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MASTER

NURSE-1

A NUCLEAR ROCKET SAFETY EVALUATION CODE
FOR THE CONTROL DATA 3600

For

Space Nuclear Propulsion Office
Atomic Energy Commission
National Aeronautics and Space Administration

By

APPROVED FOR PUBLIC RELEASE

M. L. Couchman

A. W. DeAgazio

Y. S. Kim

December, 1964

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ERRATA SHEET

for

NURSE-1

A NUCLEAR ROCKET SAFETY EVALUATION CODE

FOR THE CONTROL DATA 3600

NUS-180

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12 (III-25)

$$\frac{d N_j(t)}{dt} = P F Y_i - \lambda_i N_i(t) + \sum_{j=1}^{j-1} \lambda_j N_j(t) Y_{ij}$$

13 (III-27)

$$N_i(\tau) = \sum_{k=1}^{l-1} \left[\bar{N}_k \left(\prod_{j=1}^{i-1} \lambda_j \right) \prod_{j=k+1}^i (Y_{j-1,j}) \sum_{\substack{l=k \\ m=k \\ m \neq l}}^i \frac{e^{-\lambda_l \tau}}{(\lambda_m - \lambda_l)} \right] + N_i e^{-\lambda_i \tau}$$

(III-28)

$$\int_0^T N_i(t) dt = \sum_{k=1}^{i-1} \left[\bar{N}_k \left(\prod_{j=k}^{i-1} \lambda_j \right) \prod_{j=k+1}^i (Y_{j-1,j}) \sum_{\substack{l=k \\ m=k \\ m \neq l}}^i \frac{1 - e^{-\lambda_l T}}{\lambda_l \prod_{m=k}^i (\lambda_m - \lambda_l)} \right] + \frac{1 - e^{-\lambda_i T}}{\lambda_i}$$

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14 (III-30)

$$\int_0^T N_i(t) dt = \sum_{K=1}^{i-1} \left\{ \bar{N}_K \left(\prod_{j=K}^{i-1} \lambda_j \right) \prod_{j=K+1}^i \left(Y_{j-1, j} \right) \right.$$

$$\left[\left(\sum_{\substack{\ell=K \\ \ell \neq n}}^i \frac{1 - e^{-\lambda_\ell T}}{\lambda_\ell \prod_{\substack{m=K \\ m \neq \ell \\ m \neq n}}^i (\lambda_m - \lambda_\ell)} \right) + \left(\frac{1 - e^{-\lambda' T}}{(\lambda')^{N-1}} \sum_{\ell=0}^{N-1} \frac{(\lambda' T)^\ell}{\ell!} \right) \right] \Bigg\}$$

$$+ N_i \frac{1 - e^{-\lambda_i T}}{\lambda_i}$$

A-0 KL

(7 and 8 are undefined)

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TAPE , Library Tape Generation Routine

I. SUMMARY

The NURSE-1 Code evaluates the radiation hazards resulting from the rapid release of fission products from a nuclear rocket engine. The original work on NURSE-1 was done in FORTRAN II on an IBM 7090 with 32K memory. However, due to a change in computer assignment, NURSE-1, as released, is programmed in FORTRAN 3600 for use on a CONTROL DATA 3600. NURSE-1 requires 64K memory. Six tapes are used in addition to those required by the SCOPE Monitor System.

A library tape containing nuclear and atmospheric diffusion data is necessary for the operation of the code. The library tape generation routine and the library data are described in Appendix E.

The program determines several different doses at positions down- and cross-wind from the point of the excursion. This program considers only a release occurring in the lower atmosphere (on or near the ground). The code has several options which permit selection of the kinds of doses to be calculated.

The models and parameters employed are believed to represent the best information available at the time of preparation. It is anticipated that the models and parameters may change as the nuclear rocket program matures and the NURSE-1 code is designed for ready replacement of models or parameters as better information becomes available.

II. INTRODUCTION

In evaluating the potential radiological hazard associated with the operation of a nuclear rocket engine, the possibility of a nuclear excursion or a system failure releasing fission products to the atmosphere must be considered. The degree of hazard to individuals in or near the resulting cloud formation and fallout area must be estimated both from the standpoint of internal and external exposures. Consideration must be given to the various mechanisms for transport of the radioactive materials as well as the various body organs affected. This report describes a digital computer method for calculating the total radiological hazards resulting from an instantaneous release of fission products to the atmosphere from a reactor on or near the ground.

Under a given set of conditions, there will be one mechanism for transport of radioactive material which contributes most heavily to the radiological hazards. Similarly, under a given set of conditions, a particular body organ will be most severely affected. However, it is not always possible to single out a transport mechanism or a body organ which would give the limiting effects under any condition. Therefore, in methods to be described, three mechanisms for transport of the radioactivity and four body organ doses plus the whole body doses are considered.

There are available both hand calculational techniques and computer programs for evaluating the radiological hazard resulting from a single transport mechanism. However, these methods are of limited use in the present application; hence, the NURSE-1 program was developed.

III. TRANSPORT AND DOSE MODELS

A. TRANSPORT MECHANISMS

The spread of radioactive effluent from a reactor accident must be determined. The amount of radioactive materials deposited on a unit area of ground and contained in a unit volume of the cloud must be calculated in order to determine the dose to an individual. The above quantities must be determined as a function of position and time.

1. Gaseous Cloud

The cloud which results from a reactor accident will grow due to thermal expansion and turbulent diffusion. It will also rise because of the heat contained in it.

a. Growth and Rise

The cloud growth model used in the NURSE-1 program is based on modifications to the Anderson model.⁽¹⁾ The basic model was discussed in NUS-144⁽²⁾ Modifications to the previous model were necessary to permit the use of small values of energy yield.

The equation used by Anderson to describe cloud diameter is:

$$\Phi = 331 t^{0.25} W^{0.11} t^{0.22} \text{ meters} \quad (\text{III-1})$$

where Φ , the cloud diameter in meters; W, the energy yield in kilotons (KT) and t, the time in seconds.

The cloud is allowed to grow due to thermal effects for 360 seconds. At 360 seconds, the cloud is assumed to stop growing. One difficulty with Equation III-1 is that the diameter exhibits a maximum value at some value of time for all yields less than 1 KT due to the time dependent exponent. For yields of 3.8×10^{-2} KT or less, the maximum in Φ occurs when t is equal to or less than 360 seconds. The lower limit of equivalent

yields of interest in examining the hazards associated with nuclear rocket launch operations is considerably below this; consequently, cloud dimensions cannot be adequately described by the Anderson equation. Unfortunately, other known relationships for obtaining cloud rise are for low rates of energy releases from stacks. The basic modification to the Anderson equation for cloud growth is to substitute the following relationship for cloud diameter:

$$\Phi = 331 t^{0.25} W^{0.267} \text{ meters} \quad (\text{III-2})$$

This relationship was obtained from NRDL⁽³⁾ as is used in their D model for yield below 1 KT.

The equations to describe the top and bottom elevations of the clouds are the same as those used by Anderson. The height of the cloud top is given by:

$$H_T = 238 W^{0.25} t^{0.5} \text{ meters} \quad (\text{III-3})$$

and the height of the cloud bottom is given by:

$$H_B = 104 W^{0.25} t^{0.5} \text{ meters} \quad (\text{III-4})$$

The cloud, which is assumed to be an ellipsoid, is allowed to grow due to thermal effects and diffusion for the first 360 seconds and by diffusion only, thereafter. The diffusion and thermal effects are combined by first defining

$$\sigma_{y_{th}} = \frac{\Phi}{4} \quad \text{and} \quad \sigma_{z_{th}} = \frac{H_T - H_B}{4}$$

The definition assumes that the boundaries of the cloud, which is assumed to be Gaussian, are at $2 \sigma_{th}$ if the cloud were to grow only from thermal effects. However, since the

cloud can grow by diffusion also, the value of σ_d as determined from the meteorological conditions must also be included. Values of σ_d in both the y and z direction have been presented by Hilsmeier⁽⁴⁾ and Gifford.^(5, 6) The values are given as a function of downwind distance for several meteorological conditions or stability classes. σ_{th} and σ_d are combined as follows:

$$\sigma = \sqrt{\sigma_{th}^2 + \sigma_d^2} \quad (III-5)$$

to obtain both the horizontal and vertical dimensions.

The cloud growth model includes the effect of increasing wind velocity with altitude. The vertical wind shear used is:

$$\bar{u}_{(A)} = \bar{u}_o \left(\frac{A}{A_r} \right)^{0.2} \quad (III-6)$$

where $\bar{u}_o$ is the wind speed at reference altitude A_r . The downwind position of the cloud center line when $t \leq 360$ seconds is:

$$\begin{aligned} \bar{x} &= \int_0^t \bar{u}_o \left(\frac{A(t)}{A_r} \right)^{0.2} dt = \frac{\bar{u}_o}{A_r^{0.2}} \int_0^t [166 W^{0.25} t^{0.5}]^{0.2} dt \\ \bar{x} &= \left(\frac{\bar{u}_o}{A_r^{0.2}} \right) \frac{[166 W^{0.25}]^{0.2} t^{1.1}}{1.1} \end{aligned} \quad (III-7)$$

when $t > 360$ sec.

$$\bar{x} = x_{(360 \text{ sec})} + \frac{\bar{u}_o [166 W^{0.25} (360)^{0.5}]^{0.2}}{A_r^{0.2}} (t - 360) \quad (III-8)$$

b. Cloud Diffusion

There are many analytical relationships presented in the literature for computing the airborne concentration of a material downwind from a source as a function of the various meteorological parameters involved. Among these are the classic equation by Sutton⁽⁷⁾ and the relationship presented by Pasquill.⁽⁸⁾ Sutton's equation has been widely used in the atomic energy industry, and it enables a number of useful derivations to be made. The basic form for the cloud centerline concentration downwind from a ground level point source is:

$$\chi(x) = \frac{2Q}{\pi C_y C_z \bar{u} x^{2-n}} \exp - \left(\frac{y^2}{C_y^2 x^{2-n}} + \frac{h^2}{C_z^2 x^{2-n}} \right) \quad (\text{III-9})$$

where:

- $\chi(x)$ = ground level concentration at x, units/m³
- Q = source strength, units/sec
- C_y, C_z = dispersion coefficients in the y and z direction, meters^{n/2}
- n = a turbulence parameter
- $\bar{u}$ = mean wind speed, meters/sec
- x = downwind distance, meters
- h = height of emissions above the ground, meters

The formulation used in this program is that presented by Gifford^(5, 6) derived from the work of Pasquill⁽⁸⁾ and Meade.⁽⁹⁾ This formulation of the continuity equation is expressed as:

$$\chi(x, y) = \frac{Q}{\pi \sigma_y \sigma_z \bar{u}} \exp - \left[\frac{y^2}{2 \sigma_y^2} + \frac{h^2}{2 \sigma_z^2} \right] \quad (\text{III-10})$$

where:

- σ_y, σ_z = dispersion parameter representing the Gaussian standard deviation of cloud concentration in the y and z directions (described above), meters
- h = height of emission above the ground, meters
- y = lateral, or crosswind, distance from plume centerline, meters
- $\exp []$ = Gaussian expression for concentration not on plume centerline.

The derivation of the cloud depletion correction for dry deposition follows (after Gifford):

$$w(x, y) = V_g \chi(x, y, h) = \frac{V_g Q_x}{\pi \sigma_y \sigma_z \bar{u}} \exp - \left[\frac{y^2}{2 \sigma_y^2} + \frac{h^2}{2 \sigma_z^2} \right] \quad (\text{III-11})$$

where:

- $w(x, y)$ = the surface deposition at (x, y), units/m² sec.
- V_g = the deposition velocity, m/sec; and
- Q_x = the residual source at $\underline{x}$ meters downwind unit/sec.

The depletion of the source per unit distance is given by:

$$\frac{\delta Q_x}{\delta Q} = \int_{-\infty}^{\infty} w(x, y) dy = - \sqrt{\frac{2}{\pi}} \frac{V_g Q_x}{\bar{u} \sigma_z(x)} \exp - \frac{h^2}{2 \sigma_z^2(x)} ;$$

and rearranging

$$\frac{\delta Q_x}{Q_x} = -\sqrt{\frac{2}{\pi}} \frac{V_g}{\bar{u}} \frac{e^{-\left(\frac{h^2}{2\sigma_z(t)^2}\right)} dx}{\sigma_z(x)}$$

Integrating with an initial condition that $Q_x \equiv Q_0$
at $x \equiv 0$, gives

$$\frac{Q_x}{Q_0} = \exp \left[\sqrt{\frac{2}{\pi}} \frac{V_g}{\bar{u}} \int_0^x \frac{e^{-\left(\frac{h^2}{2\sigma_z(t)^2}\right)} dt}{\sigma_z(t)} \right] \quad (\text{III-12})$$

2. Particulate Transport

The size of a particle released from a reactor excursion determines, in part, where that particle will be deposited. For an excursion of a given magnitude, the size distribution of the released particles as derived in NUS-179⁽¹⁰⁾ is as follows:

$$F(d) = \exp - [3.59 \times 10^{-3} d E_x] \quad (\text{III-13})$$

where:

$F(d)$ = the fraction of particles larger than d
 d = the diameter of the particle, cm,
 E_x = the explosive energy of the excursion, kilotons
determined from a fit of Figure 7, RFS-135⁽¹¹⁾
as follows:

$$E_x = 10^{B_1} E_{nuc}^{B_2}$$

where:

$$\begin{aligned} B_1 &= -226.34 \\ B_2 &= 11.1 \end{aligned} \quad E_{nuc} \leq 2.8 \times 10^{20}$$

$$B_1 = -40.95$$

$$E_{nuc} > 2.8 \times 10^{20}$$

$$B_2 = 2.03$$

E_{nuc} = the excursion yield, fissions

B_1 and B_2 are fit parameters.

Some of the solid material may also be vaporized. This fraction is determined as follows:

$$F_v = E_{gas} \left(\frac{10^{12} \text{ cal}}{KT} \right) \left(\frac{\text{gm}}{1.62 \times 10^4 \text{ cal}} \right) \left(\frac{1}{CW} \right)$$

where:

F_v = the fraction of the core vaporized, dimensionless

CW = the core weight in grams

E_{gas} = the energy released to gas, KT, determined from Figures 6 and 8, RFS-135⁽¹¹⁾ as follows:

$$E_{gas} = \frac{E_{nuc} \times 10^c}{1.45 \times 10^{23}} \quad \text{for } E_{nuc} < 8.5 \times 10^{20} \text{ fissions}$$

$$c = (\log_{10} E_{nuc} - 20) 1.82 - 2$$

$$E_{gas} = E_{nuc} / 2.9 \times 10^{23} \quad \text{for } E_{nuc} \geq 8.5 \times 10^{20} \text{ fission}$$

A comparison of the above fit, for E_{gas} as a function of E_{nuc} and the original LASL data is shown in Figure 9, NUS-179.⁽¹⁰⁾

The equations describing the position of particulate material are somewhat different than those which describe gaseous cloud position and hence introduce some discrepancies in time of arrival of the gaseous cloud and fallout; the discrepancies are, however, insignificant. It is first necessary to determine the vertical path of a given particle both while the particle is in the gaseous cloud and after it has left the cloud.

If Equations III-3 and III-4 are differentiated, the rise velocity of the cloud can be obtained:

$$V_T = 114 W^{0.25} t^{-0.5} \quad (\text{III-14})$$

$$V_B = 52 W^{0.25} t^{-0.5} \quad (\text{III-15})$$

The average rise velocity of the cloud is then

$$V_M = 83 W^{0.25} t^{-0.5} \quad (\text{III-16})$$

The terminal velocity for falling bodies is of the form

$$V_A = V_O e^{\gamma A} \quad (\text{III-17})$$

where:

$$\begin{aligned} V_A &= \text{the terminal velocity at altitude } A \\ V_O &= \text{the terminal velocity at ground level} \\ \gamma &= \text{a constant} \end{aligned}$$

Assuming the particle terminal velocity is the same whether inside or outside the cloud and that the particle is initially at the top of the cloud, then the net velocity of the particle within the cloud is

$$V_{\text{net}} = \frac{dA}{dt} = 114 W^{0.25} t^{-0.5} - V_O e^{\gamma A} \quad (\text{III-18})$$

Integrating Equation III-18 yields the particle altitude as a function of time while it is within the cloud

$$A = \frac{1}{\gamma} \ln \frac{1}{\frac{V_O}{114 W^{0.25}} \left(\sqrt{t} - \frac{1}{2\gamma(114 W^{0.25})} \right) + C e^{-2\gamma(114 W^{0.25}) \sqrt{2}}} \quad (\text{III-19})$$

The constant is evaluated from the condition that when $t = 0$,

$A = A_O$ and

$$C = e^{-A_O \gamma} + \frac{V_O}{[114 W^{0.25}]^2 2\gamma} \quad (\text{III-20})$$

Once the particle altitude becomes equal to the altitude of the cloud bottom, Equation III-19 is no longer used to describe the particle altitude but rather the integrated form of III-17 is used.

Integrating Equation III-16 with respect to t , we get

$$H_c = 166 W^{0.25} t^{0.5} \quad (\text{III-21})$$

where:

H_c = the altitude of the center of cloud, meters.

Take into consideration both the effect of turbulent diffusion and thermal growth on cloud size, then

$$H'_B = 166 W^{0.25} t^{0.5} - 2 \sigma_z(t) \quad (\text{III-22})$$

where:

H'_B = the altitude of the bottom of the cloud, meter

$\sigma_z(t)$ = the Gaussian parameter of cloud size in the vertical direction from (III-5)

Setting Equation III-19 and III-22 equal and solving for t , we find the time the particles remain in the cloud. By integrating Equation III-17, we can then determine the time it takes the particle to fall from H'_B to the ground.

$$T = \frac{1 - e^{-\gamma A}}{V_o \gamma} \quad (\text{III-23})$$

Then the altitude of a particle outside of the cloud is

$$A = \frac{1}{\gamma} \ln \left(\frac{1}{1 - V_o \gamma t} \right) \quad (\text{III-24})$$

where:

t = the time since the particle left the cloud, sec.

Equation III-6 is then integrated using the values of A determined by Equation III-19 and III-24. This determines the maximum distance that a given size particle may travel.

The minimum distance that a given size particle will travel is determined as follows. It is assumed that a particle rises with the bottom of the cloud (Equation III-22) for one second at which time it leaves the cloud and falls with a velocity as given in Equation III-17. The minimum particle distance is then determined as explained above. Between the minimum and maximum distance, a logarithmic normal distribution is assumed in the downwind direction; and a normal distribution is assumed in the crosswind direction.

B. ISOTOPIC CONCENTRATIONS

In order to determine a dose to an individual at a given instant and over a given period of time, the instantaneous and integrated isotopic concentration must be known. If the operating history of the reactor and/or the magnitude of the excursion are known, the following differential equation may be solved over various time steps to determine isotopic concentration.

$$\frac{d N_1(t)}{dt} = P F Y_1 - \lambda_1 N_1(t) + \sum_{j=1}^{i-1} \lambda_j N_j Y_{1j} \quad (\text{III-25})$$

where:

$N_1(t)$ = the abundance of isotope 1 at time, t, atoms

P = production rate, fissions/sec

λ_1 = decay constant for isotope 1, sec^{-1}

$F Y_1$ = fission yield of isotope 1, atoms/fission

Y_{1j} = yield of isotope 1 from decay of isotope j

Equation III-25 is solved by the method of Runge-Kutte Gill^(12,13) over the period of reactor operation. The excursion yield is combined with the result thus obtained, to yield isotopic concentrations at the time of release.

$$\bar{N}_i = \int_0^{T_p} \frac{d N_i(t)}{dt} dt + F_E F Y_i \quad (\text{III-26})$$

where:

- $\bar{N}_i$ = the abundance of isotope i at the time of release, atoms
 T_p = production time, sec
 F_E = excursion magnitude, fissions

The abundance of the isotopes as a function of time after release is determined from the generalized Bateman equations. ⁽¹⁴⁾

$$N_i(T) = \sum_{k=1}^{\ell-1} \left[\bar{N}_k \left(\prod_{j=1}^{i-1} \lambda_j \right) \prod_{j=k+1}^i \left(\frac{\lambda_{j-1}}{\lambda_j - \lambda_k} \right) \sum_{\substack{m=k \\ m \neq \ell}}^i \frac{e^{-\lambda_m T}}{\lambda_m - \lambda_k} \right] + N_i e^{-\lambda_i T} \quad (\text{III-27})$$

where:

- $N_i(T)$ = abundance of isotope, i, at time, T, atom
 T = time after release

and k ranges over all isotopes contributing to isotope, i.

Equation III-27 is integrated to determine the integrated abundance.

$$\int_0^T N_i(t) dt = \sum_{k=1}^{\ell-1} \left[\bar{N}_k \left(\prod_{j=1}^{i-1} \lambda_j \right) \prod_{j=k+1}^i \left(\frac{\lambda_{j-1}}{\lambda_j - \lambda_k} \right) \sum_{\substack{m=k \\ m \neq \ell}}^i \frac{1 - e^{-\lambda_m T}}{\lambda_m - \lambda_k} \right] + \frac{1 - e^{-\lambda_i T}}{\lambda_i} \quad (\text{III-28})$$

If in Equation III-27 and III-28, two or more decay constants (λ 's) are equal, then these equations do not apply in the form shown. However, if these two equations are expanded, solutions are obtained for the case of N equals decay constants.

$$N_i(T) = \sum_{k=1}^{i-1} \left\{ \bar{N}_k \left(\prod_{j=k}^{i-1} \lambda_j \right) \prod_{j=k+1}^i \left(Y_{j-1,j} \right) \right. \\ \left. \left[\left(\sum_{\substack{l=k \\ l \neq n}}^i \frac{e^{-\lambda_l T}}{\lambda_l} \prod_{\substack{m=k \\ m \neq l \\ m \neq n}} (\lambda_m - \lambda_l) \right) + \frac{T^{N-1}}{(N-1)!} e^{-\lambda T} \right] \right\} + N_i e^{-\lambda_i T} \quad (\text{III-29})$$

and integrating we get:

$$\int_0^T N_i(t) dt = \sum_{k=1}^{i-1} \left\{ \bar{N}_k \left(\prod_{j=k}^{i-1} \lambda_j \right) \prod_{j=k+1}^i \left(Y_{j-1,j} \right) \right. \\ \left. \left[\left(\sum_{\substack{l=k \\ l \neq n}}^i \frac{1 - e^{-\lambda_l T}}{\lambda_l} \prod_{\substack{m=k \\ m \neq l \\ m \neq n}} (\lambda_m - \lambda_l) \right) + \left(\frac{1 - e^{-\lambda' T}}{(\lambda')^{N-1}} \sum_{l=0}^{N-1} \frac{(\lambda' T)^l}{l!} \right) \right] \right\} \\ + N_i \frac{1 - e^{-\lambda_i T}}{\lambda_i} \quad (\text{III-30})$$

where:

λ' = the decay constant for the N isotopes, sec^{-1}

n = the indices of the isotopes having equal decay constants

C. DOSE MODELS

1. Beta Skin Dose

The model used to calculate the skin dose from a particle in contact with a person's skin considers that the cells in the basal layer of the epidermis are located at a depth of approximately 0.007 cm from the surface and that the skin between the surface and the basal layer may be considered "inert"⁽¹⁵⁾. The model adjusts for self-absorption of the particle and the absorption that will occur in the outer .007 cm layer and calculates the dose from a depth of 0.007 cm to the maximum beta particle range. This dose is then averaged over the active volume of tissue considered. The beta dose from a point source is given as:⁽¹⁶⁾

$$J(x) = \frac{1}{(\nu \delta x)^2} \left\{ c \left[1 - \frac{\nu \delta x}{c} e^{1 - \frac{\nu \delta x}{c}} \right] + \nu \delta x e^{1 - \nu \delta x} \right\} \quad (III-31)$$

[] = 0 $x \geq \frac{c}{\nu \delta}$

where:

$$\begin{aligned} k &= 1.28 \times 10^{-9} \rho^2 \nu^3 \bar{E}_\beta \alpha, \frac{\text{rad}}{\text{dis}} \\ \alpha &= [3c^2 - (c^2 - 1)e]^{-1} \\ \nu_{\text{tissue}} &= \frac{18.6}{(E_0 - 0.036)^{1.37}} \frac{\text{cm}^2}{\text{gm}} \\ \rho &= \text{tissue density, gm/cm}^3 \\ x &= \text{distance, cm} \\ E_0 &= \text{maximum beta energy, Mev} \\ E_\beta &= \text{average beta energy, Mev} \\ c &= 1 \end{aligned} \quad (III-32)$$

The constant, c , is introduced to correct for discrepancies that develop in the equation compared to experimental measurements. The value of this constant has been considered to be unity, since the correction is not significant for the important beta energy ranges.

The relationship for the average beta dose rate in the affected tissue volume (from a depth of 0.007 cm to the maximum beta range) can be derived as follows:

$$\bar{J} = \frac{1}{V} \int_{x_1}^{x_2} J(x) dV = \frac{1}{V} \int_{x_1}^{x_2} 4\pi J(x) x^2 dx$$

$$\text{if } x_1 \leq \frac{1}{\sqrt{\delta}}$$

$$\bar{J} = \frac{(3) 4\pi}{4\pi (x_2^3 - x_1^3)} \int_{x_1}^{1/\sqrt{\delta}} J(x) x^2 dx + \int_{1/\sqrt{\delta}}^{x_2} J(x) x^2 dx$$

$$\bar{J} = \frac{3k}{(\sqrt{\delta})^2 (x_2^3 - x_1^3)} \left[\left(\frac{1}{\sqrt{\delta}} - x_1 \right) + \frac{1}{\sqrt{\delta}} \left(2 - (\sqrt{\delta} x_2 + 1) e^{1-\sqrt{\delta} x_2} \right) \right] \quad (\text{III-33})$$

$$\text{if } x_1 > \frac{1}{\sqrt{\delta}}$$

$$\bar{J} = \frac{3k}{(\sqrt{\delta})^3 (x_2^3 - x_1^2)} \left[e^{1-\sqrt{\delta} x_1} (\sqrt{\delta} x_1 + 1) - e^{1-\sqrt{\delta} x_2} (\sqrt{\delta} x_2 + 1) \right] \quad (\text{III-34})$$

where x_1 and x_2 are 0.007 cm and the maximum beta range, respectively. The maximum beta range is calculated from the following equation:

$$x_2 = 0.393 E_o^{1.28} \quad (\text{III-35})$$

Equation III-35 is derived as an empirical fit to experimental curves for maximum range in water.⁽¹⁷⁾ The model is applied in the NURSE-1 computer program by calculating the average dose to the sub-epidermal volume of tissue delivered by each isotope individually. The decay of the isotope is considered and the dose numerically integrated as a function of time. Each isotope is considered separately, since the absorption coefficient, ν , and the maximum range, x_2 , is strongly affected by the maximum beta particle energy.

A correction for self-absorption within the particle is included. The self-absorption is a function of particle size, density, and beta particle energy and is obtained by multiplying the ratio of the dose at the center of a sphere of radius, b , to the dose inside a large sphere with equal concentration, i.e., $D(o,b)/D_\infty$, by the ratio of the average dose inside the sphere to the dose at the center, i.e., $D(\bar{b},b)/D(o,b)$.

The product, then, gives the ratio of the average dose inside a sphere of radius b to the dose inside a large sphere with equal concentrations. The result represents the fractional dose absorbed in the sphere. The ratios $D(o,b)/D_\infty$ and $D(\bar{b},b)/D(o,b)$ are determined from Figure 23, Figure 25, Section 16, in reference (16). These ratios are fitted by various analytical expressions for use in the computer program. The fit used for $D(o,b)/D_\infty$ is:

$$\begin{aligned} \text{for } \nu \rho b \leq 1.0 & \quad D(o,b)/D_\infty = \frac{\nu \rho b}{3} & \text{(III-36)} \\ \nu \rho b > 1.0 & \quad D(o,b)/D_\infty = 1.0 - \frac{1 + \nu \rho b e^{1 - \nu \rho b}}{3} \end{aligned}$$

The fit for $D(\bar{b},b)/D(o,b)$ is:

$$\begin{aligned} \nu \rho b \leq 5.0 \quad D(\bar{b},b)/D(o,b) & = 0.75 \\ 5.0 < \nu \rho b \leq 50.0 \quad D(\bar{b},b)/D(o,b) & = 0.75 + (\log_{10} \frac{\nu \rho b}{5}) 0.23 \\ \nu \rho b > 50.0 \quad D(\bar{b},b)/D(o,b) & = 0.98 \end{aligned} \quad \text{(III-37)}$$

where b is the particle radius and ρ is the particle density. The absorption coefficient for the particle material is determined as before from Equation III-32.

The effect of the assumed 7 mg/cm^2 thick layer of "inert" skin can be seen by comparing the doses calculated with and without the absorbing "inert" layer. The effect of the "inert" layer is significant at low maximum beta energies and decreases with increasing energy.

2. Ground Dose

Radioactive material is deposited on the ground by gravitational forces or as material depleted from the cloud by other deposition mechanisms. Once the concentration of activity on the ground is determined, the beta and gamma whole body ground dose may be determined for an individual as follows:

$$\begin{aligned} \text{Dose}_{x_r, y_r} = & \left[\int_{T_g}^{T_g + 4t} \sum_{i=1}^{i \text{ max}} N_i(t) \lambda_i \sum_{j=1}^{j \text{ max}} E_{ij} \bar{E}_j C_j \int_0^\infty \int_{-\infty}^\infty \left(\frac{\Omega(x, y)}{Q(0)} \right)_i \right. \\ & \left. \frac{(1 + K\mu_j R)}{4\pi R^2} e^{-\mu_j R} dy dx dz \right] + \left[\int_{T_f}^{T_f + 4t_2} \sum_{i=1}^{i \text{ max}} N_i(t) \lambda_i \sum_{j=1}^{j \text{ max}} E_{ij} \bar{E}_j C_j \right. \\ & \left. \int_0^\infty \int_{-\infty}^\infty \frac{PD(x, y) \cdot DP(xy)}{CM} F_{\rho_i} SA(x, y) \frac{(1 + K\mu_j R)}{4\pi R^2} e^{-\mu_j R} dy dx dz \right] \end{aligned}$$

where:

C_j	=	dose conversion factor, rad-meter ² /Mev
E_{ij}	=	the fractional contribution of the i^{th} isotope to the j^{th} energy group dimensionless
E_j	=	the mean energy in the j^{th} energy group, Mev/disintegration
T_c	=	cloud arrival time, seconds
T_f	=	mean fallout arrival time, seconds
Δt_1	=	t_e for $T_c \leq T_f$, seconds
Δt_1	=	$t_e - T_c + T_f$ for $T_c > T_f$
Δt_1	=	0 for $t_e + T_f \leq T_c$
Δt_2	=	$t_e - T_f + T_c$ for $T_c < T_f$, seconds
Δt_2	=	t_e for $T_c \geq T_f$
Δt_2	=	0 for $t_e + T_c \leq T_f$
t_e	=	exposure time, seconds
$\frac{\Omega(x,y)}{Q(o)}$	=	relative concentration of the i^{th} isotope at (x,y)
PD (x,y)	=	number of particles per square meter at (x,y) meters ⁻²
DP (x,y)	=	mass of "typical" particle at x,y, grams
CM	=	mass of core, grams
F_{p_1}	=	fraction of the i^{th} isotope remaining with the solid cor
SA (x,y)	=	particle non-self-absorption fraction as calculated from Equations III-36 and III-37.

The above integrals are solved numerically over 189 area segments. The ground area segments for integration are centered around each receptor point. The activity over each individual area is assumed to be constant. The area around each point is

$$\text{Area}_i = 1.5 \sigma_y (X_i) \cdot \left(\frac{X(1+1) - (1-1)}{2} \right) \quad \text{and}$$

the distance between a receptor point, (X_r, Y_r) , and a dose integration area, (X_i, Y_{ij}) is:

$$\bar{R} = \sqrt{(X_i - X_R)^2 + (Y_{ij} - Y_R)^2 + 1}$$

The 1 is included to give the human an effective center 1 meter above ground.

The above integration method does not apply in the segment in which the receptor is located. Assuming the activity to be constant over this area, the following integral is solved.

$$\bar{D} = \int_0^{2\pi} \int_1^R \frac{(1 + K\mu_j r) e^{-\mu_j r}}{4\pi r^2} dr d\theta \quad (\text{III-39})$$

Integrating this yields:

$$\bar{D} = \frac{1}{2} \left[\log R + \sum_{i=1}^{\infty} \frac{(\mu_j)^i - (\mu_j R)^i}{i \cdot i!} \right] + \frac{K}{2} \left[e^{-\mu_j} - e^{-\mu_j R} \right] \quad (\text{III-40})$$

where:

$$R = \sqrt{\frac{\text{Area}}{2\pi} + 1}$$

3. Internal Doses

A person at a downwind position from the source of nuclear accident will inhale radioactive materials directly from the passing cloud and may ingest food materials contaminated with deposited radioactive isotopes. Once inside the body, the individual radioactive isotopes will be carried to various body organs contributing to the internal dose. The body organs considered in the program are thyroid, bone, gastro-intestinal (G.I.) tract, and lungs. The ICRP (International Committee on Radiation Protection) inhalation and ingestion models⁽¹⁸⁾ are used for computation of individual internal doses.

a. Derivation of Basic Equations

For a single intake of a radioactive isotope by a body organ, the dose rate is given by:

$$\dot{D} = \frac{(1.6 \times 10^{-6}) A E_a e^{-\lambda_e t}}{100 m} \quad \text{(III-41)}$$

$$\dot{D} = \frac{(1.6 \times 10^{-8}) A E_a e^{-\lambda_e t}}{m} \quad \text{rad/sec}$$

where:

- $\dot{D}$ = Dose rate at time t , rad/sec
- A = Intake activity, disintegrations/sec
- E_a = Effective energy absorbed by the body organ per disintegration, Mev/disintegration
- λ_e = Effective decay constant (sum of radioactive and biological decay constants), sec^{-1}
- m = Mass of the body organ, g
- t = Time after intake, sec

The integral dose delivered to the organ during time T is obtained by integrating Equation III-39 from $t=0$ to $t=T$.

$$D_T = \int_0^T \dot{D} dt$$

$$= \frac{(1.6 \times 10^{-8}) A E_a (1 - e^{-\lambda_e T})}{m \lambda_e} \quad \text{rads} \quad \text{(III-42)}$$

When the time T is much greater than the effective half-life of the isotope, the dose to the body organ (D_{∞}) becomes:

$$D_{\infty} = \frac{(1.6 \times 10^{-8}) A E_a}{m \lambda_e} \text{ rads} \quad (\text{III-43})$$

and when there is more than one radioactive isotope in a single intake, Equation III-43 can be written as:

$$D_{\infty} = \frac{(1.6 \times 10^{-8})}{m} \sum_{k=1}^K \frac{A_k E_{a,k}}{\lambda_{e,k}} \quad (\text{III-44})$$

where k designates individual isotopes and K is the total number of isotopes present in the intake.

b. Dose Computation Model

Equation III-44 is the starting point of the internal dose computation. For this computation, the quantity A_k , intake activity of radioactive nuclide k, is generally the sum of the inhaled and ingested activities.

While the inhalation results in a single intake of radioactive materials, the ingestion provides a continuous intake of radioactive materials to the body. It is assumed that of the four internal organ doses considered, the lung dose is contributed only by inhalation of radioactive materials because of the dominant effect of inhalation on the lung dose.

The inhalation portion of A_k ($A_{k,l}$) is the product of three different quantities and is expressed by:

$$A_{k,l} = R_g \times_{g,k} f_{l,k} \quad (\text{III-45})$$

where: R_g = inhalation rate, m^3/sec

$\chi_{g,k}$ = instantaneous cloud concentration of radioactive k , disintegrations/ m^3

$f_{1,k}$ = fraction of inhaled nuclide reaching the body organ

The quantity of $f_{1,k}$ depends on the organ of interest and hence the value of $A_{k,1}$ will be different for each body organ. The ingestion portion of A_k , ($A_{k,2}$) is given by:

$$A_{k,2} = \sum_{r=1}^R \left[\int_{T_{m,r}}^{\tau} N_k \lambda_k dt \right] f_{g,r} f_{3,r} f_{2,k} \quad (III-46)$$

where:

$\int_{T_{m,r}}^{\tau} N_k \lambda_k dt$ = integrated ground concentration of radioactive nuclide k from $T_{m,r}$ to time τ , disintegrations/ m^2

τ = exposure time, i.e., the period from the arrival of contaminated particles to the end of intake, sec.

$T_{m,r}$ = ingestion delay time, i.e., the time required for a nuclide to reach a human body through a given ingestion route, sec.

N_k = ground concentration of isotope k in atoms/ m^2

λ_k = radioactive decay constant of isotope k , sec^{-1}

$f_{g,r}$ = factor for converting the ground concentration to the rate of radioactive nuclide reaching the body, m^2/sec .

$f_{3,r}$ = adjustment factor for $f_{g,r}$

$f_{2,k}$ = fraction of ingested amount reaching the organ of interest.

Symbols r and R represent the ingestion route number and the total number of ingestion routes considered respectively. It is obvious from the physical viewpoint that $A_{k,2}$ must be set to zero when τ is equal or less than $T_{m,r}$.

$A_{k,2}$ is different for each body organ because $f_{2,k}$ is dependent upon the body organ considered. The value of $f_{g,r}$ is determined from the experimental or assumed value of daily intake of food materials through different ingestion routes. The adjustment factor $f_{3,r}$ is usually set to one; however, this factor is a function of body organs and can be used to fit the experimental intake data to calculated values.

The effective energy computed in the NUS Effective Energy Program⁽¹⁹⁾ briefly described in c., below, is the total energy absorbed by a body organ due to intake of a radioactive nuclide, under the assumption that the nuclide is located at the center of a sphere with the effective radius of the body organ. For the G.I. dose calculation, this effective energy must be divided by 2 because of the fact that the dose to the intestinal wall is approximately half the dose to the contents of the G.I. tract. This feature is incorporated into the routine which calculates the G.I. dose.

c. Effective Energy

The effective energy $E_{a,k}$ in Equation III-47a is defined as the total energy absorbed by a body organ per disintegration of a particular radioactive nuclide. This definition is sufficient for calculation of the effective energy of a radioactive nuclide whose daughter nuclide is a stable one. However, the definition must be expanded when the radioactive nuclide yields daughter nuclides which are also radioactive;

in this case, the effective energy per disintegration of a parent nuclide should be the sum of the total energies deposited in the body organ due to radioactive disintegration of the parent and daughter nuclides in the organ of interest.

Beta and gamma energies were used for the effective energy calculation. It is assumed that all the energy of each beta particle is dissipated within the body organ. This assumption is justified on the basis that it is the maximum dose that is of interest here. For gamma radiation, an effective radius for each body organ⁽¹⁷⁾ and a constant value of the total energy absorption coefficient (0.035 cm^{-1}) were used to determine the fraction of the gamma energy dissipated in the body organ. The total gamma energy absorption coefficient of 0.035 cm^{-1} is the maximum value in the gamma energy range of 0.06 and 3 Mev for water. The effective organ radii from Reference (18) are:

Thyroid:	3 cm
Bone:	5 cm
G.I. Tract (LLI):	5 cm
Lung:	10 cm

The lower large intestine (LLI) is taken as representative of the G.I. tract. For the bone dose calculation, the beta energy is multiplied by a relative damage factor of 5.0 in line with the ICRP model⁽¹⁸⁾, and the relative biological effectiveness (RBE) was set to unity for the beta and gamma energies considered in the calculation.

Under the assumptions discussed in the preceding section, the effective energies for a radioactive nuclide with a stable daughter nuclide are given by:

$$\begin{array}{ll} \text{Thyroid:} & E_a = \bar{E}_\beta + (0.100) E_\gamma \\ \text{Bone:} & E_a = (5) \bar{E}_\beta + (0.161) E_\gamma \\ \text{G.I. Tract:} & E_a = \bar{E}_\beta + (0.161) E_\gamma \\ \text{Lung:} & E_a = \bar{E}_\beta + (0.295) E_\gamma \end{array}$$

where:

E_a = effective energy absorbed by each organ,
Mev/disintegration.

$\bar{E}_\beta$ = average β decay energy of the parent nuclide,
Mev/disintegration

E_γ = total γ energy of the parent nuclide, Mev/dis-
integration

Combining the inhalation and ingestion effects, we can rewrite the general expression for an internal dose as follows:

$$D_\infty = \frac{1.6 \times 10^{-8}}{m} \sum_{k=1}^K \frac{A_k E_{a,k}}{\lambda_{e,k}} \quad (\text{III-47a})$$

$$A_k = R_g X_{g,k} f_{1,k} + \sum_{r=1}^R \left[\int_{T_{m,r}}^{\tau} N_k \lambda_k dt \right] f_{g,r} f_{3,r} f_{2,k} \quad (\text{III-47b})$$

The second term of Equation III-47b is discarded in the calculation of lung dose,

The effective radius of 5 cm and mass of 150 g used in the G.I. dose calculation are for the lower large intestine (LLI). The reason for selecting the LLI for the G.I. dose calculation is that it has a low mass and a long residence time for food compared with other G.I. tract contents as seen from the following table. ⁽¹⁸⁾

<u>Portion of G.I. Tract</u>	<u>Mass of content, g</u>	<u>Time food remains, hr</u>	<u>Effective radius, cm</u>
Stomach (S)	250	1	10
Small intestine (SI)	1100	4	30
Upper large intestine (ULI)	135	8	5
Lower large intestine (LLI)	150	18	5

The long residence time will result in a large effective energy and the small mass will give a large dose in rads because the dose is inversely proportional to the organ mass. Calculations confirm that the LLI is the most critical section of the G.I. tract.

The effective energy for a radioactive nuclide whose daughter nuclide or nuclides are also radioactive can be calculated similarly. However, the expressions become complicated, because of the number of elements in the decay chain involved, the varying amounts of daughter nuclides with time, and additional removal of the nuclides from a given organ by biological processes.

For the thyroid, bone and lung doses, it is assumed that once a particular nuclide reaches a critical organ, the removal of the parent and subsequently generated daughter nuclides is accomplished only by radioactive decay and biological elimination. This means that the effective holdup

time of the parent and daughter nuclides for the above three body organs is determined by the radioactive and biological removal rates. For the G.I. dose, there is a finite holdup time because the administered parent nuclide and subsequently generated daughter nuclides move along the intestines and are finally removed from the tract. In any case, the effective energy is the sum of energies released in a given organ by radioactive decay of the parent and daughter nuclides based on radioactive disintegration of one parent nuclide.

The detailed description of the model used for the effective energy calculation is given in the NUS Effective Energy Program⁽¹⁹⁾ and the values of effective energy computed with the model are given in Appendix C to NUS-179⁽¹⁰⁾.

d. Internal Dose Constants

The instantaneous cloud and integrated ground concentrations of a nuclide in Equation III-47b vary with the distance from the source, and they must be recomputed whenever the size of the source or the meteorological parameters change. Other terms in Equations III-47a and III-47b are independent of the distance from the source; hence they are called internal dose constants.

The internal dose constants including $f_{1,k}$, $f_{2,k}$, $E_{a,k}$ and decay constants are given in Appendix C to NUS-179⁽¹⁰⁾ for each nuclide and body organ. The effective energy, $E_{a,k}$ was calculated from the nuclear data reported in NUS-179. The values of $f_{1,k}$ for the G.I. and lung doses (0.625 and 0.125 respectively) were determined according to the ICRP model. For this model, it is assumed that 25 per cent of the inhaled material is immediately exhaled, 50 per cent is

deposited in lungs (of which 12.5 per cent is eliminated eventually and swallowed, and 12.5 per cent is retained with a biological half-life of 120 days). Other values of $f_{1,k}$ and $f_{2,k}$, the biological decay constants were obtained from Reference (18).

The following values are presently used for the mass of each body organ:

Thyroid:	20g
Bone:	7000g
G.I. (LLI):	150g
Lung:	1000g

The inhalation rate is based on 10^7 cm^3 per 8-hour work day. The conversion constant, $f_{g,r}$ which is a function of ingestion route only and the adjustment factor which is a function of ingestion route and nuclide, will be either assumed or determined from experimental data. Typical data are:

$$\begin{aligned} f_{g,1} &= 1.157 \times 10^{-6} \text{ m}^2/\text{sec}; \text{ for milk route (1 liter/day)} \\ f_{g,2} &= 1.157 \times 10^{-9} \text{ m}^2/\text{sec}; \text{ for drinking water (1 liter/day} \\ &\quad \text{from reservoir uniformly contaminated to 10m depth)} \\ f_{g,3} &= 0; \text{ additional route unused at present.} \end{aligned}$$

The ingestion delay time, $T_{m,r}$, can be expressed as a function of ingestion route and type of body organ. For all ingestion routes, it is assumed that a delay of one day exists between deposition and ingestion.

The internal dose constants discussed here will be provided to the program as input to library data on a magnetic tape; hence, it is unnecessary to modify the internal dose routines when some changes are to be made in the internal dose constants.

4. Cloud Doses

Assuming that σ_x , the dispersion parameter in the x direction, is equal to σ_y , then the gamma whole body cloud doses are determined for an individual as follows:

$$\text{Dose}_{x_r, y_r} = \int_0^{\infty} \frac{Q(x_c)}{Q(0)} \sum_{i=1}^{i \max} N_i(t) \lambda_i \sum_{j=1}^{j \max} E_{ij} \bar{E}_j C_j \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{(1 + K_j \mu_j R)}{(2\pi)^{3/2} 4\pi R^2 \sigma_y(x_c)^2 \sigma_z(x_c)} \exp - \left[\left(\frac{x}{\sigma_y(x_c)} \right)^2 + \left(\frac{y}{\sigma_y(x_c)} \right)^2 + \left(\frac{z}{\sigma_z(x_c)} \right)^2 \right] + \mu_j R \, dz dy dx \, dt$$

where:

- Dose_{x_r, y_r} = external dose in rads, gamma
- C_j = dose conversion factor, rad meter²/Mev
- x_r = downwind distance from origin to the receptor, meters
- y_r = crosswind distance from cloud center, meters
- $\frac{Q(x_c)}{Q(0)}$ = cloud depletion from III-12, dimensionless
- x_c = downwind cloud position as a function of time, meters
- i = isotope indicator
- j = gamma energy group indicator
- $N_i(t)$ = abundance of the i^{th} isotope, atoms
- λ_i = decay constant of the i^{th} isotope, $\frac{\text{disintegrations}}{\text{atom-sec}}$
- E_{ij} = the fractional contribution of the i^{th} isotope to the j^{th} energy group, dimensionless
- $\bar{E}_j$ = the mean energy in j^{th} energy group, Mev/disintegration

- x, y, z = positions in the cloud relative to the cloud center, meters
- $\sigma_y(x_c), \sigma_z(x_c)$ = the cloud diffusion parameter as previously described, meters
- K_j = $\frac{\mu'_j - \mu'_{aj}}{\mu'_{aj}}$, correction for gamma air scattering, dimensionless
- μ_j = total linear attenuation coefficient of air for the j^{th} energy group corrected for temperature and pressure, meter⁻¹
- μ'_j = total linear attenuation coefficient of air for the j^{th} energy group at STP, meter
- μ'_{aj} = linear energy absorption coefficient of air for the j^{th} energy group at STP, meter⁻¹
- R = $\left[(x_r - x_c - x)^2 + (y_r - y)^2 + \bar{z}^2 \right]^{1/2}$ meter

The distance from the source to the receptor

$$\begin{aligned} \bar{z} &= z + H_c - 1 & \text{for } z > -H_c \\ \bar{z} &= 1 + H_c + z & \text{for } z \leq -H_c \end{aligned}$$

H_c = the cloud center height at a given time, meters, (III-21).

It is not possible to solve the integrals analytically; hence, the equations were solved numerically. The three integrals inside the summation sign are solved using three dimensional elliptical integration dividing the cloud into one, fifty-four, or two-thousand segments, depending on cloud size and position. The remaining integral is solved by Simpson's Rule⁽²⁰⁾ over seven time steps.

In order to better calculate the dose from that portion of the cloud which immediately surrounds the receptors, the maximum radius of integration is always at least 1.25 times the cloud height regardless of cloud size. This insures that there will always be several integration points in the immediate area of the centerline receptor point.

D. PROPOSED MODIFICATIONS TO THE NURSE PROGRAM

With the completion of the NURSE-1 program, several future additions and modifications are envisioned. The more important of these are discussed below.

To be added to the program is the option of specifying crosswind positions, or mesh points, as a function of the downwind position and the ground elevation at every mesh point. By thus allowing for the inclusion of mesh specification and the terrain, the usefulness of the program will be improved.

A provision for continuous release over a short time step will be included. This is in contrast to NURSE-1 which allows only evaluation of instantaneous release.

The effects of propellant exhaust velocity and thermal energy content are also being examined with the intent of replacing the thermal cloud growth routine by one more appropriate to the reactor or engine test situations.

Another change will allow for the meteorological condition to change with time. This would facilitate a more accurate description of actual conditions than does the NURSE-1 program where mean wind speed, stability class, and capping inversion height are held constant with time.

Additional features that would be desirable are the inclusion of the high altitude release and re-entry release conditions as options. Also, the options of marine impact excursion and marine dispersion of fission products may be included.

IV. PROGRAM DESCRIPTION

NURSE-1 (Nuclear Rocket Safety Evaluation) is the first in a series of computer programs designed to evaluate the hazards resulting from the accidental or intentional nuclear self-destruction of a nuclear rocket engine. The program can be used to evaluate the hazards which occur as a result of accidents at or near the launch site. The program is written in the ~~FORTRAN~~ ^{FORTRAN} language for a CONTROL DATA 3600 computer.

The program consists of a main program and four overlays or chains. In operation it is necessary to use the MAIN program and CHAIN 1. CHAINS 2, 3, and 4 can be used at the option of the user depending on the particular information desired. Listings of the routines are given in Appendix C. Operating instructions are given in Appendix A.

The NURSE-1 program has one major limitation. That is, the accident must occur at or near the ground. The calculational scheme allows initial reactor heights of less than one thousand meters. This limitation is imposed because the methods of evaluating cloud growth, rise, and diffusion are based on empirical methods not confirmed for elevated releases.

In the calculational schemes it is assumed that the dose receptor is standing on an infinite flat plain (although modifications in the program are presently underway for incorporating actual terrain). It is further assumed that wind direction and wind velocity at ground level remain constant for the entire period over which cloud and fallout transport are calculated; the effect of wind speed variation with altitude is included.

Each of the chains performs a particular set of calculations. CHAIN 1 prepares information needed for calculation in later chains. CHAIN 1 sets up the output mesh which consists of 21 downwind positions and 5 crosswind positions at each downwind position or a total of 105 mesh points. CHAIN 1

determines the cloud rise, growth, diffusion, and depletion. The fallout particle distribution is calculated as well as the ground contamination from cloud depletion. CHAIN 1 also calculates the beta self-absorption in fallout particles as a function of beta energy and particle size.

CHAIN 2 calculates instantaneous and integrated isotopic activities for later use in CHAIN 3.

CHAIN 3 calculates single particle beta dose to the skin resulting from particle fallout. The particle density on the ground is determined for each mesh point as a function of particle size. Dose is calculated as a function of downwind position, particle size, and total exposure time.

CHAIN 3 also calculates beta and gamma doses resulting from ground contamination. Ground contamination from both cloud depletion and particle fallout are considered. Beta and gamma doses are calculated at each mesh point as a function of total exposure time.

In addition, CHAIN 3 calculates the internal doses to the bone, thyroid lung, and GI (gastrointestinal) tract. Inhalation doses due to cloud passage are calculated for all four organs and integrated ingestion doses to the thyroid, bone and GI tract are calculated all as a function of exposure time at each mesh point.

CHAIN 4 calculates the gamma whole body doses which result from the passage of radioactive cloud. Dose rates to a receptor at each mesh point are integrated over the total cloud travel.

A. MAIN PROGRAM

1. Program Input
Option control and title card (described in Appendix A)
2. Program Output (console typewrite)
 - a. operating instructions
 - b. machine or type error diagnostics
 - c. restart instructions
 - d. tape handling instructions
3. Program Function
 - a. MAIN selects the proper operating sequence determined from the input option control numbers
 - b. MAIN calls the selected chains
 - c. MAIN handles program termination, restart and machine or tape error recovery

B. CHAIN 1, GENERAL INFORMATION CALCULATOR

1. Program Input
 - a. Input card no. 1
stability class, after Pasquill
mean wind speed, meters/sec
wind measurement height, meters
fission product release height, meters
capping inversion height, meters
maximum fallout particle diameter, microns
production rate, fissions/sec
production time, seconds
 - b. Input card no. 2
nuclear energy release, fissions
chemical energy release, kilotons
core volume, cm^3
core density, gm/cm^3
fraction of gaseous material released
fraction of particulate material released
 - c. Input card type 3 if needed (described in Appendix A)

d. Library constants from library tape

2. Calculation of Diffusion Parameters

a. Downwind position, X

$$X_i = 10 \frac{(i+3)}{4} \quad 1 \leq i \leq 2$$

b. Crosswind position, Y

$$Y_{ij} = \sigma_y(X_i) \cdot (j-1) \cdot 1.50$$

c. $\sigma_y(X_i)$ and $\sigma_z(X_i)$

These values include the combined effects of thermal cloud growth and growth by diffusion as described in Section III.A.1

The turbulent diffusion contribution to σ_y and σ_z is taken from Hilsmeier's⁽⁴⁾ curves. The program calculates this contribution from the following fits of these curves:

$$\sigma = A_0 X^{A_1} \exp(A_2 X) \quad X \leq 1000 \text{ meters}$$

$$\sigma = B_0 X^{B_1} \exp(B_2 X) \quad X \geq 1000 \text{ meters}$$

where X = downwind distance, meters and $A_0, A_1, A_2,$

$B_0, B_1,$ & B_2 are fit parameters input from the library tape.

$$d. \int_0^{X_i} \frac{\exp}{\sigma_z(x)} - \frac{1}{2} \left[\left(\frac{h}{\sigma_z(x)} \right) \right]^2 dx$$

This is used in calculating cloud depletion in IV.B.4.

e. Area (X_i, Y_{ij})

$$\text{area} = \frac{(X_{i-1} + X_{i+1})}{2} \cdot 1.50 \sigma_y(X_i)$$

f. Exposure times (not used for cloud and lung dose)

- 1 hour
- 2 hours
- 8 hours
- 1 day
- 1 week
- 1 month
- 1 year
- ∞ (approximated as 10 years)

g. Center line cloud height (as a function of t_1)

$$\begin{aligned}\text{cloud height}_1 &= 166.6 \cdot W^{0.25} \sqrt{t_1} ; t_1 \leq 360 \text{ sec.} \\ &= 166.6 W^{0.25} \sqrt{360} ; t_1 > 360 \text{ sec.}\end{aligned}$$

where W = total energy (kilotons) and cloud height must always be less than or equal to the capping inversion height

h. Cloud arrival time (T_{c_1})

$$T_{c_1} = 1.1 \cdot \frac{(X)_1^{\frac{1}{1.1}}}{\bar{u} \cdot (166.6 W^{0.25})^{0.2}} \quad T_{c_1} \leq 360.0$$

where $\bar{u}$ = mean wind speed at 1 meter and if $T_{c_1} > 360.0$ from above

$$T_{c_1} = 360 + (X_1 - \bar{X}) \bar{u} H_m^{0.2}$$

where $\bar{X}$ = distance cloud travel in 360 sec. and

$$H_m = 166.6 W^{0.25} \sqrt{360} = \text{cloud height at 360 sec.}$$

3. Fallout Parameters

Fallout distribution on the ground and mean fallout arrival times described in Section III.A.2.

4. Calculation of Cloud Depletion, Diffusion, and Deposition

a. Cloud depletion ($Q(X_1)/Q(0)$)

$$\frac{Q(X_1)}{Q(0)} = \exp \left\{ -\sqrt{\frac{2}{\pi}} \frac{V_g}{\bar{u}} \cdot \int_0^{X_1} \frac{\exp \left[-\frac{1}{2} \left(\frac{h}{\sigma_z(X)} \right)^2 \right] dx}{\sigma_z(X)} \right\}$$

where V_g is the deposition velocity (meter/sec)

$$\text{and } \int_0^{X_1} \frac{\exp \left[-\frac{1}{2} \left(\frac{h}{\sigma_z(X)} \right)^2 \right] dx}{\sigma_z(X)} \quad \text{is described in}$$

Section III.A.1.

b. Cloud concentration χ/Q (X, Y)

$$\frac{\chi(X_1, Y_{1j})}{Q(X_1)} = \frac{1}{2 \pi \sigma_y(X_1) \sigma_z(X_1) \bar{u}} \exp \left[-\frac{1}{2} \left(\frac{Y_{1j}}{\sigma_y(X_1)} \right)^2 - \frac{1}{2} \left(\frac{R}{\sigma_z(X_1)} \right)^2 \right]$$

where R = the vertical distance from the cloud center to a receptor.

c. Relative cloud concentration available for inhalation

$$V_{c_{1j}} = \frac{\chi(X_1, Y_{1j})}{Q(X_1)} \cdot \frac{Q(X_1)}{Q(o)}$$

d. Relative ground concentration due to depletion, Ω_{1j}

$$\Omega_{1j} = V_g \cdot \frac{\chi(X_1, Y_{1j})}{Q(X_1)} \cdot \frac{Q(X_1)}{Q(o)}$$

5. Release Fraction

a. Release classes

Each isotope is assigned to one of two release classes, class 0 or class 1.

b. Gaseous release

For class 0

fraction released = F_{gas}

where F_{gas} = fraction of gaseous material released (input)

For class 1

fraction released = F_v

where F_v = fraction of solid core vaporized, described in Section III.A.2.

c. Particulate release

For class 0

fraction released = $(1 - F_{\text{gas}}) F_{\text{par}}$

where F_{par} = fraction of particulate material released, (input)

For class 1

fraction released = $(1 - F_v) F_{\text{par}}$

- d. Special case, where F_{par} is negative all material is assumed to be vaporized and the fraction, F_{gas} , is released

6. Single Particle Self-Absorption

Single particle beta self-absorption are calculated for each particle size as described in Section III.C.1.

7. Chain 1 Output

a. Program constants

library description
exposure times
particle size groups

b. Input data

mean wind speed
wind measurement height
stability class
capping height
release height
excursion power
chemical energy
production rate
production time
maximum particle size
material volume
material density
fraction of gases released
fraction of solids released

c. Calculated constants

maximum cloud rise (center line)
equivalent energy (excursion energy expressed in kilotons)
total energy (excursion plus chemical energies in kilotons)
fractions of non-volatiles released (fraction of solid core vaporized)

X_1 (downwind position)

$\left. \begin{array}{l} \sigma_y(X_1) \\ \sigma_z(X_1) \end{array} \right\}$ Gaussian dispersion parameter

H_1 (downwind cloud center line heights)

T_{C1} (cloud arrival times)

T_{f1} (mean fallout arrival times)

Y_{1j} (crosswind positions)

d. General information output at top of each page

case title

running time (hours, minutes, seconds)

page number

C. CHAIN 2, ISOTOPIC CONCENTRATION CALCULATOR

1. Input

a. General information from library tape

b. times, from CHAIN 1

2. Isotopic abundances as described in Section III.B.

3. Output

Time dependent instantaneous and integrated isotopic activities are output on tape for use in CHAIN 3.

D. CHAIN 3, GENERAL DOSE CALCULATOR

1. Input

a. General data from library tape

b. Cloud and fallout parameter from CHAIN 1

c. Isotopic activities from CHAIN 2

2. Single particle beta dose calculation

a. Particle self-absorptions,

b. Volume averaged dose factors and,

c. Dose calculations as described in Section III.C.1.

3. Single particle beta dose output

a. Particle density on the ground by particle size group as a function of X_1 and Y_{1j} , particles/meter^2

b. Single particle beta skin dose by particle size as a function of X_1 and exposure time, rads

4. External ground dose calculation

a. Energy attenuation factor, B_{1j}^m

$$E_{ij}^{tm} = \frac{(1 + K_{uj}) e^{-u_j r}}{4 \pi r^2}$$

where r is the distance to the receptor (meters), and r is determined by i , ℓ , and m .

$$K_j = \frac{u' - u'_{aj}}{u'_{aj}} \text{ for gamma dose,}$$

and $K_j = 0$ for beta dose

u_j = total linear attenuation coefficient in air corrected for temperature and pressure,

u'_j = total linear attenuation coefficient in air at STP, $^{-1}$ and

u'_{aj} = total absorption coefficient in air at STP, $^{-1}$

$$r = \sqrt{(X_\ell - X_i)^2 + (Y_m - Y_i)^2}$$

i = receptor position indicator

j = energy group indicator

ℓ = downwind position indicator for area of integration

n = crosswind position indicator for area of integration

b. Dose conversion factor $\bar{D}_j$

$$\bar{D}_j = 1.6 \times 10^{-12} \frac{12.8 / (E_{oj} - 0.036)^{1.37}}{\text{rads/Mev}}$$

for beta dose and $(12.675 + .17 \log_{10} E_{aj})$

$$\bar{D}_j = 1.0 / 3.6 \times 10 \text{ rads/Mev}$$

for gamma dose

E_{oj} = maximum energy for a given isotope, Mev/dis and

E_{aj} = average energy for a given isotope, Mev/dis

c. Radiation energy on the ground, P_j

$$P_{kjl\ell m} = E_{aj} A_{kjl\ell m} \text{ (Mev/M}^2\text{)}$$

where A_j is the integrated activity (dis/M^2) on the ground, at a given position (ℓm) for a given isotope (k).

5. Ground Dose Integration and Output

a. The beta and gamma ground doses at a given receptor position (i) are mechanically integrated

$$\text{Dose}_i = \sum_{j=1}^{j \text{ max}} \sum_{k=1}^{\text{all isotopes}} \sum_{\ell=1}^{21} \sum_{m=1}^5 \text{Area}_{\ell m} \bar{D}_j P_{kjl\ell m} E_{ij}^{tm}$$

b. Output

Dose₁ is printed for 105 mesh points (1) and 8 exposure times

6. Internal dose calculations

a. Adjusted Fraction of Integrated Isotopic Ground Activity for Each Ingestion Route

$$g_r = f_{g,r} \cdot f_{3,r}$$

where

$f_{g,r}$ = factor for conversion of the ground concentration to the amount of radioactive nuclide reaching the body through a given ingestion route r , m^2/sec .

$f_{3,r}$ = adjustment factor for a given ingestion route r

b. Inhalation Part of Internal Dose for Thyroid, Bone, G.I. Tract, and Lungs

$$D_h = \sum_{k=1} [C_s \cdot \chi_{g,h} \cdot F_{1,k}]$$

where k designates nuclides and $\chi_{g,k}$ is the isotopic cloud concentration for nuclide k in disintegrations/ m^3 . D_h and $\chi_{g,k}$ are functions of receptor positions.

$$1. C_s = \frac{1.6 \times 10^{-8}}{m}$$

m = 20 for thyroid
 = 7000 for bone
 = 150 for G.I. tract
 = 1000 for lungs

$$11. F_{1,k} = R_g \cdot f_{1,k} \cdot E_{a,k} / (\lambda_k + \lambda_{b,k})$$

R_g = inhalation rate, m^3/sec

$f_{1,k}$ = fraction of inhaled nuclide reaching a body organ

$E_{a,k}$ = effective energy, Mev/dis

λ_k = radioactive decay constant, sec^{-1}

$\lambda_{b,k}$ = biological decay constant, sec^{-1}

7. Ingestion Part of Internal Dose for Thyroid, Bone, and G.I. Tract

$$D_g = C_s \cdot \sum_{r=1}^R \sum_{k=1}^K \left[\int_{T_{m,r}}^{\tau} N_k \lambda_k dt \right] \cdot F_{2,k}$$

where D_g is a function of receptor position and exposure time. No contribution of ingestion is considered for the lung dose calculation.

a. $\int_{T_{m,r}}^{\tau} N_k \lambda_k dt$ = integrated isotopic ground concentration of nuclide k from $T_{m,r}$ to τ , disintegrations/ m^2
 $T_{m,r}$ = ingestion delay time, sec.
 τ = exposure time, sec.

b. $F_{2,k} = g_r \cdot f_{2,k} \cdot E_{a,k} / (\lambda_k + \lambda_{b,k})$
 $f_{2,k}$ = fraction of ingested amount reaching a body organ.

8. Internal Dose Output

For each of the thyroid, bone, and G.I. dose outputs, the dose due to ingestion is printed for each exposure time step for the 21 downwind and 5 crosswind positions, and the dose due to inhalation only is printed at each downwind and crosswind positions. The lung dose is printed at each downwind and crosswind position.

E. CHAIN 4, EXTERNAL CLOUD DOSE CALCULATOR

1. Input

- a. Cloud dose and isotopic constants from library tape.
- b. Diffusion data from CHAIN 1.
- c. Fallout particle self-absorption from CHAIN 1.

2. Calculate Gaseous and Particulate Release Fraction

As described in Section IV.B.5.

3. For purposes of mechanical integration of the dose, 7 cloud positions are determined for each of the 21 downwind receptor positions.

a. The 4th or central position is centered directly over the receptor.

b. The 5th, 6th, and 7th positions are $4/3 \sigma_y$, $8/3 \sigma_y$ and $4 \sigma_y$ beyond the receptor, respectively.

c. The 1st, 2nd and 3rd positions are determined as follows:

$b_1 = 500$ (meters) and $b_2 = 4 \sigma_y$ (meters)

if $b_1 > b_2$, $\bar{b} = b_1$ and if $b_2 \geq b_1$, $\bar{b} = b_2$

if $X_1 < \bar{b}$ the 1st, 2nd, and 3rd positions respectively, are at 0, $1/3 X_1$ and $2/3 X_1$

if $X_1 > \bar{b}$ the 1st, 2nd, and 3rd positions respectively, are at $X_1 - \bar{b}$, $X_1 - 2/3 \bar{b}$, and $X_1 - 1/3 \bar{b}$

4. Calculation of Diffusion Parameters

a. Cloud height from (III-21)

b. σ_y and σ_z described in Section III.A.1.

c. Cloud arrival time, T, calculated as in Section IV. B. 2.h.

d. $\int_0^T \frac{\exp - [1/2 (\frac{h}{\sigma_z(t)})^2]}{\sigma_z(t)} dt$ and

e. $Q(x)/Q(o)$ derived in Section III.A.1.

5. Instantaneous Isotopic Concentration

Calculated as in Section III.B.

6. Total Instantaneous Energy in the cloud at time (t)

$$E_i(t) = \sum_{k=1}^{\text{all isotopes}} \lambda_k \left[SA_1 \cdot FN_k \cdot F_{P_k} + \frac{Q(X_1)}{Q(o)} \cdot F_{gk} \right] \bar{D}_i P_i$$

where:

- $E_i(t)$ = the total energy in the i^{th} energy group in the cloud at time (t), rads
 i = energy group indicator
 λ_k = decay constant, sec^{-1}
 SA_i = particle self-absorption, dimensionless
 FN_k = fraction of total fallout remaining in cloud, dimensionless
 F_{p_k} = particulate release fraction, dimensionless
 F_{g_k} = gaseous release fraction,
 $\bar{D}_1$ = dose conversion factors as in D.4.b above (rads/Mev) and
 P_{ik} = $E_{a_k} N_k'(t)$
 N_k = cloud concentrations total atoms of isotope k in the cloud at time (t)
 E_{a_k} = the mean energy for a given isotope, Mev/dis

7. Dose to the receptor

Integrated dose = $\int_T \int_V E_i(t) A_i dV dt$ where A_i is the energy attenuation in D.4.a. above. $\int_V dV$ is a three dimensional elliptical integration over a variable number of volume segments. The number of segments, N_s , is determined as follows:

for $j \neq 4$ and

$$R > 4 \bar{\sigma} \quad N_s = 1$$

$$R < 4 \bar{\sigma} \quad N_s = 54$$

for $j = 4$

$$N_s = 2000$$

where

j = cloud position indicator from 3 above

R = is the distance from the cloud center to the receptor

$\bar{\sigma}$ = is the effective Gaussian dispersion parameter in the direction of the receptor

$\int_T dt$ is over the 7 time steps in 3 above and is calculated using Simpson's ⁽²⁰⁾ Rule.

8. Output

The gamma external cloud doses are printed for the 5 crosswind positions at each of its 21 downwind positions.

BIBLIOGRAPHY

- (1) Klienecke, D. C., "A Comparison Between Anderson's Dynamic Model of Fallout and Other Models." University of California, CDRP-182-112 (October, 1962).
- (2) "Semi-Annual Progress Report, Environmental Aspects of Nuclear Rocket Flight Operations." Nuclear Utility Services, Inc., NUS-144 (July, 1963).
- (3) Cassidy, S. H., personal communication, August, 1964.
- (4) Hilsmeier, W. F., personal communication, May 13, 1963.
- (5) Gifford, F. A. Nuclear Safety, I, 56-62, (March, 1960).
- (6) Gifford, F. A. Nuclear Safety, II, 56-59, (December, 1960).
- (7) Sutton, O. G. Micrometeorology, McGraw-Hill Book Company, Inc. New York (1953).
- (8) Pasquill, F. Atmospheric Diffusion, D. Van Nostrand, New York (1962).
- (9) Meade, P. J., Technical Note No. 33, Part I, World Meteorological Organization (1960).
- (10) "Annual Progress Report, Environmental Safety Aspects of Nuclear Rocket Flight Operations," Nuclear Utility Services, Inc., NUS-179 (July, 1964).
- (11) King, L. D. P. and Stratton, W. R., "The Response of KIWI Reactors to Abnormal Reactivity Insertions," Los Alamos Scientific Laboratory, RFS-135 (1963) (C-RD).
- (12) Hamming, R. W. Numerical Methods for Scientists and Engineers, Chapter 16. McGraw-Hill Book Company, Inc. (1962).
- (13) Gill, S., "A Process for the Step by Step Integration of Differential Equations in an Automatic Digital Computing Machine," Proceedings of the Cambridge Philosophical Society, 47, 96 (1951).
- (14) Benedict, M. and Pigford, T. Nuclear Chemical Engineers, McGraw-Hill, 1957.

- (15) "Permissible Dose from External Sources of Ionizing Radiation," U. S. Department of Commerce, National Bureau of Standards, Handbook 59.
- (16) Loevinger, R., Japha, E. M., and Brownell, G. L., "Discrete Radioisotope Sources." Radiation Dosimetry, Chapter 16, Academic Press (1956).
- (17) "Radiological Health Handbook," U. S. Department of Health, Education and Welfare, PB 121784R.
- (18) International Commission on Radiological Protection, "Report of Committee II on Permissible Dose for Internal Radiation (1959)," ICRP Publication 2, Pergamon Press, New York, 1959.
- (19) Kim, Y. S., "NUS Effective Energy Program." Nuclear Utility Services, Inc., NUS-156 (October, 1963).
- (20) Scarborough, J. B., "Numerical Integration," Numerical Mathematical Analysis, Chapter VII, II, The Johns Hopkins Press (1955).
- (21) "CONTROL DATA 3600 Computer System Reference Manual," Control Data Corporation, Pub. No. 2136 (November, 1963).
- (22) "SCOPE Reference Manual," Control Data Corporation, Pub. No. 533 (August 1963).
- (23) "3600 SCOPE Overlay Processing," Control Data Corporation, Pub. No. CA-07 (April, 1964).
- (24) "3600 SCOPE Messages and Diagnostics," Control Data Corporation, Pub. No. CA-03 (March, 1964).
- (25) "CONTROL DATA 3600 Computer System FORTRAN/Reference Manual," Control Data Corporation, Pub. No. 60053700 (February, 1964).
- (26) "Reference Manual 709/7090 Programming System," International Business Machines Corporation, C28-6054-2 (1961).

APPENDIX A
INPUT DESCRIPTION AND OPERATING INSTRUCTIONS

I. INPUT

Card No.	Columns	Format	Information
1	1-2	I2	ICHN (1) { 0 - do not calculate Single Particle Beta Dose 1 - do
	3-4	I2	ICHN (2) { 0 - do not calculate External Ground Dose 1 - do
	5-6	I2	ICHN (3) { 0 - do not calculate Internal Doses 1 - do
	7-8	I2	ICHN (4) { 0 - do not calculate External Cloud Doses 1 - do
	11-70	60H	Title
2	1-2	I2	KL Stability Class Index 1 = A 4 = D 2 = B 5 = E (8 and 9 are 3 = C 6 = F undefined)
	8-10	E8	URBI Mean Wind Speed (meters/sec) at WH
	11-20	E10	WH Wind Measurement Height (meters)
	21-30	E10	RH Release Height (meters)
	31-40	E10	HMX Capping Inversion Height (meters), if no capping inversion, HMX = 10 ²⁰ should be input
	41-50	E10	RMAX Maximum fallout particle diameter (microns)
	51-60	E10	FIS Production rate (fissions/second)
	61-70	E10	SEC Production time (seconds)

Card No.	Columns	Format	Information	
3	1-3	I3	J1	{Blank if further input to follow 999 if this is last card
	11-20	E10	ENUC	Integrated Nuclear Energy (fission)
	21-30	E10	CHEM	Chemical Energy (kilotons)*
	31-40	E10	VOL	Solid Core Volume (cm ³)
	41-50	E10	DEN	Solid Core Density (gm/cm ³)
	51-60	E10	FGAS	Fraction of Gaseous Fission Products Released
	61-70	E10	FPAR	Fraction of Solid Core Released**
4			If required (on card #3, J1 blank)	
	1-3	I3	J1	as on card #3
	8-10	I3	J	downwind position number, $1 \leq J \leq 21$
	11-20	E10	VG (1, J)	Deposition Velocities for each deposition class for all downwind positions from 1 through J (If not input, Deposition Velocities are taken from library tape).
	21-30	E10	VG (2, J)	
	31-40	E10	VG (3, J)	
	41-50	E10	VG (4, J)	
	51-60	E10	VG (5, J)	
	61-70	E10	VG (6, J)	
			As many cards as needed to describe the deposition matrix.	

* CHEM may be set negative to force the cloud to remain at the input release height, RH

**FPAR may be set negative to force the entire core to be vaporized and, hence, the release fraction for all isotopes will be equal to FGAS

II. OPERATING DECK MAKEUP

(the 7/9 shown in column one is a 7-9 punch)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
7/9	S	E	Q	U	E	N	C	E	,	O	O	O	I																										
7/9	J	Ø	B	,	N	N	N	N	N	,	I	I	I	,	T	T	T																						
7/9	E	Q	U	I	P	,	O	1	=	S	V																												
7/9	E	Q	U	I	P	,	O	2	=	S	V																												
7/9	E	Q	U	I	P	,	O	3	=	S	V																												
7/9	E	Q	U	I	P	,	O	4	=	S	V																												
7/9	E	Q	U	I	P	,	O	9	=	(	N	U	R	S	E		L	I	B	,	I	,	I	)	,	H	I	,	S	V	,	R	Ø						
7/9	E	Q	U	I	P	,	I	0	=	(	N	U	R	S	E		P	R	Ø	G	,	I	,	I	)	,	H	I	,	S	V	,	R	Ø					
7/9	E	Q	U	I	P	,	2	0	=	6	4																												
7/9	L	Ø	A	D	M	A	I	N	,	I	0																												
7/9	R	U	N	,	T	T	T	,	M	M	M	M	M	,	7																								
	I	N	P	U	T		D	A	T	A		D	E	C	K																								
	C	O	N	T	R	O	L		D	A	T	A		"	E	N	D		F	I	L	E	"		C	A	R	D											

NOTE: Only one case may be run at a time, that is, in order to run consecutive cases all cards from the "SEQUENCE" card to the "END FILE" card must be repeated.

In the above cards

- NNNNN = the accounting number (assigned by a given installation)
- III = the user's initials
- MMMMM = the maximum number of lines of output
- TTT = the maximum running time in minutes

III. MACHINE REQUIREMENT

1. CONTROL DATA 3600 with 64K (2 bank) memory⁽²¹⁾
2. 10 tape drives
3. On-line typewriter
4. SCOPE Monitor System (with Overlays)⁽²²⁾

IV. OPERATING INSTRUCTIONS

A. Time Requirements

The time to run a single case varies widely depending upon the options selected. However, the maximum running time for each option may be determined and each is given below.

Single particle beta dose	6 min.
External ground dose	40 min.
Internal doses	7 min.
External cloud dose	7 min.

Maximum running time for entire program (all options used)	60 min.
--	---------

B. Tape Assignments

<u>Logical Tape No.</u>	<u>Tape Assignment</u>
70	SCOPE Library
60	Input tape
61	Output tape
10	Program tape
9	Library tape
1	Scratch tape
2	Scratch tape
3	Scratch tape
4	Scratch tape
80	SCOPE System recovery tape

C. Operation

1. Standard operation under SCOPE Monitor System (with overlays)⁽²²⁾ applies. Refer to "3600 SCOPE OVERLAY PROCESSING"⁽²³⁾ for instructions on program tape generation and program execution.

2. Operating instructions

a. Refer to reference 22, 23, 24 and 25 for information on CONTROL DATA 3600 operations.

b. The following special instructions apply and are printed on the on-line, console typewriter for the operator.

i. General operator instructions

TO RESTART THIS PROGRAM, DO THE FOLLOWING

REMOVE OUTPUT TAPE (LOGICAL 61) AND PRINT

MOUNT NEW OUTPUT TAPE

REMOUNT ALL OTHER TAPES

PREVENT SCOPE FROM WRITING NEW LABEL ON ANY BUT OUTPUT
TAPE

USE SENSE SWITCH SETTING AS GIVEN BELOW

USE NORMAL STARTING PROCEDURE

IF PROGRAM STOPS DUE TO MACHINE OR TAPE ERROR,
ATTEMPT RESTART AS PER INSTRUCTIONS

TO TERMINATE AT ANY POINT,
DEPRESS SENSE SWITCH 6

THE FOLLOWING TAPES ARE NEEDED

NURSE PROGRAM TAPE (LOGICAL 10)

NURSE LIBRARY TAPE (LOGICAL 9)

4 SCRATCH TAPES (LOGICAL 1, 2, 3 and 4)

INPUT IS LOGICAL 60
OUTPUT IS LOGICAL 61
IF ALL UNITS READY
PRESS -- GO --

At this point the program pauses so that the operator may check the program set-up and correct any erroneous condition before continuing.

ii. CHAIN 1 and 2 restart instruction
FROM THIS POINT ALL SENSE SWITCHES UP FOR RESTART

iii. CHAIN 3 (Single particle beta dose routine) restart instructions
FROM THIS POINT SET SENSE SWITCH 2 FOR RESTART

iv. CHAIN 3 (External ground dose routine) restart instructions
FROM THIS POINT SET SENSE SWITCH 3 FOR RESTART

v. CHAIN 3 (Internal dose routine) restart instructions
FROM THIS POINT SET SENSE SWITCH 4 FOR RESTART

vi. CHAIN 4 restart instructions
FROM THIS POINT SET SENSE SWITCH 5 FOR RESTART

vii. Normal program termination
NURSE LIBRARY TAPE (LOGICAL 9) SHOULD BE SAVED
NURSE PROGRAM TAPE (LOGICAL 10) SHOULD BE SAVED
OUTPUT IS LOGICAL 61

ALL OTHER TAPES MAY BE RELEASED

viii. Operator termination

THIS CASE TERMINATED BY OPERATOR
IF RESTART DESIRED - LOGICAL TAPES 1, 2, 3 AND 4 SHOULD BE SAVED
IF NOT THEY MAY BE RELEASED

RESTART INSTRUCTIONS GIVEN ABOVE

NURSE LIBRARY TAPE (LOGICAL 9) SHOULD BE SAVED

NURSE PROGRAM TAPE (LOGICAL 10) SHOULD BE SAVED

OUTPUT IS LOGICAL 61

The following is written on the standard output

THIS CASE TERMINATED BY OPERATOR

3. Sense Switch Setup	
Sense Switch No.	Use
1	Not used
2	CHAIN 3 (Single particle beta dose routine) restart
3	CHAIN 3 (External ground dose routine) restart
4	CHAIN 3 (Internal dose routine) restart
5	CHAIN 4 restart
6	Forced program termination
All switches up	Normal operation

V. DIAGNOSTICS

A. The five following diagnostics may be written on the on-line typewriter. (TT represents the logical tape numbers)

1. Errors on scratch tapes on library tape while reading.

EOF OR PARITY ERROR ENCOUNTERED WHILE ATTEMPTING
BINARY BUFFER IN FROM TAPE TT
ATTEMPT RESTART - INSTRUCTIONS ABOVE

2. Tape unit failures while reading the scratch tape on the library tape

UNABLE TO READY TAPE TT FOR BUFFER IN
ATTEMPT RESTART - INSTRUCTIONS ABOVE

3. Tape unit failure while writing on the scratch tape
UNABLE TO READY TAPE TT FOR BUFFER OUT
ATTEMPT RESTART - INSTRUCTIONS ABOVE

4. Input tape failure
PARITY ERROR ENCOUNTERED WHILE ATTEMPTING
BCD READ FROM TAPE 60
ATTEMPT RESTART - INSTRUCTIONS ABOVE

5. Improper input deck make up
EOF ENCOUNTERED WHILE ATTEMPTING
BCD READ FROM TAPE 60
DO NOT ATTEMPT RESTART

6. All of the above are followed by
IF RESTART DESIRED - LOGICAL TAPES 1, 2, 3 AND 4
SHOULD BE SAVED
IF NOT THEY MAY BE RELEASED
RESTART INSTRUCTIONS GIVEN ABOVE

NURSE LIBRARY TAPE (LOGICAL 9) SHOULD BE SAVED
NURSE PROGRAM TAPE (LOGICAL 10) SHOULD BE SAVED
OUTPUT IS LOGICAL 61

B. The three following diagnostics may be written on the
stand output medium. (TT represents the logical tape number)

1. Tape failure
EOF OR PARITY ERROR ON TAPE TT
2. Tape unit failure on reading
UNABLE TO READ FROM TAPE TT
3. Tape unit failure on writing
UNABLE TO WRITE ON TAPE TT

C. Input error diagnostics

1. A complete and self-explanatory diagnostic of input errors is written on the standard output medium and the program is terminated.
2. No input error diagnostics are written on the on-line, typewriter output.

APPENDIX B
SAMPLE PROBLEM

NURSE-I
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 1 50,52

PAGE 1

TNT TEST RUN CONTROL DATA VERSION HLC 12/1/64

LIBRARY TAPE USED IS NUCLEAR UTILITY SERVICE, INC. LIBRARY NO. 1
WRITTEN BY MELVIN L. COUCHMAN ON OCTOBER 21, 1964.
REVISED BY MELVIN L. COUCHMAN ON NOVEMBER 9, 1964

TOTAL NUMBER OF ISOTOPES = 107

I=DOWNWIND POSITION INDICATOR

J=CROSSWIND POSITION INDICATOR

K=EXPOSURE TIME INDICATOR

L=PARTICLE SIZE RANGE INDICATOR

EXPOSURE TIME

K		
1	3.600*003 SEC.	1 HOUR
2	7.200*003 SEC.	2 HOURS
3	2.880*004 SEC.	8 HOURS
4	8.640*004 SEC.	1 DAY
5	6.048*005 SEC.	1 WEEK
6	2.629*006 SEC.	1 MONTH
7	3.154*007 SEC.	1 YEAR
8	3.154*009 SEC.	INFINITY

PARTICLE SIZE RANGE

L		
1	2.5000*001 MICRONS TO	5.0000*001 MICRONS
2	5.0010*001 MICRONS TO	7.5000*001 MICRONS
3	7.5010*001 MICRONS TO	1.0000*002 MICRONS
4	1.0010*002 MICRONS TO	2.0000*002 MICRONS
5	2.0010*002 MICRONS TO	6.0000*002 MICRONS
6	6.0010*002 MICRONS TO	1.0000*003 MICRONS
7	1.0010*003 MICRONS TO	2.0000*003 MICRONS
8	2.0010*003 MICRONS TO	6.0000*003 MICRONS
9	6.0010*003 MICRONS TO	1.9000*004 MICRONS

TNT TEST RUN CONTROL DATA VERSION MLC 12/1/64

MEAN WIND SPEED = 5.000+000 METERS/SEC AT 3.000+000 METERS ABOVE GROUND
STABILITY CLASS C CAPPING HEIGHT = 1.000+020 METERS
RELEASE HEIGHT = 0.000+000 METERS MAXIMUM CLOUD RISE = 9.361+002 METERS
EXCURSION POWER = 1.000+021 FISSIONS EQUIVALENT ENERGY = 7.692+003 KILOTONS
CHEMICAL ENERGY = 0.000+000 KILOTONS TOTAL ENERGY = 7.692+003 KILOTONS
PRODUCTION RATE = 0.000+000 FISSIONS/SEC PRODUCTION TIME = 0.000+000 SECONDS
MAXIMUM PARTICLE SIZE = 1.900+004 MICRONS FRACTION OF NON-VOLATILES VAPORIZED = 37.77 PERCENT
MATERIAL VOLUME = 6.000+005 CUBIC CENTIMETERS MATERIAL DENSITY = 2.000+000 GRAMS/CC
FRACTION OF GASES RELEASED = 100.00 PERCENT FRACTION OF SOLIDS RELEASED = 100.00 PERCENT

VARIOUS PARAMETERS AS A FUNCTION OF DOWNWIND POSITION

I	DISTANCE FROM THE ORIGIN (METERS)	SIGMA - Y (METERS)	SIGMA - Z (METERS)	CLOUD HEIGHT (METERS)	CLOUD ARRIVAL TIME (SECONDS)	FALLOUT ARRIVAL TIME (SECONDS)
1	1.0000+001	2.3794+001	1.0216+001	5.4737+001	1.2308+000	
2	1.7783+001	2.7172+001	1.3305+001	7.1108+001	2.0771+000	2.2910+000
3	3.1623+001	3.1118+001	1.7364+001	9.2376+001	3.5054+000	3.8295+000
4	5.6234+001	3.5877+001	2.2746+001	1.2000+002	5.9197+000	5.8402+000
5	1.0000+002	4.1999+001	2.9988+001	1.5589+002	9.9835+000	1.0046+001
6	1.7783+002	5.0717+001	3.9958+001	2.0252+002	1.6848+001	1.6098+001
7	3.1623+002	6.4520+001	5.4092+001	2.6309+002	2.8433+001	2.7572+001
8	5.6234+002	8.7274+001	7.4716+001	3.4177+002	4.7984+001	4.4839+001
9	1.0000+003	1.2232+002	1.0509+002	4.4399+002	8.0979+001	7.5097+001
10	1.7783+003	1.9659+002	1.5086+002	5.7678+002	1.3666+002	1.2923+002
11	3.1623+003	3.1038+002	2.2188+002	7.4929+002	2.3063+002	2.2251+002
12	5.6234+003	4.9930+002	3.2951+002	9.3614+002	3.8933+002	3.8069+002
13	1.0000+004	8.0960+002	4.8212+002	9.3614+002	6.6687+002	6.5766+002
14	1.7783+004	1.3187+003	7.3308+002	9.3614+002	1.1604+003	1.1512+003
15	3.1623+004	2.1419+003	1.1128+003	9.3614+002	2.0381+003	2.0275+003
16	5.6234+004	3.4478+003	1.6291+003	9.3614+002	3.5988+003	3.5849+003
17	1.0000+005	5.4532+003	2.2061+003	9.3614+002	6.3741+003	6.3565+003
18	1.7783+005	8.3553+003	2.5865+003	9.3614+002	1.1310+004	1.1291+004
19	3.1623+005	1.2099+004	2.6013+003	9.3614+002	2.0086+004	
20	5.6234+005	1.5827+004	2.6013+003	9.3614+002	3.5693+004	
21	1.0000+006	1.7305+004	2.6013+003	9.3614+002	6.3447+004	

NURSE-I
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 1 51.21

PAGE 3

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

DISTANCE FROM CLOUD CENTERLINE IN METERS
AS A FUNCTION OF DOWNWIND AND CROSSWIND POSITION

J	1	2	3	4	5
1	0.0	3.5691+001	7.1381+001	1.0707+002	1.4276+002
2	0.0	4.0758+001	8.1517+001	1.2228+002	1.6303+002
3	0.0	4.6677+001	9.3354+001	1.4003+002	1.8671+002
4	0.0	5.3816+001	1.0763+002	1.6145+002	2.1526+002
5	0.0	6.2998+001	1.2600+002	1.8900+002	2.5199+002
6	0.0	7.6076+001	1.5215+002	2.2823+002	3.0430+002
7	0.0	9.6780+001	1.9356+002	2.9034+002	3.8712+002
8	0.0	1.3091+002	2.6183+002	3.9274+002	5.2366+002
9	0.0	1.8348+002	3.6697+002	5.5045+002	7.3394+002
10	0.0	2.9488+002	5.8976+002	8.8464+002	1.1795+003
11	0.0	4.6557+002	9.3114+002	1.3967+003	1.8623+003
12	0.0	7.4895+002	1.4979+003	2.2468+003	2.9958+003
13	0.0	1.2144+003	2.4288+003	3.6432+003	4.8576+003
14	0.0	1.9780+003	3.9560+003	5.9340+003	7.9120+003
15	0.0	3.2128+003	6.4257+003	9.6385+003	1.2851+004
16	0.0	5.1717+003	1.0343+004	1.5515+004	2.0687+004
17	0.0	8.1799+003	1.6360+004	2.4540+004	3.2719+004
18	0.0	1.2533+004	2.5066+004	3.7599+004	5.0132+004
19	0.0	1.8143+004	3.6286+004	5.4429+004	7.2572+004
20	0.0	2.3741+004	4.7481+004	7.1222+004	9.4962+004
21	0.0	2.5957+004	5.1914+004	7.7871+004	1.0383+005

MLC 12/1/64

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = .1

[illegible]

EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 1

[illegible]

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = '2

[illegible]

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I ,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, 1 2

[illegible]

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 30.05

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 3

J	L	1	2	3	4	5	6	7	8	9
1	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	4.901+002	3.278+003	0.000+000
2	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.862+002	1.293+003	0.000+000
3	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.019+001	7.963+001	0.000+000
4	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	7.156+002	6.922+001	0.000+000
5	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	5.933+005	7.860+004	8.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 3

K	L	1	2	3	4	5	6	7	8	9
1								1.466+002	1.548+003	
2								1.935+002	2.030+003	
3								2.785+002	2.900+003	
4								3.615+002	3.712+003	
5								5.016+002	5.076+003	
6								5.381+002	5.442+003	
7								6.093+002	6.186+003	
8								6.125+002	6.224+003	

TNT TEST RERUN CONTROL DATA VERSION HLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 4

L	1	2	3	4	5	6	7	8	9
J									
1	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.581+002	5.008+003	0.000+000	0.000+000
2	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	6.007+001	1.903+003	0.000+000	0.000+000
3	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	3.287+000	1.041+002	0.000+000	0.000+000
4	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	2.308+002	7.312+001	0.000+000	0.000+000
5	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.914+005	6.062+004	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 4

L	1	2	3	4	5	6	7	8	9
K									
1						2.896+001	1.464+002		
2						3.860+001	1.933+002		
3						5.604+001	2.783+002		
4						7.314+001	3.612+002		
5						1.029+002	5.014+002		
6						1.113+002	5.378+002		
7						1.284+002	6.090+002		
8						1.291+002	6.123+002		

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = .5

J	1	2	3	4	5	6	7	8	9
1	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.379+003	1.344+003	0.000+000	0.000+000
2	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	5.238+002	5.145+002	0.000+000	0.000+000
3	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	2.866+001	2.887+001	0.000+000	0.000+000
4	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	2.013+001	2.120+001	0.000+000	0.000+000
5	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	1.669+004	1.879+004	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = .5

K	1	2	3	4	5	6	7	8	9
1						2.891+001	1.461+002		
2						3.054+001	1.929+002		
3						5.597+001	2.778+002		
4						7.306+001	3.608+002		
5						1.028+002	5.009+002		
6						1.112+002	5.374+002		
7						1.284+002	6.086+002		
8						1.291+002	6.118+002		

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 31.22

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 6

L	1	2	3	4	5	6	7	8	9
J									
1	0.000+000	0.000+000	0.000+000	0.000+000	1.933+002	2.267+003	0.000+000	0.000+000	0.000+000
2	0.000+000	0.000+000	0.000+000	0.000+000	7.545+001	8.612+002	0.000+000	0.000+000	0.000+000
3	0.000+000	0.000+000	0.000+000	0.000+000	4.019+000	4.713+001	0.000+000	0.000+000	0.000+000
4	0.000+000	0.000+000	0.000+000	0.000+000	2.822+002	3.309+001	0.000+000	0.000+000	0.000+000
5	0.000+000	0.000+000	0.000+000	0.000+000	2.540+005	2.744+004	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 6

L	1	2	3	4	5	6	7	8	9
K									
1					4.149+000	2.884+001			
2					5.560+000	3.846+001			
3					8.133+000	5.588+001			
4					1.070+001	7.298+001			
5					1.535+001	1.027+002			
6					1.676+001	1.111+002			
7					1.977+001	1.283+002			
8					1.988+001	1.290+002			

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 31,60

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = ?

L	1	2	3	4	5	6	7	8	9
J									
1	0.000+000	0.000+000	0.000+000	0.000+000	7.979+002	7.218+002	0.000+000	0.000+000	0.000+000
2	0.000+000	0.000+000	0.000+000	0.000+000	3.032+002	2.742+002	0.000+000	0.000+000	0.000+000
3	0.000+000	0.000+000	0.000+000	0.000+000	1.659+001	1.501+001	0.000+000	0.000+000	0.000+000
4	0.000+000	0.000+000	0.000+000	0.000+000	1.165+001	1.054+001	0.000+000	0.000+000	0.000+000
5	0.000+000	0.000+000	0.000+000	0.000+000	9.659+005	8.737+005	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = ?

L	1	2	3	4	5	6	7	8	9
K									
1					4.130+000	2.875+001			
2					5.544+000	3.833+001			
3					8.115+000	5.574+001			
4					1.068+001	7.284+001			
5					1.533+001	1.026+002			
6					1.674+001	1.110+002			
7					1.975+001	1.281+002			
8					1.986+001	1.288+002			

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 31,99

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 8

J	1	2	3	4	5	6	7	8	9
1	0.000+000	0.000+000	0.000+000	5.442+002	1.366+003	4.340+001	0.000+000	0.000+000	0.000+000
2	0.000+000	0.000+000	0.000+000	2.068+002	5.191+002	1.655+001	0.000+000	0.000+000	0.000+000
3	0.000+000	0.000+000	0.000+000	1.131+001	2.841+001	9.167+001	0.000+000	0.000+000	0.000+000
4	0.000+000	0.000+000	0.000+000	7.945+002	1.995+001	6.578+003	0.000+000	0.000+000	0.000+000
5	0.000+000	0.000+000	0.000+000	6.588+005	1.654+004	5.630+006	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 8

K	1	2	3	4	5	6	7	8	9
1				2.354+001	4.123+000	2.864+001			
2				3.160+001	5.522+000	3.817+001			
3				4.651+001	8.090+000	5.556+001			
4				6.174+001	1.066+001	7.265+001			
5				9.010+001	1.530+001	1.024+002			
6				9.892+001	1.671+001	1.108+002			
7				1.180+000	1.973+001	1.279+002			
8				1.187+000	1.984+001	1.286+002			

TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 9

J	L	1	2	3	4	5	6	7	8	9
1	0.000+000	0.000+000	2.785+002	1.353+003	1.003+003	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
2	0.000+000	0.000+000	1.058+002	5.140+002	3.809+002	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
3	0.000+000	0.000+000	5.790+000	2.813+001	2.084+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
4	0.000+000	0.000+000	4.066+002	1.975+001	1.464+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
5	0.000+000	0.000+000	3.371+005	1.638+004	1.214+004	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RAD

DOWNWIND POSITION, I = 9

K	L	1	2	3	4	5	6	7	8	9
1				4.735+002	2.341+001	4.099+000				
2				6.356+002	3.140+001	5.486+000				
3				9.378+002	4.628+001	8.049+000				
4				1.248+001	6.150+001	1.062+001				
5				1.831+001	8.986+001	1.526+001				
6				2.013+001	9.868+001	1.667+001				
7				2.408+001	1.178+000	1.968+001				
8				2.422+001	1.185+000	1.980+001				

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 12

L	1	2	3	4	5	6	7	8	9
J									
1	0.000+000	1.894+002	5.950+002	1.321+003	2.857+002	0.000+000	0.000+000	0.000+000	0.000+000
2	0.000+000	7.196+001	2.261+002	5.019+002	1.085+002	0.000+000	0.000+000	0.000+000	0.000+000
3	0.000+000	3.938+000	1.237+001	2.747+001	5.939+000	0.000+000	0.000+000	0.000+000	0.000+000
4	0.000+000	2.765+002	8.687+002	1.929+001	4.171+002	0.000+000	0.000+000	0.000+000	0.000+000
5	0.000+000	2.293+002	7.203+005	1.599+004	3.458+005	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 10

L	1	2	3	4	5	6	7	8	9
K									
1		1.722+002	4.690+002	2.318+001	4.058+000				
2		2.309+002	6.288+002	3.106+001	5.424+000				
3		3.416+002	9.298+002	4.589+001	7.977+000				
4		4.560+002	1.240+001	6.110+001	1.054+001				
5		6.710+002	1.822+001	8.944+001	1.518+001				
6		7.383+002	2.004+001	9.826+001	1.659+001				
7		8.848+002	2.400+001	1.174+000	1.961+001				
8		8.899+002	2.414+001	1.181+000	1.972+001				

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 11

L	1	2	3	4	5	6	7	8	9
J									
1	6.039+001	4.630+002	5.884+002	5.942+002	3.685+001	0.000+000	0.000+000	0.000+000	0.000+000
2	2.294+001	1.759+002	2.236+002	2.258+002	1.400+001	0.000+000	0.000+000	0.000+000	0.000+000
3	1.256+000	9.627+000	1.223+001	1.235+001	7.663+001	0.000+000	0.000+000	0.000+000	0.000+000
4	8.817+003	6.760+002	8.591+002	8.675+002	5.381+003	0.000+000	0.000+000	0.000+000	0.000+000
5	7.310+006	5.605+005	7.123+005	7.193+005	4.461+006	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 11

L	1	2	3	4	5	6	7	8	9
K									
1	3.686+003	1.694+002	4.612+002	2.279+001	3.986+000				
2	4.932+003	2.266+002	6.168+002	3.847+001	5.317+000				
3	7.330+003	3.366+002	9.161+002	4.520+001	7.855+000				
4	9.823+003	4.508+002	1.226+001	6.839+001	1.042+001				
5	1.453+002	6.657+002	1.808+001	8.872+001	1.506+001				
6	1.600+002	7.330+002	1.990+001	9.754+001	1.647+001				
7	1.922+002	8.795+002	2.385+001	1.167+000	1.948+001				
8	1.933+002	8.846+002	2.399+001	1.173+000	1.959+001				

LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 34.10

TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 12

J	1	2	3	4	5	6	7	8	9
1	2.394+002	5.003+002	2.608+002	1.188+002	2.066+000	0.000+000	0.000+000	0.000+000	0.000+000
2	9.096+001	1.924+002	9.909+001	4.514+001	7.849+001	0.000+000	0.000+000	0.000+000	0.000+000
3	4.977+000	1.053+001	5.423+000	2.470+000	4.295+002	0.000+000	0.000+000	0.000+000	0.000+000
4	3.495+002	7.391+002	3.808+002	1.735+002	3.016+004	0.000+000	0.000+000	0.000+000	0.000+000
5	2.898+005	6.128+005	3.157+005	1.438+005	2.501+007	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 12

K	1	2	3	4	5	6	7	8	9
1	3.571+003	1.641+004	4.468+002	2.207+001	3.856+000				
2	4.765+003	2.189+002	5.959+002	2.943+001	5.132+000				
3	7.139+003	3.278+002	8.921+002	4.401+001	7.643+000				
4	9.626+003	4.417+002	1.201+001	5.917+001	1.020+001				
5	1.432+002	6.564+002	1.783+001	8.747+001	1.483+001				
6	1.580+002	7.237+002	1.965+001	9.628+001	1.624+001				
7	1.901+002	8.702+002	2.360+001	1.154+000	1.926+001				
8	1.913+002	8.753+002	2.374+001	1.161+000	1.937+001				

NURSH-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 34,73

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 13

L	1	2	3	4	5	6	7	8	9
J									
1	4.281+002	2.514+002	5.244+001	1.065+001	5.009+002	0.000+000	0.000+000	0.000+000	0.000+000
2	1.626+002	9.552+001	1.992+001	4.046+000	1.932+002	0.000+000	0.000+000	0.000+000	0.000+000
3	8.900+000	5.227+000	1.090+000	2.214+001	1.109+003	0.000+000	0.000+000	0.000+000	0.000+000
4	6.250+002	3.871+002	7.656+003	1.555+003	8.497+006	0.000+000	0.000+000	0.000+000	0.000+000
5	5.182+005	3.043+005	6.347+006	1.289+006	8.007+009	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 13

L	1	2	3	4	5	6	7	8	9
K									
1	3.345+003	1.537+002	4.184+002	2.066+001	3.605+000				
2	4.457+003	2.047+002	5.573+002	2.752+001	4.793+000				
3	6.790+003	3.118+002	8.484+002	4.185+001	7.260+000				
4	9.268+003	4.253+002	1.156+001	5.694+001	9.806+000				
5	1.396+002	6.396+002	1.737+001	8.519+001	1.443+001				
6	1.543+002	7.069+002	1.919+001	9.401+001	1.584+001				
7	1.865+002	8.533+002	2.314+001	1.131+000	1.885+001				
8	1.876+002	8.585+002	2.328+001	1.138+000	1.897+001				

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

DALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 14

J	1	2	3	4	5	6	7	8	9
1	3.486+002	5.700+001	4.787+000	4.268+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
2	1.324+002	2.166+001	1.819+000	1.622+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
3	7.247+000	1.185+000	9.952+002	8.875+003	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
4	5.089+002	8.322+003	6.988+004	6.232+005	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
5	4.219+005	6.900+006	5.794+007	5.167+008	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 14

K	1	2	3	4	5	6	7	8	9
1	2.906+003	1.335+002	3.634+002	1.794+001					
2	3.897+003	1.790+002	4.872+002	2.405+001					
3	6.162+003	2.820+002	7.698+002	3.796+001					
4	8.624+003	3.957+002	1.076+001	5.295+001					
5	1.330+002	6.093+002	1.654+001	8.112+001					
6	1.477+002	6.765+002	1.836+001	8.992+001					
7	1.799+002	8.230+002	2.231+001	1.890+000					
8	1.810+002	8.282+002	2.245+001	1.897+000					

TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 15

J	L	1	2	3	4	5	6	7	8	9
1	1.307+002	5.951+000	1.987+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
2	4.965+001	2.254+000	7.551+002	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
3	2.717+000	1.233+001	4.132+003	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
4	1.908+002	8.660+004	2.902+005	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
5	1.592+005	7.180+007	2.406+008	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 15

K	L	1	2	3	4	5	6	7	8	9
1	2.183+003	1.003+002	2.729+002							
2	3.817+003	1.386+002	3.771+002							
3	5.175+003	2.376+002	6.463+002							
4	7.608+003	3.498+002	9.487+002							
5	1.226+002	5.615+002	1.524+001							
6	1.373+002	6.286+002	1.706+001							
7	1.695+002	7.751+002	2.101+001							
8	1.706+002	7.802+002	2.115+001							

NURSE=I
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 36,35

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 16

J	1	2	3	4	5	6	7	8	9
1	2.270+001	2.856+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
2	8.627+000	1.078+001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
3	4.721+001	5.898+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
4	3.315+003	4.141+002	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
5	2.748+006	3.434+008	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 16

K	1	2	3	4	5	6	7	8	9
1	1.331+003	6.113+003							
2	2.000+003	9.181+003							
3	3.996+003	1.834+002							
4	6.382+003	2.926+002							
5	1.099+002	5.031+002							
6	1.246+002	5.701+002							
7	1.567+002	7.165+002							
8	1.578+002	7.217+002							

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 36.72

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 17

L	1	2	3	4	5	6	7	8	9
J									
1	1.838+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
2	6.985-001	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
3	3.822-002	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
4	2.684-004	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000
5	2.225-007	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000	0.000+000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 17

L	1	2	3	4	5	6	7	8	9
K									
1	7.434-004								
2	1.266-003								
3	3.035-003								
4	5.342-003								
5	9.871-003								
6	1.133-002								
7	1.455-002								
8	1.466-002								

NURSE=1 TIME 0 9 37.00
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 18

J	1	2	3	4	5	6	7	8	9
1	6.996-002	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000
2	2.678-002	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000
3	1.455-003	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000
4	1.021-005	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000
5	8.469-009	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000	0.000*000

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, I = 18

K	1	2	3	4	5	6	7	8	9
1	4.773-004								
2	8.657-004								
3	2.350-003								
4	4.535-003								
5	8.929-003								
6	1.038-002								
7	1.359-002								
8	1.371-002								

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DOWNWIND POSITION, I = 10

[illegible]

DOSE IS IN RADS

DOWNWIND POSITION, I = 19

[illegible]

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

FALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND PARTICLE SIZE RANGE, L

DENSITY IS IN PARTICLES/SQUARE METER

DOWNWIND POSITION, I = 20

[illegible]

SINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
EXPOSURE TIME, K AND PARTICLE SIZE RANGE, L

DOSE IS IN RADS

DOWNWIND POSITION, 1 - 20

[illegible]

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 9 42,92

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 1

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.698+003	2.309+003	2.809+002	7.643+002	2.793+000	1.287+002	1.240+002	3.872+001	5.368+004	1.608+001
2	1.699+003	2.632+003	2.810+002	8.719+002	2.793+000	1.471+002	1.240+002	4.427+001	5.368+004	1.836+001
3	1.703+003	3.080+003	2.811+002	1.022+003	2.793+000	1.731+002	1.240+002	5.212+001	5.368+004	2.156+001
4	1.703+003	3.778+003	2.811+002	1.256+003	2.793+000	2.141+002	1.240+002	6.444+001	5.368+004	2.651+001
5	1.703+003	4.954+003	2.811+002	1.657+003	2.793+000	2.861+002	1.240+002	8.576+001	5.368+004	3.474+001
6	1.703+003	5.487+003	2.811+002	1.838+003	2.793+000	3.185+002	1.240+002	9.539+001	5.368+004	3.847+001
7	1.703+003	7.187+003	2.811+002	2.408+003	2.793+000	4.175+002	1.240+002	1.253+002	5.368+004	5.059+001
8	1.703+003	7.252+003	2.811+002	2.429+003	2.793+000	4.213+002	1.240+002	1.264+002	5.368+004	5.106+001

DOWNWIND POSITION, I = 2

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	2.562+004	4.963+003	1.012+004	2.033+003	6.277+002	1.922+002	5.528+000	2.705+001	6.421+003	1.108+001
2	2.877+004	5.655+003	1.136+004	2.317+003	7.050+002	2.193+002	6.209+000	3.091+001	7.209+003	1.264+001
3	3.475+004	6.608+003	1.373+004	2.708+003	8.518+002	2.570+002	7.502+000	3.636+001	8.706+003	1.480+001
4	3.605+004	8.083+003	1.424+004	3.314+003	8.837+002	3.159+002	7.783+000	4.486+001	9.031+003	1.812+001
5	3.694+004	1.052+004	1.460+004	4.320+003	9.056+002	4.158+002	7.975+000	5.935+001	9.254+003	2.351+001
6	3.707+004	1.163+004	1.465+004	4.776+003	9.088+002	4.610+002	8.004+000	6.591+001	9.287+003	2.596+001
7	3.728+004	1.524+004	1.473+004	6.258+003	9.139+002	6.043+002	8.049+000	8.661+001	9.339+003	3.414+001
8	3.750+004	1.538+004	1.482+004	6.315+003	9.192+002	6.098+002	8.095+000	8.740+001	9.393+003	3.445+001

DOWNWIND POSITION, I = 3

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	7.419+003	1.719+003	2.913+003	6.972+002	1.786+002	8.218+001	1.549+000	1.752+001	1.756+003	7.465+000
2	8.723+003	1.960+003	3.427+003	7.951+002	2.103+002	9.386+001	1.824+000	2.002+001	2.068+003	8.501+000
3	1.121+004	2.295+003	4.408+003	9.314+002	2.706+002	1.103+002	2.348+000	2.351+001	2.662+003	9.915+000
4	1.174+004	2.816+003	4.618+003	1.144+003	2.836+002	1.360+002	2.460+000	2.893+001	2.790+003	1.207+001
5	1.211+004	3.694+003	4.761+003	1.504+003	2.924+002	1.804+002	2.537+000	3.797+001	2.876+003	1.547+001
6	1.216+004	4.092+003	4.782+003	1.667+003	2.937+002	2.004+002	2.548+000	4.207+001	2.889+003	1.702+001
7	1.224+004	5.360+003	4.815+003	2.184+003	2.957+002	2.629+002	2.565+000	5.532+001	2.909+003	2.236+001
8	1.233+004	5.409+003	4.848+003	2.204+003	2.978+002	2.653+002	2.583+000	5.583+001	2.929+003	2.257+001

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 16 32.41

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RAD

DOWNWIND POSITION, I = 4

K	J	1		2		3		4		5	
		BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1		8.057+002	3.039+002	3.061+002	1.468+002	1.675+001	3.337+001	1.176+001	1.080+001	9.750+005	4.738+000
2		9.786+002	3.470+002	3.718+002	1.677+002	2.034+001	3.814+001	1.428+001	1.232+001	1.184+004	5.381+000
3		1.303+003	4.077+002	4.952+002	1.972+002	2.710+001	4.488+001	1.903+001	1.442+001	1.577+004	6.241+000
4		1.384+003	5.033+002	5.258+002	2.437+002	2.877+001	5.545+001	2.020+001	1.765+001	1.675+004	7.542+000
5		1.449+003	6.699+002	5.506+002	3.249+002	3.013+001	7.358+001	2.115+001	2.287+001	1.754+004	9.512+000
6		1.459+003	7.450+002	5.542+002	3.615+002	3.032+001	8.177+001	2.129+001	2.525+001	1.765+004	1.042+001
7		1.472+003	9.761+002	5.592+002	4.739+002	3.060+001	1.074+002	2.149+001	3.320+001	1.781+004	1.365+001
8		1.485+003	9.849+002	5.644+002	4.782+002	3.088+001	1.084+002	2.168+001	3.351+001	1.798+004	1.378+001

DOWNWIND POSITION, I = 5

K	J	1	2	3	4	5					
		BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1		2.689+002	8.062+001	1.029+002	4.551+001	5.752+000	1.485+001	4.201+002	5.769+000	3.692+005	2.624+000
2		3.293+002	9.209+001	1.260+002	5.199+001	7.044+000	1.695+001	5.144+002	6.558+000	4.521+005	2.966+000
3		4.424+002	1.083+002	1.692+002	6.114+001	9.464+000	1.988+001	6.912+002	7.625+000	6.074+005	3.409+000
4		4.719+002	1.337+002	1.805+002	7.547+001	1.009+001	2.441+001	7.371+002	9.246+000	6.479+005	4.070+000
5		4.969+002	1.774+002	1.901+002	9.996+001	1.063+001	3.186+001	7.763+002	1.174+001	6.823+005	5.027+000
6		5.005+002	1.971+002	1.915+002	1.110+002	1.071+001	3.526+001	7.819+002	1.288+001	6.872+005	5.471+000
7		5.053+002	2.587+002	1.933+002	1.459+002	1.081+001	4.637+001	7.894+002	1.690+001	6.938+005	7.126+000
8		5.101+002	2.611+002	1.951+002	1.472+002	1.091+001	4.679+001	7.969+002	1.706+001	7.004+005	7.192+000

DOWNWIND POSITION, I = 6

K	J	1		2		3		4		5	
		BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1		7.360+001	1.909+001	2.797+001	1.191+001	1.530+000	5.007+000	1.075+002	2.291+000	8.910+006	1.104+000
2		9.145+001	2.177+001	3.475+001	1.357+001	1.902+000	5.684+000	1.335+002	2.585+000	1.107+005	1.237+000
3		1.247+002	2.549+001	4.736+001	1.587+001	2.592+000	6.596+000	1.820+002	2.964+000	1.509+005	1.399+000
4		1.347+002	3.126+001	5.120+001	1.940+001	2.802+000	7.977+000	1.987+002	3.529+000	1.631+005	1.636+000
5		1.445+002	4.074+001	5.492+001	2.510+001	3.005+000	1.008+001	2.110+002	4.339+000	1.750+005	1.980+000
6		1.459+002	4.505+001	5.544+001	2.770+001	3.034+000	1.105+001	2.130+002	4.715+000	1.766+005	2.112+000
7		1.474+002	5.918+001	5.601+001	3.639+001	3.065+000	1.449+001	2.152+002	6.129+000	1.784+005	2.707+000
8		1.489+002	5.973+001	5.657+001	3.673+001	3.096+000	1.462+001	2.174+002	6.185+000	1.802+005	2.731+000

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 23 21,73

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TNI TEST RERUN

CONTROL DATA VERSION

HLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 7

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	3.135+001	5.076+000	1.191+001	2.935+000	6.519+001	1.167+000	4.577+003	5.738+001	3.795+006	2.924+001
2	3.944+001	5.765+000	1.499+001	3.323+000	8.201+001	1.309+000	5.759+003	6.380+001	4.775+006	3.223+001
3	5.446+001	6.702+000	2.069+001	3.840+000	1.132+000	1.485+000	7.951+003	7.114+001	6.593+006	3.535+001
4	5.933+001	8.144+000	2.254+001	4.628+000	1.234+000	1.748+000	8.662+003	8.186+001	7.182+006	3.985+001
5	6.426+001	1.046+001	2.442+001	5.855+000	1.336+000	2.121+000	9.382+003	9.618+001	7.779+006	4.558+001
6	6.495+001	1.151+001	2.468+001	6.417+000	1.350+000	2.294+000	9.482+003	1.028+000	7.862+006	4.838+001
7	6.565+001	1.506+001	2.494+001	8.362+000	1.365+000	2.949+000	9.585+003	1.296+000	7.947+006	5.954+001
8	6.633+001	1.519+001	2.520+001	8.438+000	1.379+000	2.975+000	9.684+003	1.307+000	8.029+006	5.999+001

DOWNWIND POSITION, I = 8

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.120+001	1.162+000	4.260+000	5.875+001	2.337+001	1.732+001	1.648+003	7.986+002	1.376+006	4.169+002
2	1.431+001	1.318+000	5.443+000	6.628+001	2.986+001	1.914+001	2.106+003	8.686+002	1.758+006	4.496+002
3	2.007+001	1.530+000	7.630+000	7.619+001	4.185+001	2.114+001	2.952+003	9.287+002	2.464+006	4.722+002
4	2.213+001	1.860+000	8.414+000	9.144+001	4.616+001	2.410+001	3.255+003	1.014+001	2.717+006	5.034+002
5	2.435+001	2.404+000	9.260+000	1.161+000	5.080+001	2.842+001	3.583+003	1.125+001	2.990+006	5.428+002
6	2.466+001	2.651+000	9.377+000	1.273+000	5.144+001	3.039+001	3.628+003	1.176+001	3.028+006	5.603+002
7	2.494+001	3.455+000	9.484+000	1.646+000	5.202+001	3.766+001	3.669+003	1.383+001	3.062+006	6.340+002
8	2.521+001	3.486+000	9.585+000	1.660+000	5.258+001	3.795+001	3.708+003	1.391+001	3.095+006	6.371+002

DOWNWIND POSITION, I = 9

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	9.715+000	6.733+001	3.691+000	2.895+001	2.020+001	3.881+002	1.418+003	8.085+003	1.176+006	3.384+003
2	1.261+001	7.683+001	4.791+000	3.298+001	2.622+001	4.360+002	1.841+003	8.769+003	1.526+006	3.607+003
3	1.797+001	9.834+001	6.826+000	3.867+001	3.735+001	4.977+002	2.623+003	9.329+003	2.175+006	3.700+003
4	1.999+001	1.114+000	7.594+000	4.750+001	4.156+001	5.917+002	2.918+003	1.013+002	2.419+006	3.817+003
5	2.223+001	1.465+000	8.447+000	6.213+001	4.622+001	7.396+002	3.246+003	1.124+002	2.601+006	3.966+003
6	2.254+001	1.625+000	8.564+000	6.878+001	4.686+001	8.072+002	3.291+003	1.174+002	2.728+006	4.029+003
7	2.281+001	2.139+000	8.666+000	9.037+001	4.742+001	1.038+001	3.330+003	1.369+002	2.781+006	4.295+003
8	2.306+001	2.158+000	8.763+000	9.120+001	4.795+001	1.047+001	3.367+003	1.377+002	2.792+006	4.306+003

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 10

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	5.005+000	2.545+001	1.901+000	1.030+001	1.040+001	9.015+003	7.303+004	6.102+004	6.055+007	1.118+004
2	6.613+000	2.907+001	2.512+000	1.175+001	1.375+001	1.021+002	9.651+004	6.683+004	8.001+007	1.190+004
3	9.599+000	3.434+001	3.647+000	1.386+001	1.995+001	1.185+002	1.401+003	7.255+004	1.161+006	1.216+004
4	1.075+001	4.254+001	4.086+000	1.712+001	2.236+001	1.436+002	1.570+003	8.086+004	1.371+006	1.250+004
5	1.205+001	5.613+001	4.579+000	2.249+001	2.575+001	1.830+002	1.759+003	9.237+004	1.458+006	1.291+004
6	1.223+001	6.230+001	4.647+000	2.494+001	2.542+001	2.010+002	1.785+003	9.766+004	1.480+006	1.309+004
7	1.238+001	8.237+001	4.705+000	3.294+001	2.574+001	2.630+002	1.807+003	1.181+003	1.498+006	1.385+004
8	1.253+001	8.315+001	4.760+000	3.325+001	2.604+001	2.654+002	1.828+003	1.190+003	1.516+006	1.388+004

DOWNWIND POSITION, I = 11

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.637+000	6.269+002	6.216+001	2.444+002	3.395+002	1.641+003	2.380+004	4.104+005	1.972+007	2.110+006
2	2.204+000	7.169+002	8.366+001	2.793+002	4.570+002	1.863+003	3.205+004	4.522+005	2.655+007	2.250+006
3	3.263+000	8.528+002	1.239+000	3.316+002	6.772+002	2.184+003	4.750+004	4.978+005	3.936+007	2.300+006
4	3.682+000	1.064+001	1.398+000	4.128+002	7.641+002	2.679+003	5.360+004	5.650+005	4.441+007	2.360+006
5	4.156+000	1.411+001	1.578+000	5.461+002	8.625+002	3.473+003	6.051+004	6.627+005	5.014+007	2.436+006
6	4.221+000	1.569+001	1.603+000	6.068+002	8.761+002	3.836+003	6.146+004	7.075+005	5.092+007	2.470+006
7	4.277+000	2.085+001	1.624+000	8.057+002	8.876+002	5.049+003	6.226+004	8.720+005	5.159+007	2.602+006
8	4.329+000	2.105+001	1.644+000	8.135+002	8.984+002	5.097+003	6.302+004	8.786+005	5.221+007	2.607+006

DOWNWIND POSITION, I = 12

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	4.673+001	1.363+002	1.760+001	5.192+003	9.447+003	2.967+004	6.528+005	3.157+006	5.363+008	3.453+008
2	6.370+001	1.571+002	2.402+001	5.978+003	1.292+002	3.400+004	8.944+005	3.541+006	7.355+008	3.733+008
3	9.580+001	1.907+002	3.616+001	7.239+003	1.950+002	4.084+004	1.353+004	4.072+006	1.114+007	3.855+008
4	1.088+000	2.405+002	4.109+001	9.127+003	2.217+002	5.120+004	1.539+004	4.869+006	1.267+007	3.989+008
5	1.236+000	3.218+002	4.666+001	1.221+002	2.520+002	6.811+004	1.751+004	6.142+006	1.442+007	4.186+008
6	1.257+000	3.595+002	4.747+001	1.363+002	2.563+002	7.589+004	1.780+004	6.734+006	1.467+007	4.314+008
7	1.276+000	4.792+002	4.817+001	1.819+002	2.600+002	1.011+003	1.805+004	8.665+006	1.487+007	4.619+008
8	1.294+000	4.841+002	4.885+001	1.837+002	2.635+002	1.023+003	1.829+004	8.742+006	1.506+007	4.630+008

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 33 29.52

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 13

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	2.592-001	4.795-003	9.113-002	1.730-003	4.102-003	8.409-005	2.378-005	5.586-007	1.737-008	7.843-010
2	3.429-001	6.059-003	1.211-001	2.166-003	5.520-003	1.027-004	3.249-005	6.635-007	2.400-008	8.972-010
3	4.972-001	8.214-003	1.766-001	2.913-003	8.187-003	1.349-004	4.911-005	8.440-007	3.682-008	1.063-009
4	5.644-001	1.025-002	2.007-001	3.647-003	9.329-003	1.703-004	5.613-005	1.068-006	4.217-008	1.253-009
5	6.298-001	1.351-002	2.245-001	4.822-003	1.051-002	2.273-004	6.376-005	1.430-006	4.819-008	1.568-009
6	6.462-001	1.525-002	2.302-001	5.443-003	1.076-002	2.564-004	6.511-005	1.613-006	4.913-008	1.779-009
7	6.656-001	1.884-002	2.368-001	6.789-003	1.103-002	3.278-004	6.646-005	2.106-006	5.000-008	2.217-009
8	6.887-001	1.910-002	2.446-001	6.880-003	1.133-002	3.319-004	6.791-005	2.130-006	5.088-008	2.235-009

DOWNWIND POSITION, I = 14

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	2.366-001	3.583-003	7.918-002	1.211-003	3.043-003	4.808-005	1.401-005	2.348-007	8.128-009	1.497-010
2	3.155-001	5.064-003	1.058-001	1.699-003	4.099-003	6.588-005	1.913-005	3.089-007	1.129-008	1.679-010
3	4.605-001	7.654-003	1.550-001	2.556-003	6.073-003	9.751-005	2.892-005	4.444-007	1.748-008	2.602-010
4	5.290-001	9.436-003	1.781-001	3.161-003	6.989-003	1.219-004	3.337-005	5.657-007	2.022-008	3.378-010
5	5.843-001	1.223-002	1.971-001	4.111-003	7.788-003	1.603-004	3.759-005	7.090-007	2.307-008	4.626-010
6	6.067-001	1.398-002	2.045-001	4.697-003	8.061-003	1.831-004	3.876-005	8.670-007	2.368-008	5.299-010
7	6.371-001	1.579-002	2.145-001	5.349-003	8.419-003	2.146-004	4.021-005	1.064-006	2.437-008	6.827-010
8	6.753-001	1.608-002	2.270-001	5.445-003	8.863-003	2.182-004	4.195-005	1.080-006	2.516-008	6.918-010

DOWNWIND POSITION, I = 15

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.526-001	2.513-003	5.026-002	8.264-004	1.821-003	2.978-005	7.486-006	1.211-007	3.694-009	5.868-011
2	2.152-001	3.762-003	7.094-002	1.234-003	2.578-003	4.402-005	1.067-005	1.751-007	5.321-009	8.169-011
3	3.373-001	6.052-003	1.113-001	1.983-003	4.066-003	7.049-005	1.700-005	2.781-007	8.623-009	1.278-010
4	3.991-001	7.556-003	1.317-001	2.481-003	4.811-003	8.887-005	2.013-005	3.566-007	1.021-008	1.689-010
5	4.460-001	9.931-003	1.473-001	3.268-003	5.404-003	1.179-004	2.278-005	4.813-007	1.170-008	2.346-010
6	4.685-001	1.150-002	1.547-001	3.785-003	5.664-003	1.367-004	2.380-005	5.580-007	1.215-008	2.723-010
7	5.002-001	1.260-002	1.651-001	4.165-003	6.025-003	1.530-004	2.516-005	6.477-007	1.273-008	3.347-010
8	5.407-001	1.287-002	1.782-001	4.253-003	6.481-003	1.562-004	2.686-005	6.602-007	1.342-008	3.405-010

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 35 06.15

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 16

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	7.628-002	1.458-003	2.489-002	4.746-004	8.693-004	1.640-005	3.296-006	6.063-008	1.402-009	2.441-011
2	1.160-001	2.275-003	3.786-002	7.402-004	1.323-003	2.554-005	5.028-006	9.406-008	2.147-009	3.755-011
3	2.016-001	3.897-003	6.582-002	1.268-003	2.344-003	4.380-005	8.779-006	1.617-007	3.772-009	6.491-011
4	2.489-001	5.022-003	8.125-002	1.636-003	2.843-003	5.670-005	1.083-005	2.112-007	4.648-009	8.644-011
5	2.845-001	6.839-003	9.291-002	2.229-003	3.257-003	7.754-005	1.245-005	2.911-007	5.385-009	1.213-010
6	3.034-001	8.083-003	9.906-002	2.635-003	3.469-003	9.167-005	1.324-005	3.443-007	5.700-009	1.436-010
7	3.303-001	8.749-003	1.078-001	2.857-003	3.771-003	1.001-004	1.434-005	3.822-007	6.133-009	1.649-010
8	3.649-001	8.964-003	1.190-001	2.927-003	4.156-003	1.025-004	1.574-005	3.913-007	6.680-009	1.687-010

DOWNWIND POSITION, I = 17

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	3.672-002	7.608-004	1.193-002	2.470-004	4.097-004	8.461-006	1.491-006	3.058-008	5.791-010	1.169-011
2	5.985-002	1.229-003	1.945-002	3.989-004	6.679-004	1.366-005	2.431-006	4.939-008	9.450-010	1.888-011
3	1.169-001	2.290-003	3.803-002	7.456-004	1.305-003	2.555-005	4.752-006	9.247-008	1.848-009	3.546-011
4	1.525-001	3.149-003	4.955-002	1.023-003	1.702-003	3.508-005	6.195-006	1.272-007	2.408-009	4.899-011
5	1.804-001	4.589-003	5.864-002	1.491-003	2.015-003	5.115-005	7.339-006	1.858-007	2.858-009	7.181-011
6	1.962-001	5.590-003	6.374-002	1.819-003	2.189-003	6.240-005	7.972-006	2.266-007	3.101-009	8.760-011
7	2.187-001	6.076-003	7.107-002	1.974-003	2.441-003	6.784-005	8.880-006	2.472-007	3.448-009	9.629-011
8	2.477-001	6.252-003	8.049-002	2.032-003	2.763-003	6.980-005	1.004-005	2.543-007	3.892-009	9.903-011

DOWNWIND POSITION, I = 18

K	J 1		2		3		4		5	
	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.880-002	3.718-004	6.103-003	1.207-004	2.089-004	4.131-006	7.538-007	1.490-008	2.870-010	5.667-012
2	3.233-002	6.267-004	1.050-002	2.035-004	3.593-004	6.963-006	1.297-006	2.512-008	4.937-010	9.553-012
3	7.175-002	1.359-003	2.330-002	4.411-004	7.973-004	1.510-005	2.877-006	5.446-008	1.096-009	2.072-011
4	1.005-001	2.076-003	3.262-002	6.741-004	1.116-003	2.307-005	4.029-006	8.325-008	1.534-009	3.168-011
5	1.254-001	3.379-003	4.072-002	1.097-003	1.394-003	3.755-005	5.030-006	1.355-007	1.915-009	5.157-011
6	1.401-001	4.313-003	4.549-002	1.400-003	1.557-003	4.792-005	5.619-006	1.729-007	2.139-009	6.582-011
7	1.613-001	4.746-003	5.237-002	1.541-003	1.792-003	5.274-005	6.468-006	1.904-007	2.462-009	7.250-011
8	1.885-001	4.910-003	6.121-002	1.594-003	2.095-003	5.456-005	7.559-006	1.969-007	2.877-009	7.501-011

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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INI TEST RERUN CONTROL DATA VERSION MLC 12/1/64

EXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K

DOSE IS IN RADS

DOWNWIND POSITION, I = 19

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	1.015=002	1.833=004	3.294=003	5.951=005	1.127=004	2.036=006	4.066=007	7.344=009	1.545=010	2.792=012
2	1.830=002	3.305=004	5.940=003	1.073=004	2.033=004	3.672=006	7.331=007	1.324=008	2.787=010	5.034=012
3	4.672=002	8.875=004	1.517=002	2.881=004	5.190=004	9.859=006	1.872=006	3.556=008	7.115=010	1.352=011
4	7.164=002	1.560=003	2.326=002	5.066=004	7.959=004	1.736=005	2.870=006	6.252=008	1.091=009	2.377=011
5	9.710=002	2.926=003	3.152=002	9.501=004	1.079=003	3.251=005	3.890=006	1.172=007	1.479=009	4.457=011
6	1.131=001	3.940=003	3.673=002	1.279=003	1.257=003	4.377=005	4.533=006	1.579=007	1.723=009	6.000=011
7	1.364=001	4.412=003	4.429=002	1.432=003	1.515=003	4.901=005	5.465=006	1.768=007	2.078=009	6.719=011
8	1.664=001	4.592=003	5.401=002	1.491=003	1.848=003	5.101=005	6.666=006	1.840=007	2.534=009	6.993=011

DOWNWIND POSITION, I = 20

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	5.368=003	1.054=004	1.743=003	3.420=005	5.964=005	1.170=006	2.151=007	4.221=009	8.176=011	1.605=012
2	1.004=002	2.002=004	3.259=003	6.501=005	1.115=004	2.225=006	4.022=007	8.023=009	1.529=010	3.050=012
3	2.883=002	6.276=004	9.359=003	2.037=004	3.203=004	6.972=006	1.155=006	2.514=008	4.391=010	9.558=012
4	4.904=002	1.246=003	1.592=002	4.044=004	5.448=004	1.384=005	1.965=006	4.991=008	7.469=010	1.897=011
5	7.530=002	2.719=003	2.445=002	8.828=004	8.365=004	3.021=005	3.017=006	1.089=007	1.147=009	4.141=011
6	9.367=002	3.874=003	3.041=002	1.258=003	1.041=003	4.303=005	3.753=006	1.552=007	1.427=009	5.899=011
7	1.206=001	4.417=003	3.916=002	1.434=003	1.340=003	4.906=005	4.832=006	1.770=007	1.837=009	6.727=011
8	1.554=001	4.625=003	5.044=002	1.502=003	1.726=003	5.138=005	6.225=006	1.853=007	2.366=009	7.044=011

DOWNWIND POSITION, I = 21

J	1		2		3		4		5	
K	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA	BETA	GAMMA
1	2.349=003	5.999=005	7.628=004	1.948=005	2.610=005	6.665=007	9.413=008	2.404=009	3.578=011	9.137=013
2	4.488=003	1.164=004	1.457=003	3.778=005	4.986=005	1.293=006	1.798=007	4.663=009	6.836=011	1.772=012
3	1.415=002	3.967=004	4.593=003	1.288=004	1.572=004	4.407=006	5.669=007	1.589=008	2.155=010	6.042=012
4	2.738=002	8.782=004	8.888=003	2.851=004	3.041=004	9.755=006	1.097=006	3.518=008	4.170=010	1.337=011
5	5.103=002	2.294=003	1.657=002	7.447=004	5.669=004	2.548=005	2.045=006	9.190=008	7.773=010	3.493=011
6	7.031=002	3.496=003	2.283=002	1.135=003	7.811=004	3.884=005	2.817=006	1.401=007	1.071=009	5.324=011
7	9.910=002	4.187=003	3.217=002	1.322=003	1.101=003	4.523=005	3.970=006	1.631=007	1.509=009	6.201=011
8	1.364=001	4.295=003	4.428=002	1.394=003	1.515=003	4.771=005	5.465=006	1.721=007	2.077=009	6.542=011

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 1

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	8.3699-005	2.7173-005	9.2981-007	3.3534-009	1.2747-012
6	1.4720-004	4.7789-005	1.6352-006	5.8974-009	2.2418-012
7	1.5693-004	5.0946-005	1.7433-006	6.2873-009	2.3900-012
8	1.5693-004	5.0946-005	1.7433-006	6.2873-009	2.3900-012
INHALED	1.6646-003	5.4042-004	1.8492-005	6.6693-008	2.5352-011

DOWNWIND POSITION, I = 2

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	5.4551-005	1.7710-005	6.0601-007	2.1656-009	8.3081-013
6	9.5938-005	3.1146-005	1.0658-006	3.8438-009	1.4611-012
7	1.0228-004	3.3205-005	1.1362-006	4.0978-009	1.5577-012
8	1.0228-004	3.3205-005	1.1362-006	4.0978-009	1.5577-012
INHALED	1.0334-003	3.3549-004	1.1480-005	4.1403-008	1.5738-011

DOWNWIND POSITION, I = 3

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.8276-005	1.2426-005	4.2520-007	1.5335-009	5.8294-013
6	6.7314-005	2.1854-005	7.4780-007	2.8970-009	1.0222-012
7	7.1762-005	2.3298-005	7.9721-007	2.8752-009	1.0929-012
8	7.1762-005	2.3298-005	7.9721-007	2.8752-009	1.0929-012
INHALED	4.7789-004	2.4875-004	7.4854-006	2.6996-008	1.0202-011

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 4

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.9818*005	9.6806*006	3.3125*007	1.1947*009	4.5413*013
6	5.2441*005	1.7025*005	5.8257*007	2.1011*009	7.9867*013
7	5.5906*005	1.8150*005	6.2106*007	2.2399*009	8.5145*013
8	5.5906*005	1.8150*005	6.2106*007	2.2399*009	8.5145*013
INHALED	4.7347*004	1.5371*004	5.2598*006	1.8970*008	7.2110*012

DOWNWIND POSITION, I = 5

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.7185*005	8.8256*006	3.8199*007	1.0892*009	4.1402*013
6	4.7810*005	1.5522*005	5.3112*007	1.9155*009	7.2814*013
7	5.0969*005	1.6547*005	5.6621*007	2.0421*009	7.7625*013
8	5.0969*005	1.6547*005	5.6621*007	2.0421*009	7.7625*013
INHALED	3.7809*004	1.2275*004	4.2002*006	1.5148*008	5.7583*012

DOWNWIND POSITION, I = 6

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.1065*005	1.0085*005	3.4510*007	1.2446*009	4.7312*013
6	5.8634*005	1.7737*005	6.0693*007	2.1889*009	8.3208*013
7	5.8245*005	1.8909*005	6.4704*007	2.3336*009	8.8706*013
8	5.8245*005	1.8909*005	6.4704*007	2.3336*009	8.8706*013
INHALED	3.4985*004	1.2007*004	4.1087*006	1.4818*008	5.6328*012

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 7

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.7107*005	1.5293*005	5.2331*007	1.8874*009	7.1744*013
6	8.12849*005	2.6897*005	9.2037*007	3.3194*009	1.2618*012
7	8.8324*005	2.8675*005	9.8119*007	3.5387*009	1.3492*012
8	8.8324*005	2.8675*005	9.8119*007	3.5387*009	1.3452*012
INHALED	4.7107*005	1.5301*004	5.2358*006	1.8883*008	7.1781*012

DOWNWIND POSITION, I = 8

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	9.3573*005	3.0379*005	1.0395*006	3.7490*009	1.4251*012
6	1.6458*004	5.3430*005	1.8283*006	6.5938*009	2.5065*012
7	1.7545*004	5.6961*005	1.9491*006	7.0295*009	2.6721*012
8	1.7545*004	5.6961*005	1.9491*006	7.0295*009	2.6721*012
INHALED	7.7117*004	2.5036*004	8.5669*006	3.0897*008	1.1745*011

DOWNWIND POSITION, I = 9

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.0943*004	6.7993*005	2.3266*006	8.3910*009	3.1897*012
6	3.16837*004	1.1959*004	4.0922*006	1.4759*008	5.6102*012
7	3.0271*004	1.2749*004	4.3626*006	1.5734*008	5.9810*012
8	3.0271*004	1.2749*004	4.3626*006	1.5734*008	5.9810*012
INHALED	1.4065*003	4.5661*004	1.5624*005	5.6358*008	2.1420*011

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 42.39

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TNT TEST RUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 10

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.3311-004	1.4061-004	4.8115-006	1.7353-008	6.5963-012
6	7.6186-004	2.4734-004	8.4634-006	3.0524-008	1.1603-011
7	8.1221-004	2.6369-004	9.0228-006	3.2541-008	1.2370-011
8	8.1221-004	2.6369-004	9.0228-006	3.2541-008	1.2370-011
INHALED	2.4430-003	7.9312-004	2.7139-005	9.7878-008	3.7206-011

DOWNWIND POSITION, I = 11

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	8.8196-004	2.8633-004	9.7977-006	3.5336-008	1.3432-011
6	1.5516-003	5.0373-004	1.7237-005	6.2165-008	2.3631-011
7	1.6542-003	5.3703-004	1.8376-005	6.6275-008	2.5193-011
8	1.6542-003	5.3703-004	1.8376-005	6.6275-008	2.5193-011
INHALED	4.4650-003	1.4496-003	4.9602-005	1.7889-007	6.8002-011

DOWNWIND POSITION, I = 12

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.8674-003	6.0626-004	2.0745-005	7.4819-008	2.8441-011
6	3.2860-003	1.8668-003	3.6505-005	1.3166-007	5.0046-011
7	3.5033-003	1.1374-003	3.8919-005	1.4036-007	5.3356-011
8	3.5033-003	1.1374-003	3.8919-005	1.4036-007	5.3356-011
INHALED	9.1574-003	2.9730-003	1.8173-004	3.6690-007	1.3947-010

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 42,76

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TNT TEST RUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 13

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	6.7521*003	2.1921*003	7.5009*005	2.7052*007	1.0283*010
6	1.1886*002	3.8589*003	1.3204*004	4.7622*007	1.8103*010
7	1.2673*002	4.1142*003	1.4078*004	5.0773*007	1.9300*010
8	1.2673*002	4.1142*003	1.4078*004	5.0773*007	1.9300*010
INHALED	3.4308*002	1.1138*002	3.8113*004	1.3746*006	5.2252*010

DOWNWIND POSITION, I = 14

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	7.9259*003	2.5732*003	8.8049*005	3.1755*007	1.2071*010
6	1.3963*002	4.5330*003	1.5511*004	5.5942*007	2.1265*010
7	1.4887*002	4.8332*003	1.6538*004	5.9646*007	2.2673*010
8	1.4887*002	4.8332*003	1.6538*004	5.9647*007	2.2673*010
INHALED	4.2972*002	1.3951*002	4.7738*004	1.7217*006	6.5447*010

DOWNWIND POSITION, I = 15

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	5.0757*003	1.6479*003	5.6386*005	2.0336*007	7.7303*011
6	8.9529*003	2.9066*003	9.9458*005	3.5870*007	1.3635*010
7	9.5469*003	3.0994*003	1.0606*004	3.8250*007	1.4540*010
8	9.5469*003	3.0994*003	1.0606*004	3.8250*007	1.4540*010
INHALED	2.9430*002	9.5545*003	3.2094*004	1.1791*006	4.4822*010

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 16

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.5799=003	8.3758=004	2.8660=005	1.0337=007	3.9292=011
6	4.5609=003	1.4807=003	5.0667=005	1.8273=007	6.9462=011
7	4.8644=003	1.5792=003	5.4038=005	1.9489=007	7.4084=011
8	4.8644=003	1.5792=003	5.4038=005	1.9489=007	7.4084=011
INHALED	1.5675=002	5.0890=003	1.7414=004	6.2804=007	2.3873=010

DOWNWIND POSITION, I = 17

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.2803=003	4.1566=004	1.4223=005	5.1297=008	1.9500=011
6	2.2724=003	7.3773=004	2.5244=005	9.1043=008	3.4608=011
7	2.4244=003	7.8708=004	2.6933=005	9.7134=008	3.6923=011
8	2.4244=003	7.8708=004	2.6933=005	9.7134=008	3.6923=011
INHALED	7.6138=003	2.4718=003	8.4581=005	3.0505=007	1.1596=010

DOWNWIND POSITION, I = 18

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	7.1317=004	2.3153=004	7.9226=006	2.8573=008	1.8862=011
6	1.2745=003	4.1378=004	1.4159=005	5.1064=008	1.9411=011
7	1.3606=003	4.4171=004	1.5115=005	5.4511=008	2.0721=011
8	1.3606=003	4.4171=004	1.5115=005	5.4512=008	2.0721=011
INHALED	3.1919=003	1.2076=003	4.1321=005	1.4903=007	5.6649=011

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 43.50

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 19

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.7049=004	1.5274=004	5.2266=006	1.8850=008	7.1655=012
6	8.15088=004	2.7624=004	9.4524=006	3.4051=008	1.2959=011
7	9.0922=004	2.9518=004	1.0101=005	3.6428=008	1.3847=011
8	9.0922=004	2.9518=004	1.0101=005	3.6428=008	1.3847=011
INHALED	2.0212=003	6.5620=004	2.2454=005	8.0982=008	3.0784=011

DOWNWIND POSITION, I = 20

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.3540=004	1.0889=004	3.7260=006	1.3438=008	5.1082=012
6	6.1884=004	2.0091=004	6.8747=006	2.4794=008	9.4249=012
7	6.6235=004	2.1503=004	7.3580=006	2.6537=008	1.0088=011
8	6.6235=004	2.1503=004	7.3580=006	2.6537=008	1.0088=011
INHALED	1.1950=003	3.8796=004	1.5275=005	4.7878=008	1.8200=011

DOWNWIND POSITION, I = 21

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.7383=004	8.8899=005	3.0419=006	1.0971=008	4.1704=012
6	5.2168=004	1.6937=004	5.7954=006	2.0901=008	7.9452=012
7	5.5979=004	1.8174=004	6.2187=006	2.2428=008	8.5256=012
8	5.5979=004	1.8174=004	6.2187=006	2.2428=008	8.5256=012
INHALED	7.7383=004	2.5123=004	8.9965=006	3.1004=008	1.1785=011

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 1

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	4.8767-006	1.5832-006	5.4176-008	1.9539-010	7.4273-014
6	1.8832-005	6.1139-006	2.8921-007	7.5451-010	2.8681-013
7	1.4384-004	4.6697-005	1.5979-006	5.7629-009	2.1906-012
8	4.6546-003	1.5111-003	5.1708-005	1.8649-007	7.0890-011
INHALED	6.2991-005	2.0450-005	6.9977-007	2.5238-009	9.5936-013

DOWNWIND POSITION, I = 2

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	3.1784-006	1.0319-006	3.5309-008	1.2735-010	4.8408-014
6	1.2274-005	3.9848-006	1.3635-007	4.9176-010	1.8693-013
7	9.3746-005	3.0435-005	1.0414-006	3.7560-009	1.4278-012
8	3.0337-003	9.8489-004	3.3701-005	1.2155-007	4.6203-011
INHALED	4.0992-005	1.3308-005	4.5538-007	1.6424-009	6.2431-013

DOWNWIND POSITION, I = 3

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	2.2301-006	7.2402-007	2.4775-008	8.9352-011	3.3965-014
6	8.6120-006	2.7959-006	9.5671-008	3.4504-010	1.3116-013
7	6.1577-005	2.1355-005	7.3072-007	2.6354-009	1.0018-012
8	2.1286-003	6.9105-004	2.3646-005	8.5282-008	3.2418-011
INHALED	2.8639-005	9.2976-006	3.1815-007	1.1474-009	4.3617-013

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 4

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.7374*006	5.6405*007	1.9301*008	6.9609*011	2.6460*014
6	6.7092*006	2.1781*006	7.4532*008	2.6880*010	1.0218*013
7	5.1244*005	1.6636*005	5.6926*007	2.0531*009	7.8044*013
8	1.6583*003	5.3836*004	1.8422*005	6.6439*008	2.5255*011
INHALED	2.2102*005	7.1753*006	2.4553*007	8.8551*010	3.3661*013

DOWNWIND POSITION, I = 5

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.5840*006	5.4424*007	1.7596*008	6.3462*011	2.4124*014
6	6.1167*006	1.9858*006	6.7951*008	2.4507*010	9.3157*014
7	4.6719*005	1.5167*005	5.1900*007	1.8718*009	7.1152*013
8	1.5118*003	4.9082*004	1.6795*005	6.0572*008	2.3025*011
INHALED	1.9827*005	6.4368*006	2.2026*007	7.9437*010	3.0196*013

DOWNWIND POSITION, I = 6

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.8101*006	5.8765*007	2.0108*008	7.2522*011	2.7568*014
6	6.9900*006	2.2693*006	7.7652*008	2.8006*010	1.0646*013
7	5.3389*005	1.7333*005	5.9310*007	2.1390*009	8.1311*013
8	1.7277*003	5.6090*004	1.9193*005	6.9220*008	2.6313*011
INHALED	2.2190*005	7.2039*006	2.4651*007	8.8904*010	3.3795*013

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 7

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	2.7449-006	8.9115-007	3.8494-008	1.0998-010	4.1805-014
6	1.0600-005	3.4414-006	1.1776-007	4.2470-010	1.6144-013
7	8.0963-005	2.6285-005	8.9942-007	3.2438-009	1.2331-012
8	2.6200-003	8.5059-004	2.9106-005	1.0497-007	3.9903-011
INHALED	3.3007-005	1.0716-005	3.6668-007	1.3224-009	5.0270-013

DOWNWIND POSITION, I = 8

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	5.4529-006	1.7703-006	6.8576-008	2.1847-010	8.3048-014
6	2.1058-005	6.8364-006	2.3393-007	8.4368-010	3.2071-013
7	1.6084-004	5.2216-005	1.7867-006	6.4440-009	2.4496-012
8	5.2048-003	1.6898-003	5.7820-005	2.0853-007	7.9269-011
INHALED	6.4848-005	2.1053-005	7.2039-007	2.5981-009	9.8763-013

DOWNWIND POSITION, I = 9

J	1	2	3	4	5
INGESTED K					
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	1.2206-005	3.9627-006	1.3560-007	4.8903-010	1.8590-013
6	4.7137-005	1.5303-005	5.2365-007	1.8886-009	7.1790-013
7	3.6004-004	1.1689-004	3.9996-006	1.4425-008	5.4833-012
8	1.1651-002	3.7825-003	1.2943-004	4.6680-007	1.7744-010
INHALED	1.4482-004	4.7017-005	1.6088-006	5.8023-009	2.2056-012

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 44.99

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 10

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.5247*005	8.1965*006	2.8047*007	1.0115*009	3.8451*013
6	9.7503*005	3.1655*005	1.0832*006	3.9065*009	1.4850*012
7	7.4474*004	2.4178*004	8.2734*006	2.9838*008	1.1342*011
8	2.4100*002	7.8243*003	2.6773*004	9.6559*007	3.6705*010
INHALED	2.9875*004	9.6990*005	3.3188*006	1.1970*008	4.5500*012

DOWNWIND POSITION, I = 11

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	5.1427*005	1.6696*005	5.7131*007	2.0604*009	7.8324*013
6	1.9862*004	6.4483*005	2.2065*006	7.9579*009	3.0250*012
7	1.5172*003	4.9255*004	1.6854*005	6.0786*008	2.3106*011
8	4.1907*002	1.5939*002	5.4542*004	1.9671*006	7.4774*010
INHALED	5.9841*004	1.9428*004	6.6478*006	2.3976*008	9.1138*012

DOWNWIND POSITION, I = 12

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.0895*004	3.5370*005	1.2103*006	4.3651*009	1.6593*012
6	4.2083*004	1.3662*004	4.6750*006	1.6861*008	6.4092*012
7	3.2146*003	1.0436*003	3.5711*005	1.2879*007	4.8959*011
8	1.1040*001	3.3773*002	1.1557*003	4.1680*006	1.5844*009
INHALED	1.2145*003	3.9430*004	1.3492*005	4.8661*008	1.8497*011

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 13

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.9431*004	1.2801*004	4.3804*006	1.5798*008	6.0053*012
6	1.5234*003	4.9456*004	1.6923*005	6.1034*008	2.3201*011
7	1.1638*002	3.7782*003	1.2928*004	4.6627*007	1.7724*010
8	3.7662*001	1.2227*001	4.1838*003	1.5089*005	5.7358*009
INHALED	4.0661*003	1.3201*003	4.5171*005	1.6291*007	6.1927*011

DOWNWIND POSITION, I = 14

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.6371*004	1.5055*004	5.1514*006	1.8579*008	7.0623*012
6	1.7921*003	5.8180*004	1.9908*005	7.1800*008	2.7293*011
7	1.3693*002	4.4454*003	1.5211*004	5.4861*007	2.0854*010
8	4.1431*001	1.4387*001	4.9228*003	1.7755*005	6.7490*009
INHALED	4.2575*003	1.3822*003	4.7297*005	1.7058*007	6.4842*011

DOWNWIND POSITION, I = 15

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.9795*004	9.6731*005	3.3100*006	1.1938*008	4.5378*012
6	1.1522*003	3.7406*004	1.2800*005	4.6163*008	1.7548*011
7	8.1806*003	2.8589*003	9.7827*005	3.5282*007	1.3412*010
8	2.1850*001	9.2528*002	3.1661*003	1.1419*005	4.3407*009
INHALED	2.3675*003	7.6861*004	2.6300*005	9.4854*008	3.6057*011

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BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 16

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.5233*004	4.9456*005	1.6923*006	6.1033*009	2.3201*012
6	5.8970*004	1.9145*004	6.5509*006	2.3626*008	8.9811*012
7	4.5094*003	1.4640*003	5.0095*005	1.8067*007	6.8678*011
8	1.4596*001	4.7386*002	1.6215*003	5.8479*006	2.2230*009
INHALED	1.0434*003	3.3873*004	1.1591*005	4.1803*008	1.5891*011

DOWNWIND POSITION, I = 17

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	7.6367*005	2.4793*005	8.4836*007	3.0597*009	1.1631*012
6	2.9616*004	9.6149*005	3.2901*006	1.1866*008	4.5105*012
7	2.2668*003	7.3591*004	2.5181*005	9.0818*008	3.4523*011
8	7.3383*002	2.3824*002	8.1521*004	2.9401*006	1.1176*009
INHALED	4.5649*004	1.4820*004	5.0712*006	1.8289*008	6.9524*012

DOWNWIND POSITION, I = 18

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.3289*005	1.4054*005	4.8089*007	1.7344*009	6.5928*013
6	1.6840*004	5.4671*005	1.8707*006	6.7469*009	2.5647*012
7	1.2909*003	4.1908*004	1.434*005	5.1719*008	1.9660*011
8	4.1802*002	1.3571*002	4.6438*004	1.8748*006	6.3665*010
INHALED	2.2611*004	7.3406*005	2.5118*006	9.0590*009	3.4436*012

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 46.11

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BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 19

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.9436*005	9.5566*006	3.2701*007	1.1794*009	4.4831*013
6	1.1510*004	3.7367*005	1.2786*006	4.6115*009	1.7529*012
7	8.8460*004	2.8719*004	9.8270*006	3.5442*008	1.3472*011
8	2.18661*002	9.3049*003	3.1840*004	1.1483*006	4.3651*010
INHALED	1.3208*004	4.2881*005	1.4673*006	5.2919*009	2.0116*012

DOWNWIND POSITION, I = 20

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.2099*005	7.1746*006	2.4550*007	8.8541*010	3.3657*013
6	8.7112*005	2.8281*005	9.6773*007	3.4902*009	1.3267*012
7	6.7238*004	2.1829*004	7.4695*006	2.6939*008	1.6240*011
8	2.11804*002	7.0788*003	2.4222*004	8.7359*007	3.3208*010
INHALED	8.3156*005	2.6997*005	9.2378*007	3.3317*009	1.2665*012

DOWNWIND POSITION, I = 21

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.9652*005	6.3801*006	2.1832*007	7.8737*010	2.9930*013
6	7.18391*005	2.5450*005	8.7084*007	3.1407*009	1.1939*012
7	6.0918*004	1.9777*004	6.7874*006	2.4407*008	9.2778*012
8	1.9783*002	6.4225*003	2.1977*004	7.9260*007	3.0129*010
INHALED	6.1615*005	2.0003*005	6.8448*007	2.4686*009	9.3839*013

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

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G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 1

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.9542=005	1.6084=005	5.5036=007	1.9849=009	7.5453=013
6	8.6460=005	2.8070=005	9.6049=007	3.4641=009	1.3168=012
7	1.2789=004	4.1520=005	1.4207=006	5.1240=009	1.9478=012
8	1.5226=004	4.9430=005	1.6914=006	6.1002=009	2.3188=012
INHALED	2.8271=003	9.1781=004	3.1406=005	1.1327=007	4.3056=011

DOWNWIND POSITION, I = 2

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.2289=005	1.0483=005	3.5870=007	1.2937=009	4.9176=013
6	5.6351=005	1.8294=005	6.2600=007	2.2577=009	8.5822=013
7	8.3353=005	2.7061=005	9.2597=007	3.3396=009	1.2695=012
8	9.9233=005	3.2216=005	1.1024=006	3.9758=009	1.5113=012
INHALED	1.8476=003	5.9982=004	2.0525=005	7.4024=008	2.8139=011

DOWNWIND POSITION, I = 3

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.2655=005	7.3552=006	2.5168=007	9.0770=010	3.4504=013
6	3.9538=005	1.2836=005	4.3923=007	1.5841=009	6.0217=013
7	5.8485=005	1.8987=005	6.4971=007	2.3432=009	8.9022=013
8	6.19627=005	2.2604=005	7.7348=007	2.7896=009	1.0604=012
INHALED	1.2982=003	4.2148=004	1.4422=005	5.2015=008	1.9772=011

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

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G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 4

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.7649*005	5.7299*006	1.9607*007	7.0713*010	2.6880*013
6	3.0802*005	9.9999*006	3.4218*007	1.2341*009	4.6911*013
7	4.5562*005	1.4792*005	5.0615*007	1.8255*009	6.9391*013
8	5.4242*005	1.7610*005	6.0258*007	2.1732*009	8.2611*013
INHALED	1.0081*003	3.2728*004	1.1199*005	4.0389*008	1.5353*011

DOWNWIND POSITION, I = 5

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.6091*005	5.2238*006	1.7875*007	6.4467*010	2.4506*013
6	2.8082*005	9.1168*006	3.1196*007	1.1251*009	4.2768*013
7	4.1538*005	1.3486*005	4.6145*007	1.6642*009	6.3263*013
8	4.9452*005	1.6055*005	5.4936*007	1.9813*009	7.5315*013
INHALED	9.0697*004	2.9445*004	1.0075*005	3.6338*008	1.3813*011

DOWNWIND POSITION, I = 6

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.8387*005	5.9694*006	2.0426*007	7.3668*010	2.8003*013
6	3.2090*005	1.0418*005	3.5649*007	1.2857*009	4.8873*013
7	4.7468*005	1.5411*005	5.2732*007	1.9018*009	7.2294*013
8	5.1651*005	1.8347*005	6.2779*007	2.2641*009	8.6067*013
INHALED	1.0075*003	3.2710*004	1.1193*005	4.0387*008	1.5345*011

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION HLC 12/1/64

Q.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 7

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.7881=005	9.0518=006	3.0974=007	1.1171=009	4.2463=013
6	4.8662=005	1.5798=005	5.4058=007	1.9496=009	7.4112=013
7	7.1982=005	2.3369=005	7.9965=007	2.8840=009	1.0963=012
8	8.5696=005	2.7821=005	9.5200=007	3.4334=009	1.3052=012
INHALED	1.4587=003	4.7356=004	1.6204=005	5.8443=008	2.2216=011

DOWNWIND POSITION, I = 8

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	5.5381=005	1.7980=005	6.1523=007	2.2189=009	8.4346=013
6	9.1662=005	3.1382=005	1.0738=006	3.8728=009	1.4722=012
7	1.4299=004	4.6422=005	1.5885=006	5.7289=009	2.1777=012
8	1.7023=004	5.5267=005	1.8911=006	6.8204=009	2.5926=012
INHALED	2.1709=003	8.7977=004	3.8104=005	1.0857=007	4.1271=011

DOWNWIND POSITION, I = 9

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.2395=004	4.0239=005	1.3769=006	4.9659=009	1.8877=012
6	2.1635=004	7.0238=005	2.4034=006	8.6681=009	3.2950=012
7	3.2005=004	1.0391=004	3.5555=006	1.2823=008	4.8744=012
8	3.8104=004	1.2371=004	4.2330=006	1.5266=008	5.8032=012
INHALED	5.5394=003	1.7984=003	6.1537=005	2.2194=007	8.4365=011

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

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G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 10

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.5630=004	8.3207=005	2.8472=006	1.0269=008	3.9034=012
6	4.4743=004	1.4526=004	4.9705=006	1.7926=008	6.8143=012
7	6.6194=004	2.1490=004	7.3535=006	2.6521=008	1.0081=011
8	7.8809=004	2.5086=004	8.7549=006	3.1575=008	1.2003=011
INHALED	1.0207=002	3.3136=003	1.1339=004	4.0894=007	1.5545=010

DOWNWIND POSITION, I = 11

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	5.2181=004	1.6941=004	5.7967=006	2.0906=008	7.9471=012
6	9.1115=004	2.9581=004	1.8122=005	3.8505=008	1.3877=011
7	1.3481=003	4.3767=004	1.4976=005	5.4013=008	2.0532=011
8	1.6051=003	5.2111=004	1.7831=005	6.4310=008	2.4446=011
INHALED	1.8179=002	5.9020=003	2.8195=004	7.2836=007	2.7687=010

DOWNWIND POSITION, I = 12

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.1045=003	3.5858=004	1.2270=005	4.4253=008	1.6822=011
6	1.9294=003	6.2637=004	2.1433=005	7.7301=008	2.9384=011
7	2.8552=003	9.2696=004	3.1719=005	1.1440=007	4.3485=011
8	3.3998=003	1.1037=003	3.7768=005	1.3621=007	5.1779=011
INHALED	3.3462=002	1.0863=002	3.7173=004	1.3407=006	5.8942=010

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LAUNCH SITE HAZARDS EVALUATION ROUTINE

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 13

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	3.9916=003	1.2959=003	4.4343=005	1.5992=007	6.0792=011
6	6.19771=003	2.2651=003	7.7509=005	2.7954=007	1.0626=010
7	1.0329=002	3.3533=003	1.1474=004	4.1383=007	1.5731=010
8	1.12300=002	3.9933=003	1.3664=004	4.9281=007	1.8733=010
INHALED	1.0408=001	3.3791=002	1.1563=003	4.1701=006	1.5852=009

DOWNWIND POSITION, I = 14

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.6818=003	1.5200=003	5.2010=005	1.8758=007	7.1303=011
6	8.11932=003	2.6599=003	9.1018=005	3.2826=007	1.2478=010
7	1.2137=002	3.9402=003	1.3482=004	4.8625=007	1.8484=010
8	1.4456=002	4.6932=003	1.6059=004	5.7919=007	2.2017=010
INHALED	1.0222=001	3.3187=002	1.1356=003	4.0956=006	1.5569=009

DOWNWIND POSITION, I = 15

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.9942=003	9.7207=004	3.8262=005	1.1996=007	4.5601=011
6	5.2509=003	1.7047=003	5.8332=005	2.1038=007	7.9971=011
7	7.7866=003	2.5279=003	8.6503=005	3.1197=007	1.1859=010
8	9.12784=003	3.0123=003	1.0307=004	3.7174=007	1.4131=010
INHALED	5.2808=002	1.7144=002	5.8644=004	2.1157=006	8.0426=010

NURSE=1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 48.34

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TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 16

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.5183=003	4.9292=004	1.6867=005	6.0831=008	2.3124=011
6	2.6725=003	8.6762=004	2.9688=005	1.0707=007	4.0702=011
7	3.9706=003	1.2891=003	4.4110=005	1.9908=007	6.0473=011
8	4.7346=003	1.5371=003	5.2597=005	1.8989=007	7.2108=011
INHALED	2.1000=002	6.8177=003	2.3329=004	8.4138=007	3.1983=010

DOWNWIND POSITION, I = 17

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	7.5032=004	2.4359=004	8.3353=006	3.0062=008	1.1427=011
6	1.3292=003	4.3154=004	1.4767=005	5.3257=008	2.0244=011
7	1.9815=003	6.4331=004	2.2013=005	7.9390=008	3.0179=011
8	2.3656=003	7.6800=004	2.6280=005	9.4779=008	3.6028=011
INHALED	7.9596=003	2.5841=003	8.8423=005	3.1890=007	1.2122=010

DOWNWIND POSITION, I = 18

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	4.1497=004	1.3472=004	4.6099=006	1.8626=008	6.3200=012
6	7.4341=004	2.4135=004	8.2586=006	2.9785=008	1.1322=011
7	1.1146=003	3.6185=004	1.8382=005	4.4656=008	1.6975=011
8	1.3334=003	4.3288=004	1.4812=005	5.3422=008	2.0307=011
INHALED	3.2909=003	1.0704=003	3.6626=005	1.3209=007	5.0212=011

TNT TEST RERUN CONTROL DATA VERSION MLC 12/1/64

G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,
CROSSWIND POSITION, J AND EXPOSURE TIME, K
DOSE IS IN REMS

DOWNWIND POSITION, I = 19

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	2.7072=004	8.7890=005	3.8074=006	1.0846=008	4.1231=012
6	4.9429=004	1.6047=004	5.4911=006	1.9804=008	7.5281=012
7	7.4829=004	2.4294=004	8.3128=006	2.9981=008	1.1397=011
8	8.9828=004	2.9163=004	9.9790=006	3.9990=008	1.3681=011
INHALED	1.5660=003	5.0841=004	1.7397=005	6.2743=008	2.3850=011

DOWNWIND POSITION, I = 20

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.8998=004	6.1678=005	2.1103=006	7.6117=009	2.8934=012
6	3.5793=004	1.1620=004	3.9782=006	1.4340=008	5.4512=012
7	5.5051=004	1.7873=004	6.1156=006	2.2056=008	8.3843=012
8	6.1646=004	2.1576=004	7.3830=006	2.6627=008	1.0122=011
INHALED	7.1619=004	2.4728=004	8.4616=006	3.0517=008	1.1601=011

DOWNWIND POSITION, I = 21

J	1	2	3	4	5
INGESTED K					
1	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
2	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
3	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
4	0.0000*000	0.0000*000	0.0000*000	0.0000*000	0.0000*000
5	1.5226=004	4.9431=005	1.6914=006	6.1103=009	2.3189=012
6	3.0130=004	9.7818=005	3.5471=006	1.2072=008	4.5888=012
7	4.7500=004	1.5421=004	5.2787=006	1.9031=008	7.2342=012
8	5.7847=004	1.8780=004	6.4262=006	2.3177=008	8.8101=012
INHALED	5.8656=004	1.2550=004	4.2943=006	1.5488=008	5.8873=012

NURSE=I
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 38 49.00

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TNT TEST RERUN CONTROL DATA VERSION HLC 12/1/64

LUNG DOSE AS A FUNCTION OF DOWNWIND POSITION, I
AND CROSSWIND POSITION, J
TIME OF EXPOSURE = TIME OF CLOUD PASSAGE

DOSE IS IN REMS

J	1	2	3	4	5
1	2.0318=004	6.5963=005	2.2571=006	8.1405=009	3.0944=012
2	1.3288=004	4.3140=005	1.4762=006	5.3239=009	2.0238=012
3	9.3491=005	3.0352=005	1.0386=006	3.7458=009	1.4239=012
4	7.2766=005	2.3624=005	8.0836=007	2.9154=009	1.1082=012
5	6.5734=005	2.1341=005	7.3024=007	2.6337=009	1.0011=012
6	7.3501=005	2.3862=005	8.1652=007	2.9448=009	1.1194=012
7	1.0742=004	3.4874=005	1.1933=006	4.3037=009	1.6360=012
8	2.0212=004	6.5620=005	2.2454=006	8.0981=009	3.0783=012
9	4.2042=004	1.3649=004	4.6704=006	1.6844=008	6.4030=012
10	7.9337=004	2.5757=004	8.8135=006	3.1787=008	1.2083=011
11	1.4575=003	4.7319=004	1.6192=005	5.8396=008	2.2198=011
12	2.7807=003	9.0277=004	3.0891=005	1.1141=007	4.2350=011
13	9.0088=003	2.9247=003	1.0008=004	3.6094=007	1.3720=010
14	9.2961=003	3.0180=003	1.0327=004	3.7245=007	1.4158=010
15	5.1151=003	1.6606=003	5.6824=005	2.0494=007	7.7903=011
16	2.2037=003	7.1544=004	2.4481=005	8.8292=008	3.3562=011
17	9.2410=004	3.0001=004	1.0266=005	3.7024=008	1.4074=011
18	4.3642=004	1.4168=004	4.8481=006	1.7485=008	6.6466=012
19	2.4662=004	8.0065=005	2.7397=006	9.8808=009	3.7560=012
20	1.5270=004	4.9575=005	1.6964=006	6.1180=009	2.3256=012
21	1.1091=004	3.6008=005	1.2321=006	4.4437=009	1.6892=012

NURSE=I
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 30 54.97

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TNT TEST RERUN CONTROL DATA VERSION HLC 12/1/64

EXTERNAL GAMMA CLOUD DOSE AS A FUNCTION OF DOWNWIND POSITION, I
AND CROSSWIND POSITION, J

DOSE IS IN RADS

J	1	2	3	4	5
1					
1	1.110*002	5.953*001	2.927*001	1.607*001	9.725*000
2	7.580*001	4.383*001	2.256*001	1.261*001	7.654*000
3	5.217*001	3.217*001	1.734*001	9.875*000	6.025*000
4	3.633*001	2.387*001	1.341*001	7.749*000	4.718*000
5	2.339*001	1.614*001	9.369*000	5.448*000	3.287*000
6	1.765*001	1.243*001	7.318*000	4.220*000	2.487*000
7	1.133*001	7.763*000	4.448*000	2.474*000	1.392*000
8	6.240*000	3.900*000	2.025*000	1.023*000	5.220*001
9	2.344*000	1.242*000	5.406*001	2.298*001	9.871*002
10	3.008*001	1.284*001	4.385*002	1.468*002	5.168*003
11	1.796*002	8.634*003	5.026*003	2.287*003	1.711*003
12	1.242*001	6.698*003	6.259*004	1.256*004	2.743*005
13	1.443*001	8.224*004	1.450*005	2.848*007	4.353*009
14	1.265*001	5.748*005	3.565*007	1.329*009	1.532*012
15	6.155*002	4.928*006	3.013*009	4.897*013	9.740*018
16	1.953*002	1.852*007	1.676*012	1.693*018	5.503*026
17	8.300*003	1.224*009	1.744*017	6.676*027	1.147*038
18	1.681*003	8.708*024	0.000*000	0.000*000	0.000*000
19	4.023*004	4.517*033	0.000*000	0.000*000	0.000*000
20	9.144*005	0.000*000	0.000*000	0.000*000	0.000*000
21	1.894*005	0.000*000	0.000*000	0.000*000	0.000*000

NURSE-1
LAUNCH SITE HAZARDS EVALUATION ROUTINE

TIME 0 43.17,47

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TNT TEST RERUN

CONTROL DATA VERSION

MLC 12/1/64

*****END OF OUTPUT*****

APPENDIX C
PROGRAM LISTING

```

PROGRAM MAIN
RANK(0),MAIN,/AA1/,/AA2/,ERROR,OTND,CLCTM,PAGE,FEXP
RANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
DATA (FACT=1.0,2.0,3.0,4.0,5.0,6.0,7.0,8.0,9.0,10.0,11.0,12.0,13.0
1 14.0,15.0,16.0,17.0,18.0,19.0,20.0)
COMMON /AA2/ AA2
DIMENSION AA2(7500)
COMMON /AA3/ AA3
DIMENSION AA3(32200)
9 FORMAT(/*TO RESTART THIS PROGRAM DO THE FOLLOWING*/ * REMOVE OU
1 INPUT TAPE (LOGICAL 61) AND PRINT*/ * MOUNT NEW OUTPUT TAPE*/ *
2 REMOUNT ALL OTHER TAPES*/ * PREVENT SCOPE FROM WRITING NEW LA
3 REL ON ANY BUT OUTPUT TAPE*/ * USE SENSE SWITCH SETTING AS GIVE
4N BELOW*/ * USE NORMAL STARTING PROCEDURE*/)
10 FORMAT(/*TO TERMINATE AT ANY POINT*/ * DEPRESS SENSE SWITCH 6*/ * TH
1 FOLLOWING TAPES ARE NEEDED*/ * NURSE PROGRAM TAPE (LOGICAL 10
2)*/ * NURSE LIBRARY TAPE (LOGICAL 9)*/ * 4 SC
3 RATCH TAPES (LOGICAL 1,2,3 AND 4)*/ * INPUT IS LOGICAL 60*/ * OUTPUT
4 IS LOGICAL 61*/ * IF ALL UNITS READY*/ * PRESS --GO--*/)
11 FORMAT(/*IF PROGRAM STOPS DUE TO MACHINE OR TAPE ERROR*/ * ATTEMPT R
1 RESTART AS PER INSTRUCTIONS*/)
DO 2 I=3,20
2 FACT(I)=FACT(I)*FACT(I-1)
READ INPUT TAPE 60,150,(ICHN(I),I=1,4),(ALPHA(J),J=1,8)
150 FORMAT(A12,2X,7A8,A4)
IF(EOF,60)901,105
105 IF(IOCHECK,60)902,306
306 TMS=TIMEF(A1)
IPAGE=-1
CALL PAGE
1 PI=3.14159265
WRITE OUTPUT TAPE 20,9
WRITE OUTPUT TAPE 20,11
WRITE OUTPUT TAPE 20,10
PAUSE
REWIND 9
REWIND 1
REWIND 2
REWIND 3
REWIND 4
IPAGE=0$KCHK=0
ASSIGN 104 TO M
101 IF(KCHK-10**6)102,904,904
102 IF(UNIT,9)225,103,900,900
225 KCHK=KCHK+1
GO TO 101
103 GO TO M,(104,110)
104 BUFFER IN (9,1) (I12,I21)
KCHK=0
106 ASSIGN 110 TO M
GO TO 101
110 REWIND 9
IF(SENSE SWITCH 2)120,111
111 IF(SENSE SWITCH 3)120,112

```

112 IF(SENSE SWITCH 4)120,113
113 IF(SENSE SWITCH 5)125,114
114 CALL OVERLAY(1, ,10,)
 IF(ICHN(1)+ICHN(2)+ICHN(3))205,205,201
201 CALL OVERLAY (2, ,10,)
120 CALL OVERLAY(3, ,10,)
205 IF(ICHN(4))210,210,125
125 CALL OVERLAY(4, ,10,)
210 CALL TERMIN
900 CALL ERROR(1,9)
901 CALL ERROR(2,60)
902 CALL ERROR(3,60)
904 CALL ERROR(4,9)
 END

SUBROUTINE OTND

```

1  FORMAT(1H1)
2  FORMAT(1H0,40X,384***THIS CASE TERMINATED BY OPERATOR***///)
3  FORMAT(1H0,48X,234*****END OF OUTPUT*****//)
10 FORMAT(//*THIS CASE TERMINATED BY OPERATOR*)
11 FORMAT(                                     /*IF RESTART DESIRED -
    LOGICAL TAPES 1,2,3, AND 4 SHOULD BE SAVED*//*IF NOT THEY MAY BE RE
    LEASED*//*RESTART INSTRUCTIONS GIVEN ABOVE*)
12 FORMAT(//*NURSE LIBRARY TAPE (LOGICAL 9) SHOULD BE SAVED*//*NURSE PR
    OGRAM TAPE (LOGICAL 10) SHOULD BE SAVED*//*OUTPUT IS LOGICAL 61*)
13 FORMAT(//*ALL OTHER TAPES MAY BE RELEASED*//)
    WRITE OUTPUT TAPE 20,10
    WRITE OUTPUT TAPE 61,2
    ENTRY EROUT
    WRITE OUTPUT TAPE 20,11
    WRITE OUTPUT TAPE 20,12
    GO TO 100
    ENTRY TERMIN
    WRITE OUTPUT TAPE 20,12
    WRITE OUTPUT TAPE 20,13
100 CALL PAGE
    WRITE OUTPUT TAPE 61,3
    WRITE OUTPUT TAPE 61,1
    REWIND 1
    REWIND 2
    REWIND 3
    REWIND 4
    REWIND 9
    REWIND 10
    STOP
    END

```

SUBROUTINE CLCTM(X,I1,I2,X3)

C TIME CALCULATION ROUTINE

X=X*1.0E-3

IF(X-3600.0)20,10,10

10 X1=INTF(X/3600.0)

X=X-X1*3600.0

GO TO 21

20 X1=0.0

21 I1=X1+0.01

IF(X-60.0)30,22,22

22 X2=INTF(X/60.0)

X=X-X2*60.0

GO TO 31

30 X2=0.0

31 I2=X2+0.01

X3=X

RETURN

END

SUBROUTINE PAGE

PAGE 010

PAGE CHANGING SUBROUTINE

PAGE 020

BANK(0),MAIN,/AA1/,/AA2/,ERROR,OTND,CLCTM,PAGE,FEXP

BANK(1),/AA3/

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ AA2

DIMENSION AA2(7500)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

100 FORMAT(1H1)

PAGE 050

101 FORMAT(1H0)

PAGE 060

102 FORMAT(1H,56X*NURSE-I*15X*TIME *I2,1X,I2,1X,F5.2,12X*PAGE *I3/41X

1*LAUNCH SITE HAZARDS EVALUATION ROUTINE*)

103 FORMAT(1H0,29X,7A8,A4)

IPAGE=IPAGE+1

PAGE 100

A1=TIMEF(A2)-TMS

CALL CLCTM (A1,I1,I2,A2)

WRITE OUTPUT TAPE61,100

WRITE OUTPUT TAPE 61,102,I1,I2,A2,IPAGE

WRITE OUTPUT TAPE61,103,(ALPHA(I),I=1,8)

WRITE OUTPUT TAPE61,101

RETURN

PAGE 160

END

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```
FUNCTION FEXP(X1)
  IF(X1)1,3,4
1  IF(X1+700.0)2,2,10
2  FEXP=0.0
   GO TO 20
3  FEXP=1.0
   GO TO 20
4  IF(X1-700.0)10,5,5
5  FEXP=1.0E300
   GO TO 20
10 FEXP=EXP(X1)
20 RETURN
END
```

SIRROLTIME ERROR (I1,J1)

1 FORMAT(///5H*****//)

2 FORMAT(/*EOF OR PARITY ERROR ENCOUNTERED WHILE */*ATTEMPTING BINAR
1Y RUFFER IN FROM TAPE *I2 /*ATTEMPT RESTART - INSTRUCTIONS ABOVE*)

3 FORMAT(/*EOF ENCOUNTERED WHILE ATTEMPTING BCD */*READ FROM TAPE *I
12/*DO NOT ATTEMPT RESTART*)

4 FORMAT(/*PARITY ERROR ENCOUNTERED WHILE ATTEMPTING */*BCD READ FRO
1M TAPE *I2/*ATTEMPT RESTART - INSTRUCTIONS ABOVE*/)

5 FORMAT(/*UNABLE TO READY TAPE *I2*FOR RUFFER IN*/ *ATTEMPT RESTART
1 - INSTRUCTIONS ABOVE*/)

6 FORMAT(/*UNABLE TO READY TAPE *I2*FOR RUFFER OUT*/*ATTEMPT RESTART
1 - INSTRUCTIONS ABOVE*/)

12 FORMAT(1H0,44X*EOF OR PARITY ERROR ON TAPE *I2///)

13 FORMAT(1H0,46X*UNABLE TO READ FROM TAPE &I2///)

14 FORMAT(1H0,46X*UNABLE TO WRITE ON TAPE &I2///)

CALL PAGE

IF(I1-4)20,21,22

20 WRITE OUTPUT TAPE 61,12,J1

GO TO 23

21 WRITE OUTPUT TAPE 61,13,J1

GO TO 23

22 WRITE OUTPUT TAPE 61,14,J1

23 I2=I1+1

WRITE OUTPUT TAPE 20,1

GO TO(101,102,103,104,105,105,105,105),I1

101 WRITE OUTPUT TAPE 20,2,J1

GO TO 24

102 WRITE OUTPUT TAPE 20,3,J1

GO TO 24

103 WRITE OUTPUT TAPE 20,4,J1

GO TO 24

104 WRITE OUTPUT TAPE 20,5,J1

GO TO 24

105 WRITE OUTPUT TAPE 20,6,J1

24 CONTINUE

WRITE OUTPUT TAPE 20,1

CALL FROUT

RETURN

END

10/19/64

```

PROGRAM CHAIN1
RANK(0),CHAIN1,/AA1/,/AA2/,READ1,XANDY,DIFF,INTZ,FLOUT,XQW,SLFAB,
1      OUT1
RANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ OT1,PUT1,KL,E0,LCHN2,RY,H,UBR,VOL,WH,UBRI,CHEM,SKIP,
1      EQV,RMAX,AA2
COMMON /AA3/ AA3
DIMENSION SKIP(2),AA2(3874)
DIMENSION AA3(32200)
DIMENSION OT1(3300)
DIMENSION      VG(      6,21),      CY(      3, 2),      CZ(      3, 2),
1      SIGY(      21),      SIGZ(      34),      ASGZ(      21),
2      X(      21),      YX(      5,21),      AREA(      21, 5),
3      RED(      9,21),      T1(      8),      T2(      21),
4      T3(      21),      FRAC(      9),      SIZE(      9),
5      PRYS(      21),      FALN(21, 5, 9),      OMEGA(21, 5, 6),
6      FALL(      21, 5),      XI(21, 5, 6),      QOVRQ(      6,21),
7      FN(      21)
EQUIVALENCE (OT1( 1),ZZ      ),(OT1( 2),VG(1)      ),
1      (OT1(128),TENG      ),(OT1(129),RISE      ),
2      (OT1(130),TAU      ),(OT1(131),XBAR      ),
3      (OT1(132),TBAR      ),(OT1(133),HMAX      ),
4      (OT1(134),UMAX      ),(OT1(135),URAR      ),
5      (OT1(136),XCON      ),(OT1(137),TCON      ),
6      (OT1(138),RH      ),(OT1(139),SIGY(1)      ),
7      (OT1(160),SIG7(1)      ),(OT1(191),ASGZ(1)      ),
8      (OT1(212),HMX      ),(OT1(213),TBRH      ),
9      (OT1(214),XRRH      ),(OT1(215),CY(1)      ),
1      (OT1(221),CZ(1)      ),(OT1(227),Y1      ),
2      (OT1(228),Y2      ),(OT1(229),Y3      ),
3      (OT1(230),Y4      ),(OT1(231),YY      ),
4      (OT1(232),DEN      ),(OT1(233),FGAS      ),
5      (OT1(234),FPAR      ),(OT1(235),ROP      ),
6      (OT1(236),X(1)      ),(OT1(257),YX(1)      ),
7      (OT1(362),AREA(1)      ),(OT1(467),RED(1)      ),
8      (OT1(656),ENUC      ),(OT1(657),FIS      ),
9      (OT1(658),SEC      ),(OT1(659),T1(1)      ),
1      (OT1(667),T2(1)      ),(OT1(688),T3(1)      ),
2      (OT1(709),FRAC(1)      ),(OT1(718),SIZE(1)      ),
3      (OT1(727),PRYS(1)      ),(OT1(748),FALN(1)      ),
4      (OT1(1693),OMEGA(1)      ),(OT1(2323),FALL(1)      ),
5      (OT1(2428),XI(1)      ),(OT1(3058),QOVRQ(1)      ),
6      (OT1(3184),FN(1)      )
DIMENSION PUT1(      160),      AYZ(      8, 3, 4),      GAM(      9),
1      VO(      9),      RMX(      9),      ALFA(      7),
2      BLFA(      7),      CLFA(      7),      DLFA(      8),
3E0(9),RY(21,5),H(21),UBR(21)
EQUIVALENCE (PUT1( 1),AYZ(1)      ),(PUT1( 97),GAM(1)      ),
1      (PUT1(106),VO(1)      ),(PUT1(115),RMX(1)      ),
2      (PUT1(124),ALFA(1)      ),(PUT1(131),BLFA(1)      ),
3      (PUT1(138),CLFA(1)      ),(PUT1(145),DLFA(1)      )
10 FORMAT(/*FROM THIS POINT ALL SENSE SWITCHES UP FOR RESTART*/)
WRITE OUTPUT TAPE 20,10
LCHN2=1

```

```

SENSE LIGHT 0
SENSE LIGHT 1
REWIND 1
REWIND 9
ASSIGN 100 TO M
KCHK=0
200 IF(UNIT,9)201,202,900,900
201 KCHK=KCHK+1
    IF(KCHK-10**6)200,901,901
202 GO TO M,(100,101,102,103,300)
100 BUFFER IN(9,1) (SKIP(1),SKIP(2))
    KCHK=0$ASSIGN 101 TO M
    GO TO 200
101 BUFFER IN (9,1) (VG(1,21),VG(6,21))
    KCHK=0$ASSIGN 102 TO M
    GO TO 200
102 BUFFER IN (9,1) (PUT1(1),PUT1(152))
    KCHK=0$ASSIGN 103 TO M
    GO TO 200
103 BUFFER IN (9,1) (EO(1),EO(9))
    KCHK=0$ASSIGN 300 TO M
    GO TO 200
300 CALL READ1
    CALL XANDY
    CALL FLOUT
    CALL XQW
    CALL SLFAB
    CALL OUT1
    IF(SENSE SWITCH 6)1001,1002
1001 CALL OTND
1002 CONTINUE
    REWIND 1
    REWIND 9
    RETURN
900 CALL ERROR (1,9)
901 CALL ERROR (4,9)
END

```

SUBROUTINE READ1

C

INPUT READING SUBROUTINE

BANK(0),CHAIN1,AA1,AA2,READ1,XANDY,DIFF,INT4,FLOUT,XQW,SLFAB,

1 OUT1

BANK(1),AA3/

COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ OT1,PUT1,KL,EO,LCHN2,BY,H,UBR,VOL,WH,UBR1,CHEM,SKIP,

1 EQV,RMAX,AA2

DIMENSION SKIP(2),AA2(3874)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

DIMENSION OT1(3300)

DIMENSION	VG(	6,21),	CY(	3, 2),	CZ(	3, 2),
1	SIGY(	21),	SIGZ(	31),	ASGZ(	21),
2	X(	21),	YX(	5,21),	AREA(	21, 5),
3	RED(	9,21),	T1(	8),	T2(	21),
4	T3(	21),	FRAC(	9),	SIZE(	9),
5	PRTS(	21),	FALN(	21, 5, 9),	OMEGA(	21, 5, 6),
6	FALL(	21, 5),	XI(	21, 5, 6),	QOVRQ(	6,21),
7	FN(	21)				

EQUIVALENCE	(OT1(	1),ZZ	),(OT1(	2),VG(1)	),
1	(OT1(	128),TENG	),(OT1(	129),RISE	),
2	(OT1(	130),TAU	),(OT1(	131),XBAR	),
3	(OT1(	132),TBAR	),(OT1(	133),HMAX	),
4	(OT1(	134),UMAX	),(OT1(	135),UBAR	),
5	(OT1(	136),XCON	),(OT1(	137),TCON	),
6	(OT1(	138),RH	),(OT1(	139),SIGY(1)	),
7	(OT1(	160),SIGZ(1)	),(OT1(	191),ASGZ(1)	),
8	(OT1(	212),HMX	),(OT1(	213),TBRH	),
9	(OT1(	214),XBRH	),(OT1(	215),CY(1)	),
1	(OT1(	221),CZ(1)	),(OT1(	227),Y1	),
2	(OT1(	228),Y2	),(OT1(	229),Y3	),
3	(OT1(	230),Y4	),(OT1(	231),YY	),
4	(OT1(	232),DEN	),(OT1(	233),FGAS	),
5	(OT1(	234),FPAR	),(OT1(	235),ROP	),
6	(OT1(	236),X(1)	),(OT1(	257),YX(1)	),
7	(OT1(	362),AREA(1)	),(OT1(	467),RED(1)	),
8	(OT1(	656),ENUC	),(OT1(	657),FIS	),
9	(OT1(	658),SEC	),(OT1(	659),T1(1)	),
1	(OT1(	667),T2(1)	),(OT1(	688),T3(1)	),
2	(OT1(	709),FRAC(1)	),(OT1(	718),SIZE(1)	),
3	(OT1(	727),PRTS(1)	),(OT1(	748),FALN(1)	),
4	(OT1(	1693),OMEGA(1)	),(OT1(	2323),FALL(1)	),
5	(OT1(	2428),XI(1)	),(OT1(	3058),QOVRQ(1)	),
6	(OT1(	3184),FN(1)	)		

DIMENSION	PUT1(	160),	AYZ(	8, 3, 4),	GAM(	9),
1	VO(	9),	RMX(	9),	ALFA(	7),
2	BLFA(	7),	CLFA(	7),	DLFA(	8),

3EO(9),BY(21,5),H(21),UBR(21)

EQUIVALENCE	(PUT1(	1),AYZ(1)	),(PUT1(	97),GAM(1)	),
1	(PUT1(	106),VO(1)	),(PUT1(	115),RMX(1)	),
2	(PUT1(	124),ALFA(1)	),(PUT1(	131),BLFA(1)	),
3	(PUT1(	138),CLFA(1)	),(PUT1(	145),DLFA(1)	)

101 FORMAT(I2,F8,6E10)

102 FORMAT(I3,7X,6E10)


```

1001 FORMAT(13,4X,13,6E10)
1002 FORMAT(1H0,40X,32H***INPUT ERROR - PROGRAM STOP***////////)
1003 FORMAT(1H0,40X,47HGASEOUS AND PARTICULATE RELEASE FRACTIONS = 0,0)
1004 FORMAT(1H0,40X,19HNO CHAINS REQUESTED)
1005 FORMAT(1H0,40X,34HSTABILITY CLASS INDEX OUT OF RANGE)
1006 FORMAT(1H0,40X,32HMEAN WIND SPEED ZERO OR NEGATIVE)
1007 FORMAT(1H0,40X* NUCLEAR ENRGY + PRODUCTION TERM ZERO OR NEGATIVE*
1)
1008 FORMAT(1H0,40X,32H CORE VOLUME ZERO OR NEGATIVE)
1009 FORMAT(1H0,40X,32H CORE DENSITY ZERO OR NEGATIVE)
1010 FORMAT(1H0,40X,32H CAPPING HEIGHT ZERO OR NEGATIVE)
1011 FORMAT(1H0,40X,32H WIND HEIGHT ZERO OR NEGATIVE)
IER=0
DO1101 K=1,6
DO 1101 J=1,20
1101 VG(K,J)=-1.0
READ INPUT TAPE60,101,KL,UBRI,WH,RH,HMX,RMAX,SEC,FIS
IF(EOF,60)900,950
950 IF(IOCHECK,60)901,960
960 CONTINUE
READ INPUT TAPE60,102,J1,ENUC,CHEM,VOL,DEN,FGAS,FPAR
IF(EOF,60)900,951
951 IF(IOCHECK,60)901,961
961 CONTINUE
IF(FGAS)301,301,302
301 IF(FPAR)305,305,303
302 IF(FPAR)304,304,300
303 ICHN(4)=0
GO TO 300
304 ICHN(1)=0
GO TO 300
305 WRITE OUTPUT TAPE61,1003
IER=IER+1
300 DO 306 I=1,4
IF(ICHN(I))306,306,307
306 CONTINUE
WRITE OUTPUT TAPE61,1004
IER=IER+1
307 IF(KL)309,309,308
308 IF(KL-8)310,310,309
309 WRITE OUTPUT TAPE61,1005
IER=IER+1
310 IF(UBRI)311,311,312
311 WRITE OUTPUT TAPE61,1006
IER=IER+1
312 IF(ENUC+SEC*FIS)313,313,314
313 WRITE OUTPUT TAPE61,1007
IER=IER+1
314 IF(VOL)315,315,316
315 WRITE OUTPUT TAPE61,1008
IER=IER+1
316 IF(DEN)317,317,318
317 WRITE OUTPUT TAPE61,1009
IER=IER+1
318 IF(HMX)319,319,320
319 WRITE OUTPUT TAPE61,1010

```

```

IER=IER+1
320 IF(WH)321,321,322
321 WRITE OUTPUT TAPE61,1011
IER=IER+1
322 IF(IER)323,323,400
400 WRITE OUTPUT TAPE61,1002
CALL TERMIN
323 CONTINUE
RMAX=RMAX*(10.0**(-4))
204 IF(J1-999)205,500,500
205 READ INPUT TAPE60,1001,K1,J,(VG(K,J),K=1,6)
IF(EOF,60)500,952
952 IF(IOCHECK,60)901,962
962 CONTINUE
IF(K1-999)205,500,500
500 DO 104 K=1,6
DO 104 J=1,20
K1=21-J
IF(VG(K,K1))105,104,104
105 VG(K,K1)=VG(K,K1+1)
104 CONTINUE
RETURN
900 CALL ERROR(2,60)
901 CALL ERROR(3,60)
END

```

1110
1120
1130

SUBROUTINE XANDY

SUBROUTINE TO CALCULATE X AND Y OF X

BANK(0),CHAIN1,/AA1/,/AA2/,READ1,XANDY,DIFF,INTZ,FLOUT,XQW,SLFAB,

0010
0020

1 OUT1

BANK(1),/AA3/

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ OT1,PUT1,KL,E0,LCWN2,BY,H,UBR,VOL,WH,UBRI,CHEM,SKIP,

1 EQV,RMAX,AA2

DIMENSION SKIP(2),AA2(3874)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

DIMENSION OT1(3300)

DIMENSION VG(6,21), CY(3, 2), CZ(3, 2),

1 SIGY(21), SIGZ(31), ASGZ(21),

2 X(21), YX(5,21), AREA(21, 5),

3 RED(9,21), T1(8), T2(21),

4 T3(21), FRAC(9), SIZE(9),

5 PRTS(21), FALN(21, 5, 9), OMEGA(21, 5, 6),

6 FALL(21, 5), XI(21, 5, 6), QOVRQ(6,21),

7 FN(21)

EQUIVALENCE (OT1(1),ZZ), (OT1(2),VG(1)),

1 (OT1(128),TENG), (OT1(129),RISE),

2 (OT1(130),TAU), (OT1(131),XBAR),

3 (OT1(132),TBAR), (OT1(133),HMAX),

4 (OT1(134),UMAX), (OT1(135),UBAR),

5 (OT1(136),XCON), (OT1(137),TCON),

6 (OT1(138),RH), (OT1(139),SIGY(1)),

7 (OT1(160),SIGZ(1)), (OT1(191),ASGZ(1)),

8 (OT1(212),HMX), (OT1(213),TBRH),

9 (OT1(214),XBRH), (OT1(215),CY(1)),

2 (OT1(228),Y2), (OT1(229),Y3),

3 (OT1(230),Y4), (OT1(231),YY),

4 (OT1(232),DEN), (OT1(233),FGAS),

5 (OT1(234),FPAR), (OT1(235),ROP),

6 (OT1(236),X(1)), (OT1(257),YX(1)),

7 (OT1(362),AREA(1)), (OT1(467),RED(1)),

8 (OT1(656),ENUC), (OT1(657),FIS),

9 (OT1(658),SEC), (OT1(659),T1(1)),

1 (OT1(667),T2(1)), (OT1(688),T3(1)),

2 (OT1(709),FRAC(1)), (OT1(718),SIZE(1)),

3 (OT1(727),PRTS(1)), (OT1(748),FALN(1)),

4 (OT1(1693),OMEGA(1)), (OT1(2323),FALL(1)),

5 (OT1(2428),XI(1)), (OT1(3058),QOVRQ(1)),

6 (OT1(3184),FN(1))

DIMENSION PUT1(160), AYZ(8, 3, 4), GAM(9),

1 VO(9), RMX(9), ALFA(7),

2 BLFA(7), CLFA(7), DLFA(8),

3E0(9),BY(21,5),H(21),UBR(21)

EQUIVALENCE (PUT1(1),AYZ(1)), (PUT1(97),GAM(1)),

1 (PUT1(106),VO(1)), (PUT1(115),RMX(1)),

2 (PUT1(124),ALFA(1)), (PUT1(131),BLFA(1)),

3 (PUT1(138),CLFA(1)), (PUT1(145),DLFA(1))

DIMENSION A(4)

A(4)=10.0

A(2)=SQRTF(10.0)

1040

1050

A(1)=SQRTF(A(2))	1060
A(3)=A(1)*A(2)	1070
X(1)=10.0	
DO 102 I=1,17,4	
DO 102 J=1,4	1090
K=J+1	1101
102 X(K)=X(I)*A(J)	1102
CALL DIFF	
DO 103 I=1,21	
YX(1,I)=0.0	1130
YX(2,I)=1.50*SIGY(I)	
YX(3,I)=3.00*SIGY(I)	
YX(4,I)=4.50*SIGY(I)	
103 YX(5,I)=6.00*SIGY(I)	
DO 104 I=1,21	
RY(I,1)=0.75*SIGY(I)	
RY(I,2)=2.25*SIGY(I)	
RY(I,3)=3.75*SIGY(I)	
RY(I,4)=5.25*SIGY(I)	
104 RY(I,5)=6.75*SIGY(I)	
DO 121 K=1,5	
DO 120 J=2,20	
20 AREA(J,K)=1.50*SIGY(J)*(X(J+1)-X(J-1))/2.0	
J=1	
AREA(J,K)=1.50*SIGY(J)*(X(J+1)+X(J))/2.0	
J=21	
21 AREA(21,K)=1.50*SIGY(J)*(X(21)-X(20))	
T1(1)=3.6*10.0**3	
T1(2)=7.2*10.0**3	
T1(3)=2.88*10.0**4	
T1(4)=8.64*10.0**4	
T1(5)=6.048*10.0**5	
T1(6)=2.62855*10.0**6	
T1(7)=3.15426*10.0**7	
T1(8)=3.15426*10.0**9	
RETURN	1230
END	1240

SUBROUTINE DIFF

C SUBROUTINE TO CALCULATE DIFFUSION COEFFICIENTS

RANK(0),CHAIN1, /AA1/, /AA2/, READ1, XANDY, DIFF, INT4, FLOUT, XQW, SLFAB,

1 OUT1

RANK(1), /AA3/

COMMON /AA1/ ICHN, IPAGE, ALPHA, I12, IMAX, I21, FACT, P1, TMS

DIMENSION ICHN(4), ALPHA(8), FACT(20)

COMMON /AA2/ OT1, PUT1, KL, ED, LCHN2, RY, H, UBR, VOL, WH, UBR1, CHEM, SKIP,

1 EQV, RMAX, AA2

DIMENSION SKIP(2), AA2(3874)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

DIMENSION OT1(3300)

DIMENSION VG(6, 21), CY(3, 2), CZ(3, 2),

1 SIGY(21), SIGZ(31), ASGZ(21),

2 X(21), YX(5, 21), AREA(21, 5),

3 RED(9, 21), T1(8), T2(21),

4 T3(21), FRAC(9), SIZE(9),

5 PRIS(21), FALN(21, 5, 9), OMEGA(21, 5, 6),

6 FALL(21, 5), XI(21, 5, 6), QOVRQ(6, 21),

7 FN(21)

EQUIVALENCE (OT1(1), ZZ), (OT1(2), VG(1)),

1 (OT1(128), TENG), (OT1(129), RISE),

2 (OT1(130), TAU), (OT1(131), XBRAR),

3 (OT1(132), TBAR), (OT1(133), HMAX),

4 (OT1(134), UMAX), (OT1(135), UBAR),

5 (OT1(136), XCON), (OT1(137), TCON),

6 (OT1(138), RH), (OT1(139), SIGY(1)),

7 (OT1(160), SIGZ(1)), (OT1(191), ASGZ(1)),

8 (OT1(212), HMX), (OT1(213), TBRH),

9 (OT1(214), XBRH), (OT1(215), CY(1)),

1 (OT1(221), CZ(1)), (OT1(227), Y1),

2 (OT1(228), Y2), (OT1(229), Y3),

3 (OT1(230), Y4), (OT1(231), YY),

4 (OT1(232), DEN), (OT1(233), FGAS),

5 (OT1(234), FPAR), (OT1(235), ROP),

6 (OT1(236), X(1)), (OT1(257), YX(1)),

7 (OT1(362), AREA(1)), (OT1(467), RED(1)),

8 (OT1(656), ENUC), (OT1(657), FIS),

9 (OT1(658), SEC), (OT1(659), T1(1)),

1 (OT1(667), T2(1)), (OT1(688), T3(1)),

2 (OT1(709), FRAC(1)), (OT1(718), SIZE(1)),

3 (OT1(727), PRIS(1)), (OT1(748), FALN(1)),

4 (OT1(1693), OMEGA(1)), (OT1(2323), FALL(1)),

5 (OT1(2428), XI(1)), (OT1(3058), QOVRQ(1)),

6 (OT1(3184), FN(1))

DIMENSION PUT1(160), AYZ(8, 3, 4), GAM(9),

1 VO(9), RMX(9), ALFA(7),

2 BLFA(7), CLFA(7), DLFA(8),

3 RD(9), RY(21, 5), H(21), UBR(21)

EQUIVALENCE (PUT1(1), AYZ(1)), (PUT1(97), GAM(1)),

1 (PUT1(106), VO(1)), (PUT1(115), RMX(1)),

2 (PUT1(124), ALFA(1)), (PUT1(131), BLFA(1)),

3 (PUT1(138), CLFA(1)), (PUT1(145), DLFA(1))

DIMENSION H9(7)

LOG10F(X)=LOGF(X)/2.3

```

DO 51 I=1,3
51 CY(I,1)=AYZ(KL,I,1)
DO 52 I=1,3
52 CY(I,2)=AYZ(KL,I,2)
DO 53 I=1,3
53 CZ(I,1)=AYZ(KL,I,3)
DO 54 I=1,3
54 CZ(I,2)=AYZ(KL,I,4)
IF(ENUC)69,69,60
69 ENUC=EQV=ROP=0.0
IF(FPAR)70,67,67
70 ROP=1.0$FPAR=0.0$ICHN(1)=0
GO TO 67
60 IF(ENUC-(8.5*(10.0**20)))63,62,62
62 EQV=ENUC/(1.30*(10.0**23))
GO TO 64
63 C1=LOG10F(ENUC)
C1=C1-20.0
C1=C1*1.82
C1=C1-2.0
C1=10.0**C1
EQV=C1*ENUC/(0.65*(10.0**23))
IF(FPAR)61,64,64
61 ROP=1.0
FPAR=0.0
ICHN(1)=0
GO TO 67
64 CONTINUE
C1=EQV*4.54*3.8*(10.0**7)/2.93
C2=VOL*DEN
IF(C2-C1)65,65,66
65 ROP=1.0
IF(ICHN(1))67,67,68
68 ICHN(1)=0
LCHN2=2
GO TO 67
66 ROP=C1/C2
67 UBAR=CBRI*(1.0/WH)**0.2
TENG=EQV+CHEM
IF(TENG)72,72,73
73 IF(CHEM)72,74,74
72 CHEM=EQV=TENG=RISE=TAU=TBRH=0.0
TBAR=XBRH=XBAR=TCON=XCON=0.0
HMAX=RH$UMAX=UBAR
YY=Y1=Y2=Y3=Y4=0.0
ZZ=0.0
GO TO 104
74 TBAR=360.0
RISE=166.6*(TENG**0.25)
C1=SQRTF(360.0)
TAU=(RH/RISE)**2
TBRH=((HMX-RH)/RISE)**2
IF(TBRH-TBAR)301,301,300
300 TBRH=TBAR
301 CONTINUE
HMAX=RISE*SQRTF(TBRH)*RH

```

```

      UMAX=UBAR*(HMAX**0.2)
      XBRH=UBAR*(RISE**0.2)*(((TBRH+TAU)**1.1)-(TAU**1.1))/1.1
      XBAR=XBRH+(TBRH-TBRH)*UMAX
      XCON=(UBAR*(RISE**0.2))/1.1
      TCON=(1.1/(UBAR*(RISE**0.2)))
      IF(TENG-1.0)101,101,102
101  Y1=82.75
      Y2=0.0
      Y3=0.267
      Y4=0.25
      GO TO 103
102  Y1=82.75
      Y2=0.22
      Y3=0.11
      Y4=0.25
103  YY=Y1*(TBRH**Y4)*(TENG**((Y3*TBRH**Y2)))
      ZZ=31.0*(TENG**0.25)*C1
104  DO 123 I=1,21
      IF(X(I)-XBAR)121,122,122
121  C1=(TCON*X(I)+(TAU**1.1))**((1.0/1.1))
      C1=C1-TAU
      IF(C1-TBRH)115,115,116
115  T2(I)=C1
      H(I)=RISE*SQRTF(C1)*RH
      UBR(I)=UBAR*(H(I)**0.2)
      GO TO 123
116  T2(I)=(X(I)-XBRH)/UMAX+TBRH
      H(I)=HMAX
      UBR(I)=UMAX
      GO TO 123
122  H(I)=HMAX
      UBR(I)=UMAX
      T2(I)=TBRH+((X(I)-XBAR)/UMAX)
123  CONTINUE
      DO 130 I=1,21
130  SIGY(I)=0.0
      DO 145 I=1,21
      IF(X(I)-XBAR)132,132,131
132  C1=(TCON*X(I)+(TAU**1.1))**((1.0/1.1))
      C1=C1-TAU
      IF(TENG)131,131,108
108  C3=Y1*(C1**Y4)*(TENG**((Y3*C1**Y2)))
      GO TO 133
131  C3=YY
133  IF(X(I)-1000.0)134,134,135
134  I1=1
      GO TO 136
135  I1=2
136  C2=CY(3,I1)*X(I)+CY(2,I1)*LOGF(X(I))
137  C2=CY(1,I1)*FEXP(C2)
142  C3=C3/C2
      SIGY(I)=C2*SQRTF(1.0+(C3**2))
139  IF(I-1)145,145,140
140  C1=SIGY(I-1)-SIGY(I)
      IF(C1)145,145,141
141  SIGY(I)=SIGY(I-1)

```

145 CONTINUE

DO 146 I=1,21

ASGZ(I)=0.0

146 SIGZ(I)=0.0

DO 170 I=1,21

IF(I-1)151,151,152

151 C4=1.0

FH1=RH

FX1=0.0

C5=(CZ(1,1)*FEXP(CZ(3,1)))*2

IF(TENG)106,106,105

105 C5=C5+(31.0*TENG**0.25)**2

106 C5=SQRTF(C5)

SIGZ(31)=1.0/C5

GO TO 153

152 C4=X(I-1)

FH1=H(I-1)

FX1=X(I-1)

C5=SIGZ(I-1)

SIGZ(31)=ASGZ(I-1)

153 E6=(X(I)-C4)/6.0

FH2=H(I)

FX2=X(I)

SIGZ(24)=C5

H9(1)=FH1

C7=C4

DO 166 J=25,30

K=J-23

C7=C7+E6

C8=FX2-FX1

H9(K)=(C7-FX1)*FH2/C8+(FX2-C7)*FH1/C8

IF(C7-XBAR)155,156,156

155 C1=(TCOON*X(I)+(TAU**1,1))**2*(1.0/1,1)

C1=C1-TAU

IF(TENG)156,156,107

107 C3=31.0*(TENG**0.25)*SQRTF(C1)

GO TO 157

156 C3=ZZ

157 IF(C7-1000.0)158,158,159

158 I1=1

GO TO 167

159 I1=2

167 CONTINUE

C2=CZ(3,I1)*C7+CZ(2,I1)*LOGF(C7)

161 C2=CZ(1,I1)*FEXP(C2)

162 C3=C3/C2

SIGZ(J)=C2*SQRTF(1.0+(C3**2))

IF(J-25)169,169,164

169 IF(I-1)166,166,168

168 C6=SIGZ(I-1)-SIGZ(J)

GO TO 171

164 C6=SIGZ(J-1)-SIGZ(J)

171 IF(C6)166,166,165

165 IF(J-25)172,172,173

172 SIGZ(J)=SIGZ(I-1)

GO TO 166

173 SIGZ(J)=SIGZ(J-1)
166 CONTINUE
SIGZ(I)=SIGZ(30)
J=I
CALL INTZ(J,E6,H9)
170 CONTINUE
IF(SENSE SWITCH 1)81,82
70 FORMAT(1H ,2X, 6E19,4)
71 FORMAT(1H0)
81 WRITE OUTPUT TAPE61,70,RISE,TAU,XBAR,UMAX,XCON,TCON,XBRH,TBRH,UBAR
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,YY,Y1,Y2,Y3,Y4,ZZ
WRITE OUTPUT TAPE61,70,((CY(I,J),I=1,3),J=1,2)
WRITE OUTPUT TAPE61,70,((CZ(I,J),I=1,3),J=1,2)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(ASGZ(I),I=1,21)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(UBR(I),I=1,21)
82 CONTINUE
RETURN
END

SUBROUTINE INTZ (K,C2,H1)

SUBROUTINE TO INTEGRATE ONE OVER SIGMA-Z OF X AND KL

BANK(0),CHAIN1,AA1,AA2,READ1,XANDY,DIFF,INTZ,FLOUT,XQH,BLFA0,

1 OUT1

BANK(1),AA3/

COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,P1,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ OT1,PUT1,KL,EO,LCHN2,BY,H,UBR,VOL,WH,UBR1,CHEM,SKIP,

1 EOV,RMAX,AA2

DIMENSION SKIP(2),AA2(3874)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

DIMENSION OT1(3300),

DIMENSION VG(6,21), CY(3, 2), CZ(3, 2),

1 SIGY(21), SIGZ(31), ASGZ(21),

2 X(21), YX(5,21), AREA(21, 5),

3 RED(9,21), T1(8), T2(21),

4 T3(21), FRAC(9), SIZE(9),

5 PRTS(21), FALN(21, 5, 9), OMEGA(21, 5, 6),

6 FALL(21, 5), XI(21, 5, 6), QOVRQ(6,21),

7 FN(21)

EQUIVALENCE (OT1(1),ZZ), (OT1(2),VG(1)),

1 (OT1(128),TENG), (OT1(129),RISE),

2 (OT1(130),TAU), (OT1(131),XBAR),

3 (OT1(132),TBAR), (OT1(133),HMAX),

4 (OT1(134),UMAX), (OT1(135),UBAR),

5 (OT1(136),XCON), (OT1(137),TCON),

6 (OT1(138),RH), (OT1(139),SIGY(1)),

7 (OT1(160),SIGZ(1)), (OT1(191),ASGZ(1)),

8 (OT1(212),HMX), (OT1(213),TBRH),

9 (OT1(214),XBRW), (OT1(215),CY(1)),

1 (OT1(221),CZ(1)), (OT1(227),Y1),

2 (OT1(228),Y2), (OT1(229),Y3),

3 (OT1(230),Y4), (OT1(231),YY),

4 (OT1(232),DEN), (OT1(233),FGAS),

5 (OT1(234),FPAR), (OT1(235),ROP),

6 (OT1(236),X(1)), (OT1(257),YX(1)),

7 (OT1(362),AREA(1)), (OT1(467),RED(1)),

8 (OT1(656),ENUC), (OT1(657),FIS),

9 (OT1(658),SEC), (OT1(659),T1(1)),

1 (OT1(667),T2(1)), (OT1(688),T3(1)),

2 (OT1(709),FRAC(1)), (OT1(718),SIZE(1)),

3 (OT1(727),PRTS(1)), (OT1(748),FALN(1)),

4 (OT1(1693),OMEGA(1)), (OT1(2323),FALL(1)),

5 (OT1(2428),XI(1)), (OT1(3058),QOVRQ(1)),

6 (OT1(3184),FN(1))

DIMENSION PUT1(160), AYZ(8, 3, 4), GAM(9),

1 VO(9), RMX(9), ALFA(7),

2 BLFA(7), CLFA(7), DLFA(8),

3 EO(9),BY(21,5),H(21),UBR(21)

EQUIVALENCE (PUT1(1),AYZ(1)), (PUT1(97),GAM(1)),

1 (PUT1(106),VO(1)), (PUT1(115),RMX(1)),

2 (PUT1(124),ALFA(1)), (PUT1(131),BLFA(1)),

3 (PUT1(138),CLFA(1)), (PUT1(145),DLFA(1))

DIMENSION ALPHA3(7)

DATA(ALPHA3=1.0,5.0,1.0,6.0,1.0,5.0,1.0)

```

COMMON /AA1/ ICHN, IPAGE, ALPHA, I12, IMAX, I21, FACT, PI, TMS
DIMENSION ICHN(4), ALPHA(8), FACT(20)
COMMON /AA2/ OT1, PUT1, KL, EG, LCHN2, RY, H, UBR, VOL, WH, UBRI, CHEM, SKIP,
EQV, RMAX, AA2
DIMENSION SKIP(2), AA2(3674)
COMMON /AA3/ AA3
DIMENSION AA3(32200)
DIMENSION OT1(3300)
DIMENSION
1      VG(      6, 21),      CY(      3,  2),      CZ(      3,  2),
2      SIGY(      21),      SIGZ(      31),      ASGZ(      21),
3      X(      21),      YX(      5, 21),      AREA(      21,  5),
4      RED(      9, 21),      T1(      8),      T2(      21),
5      T3(      21),      FRAC(      9),      SIZE(      9),
6      PRTS(      21),      FALN( 21,  5,  9),      OMEGA( 21,  5,  6),
7      FALL(      21,  5),      XI( 21,  5,  6),      QOVRQ(      6, 21),
      FN(      21)
EQUIVALENCE (OT1(      1), ZZ      ), (OT1(      2), VG(1)      ),
1      (OT1( 128), TENG      ), (OT1( 129), RISE      ),
2      (OT1( 130), TAU      ), (OT1( 131), XBAR      ),
3      (OT1( 132), TBAR      ), (OT1( 133), HMAX      ),
4      (OT1( 134), UMAX      ), (OT1( 135), UBAR      ),
5      (OT1( 136), XCON      ), (OT1( 137), TCON      ),
6      (OT1( 138), RH      ), (OT1( 139), SIGY(1)      ),
7      (OT1( 160), SIGZ(1)      ), (OT1( 191), ASGZ(1)      ),
8      (OT1( 212), RMX      ), (OT1( 213), TBRH      ),
9      (OT1( 214), XBRH      ), (OT1( 215), CY(1)      ),
1     (OT1( 221), CZ(1)      ), (OT1( 227), Y1      ),
2     (OT1( 228), Y2      ), (OT1( 229), Y3      ),
3     (OT1( 230), Y4      ), (OT1( 231), YY      ),
4     (OT1( 232), DEN      ), (OT1( 233), FGAS      ),
5     (OT1( 234), FPAR      ), (OT1( 235), ROP      ),
6     (OT1( 236), X(1)      ), (OT1( 257), YX(1)      ),
7     (OT1( 332), AREA(1)      ), (OT1( 467), RED(1)      ),
8     (OT1( 656), ENUC      ), (OT1( 657), FIS      ),
9     (OT1( 658), SEC      ), (OT1( 659), T1(1)      ),
1     (OT1( 667), T2(1)      ), (OT1( 668), T3(1)      ),
2     (OT1( 709), FRAC(1)      ), (OT1( 718), SIZE(1)      ),
3     (OT1( 727), PRTS(1)      ), (OT1( 748), FALN(1)      ),
4     (OT1(1693), OMEGA(1)      ), (OT1(2323), FALL(1)      ),
5     (OT1(2428), XI(1)      ), (OT1(3058), QOVRQ(1)      ),
6     (OT1(3184), FN(1)      ),
7     (OT1(3185), FN(2)      ),
8     (OT1(3186), FN(3)      ),
9     (OT1(3187), FN(4)      ),
10    (OT1(3188), FN(5)      ),
11    (OT1(3189), FN(6)      ),
12    (OT1(3190), FN(7)      ),
13    (OT1(3191), FN(8)      ),
14    (OT1(3192), FN(9)      ),
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17    (OT1(3195), FN(12)      ),
18    (OT1(3196), FN(13)      ),
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23    (OT1(3201), FN(18)      ),
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25    (OT1(3203), FN(20)      ),
26    (OT1(3204), FN(21)      ),
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28    (OT1(3206), FN(23)      ),
29    (OT1(3207), FN(24)      ),
30    (OT1(3208), FN(25)      ),
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209   (OT1(3387), FN(204)      ),
210   (OT1(3388), FN(205)      ),
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212   (OT1(3390), FN(207)      ),
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215   (OT1(3393), FN(210)      ),
216   (OT1(3394), FN(211)      ),
217   (OT1(3395), FN(212)      ),
218   (OT1(3396), FN(213)      ),
219   (OT1(3397), FN(214)      ),
220   (OT1(3398), FN(215)      ),
221   (OT1(3399), FN(216)      ),
222   (OT1(3400), FN(217)      ),
223   (OT1(3401), FN(218)      ),
224   (OT1(3402), FN(219)      ),
225   (OT1(3403), FN(220)      ),
226   (OT1(3404), FN(221)      ),
227   (OT1(3405), FN(222)      ),
228   (OT1(3406), FN(223)      ),
229   (OT1(3407), FN(224)      ),
230   (OT1(3408), FN(225)      ),
231   (OT1(3409), FN(226)      ),
232   (OT1(3410), FN(227)      ),
233   (OT1(3411), FN(228)      ),
234   (OT1(3412), FN(229)      ),
235   (OT1(3413), FN(230)      ),
236   (OT1(3414), FN(231)      ),
237   (OT1(3415), FN(232)      ),
238   (OT1(3416), FN(233)      ),
239   (OT1(3417), FN(234)      ),
240   (OT1(3418), FN(235)      ),
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242   (OT1(3420), FN(237)      ),
243   (OT1(3421), FN(238)      ),
244   (OT1(3422), FN(239)      ),
245   (OT1(3423), FN(240)      ),
246   (OT1(3424), FN(241)      ),
247   (OT1(3425), FN(242)      ),
248   (OT1(3426), FN(243)      ),
249   (OT1(3427), FN(244)      ),
250   (OT1(3428), FN(245)      ),
251   (OT1(3429), FN(246)      ),
252   (OT1(3430), FN(247)      ),
253   (OT1(3431), FN(248)      ),
254   (OT1(3432), FN(249)      ),
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256   (OT1(3434), FN(251)      ),
257   (OT1(3435), FN(252)      ),
258   (OT1(3436), FN(253)      ),
259   (OT1(3437), FN(254)      ),
260   (OT1(3438), FN(255)      ),
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262   (OT1(3440), FN(257)      ),
263   (OT1(3441), FN(258)      ),
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266   (OT1(3444), FN(261)      ),
267   (OT1(3445), FN(262)      ),
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269   (OT1(3447), FN(264)      ),
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272   (OT1(3450), FN(267)      ),
273   (OT1(3451), FN(268)      ),
274   (OT1(3452), FN(269)      ),
275   (OT1(3453), FN(270)      ),
276   (OT1(3454), FN(271)      ),
277   (OT1(3455), FN(272)      ),
278   (OT1(3456), FN(273)      ),
279   (OT1(3457), FN(274)      ),
280   (OT1(3458), FN(275)      ),
281   (OT1(3459), FN(276)      ),
282   (OT1(3460), FN(277)      ),
283   (OT1(3461), FN(278)      ),
284   (OT1(3462), FN(279)      ),
285   (OT1(3463), FN(280)      ),
286   (OT1(3464), FN(281)      ),
287   (OT1(3465), FN(282)      ),
288   (OT1(3466), FN(283)      ),
289   (OT1(3467), FN(284)      ),
290   (OT1(3468), FN(285)      ),
291   (OT1(3469), FN(286)      ),
292   (OT1(3470), FN(287)      ),
293   (OT1(3471), FN(288)      ),
294   (OT1(3472), FN(289)      ),
295   (OT1(3473), FN(290)      ),
296   (OT1(3474), FN(291)      ),
297   (OT1(3475), FN(292)      ),
298   (OT1(3476), FN(293)      ),
299   (OT1(3477), FN(294)      ),
300   (OT1(3478), FN(295)      ),
301   (OT1(3479), FN(296)      ),
302   (OT1(3480), FN(297)      ),
303   (OT1(3481), FN(298)      ),
304   (OT1(3482), FN(299)      ),
305   (OT1(3483), FN(300)      ),
306   (OT1(3484), FN(301)      ),
307   (OT1(3485), FN(302)      ),
308   (OT1(3486), FN(303)      ),
309   (OT1(3487), FN(304)      ),
310   (OT1(3488), FN(305)      ),
311   (OT1(3489), FN(306)      ),
312   (OT1(3490), FN(307)      ),
313   (OT1(3491), FN(308)      ),
314   (OT1(3492), FN(309)      ),
315   (OT1(3493), FN(310)      ),
316   (OT1(3494), FN(311)      ),
317   (OT1(3495), FN(312)      ),
318   (OT1(3496), FN(313)      ),
319   (OT1(3497), FN(314)      ),
320   (OT1(3498), FN(315)      ),
321   (OT1(3499), FN(316)      ),
322   (OT1(3500), FN(317)      ),
323   (OT1(3501), FN(318)      ),
324   (OT1(3502), FN(319)      ),
325   (OT1(3503), FN(320)      ),
326   (OT1(3504), FN(321)      ),
327   (OT1(3505), FN(322)      ),
328   (OT1(3506), FN(323)      ),
329   (OT1(3507), FN(324)      ),
330   (OT1(3508), FN(325)      ),
331   (OT1(3509), FN(326)      ),
332   (OT1(3510), FN(327)      ),
333   (OT1(3511), FN(328)      ),
334   (OT1(3512), FN(329)      ),
335   (OT1(3513), FN(330)      ),
336   (OT1(3514), FN(331)      ),
337   (OT1(3515), FN(332)      ),
338   (OT1(3516), FN(333)      ),
339   (OT1(3517), FN(334)      ),
340   (OT1(3518), FN(335)      ),
341   (OT1(3519), FN(336)      ),
342   (OT1(3520), FN(337)      ),
343   (OT1(3521), FN(338)      ),
344   (OT1(3522), FN(339)      ),
345   (OT1(3523), FN(340)      ),
346   (OT1(3524), FN(341)      ),
347   (OT1(3525), FN(342)      ),
348   (OT1(3526), FN(343)      ),
349   (OT1(3527), FN(344)      ),
350   (OT1(3528), FN(345)      ),
351   (OT1(3529), FN(346)      ),
352   (OT1(3530), FN(347)      ),
353   (OT1(3531), FN(348)      ),
354   (OT1(3532), FN(349)      ),
355   (OT1(3533), FN(350)      ),
356   (OT1(3534), FN(351)      ),
357   (OT1(3535), FN(352)      ),
358   (OT1(3536), FN(353)      ),
359   (OT1(3537), FN(354)      ),
360   (OT1(3538), FN(355)      ),
361   (OT1(3539), FN(356)      ),
362   (OT1(3540), FN(357)      ),
363   (OT1(3541), FN(358)      ),
364   (OT1(3542), FN(359)      ),
365   (OT1(3543), FN(360)      ),
366   (OT1(3544), FN(361)      ),
367   (OT1(3545), FN(362)      ),
368   (OT1(3546), FN(363)      ),
369   (OT1(3547), FN(364)      ),
370   (OT1(3548), FN(365)      ),
371   (OT1(3549), FN(366)      ),
372   (OT1(3550), FN(367)      ),
373   (OT1(3551), FN(368)      ),
374   (OT1(3552), FN(369)      ),
375   (OT1(3553), FN(370)      ),
376   (OT1(3554), FN(371)      ),
377   (OT1(3555), FN(372)      ),
378   (OT1(3556), FN(373)      ),
379   (OT1(3557), FN(374)      ),
380   (OT1(3558), FN(375)      ),
381   (OT1(3559), FN(376)      ),
382   (OT1(3560), FN(377)      ),
383   (OT1(3561), FN(378)      ),
384   (OT1(3562), FN(379)      ),
385   (OT1(3563), FN(380)      ),
386   (OT1(3564), FN(381)      ),
387   (OT1(3565), FN(382)      ),
388   (OT1(3566), FN(383)      ),
389   (OT1(3567), FN(384)      ),
390   (OT1(3568), FN(385)      ),
391   (OT1(3569), FN(386)      ),
392   (OT1(3570), FN(387)      ),
393   (OT1(3571), FN(388)      ),
394   (OT1(3572), FN(389)      ),
395   (OT1(3573), FN(390)      ),
396   (OT1(3574), FN(391)      ),
397   (OT1(3575), FN(392)      ),
398   (OT1(3576), FN(393)      ),
399   (OT1(3577), FN(394)      ),
400   (OT1(3578), FN(395)      ),
401   (OT1(3579), FN(396)      ),
402   (OT1(3580), FN(397)      ),
403   (OT1(3581), FN(398)      ),
404   (OT1(3582), FN(399)      ),
405   (OT1(3583), FN(400)      ),
406   (OT1(3584), FN(401)      ),
407   (OT1(3585), FN(402)      ),
408   (OT1(3586), FN(403)      ),
409   (OT1(3587), FN(404)      ),
410   (OT1(3588), FN(405)      ),
411   (OT1(3589), FN(406)      ),
412   (OT1(3590), FN(407)      ),
413   (OT1(3591), FN(408)      ),
414   (OT1(3592), FN(409)      ),
415   (OT1(3593), FN(410)      ),
416   (OT1(3594), FN(411)      ),
417   (OT1(3595), FN(412)      ),
418   (OT1(3596), FN(413)      ),
419   (OT1(3597), FN(414)      ),
420   (OT1(3598), FN(415)      ),
421   (OT1(3599), FN(416)      ),
422   (OT1(3600), FN(417)      ),
423   (OT1(3601), FN(418)      ),
424   (OT1(3602), FN(419)      ),
425   (OT1(3603), FN(420)      ),
426   (OT1(3604), FN(421)      ),
427   (OT1(3605), FN(422)      ),
428   (OT1(3606), FN(423)      ),
429   (OT1(3607), FN(424)      ),
430   (OT1(3608), FN(425)      ),
431   (OT1(3609), FN(426)      ),
432   (OT1(3610), FN(427)      ),
433   (OT1(3611), FN(428)      ),
434   (OT1(3612), FN(429)      ),
435   (OT1(3613), FN(430)      ),
436   (OT1(3614), FN(431)      ),
437   (OT1(3615), FN(432)      ),
438   (OT1(3616), FN(433)      ),
439   (OT1(3617), FN(434)      ),
440   (OT1(3618), FN(435)      ),
441   (OT1(3619), FN(436)      ),
442   (OT1(3620), FN(437)      ),
443   (OT1(3621), FN(438)      ),
444   (OT1(3622), FN(439)      ),
445   (OT1(3623), FN(440)      ),
446   (OT1(3624), FN(441)      ),
447   (OT1(3625), FN(442)      ),
448   (OT1(3626), FN(443)      ),
449   (OT1(3627), FN(444)      ),
450   (OT1(3628), FN(445)      ),
451   (OT1(3629), FN(446)      ),
452   (OT1(3630), FN(447)      ),
453   (OT1(3631), FN(448)      ),
454   (OT1(3632), FN(449)      ),
455   (OT1(3633), FN(450)      ),
456   (OT1(3634), FN(451)      ),
457   (OT1(3635), FN(452)      ),
458   (OT1(3636), FN(453)      ),
459   (OT1(3637), FN(454)      ),
460   (OT1(3638), FN(455)      ),
461   (OT1(3639), FN(456)      ),
462   (OT1(3640), FN(457)      ),
463   (OT1(3641), FN(458)      ),
464   (OT1(3642), FN(459)      ),
465   (OT1(3643), FN(460)      ),
466   (OT1(3644), FN(461)      ),
467   (OT1(3645), FN(462)      ),
468   (OT1(3646), FN(463)      ),
469   (OT1(3647), FN(464)      ),
470   (OT1(3648), FN(465)      ),
471   (OT1(3649), FN(466)      ),
472   (OT1(3650), FN(467)      ),
473   (OT1(3651), FN(468)      ),
474   (OT1(3652), FN(469)      ),
475   (OT1(3653), FN(470)      ),
476   (OT1(3654), FN(471)      ),
477   (OT1(3655), FN(472)      ),
478   (OT1(3656), FN(473)      ),
479   (OT1(3657), FN(474)      ),
480   (OT1(3658), FN(475)      ),
481   (OT1(3659), FN(476)      ),
482   (OT1(3660), FN(477)      ),
483   (OT1(3661), FN(478)      ),
484   (OT1(3662), FN(479)      ),
485   (OT1(3663), FN(480)      ),
486   (OT1(3664), FN(481)      ),
487   (OT1(3665), FN(482)      ),
488   (OT1(3666), FN(483)      ),
489   (OT1(3667), FN(484)      ),
490   (OT1(3668), FN(485)      ),
491   (OT1(3669), FN(486)      ),
492   (OT1(3670), FN(487)      ),
493   (OT1(3671), FN(488)      ),
494   (OT1(3672), FN(489)      ),
495   (OT1(3673), FN(490)      ),
496   (OT1(3674), FN(491)      ),
497   (OT1(3675), FN(492)      ),
498   (OT1(3676), FN(493)      ),
499   (OT1(3677), FN(494)      ),
500   (OT1(3678), FN(495)      ),
501   (OT1(3679), FN(496)      ),
502   (OT1(3680), FN(497)      ),
503   (OT1(3681), FN(498)      ),
504   (OT1(3682), FN(499)      ),
505   (OT1(3683), FN(500)      ),
506   (OT1(3684), FN(501)      ),
507   (OT1(3685), FN(502)      ),
508   (OT1(3686), FN(503)      ),
509   (OT1(3687), FN(504)      ),
510   (OT1(3688), FN(505)      ),
511   (OT1(3689), FN(506)      ),
512   (OT1(3690), FN(507)      ),
513   (OT1(3691), FN(508)      ),
514   (OT1(3692), FN(509)      ),
515   (OT1(3693), FN(510)      ),
516   (OT1(3694), FN(511)      ),
517   (OT1(3695), FN(512)      ),
518   (OT1(3696), FN(513)      ),
519   (OT1(3697), FN(514)      ),
520   (OT1(3698), FN(515)      ),
521   (OT1(3699), FN(516)      ),
522   (OT1(3700), FN(517)      ),
523   (OT1(3701), FN(518)      ),
524   (OT1(3
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DIMENSION H1(7)
C1=0.30*C2
DO 151 I=24,30
J=I-23
C3=((H1(J)/SIGZ(I))*2)/2.0
101 C3=FEXP(C3)
ASGZ(K)=ASGZ(K)+(ALPHA3(J)*C3/SIGZ(I))
151 CONTINUE
199 ASGZ(K)=ASGZ(K)*C1
ASGZ(K)=ASGZ(K)+SIGZ(31)
RETURN
END

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1230

1240

1250

SUBROUTINE FLOUT
 SUBROUTINE TO CALCULATE FALLOUT DISTRIBUTION
 RANK(0),CHAIN1,/AA1/,/AA2/,READ1,XANDY,DIFF,INTZ,FLOUT,XQW,SLFAB,

1 OUT1
 RANK(1),/AA3/
 COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
 DIMENSION ICHN(4),ALPHA(8),FACT(20)
 COMMON /AA2/ OT1,PUT1,KL,EO,LCHN2,BY,H,UBR,VOL,WH,UBRI,CHEM,SKIP,

1 EQV,RMAX,AA2
 DIMENSION SKIP(2),AA2(3874)

COMMON /AA3/ AA3
 DIMENSION AA3(32200)
 DIMENSION OT1(3300)

DIMENSION VG(6,21), CY(3, 2), CZ(3, 2),
 1 SIGY(21), SIGZ(31), ASGZ(21),
 2 X(21), YX(5,21), AREA(21, 5),
 3 RED(9,21), T1(8), T2(21),
 4 T3(21), FRAC(9), SIZE(9),
 5 PRTS(21), FALN(21, 5, 9), OMEGA(21, 5, 6),
 6 FALL(21, 5), XI(21, 5, 6), QOVRQ(6,21),
 7 FN(21)

EQUIVALENC (OT1(1),ZZ),(OT1(2),VG(1)),
 1 (OT1(128),TENG),(OT1(129),RISE),
 2 (OT1(130),TAU),(OT1(131),XBAR),
 3 (OT1(132),TBR),(OT1(133),HMAX),
 4 (OT1(134),UMAX),(OT1(135),UBAR),
 5 (OT1(136),XCON),(OT1(137),TCON),
 6 (OT1(138),RH),(OT1(139),SIGY(1)),
 7 (OT1(160),SIGZ(1)),(OT1(191),ASGZ(1)),
 8 (OT1(212),HMX),(OT1(213),TBRH),
 9 (OT1(214),XBRH),(OT1(215),CY(1)),
 1 (OT1(221),CZ(1)),(OT1(227),Y1),
 2 (OT1(228),Y2),(OT1(229),Y3),
 3 (OT1(230),Y4),(OT1(231),YY),
 4 (OT1(232),DEN),(OT1(233),FGAS),
 5 (OT1(234),FPAR),(OT1(235),ROP),
 6 (OT1(236),X(1)),(OT1(257),YX(1)),
 7 (OT1(362),AREA(1)),(OT1(467),RED(1)),
 8 (OT1(656),ENUC),(OT1(657),FIS),
 9 (OT1(658),SEC),(OT1(659),T1(1)),
 1 (OT1(667),T2(1)),(OT1(688),T3(1)),
 2 (OT1(709),FRAC(1)),(OT1(718),SIZE(1)),
 3 (OT1(727),PRTS(1)),(OT1(748),FALN(1)),
 4 (OT1(1693),OMEGA(1)),(OT1(2323),FALL(1)),
 5 (OT1(2428),XI(1)),(OT1(3058),QOVRQ(1)),
 6 (OT1(3184),FN(1))

DIMENSION PUT1(160), AYZ(8, 3, 4), GAM(9),
 1 VO(9), RMX(9), ALFA(7),
 2 BLFA(7), CLFA(7), DLFA(8),

3EO(9),BY(21,5),H(21),UBR(21)
 EQUIVALENC (PUT1(1),AYZ(1)),(PUT1(97),GAM(1)),
 1 (PUT1(106),VO(1)),(PUT1(115),RMX(1)),
 2 (PUT1(124),ALFA(1)),(PUT1(131),BLFA(1)),
 3 (PUT1(138),CLFA(1)),(PUT1(145),DLFA(1))

DIMENSION TIM(9),XMIN(9),TMIN(9),XMAX(9),TMAX(9),XFRE(9),TF(21,9)
 DIMENSION FPRT(9)

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LOG10F(X)=LOGF(X)/2.3
IF(RISE)111,111,1
1 C1=RISE*114.0/166.6
C2=103.6*RISE/166.6
DO 100 I=1,9
IF(SENSE SWITCH 6)1001,1002
1001 CALL OTND
1002 CONTINUE
ALT=RH+C2
IF(RH)3,3,2
2 C6=C9=UBAR*(RH**0.2)
GO TO 4
3 C6=C9=UBAR
4 CONTINUE
DO 101 J=2,360
TAB=J
SQT=SQRTF(TAB)
V=(C1/SQT)-(VO(I)*FEXP(GAM(I)*ALT))
ALT=ALT+V
IF(ALT)5,5,6
5 C6=C6+UBAR
GO TO 7
6 C6=C6+UBAR*(ALT**0.2)
7 CONTINUE
C5=RH+(C2*SQT)
IF(ALT-HMX)801,102,102
801 IF(ALT-C5)102,102,101
101 CONTINUE
102 TIM(I)=TAB
XMIN(I)=C9
TMIN(I)=1.0
C4=RH+C2
C3=C4/(1000.0*VO(I))
107 CONTINUE
TMIN(I)=TMIN(I)+C3
XMIN(I)=XMIN(I)+(C3*UBAR*(C4**0.2))
V=VO(I)*FEXP(GAM(I)*C4)
C4=C4-(C3*V)
IF(C4)104,104,107
104 XMAX(I)=C6
TMAX(I)=TAB
XFRE(I)=XMAX(I)
IF(ALT)8,8,9
8 C4=1.0
GO TO 10
9 C4=ALT
10 CONTINUE
C3=C4/(1000.0*VO(I))
103 CONTINUE
TMAX(I)=TMAX(I)+C3
XMAX(I)=XMAX(I)+(C3*UBAR*(C4**0.2))
V=VO(I)*FEXP(GAM(I)*C4)
C4=C4-(C3*V)
IF(C4)106,106,103
106 XFRE(I)=XMAX(I)-XFRE(I)
100 CONTINUE

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      IF(FPAR)111,111,116
116 IF (ROP-1.0)716,111,111
716 DO 115 I=1,9
115 RMX(I)=RMX(I)*(10.0**(-4))
      IF(ENUC-(2.8*(10.0**20)))701,701,702
701 B1=-226.34
      B2=11.1
      GO TO 124
702 R1=-40.95
      B2=2.03
124 F1=B1+(B2*LOG10F(ENUC))
      IF(E1+10.0)123,125,125
123 IF(ICHN(1))111,111,110
110 ICHN2=3
111 ICHN(1)=0
      FPAR=0.0
      DO 114 I=1,9
      FPRT(I)=0.0
      DO 114 K=1,5
      DO 114 J=1,21
      T3(J)=0.0
      FALL(J,K)=0.0
114 FALN(J,K,I)=0.0
      GO TO 999
125 F1=10.0**E1
      C1=E1*3.59*(10.0**(-3))
      C3=1.0-FEXP(-0.5*RMX(1)*C1)
      ROP=ROP+((1.0-ROP)*C3)
      DO 130 I=1,9
      IF(RMX(I)-RMAX)126,126,127
127 IF(I-1)705,705,703
703 IF( RMX(I-1)-RMAX)705,704,704
704 FPRT(I)=0.0
      GO TO 128
705 RMX(I)=RMAX
126 FPRT(I)=FEXP(-RMX(I)*C1)
      FPRT(I)=1.0-FPRT(I)-C3
      C3=C3+FPRT(I)
128 CONTINUE
      IF(I-1)121,121,122
121 SIZE(I)=0.75*RMX(I)
      GO TO 130
122 SIZE(I)=0.5*(RMX(I)+RMX(I-1))
130 CONTINUE
112 CONTINUE
      C1=0.0
      DO 131 I=1,9
131 C1=C1+FPRT(I)
      DO 132 I=1,9
132 FPRT(I)=FPRT(I)/C1
      DO 140 I=1,9
      SIZE(I)=SIZE(I)/2.0
140 FRAC(I)=(SIZE(I)**3)*PI*4.0/(3.0*VOL)
      DO 142 J=1,21
      DO 142 I=1,9
      DO 141 K=1,5

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141 FALN(J,K,I)=0.0
142 TF(J,I)=0.0
    DO 200 J=1,21
    IF(SENSE SWITCH 6)1003,1004
1003 CALL OTND
1004 CONTINUE
    IF(J=1)501,501,502
502 IF(J=21)503,504,504
501 XLM=0.0
    XLX=LOGF((X(J)+X(J+1))/2.0)
    GO TO 505
504 XLM=LOGF((X(J)+X(J-1))/2.0)
    XLX=LOGF((2.0*X(J))-X(J-1))
    GO TO 505
503 XLM=LOGF((X(J)+X(J-1))/2.0)
    XLX=LOGF((X(J)+X(J+1))/2.0)
505 CONTINUE
    DO 202 I=1,9
    XMN=LOGF(XMIN(I))
    XMX=LOGF(XMAX(I))
    SGP=(XMX-XMN)/7.0
    XMEAN=(XMX+XMN)/2.0
    IF(X(J)-XMIN(I))202,202,203
203 IF(X(J)-XMAX(I))204,202,202
204 TD=TIM(I)*(X(J)-XMIN(I))/(XMAX(I)-XMIN(I))
    XD=UBAR*(RISE**0.2)*(((TD+TAU)**1.1)-(TAU**1.1))/1.1
    DX=(X(J)-XMIN(I))/(XMAX(I)-XMIN(I))
    DX=DX*(XFRE(I)-XMIN(I))
    DX=DX+XMIN(I)
    DX=DX+XD
    IF(XD-XBRH)231,232,232
231 C1=((ICON*XD)+(TAU**1.1))**((1.0/1.1))
    GO TO 233
232 C1=TBRH +((XD-XBRH)/UMAX)
233 IF(DX-XBRH)234,235,235
234 C2=((ICON*DX)+(TAU**1.1))**((1.0/1.1))
    GO TO 236
235 C2=TBRH +((DX-XBRH)/UMAX)
236 CONTINUE
    TD=TD+C2-C1
    TF(J,I)=TD
205 IF(DX-XBAR)206,206,207
206 C1=(TCON*DX+(TAU**1.1))**((1.0/1.1))
    C1=C1-TAU
    C3=Y1*(C1**Y4)*(TENG**((Y3*C1**Y2)))
    GO TO 217
207 C3=YY
217 IF(DX-1000.0)208,208,209
208 I1=1
    GO TO 210
209 I1=2
210 C2=C1*(3,I1)*DX+C1*(2,I1)*LOGF(DX)
211 C2=C1*(1,I1)*FEXP(C2)
218 C3=C3/C2
    SGY=C2*SQRTE(1.0*(C3**2))
213 IF(SGY-SIGY(J))214,220,220

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214 SGY=SIGY(J)
220 C2=(XLM-XMEAN)/SGP
    C3=(XLX-XMEAN)/SGP
    C4=(C3-C2)/30.0
    C5=0.0
    DO 216 L=1,30
    C2=C2+C4
216 C5=C5+FEXP(-(C2**2)/2.0)*C4
    FRP=C5/SQRTF(2.0*PI)
    DO 300 K=1,5
    IF(K-1)221,221,222
221 C2=-BY(J,K)/SGY
    C3=BY(J,K)/SGY
    C1=2.0*BY(J,K)
    GO TO 223
222 C2=BY(J,K-1)/SGY
    C3=BY(J,K)/SGY
    C1=BY(J,K)-BY(J,K-1)
223 C4=(C3-C2)/30.0
    C1=FPRT(I)*FRP/AREA(J,K)
    C5=0.0
    DO 225 L=1,30
    C2=C2+C4
225 C5=C5+FEXP(-(C2**2)/2.0)*C4
    C1=C1/(SQRTF(2.0*PI))
    C1=C1*C5
300 FALN(J,K,I)=C1*AREA(J,K)
202 CONTINUE
200 CONTINUE
    DO 151 I=1,9
    C1=0.0
    DO 152 J=1,21
    DO 152 K=1,5
152 C1=C1+FALN(J,K,I)
    DO 153 J=1,21
    DO 153 K=1,5
153 FALN(J,K,I)=FALN(J,K,I)*FPRT(I)/C1
151 CONTINUE
    DO 154 J=1,21
    C1=0.0
    T3(J)=0.0
    PRTS(J)=0.0
    FN(J)=0.0
    DO 155 K=1,5
    FALL(J,K)=0.0
    C2=0.0
    DO 166 I=1,9
    C2=C2+FALN(J,K,I)
    FALL(J,K)=FALL(J,K)+FALN(J,K,I)
    PRTS(J)=PRTS(J)+(FALN(J,K,I)*SIZE(I))
166 T3(J)=T3(J)+TF(J,I)*FALN(J,K,I)
    FALL(J,K)=FALL(J,K)/AREA(J,K)
155 C1=C1+C2
    PRTS(J)=PRTS(J)/C1
154 T3(J)=T3(J)/C1
    DO 156 J=1,21

```

```

DO 156 K=1,5
DO 156 I=1,9
FALN(J,K,I)=FALN(J,K,I)/(AREA(J,K)*FRAC(I))
156 FALN(J,K,I)=FALN(J,K,I)*FPAR
C1=0.0
DO 400 J=1,21
DO 400 K=1,5
400 C1=C1+FALL(J,K)*AREA(J,K)
C2=0.0
DO 401 J=1,21
C3=0.0
DO 402 K=1,5
402 C3=C3+FALL(J,K)*AREA(J,K)
C2=C2+C3
401 FN(J)=1.0-(C2/C1)
C2=0.0
DO 403 J=1,21
IF(FN(J))404,403,403
404 FN(J)=0.0
403 CONTINUE
DO 410 I=1,21
C1=0.0
DO 409 J=1,9
409 C1=C1+FALN(I,1,J)
IF(C1)405,405,406
405 T3(I)=0.0
GO TO 410
406 IF(T3(I))407,407,410
407 T3(I)=T2(I)
410 CONTINUE
999 CONTINUE
IF(SENSE SWITCH 1)81,82
70 FORMAT(1H ,9X, 5E20.4)
71 FORMAT(1H0)
81 WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(((FALL(J,K),K=1,5),J=1,21))
WRITE OUTPUT TAPE61,71
DO 83 J=1,21
83 WRITE OUTPUT TAPE61,70,(TF(J,I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(((FALN(J,K,I),K=1,5),I=1,9),J=1,21)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(PRTS(J),J=1,21)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(FN(I),I=1,21)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(FRAC(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(XMIN(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(XMAX(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(TMIN(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(TMAX(I),I=1,9)
WRITE OUTPUT TAPE61,71

```

```
WRITE OUTPUT TAPE61,70,(XFRE(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(TIM(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(SIZE(I),I=1,9)
WRITE OUTPUT TAPE61,71
WRITE OUTPUT TAPE61,70,(FPRT(I),I=1,9)
82 CONTINUE
RETURN
END
```

SUBROUTINE XQW

0010

SUBROUTINE TO CALCULATE CHI/Q, Q/Q, AND OMEGA/Q OF X, YX, ICLS
RANK(0),CHAIN1, /AA1/, /AA2/, READ1, XANDY, DIFF, INTZ, FLOUT, XQW, SLFAB,

1 OUT1

RANK(1), /AA3/

COMMON /AA1/ ICHN, IPAGE, ALPHA, I12, IMAX, I21, FACT, PI, TMS

DIMENSION ICHN(4), ALPHA(8), FACT(20)

COMMON /AA2/ OT1, PUT1, KL, EO, LCHN2, BY, H, UBR, VOL, WH, UBRI, CHEM, SKIP,

1 EQV, RMAX, AA2

DIMENSION SKIP(2), AA2(3874)

COMMON /AA3/ AA3

DIMENSION AA3(32200)

DIMENSION OT1(3300)

DIMENSION	VG(	6,21),	CY(	3, 2),	CZ(	3, 2),
1	SIGY(	21),	SIGZ(	31),	ASGZ(	21),
2	X(	21),	YX(	5,21),	AREA(	21, 5),
3	RED(	9,21),	T1(	8),	T2(	21),
4	T3(	21),	FRAC(	9),	SIZE(	9),
5	PRTS(	21),	FALN(	21, 5, 9),	OMEGA(	21, 5, 6),
6	FALL(	21, 5),	XI(	21, 5, 6),	QOVRQ(	6,21),
7	FN(	21)				

EQUIVALENCE	(OT1(	1), ZZ	), (OT1(	2), VG(1)	),
1	(OT1(	128), TENG	), (OT1(	129), RISE	),
2	(OT1(	130), TAU	), (OT1(	131), XBAR	),
3	(OT1(	132), TBAR	), (OT1(	133), HMAX	),
4	(OT1(	134), UMAX	), (OT1(	135), UBAR	),
5	(OT1(	136), XCON	), (OT1(	137), TCON	),
6	(OT1(	138), RH	), (OT1(	139), SIGY(1)	),
7	(OT1(	160), SIGZ(1)	), (OT1(	191), ASGZ(1)	),
8	(OT1(	212), HMX	), (OT1(	213), TBRH	),
9	(OT1(	214), XBRH	), (OT1(	215), CY(1)	),
1	(OT1(	221), CZ(1)	), (OT1(	227), Y1	),
2	(OT1(	228), Y2	), (OT1(	229), Y3	),
3	(OT1(	230), Y4	), (OT1(	231), YY	),
4	(OT1(	232), DEN	), (OT1(	233), FGAS	),
5	(OT1(	234), FPAR	), (OT1(	235), ROP	),
6	(OT1(	236), X(1)	), (OT1(	257), YX(1)	),
7	(OT1(	362), AREA(1)	), (OT1(	467), RED(1)	),
8	(OT1(	656), ENUC	), (OT1(	657), FIS	),
9	(OT1(	658), SEC	), (OT1(	659), T1(1)	),
1	(OT1(	667), T2(1)	), (OT1(	688), T3(1)	),
2	(OT1(	709), FRAC(1)	), (OT1(	718), SIZE(1)	),
3	(OT1(	727), PRTS(1)	), (OT1(	748), FALN(1)	),
4	(OT1(	1693), OMEGA(1)	), (OT1(	2323), FALL(1)	),
5	(OT1(	2428), XI(1)	), (OT1(	3058), QOVRQ(1)	),
6	(OT1(	3184), FN(1)	)		

DIMENSION	PUT1(	160),	AYZ(	8, 3, 4),	GAM(	9),
1	VO(	9),	RMX(	9),	ALFA(	7),
2	BLFA(	7),	CLFA(	7),	DLFA(	8),

3FO(9), BY(21,5), H(21), UBR(21)

EQUIVALENCE	(PUT1(	1), AYZ(1)	), (PUT1(	97), GAM(1)	),
1	(PUT1(	106), VO(1)	), (PUT1(	115), RMX(1)	),
2	(PUT1(	124), ALFA(1)	), (PUT1(	131), BLFA(1)	),
3	(PUT1(	138), CLFA(1)	), (PUT1(	145), DLFA(1)	)

C1=SQRTF(2.0/PI)

DD 110 K=1,6

1010

1110

```

      B2=ASGZ(1)*C1*VG(K,1)/UBR(1)
      QOVRQ(K,1)=FEXP(-B2)
      DO 151 J=2,21
      B2=(ASGZ(J)-ASGZ(J-1))*C1*VG(K,J)/UBR(J)
112  C2=FEXP(-B2)
151  QOVRQ(K,J)=QOVRQ(K,J-1)*C2
110  CONTINUE
      DO 100 J=1,21
      C6=LOGF(SIGZ(J))+LOGF(SIGY(J))
      C6=C6+LOGF(2.0*PI*UBR(J))
      C2=0.5*(((H(J)-1.0)/SIGZ(J))**2)
      C3=0.5*(((H(J)+1.0)/SIGZ(J))**2)
      C7=0.5*(((2.0*HMX-H(J)-1.0)/SIGZ(J))**2)
      C8=0.5*(((2.0*HMX-H(J)+1.0)/SIGZ(J))**2)
      DO 100 K=1,5
      C1=C6+0.5*(YX(K,J)/SIGY(J))**2
      DO 100 L=1,6
      XI(J,K,L)=0.0
      IF(QOVRQ(L,J))100,100,113
113  C4=LOGF(QOVRQ(L,J))
      C5=C1+C2-C4
101  XI(J,K,L)=XI(J,K,L)+FEXP(-C5)
102  C5=C1+C3-C4
103  XI(J,K,L)=XI(J,K,L)+FEXP(-C5)
104  C5=C1+C7-C4
105  XI(J,K,L)=XI(J,K,L)+FEXP(-C5)
106  C5=C1+C8-C4
107  XI(J,K,L)=XI(J,K,L)+FEXP(-C5)
100  CONTINUE
      DO 130 L=1,6
      DO 130 K=1,5
      DO 130 J=1,21
130  OMEGA(J,K,L)=VG(L,J)*XI(J,K,L)
      IF(SENSE SWITCH 1)81,82
      70  FORMAT(1H ,9X, 5E20.4)
      71  FORMAT(1H0)
      81  WRITE OUTPUT TAPE61,71
      WRITE OUTPUT TAPE61,70,(((XI(J,K,L),K=1,5),J=1,21),L=1,6)
      WRITE OUTPUT TAPE61,71
      WRITE OUTPUT TAPE61,70,(((OMEGA(J,K,L),K=1,5),J=1,21),L=1,6)
      WRITE OUTPUT TAPE61,71
      WRITE OUTPUT TAPE61,70,((QOVRQ(J,I),I=1,21),J=1,6)
      WRITE OUTPUT TAPE61,71
      WRITE OUTPUT TAPE61,70,((VG(J,I),I=1,21),J=1,6)
      82  CONTINUE
      RETURN
      END

```

1260

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1290

SUBROUTINE SLFAB
 BETA PARTICLE SELF-ABSORPTION SUBROUTINE
 BANK(0),CHAIN1,/AA1/,/AA2/,READ1,XANDY,DIFF,INTZ,FLOUT,XQW,SLFAB,

1 OUT1
 BANK(1),/AA3/
 COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
 DIMENSION ICHN(4),ALPHA(8),FACT(20)
 COMMON /AA2/ OT1,PUT1,KL,EO,LCHN2,BY,H,UBR,VOL,WH,UBRI,CHEM,SKIP,

1 EQV,RMAX,AA2
 DIMENSION SKIP(2),AA2(3874)
 COMMON /AA3/ AA3
 DIMENSION AA3(32200)
 DIMENSION OT1(3300)

DIMENSION VG(6,21), CY(3, 2), CZ(3, 2),
 1 SIGY(21), SIGZ(31), ASGZ(21),
 2 X(21), YX(5,21), AREA(21, 5),
 3 RED(9,21), T1(8), T2(21),
 4 T3(21), FRAC(9), SIZE(9),
 5 PRTS(21), FALN(21, 5, 9), OMEGA(21, 5, 6),
 6 FALL(21, 5), XI(21, 5, 6), QOVRQ(6,21),
 7 FN(21)

EQUIVALENCE (OT1(1),ZZ),(OT1(2),VG(1)),
 1 (OT1(128),TENG),(OT1(129),RISE),
 2 (OT1(130),TAU),(OT1(131),XBAR),
 3 (OT1(132),TBAR),(OT1(133),HMAX),
 4 (OT1(134),UMAX),(OT1(135),UBAR),
 5 (OT1(136),XCON),(OT1(137),TCON),
 6 (OT1(138),RH),(OT1(139),SIGY(1)),
 7 (OT1(160),SIGZ(1)),(OT1(191),ASGZ(1)),
 8 (OT1(212),HMX),(OT1(213),TBRH),
 9 (OT1(214),XBRH),(OT1(215),CY(1)),
 1 (OT1(221),CZ(1)),(OT1(227),Y1),
 2 (OT1(228),Y2),(OT1(229),Y3),
 3 (OT1(230),Y4),(OT1(231),YY),
 4 (OT1(232),DEN),(OT1(233),FGAS),
 5 (OT1(234),FPAR),(OT1(235),ROP),
 6 (OT1(236),X(1)),(OT1(257),YX(1)),
 7 (OT1(362),AREA(1)),(OT1(467),RED(1)),
 8 (OT1(656),ENUC),(OT1(657),FIS),
 9 (OT1(658),SEC),(OT1(659),T1(1)),
 1 (OT1(667),T2(1)),(OT1(688),T3(1)),
 2 (OT1(709),FRAC(1)),(OT1(718),SIZE(1)),
 3 (OT1(727),PRTS(1)),(OT1(748),FALN(1)),
 4 (OT1(1693),OMEGA(1)),(OT1(2323),FALL(1)),
 5 (OT1(2428),XI(1)),(OT1(3058),QOVRQ(1)),
 6 (OT1(3184),FN(1))

DIMENSION PUT1(160), AYZ(8, 3, 4), GAM(9),
 1 VO(9), RMX(9), ALFA(7),
 2 BLFA(7), CLFA(7), DLFA(8),

3EO(9),BY(21,5),H(21),UBR(21)
 EQUIVALENCE (PUT1(1),AYZ(1)),(PUT1(97),GAM(1)),
 1 (PUT1(106),VO(1)),(PUT1(115),RMX(1)),
 2 (PUT1(124),ALFA(1)),(PUT1(131),BLFA(1)),
 3 (PUT1(138),CLFA(1)),(PUT1(145),DLFA(1))

DIMENSION GNU(5)
 LOG10F(X)=LOGF(X)/2.3

```

      DO 100 I=1,5
100  GNU(I)=18.6*DEN/((EO(I)-0.036)**1.37)
      DO 101 J=1,21
      DO 103 I=1,5
      C1=PRIS(J )*GNU(I)/2.0
      IF(C1-1.0)104,104,105
104  C2=C1/3.0
      GO TO 106
105  C2=1.0-((1.0+C1)*FEXP(1.0-C1)/3.0)
106  CONTINUE
      IF(C1-5.0)108,109,107
107  IF(C1-50.0)109,110,110
108  RED(I,J )=0.75*C2
      GO TO 103
109  RED(I,J )=C2*(0.75+(LOG10F(C1/5.0)*0.23))
      GO TO 103
110  RED(I,J )=0.96*C2
103  RED(I,J )=1.0-RED(I,J)
      DO 111 I=6,9
111  RED(I,J )=1.0
101  CONTINUE
      IF(SENSE SWITCH 1)81,82
70  FORMAT(1H ,9X, 5E20.4)
71  FORMAT(1HU)
81  WRITE OUTPUT TAPE61,71
      WRITE OUTPUT TAPE61,70, ((RED(I ,J),I=1,5) ,J=1,21)
82  CONTINUE
      RETURN
      END

```

```

SUBROUTINE OUT1
OUTPUT WRITING SUBROUTINE NO. 1
BANK(0),CHAIN1,/AA1/,/AA2/,READ1,XANDY,DIFF,INTZ,FLOUT,XQW,SLFAB,
1      OUT1
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ OT1,PUT1,KL,EO,LCHN2,RY,H,UBR,VOL,WH,UBRI,CHEM,SKIP,
1      EOV,RMAX,AA2
DIMENSION SKIP(2),AA2(3874)
COMMON /AA3/ AA3
DIMENSION AA3(32200)
DIMENSION OT1(3300)
DIMENSION
1      VG(      6,21),      CY(      3, 2),      CZ(      3, 2),
2      SIGY(      21),      SIGZ(      31),      ASGZ(      21),
3      X(      21),      YX(      5,21),      AREA(      21, 5),
4      RED(      9,21),      T1(      8),      T2(      21),
5      T3(      21),      FRAC(      9),      SIZE(      9),
6      PRTS(      21),      FALN( 21, 5, 9),      OMEGA( 21, 5, 6),
7      FALL(      21, 5),      XI( 21, 5, 6),      QOVRQ(      6,21),
      FN(      21)
EQUIVALENCE (OT1( 1),ZZ      ),(OT1( 2),VG(1)      ),
1      (OT1( 128),TENG      ),(OT1( 129),RISE      ),
2      (OT1( 130),TAU      ),(OT1( 131),XBAR      ),
3      (OT1( 132),TBAR      ),(OT1( 133),HMAX      ),
4      (OT1( 134),UMAX      ),(OT1( 135),UBAR      ),
5      (OT1( 136),XCON      ),(OT1( 137),TCON      ),
6      (OT1( 138),RH      ),(OT1( 139),SIGY(1)      ),
7      (OT1( 160),SIGZ(1)      ),(OT1( 191),ASGZ(1)      ),
8      (OT1( 212),HMX      ),(OT1( 213),TRRH      ),
9      (OT1( 214),XBRH      ),(OT1( 215),CY(1)      ),
1      (OT1( 221),CZ(1)      ),(OT1( 227),Y1      ),
2      (OT1( 228),Y2      ),(OT1( 229),Y3      ),
3      (OT1( 230),Y4      ),(OT1( 231),YY      ),
4      (OT1( 232),DEN      ),(OT1( 233),FGAS      ),
5      (OT1( 234),FPAR      ),(OT1( 235),ROP      ),
6      (OT1( 236),X(1)      ),(OT1( 257),YX(1)      ),
7      (OT1( 362),AREA(1)      ),(OT1( 467),RED(1)      ),
8      (OT1( 656),ENUC      ),(OT1( 657),FIS      ),
9      (OT1( 658),SEC      ),(OT1( 659),T1(1)      ),
1      (OT1( 667),T2(1)      ),(OT1( 688),T3(1)      ),
2      (OT1( 709),FRAC(1)      ),(OT1( 718),SIZE(1)      ),
3      (OT1( 727),PRTS(1)      ),(OT1( 748),FALN(1)      ),
4      (OT1(1693),OMEGA(1)      ),(OT1(2323),FALL(1)      ),
5      (OT1(2428),XI(1)      ),(OT1(3058),QOVRQ(1)      ),
6      (OT1(3184),FN(1)      )
DIMENSION PUT1(      160),      AYZ( 8, 3, 4),      GAM(      9),
1      VO(      9),      RMX(      9),      ALFA(      7),
2      BLFA(      7),      CLFA(      7),      DLFA(      8),
3FO(9),BY(21,5),H(21),UBR(21)
EQUIVALENCE (PUT1( 1),AYZ(1)      ),(PUT1( 97),GAM(1)      ),
1      (PUT1(106),VO(1)      ),(PUT1(115),RMX(1)      ),
2      (PUT1(124),ALFA(1)      ),(PUT1(131),BLFA(1)      ),
3      (PUT1(138),CLFA(1)      ),(PUT1(145),DLFA(1)      )
DIMENSION ALFA1(8)
DATA(ALFA1=8H1 HOUR ,8H2 HOURS ,8H8 HOURS ,8H1 DAY ,8H1 WEEK ,

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18H1 MONTH ,8H1 YEAR ,8HINFINITY)
  LOG10F(X)=LOGF(X)/2.3
100 FORMAT(1H0)
101 FORMAT(1H0,13X,17HMEAN WIND SPEED =,E10.3,11H METERS/SEC,
  110X,2HAT,E10.3,20H METERS ABOVE GROUND//14X,16HSTABILITY CLASS ,
  1A2,30X,16HCAPPING HEIGHT =,E10.3,7H METERS//
  1 14X,16HRELEASE HEIGHT =,E10.3,7H METERS,15X,20HMAXIMUM CLOUD R
  2ISE =, E10.3,7H METERS//13X, * EXCURSION POWER =*E10.3,9H FISSION
  3S, 12X,19HEQUIVALENT ENERGY =,E10.3,9H KILOTONS//14X,17HCHEMICA
  4L ENERGY =, E10.3,9H KILOTONS,12X,14HTOTAL ENERGY =,E10.3, 9H
  5KILOTONS)
102 FORMAT(1H0,22X,26HTOTAL NUMBER OF ISOTOPES =,I4)
103 FORMAT(1H0,19X, *LIBRARY TAPE USED IS*6A8,A2)
104 FORMAT(1H ,22X*WRITTEN BY *3A8,A6* ON * 2A8,A4)
105 FORMAT(1H ,22X*REVISED BY *3A8,A6* ON * 2A8,A4)
106 FORMAT(1H0,13X,23HMAXIMUM PARTICLE SIZE =,F10.3,8H MICRONS,7X,
  137HFRACTION OF NON-VOLATILES VAPORIZED =,2PF7.2,8H PERCENT)
107 FORMAT(1H0,39X,40HDISTANCE FROM CLOUD CENTERLINE IN METERS)
108 FORMAT(1H ,35X,48HAS A FUNCTION OF DOWNWIND AND CROSSWIND POSITION
  1//)
109 FORMAT(1H0,44X,29HI=DOWNWIND POSITION INDICATOR)
110 FORMAT(1H0,44X,30HJ=CROSSWIND POSITION INDICATOR)
111 FORMAT(1H0,44X,25HK=EXPOSURE TIME INDICATOR)
112 FORMAT(1H ,40X,I1,F16.3,5H SEC.,10X,A8)
113 FORMAT(1H0,22X*CHAIN 2 DELETED - ENTIRE CORE VAPORIZED*)
114 FORMAT(1H0,22X*CHAIN 2 DELETED - INSUFFICIENT ENERGY TO FRAGMENT C
  1ORF*)
120 FORMAT(1H0,13X, *PRODUCTION RATE =*E10.3,13H FISSIONS/SEC,8X,17HPR
  1ODUCTION TIME =,F10.3,8H SECONDS)
121 FORMAT(1H0,40X,1X ,17X,13HFXPOSURE TIME/41X,1HK)
122 FORMAT(1H ,10X,I2,6E16.4)
123 FORMAT(1H0,32X,53HVARIOUS PARAMETERS AS A FUNCTION OF DOWNWIND POS
  1ITION)
124 FORMAT(1H0,11X,99H          DISTANCE FROM
  1          CLOUD ARRIVAL  FALLOUT ARRIVAL)
125 FORMAT(1H ,11X,99HI          THE ORIGIN          SIGMA = Y          SIGMA = Z
  1          CLOUD HEIGHT          TIME          TIME          )
126 FORMAT(1H ,11X,99H          (METERS)          (METERS)          (METERS)
  1          (METERS)          (SECONDS)          (SECONDS)          //)
127 FORMAT(1H ,18X,I2,9X,F3.1,4X,4E16.4)
128 FORMAT(1H0,19X,76H J          1          2          3
  1          4          5/20X,1HI//)
129 FORMAT(1H0,13X,17HMATERIAL VOLUME =,E10.3,18H CUBIC CENTIMETERS,
  1 3X,18HMATERIAL DENSITY =,F10.3,9H GRAMS/CC)
130 FORMAT(1H0,44X,31HL=PARTICLE SIZE RANGE INDICATOR)
131 FORMAT(1H ,34X,I1,E20.4,12H MICRONS TO ,F11.4,8H MICRONS)
132 FORMAT(1H0,55X,19HPARTICLE SIZE RANGE/35X,1HL)
133 FORMAT(1H0,13X,29HFRACTION OF GASES RELEASED = ,2PF6.2,8H PERCENT,
  15X,30HFRACTION OF SOLIDS RELEASED = ,2PF6.2,8H PERCENT)
  RMAX=RMAX*(10.0**4)
  KCHK=0
  ITPS=1
  IF(UNIT,1)3001,2011
3001 KCHK=KCHK+1
  IF(KCHK-10**6)3011,4000,4000
2011 ASSIGN 3011 TO M

```

```

GO TO (2001,2002,2003,2004,2005,2006,3011),ITPS
3011 CONTINUE
CALL PAGE
I1=IMAX-1
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,103,(ALFA(I),I=1,7)
WRITE OUTPUT TAPE 61,104,(RLFA(I),I=1,7)
WRITE OUTPUT TAPE 61,105,(CLFA(I),I=1,7)
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,102,I1
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,109
WRITE OUTPUT TAPE 61,110
WRITE OUTPUT TAPE 61,111
WRITE OUTPUT TAPE 61,130
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,121
DO 301 J=1,8
301 WRITE OUTPUT TAPE 61,112,J,T1(J),ALFA1(J)
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,132
IF(UNIT,1)3002,2012
3002 KCHK=KCHK+1
IF(KCHK-10**6)3012,4000,4000
2012 ASSIGN 3012 TO M
GO TO (2001,2002,2003,2004,2005,2006,3012),ITPS
3012 CONTINUE
DO 400 I=1,9
IF(I-1)401,401,402
401 C1=RMX(I)*0.5E4
GO TO 403
402 C1=RMX(I-1)
C2=LOG10F(C1)+4.01
C1=C1*1.0E4
I2=C2
C1=C1+(10.0**((I2-3)))
403 CONTINUE
C2=RMX(I)*1.0E4
400 WRITE OUTPUT TAPE 61,131,I,C1,C2
IF(UNIT,1)3003,2013
3003 KCHK=KCHK+1
IF(KCHK-10**6)3013,4000,4000
2013 ASSIGN 3013 TO M
GO TO (2001,2002,2003,2004,2005,2006,3013),ITPS
3013 CONTINUE
CALL PAGE
GO TO (4119,4116,4117),LCHN2
4116 WRITE OUTPUT TAPE 61,113
GO TO 4118
4117 WRITE OUTPUT TAPE 61,114
GO TO 4118
4119 WRITE OUTPUT TAPE 61,100
4118 WRITE OUTPUT TAPE 61,100
IF(UNIT,1)3004,2014
3004 KCHK=KCHK+1
IF(KCHK-10**6)3014,4000,4000

```

```

2014 ASSIGN 3014 TO M
GO TO (2001,2002,2003,2004,2005,2006,3014),ITPS
3014 CONTINUE
WRITE OUTPUT TAPE 61,101,UBRI,WH,DLFA(KL),HMX,RH,HMAX,ENUC,EQV,CHEM
1,IFNG
WRITE OUTPUT TAPE 61,120,FIS,SEC
WRITE OUTPUT TAPE 61,106,RMAX,ROP
WRITE OUTPUT TAPE 61,129,VOL,DEN
WRITE OUTPUT TAPE 61,133,FGAS,FPAR
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,123
WRITE OUTPUT TAPE 61,124
WRITE OUTPUT TAPE 61,125
WRITE OUTPUT TAPE 61,126
IF(UNIT,1)3005,2015
3005 KCHK=KCHK+1
IF(KCHK-10**6)3015,4000,4000
2015 ASSIGN 3015 TO M
GO TO (2001,2002,2003,2004,2005,2006,3015),ITPS
3015 CONTINUE
DO 201 I= 1,21
IF(T3(I))203,203,202
202 WRITE OUTPUT TAPE 61,122,I,X(I),SIGY(I),SIGZ(I),H(I),T2(I),T3(I)
GO TO 201
203 WRITE OUTPUT TAPE 61,122,I,X(I),SIGY(I),SIGZ(I),H(I),T2(I)
201 CONTINUE
IF(UNIT,1)3006,2016
3006 KCHK=KCHK+1
IF(KCHK-10**6)3016,4000,4000
2016 ASSIGN 3016 TO M
GO TO (2001,2002,2003,2004,2005,2006,3016),ITPS
3016 CONTINUE
CALL PAGE
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,100
WRITE OUTPUT TAPE 61,107
WRITE OUTPUT TAPE 61,108
WRITE OUTPUT TAPE 61,128
IF(UNIT,1)3007,2017
3007 KCHK=KCHK+1
IF(KCHK-10**6)3017,4000,4000
2017 ASSIGN 3017 TO M
GO TO (2001,2002,2003,2004,2005,2006,3017),ITPS
3017 CONTINUE
C1=0.0001
DO1202 I= 1,21
1202 WRITE OUTPUT TAPE 61,127,I,C1,(YX(K,I),K=2,5)
3010 IF(UNIT,1)3008,2018
3008 KCHK=KCHK+1
IF(KCHK-10**6)3010,4000,4000
2018 ASSIGN 3010 TO M
GO TO (2001,2002,2003,2004,2005,2006,3009),ITPS
2001 BUFFER OUT (1,1) (OT1( 1),OT1( 231))
GO TO 2007

```

2002 BUFFER OUT (1,1) (OT1(232),OT1(655))
GO TO 2007
2003 BUFFER OUT (1,1) (OT1(656),OT1(708))
GO TO 2007
2004 BUFFER OUT (1,1) (OT1(709),OT1(1692))
GO TO 2007
2005 BUFFER OUT (1,1) (OT1(1693),OT1(2427))
GO TO 2007
2006 BUFFER OUT (1,1) (OT1(2428),OT1(3204))
2007 ITPS=ITPS+1
KCHK=0
GO TO M,(3011,3012,3013,3014,3015,3016,3017,3010)
4000 CALL ERROR (5,1)
3009 RETURN
END

PROGRAM CHAIN2

RANK(0),CHAIN2,AA1/,AA2/,PRODUCE,RKLEQ,CALC1,CONC1

RANK(1),AA3/

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/PUT2,PUT3,AL,KSIP,A,B,C3,J1,IN1,K8,ITM1,ITM2,ITM3,ITMS

1 ,ITAP,SKIP,ICAL,IWRT,KCHK,KOT1,KOT2,KOMX,KDEL,T,T4,TD,

2 DT,IT,ICLK,AA2

COMMON /AA3/ C,D,AA3

DIMENSION ICHK(80),AA2(5547),AA3(40)

EQUIVALENCE (PUT2(1),IP(1)), (PUT2(604),Y(1)), (PUT3(1),ENUC),

1 (PUT3(2),FIS), (PUT3(3),SEC),

1 (PUT3(4),T1(1)), (PUT3(12),T2(1)), (PUT3(33),T3(1)

2)

DIMENSION PUT2(1210),PUT3(60),AL(201),C(201,80),D(16080)

DIMENSION IP(201,3),Y(201,3),T1(8),T2(21),T3(21),T4(3,3)

DIMENSION A(10),B(10),C3(11,11),IN1(10),K8(10),T(80),SKIP(4)

TYPE DOUBLE A,C3

SENSE LIGHT 1

SENSE LIGHT 2

REWIND 1

REWIND 2

REWIND 3

REWIND 4

REWIND 9

I1=1

I9=1

J1=2

J9=4

K1=0

K9=0

8 IF(I9-J9)9,9,12

9 IF(UNIT,9)10,11,901,901

10 K9=K9+1

IF(K9-10**6)13,902,902

11 BUFFER 14 (9,1) (SKIP(1),SKIP(2))

K9=0;I9=I2+1

GO TO 13

12 IF(I1-J1)14,14,50

13 IF(I1-J1)14,14,8

14 IF(UNIT,1)15,16,903,903

15 K1=K1+1

IF(K1-10**6)8,904,904

16 BUFFER 14 (1,1) (SKIP(3),SKIP(4))

K1=0;I1=I1+1

GO TO 8

50 I1=1;I9=1;J1=1;J9=3;K1=0;K9=0

51 IF(UNIT,2)52,50,901,901

52 K9=K9+1

IF(K9-10**6)75,902,902

53 GO TO (54,58,60,75),I9

54 BUFFER 14 (9,1) (PUT2(202),PUT2(1206))

GO TO 65

58 BUFFER 14 (9,1) (AL(1),AL(201))

GO TO 65

60 BUFFER 14 (9,1) (T4(1,1),T4(3,3))

```

65 K2=0.619=19+1
75 IF(UNIT,1)76,80,903,903
76 K1=K1+1
   IF(K1-10**6)51,904,904
80 IF(I1-1)92,92,91
81 IF(I9-3)51,51,90
82 BUFFER IN (1,1) (PUT3(1),PUT3(53))
   K1=0.511=11+1
   GO TO 51
90 REWIND 1$REWIND 9
   DO 91 I=1,80
91 ICHK(I)=0
   CALL PRODUCE
   ITAP=2$KSTP=1$KCHK=ITMS=0
   IF(ICHN(1))200,200,100
100 ITM1=0.51ITM2=1$K1=0$K2=0
101 DO 102 I=1,80
   DO 102 J=1,201
102 C(J,I)=0.0
103 K1=K1+1
   IF(T3(K1))104,104,105
104 IF(K1-21)103,110,110
105 K2=K2+1
   I(K2)=T3(K1)
   DO 106 I=1,8
   K2=K2+1
106 I(K2)=T3(K1)+I1(I)
   IF(K2-72)103,110,110
110 ITM3=K2
   IF(ITM3)200,200,100
100 CALL CALG1
111 IF(KSTP)112,112,120
112 IF(UNIT,1-ITAP)113,114
113 KCHK=KCHK+1
   IF(KCHK-1000)112,900,900
114 KOT1=KOT2+1
   IF(KOT1-KOMX)125,125,126
126 KSTP=1$GO TO 127
125 KOT2=KOT1+KDEL-1
   BUFFER OUT (ITAP,1) (D(KOT1),D(KOT2))
127 KCHK=0
   GO TO 111
120 KOMX=K2*201$KDEL=1809$KSTP=K2=KOT2=0
   DO 124 J=1,ITM3
   DO 124 I=1,201
   K=I+201*(J-1)
124 C(K)=C(I,J)*AL(I)
   IF(K1-21)123,200,200
123 IF(T3(K1+1))200,200,101
200 IF(ICHN(2))300,300,201
201 ITM1=0.51ITM2=1$K1=0$K2=0
202 DO 203 I=1,80
   DO 203 J=1,201
203 C(J,I)=0.0
   DO 206 I=1,10
   K2=K2+1

```

```

      IF (T3(1)) 201, 204, 205
204  C1=T2(1)
      GO TO 205
205  C1=MIN1F(T2(1), T3(1))
206  T(K2)=C1
      GO TO 211
207  K1=K1+1
      IF (K1-21) 208, 208, 215
208  IF (T3(K1)) 209, 209, 210
209  C1=T2(K1)
      GO TO 211
210  C1=MIN1F(T2(K1), T3(K1))
211  IF (K1-10) 213, 213, 212
212  K2=K2+1
      T(K2)=C1
213  DO 214 I=1, 8
      K2=K2+1
214  T(K2)=C1+T1(I)
      IF (K1-10) 207, 215, 220
220  IF (K2-72) 207, 215, 215
215  ITM3=K2
      CALL CAL01
216  IF (KSTP) 217, 217, 228
217  IF (UNIT, ITAP) 218, 219
218  KCHK=KCHK+1
      IF (KCHK-1000) 217, 900, 900
219  KOT1=KOT1+1
      IF (KOT1-KOMX) 232, 232, 233
233  KSTP=15G) TO 240
232  KOT2=KOT1+KDEL-1
      3JEFLR OJF (ITAP, 1) (D(KOT1), D(KOT2))
240  KCHK=0
      GO TO 216
228  IF (ITAP-2) 229, 229, 230
229  ITAP=33K)EL=2010
      GO TO 230
230  IF (K1-10) 501, 501, 502
501  KDEL=150)
      GO TO 230
502  KDEL=180)
236  KOMX=K2+201, KSTP=K2=KOT2=0
      DO 251 J=1, ITM3
      DO 251 I=1, 201
      K=I+201*(J-1)
234  D(K)=C(1, J)*AL(1)
503  IF (K1-21) 234, 300, 300
234  DO 235 I=1, 80
      DO 235 J=1, 201
235  C(J, I)=0.0
      GO TO 207
300  IF (JCHN(3)) 400, 400, 301
501  ITM1=15 ITM2=25 ITMS=185 K1=0 K2=0
302  DO 303 I=1, 80
      DO 303 J=1, 201
303  C(J, I)=0.0
304  K1=K1+1

```

```

IF(K1-21)305,305,308
305 K2=K2+1
T(K2)=T2(K1)
DO 307 I=1,8
K2=K2+1
307 T(K2)=T2(K1)+T1(I)
DO 306 I1=1,3
DO 306 I2=1,3
K2=K2+1
306 T(K2)=T2(K1)+T4(I2,I1)
IF(K2-72)304,308,308
308 ITM3=K2
I1=ITM3-1
ICLK(ITM3)=0
DO 370 I=1,I1
ICLK(I)=0
IF(T(I))370,370,352
352 L3=I+1
DO 365 K=L3,ITM3
J=ITM3+L3-K
IF(T(J))365,365,355
355 IF(T(I)-T(J))365,356
356 ICHK(I)=J$GO TO 370
365 CONTINUE
370 CONTINUE
CALL CALC1
309 IF(KSTP)310,310,318
310 IF(UNIT,ITAP)311,312
311 KCHK=KCHK+1
IF(KCHK-1000)310,900,900
312 KOT1=KOT2+1
IF(KOT1-KUMX)322,322,323
323 KSTP=1$GO TO 324
322 KOT2=KOT1+KDEL-1
BUFFER OUT (ITAP,1) (D(KOT1),D(KOT2))
324 KCHK=0
GO TO 302
318 IF(ITAP-3)319,319,320
319 ITAP=4
320 KUMX=K2=201$KDEL=3618$KSTP=K2=KOT2=0
DO 321 J=1,ITM3
IF(ICLK(J))371,371,372
371 L=J$GO TO 373
372 L=ICLK(J)
373 DO 321 I=1,201
K=I+201*(J-1)
321 Y(K)=G(I,L)*AL(I)
IF(K1-21)302,400,400
400 IF(KSTP)401,401,1000
401 IF(UNIT,ITAP)402,403
402 KCHK=KCHK+1
IF(KCHK-10**6)401,900,900
403 KOT1=KOT2+1
IF(KOT1-KUMX)404,404,405
405 KSTP=1$GO TO 406
404 KOT2=KOT1+KDEL-1

```



```
----- BUFFER OUT (ITAP,1) (D(KOT1),D(KOT2))
406 KCHK=0
----- GO TO 403
900 CALL ERROR(5,ITAP)
901 CALL ERROR (1,9)
902 CALL ERROR (4,9)
903 CALL ERROR (1,1)
904 CALL ERROR (4,1)
1000 END FILE 2
      END FILE 3
      END FILE 4
      REWIND 2
      REWIND 3
      REWIND 4
      RETURN
      END
```

SUBROUTINE PRODUCE

RANK(0),CHAIN2,AA1,AA2,PRODUCE,RKLEQ,CALC1,CONC1

RANK(1),AA3

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/PUT2,PUT3,AL,KSTP,A,B,C3,J,IN1,K8,ITM1,ITM2,ITM3,ITMS

1 ITAP,SKIP,ICAL,IWRT,KCHK,KOT1,KOT2,KOMX,KDEL,T,T4,TD,

2 DT,NT,ICLK,AA2

COMMON /AA3/ C,D,AA3

DIMENSION ICHK(80),AA2(5547),AA3(40)

EQUIVALENCE (PUT2(1),IP(1)), (PUT2(604),Y(1)), (PUT3(1),FNUC),

1 (PUT3(2),FIS), (PUT3(3),SEC),

1 (PUT3(4),T1(1)), (PUT3(12),T2(1)), (PUT3(33),T3(1)

2)

DIMENSION PUT2(1210),PUT3(60),AL(201),C(201,80),D(16080)

DIMENSION IP(201,3),Y(201,3),T1(8),T2(21),T3(21),T4(3,3)

DIMENSION A(10),B(10),C3(11,11),IN1(10),K8(10),I(80),SKIP(4)

TYPE DOUBLE A,(3

DIMENSION F(201),Q(201),CZERO(201)

EQUIVALENCE (C(1) ,F(1)), (C(202) ,Q(1)), (C(406) ,CZERO(1))

TD=0.0

DT=2.0*IN1F(SEC/10.)+2.0

DT=SEC/DT

DO 10 I=1,IMAX

10 CZERO(1)=0.0

IF(SEC)100,100,11

11 IF(FIS)100,100,12

12 NT=0

13 DO 50 I=2,IMAX

F(I)=-AL(I)*CZERO(I)+Y(I,1)*FIS

DO 50 J=2,3

IJ=IP(I,J)

IF(IJ-1)50,50,12

42 F(I)=F(I)+Y(I,J)*CZERO(IJ)+AL(I)

50 CONTINUE

CALL RKLEQ(S)

IF(S-1.0)51,51,13

51 IF(TD-SEC)13,100,100

100 DO 103 I=2,IMAX

Y(I,1)=FNUC*Y(I,1)+CZERO(I)

IF(Y(I,1))102,102,101

101 IP(I,1)=1

GO TO 103

102 IP(I,1)=0

103 CONTINUE

RETURN

END

```

SUBROUTINE RKLEDEQ (S)
  RANK(0),CHAIN2,/AA1/,/AA2/,PRODUCE,RKLEDEQ,CALC1,CONC1
  RANK(1),/AA3/
  COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
  DIMENSION ICHN(4),ALPHA(8),FACT(20)
  COMMON /AA2/PUT2,PUT3,AL,KSTP,A,B,C3,J1,IN1,K8,ITM1,ITM2,ITM3,ITMS
  1      ,ITAP,SKIP,ICAL,IWRT,KCHK,KOT1,KOT2,KOMX,KDEL,T,T4,TD,
  2      DT,NT,ICLK,AA2
  COMMON /AA3/ C,D,AA3
  DIMENSION ICHK(80),AA2(5547),AA3(40)
  EQUIVALENCE( (PUT2(1),IP(1) ), (PUT2(604),Y(1) ), (PUT3(1),ENUC),
  1      (PUT3(2),FIS), (PUT3(3),SEC),
  1      (PUT3(4),T1(1)), (PUT3(12),T2(1)), (PUT3(33),T3(1))
  2 )
  DIMENSION PUT2(1210),PUT3(60),AL(201),G(201,80),D(16080)
  DIMENSION IP(201,3),Y(201,3),T1(8),T2(21),T3(21),T4(3,3)
  DIMENSION A(10),B(10),C3(11,11),IN1(10),K8(10),T(80),SKIP(4)
  TYPE DOUBLE A,C3
  DIMENSION F(201),Q(201),CZERO(201)
  EQUIVALENCE(C(1),F(1)),(C(202),Q(1)),(C(403),CZERO(1))
  NT=NT*1
  GO TO (1,2,3,4),NT
  1 DO 11 I=2,IMAX
  11 Q(I)=0.0
  C1=0.5
  TD=TD+DT/2.0
  GO TO 5
  2 C1=0.29249324881
  GO TO 5
  3 C1=1.70/1067812
  TD=TD+DT/2.0
  GO TO 5
  4 C1=DT/6.0
  DO 41 I=2,IMAX
  41 CZERO(I)=CZERO(I)+DT*F(I)/6.0+Q(I)/3.0
  IT=0
  S=2.0
  GO TO 6
  5 C2=2.0+C1*DT
  C3=1.0-3.0*C1
  DO 51 I=2,IMAX
  CZERO(I)=CZERO(I)+C1*(DT*F(I)-Q(I))
  51 Q(I)=C2*F(I)+C3*Q(I)
  S=1.0
  6 RETURN
  END

```

----	SUBROUTINE CALC1	
----	GENERALIZED DECAY CHAIN CALCULATION SUBROUTINE	0020
----	RANK(0),CHAIN2, /AA1/, /AA2/, PRODUCE, RKLREQ, CALC1, CONC1	
----	RANK(1), /AA3/	
----	COMMON /AA1/ ICHN, IPAGE, ALPHA, I12, IMAX, I21, FACT, PI, TMS	
----	DIMENSION ICHN(4), ALPHA(8), FACT(20)	
----	COMMON /AA2/ PUT2, PUT3, AL, KSTP, A, B, C3, J1, IN1, K8, ITM1, ITM2, ITM3, ITMS	
1	, ITAP, SKIP, ICAL, IWR, KCHK, KOT1, KOT2, KOMX, KDEL, T, T4, TD,	
2	LT, NT, ICHK, AA2	
----	COMMON /AA3/ C, D, AA3	
----	DIMENSION ICHK(80), AA2(5547), AA3(40)	
----	EQUIVALENCE (PUT2(1), IP(1)), (PUT2(64), Y(1)), (PUT3(1), ENUC),	
1	(PUT3(2), F15), (PUT3(3), SEC),	
1	(PUT3(4), T1(1)), (PUT3(12), T2(1)), (PUT3(33), T3(1))	
2		
----	DIMENSION PUT2(1210), PUT3(60), AL(201), C(201, 80), D(16080)	
----	DIMENSION IP(201, 3), Y(201, 3), T1(8), T2(21), T3(21), T4(3, 3)	
----	DIMENSION A(10), B(10), C3(11, 11), IN1(10), K8(10), T(80), SKIP(4)	
----	TYPE DOUBLE A, C3	
----	DO 100 I1=2, IMAX	
----	IF(SENSE SWITCH 6) 5001, 5002	
0	CALL OTND	
00	CONTINUE	
	J1=11	1130
----	IF(KSTP) 701, 701, 750	
7	IF(UNIT, ITAP) 702, 703	
702	KCHK=KCHK+1	
	IF(KCHK-1000) 750, 900, 900	
7	KOT1=KOT1+1	
	IF(KOT1-KOMX) 751, 751, 752	
752	KSTP=1360 TO 753	
7	KOT2=KOT1+KDEL-1	
----	BUFFER OUT (ITAP, 1) (D(KOT1), D(KOT2))	
753	KCHK=0	
7	CONTINUE	
	DO 2 I=1, 10	1160
----	B(I)=0.0	1170
----	A(I)=0.00	
----	A(1)=AL(J1)	
	DO 101 I2=1, 3	1200
----	J2=IP(J1, I2)	1210
	IF(J2) 101, 101, 200	1220
201	B(1)=Y(J1, I2)	1230
	IF(J2-1) 201, 201, 202	1240
2	CALL CONC1 (1)	
	GO TO 101	1260
202	A(2)=AL(J2)	
	DO 102 I3=1, 3	1280
----	J3=IP(J2, I3)	1290
	IF(J3) 102, 102, 203	1300
203	B(2)=Y(J2, I3)	1310
	IF(J3-1) 204, 204, 205	1320
2	CALL CONC1 (2)	
	GO TO 102	1340
2	A(3)=AL(J3)	
	DO 103 I4=1, 3	1360

J4=IP(J3,14)	1370
IF(J4)103,103,206	1380
206 R(3)=Y(J3,14)	1390
IF(J4-1)207,207,208	1400
207 CALL CONG1 (3)	
GO TO 103	1420
208 A(4)=AL(J4)	
DO 104 I5=1,3	1440
J5=IP(J4,I5)	1450
IF(J5)104,104,209	1460
209 R(4)=Y(J4,I5)	1470
IF(J5-1)210,210,211	1480
210 CALL CONG1 (4)	
GO TO 104	1500
211 A(5)=AL(J5)	
DO 105 I6=1,3	1520
J6=IP(J5,I6)	1530
IF(J6)105,105,212	1540
212 R(5)=Y(J5,I6)	1550
IF(J6-1)213,213,214	1560
213 CALL CONG1 (5)	
GO TO 105	1580
214 A(6)=AL(J6)	
DO 106 I7=1,3	1600
J7=IP(J6,I7)	1610
IF(J7)106,106,215	1620
215 R(6)=Y(J6,I7)	1630
IF(J7-1)216,216,217	1640
216 CALL CONG1 (6)	
GO TO 106	1660
217 A(7)=AL(J7)	
DO 107 I8=1,3	1680
J8=IP(J7,I8)	1690
IF(J8)107,107,218	1700
218 R(7)=Y(J7,I8)	1710
IF(J8-1)219,219,220	1720
219 CALL CONG1 (7)	
GO TO 107	1740
220 A(8)=AL(J8)	
DO 108 I9=1,3	1760
J9=IP(J8,I9)	1770
IF(J9)108,108,221	1780
221 R(8)=Y(J8,I9)	1790
IF(J9-1)222,222,223	1800
222 CALL CONG1 (8)	
GO TO 108	1820
223 A(9)=AL(J9)	
DO 109 I11=1,3	
J11=IP(J9,I11)	
IF(J11)109,109,224	
224 R(9)=Y(J9,I11)	
IF(J11-1)225,225,226	
225 CALL CONG1 (9)	
GO TO 109	1900
226 A(10)=AL(J11)	
R(10)=Y(J11,1)	

CALL CONC1 (10)

109 CONTINUE	1940
108 CONTINUE	1950
107 CONTINUE	1960
106 CONTINUE	1970
105 CONTINUE	1980
104 CONTINUE	1990
103 CONTINUE	2000
102 CONTINUE	2010
101 CONTINUE	2020
100 CONTINUE	2030
RETURN	2040
900 CALL ERROR (4,ITAP)	
END	2050

SUBROUTINE CONC1 (K)		
GENERALIZED BAILEMAN EQUATION SUBROUTINE		0020
RANK(0),CHAIN2, /AA1/, /AA2/, PRODUCE, RKLDEQ, CALC1, CONC1		
RANK(1), /AA3/		
COMMON /AA1/ ICHN, IPAGE, ALPHA, I12, IMAX, I21, FACT, PI, TMS		
DIMENSION ICHN(4), ALPHA(8), FACT(20)		
COMMON /AA2/ PUT2, PUT3, AL, KSTP, A, B, C3, J1, IN1, K8, ITM1, ITM2, ITM3, ITMS		
, ITAP, SKIP, ICAL, IWRT, KCHK, KOT1, KOT2, KOMX, KDEL, T, T4, TD,		
DI, NT, ICHK, AA2		
COMMON /AA3/ C, D, AA3		
DIMENSION ICHK(30), AA2(5547), AA3(40)		
EQUIVALENCE (PUT2(1), IP(1)), (PUT2(604), Y(1)), (PUT3(1), ENUC),		
(PUT3(2), FIS), (PUT3(3), SEC),		
1	(PUT3(4), T1(1)), (PUT3(12), T2(1)), (PUT3(33), T3(1))	
)		
DIMENSION PUT2(1210), PUT3(60), AL(201), C(201,80), D(16080)		
DIMENSION IP(201,3), Y(201,3), T1(8), T2(21), T3(21), T4(3,3)		
DIMENSION A(10), B(10), C3(11,11), IN1(10), K8(10), T(80), SKIP(4)		
TYPE DOUBLE A, C3		
TYPE DOUBLE D1, D2, D3		
IF(K-1) 150, 150, 151		1180
0	10 400 L1=1, ITM3	
IF(ICHK(L1)) 400, 153		
3	C8=T(L1)*A(1)	
IF(T(L1)) 601, 400, 1601		
1	C4=FFEXP(C8)*B(1)	
30	10 401	
1	C4=FFEXP(-C8)*B(1)	
C4=(C(1)-C4)/A(1)		
1	C(J1,L1)=C(J1,L1)+C4	
0	CONTINUE	
RETURN		
1	10 2 J=1, 10	
2	IN1(J)=0	1170
T1=1.0		
0	10 100 K1=2, K	1270
0	C1=C1* A(K1)	
00	40 K1=1, K	1290
00	C3(K1,K1)=1.00	
K4=K-1		1310
00	41 K1=1, K4	1320
K5=K1+1		1330
0	41 K2=K5, K	1340
C3(K1,K2)=A(K2)-A(K1)		
1	C3(K2,K1)=-C3(K1,K2)	
0	42 K1=1, K	1370
03	(K1,11)=1.00	
00	42 K2=1, K	1390
F(IN1(K1)) 55, 55, 42		1400
5	F(C3(K1,K2)) 45, 52	
2	IF(K1-K2) 53, 42, 42	1440
3	IN1(K1)=K2	1450
T0 42		1460
3	C3(K1,11)=C3(K1,11)* C3(K1,K2)	
2	CONTINUE	1480
K2=K-1		

```

00 71 K1=1,K2
IF(IN1(K1))71,71,72
72 K3=IN1(K1)
73 IF(IN1(K3))71,74,75
74 IN1(K3)=-1 GO TO 71
75 K3=IN1(K3) GO TO 73
71 CONTINUE
00 500 L1=1,ITM3
IF(IGMK(L1))500,302
302 J3=0,0D
00 101 K1=1,K
IF(IN1(K1))101,102,101
102 D1=T(L1)*A(K1)
IF(T(L1))614,500,1614
614 IF(D1+600.0)101,101,611
611 D2=DEXP(D1)/C3(K1,11)
613 J3=D3+D2 GO TO 101
1614 IF(D1-600.0)1611,1612,1612
1611 D2=DEXP(-D1)/C3(K1,11)
GO TO 1613
1612 D2=0,0D
1613 J3=D3+((1.0D/C3(K1,11))-D2)/A(K1)
101 CONTINUE
00 105 K1=1,10
105 K8(K1)=K1
00 60 K1=1,K
IF(K1-K8(K1))60,64,60
64 IF(IN1(K1))60,60,61
61 K2=1
K3=IN1(K1)
K8(K3)=0
63 IF(IN1(K3))70,70,62
62 K3=IN1(K3)
K2=K2+1
K8(K3)=0
GO TO 63
70 D1=T(L1)*A(K1)
IF(T(L1))622,500,1622
622 D2=((-T(L1))**K2)/FACT(K2)
IF(D1+600.0)60,60,621
621 D3=D3+((DEXP(-D1)*D2/C3(K1,11))
GO TO 60
622 D2=1,0D
00 65 K3=1,K2
65 D2=D2+((1.0/FACT(K3))*((-D1)**K3)
IF(D1-600.0)625,1621,1621
1621 D2=1,0D GO TO 626
625 D2=1,0D-(D2*DEXP(-D1))
623 D2=D2/(A(K1)**(K2+1)*C3(K1,11))
D3=D3+D2
60 CONTINUE
C4=1,0
00 103 K1=1,K
103 C4=C4*B(K1)
C4=C4+C1*D3
152 C(J1,L1)=C(J1,L1)+C4

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1800

1970
1980
1990

204 CONTINUE
205 RETURN
206 END

2040

2070

```

PROGRAM CHAIN3
BANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1 INGEST,IDOUT
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5,SKIP,GAS,PAR,AL,TM,REM,EM,
1 GNU,DBAR,RD,DOS,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(1454),AA3(15954)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),RUP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1) ),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1) ),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALI( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 ER( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),ER(1) ),(PUT6(5070),F2(1) )
DIMENSION GNU(201),DBAR(201),RD(9,201),DOS(9)
REWIND 1
REWIND 2
REWIND 3
REWIND 4
REWIND 9
SENSE LIGHT 0
SENSE LIGHT 3
I1=1$I9=1$J1=1$J9=3$K1=0$K9=0
11 IF(I9-J9)12,12,15
12 IF(UNIT,9)13,14,900,900
13 K9=K9+1
IF(K9-10**6)16,901,901
14 BUFFER IN (9,1) (SKIP(1),SKIP(2))
K9=0$I9=I9+1
GO TO 16
15 IF(I1-J1)17,17,50

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16 IF(I1-J1)17,17,11
17 IF(UNIT,1)18,19,902,902
18 K1=K1+1
   IF(K1-10**6)11,903,903
19 BUFFER IN (1,1) (SKIP(3),SKIP(4))
   K1=0$I1=I1+1
   GO TO 11
50 I1=1$I9=1$J1=5$J9=6$K1=0$K9=0
51 IF(UNIT,9)52,53,900,900
52 K9=K9+1
   IF(K9-10**6)75,901,901
53 GO TO (57,59,54,55,56,58,75),19
57 BUFFER IN (9,1) (EM(1),EM(9))
   GO TO 65
59 BUFFER IN (9,1) (SKIP(1),SKIP(2))
   GO TO 65
54 BUFFER IN (9,1) (AL(1),AL(201))
   GO TO 65
55 BUFFER IN (9,1) (TM(1,1),TM(3,3))
   GO TO 65
56 BUFFER IN (9,1) (PUT6(1),PUT6(2238))
   GO TO 65
58 BUFFER IN (9,1) (PUT6(2239),PUT6(5672))
65 K9=0$I9=I9+1
75 IF(UNIT,1)76,80,902,902
76 K1=K1+1
   IF(K1-10**6)51,903,903
80 IF(I1-J1)82,82,81
81 IF(I9-J9)51,51,90
82 GO TO (83,84,85,86,87,51),11
83 BUFFER IN (1,1) (PUT5(1),PUT5(424))
   GO TO 88
84 BUFFER IN (1,1) (SKIP(3),SKIP(4))
   GO TO 88
85 BUFFER IN (1,1) (PUT5(425),PUT5(1408))
   GO TO 88
86 BUFFER IN (1,1) (PUT5(1409),PUT5(2143))
   GO TO 88
87 BUFFER IN (1,1) (PUT5(2144),PUT5(2920))
88 K1=0$I1=I1+1
   GO TO 51
90 REWIND 1$REWIND 9
   CALL GSFR
   IF(SENSE SWITCH 2)95,101
101 IF(SENSE SWITCH 3)63,102
102 IF(SENSE SWITCH 4)67,103
103 IF(ICHN(1))60,60,95
   95 CALL SBETA
   60 IF(ICHN(2))96,96,63
   63 CALL GRDOS
   96 IF(ICHN(3))70,70,67
   67 CALL INDOS
   CALL INGEST
   IF(SENSE SWITCH 6)68,69
   68 CALL UTND
   69 CALL IDOUI

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      GO TO 70
900 CALL ERROR(1,9)
901 CALL ERROR(4,9)
902 CALL ERROR(1,1)
903 CALL ERROR(4,1)
70  REWIND 1
    REWIND 2
    REWIND 3
    REWIND 4
    REWIND 9
    RETURN
    END
```

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C SUBROUTINE GSFR
SUBROUTINE TO CALCULATE GASEOUS AND PARTICULATE RELEASE FRACTIONS
RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1 INGEST,IDOUT
RANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5,SKIP,GAS,PAR,AL,TM,REM,EM,
1 GNU,DBAR,RD,DOS,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(1454),AA3(15954)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 EB( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),EB(1) ),(PUT6(5070),F2(1))
DIMENSION GNU(201),DBAR(201),RD(9,201),DOS(9)
DO 802 I=2,IMAX
IF (IGS(I))803,803,804
803 GAS(I)=FGAS
PAR(I)=(1.0-FGAS)*FPAR
GO TO 802
804 GAS(I)=ROP
PAR(I)=(1.0-ROP)*FPAR
802 REM(I)=1.0-GAS(I)-PAR(I)
RETURN
END

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SUBROUTINE SBETA
C SINGLE PARTICLE BETA DOSE CALCULATING SUBROUTINE
BANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1 INGEST,IDOUT
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5,SKIP,GAS,PAR,AL,TM,REM,EM,
1 GNU,DBAR,RD,DOS,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(1454),AA3(15954)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 EB( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),EB(1) ),(PUT6(5070),F2(1))
DIMENSION GNU(201),DBAR(201),RD(9,201),DOS(9)
LOG10F(X)=LOGF(X)/2.3
10 FORMAT(/*FROM THIS POINT SET SENSE SWITCH 2 FOR RESTART*/)
WRITE OUTPUT TAPE 20,10
500 FORMAT(1H0)
501 FORMAT(1H ,24X,69HSINGLE PARTICLE BETA SKIN DOSE AS A FUNCTION OF
DOWNWIND POSITION, I,/38X,43HEXPOSURE TIME, K AND PARTICLE SIZE RA
NGE, L//49X,21H***DOSE IS IN RADS***)
502 FORMAT(1H ,46X,22HDOWNWIND POSITION, I =,13)
503 FORMAT(1H0, 117H L 1 2 3
1 4 5 6 7 8
2 9)
601 FORMAT(1H ,I2,9E13.3)
602 FORMAT(1H ,I2,13X,8E13.3)
603 FORMAT(1H ,I2,26X,7E13.3)
604 FORMAT(1H ,I2,39X,6E13.3)

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605 FORMAL(1H ,12,22X,5E13.3)
606 FORMAL(1H ,12,55X,4E13.3)
607 FORMAL(1H ,12,78X,3E13.3)
608 FORMAL(1H ,12,91X,2E13.3)
609 FORMAL(1H ,12,104X,E13.3)
610 FORMAL(1H ,12)
505 FORMAL(1H ,2H J)
506 FORMAL(1H ,2H K)
507 FORMAL(1H0,27X,63HFALLOUT PARTICLE DENSITY AS A FUNCTION OF DOWNWI
1ND POSITION, I,/35X,48HCROSSWIND POSITION, J AND PARTICLE SIZE RAN
2GE, L//39X,42H***DENSITY IS IN PARTICLES/SQUARE METER***)
RO=0.007
RO2=RO**2
DO 100 I=2,IMAX
IF (EO(I)-0.036)11,11,12
11 GNU(I)=DBAR(I)=0.0
GO TO 100
12 RMAX=0.393*(EO(I)**1.28)
GNU(I)=18.6/((EO(I)-0.036)**1.37)
C3=GNU(I)**3
AK=4.267*(10.0**(-10))*C3*EB(I)
RM2=RMAX**2
IF (RMAX-RO)451,451,452
451 DBAR(I)=0.0
GO TO 100
452 IF (RO-(1.0/GNU(I)))455,453,453
455 IF (RMAX-(1.0/GNU(I)))453,453,454
453 DBAR(I)=AK*GNU(I)/(C3*(RMAX+RO))
GO TO 100
454 DBAR(I)=AK/(C3*(RM2-RO2))*((1.0-GNU(I)*RO)+2.0-(1.0+GNU(I)*RMAX)*
1FEXP(1.0-GNU(I)*RMAX))
100 CONTINUE
DO 10/ K=1,9
DO 10/ I=2,IMAX
IF (SENSE SWITCH 6)1001,1002
1001 CALL UTND
1002 CONTINUE
C1= SIZE(K) *GNU(I)*DEN
IF ((1-1.0)108,109,109
108 C2=C1/3.0
GO TO 110
109 C2=1.0-((1.0+C1)*FEXP(1.0-C1)/3.0)
110 IF (C1-5.0)112,113,111
111 IF (C1-50.0)113,114,114
112 RD(K,I)=0.75*C2
GO TO 115
113 C4=0.75+(LOG10F(C1/5.0)*0.23)
RD(K,I)=C4*C2
GO TO 115
114 RI(K,I)=0.98*C2
115 RI(K,I)=(1.0-RD(K,I))
117 CONTINUE
IF (SENSE SWITCH 1)81,82
70 FORMAL(1H ,9X,5E20.4)
71 FORMAL(1HU)
81 WRITE OUTPUT TAPE 61,71

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WRITE OUTPUT TAPE 61,70,(GNU(I),I=2,IMAX)
WRITE OUTPUT TAPE 61,71
WRITE OUTPUT TAPE 61,70,(DBAR(I),I=2,IMAX)
WRITE OUTPUT TAPE 61,71
WRITE OUTPUT TAPE 61,70,((RD(K,I),K=1,9),I=2,IMAX)
82 CONTINUE
KCHK=0$ITAP=2$IRED=1$ICAL=2
REWIND ITAP
DO 200 N=1,21
IF(SENSE SWITCH 6)1003,1004
1003 CALL OTND
1004 CONTINUE
DO 617 I=1,9
IF(FALN(N,1,I))617,617,620
617 CONTINUE
GO TO 621
620 IF(N-1)630,630,640
630 IF(UNIT,ITAP)631,632,900,900
631 KCHK=KCHK+1
IF(KCHK-10**6)630,901,901
632 BUFFER IN (ITAP,1) (C(1,1,IRED),C(201,9,IRED))
KCHK=0
640 ITMP=ICAL
ICAL=IRED
IRED=ITMP
621 IF(UNIT,ITAP)622,623,900,900
622 KCHK=KCHK+1
IF(KCHK-10**6)621,901,901
623 IF(N-21)624,670,670
624 N1=N+1
DO 625 I=1,9
IF(FALN(N1,1,I))625,625,626
625 CONTINUE
GO TO 670
626 BUFFER IN (ITAP,1) (C(1,1,IRED),C(201,9,IRED))
KCHK=0
670 CONTINUE
CALL PAGE
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,507
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,502,N
WRITE OUTPUT TAPE 61,503
WRITE OUTPUT TAPE 61,505
DO 202 K=1,5
202 WRITE OUTPUT TAPE 61,601,K,(FALN(N,K,I),I=1,9)
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,501
WRITE OUTPUT TAPE 61,500
WRITE OUTPUT TAPE 61,502,N
WRITE OUTPUT TAPE 61,503
WRITE OUTPUT TAPE 61,506
IFMT=601
ISTM=-1

```



```

DO 612 I=1,9
I=(FALN(N,1,I))611,611,615
611 IFMT=IFMT+1
612 CONTINUE
615 DO 614 I=1,9
I=(FALN(N,1,I))614,614,613
613 ISTM=ISTM+1
614 CONTINUE
DO 101 L=1,8
DO 102 M=1,9
DOS(M)=0.0
IF(FALN(N,1,M))102,102,103
103 DO 408 I=2,IMAX
408 DOS(M)=DOS(M)+(DBAR(I)*RD(M,I)*(C(I,L+1,ICAL)-C(I,1,ICAL))*PAR(I)/
1F-AR)
DOS(M)=DOS(M)*FRAC(M)
102 CONTINUE
I1=IFMT-600&I2=I1+ISTM
IF(I1-I2)652,652,651
651 WRITE OUTPUT TAPE 61,610,L
GO TO 101
652 GO TO (701,702,703,704,705,706,707,708,709),I1
701 WRITE OUTPUT TAPE 61,601,L,(DOS(M),M=I1,I2)
GO TO 101
702 WRITE OUTPUT TAPE 61,602,L,(DOS(M),M=I1,I2)
GO TO 101
703 WRITE OUTPUT TAPE 61,603,L,(DOS(M),M=I1,I2)
GO TO 101
704 WRITE OUTPUT TAPE 61,604,L,(DOS(M),M=I1,I2)
GO TO 101
705 WRITE OUTPUT TAPE 61,605,L,(DOS(M),M=I1,I2)
GO TO 101
706 WRITE OUTPUT TAPE 61,606,L,(DOS(M),M=I1,I2)
GO TO 101
707 WRITE OUTPUT TAPE 61,607,L,(DOS(M),M=I1,I2)
GO TO 101
708 WRITE OUTPUT TAPE 61,608,L,(DOS(M),M=I1,I2)
GO TO 101
709 WRITE OUTPUT TAPE 61,609,L,(DOS(M),M=I1,I2)
101 CONTINUE
200 CONTINUE
REWIND ITAP
GO TO 910
900 CALL ERROR(1,ITAP)
901 CALL ERROR(4,ITAP)
910 RETURN
END

```

```

SUBROUTINE ORIGIN(J1,N1)
C SUBROUTINE TO CALCULATE DOSE FROM ORIGIN
RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDCS,
1 INGEST,IDOUT
RANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5 ,SKIP,GAS,PAR,AL,TM,REM,EM,
1 DOS,AK,DBAR,R1,R2,GR1,GR,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(2701),AA3(15954)
DIMENSION DOS(5,9),AK(9),DBAR(9),R1(5,10,5),R2(5,10,4),GR1(10,5,9)
1 GR(5,2)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),ARFA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 EB( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UR(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),EB(1) ),(PUT6(5070),F2(1))
DO 100 K=1,5
R=SGRIF(X(J1)**2+YX(K,J1)**2+1.0)
GR(K,1)=0.0
GR(K,2)=0.0
DO 100 L=1,9
IF(L=5)1,1,2
1 I1=1
GO TO 3
2 I1=2
3 DB=(1.0+AK(L)*U(L)*R)*FEXP(-U(L)*R)/(4.0*PI*R**2)
DO 100 I=2,IMAX
GR(K,I1)=GR(K,I1)+(C(I,N1,ICAL)*REM(I)*ENR(1,L)*ENR(I,L)*DB*
1 DBAR(L))
100 CONTINUE

```

RETURN
END

```

SUBROUTINE DOSIN(IA)
GROUND DOSE INTEGRATING SUBROUTINE
RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1 INGEST,IDOUT
BANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5 ,SKIP,GAS,PAR,AL,TM,REM,EM,
1 DOS,AK,DBAR,R1,R2,GR1,GR,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(2701),AA3(15954)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 EB( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),EB(1) ),(PUT6(5070),F2(1))
DIMENSION DOS(5,9),AK(9),DBAR(9),R1(5,10,5),R2(5,10,4),GR1(10,5,9)
1 ,GR(5,2)
DO 100 I1=1,5
R=SQRIF(AREA(IA,I1)/PI+1.0)
DO 101 L=1,9
I=(R-2.0)108,109,109
108 R=2.0
109 CONTINUE
C2=0.0
C1=1.0
C4=(R-1.0)/100.0
DO 102 I=1,101
C5=LOGF(C1)+U(L)*C1
103 C2=C2+C4*FEXP(-C3)
102 C1=C1+C4
104 C5=U(L)*R

```

```
105 C5=FEXP(-C5)
107 DOS(I1,L)=AK(L)*(FEXP(-U(L))-C5)+C2
101 DOS(I1,L)=DOS(I1,L)/2.0
100 CONTINUE
    IF(SENSE SWITCH 1)81,82
70  FORMAT(1H ,9X,5E20.4)
71  FORMAI(1H0)
81  WRITE OUTPUT TAPE 61,71
    WRITE OUTPUT TAPE 61,70,((DOS(K,I),K=1,5),I=1,9)
82  CONTINUE
    RETURN
    END
```

```

SUBROUTINE GRDOS
EXTERNAL GROUND DOSE CALCULATING SUBROUTINE
RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1 INGEST,IDOUT
RANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5 ,SKIP,GAS,PAR,AL,TM,REM,EM,
1 DOS,AK,DBAR,R1,R2,GR1,GR,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(2701),AA3(15954)
EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),
1 (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2 (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3 (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4 (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5 (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7 (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1) )
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X( 21), YX( 5,21), AREA( 21, 5),
1 RED( 9,21), FRAC( 9), SIZE( 9),
2 PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
3 FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
4 FN( 21), IDP( 201), IGS( 201),
5 U( 9), UP( 9), UPA( 9),
6 ENR( 201, 9), FG( 3), GM( 4),
7 F1( 201, 4), UB( 201, 4), ENG( 201, 4),
8 F2(201, 3, 3), F3( 3, 3), EO( 201),
9 EB( 201), TM( 3, 3)
EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1 (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2 (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3 (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4 (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5 (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6 (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7 (PUT6(4869),EB(1) ),(PUT6(5070),F2(1))
DIMENSION DOS(5,9),AK(9),DBAR(9),R1(5,10,5),R2(5,10,4),GR1(10,5,9)
1 ,GR(5,2)
LOG10(X)=LOGF(X)/2.3
10 FORMAT(/*FROM THIS POINT SET SENSE SWITCH 3 FOR RESTART*/)
WRITE OUTPUT TAPE 20,10
101 FORMAT(1H0)
102 FORMAT(1H0,22X,/4HEXTERNAL GROUND DOSE (BETA + GAMMA) AS A FUNCTIO
1N OF DOWNWIND POSITION, I,/39X,42HCROSSWIND POSITION, J AND EXPOSU
1RE TIME, K//49X,21H***DOSE IS IN RADS***)
103 FORMAT(1H0,7X,1HJ,9X,1H1,21X,1H2,21X,1H3,21X,1H4,21X,1H5/5X,1HK/
112X,4HBETA,5X,5HGAMMA,8X,4HBETA,3X,5HGAMMA,8X,4HBETA,5X,5HGAMMA,8X
2,4HBETA,5X,5HGAMMA,8X,4HBETA,5X,5HGAMMA)
104 FORMAT(1H ,3X,I2,5(E12.3,E10.3))
105 FORMAT(1H ,46X,22HDOWNWIND POSITION, I =,I3)
ITAP=3$ICAL=1$IREO=2$KCHK=0
REWIND ITAP

```

```

700 IF (UNIT, ITAP) 701, 702, 900, 900
701 KCHK=KCHK+1
    IF (KCHK-10**6) 700, 901, 901
702 BUFFER IN (ITAP, 1) (CI(1,1), CI(201,10))
    KCHK=0
    DO 204 I=1,5
204 AK(I)=0.0
    DO 203 I=6,9
203 AK(I)=((UP(I)-UPA(I))/UPA(I))
    DO 213 L=1,9
    IF (L-5) 211, 211, 212
211 C6=18.6/((FM(L)-0.036)**1.37)
    C6=C6*1.6*(10.0**(-12))
    GO TO 213
212 C6=LOG10F(ENR(1,L))
    C6=5.675+(0.17*C6)+7.0
    C6=(10.0**C6)*3.6
    C6=1.0/C6
213 DBAR(L)=C6
703 IF (UNIT, ITAP) 704, 705, 900, 900
704 KCHK=KCHK+1
    IF (KCHK-10**6) 703, 901, 901
705 BUFFER IN (ITAP, 1) (C(1,1, IRED), C(201,8, IRED))
    KCHK=0
    NL=3
    J1=0
2001 J1=J1+1
    IF (NL-3) 451, 450, 450
450 CALL PAGE
    WRITE OUTPUT TAPE 61,102
    NL=0
451 NL=NL+1
    WRITE OUTPUT TAPE 61,101
    WRITE OUTPUT TAPE 61,105,J1
    WRITE OUTPUT TAPE 61,103
    DO 202 I=1,5
    DO 202 J=1,10
    DO 201 K=1,5
201 R1(I,J,K)=SQRTF((X(J1)-X(J))**2+(YX(I,J1)-YX(K,J))**2)
    DO 202 L=1,4
    K=L+1
202 R2(I,J,L)=SQRTF((X(J1)-X(J))**2+(YX(I,J1)+YX(K,J))**2)
706 IF (UNIT, ITAP) 707, 708, 900, 900
707 KCHK=KCHK+1
    IF (KCHK-10**6) 706, 901, 901
708 ITEMP=ICAL
    ICAL=IRED
    IRED=ITEMP
    IF (J1-10) 709, 710, 710
709 BUFFER IN (ITAP, 1) (C(1,1, IRED), C(201,8, IRED))
    GO TO 711
710 BUFFER IN (ITAP, 1) (C(1,1, IRED), C(201,9, IRED))
711 KCHK=0
    DO 401 NT=1,8
    DO 407 L=1,9
    DO 407 J=1,10

```

```

DO 407 M=1,5
GR1(J,M,L)=0.0
DO 408 I=2,IMAX
I1=IDP(I)
C1=RED(L, J)*FALL(J,M)*PAR(I)
C1=C1+OMEGA(J,M,I1)*GAS(I)
C2=C(I,NT,ICAL)-CI(L,J)
IF(C2)408,408,405
405 GR1(J,M,L)=GR1(J,M,L)+C2*C1*ENR(1,L)*ENR(I,L)*DBAR(L)
408 CONTINUE
407 CONTINUE
IF(SENSE SWITCH 6)1001,1002
1001 CALL QTND
1002 CONTINUE
CALL ORIGIN (J1,NI)
DO 409 K=1,5
DO 409 L=1,9
IF(L=5)523,523,524
523 N=1
GO TO 525
524 N=2
525 CONTINUE
DO 409 J=1,10
DO 412 M=1,5
420 IF(J=J1)411,410,411
410 IF(M=K)411,412,411
411 GR(K,N)=GR(K,N)+(GR1(J,M,L)*(1.0+(AK(L)*U(L)*R1(K,J,M)))*FEXP(-U(L
1)*R1(K,J,M))*AREA(J,M)/(4.0*PI*(R1(K,J,M)**2)))
412 CONTINUE
DO 413 I=1,4
421 M=I+1
GR(K,N)=GR(K,N)+(GR1(J,M,L)*(1.0+(AK(L)*U(L)*R2(K,J,I)))*FEXP(-U(L
1)*R2(K,J,I))*AREA(J,M)/(4.0*PI*(R2(K,J,I)**2)))
413 CONTINUE
409 CONTINUE
CALL DOSIN (J1)
DO 414 K=1,5
DO 415 L=1,5
415 GR(K,1)=GR(K,1)+(GR1(J1,K,L)*DOS(K,L))
DO 416 L=6,9
416 GR(K,2)=GR(K,2)+(GR1(J1,K,L)*DOS(K,L))
414 CONTINUE
417 WRITE OUTPUT TAPE 61,104,NT,((GR(K,L),L=1,2),K=1,5)
401 CONTINUE
400 IF(J1=10)2001,2003,2003
2003 J1=J1+1
J=J1
IF(NL=3)503,502,502
502 CALL PAGE
WRITE OUTPUT TAPE 61,102
NL=0
503 NL=NL+1
WRITE OUTPUT TAPE 61,101
WRITE OUTPUT TAPE 61,105,J
WRITE OUTPUT TAPE 61,103
712 IF(UNIT,IAP)713,714,900,900

```



```

713 KCHK=KCHK+1
   IF (KCHK-10**6) 712,901,901
714 IIMP=ICAL
   ICAL=IRED
   IRED=IIMP
   IF (J1-21)/15,716,716
715 BUFFER IN (ITAP,1) (C(1,1,IRED),C(201,9,IRED))
716 KCHK=0
   DO 504 N=1,8
   IF (SENSE SWITCH 6) 1003,1004
1003 CALL UTND
1004 CONTINUE
   DO 505 L=1,9
   DO 505 K=1,5
   GR1(1,K,L)=0.0
   DO 506 I=2,IMAX
   I1=IDP(I)
   C1=RED(L,J)*FALL(J,K)*PAR(I)
   C1=C1+OMEGA(J,K,I1)*GAS(I)
   C2=C(1,N+1,ICAL)-C(I,1,ICAL)
   IF (C2) 506,506,508
508 GR1(1,K,L)=GR1(1,K,L)+C2*C1*ENR(1,L)*ENR(I,L)*DBAR(L)
506 CONTINUE
505 CONTINUE
   DO 507 K=1,5
   GR(K,1)=0.0
   GR(K,2)=0.0
   DO 509 I=1,5
   IF (I-K) 510,509,510
510 RX=ABSF(YX(K,J)-YX(I,J))
   DO 511 L=1,5
611 GR(K,1)=GR(K,1)+GR1(1,I,L)*(1.0+(AK(L)*U(L)*RX))*FEXP(-U(L)*RX)*AR
1EA(J,1)/(4.0*PI*(RX**2))
511 CONTINUE
   DO 514 L=6,9
614 GR(K,2)=GR(K,2)+GR1(1,I,L)*(1.0+(AK(L)*U(L)*RX))*FEXP(-U(L)*RX)*AR
1EA(J,1)/(4.0*PI*(RX**2))
514 CONTINUE
509 CONTINUE
   DO 540 I=1,4
   M=I+1
   RX=YX(K,J)+YX(M,J)
   DO 512 L=1,5
612 GR(K,1)=GR(K,1)+GR1(1,M,L)*(1.0+(AK(L)*U(L)*RX))*FEXP(-U(L)*RX)*AR
1EA(J,M)/(4.0*PI*(RX**2))
512 CONTINUE
   DO 515 L=6,9
615 GR(K,2)=GR(K,2)+GR1(1,M,L)*(1.0+(AK(L)*U(L)*RX))*FEXP(-U(L)*RX)*AR
1EA(J,M)/(4.0*PI*(RX**2))
515 CONTINUE
540 CONTINUE
507 CONTINUE
   CALL DOSIN(J)
   DO 513 K=1,5
   DO 516 L=1,5
516 GR(K,1)=GR(K,1)+GR1(1,K,L)*DOS(K,L)

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```
DO 51/ L=6,9
517 GR(K,2)=GR(K,2)+GR1(1,K,L)*DOS(K,L)
513 CONTINUE
519 WRITE OUTPUT TAPE 61,104,N,((GR(K,L),L=1,2)K=1,5)
504 CONTINUE
511 IF (J1-21)2003,2004,2004
-- 2004 REWIND ITAP
GO TO 910
900 CALL ERROR (1,ITAP)
901 CALL ERROR (4,ITAP)
910 RETURN
END
```

SUBROUTINE INDOS

INTERNAL DOSE COMPUTING ROUTINE (3X3 INGESTION DELAY TIMES)

RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,

1 INGEST,IDOUT

RANK(1),/AA3/

COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ PUT5,SKIP,GAS,PAR,AL,TM,REM,EM,

1 IXAX,JMAX,KMAX,LMAX,IRMAX,GTI,DOSL,ET,EX,EG,IS,N,TDOH

2 BDOH,GDOH,TDOG,BDOG,GDOG,AA2

COMMON /AA3/ CI,C,PUT6,AA3

DIMENSION EM(9),AA2(109),AA3(15954)

EQUIVALENCE (PUT5(1),DEN), (PUT5(2),FGAS),

1 (PUT5(3),FPAR), (PUT5(4),ROP),

2 (PUT5(5),X(1)), (PUT5(26),YX(1)),

3 (PUT5(131),AREA(1)), (PUT5(236),RED(1)),

4 (PUT5(425),FRAC(1)), (PUT5(434),SIZE(1)),

5 (PUT5(443),PRTS(1)), (PUT5(464),FALN(1)),

6 (PUT5(1409),OMEGA(1)), (PUT5(2039),FALL(1)),

7 (PUT5(2144),XI(1)), (PUT5(2774),QOVRQ(1)),

8 (PUT5(2900),FN(1))

DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),

1 AL(201),GAS(201),PAR(201),REM(201)

DIMENSION X(21), YX(5,21), AREA(21,5),

1 RED(9,21), FRAC(9), SIZE(9),

2 PRTS(21), FALN(21,5,9), OMEGA(21,5,6),

3 FALL(21,5), XI(21,5,6), QOVRQ(6,21),

4 FN(21), IDP(201), IGS(201),

5 U(9), UP(9), UPA(9),

6 ENR(201,9), FG(3), GM(4),

7 F1(201,4), UB(201,4), ENG(201,4),

8 F2(201,3,3), F3(3,3), EO(201),

9 EB(201), TM(3,3)

EQUIVALENCE (PUT6(1),IDP(1)), (PUT6(202),IGS(1)),

1 (PUT6(403),U(1)), (PUT6(412),UP(1)),

2 (PUT6(421),UPA(1)), (PUT6(430),ENR(1)),

3 (PUT6(2239),RG), (PUT6(2240),FG(1)),

4 (PUT6(2243),GM(1)), (PUT6(2247),F1(1)),

5 (PUT6(3051),UB(1)), (PUT6(3855),ENG(1)),

6 (PUT6(4659),F3(1)), (PUT6(4668),EO(1)),

7 (PUT6(4869),EB(1)), (PUT6(5070),F2(1))

DIMENSION C1(4),DOSL(5,21),ET(5),EX(5),EG(5),TDOH(5,21),

1 BDOH(5,21),GDOH(5,21),TDOG(5,8,21),BDOG(5,8,21),

2 GDOG(5,8,21),GTI(201,3)

10 FORMAT(/*FROM THIS POINT SET SENSE SWITCH 4 FOR RESTART*/)
 WRITE OUTPUT TAPE 20,10

951 FORMAT(1H1, //40X, 18H **RECORDS ON 9**)

952 FORMAT(/2X, 21H I J K L IR RG =, 514, E14 4//2X, 9H GM FG =,
 1 7E13.4)

953 FORMAT(/2X, 5H U(K)/(2X 10E11.3))

954 FORMAT(/2X, 5H T(L)/2X 8E11.3//2X, 10H TM(IS,IR)/2X 9E11.3)

955 FORMAT(/2X, 9H F1(K,IS), 4H IS=, I2/(2X 10E11.3))

956 FORMAT(/2X, 9H F2(K,IS), 4H IS=, I2/(2X 10E11.3))

957 FORMAT(/2X, 9H UB(K,IS), 4H IS=, I2/(2X 10E11.3))

958 FORMAT(/2X, 10H ENG(K,IS), 4H IS=, I2/(2X 10E11.3))

961 FORMAT(/2X, 3H I=, I2, 3H J=, I2//2X, 7H C(J,K)/(2X 10E11.3))

```

962 FORMAT(/2X,3H J=,I2,4H IR=,I2,4H IS=,I2/(2X 10E11.3))
966 FORMAT(/2X,32H (F3(IS,IR),IS=1,3),IR=1,IRMAX =/2X 10E11.3)
972 FORMAT(/2X,14H CI(K,J,L),L=,I2)
    IXAX=21$JMAX=5$KMAX=IMAX$LMAX=8$IRMAX=3
    ITAP=4$KCHK=0$ICAL=2$IRED=1
    REWIND ITAP
400 IF(UNIT,ITAP)401,402,900,900
401 KCHK=KCHK+1
    IF(KCHK-10**6)400,901,901
402 BUFFER IN (ITAP,1) (C(1,1,IRED),C(201,18,IRED))
    KCHK=0
    IF(SENSE SWITCH 1)111,11
111 WRITE OUTPUT TAPE61,951
    WRITE OUTPUT TAPE61,952,IXAX,JMAX,KMAX,LMAX,IRMAX,RG,(GM(IS),IS=1,
14),(FG(IR),IR=1,IRMAX)
    WRITE OUTPUT TAPE 61,953,(AL(K),K=2,KMAX)
    DO 113 IS=1,4
    M=IS
113 WRITE OUTPUT TAPE61,955,M,(F1(K,IS),K=2,KMAX)
    DO 115 IS=1,3
    M=IS
115 WRITE OUTPUT TAPE61,956,M,(F2(K,IS,1),K=2,KMAX)
    WRITE OUTPUT TAPE61,966, ((F3(IS,IR),IS=1,3),IR=1,IRMAX)
    DO 119 IS=1,4
    M=IS
119 WRITE OUTPUT TAPE61,957,M,(UB(K,IS),K=2,KMAX)
    DO 121 IS=1,4
    M=IS
121 WRITE OUTPUT TAPE61,958,M,(ENG(K,IS),K=2,KMAX)
11 CALL INGEST
    DO 13 IS=1,4
    C1(IS)=1.60E-8/GM(IS)
    DO 13 K=2,KMAX
    F1(K,IS)=RG*F1(K,IS)
    ENG(K,IS)=ENG(K,IS)/(AL(K)*UB(K,IS))
13 F1(K,IS)=F1(K,IS)*ENG(K,IS)
    DO 15 IS=1,3
    DO 15 K=2,KMAX
    EM=ENG(K,IS)*F2(K,IS,1)
    DO 15 IR=1,IRMAX
15 F2(K,IS,IR)=EM*GTI(IS,IR)
    DO 17 I=1,IXAX
    DO 17 J=1,JMAX
17 DOSL(J,1)=0.0
    DO 19 I=1,IXAX
    DO 19 J=1,JMAX
    DO 19 L=1,LMAX
    TDOG(J,L,I)=0.0
    BDOG(J,L,I)=0.0
19 GDOG(J,L,I)=0.0
    I=1
21 IF(UNIT,ITAP) 411,412,900,900
411 KCHK=KCHK+1
    IF(KCHK-10**6)21,901,901
412 ITMP=ICAL
    ICAL=IRED

```

```

      IRED=ITMP
      IF(I-IXAX)413,414,414
413  BUJFER IN (ITAP,1) (C(1,1,IRED),C(201,18,IRED))
414  KCHK=0
      DO 25 J=1,JMAX
      ET(J)=0.0
      EX(J)=0.0
      EG(J)=0.0
      DO 23 K=2,KMAX
      I1=IDP(K)
      EC=C(K,1,ICAL)*GAS(K)*XI(I,J,I1)
      ET(J)=ET(J)+EC*F1(K,1)
      EX(J)=EX(J)+EC*F1(K,2)
      EG(J)=EG(J)+EC*F1(K,3)
23   D0SL(J,I)=D0SL(J,I)+EC*F1(K,4)
      TDOH(J,I)=C1(1)*ET(J)
      BDOH(J,I)=C1(2)*EX(J)
      GDOH(J,I)=C1(3)*EG(J)
25   D0SL(J,I)=D0SL(J,I)*C1(4)
      IR=1
327  IF(FG(IR))27,239,27
27   IS=1
227  CONTINUE
      I2=IS+3*(IR-1)+9
136  DO 36 L=1,LMAX
      M=L+1% C4=C5=0.0
1000 DO 1001 K=2,KMAX
      C4=C4+C(K,M,ICAL)
1001 C5=C5+C(K,I2,ICAL)
      IF(C4-C5)36,36,31
31   DO 34 J=1,JMAX
      DO 33 K=2,KMAX
      I1=IDP(K)
      C3=C(K,M,ICAL)-C(K,I2,ICAL)
      IF(C3)33,33,415
415  ECI=C3*OMEGA(I,J,I1)*GAS(K)
      GO TO (231,233,235),IS
231  TDOG(J,L,I)=TDOG(J,L,I)+ECI*F2(K,1,IR)
      GO TO 33
233  BDOG(J,L,I)=BDOG(J,L,I)+ECI*F2(K,2,IR)
      GO TO 33
235  GDOG(J,L,I)=GDOG(J,L,I)+ECI*F2(K,3,IR)
33   CONTINUE
34   CONTINUE
36   CONTINUE
      IS=IS+1
      IF(IS-3)227,227,239
239  IR=IR+1
      IF(IR-IRMAX)327,327,35
35   DO 37 L=1,LMAX
      DO 37 J=1,JMAX
      TDOG(J,L,I)=C1(1)*TDOG(J,L,I)
      BDOG(J,L,I)=C1(2)*BDOG(J,L,I)
37   GDOG(J,L,I)=C1(3)*GDOG(J,L,I)
      I=I+1
      IF(I-IXAX)21,21,39

```

```
39 DO 200 I=1,IXAX
   DO 100 L=1,LMAX
   DO 100 J=1,JMAX
100 GDOG(J,L,I)=GDOG(J,L,I)*0.5
   DO 200 J=1,JMAX
200 GDOH(J,I)=GDOH(J,I)*0.5
   REWIND ITAP
   GO TO 910
900 CALL ERROR (1,ITAP)
901 CALL ERROR (4,ITAP)
910 RETURN
END
```

```

SUBROUTINE INGEST
BANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDCS,
1  INGEST,IDOUT
BANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ PUT5,SKIP,GAS,PAR,AL,TM,REM,EM,
1 IXAX,JMAX,KMAX,LMAX,IRMAX,GTI,DOSL,ET,EX,EG,IS,N,TDOH
2 BDOH,GDOH,TDOG,BDOG,GDOG,AA2
COMMON /AA3/ CI,C,PUT6,AA3
DIMENSION EM(9),AA2(109),AA3(15954)
EQUIVALENCE (PUT5(1),DEN),(PUT5(2),FGAS),
1 (PUT5(3),FPAR),(PUT5(4),ROP),
2 (PUT5(5),X(1)),(PUT5(26),YX(1)),
3 (PUT5(131),AREA(1)),(PUT5(236),RED(1)),
4 (PUT5(425),FRAC(1)),(PUT5(434),SIZE(1)),
5 (PUT5(443),PRTS(1)),(PUT5(464),FALN(1)),
6 (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1)),
7 (PUT5(2144),XI(1)),(PUT5(2774),QOVRQ(1)),
8 (PUT5(2900),FN(1))
DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),
1 AL(201),GAS(201),PAR(201),REM(201)
DIMENSION X(21),YX(5,21),AREA(21,5),
1 RED(9,21),FRAC(9),SIZE(9),
2 PRTS(21),FALN(21,5,9),OMEGA(21,5,6),
3 FALL(21,5),XI(21,5,6),QOVRQ(6,21),
4 FN(21),IDP(201),IGS(201),
5 U(9),UP(9),UPA(9),
6 ENR(201,9),FG(3),GM(4),
7 F1(201,4),UB(201,4),ENG(201,4),
8 F2(201,3,3),F3(3,3),EO(201),
9 EB(201),TM(3,3)
EQUIVALENCE (PUT6(1),IDP(1)),(PUT6(202),IGS(1)),
1 (PUT6(403),U(1)),(PUT6(412),UP(1)),
2 (PUT6(421),UPA(1)),(PUT6(430),ENR(1)),
3 (PUT6(2239),RG),(PUT6(2240),FG(1)),
4 (PUT6(2243),GM(1)),(PUT6(2247),F1(1)),
5 (PUT6(3051),UB(1)),(PUT6(3855),ENG(1)),
6 (PUT6(4659),F3(1)),(PUT6(4668),EO(1)),
7 (PUT6(4869),EB(1)),(PUT6(5070),F2(1))
DIMENSION C1(4),DOSL(5,21),ET(5),EX(5),EG(5),TDOH(5,21),
1 BDOH(5,21),GDOH(5,21),TDOG(5,8,21),BDOG(5,8,21),
2 GDOG(5,8,21),GTI(201,3)
DO 11 IR=1,IRMAX
DO 11 IS=1,3
11 G1I(IS,IR)=FG(IR)*F3(IS,IR)
RETURN
END

```

```

SUBROUTINE IDOUT
  RANK(0),CHAIN3,/AA1/,/AA2/,GSFR,SBETA,ORIGIN,DOSIN,GRDOS,INDOS,
1  INGEST,IDOUT
  BANK(1),/AA3/
  COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
  DIMENSION ICHN(4),ALPHA(8),FACT(20)
  COMMON /AA2/ PUT5
1  IXAX,JMAX,KMAX,LMAX,IRMAX,GTI,DOSL,ET,EX,EG,IS,N,TD0H
2  BDOH,GDOH,TD0G,BDOG,GDOG,AA2
  COMMON /AA3/ CI,C,PUT6,AA3
  DIMENSION EM(9),AA2( 109),AA3(15954).
  EQUIVALENCE (PUT5( 1),DEN ),(PUT5( 2),FGAS ),

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```

1  (PUT5( 3),FPAR ),(PUT5( 4),ROP ),
2  (PUT5( 5),X(1) ),(PUT5( 26),YX(1) ),
3  (PUT5( 131),AREA(1) ),(PUT5( 236),RED(1) ),
4  (PUT5( 425),FRAC(1) ),(PUT5( 434),SIZE(1) ),
5  (PUT5( 443),PRTS(1) ),(PUT5( 464),FALN(1) ),
6  (PUT5(1409),OMEGA(1)),(PUT5(2039),FALL(1) ),
7  (PUT5(2144),XI(1) ),(PUT5(2774),QOVRQ(1)),
8  (PUT5(2900),FN(1) )
  DIMENSION PUT5(3000),PUT6(7000),CI(201,10),C(201,18,2),SKIP(4),

```

```

1  AL(201),GAS(201),PAR(201),REM(201)
  DIMENSION
1  X( 21), YX( 5,21), AREA( 21, 5),
2  RED( 9,21), FRAC( 9), SIZE( 9),
3  PRTS( 21), FALN( 21, 5, 9),OMEGA( 21, 5, 6),
4  FALL( 21, 5), XI( 21, 5, 6),QOVRQ( 6,21),
5  FN( 21), IDP( 201), IGS( 201),
6  U( 9), UP( 9), UPA( 9),
7  ENR( 201, 9), FG( 3), GM( 4),
8  F1( 201, 4), UB( 201, 4), ENG( 201, 4),
9  F2(201, 3, 3), F3( 3, 3), EO( 201),
  EB( 201), TM( 3, 3)
  EQUIVALENCE (PUT6( 1),IDP(1) ),(PUT6( 202),IGS(1) ),
1  (PUT6( 403),U(1) ),(PUT6( 412),UP(1) ),
2  (PUT6( 421),UPA(1) ),(PUT6( 430),ENR(1) ),
3  (PUT6(2239),RG ),(PUT6(2240),FG(1) ),
4  (PUT6(2243),GM(1) ),(PUT6(2247),F1(1) ),
5  (PUT6(3051),UB(1) ),(PUT6(3855),ENG(1) ),
6  (PUT6(4659),F3(1) ),(PUT6(4668),EO(1) ),
7  (PUT6(4869),EB(1) ),(PUT6(5070),F2(1) )
  DIMENSION C1(4),DOSL(5,21),ET(5),EX(5),EG(5),TD0H(5,21),
1  BDOH(5,21),GDOH(5,21),TD0G(5,8,21),BDOG(5,8,21),
2  GDOG(5,8,21),GTI(201,3)
  DIMENSION IL(21),KL(8)

```

C

```

INTERNAL DOSE OUTPUT ROUTINE
901 FORMAT( 29X,52H THYROID DOSE AS A FUNCTION OF DOWNWIND POSITION,
1I,)
902 FORMAT( 31X,49H BONE DOSE AS A FUNCTION OF DOWNWIND POSITION, I,)
903 FORMAT( 31X,49H G.I. DOSE AS A FUNCTION OF DOWNWIND POSITION, I,)
904 FORMAT(/31X,49H LUNG DOSE AS A FUNCTION OF DOWNWIND POSITION, I /
141X,26H AND CROSSWIND POSITION, J/36X,41H TIME OF EXPOSURE = TIME
2OF CLOUD PASSAGE//43X,22H ***DOSE IS IN REMS***)
905 FORMAT(33X,43H CROSSWIND POSITION, J AND EXPOSURE TIME, K/ 43X,22H
1 ***DOSE IS IN REMS***)
907 FORMAT(/41X,23H DOWNWIND POSITION, I =,I3//16X, 2H J,7X2H 1,14X2H
1 2,14X2H 3,14X2H 4,14X2H 5/5X,11H INGESTED K/(14X,I2, 5E16.4))

```



```

908 FORMAT(/5X,8H INHALED,3X, 5E16.4)
909 FORMAT(////16X,2H J,7X2H 1,14X2H 2,14X2H 3,14X2H 4,14X2H 5/14X,2H
1I/(14X,I2, 5E16.4))
910 FORMAT(////1H0)
    DO 1 L=1,LMAX
      1 KL(L)=L
      DO 2 I=1,IXAX
        2 IL(I)=I
        IS=1
        3 I1=1
        4 I2=I1+2
        IF(I2-IXAX)5,14,14
14 I2=IXAX
      5 CALL PAGE
      GO TO (7,9,11),IS
      7 WRITE OUTPUT TAPE61,901
      GO TO 13
      9 WRITE OUTPUT TAPE61,902
      GO TO 13
11 WRITE OUTPUT TAPE61,903
13 WRITE OUTPUT TAPE61,905
      DO 21 I=I1,I2
        IP=I
        GO TO (15,17,19),IS
15 WRITE OUTPUT TAPE61,907,IP,(KL(L),(TDOG(J,L,I),J=1,JMAX),L=1,LMAX)
      WRITE OUTPUT TAPE61,908,(TDOH(J,I),J=1,JMAX)
      GO TO 21
17 WRITE OUTPUT TAPE61,907,IP,(KL(L),(BDOG(J,L,I),J=1,JMAX),L=1,LMAX)
      WRITE OUTPUT TAPE61,908,(BDOH(J,I),J=1,JMAX)
      GO TO 21
19 WRITE OUTPUT TAPE61,907,IP,(KL(L),(GDOG(J,L,I),J=1,JMAX),L=1,LMAX)
      WRITE OUTPUT TAPE61,908,(GDOH(J,I),J=1,JMAX)
21 CONTINUE
      IF(I2-IXAX)23,31,31
23 I1=I2+1
      GO TO 4
31 IS=IS+1
      IF(IS-3)3,3,33
33 CALL PAGE
      WRITE OUTPUT TAPE 61,904
      WRITE OUTPUT TAPE61,909,(IL(I),(DOSL(J,I),J=1,JMAX),I=1,IXAX)
      WRITE OUTPUT TAPE61,910
      RETURN
      END

```

PROGRAM CHAIN4
BANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
CLINT,CALC3,CONC4

1 RANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
1 ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2 AL,SKIP,EO,TD,DT,NT,AA2.
COMMON/AA3/C,ICLK,AA3

DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
EQUIVALENCE (PUT7(1),ZZ),(PUT7(2),VG(1)),
1 (PUT7(128),TENG),(PUT7(129),RISE),
2 (PUT7(130),TAU),(PUT7(131),XBAR),
3 (PUT7(132),TBRAR),(PUT7(133),HMAX),
4 (PUT7(134),UMAX),(PUT7(135),UBAR),
5 (PUT7(136),XCON),(PUT7(137),TCON),
6 (PUT7(138),RH),(PUT7(139),SIGY(1)),
7 (PUT7(160),SIGZ(1)),(PUT7(191),ASGZ(1)),
8 (PUT7(212),HMX),(PUT7(213),TBRH),
9 (PUT7(214),XBRH),(PUT7(215),CY(1)),
1 (PUT7(221),CZ(1)),(PUT7(227),Y1),
2 (PUT7(228),Y2),(PUT7(229),Y3),
3 (PUT7(230),Y4),(PUT7(231),YY),
4 (PUT7(232),DEN),(PUT7(233),FGAS),
5 (PUT7(234),FPAR),(PUT7(235),ROP),
6 (PUT7(236),X(1)),(PUT7(257),YX(1)),
7 (PUT7(362),AREA(1)),(PUT7(467),RED(1)),
8 (PUT7(656),ENUC),(PUT7(657),FIS),
9 (PUT7(658),SEC),(PUT7(659),T1(1)),
1 (PUT7(667),T2(1)),(PUT7(688),T3(1)),
2 (PUT7(709),XI(1)),(PUT7(1339),QOVRQ(1)),
3 (PUT7(1465),FN(1))

EQUIVALENCE (PUT9(1),IDP(1)),(PUT9(202),IGS(1)),
1 (PUT9(403),U(1)),(PUT9(412),UP(1)),
2 (PUT9(421),UPA(1)),(PUT9(430),ENR(1)),
EQUIVALENCE (PUT8(1),IP(1)),(PUT8(604),Y(1))
DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EO(9)

DIMENSION VG(6,21), SIGY(21), SIGZ(31),
1 ASGZ(21), CY(3, 2), CZ(3, 2),
2 X(21), YX(5,21), AREA(21, 5),
3 RED(9,21), T1(8), I2(21),
4 T3(21), XI(21, 5, 6),QOVRQ(6,21),
5 FN(21), IDP(201), IGS(201),
6 U(9), UP(9), UPA(9),
7 ENR(201, 9), IP(201, 3), Y(201, 3),
8 AK(9), CLOS(9), CLDS(5, 2),
9 YR(5), T(7,21), DOS(5, 2),
1 QVQ(6), CLD(9), XIR(5),
2 B(10), C(201, 7,21), IN1(10),
3 K8(10), GAS(201), PAR(201),
4 A(10), C3(11,11)

TYPE DOUBLE A,C3

10 FORMAT(/*FROM THIS POINT SET SENSE SWITCH 5 FOR RESTART*/)
WRITE OUTPUT TAPE 20,10
REWIND 9

```

REWIND 1
I1=1$I9=1$J1=6$J9=8$K1=0$K9=0$
11 IF(I1-J1)12,12,15
12 IF(UNIT,1)13,14,900,900
13 K1=K1+1
   IF(K1-10**6)16,901,901
14 GO TO (101,102,103,104,104,105,15),I1
101 BUFFER IN (1,1) (PUT7(1),PUT7(231))
   GO TO 110
102 BUFFER IN(1,1) (PUT7(232),PUT7(655))
   GO TO 110
103 BUFFER IN(1,1) (PUT7(656),PUT7(708))
   GO TO 110
104 BUFFER IN (1,1) (SKIP(1),SKIP(2))
   GO TO 110
105 BUFFER IN (1,1) (PUT7(709),PUT7(1485))
110 K1=0$I1=I1+1
   GO TO 16
15 IF(I9-J9)17,17,50
16 IF(I9-J9)17,17,11
17 IF(UNIT,9)18,19,902,902
18 K9=K9+1
   IF(K9-10**6)11,903,903
19 GO TO (111,111,111,115,112,113,111,114,11),I9
111 BUFFER IN (9,1) (SKIP(3),SKIP(4))
   GO TO 120
112 BUFFER IN (9,1) (PUT8(202),PUT8(1206))
   GO TO 120
113 BUFFER IN (9,1) (AL(1),AL(201))
   GO TO 120
114 BUFFER IN (9,1) (PUT9(1),PUT9(2238))
   GO TO 120
115 BUFFER IN (9,1) (EO(1),EO(9))
120 K9=0$I9=I9+1
   GO TO 11
50 REWIND 9$REWIND 1
   CALL CLOUD
   RETURN
900 CALL ERROR (1,1)
901 CALL ERROR (4,1)
902 CALL ERROR (1,9)
903 CALL ERROR (4,9)
END

```

```

SUBROUTINE PRODUCE
BANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
1      CLINT,CALC3,CONC4
BANK(1),/AA3/
COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
1      ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2      AL,SKIP,EO,TD,DT,NT,AA2
COMMON/AA3/C,ICLK,AA3
DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
EQUIVALENCE (PUT7( 1),ZZ ),(PUT7( 2),VG(1) ),
1      (PUT7( 128),TENG ),(PUT7( 129),RISE ),
2      (PUT7( 130),TAU ),(PUT7( 131),XBAR ),
3      (PUT7( 132),TBAR ),(PUT7( 133),HMAX ),
4      (PUT7( 134),UMAX ),(PUT7( 135),UBAR ),
5      (PUT7( 136),XCON ),(PUT7( 137),TCON ),
6      (PUT7( 138),RH ),(PUT7( 139),SIGY(1) ),
7      (PUT7( 160),SIGZ(1) ),(PUT7( 191),ASGZ(1) ),
8      (PUT7( 212),HMX ),(PUT7( 213),TBRH ),
9      (PUT7( 214),XBRH ),(PUT7( 215),CY(1) ),
1     (PUT7( 221),CZ(1) ),(PUT7( 227),Y1 ),
2     (PUT7( 228),Y2 ),(PUT7( 229),Y3 ),
3     (PUT7( 230),Y4 ),(PUT7( 231),YY ),
4     (PUT7( 232),DEN ),(PUT7( 233),FGAS ),
5     (PUT7( 234),FPAR ),(PUT7( 235),ROP ),
6     (PUT7( 236),X(1) ),(PUT7( 257),YX(1) ),
7     (PUT7( 362),AREA(1) ),(PUT7( 467),RED(1) ),
8     (PUT7( 656),ENUC ),(PUT7( 657),FIS ),
9     (PUT7( 658),SEC ),(PUT7( 659),T1(1) ),
1     (PUT7( 667),T2(1) ),(PUT7( 688),T3(1) ),
2     (PUT7( 709),XI(1) ),(PUT7(1339),QOVRQ(1) ),
3     (PUT7(1465),FN(1) )
EQUIVALENCE (PUT9( 1),IDP(1) ),(PUT9( 202),IGS(1) ),
1     (PUT9( 403),U(1) ),(PUT9( 412),UP(1) ),
2     (PUT9( 421),UPA(1) ),(PUT9( 430),ENR(1))
EQUIVALENCE (PUT8( 1),IP(1) ),(PUT8( 604),Y(1) )
DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EO(9)
DIMENSION VG( 6,21), SIGY( 21), SIGZ( 31),
1     ASGZ( 21), CY( 3, 2), CZ( 3, 2),
2     X( 21), YX( 5,21), AREA( 21, 5),
3     RED( 9,21), T1( 8), T2( 21),
4     T3( 21), XI( 21, 5, 6),QOVRQ( 6,21),
5     FN( 21), IDP( 201), IGS( 201),
6     U( 9), UP( 9), UPA( 9),
7     ENR( 201, 9), IP( 201, 3), Y( 201, 3),
8     AK( 9), CLOS( 9), CLDS( 5, 2),
9     YR( 5), T( 7,21), DOS( 5, 2),
1     QVQ( 6), CLD( 9), XIR( 5),
2     B( 10), C(201, 7,21), IN1( 10),
3     K8( 10), GAS( 201), PAR( 201),
4     A( 10), C3( 11,11)
TYPE DOUBLE A,C3
DIMENSION F(201),Q(201),CZERO(201)
EQUIVALENCE(C(1) ,F(1)),(C(202) ),Q(1)),(C(403) ),CZERO(1))
TD=0.0

```

```

DT=2.0*INTF(SEC/10.)+2.0
DT=SEC/DT
DO 10 I=1,IMAX
10 CZERO(I)=0.0
  IF(SEC)100,100,11
11 IF(FIS)100,100,12
12 N1=0
13 DO 50 I=2,IMAX
  F(I)=-AL(I)*CZERO(I)+Y(I,1)*FIS
  DO 50 J=2,3
    IJ=IP(I,J)
    IF(IJ-1)50,50,42
42 F(I)=F(I)+Y(I,J)*CZERO(IJ)*AL(I)
50 CONTINUE
  CALL RKLDEQ(S)
  IF(S-1.0)51,51,13
51 IF(TD-SEC)13,100,100
100 DO 103 I=2,IMAX
  Y(I,1)=ENUC*Y(I,1)+CZERO(I)
  IF(Y(I,1))102,102,101
101 IP(I,1)=1
  GO TO 103
102 IP(I,1)=0
103 CONTINUE
  RETURN
  END

```

```

SUBROUTINE RKLDEQ (S)
  RANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
1  CLINT,CALC3,CONC4
  RANK(1),/AA3/
  COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
  DIMENSION ICHN(4),ALPHA(8),FACT(20)
  COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
1  ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2  AL,SKIP,E0,TD,DT,NT,AA2
  COMMON/AA3/C,ICLK,AA3
  DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
  EQUIVALENCE (PUT7( 1),ZZ ),(PUT7( 2),VG(1) ),
1  (PUT7( 128),TENG ),(PUT7( 129),RISE ),
2  (PUT7( 130),TAU ),(PUT7( 131),XBAR ),
3  (PUT7( 132),TBAR ),(PUT7( 133),HMAX ),
4  (PUT7( 134),UMAX ),(PUT7( 135),UBAR ),
5  (PUT7( 136),XCON ),(PUT7( 137),TCON ),
6  (PUT7( 138),RH ),(PUT7( 139),SIGY(1) ),
7  (PUT7( 160),SIGZ(1) ),(PUT7( 191),ASGZ(1) ),
8  (PUT7( 212),HMX ),(PUT7( 213),TBRH ),
9  (PUT7( 214),XBRH ),(PUT7( 215),CY(1) ),
1  (PUT7( 221),CZ(1) ),(PUT7( 227),Y1 ),
2  (PUT7( 228),Y2 ),(PUT7( 229),Y3 ),
3  (PUT7( 230),Y4 ),(PUT7( 231),YY ),
4  (PUT7( 232),DEN ),(PUT7( 233),FGAS ),
5  (PUT7( 234),FPAR ),(PUT7( 235),ROP ),
6  (PUT7( 236),X(1) ),(PUT7( 257),YX(1) ),
7  (PUT7( 362),AREA(1) ),(PUT7( 467),RED(1) ),
8  (PUT7( 656),ENUC ),(PUT7( 657),FIS ),
9  (PUT7( 658),SEC ),(PUT7( 659),T1(1) ),
1  (PUT7( 667),T2(1) ),(PUT7( 688),T3(1) ),
2  (PUT7( 709),XI(1) ),(PUT7(1339),QOVRQ(1) ),
3  (PUT7(1465),FN(1) )
  EQUIVALENCE (PUT9( 1),IDP(1) ),(PUT9( 202),IGS(1) ),
1  (PUT9( 403),U(1) ),(PUT9( 412),UP(1) ),
2  (PUT9( 421),UPA(1) ),(PUT9( 430),ENR(1))
  EQUIVALENCE (PUT8( 1),IP(1) ),(PUT8( 604),Y(1) )
  DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),E0(9)
  DIMENSION VG( 6,21), SIGY( 21), SIGZ( 31),
1  ASGZ( 21), CY( 3, 2), CZ( 3, 2),
2  X( 21), YX( 5,21), AREA( 21, 5),
3  RED( 9,21), T1( 8), T2( 21),
4  T3( 21), XI( 21, 5, 6),QOVRQ( 6,21),
5  FN( 21), IDP( 201), IGS( 201),
6  U( 9), UP( 9), UPA( 9),
7  ENR( 201, 9), IP( 201, 3), Y( 201, 3),
8  AK( 9), CLOS( 9), CLDS( 5, 2),
9  YR( 5), T( 7,21), DOS( 5, 2),
1  QVQ( 6), CLD( 9), XIR( 5),
2  B( 10), C(201, 7,21), IN1( 10),
3  K8( 10), GAS( 201), PAR( 201),
4  A( 10), C3( 11,11)
  TYPE DOUBLE A,C3
  DIMENSION F(201),Q(201),CZERO(201)
  EQUIVALENCE(C(1) ,F(1)),(C(202) ,Q(1)),(C(403) ,CZERO(1))
  NT=NT+1

```

```

      GO TO (1,2,3,4),NT
1  DO 11 I=2,IMAX
11 Q(I)=0.0
   C1=0.5
   TD=TD+DT/2.0
   GO TO 5
2  C1=0.29289321881
   GO TO 5
3  C1=1.7071067812
   TD=TD+DT/2.0
   GO TO 5
4  D1=DT/6.0
   DO 41 I=2,IMAX
41 CZERO(I)=CZERO(I)+DT*F(I)/6.0-Q(I)/3.0
   NT=0
   S=2.0
   GO TO 6
5  C2=2.0*C1*DT
   C3=1.0-3.0*C1
   DO 51 I=2,IMAX
   CZERO(I)=CZERO(I)+C1*(DT*F(I)-Q(I))
51 Q(I)=C2*F(I)+C3*Q(I)
   S=1.0
6  RETURN
   END

```

```

SUBROUTINE GSFR
SUBROUTINE TO CALCULATE GASEOUS AND PARTICULATE RELEASE FRACTIONS
RANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
1 CLINT,CALC3,CONC4
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
1 ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2 AL,SKIP,E0,TD,DT,NT,AA2
COMMON/AA3/C,ICLK,AA3
DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
EQUIVALENCE (PUT7( 1),ZZ ),(PUT7( 2),VG(1) ),
1 (PUT7( 128),TENG ),(PUT7( 129),RISE ),
2 (PUT7( 130),TAU ),(PUT7( 131),XBAR ),
3 (PUT7( 132),TBAR ),(PUT7( 133),HMAX ),
4 (PUT7( 134),UMAX ),(PUT7( 135),UBAR ),
5 (PUT7( 136),XCON ),(PUT7( 137),TCON ),
6 (PUT7( 138),RH ),(PUT7( 139),SIGY(1) ),
7 (PUT7( 160),SIGZ(1) ),(PUT7( 191),ASGZ(1) ),
8 (PUT7( 212),HMX ),(PUT7( 213),TBRH ),
9 (PUT7( 214),XBRH ),(PUT7( 215),CY(1) ),
1 (PUT7( 221),CZ(1) ),(PUT7( 227),Y1 ),
2 (PUT7( 228),Y2 ),(PUT7( 229),Y3 ),
3 (PUT7( 230),Y4 ),(PUT7( 231),YY ),
4 (PUT7( 232),DEN ),(PUT7( 233),FGAS ),
5 (PUT7( 234),FPAR ),(PUT7( 235),ROP ),
6 (PUT7( 236),X(1) ),(PUT7( 257),YX(1) ),
7 (PUT7( 362),AREA(1) ),(PUT7( 467),RED(1) ),
8 (PUT7( 656),ENUC ),(PUT7( 657),FIS ),
9 (PUT7( 658),SEC ),(PUT7( 659),T1(1) ),
1 (PUT7( 667),T2(1) ),(PUT7( 688),T3(1) ),
2 (PUT7( 709),XI(1) ),(PUT7(1339),QOVRQ(1) ),
3 (PUT7(1465),FN(1) )
EQUIVALENCE (PUT9( 1),IDP(1) ),(PUT9( 202),IGS(1) ),
1 (PUT9( 403),U(1) ),(PUT9( 412),UP(1) ),
2 (PUT9( 421),UPA(1) ),(PUT9( 430),ENR(1))
EQUIVALENCE (PUT8( 1),IP(1) ),(PUT8( 604),Y(1) )
DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),E0(9)
DIMENSION VG( 6,21), SIGY( 21), SIGZ( 31),
1 ASGZ( 21), CY( 3, 2), CZ( 3, 2),
2 X( 21), YX( 5,21), AREA( 21, 5),
3 RED( 9,21), T1( 8), T2( 21),
4 T3( 21), XI( 21, 5, 6),QOVRQ( 6,21),
5 FN( 21), IDP( 201), IGS( 201),
6 U( 9), UP( 9), UPA( 9),
7 ENR( 201, 9), IP( 201, 3), Y( 201, 3),
8 AK( 9), CLOS( 9), CLDS( 5, 2),
9 YR( 5), T( 7,21), DOS( 5, 2),
1 QVQ( 6), CLD( 9), XIR( 5),
2 B( 10), C(201, 7,21), IN1( 10),
3 K8( 10), GAS( 201), PAR( 201),
4 A( 10), C3( 11,11)
TYPE DOUBLE A,C3
DO 802 I=2,IMAX
IF(IGS(I))803,803,804

```


803 GAS(I)=FGAS
PAR(I)=(1.0-FGAS)*FPAR
GO TO 802
804 GAS(I)=ROP
PAR(I)=(1.0-ROP)*FPAR
802 CONTINUE
RETURN
END

SUBROUTINE CLOUD

SUBROUTINE TO CALCULATE EXTERNAL CLOUD DOSE

BANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,

1 CLINT,CALC3,CONC4

BANK(1),/AA3/

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD

1 ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,

2 AL,SKIP,EO,TD,DT,NT,AA2

COMMON/AA3/C,ICHK,AA3

DIMENSION AA2(1318),ICHK(7,21,2),AA3(2359)

EQUIVALENCE (PUT7(1),ZZ),(PUT7(2),VG(1)),
1 (PUT7(128),TENG),(PUT7(129),RISE),
2 (PUT7(130),TAU),(PUT7(131),XBAR),
3 (PUT7(132),TBAR),(PUT7(133),HMAX),
4 (PUT7(134),UMAX),(PUT7(135),UBAR),
5 (PUT7(136),XCON),(PUT7(137),TCON),
6 (PUT7(138),RH),(PUT7(139),SIGY(1)),
7 (PUT7(160),SIGZ(1)),(PUT7(191),ASGZ(1)),
8 (PUT7(212),HMX),(PUT7(213),TBRH),
9 (PUT7(214),XBRH),(PUT7(215),CY(1)),
1 (PUT7(221),CZ(1)),(PUT7(227),Y1),
2 (PUT7(228),Y2),(PUT7(229),Y3),
3 (PUT7(230),Y4),(PUT7(231),YY),
4 (PUT7(232),DEN),(PUT7(233),FGAS),
5 (PUT7(234),FPAR),(PUT7(235),ROP),
6 (PUT7(236),X(1)),(PUT7(257),YX(1)),
7 (PUT7(362),AREA(1)),(PUT7(467),RED(1)),
8 (PUT7(656),ENUC),(PUT7(657),FIS),
9 (PUT7(658),SEC),(PUT7(659),T1(1)),
1 (PUT7(667),T2(1)),(PUT7(688),T3(1)),
2 (PUT7(709),XI(1)),(PUT7(1339),QOVRQ(1)),
3 (PUT7(1465),FN(1))

EQUIVALENCE (PUT9(1),IDP(1)),(PUT9(202),IGS(1)),
1 (PUT9(403),U(1)),(PUT9(412),UP(1)),
2 (PUT9(421),UPA(1)),(PUT9(430),ENR(1))

EQUIVALENCE (PUT8(1),IP(1)),(PUT8(604),Y(1))

DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EO(9)

DIMENSION VG(6,21), SIGY(21), SIGZ(31),
1 ASGZ(21), CY(3, 2), CZ(3, 2),
2 X(21), YX(5,21), AREA(21, 5),
3 RED(9,21), T1(8), T2(21),
4 T3(21), XI(21, 5, 6),QOVRQ(6,21),
5 FN(21), IDP(201), IGS(201),
6 U(9), UP(9), UPA(9),
7 ENR(201, 9), IP(201, 3), Y(201, 3),
8 AK(9), CLOS(9), CLDS(5, 2),
9 YR(5), T(7,21), DOS(5, 2),
1 QVQ(6), CLD(9), XIR(5),
2 B(10), C(201, 7,21), IN1(10),
3 K8(10), GAS(201), PAR(201),
4 A(10), C3(11,11)

TYPE DOUBLE A,C3

DIMENSION G(7)

DATA(G=1.0,4.0,2.0,4.0,2.0,4.0,1.0)

```

      DIMENSION DLT1(21),DLT2(21),DLT3(21)
100  FORMAT(1H0)
101  FORMAT(1H0,28X*EXTERNAL GAMMA CLOUD DOSE AS A FUNCTION OF DOWNWIND
      1 POSITION, 1*/48X*AND CROSSWIND POSITION, J*)
102  FORMAT(1H0,50X,21H***DOSE IS IN RADS***)
103  FORMAT(1H0,16X*J*8X*1*15X*2*15X*3*15X*4*15X*5*/15X*[*])
104  FORMAT(1H ,13X,I2,5E16.3)
      CALL PAGE
      WRITE OUTPUT TAPE 61,100
      WRITE OUTPUT TAPE 61,101
      WRITE OUTPUT TAPE 61,102
      WRITE OUTPUT TAPE 61,100
      WRITE OUTPUT TAPE 61,100
      WRITE OUTPUT TAPE 61,103
      CALL GSFR
      CALL PRODUCE
      DO 893 I=1,5
893  AK(I)=0.0
      DO 894 I=6,9
894  AK(I)=((UP(I)-UPA(I))/UPA(I))
      JL=10
      DO 650 J=1,21
      IR=J
      XR=X(J)
      TR=T2(J)
      C2=XR-4.0*SIGY(IR)
204  C1=XR-500.0
      IF(C2-C1)50,551,551
550  C1=C2
551  IF(C1-1.0)203,203,552
203  C1=1.0
552  CONTINUE
      IF(C1-XBRH)205,205,206
205  TMN=((TCON*C1)+(TAU**1.1))**(1.0/1.1)
      TMN=TMN-TAU
      GO TO 207
206  TMN=TBRH +((C1-XBRH)/UMAX)
207  C1=1.0/UBAR
      IF(TMN-C1)400,401,401
400  TMN=C1
401  C1=XR+500.0
      C2=XR+4.0*SIGY(IR)
      IF(C2-C1)554,554,553
553  C1=C2
554  CONTINUE
      IF(C1-XBRH)208,208,209
208  TMX=((TCON*C1)+(TAU**1.1))**(1.0/1.1)
      TMX=TMX-TAU
      GO TO 210
209  TMX=TBRH +((C1-XBRH)/UMAX)
210  CONTINUE
      DLT1(J)=(IR-TMN)/3.0
      DLT2(J)=(TMX-TR)/3.0
      DLT3(J)=(DLT1(J)+DLT2(J))/2.0
      C1=TMN-DLT1(J)
      DO 211 I=1,3

```

```

      C1=C1+DLT1(J)
      T(I,J)=C1
211  CONTINUE
      C1=TR
      T(4,J)=TR
      DO 212 I=5,7
      C1=C1+DLT2(J)
      T(I,J)=C1
212  CONTINUE
650  CONTINUE
      DO 580 J=1,21
      DO 579 I=1,7
      ICHK(I,J,1)=0
      ICHK(I,J,2)=0
      IF(J+I-28)560,579,579
560  IF(I-7)561,562,562
561  J2=J$GO TO 563
562  J2=J+1
563  DO 578 J1=J2,21
      DO 577 I1=1,7
      IF(J1-J)564,564,565
564  IF(I1-I)577,577,565
565  C1=T(I,J)-T(I1,J1)
      IF(C1-.01)566,567,577
566  IF(C1+.01)577,567,567
567  ICHK(I,J,1)=I1
      ICHK(I,J,2)=J1
577  CONTINUE
578  CONTINUE
579  CONTINUE
580  CONTINUE
      CALL CALC3
      IR=0
2000 IR=IR+1
      IF(SENSE SWITCH 6)1001,1002
1001 CALL OTND
1002 CONTINUE
      DO 201 I=1,5
201  YR(I)=YX(I,IR)
      XR=X(IR)
      TR=T2(IR)
      DO 213 K=1,5
213  CLDS(K,2)=0.0
      DO 490 I=1,7
      I=I
      DO 300 K1=1,5
300  DOS(K1,2)=0.0
      TC=T(I,IR)
      IF(TC-TBRH )220,221,221
220  XC=XCON*((TC+TAU)**1.1)-(TAU**1.1)
      H=(RISE*SQRTF(TC))+RH
      UBC=UBAR*(H**0.2)
      GO TO 222
221  XC=XBRH*((TC-TBRH )*UMAX)
      H=HMAX
      UBC=UMAX

```

```

222 CONTINUE
    IF (I-4) 3002, 3001, 3002
3001 XC=XR
3002 CONTINUE
    CALL TRANS
    CALL ENERGY (I)
224 CALL CLINI(I)
230 CONTINUE
    IF (I-4) 231, 232, 233
231 C1=DLT1(IR)
    GO TO 235
232 C1=DLT3(IR)
    GO TO 235
233 C1=DLT2(IR)
235 CONTINUE
    DO 123 K=1,5
    CLDS(K,2)=CLDS(K,2)+(DOS(K,2)*G(I)*C1/3.0)
123 CONTINUE
490 CONTINUE
    DO 581 K=1,5
    K=K
    IF (CLDS(K,2)-1.0E-40) 585, 585, 581
581 CONTINUE
    GO TO 590
585 DO 586 K1=K,5
586 CLDS(K1,2)=0.0
590 CONTINUE
    WRITE OUTPUT TAPE 61,104,IR,(CLDS(K,2),K=1,5)
500 IF (IR-21) 2000, 2001, 2001
2001 CONTINUE
    RETURN
    END

```

C

```

SUBROUTINE TRANS
SUBROUTINE TO CALCULATE CLOUD DIFFUSION AND TRANSPORT PARAMETERS
BANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
1      CLINT,CALC3,CONC4
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS
DIMENSION ICHN(4),ALPHA(8),FACT(20)
COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
1      ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2      AL,SKIP,EO,TD,DT,NT,AA2
COMMON/AA3/C,ICLK,AA3
DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
EQUIVALENCE (PUT7( 1),ZZ ),(PUT7( 2),VG(1) ),
1      (PUT7( 128),TENG ),(PUT7( 129),RISE ),
2      (PUT7( 130),TAU ),(PUT7( 131),XBAR ),
3      (PUT7( 132),TBAR ),(PUT7( 133),HMAX ),
4      (PUT7( 134),UMAX ),(PUT7( 135),UBAR ),
5      (PUT7( 136),XCON ),(PUT7( 137),TCON ),
6      (PUT7( 138),RH ),(PUT7( 139),SIGY(1) ),
7      (PUT7( 160),SIGZ(1) ),(PUT7( 191),ASGZ(1) ),
8      (PUT7( 212),HMX ),(PUT7( 213),TBRH ),
9      (PUT7( 214),XBRH ),(PUT7( 215),CY(1) ),
1     (PUT7( 221),GZ(1) ),(PUT7( 227),Y1 ),
2     (PUT7( 228),Y2 ),(PUT7( 229),Y3 ),
3     (PUT7( 230),Y4 ),(PUT7( 231),YY ),
4     (PUT7( 232),DEN ),(PUT7( 233),FGAS ),
5     (PUT7( 234),FPAR ),(PUT7( 235),ROP ),
6     (PUT7( 236),X(1) ),(PUT7( 257),YX(1) ),
7     (PUT7( 362),AREA(1) ),(PUT7( 467),RED(1) ),
8     (PUT7( 656),ENUC ),(PUT7( 657),FIS ),
9     (PUT7( 658),SEC ),(PUT7( 659),T1(1) ),
1     (PUT7( 667),T2(1) ),(PUT7( 688),T3(1) ),
2     (PUT7( 709),XI(1) ),(PUT7(1339),QOVRQ(1) ),
3     (PUT7(1465),FN(1) )
EQUIVALENCE (PUT9( 1),IDP(1) ),(PUT9( 202),IGS(1) ),
1     (PUT9( 403),U(1) ),(PUT9( 412),UP(1) ),
2     (PUT9( 421),UPA(1) ),(PUT9( 430),ENR(1) )
EQUIVALENCE (PUT8( 1),IP(1) ),(PUT8( 604),Y(1) )
DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EO(9)
DIMENSION VG( 6,21), SIGY( 21), SIGZ( 31),
1     ASGZ( 21), CY( 3, 2), CZ( 3, 2),
2     X( 21), YX( 5,21), AREA( 21, 5),
3     RED( 9,21), T1( 8), T2( 21),
4     T3( 21), XI( 21, 5, 6),QOVRQ( 6,21),
5     FN( 21), IDP( 201), IGS( 201),
6     U( 9), UP( 9), UPA( 9),
7     ENR( 201, 9), IP( 201, 3), Y( 201, 3),
8     AK( 9), CLOS( 9), CLDS( 5, 2),
9     YR( 5), T( 7,21), DOS( 5, 2),
1     QVQ( 6), CLD( 9), XIR( 5),
2     B( 10), C(201, 7,21), IN1( 10),
3     K8( 10), GAS( 201), PAR( 201),
4     A( 10), C3( 11,11)
TYPE DOUBLE A,C3
IF(XC-10.0)98,98,99
98 IC=1

```

```

      GO TO 111
99  DO 100 I=1,21
      IC=22-I
      IF(XC-X(IC))100,111,111
100 CONTINUE
111 IF(XC-1000.0)121,121,122
121 I1=1
      GO TO 103
122 I1=2
103 CONTINUE
      IF(XC-XBAR)112,112,114
112 C4=Y1*(TC**Y4)*(TENG**(Y3*TC**Y2))
      GO TO 123
114 C4=YY
123 C2=CY(3,I1)*XC+CY(2,I1)*LOGF(XC)
124 C2=CY(1,I1)*FEXP(C2)
126 C4=C4/C2
      SGY=C2*SQRTF(1.0+(C4**2))
      IF(XC-X(IC))150,140,140
140 IF(SGY-SIGY(IC))141,150,150
141 SGY=SIGY(IC)
150 CONTINUE
151 IF(XC-XBAR)152,152,153
152 C4=31.0*(TENG**0.25)*SQRTF(TC)
      GO TO 160
153 C4=ZZ
160 C2=CZ(3,I1)*XC+CZ(2,I1)*LOGF(XC)
161 C2=CZ(1,I1)*FEXP(C2)
163 C4=C4/C2
      SGZ=C2*SQRTF(1.0+(C4**2))
      IF(XC-X(IC))170,167,167
167 IF(SGZ-SIGZ(IC))166,170,170
166 SGZ=SIGZ(IC)
170 CONTINUE
      IF(XC- 10.0)190,191,191
190 DO 202 I=1,6
202 QVQ(I)=1.0
      GO TO 205
191 C1=(H**2)/(2.0*SGZ**2)
301 C1=FEXP(-C1)
302 ASZ=(C1/SGZ)*(XC-X(IC))
      C2=SQRTF(2.0/PI)
      DO 201 I=1,6
      C1=ASZ*C2*VG(I,IC)/UBC
203 QVQ(I)=QOVRQ(I,IC)*FEXP(-C1)
201 CONTINUE
205 CONTINUE
      IF(SENSE SWITCH 1)81,82
70 FORMAT(1H ,2X,6E19.4)
71 FORMAT(1H0)
81 WRITE OUTPUT TAPE 61,71
      WRITE OUTPUT TAPE 61,70,SGY,SGZ,ASZ
      WRITE OUTPUT TAPE 61,71
      WRITE OUTPUT TAPE 61,70,(QVQ(I),I=1,6)
      WRITE OUTPUT TAPE 61,71
82 CONTINUE

```

RETURN
END


```

SUBROUTINE ENERGY(IA)
SUBROUTINE TO CALCULATE TOTAL RADS
RANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLEQ,GSFR,CLOUD,TRANS,ENERGY,
1      CLINT,CALC3,CONC4
BANK(1),/AA3/
COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,M1,TMS
DIMENSION ICHN(4),ALPHA(3),FACT(20)
COMMON /AA2/ AK,CLOS,IR,CLOS,YR,XR,TR,T,DOS,TC,XG,H,UBG,IG,QVQ,CLD
1      ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,
2      AL,SKIP,EO,FD,DT,NT,AA2
COMMON/AA3/C,ICLK,AA3
DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)
EQUIVALENCE (PUT7( 1),ZZ), (PUT7( 2),VG(1)),
1      (PUT7( 128),FENG), (PUT7( 129),RISE),
2      (PUT7( 130),TAU), (PUT7( 131),XBAR),
3      (PUT7( 132),FBAR), (PUT7( 133),HMAX),
4      (PUT7( 134),UMAX), (PUT7( 135),UBAR),
5      (PUT7( 136),XCON), (PUT7( 137),TCON),
6      (PUT7( 138),RH), (PUT7( 139),SIGY(1)),
7      (PUT7( 160),SIGZ(1)), (PUT7( 191),ASGZ(1)),
8      (PUT7( 212),HMX), (PUT7( 213),TBRH),
9      (PUT7( 214),XBRH), (PUT7( 215),CY(1)),
1     (PUT7( 221),CZ(1)), (PUT7( 227),Y1),
2     (PUT7( 228),Y2), (PUT7( 229),Y3),
3     (PUT7( 230),Y4), (PUT7( 231),YY),
4     (PUT7( 232),DEN), (PUT7( 233),FLAS),
5     (PUT7( 234),FPAK), (PUT7( 235),RUP),
6     (PUT7( 236),X(1)), (PUT7( 257),YX(1)),
7     (PUT7( 362),AREA(1)), (PUT7( 467),RED(1)),
8     (PUT7( 656),ENRG), (PUT7( 657),FIS),
9     (PUT7( 658),SEC), (PUT7( 659),T1(1)),
1     (PUT7( 667),T2(1)), (PUT7( 688),T3(1)),
2     (PUT7( 709),XI(1)), (PUT7(1339),QVVRQ(1)),
3     (PUT7(1465),FN(1))
EQUIVALENCE (PUT9( 1),IDP(1)), (PUT9( 202),IGS(1)),
1     (PUT9( 403),U(1)), (PUT9( 412),UP(1)),
2     (PUT9( 421),UPA(1)), (PUT9( 430),ENR(1))
EQUIVALENCE (PUT8( 1),IP(1)), (PUT8( 604),Y(1))
DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EC(9)
DIMENSION VG( 6,21), SIGY( 21), SIGZ( 31),
1     ASGZ( 21), CY( 3, 2), CZ( 3, 2),
2     XL( 21), YX( 5,21), AREA( 21, 5),
3     RED( 9,21), T1( 8), T2( 21),
4     T3( 21), XI( 21, 5, 6), QVVRQ( 6,21),
5     FN( 21), IDP( 201), IGS( 201),
6     U( 9), UP( 9), UPA( 9),
7     ENR( 201, 9), IP( 201, 3), Y( 201, 3),
8     AK( 9), CLOS( 9), CLOS( 5, 2),
9     YR( 5), TC( 7,21), DOS( 5, 2),
1     QVQ( 6), CLD( 9), XIR( 5),
2     B( 10), C(201, 7,21), IN1( 10),
3     K8( 10), GAS( 201), PAR( 201),
4     A( 10), C3( 11,11)
TYPE DOUBLE A,C3
LOG10F(X)=LOGF(X)/2.3
DO 100 L=6,9

```

```

202 C6=LOG10F(ENR(1,L))
   C6=5.675+(0.17*C6)+1.0
   C6=(10.0**C6)*3.6
   C6=1.0/C6
203 CONTINUE
   C2=0.0
   IF(ICHK(IA,IR,1))210,210,211
210 M1=IA,M2=IR,GO TO 212
211 M1=ICHK(IA,IR,1)
   M2=ICHK(IA,IR,2)
212 CONTINUE
   DO 101 I=2,IMAX
   I1=IDP(I)
102 C1=RED(IC ,L)*FN(IC)*PAR(I)
103 C1=C1+(QVQ(I1)*GAS(I))
101 C2=C2+(C(I,M1,M2)*ENR(1,L)*ENR(I,L)*AL(I)*C1)
100 CLD( L)=C2*C6
   RETURN
   END

```

SUBROUTINE CLINI(1A)

SUBROUTINE TO INTEGRATE DOSE OVER CLOUD TO A RECEPTOR

BANK(0),CHAIN4,AA1,AA2,PRODUCE,RKLEDEQ,GSFR,CLOUD,TRANS,ENERGY,
1 CLINT,CALC3,CONC4

BANK(1),AA3

COMMON /AA1/ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD

1 ,SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,

2 AL,SKIP,EO,TD,DT,NT,AA2

COMMON/AA3/C,ICLK,AA3

DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)

EQUIVALENCE (PUT7(1),ZZ), (PUT7(2),VG(1)),

1 (PUT7(128),TENG), (PUT7(129),RISE),

2 (PUT7(130),TAU), (PUT7(131),XBAR),

3 (PUT7(132),TBAK), (PUT7(133),HMAX),

4 (PUT7(134),UMAX), (PUT7(135),UBAR),

5 (PUT7(136),XCON), (PUT7(137),TCUN),

6 (PUT7(138),RH), (PUT7(139),SIGY(1)),

7 (PUT7(160),SIGZ(1)), (PUT7(191),ASGZ(1)),

8 (PUT7(212),HMX), (PUT7(213),TBRH),

9 (PUT7(214),XBRH), (PUT7(215),CY(1)),

1 (PUT7(221),CZ(1)), (PUT7(227),Y1),

2 (PUT7(228),Y2), (PUT7(229),Y3),

3 (PUT7(230),Y4), (PUT7(231),YY),

4 (PUT7(232),DEN), (PUT7(233),FGAS),

5 (PUT7(234),FPAK), (PUT7(235),RUP),

6 (PUT7(236),X(1)), (PUT7(257),YX(1)),

7 (PUT7(362),AREA(1)), (PUT7(467),RED(1)),

8 (PUT7(656),ENIC), (PUT7(657),FIS),

9 (PUT7(658),SEC), (PUT7(659),T1(1)),

1 (PUT7(667),T2(1)), (PUT7(688),T3(1)),

2 (PUT7(709),XI(1)), (PUT7(1339),QVVRQ(1)),

3 (PUT7(1465),FN(1))

EQUIVALENCE (PUT9(1),IDP(1)), (PUT9(202),IGS(1)),

1 (PUT9(403),U(1)), (PUT9(412),UP(1)),

2 (PUT9(421),UPA(1)), (PUT9(430),ENR(1))

EQUIVALENCE (PUT8(1),IP(1)), (PUT8(604),Y(1))

DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EC(9)

DIMENSION VB(6,21), SIGY(21), SIGZ(31),

1 ASGZ(21), CY(3, 2), CZ(3, 2),

2 X(21), YX(5,21), AREA(21, 5),

3 RED(9,21), T1(8), I2(21),

4 T3(21), XI(21, 5, 6), QVVRQ(6,21),

5 FN(21), IDP(201), IGS(201),

6 U(9), UP(9), UPA(9),

7 ENR(201, 9), IP(201, 3), Y(201, 3),

8 AK(9), CLOS(9), CLDS(5, 2),

9 YR(5), IC(7,21), DOS(5, 2),

1 QVQ(6), CLD(9), XIR(5),

2 B(10), C(201, 7,21), IN1(10),

3 K8(10), GAS(201), PAR(201),

4 A(10), C3(11,11)

TYPE DOUBLE A,C3

240 SLY=LOGF(SGY)

SLZ=LOGF(SGZ)

```

H1=H*1.0
DM=5.28/85+2.0*SLY+SLZ
SGD=SGZ A H2=H*1.25
IF (1A-4)1,9
1 C1=SQRTF(H1**2+(XR-XC)**2)
C2=SGY*(H1/C1)**2+SGZ*((XR-XC)/C1)**2
IF (C1=4.0*C2)6,2,2
2 C4=C1**2
DO 5 K=1,5
C2=SQRTF(C4+YX(K,IR)**2)
DO 4 L=6,9
D1=LOGF(CLD(L))
D2=LOGF(1.0+AK(L)*U(L)*C2)
D3=2.0*LOGF(C2)+2.53103
D4=D1+D2-D3-U(L)*C2
4 DOS(K,2)=DOS(K,2)+FEXP(D4)
5 CONTINUE
GO TO 100
6 A1=1.0$KR=KP=3$KT=6$A2=3.0$A3=6.0
GO TO 10
9 A1=2.0$KR=10$KP=KT=5$A2=A3=10.0
IF (2.575*SGD-H2)11,10,10
11 SGD=H2/2.575
10 DLT=2.0*PI/A3
DLP=DLT
T1=-DLT$T2=-0.5*DLT$T3=0.0
DO 95 I=1,KT
T1=T1+DLT
T2=T2+DLT
T3=T3+DLT
SINI=SINF(T2)
COSI=COSF(T2)
P1=-DLP$P2=-0.5*DLP$P3=0.0
DO 90 J=1,KP
P1=P1+DLP
P2=P2+DLP
P3=P3+DLP
SINP=SINF(P2)
COSP=COSF(P2)
SGB=SGY*SINP**2+SGD*COSP**2
DLR=2.575*SGB/A2
IF (DLR-1.0E+24)20,20,12
12 DLR=1.0E+24
20 R1=-DLR$R2=-0.5*DLR$R3=0.0
DO 90 K=1,KR
R1=R1+DLR
R2=R2+DLR
R3=R3+DLR
Z1=R2*COSP
Y1=R2*SINP*COSI
X1=R2*SINP*SINI
F1=0.5*((X1/SGY)**2+(Y1/SGY)**2+(Z1/SGZ)**2)
D1=LOGF(R3**3-F1**3)
D1=D1-LOGF(3.0*DLP*DLT*SINP)
DV=D1
D1=H-R2*COSP

```

```

      IF(D1)24,34,21
21  IF(D1-HMX)34,34,22
22  IF(D1-2.0*HMX)27,27,23
23  IF(D1-3.0*HMX)28,28,29
24  IF(D1+HMX)25,30,30
25  IF(D1+2.0*HMX)26,31,31
26  IF(D1+3.0*HMX)33,32,32
27  D2=2.0*HMX-D1-1.0$GU TO 40
28  D2=D1-2.0*HMX-1.0$GU TO 40
29  D2=4.0*HMX-D1-1.0$GU TO 40
30  D2=-D1-1.0$GU TO 40
31  D2=2.0*HMX+D1-1.0$GU TO 40
32  D2=-D1-2.0*HMX-1.0$GU TO 40
33  D2=4.0*HMX+D1-1.0$GU TO 40
34  D2=D1-1.0
40  X2=XR-XC-R2*COS1*SINP
      Y2=R2*SINP*SINT
      R4=D2**2+X2**2
41  DO 85 K1=1,5
      R=R4+(Y2+YR(K1))**2
      R=SQR1F(R)
      IF(R=1.0)43,44,42
42  IF(R-1.0E+5)44,85,85
43  R=1.0
44  F2=DM+2.0*LOGF(R)
      DO 80 L=6,9
      F3=LOGF(CTD(L))+LOGF(1.0*AK(L)*U(L)*R)*DV
      F4=F1+U(L)*R
      F5=F3-F2-F4
80  F5=FEXP(F5)
      DOS(K1,2)=DOS(K1,2)+A1*F5
85  CONTINUE
90  CONTINUE
95  CONTINUE
100 RETURN
      END

```

SUBROUTINE CALC3

GENERALIZED DECAY CHAIN CALCULATION SUBROUTINE

0020

RANK(0),CHAIN4,/AA1/,/AA2/,PRODUCE,RKLDEQ,GSFR,CLOUD,TRANS,ENERGY,
CLINT,CALC3,CONC4

BANK(1),/AA3/

COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ AK,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD
SGY,SGZ,XIR,J1,B,IN1,K8,A,C3,GAS,PAR,PUT7,PUT8,PUT9,

COMMON/AA3/C,ICLK,AA3

DIMENSION AA2(1318),ICLK(7,21,2),AA3(2359)

EQUIVALENCE (PUT7(1),ZZ), (PUT7(2),VG(1)),

(PUT7(128),TENG), (PUT7(129),RISE),

(PUT7(130),TAU), (PUT7(131),XBAR),

(PUT7(132),TBAR), (PUT7(133),HMAX),

(PUT7(134),UMAX), (PUT7(135),UBAR),

(PUT7(136),XCON), (PUT7(137),TCON),

(PUT7(138),RH), (PUT7(139),SIGY(1)),

(PUT7(160),SIGZ(1)), (PUT7(191),ASGZ(1)),

(PUT7(212),HMX), (PUT7(213),TBRH),

(PUT7(214),XBRH), (PUT7(215),CY(1)),

(PUT7(221),CZ(1)), (PUT7(227),Y1),

(PUT7(228),Y2), (PUT7(229),Y3),

(PUT7(230),Y4), (PUT7(231),YY),

(PUT7(232),DEN), (PUT7(233),FGAS),

(PUT7(234),FPAR), (PUT7(235),ROP),

(PUT7(236),X(1)), (PUT7(257),YX(1)),

(PUT7(362),AREA(1)), (PUT7(467),RED(1)),

(PUT7(656),ENUC), (PUT7(657),FIS),

(PUT7(658),SEC), (PUT7(659),T1(1)),

(PUT7(667),T2(1)), (PUT7(688),T3(1)),

(PUT7(709),XI(1)), (PUT7(1339),QOVRQ(1)),

(PUT7(1465),FN(1))

EQUIVALENCE (PUT9(1),IDP(1)), (PUT9(202),IGS(1)),

(PUT9(403),U(1)), (PUT9(412),UP(1)),

(PUT9(421),UPA(1)), (PUT9(430),ENR(1)),

EQUIVALENCE (PUT8(1),IP(1)), (PUT8(604),Y(1))

DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EO(9)

DIMENSION VG(6,21), SIGY(21), SIGZ(31),

ASGZ(21), CY(3, 2), CZ(3, 2),

X(21), YX(5,21), AREA(21, 5),

RED(9,21), T1(8), T2(21),

T3(21), XI(21, 5, 6), QOVRQ(6,21),

FN(21), IDP(201), IGS(201),

U(9), UP(9), UPA(9),

ENR(201, 9), IP(201, 3), Y(201, 3),

AK(9), CLOS(9), CLDS(5, 2),

YR(5), T(7,21), DOS(5, 2),

QVQ(6), CLD(9), XIR(5),

B(10), C(201, 7,21), IN1(10),

K8(10), GAS(201), PAR(201),

A(10), C3(11,11)

TYPE DOUBLE A,C3

DO 100 I1=2,IMAX

IF(SENSE SWITCH 6)5001,5002

```

5001 CALL OTND
5002 CONTINUE
      J1=J1
      DO 500 J=1,21
      DO 500 I=1,7
500  C(J1,I,J)=0.0
      DO 2 I=1,10
      R(I)=0.0
      2-A(I)=0.0D
      A(1)=AL(J1)
      DO 101 I2=1,3
      J2=IP(J1,I2)
      IF(J2)101,101,200
200  R(1)=Y(J1,I2)
      IF(J2-1)201,201,202
201  CALL CONC4(1)
      GO TO 101
202  A(2)=AL(J2)
      DO 102 I3=1,3
      J3=IP(J2,I3)
      IF(J3)102,102,203
203  R(2)=Y(J2,I3)
      IF(J3-1)204,204,205
204  CALL CONC4(2)
      GO TO 102
205  A(3)=AL(J3)
      DO 103 I4=1,3
      J4=IP(J3,I4)
      IF(J4)103,103,206
206  R(3)=Y(J3,I4)
      IF(J4-1)207,207,208
207  CALL CONC4(3)
      GO TO 103
208  A(4)=AL(J4)
      DO 104 I5=1,3
      J5=IP(J4,I5)
      IF(J5)104,104,209
209  R(4)=Y(J4,I5)
      IF(J5-1)210,210,211
210  CALL CONC4(4)
      GO TO 104
211  A(5)=AL(J5)
      DO 105 I6=1,3
      J6=IP(J5,I6)
      IF(J6)105,105,212
212  R(5)=Y(J5,I6)
      IF(J6-1)213,213,214
213  CALL CONC4(5)
      GO TO 105
214  A(6)=AL(J6)
      DO 106 I7=1,3
      J7=IP(J6,I7)
      IF(J7)106,106,215
215  R(6)=Y(J6,I7)
      IF(J7-1)216,216,217
216  CALL CONC4(6)

```

	GO TO 106	1660
217	A(7)=AL(J/)	1680
	DO 107 18=1,3	1690
	J6=IP(J7,18)	1700
	IF(J8)107,107,218	1710
218	B(7)=Y(J7,18)	1720
	IF(J8-1)219,219,220	
219	CALL CONC4(7)	1740
	GO TO 107	
220	A(8)=AL(J8)	1760
	DO 108 19=1,3	1770
	J9=IP(J8,19)	1780
	IF(J9)108,108,221	1790
221	B(8)=Y(J8,19)	1800
	IF(J9-1)222,222,223	
222	CALL CONC4(8)	1820
	GO TO 108	
223	A(9)=AL(J9)	
	DO 109 111=1,3	
	J1J=IP(J9,111)	
	IF(J1J)109,109,224	
224	B(9)=Y(J9,111)	
	IF(J1J-1)225,225,226	
225	CALL CONC4(9)	1900
	GO TO 109	
226	A(10)=AL(J1J)	
	B(10)=Y(J1J,1)	
	CALL CONC4(10)	1940
109	CONTINUE	1950
108	CONTINUE	1960
107	CONTINUE	1970
106	CONTINUE	1980
105	CONTINUE	1990
104	CONTINUE	2000
103	CONTINUE	2010
102	CONTINUE	2020
101	CONTINUE	2030
100	CONTINUE	2040
	RETURN	2050
	END	

SUBROUTINE CONC(4,K)

GENERALIZED HATMAN EQUATION SUBROUTINE

002

RANK(0),TCH,IN4,AA1,AA2,PRODUCE,RK,PEG,GSFR,CLOUD,TRANS,ENERGY,

1 CLINT,ALC3,CONC4

RANK(1),AA3

COMMON /AA1/ ICHN,IPAGE,ALPHA,I12,IMAX,I21,FACT,PI,TMS

DIMENSION ICHN(4),ALPHA(8),FACT(20)

COMMON /AA2/ AB,CLOS,IR,CLDS,YR,XR,TR,T,DOS,TC,XC,H,UBC,IC,QVQ,CLD

1 ,SGY,SGZ,XIR,J1,K,IN1,K8,A,G3,GAS,PAR,PUT7,PUT8,PUT9,

2 AL,SKIP,EO,TD,LT,NT,AA2

COMMON/AA3/C,ICHK,AA3

DIMENSION AA2(3318),ICHK(7,21,2),AA3(2359)

EQUIVALENC (PUT7(1),ZZ),(PUT7(2),VG(1)),

1 (PUT7(128),TENG),(PUT7(129),RISE),

2 (PUT7(130),TAH),(PUT7(131),XBAR),

3 (PUT7(132),TBAP),(PUT7(133),HMAX),

4 (PUT7(134),UMA),(PUT7(135),UBAR),

5 (PUT7(136),XCON),(PUT7(137),TCON),

6 (PUT7(138),RH),(PUT7(139),SIGY(1)),

7 (PUT7(160),SI,/(1)),(PUT7(191),ASGZ(1)),

8 (PUT7(212),HMX),(PUT7(213),TBRH),

9 (PUT7(214),XBPH),(PUT7(215),CY(1)),

1 (PUT7(221),CZ(1)),(PUT7(227),Y1),

2 (PUT7(228),Y2),(PUT7(229),Y3),

3 (PUT7(230),Y4),(PUT7(231),YY),

4 (PUT7(232),DEN),(PUT7(233),FGAS),

5 (PUT7(234),FPAH),(PUT7(235),RUP),

6 (PUT7(236),X(1)),(PUT7(257),YX(1)),

7 (PUT7(362),AREA(1)),(PUT7(467),RED(1)),

8 (PUT7(656),ENH),(PUT7(657),FIS),

9 (PUT7(658),SEC),(PUT7(659),T1(1)),

1 (PUT7(667),T2(1)),(PUT7(688),T3(1)),

2 (PUT7(769),XI(1)),(PUT7(1339),QOVRQ(1)),

3 (PUT7(1465),FN(1))

EQUIVALENC (PUT9(1),IDP(1)),(PUT9(202),IGS(1)),

1 (PUT9(403),U(1)),(PUT9(412),UP(1)),

2 (PUT9(421),UPA(1)),(PUT9(430),ENR(1))

EQUIVALENC (PUT8(1),IP(1)),(PUT8(604),Y(1))

DIMENSION PUT7(1500),PUT8(1250),PUT9(2300),AL(201),SKIP(4),EC(9)

DIMENSION VG(6,21), SIGY(21), SIGZ(31),

1 ASGZ(21), CY(3, 2), CZ(3, 2),

2 X(21), YX(5, 21), AREA(21, 5),

3 RE(9, 21), T1(8), T2(21),

4 T3(21), XI(21, 5, 6), QOVRQ(6, 21),

5 FI(21), IDP(201), IGS(201),

6 U(9), UP(9), UPA(9),

7 ENR(201, 9), IP(201, 3), Y(201, 3),

8 AK(9), CLOS(9), CLDS(5, 2),

9 YR(5), TC(7, 21), DOS(5, 2),

1 QVQ(6), CLD(9), XIR(5),

2 K(10), G(201, 7, 21), IN1(10),

3 K8(10), GAS(201), PAR(201),

4 A(10), G3(11, 11)

TYPE DOUBLE A,G3

TYPE DOUBLE D1,D2,D3

IF(K-1)150,150,151

1180

150	DO 400 M=1,21	
	DO 400 L=1,7	
	IF (ICLK(L,M,1)) 390,399,400	
390	IF (T(L,M)) 401,401,600	
401	C(J1,L,M)=Y(J1,1)	
	GO TO 400	
600	C8=T(L,M)*A(1)	
601	C4=FXP(-C8)*B(1)	
	C(J1,L,M)=C(J1,L,M)+C4	
400	CONTINUE	
	RETURN	
151	DO 2 J=1,10	
2	IN1(J)=0	1170
	C1=1.0	
	DO 100 K1=2,K	1270
100	C1=C1*A(K1)	
	DO 40 K1=1,K	1290
40	C3(K1,K1)=1.00	
	K4=K-1	1310
	DO 41 K1=1,K4	1320
	K5=K1+1	1330
	DO 41 K2=K5,K	1340
	C3(K1,K2)=A(K2)-A(K1)	
41	C3(K2,K1)=-C3(K1,K2)	
	DO 42 K1=1,K	1370
	C3(K1,11)=1.00	
	DO 42 K2=1,K	1390
	IF (IN1(K1)) 55,55,42	1400
55	IF (C3(K1,K2)) 43,52	
52	IF (K1-K2) 53,42,42	1440
53	IN1(K1)=K2	1450
	GO TO 42	1460
43	C3(K1,11)=C3(K1,11)*C3(K1,K2)	
42	CONTINUE	1480
	K2=K-1	
	DO 71 K1=1,K2	
	IF (IN1(K1)) 71,71,72	
72	K3=IN1(K1)	
73	IF (IN1(K3)) 71,74,75	
74	IN1(K3)=-1+GO TO 71	
75	K3=IN1(K3)+GO TO 73	
71	CONTINUE	
	DO 500 M=1,21	
	DO 500 L=1,7	
	IF (ICLK(L,M,1)) 499,499,500	
499	IF (T(L,M)) 501,501,302	
501	C(J1,L,M)=Y(J1,1)	
	GO TO 500	
302	D3=0.00	
	DO 101 K1=1,K	1570
	IF (IN1(K1)) 101,102,101	1580
102	D1=T(L,M)*A(K1)	
	IF (D1=600.0) 11,101,101	
611	D2=DEXP(-D1)/C3(K1,11)	
613	D3=D3+D2	
101	CONTINUE	1660

10-15 K1=1,10	1670
K8(K1)=K1	1680
10-60 K1=1,K	1690
IF(K1-K0(K1))60,64,60	1700
64 IF(IV1(K1))61,60,61	1710
61 K2=1	1720
K3=IV1(K1)	1730
K8(K3)=0	1740
63 IF(IV1(K3))70,70,62	
62 K3=IV1(K3)	1770
K2=K2+1	1780
K8(K3)=0	1790
60-70 63	1800
70 D2=(T(L,1)*K2)/FACT(K2)	
D1=T(L,M)*A(K1)	
IF(D1-600.0)21,60,60	
621 D3=D1+(D1*P(-D1)*D2/C3(K1,11))	
60 CONTINUE	
C4=1.0	1970
10-103 K1=1,K	1980
103 C4=C4*B(K1)	1990
C4=C4*C1*D3	
152 C(J1,L,M)=C(J1,L,M)+C4	
200 CONTINUE	2040
RETURN	2060
END	2070

APPENDIX D

USE ON OTHER COMPUTERS

NURSE-1 is written entirely in the FORTRAN language. However, some special features available only on CONTROL DATA computers have been used and would have to be replaced. In addition, NURSE-1 is designed for a computer with 64K memory hence, if a smaller computer were used, the dimensions of some variable would have to be decreased and the program would have to be further segmented. The operating instructions given in this report pertain to the SCOFI Monitor System⁽²²⁾ and would necessarily be different when operating under any other system.

For example, if one desired to modify NURSE-1 for use on an IBM 7090-7094 with 32K memory operating with FORTRAN II under the FORTRAN Monitor System⁽²⁶⁾ the following would be necessary:

1. Modify the program to conform to the rules of FORTRAN II
 - a. replace "BUFFER IN" statements with "READ TAPE"
 - b. replace "BUFFER OUT" statements with "WRITE TAPE"
 - c. remove "IF UNIT," "IF EOF" and "IF IOCHECK" statements
 - d. change logical tape assignments
 - e. modify the method of handling double precision numbers
 - f. modify the method for chain linking and calling
2. Decrease size to fit 32K memory
 - a. decrease the storage requirement in CHAIN 2, 3 and 4
 - b. decrease the number of times per calculation step in the isotopic concentration routine in CHAIN 2 and 4
 - c. write out less information per command in CHAIN 2
 - d. read and process less information per command in CHAIN 3

This author and NUS would be pleased to offer guidance and assistance to anyone attempting to modify NURSE-1 for use on any other computer.

APPENDIX F

TAPF, LIBRARY TAPF GENERATION ROUTINE

TAPF Program

1. INTRODUCTION

The TAPF Program prepares the library tape needed to run the NURSE-1 program. TAPF may be operated in three modes:

- a. prepare new tape and list
- b. modify existing tape and list
- c. list existing tape without modification

Following is an input description, operating instructions, listing of the present library tape and program listing for TAPF.

II. INPUT DESCRIPTION

Card No.	Columns	Format	Information
1	8-10	I3	I2 { -1 prepare new tape 0 modify existing tape 1 list existing tape only
	11-40	30H	Name name of person preparing or modifying tape (blank if I2 = 1)
	41-60	20H	Date date of tape preparation or modification (blank if I2 = 1)
			<u>no additional cards needed if I2 = 1</u>
2			<u>needed only if I2 < 1</u>
	11-60	50H	TITLE Title of library tape
3	1	I1	INF1 { 0 do not 1 do include card type 4
	2	I1	INF2 { 0 do not 1 do include card type 5

Card No.	Columns	Format	Information
	3	I1	INP(3) { 0-do not 1-do include card type 6
	4	I1	INP(4) { 0-do not 1-do include card type 7
	5	I1	INP(5) { 0-do not 1-do include card type 8
	6	I1	INP(6) { 0-do not 1-do include card type 9
	7	I1	INP(7) { 0-do not 1-do include card type 10
	8	I1	INP(8) { 0-do not 1-do include card type 11
	9	I1	INP(9) { 0-do not 1-do include card type 12
	10	I1	INP(10) { 0-do not 1-do include card type 13
	11	I1	INP(11) { 0-do not 1-do include card type 14
	12	I1	INP(12) { 0-do not 1-do include card type 15
	13	I1	INP(13) { 0-do not 1-do include card type 16
	14	I1	INP(14) { 0-do not 1-do include card type 17
	15	I1	INP(15) { 0-do not 1-do include card type 18
All the above must be equal to 1 (one) for J2 = -1. For the following cards only those for which INP = 1 should be input.			
4	16-20	I5	IMAX maximum isotope number (number of isotopes + 1)

Card No.	Columns	Format	Information
5	1-3	I3	J1 { blank if not last card of 5 series 999 if last card of 5 series
	4-6	I3	I isotope indexing number $2 \leq I \leq \text{IMAX}$
	7-14	8H	NAME(I) isotope name
	15 -22	E8	AL(I) decay constant (sec^{-1})
	23-24	I2	IDP(I) deposition index ($1 \leq \text{IDP} \leq 6$)
	25-26	I2	IGS(I) gaseous-particulate index ($0 \leq \text{IGS} \leq 1$)
	27- 44	E8	Y(I, 1) direct fission yield (atoms/fission)
	35-42	E8	Y(I, 2) fractional yield from first precursor
	43-50	E8	Y(I, 3) fractional yield from second precursor
	51-53	I2	IP(I, 1) index number of first precursor
	54-56	I2	IP(I, 2) index number of second precursor
	57-64	E8	EO(I) maximum beta decay energy (Mev/ disintegration)
	65- 72	E8	EB(I) average beta decay energy (Mev/ disintegration)
6 (1)	1-3	I3	J1 blank if not last card of 6 series 999 if last card of 6 series
	4-6	I3	001
	9-15	E7	ENR(1, 1) average energy-beta group 1 (Mev/dis.)
	16-22	E7	ENR(1, 2) average energy-beta group 2 (Mev/dis.)
	23-29	E7	ENR(1, 3) average energy-beta group 3 (Mev/dis.)
	30-36	E7	ENR(1, 4) average energy-beta group 4 (Mev/dis.)
	37-43	E7	ENR(1, 5) average energy-beta group 5 (Mev/dis.)
	44-50	E7	ENR(1, 6) average energy-gamma group 1 (Mev/dis.)
	51-57	E7	ENR(1, 7) average energy-gamma group 2 (Mev/dis.)
	58-64	E7	ENR(1, 8) average energy-gamma group 3 (Mev/dis.)

Card No.	Columns	Format	Information
6 (2)	65-71	E7	ENR(1,9) average energy-gamma group 4 (Mev/dis.)
	1-3	I3	J1 { blank if not last card of 6 series 999 if last card of 6 series
	4-6	I3	I isotope index number
	9-15	E7	ENR(1,1) contribution to beta group 1 (per cent)
	16-22	E7	ENR(1,2) contribution to beta group 2 (per cent)
	23-29	E7	ENR(1,3) contribution to beta group 3 (per cent)
	30-36	E7	ENR(1,4) contribution to beta group 4 (per cent)
	37-43	E7	ENR(1,5) contribution to beta group 5 (per cent)
	44-50	E7	ENR(1,6) contribution to gamma group 1 (per cent)
	51-57	E7	ENR(1,7) contribution to gamma group 2 (per cent)
	58-64	E7	ENR(1,8) contribution to gamma group 3 (per cent)
7	65-71	E7	ENR(1,9) contribution to gamma group 4 (per cent)
	1-3	I3	J1 { blank if not last card of 7 series 999 if last card of 7 series
	4-6	I3	I isotope index number
	9-16	E8	F1(1,1) thyroid dose inhalation fraction
	17-24	E8	F1(1,2) bone dose inhalation fraction
	25-32	E8	F1(1,3) GI tract dose inhalation fraction
	33-40	E8	F1(1,4) lung dose inhalation fraction
	41-48	E8	F2(1,1) thyroid dose ingestion fraction
	49-56	E8	F2(1,2) bone dose ingestion fraction
8	57-64	E8	F2(1,3) GI tract dose ingestion fraction
	1-3	I3	J1 { blank if not last card of 8 series 999 if last card of 8 series
	4-6	E8	I isotope index number

Card No.	Columns	Format	Information	
9	9-16	E8	BL(I, 1)	biological decay constant-thyroid (sec^{-1})
	17-24	E8	BL(I, 2)	biological decay constant-bone (sec^{-1})
	25-32	E8	BL(I, 3)	biological decay constant-GI tract (sec^{-1})
	33-40	E8	BL(I, 4)	biological decay constant-lung (sec^{-1})
	41-48	E8	ENG(I, 1)	effective decay energy-thyroid (Mev/dis.)
	49-56	E8	ENG(I, 1)	effective decay energy-bone (Mev/dis.)
	57-64	E8	ENG(I, 3)	effective decay energy-GI tract (Mev/dis.)
	65-72	E8	ENG(I, 4)	effective decay energy-lung (Mev/dis.)
	Ingestion Route Adjustment Factors			
	9-15	E7	F3(1, 1)	thyroid route 1
	16-22	E7	F3(2, 1)	thyroid route 2
	23-29	E7	F3(3, 1)	thyroid route 3
	30-36	E7	F3(1, 2)	bone route 1
	37-43	E7	F3(2, 2)	bone route 2
	44-50	E7	F3(3, 2)	bone route 3
	51-57	E7	F3(1, 3)	GI tract route 1
	58-64	E7	F3(2, 3)	GI tract route 2
	65-71	E7	F3(3, 3)	GI tract route 3
10	11-20	E10	VG(1)	Deposition velocity-Dep. Index = 1 (meter/sec)

Card No.	Columns	Format	Information	
11	21-30	E10	VG(2)	Deposition velocity-Dep. Index = 2 (meter/sec)
	31-40	E10	VG(3)	Deposition velocity-Dep. Index = 3 (meter/sec)
	41-50	E10	VG(4)	Deposition velocity-Dep. Index = 4 (meter/sec)
	51-60	E10	VG(5)	Deposition velocity-Dep. Index = 5 (meter/sec)
	61-70	E10	VG(6)	Deposition velocity-Dep. Index = 6 (meter/sec)
	14-15	2H	NAME (1)	name of stability class no. 1
	19-20	2H	NAME (2)	name of stability class no. 2
	24-25	2H	NAME (3)	name of stability class no. 3
	29-30	2H	NAME (4)	name of stability class no. 4
	34-35	2H	NAME (5)	name of stability class no. 5
	39-40	2H	NAME (6)	name of stability class no. 6
12	44-45	2H	NAME (7)	name of stability class no. 7
	49-50	2H	NAME (8)	name of stability class no. 8
	1-3	I3	J1	{ blank if not last card of 12 series 999 if last card of 12 series
	4-6	I3	J	stability class number $1 \leq J \leq 8$
	11-20	F10	AO(J)	fit parameter for σ_y
	21-30	F10	A1(J)	
	31-40	F10	A2(J)	
	41-50	F10	BO(J)	
	51-60	F10	B1(J)	
	61-70	F10	B2(J)	

Card No.	Columns	Format	Information	
13	1-3	I3	11	{ blank if not last card of 13 series 999 if last card of 13 series
	4-6	I3	.	stability case number $1 \leq J \leq 8$
	11-20	E10	AO	} fit parameter for σ_z
	21-30	E10	A1	
	31-40	E10	A2	
	41-50	E10	BO	
	51-60	E10	B1	
	61-70	F10	B	
14	9-16	F8	RG	breathing rate (M^3/sec)
	17-24	F8	FG 1	Fraction of ground concentration to ingestion route 1
	25-32	F8	FG 2	Fraction of ground concentration to ingestion route 2
	33-40	F8	FG 3	Fraction of ground concentration to ingestion route 3
	41-48	F8	GM 1	mass of thyroid (gas)
	49-56	F8	GM 2	mass of bones (gas)
	57-64	F8	GM 3	mass of GI tract (gas)
	65-72	F8	GM 4	mass of lungs (gas)
The following three cards are input as a unit				
15 (1)	9-15	I7	17/1	total linear attenuation coefficient in air corrected for temperature and pressure beta group 1 (meter^{-1})
	15-22	I7	17	total linear attenuation coefficient in air corrected for temperature and pressure beta group 2 (meter^{-1})

Card No.	Columns	Format	Information	
15 ₍₂₎	23-29	E7	U(3)	total linear attenuation coefficient in air corrected for temperature and pressure-beta group 3 (meter ⁻¹)
	30-36	E7	U(4)	total linear attenuation coefficient in air corrected for temperature and pressure-beta group 4 (meter ⁻¹)
	37-43	E7	U(5)	total linear attenuation coefficient in air corrected for temperature and pressure-beta group 5 (meter ⁻¹)
	44-50	E7	U(6)	total linear attenuation coefficient in air corrected for temperature and pressure-gamma group 1 (meter ⁻¹)
	51-57	E7	U(7)	total linear attenuation coefficient in air corrected for temperature and pressure-gamma group 2 (meter ⁻¹)
	58-64	E7	U(8)	total linear attenuation coefficient in air corrected for temperature and pressure-gamma group 3 (meter ⁻¹)
	65-71	E7	U(9)	total linear attenuation coefficient in air corrected for temperature and pressure-gamma group 4 (meter ⁻¹)
	9-15	E7	UP(1)	total linear attenuation coefficient
	16-22	E7	UP(2)	in air at STP input as above
	23-29	E7	UP(3)	
	30-36	E7	UP(4)	
	37-43	E7	UP(5)	
	44-50	E7	UP(6)	
	51-57	E7	UP(7)	
	58-64	E7	UP(8)	
	65-71	E7	UP(9)	

Card No.	Columns	Format	Information	
15 ₍₃₎	9-15	E7	UPA(1)	total absorption coefficient in air
	16-22	E7	UFA(2)	at STP input as above
	23-29	E7	UFA(3)	
	30-36	E7	UFA(4)	
	37-45	E7	UFA(5)	
	44-50	E7	UFA(6)	
	51-57	E7	UFA(7)	
	58-64	E7	UFA(8)	
	65-71	E7	UFA(9)	
<u>The next three cards are input as a group</u>				
16 ₍₁₎	9-15	E7	DMAX(1)	maximum particle diameter-group 1 (microns)
	16-22	E7	DMAX(2)	maximum particle diameter-group 2 (microns)
	23-29	E7	DMAX(3)	maximum particle diameter-group 3 (microns)
	30-36	E7	DMAX(4)	maximum particle diameter-group 4 (microns)
	37-43	E7	DMAX(5)	maximum particle diameter-group 5 (microns)
	44-50	E7	DMAX(6)	maximum particle diameter-group 6 (microns)
	51-57	E7	DMAX(7)	maximum particle diameter-group 7 (microns)
	58-64	E7	DMAX(8)	maximum particle diameter-group 8 (microns)
	65-71	E7	DMAX(9)	maximum particle diameter-group 9 (microns)

Card No.	Columns	Format	Information	
16 ₍₂₎	9-15	E7	VO(1)	
	16-22	E7	VO(2)	
	23-29	E7	VO(3)	
	30-36	E7	VO(4)	
	37-43	E7	VO(5)	fallout particle terminal velocities input as above (meters/sec)
	44-50	E7	VO(6)	
	51-57	E7	VO(7)	
	58-64	E7	VO(8)	
	65-71	E7	VO(9)	
16 ₍₃₎	9-15	E7	GAM(1)	
	16-22	E7	GAM(2)	
	23-29	E7	GAM(3)	
	30-36	E7	GAM(4)	fallout settling equation constant input as above (meter ⁻¹)
	37-43	E7	GAM(5)	
	44-50	E7	GAM(6)	
	51-57	E7	GAM(7)	
	58-64	E7	GAM(8)	
	65-71	E7	GAM(9)	
17	9-15	E7	E1(1)	maximum energy-beta group 1 (Mev/dis)
	16-22	E7	E1(2)	maximum energy-beta group 2 (Mev/dis)
	23-29	E7	E1(3)	maximum energy-beta group 3 (Mev/dis)
	30-36	E7	E1(4)	maximum energy-beta group 4
	37-43	E7	E1(5)	maximum energy-beta group 5 (Mev/dis)

Card No.	Columns	Format	Information	
18	44-50	E7	E1(6)	maximum energy-gamma group 1 (Mev/dis)
	51-57	E7	E1(7)	maximum energy-gamma group 2 (Mev/dis)
	58-64	E7	E1(8)	maximum energy-gamma group 3 (Mev/dis)
	65-71	E7	E1(9)	maximum energy-gamma group 4 (Mev/dis)
	9-15	E7	T4(1, 1)	thyroid ingestion delay time - route 1 (dis)
	16-22	E7	T4(2, 1)	thyroid ingestion delay time - route 2 (dis)
	23-29	E7	T4(3, 1)	thyroid ingestion delay time - route 3 (dis)
	30-36	E7	T4(1, 2)	bone ingestion delay time - route 1 (dis)
	37-43	E7	T4(2, 2)	bone ingestion delay time - route 2 (dis)
	44-50	E7	T4(3, 2)	bone ingestion delay time - route 3 (dis)
	51-57	E7	T4(1, 3)	GI tract ingestion delay time - route 1 (dis)
	58-64	E7	T4(2, 3)	GI tract ingestion delay time - route 2 (dis)
	65-71	E7	T4(3, 3)	GI tract ingestion delay time - route 3 (dis)

III. OPERATING DECK MAKE UP

(the 7/9 in column one is a 7-9 punch)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
7/9	S	E	Q	U	E	N	C	E	,	O	O	O	I																										
7/9	J	O	B	,	N	N	N	N	N	,	I	I	I	,	T	T	T																						
7/9	E	Q	U	I	P	,	O	5	=	6	0																												
7/9	E	Q	U	I	P	,	O	6	=	6	1																												
7/9	E	Q	U	I	P	,	O	9	=	(	N	U	R	S	E		L	I	B	,	I	,	I	)	,	H	I	,	S	V									
7/9	R	U	N	,	T	T	T	,	M	M	M	M	,	7																									

On the above cards

NNNNN = the accounting number (assigned by a given installation)
 III = the user's initials
 MMMMM = the maximum number of lines of output
 TTT = the maximum running time in minutes

IV. MACHINE REQUIREMENTS

- CONTROL DATA 3600 with 64K (2 bank) memory⁽²¹⁾
- 5 tape drives
- SCOPE Monitor System⁽²²⁾

V. OPERATING INSTRUCTIONS

- Time Requirements
approximately 2 minutes
- Tape Assignments

<u>Logical Tape No.</u>	<u>Assignment</u>
70	SCOPE Monitor System
60	Input tape
61	Output tape
9	Library tape
80	SCOPE System Recovery tape

c. Operation

1. Standard operation under SCOPE Monitor System
2. No special operating instructions

d. Program Stops

Stop	Diagnosis
1 ₈	EOF or parity error on Logical 9
2 ₈	unable to ready unit Logical 9

VI. PROGRAM LISTING

PROGRAM TAPES

NUS NURSE - 1 CODE TAPE WRITING PROGRAM

COMMON /TPS/I12,I1MAX,I21,PUT

DIMENSION PUT(7500)

EQUIVALENCE (PUT(1),VG(1)),(PUT(7),AYZ(1)),

1 (PUT(103),GAM(1)),(PUT(112),VO(1)),

2 (PUT(121),RMX(1)),(PUT(130),ALFA(1)),

3 (PUT(137),BLFA(1)),(PUT(144),CLFA(1)),

4 (PUT(151),DLFA(1)),(PUT(159),E1(1)),

5 (PUT(168),IP(1)),(PUT(570),Y(1)),

6 (PUT(1173),AL(1)),(PUT(1374),T4(1)),

7 (PUT(1383),IDP(1)),(PUT(1584),IGS(1)),

8 (PUT(1785),U(1)),(PUT(1794),UP(1)),

9 (PUT(1803),UPA(1)),(PUT(1812),ENR(1)),

1 (PUT(3621),RG),(PUT(3622),FG(1)),

2 (PUT(3625),GM),(PUT(3629),F1(1)),

3 (PUT(4433),BL(1)),(PUT(5237),ENG(1)),

4 (PUT(6041),F3(1)),(PUT(6050),EO(1)),

5 (PUT(6251),EB(1)),(PUT(6452),F2(1))

DIMENSION ALFA(7),BLFA(7),CLFA(7),DLFA(8),ELFA(201),FLFA(7),

1 VG(6),AYZ(8,3,4),RMX(9),AL(201),

2 IDP(201),Y(201,3),IP(201,2),IGS(201),EO(201),EB(201),

3 GM(4),F1(201,4),BL(201,4),ENG(201,4),F2(201,4),U(9),

4 UP(9),UPA(9),E1(9),ENR(201,9),INP(15),GAM(9),VO(9)

5 ,FG(3),F3(3,3),T4(3,3)

DIMENSION AB(1)

DATA(AB=8H)

LOG10F(X)=LOGF(X)/2.3

100 FORMAT(15I1)

101 FORMAT(4X,I6,6A8,A2)

99 FORMAT(4X,I6,3A8,A6,2A8,A4)

102 FORMAT(10X,I5)

103 FORMAT(2I3, A8,E8,2I2,3E8,2I3,2E8)

104 FORMAT(2I3,2X,8E8)

105 FORMAT(10X,6E10)

106 FORMAT(10X,8(3X,A2))

107 FORMAT(2I3,4X,6E10)

108 FORMAT(2I3,2X,9E7)

109 FORMAT(8X,9E7)

200 FORMAT(1H1)

201 FORMAT(1H0)

202 FORMAT(1H ,42X,33HNURSE = 1 PROGRAM LIBRARY LISTING,34X,4HPAGE,{4})

203 FORMAT(1H0,24X,20HLIBRARY DESCRIPTION ,6A8,A2)

204 FORMAT(1H0,24X*WRITTEN BY *3A8,A6* ON *2A8,A4)

205 FORMAT(1H0,24X*REVISED BY *3A8,A6* ON *2A8,A4)

206 FORMAT(1H0,39X,39HTOTAL NO. OF ISOTOPES PLUS ONE, I1MAX = ,I3)

207 FORMAT(1H0,43X,31HFIT PARAMETERS FOR SIGMA-Y OF X)

208 FORMAT(1H0,7X,9HSTABILITY/6X,103HCLASS INDEX A0

1 A1 A2 B0 B1

2 B2//)

209 FORMAT(1H ,6X,A2,I8,6E16,4)

210 FORMAT(1H0,43X,31HFIT PARAMETERS FOR SIGMA-Z OF X)

211 FORMAT(1H0, 119H I ISOTOPE DECAY DEP. GAS,

1 FISSION FIRST PRECURSOR SECOND PRECURSOR

2 I/ YIELD 110H CONSTANT INDEX INDEX

3 YIELD NO. YIELD NO. YIELD//)

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212 FORMAT(1H ,14,4X, A8, E15.3,218,3( E15.3,19))
213 FORMAT(1H0,42X,35H THYROID DOSE CALCULATION PARAMETERS)
214 FORMAT(1H0,40X,35H BONE DOSE CALCULATION PARAMETERS)
215 FORMAT(1H0,40X,35H G.I. DOSE CALCULATION PARAMETERS)
216 FORMAT(1H0,40X,35H LUNG DOSE CALCULATION PARAMETERS)
217 FORMAT(1H0,21X,81HI ISOTOPE BIOL. DECAY INHALATI
10N INGESTION EFFECTIVE/
2 22X,81H CONSTANT FRACTIO
3N FRACTION ENERGY //)
218 FORMAT(1H ,19X,13,7X, A8, 4E16.3)
221 FORMAT(1H0,38X,43HBETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE)
222 FORMAT(1H0,37X,12HENERGY GROUP,8X,14HAVERAGE ENERGY,6X,14HMAXIMUM
1ENERGY//)
223 FORMAT(1H ,34X,15H BETA GROUP NO.,12, E16.3,4H MEV, E16.3,4H MEV
1)
224 FORMAT(1H ,34X,15HGAMMA GROUP NO.,12, E16.3,4H MEV, E16.3,4H MEV
1)
225 FORMAT(1H0,4X,12HI ISOTOPE, 30X,54HBETA
1 GAMMA/18X,100H GROUP 1 G
2GROUP 2 GROUP 3 GROUP 4 GROUP 5 GROUP 1 GROUP 2 G
3GROUP 3 GROUP 4//)
226 FORMAT(1H ,15,4X, A8,2P9F11.1)
227 FORMAT(1H ,41X,38HPERCENT CONTRIBUTIONS TO ENERGY GROUPS)
228 FORMAT(1H ,18X,12, 4E20,3)
229 FORMAT(1H0,17X,83HGROUP MIN. SIZE MAX. SIZE
1 TERM. VEL. GAMMA /
2 18X,83H NO. (MICRONS) (MICRONS)
3 (METERS/SEC.) (1/METERS//)
230 FORMAT(1H0,37X,43HPARTICLE SIZE RANGE AND PARAMETERS BY GROUP)
231 FORMAT(1H ,31X,13,3X, A8, E17.3,4H MEV, E17.3,4H MEV)
232 FORMAT(1H0,33X,1H1,4X,7HISOTOPE,12X,7HAVERAGE,14X,7HMAXIMUM//)
233 FORMAT(1H0,44X,30HBETA DECAY ENERGIES BY ISOTOPE)
234 FORMAT(1H ,28X,12, 3E20,3)
235 FORMAT(1H0,23X,64H BETA TOTAL TOTAL
1 ENERGY)
236 FORMAT(1H0,23X,64H GAMMA TOTAL TOTAL
1 ENERGY)
237 FORMAT(1H ,23X,64HGROUP NO, CORRECTED AT STP
1 AT STP//)
238 FORMAT(1H0,29X,53HABSORPTION COEFFICIENTS AS A FUNCTION OF ENERGY
1GROUP)
239 FORMAT(1H0,30X,16HBREATHING RATE =, E10.3,18H CUBIC METERS/SEC.)
240 FORMAT(1H0,37X,45HINGESTION FROM GROUND CONCENTRATION FRACTIONS//)
241 FORMAT(1H ,30X,17H THYROID MASS =, F10.3,6H GRAMS)
242 FORMAT(1H ,30X,17H BONE MASS =, E10.3,6H GRAMS)
243 FORMAT(1H ,30X,17H G.I. TRACT MASS =, E10.3,6H GRAMS)
244 FORMAT(1H ,30X,17H LUNG MASS =, E10.3,6H GRAMS)
245 FORMAT(1H ,42X,12, E20.3,12H METERS/SEC.)
246 FORMAT(1H0,39X,36HDEP. INDEX DEPOSITION VELOCITY//)
247 FORMAT(1H0,40X,39HDEPOSITION VELOCITY BY DEPOSITION INDEX)
248 FORMAT(1H0,49X,21HINGESTION DELAY TIMES)
249 FORMAT(1H0,54X,40H THYROID BONE G I TRACT//)
250 FORMAT(1H ,24X,20HINGESTION ROUTE NO. ,12, 3E16.4)
251 FORMAT(1H ,40X,20HINGESTION ROUTE NO. ,12, E16.4)
252 FORMAT(1H0,42X,34HINGESTION ROUTE ADJUSTMENT FACTORS)
253 FORMAT(1H0,28X,64HI ISOTOPE ROUTE NO. 1 ROUTE NO. 2

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1      ROUTE NO. 3//)
254  FORMAT(1H ,26X,I3,7X,2A4,1P3E16.4)
      ITAPE=0
      DO 90 I=1,7500
90    PUT(I)=0,0
      DO 91 I=130,158
91    PUT(I)=AB(I)
      DO 92 I=1,201
      ELFA(I)=AB(I)
      IP(I,1)=IP(I,2)=0
92    IDP(I)=IGS(I)=0
      READ INPUT TAPE 5, 99,J2,(FLFA(I),I=1, 7)
      IF(J2)180,300,300
300  CONTINUE
      REWIND 9
      I1=1$I2=10$I3=0
1000 IF(UNIT,9)1011,1012,9000,9000
1011 I3=I3+1
      IF(I3-10**6)1000,9001,9001
1012 GO TO (1001,1002,1003,1004,1005,1006,1007,1008,1009,1010,1020),I1
1001 BUFFER IN (9,1) (I12,I21)
      I3=0$I1=I1+1$GO TO 1000
1002 BUFFER IN (9,1) (PUT( 1),PUT( 6))
      I3=0$I1=I1+1$GO TO 1000
1003 BUFFER IN (9,1) (PUT( 7),PUT( 158))
      I3=0$I1=I1+1$GO TO 1000
1004 BUFFER IN (9,1) (PUT( 159),PUT( 167))
      I3=0$I1=I1+1$GO TO 1000
1005 BUFFER IN (9,1) (PUT( 168),PUT(1172))
      I3=0$I1=I1+1$GO TO 1000
1006 BUFFER IN (9,1) (PUT(1173),PUT(1373))
      I3=0$I1=I1+1$GO TO 1000
1007 BUFFER IN (9,1) (PUT(1374),PUT(1382))
      I3=0$I1=I1+1$GO TO 1000
1008 BUFFER IN (9,1) (PUT(1383),PUT(3620))
      I3=0$I1=I1+1$GO TO 1000
1009 BUFFER IN (9,1) (PUT(3621),PUT(7054))
      I3=0$I1=I1+1$GO TO 1000
1010 BUFFER IN (9,1) (ELFA(1),ELFA(201))
      I3=0$I1=I1+1$GO TO 1000
1020 REWIND 9
      IF(ITAPE)180,180,400
180  ITAPE=1
      IF(J2)301,331,400
331  DO 335 I=1,7
335  CLFA(I)=FLFA(I)
      GO TO 333
301  DO 302 I=1,7
      RLFA(I)=FLFA(I)
302  CLFA(I)=AB(I)
      READ INPUT TAPE 5,101,J1,(ALFA(I),I=1, 7)
333  READ INPUT TAPE 5,100,(INP(I),I=1,15)
      IF(INP(1))353,353,303
303  READ INPUT TAPE 5,102,IMAX
353  IF(INP(2))354,354,304
304  READ INPUT TAPE 5,103,J1,I,(ELFA(I)),      AL(I),IDP(I),IGS(I),

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1(Y(I,J),J=1,3),(IP(I,J),J=1,2),EO(I),EB(I)
  IF(J1-999)304,354,354
354 IF(INP(3))355,355,305
305 READ INPUT TAPE 5,108,J1,I,(ENR(I,J),J=1,9)
  IF(J1-999)305,355,355
355 IF(INP(4))356,356,306
306 READ INPUT TAPE 5,104,J1,I,(F1(I,J),J=1,4),(F2(I,J),J=1,3),A1
  IF(J1-999)306,356,356
356 IF(INP(5))376,376,370
370 READ INPUT TAPE 5,104,J1,I,(BL(I,J),J=1,4),(ENG(I,J),J=1,4)
  IF(J1-999)370,376,376
376 IF(INP(6))357,357,307
307 READ INPUT TAPE 5,109,((F3(I,L),I=1,3),L=1,3)
357 IF(INP(7))358,358,308
308 READ INPUT TAPE 5,105,(VG(I),I=1,6)
358 IF(INP(8))359,359,309
309 READ INPUT TAPE 5,106,(DLFA(I),I=1,8)
359 IF(INP(9))360,360,310
310 READ INPUT TAPE 5,107,J1,I,((AYZ(I,J,K),J=1,3),K=1,2)
  IF(J1-999)310,360,360
360 IF(INP(10))361,361,311
311 READ INPUT TAPE 5,107,J1,I,((AYZ(I,J,K),J=1,3),K=3,4)
  IF(J1-999)311,361,361
361 IF(INP(11))362,362,312
312 READ INPUT TAPE 5,104,J1,J2,RG,(FG(I),I=1,3),(GM(I),I=1,4)
362 IF(INP(12))363,363,313
313 READ INPUT TAPE 5,109,(U(I),I=1,9)
  READ INPUT TAPE 5,109,(UP(I),I=1,9)
  READ INPUT TAPE 5,109,(UPA(I),I=1,9)
363 IF(INP(13))364,364,314
314 READ INPUT TAPE 5,109,(RMX(I),I=1,9)
  READ INPUT TAPE 5,109,(VO(I),I=1,9)
  READ INPUT TAPE 5,109,(GAM(I),I=1,9)
364 IF(INP(14))365,365,315
315 READ INPUT TAPE 5,109,(E1(I),I=1,9)
365 IF(INP(15))375,375,371
371 READ INPUT TAPE 5,109,((T4(I,J),I=1,3),J=1,3)
375 CONTINUE
  REWIND 9
  I1=1$I2=10$I3=0
2000 IF(UNIT,9)2011,2012,9000,9000
3011 I3=I3+1
  IF(I3-10**6)2000,9001,9001
2012 GO TO (2001,2002,2003,2004,2005,2006,2007,2008,2009,2010,2020),I1
3001 BUFFER OUT (9,1) (I12,I21)
  I3=0$I1=I1+1$GO TO 2000
2002 BUFFER OUT (9,1) (PUT( 1),PUT( 6))
  I3=0$I1=I1+1$GO TO 2000
 003 BUFFER OUT (9,1) (PUT( 7),PUT( 158))
  I3=0$I1=I1+1$GO TO 2000
2004 BUFFER OUT (9,1) (PUT( 159),PUT( 167))
  I3=0$I1=I1+1$GO TO 2000
3005 BUFFER OUT (9,1) (PUT( 168),PUT(1172))
  I3=0$I1=I1+1$GO TO 2000
3006 BUFFER OUT (9,1) (PUT(1173),PUT(1373))
  I3=0$I1=I1+1$GO TO 2000

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2007 BUFFER OUT (9,1) (PUT(1374),PUT(1382))
      I3=0$I1=I1+1$GO TO 2000
2008 BUFFER OUT (9,1) (PUT(1383),PUT(3620))
      I3=0$I1=I1+1$GO TO 2000
2009 BUFFER OUT (9,1) (PUT(3621),PUT(7054))
      I3=0$I1=I1+1$GO TO 2000
2010 BUFFER OUT (9,1) (ELFA(1),ELFA(201))
      I3=0$I1=I1+1$GO TO 2000
2020 REWIND 9
      GO TO 300
400 IPAGE=1
      WRITE OUTPUT TAPE 6,200
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,202,IPAGE
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,203,(ALFA(I),I=1,7)
      WRITE OUTPUT TAPE 6,204,(BLFA(I),I=1,7)
      WRITE OUTPUT TAPE 6,205,(CLFA(I),I=1,7)
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,206,IMAX
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,207
      WRITE OUTPUT TAPE 6,208
      DO 401 I=1,8
401  WRITE OUTPUT TAPE 6,209,DLFA(I),I,((AYZ(I,J,K),J=1,3),K=1,2)
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,210
      WRITE OUTPUT TAPE 6,208
      DO 402 I=1,8
402  WRITE OUTPUT TAPE 6,209,DLFA(I),I,((AYZ(I,J,K),J=1,3),K=3,4)
      IPAGE=2
      WRITE OUTPUT TAPE 6,200
      WRITE OUTPUT TAPE 6,202,IPAGE
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,211
      NL=0
      DO 405 I=2,IMAX
      IF(NL-40)404,403,403
403  IPAGE=IPAGE+1
      WRITE OUTPUT TAPE 6,200
      WRITE OUTPUT TAPE 6,202,IPAGE
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,211
      NL=0
404  WRITE OUTPUT TAPE 6,212,I,ELFA(I),      AL(I),IDP(I),IGS(I),
      1Y(I,1),IP(I,1),Y(I,2),IP(I,2),Y(I,3),I
405  NL=NL+1
      IPAGE=IPAGE+1
      WRITE OUTPUT TAPE 6,200
      WRITE OUTPUT TAPE 6,202,IPAGE
      WRITE OUTPUT TAPE 6,201
      WRITE OUTPUT TAPE 6,221
      WRITE OUTPUT TAPE 6,222
      DO 501 I=1,5

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501 WRITE OUTPUT TAPE 6,223,I,(ENR(1,I),E1(I))
DO 502 I=6,9
J=1-9
502 WRITE OUTPUT TAPE 6,224,J,(ENR(1,I),E1(I))
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,227
WRITE OUTPUT TAPE 6,225
NL=25
DO 510 I=2,IMAX
IF(NL-40)504,503,503
503 IPAGE=IPAGE+1
WRITE OUTPUT TAPE 6,200
WRITE OUTPUT TAPE 6,202,IPAGE
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,221
WRITE OUTPUT TAPE 6,227
WRITE OUTPUT TAPE 6,225
NL=0
504 WRITE OUTPUT TAPE 6,226,I,ELFA(I), (ENR(I,J),J=1,9)
510 NL=NL+1
DO 450 J=1,4
NL=60
K=J
DO 450 I=2,IMAX
IF(NL-40)420,410,410
410 IPAGE=IPAGE+1
WRITE OUTPUT TAPE 6,200
WRITE OUTPUT TAPE 6,202,IPAGE
WRITE OUTPUT TAPE 6,201
GO TO (411,412,413,414),K
411 WRITE OUTPUT TAPE 6,213
GO TO 415
412 WRITE OUTPUT TAPE 6,214
GO TO 415
413 WRITE OUTPUT TAPE 6,215
GO TO 415
414 WRITE OUTPUT TAPE 6,216
415 WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,217
NL=0
420 WRITE OUTPUT TAPE 6,218,I,ELFA(I), BL(I,J),F1(I,J),F2(I,J),
1ENG(I,J)
450 NL=NL+1
NL=60
DO 521 I=2,IMAX
IF(NL-40)523,522,522
522 IPAGE=IPAGE+1
WRITE OUTPUT TAPE 6,200
WRITE OUTPUT TAPE 6,202,IPAGE
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,233
WRITE OUTPUT TAPE 6,232
NL=0
523 NL=NL+1

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521 WRITE OUTPUT TAPE 6,231,I,ELFA(I),      EB(I),EO(I)
    IPAGE=IPAGE+1
    WRITE OUTPUT TAPE 6,200
    WRITE OUTPUT TAPE 6,202,IPAGE
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,230
    WRITE OUTPUT TAPE 6,229
    C1=0.5*RMX(1)
    C2=RMX(1)
    I=1
    WRITE OUTPUT TAPE 6,228,I,C1,C2,VO(I),GAM(I)
    DO 520 I=2,9
    C1= RMX(I-1)
    C3=LOG10F(C1)
    C3=INTF(C3)-4.0
    C1=C1+(10.0**C3)
    C2=RMX(I)
520 WRITE OUTPUT TAPE 6,228,I,C1,C2,VO(I),GAM(I)
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,238
    WRITE OUTPUT TAPE 6,235
    WRITE OUTPUT TAPE 6,237
    DO 524 I=1,5
524 WRITE OUTPUT TAPE 6,234,I,U(I),UP(I),UPA(I)
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,236
    WRITE OUTPUT TAPE 6,237
    DO 525 I=6,9
    L=I-5
525 WRITE OUTPUT TAPE 6,234,L,U(I),UP(I),UPA(I)
    IPAGE=IPAGE+1
    WRITE OUTPUT TAPE 6,200
    WRITE OUTPUT TAPE 6,202,IPAGE
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,240
    DO 530 I=1,3
530 WRITE OUTPUT TAPE 6,251,I,FG(I)
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,239,RG
    WRITE OUTPUT TAPE 6,241,GM(1)
    WRITE OUTPUT TAPE 6,242,GM(2)
    WRITE OUTPUT TAPE 6,243,GM(3)
    WRITE OUTPUT TAPE 6,244,GM(4)
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,247
    WRITE OUTPUT TAPE 6,246
    DO 526 I=1,6
526 WRITE OUTPUT TAPE 6,245,I,VG(I)
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,201
    WRITE OUTPUT TAPE 6,248
    WRITE OUTPUT TAPE 6,249

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```
DO 531 I=1,3
531 WRITE OUTPUT TAPE 6,250,I,(T4(J,I),J=1,3)
461 IPAGE=IPAGE+1
WRITE OUTPUT TAPE 6,200
WRITE OUTPUT TAPE 6,202,IPAGE
WRITE OUTPUT TAPE 6,201
WRITE OUTPUT TAPE 6,252
WRITE OUTPUT TAPE 6,249
DO 460 I=1,3
460 WRITE OUTPUT TAPE 6,250,I,(F3(J,I),J=1,3)
WRITE OUTPUT TAPE 6,200
WRITE OUTPUT TAPE 6,200
STOP
9000 STOP 1
9001 STOP 2
END
```

VII. SAMPLE PROBLEM

NURSE # 1 PROGRAM LIBRARY LISTING

PAGE 1

LIBRARY DESCRIPTION NUCLEAR UTILITY SERVICE, INC. LIBRARY NO. 1

WRITTEN BY MELVIN L. COUCHMAN

ON OCTOBER 21, 1964

REVISED BY MELVIN L. COUCHMAN

ON NOVEMBER 9, 1964

TOTAL NO. OF ISOTOPES PLUS ONE, IMAX = 188

FIT PARAMETERS FOR SIGMA=Y OF X

STABILITY CLASS	INDEX	A0	A1	A2	B0	B1	B2
A	1	2.3570-001	9.8850-001	-1.9400-004	3.2690-001	9.1380-001	-1.9300-006
B	2	1.5800-001	1.0060+000	-1.6540-004	2.8220-001	8.9850-001	-8.0280-006
C	3	1.1650-001	1.0210+000	-2.7900-004	2.7310-001	8.6820-001	-9.3800-007
D	4	8.0860-002	1.0880+000	-2.1500-004	1.1600-001	9.2490-001	-2.0120-006
E	5	6.0440-002	9.9700-001	-1.1230-004	1.2040-001	8.8110-001	-9.0100-007
F	6	4.0600-002	9.9140-001	-6.7900-005	7.4300-002	8.9510-001	-1.0490-006
	7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
	8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

FIT PARAMETERS FOR SIGMA=Z OF X

STABILITY CLASS	INDEX	A0	A1	A2	B0	B1	B2
A	1	1.8380-001	9.0680-001	1.7400-003	1.8380-001	9.0680-001	1.7400-003
B	2	1.1590-001	9.7200-001	2.9260-004	1.1590-001	9.7200-001	2.9260-004
C	3	8.1110-002	9.8920-001	-1.4690-004	1.7530-001	8.5690-001	-4.2830-006
D	4	5.2600-002	9.8390-001	-3.8540-004	3.2960-001	6.6320-001	-4.1600-006
E	5	3.1180-002	9.9900-001	-3.4190-004	3.0210-001	6.2190-001	-7.7000-006
F	6	1.8690-002	1.0320+000	-5.4600-004	2.8680-001	5.5850-001	-6.5900-006
	7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
	8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

I	ISOTOPE	DECAY CONSTANT	DEP. INDEX	GAS, INDEX	FISSION YIELD	FIRST PRECURSOR NO,	YIELD	SECOND PRECURSOR NO,	YIELD	I
2	32GE77M	1,340-002	2	=0	4,842-005	=0	=0,000+000	=0	=0,000+000	2
3	32GE77	1,600-005	2	=0	3,395-005	2	3,600-001	=0	=0,000+000	3
4	33AS77	4,970-006	2	=0	1,100-007	2	6,400-001	3	1,000+000	4
5	32GE78	9,170-005	2	=0	1,963-004	=0	=0,000+000	=0	=0,000+000	5
6	33AS78	1,270-004	2	=0	4,650-006	5	1,000+000	=0	=0,000+000	6
7	33AS79	1,280-003	2	=0	5,562-004	=0	=0,000+000	=0	=0,000+000	7
8	34SE79M	2,950-003	2	=0	=0,000+000	7	1,000+000	=0	=0,000+000	8
9	34SE81M	2,030-004	2	=0	1,077-004	=0	=0,000+000	=0	=0,000+000	9
10	34SE81	6,350-004	2	=0	1,303-003	9	1,000+000	=0	=0,000+000	10
11	34SE83M	1,000-002	2	=0	2,425-003	=0	=0,000+000	=0	=0,000+000	11
12	34SE83	4,620-004	2	=0	2,996-003	11	1,000-001	=0	=0,000+000	12
13	35BR83	8,370-005	4	=0	7,130-006	11	9,000-001	12	1,000+000	13
14	36KR83M	1,010-004	1	=0	=0,000+000	13	1,000+000	=0	=0,000+000	14
15	35BR84A	1,920-003	4	=0	1,241-004	=0	=0,000+000	=0	=0,000+000	15
16	34SE84	3,500-003	2	=0	9,802-003	=0	=0,000+000	=0	=0,000+000	16
17	35BR84B	3,630-004	4	=0	1,241-004	13	1,000+000	=0	=0,000+000	17
18	34SE85	1,780-003	2	=0	1,049-002	=0	=0,000+000	=0	=0,000+000	18
19	35BR85	3,850-003	4	=0	2,501-003	18	1,000+000	=0	=0,000+000	19
20	36KR85M	4,380-005	1	=0	5,552-005	19	1,000+000	=0	=0,000+000	20
21	36KR85	2,060-009	1	=0	5,552-005	20	1,900-001	=0	=0,000+000	21
22	34SE87	4,330-002	2	=0	1,087-002	=0	=0,000+000	=0	=0,000+000	22
23	35BR87	1,260-002	4	=0	1,070-002	22	1,000+000	=0	=0,000+000	23
24	36KR87	1,480-004	1	=0	3,281-003	23	9,700-001	25	7,000-002	24
25	35BR88	4,470-002	4	=0	2,606-002	=0	=0,000+000	=0	=0,000+000	25
26	36KR88	6,950-005	1	=0	8,693-003	25	9,300-001	28	1,180-001	26
27	37RB88	6,490-004	2	=0	9,334-004	26	1,000+000	=0	=0,000+000	27
28	35BR89	1,540-002	4	=0	2,580-002	=0	=0,000+000	=0	=0,000+000	28
29	36KR89	3,630-003	1	=0	1,751-002	28	8,820-001	=0	=0,000+000	29
30	37RB89	7,500-004	2	=0	3,862-003	29	1,000+000	=0	=0,000+000	30
31	38SR89	1,590-007	2	=0	=0,000+000	30	1,000+000	=0	=0,000+000	31
32	36KR90	2,100-002	1	=0	4,774-002	=0	=0,000+000	=0	=0,000+000	32
33	37RB90	4,220-003	2	=0	9,864-003	32	1,000+000	=0	=0,000+000	33
34	38SR90	7,920-010	2	=0	=0,000+000	33	1,000+000	=0	=0,000+000	34
35	39Y90	2,980-006	2	=0	=0,000+000	34	1,000+000	=0	=0,000+000	35
36	36KR91	7,070-002	1	=0	3,847-002	=0	=0,000+000	=0	=0,000+000	36
37	37RB91M	8,250-004	2	=0	8,603-003	36	5,000-001	=0	=0,000+000	37
38	37RB91	6,930-003	2	=0	8,603-003	36	5,000-001	=0	=0,000+000	38
39	38SR91	1,990-005	2	=0	2,581-003	37	1,000+000	38	1,000+000	39
40	39Y91M	2,310-004	2	=0	=0,000+000	39	6,000-001	=0	=0,000+000	40
41	39Y91	1,360-007	2	=0	=0,000+000	39	4,000-001	40	1,000+000	41

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42	36KR92	2.310-001	1	-0	2.850-002	=0	=0.000+000	=0	=0.000+000	42
43	37RB92	8.660-003	2	-0	2.461-002	42	1.000+000	=0	=0.000+000	43
44	38SR92	7.410-005	2	-0	6.593-003	43	1.000+000	=0	=0.000+000	44
45	39Y92	5.350-005	2	-0	6.652-005	44	1.000+000	=0	=0.000+000	45
46	36KR93	3.470-001	1	-0	1.881-002	=0	=0.000+000	=0	=0.000+000	46
47	38SR93	1.410-003	2	-0	4.452-002	46	1.000+000	=0	=0.000+000	47
48	39Y93	1.850-005	2	-0	1.030-003	47	1.000+000	=0	=0.000+000	48
49	38SR94	8.890-003	2	-0	5.941-002	=0	=0.000+000	=0	=0.000+000	49
50	39Y94	5.780-004	2	=0	4.452-003	49	1.000+000	=0	=0.000+000	50
51	39Y95	1.100-003	2	-0	6.238-002	=0	=0.000+000	=0	=0.000+000	51
52	40ZR95	1.230-007	2	1	1.891-004	51	1.000+000	=0	=0.000+000	52
53	41NB95M	2.140-006	2	1	=0.000+000	52	2.000-002	=0	=0.000+000	53
54	41NB95	2.290-007	2	1	=0.000+000	52	9.800-001	53	1.000+000	54
55	40ZR97	1.130-005	2	1	5.485-002	=0	=0.000+000	=0	=0.000+000	55
56	41NB97M	1.160-002	2	1	2.976-003	55	9.600-001	=0	=0.000+000	56
57	41NB97	1.600-004	2	1	2.976-003	55	4.000-002	56	1.000+000	57
58	41NB98	2.260-004	2	1	8.604-004	=0	=0.000+000	=0	=0.000+000	58
59	42MO99	2.920-006	2	1	6.066-002	=0	=0.000+000	=0	=0.000+000	59
60	43TC99M	3.910-005	2	1	=0.000+000	59	8.700-001	=0	=0.000+000	60
61	42MO101	7.910-004	2	1	5.011-002	=0	=0.000+000	=0	=0.000+000	61
62	43TC101	8.250-004	2	1	1.571-004	61	1.000+000	=0	=0.000+000	62
63	42MO102	1.000-004	2	1	3.978-002	=0	=0.000+000	=0	=0.000+000	63
64	43TC102	1.390-001	2	1	1.411-003	63	1.000+000	=0	=0.000+000	64
65	44RU103	2.010-007	2	1	2.978-002	=0	=0.000+000	=0	=0.000+000	65
66	45RH103M	2.030-004	2	1	=0.000+000	65	9.950-001	=0	=0.000+000	66
67	43TC104	6.420-004	2	1	1.786-002	=0	=0.000+000	=0	=0.000+000	67
68	42MO105	5.780-003	2	1	6.985-003	=0	=0.000+000	=0	=0.000+000	68
69	44RU105	4.380-005	2	1	2.658-003	68	1.000+000	=0	=0.000+000	69
70	45RH105M	2.310-002	2	1	=0.000+000	69	2.060-001	=0	=0.000+000	70
71	45RH105	5.270-006	2	1	=0.000+000	69	7.940-001	70	1.000+000	71
72	44RU106	2.200-008	2	1	3.922-003	=0	=0.000+000	=0	=0.000+000	72
73	45RH106	2.310-002	2	1	=0.000+000	72	1.000+000	=0	=0.000+000	73
74	43TC107	7.700-003	2	1	1.827-003	=0	=0.000+000	=0	=0.000+000	74
75	44RU107	2.890-003	2	1	8.063-005	74	1.000+000	=0	=0.000+000	75
76	45RH107	5.320-004	2	1	=0.000+000	75	1.000+000	=0	=0.000+000	76
77	45RH108	4.070-002	2	1	7.004-004	=0	=0.000+000	=0	=0.000+000	77
78	45RH109	2.310-002	2	1	3.808-004	=0	=0.000+000	=0	=0.000+000	78
79	46PD109	1.430-005	2	=0	=0.000+000	78	1.000+000	=0	=0.000+000	79
80	47AG109M	1.730-002	2	-0	=0.000+000	79	1.000+000	=0	=0.000+000	80
81	46PD111	5.250-004	2	-0	1.809-004	=0	=0.000+000	=0	=0.000+000	81

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82	47AG111	1.060-006	2	-0	-0.000+000	81	1.000+000	-0	-0.000+000	82
83	46PD112	9.170-006	2	-0	1.001-004	-0	-0.000+000	-0	-0.000+000	83
84	47AG112	6.020-005	2	-0	-0.000+000	83	1.000+000	-0	-0.000+000	84
85	47AG113	3.630-005	2	-0	1.605-004	-0	-0.000+000	-0	-0.000+000	85
86	48CD113M	1.570-009	2	-0	-0.000+000	85	1.000+000	-0	-0.000+000	86
87	47AG114	5.780-003	2	-0	1.374-004	-0	-0.000+000	-0	-0.000+000	87
88	47AG115	5.470-004	2	-0	1.099-004	-0	-0.000+000	-0	-0.000+000	88
89	48CD115M	1.860-007	2	-0	-0.000+000	88	9.000-002	-0	-0.000+000	89
90	48CD115	3.440-006	2	-0	-0.000+000	88	9.100-001	-0	-0.000+000	90
91	49IN115M	4.280-005	2	-0	-0.000+000	90	1.000+000	-0	-0.000+000	91
92	48CD117M	6.660-005	2	-0	5.501-005	-0	-0.000+000	-0	-0.000+000	92
93	48CD117	2.310-004	2	-0	5.501-005	92	6.000-001	-0	-0.000+000	93
94	49IN117M	1.010-004	2	-0	-0.000+000	92	4.000-001	93	1.000+000	94
95	49IN117	1.750-004	2	-0	-0.000+000	94	2.000-001	-0	-0.000+000	95
96	48CD118	2.780-004	2	-0	1.424-004	-0	-0.000+000	-0	-0.000+000	96
97	49IN118	1.390-001	2	-0	-0.000+000	96	1.000+000	-0	-0.000+000	97
98	49IN119	6.600-004	2	-0	1.418-004	-0	-0.000+000	-0	-0.000+000	98
99	50SN119M	3.270-008	2	-0	-0.000+000	98	5.000-001	-0	-0.000+000	99
100	50SN121	7.000-006	2	-0	1.406-004	-0	-0.000+000	-0	-0.000+000	100
101	50SN123A	5.900-008	2	-0	8.073-005	-0	-0.000+000	-0	-0.000+000	101
102	50SN123B	2.700-004	2	-0	8.073-005	-0	-0.000+000	-0	-0.000+000	102
103	50SN125A	8.530-007	2	-0	1.017-004	-0	-0.000+000	-0	-0.000+000	103
104	50SN125B	1.220-003	2	-0	1.017-004	-0	-0.000+000	-0	-0.000+000	104
105	51SB125	8.140-009	2	-0	1.281-005	103	1.000+000	104	1.000+000	105
106	52TE125M	1.380-007	2	-0	-0.000+000	105	3.000-001	-0	-0.000+000	106
107	51SB126	2.140-005	2	-0	3.193-004	-0	-0.000+000	-0	-0.000+000	107
108	50SN127	7.410-005	2	-0	1.067-003	-0	-0.000+000	-0	-0.000+000	108
109	51SB127	2.190-006	2	-0	2.071-004	108	1.000+000	-0	-0.000+000	109
110	52TE127M	7.640-006	2	-0	1.300-005	109	2.000-001	-0	-0.000+000	110
111	52TE127	2.070-005	2	-0	1.301-005	109	8.000-001	110	9.800-001	111
112	50SN128	2.020-004	2	-0	2.381-003	-0	-0.000+000	-0	-0.000+000	112
113	51SB128A	1.160-003	2	-0	5.052-004	112	9.700-001	-0	-0.000+000	113
114	51SB128B	2.000-005	2	-0	5.052-004	112	3.000-002	-0	-0.000+000	114
115	51SB129	4.320-005	2	-0	7.404-003	-0	-0.000+000	-0	-0.000+000	115
116	52TE129M	2.390-007	2	-0	3.096-004	115	3.600-001	-0	-0.000+000	116
117	52TE129	1.710-004	2	-0	3.096-004	115	6.400-001	116	1.000+000	117
118	50SN130	4.440-003	2	-0	9.534-003	-0	-0.000+000	-0	-0.000+000	118
119	51SB130	1.630-003	2	-0	8.123-003	118	1.000+000	-0	-0.000+000	119
120	51SB131	5.000-004	2	-0	2.462-002	-0	-0.000+000	-0	-0.000+000	120
121	52TE131M	6.690-005	2	-0	2.301-003	120	1.500-001	-0	-0.000+000	121

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122	52TE131	4.660-004	2	∞0	2,301-003	120	0.500-001	121	2.000-001	122
123	53I131	9.860-007	4	∞0	9,454-005	121	8.000-001	122	1.000-000	123
124	54XE131M	6.680-007	1	∞0	-0.000-000	123	8.000-003	∞0	-0.000-000	124
125	51SB132	5.500-003	2	∞0	2,993-002	∞0	-0.000-000	∞0	-0.000-000	125
126	52TE132	2.480-006	2	∞0	1,220-002	125	1.000-000	∞0	-0.000-000	126
127	53I132	8.520-005	4	∞0	1,671-003	126	1.000-000	∞0	-0.000-000	127
128	51SB133	2.820-003	2	∞0	3,325-002	∞0	-0.000-000	∞0	-0.000-000	128
129	52TE133M	2.180-004	2	∞0	1,306-002	128	7,200-001	∞0	-0.000-000	129
130	52TE133	5.780-003	2	∞0	1,306-002	128	2,800-001	129	1,300-001	130
131	53I133	9.250-006	4	∞0	6,443-003	129	8,700-001	130	1,000-000	131
132	54XE133M	3.490-006	1	∞0	-0.000-000	131	2,400-002	∞0	-0.000-000	132
133	54XF133	1.520-006	1	∞0	-0.000-000	131	9,760-001	132	1,000-000	133
134	51SR134	1.540-002	2	∞0	1,806-002	∞0	-0.000-000	∞0	-0.000-000	134
135	52TE134	2.630-004	2	∞0	3,782-002	134	1,000-000	∞0	-0.000-000	135
136	53I134	2.200-004	4	∞0	2,171-002	135	1,000-000	∞0	-0.000-000	136
137	52TE135	8.250-003	2	∞0	2,688-002	∞0	-0.000-000	∞0	-0.000-000	137
138	53I135	2.870-005	2	∞0	2,851-002	137	1,000-000	∞0	-0.000-000	138
139	54XE135M	7.400-006	1	∞0	4,652-003	138	3,000-001	∞0	-0.000-000	139
140	54XF135	2.110-005	1	∞0	4,652-003	138	7,000-001	139	1,000-000	140
141	53I136	8.350-003	4	∞0	3,924-002	∞0	-0.000-000	∞0	-0.000-000	141
142	55CS136	6.170-007	2	∞0	3,772-003	∞0	-0.000-000	∞0	-0.000-000	142
143	53I137	2.890-002	4	∞0	2,661-002	∞0	-0.000-000	∞0	-0.000-000	143
144	54XF137	2.960-003	1	∞0	2,661-002	143	9,600-001	147	4,000-002	144
145	55CS137	7.320-010	2	∞0	8,153-003	144	1,000-000	∞0	-0.000-000	145
146	56BA137M	4.440-003	2	∞0	5,852-005	145	9,200-001	∞0	-0.000-000	146
147	53I138	1.170-001	4	∞0	1,458-002	∞0	-0.000-000	∞0	-0.000-000	147
148	54XF138	6.790-004	1	∞0	2,751-002	147	9,600-001	150	4,000-002	148
149	55CS138	3.590-004	2	∞0	1,401-002	148	1,000-000	∞0	-0.000-000	149
150	53I139	2.570-001	4	∞0	7,849-003	∞0	-0.000-000	∞0	-0.000-000	150
151	54XF139	1.690-002	1	∞0	2,751-002	150	9,600-001	∞0	-0.000-000	151
152	55CS139	1,220-003	2	∞0	2,441-002	151	1,000-000	∞0	-0.000-000	152
153	56BA139	1,360-004	2	∞0	5,472-003	152	1,000-000	∞0	-0.000-000	153
154	54XF140	4,330-002	1	∞0	2,307-002	∞0	-0.000-000	∞0	-0.000-000	154
155	55CS140	1,050-002	2	∞0	2,961-002	154	1,000-000	∞0	-0.000-000	155
156	56BA140	6,270-007	2	∞0	1,120-002	155	1,000-000	∞0	-0.000-000	156
157	57LA140	4,790-006	2	∞0	3,712-004	156	1,000-000	∞0	-0.000-000	157
158	56BA141	6,420-004	2	∞0	6,097-002	∞0	-0.000-000	∞0	-0.000-000	158
159	57LA141	5,200-005	2	∞0	3,411-003	158	1,000-000	∞0	-0.000-000	159
160	58CE141	2,420-007	2	∞0	-0.000-000	159	1,000-000	∞0	-0.000-000	160
161	55CS142	1,160-002	2	∞0	2,857-002	∞0	-0.000-000	∞0	-0.000-000	161

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162	56BA142	1.858-003	2	=0	2,491-002	161	1,000+000	=0	=0,000+000	162
163	57LA142	1.368-004	2	=0	6,703-003	162	1,000+000	=0	=0,000+000	163
164	56BA143	5.788-002	2	=0	4,472-002	=0	=0,000+000	=0	=0,000+000	164
165	57LA143	8.258-004	2	=0	1,431-002	164	1,000+000	=0	=0,000+000	165
166	58CE143	5.768-006	2	=0	1,251-003	165	1,000+000	=0	=0,000+000	166
167	59PR143	5.838-007	2	=0	=0,000+000	166	1,000+000	=0	=0,000+000	167
168	58CE144	2,828-008	2	=0	5,576-002	=0	=0,000+000	=0	=0,000+000	168
169	59PR144	6,688-004	2	=0	=0,000+000	168	1,000+000	=0	=0,000+000	169
170	58CE145	3,858-003	2	=0	3,943-002	=0	=0,000+000	=0	=0,000+000	170
171	59PR145	3,218-005	2	=0	1,110-004	170	1,000+000	=0	=0,000+000	171
172	58CE146	8,318-004	2	=0	2,970-002	=0	=0,000+000	=0	=0,000+000	172
173	59PR146	4,738-004	2	=0	1,120-004	172	1,000+000	=0	=0,000+000	173
174	60ND147	7,238-007	2	=0	2,372-002	=0	=0,000+000	=0	=0,000+000	174
175	61PN147	8,468-009	2	=0	=0,000+000	174	1,000+000	=0	=0,000+000	175
176	60ND149	1,818-004	2	=0	1,130-002	=0	=0,000+000	=0	=0,000+000	176
177	61PN149	3,638-006	2	=0	=0,000+000	176	1,000+000	=0	=0,000+000	177
178	60ND151	9,638-004	2	=0	4,193-003	=0	=0,000+000	=0	=0,000+000	178
179	61PN151	6,888-006	2	=0	2,321-004	178	1,000+000	=0	=0,000+000	179
180	62SM151	2,378-010	2	=0	=0,000+000	179	1,000+000	=0	=0,000+000	180
181	62SM153	4,188-006	2	=0	1,724-003	=0	=0,000+000	=0	=0,000+000	181
182	62SM155	5,258-004	2	=0	3,235-004	=0	=0,000+000	=0	=0,000+000	182
183	63EU155	1,218-008	2	=0	2,498-006	182	1,000+000	=0	=0,000+000	183
184	62SM156	1,938-005	2	=0	1,336-004	=0	=0,000+000	=0	=0,000+000	184
185	63EU156	5,498-007	2	=0	7,388-006	184	1,000+000	=0	=0,000+000	185
186	63EU157	1,258-005	2	=0	7,720-005	=0	=0,000+000	=0	=0,000+000	186
187	63EU158	1,938-004	2	=0	1,976-005	=0	=0,000+000	=0	=0,000+000	187
188	64GD159	1,878-005	2	=0	1,847-005	=0	=0,000+000	=0	=0,000+000	188

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE

ENERGY GROUP	AVERAGE ENERGY	MAXIMUM ENERGY
BETA GROUP NO, 1	1,250+001 MEV	2,500+001 MEV
BETA GROUP NO, 2	5,000+001 MEV	7,500+001 MEV
BETA GROUP NO, 3	1,000+000 MEV	1,250+000 MEV
BETA GROUP NO, 4	1,500+000 MEV	1,750+000 MEV
BETA GROUP NO, 5	3,500+000 MEV	5,250+000 MEV
GAMMA GROUP NO, 1	1,250+001 MEV	2,500+001 MEV
GAMMA GROUP NO, 2	5,000+001 MEV	1,000+000 MEV
GAMMA GROUP NO, 3	1,350+000 MEV	1,700+000 MEV
GAMMA GROUP NO, 4	3,420+000 MEV	5,130+000 MEV

PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
2	32GE77M	0,0	0,0	64,0	0,0	0,0	54,0	0,0	0,0	0,0
3	32GE77	3,0	83,0	14,0	0,0	0,0	63,6	144,9	32,7	5,9
4	33AS77	100,0	0,0	0,0	0,0	0,0	2,8	2,8	0,0	0,0
5	32GE78	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	33AS78	0,0	24,5	28,7	47,0	0,0	1,2	71,1	21,7	6,3
7	33AS79	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
8	34SE79M	0,0	0,0	0,0	0,0	0,0	100,0	0,0	0,0	0,0
9	34SE81M	0,0	0,0	0,0	0,0	0,0	100,0	0,0	0,0	0,0
10	34SE81	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
11	34SE83M	0,0	10,0	90,0	0,0	0,0	0,0	10,0	7,5	5,0
12	34SE83	0,0	100,0	0,0	0,0	0,0	0,0	100,0	50,0	0,0
13	35BR83	0,0	100,0	0,0	0,0	0,0	20,0	0,0	0,0	0,0
14	36KR83M	0,0	0,0	0,0	0,0	0,0	200,0	0,0	0,0	0,0
15	35BR84A	0,0	92,0	0,0	0,0	0,0	0,0	130,0	60,0	20,0
16	34SE84	0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE
PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
17	35BR84B	3.0	36.5	15.0	46.0	0.0	0.0	60.1	14.7	49.4
18	34SE85	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
19	35BR85	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
20	36KR85M	0.0	81.0	0.0	0.0	0.0	81.0	19.0	0.0	0.0
21	36KR85	100.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
22	34SE87	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
23	35BR87	0.0	0.0	70.0	0.0	30.0	0.0	0.0	0.0	70.0
24	36KR87	0.0	25.0	10.0	65.0	0.0	0.0	100.0	0.0	24.0
25	35BR88	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
26	36KR88	70.0	10.0	20.0	0.0	0.0	49.0	28.0	18.0	68.0
27	37RB88	6.0	0.0	94.0	0.0	0.0	0.0	14.5	1.4	18.0
28	35ER89	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
29	35KR89	0.0	35.0	0.0	65.0	0.0	0.0	0.0	0.0	0.0
30	37RB89	30.0	58.0	5.0	7.0	0.0	0.0	15.0	132.0	32.0
31	38SR89	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	36KR90	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
33	37RB90	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
34	38SR90	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	39Y90	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
36	36KR91	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
37	37RB91M	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
38	37RB91	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
39	38SR91	7.0	66.0	27.0	0.0	0.0	0.0	46.0	37.0	0.0
40	39Y91M	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
41	39Y91	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
42	36KR92	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
43	37RB92	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
44	38SR92	90.0	10.0	0.0	0.0	0.0	3.5	4.1	90.0	0.0
45	39Y92	0.0	12.0	88.0	0.0	0.0	0.0	0.0	0.0	12.0
46	36KR93	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
47	38SR93	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
48	39Y93	2.0	3.9	93.9	0.0	0.0	0.0	9.6	0.9	2.0
49	38SR94	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
50	39Y94	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
51	39Y95	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
52	40ZR95	98.0	2.0	0.0	0.0	0.0	2.0	98.0	0.0	0.0
53	41NB95M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
54	41NB95	99.0	1.0	0.0	0.0	0.0	0.0	99.0	0.0	0.0
55	40ZR97	10.0	90.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
56	41NB97M	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE
PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
57	41NB97	0.0	100.0	0.0	0.0	0.0	0.0	99.0	1.0	0.0
58	41NB98	0.0	44.0	31.0	25.0	0.0	0.0	175.0	40.0	4.0
59	42MO99	14.0	86.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
60	43TC99M	0.0	0.0	0.0	0.0	0.0	198.6	0.0	0.0	0.0
61	42MO101	41.0	59.0	0.0	0.0	0.0	30.0	17.6	64.0	16.0
62	43TC101	0.0	98.0	0.0	0.0	0.0	0.0	98.0	0.0	0.0
63	42HO102	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	43TC102	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
65	44RU103	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
66	45RH103M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
67	43TC104	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
68	42MO105	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
69	44RU105	4.0	96.0	0.0	0.0	0.0	5.0	107.5	0.0	0.0
70	45RH105M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
71	45RH105	100.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
72	44RU106	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	45HH106	0.0	3.0	97.0	0.0	0.0	0.0	31.4	1.5	0.0
74	43TC107	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
75	44RU107	0.0	0.0	12.0	88.0	0.0	17.0	8.0	4.0	0.0
76	45RH107	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
77	45RH108	0.0	0.0	22.0	68.0	0.0	0.0	65.0	0.0	0.0
78	45RH109	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
79	46PD109	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80	47AG109M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
81	46PD111	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	47AG111	6.2	93.8	0.0	0.0	0.0	1.3	6.1	0.0	0.0
83	46PD112	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
84	47AG112	0.0	21.1	23.3	56.0	0.0	0.0	48.2	12.3	8.4
85	47AG113	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
86	48CD113M	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
87	47AG114	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
88	47AG115	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0
89	48CD115M	0.0	2.0	0.0	98.0	0.0	0.0	0.0	0.0	0.0
90	48CD115	37.0	63.0	0.0	0.0	0.0	0.0	37.9	0.0	0.0
91	49IN115M	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
92	48CD117M	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
93	48CD117	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0
94	49IN117M	0.0	80.0	0.0	0.0	0.0	73.0	24.0	0.0	0.0
95	49IN117	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
96	48CD118	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE
PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
97	49IN118	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
98	49IN119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
99	50SN119M	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0	0.0
100	50SN121	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	50SN123A	2.0	98.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
102	50SN123B	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
103	50SN125A	3.6	1.3	95.0	0.0	0.0	0.0	2.4	3.9	1.2
104	50SN125B	2.2	97.8	0.0	0.0	0.0	0.0	100.0	2.2	0.0
105	51SB125	100.0	0.0	0.0	0.0	0.0	8.0	80.0	0.0	0.0
106	52TE125M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
107	51SB126	100.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0
108	50SN127	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
109	51SB127	0.0	100.0	0.0	0.0	0.0	18.0	84.0	0.0	0.0
110	52TE127M	0.0	1.5	0.0	0.0	0.0	98.5	0.0	0.0	0.0
111	52TE127	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	50SN128	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
113	51SB128A	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
114	51SB128B	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
115	51SB129	0.0	20.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
116	52TE129M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
117	52TE129	4.0	96.0	0.0	0.0	0.0	100.0	19.0	1.0	0.0
118	50SN130	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
119	51SB130	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
120	51SB131	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
121	52TE131M	77.0	0.0	3.8	0.0	0.0	23.0	141.0	50.0	21.0
122	52TE131	0.0	100.0	0.0	0.0	0.0	80.0	31.0	10.0	0.0
123	53I131	99.4	0.7	0.0	0.0	0.0	0.0	98.4	0.0	0.0
124	54XE131M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
125	51SB132	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
126	52TE132	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
127	53I132	0.0	99.0	0.0	0.0	0.0	1.3	267.9	16.0	0.0
128	51SB133	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
129	52TE133M	0.0	70.0	30.0	0.0	0.0	0.0	240.0	0.0	0.0
130	52TE133	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
131	53I133	9.0	91.0	0.0	0.0	0.0	0.0	109.0	4.0	0.0
132	54XE133M	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
133	54XE133	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
134	51SB134	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
135	52TE134	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
136	53I134	6.5	68.0	25.0	0.0	0.0	3.0	219.9	37.0	5.0

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE
 PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
137	52TE135	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
138	53I135	35.0	65.0	0.0	0.0	0.0	0.0	26.0	146.0	0.0
139	54XE135M	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
140	54XE135	3.0	97.0	0.0	0.0	0.0	97.0	3.0	0.0	0.0
141	53I136	0.0	0.0	6.0	29.0	65.0	12.0	29.0	99.0	51.0
142	55CS136	100.0	0.0	0.0	0.0	0.0	19.0	18.0	105.0	0.0
143	53I137	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
144	54XE137	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
145	55CS137	95.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
146	56BA137M	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
147	53I138	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
148	54XE138	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0
149	55CS138	0.0	10.0	90.0	0.0	0.0	4.4	38.0	98.0	27.5
150	53I139	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
151	54XE139	0.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0
152	55CS139	0.0	0.0	20.0	80.0	0.0	0.0	4.0	16.0	0.0
153	569A139	0.0	28.0	72.0	0.0	0.0	28.0	0.0	0.0	0.0
154	54XE140	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
155	55CS140	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
156	56BA140	35.0	65.0	0.0	0.0	0.0	110.0	40.0	0.0	0.0
157	57LA140	0.0	100.0	0.0	0.0	0.0	0.0	0.0	7.0	93.0
158	56BA141	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
159	57LA141	0.0	2.0	98.0	0.0	0.0	0.0	0.0	2.0	0.0
160	58CE141	100.0	0.0	0.0	0.0	0.0	70.0	0.0	0.0	0.0
161	55CS142	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
162	56BA142	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
163	57LA142	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
164	56BA143	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
165	57LA143	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
166	58CE143	23.0	77.0	0.0	0.0	0.0	105.0	82.0	9.0	0.0
167	59PR143	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
168	58CE144	100.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0
169	59PR144	0.0	1.0	99.0	0.0	0.0	0.0	1.3	1.0	0.0
170	58CE145	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
171	59PR145	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
172	58CE146	100.0	0.0	0.0	0.0	0.0	72.0	64.0	0.0	0.0
173	59PR146	0.0	0.0	100.0	0.0	0.0	0.0	146.0	33.0	0.0
174	60ND147	23.0	77.0	0.0	0.0	0.0	77.0	23.0	0.0	0.0
175	61PM147	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
176	60ND149	0.0	90.0	0.0	0.0	0.0	0.0	144.5	20.0	0.0

BETA AND GAMMA ENERGY BREAKDOWNS BY ISOTOPE
PERCENT CONTRIBUTIONS TO ENERGY GROUPS

I	ISOTOPE	BETA					GAMMA			
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 1	GROUP 2	GROUP 3	GROUP 4
177	61PM149	97.0	5.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
178	60ND151	1.0	100.0	0.0	0.0	0.0	150.0	100.0	50.0	0.0
179	61PM151	14.0	82.0	0.0	0.0	0.0	109.4	41.3	0.0	0.0
180	62SM151	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
181	62SM153	80.0	20.0	0.0	0.0	0.0	112.1	0.0	0.0	0.0
182	62SM155	0.0	100.0	0.0	0.0	0.0	107.0	0.0	0.0	0.0
183	63EU155	100.0	0.0	0.0	0.0	0.0	108.0	0.0	0.0	0.0
184	62SM156	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
185	63EU156	60.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0
186	63EU157	0.0	100.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0
187	63EU158	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
188	64GD159	13.0	87.0	0.0	0.0	0.0	25.0	12.0	0.0	0.0

THYROID DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
2	32GE77M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
3	32GE77	-0.000+000	-0.000+000	-0.000+000	-0.000+000
4	33AS77	-0.000+000	-0.000+000	-0.000+000	-0.000+000
5	32GE78	-0.000+000	-0.000+000	-0.000+000	-0.000+000
6	33AS78	-0.000+000	-0.000+000	-0.000+000	-0.000+000
7	33AS79	-0.000+000	-0.000+000	-0.000+000	-0.000+000
8	34SE79M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
9	34SE81M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
10	34SE81	-0.000+000	-0.000+000	-0.000+000	-0.000+000
11	34SE83M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
12	34SE83	-0.000+000	-0.000+000	-0.000+000	-0.000+000
13	35BR83	-0.000+000	-0.000+000	-0.000+000	-0.000+000
14	36KR83M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
15	35BR84A	-0.000+000	-0.000+000	-0.000+000	-0.000+000
16	34SE84	-0.000+000	-0.000+000	-0.000+000	-0.000+000
17	35BR84B	-0.000+000	-0.000+000	-0.000+000	-0.000+000
18	34SE85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
19	35BR85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
20	36KR85M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
21	36KR85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
22	34SE87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
23	35BR87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
24	36KR87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
25	35BR88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
26	36KR88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
27	37RB88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
28	35BR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
29	36KR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
30	37RB89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
31	38SR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
32	36KR90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
33	37RB90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
34	38SR90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
35	39Y90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
36	36KR91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
37	37RB91M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
38	37RB91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
39	38SR91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
40	39Y91M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
41	39Y91	-0.000+000	-0.000+000	-0.000+000	-0.000+000

THYROID DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
42	36KR92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
43	37RB92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
44	38SR92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
45	39Y92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
46	36KR93	-0.000+000	-0.000+000	-0.000+000	-0.000+000
47	38SR93	-0.000+000	-0.000+000	-0.000+000	-0.000+000
48	39Y93	-0.000+000	-0.000+000	-0.000+000	-0.000+000
49	38SR94	-0.000+000	-0.000+000	-0.000+000	-0.000+000
50	39Y94	-0.000+000	-0.000+000	-0.000+000	-0.000+000
51	39Y95	-0.000+000	-0.000+000	-0.000+000	-0.000+000
52	40ZR95	-0.000+000	-0.000+000	-0.000+000	-0.000+000
53	41NB95M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
54	41NB95	-0.000+000	-0.000+000	-0.000+000	-0.000+000
55	40ZR97	-0.000+000	-0.000+000	-0.000+000	-0.000+000
56	41NB97M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
57	41NB97	-0.000+000	-0.000+000	-0.000+000	-0.000+000
58	41NB98	-0.000+000	-0.000+000	-0.000+000	-0.000+000
59	42MO99	-0.000+000	-0.000+000	-0.000+000	-0.000+000
60	43TC99M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
61	42MO101	-0.000+000	-0.000+000	-0.000+000	-0.000+000
62	43TC101	-0.000+000	-0.000+000	-0.000+000	-0.000+000
63	42MO102	-0.000+000	-0.000+000	-0.000+000	-0.000+000
64	43TC102	-0.000+000	-0.000+000	-0.000+000	-0.000+000
65	44RU103	-0.000+000	-0.000+000	-0.000+000	-0.000+000
66	45RH103M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
67	43TC104	-0.000+000	-0.000+000	-0.000+000	-0.000+000
68	42MO105	-0.000+000	-0.000+000	-0.000+000	-0.000+000
69	44RU105	-0.000+000	-0.000+000	-0.000+000	-0.000+000
70	45RH105M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
71	45RH105	-0.000+000	-0.000+000	-0.000+000	-0.000+000
72	44RU106	-0.000+000	-0.000+000	-0.000+000	-0.000+000
73	45RH106	-0.000+000	-0.000+000	-0.000+000	-0.000+000
74	43TC107	-0.000+000	-0.000+000	-0.000+000	-0.000+000
75	44RU107	-0.000+000	-0.000+000	-0.000+000	-0.000+000
76	45RH107	-0.000+000	-0.000+000	-0.000+000	-0.000+000
77	45RH108	-0.000+000	-0.000+000	-0.000+000	-0.000+000
78	45RH109	-0.000+000	-0.000+000	-0.000+000	-0.000+000
79	46PD109	-0.000+000	-0.000+000	-0.000+000	-0.000+000
80	47AG109M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
81	46PD111	-0.000+000	-0.000+000	-0.000+000	-0.000+000

THYROID DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
82	47AG111	-0.000+000	-0.000+000	-0.000+000	-0.000+000
83	46PD112	-0.000+000	-0.000+000	-0.000+000	-0.000+000
84	47AG112	-0.000+000	-0.000+000	-0.000+000	-0.000+000
85	47AG113	-0.000+000	-0.000+000	-0.000+000	-0.000+000
86	48CD113M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
87	47AG114	-0.000+000	-0.000+000	-0.000+000	-0.000+000
88	47AG115	-0.000+000	-0.000+000	-0.000+000	-0.000+000
89	48CD115M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
90	48CD115	-0.000+000	-0.000+000	-0.000+000	-0.000+000
91	49IN115M	9.550-007	1.000-004	8.000-007	4.670-002
92	48CD117M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
93	48CD117	-0.000+000	-0.000+000	-0.000+000	-0.000+000
94	49IN117M	9.550-007	1.000-004	8.000-007	5.236-001
95	49IN117	9.550-007	1.000-004	8.000-007	3.035-001
96	48CD118	-0.000+000	-0.000+000	-0.000+000	-0.000+000
97	49IN118	9.550-007	1.000-004	8.000-007	1.470-000
98	49IN119	9.550-007	1.000-004	8.000-007	9.010-001
99	50SN119M	1.146-007	2.800-005	5.000-006	9.000-003
100	50SN121	1.146-007	2.800-005	5.000-006	1.280-001
101	50SN123A	1.146-007	2.800-005	5.000-006	4.682-001
102	50SN123B	1.146-007	2.800-005	5.000-006	4.360-001
103	50SN125A	1.146-007	2.800-005	5.000-006	7.363-001
104	50SN125B	1.146-007	2.800-005	5.000-006	7.570-001
105	51SB125	2.006-006	8.000-006	9.000-007	1.355-001
106	52TE125M	8.913-007	3.800-004	2.500-004	1.450-002
107	51SB126	2.006-006	8.000-006	9.000-007	4.600-001
108	50SN127	1.146-007	2.800-005	5.000-006	7.354-001
109	51SB127	2.006-006	8.000-006	9.000-007	5.799-001
110	52TE127M	8.913-007	3.800-004	2.500-004	2.298-001
111	52TE127	8.913-007	3.800-004	2.500-004	2.300-001
112	50SN128	1.146-007	2.800-005	5.000-006	7.847-001
113	51SB128A	2.006-006	8.000-006	9.000-007	3.330-001
114	51SB128B	2.006-006	8.000-006	9.000-007	9.670-001
115	51SB129	2.006-006	8.000-006	9.000-007	7.654-001
116	52TE129M	8.913-007	3.800-004	2.500-004	4.718-001
117	52TE129	8.913-007	3.800-004	2.500-004	4.636-001
118	50SN130	1.146-007	2.800-004	5.000-006	6.660-001
119	51SB130	2.006-006	8.000-006	9.000-007	1.670-000
120	51SB131	2.006-006	8.000-006	9.000-007	1.909-000
121	52TE131M	8.913-007	3.800-004	2.500-004	5.834-001

THYROID DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
122	52TE131	8,913=007	3,800=004	2,500=004	8,867=001
123	53I131	5,813=008	2,300=001	3,000=001	2,299=001
124	54XE131M	9,438=005	=0,000+000	=0,000+000	1,640=002
125	51SB132	2,006=006	8,000=006	9,000=007	2,563=000
126	52TE132	8,913=007	3,800=004	2,500=004	7,653=001
127	53I132	5,813=008	2,300=001	3,000=001	6,695=001
128	51SB133	2,006=006	8,000=006	9,000=007	2,617=000
129	52TE133M	8,913=007	3,800=004	2,500=004	1,295=000
130	52TE133	8,913=007	3,800=004	2,500=004	1,279=000
131	53I133	5,813=008	2,300=001	3,000=001	4,820=001
132	54XE133M	9,438=005	=0,000+000	=0,000+000	2,530=002
133	54XE133	9,438=005	=0,000+000	=0,000+000	1,231=001
134	51SB134	2,006=006	8,000=006	9,000=007	4,177=000
135	52TE134	8,913=007	3,800=004	2,500=004	1,281=000
136	53I134	5,813=008	2,300=001	3,000=001	8,111=001
137	52TE135	8,913=007	3,800=004	2,500=004	2,565=000
138	53I135	5,813=008	2,300=001	3,000=001	5,659=001
139	54XE135M	9,438=005	=0,000+000	=0,000+000	1,126=001
140	54XE135	9,438=005	=0,000+000	=0,000+000	3,264=001
141	53I136	5,813=008	2,300=001	3,000=001	1,685=000
142	55CS136	1,194=007	=0,000+000	=0,000+000	3,485=001
143	53I137	5,813=008	2,300=001	3,000=001	3,265=000
144	54XE137	9,438=005	=0,000+000	=0,000+000	1,171=000
145	55CS137	1,146=007	=0,000+000	=0,000+000	1,820=001
146	56BA137M	=0,000+000	=0,000+000	=0,000+000	=0,000+000
147	53I138	5,813=008	2,300=001	3,000=001	4,226=000
148	54XE138	9,438=005	=0,000+000	=0,000+000	1,957=000
149	55CS138	1,146=007	=0,000+000	=0,000+000	1,115=000
150	53I139	5,813=008	2,300=001	3,000=001	4,811=000
151	54XE139	9,438=005	=0,000+000	=0,000+000	2,813=000
152	55CS139	1,146=007	=0,000+000	=0,000+000	1,283=000
153	56BA139	=0,000+000	=0,000+000	=0,000+000	=0,000+000
154	54XE140	9,438=005	=0,000+000	=0,000+000	3,320=000
155	55CS140	1,146=007	=0,000+000	=0,000+000	2,000=000
156	56BA140	=0,000+000	=0,000+000	=0,000+000	=0,000+000
157	57LA140	=0,000+000	=0,000+000	=0,000+000	=0,000+000
158	56BA141	=0,000+000	=0,000+000	=0,000+000	=0,000+000
159	57LA141	=0,000+000	=0,000+000	=0,000+000	=0,000+000
160	58CE141	=0,000+000	=0,000+000	=0,000+000	=0,000+000
161	55CS142	1,146=007	=0,000+000	=0,000+000	2,300=000

THYROID DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
162	56BA142	-0.000+000	-0.000+000	-0.000+000	-0.000+000
163	57LA142	-0.000+000	-0.000+000	-0.000+000	-0.000+000
164	56BA143	-0.000+000	-0.000+000	-0.000+000	-0.000+000
165	57LA143	-0.000+000	-0.000+000	-0.000+000	-0.000+000
166	58CE143	-0.000+000	-0.000+000	-0.000+000	-0.000+000
167	59PR143	-0.000+000	-0.000+000	-0.000+000	-0.000+000
168	58CE144	-0.000+000	-0.000+000	-0.000+000	-0.000+000
169	59PR144	-0.000+000	-0.000+000	-0.000+000	-0.000+000
170	58CE145	-0.000+000	-0.000+000	-0.000+000	-0.000+000
171	59PR145	-0.000+000	-0.000+000	-0.000+000	-0.000+000
172	58CE146	-0.000+000	-0.000+000	-0.000+000	-0.000+000
173	59PR146	-0.000+000	-0.000+000	-0.000+000	-0.000+000
174	60ND147	-0.000+000	-0.000+000	-0.000+000	-0.000+000
175	61PM147	-0.000+000	-0.000+000	-0.000+000	-0.000+000
176	60ND149	-0.000+000	-0.000+000	-0.000+000	-0.000+000
177	61PM149	-0.000+000	-0.000+000	-0.000+000	-0.000+000
178	60ND151	-0.000+000	-0.000+000	-0.000+000	-0.000+000
179	61PM151	-0.000+000	-0.000+000	-0.000+000	-0.000+000
180	62SM151	-0.000+000	-0.000+000	-0.000+000	-0.000+000
181	62SM153	-0.000+000	-0.000+000	-0.000+000	-0.000+000
182	62SM155	-0.000+000	-0.000+000	-0.000+000	-0.000+000
183	63EU155	-0.000+000	-0.000+000	-0.000+000	-0.000+000
184	62SM156	-0.000+000	-0.000+000	-0.000+000	-0.000+000
185	63EU156	-0.000+000	-0.000+000	-0.000+000	-0.000+000
186	63EU157	-0.000+000	-0.000+000	-0.000+000	-0.000+000
187	63EU158	-0.000+000	-0.000+000	-0.000+000	-0.000+000
188	64GD159	-0.000+000	-0.000+000	-0.000+000	-0.000+000

BONE DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL, DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
2	32GE77M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
3	32GE77	-0.000+000	-0.000+000	-0.000+000	-0.000+000
4	33AS77	-0.000+000	-0.000+000	-0.000+000	-0.000+000
5	32GE78	-0.000+000	-0.000+000	-0.000+000	-0.000+000
6	33AS78	-0.000+000	-0.000+000	-0.000+000	-0.000+000
7	33AS79	-0.000+000	-0.000+000	-0.000+000	-0.000+000
8	34SE79M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
9	34SE81M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
10	34SE81	-0.000+000	-0.000+000	-0.000+000	-0.000+000
11	34SE83M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
12	34SE83	-0.000+000	-0.000+000	-0.000+000	-0.000+000
13	35BR83	-0.000+000	-0.000+000	-0.000+000	-0.000+000
14	36KR83M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
15	35BR84A	-0.000+000	-0.000+000	-0.000+000	-0.000+000
16	34SE84	-0.000+000	-0.000+000	-0.000+000	-0.000+000
17	35BR84B	-0.000+000	-0.000+000	-0.000+000	-0.000+000
18	34SE85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
19	35BR85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
20	36KR85M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
21	36KR85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
22	34SE87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
23	35BR87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
24	36KR87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
25	35BR88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
26	36KR88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
27	37RB88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
28	35BR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
29	36KR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
30	37RB89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
31	38SR89	4.457-010	1.200-001	9.000-002	2.435+000
32	36KR90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
33	37RB90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
34	38SR90	4.457-010	1.200-001	9.000-002	4.689+000
35	39Y90	4.457-010	1.900-001	7.500-005	3.785+000
36	36KR91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
37	37RB91M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
38	37RB91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
39	38SR91	4.457-010	1.200-001	9.000-002	5.395+000
40	39Y91M	4.457-010	1.900-001	7.500-005	2.646+000
41	39Y91	4.457-010	1.900-001	7.500-005	2.566+000

BONE DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
42	36KR92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
43	37RB92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
44	38SR92	4.457-010	1.200-001	9.000-002	6.866+000
45	39Y92	4.457-010	1.900-001	7.500-005	5.599+000
46	36KR93	-0.000+000	-0.000+000	-0.000+000	-0.000+000
47	38SR93	4.457-010	1.200-001	9.000-002	1.180+001
48	39Y93	4.457-010	1.900-001	7.500-005	4.797+000
49	38SR94	4.457-010	1.200-001	9.000-002	1.646+001
50	39Y94	4.457-010	1.900-001	7.500-005	4.797+000
51	39Y95	4.457-010	1.900-001	7.500-005	8.935+000
52	40ZR95	8.023-009	9.000-002	3.600-005	1.156+000
53	41NB95M	8.023-009	1.000-001	3.800-005	4.257+001
54	41NB95	8.023-009	1.000-001	3.800-005	4.814+001
55	40ZR97	8.023-009	9.000-002	3.600-005	5.274+000
56	41NB97M	8.023-009	1.000-001	3.800-005	2.333+000
57	41NB97	8.023-009	1.000-001	3.800-005	2.213+000
58	41NB98	8.023-009	1.000-001	3.800-005	4.838+000
59	42MO99	-0.000+000	-0.000+000	-0.000+000	-0.000+000
60	43TC99M	3.209-007	1.000-003	1.000-003	2.290+002
61	42MO101	-0.000+000	-0.000+000	-0.000+000	-0.000+000
62	43TC101	3.209-007	1.000-003	1.000-003	2.171+000
63	42MO102	-0.000+000	-0.000+000	-0.000+000	-0.000+000
64	43TC102	3.209-007	1.000-003	1.000-003	6.850+000
65	44RU103	5.014-007	2.000-002	2.400-003	4.563+001
66	45RH103M	4.833-007	2.000-002	1.000-002	6.400+003
67	43TC104	3.209-007	1.000-003	1.000-003	5.000+000
68	42MO105	-0.000+000	-0.000+000	-0.000+000	-0.000+000
69	44RU105	5.014-007	2.000-002	2.400-003	2.860+000
70	45RH105M	4.833-007	2.000-002	1.000-002	8.408+001
71	45RH105	4.833-007	2.000-002	1.000-002	8.952+001
72	44RU106	5.014-007	2.000-002	2.400-003	5.640+000
73	45RH106	4.833-007	2.000-002	1.000-002	5.575+000
74	43TC107	3.209-007	1.000-003	1.000-003	1.847+001
75	44RU107	5.014-007	2.000-002	2.400-003	8.474+000
76	45RH107	4.833-007	2.000-002	1.000-002	2.018+000
77	45RH108	4.833-007	2.000-002	1.000-002	6.930+000
78	45RH109	4.833-007	2.000-002	1.000-002	4.000+000
79	46PD109	-0.000+000	-0.000+000	-0.000+000	-0.000+000
80	47AG109M	2.674-007	1.300-002	5.000-004	1.420+002
81	46PD111	-0.000+000	-0.000+000	-0.000+000	-0.000+000

BONE DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
82	47AG111	2,674-007	1,300-002	5,000-004	1,714-000
83	46PD112	-0.000+000	-0.000+000	-0.000+000	-0.000+000
84	47AG112	2,674-007	1,300-002	5,000-004	5,713+000
85	47AG113	2,674-007	1,300-002	5,000-004	3,350+000
86	48CD113M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
87	47AG114	2,674-007	1,300-002	5,000-004	6,850+000
88	47AG115	2,674-007	1,300-002	5,000-004	4,879+000
89	48CD115M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
90	48CD115	-0.000+000	-0.000+000	-0.000+000	-0.000+000
91	49IN115M	1,407-007	4,000-002	3,400-004	1,260-001
92	48CD117M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
93	48CD117	-0.000+000	-0.000+000	-0.000+000	-0.000+000
94	49IN117M	1,407-007	4,000-002	3,400-004	2,536+000
95	49IN117	1,407-007	4,000-002	3,400-004	1,326+000
96	48CD118	-0.000+000	-0.000+000	-0.000+000	-0.000+000
97	49IN118	1,407-007	4,000-002	3,400-004	7,350+000
98	49IN119	1,407-007	4,000-002	3,400-004	4,502+000
99	50SN119M	8,023-008	8,000-002	2,000-002	1,440-002
100	50SN121	8,023-008	8,000-002	2,000-002	6,400-001
101	50SN123A	8,023-008	8,000-002	2,000-002	2,334+000
102	50SN123B	8,023-008	8,000-002	2,000-002	2,126+000
103	50SN125A	8,023-008	8,000-002	2,000-002	3,606+000
104	50SN125B	8,023-008	8,000-002	2,000-002	3,802+000
105	51SB125	8,023-008	3,000-002	3,000-003	5,316-001
106	52TE125M	2,674-007	3,400-002	2,300-002	2,330-002
107	51SB126	8,023-008	3,000-002	3,000-003	1,859+000
108	50SN127	8,023-008	8,000-002	2,000-002	4,860+000
109	51SB127	8,023-008	3,000-002	3,000-003	2,793+000
110	52TE127M	2,674-007	3,400-002	2,300-002	1,152+000
111	52TE127	2,674-007	3,400-002	2,300-002	1,150+000
112	50SN128	8,023-008	8,000-002	2,000-002	3,924+000
113	51SB128A	8,023-008	3,000-002	3,000-003	1,665+000
114	51SB128B	8,023-008	3,000-002	3,000-003	4,835+000
115	51SB129	8,023-008	3,000-002	3,000-003	3,862+000
116	52TE129M	2,674-007	3,400-002	2,300-002	2,285+000
117	52TE129	2,674-007	3,400-002	2,300-002	2,272+000
118	50SN130	8,023-008	8,000-002	2,000-002	3,330+000
119	51SB130	8,023-008	3,000-002	1,000-003	8,350+000
120	51SB131	8,023-008	3,000-002	1,000-003	8,885+000
121	52TE131M	2,674-007	3,400-002	2,300-002	1,749+000

BONE DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
122	52TE131	2.674+007	3.400+002	2.300+002	3.854+000
123	53I131	5.730+007	5.300+002	7.000+002	1.018+000
124	54XE131M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
125	51SB132	8.023+008	3.000+002	1.000+003	1.272+001
126	52TE132	2.674+007	3.400+002	2.300+002	3.015+000
127	53I132	5.730+007	5.300+002	7.000+002	2.631+000
128	51SB133	8.022+008	3.000+002	1.000+003	1.234+001
129	52TE133M	2.674+007	3.400+002	2.300+002	5.557+000
130	52TE133	2.674+007	3.400+002	2.300+002	6.049+000
131	53I133	5.730+007	5.300+002	7.000+002	2.176+000
132	54XE133M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
133	54XE133	-0.000+000	-0.000+000	-0.000+000	-0.000+000
134	51SB134	8.023+008	3.000+002	1.000+003	2.008+001
135	52TE134	2.674+007	3.400+002	2.300+002	5.590+000
136	53I134	5.730+007	5.300+002	7.000+002	3.248+000
137	52TE135	2.674+007	3.400+002	2.300+002	1.184+001
138	53I135	5.730+007	5.300+002	7.000+002	1.874+000
139	54XE135M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
140	54XE135	-0.000+000	-0.000+000	-0.000+000	-0.000+000
141	53I136	5.730+007	5.300+002	7.000+002	7.482+000
142	55CS136	5.730+008	3.000+002	4.000+002	9.713+001
143	53I137	5.730+007	5.300+002	7.000+002	1.065+001
144	54XE137	-0.000+000	-0.000+000	-0.000+000	-0.000+000
145	55CS137	5.730+008	3.000+002	4.000+002	1.008+000
146	56BA137M	1.234+007	1.900+001	3.500+002	1.066+001
147	53I138	5.730+007	5.300+002	7.000+002	2.145+001
148	54XE138	-0.000+000	-0.000+000	-0.000+000	8.913+000
149	55CS138	5.730+008	3.000+002	4.000+002	4.846+000
150	53I139	5.730+007	5.300+002	7.000+002	1.080+001
151	54XE139	-0.000+000	-0.000+000	-0.000+000	-0.000+000
152	55CS139	5.730+008	3.000+002	4.000+002	1.016+001
153	56BA139	1.234+007	1.900+001	3.500+002	3.827+000
154	54XE140	-0.000+000	-0.000+000	-0.000+000	-0.000+000
155	55CS140	5.730+008	3.000+002	4.000+002	1.336+001
156	56BA140	1.234+007	1.900+001	3.500+002	4.014+000
157	57LA140	8.023+008	1.000+001	4.000+005	2.634+000
158	56BA141	1.234+007	1.900+001	3.500+002	9.442+000
159	57LA141	8.023+008	1.000+001	4.000+005	4.799+000
160	58CE141	5.348+009	7.500+002	3.000+005	8.114+001
161	55CS142	5.730+008	3.000+002	4.000+002	2.284+001

BONE DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL, DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
162	56BA142	1.234=007	1.900=001	3.500=002	1.135=001
163	57LA142	8.023=008	1.000=001	4.000=005	7.500=000
164	56BA143	1.234=007	1.900=001	3.500=002	1.473=001
165	57LA143	8.023=008	1.000=001	4.000=005	8.886=000
166	58CE143	5.348=009	7.500=002	3.000=005	3.389=000
167	59PRI43	5.348=009	1.000=001	4.000=005	1.555=000
168	58CE144	5.348=009	7.500=002	3.000=005	5.407=000
169	59PRI44	5.348=009	1.000=001	4.000=005	4.920=000
170	58CE145	5.348=009	7.500=002	3.000=005	6.350=000
171	59PRI45	5.348=009	1.000=001	4.000=005	3.000=000
172	58CE146	5.348=009	7.500=002	3.000=005	6.540=000
173	59PRI46	5.348=009	1.000=001	4.000=005	5.349=000
174	60ND147	5.348=009	9.000=002	3.500=005	1.436=000
175	61PM147	5.348=009	9.000=002	3.500=005	3.750=001
176	60ND149	5.348=009	9.000=002	3.500=005	2.069=000
177	61PM149	5.348=009	9.000=002	3.500=005	2.165=001
178	60ND151	5.348=009	9.000=002	3.500=005	4.419=000
179	61PM151	5.348=009	9.000=002	3.500=005	1.520=000
180	62SM151	5.348=009	9.000=002	3.500=005	1.285=001
181	62SM153	5.348=009	9.000=002	3.500=005	1.182=000
182	62SM155	5.348=009	9.000=002	3.500=005	2.759=000
183	63EU155	5.348=009	9.000=002	3.600=005	2.879=001
184	62SM156	5.348=009	9.000=002	3.500=005	3.771=000
185	63EU156	5.348=009	9.000=002	3.600=005	2.293=000
186	63EU157	5.348=009	9.000=002	3.600=005	1.813=000
187	63EU158	5.348=009	9.000=002	3.600=005	4.350=000
188	64GD159	8.023=009	9.000=002	3.600=005	1.489=000

G.I. DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
2	32GE77M	-0.000+000	6.250-001	1.000+000	8.372+001
3	32GE77	-0.000+000	6.250-001	1.000+000	4.872+001
4	33AS77	-0.000+000	6.250-001	1.000+000	6.180+002
5	32GE78	-0.000+000	6.250-001	1.000+000	1.554+000
6	33AS78	-0.000+000	6.250-001	1.000+000	1.265+000
7	33AS79	-0.000+000	6.250-001	1.000+000	7.485+001
8	34SE79M	-0.000+000	6.250-001	1.000+000	1.550+002
9	34SE81M	-0.000+000	6.250-001	1.000+000	4.766+001
10	34SE81	-0.000+000	6.250-001	1.000+000	4.600+001
11	34SE83M	-0.000+000	6.250-001	1.000+000	1.632+000
12	34SE83	-0.000+000	6.250-001	1.000+000	9.794+001
13	35BR83	-0.000+000	6.250-001	1.000+000	3.171+001
14	36KR83M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
15	35BR84A	-0.000+000	6.250-001	1.000+000	9.386+001
16	34SE84	-0.000+000	6.250-001	1.000+000	1.881+000
17	35BR84B	-0.000+000	6.250-001	1.000+000	1.251+000
18	34SE85	-0.000+000	6.250-001	1.000+000	2.490+000
19	35BR85	-0.000+000	6.250-001	1.000+000	8.300+001
20	36KR85M	-0.000+000	-0.000+000	-0.000+000	-0.000+000
21	36KR85	-0.000+000	-0.000+000	-0.000+000	-0.000+000
22	34SE87	-0.000+000	6.250-001	1.000+000	4.686+000
23	35BR87	-0.000+000	6.250-001	1.000+000	2.016+000
24	36KR87	-0.000+000	-0.000+000	-0.000+000	-0.000+000
25	35BR88	-0.000+000	6.250-001	1.000+000	2.900+000
26	36KR88	-0.000+000	-0.000+000	-0.000+000	-0.000+000
27	37RB88	-0.000+000	6.250-001	1.000+000	1.589+000
28	35BR89	-0.000+000	6.250-001	1.000+000	2.370+000
29	36KR89	-0.000+000	-0.000+000	-0.000+000	-0.000+000
30	37RB89	-0.000+000	6.250-001	1.000+000	9.025+001
31	38SR89	-0.000+000	6.250-001	1.000+000	5.000+003
32	36KR90	-0.000+000	-0.000+000	-0.000+000	-0.000+000
33	37RB90	-0.000+000	6.250-001	1.000+000	1.900+000
34	38SR90	-0.000+000	6.250-001	1.000+000	0.000+000
35	39Y90	-0.000+000	6.250-001	1.000+000	1.329+001
36	36KR91	-0.000+000	-0.000+000	-0.000+000	-0.000+000
37	37RB91M	-0.000+000	6.250-001	1.000+000	1.507+000
38	37RB91	-0.000+000	6.250-001	1.000+000	2.041+000
39	38SR91	-0.000+000	6.250-001	1.000+000	5.118+001
40	39Y91M	-0.000+000	6.250-001	1.000+000	9.290+002
41	39Y91	-0.000+000	6.250-001	1.000+000	4.500+003

G.I. DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
42	36KR92	-0.000+000	-0.000+000	-0.000+000	-0.000+000
43	37RB92	-0.000+000	6.250-001	1.000+000	4.057+000
44	38SR92	-0.000+000	6.250-001	1.000+000	1.557+000
45	39Y92	-0.000+000	6.250-001	1.000+000	1.155+000
46	36KR93	-0.000+000	-0.000+000	-0.000+000	-0.000+000
47	38SR93	-0.000+000	6.250-001	1.000+000	2.151+000
48	39Y93	-0.000+000	6.250-001	1.000+000	7.549-001
49	38SR94	-0.000+000	6.250-001	1.000+000	1.887+000
50	39Y94	-0.000+000	6.250-001	1.000+000	7.549-001
51	39Y95	-0.000+000	6.250-001	1.000+000	1.572+000
52	40ZR95	-0.000+000	6.250-001	1.000+000	2.000-003
53	41NB95M	-0.000+000	6.250-001	1.000+000	5.100-003
54	41NB95	-0.000+000	6.250-001	1.000+000	2.600-003
55	40ZR97	-0.000+000	6.250-001	1.000+000	6.232-001
56	41NB97M	-0.000+000	6.250-001	1.000+000	6.494-001
57	41NB97	-0.000+000	6.250-001	1.000+000	5.287-001
58	41NB98	-0.000+000	6.250-001	1.000+000	1.214+000
59	42MO99	-0.000+000	6.250-001	1.000+000	6.940-002
60	43TC99M	-0.000+000	6.250-001	1.000+000	2.110-002
61	42MO101	-0.000+000	6.250-001	1.000+000	1.124+000
62	43TC101	-0.000+000	6.250-001	1.000+000	4.755-001
63	42MO102	-0.000+000	6.250-001	1.000+000	3.994-001
64	43TC102	-0.000+000	6.250-001	1.000+000	1.370+000
65	44RU103	-0.000+000	6.250-001	1.000+000	2.100-003
66	45RH103M	-0.000+000	6.250-001	1.000+000	6.400-003
67	43TC104	-0.000+000	6.250-001	1.000+000	1.000+000
68	42MO105	-0.000+000	6.250-001	1.000+000	2.337+000
69	44RU105	-0.000+000	6.250-001	1.000+000	5.070-001
70	45RH105M	-0.000+000	6.250-001	1.000+000	7.370-002
71	45RH105	-0.000+000	6.250-001	1.000+000	5.300-002
72	44RU106	-0.000+000	6.250-001	1.000+000	1.600-003
73	45RH106	-0.000+000	6.250-001	1.000+000	1.139+000
74	43TC107	-0.000+000	6.250-001	1.000+000	3.756+000
75	44RU107	-0.000+000	6.250-001	1.000+000	1.756+000
76	45RH107	-0.000+000	6.250-001	1.000+000	4.457-001
77	45RH108	-0.000+000	6.250-001	1.000+000	1.434+000
78	45RH109	-0.000+000	6.250-001	1.000+000	1.015+000
79	46PD109	-0.000+000	6.250-001	1.000+000	2.152-001
80	47AG109M	-0.000+000	6.250-001	1.000+000	1.420-002
81	46PD111	-0.000+000	6.250-001	1.000+000	7.323-001

G.I. DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
82	47AG111	-0.000+000	6,250-001	1.000+000	2.300-002
83	46PD112	-0.000+000	6,250-001	1.000+000	4,746-001
84	47AG112	-0.000+000	6,250-001	1.000+000	1,204+000
85	47AG113	-0.000+000	6,250-001	1.000+000	6,063-001
86	48CD113M	-0.000+000	6,250-001	1.000+000	0,000+000
87	47AG114	-0.000+000	6,250-001	1.000+000	1,370-000
88	47AG115	-0.000+000	6,250-001	1.000+000	1,068+000
89	48CD115M	-0.000+000	6,250-001	1.000+000	6,900-003
90	48CD115	-0.000+000	6,250-001	1.000+000	7,640-002
91	49IN115M	-0.000+000	6,250-001	1.000+000	6,190-002
92	48CD117M	-0.000+000	6,250-001	1.000+000	1,499+000
93	48CD117	-0.000+000	6,250-001	1.000+000	1,373+000
94	49IN117M	-0.000+000	6,250-001	1.000+000	5,379-001
95	49IN117	-0.000+000	6,250-001	1.000+000	3,380-001
96	48CD118	-0.000+000	6,250-001	1.000+000	1,737+000
97	49IN118	-0.000+000	6,250-001	1.000+000	1,470+000
98	49IN119	-0.000+000	6,250-001	1.000+000	9,000-001
99	50SN119M	-0.000+000	6,250-001	1.000+000	0,000+000
100	50SN121	-0.000+000	6,250-001	1.000+000	4,670-002
101	50SN123A	-0.000+000	6,250-001	1.000+000	1,800-003
102	50SN123B	-0.000+000	6,250-001	1.000+000	4,458-001
103	50SN125A	-0.000+000	6,250-001	1.000+000	7,576-001
104	50SN125B	-0.000+000	6,250-001	1.000+000	4,100-002
105	51SB125	-0.000+000	6,250-001	1.000+000	1,000-004
106	52TE125M	-0.000+000	6,250-001	1.000+000	2,000-004
107	51SB126	-0.000+000	6,250-001	1.000+000	4,045-001
108	50SN127	-0.000+000	6,250-001	1.000+000	4,956-001
109	51SB127	-0.000+000	6,250-001	1.000+000	6,800-002
110	52TE127M	-0.000+000	6,250-001	1.000+000	6,000-004
111	52TE127	-0.000+000	6,250-001	1.000+000	1,699-001
112	50SN128	-0.000+000	6,250-001	1.000+000	7,762-001
113	51SB128A	-0.000+000	6,250-001	1.000+000	3,330-001
114	51SB128B	-0.000+000	6,250-001	1.000+000	7,024-001
115	51SB129	-0.000+000	6,250-001	1.000+000	7,123-001
116	52TE129M	-0.000+000	6,250-001	1.000+000	6,900-003
117	52TE129	-0.000+000	6,250-001	1.000+000	4,719-001
118	50SN130	-0.000+000	6,250-001	1.000+000	6,660-001
119	51SB130	-0.000+000	6,250-001	1.000+000	1,670+000
120	51SB131	-0.000+000	6,250-001	1.000+000	1,748+000
121	52TE131M	-0.000+000	6,250-001	1.000+000	5,027-001

G.I. DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
122	52TE131	-0.000+000	6.250-001	1.000+000	7.096-001
123	53I131	-0.000+000	6.250-001	1.000+000	1.570-002
124	54XE131M	-0.000+000	6.250-001	1.000+000	1.100-003
125	51SB132	-0.000+000	6.250-001	1.000+000	2.114+000
126	52TE132	-0.000+000	6.250-001	1.000+000	1.147-001
127	53I132	-0.000+000	6.250-001	1.000+000	7.953-001
128	51SB133	-0.000+000	6.250-001	1.000+000	2.443+000
129	52TE133M	-0.000+000	6.250-001	1.000+000	1.144+000
130	52TE133	-0.000+000	6.250-001	1.000+000	1.037+000
131	53I133	-0.000+000	6.250-001	1.000+000	2.376-001
132	54XE133M	-0.000+000	6.250-001	1.000+000	8.900-003
133	54XE133	-0.000+000	6.250-001	1.000+000	1.200-002
134	51SB134	-0.000+000	6.250-001	1.000+000	4.326+000
135	52TE134	-0.000+000	6.250-001	1.000+000	1.426+000
136	53I134	-0.000+000	6.250-001	1.000+000	9.563-001
137	52TE135	-0.000+000	6.250-001	1.000+000	2.678+000
138	53I135	-0.000+000	6.250-001	1.000+000	6.791-001
139	54XE135M	-0.000+000	6.250-001	1.000+000	9.560-002
140	54XE135	-0.000+000	6.250-001	1.000+000	2.552-001
141	53I136	-0.000+000	6.250-001	1.000+000	1.854+000
142	55CS136	-0.000+000	6.250-001	1.000+000	1.910-002
143	53I137	-0.000+000	6.250-001	1.000+000	3.300+000
144	54XE137	-0.000+000	6.250-001	1.000+000	1.170+000
145	55CS137	-0.000+000	6.250-001	1.000+000	0.000+000
146	56BA137M	-0.000+000	6.250-001	1.000+000	1.066-001
147	53I138	-0.000+000	6.250-001	1.000+000	4.610+000
148	54XE138	-0.000+000	6.250-001	1.000+000	2.114+000
149	55CS138	-0.000+000	6.250-001	1.000+000	1.246+000
150	53I139	-0.000+000	6.250-001	1.000+000	5.614+000
151	54XE139	-0.000+000	6.250-001	1.000+000	3.598+000
152	55CS139	-0.000+000	6.250-001	1.000+000	2.068+000
153	56BA139	-0.000+000	6.250-001	1.000+000	7.713-001
154	54XE140	-0.000+000	6.250-001	1.000+000	3.337+000
155	55CS140	-0.000+000	6.250-001	1.000+000	2.017+000
156	56BA140	-0.000+000	6.250-001	1.000+000	1.740-002
157	57LA140	-0.000+000	6.250-001	1.000+000	2.288-001
158	56BA141	-0.000+000	6.250-001	1.000+000	1.703+000
159	57LA141	-0.000+000	6.250-001	1.000+000	7.759-001
160	58CE141	-0.000+000	6.250-001	1.000+000	2.700-003
161	55CS142	-0.000+000	6.250-001	1.000+000	4.570+000

G.I. DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
162	56BA142	-0.000+000	6.250-001	1.000+000	2.270+000
163	57LA142	-0.000+000	6.250-001	1.000+000	1.500+000
164	56BA143	-0.000+000	6.250-001	1.000+000	2.406+000
165	57LA143	-0.000+000	6.250-001	1.000+000	1.236+000
166	58CE143	-0.000+000	6.250-001	1.000+000	1.378+001
167	59PR143	-0.000+000	6.250-001	1.000+000	1.150+002
168	58CE144	-0.000+000	6.250-001	1.000+000	2.000+003
169	59PR144	-0.000+000	6.250-001	1.000+000	9.882+001
170	58CE145	-0.000+000	6.250-001	1.000+000	1.194+000
171	59PR145	-0.000+000	6.250-001	1.000+000	5.251+001
172	58CE146	-0.000+000	6.250-001	1.000+000	1.508+000
173	59PR146	-0.000+000	6.250-001	1.000+000	1.237+000
174	60ND147	-0.000+000	6.250-001	1.000+000	1.220+002
175	61PM147	-0.000+000	6.250-001	1.000+000	0.000+000
176	60ND149	-0.000+000	6.250-001	1.000+000	4.199+001
177	61PM149	-0.000+000	6.250-001	1.000+000	9.300+003
178	60ND151	-0.000+000	6.250-001	1.000+000	7.646+001
179	61PM151	-0.000+000	6.250-001	1.000+000	1.216+001
180	62SM151	-0.000+000	6.250-001	1.000+000	0.000+000
181	62SM153	-0.000+000	6.250-001	1.000+000	5.830+002
182	62SM155	-0.000+000	6.250-001	1.000+000	5.274+001
183	63EU155	-0.000+000	6.250-001	1.000+000	1.000+004
184	62SM156	-0.000+000	6.250-001	1.000+000	2.234+001
185	63EU156	-0.000+000	6.250-001	1.000+000	2.140+002
186	63EU157	-0.000+000	6.250-001	1.000+000	2.157+001
187	63EU158	-0.000+000	6.250-001	1.000+000	8.700+001
188	64GD159	-0.000+000	6.250-001	1.000+000	1.527+001

LUNG DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
2	32GE77M	6.685+008	1.250+001	0.000+000	1.169+000
3	32GE77	6.685+008	1.250+001	0.000+000	1.090+000
4	33AS77	6.685+008	1.250+001	0.000+000	2.272+001
5	32GE78	6.685+008	1.250+001	0.000+000	1.684+000
6	33AS78	6.685+008	1.250+001	0.000+000	1.384+000
7	33AS79	6.685+008	1.250+001	0.000+000	7.613+001
8	34SE79M	6.685+008	1.250+001	0.000+000	2.830+002
9	34SE81M	6.685+008	1.250+001	0.000+000	4.903+001
10	34SE81	6.685+008	1.250+001	0.000+000	4.600+001
11	34SE83M	6.685+008	1.250+001	0.000+000	1.797+000
12	34SE83	6.685+008	1.250+001	0.000+000	1.117+000
13	35BR83	6.685+008	1.250+001	0.000+000	3.197+001
14	36KR83M	-0.000+000	-0.000+000	0.000+000	-0.000+000
15	35BR84A	6.685+008	1.250+001	0.000+000	1.225+000
16	34SE84	6.685+008	1.250+001	0.000+000	2.129+000
17	35BR84B	6.685+008	1.250+001	0.000+000	1.500+000
18	34SE85	6.685+008	1.250+001	0.000+000	2.490+000
19	35BR85	6.685+008	1.250+001	0.000+000	8.300+001
20	36KR85M	-0.000+000	-0.000+000	0.000+000	-0.000+000
21	36KR85	-0.000+000	-0.000+000	0.000+000	-0.000+000
22	34SE87	6.685+008	1.250+001	0.000+000	5.192+000
23	35BR87	6.685+008	1.250+001	0.000+000	2.522+000
24	36KR87	-0.000+000	-0.000+000	0.000+000	-0.000+000
25	35BR88	6.685+008	1.250+001	0.000+000	2.900+000
26	36KR88	-0.000+000	-0.000+000	0.000+000	-0.000+000
27	37RB88	6.685+008	1.250+001	0.000+000	1.675+000
28	35BR89	6.685+008	1.250+001	0.000+000	2.370+000
29	36KR89	-0.000+000	-0.000+000	0.000+000	-0.000+000
30	37RB89	6.685+008	1.250+001	0.000+000	1.564+000
31	38SR89	6.685+008	1.250+001	0.000+000	4.870+001
32	36KR90	-0.000+000	-0.000+000	0.000+000	-0.000+000
33	37RB90	6.685+008	1.250+001	0.000+000	1.911+000
34	38SR90	6.685+008	1.250+001	0.000+000	9.214+001
35	39Y90	6.685+008	1.250+001	0.000+000	7.570+001
36	36KR91	-0.000+000	-0.000+000	0.000+000	-0.000+000
37	37RB91M	6.685+008	1.250+001	0.000+000	2.190+000
38	37RB91	6.685+008	1.250+001	0.000+000	2.720+000
39	38SR91	6.685+008	1.250+001	0.000+000	1.194+000
40	39Y91M	6.685+008	1.250+001	0.000+000	5.072+001
41	39Y91	6.685+008	1.250+001	0.000+000	5.142+001

LUNG DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
42	36KR92	-0.000+000	-0.000+000	0.000+000	-0.000+000
43	37RB92	6.685-008	1.250-001	0.000+000	4.274+000
44	38SR92	6.685-008	1.250-001	0.000+000	1.775+000
45	39Y92	6.685-008	1.250-001	0.000+000	1.191+000
46	36KR93	-0.000+000	-0.000+000	0.000+000	-0.000+000
47	38SR93	6.685-008	1.250-001	0.000+000	2.603+000
48	39Y93	6.685-008	1.250-001	0.000+000	1.207+000
49	38SR94	6.685-008	1.250-001	0.000+000	2.336+000
50	39Y94	6.685-008	1.250-001	0.000+000	1.207+000
51	39Y95	6.685-008	1.250-001	0.000+000	1.934+000
52	40ZR95	6.685-008	1.250-001	0.000+000	5.615+001
53	41NB95M	6.685-008	1.250-001	0.000+000	2.848+001
54	41NB95	6.685-008	1.250-001	0.000+000	2.784+001
55	40ZR97	6.685-008	1.250-001	0.000+000	1.428+000
56	41NB97M	6.685-008	1.250-001	0.000+000	8.394+001
57	41NB97	6.685-008	1.250-001	0.000+000	6.184+001
58	41NB98	6.685-008	1.250-001	0.000+000	1.470+000
59	42MO99	6.685-008	1.250-001	0.000+000	4.405+001
60	43TC99M	6.685-008	1.250-001	0.000+000	4.190+002
61	42MO101	6.685-008	1.250-001	0.000+000	1.390+000
62	43TC101	6.685-008	1.250-001	0.000+000	5.184+001
63	42MO102	6.685-008	1.250-001	0.000+000	4.000+001
64	43TC102	6.685-008	1.250-001	0.000+000	1.370+000
65	44RU103	6.685-008	1.250-001	0.000+000	2.321+001
66	45RH103M	6.685-008	1.250-001	0.000+000	1.180+002
67	43TC104	6.685-008	1.250-001	0.000+000	1.000+000
68	42MO105	6.685-008	1.250-001	0.000+000	2.609+000
69	44RU105	6.685-008	1.250-001	0.000+000	7.800+001
70	45RH105M	6.685-008	1.250-001	0.000+000	2.232+001
71	45RH105	6.685-008	1.250-001	0.000+000	1.874+001
72	44RU106	6.685-008	1.250-001	0.000+000	1.178+000
73	45RH106	6.685-008	1.250-001	0.000+000	1.165+000
74	43TC107	6.685-008	1.250-001	0.000+000	3.819+000
75	44RU107	6.685-008	1.250-001	0.000+000	1.819+000
76	45RH107	6.685-008	1.250-001	0.000+000	4.895+001
77	45RH108	6.685-008	1.250-001	0.000+000	1.484+000
78	45RH109	6.685-008	1.250-001	0.000+000	1.166+000
79	46PD109	6.685-008	1.250-001	0.000+000	3.680+001
80	47AG109M	6.685-008	1.250-001	0.000+000	2.600+002
81	46PD111	6.685-008	1.250-001	0.000+000	1.638+000

LUNG DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
82	47AG111	6.685-008	1.250-001	0.000+000	3.491+001
83	46PD112	6.685-008	1.250-001	0.000+000	1.412+000
84	47AG112	6.685-008	1.250-001	0.000+000	1.318+000
85	47AG113	6.685-008	1.250-001	0.000+000	6.746+001
86	48CD113M	6.685-008	1.250-001	0.000+000	2.000+001
87	47AG114	6.685-008	1.250-001	0.000+000	1.370+000
88	47AG115	6.685-008	1.250-001	0.000+000	1.511+000
89	48CD115M	6.685-008	1.250-001	0.000+000	1.008+000
90	48CD115	6.685-008	1.250-001	0.000+000	4.714+001
91	49IN115M	6.685-008	1.250-001	0.000+000	1.085+001
92	48CD117M	6.685-008	1.250-001	0.000+000	1.825+000
93	48CD117	6.685-008	1.250-001	0.000+000	1.464+000
94	49IN117M	6.685-008	1.250-001	0.000+000	5.716+001
95	49IN117	6.685-008	1.250-001	0.000+000	4.137+001
96	48CD118	6.685-008	1.250-001	0.000+000	1.737+000
97	49IN118	6.685-008	1.250-001	0.000+000	1.470+000
98	49IN119	6.685-008	1.250-001	0.000+000	9.043+001
99	50SN119M	6.685-008	1.250-001	0.000+000	2.640+002
100	50SN121	6.685-008	1.250-001	0.000+000	1.280+001
101	50SN123A	6.685-008	1.250-001	0.000+000	4.725+001
102	50SN123B	6.685-008	1.250-001	0.000+000	4.672+001
103	50SN125A	6.685-008	1.250-001	0.000+000	8.300+001
104	50SN125B	6.685-008	1.250-001	0.000+000	7.975+001
105	51SB125	6.685-008	1.250-001	0.000+000	2.275+001
106	52TE125M	6.685-008	1.250-001	0.000+000	4.280+002
107	51SB126	6.685-008	1.250-001	0.000+000	7.135+001
108	50SN127	6.685-008	1.250-001	0.000+000	1.118+000
109	51SB127	6.685-008	1.250-001	0.000+000	7.059+001
110	52TE127M	6.685-008	1.250-001	0.000+000	2.553+001
111	52TE127	6.685-008	1.250-001	0.000+000	2.300+001
112	50SN128	6.685-008	1.250-001	0.000+000	7.849+001
113	51SB128A	6.685-008	1.250-001	0.000+000	3.330+001
114	51SB128B	6.685-008	1.250-001	0.000+000	9.670+001
115	51SB129	6.685-008	1.250-001	0.000+000	9.808+001
116	52TE129M	6.685-008	1.250-001	0.000+000	5.212+001
117	52TE129	6.685-008	1.250-001	0.000+000	4.901+001
118	50SN130	6.685-008	1.250-001	0.000+000	6.660+001
119	51SB130	6.685-008	1.250-001	0.000+000	1.670+000
120	51SB131	6.685-008	1.250-001	0.000+000	2.110+000
121	52TE131M	6.685-008	1.250-001	0.000+000	1.071+000

LUNG DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
122	52TE131	6.685-008	1.250-001	0.000+000	1.035+000
123	53I131	6.685-008	1.250-001	0.000+000	3.058+001
124	54XE131M	9.438-005	1.250-001	0.000+000	4.840+002
125	51SB132	6.685-008	1.250-001	0.000+000	3.191+000
126	52TE132	6.685-008	1.250-001	0.000+000	1.223+000
127	53I132	6.685-008	1.250-001	0.000+000	1.082+000
128	51SB133	6.685-008	1.250-001	0.000+000	3.117+000
129	52TE133M	6.685-008	1.250-001	0.000+000	1.884+000
130	52TE133	6.685-008	1.250-001	0.000+000	1.538+000
131	53I133	6.685-008	1.250-001	0.000+000	7.433+001
132	54XE133M	9.438-005	1.250-001	0.000+000	2.018+001
133	54XE133	9.438-005	1.250-001	0.000+000	1.389+001
134	51SB134	6.685-008	1.250-001	0.000+000	4.645+000
135	52TE134	6.685-008	1.250-001	0.000+000	1.745+000
136	53I134	6.685-008	1.250-001	0.000+000	1.275+000
137	52TE135	6.685-008	1.250-001	0.000+000	2.995+000
138	53I135	6.685-008	1.250-001	0.000+000	9.975+001
139	54XE135M	9.438-005	1.250-001	0.000+000	2.254+001
140	54XE135	9.438-005	1.250-001	0.000+000	3.779+001
141	53I136	6.685-008	1.250-001	0.000+000	2.226+000
142	55CS136	5.730-008	1.250-001	0.000+000	7.921+001
143	53I137	6.685-008	1.250-001	0.000+000	3.268+000
144	54XE137	9.438-005	1.250-001	0.000+000	1.175+000
145	55CS137	5.730-008	1.250-001	0.000+000	3.617+001
146	56BA137M	1.234-009	1.250-001	0.000+000	1.953+001
147	53I138	6.685-008	1.250-001	0.000+000	4.653+000
148	54XE138	9.438-005	1.250-001	0.000+000	2.458+000
149	55CS138	5.730-008	1.250-001	0.000+000	1.534+000
150	53I139	6.685-008	1.250-001	0.000+000	5.630+000
151	54XE139	9.438-005	1.250-001	0.000+000	3.635+000
152	55CS139	5.730-008	1.250-001	0.000+000	2.105+000
153	56BA139	1.234-009	1.250-001	0.000+000	7.776+001
154	54XE140	9.438-005	1.250-001	0.000+000	4.850+000
155	55CS140	5.730-008	1.250-001	0.000+000	3.530+000
156	56BA140	1.234-009	1.250-001	0.000+000	1.533+000
157	57LA140	6.685-008	1.250-001	0.000+000	1.202+000
158	56BA141	1.234-009	1.250-001	0.000+000	1.879+000
159	57LA141	6.685-008	1.250-001	0.000+000	9.500+001
160	58CE141	6.685-008	1.250-001	0.000+000	1.891+001
161	55CS142	5.730-008	1.250-001	0.000+000	4.569+000

LUNG DOSE CALCULATION PARAMETERS

I	ISOTOPE	BIOL. DECAY CONSTANT	INHALATION FRACTION	INGESTION FRACTION	EFFECTIVE ENERGY
162	56BA142	1,234-009	1,250-001	0,000+000	2,269+000
163	57LA142	6,685-008	1,250-001	0,000+000	1,500+000
164	56BA143	1,234-009	1,250-001	0,000+000	3,045+000
165	57LA143	6,685-008	1,250-001	0,000+000	1,875+000
166	58CE143	6,685-008	1,250-001	0,000+000	7,842+001
167	59PR143	6,685-008	1,250-001	0,000+000	3,110+001
168	58CE144	6,685-008	1,250-001	0,000+000	1,100+000
169	59PR144	6,685-008	1,250-001	0,000+000	9,924+001
170	58CE145	6,685-008	1,250-001	0,000+000	1,269+000
171	59PR145	6,685-008	1,250-001	0,000+000	6,000+001
172	58CE146	6,685-008	1,250-001	0,000+000	1,716+000
173	59PR146	6,685-008	1,250-001	0,000+000	1,411+000
174	60ND147	6,685-008	1,250-001	0,000+000	3,015+001
175	61PM147	6,685-008	1,250-001	0,000+000	7,500+002
176	60ND149	6,685-008	1,250-001	0,000+000	5,010+001
177	61PM149	6,685-008	1,250-001	0,000+000	4,570+002
178	60ND151	6,685-008	1,250-001	0,000+000	1,003+000
179	61PM151	6,685-008	1,250-001	0,000+000	3,749+001
180	62SM151	6,685-008	1,250-001	0,000+000	3,150+002
181	62SM153	6,685-008	1,250-001	0,000+000	2,640+001
182	62SM155	6,685-008	1,250-001	0,000+000	5,554+001
183	63EU155	6,685-008	1,250-001	0,000+000	7,860+002
184	62SM156	6,685-008	1,250-001	0,000+000	9,899+001
185	63EU156	6,685-008	1,250-001	0,000+000	7,740+001
186	63EU157	6,685-008	1,250-001	0,000+000	4,156+001
187	63EU158	6,685-008	1,250-001	0,000+000	8,700+001
188	64GD159	6,685-008	1,250-001	0,000+000	3,131+001

BETA DECAY ENERGIES BY ISOTOPE

I	ISOTOPE	AVERAGE	MAXIMUM
2	32GE77H	6,670+001 MEV	2,900+000 MEV
3	32GE77	5,390+001 MEV	2,270+000 MEV
4	33AS77	2,210+001 MEV	6,640+001 MEV
5	32GE78	3,000+001 MEV	9,000+001 MEV
6	33AS78	1,123+000 MEV	4,270+000 MEV
7	33AS79	7,330+001 MEV	2,200+000 MEV
8	34SE79H	-0,000+000 MEV	-0,000+000 MEV
9	34SE81H	-0,000+000 MEV	-0,000+000 MEV
10	34SE81	4,600+001 MEV	1,380+000 MEV
11	34SE83H	1,070+000 MEV	3,400+000 MEV
12	34SE83	5,800+001 MEV	1,500+000 MEV
13	35BR83	3,170+001 MEV	9,600+001 MEV
14	36KR83H	-0,000+000 MEV	-0,000+000 MEV
15	35BR84A	5,950+001 MEV	3,200+000 MEV
16	34SE84	6,300+001 MEV	1,900+000 MEV
17	35BR84B	9,520+001 MEV	4,680+000 MEV
18	34SE85	1,660+000 MEV	5,000+000 MEV
19	35BR85	8,300+001 MEV	2,500+000 MEV
20	36KR85H	2,220+001 MEV	8,240+001 MEV
21	36KR85	2,220+001 MEV	6,720+001 MEV
22	34SE87	2,670+000 MEV	8,000+000 MEV
23	35BR87	1,407+000 MEV	8,000+000 MEV
24	36KR87	1,038+000 MEV	3,800+000 MEV
25	35BR88	2,900+000 MEV	8,700+000 MEV
26	36KR88	3,310+001 MEV	2,700+000 MEV
27	37RB88	1,487+000 MEV	5,200+000 MEV
28	35BR89	2,370+000 MEV	7,100+000 MEV
29	36KR89	1,100+000 MEV	4,000+000 MEV
30	37RB89	5,090+001 MEV	3,920+000 MEV
31	38SR89	4,870+001 MEV	1,463+000 MEV
32	36KR90	1,070+000 MEV	3,200+000 MEV
33	37RB90	1,900+000 MEV	5,700+000 MEV
34	38SR90	1,810+001 MEV	5,440+001 MEV
35	39Y90	7,570+001 MEV	2,270+000 MEV
36	36KR91	1,200+000 MEV	3,600+000 MEV
37	37RB91H	1,800+000 MEV	3,000+000 MEV
38	37RB91	1,530+000 MEV	4,600+000 MEV
39	38SR91	5,330+001 MEV	2,670+000 MEV
40	39Y91H	-0,000+000 MEV	-0,000+000 MEV
41	39Y91	5,130+001 MEV	1,540+000 MEV

BETA DECAY ENERGIES BY ISOTOPE

I	ISOTOPE	AVERAGE	MAXIMUM
42	36KR92	1.670+000 MEV	5.000+000 MEV
43	37RB92	2.500+000 MEV	7.590+000 MEV
44	38SR92	2.130+001 MEV	1.500+000 MEV
45	39Y92	1.111+000 MEV	3.600+000 MEV
46	36KR93	2.660+000 MEV	8.000+000 MEV
47	38SR93	1.400+000 MEV	4.130+000 MEV
48	39Y93	9.290+001 MEV	2.890+000 MEV
49	38SR94	1.133+000 MEV	3.400+000 MEV
50	39Y94	1.670+000 MEV	5.000+000 MEV
51	39Y95	1.570+000 MEV	4.700+000 MEV
52	40ZR95	1.300+001 MEV	8.850+001 MEV
53	41NB95M	-0.000+000 MEV	-0.000+000 MEV
54	41NB95	5.600+002 MEV	9.300+001 MEV
55	40ZR97	5.880+001 MEV	1.910+000 MEV
56	41NB97M	-0.000+000 MEV	-0.000+000 MEV
57	41NB97	4.210+001 MEV	1.267+000 MEV
58	41NB98	9.860+001 MEV	3.820+000 MEV
59	42MU99	3.720+001 MEV	1.230+000 MEV
60	43YC99M	-0.000+000 MEV	-0.000+000 MEV
61	42MO101	3.810+001 MEV	2.230+000 MEV
62	43TC101	4.240+001 MEV	1.320+000 MEV
63	42MO102	4.000+001 MEV	1.200+000 MEV
64	43TC102	1.370+000 MEV	4.100+000 MEV
65	44RU103	7.400+002 MEV	7.100+001 MEV
66	45RH103M	-0.000+000 MEV	-0.000+000 MEV
67	43TC104	1.000+000 MEV	3.000+000 MEV
68	42MO105	1.830+000 MEV	5.500+000 MEV
69	44RU105	3.850+001 MEV	1.870+000 MEV
70	45RH105M	-0.000+000 MEV	-0.000+000 MEV
71	45RH105	1.780+001 MEV	5.650+001 MEV
72	44RU106	1.300+002 MEV	3.900+002 MEV
73	45RH106	1.109+000 MEV	3.540+000 MEV
74	43TC107	2.000+000 MEV	6.000+000 MEV
75	44RU107	1.287+000 MEV	4.000+000 MEV
76	45RH107	3.930+001 MEV	1.200+000 MEV
77	45RH108	1.374+000 MEV	4.500+000 MEV
78	45RH109	8.000+001 MEV	2.390+000 MEV
79	46PD109	3.420+001 MEV	1.025+000 MEV
80	47AG109M	-0.000+000 MEV	-0.000+000 MEV
81	46PD111	7.100+001 MEV	2.130+000 MEV

BETA DECAY ENERGIES BY ISOTOPE

I	ISOTOPE	AVERAGE	MAXIMUM
82	47AG111	3,420+001 MEV	1,050+000 MEV
83	46PD112	9,000+002 MEV	2,800+001 MEV
84	47AG112	1,121+000 MEV	4,040+000 MEV
85	47AG113	6,700+001 MEV	2,000+000 MEV
86	48CD113M	2,000+001 MEV	5,750+001 MEV
87	47AG114	1,370+000 MEV	4,110+000 MEV
88	47AG115	9,700+001 MEV	2,900+000 MEV
89	48CD115M	5,310+001 MEV	1,610+000 MEV
90	48CD115	3,070+001 MEV	1,110+000 MEV
91	49IN115M	1,500+002 MEV	8,400+001 MEV
92	48CD117M	3,300+001 MEV	1,000+000 MEV
93	48CD117	7,670+001 MEV	2,300+000 MEV
94	49IN117M	4,500+001 MEV	1,770+000 MEV
95	49IN117	2,470+001 MEV	7,400+001 MEV
96	48CD118	2,670+001 MEV	8,000+001 MEV
97	49IN118	1,470+000 MEV	4,400+000 MEV
98	49IN119	9,000+001 MEV	2,700+000 MEV
99	50SN119M	-0.000+000 MEV	-0.000+000 MEV
100	50SN121	1,280+001 MEV	3,830+001 MEV
101	50SN123A	4,660+001 MEV	1,420+000 MEV
102	50SN123B	4,200+001 MEV	1,260+000 MEV
103	50SN125A	7,480+001 MEV	2,330+000 MEV
104	50SN125B	7,000+001 MEV	2,040+000 MEV
105	51SB125	9,200+002 MEV	6,120+001 MEV
106	52TE125M	-0.000+000 MEV	-0.000+000 MEV
107	51SB126	3,300+001 MEV	1,000+000 MEV
108	50SN127	1,610+000 MEV	4,840+000 MEV
109	51SB127	3,510+001 MEV	1,500+000 MEV
110	52TE127M	7,300+001 MEV	4,000+003 MEV
111	52TE127	2,300+001 MEV	6,950+001 MEV
112	50SN128	4,330+001 MEV	1,300+000 MEV
113	51SB128A	3,330+001 MEV	1,000+000 MEV
114	51SB128B	9,670+001 MEV	2,900+000 MEV
115	51SB129	3,900+001 MEV	1,870+000 MEV
116	52TE129M	-0.000+000 MEV	-0.000+000 MEV
117	52TE129	4,500+001 MEV	1,460+000 MEV
118	50SN130	6,660+001 MEV	2,000+000 MEV
119	51SB130	1,670+000 MEV	5,000+000 MEV
120	51SB131	1,070+000 MEV	3,200+000 MEV
121	52TE131M	1,520+001 MEV	2,457+000 MEV

BETA DECAY ENERGIES BY ISOTOPE

I	ISOTOPE	AVERAGE	MAXIMUM
122	52TE131	6,290+001 MEV	2,140+000 MEV
123	53I131	1,910+001 MEV	8,100+001 MEV
124	54XE131M	-0,000+000 MEV	-0,000+000 MEV
125	51SB132	2,000+000 MEV	6,000+000 MEV
126	52TE132	7,300+002 MEV	2,200+001 MEV
127	53I132	4,580+001 MEV	2,920+000 MEV
128	51SB133	1,330+000 MEV	4,000+000 MEV
129	52TE133M	5,430+001 MEV	2,400+000 MEV
130	52TE133	6,000+001 MEV	2,400+000 MEV
131	53I133	4,140+001 MEV	1,300+000 MEV
132	54XE133M	-0,000+000 MEV	-0,000+000 MEV
133	54XE133	1,150+001 MEV	3,470+001 MEV
134	51SB134	2,900+000 MEV	8,570+000 MEV
135	52TE134	4,700+001 MEV	1,400+000 MEV
136	53I134	5,730+001 MEV	2,410+000 MEV
137	52TE135	2,000+000 MEV	6,000+000 MEV
138	53I135	3,050+001 MEV	1,400+000 MEV
139	54XE135M	-0,000+000 MEV	-0,000+000 MEV
140	54XE135	3,000+001 MEV	9,100+001 MEV
141	53I136	1,407+000 MEV	7,000+000 MEV
142	55CS136	1,210+001 MEV	6,570+001 MEV
143	53I137	2,130+000 MEV	6,400+000 MEV
144	54XE137	1,170+000 MEV	3,500+000 MEV
145	55CS137	1,820+001 MEV	1,180+000 MEV
146	56BA137M	-0,000+000 MEV	-0,000+000 MEV
147	53I138	2,560+000 MEV	7,690+000 MEV
148	54XE138	8,000+001 MEV	2,400+000 MEV
149	55CS138	9,000+001 MEV	3,400+000 MEV
150	53I139	2,160+000 MEV	6,480+000 MEV
151	54XE139	1,530+000 MEV	4,600+000 MEV
152	55CS139	1,260+000 MEV	4,000+000 MEV
153	56BA139	7,640+001 MEV	2,340+000 MEV
154	54XE140	1,320+000 MEV	3,970+000 MEV
155	55CS140	2,000+000 MEV	5,930+000 MEV
156	56BA140	2,770+001 MEV	1,000+000 MEV
157	57LA140	4,440+001 MEV	2,200+000 MEV
158	56BA141	9,300+001 MEV	2,800+000 MEV
159	57LA141	8,010+001 MEV	2,430+000 MEV
160	58CE141	1,590+001 MEV	5,800+001 MEV
161	55CS142	2,300+000 MEV	6,830+000 MEV

BETA DECAY ENERGIES BY ISOTOPE

I	ISOTOPE	AVERAGE	MAXIMUM
162	56BA142	7,700+001 MEV	2,300+000 MEV
163	57LA142	1,500+000 MEV	4,500+000 MEV
164	56BA143	1,170+000 MEV	3,500+000 MEV
165	57LA143	1,100+000 MEV	3,300+000 MEV
166	58CE143	3,530+001 MEV	1,380+000 MEV
167	59PR143	3,110+001 MEV	9,330+001 MEV
168	58CE144	9,600+002 MEV	3,200+001 MEV
169	59PR144	9,830+001 MEV	2,980+000 MEV
170	58CE145	6,700+001 MEV	2,000+000 MEV
171	59PR145	6,000+001 MEV	1,800+000 MEV
172	58CE146	2,300+001 MEV	7,000+001 MEV
173	59PR146	1,028+000 MEV	3,700+000 MEV
174	60ND147	2,350+001 MEV	8,100+001 MEV
175	61PM147	7,500+002 MEV	2,250+001 MEV
176	60ND149	3,600+001 MEV	1,500+000 MEV
177	61PM149	4,300+002 MEV	7,880+001 MEV
178	60ND151	5,640+001 MEV	2,060+000 MEV
179	61PM151	2,940+001 MEV	1,200+000 MEV
180	62SM151	2,500+002 MEV	7,500+002 MEV
181	62SM153	2,330+001 MEV	8,040+001 MEV
182	62SM155	5,080+001 MEV	1,530+000 MEV
183	63EU155	5,500+002 MEV	2,470+001 MEV
184	62SM156	3,000+001 MEV	9,000+001 MEV
185	63EU156	4,200+001 MEV	2,400+000 MEV
186	63EU157	3,560+001 MEV	1,270+000 MEV
187	63EU158	8,700+001 MEV	2,600+000 MEV
188	64GD159	2,960+001 MEV	9,470+001 MEV

PARTICLE SIZE RANGE AND PARAMETERS BY GROUP

GROUP NO.	MIN. SIZE (MICRONS)	MAX. SIZE (MICRONS)	TERM. VEL. (METERS/SEC.)	GAMMA (1/METERS)
1	2.500+001	5.000+001	7.000+002	1.900+005
2	5.000+001	7.500+001	1.800+001	1.900+005
3	7.500+001	1.000+002	3.500+001	1.900+005
4	1.000+002	2.000+002	6.200+001	4.200+005
5	2.000+002	6.000+002	1.500+000	4.200+005
6	6.000+002	1.000+003	4.400+000	4.200+005
7	1.000+003	2.000+003	8.000+000	4.200+005
8	2.000+003	6.000+003	1.300+001	5.300+005
9	6.000+003	1.900+004	2.200+001	5.300+005

ABSORPTION COEFFICIENTS AS A FUNCTION OF ENERGY GROUP

BETA GROUP NO.	TOTAL CORRECTED	TOTAL AT STP	ENERGY AT STP
1	1.100+001	=0.000+000	=0.000+000
2	3.140+000	=0.000+000	=0.000+000
3	1.750+000	=0.000+000	=0.000+000
4	1.190+000	=0.000+000	=0.000+000
5	3.430+001	=0.000+000	=0.000+000

GAMMA GROUP NO.	TOTAL CORRECTED	TOTAL AT STP	ENERGY AT STP
1	1.690+002	1.690+002	3.720+003
2	8.910+003	8.910+003	3.590+003
3	6.250+003	6.250+003	3.190+003
4	3.590+003	3.590+003	2.390+003

INGESTION FROM GROUND CONCENTRATION FRACTIONS

INGESTION ROUTE NO, 1	1.1570+006
INGESTION ROUTE NO, 2	0.0000+000
INGESTION ROUTE NO, 3	0.0000+000

BREATHING RATE = 3.472+004 CUBIC METERS/SEC,
THYROID MASS = 2.000+001 GRAMS
BONE MASS = 7.000+003 GRAMS
G.I. TRACT MASS = 1.500+002 GRAMS
LUNG MASS = 1.000+003 GRAMS

DEPOSITION VELOCITY BY DEPOSITION INDEX

DEP. INDEX	DEPOSITION VELOCITY
1	0.000+000 METERS/SEC.
2	1.000+003 METERS/SEC.
3	5.000+003 METERS/SEC.
4	1.000+002 METERS/SEC.
5	2.000+002 METERS/SEC.
6	5.000+002 METERS/SEC.

INGESTION DELAY TIMES

	THYROID	BONE	G I TRACT
INGESTION ROUTE NO, 1	8.6500+004	8.6500+004	8.6500+004
INGESTION ROUTE NO, 2	0.0000+000	0.0000+000	0.0000+000
INGESTION ROUTE NO, 3	0.0000+000	0.0000+000	0.0000+000

INGESTION ROUTE ADJUSTMENT FACTORS

	THYROID	BONE	G I TRACT
INGESTION ROUTE NO, 1	3.7840+001	1.0000+000	1.0000+000
INGESTION ROUTE NO, 2	1.0000+000	1.0000+000	1.0000+000
INGESTION ROUTE NO, 3	1.0000+000	1.0000+000	1.0000+000