	0.	0.00000	0.	0.00000	0.00000
1.4000E+01	3.05382E-04	.17155	0.	0.00000	0.	0.00000	0.00000

SURFACE 11				SURFACE 14			
ENERGY	- TO +	REL. ERROR	* TO -	REL. ERROR	REL. ERROR	* TO -	REL. ERROR
5.0000E-03	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E-02	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.0000E+00	2.18563E-04	.16192	0.	0.00000	0.	0.00000	0.00000
5.0000E+00	0.	0.00000	0.	0.00000	0.	0.00000	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000	0.00000

NUMBER FLUX INTEGRATED OVER SURFACE

TIME	0.	1.0000E-02
	SURFACE	RELATIVE
ENERGY	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
	SURFACE	RELATIVE
ENERGY	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	7.15477E-02	.04836
5.0000E+00	3.34688E-03	.07444
1.4000E+01	2.79994E-03	.08408

TIME	1.0000E-01	1.0000E+00
	SURFACE	RELATIVE
ENERGY	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	3.79357E-02	.08376
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
	SURFACE	RELATIVE
ENERGY	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

PATH LENGTH/VOLUME

TIME	0.	1.0000E-02
	CELL	RELATIVE
ENERGY	3	ERROR
1.0000E-01	4.27306E-07	.47126
5.0000E-01	2.45558E-06	.16268
1.0000E+00	2.93519E-06	.12496
5.0000E+00	4.74810E-07	.15388
1.4000E+01	8.06218E-07	.14615

TIME	1.0000E-02	1.0000E-01
	CELL	RELATIVE
ENERGY	3	ERROR
1.0000E-01	3.91645E-04	.04758
5.0000E-01	7.55486E-04	.02704
1.0000E+00	2.73593E-04	.03600
5.0000E+00	3.93950E-05	.04068
1.4000E+01	5.78125E-05	.04498

TIME	1.0000E-01	1.0000E+00
	CELL	RELATIVE
ENERGY	3	ERROR
1.0000E-01	1.58796E-04	.06697
5.0000E-01	3.00687E-05	.10717
1.0000E+00	9.54413E-07	.51550
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
	CELL	RELATIVE
ENERGY	3	ERROR
1.0000E-01	0.	0.00000
5.0000E-01	0.	0.00000
1.0000E+00	4.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

NUMBER FLUX AT DETECTOR

TIME	0.	1.0000E-02
	DETECTOR	RELATIVE
ENERGY	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
	DETECTOR	RELATIVE
ENERGY	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	1.69688E-05	.02373
5.0000E+00	3.27198E-06	.02565
1.4000E+01	3.03619E-06	.02687

TIME	1.0000E-01	1.0000E+00
	DETECTOR	RELATIVE
ENERGY	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	1.38177E-05	.02606
5.0000E+00	1.37695E-07	.14637
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
	DETECTOR	RELATIVE
ENERGY	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

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TAPE DUMP NO. 3 NPS# 30100

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20.25.51 $RMTR      JOB CARD READ WITH NO ERRORS
20.25.51 *LOS      01 CARDS = 0000308
20.25.53 $RMTR      READ. JOB READY TO BE SCHEDULED.
20.25.55 $RMTR      00 CROS 1.02 72/12/06 MACH. 14      TAPE
SY750073
20.25.56 $UMTR      .USER MONITOR OF 11/02/72 INITIALIZED.
20.25.56 $UMTR      .JOB NAME=SchrandtVI,DATE = 72/12/08
20.25.56 *CCP      00 $JOB (NAME=Schrandt,CAT=05,CL=U,AC=V06,UA=9406C050M
CG,PR=10,PL=40,TL=5M)
20.25.56 $UMTR      .FILE SET CCD OPENED+BUFFER LENGTH =00001100.
20.25.56 $UMTR      .FILE SET INP OPENED+BUFFER LENGTH =00010100.
20.25.56 *CCP      3. CONTINUE RUN--MCG TEST PROBLEM.
20.25.56 *CCP      $LABEL(STAGE)
20.25.56 *CCP      1 $CREATE(IFS=RUNTP,CL=U,SET=2000,PREMT=XX003024)
20.25.57 *CCP      2 $OPEN(IFS=DUMMY,SET=2000)
20.25.57 $UMTR      .FILE SET DUMMY OPENED+BUFFER LENGTH =00032100.
20.25.57 *CCP      3 $COPY(I=RUNTP,O=DUMMY) TO VERIFY POINTER #GRD
S
20.25.57 $UMTR      .FILE SET RUNTP OPENED+BUFFER LENGTH =00032100.
20.25.57 $BMTR      ROLLOUT STARTED
20.25.58 $RMTR      ROLLOUT DONE
20.26.07 *LOS      05 XX003024 IS ON UNIT 0 FILE RUNTP      800 BIN
20.26.26 $UMTR      ROLLIN STARTED
20.26.27 $BMTR      ROLLIN DONE
20.26.28 *CCP      4 $IF(FALSE=READY)
20.26.28 *CCP      $LABEL(READY) SUCCESSFUL STAGING
20.26.28 *CCP      5 $AFSREL(IFS=DUMMY)
20.26.28 $UMTR      .FILE SET DUMMY CLOSED+BUFFER LENGTH =00032100.
20.26.28 *CCP      .FILE SET STATISTICS
20.26.28 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000101 000000000 000000000 000000011
20.26.28 *CCP      . LWA=0000192711,DEVICE=03
20.26.29 *CCP      6 $REWIND(RUNTP)
20.26.29 *CCP      7 $SETQ(KEY=KATP)
20.26.29 *CCP      8 $SETQ.
20.26.29 *CCP      9 $LOAD(I=RUNTP)
20.26.31 $UMTR      .FILE SET OUT OPENED+BUFFER LENGTH =00032100.
20.26.34 $RMTR      ROLLOUT STARTED
20.26.35 $BMTR      ROLLOUT DONE
20.27.18 $RMTR      ROLLIN STARTED
20.27.19 $BMTR      ROLLIN DONE
20.28.10 $RMTR      ROLLOUT STARTED
20.28.11 $BMTR      ROLLOUT DONE
20.29.21 $RMTR      ROLLIN STARTED
20.29.22 $BMTR      ROLLIN DONE
20.31.07 $RMTR      ROLLOUT STARTED
20.31.08 $BMTR      ROLLOUT DONE
20.31.43 $RMTR      ROLLIN STARTED
20.31.44 $BMTR      ROLLIN DONE
20.32.42 $RMTR      ROLLOUT STARTED
20.32.43 $BMTR      ROLLOUT DONE
20.32.47 $RMTR      ROLLIN STARTED
20.32.48 $BMTR      ROLLIN DONE
20.33.53 MCGPH5 .END
20.33.53 $UMTR      .FILE SET IMAGE OPENED+BUFFER LENGTH =00064100.
20.33.53 $UMTR      .FILE SET IMAGE CLOSED+BUFFER LENGTH =00064100.
20.33.53 *CCP      .FILE SET STATISTICS
20.33.53 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000003 000000001 000000000 000000004
20.33.53 *CCP      . LWA=0000130676,DEVICE=03
20.33.54 *CCP      10 $IF(FALSE=TAPE)
20.33.54 *CCP      $LABEL(TAPE)
20.33.54 *CCP      11 $AFSREL(IFS=RUNTP,ADISP=STAPE,POSMT=XX003024)
20.33.54 $UMTR      .FILE SET RUNTP CLOSED+BUFFER LENGTH =00032100.
20.33.54 *CCP      .FILE SET STATISTICS
20.33.54 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000210 000000002 000000003 000000020 000000003
20.33.54 *CCP      . LWA=0000210131,DEVICE=03
20.33.54 *CCP      .EOF OR EOI ON CC FILE. FSET=CCD
20.33.54 $UMTR      .FILE SET CCD CLOSED+BUFFER LENGTH =00001100.
20.33.54 *CCP      .FILE SET STATISTICS
20.33.54 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000046 000000025 000000023 000000000 000000000
20.33.54 *CCP      . LWA=0000000000,DEVICE=00
20.33.54 $UMTR      .FILE SET INP CLOSED+BUFFER LENGTH =00010100.
20.33.54 *CCP      .FILE SET STATISTICS
20.33.54 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000001 000000001 000000001 000000000 000000000
20.33.54 *CCP      . LWA=0000000000,DEVICE=00
20.33.54 $UMTR      .FILE SET OUT CLOSED+BUFFER LENGTH =00032100.
20.33.54 *CCP      .FILE SET STATISTICS
20.33.54 *CCP      . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000054 000000000 000000000 000000001
20.33.54 *CCP      . LWA=0000010463,DEVICE=01
20.33.54 $UMTR      99 .JOB TERMINATION.
.ELAPSED CP TIME = 00208.44490
.ESTIMATED JOB COST =0036.05
20.34.24 *LOS      06 XX003024 IS ON UNIT 0 FILE RUNTP      800 BIN
20.34.26 *LOS      03 RCOVERED MPE UNIT 0 FILE RUNTP
20.34.34 $OUTPUT      FS=OUT OSP=PRT 4404 WORDS      6 PAGES
20.34.37 $OUTPUT      FS=RUNTP OSP=TAPE 69722 WORDS

```

FILE COMPLETE SchrandtVI 2

TABLE V
SAMPLE RUN - MCP

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SURROUTINE SOURCE
1  COMMON MAX,MAJ,MXS,MXF,MXFM,MXLC,LC3,IFO,MSA7,IL1,NSR,I11,I12,J11,
A J12,K11,K12,I11,LL1,1X1,121,122,J21,J22,I12,1+1,1+2,I51,I52,J51,
B J52,I15,NDCTX,LC0,LCPI,J+1,J+2,I1+SRC(8),SPB(24),SWM(24),SEG(24),
C IDY(5),J(16),MIF(7),LDF(6),NCL(120),P10(120),ML1(120),ML2(120),LC
D A(121),LJA(400),LCAJ(400),LAJ(960),KST(120),LSC(121),SEF(300),LCB
E (960),LFD(16),LPR(16),LJP(60),QAI(20),IFP(40),PI(200),CLCTX(25,3),RO
F (25),FRQ(25),VOL(120),LNE(1800),FRC(1800),NDC,
G NST,KRN,NRN,TMS,
H TES,NPS,NTR,NCT,TMO,ETH(6),NTM(6),WTH(6),ECR(18000)
1  COMMON/G1/SIG,ULS,PL,GPL,PMF,DEQ,CSJA,CSA,IAP,NE,NCP,ROD,
A X,Y,Z,U,V,W,E,AG,WT,TME,VL,DEL,IA,JA,NP,USQ,VSQ,W5G,I6F,
B I1F,I2F,I5F,I6F
1  COMMON/G2/J0(2),TP(25),JSP(120),S01(120),S02(120),TCR(13),
A PCR(52),HNK(22,100)
1  COMMON/G3/IS(9,F24),F248
1  COMMON/G4/VIC(21),WCO(55),VCO(55)
1  COMMON/DXCOM/IDEX,CSDA,DDCTX,DIFAC,MFP,PBL5AV(13),LV2,LV3,
A LV4,PSC,UOLD,VOLD,WOLD
C UNIFORMLY DISTRIBUTED IN VOLUME IN SPECIFIED SPHERICAL CELL.
C STARTING DIRECTION ISOTROPIC BUT BIASED IN POSITIVE V-DIRECTION.
C ENERGY DISTRIBUTION.
C S7 CARD REQUIRED IN PROBLEM DECK.
C SRC(1)=CELL NUMBER.
C SRC(2)=RADIUS OF CELL IN CM.
C SRC(3)=FRACTION OF NEUTRONS WHOSE STARTING DIRECTION WAS
C POSITIVE V.
C
C DISTANCE FROM ORIGIN SAMPLED FROM THE INTERVAL (.0,SRC(2))
C DISTRIBUTED ACCORDING TO THE DISTANCE CUBED.
1  R=SRC(2)*((FRN(KRN))**.333333333
C SAMPLE UNIFORMLY FROM POINTS INSIDE THE UNIT CIRCLE.
10  TP(1)=2.*FRN(KRN)-1.
15  TP(2)=2.*FRN(KRN)-1.
22  TP(3)=TP(1)**2+TP(2)**2
24  IF (TP(3).GT.1.) GO TO 15
C TP(3) DISTRIBUTED UNIFORMLY ON THE INTERVAL (0,1). TP(4) IS
C THE COSINE OF THE POLAR ANGLE OF THE STARTING POINT.
30  TP(4)=2.*TP(3)-1.
31  TP(5)=R*SQRT((1.-TP(4)**2)/TP(3))
37  X=TP(4)
40  Y=TP(1)*TP(5)
41  Z=TP(2)*TP(5)
43  IF (FRN(KRN).GT.SRC(3)) GO TO 30
C SET V POSITIVE SRC(3) OF THE TIME.
51  V=ABS(V)
52  WT=0.5/SRC(3)
56  15  IA=SRC(1)
55  JA=1
56  TME=0
57  DEL=0
60  R=FRN(KRN)
63  DD 20 1+2,8
64  IF (R.LT. SPB(1)) GO TO 25
67  20  CONTINUE
72  25  ENG=SEG(I-1)+(SEG(1)-SEG(I-1))*(R-SPB(I-1))/
1  (SPB(1)-SPB(I-1))
100  WT=WT*SWM(I)
102  RETURN
C SET V NEGATIVE -SRC(3) OF THE TIME.
103  30  V=-ABS(V)
105  WT=0.5/(1.-SRC(3))
110  GO TO 15
111  END

```

SUBPROGRAM LENGTH - SOURCE
144

STATEMENT ASSIGNMENTS

STMT NO	LOCATION	STMT NO	LOCATION	STMT NO	LOCATION	STMT NO	LOCATION
10	11	15	55	25	72	30	104

BLOCK NAMES AND LENGTHS

BLK	NAME	LENGTH	BLK	NAME	LENGTH	BLK	NAME	LENGTH
01	57747	42	02	5134		03		3
04	203	31						

VARIABLE ASSIGNMENTS

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
BK	704C03	COETX	11106C01	DEL	26C02	ECR	14627C01
ERG	22C02	ETM	14605C01	F10	410C01	FRC	13133C01
FRO	11252C01	I	142	IA	27C02	IO	173C01
IDY	166C01	IFP	10502C01	IJP	10216C01	JA	30C02
JO	0C03	JSF	33C03	KR	14575C01	KST	5151C01
LAI	3251C01	LCA	1160C01	LCAJ	2311C01	LCB	6302C01
LDF	212C01	LFD	10202C01	LJA	1351C01	LME	11473C01
LPR	10210C01	LSC	5341C01	ML	600C01	ML2	770C01
NCL	220C01	NIF	203C01	NTM	14613C01	P	16576C01
PHL5AV	5C06	PCR	620C03	QA	10312C01	R	143
RO	11221C01	SCF	5532C01	SEU	136C01	SGI	223C03
S02	413C03	SPB	56C01	SRC	46C01	SWM	106C01
TCR	603C03	TME	24C02	TP	2C03	V	20C02
VCO	114C05	VIC	8C05	VOL	11303C01	WCO	25C05
WT	23C02	WTH	14621C01	X	14C02	Y	15C02
Z	10C02						

EXTERNAL ASSIGNMENTS

FRN	CONSTANTS	TEMPORARIES	INDIRECTS	UNUSED COMPILER SPACE
113	117	141	77100	

CORE MAP ***** DATE- 72/12/07 TIME- 16.25.42 ***** NORMAL LOAD *****

CODE	FWA	LWA	BLNK COM	LENGTH
LOADER	000100	076066	016140	057147
TABLES	143602	150071		
	143601	141761		

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LCM BLOCK	ADDRESS
CODETP						
SYSLIB	IMCPPRS	002154	C1	000100		
	ACQDER	006734				
	BUFFE1	006746				
	BUFFE0	007067				
	ENDFIL	007151				
	INPUTC	007165				
	INPUTS	007341				
	IOCMER	007427				
	LENGTH	007453				
	LOCF	007473				
	OUTPTC	007505				
	OUTPTS	007643				
	HEMINM	007734				
	SYSTEM	007767				
	IBAIEX	011025				
	BS4020	011056				
	C4020	011036				
	GETBA	011732				
	IOUTIL	011766				
	RODER	013257				
	RRARER	014554				
	HENDRY	015615				
	SKIPR	015775				
	MOI	016047				
	PSCALE	016113				

UNSATISFIED EXTERNALS	REFERENCED BY	AT LOCATION
*****	*****	*****

MCP TEST #PROBLEM

```

1 45 .00926 1.12 -1.2
2 43 .0093 1.1 -2.453
3 44 .123 2.2 -4.4 -3.6
4 46 .1173 2.2 4.3 15.5 -3.6
5 46 .1173 2.2 -15.4 -3.15
6 61 .0463 3.443 -.717 -7.8
7 43 .0093 5.6 15.16 -6.22 -7.9
8 43 .0093 5.8 7.7 -6.23 -6.11
9 41 .0463 -5.9 7.6 -6.10
10 41 .0463 5.10 8.9 -6.24 -9.13
11 43 .0093 5.12 9.10 -10.14
12 44 .123 -5.13 9.10 -10.14
13 43 .0093 5.12 9.11 -6.25 -11.32
14 43 .0093 -9.13 16.12 -11.32
15 45 .00926 3.5 16.17 -5.16
16 43 .0093 5.15 16.18 -6.21 -15.7
17 45 .00926 -5.18 17.19 -16.15
18 43 .0093 5.17 19.19 -16.20
19 46 .1173 6.18 18.32 -12.26 -16.21
20 46 .1173 6.18 18.32 -12.26 -16.21
21 46 .1173 6.18 18.32 -12.26 -16.21
22 46 .1173 6.7 15.41 -12.26 -7.23
23 46 .1173 6.9 7.22 -12.29 -8.24
24 46 .1173 6.11 8.23 -12.30 -9.25
25 46 .1173 6.13 9.24 -12.30 -11.32
26 42 .0047 12.20 18.32 -13.31 -16.27
27 42 .0047 12.21 18.32 -13.31 -15.28
28 42 .0047 12.22 15.27 -13.31 -7.29
29 42 .0047 12.23 7.48 -13.31 -8.30
30 42 .0047 12.24 25.8 2.9 -13.31 -11.32
31 0 13.56 27.28 29.38 18.32 -14.32 -11.32
32 0 14.31 -18.19 16.20 20.20 11.14 13.25 30.31
1 50 3.0
2 50 5.0
3 50 10.0
4 43 0 .333333333333
5 50 10.0
6 50 10.0
7 50 10.0
8 50 10.0
9 50 10.0
10 50 10.0
11 50 10.0
12 50 10.0
13 50 10.0
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90 50 10.0
91 50 10.0
92 50 10.0
93 50 10.0
94 50 10.0
95 50 10.0
96 50 10.0
97 50 10.0
98 50 10.0
99 50 10.0
100 50 10.0

```

NO. CELLS= 32			NO. SURFACES= 18		
PROGRAM NAME	CELLS PROBLEM NAME	TALLY FORMULA	PROGRAM NAME	SURFACES PROBLEM NAME	TALLY FORMULA
1	1		1	1	1
2	2		2	2	
3	3	4	3	3	
4	4		4	4	
5	5		5	5	
6	6		6	6	
7	7		7	7	
8	8		8	8	
9	9		9	9	
10	10		10	10	1
11	11		11	11	1
12	12		12	12	
13	13		13	13	
14	14		14	14	1
15	15		15	15	
16	16		16	16	
17	17		17	17	2
18	18		18	18	
19	19				
20	20				
21	21				
22	22				
23	23				
24	24				
25	25				
26	26				
27	27				
28	28				
29	29				
30	30				
31	31				
32	32				

CELL	AMB. SURF.	MATERIAL	DENSITY	10
1		45	9.2130E-03	1.0000E+00
2		43	6.0300E-02	1.0000E+00
3		44	1.2530E-01	2.0000E+00
4		46	1.1710E-01	2.0000E+00
5		46	1.1730E-01	1.0000E+00
6		41	4.6370E-02	4.0000E+00
7		43	6.0300E-02	4.0000E+00
8		41	4.6370E-02	8.0000E+00
9		43	6.0300E-02	8.0000E+00
10		41	4.6370E-02	1.6000E+01
11		43	6.0300E-02	8.0000E+00
12		44	1.2530E-01	3.2000E+01
13		43	6.0300E-02	1.6000E+01
14		43	6.0300E-02	3.2000E+01
15		45	9.2630E-03	1.0000E+00
16		43	6.0300E-02	1.0000E+00
17		45	9.2630E-03	1.0000E+00
18		43	6.0300E-02	1.3000E+00
19		43	6.0300E-02	1.0000E+00
20		46	1.1730E-01	1.0000E+00
21		46	1.1730E-01	1.0000E+00
22		46	1.1730E-01	4.0000E+00
23		46	1.1730E-01	4.0000E+00
24		46	1.1730E-01	8.0000E+00
25		46	1.1730E-01	8.0000E+00
26		42	8.4700E-02	1.0000E+00
27		42	8.4700E-02	1.0000E+00
28		42	8.4700E-02	2.0000E+00
29		42	8.4700E-02	2.0000E+00
30		42	8.4710E-02	4.0000E+00
31		0	0.	1.0000E+00
32		0	0.	0.

FORMULA 1 -- NEUTRONS CROSSING SURFACE
 SURFACE 1 10 11 14
 ENERGY 5.0000E-03 1.0000E-02 1.0000E+00 5.0000E+00 1.4000E+01
 TIME 1.0000E-02
 COSINE 8.0000E-01 0.0000E-01 4.0000E-01 2.0000E-01 0.

FORMULA 2 -- FLUX INTEGRATED OVER SURFACE
 SURFACE 17
 ENERGY 5.0000E-03 1.0000E-02 1.0000E+00 5.0000E+00 1.4000E+01
 TIME 1.0000E-02 1.0000E-01 1.0000E+00 1.0000E+01

FORMULA 4 -- PATH LENGTH/VOLUME
 CELL 3
 ENERGY 1.0000E-01 5.0000E-01 1.0000E+00 5.0000E+00 1.4000E+01
 TIME 1.0000E-02 1.0000E-01 1.0000E+00 1.0000E+01
 VOLUME 2.4552E+02

FORMULA 5 -- FLUX AT DETECTOR
 DETECTOR 1 X Y NEIGHBORHOOD
 0. 1.0000E+01 2.5000E+01 0.
 CELL ALL
 ENERGY 5.0000E-03 1.0000E-02 1.0000E+00 5.0000E+00 1.4000E+01
 TIME 1.0000E-02 1.0000E-01 1.0000E+00 1.0000E+01

SOURCE= 7

	SRC(1)	SRC(2)	SRC(3)
	1.0000E+00	3.0000E+00	7.5000E+01
N	ENERGY	CUM. PROB.	WT. MULT.
1	1.0000E-03	0.	0.
2	1.0000E-02	2.0000E-02	5.0000E+00
3	1.0000E-01	1.0000E-01	2.5000E+00
4	5.0000E-01	3.0000E-01	1.5000E+00
5	1.0000E+00	0.0000E-01	1.0000E+00
6	5.0000E+00	0.0000E-01	2.5000E+01
7	1.0000E+01	7.5000E-01	2.0000E+01
8	1.4000E+01	1.0000E+00	4.0000E+01

MATERIAL DATA

MAT. NO.	ELEM. NO.	FRACTION
41	3	1.00000
MAT. NO.	ELEM. NO.	FRACTION
42	26	1.00000
MAT. NO.	ELEM. NO.	FRACTION
43	13	1.00000
MAT. NO.	ELEM. NO.	FRACTION
44	4	1.00000
MAT. NO.	ELEM. NO.	FRACTION
45	1 6	.50000 .50000
MAT. NO.	ELEM. NO.	FRACTION
46	1 6	.66667 .33333

INITIATION COMPLETED

CORE MAP ***** DATE- 72/12/07*** TIME- 18.25.46***** NORMAL LOAD *****

	FWA	LWA	BLNK COM	LENGTH
CODE	000100	110757	031011	057747
LOADER	143602	150071		
TABLES	143601	140017		

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LCM BLOCK	ADDRESS
*****	*****	*****	*****	*****	*****	*****
RUNTP	SOURCE	005535	01	000100		
			02	000142		
			03	005276		
			04	005301		
	MCPPR5	005701	DXCOM	005504		
			01	000100		
			02	000142		
			03	005276		
			04	005301		
	UBPNT	016730	DXCOM	005504		
			01	000100		
			02	000142		
			03	005276		
			04	005301		
	FRN	017301	DXCOM	005504		
			01	000100		
			02	000142		
			03	005276		
			04	005301		
	INN	017327	DXCOM	005504		
			01	000100		
			02	000142		
			03	005276		
			04	005301		
			DXCOM	005504		

SYSLIB

ACGGER	017355
BACKSP	017367
BUFFE1	017416
BUFFE0	017537
CLOCKF	017621
DRPXX	017724
ENDFIL	020466
INPUTC	020502
IOCHK	020656
LENGTH	020702
LOGF	020722
OUTPTC	020734
PACKAGE	021072
SET0	021157
SWTCH	021400
SYSTEM	021466
XIT	022524
ALNLOG	022643
EXP	022732
IBAIEX	023005
RBAIEX	023036
RHAREX	023067
SURT	023146
ABORT	023224
H54020	023275
C4020	024055
ENR	024151
GETBA	024205
IOUTIL	024241
ROGER	025532
RRAKER	027027
LABRT	030070
MEMORY	030176
OUTPYS	030356
REMARK	030447
METH	030502
SKIPR	030532
SHIFT	030604
BDI	030621
PSCALE	030665
N2035R	030672

UNSATISFIED
EXTERNALS

SRCDX

REFERENCED
BY

MCPPR5

----- AT
----- LOCATION

006677

MCP TEST PROBLEM

SOURCE NO. 7	TIME CUTOFF 1.0000E+02			ENERGY CUTOFF 1.0000E+03			RUN TIME 4.9000E+00			O.F. CYCLE 2500%			DUMP CYCLE 25000			DUMP NO. =0	CUTOFF CYCLE =0		
NPS	X	Y	Z	IA	JA	U	V	W	TKE							WT	DEL	ERG	
1	1.8634E+00	-1.1784E+00	-1.9418E+00	1	1	7.8852E-01	6.0053E-01	1.2328E-01	0.	6.6667E-01	0.	7.5687E-01							
2	-7.6927E-01	9.4340E-01	-1.0674E+00	1	1	8.5543E-01	-3.2219E-01	-4.0551E-01	0.	3.0000E+00	0.	3.8554E-01							
3	-2.4466E+00	-4.0041E-01	-4.9125E-01	1	1	7.7575E-01	2.9254E-01	-5.5913E-01	0.	1.6667E-01	0.	2.5128E+00							
4	-7.5052E-01	2.6368E+00	2.9899E-01	1	1	-9.8079E-01	-2.6476E-02	1.9324E-01	0.	8.0000E-01	0.	1.0061E-01							
5	1.5596E+00	9.0693E-01	-4.7437E-01	1	1	7.3281E-01	4.7166E-01	-4.9044E-01	0.	6.6667E-01	0.	9.0880E-01							
6	8.8854E-01	1.1039E-01	-1.8744E+00	1	1	-6.0454E-01	3.3734E-01	7.2162E-01	0.	1.0000E+00	0.	4.6181E-01							
7	2.5917E+00	-5.4249E-01	4.3255E-01	1	1	-2.9061E-01	4.0562E-01	-8.3591E-01	0.	1.6667E-01	0.	4.1620E+00							
8	-8.7200E-01	6.2016E-01	2.1681E+00	1	1	-2.2042E-01	-5.4173E-02	9.7390E-01	0.	4.0000E-01	0.	5.1466E+00							
9	-2.0645E+00	1.3224E+00	-5.6974E-01	1	1	6.5875E-01	6.0167E-01	3.5812E-01	0.	1.6667E-01	0.	2.6810E+00							
10	1.0045E+00	1.3225E+00	4.1324E-01	1	1	-8.3340E-01	3.6956E-02	5.5144E-01	0.	1.3333E-01	0.	1.2481E+00							
11	-7.9293E-02	3.6146E-01	2.3623E+00	1	1	-1.5551E-01	-2.8660E-02	9.8742E-01	0.	5.0000E+00	0.	3.1242E-02							
12	-9.6391E-01	-6.9394E-01	2.2224E-01	1	1	7.7150E-01	6.3355E-01	5.4942E-02	0.	1.0000E+00	0.	2.8891E-01							
13	-6.8898E-01	2.9487E-03	-7.1511E-01	1	1	-5.7973E-01	-1.3928E-01	8.0282E-01	0.	3.0000E+00	0.	1.8121E-01							
14	-2.3188E+00	-4.5438E-01	-1.5132E+00	1	1	-6.1893E-01	-7.8544E-01	-3.2888E-03	0.	5.0000E-01	0.	2.4521E+00							
15	1.3775E+00	2.3000E-00	-2.4732E-01	1	1	-2.6839E-01	2.5913E-01	9.2780E-01	0.	1.6667E-00	0.	3.0584E-02							
16	1.3847E-01	2.3330E-00	-3.8756E-01	1	1	-2.5318E-01	8.1735E-02	-6.4396E-01	0.	6.6667E-01	0.	6.1986E-01							
17	1.9894E+00	-2.0589E+00	-8.8648E-01	1	1	2.0806E-01	-7.3541E-01	-6.4472E-01	0.	3.0000E+00	0.	1.9222E-01							
18	5.7099E-01	-5.9941E-01	-7.1424E-01	1	1	6.3296E-01	4.0073E-01	-6.6240E-01	0.	6.6667E-01	0.	7.6630E-01							
19	-1.5302E+00	-2.2209E+00	4.5534E-01	1	1	9.4572E-01	3.2389E-01	2.6606E-02	0.	6.6667E-01	0.	4.0117E-01							
20	1.7716E+00	-5.2536E-01	1.3888E+00	1	1	-5.9955E-01	-6.3481E-01	4.8738E-01	0.	3.0000E+00	0.	1.9734E-01							
21	-1.0808E+00	-7.1116E-01	-1.1190E-01	1	1	8.9975E-01	3.5950E-01	2.4728E-01	0.	6.6667E-01	0.	6.2104E-01							
22	-8.2244E-01	4.9091E-01	-7.9707E-01	1	1	-9.9231E-01	1.1765E-01	3.8517E-02	0.	1.3333E-01	0.	5.8952E-00							
23	6.5986E-01	8.5280E-01	-1.8288E-01	1	1	-7.6712E-01	2.2883E-01	-5.9930E-01	0.	6.6667E-01	0.	5.4739E-01							
24	4.5570E-01	1.4091E+00	-5.9566E-01	1	1	-3.9194E-01	1.2040E-01	9.1004E-01	0.	1.0000E+00	0.	3.3358E-01							
25	4.4906E-01	1.3921E+00	1.1531E+00	1	1	1.2420E-01	-8.6507E-01	-4.8496E-01	0.	5.0000E+00	0.	1.2880E-02							
26	2.8902E+00	6.2510E-01	4.6220E-01	1	1	6.1286E-01	7.4018E-01	-3.8154E-03	0.	6.6667E-01	0.	7.8886E-01							
27	-5.7488E-01	6.0524E-02	-2.3618E-00	1	1	-2.8626E-01	-8.8806E-01	3.5970E-01	0.	4.0000E-01	0.	6.4639E+00							
28	2.6345E+00	-8.0678E-01	-1.1377E+00	1	1	-1.9296E-01	4.1077E-02	-9.8035E-01	0.	1.6667E+00	0.	7.6937E-02							
29	1.6317E+00	-4.8622E-01	2.6900E+00	1	1	2.6737E-01	9.6248E-01	4.6280E-02	0.	1.6667E-01	0.	2.2300E-01							
30	1.3357E+00	2.3638E-01	-1.9277E-01	1	1	1.7439E-02	1.3122E-02	9.9976E-01	0.	1.0000E+00	0.	1.5420E-01							
31	8.9330E-01	-8.7418E-01	5.8956E-01	1	1	-3.4255E-01	6.4344E-01	6.8450E-01	0.	1.0000E+00	0.	3.9580E-01							
32	-1.1163E+00	2.3696E+00	7.7764E-01	1	1	-1.2820E-01	7.6786E-01	6.2764E-01	0.	1.6667E-01	0.	1.3541E+00							
33	2.5938E+00	-8.6808E-01	-1.4908E-02	1	1	1.7859E-01	-2.9988E-01	9.4025E-01	0.	2.0000E+00	0.	5.5342E-01							
34	2.3214E-02	-2.2209E-01	3.5839E-01	1	1	4.6249E-01	4.6780E-01	-7.5317E-01	0.	1.6667E+00	0.	6.9213E-02							
35	6.5634E-01	1.9474E-00	-1.7164E+00	1	1	1.1932E-01	-7.5493E-01	-6.4488E-01	0.	4.0000E-01	0.	7.8823E+00							
36	8.1224E-01	2.6601E+00	8.8752E-01	1	1	-8.8208E-01	2.0539E-01	4.2397E-01	0.	1.6667E-01	0.	2.5452E+00							
37	-8.4098E-01	1.7157E-01	-2.3035E+00	1	1	-9.3820E-01	9.2612E-02	-3.3348E-01	0.	1.6667E-01	0.	6.2433E+00							
38	3.5784E-01	5.1613E-01	1.3592E+00	1	1	-4.1469E-01	8.1499E-01	-4.0474E-01	0.	1.6667E-01	0.	4.5873E+00							
39	1.8519E+00	2.1294E+00	3.4944E-01	1	1	-7.5653E-01	2.6252E-01	-5.9845E-01	0.	1.6667E-01	0.	2.0123E+00							
40	-2.3624E+00	-1.5042E-01	9.4255E-01	1	1	-6.9761E-02	0.2774E-01	-3.6684E-01	0.	1.0000E+00	0.	4.2103E-01							
41	-9.9362E-02	5.5475E-01	-2.6669E+00	1	1	-8.7580E-01	4.8268E-01	1.4833E-03	0.	6.6667E-01	0.	7.0687E-01							
42	1.3828E+00	1.1500E+00	2.2912E+00	1	1	-6.6437E-01	-6.2985E-01	4.0237E-01	0.	5.0000E-01	0.	4.3988E+00							
43	-2.3392E-01	-2.2430E-01	-5.9501E-01	1	1	-3.2391E-01	2.0279E-01	9.2424E-01	0.	1.3333E-01	0.	6.9181E+00							
44	-2.4562E+00	1.0774E-00	-3.1791E-01	1	1	5.6814E-01	1.6974E-01	-8.0523E-01	0.	6.6667E-01	0.	5.1485E-01							
45	-4.5430E-01	-9.8526E-02	-5.9728E-02	1	1	-3.4506E-01	7.1088E-01	2.2514E-01	0.	6.6667E-01	0.	7.4685E-01							
46	-4.4030E-01	-1.9660E-01	5.2124E-01	1	1	1.6513E-01	-1.2814E-01	-9.7791E-01	0.	2.0000E+00	0.	7.1822E-01							
47	8.5038E-01	2.3612E-01	1.3213E+00	1	1	-1.2435E-01	6.0094E-01	-7.8956E-01	0.	2.6667E-01	0.	1.1444E-01							
48	-6.2690E-01	2.2637E+00	6.2585E-01	1	1	-8.6021E-01	2.6343E-01	4.3663E-01	0.	1.0000E+00	0.	1.5058E-01							
49	-7.8057E-01	-2.5449E+00	-5.0268E-01	1	1	-1.4857E-01	-6.4491E-01	-8.7606E-01	0.	6.6667E-01	0.	5.8823E-01							
50	-2.0422E+00	1.4790E+00	5.9978E-01	1	1	5.2481E-01	3.7261E-02	-8.5040E-01	0.	6.6667E-01	0.	7.0803E-01							

MCP TEST PROBLEM

TIME= 4.605 MINUTES

NUMBER OF PHOTONS STARTED 16414	TOTAL NUMBER OF COLLISIONS 178840	RANDOM NUMBERS GENERATED 1837675	TOTAL WEIGHT STARTED 1.6503E+04	TOTAL ENERGY STARTED 1.5567E+04	COLLISIONS PER PHOTON STARTED 1.0896E+01	TRACKS PER PHOTON STARTED 5.5690E+00	PHOTONS PROCESSED PER MINUTE 3.5642E+03
TOTAL TRACKS STARTED 91410	LOSS TO ENERGY CUTOFF 0	LOSS TO TIME CUTOFF 0	LOSS TO ESCAPE 22460	LOSS TO CAPTURE 16752	LOSS TO SPLITTING 52198	TOTAL TRACKS LOST 91410	
WEIGHT STARTED PER PHOTON 1.0054E+00	LOSS TO ENERGY CUTOFF 0.	LOSS TO TIME CUTOFF 0.	LOSS TO ESCAPE 3.3986E-01	LOSS TO CAPTURE 6.8340E-01	WEIGHT LOST PER PHOTON 1.0229E+00	PAIR PRODUCTION PER PHOTON 9.4479E-03	
ENERGY STARTED PER PHOTON 9.4841E-01	LOSS TO ENERGY CUTOFF 0.	LOSS TO TIME CUTOFF 0.	LOSS TO ESCAPE 4.4966E-01	LOSS TO CAPTURE 4.6119E-02	LOSS TO PAIR PRODUCTION 7.1904E-02	LOSS TO COMPTON 3.7334E-01	ENERGY LOST PER PHOTON 9.4181E-01

TOTAL CELL DEPOSITION DATA

CELL	NO. OF PHOTONS CAPTURED	RELATIVE ERROR	PHOTONS LOST E. C.	RELATIVE ERROR	PHOTONS CREATING A PAIR	RELATIVE ERROR
1	8.0013E-02	.07114	0.	0.00000	2.0308E-05	.70706
2	2.2259E-01	.02913	0.	0.00000	3.0259E-03	.09037
3	2.8431E-04	.39682	0.	0.00000	7.6155E-05	.29049
4	4.4799E-03	.11637	0.	0.00000	3.1883E-04	.14594
5	4.7155E-03	.18524	0.	0.00000	5.3613E-04	.24194
6	8.8847E-05	.42467	0.	0.00000	3.1485E-05	.30232
7	4.3994E-02	.03631	0.	0.00000	4.1580E-04	.08924
8	3.3000E-05	.42475	0.	0.00000	1.0408E-05	.37222
9	6.9026E-03	.05491	0.	0.00000	5.0262E-05	.17331
10	3.5539E-05	.34307	0.	0.00000	1.1169E-05	.25398
11	4.6413E-03	.06325	0.	0.00000	3.5285E-05	.22952
12	1.0233E-04	.12058	0.	0.00000	2.4687E-05	.14459
13	2.8366E-03	.05932	0.	0.00000	3.7450E-05	.19971
14	1.9202E-03	.05366	0.	0.00000	1.9546E-05	.16383
15	0.	0.00000	0.	0.00000	2.4369E-05	.99997
16	3.3688E-02	.06420	0.	0.00000	4.6302E-04	.28864
17	1.0154E-04	.72107	0.	0.00000	0.	0.00000
18	8.1577E-03	.13494	0.	0.00000	2.4369E-05	.99997
19	1.1777E-02	.11415	0.	0.00000	1.0357E-04	.50253
20	2.4776E-04	.54637	0.	0.00000	1.2794E-04	.52375
21	1.1799E-03	.32748	0.	0.00000	1.2997E-04	.49994
22	1.6262E-03	.11332	0.	0.00000	1.9699E-04	.12655
23	1.3209E-04	.34176	0.	0.00000	1.6246E-05	.43294
24	1.4038E-04	.23902	0.	0.00000	1.7262E-05	.28957
25	4.3154E-05	.44792	0.	0.00000	1.5992E-05	.31537
26	1.4680E-02	.08060	0.	0.00000	3.5485E-04	.30071
27	9.9228E-02	.03695	0.	0.00000	1.1941E-03	.17063
28	1.0416E-01	.02473	0.	0.00000	1.5688E-03	.06460
29	1.4863E-02	.05279	0.	0.00000	2.3862E-04	.16945
30	1.5262E-02	.04260	0.	0.00000	3.5285E-04	.16369
31	0.	0.00000	0.	0.00000	0.	0.00000
32	0.	0.00000	0.	0.00000	0.	0.00000

CELL	ENERGY LOST TO CAPTURE	RELATIVE ERROR	ENERGY LOST TO ENERGY CUTOFF	RELATIVE ERROR	ENERGY LOST TO PAIR PRODUCTION	RELATIVE ERROR	ENERGY LOST TO COMPTON	RELATIVE ERROR	TOTAL ENERGY DEPOSITED
1	3.8117E-04	.07971	0.	0.00000	4.8341E-05	.74803	4.6247E-03	.12217	5.0543E-03
2	1.0817E-02	.03111	0.	0.00000	2.3362E-02	.10016	1.0715E-01	.02858	1.4183E-01
3	1.1826E-04	.38612	0.	0.00000	6.1205E-04	.34638	8.4404E-03	.05102	9.0643E-03
4	2.2643E-04	.12327	0.	0.00000	2.5830E-03	.16619	3.4432E-02	.02729	3.7244E-02
5	2.7657E-04	.19232	0.	0.00000	3.9758E-03	.28195	4.2644E-02	.04948	4.6897E-02
6	3.1791E-04	.45401	0.	0.00000	2.3263E-04	.37502	9.0944E-03	.03611	9.3302E-03
7	2.7148E-03	.03287	0.	0.00000	3.1793E-03	.10606	1.7718E-02	.02609	2.3612E-02
8	1.4423E-03	.43227	0.	0.00000	8.4134E-05	.41207	2.1630E-03	.05614	2.2491E-03
9	4.1002E-04	.05403	0.	0.00000	3.3654E-04	.20217	2.2123E-03	.05846	2.9649E-03
10	1.5718E-03	.37612	0.	0.00000	8.5161E-05	.30012	1.4157E-03	.05557	1.5025E-03
11	2.6894E-04	.06001	0.	0.00000	2.9552E-04	.26054	1.3173E-03	.07146	1.8777E-03
12	1.3002E-05	.11319	0.	0.00000	1.8804E-04	.16942	3.0131E-03	.04475	3.2242E-03
13	1.6138E-04	.05742	0.	0.00000	3.2544E-04	.23358	9.3093E-04	.07772	1.4183E-03
14	1.0544E-04	.05326	0.	0.00000	1.5272E-04	.18517	6.7912E-04	.06969	9.3728E-04
15	0.	0.00000	0.	0.00000	1.0294E-04	.99997	1.1144E-03	.16979	1.3073E-03
16	2.1096E-03	.06810	0.	0.00000	3.4418E-03	.36622	1.6859E-02	.08429	2.2410E-02
17	5.9928E-06	.81264	0.	0.00000	0.	0.00000	3.8357E-04	.37941	3.8957E-04
18	5.1776E-04	.13798	0.	0.00000	1.0750E-04	.99997	2.6145E-03	.22730	3.2397E-03
19	7.4832E-04	.11834	0.	0.00000	5.5681E-04	.51243	6.9717E-03	.13967	8.3268E-03
20	1.2175E-05	.53274	0.	0.00000	8.2338E-04	.62091	3.4254E-03	.17297	4.2624E-03
21	6.3843E-05	.33577	0.	0.00000	1.1715E-03	.58472	1.3371E-02	.07453	1.4606E-02
22	9.6192E-05	.12070	0.	0.00000	1.4221E-03	.15024	1.6684E-02	.02481	1.8202E-02
23	6.1711E-04	.32812	0.	0.00000	1.4552E-04	.47810	2.4448E-03	.06859	2.5967E-03
24	9.2218E-04	.23931	0.	0.00000	1.0726E-04	.34428	1.5706E-03	.07032	1.6871E-03
25	2.2160E-04	.43762	0.	0.00000	1.2895E-04	.37847	1.1970E-03	.10620	1.3281E-03
26	2.1383E-03	.09011	0.	0.00000	2.0786E-03	.36484	6.7942E-03	.15707	1.1011E-02
27	1.0615E-02	.04026	0.	0.00000	9.8624E-03	.21577	2.6302E-02	.07737	4.6780E-02
28	1.1169E-02	.02581	0.	0.00000	1.1921E-02	.07502	2.8480E-02	.02923	3.1571E-02
29	1.5938E-03	.05302	0.	0.00000	1.6043E-03	.22462	4.7693E-03	.08217	7.9674E-03
30	1.5842E-03	.04420	0.	0.00000	2.3861E-03	.12655	4.5188E-03	.06043	8.4712E-03
31	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.
32	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.

NUMBER OF PHOTONS CROSSING SURFACE

TIME 0. 1.0000E+02

COSINE 1.0000E+00 0.0000E+01

ENERGY - TO * REL. ERROR
5.0000E-03 1.71539E-03 .66328
1.0000E-02 7.51371E-03 .22109
1.0000E+00 4.23776E-01 .01613
5.0000E+00 2.38922E-02 .02814
1.4000E+01 2.43207E-02 .02952

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 0. 0.00000
1.0000E+00 1.28570E-02 .04296
5.0000E+00 2.47159E-03 .06087
1.4000E+01 2.56209E-03 .06364

COSINE 0.0000E+01 0.0000E+01

ENERGY - TO * REL. ERROR
5.0000E-03 1.82771E-03 .57770
1.0000E-02 6.09236E-03 .24482
1.0000E+00 2.59362E-01 .02156
5.0000E+00 1.49527E-02 .03604
1.4000E+01 1.40628E-02 .03829

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 0. 0.00000
1.0000E+00 5.11663E-03 .07338
5.0000E+00 6.10949E-04 .12786
1.4000E+01 4.31542E-04 .20521

COSINE 0.0000E+01 0.0000E+01

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 6.09236E-03 .24482
1.0000E+00 1.40244E-01 .03015
5.0000E+00 7.36566E-03 .05167
1.4000E+01 7.76573E-03 .05365

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 0. 0.00000
1.0000E+00 2.06233E-03 .08634
5.0000E+00 1.05830E-04 .30983
1.4000E+01 0. 0.00000

COSINE 4.0000E-01 2.0000E-01

ENERGY - TO * REL. ERROR
5.0000E-03 2.83079E-04 .99997
1.0000E-02 2.84002E-03 .42822
1.0000E+00 6.02697E-02 .04605
5.0000E+00 2.38414E-03 .09246
1.4000E+01 2.45319E-03 .09262

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 0. 0.00000
1.0000E+00 7.01129E-04 .09516
5.0000E+00 1.24386E-05 .73039
1.4000E+01 0. 0.00000

COSINE 2.0000E-01 0.

ENERGY - TO * REL. ERROR
5.0000E-03 6.09236E-04 .57730
1.0000E-02 0. 0.00000
1.0000E+00 1.20466E-02 .10072
5.0000E+00 3.55388E-04 .21932
1.4000E+01 3.81788E-04 .22803

ENERGY - TO * REL. ERROR
5.0000E-03 0. 0.00000
1.0000E-02 0. 0.00000
1.0000E+00 3.83248E-04 .27697
5.0000E+00 0. 0.00000
1.4000E+01 0. 0.00000

1 * TO - REL. ERROR
0. 0.00000
0. 0.00000
2.91580E-02 .07686
0. 0.00000
0. 0.00000

11 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

1 * TO - REL. ERROR

0.82315E-04 .79053
0. 0.00000
2.81000E-02 .06818
0. 0.00000
0. 0.00000

11 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

1 * TO - REL. ERROR

0. 0.00000
0. 0.00000
1.87740E-02 .08237
0. 0.00000
0. 0.00000

11 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

1 * TO - REL. ERROR

2.83079E-04 .99997
0. 0.00000
1.30539E-02 .89732
0. 0.00000
0. 0.00000

11 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

1 * TO - REL. ERROR

0. 0.00000
0. 0.00000
4.97949E-03 .15212
0. 0.00000
0. 0.00000

11 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
7.72638E-03 .04014
8.17899E-04 .08357
0.02177E-04 .10530

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
1.43928E-01 .02476
1.76821E-02 .03533
1.55802E-02 .04020

10 * TO - REL. ERROR

0. 0.00000
0. 0.00000
2.42698E-03 .04066
3.42081E-05 .13287
0. 0.00000

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0.72796E-02 .05057
2.33337E-03 .08202
2.25823E-03 .09024

10 * TO - REL. ERROR

0. 0.00000
0. 0.00000
1.44173E-03 .05089
5.26735E-06 .31844
0. 0.00000

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
4.19764E-03 .11768
1.27948E-04 .29728
0. 0.00000

10 * TO - REL. ERROR

0. 0.00000
0. 0.00000
6.91356E-04 .06432
0. 0.00000
0. 0.00000

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
3.43511E-04 .45382
0. 0.00000
0. 0.00000

10 * TO - REL. ERROR

0. 0.00000
0. 0.00000
1.96098E-04 .10373
0. 0.00000
0. 0.00000

10 * TO - REL. ERROR
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000
0. 0.00000

NUMBER FLUX INTEGRATED OVER SURFACE

TIME	0.	1.0000E-02
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	7.72276E-02	.07031
5.0000E+00	4.32173E-03	.08710
1.4000E+01	2.74300E-03	.11593

TIME	1.0000E-01	1.0000E+00
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	3.72053E-02	.10142
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

PATH LENGTH/VOLUME:

TIME	0.	1.0000E-02
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	7.50090E-07	.57706
5.0000E-01	3.13105E-06	.20956
1.0000E+00	2.13378E-06	.10010
5.0000E+00	6.38992E-07	.17916
1.4000E+01	7.15237E-07	.19121

TIME	1.0000E-02	1.0000E-01
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	4.12029E-04	.06899
5.0000E-01	7.15813E-04	.03874
1.0000E+00	2.83715E-04	.04827
5.0000E+00	6.00373E-05	.05492
1.4000E+01	6.21578E-05	.05909

TIME	1.0000E-01	1.0000E+00
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	1.42780E-04	.09497
5.0000E-01	3.87072E-05	.15782
1.0000E+00	8.89763E-08	.99997
5.0000E+00	6.	0.00000
1.4000E+01	6.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	0.	0.00000
5.0000E-01	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

NUMBER FLUX AT DETECTOR

TIME	0.	1.0000E-02
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	1.46701E-29	.99997
1.0000E+00	1.60796E-05	.03019
5.0000E+00	3.28125E-06	.03420
1.4000E+01	3.12916E-06	.03027

TIME	1.0000E-01	1.0000E+00
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	4.23541E-10	.80352
1.0000E+00	1.28952E-05	.03838
5.0000E+00	1.04510E-07	.13699
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TAPE DUMP NO. 2

NPS= 16414

```

17.56.41 $UMTR      JOB CARD READ WITH NO ERRORS
17.56.48 $LOS      01 CARDS      000263R
17.56.49 $UMTR      READ.  JOB READY TO BE SCHEDULED.
17.56.50 $UMTR      00 CROS 1.02 72/12/06  MACH. 14      TAPE
SY760073
17.56.51 $UMTR      .USER MONITOR OF 11/02/72 INITIALIZED.
17.56.51 $UMTR      .JOB NAME=SCRRAND1BR,DATE = 72/12/07
17.56.51 *CCP      00 $JOB(NAME=SCRRAND1,CAT=05,CL=U,AC=V05,UA=9006C050M
CP,PR=10,PL=40,TL=50)
17.56.51 $UMTR      .FILE SET CCD OPENED,BUFFER LENGTH =00001100.
17.56.51 $UMTR      .FILE SET INP OPENED,BUFFER LENGTH =00010100.
17.56.51 *CCP      $. INITIATE AND RUN MCP TEST PROBLEM.
17.56.51 *CCP      $LABEL(ISTAGE)
17.56.51 *CCP      1 $CREATE(FS=CODETP,CL=U,PREMT=XX00930)
17.56.52 *CCP      2 $OPEN(FS=DUMMY,SCF=2000)
17.56.52 $UMTR      .FILE SET DUMMY OPENED,BUFFER LENGTH =00032100.
17.56.52 *CCP      3 $COPY(I=CODETP,O=DUMMY)
17.56.52 $UMTR      .FILE SET CODETP OPENED,BUFFER LENGTH =00032100.
17.56.52 $UMTR      ROLLOUT STARTED
17.56.53 $UMTR      ROLLOUT DONE
18.11.46 $LOS      05 XX009301 IS ON UNIT 2 FILE CODETP      800 BIN
18.25.34 $UMTR      ROLLIN STARTED
18.25.35 $UMTR      ROLLIN DONE
18.25.38 *CCP      4 $IF(FALSE=READY)
18.25.38 *CCP      $LABEL(READY)
18.25.38 *CCP      5 $AFSREL(FS=DUMMY)
18.25.38 $UMTR      .FILE SET DUMMY CLOSED,BUFFER LENGTH =00032100.
18.25.38 .FILE SET STATISTICS
18.25.38 . READS WRITES POSITIONS DISK RDS DISK WRS
18.25.38 000000000 000000320 000000000 000000000 000000010
18.25.38 LWA=0000256555,DEVICE=01
18.25.38 *CCP      6 $REWIND(CODETP)
18.25.39 *CCP      7 $RUN(C=SI,B=RUNTP)
18.25.39 $UMTR      .FILE SET RUNTP OPENED,BUFFER LENGTH =00032100.
18.25.39 $UMTR      .FILE SET OUT OPENED,BUFFER LENGTH =00032100.
18.25.39 $UMTR      .FILE LENGTH IS 000776
18.25.39 $UMTR      .RUN-LCM09 CTIME 000.259 SEC.
18.25.40 *CCP      8 $COPY(F=CODETP,O=RUNTP)
18.25.40 *CCP      9 $SETQ(KEY=MKTP)
18.25.40 *CCP      10 $SETQ.
18.25.40 *CCP      11 $LOGO(I=CODETP)
18.25.43 $MCPPRS5 .END
18.25.43 $UMTR      .FILE SET IMAGE OPENED,BUFFER LENGTH =00064100.
18.25.43 $UMTR      .FILE SET IMAGE CLOSED,BUFFER LENGTH =00064100.
18.25.43 .FILE SET STATISTICS
18.25.43 . READS WRITES POSITIONS DISK RDS DISK WRS
18.25.43 000000000 000000003 000000001 000000000 000000003
18.25.43 LWA=00000076344,DEVICE=01
18.25.44 *CCP      12 $.F(FALSE=FUN)
18.25.44 *CCP      $LABEL(RUN)
18.25.44 *CCP      13 $AFSREL(FS=CODETP)
18.25.44 $UMTR      .FILE SET CODETP CLOSED,BUFFER LENGTH =00032100.
18.25.44 .FILE SET STATISTICS
18.25.44 . READS WRITES POSITIONS DISK RDS DISK WRS
18.25.44 000000404 000000000 000000001 000000020 000000000
18.25.44 LWA=0000256555,DEVICE=01
18.25.44 *CCP      14 $SETQ(KEY=MKTP)
18.25.44 *CCP      15 $SETQ.
18.25.44 *CCP      16 $LOGO(I=RUNTP)
19.00.58 $MCPPRS5 .END
19.00.58 $UMTR      .FILE SET IMAGE OPENED,BUFFER LENGTH =00064100.
19.00.59 $UMTR      .FILE SET IMAGE CLOSED,BUFFER LENGTH =00064100.
19.00.59 .FILE SET STATISTICS
19.00.59 . READS WRITES POSITIONS DISK RDS DISK WRS
19.00.59 000000000 000000003 000000001 000000001 000000003
19.00.59 LWA=0000111257,DEVICE=01
19.00.59 *CCP      17 $IF(FALSE=TAPE)
19.00.59 *CCP      $LABEL(TAPE)
19.00.59 *CCP      18 $AFSREL(FS=RUNTP,ADISP=TAPE)
19.01.00 $UMTR      .FILE SET RUNTP CLOSED,BUFFER LENGTH =00032100.
19.01.00 .FILE SET STATISTICS
19.01.00 . READS WRITES POSITIONS DISK RDS DISK WRS
19.01.00 000000025 000000027 000000003 000000004 000000011
19.01.00 LWA=0000111032,DEVICE=01
19.01.00 $CCP      .EGF OR EOI ON CC FILE. FSE7=CCD
19.01.00 $UMTR      .FILE SET CCD CLOSED,BUFFER LENGTH =00001100.
19.01.00 .FILE SET STATISTICS
19.01.00 . READS WRITES POSITIONS DISK RDS DISK WRS
19.01.00 000000071 000000037 000000034 000000000 000000000
19.01.00 LWA=0000000000,DEVICE=00
19.01.00 $UMTR      .FILE SET INP CLOSED,BUFFER LENGTH =00010100.
19.01.00 .FILE SET STATISTICS
19.01.00 . READS WRITES POSITIONS DISK RDS DISK WRS
19.01.00 000000222 000000222 000000001 000000000 000000000
19.01.00 LWA=0000000000,DEVICE=00
19.01.00 $UMTR      .FILE SET OUT CLOSED,BUFFER LENGTH =00032100.
19.01.00 .FILE SET STATISTICS
19.01.00 . READS WRITES POSITIONS DISK RDS DISK WRS
19.01.00 000000000 000001463 000000000 000000000 000000002
19.01.00 LWA=0000021702,DEVICE=03
19.01.00 $UMTR      99 .JOB TERMINATION.
ELAPSED CP TIME = 00208.19619
ESTIMATED JOB COST 90036.02
XX008199 IS ON UNIT 1 FILE RUNTP      800 BIN
19.02.13 $OUTPUT    F$RUNTP  DSP=TAPE  49691 WORDS
19.02.17 $OUTPUT    F$OUT    DSP=PRT   9155 WORDS      13 PAGES

```

FILE COMPLETE SCRRAND1BR 1

CORE MAP ***** DATE= 72/12/08*** TIME= 20.28.15*** ***** NORMAL LOAD *****

	FNA	LNA	BLNK COM	LE-6TH
CODE	000100	110757	031011	051747
LOADER	143602	150071		
TABLES	143601	148017		

FILE	PROGRAM	ADDRESS	NAMED COMMON	ADDRESS	LCM BLOCK	ADDRESS
*****	*****	*****	*****	*****	*****	*****
RUNTP	SOURCE	005535	G1	000100		
			G2	000142		
			G3	000276		
			G4	000501		
	MCPPRS	005701	DXCOM	000504		
			G1	000100		
			G2	000142		
			G3	000276		
			G4	000501		
	DAPNT	016730	DXCOM	000504		
			G1	000100		
			G2	000142		
			G3	000276		
			G4	000501		
	FRN	017301	DXCOM	000504		
			G1	000100		
			G2	000142		
			G3	000276		
			G4	000501		
	IRN	017327	DXCOM	000504		
			G1	000100		
			G2	000142		
			G3	000276		
			G4	000501		
			DXCOM	000504		

SYSLIB	ACGOER	017355	RBAREX	023067
	BACKSP	017367	SORT	023146
	BUFFE1	017416	ARQRT	023224
	BUFFE0	017537	BS4020	023275
	CLOCKF	017621	C4020	024055
	DMPXX	017724	ENTR	024151
	ENDFIL	020466	GETBA	024205
	INPUTC	020502	IOUTIL	024241
	IOCHKR	020656	KODER	025532
	LENGTH	020702	KRAKER	027027
	LOCF	020722	LAHRT	030070
	OUTPTC	020734	MEMORY	030176
	PACKAGE	021072	OUTPTS	030356
	SET0	021157	REMARK	030447
	SSWTCM	021400	RETN	030502
	SYSTEM	021466	SKIPR	030532
	XIT	022524	SHIFT	030604
	ALNLOO	022643	BOI	030621
	EXP	022732	PSCALE	030665
	IRAIEX	023005	M203SR	030672
	RBAIEX	023036		

UNSATISFIED EXTERNALS	REFERENCED BY	AT LOCATION
*****	*****	*****
SRCOX	MCPPRS	006677

MCP TEST PROBLEM

SOURCE NO.	TIME CUTOFF	ENERGY CUTOFF	RUN TIME	O.P. CYCLE	DUMP CYCLE	DUMP NO.	CUTOFF CYCLE
7	1.0000E+02	1.0000E+03	4.9000E+00	50000	50000	-0	-0

TIME= 9.50 MINUTES

NUMBER OF PHOTONS STARTED	TOTAL NUMBER OF COLLISIONS	RANDOM NUMBERS GENERATED	TOTAL RETOMT STARTED	TOTAL ENERGY STARTED	COLLISIONS PER PHOTON STARTED	TRACKS PER PHOTON STARTED	PHOTONS PROCESSED PER MINUTE
33217	365325	3740703	3.3418E+04	3.1508E+04	1.0998E+01	5.5468E+00	3.5526E+03
TOTAL TRACKS STARTED	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	LOSS TO SPLITTING	TOTAL TRACKS LOST	
184248	0	0	44545	34312	105391	184248	
WEIGHT STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	WEIGHT LOST PER PHOTON	PAIR PRODUCTION PER PHOTON	
1.0061E+00	0.	0.	3.3946E+01	6.8302E+01	1.0225E+00	9.8588E+03	
ENERGY STARTED PER PHOTON	LOSS TO ENERGY CUTOFF	LOSS TO TIME CUTOFF	LOSS TO ESCAPE	LOSS TO CAPTURE	LOSS TO PAIR PRODUCTION	LOSS TO COMPTON	ENERGY LOST PER PHOTON
9.4855E+01	0.	0.	4.3585E+01	4.6006E+02	7.4350E+02	3.6930E+01	9.4551E+01

TOTAL CELL DEPOSITION DATA

CELL	NO. OF PHOTONS CAPTURED	RELATIVE ERROR	PHOTONS LOST TO E. C.	RELATIVE ERROR	PHOTONS CAPTURED A PAIR	RELATIVE ERROR
1	7.6768E-02	.05057	0.	0.00000	3.1109E-05	.42179
2	7.2495E-01	.02053	0.	0.00000	3.0736E-03	.06389
3	2.7596E-04	.28191	0.	0.00000	6.6731E-05	.20433
4	4.6708E-03	.08040	0.	0.00000	3.5725E-04	.07361
5	5.1749E-03	.12949	0.	0.00000	4.6462E-04	.18507
6	1.2067E-04	.28184	0.	0.00000	4.1645E-05	.18206
7	4.3895E-02	.02496	0.	0.00000	4.3703E-04	.06098
8	5.3060E-05	.29861	0.	0.00000	1.0180E-05	.26386
9	6.7887E-03	.03958	0.	0.00000	4.5655E-03	.13797
10	3.6879E-05	.23812	0.	0.00000	8.7176E-06	.25124
11	4.6651E-03	.04496	0.	0.00000	3.3934E-05	.17272
12	3.5245E-04	.07627	0.	0.00000	2.4921E-05	.10036
13	2.9434E-03	.04047	0.	0.00000	3.3241E-05	.14187
14	1.9798E-03	.03854	0.	0.00000	1.8244E-05	.11828
15	5.0175E-05	.72109	0.	0.00000	6.8210E-05	.59997
16	3.6005E-02	.04418	0.	0.00000	4.1846E-04	.20812
17	7.0245E-05	.50899	0.	0.00000	1.2042E-05	.99998
18	7.8675E-03	.09833	0.	0.00000	4.8168E-05	.49997
19	1.1145E-02	.08334	0.	0.00000	1.1741E-04	.33526
20	2.5689E-04	.38162	0.	0.00000	6.3221E-05	.52378
21	1.4189E-03	.22039	0.	0.00000	1.2443E-04	.36344
22	1.8326E-03	.00026	0.	0.00000	1.8644E-04	.09076
23	2.0898E-04	.21607	0.	0.00000	2.5848E-05	.22617
24	1.7687E-04	.19561	0.	0.00000	1.5931E-05	.28389
25	8.6928E-05	.22658	0.	0.00000	1.7185E-05	.21689
26	2.1357E-02	.05463	0.	0.00000	4.5761E-04	.17984
27	9.4627E-02	.02573	0.	0.00000	1.4379E-03	.11048
28	3.5535E-01	.01761	0.	0.00000	1.4904E-03	.04594
29	1.4998E-02	.03663	0.	0.00000	2.7797E-04	.11239
30	1.4988E-02	.02928	0.	0.00000	3.2313E-04	.07889
31	0.	0.00000	0.	0.00000	0.	0.00000
32	0.	0.00000	0.	0.00000	0.	0.00000

CELL	ENERGY LOST TO CAPTURE	RELATIVE ERROR	ENERGY LOST TO ENERGY CUTOFF	RELATIVE ERROR	ENERGY LOST TO PAIR PRODUCTION	RELATIVE ERROR	ENERGY LOST TO COMPTON	RELATIVE ERROR	TOTAL ENERGY DEPOSITED
1	3.9056E-04	.05606	0.	0.00000	1.7611E-04	.53518	4.3414E-03	.08718	4.9243E-03
2	1.0844E-02	.02184	0.	0.00000	2.3899E-02	.07641	1.8577E-01	.01963	1.3362E-01
3	1.2038E-05	.27761	0.	0.00000	4.5815E-04	.25187	8.5412E-03	.03687	9.0274E-03
4	2.4910E-04	.08470	0.	0.00000	2.7599E-03	.10731	3.4544E-02	.01869	1.7543E-02
5	3.1337E-04	.13989	0.	0.00000	1.4714E-03	.21542	4.3414E-02	.03616	4.5395E-02
6	5.0749E-06	.28477	0.	0.00000	1.6727E-04	.21871	8.5153E-03	.02484	8.8274E-03
7	2.7672E-03	.02314	0.	0.00000	1.3457E-03	.07288	1.7954E-02	.01817	2.4009E-02
8	2.2645E-06	.30600	0.	0.00000	8.5105E-05	.29291	2.0308E-03	.03037	2.1741E-03
9	3.9028E-04	.03781	0.	0.00000	3.4474E-04	.14561	2.0684E-03	.04053	2.8147E-03
10	1.4504E-06	.24923	0.	0.00000	6.8432E-05	.24967	1.3893E-03	.03758	1.3712E-03
11	2.6743E-04	.04258	0.	0.00000	2.8527E-04	.20289	1.2414E-03	.05285	1.8302E-03
12	1.5847E-05	.07617	0.	0.00000	1.9749E-04	.12333	2.8474E-03	.03144	3.1010E-03
13	1.6726E-04	.03936	0.	0.00000	2.8248E-04	.16474	8.8054E-04	.05388	1.3303E-03
14	1.0881E-04	.03779	0.	0.00000	1.2108E-04	.13837	6.1181E-04	.04893	4.6172E-04
15	3.2040E-06	.81397	0.	0.00000	8.6465E-04	.62459	1.0457E-03	.12185	1.7756E-03
16	2.2427E-03	.04682	0.	0.00000	3.1894E-03	.25654	1.6111E-02	.05489	2.1461E-02
17	3.7538E-06	.67499	0.	0.00000	9.3417E-05	.09999	3.5758E-04	.24928	4.5519E-04
18	5.1868E-04	.10077	0.	0.00000	2.9471E-04	.51042	2.7645E-03	.14786	3.7419E-03
19	7.6769E-04	.08757	0.	0.00000	6.3454E-04	.36647	4.8214E-03	.09744	7.6054E-03
20	1.5945E-05	.44236	0.	0.00000	4.8487E-04	.62093	3.5737E-03	.05787	4.2082E-03
21	7.1014E-05	.22462	0.	0.00000	1.8771E-03	.43560	1.7663E-02	.03014	1.6715E-02
22	1.1117E-04	.08691	0.	0.00000	1.5407E-03	.10679	2.3884E-03	.04705	2.5884E-03
23	9.4307E-06	.21384	0.	0.00000	1.7092E-04	.27034	1.4807E-03	.04800	1.5004E-03
24	1.0378E-05	.15555	0.	0.00000	9.0358E-05	.24676	1.2103E-03	.08724	1.3605E-03
25	4.8605E-06	.23331	0.	0.00000	3.6959E-03	.23316	8.8759E-03	.10149	1.2969E-02
26	2.3969E-03	.0637	0.	0.00000	1.8145E-02	.13578	2.4326E-02	.05138	4.4407E-02
27	1.8826E-02	.028	0.	0.00000	1.3117E-02	.05444	2.8826E-02	.82112	5.3104E-02
28	1.1294E-02	.017	0.	0.00000	1.9548E-03	.14238	4.5566E-03	.05612	6.1084E-03
29	1.8698E-03	.037	0.	0.00000	2.3824E-03	.09629	4.4761E-03	.06256	8.3624E-03
30	1.5839E-03	.03637	0.	0.00000	0.	0.00000	0.	0.00000	0.
31	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.
32	0.	0.00000	0.	0.00000	0.	0.00000	0.	0.00000	0.

NUMBER OF PROTONS CROSSING SURFACE

TIME 0. 1.0000E+02

COSINE 1.0000E+00 0.0000E+01

SURFACE 1			SURFACE 10			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	1.46498E-03	.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.03202E-03	.00000	0.	0.00000	0.	0.00000
1.0000E+00	4.23907E-01	.01136	0.	0.00000	0.	0.00000
5.0000E+00	2.36110E-02	.01987	0.	0.00000	0.	0.00000
1.4000E+01	2.03229E-02	.02084	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+00	1.24008E-02	.03030	0.	0.00000	0.	0.00000
5.0000E+00	2.34054E-03	.04260	0.	0.00000	0.	0.00000
1.4000E+01	2.38034E-03	.04789	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	1.00358E-03	.52412	0.	0.00000	0.	0.00000
1.0000E+02	0.27171E-03	.16907	0.	0.00000	0.	0.00000
1.0000E+00	2.63121E-01	.03560	0.	0.00000	0.	0.00000
5.0000E+00	1.42770E-02	.02570	0.	0.00000	0.	0.00000
1.4000E+01	1.40700E-02	.02703	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+00	5.00553E-03	.04839	0.	0.00000	0.	0.00000
5.0000E+00	5.00174E-04	.04695	0.	0.00000	0.	0.00000
1.4000E+01	4.04931E-04	.15304	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	3.01481E-04	.79055	0.	0.00000	0.	0.00000
1.0000E+02	4.01611E-03	.19670	0.	0.00000	0.	0.00000
1.0000E+00	1.41453E-01	.02090	0.	0.00000	0.	0.00000
5.0000E+00	7.56043E-03	.03615	0.	0.00000	0.	0.00000
1.4000E+01	7.62266E-03	.03010	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+00	2.16057E-03	.00820	0.	0.00000	0.	0.00000
5.0000E+00	0.00000E+00	.21010	0.	0.00000	0.	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 2.0000E+01

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	2.00700E-04	.70700	0.	0.00000	0.	0.00000
1.0000E+02	2.01016E-03	.27705	0.	0.00000	0.	0.00000
1.0000E+00	5.93702E-02	.03230	0.	0.00000	0.	0.00000
5.0000E+00	2.60038E-03	.00305	0.	0.00000	0.	0.00000
1.4000E+01	2.60509E-03	.00308	0.	0.00000	0.	0.00000

COSINE 0.0000E+01 0.

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+00	0.02803E-04	.12274	0.	0.00000	0.	0.00000
5.0000E+00	0.52977E-06	.55452	0.	0.00000	0.	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000

COSINE 2.0000E+01 0.

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	3.01051E-04	.57732	0.	0.00000	0.	0.00000
1.0000E+02	3.01051E-04	.99900	0.	0.00000	0.	0.00000
1.0000E+00	1.17012E-02	.07240	0.	0.00000	0.	0.00000
5.0000E+00	3.00350E-04	.15560	0.	0.00000	0.	0.00000
1.4000E+01	4.53503E-04	.15405	0.	0.00000	0.	0.00000

COSINE 2.0000E+01 0.

SURFACE 11			SURFACE 14			
ENERGY	- TO *	REL. ERROR	- TO *	REL. ERROR	- TO *	REL. ERROR
5.0000E+03	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+02	0.	0.00000	0.	0.00000	0.	0.00000
1.0000E+00	3.00675E-04	.10353	0.	0.00000	0.	0.00000
5.0000E+00	0.	0.00000	0.	0.00000	0.	0.00000
1.4000E+01	0.	0.00000	0.	0.00000	0.	0.00000

NUMBER FLUX INTEGRATED OVER SURFACE

TIME	0.	1.0000E-02
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.07700E-02	.05459
5.0000E+00	3.57769E-03	.06721
1.4000E+01	2.74901E-03	.08264

TIME	1.0000E-01	1.0000E+00
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	1.41170E-02	.07052
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	SURFACE	RELATIVE
	17	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

PATH LENGTH/VOLUME

TIME	0.	1.0000E-02
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	4.17714E-07	.51739
5.0000E-01	3.12164E-06	.14615
1.0000E+00	2.66085E-06	.12520
5.0000E+00	6.03493E-07	.12646
1.4000E+01	8.41104E-07	.14639

TIME	1.0000E-02	1.0000E-01
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	4.08842E-04	.04696
5.0000E-01	1.41274E-04	.02636
1.0000E+00	2.79083E-04	.03420
5.0000E+00	5.09545E-05	.03888
1.4000E+01	5.93374E-05	.04222

TIME	1.0000E-01	1.0000E+00
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	1.70723E-04	.06573
5.0000E-01	3.86504E-05	.10721
1.0000E+00	1.09136E-07	.59414
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	CELL	RELATIVE
	3	ERROR
1.0000E-01	0.	0.00000
5.0000E-01	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

NUMBER FLUX AT DETECTOR

TIME	0.	1.0000E-02
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TIME	1.0000E-02	1.0000E-01
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	9.71485E-39	.99999
1.0000E+00	1.67103E-05	.02255
5.0000E+00	3.30900E-06	.02554
1.4000E+01	3.12255E-06	.02215

TIME	1.0000E-01	1.0000E+00
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	2.14501E-10	.76412
1.0000E+00	1.35727E-05	.03892
5.0000E+00	1.64017E-07	.37654
1.4000E+01	0.	0.00000

TIME	1.0000E+00	1.0000E+01
ENERGY	DETECTOR	RELATIVE
	1	ERROR
5.0000E-03	0.	0.00000
1.0000E-02	0.	0.00000
1.0000E+00	0.	0.00000
5.0000E+00	0.	0.00000
1.4000E+01	0.	0.00000

TAPE DUMP NO. 3 NPS= 33217

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20.25.56 $RMTR JOB CARD READ WITH NO ERRORS
20.25.59 *LOS 01 CARDS 0000308
20.26.01 $RMTR READ, JOB READY TO BE SCHEDULED.
20.26.02 $RMTR 00 CRNS 1.42 72/12/06 MACM. 14 (APE
20.26.03 SY760073
20.26.03 $RMTR .USER MONITOR OF 11/02/72 INITIALIZED.
20.26.03 $RMTR .JOB NAME=SCMRANDIVJ.GATE = 72/12/06
20.26.03 *CCP 00 $JOBNAME=SCMRANDI.CAT=05.CLU=AC.V06.UA=9406C050M
CP,PR=10,PL=40,TL=5M)
20.26.03 $RMTR .FILE SET CCD OPENED+BUFFER LENGTH =00001100.
20.26.03 $RMTR .FILE SET INP OPENED+BUFFER LENGTH =10101100.
20.26.03 *CCP 5. CONTINUE RUN--MCP TEST PROBLEM.
20.26.03 *CCP $LABEL(ISTAGE)
20.26.03 *CCP 1 $CREATE (FS=RUNTP,CL=U,SET=2000,PREMT=XX0009199)
20.26.04 $RMTR 01 DISK ERROR CHN=2,3 DISK#A FS=5Y5L18 REQ=READ
$RMTR 01 ERRN=0002 IRKN=0005 SCTN=0004 MDGN=0000 VRA=0001
$RMTR 01 PPN=0003 SHTR=0005 SHSE=0004 SHNE=0000 SPAR=0000
$RMTR 01 STIR=0502 SPAR=0000 STIP=0502 ST2P=2000 PAR=0000
20.26.04 *CCP 2 $OPEN (FS=DUMMY,SET=2000)
20.26.04 $RMTR .FILE SET DUMMY OPENED+BUFFER LENGTH =LJ032100.
20.26.04 *CCP 3 $COPY (I=RUNTP,O=DUMMY) TO VERIFY POINTER WORD
S
20.26.04 $RMTR .FILE SET RUNTP OPENED+BUFFER LENGTH =00032100.
20.26.04 $RMTR ROLLOUT STARTED
20.26.05 $RMTR ROLLOUT DONE
20.26.13 *LOS 05 XX008199 IS ON UNIT 1 FILE RUNTP 800 BIN
20.26.11 $RMTR ROLLIN STARTED
20.26.12 $RMTR ROLLIN DONE
20.26.13 *CCP 4 $IF (FALSE=READY)
20.26.13 *CCP $LABEL(READY) SUCCESSFUL STAGING
20.26.13 *CCP 5 $AFSHEL (FS=DUMMY)
20.26.13 $RMTR .FILE SET DUMMY CLOSED+BUFFER LENGTH =P0032100.
20.26.13 $RMTR .FILE SET STATISTICS
20.26.13 . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000010 000000000 000000000 000000010
20.26.13 . LWA=0000141155+DEVICE=03
20.26.13 *CCP 6 $REWIND (RUNTP)
20.26.13 *CCP 7 $SETQ (KEY=KKTIP)
20.26.13 *CCP 8 $SETQ.
20.26.13 *CCP 9 $LOGG (I=RUNTP)
20.26.15 $RMTR .FILE SET OUT OPENED+BUFFER LENGTH =P0032100.
20.26.10 $RMTR ROLLOUT STARTED
20.26.11 $RMTR ROLLOUT DONE
20.26.30 $RMTR ROLLIN STARTED
20.26.31 $RMTR ROLLIN DONE
20.26.21 *MCPPRE
20.26.21 $RMTR .END
20.26.21 $RMTR .FILE SET IMAGE OPENED+BUFFER LENGTH =LJ004100.
20.26.21 $RMTR .FILE SET IMAGE CLOSED+BUFFER LENGTH =00064100.
20.26.21 .FILE SET STATISTICS
20.26.21 . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000003 000000001 000000000 000000003
20.26.21 . LWA=0000111257+DEVICE=01
20.26.21 *CCP 11 $IF (FALSE=TAPE)
20.26.21 *CCP 11 $LABEL(TAPE)
20.26.21 $RMTR $AFSHEL (FS=RUNTP,ADISP=STAPE,POSMT=XX008199)
20.26.21 $RMTR .FILE SET RUNTP CLOSED+BUFFER LENGTH =10032100.
20.26.21 $RMTR .FILE SET STATISTICS
20.26.21 . READS WRITES POSITIONS DISK RDS DISK WRS
000000177 000000002 000000003 000000016 000000000
20.26.21 . LWA=0000204751+DEVICE=01
20.26.22 $CCP .EOF OR EOI ON CC FILE. FSFT=CCD
20.26.22 $RMTR .FILE SET CCD CLOSED+BUFFER LENGTH =LJ001100.
20.26.22 $RMTR .FILE SET STATISTICS
20.26.22 . READS WRITES POSITIONS DISK RDS DISK WRS
000000046 000000025 000000023 000000000 100000000
20.26.22 . LWA=0000000000+DEVICE=00
20.26.22 $RMTR .FILE SET INP CLOSED+BUFFER LENGTH =RJ010100.
20.26.22 $RMTR .FILE SET STATISTICS
20.26.22 . READS WRITES POSITIONS DISK RDS DISK WRS
000000001 000000001 000000001 000000000 000000000
20.26.22 . LWA=0000000000+DEVICE=00
20.26.22 $RMTR .FILE SET OUT CLOSED+BUFFER LENGTH =00032100.
20.26.22 $RMTR .FILE SET STATISTICS
20.26.22 . READS WRITES POSITIONS DISK RDS DISK WRS
000000000 000000560 000000000 000000000 000000001
20.26.22 . LWA=0000010600+DEVICE=03
20.26.22 $RMTR 99 .JOB TERMINATION.
20.26.22 .ELAPSED CP TIME = 00280.27910
20.26.22 .ESTIMATED JOB COST 30036.03
20.26.30 *LOS 06 XX008199 IS ON UNIT 1 FILE RUNTP 600 BIN
20.26.40 $OUTPUT FS=RUNTP DSP=TAPE 67754 WORDS
20.26.40 $OUTPUT FS=OUT DSP=PRT 4681 WORDS 6 PAGES

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FILE COMPLETE SCMRANDIVJ 2