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SUBDOSA — A Computer Program for Calculating External Doses from Accidental Atmospheric Releases of Radionuclides

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SUBDOSA - A COMPUTER PROGRAM FOR CALCULATING EXTERNAL DOSES FROM ACCIDENTAL ATMOSPHERIC RELEASES OF RADIONUCLIDES

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SUMMARY

A computer program, SUBDOSA, has been developed for calculating external gamma and beta doses to individuals from the accidental release of radionuclides to the atmosphere. Characteristics of SUBDOSA are:

- Doses from both gamma and beta radiation are calculated as a function of depth in tissue, summed and reported as skin, eye, gonadal and total body dose.
- Doses are calculated for releases within each of several release time intervals. Up to six time intervals can be allowed and separate nuclide inventories and atmospheric dispersion conditions are considered for each time interval.
- Radioactive decay is considered during the release and/or transit using a chain decay scheme with branching to account for transitions to and from isomeric states.
- The dose from gamma radiation is calculated using a numerical integration technique to account for the finite size of the plume.
- The program computes and lists the normalized air concentrations at ground level as a function of distance from the point of release.

INTRODUCTION

The computer program SUBDOSA has been developed for the purpose of calculating the dose to humans following accidental atmospheric releases of radionuclides. SUBDOSA calculates the dose from airborne radionuclides external to the body and does not consider the dose resulting from radionuclides deposited in the body and its organs via inhalation. Doses are calculated as a function of: quantity released, duration of release, atmospheric conditions during the release, and horizontal distance from the release point.

The dose to organs of reference in adults from airborne radionuclides external to the human body is primarily dependent upon the type of radiation, the energy of the radiation and the spatial distribution of the airborne radionuclides surrounding the human receptor. The energy and type of radiation are characteristic of each radionuclide. Spatial distribution of airborne radionuclides is determined by the quantity released, the duration of release, the atmospheric conditions prevailing during the release and the distance between the dose receptor and the point of release.

The organs of reference most frequently considered in external dose calculations are the skin, lens of the eye and total body. Corresponding tissue depths for these organs used in SUBDOSA are 0.007, 0.1 and 5 cm respectively. The male gonads are less often considered in dose calculations but when such calculations are made with SUBDOSA, the tissue depth is 1 cm.

DESCRIPTION OF MATHEMATICAL MODELS

Mathematical models used to calculate gamma and beta doses and normalized air concentrations are described in this section. The expressions of gamma dose are discussed first followed by the beta dose and normalized air concentration equations.

TOTAL BODY TISSUE DOSE FROM GAMMA RADIATION

The basic equation for the external total body tissue dose rate from a gamma emitting radionuclide present in an incremental volume of a cloud is:

$$d_\gamma = K_k \frac{E_\gamma \chi B(\mu_k r) \exp(-\mu_k r)}{4\pi r^2} \, dxdydz \qquad (1)$$

where:

d_γ • incremental dose rate to tissue, from gamma radiation emitted from an incremental cloud volume, dx, dy, dz at a distance r meters from the point of interest, rad/sec

χ • concentration in incremental cloud volume, Ci/m^3

E_γ • photon energy, MeV/disintegration

$B(\mu_k r)$ • dose buildup factor for air

μ_k • total linear attenuation coefficient in air, m^{-1}, for photons with gamma energy in energy group k

K_k • dose conversion factor, $(rad \cdot m^2)/(Ci \cdot sec)$ per MeV disintegration.

The constant K_k is:

$$K_k = \frac{3.70 \times 10^{10} \frac{dis}{Ci \cdot sec} \; 1.60 \times 10^{-6} \frac{erg}{MeV} \; 10^{-4} \frac{m^2}{cm^2}}{100 \frac{ergs}{g \cdot rad}} \left(\frac{\mu_a}{\rho}\right)_k$$

$$= 0.0592 \left(\frac{\mu_a}{\rho}\right)_k$$

where:

$\left(\frac{\mu_a}{\rho}\right)_k$ • mass absorption coefficient, cm^2/g in tissue for average gamma energy of energy group k.

A quadratic expression is used to calculate the dose buildup factor.

$$B(\mu_k r) = 1 + A_k \mu_k r + \alpha_k (\mu_k r)^2 \qquad (2)$$

where:

A_k and α_k are empirical constants determined to fit buildup factor data of Berger.[1]

Since dose rate is a function of γ-ray energy, the gamma spectrum has been divided into energy groups. The incremental dose is calculated separately as a function of photon energy and integrated over the cloud volume to obtain dose rate factors for each energy group. The dose rate factors are coupled with radionuclide release to give individual dose rates. The total dose is calculated as the time integral of dose rate.

Before integrating Equation (1), it is first necessary to describe mathematically the plume concentration, χ. To obtain a useful expression, several assumptions are necessary:

- Diffusion along the direction of cloud travel can be ignored.
- Vertical and lateral crosswind concentration is normally distributed and the standard deviations are a function of atmospheric stability and distance from the release point. In some dispersion models, the standard deviations are wind speed dependent.
- The dose receptor is at ground level.
- Cloud depletion by fallout, washout and rainout can be described by a factor dependent on the distance of travel and is independent of travel time and displacement from the centerline.
- The concentration of radionuclides in the cloud at distances beyond three standard deviations in the vertical and lateral directions is insignificant and therefore makes little

contribution to the dose rate. Radionuclide concentrations at distances greater than ±800 m in the direction of cloud travel can also be ignored.

- Radionuclide decay is calculated for each radionuclide based on travel time to the exposure point. This concentration is used for all downwind integration points (i.e., over ±800 m from the exposure point).

The plume concentration at a vertical position z and lateral position y is given by:[2]

$$\chi = Q' \frac{\exp[-(z-h)^2/2\sigma_z^2 - y^2/2\sigma_y^2]}{2\pi \bar{u}_h \sigma_y \sigma_z} \qquad (3)$$

where:

- $\bar{u}_h$ • average wind speed in direction of travel measured at height of release, m/sec
- σ_z • crosswind vertical standard deviation of cloud concentration, m
- σ_y • crosswind lateral standard deviation of cloud concentration, m
- h • height of release, m
- y • lateral displacement from cloud centerline of incremental element of cloud, m
- z • height of incremental element of cloud, m
- Q' • rate of release from source, corrected for decay during transit to exposure point, curies/sec.

Equation (3) does not include a factor of two for ground reflection. Determination of σ_y and σ_z is discussed in a subsequent section.

The dose rate from all radionuclides within the plume is obtained by performing a space integration of Equation (1) with χ defined by Equation (3). For a given nuclide and distance from release point the dose rate is (rads/sec):

$$D'_\gamma = Q' \sum_{k=1}^{\text{Energy Groups}} DRF_k \sum_{\ell=1}^{\text{Photons in Group k}} (A_k E_{\gamma k})_\ell \qquad (4)$$

where:

D'_γ • Dose rate, rad/sec

$A_{k\ell}$ • abundance of ℓ-th photon in energy group k, photons/disintegration

$E_{\gamma k\ell}$ • energy of ℓ-th photon in energy group k, MeV/photon

$$DRF_k = \frac{1}{2\pi\bar{u}_h} \int_{x_1}^{x_2} \int_{z_1}^{z_2} \frac{\exp-[(z-h)^2/2\sigma_z^2]}{\sigma_z}$$

$$\int_{y_1}^{y_2} \frac{B(\mu_k r)\exp(-y^2/2\sigma y^2)\exp(-\mu_k r)K_k}{4\pi r^2 \sigma_y} \, dxdydz \qquad (5)$$

The Dose Rate Factors, DRF, have units of rad/sec per curie (at the distance of interest) per MeV/disintegration from photons in energy group k. Equation (5) is integrated using a numerical technique as described in Reference 3. The dose rate from all nuclides is obtained by adding the contributions from all nuclides present. The total dose is the time integral of the total dose rate. Since the release rate is the only time dependent parameter, the total dose may be expressed as:

$$D_\gamma = \int_0^{T_r} D'_\gamma dt \qquad (6)$$

where:

T_r • duration of release period.

Often the total release is given as input and no time integration is necessary. However, if the total release is not known, it may be calculated from knowledge of the initial amount present and the nuclide decay schemes. The nuclide decay scheme used by SUBDOSA accounts for chain decay including transitions to and from isomeric states. The general equation for such a scheme is:

$$\frac{d M_i}{dt} = \sum_j \lambda_j K_j^i M_j - \lambda_i M_i \tag{7}$$

where:

M_i • rate of release for nuclide i after decay for travel time T, atoms/sec

M_j • rate of release of parent nuclide j, atoms/sec

λ_i • decay rate constant for nuclide i (sec^{-1})

K_j^i • branching ratio for nuclide j decaying to nuclide i.

Equation (7) may be solved analytically to obtain the rate of release at any time t as:

$$M_i(t) = \sum_{k=1}^{n} A_k e^{-\lambda_k t} \tag{8}$$

where:

n • position in decay chain of nuclide i

λ_k • physical decay constant for chain member k

A_k • coefficient composed of decay fractions and physical decay constants for nuclides in the chain

k • the summation is over all nuclides of the chain down to nuclide i.

When the nuclide inventory is given as the amount present at the start of the release period, it is necessary to integrate over the release period to determine the actual release for Equation (6). If release is assumed to be constant (except for decay) M_i of Equation (7) can be replaced by:

$$M_i(t) = \frac{Q_i(t)}{T_r} \tag{9}$$

where:

$Q_i(t)$ • amount (atoms) of nuclide i present after decay for time t

T_r • release period.

The resulting equation can be solved in the same manner as Equation (7) to obtain a solution corresponding to Equation (8):

$$Q_i'(t) = \frac{Q_i(t)}{T_r} = \sum_{k=1}^{n} \frac{A_k}{T_r} e^{-\lambda_k t} \tag{10}$$

where the terms are as previously defined, except that $Q_i'(t)$ is in units of atoms. This equation is easily integrated over the release period to give the total release for use in Equation (6) as:

$$Q_i(T_r) = \int_0^{T_r} Q_i'(t)dt = \sum_{k=1}^{n} \frac{A_k}{T_r \lambda_k} (1-e^{-\lambda_k T_r}) \tag{11}$$

The total release $Q_i(T_r)$ must be converted from atoms to curies for use in Equation (6). In practice the decay calculation, Equation (8), and time integration, Equation (11), are performed in units of curie·sec, i.e., curies divided by the physical decay constant for the nuclide. Conversion to units of curies/sec or curies is then made by simply multiplying the results by the physical decay constant.

Equation (6) gives the gamma dose to the surface tissue. The dose to tissue below the surface is calculated by applying an attenuation factor to the dose rate factor of Equation (4).

$$D'_\gamma(d) = Q' \sum_{k=1}^{\text{Energy Group}} (1 + \mu_k d)\, DRF_k e^{-\mu'_k d} \sum_{\ell=1}^{\text{Photons in Group k}} (A_k E_{\gamma k})_\ell \qquad (12)$$

where the terms are as defined for Equation (4) and:

$D'_\gamma(d)$ • gamma tissue dose rate at a depth d, rads/sec

d • depth in tissue of exposure point, cm

μ'_k • linear total attenuation coefficient of water for photons in energy group k, cm^{-1}.

The results of Equation (12), expressed as $D'_\gamma(d)/Q'$, are used in Equation (6) to determine the gamma tissue dose at depth d.

SURFACE TISSUE DOSE FROM BETA RADIATION

The beta dose calculation is considerably simpler than the gamma dose calculation. Because of the short range of beta particles in air, the radionuclide cloud may be assumed to be semi-infinite in dimension. With this assumption the beta dose to surface tissue is:[2]

$$D_\beta = 0.229\, \bar{E}_\beta\, \psi \qquad (13)$$

where:

ψ • time integrated air concentration at the receptor, Ci sec/m^3

$\bar{E}_\beta$ • effective beta energy for the nuclide being considered, MeV/disintegration

$$0.229 = \frac{(1.6 \times 10^{-6}\ \frac{ergs}{MeV})\ (3.7 \times 10^{10}\ \frac{dis}{sec \cdot curie})}{(1293\ g/m^3)\ (100\ \frac{ergs}{gamma\ rad})}\ (1/2)$$

The factor of 1/2 is to account for body self shielding from half the radioactive cloud. The total beta dose is the sum of dose contributions from each nuclide.

The time integral of air concentration is calculated from the instantaneous air concentration of Equation (3) as:

$$\psi = 2\left(\frac{\chi}{Q'}\right)\int_0^{T_r} Q'dt \qquad (14)$$

The integration is performed as for the gamma dose calculation. Since the exposure point is assumed to be on or below the cloud centerline at ground level, the term $\exp(-y^2/2\sigma_y)$ is not included in evaluating χ/Q' for the beta dose calculation. The factor of 2 is for plume reflection about the ground plane.

TISSUE DEPTH DOSE FROM BETA RADIATION

Equation (13) determines the beta dose to surface tissue. To determine beta dose to tissue below the surface, the effective beta energy at the given tissue depth must be known.

To correctly determine the effective beta energy emitted by a particular nuclide, the contributions from all beta peaks of the spectrum must be considered. A computer program has been developed to calculate the effective beta energy at a tissue depth of d mg/cm^2 using beta spectral data as input. In Appendix A the spectral data used are described together with the resulting effective beta energies as a function of tissue depth.

The effective beta energy for a given emission peak is calculated as the integral of the beta spectrum:

$$\overline{E}_{\beta i}(d) = P(d,E_o)\frac{\int_0^{E_o} E\,N(E)\,dE}{\int_0^{E_o} N(E)\,dE} \qquad (15)$$

where:

$\overline{E}_{\beta i}(d)$ • effective beta energy at a depth d in tissue for peak i MeV/disintegration

d • exposure point tissue depth in mg/cm^2

$P(d,E_0)$ • ratio of effective energy at a tissue depth of d to the effective energy at the surface

E_0 • end point energy for the given beta emission spectrum, MeV

$N(E)$ • relative number of beta particles emitted in the interval from E to E+dE.

The total effective energy for a nuclide is the sum of the individual effective energies weighted by the peak abundance.

$$\overline{E}_\beta(d) = \sum_{i=1}^{\text{Number of Beta Peaks}} E_{\beta i}(d)A_i \qquad (16)$$

where:

A_i • beta particle abundance for peak i, particles/disintegration.

A formulation of the beta energy reduction factor indicates that it is a function of tissue depth and beta end point energy.[4] Beta dose is proportional to beta energy (for the semi-infinite cloud assumption); thus the beta energy reduction factor is equal to the beta dose reduction factors.

The beta energy reduction factor is given by:

$$P(d,E_0) = \frac{\overline{E}_\beta(d)}{\overline{E}_\beta(0)} = \alpha[A\delta^2 + \exp(1 - \nu d)] \qquad (17)$$

where:

$$A = 3 - \exp(1 - \nu d/\delta) - (\nu d/\delta)(2 + \ln \delta/\nu d)$$

$A = 0$ for $d \geq \delta/\nu$

and:

ν • effective attenuation coefficient for a peak with endpoint energy E_0, cm^2/mg

d • tissue depth, mg/cm^2

E_0 • maximum energy of characteristic beta energy spectrum, MeV

α,δ • empirical constants dependent on E_0, dimensionless.

The effective attenuation coefficient ν for tissue is given by:

$$\nu = \frac{18.6}{(E_0 - 0.036)^{1.37}} (2 - \bar{E}_\beta/\bar{E}^*_\beta) \qquad (18)$$

The ratio $\bar{E}_\beta/\bar{E}^*_\beta$ is the ratio of the actual average beta energy to the hypothetical allowed average beta energy. This ratio is 1.0 for allowed emissions. Values of α and δ are given in the table below.

Values for α and δ

	α	δ
$0.10 \leq E_0 \leq 0.5$ Mev	0.260	2.0
$0.5 < E_0 \leq 1.5$ MeV	0.297	1.5
$1.5 \quad E_0 \leq 3.0$ MeV	0.333	1.0

For values of E_0 less than 0.10 MeV, the reduction factor is set to zero. For values of E_0 greater than 3.0 MeV, values of δ and α of 1 and 0.333 respectively are used with the actual value of E_0.

To determine the average beta energy for a characteristic spectrum, the shape of the peak must be known. For allowed spectra the shape is given by:[5,6]

$$N(E)\,dE = K \cdot F(Z,W)(W^2-1)^{1/2}\, W\, (E_0-E)^2\, dE \qquad (19)$$

where:

K • arbitrary constant which cancels out in Equation (16)

F(Z,W) • Fermi function for emissions from an atom of atomic number Z

W • total energy of the beta particle in units of rest mass

E • kinetic energy of beta particle in units of rest mass ($W = E + 1$)

Z = atomic mass number

Energy is converted to rest mass units by dividing the energy in MeV by 0.514.

The Fermi function is evaluated as

$$F(Z,W) = 2(1 + \gamma)(2pR)^{2(\gamma - 1)} \exp\left[\pi y \frac{|\Gamma(\gamma + iy)|^2}{\Gamma(2\gamma + 1)^2}\right] \qquad (20)$$

where:

$i = \sqrt{-1}$

$\gamma = [1 - (\alpha Z)^2]^{1/2}$ (dimensionless)

$\alpha = e^2/\hbar c \approx 1./137.$ (dimensionless)

e • elementary charge, esu

$\hbar = h/2\pi$

h • Plank's constant, erg-sec

c • speed of light, cm/sec

$y = ZW/p$ (dimensionless)

$R = 1/2\ \alpha\ A^{1/3}$, nuclear radius, cm

$P = (W^2-1)^{1/2}$, beta particle momentum

A • atomic weight

The data libraries of computer program SUBDOSA include data on 331 fission products plus 144 activation products or transuranic elements. Effective beta energies have been calculated for each of these nuclides for tissue depths of 0, 7, 20, and 100 mg/cm^2. The results have been incorporated into a data library for use by SUBDOSA.

SKIN, EYE, MALE GONAD, AND TOTAL BODY DOSE

The consequences of accidental radioactive releases to the atmosphere are often determined in terms of dose to skin, eyes, male gonads and total

body. The skin dose is the sum of the surface gamma dose and the beta depth dose at 7 mg/cm^2 (thickness of outer skin). The eye dose is the sum of the surface gamma dose and the beta depth dose at 100 mg/cm^2 (depth of lens). The dose at a tissue depth of 1 cm is representative of the dose to the male gonads. The total body dose as calculated as the gamma dose at a tissue depth of 5 cm with no beta contributions included. The computer program SUBDOSA has been designed for calculation of these special doses.

NORMALIZED AIR CONCENTRATION

The normalized air concentration has been described for gamma and beta dose calculations by Equations (3) and (14). These equations include a term for radioactive decay for a specific isotope. For hand calculation, values of χ/Q' which do not include decay are desirable. Such values are calculated as:

$$\frac{X}{Q'} = \frac{\exp\left[-h^2/2\sigma_z\right]}{\pi\, \bar{u}_h\, \sigma_y\, \sigma_z} \qquad (21)$$

Plume reflection at the ground plane is included in Equation (21).

Methods for determining the dispersion parameters σ_y and σ_z include the Hanford equations,[2,7] Sutton's equation,[2,8] Brigg's equations[9] and the curves attributed to Pasquill.[2] The Hanford equations are:

$$\sigma_y^2 = A\left[T - \alpha\left(1 - e^{-T/\alpha}\right)\right]$$

$$\sigma_z^2 = \alpha\left[1 - \exp\left(-k^2T^2\right)\right] + bT$$

where:

t · duration of the release, sec

T · transport time from the point of release to the receptor, sec

$$A = \left[c + 230\left(\sigma_\theta \bar{u}_h\right)\right]$$

$$\alpha = A/\left[2\left(\sigma_\theta \bar{u}_h\right)^2\right] \qquad (22)$$

and a, b, c, k, and $\sigma_\theta \bar{u}_h$ are parameters whose values depend upon atmospheric stability.

The Sutton Model defines the variances as:

$$\sigma_y = \frac{C_y x^{(1-n/2)}}{\sqrt{2}}$$

$$\sigma_z = \frac{C_z x^{(1-n/2)}}{\sqrt{2}} \qquad (23)$$

where C_y, C_z, and n are parameters whose values are dependent upon atmospheric stability. Characteristic values of the parameters for the Hanford and Sutton equations are listed in Tables 1 and 2, respectively.

Briggs relationships of σ_y and σ_z with distances for Pasquill Stability classes A through G are listed in Table 3.

Graphical representations of σ_y and σ_z for the six Pasquill stability categories[2] have been tabulated and incorporated in a library for the computer code KRONIC[10] (Tables 4 and 5).

TABLE 1. Values of Meteorological Parameters for the Hanford Model

Parameter	Moderately Stable Conditions	Very Stable Conditions
a	97	34
b	0.33	0.025
c	13	13
k	2.5×10^{-4}	8.8×10^{-4}

MINIMUM VALUES OF $(\sigma_\theta \bar{u})$

Assumed Duration of Release, min	$(\sigma_\theta \bar{u})$
10	0.024
60	0.040
120	0.080
240	0.10
480	0.18

TABLE 2. Numerical Values of Atmospheric Dispersion Parameters for Neutral and Unstable Atmospheres

Parameter	Release Level	Wind Speed	Unstable	Neutral
C_y	Ground	1 m/s	0.35	0.21
		5 m/s	0.30	0.15
		10 m/s	0.28	0.14
	Elevated	1 m/s	0.30	0.15
		5 m/s	0.26	0.12
		10 m/s	0.24	0.11
C_z	Ground	1 m/s	0.35	0.17
		5 m/s	0.30	0.14
		10 m/s	0.28	0.13
	Elevated	1 m/s	0.30	0.15
		5 m/s	0.26	0.12
		10 m/s	0.24	0.11
n			0.20	0.25

TABLE 3. Relationships Between Diffusion Parameters and Distance

Stability Class	Horizontal Parameter, σ_y	Vertical Parameter, σ_z
A	$220\ x/(1 + 0.1\ x)^{1/2}$ [a]	$200\ x$
B	$160\ x/(1 + 0.1\ x)^{1/2}$	$120\ x$
C	$110\ x/(1 + 0.1\ x)^{1/2}$	$80\ x/(1 + 0.2\ x)^{1/2}$
D	$80\ x/(1 + 0.1\ x)^{1/2}$	$60\ x/(1 + 1.5\ x)^{1/2}$
E	$60\ x/(1 + 0.1\ x)^{1/2}$	$30\ x/(1 + 0.3\ x)$
F	$40\ x/(1 + 0.1\ x)^{1/2}$	$20\ x/(1 + 0.3\ x)$
G	$27\ x/(1 + 0.1\ x)^{1/2}$	$12\ x/(1 + 0.3\ x)$

(a) x is distance in kilometers

TABLE 4. Values of σ_y for Pasquill Stability Categories

Downwind Distance (Meters)	σ_y for Pasquill Type					
	A	B	C	D	E	F
100	21	16	12	8.0	6.0	3.9
250	54	40	28	20	14	9.8
500	100	76	55	37	28	18
1,000	200	150	110	72	52	36
2,500	450	340	240	160	120	81
5,000	830	630	450	310	220	150
10,000	1,600	1,200	850	570	410	280
25,000	3,400	2,600	1,800	1,200	880	610
50,000	6,200	4,700	3,400	2,300	1,600	1,100
100,000	11,000	8,500	6,300	4,100	2,800	2,000

TABLE 5. Values of σ_z for Pasquill Stability Categories

Downwind Distance (Meters)	σ_z for Pasquill Types					
	A	B	C	D	E	F
100	15	10	7.8	4.7	3.0	1.4
250	43	26	18	10	7.1	4.0
500	140	57	34	19	13	7.6
1,000	670	140	64	33	22	14
2,500	2,000	580	140	62	41	25
5,000	2,000	2,000	260	95	61	35
10,000	2,000	2,000	440	140	84	47
25,000	2,000	2,000	880	220	120	64
50,000	2,000	2,000	1,400	320	140	79
100,000	2,000	2,000	2,000	450	170	94

COMPUTER PROGRAM

The models described in the previous section have been incorporated into a computer program for use on CDC CYBER 74 computers. The main program SUBDOSA is executable with or without two auxiliary programs, BELI and BIVAR.

BELI - a program for preparation of effective beta energy data.

BIVAR - a program for calculation of dose rate factors for a bivariate plume.

SUBDOSA - main program for calculating dose and normalized air concentrations.

A listing of the program is given in Appendix B. Input card preparation is described in Appendix C and sample problems are illustrated in Appendix D. A program flow diagram is given in Appendix E.

BELI

The program BELI calculates effective beta energies for each nuclide as a function of tissue depth, Equations (15) through (20). Beta spectrum data for each beta peak (abundance and endpoint energy) is used as input. Appendix A describes input data for BELI and source references for the beta spectrum data.

BIVAR

The program BIVAR calculates dose rate factors by performing the space integration indicated in Equation (5). A modified version of subroutine PLUME from the computer program RACER is used to perform the numerical integration.[3] The actual integration is performed in the following order: y direction (lateral), z direction (vertical) and x direction. The first two integrations are performed for each position in the x direction (as located to give sufficient accuracy). The resulting double integral represents the dose rate per unit length of downwind plume per curie of a nuclide. The integration is performed for each energy group at each x position. Integration in the x direction then gives the dose rate factors.

All integrations are performed by an eight point polynomial integration subroutine.

$$\int_{x_1}^{x_8} f(x)dx = \frac{x_8 - x_1}{7\,C} \sum_{i=1}^{8} f(x_i)\, W_i \qquad (24)$$

where C is 17,280 and W_i are the integration weights as follows:

$$W_1 = W_8 = 751$$

$$W_2 = W_7 = 3577$$

$$W_3 = W_6 = 1323$$

$$W_4 = W_5 = 2989$$

Each integration range is divided into sections and Equation (24) is applied to each section. This technique allows computing time to be minimized without loss of accuracy.

The dose factors are automatically punched onto cards for future use. They may be used directly by the gamma dose calculation in the program SUBDOSA or they may be incorporated into a dose rate factor library (Appendix A) for direct access by the computer.

SUBDOSA

The main program SUBDOSA calculates gamma doses, beta doses, and normalized air concentrations. The calculations in the program are completed as indicated by Equations (1) through (14) of the previous section. However, several features are worth mentioning.

- The program uses as many as three data libraries (described in Appendix A):
  1. Radionuclide data library - physical half lives, decay fractions, effective beta energy as a function of tissue depth
  2. Gamma energy library - photon energies and abundance

3. Gamma dose rate factors - as calculated by BIVAR for use in finite cloud gamma dose calculation

- Data is included for nearly 500 radionuclides which include fission products and activation products.
- Dose calculations are performed for each release period and summed to give the total dose after each successive period.
- Depth dose may be calculated for both gamma and beta exposure. Default values of tissue depths are 0, 1, and 5 cm for gamma doses and 0, 7, 20, and 100 mg/cm^2 for beta doses.
- Combinations of beta and gamma depth doses may be summed to simulate: eye dose, skin dose, dose to male gonads and total body dose. The skin dose is the sum of surface tissue dose from gamma radiation plus the dose at 0.007 cm depth in tissue from beta contributors. The eye dose is the sum of surface tissue dose from gamma radiation plus the dose at 0.1 cm in tissue from beta contributors. Both gonadal and total body doses neglect contributions from beta radiations. However, absorption of gamma radiation in tissue at the corresponding depths is accounted for in the dose calculation.

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APPENDIX A

DATA LIBRARIES

APPENDIX A

DATA LIBRARIES

This appendix describes data libraries used by BELI and SUBDOSA. Input libraries for BELI are BISLIB (beta spectrum data) and RNDBET (radionuclide and beta energy data library). SUBDOSA uses RNDBET, GISLIB (photon data library) and BIVLIB (gamma dose rate factor library). A listing of each library is included at the end of this appendix.

INPUT FOR BELI - BETA SPECTRUM DATA LIBRARY

The program BELI uses libraries BISLIB and part of RNDBET to calculate effective beta energies for library RNDBET. BELI compares the nuclides of each library and calculates effective beta energies for nuclides present in both libraries. For nuclides present only in RNDBET, effective energies of zero are entered (zeros are entered for only a few nuclides in the activation product section of the libraries).

Data of the beta spectrum library, BISLIB, include the maximum beta energy for each peak and the fraction of total disintegrations for the peak. Also included at the beginning of the library are the literature sources for the data. A listing of BISLIB is given in Appendix B.

The beta spectrum data for each nuclide are contained on from 1 to 15 cards. The first card for each nuclide has the following format:

Column	Format	Variable
1-3	I3	Atomic Mass Number
4-5	I2	Atomic Number
6-7	A2	Nuclide name
8	I1	Nuclide state: 1 - isomeric 2 - ground
9-10	I2	Number of beta peaks to be read
11-15	F5.0	Abundance of first beta peak (if any)

Column	Format	Variable
16-20	F5.0	Maximum energy of first peak, MeV
21-25	F5.0	Abundance of second peak (if any)
26-30	F5.0	Maximum energy of second peak, MeV
.		
.		
.		
61-65	F5.0	Abundance of sixth peak (if any)
66-70	F5.0	Maximum energy of sixth peak, MeV
76	I1	Spectrum type: blank - allowed 1 - unallowed

If the nuclide has more than six beta peaks, additional cards are needed. The format for additional cards is 14F5.0, with the abundances and maximum beta energies submitted in pairs (for up to seven peaks) as on the first card but starting in column 1. A maximum of 99 peaks may be supplied for each nuclide (15 cards).

RADIONUCLIDE AND BETA ENERGY DATA LIBRARY

This data library contains data on radionuclide decay schemes and half-lives and beta energy as a function of tissue depth. Program BELI only considers the list of nuclides and ignores the physical data. Program SUBDOSA uses some of the half-lives and decay scheme data.

The order of isotopes in this library determines the order for which data are supplied in the photon probability library. When the order of data is changed in the radionuclide data library, corresponding changes must be made in the photon probability library.

The first card image of the radionuclide data library contains the number of fission products in the library (Format I3). There is one card for each fission product. The cards are arranged in an ascending atomic number order within an ascending atomic mass sequence. The current radionuclide data library contains 331 fission products.

The card after the last fission product card contains the number of activation products in the library (Format I3). The term "activation product" includes all radionuclides that are not in the fission product portion of the library. There is one card per activation product. The current library contains 144 activation products.

The format for each radionuclide card is:

Column	Format	Variable
1-3	I3	Atomic Mass Number
4-5	I2	Atomic Number
6-8	A3	Nuclide symbol with isomeric states indicated by an asterisk; i.e., KR*, left justified.
9	I1	Interger to indicate isomeric state: 1 - isomeric state 2 - ground state
10-18	E9.2	Physical half-life in days
19-25	F7.4	If in isomeric state, fraction of decays by beta emission; if in ground state, fraction of decays to an isomer.
26-35	F10.6	Effective beta energy per disintegration, MeV
36-45	F10.6	Effective beta energy per disintegration corrected for penetration of 7 mg/cm^2 of tissue, MeV
46-55	F10.6	Effective beta energy per disintegration corrected for penetration of 20 mg/cm^2 of tissue, MeV
56-65	F10.6	Effective beta energy per disintegration corrected for penetration of 100 mg/cm^2 of tissue, MeV

The radionuclide library available with SUBDOSA is called RNDBET and is listed in Appendix B.

PHOTON PROBABILITY LIBRARY

The photon probability library contains data for use by subroutine SUBDOSA in calculating the cloud gamma dose. The first card image contains

the number of energy groups (Format I3) for which data are given in the library. The second card contains the upper energy bound for each group (Format 16F5.0) starting from the lowest energy group (number of entries is number of groups minus one). The next cards contain dose conversion factors in units of:

$$\frac{\text{rad}\cdot\text{cm}^2}{\text{Ci}\cdot\text{sec}}$$

One value is supplied for each energy group starting from the lowest energy. The dose conversion factor of Equation (1) in the text is the library value divided by the average energy for the group. The average energy is calculated as the midpoint of maximum energies as supplied on the second library card. The average energy for the first group is 2/3 of its maximum energy and the average for the last energy group is 1.25 times the maximum for the next lower group.

The photon probability and gamma energy cards for each nuclide follow the dose conversion factor cards. There are from one to three cards for each nuclide (in the order of nuclides as in the radionuclide data library). The first card for each nuclide has the following format:

Column	Format	Variable
1-3	I3	Atomic Mass Number
4-5	I2	Atomic number
6-7	A2	Nuclide name
8	I1	Nuclide state: 1 - isomeric 2 - ground
9-10	I2	Number of photon energies to be read
11-15	F6.0	Abundance of first photon (if any)
16-20	F5.0	Energy of first photon, MeV
21-25	F5.0	Abundance of second photon (if any)
26-30	F5.0	Energy of second photon, MeV
.		
.		
.		
61-65	F5.0	Abundance of sixth photon (if any)
66-70	F5.0	Energy of sixth photon, MeV

If the nuclide has more than 6 photons, additional cards are supplied in Format 14F5.0 with abundances and photon energies submitted in pairs (for up to 7 photons/card) as on the first card. A maximum of 99 photons may be supplied for each nuclide (15 cards). Similarities are noticeable in the data sections of the photon probability library and the beta spectrum library.

Buildup and attenuation data are stored after the photon data. Constants for the quadratic buildup equation [Equation (2) in text] are given next in Format 8F10.0. The first card gives values for A for each energy group (if there are more than eight groups, more cards are needed). Next the values of α are given, followed by values of α_1 (a dummy variable) and values of μ last (total mass attenuation coefficient in air, cm^2/g).

The photon probability library available with SUBDOSA is called GISLIB and is listed in Appendix B. The literature data sources for GISLIB are listed near the beginning of the library. The data sources for nuclides with a source code of 0 (for other) are listed in Table A-1 by nuclide number (Columns 77-79 in GISLIB).

TABLE A-1. Photon Data Literature Sources

Nuclide Number	Photon Data Source
060	Nuclear Abstracts, Abstract #8968, p. 915 (March 15, 1969)
074	Nuclear Physics A98 337-64 (1967)
103	Nuclear Data Sheets, Section A (Feb. 1968)
116	Physical Review 154: 1116-25 (Feb. 20, 1967)
118	Nuclear Data Sheets - Section A (Feb. 1968)
119	Arkir för Fysik 34: 259-62 (1967)
129	Nuclear Physics A109: 369-79 (1968)
152	Nuclear Physics 75: 209-14 (1965)
155	Physical Review 146: 883-6 (June 17, 1966)
159	Nuclear Physics 75: 209-14 (1965)
165	Radiochina Aeta 7: 114-15 (June 1967)
168	Physical Review 140B 1516-28 (Dec. 20, 1965) The Handbook of Chemistry and Physics (1964-5), pp. E74-5

TABLE A-1. (Continued)

Nuclide Number	Photon Data Source
172	Nuclear Physics A103: 385-405 (1967)
182	Physical Review 143: 918-22 (March 18, 1966)
191	Nuclear Data Sheets - Section A (Feb. 1968)
194	Nuclear Physics A126: 273-99 (1969)
195	Nuclear Physics A126: 273-99 (1969)
196	Nuclear Data Sheets - Section A (Feb. 1968)
201	Nuclear Physics A122: 557-566 (1968)
242	Nuclear Data Sheets - Section A (Feb. 1968)
249	Nuclear Physics A113: 581-92 (1968)
259	Info. comes from article referenced in 1968 Vol of Nuclear Abstracts
261	Nuclear Data Sheets - Section A 1: 521-602 (August 1966)
265	Nuclear Physics A124: 199-211 (1969)
269	Nuclear Physics A126: 428-30 (1969)
277	Nuclear Physics A99: 547-76 (1967)
279	Canadian Journal of Physics 44: 1313-20 (June 1966)
288	Nuclear Physics A123: 481-96 (1969)
289	Nuclear Physics A123: 481-96 (1969)
308	Physical Review 172: 1253-61 (Aug. 20, 1968)
309	Physical Review 172: 1253-61 (Aug. 20, 1968)
315	Airkir för Fysik 37: 203-12 (1968)
316	Airkir för Fysik 37: 203-12 (1968)
319	Canadian Journal of Physics 46: 2579-88 (Dec. 1, 1968)
334	Arkir för Fysik 37: 1-11 (1968)
343	Arkir för Fysik 34: 447-57 (1967)
345	Nuclear Physics A119: 53-64 (1968)
347	Physical Review 167: 1105-16 (March 20, 1968)
348	Physical Review 167: 1105-16 (March 20, 1968)
350	Nuclear Physics A113: 33-56 (1968)
358	Physical Review 167: 1105-16 (March 20, 1968)
379	The Handbook of Chemistry and Physics (1964-5), E 74-5

TABLE A-1. (Continued)

Nuclide Number	Photon Data Source
382	The Handbook of Chemistry and Physics (1964-5), E 74-5
391	Nuclear Data Sheets - Section A (Feb. 1968) The Handbook of Chemistry and Physics (1964-5), E 74-5
393	The Handbook of Chemistry and Physics (1964-5), E 74-5
403	The Handbook of Chemistry and Physics (1964-5), E 74-5
417	Nuclear Physics A123: 1-23 (1969)
420	Nuclear Physics 82: 614-24 (1966)
425	Physical Review 147: 845-52 (July 22, 1966)
437	Physical Review 153: 1310-11 (Jan. 20, 1967)
438	Physical Review 153: 1262-9 (Jan. 20, 1967) Nuclear Physics A118: 78-96 (1968)
440	Nuclear Physics 84: 424-42 (1966)
452	Physical Review 175: 1275-82 (Nov. 20, 1968)
478	The Handbook of Chemistry and Physics (1964-5) E 74-5
492	Nuclear Data Sheets - Section A (Feb. 9, 1968)
493	Nuclear Data Sheets - Section A (Feb. 1968)
494	Nuclear Data Sheets - Section A (Feb. 1968)
496	Nuclear Physics A84: 481-504
498	Nuclear Data Sheets - Section A (Feb. 1968)
499	Nuclear Data Sheets - Section A (Feb. 1968)
500	Nuclear Data Sheets - Section A (Feb. 1968)

Notes: 171 ($^{106M}Rh_{45}$) The info on the first 12 γ-rays came from Table 1 of The Table of Isotopes. The last two γ-rays seem to have come from some source that could not be located.

402 ($^{151}Pm_{61}$) In The Table of Isotopes much disagreement over the probabilities attached to the emission of certain γ-rays by this isotope. Therefore, the probabilities listed are very uncertain.

DOSE RATE FACTOR LIBRARY

The dose rate factor library is for supplying dose rate factors, DRF, as described by Equation (5) of the text. The factors are calculated by program BIVAR.

Data for this library are supplied in sets with each set containing DRF values for one release height, one wind speed and up to ten distances. The first card of the library gives the number of sets contained in the library (Format I5). The DRF sets follow with the structure indicated below:

Card	Column	Format	Variable/Use
1	1-10	F10.2	HD, height of release for this DRF set.
	11-15	I5	MD, number of meteorological stability categories. This variable was included for future expansion only. MD must be 1.
	16-20	I5	MRD, number of distances for which DRF values are supplied, maximum is 10.
	21-25	I5	IEN, number of energy groups for which DRF values are submitted. This number must equal the number of energy groups as supplied on the first card of the photon probability library. The current number is 12.
2	1-10 10-20 • • •	8F10.2	RD, downwind distances (meters) for which DRF values are given in this set. The number of values submitted must correspond to MRD above. If MRD is greater than 8, two cards are needed.
3	1-10	8F10.2	DRF values for a given release time and distance. One DRF value is given for each energy group. Because the current number of energy groups is 12, 2 cards are needed for each distance/release period combination.

The number of cards of Type 3 needed depends on values given for MRD and also IEN, whenever IEN is greater than 8 (and less than 16).

The dose rate factor library supplied with SUBDOSA is called BIVLIB and is listed in Appendix B. The dose rate factor sets included in BIVLIB are listed in Table A-2 in order. The dose rate factor sets may be called by number for each release period as desired when doing the gamma dose calculations.

TABLE A-2. Dose Rate Factor Sets in BIVLIB[a]

Set No.	Release Height, m	Wind Speed m/sec	Dispersion Model
1	0	1	Pasquill F
2	0	1	Pasquill E
3	0	1	Pasquill D
4	0	1	Pasquill C
5	0	1	Pasquill B
6	0	1	Pasquill A
7	0	1	Sutton unstable
8	0	1	Sutton neutral
9	0	1	Hanford very stable, $\sigma_\theta \bar{u} = 0.024$
10	0	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
11	0	5	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
12	0	10	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
13	0	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
14	0	5	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
15	0	10	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
16	0	10	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.18$
17	10	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
18	10	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
19	10	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.06$
20	60	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
21	60	5	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
22	60	10	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.024$
23	60	1	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
24	60	5	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$
25	60	10	Hanford moderately stable, $\sigma_\theta \bar{u} = 0.04$

(a) All of the above sets contain data for the distances (meters): 100, 200, 500, 10^3, 2×10^3, 5×10^3, 10^4, 2×10^4, 5×10^4, and 10^5.

APPENDIX B

PROGRAM LISTING

APPENDIX B

PROGRAM LISTING

This appendix provides a listing of the computer program with information useful to the experienced programmer who may wish to modify the program.

The subroutine and function calling sequences for each of the three parts (BELI, BIVAR, and SUBDOSA) are shown in Figures B-1 and B-2. BIVAR and SUBDOSA both use subroutines called PASSIG. These subroutines are not the same and should not be interchanged.

The purpose of each program, subroutine, and function is described below:

BELI	Program to control calculation of effective beta energies at specified tissue depths (D in statement 12 of BELI).
BLIBE	Subroutine to read library (BISLIB) of beta end point energies.
LIB	Subroutine to read library (RNDBET) of nuclides to be included in output.
SIM3NI	Function to perform Simpson 3/8 rule numerical integration of energy of the shape of the beta spectrum as defined by function FERMI.
FERMI	Function to calculate relative abundance of beta particles of a given beta energy for the spectrum being considered.
GAMMA	Function for evaluation of the Gamma function.
DEPTH	Function to calculate the depth dose reduction factor for a particular beta spectrum.
BIVAR	Program to control calculation of dose rate factors. Input data is read; subroutine PLUME is called to calculate dose rate as a function of distance (x direction); and integration over distance is performed to give total dose rate factors.
FINT	Function for integration according to Bode's rule for integration of order 2 through 7. All integrations in BIVAR and PLUME are seventh order (8 points).

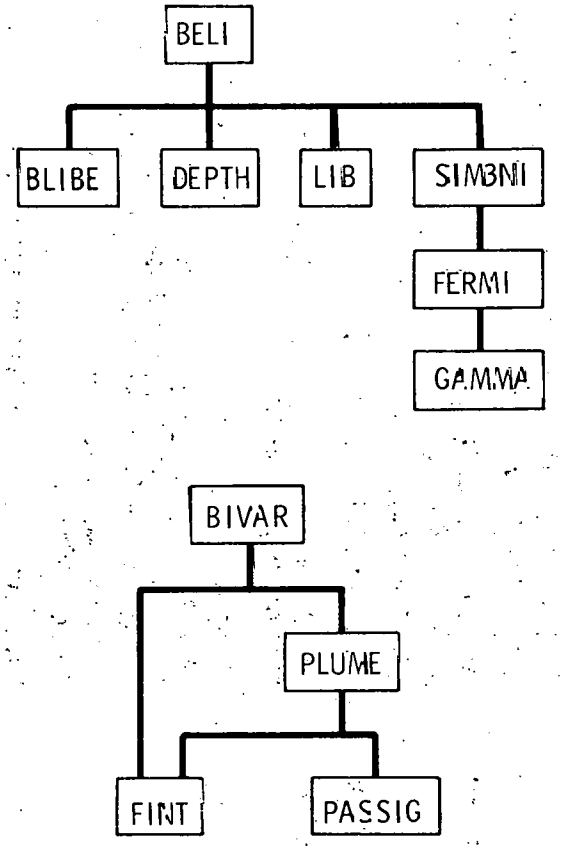

FIGURE B-1. Calling Sequence for BELI and BIVAR

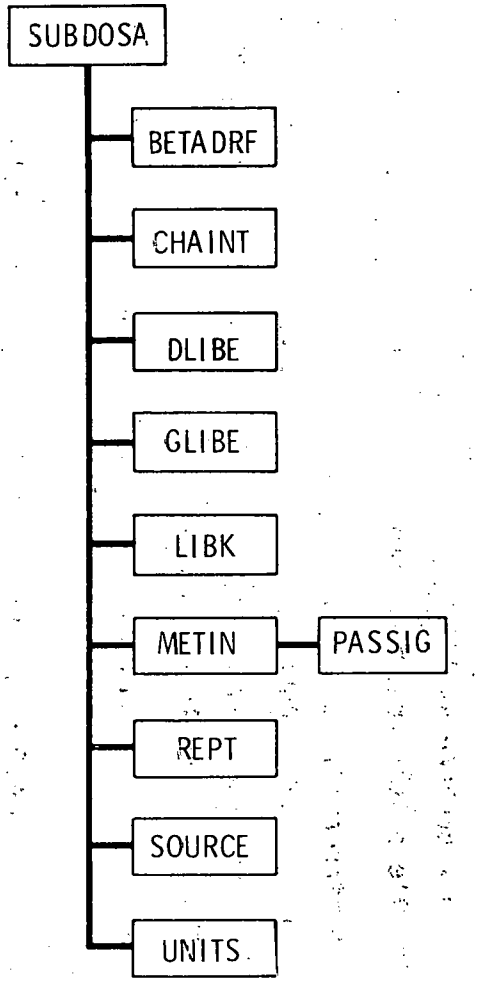

FIGURE B-2. Calling Sequence for SUBDOSA

PLUME	Subroutine to perform dose rate factor integration in lateral (y) and vertical (z) directions.
PASSIG	Subroutine to determine standard deviation of cloud concentration in lateral and vertical directions (σ_y and σ_z) as a function of distance for Pasquill dispersion categories.
SUBDOSA	Program to control and perform individual beta and gamma dose calculations.
BETADRF	Subroutine to calculate beta dose rate factors for each distance, meteorological condition and release period specified.
GLIBE	Subroutine to read photon production data library from input file GAMLIB.
DLIBE	Subroutine to read dose rate factor data library from input file DRFLIB.
LIBK	Subroutine to read nuclide physical data from input file RNDLIB.
CHAINT	Subroutine to perform fission product nuclide decay calculation by decay chains. This subroutine is also used to determine the time integral of release when release is to include decay during the release period (ITZ = 0 or 1).
METIN	Subroutine to read atmospheric stability cards (Types 8-10) and calculates stability parameter σ_y and σ_z.
PASSIG	Subroutine. (Same as PASSIG above.)
REPT	Subroutine to prepare output reports and punched card output.
SOURCE	Subroutine to read nuclide inventory cards. (Card Types 4-6.)
UNITS	Subroutine to determine units of release times for output reports.

The programs, subroutines, and functions are listed in Figures B-3 through B-9. The order of the listings is the same as the order given in Figures B-1 and B.2. Data libraries follow the program listings in the order:

BISLIB	(Beta spectrum data for BELI)
RNDBET	(Radionuclide and beta energy data library for BELI and SUBDOSA)
GISLIB	(Photon data library for SUBDOSA)
BIVLIB	(Gamma dose rate factor library for SUBDOSA)

FIGURE B-3. Program BELI Listing

```
PROGRAM BELI      73/73   OPT=1                    FTN 4.4+R401      07/07/75  17.29.02.      PAGE     1

      1               PROGRAM    BELI(PUNCH,OUTPUT,BETLIB,RNDLIB,TAPE6=OUTPUT,TAPE5=BET.
                     1IB,TAPE25=RNDLIB)
                      DIMENSION AVE(100),EM(100),FF(100)
                      DIMENSION IARY(5)
      5               DIMENSION A(2)
                      DIMENSION BFAC(4,100),BF(4)
                      LOGICAL REL
                      INTEGER REC,RECB
                      COMMON/BETA/ISOS,   D(4),ML(600),REC(600),BETENS(2,2000),IBESUB(60
     10               10),LFIS,LACT,N1,N2,MLB(600),RECB(600),IFOR(600),LAB(600),RAT(600)
                      COMMON ATN,ATA,IFORBD,EMAX,ALPHA,PI,GAM,ALYAM,RAD,X1
                      EXTERNAL FERMI
                      DATA D/0.,.7,.20.,100./
                      CBRT(X)=X**(1./3.)
     15               IARY(1)=0
                      IARY(2)=0
                      CALL SYSTEM(11S,IARY)
                      CALL LIB
                      CALL BLIBE
     20               ALPHA=1./137.
                      PI=3.14159
                      MAXIT=20
                      EPS=.001
                      REL=.TRUE.
     25               A(1)=.001
                C  LOOP ON FISSION PRODUCTS
                      DO  9 ISO=1,LFIS
                      IC=SHIFT(REC(ISO),18).AND.778
                      IF(IC.EQ.478) GO TO 103
     30               IF(IC.EQ.558) GO TO 203
                      GO TO 1
                  103 REC(ISO)=REC(ISO).AND..NOT.77000000000000008
                      REC(ISO)=REC(ISO).OR. 34000000000000008
                      GO TO 303
     35           203 IC=SHIFT(REC(ISO),12).AND.778
                      IF(IC.EQ.478) GO TO 403
                      IF(IC.EQ.558) GO TO 503
                      REC(ISO)=REC(ISO).AND..NOT.77000000000000008
                      REC(ISO)=REC(ISO).OR. 35000000000000008
     40               GO TO 303
                  403 REC(ISO)=REC(ISO).AND..NOT.77770000000000008
                      REC(ISO)=REC(ISO).OR.55340000000000008
                      GO TO 303
                  503 REC(ISO)=REC(ISO).AND..NOT.77770000000000008
     45               REC(ISO)=REC(ISO).OR.55350000000000008
                  303 CONTINUE
                      IF(ML(ISO).EQ.MLB(ISO).AND.REC(ISO).EQ.RECB(ISO)) GO TO 3
                      PRINT 1100, ML(ISO),REC(ISO),MLB(ISO),RECB(ISO)
                 1100 FORMAT(" SEQUENCE ERROR -THERM ISO "I3,A3," BETLIB ISO "I3,A3)
     50               3 NPHTN=IBESUB(ISO+1)-IBESUB(ISO)
                      EFF=0.
                      DO 104 I=1,4
                      BF(I)=0.
```

```
      104 CONTINUE
          IF(NPHTN.LE.0) GO TO 6
          DO 5 IB=1,NPHTN
          IBT=IRESUR(ISO)-1
          IFORBD=IFOR(ISO)
          EMAX=BETENS(2,IBT+IB)
          IF(EMAX.LE.1.E-20) GO TO 5
          E=EMAX
          EM(IB)=EMAX
          F=BETENS(1,IBT+IB)
          FF(IB)=F
          A(2)=EMAX
          ATW=FLOAT(LAB(ISO))
          ATW=FLOAT(ML(ISO))
          GAM=SQRT(1.-(ALPHA*ATW)**2)
          ALYAM=ALPHA*ATW
          RAD=.5*ALPHA*CBRT(ATW)
          X1=2.*GAM+1
          IF(IFORBD.LE.0) RAT(ISO)=1.0
          ENUM=SIMSNI(FERMI,A,ER,REL,MAXIT,1,IER)
          IF(IER)99,204
      204 EDENOM=SIMSNI(FERMI,A,ER,REL,MAXIT,2,IER)
          IF(IER) 98,305
      305 EAVE=ENUM/EDENOM*RAT(ISO)
          AVE(IB)=EAVE
          DO 4 I=2,4
          BFAC(I,IB)=DEPTH(E,D(I), IFOR(ISO),ISO)
          BF(I) =BF(I) +F*EAVE*BFAC(I,IB)
        4 CONTINUE
          EFF=EAVE*F+EFF
        5 CONTINUE
          PRINT 1500,ML(ISO),REC(ISO),RAT(ISO),(EM(I),AVE(I),FF(I),I=1,NPHTN)
         1)
     1500 FORMAT(" ISOTOPE "I3,A3," ENERGY RATIO ="F5.2/(" "3(2F8.4,F8.5,6X)
         1))
          BF(1)=EFF
          GO TO 8
        6 DO 7 I=1,4
          BF(I)=0.
        7 CONTINUE
C     PRINT/PUNCH RESULTS FOR CURRENT FISSION PRODUCT
        8 PRINT 1200, ML(ISO),REC(ISO),(BF(ID),ID=1,4)
          PUNCH 1300, ML(ISO),REC(ISO),(BF(ID),ID=1,4)
     1200 FORMAT(1X,I3,A3,4F10.6)
     1300 FORMAT(I3,A3,4F10.6)
        9 CONTINUE
C     PRINT BLANK ACTIVATION PRODUCT LIBRARY
          DO 17 ISO=N1,N2
          DO 10 ID=1,4
          BF(ID)=0.
       10 CONTINUE
          IC=SHIFT(REC(ISO),18),AND,77B
          IF(IC.EQ.47B) GO TO 111
```

```
      IF(IC.EQ.558) GO TO 211
      GO TO 1
  111 REC(ISO)=REC(ISO).AND..NOT.7700000000000000B
110   REC(ISO)=REC(ISO).OR. 3400000000000000B
      GO TO 311
  211 IC=SHIFT(REC(ISO),12).AND.778
      IF(IC.EQ.478) GO TO 411
      IF(IC.EQ.558) GO TO 511
115   REC(ISO)=REC(ISO).AND..NOT.7700000000000000B
      REC(ISO)=REC(ISO).OR. 3500000000000000B
      GO TO 311
  411 REC(ISO)=REC(ISO).AND..NOT.7777000000000000000B
      REC(ISO)=REC(ISO).OR.5534000000000000000B
120   GO TO 311
  511 REC(ISO)=REC(ISO).AND..NOT.7777000000000000000B
      REC(ISO)=REC(ISO).OR.5535000000000000000B
  311 CONTINUE
      DO 11 IBS=N1,ISOS
125   IF(ML(ISO).EQ.MLB(IBS).AND.REC(ISO).EQ.RECB(IBS)) GO TO 12
   11 CONTINUE
      PRINT 1400, ML(ISO),REC(ISO)
 1400 FORMAT("0NO MATCH FOR "I3,A3)
   16 PRINT 1200, ML(ISO),REC(ISO), (BF(ID),ID=1,4)
130   PUNCH 1300, ML(ISO),REC(ISO),(BF(ID),ID=1,4)
      GO TO 17
   12 NBS=IBS
      NPHTN=IBESUB(NBS+1)-IBESUB(NBS)
      DO 13 I=1,4
135   BF(I)=0.
   13 CONTINUE
      IF(NPHTN.LE.0) GO TO 16
      EFF=0.
      DO 15 IB=1,NPHTN
140   IBT=IBESUB(NBS)-1
      IFORAD=IFOR(NBS)
      EMAX=RETENS(2,IBT+IB)
      IF(EMAX.LE.1.E-20) GO TO 15
      E=EMAX
145   EM(IB)=EMAX
      F=RETENS(1,IBT+IB)
      FF(IB)=F
      A(2)=EMAX
      ATN=FLOAT(LAB(NBS))
150   ATW=FLOAT(ML(NBS))
      GAM=SQRT(1.-(ALPHA*ATN)**2)
      ALYAM=ALPHA*ATN
      RAD=.5*ALPHA*CBRT(ATW)
      X1=2.*GAM+1.
155   RAT(NBS)=1.0
      ENUM=SIMSNI(FERMI,A,ER,REL,MAXIT,1,IER)
      IF(IER) 98,214
  214 EDENOM=SIMSNI(FERMI,A,ER,REL,MAXIT,2,IER)
      IF(IER) 98,314
```

```
160          314. EAVE=ENUM/EDENOM*RAT(NBS)
                  AVE(IB)=EAVE
                  DO 14 I=2,4
                  BFAC(I,IB)=DEPTH(E,D(I),IFOR(NBS),IBO)
                  BF(I)=BF(I)+F*BFAC(I,IB)*EAVE
165           14 CONTINUE
                  BF(1)=BF(1)+F*EAVE
              15 CONTINUE
                  PRINT 1500,ML(ISO),REC(ISO),RAT(ISO),(EM(I),AVE(I),FF(I),I=1,NPHTN)
                 1)
170               GO TO 16
              17 CONTINUE
               1 PRINT 1000, ISO,IC,REC(ISO),ML(ISO)
            1000 FORMAT(" CHAR IDENT ERROR, ISO CHAR,REC,ML, ="4(O20,1X))
              99 STOP
175           98 PRINT 500, ATN,ATW
             500 FORMAT(" ERROR IN SIM3NI FOR ATOMIC NUMBER" F5.0," AND ATOMIC WEIGHT
                 1HT "F5.0)
                  STOP
                  END
```

```
      SUBROUTINE BLIBE
C     SUBROUTINE TO READ THE BETA END POINT LIBRARY
C                                                                      007
      INTEGER RECB,ANA
      COMMON/BETA/ISOS,   D(4),ML(500),REC(600),BETENS(2,2000),IBESUB(60
     10),LFIS,LACT,N1,N2,MLB(600),RECB(600),IFOR(600),LAB(600),NAT(600)
      GO TO 300
  400 DO 401 JJJ=1,NCMMT
  401 READ (5,402) NCMMTT
  402 FORMAT (A1)
      GO TO 25                                                         12/12/69
  300 READ (5,20) NPHCD,ISOS,NCMMT
   20 FORMAT (2I3,64X,I2)
      IF(ISOS .LE. 0) ISOS = NPHCD
      IF(NCMMT .GT. 0) GO TO 400
   25 CONTINUE                                                         12/12/69
C     SET UP INDEXES FOR READING IN LIBE.
      IBESUB(1) = 1
      NPHTN = 1
C     DO LOOP TO READ LIBE.
      DO 100 I=1,ISOS
      IEND = NPHTN + 5
      GO TO 500
  501 DO 502 JJJ=1,NCMMT
  502 READ (5,402) NCMMTT
  500 IF(1995 .LT. NPHTN) GO TO 60
      READ (5,30) MASS,LATNO,ANA,NPC,((BETENS(J,K),J=1,2),K=NPHTN,IEND),
     1 NCMMT,IFRD
   30 FORMAT(I3,I2,A3,I2,12E5.2,I2,3X,I1)
      IFOR(I)=IFRD
      IF(NCMMT .GT. 0) GO TO 501
      NPHTN = NPHTN + NPC
      IBESUB(I+1) = NPHTN
      IF(NPC .LE. 6) GO TO 37
      IF(2001 .LT. NPHTN) GO TO 60
      IBEGIN = NPHTN + 6 - NPC
      IEND = NPHTN -1
      READ (5,36) ((BETENS(J,K),J=1,2),K=IBEGIN,IEND)
   36 FORMAT(14E5.2)
   37 CONTINUE
   40 MLB(I)= MASS
      LAB(I)= LATNO
      RECB(I)= ANA
  100 CONTINUE
C     END LOOP TO READ BETA END POINT LIBE.
      RETURN
   60 I9 = I - 1
      WRITE (6,70) I9
   70 FORMAT(34H0BETA END PT. LIBE. EXCEEDS LIMIT,I3,14H ISOTOPES USED)
      END
```

```
      FUNCTION   DEPTH(EMAX,DD,IFORBD,ISO
C  THIS SUBROUTINE CALCULATES DD/DO FOR BETA ENERGY EMAX AT A DEPTH OF
C  D MG/CM2.  IFORBID GT 0 FOR FORBIDDEN SPECTRA.
      INTEGER RECB
      REAL NU
      COMMON/BETA/ISOS,   X(4),ML(600),REL(600),BETENS(2,2000),IBESUB(60
     10),LFIS,LACT,N1,N2,MLB(600),RECB(600),IFOR(600),LAB(600),RAT(600)
      DATA RAT(55)/1./
      DATA RAT(71)/1./
      DATA RAT(76)/1./
      DATA RAT(89)/1./
      DATA RAT(96)/1./
      DATA RAT(82)/1.17/
      DATA RAT(84)/1.02/
      DATA RAT(91)/1.04/
      DATA RAT(61)/1.03/
      RATIO=1.0
      IF(IFORBD.GT.0) RATIO=RAT(ISO)
      IF(RATIO.LE.0.1) RATIO=1.0
      RAT(ISO)=RATIO
      IF(EMAX.LT..17) GO TO 4
      IF(EMAX.LT..5) GO TO  3
      IF(EMAX.LT.1.5) GO TO 2
      IF(EMAX.GE.3.) GO TO  5
    1 C=1.0
      APH=.333
      GO TO 6
    2 C=1.5
      APH=.297
      GO TO 6
    3 C=2.
      APH=.26
      GO TO 6
    4 PRINT 100, EMAX,MLB(ISO),RECB(ISO)
  100 FORMAT(" BETA ENERGY = "F8.5," FOR ISOTOP "I3,A3)
      IF(EMAX.GT..1) GO TO 3
      DEPTH=0.
      RETURN
    5 PRINT 200,EMAX,MLB(ISO),RECB(ISO)
  200 FORMAT(" BETA ENERGY"F5.1," GREATER THAN 3. FOR ISOTOP "I3,A3)
      GO TO 1
    6 NU=18.6*(2.-RATIO)/(EMAX-.036)**1.37
      DNU=NU*DD*.001
      A=DNU/C
      D=EXP(1.-DNU)
      IF(A.GE.1.) GO TO 7
      B=EXP(1.-A)
      CC=2.+ALOG(1./A)
      BRAC=3.-B-A*CC
      GO TO 8
    7 BRAC=0.
    8 DEPTH=APH*(C*C*BRAC+D)
      RETURN
      END
```

```
      SUBROUTINE LIB
C  THIS SUBROUTINE READS A MASTER LIST OF NUCLIDE NAMES
      INTEGER REC
      REAL LAMBDA
      COMMON/BETA/ISOS,   D(4),ML(600),REC(600),BETENS(2,2000),IBESUB(60
     10),LFIS,LACT,N1,N2,ML3(600),RECB(600),IFOR(600),LAB(600),RAT(600)
C  READ FISSION PRODUCT NAMES
      READ (25,1) NCD
    1 FORMAT(I3)
      READ(25,2) (ML(J),REC(J),J=1,NCD)
    2 FORMAT(I3,2X,A3)
C  READ ACTIVATION PRODUCTS AND TRANSURANIC NAMES
      READ(25,1) N2
      N1=NCD+1
      N2=N2+NCD
      NFP=NCD
      LFIS=NFP
      READ(25,2) (ML(J),REC(J),J=N1,N2)
      REWIND 25
      RETURN
      END
```

```
      FUNCTION SIM3NI(FX,A,E,REL,MAXIT,FK   ,IER)
C-----------------------------------------------------------------------SIM3NI
C     NUMERICAL INTEGRATION USING SIMPSON'S 3/8 RULE.                   SIM3NI
C-----------------------------------------------------------------------SIM3NI
      INTEGER FK
      DIMENSION A(2)                                                    SIM3NI
      LOGICAL REL                                                       SIM3NI
      PREV=0.                                                           SIM3NI
C-----------------------------------------------------------------------
C     INITIALIZE H, X, N, M, S                                          SIM3NI
C-----------------------------------------------------------------------
      H=(A(2)-A(1))/3.                                                  SIM3NI
      X=A(1)                                                            SIM3NI
      N=0                                                               SIM3NI
      M=3                                                               SIM3NI
      S=0.                                                              SIM3NI
C-----------------------------------------------------------------------
C     LOOP TO COUNT MAXIMUM NUMBER OF EVALUATIONS                       SIM3NI
C-----------------------------------------------------------------------
      DO 3 J=1,MAXIT                                                    SIM3NI
C-----------------------------------------------------------------------
C     LOOP TO COUNT THE NUMBER OF FUNCTION EVALUATIONS                  SIM3NI
C-----------------------------------------------------------------------
      DO 1 I=N,M                                                        SIM3NI
      R=3.                                                              SIM3NI
C-----------------------------------------------------------------------
C     DETERMINE THE COEFFICIENT R                                       SIM3NI
C-----------------------------------------------------------------------
      IF(MOD(I,3).EQ.2*N) R=N+1.                                        SIM3NI
C-----------------------------------------------------------------------
C     SUM THE FUNCTION EVALUATIONS                                      SIM3NI
C-----------------------------------------------------------------------
      S=S+FX(X,FK   )*R                                                 SIM3NI
C-----------------------------------------------------------------------
C     INCREMENT X                                                       SIM3NI
C-----------------------------------------------------------------------
    1 X=X+H                                                             SIM3NI
C-----------------------------------------------------------------------
C     OBTAIN NEW VALUE OF INTEGRATION                                   SIM3NI
C-----------------------------------------------------------------------
      SIM3NI=S*H*.375/(N+1.)                                            SIM3NI
C-----------------------------------------------------------------------
C     TEST FOR FIRST LOOP, IF N=0                                       SIM3NI
C-----------------------------------------------------------------------
      IF(N.EQ.0) GO TO 2                                                SIM3NI
C-----------------------------------------------------------------------
C     NOT FIRST LOOP, HALVE H AND DOUBLE M                              SIM3NI
C-----------------------------------------------------------------------
      H=H*.5                                                            SIM3NI
      M=2*M                                                             SIM3NI
C-----------------------------------------------------------------------
C     CHECK FOR ERROR CONTROL                                           SIM3NI
C-----------------------------------------------------------------------
```

```
      R=SIM3NI-PREV                                                     SIM3NI
      IF(REL) R=R/SIM3NI                                                SIM3NI
C-----------------------------------------------------------------------
C     ERROR WITHIN ERROR LIMIT, FINISH                                  SIM3NI
C-----------------------------------------------------------------------
      IF(ABS(R).LT.E) GO TO 4                                           SIM3NI
C-----------------------------------------------------------------------
C     SET NEW VALUE OF INTEGRATION                                      SIM3NI
C-----------------------------------------------------------------------
    2 PREV=SIM3NI                                                       SIM3NI
      N=1                                                               SIM3NI
C-----------------------------------------------------------------------
C     OBTAIN NEW LOWER LIMIT FOR FUNCTION EVALUATION                    SIM3NI
C-----------------------------------------------------------------------
    3 X=A(1)+.5*H                                                       SIM3NI
      IER=1
    4 RETURN
      END
```

```
      FUNCTION FERMI(ENERGY,I)
      COMPLEX R,Z3,Z
      REAL LAN,LAW
      COMMON LAN,LAW,IFORBD,EO   ,ALPHA,PI,GAM,ALYAM,RAD,X1
      CSINH(Z)=.5*(CEXP(Z)-CEXP(-Z))
      W=ENERGY/.5109+1.
      P=SQRT(W**2-1.)
      YAM=ALYAM*W/P
      IER=0
      CALL GAMMA(X1,Y1,IER)
      IGO=IER+1
      GO TO (10,25,27),IGO
   10 Z1=Y1**2
      Z3=CMPLX(YAM,(1.-GAM))
      R=PI*Z3/CSINH(PI*Z3)
      Z2=CABS(R)
      FF=2.*(1.+GAM)*(2.*P*RAD)**(2.*(GAM-1.))*EXP(PI*YAM)*Z2/Z1
      IF(IFORBD.EQ.0) GO TO 5
      C=P**2+(EO-ENERGY)**2
      GO TO 6
    5 C=1.
    6 FERMI=C*FF*P*W*(EO-ENERGY)**2
      IF(I.EQ.1) FERMI=FERMI*ENERGY
      RETURN
   25 PRINT 400
   27 PRINT 400
  400 FORMAT(" ERROR IN GAMMA")
      STOP
      END
```

```
      SUBROUTINE GAMMA(X,GAMMAX,IER)
C  CALCULATION OF THE GAMMA FUNCTION OF X
      DIMENSION A(8)
      DATA (A(I),I=1,8)/-.577191652,.988205891,-.897056937,.918206857,
     1-.756704078,.482199394,-.193527818,.035868343/
      IF(ABS(X).LT.33.) GO TO 1
C   THE MAGNITUDE OF X IS GREATER THAN 33
      IER=1
      RETURN
C   INITIALIZE FACTOR (FACTORIAL X) AND XFACT (X-1)
    1 FACTOR=1.
      XFACT=X-1.
      IF(XFACT.LT.0.) GO TO 3
C   POSITIVE X
    2 IF(XFACT.LT.1.) GO TO 5
      FACTOR=FACTOR*XFACT
      XFACT=XFACT-1.
      GO TO 2
C   NEGATIVE X
    3 XFACT=XFACT+1.
      FACTOR=FACTOR*XFACT
      IF(XFACT) 3,7,4
    4 FACTOR=1./FACTOR
C   CALCULATION OF GAMMA FUNCTION OF XFACT+1.
    5 GAMMAX=0.
      DO 6 II=1,8
      I=9-II
    6 GAMMAX=(GAMMAX+A(I))*XFACT
      GAMMAX=(1.+GAMMAX)*FACTOR
      RETURN
    7 IER=2
      RETURN
      END
```

FIGURE B-4. Program BIVAR Listing

```
PROGRAM BIVAR    73/73   OPT=1                    FTN 4.4+R401    07/07/75  18.50.01.    PAGE     1

      1               PROGRAM   BIVAR(INPUT,OUTPUT,PUNCH,TAPE5=INPUT,TAPE6=OUTPUT)
                      DIMENSION R(10),UBAM(8),AM(6),BM(6),CM(6),DHM(6),SM(6,8), KSQM(6)
                      DIMENSION CYM(6),CZM(6),ENM(6),DUMMY(7),ITY(6),MNAME(3,6),DRF(16)
                      DIMENSION STSZ(6),STSY(6)
      5               DIMENSION IARY(5)
                      REAL KSQD,MANDIS,KSQM
                      INTEGER TYPE3
                      INTEGER TYPE,GROUPS
                      COMMON DRDX(57,16),NXINT,X(57),GROUPS,UBAR,TYPE,A,B,C,DH,SIGTUB
     10               COMMON KSQD,CY,CZ,EN,TYPE3,H,MANDIS,YP,SY(57),SZ(57),INEXT
                  100 FORMAT(3I5,2E10.3)
                  200 FORMAT(8E10.3)
                  300 FORMAT(I10,7E10.3)
                  400 FORMAT(" ERROR IN STABILITY SPECIFICATION, IER ="I3,/"0STABILITY
     15              1   A          B          C          D         KSQD      SIGTUB      CY
                     2      CZ        N")
                      IARY(1)=0
                      IARY(2)=0
                      CALL SYSTEM0(115,IARY)
     20           500 FORMAT("0"I5,3X,1P9E10.2)
                  600 FORMAT(" ERROR IN WINDSPEED/DISTANCE/STABILITY SPECIFICATION, IER
                     1="I3)
                  700 FORMAT("0"I3," WIND SPEEDS ", 8F10.3)
                  800 FORMAT("0"I3," DISTANCES   ",10F10.0)
     25           900 FORMAT("0"I3," STABILITIES ", 6(3A6,1X))
                 1000 FORMAT(12A6)
                 1100 FORMAT(23H1DOSE RATE FACTORS FOR ,3A6,5H DATE,A10)
                 1200 FORMAT(17HC     WIND SPEED =,F7.1,11H METERS/SEC)
                 1300 FORMAT(3HOC=,F9.0,4H YP=,F8.0,1P12E9.2)
     30          1400 FORMAT(8F10.4)
                 1500 FORMAT(F10.2,4I5)
                 1600 FORMAT("0END OF CASE"/"1")
                 1700 FORMAT(5H DRDX,1P10E10.3/(5X,10E10.3))
                 1800 FORMAT(5H  X  ,10F10.0/(5X,10F10.0))
     35          1900 FORMAT(20H IE, NXINT, DRF(IE) ,2I3,1PE10.3)
                 2000 FORMAT(" END OF FILE - STOP")
                 2100 FORMAT("0RELEASE HEIGHT ="F7.1," METERS")
                      CALL DATE(DD)
                      GROUPS=12
     40             1 READ(5,100) NUBAR,MET,NR,H,YPF
                      IF(EOF(5)) 20,101
                  101 CONTINUE
                  C   YPF = FACTOR FOR OFF CENTERLINE POSITION, YP=X*YPF
                  C   NUBAR = NUMBER OF WIND SPEEDS
     45           C   NR    = NUMBER OF RADIAL DISTANCES
                  C   H     = HEIGHT OF RELEASE, METERS, CONVERT TO CM FOR PLUME
                      READ(5,200)(R(I),I=1,NR)
                      READ(5,200) (UBAM(I),I=1,NUBAR)
                  C   MET  = NUMBER OF ATMOSPHERIC STABILITY CLASSES
     50               IER=0
                      IF(NR.LE.0.OR.NR.GT.10) IER=IER+1
                      IF(NUBAR.LE.0.OR.NUBAR.GT.8) IER=IER+1
                      IF(IER.GT.0) GO TO 8
```

```
      DO 2 I=1,NUBAR
   2  IF(UBAM(I).LT.1.E-30) IER=IER+1
      DO 3 I=1,NR
   3  IF(R(I).LT.1.E-30) IER=IER+1
      IF (MET.GT.6.OR.MET .LE.0) IER=IER+1
      IF(YPF.GT..5) IER=IER+1
      IF(IER.GT.0) GO TO 8
      HH=H
      H=100.*H
C  READ ATMOSPHERIC STABILITY DATA.
      READ 1000,((MNAME(I,J),I=1,3),J=1,MET)
      IEM=0
      DO 6 IM=1,MET
      READ(5,300)  ITY(IM),DUMMY
      ITYP=ITY(IM)
      IF(ITYP.LT.1) IEM=IEM+1
      IF(ITYP.GT.9) IEM=IEM+1
      IF(IEM.GT.0) GO TO 6
      IF(ITYP.GT.3) GO TO 6
      IF(ITYP.EQ.2) GO TO 5
      IF(ITYP.EQ.1) GO TO 4
      IF(ITYP.EQ.3) GO TO 105
      IEM=IEM+1
      GO TO 6
   4  AM(IM)=DUMMY(1)
      BM(IM)=DUMMY(2)
      CM(IM)=DUMMY(3)
      DHM(IM)=DUMMY(4)
      IF(ITYP.EQ.1) READ 200, (SM(IM,I),I=1,NLBAR)
      KSOM(IM)=DUMMY(5)
      GO TO 6
   5  CYM(IM)=DUMMY(1)
      CZM(IM)=DUMMY(2)
      ENM(IM)=DUMMY(3)
      GO TO 6
 105  STSY(IM)=DUMMY(1)
      STSZ(IM)=DUMMY(2)
   6  CONTINUE
      IF(IEM.EQ.0) GO TO 8
      PRINT 400, IEM
      DO 7 IM=1,MET
      PRINT 500, ITY(IM), AM(IM),BM(IM),CM(IM),DHM(IM),KSOM(IM),SM(IM,1)
     1, CYM(IM),CZM(IM),ENM(IM)
   7  CONTINUE
      STOP
   8  IF(IER.GT.0) PRINT 600,IEM
      PRINT 700, NUBAR,(UBAM(I),I=1,8)
      PRINT 800, NR,(R(I),I=1,10)
      PRINT 900, MET,((MNAME(I,J),I=1,3),J=1,MET)
      PRINT 2100, H
      IF(IER.GT.0) STOP
C  LOOP ON ATMOSPHERIC STABILITIES
      PUNCH 1500, HH,MET,NUBAR,NR,GROUPS
```

```
                      DO 15 IM=1,MET
                      TYPE=ITY(IM)
                      TYPE3=TYPE-3
      110             PRINT 1100, (MNAME(I,IM),I=1,3),DD
                      A=AM(IM)*1.E4
                      B=BM(IM)*1.E4
                      C=CM(IM)*1.E4
                      DH=DHM(IM)*100.
      115             KSOD=KSOM(IM)
                      CY=CYM(IM)*100.
                      CZ=CZM(IM)*100.
                      EN=ENM(IM)
                      IF(TYPE.GE.3) GO TO 11
      120             GO TO (9,10),TYPE
                    9 TYPE=2
                      GO TO 11
                   10 TYPE=1
                C  LOOP ON WIND SPEEDS
      125          11 DO 14 IU=1,NUBAR
                      SIGTUB=SM(IM,IU)*100.
                      UBAR=UBAM(IU)*100.
                      PRINT 1200, UBAM(IU)
                C  LOOP ON DISTANCES
      130             DO 13 IR=1,NR
                      MANDIS=R(IR)*100.
                      YP=MANDIS*YPF
                      ERR=0.
                      SY(1)=STSY(IM)
      135             SZ(1)=STSZ(IM)
                      CALL PLUME
                C  LOOP ON ENERGY GROUPS
                      DO 12 I=1,GROUPS
                      DRF(I)=0.
      140          12 CONTINUE
                      DO 212 N=1,NKINT
                      J=7*(N-1)+1
                      K=J+7
                      DIFFX=(X(K)-X(J))/7.
      145             DO 112 IE=1,GROUPS
                      DRF(IE)=DRF(IE)+DIFFX*FINT(DRDX(J,IE),8)
                   112 CONTINUE
                   212 CONTINUE
                      YP=YP/100.
      150             PRINT 1300, R(IR),YP,(DRF(I),I=1,GROUPS)
                      PUNCH 1400, (DRF(I),I=1,GROUPS)
                C  END OF LOOP ON DISTANCE
                   13 CONTINUE
                C  END OF LOOP ON WIND SPEED
      155          14 CONTINUE
                C  END OF LOOP ON ATMOSPHERIC STABILITIES
                   15 CONTINUE
                      PRINT 1600
                      GO TO 1
```

```
      SUBROUTINE PLUME
C  SUBROUTINE PLUME READS METEOROLOGICAL PARAMETERS AND CALCULATES
C  DOSE RATE PER CURIE PER CM OF DOWNWIND CLOUD FOR EACH ENERGY GROUP.
C
C  ER=1 IS ERROR RETURN FOR INCORRECT VALUE OF VARIABLE TYPE
C  ER=2 IS ERROR RETURN FOR SHORT EXPOSURE TIME OR DISTANCE TOO LONG.
C
      DIMENSION T(57),ZLIM(22),YLIM(22),EO/ERQ(57)
      DIMENSION ZSUM(16),ZLIST(8,16),YLIST(8,16),YSUM(16)                07/16/70
      DIMENSION DEP(57)
      DIMENSION Y(22),Z(22),YPM(10),ZPM(10)
      DIMENSION CAPA(16),ALFA(16),MEV(16),MU(16)
      INTEGER TYPE,TYPE3,GROUPS,VERT,POSIT
      INTEGER ENERGY
      REAL MU,MEV,KSQD,MANDIS
      LOGICAL ZDUB,YDUB,PASS
      COMMON DROX(57,16),NXINT,X(57),GROUPS,UBAR,TYPE,A,B,C,DH,SIGTUB
      COMMON KSQD,CY,CZ,EN,TYPE3,H,MANDIS,YP,SY(57),SZ(57),INEXT
      DATA (CAPA(I),I=1,12)/.4,2,2,2,2.75,2,2.35,1.56,1,0,1.0,,.9,,.85,,.8,,.75,
     1,65/
      DATA (ALFA(I),I=1,12)/.0006,,143,,754,1.287,1.287,,831,,402,,211,
     1.0837,,0373,,0204,,0103/
      DATA (MU(I),I=1,12)/.691,,229,,179,,159,,134,,106,,084,,0693,,057,
     1.048,,042,,0358/
      DATA ICALL/0/
      DATA (MEV(I),I=1,12)/303.1,40.0E,18.94,15.27,16.40,18.88,19.54,
     ,18.83,17.58,16.16,15.04,13.79/
      IF(ICALL.GT.0) GO TO 3

      GROUPS=12
      DO 2 I=1,12
    2 MU(I)=MU(I)*1.293E-3
    3 ICALL=ICALL+1
      PASS=.FALSE.                                                       08/19/70
      HYP=SQRT(H*H+YP*YP)
      UPMAX=50000.+2.*HYP
      UPTHR=15000.+2.*HYP
      UPTWO= 5000.+2.*HYP
      UPONE=1500.
C  UPDIS IS UPWIND INTEGRATION DISTANCE.
      UPDIS=AMIN1(80000.,MANDIS,UPMAX)
C  DWNDIS IS DOWNWIND INTEGRATION DISTANCE. (MAY BE NEGATIVE)
      DWNDIS=AMIN1(80000.,UPMAX)
C  TEST = UPWIND PLUS DOWNWIND DISTANCES  ZERO IMPLIES NO EXPOSURE
      IF( UPDIS+DWNDIS) 13,13,15
   13 PRINT 14, UPDIS,DWNDIS
   14 FORMAT(" NO X-INTEGRATION INTERVAL, UPDIS ="1PE10.2," METERS, DOWN
     1DIS ="E10.2," METERS")
      STOP
C  TEST = IF DWNDIS LESS THAN 100CM, SKIP DOWNWIND INTEGRATION.
   15 IF(DWNDIS.LE.100.) GO TO 18
C  TEST = IF MANDIS LESS THAN 100 CM, SKIP UPWIND INTEGRATION.
      IF(MANDIS.LT.100.) GO TO 21
```

```
      C  SET UPWIND INTEGRATION
   55    X(1)=MANDIS-UPDIS+10.
         IF(UPTHR.GT.UPDIS-3000.) GO TO 16
         X(8)=MANDIS-UPTHR
         X(15)=MANDIS-UPTWO
         X(22)=MANDIS-UPONE
   60    X(29)=MANDIS
         NXINT=4
         GO TO 18
      16 IF(UPTWO.GT.UPDIS-1000.) GO TO 17
         X(8)=MANDIS-UPTWO
   65    X(15)=MANDIS-UPONE
         X(22)=MANDIS
         NXINT=3
         GO TO 18
      17 IF(UPONE.GT.UPDIS-300.) GO TO 1017
   70    X(8)=MANDIS-UPONE
         X(15)=MANDIS
         NXINT=2
         GO TO 18
    1017 X(8)=MANDIS
   75    NXINT=1
      18 INEXT=7*(NXINT+1)+1
      C  SET DOWNWIND INTEGRATION LIMITS
         X(INEXT)=MANDIS+UPONE
         X(INEXT+7)=MANDIS+UPTWO
   80    X(INEXT+14)=MANDIS+UPTHR
         X(INEXT+21)=MANDIS+DWNDIS
         NXINT=NXINT+4
         GO TO 25                                              08/04/70
      21 X(1)=MANDIS
   85    NXINT=0
         GO TO 18
      25 CONTINUE
      C  CALCULATE X-GRID POSITIONS
      31 CONTINUE
   90    DO 33 I=1,NXINT                                       09/15/70
         J=7*(I-1)+1
         K=J+7
         DIFFX=(X(K)-X(J))/7.
         DO 32 L=2,7
   95    POSIT=7*(I-1)+L
         X(POSIT)=X(POSIT-1)+DIFFX
      32 CONTINUE
      33 CONTINUE
      C  CALCULATE TRAVEL TIME TO EACH POSITION
  100    INEXT=7*NXINT+1
         DO 34 I=1,INEXT
         T(I)= X(I)/UBAR
         DEP(I)=1.0                                            06/30/70
      34 CONTINUE
  105 C  CALCULATE SIGMA Y AND SIGMA Z FOR EACH POSITION
      39 IF(TYPE.LE.3) GO TO 45
```

```
                ERR=0.
                CALL PASSIG(ERR)
                IF(ERR) 38,38,40
  110         38 CONTINUE
                PRINT 1006, SY                                          05/19/70
             1006 FORMAT(" SY = "10F10.2/("      "10F10.2))             05/19/70
                PRINT 1007, SZ                                          05/19/70
  115        1007 FORMAT(" SZ = "10F10.2/("      "10F10.2))             05/19/70
                GO TO 52
             C  ERROR RETURN FROM PASSIG - DISTANCE TOO LONG FOR LIBRARY DATA
                40 PRINT 41, TYPE3
                41 FORMAT(" LIBRARY DISTANCE DATA TO SHORT FOR PASQUILL TYPE "I2)
  120           GO TO 38
                45 IF(TYPE.EQ.3) GO TO 49
                IF(TYPE.EQ.2) GO TO 47
             C  SUTTON EQUATION
                DO 46 I=1,INEXT
  125           XPOWR =(X(I)/100.)**(1.-EN*.5)/1.417
                SY(I)=CY*XPOWR
                SZ(I)=CZ*XPOWR
                46 CONTINUE
                PRINT 1006, SY                                          08/25/70
  130           PRINT 1007, SZ                                          08/25/70
                GO TO 52
             C  HANFORD
                47 BIGA=C-DH*SIGTUB
                ALPHA=.5*BIGA/(SIGTUE**2)
  135           DO 48 I=1,INEXT
                EXPO=T(I)/ALPHA                                         06/29/70
                IF(EXPO.LT..001) GO TO 147                              06/29/70
                SIGY2=BIGA*(T(I)-ALPHA*(1.-EXP(-T(I)/ALPHA)))
                GO TO 247                                               06/29/70
  140           147 SIGY2=12100.                                        07/16/70
                247 CONTINUE                                            06/29/70
                SY(I)=SQRT(SIGY2)
                EXPO=KSQD*T(I)**2                                       06/29/70
                IF(EXPO.LT..001) GO TO 347                              06/29/70
  145           SIGZ2=A*(1.-EXP(-KSQD*T(I)**2))+B*T(I)
                GO TO 447                                               06/29/70
                347 SIGZ2=12100.                                        07/16/70
                447 CONTINUE                                            06/29/70
                SZ(I)=SQRT(SIGZ2)
  150           48 CONTINUE
                PRINT 1006, SY                                          07/16/70
                PRINT 1007, SZ                                          07/16/70
                GO TO 52
                49 DO 50 IZ=2,INEXT
  155           SZ(IZ)=SZ(1)*100.
                SY(IZ)=SY(1)*100.
                50 CONTINUE
                SZ(1)=SZ(2)
                SY(1)=SY(2)
```

```
      PRINT 1006, SY
      PRINT 1007, SZ
C  CALCULATE AND PRINT E/Q VALUES                                        02/26/71
   52 DO 152 I=1,INEXT                                                   02/26/71
      EYP=(YP**2)/(2.*SY(I)**2)                                          02/26/71
      EZP=( H**2)/(2.*SZ(I)**2)                                          02/26/71
      EOVERQ(I)=EXP(-EYP-EZP)/(2.*3.14159*UBAR*SY(I)*SZ(I))*1.E6         02/26/71
  152 CONTINUE                                                           02/26/71
      PRINT 53, (EOVERQ(I),I=1,INEXT)                                    02/26/71
   53 FORMAT("0E/Q VALUES AT EACH DOWNWIND POSITION ARE"/(1P10E10.3))    02/26/71
C
C
C CALCULATE DOSE FACTORS FOR EACH POSITION AND ENERGY
      DO 110 IX=1,INEXT
      SIGY=SY(IX)
      SIGZ=SZ(IX)                                                        01/12/71
      D=MANDIS-X(IX)
      D=ABS(D)
C  SET LIMITS FOR Z-INTEGRATION STARTING AT +3 SIGMA Z AND WORKING DOWN.
      ZLIM(1)=3.*SIGZ
      NZINT=0
C
      IF(D.LT.101.) GO TO 58
      IF(SIGZ.LT.D) GO TO 56
      D4=4.*D
      IF(SIGZ.LT.D4) GO TO 57
      D15=15.*D
      IF(SIGZ.LT.D15) GO TO 55
      D50=50.*D
      IF(SIGZ.GT.D50) GO TO 54
      NZINT=4
      ZLIM(5)=0.
      ZLIM(4)=D4
      ZLIM(3)=D15
      ZLIM(2)=SIGZ
      GO TO 62
   54 NZINT=5
      ZLIM(6)=0.
      ZLIM(5)=D4
      ZLIM(4)=D15
      ZLIM(3)=D50
      ZLIM(2)=SIGZ
      GO TO 62
   55 NZINT=3
      ZLIM(4)=0.
      ZLIM(3)=D4
      ZLIM(2)=SIGZ
      GO TO 62
   56 ZLIM(2)=0.
      NZINT=1
      GO TO 62
   57 NZINT=2
      ZLIM(3)=0.
```

```
                      ZLIM(2)=SIGZ
                      GO TO 62
215                58 SZ04=SIGZ/4.
                      IF(SIGZ.LT.800.) GO TO 60
                      IF(SIGZ.LT.4000.) GO TO 61
                      IF(SIGZ.GT.20000.) GO TO 59
                      NZINT=5
220                   ZLIM(6)=0.
                      ZLIM(5)=200.
                      ZLIM(4)=1000.
                      ZLIM(3)=SZ04
                      ZLIM(2)=SIGZ
225                   GO TO 62
                   59 NZINT=6
                      ZLIM(7)=0.
                      ZLIM(6)=200.
                      ZLIM(5)=1000.
230                   ZLIM(4)=5000.
                      ZLIM(3)=SZ04
                      ZLIM(2)=SIGZ
                      GO TO 62
                   60 NZINT=3
235                   ZLIM(4)=0.
                      ZLIM(3)=SZ04
                      ZLIM(2)=SIGZ
                      GO TO 62
                   61 NZINT=4
240                   ZLIM(5)=0.
                      ZLIM(4)=200.
                      ZLIM(3)=SZ04
                      ZLIM(2)=SIGZ
                C
245             C
                   62 CONTINUE                                                07/16/70
                C SET Z INTEGRTION LIMITS BELOW CLOUD CENTERLINE,
                C FOR GROUND LEVEL RELEASE DOUBLE UPPER INTEGRAL (DUBLE=.TRUE.)
                      ZDUB=.FALSE.
250                   YDUB=.FALSE.
                      IF(H.LT.100.) ZDUB=.TRUE.
                      IF(YP.LT.100.) YDUB=.TRUE.
                      IF(ZDUB) GO TO 87
                      HOSZ=H/SIGZ
255                   IF(HOSZ.LT.1.) GO TO 163
                      SZ3=3.*SIGZ
                      ZMIN=-SZ3
                      ZMAX=H+SZ3
                      ZPMIN=H-5.*SIGZ
260                   IF(ZPMIN.GT.ZMIN) ZMIN=ZPMIN
                      Z(1)=ZMAX
                      Z(2)=H
                      IF(ZMIN.LE.0.) GO TO 162
                      Z(3)=H-SZ3
265                   Z(4)=ZMIN
```

```
                NZINT=3
             1162 N=NZINT+1
                DO 1262 I=1,N
             1262 ZLIM(I)=Z(I)-H
      270       GO TO 87
              162 ZP02=H/2.
                ZMID=SZ3
                IF(Z(2).LE.ZMID) ZMID=Z(2)
                IF(ZP02.GT.ZMID) ZMID=ZP02
      275       DO 262 J=1,NZINT
              262 ZPM(J)= ZLIM(NZINT-J+1)
                DO 362 J=1,NZINT
                IF(ZPM(J).GT.ZMID*.9) GO TO 462
              362 CONTINUE
      280       NZ=NZINT
                GO TO 562
              462 NZ=J-1
              562 IF(NZ.EQ.0) GO TO 762
                DO 662 J=1,NZ
      285     662 Z(J+2)=ZPM(NZ-J+1)
              762 Z(NZ+3)=0.0
                DO 862 J=1,NZINT
                I=NZ+J+3
                Z(I)=-ZLIM(NZINT+1-J)
      290       IF(Z(I).LT.ZMIN) GO TO 962
              862 CONTINUE
                GO TO 1062
              962 Z(I)=ZMIN
             1062 NZINT=I-1
      295       GO TO 1162
              163 DO 63 JZ=1,NZINT
                Z2=2.*ZLIM(NZINT-JZ+1)                                  07/16/70
                IF(Z2.GT.H) GO TO 64                                    07/16/70
               63 CONTINUE                                              07/16/70
      300       JZ=JZ+1                                                 07/16/70
               64 KZ=JZ-1                                               07/16/70
                LZ=2*JZ+1                                               07/16/70
                INDEX=LZ+NZINT                                          07/16/70
                IF(JZ.GT.NZINT) INDEX=INDEX-1                           07/16/70
      305       IF(KZ.LT.1) GO TO 66                                    07/16/70
                DO 65 I=1,KZ                                            07/16/70
                ZLIM(NZINT+I+1)=-ZLIM(NZINT-I+1)                        07/16/70
                ZLIM(INDEX-I)=-H+ZLIM(NZINT-I+1)                        07/16/70
               65 CONTINUE                                              07/16/70
      310      66 ZLIM(INDEX)=-H                                        07/16/70
                IF(JZ.LE.NZINT) ZLIM(NZINT+JZ+1)=-H/2.                  07/16/70
                DO 67 I=1,NZINT                                         07/16/70
                ZLIM(INDEX+I)=-H-ZLIM(NZINT-I+1)                        07/16/70
               67 CONTINUE                                              07/16/70
      315       NZINT=INDEX+NZINT-1                                     07/16/70
               87 CONTINUE
            C  SET Y INTEGRATION LIMITS STARTING AT 0, AND WORKING UP.
                SIGY2=SIGY*SIGY
```

```
      DENOM=SIGZ*SIGY*UBAR*2.*3.14159
320
      SIGZ2=SIGZ*SIGZ
      SY3=3.*SIGY
      DSIGY=SIGY*SIGY*2.
      DO 89 ENERGY=1,GROUPS
325   ZSUM(ENERGY)=0.0
   89 CONTINUE
      DO 108 IZ=1,NZINT
      DELZ=(ZLIM(IZ)-ZLIM(IZ+1))/7.
      ZZ=ZLIM(IZ)+H
330   DO 106 VER1=1,8
      ZMH2=(ZZ-H)**2
      VERTEX=.5*ZMH2/SIGZ2

      PERP2=D*D+ZZ*ZZ
335   PERP=SQRT(PERP2)
      YLIM(1)=0.0
      IF(PERP.LT.101.) GO TO 93
      IF(SIGY.LT.PERP) GO TO 91
      PERP4=4.*PERP
340   IF(SIGY.LT.PERP4) GO TO 92
      PERP15=15.*PERP
      IF(SIGY.LT.PERP15) GO TO 90
      PERP50=50.*PERP                                          07/16/70
      IF(SIGY.GT.PERP50) GO TO 189                             07/16/70
345   NYINT=4
      YLIM(2)=PERP4
      YLIM(3)=PERP15
      YLIM(4)=SIGY
      YLIM(5)=SY3
350   GO TO 96
  189 NYINT=5                                                  07/16/70
      YLIM(2)=PERP4                                            07/16/70
      YLIM(3)=PERP15                                           07/16/70
      YLIM(4)=PERP50                                           07/16/70
      YLIM(5)=SIGY                                             07/16/70
355   YLIM(6)=SY3                                              07/16/70
      GO TO 96                                                 07/16/70
   90 NYINT=3
      YLIM(2)=PERP4
      YLIM(3)=SIGY
360   YLIM(4)=SY3
      GO TO 96
   91 YLIM(2)=SY3
      NYINT=1
365   GO TO 96
   92 NYINT=2
      YLIM(2)=SIGY
      YLIM(3)=SY3
      GO TO 96
370   93 SY04=SIGY/4.
      IF(SIGY.LT.800.) GO TO 94
```

```
                      IF(SIGY.LT.4000.) GO TO 95                                07/16/70
                      IF(SIGY.GT.20000.) GO TO 193                              07/16/70
                      NYINT=5
  375                 YLIM(2)=200.
                      YLIM(3)=1000.
                      YLIM(4)=SYO4
                      YLIM(5)=SIGY
                      YLIM(6)=SY3
  380                 GO TO 96
                  193 NYINT=6                                                   07/16/70
                      YLIM(2)=200.                                              07/16/70
                      YLIM(3)=1000.                                             07/16/70
                      YLIM(4)=5000.                                             07/16/70
  385                 YLIM(5)=SYO4                                              07/16/70
                      YLIM(6)=SIGY                                              07/16/70
                      YLIM(7)=SY3                                               07/16/70
                      GO TO 96                                                  07/16/70
                   94 NYINT=3
  390                 YLIM(2)=SYO4
                      YLIM(3)=SIGY
                      YLIM(4)=SY3
                      GO TO 96
                   95 NYINT=4
  395                 YLIM(2)=200.
                      YLIM(3)=SYO4
                      YLIM(4)=SIGY
                      YLIM(5)=SY3
                   96 DO 97 ENERGY=1,GROUPS
  400                 YSUM(ENERGY)=0.0
                   97 CONTINUE
                      IF(YOUB) GO TO 2097
                C  SET Y LIMITS FOR OFF CENTERLINE DOSE
                      YPOSY=YP/SIGY
  405                 IF(YPOSY.LT.1.) GO TO 1297
                      YMIN=-SY3
                      YMAX=5.*SIGY
                      YPMAX=YP+SY3
                      IF(YPMAX.LT.YMAX) YMAX=YPMAX
  410                 Y(1)=-SY3
                      Y(2)=0.
                      IF(YMAX.GT.YP) GO TO 297
                      Y(3)=SY3
                      Y(4)=YMAX
  415                 NYINT=3
                 1897 N=NYINT+1
                      DO 1997 I=1,N
                 1997 YLIM(I)=Y(I)
                      GO TO 2097
  420              297 CONTINUE
                      YPO2=YP/2.
                      YMID=SY3
                      IF(YPO2.LT.SY3) YMID=YPO2
                      DO 397 J=1,NYINT
```

```
      397 YPM(J)=YP-YLIM(J+1)
          DO 497 J=1,NYINT
          IF(YPM(J).LT.YMID) GO TO 597
      497 CONTINUE
          NY=NYINT
          GO TO 697
      597 NY=J-1
      697 IF(NY.EQ.0) GO TO 897
          DO 797 J=1,NY
      797 Y(J+2)=YPM(NY+1-J)
      897 Y(NY+3)=YP
          DO 997 J=1,NYINT
          I=NY+3+J
          Y(I)=YP+YLIM(J+1)
          IF(Y(I).GT.YMAX) GO TO 1097
      997 CONTINUE
          GO TO 1197
     1097 Y(I)=YMAX
     1197 NYINT=I-1
          GO TO 1897
     1297 DO 1397 NY=1,NYINT
          Y2=2.*YLIM(NY+1)
          IF(Y2.GE.YP*.9) GO TO 1497
     1397 CONTINUE
     1497 KY=NY-1
          LY=2*NY+1
          INDEX=LY+NYINT
          IF(NY.GT.NYINT) INDEX=INDEX-1
          IF(KY.LT.1) GO TO 1697
          DO 1597 I=1,KY
          Y(NYINT+I+1)=YLIM(I+1)
     1597 Y(INDEX-I)=YP-YLIM(I+1)
     1697 Y(INDEX)=YP
          IF(NY.LE.NYINT) Y(NYINT+1+NY)=YP/2.
          DO 1797 I=1,NYINT
          Y(INDEX+I)=YP+YLIM(I+1)
     1797 Y(NYINT-I+1)=-YLIM(I+1)
          Y(NYINT+1)=0.
          NYINT=NYINT+INDEX-1
          GO TO 1897
     2097 VEXPO=EXP(-VERTEX)
C    DO LOOP ON NUMBER OF MAJOR Y INTEGRATION INTERVALS.
          DO 104 IY=1,NYINT
          CELY=(YLIM(IY+1)-YLIM(IY))/7.
          YY=YLIM(IY)
C    DO LOOP ON Y POSITIONS WITHIN MAJOR INTERVAL
          DO 102 LAT=1,8
          YY=YY+CELY
          Y2=YY+YY
          YMYP2=(YY-YP)**2
          RSQ=PERP2+YMYP2
          R=SQRT(RSQ)
C    CALCULATE INVERSE-SQUARE FACTOR FOR CURRENT X,Y,Z POSITION.
          EOQ=EXP(-Y2/OSIGY)/DENOM
```

```
                      IF(R.LT.1) GO TO 99
                      GNUM=1.
      480             IF(R.GT.140.) GO TO 98
                      GNUM=1.-EXP(-RSQ*.0006283196)
                   98 GRATIO=GNUM/(12.56639*RSQ)
                      GO TO 100
                   99 GRATIO=.00065
      485          C  CALCULATE DOSE RATE KERNEL FOR EACH ENERGY GROUP AT X,Y,Z.
                  100 VG=VEXPO*GRATIO*EOQ
                      DO 101 ENERGY=1,GROUPS
                      RMU=MU(ENERGY)*R                                    11/18/70
                      ATTEN=EXP(-RMU)                                     11/18/70
      490             BILDUP=1.+(CAPA(ENERGY)+ALFA(ENERGY)*RMU)*RMU
                      YLIST(LAT,ENERGY)=VG*ATTEN*BILDUP*MEV(ENERGY)
                  101 CONTINUE
                      YY=YY+DELY
                  102 CONTINUE
      495          C  INTEGRATE AND SUM OVER Y LINE FOR X,Z
                      DO 103 ENERGY=1,GROUPS
                      IF(YDUB) GO TO 1103
                      YSUM(ENERGY)=YSUM(ENERGY)+DELY*FINT(YLIST(1,ENERGY),8)
                      GO TO 103
      500          1103 YSUM(ENERGY)=YSUM(ENERGY)+DELY*FINT(YLIST(1,ENERGY),8)*2.0
                   103 CONTINUE
                   104 CONTINUE
                      DO 105 ENERGY=1,GROUPS
                      ZLIST(VERT,ENERGY)=YSUM(ENERGY)
      505             105 CONTINUE
                      ZZ=ZZ-DELZ
                   106 CONTINUE
                   C  INTEGRATE AND SUM OVER Z FOR CURRENT X POSITION
                      DO 108 ENERGY=1,GROUPS
      510             IF(ZDUB) GO TO 107
                      ZSUM(ENERGY)=ZSUM(ENERGY)+DELZ*FINT(ZLIST(1,ENERGY),8)
                      GO TO 108
                   107 ZSUM(ENERGY)=ZSUM(ENERGY)+DELZ*FINT(ZLIST(1,ENERGY),8)*2.
                   108 CONTINUE
      515             DO 109 ENERGY=1,GROUPS
                      ORDX(IX,ENERGY) = ZSUM(ENERGY)
                      ZSUM(ENERGY)=0.0                                    05/19/70
                   109 CONTINUE
                   110 CONTINUE
      520             RETURN
                      END
```

```
      FUNCTION FINT(LIST,NUMBER)
      REAL LIST
      DIMENSION A(35),B(7),C(7),LIST(8)
      DATA B/2*1.,3.,2.,5.,1.,7./,C/2.,3.,8.,45.,288.,140.,17280./
      DATA A/3*1.,4.,2*1.,2*3.,1.,7.,32.,12.,32.,7.,19.,75.,2*50.,75.,
     A19.,41.,216.,27.,272.,27.,216.,41.,751.,3577.,1323.,2*2989.,
     B 1323.,3577.,751./
C
      INDEX=(NUMBER*NUMBER)/2+1+NUMBER/2
      FINT=0.0
      DO 1 I=1,NUMBER
      INDEX=INDEX+1
    1 FINT=FINT+LIST(I)*A(INDEX)
      FINT=FINT*B(NUMBER+1)/C(NUMBER+1)
      RETURN
      END
```

```
      SUBROUTINE PASSIG(ERR)
      INTEGER TYPE,TYPE3,GROUPS
      DIMENSION DIST(20),SIGY(6,20),SIGZ(6,20)
      COMMON DRDX(57,16),NXINT,X(57),GROUPS,UBAR,TYPE,A,B,C,DH,SIGTUB
      COMMON KSWD,CY,CZ,EN,TYPE3,H,MANDIS,YP,SY(57),SZ(57),INEXT
      DATA (SIGY(1,I),I=1,20)/100.,2.1E3,3.2E3,5.4E3,7.5E3,1.05E4,1.42E4
     1,2.E4,2.9E4,4.5E4,6.1E4,8.3E4,1.12E5,1.55E5,2.2E5,3.4E5,4.5E5,
     26.2E5,8.2E5,1.1E6/
      DATA (SIGY(2,I),I=1,20)/100.,1.6E3,2.4E3,4.E3,5.5E3,7.6E3,1.06E4,
     11.48E4,2.15E4,3.4E4,4.6E4,6.3E4,8.4E4,1.2E5,1.68E5,2.6E5,3.5E5,
     24.7E5,6.4E5,8.5E5/
      DATA (SIGY(3,I),I=1,20)/100.,1.2E3,1.75E3,2.85E3,4.E3,5.5E3,7.6E3,
     11.06E4,1.55E4,2.4E4,3.3E4,4.5E4,6.1E4,8.5E4,1.2E5,1.85E5,2.5E5,
     23.4E5,4.7E5,6.3E5/
      DATA (SIGY(4,I),I=1,20)/100.,800.,1.2E3,1.95E3,2.65E3,3.7E3,5.1E3,
     17.2E3,1.04E4,1.6E4,2.25E4,3.1E4,4.2E4,5.7E4,7.1E4,1.25E5,1.7E5,
     22.3E5,3.E5,4.1E5/
      DATA (SIGY(5,I),I=1,20)/100.,600.,900.,1450.,2.E3,2.8E3,3.7E3,
     15.2E3,7.5E3,1.20E4,1.65E4,2.2E4,3.E4,4.1E4,5.7E4,8.8E4,1.18E5,
     21.6E5,2.1E5,2.8E5/
      DATA (SIGY(6,I),I=1,20)/100.,390.,600.,980.,1350.,1850.,2550.,
     13600.,5200.,8100.,1.1E4,1.53E4,2.1E4,2.8E4,4.E4,6.1E4,8.2E4,1.12E5
     2,1.48E5,2.E5/
      DATA (SIGZ(1,I),I=1,20)/100.,1500.,2250.,4300.,7.E3,1.35E4,2.7E4,
     16.7E4,2.E5,11*2.E5/
      DATA (SIGZ(2,I),I=1,20)/100.,1.E3,1500.,2550.,3700.,5700.,8600.,
     11.35E4,2.4E4,5.8E4,1.2E5,2.E5,8*2.E5/
      DATA (SIGZ(3,I),I=1,20)/100.,780.,1100.,1750.,2400.,3400.,4600.,
     16400.,9000.,1.4E4,1.9E4,2.6E4,3.4E4,4.4E4,6.E4,8.8E4,1.12E5,1.44E5
     2,1.78E5,2.E5/
      DATA (SIGZ(4,I),I=1,20)/100.,470.,680.,1050.,1400.,1900.,2500.,
     13300.,4300.,6200.,7600.,9500.,1.15E4,1.4E4,1.7E4,2.2E4,2.65E4,
     23.2E4,3.7E4,4.5E4/
      DATA (SIGZ(5,I),I=1,20)/100.,300.,430.,710.,940.,1300.,1700.,2200.
     1,2900.,4100.,5000.,6100.,7200.,8400.,9900.,1.17E4,1.3E4,1.4E4,
     21.55E4,1.7E4/
      DATA (SIGZ(6,I),I=1,20)/100.,140.,220.,400.,530.,760.,1000.,1350.,
     11770.,2500.,3000.,3500.,4100.,4700.,5500.,6400.,7200.,7900.,8600.,
     29400./
      DATA (DIST(I),I=1,20)/0.,1.E4,1.5E4,2.5E4,3.5E4,5.E4,7.E4,1.E5,
     11.5E5,2.5E5,3.5E5,5.E5,7.E5,1.E6,1.5E6,2.5E6,3.5E6,5.E6,7.E6,1.E7/
C  CALCULATE SY AND SZ FOR EACH X POSITION DESIRED
      IDATA=1
      ERR=0.
      DO 19 I=1,INEXT
    1 IF(IDATA.GT.20) GO TO 8
    2 IF(SIGZ(TYPE3,IDATA)) 8,8,3
    3 IF(X(I)-DIST(IDATA)) 6,5,4
    4 IDATA=IDATA+1
      GO TO 1
    5 SZ(I)=SIGZ(TYPE3,IDATA)
      GO TO 9
    6 IF(IDATA.EQ.1) GO TO 5
```

```
      SZ1=SIGZ(TYPE3,IDATA-1)
      SZ2=SIGZ(TYPE3,IDATA)
      D1=DIST(IDATA-1)
      D2=DIST(IDATA)
      SZ(I)=SZ1+(X(I)-D1)*(SZ2-SZ1)/(D2-D1)
      GO TO 9
    8 ERR=1.0
      IF(IDATA.GT.20) IDATA=21
      SZ(I)=SIGZ(TYPE3,IDATA-1)
    9 CONTINUE
   11 IF(IDATA.GT.20) GO TO 18
      IF(SIGY(TYPE3,IDATA)) 18,18,13
   13 IF(X(I)-DIST(IDATA)) 16,15,14
   14 IDATA=IDATA+1
      GO TO 11
   15 SY(I)=SIGY(TYPE3,IDATA)
      GO TO 19
   16 IF(IDATA.EQ.1) GO TO 15
      SY1=SIGY(TYPE3,IDATA-1)
      SY2=SIGY(TYPE3,IDATA)
      D1=DIST(IDATA-1)
      D2=DIST(IDATA)
      SY(I)=SY1+(X(I)-D1)*(SY2-SY1)/(D2-D1)
      GO TO 19
   18 ERR=1.0
      IF(IDATA.GT.20) IDATA=21
      SY(I)=SIGY(TYPE3,IDATA-1)
   19 CONTINUE
      RETURN
      END
```

FIGURE B-5. Program SUBDOSA Listing


```
      PROGRAM SUBDOSA(INPUT,OUTPUT,PUNCH,PNDLIB,GAMLIB,DRFLIB,BETLIB,     SUBD      2
     ,TAPE5=INPUT,TAPE6=OUTPUT,TAPE25=DRFLIB,TAPE26=BETLIB,TAPE28=GAMLIB SUBD      3
     ,,TAPE29=PNDLIB)                                                     SUBD      4
      DIMENSION RT(6),BDEP(4),NBDI(4)                                     SUBD      5
      DIMENSION IARY(5)                                                   SUPPRE    1
      DIMENSION TOTMU(12),DEPTH(12,3),TDEP(3)                             SUBD      6
      LOGICAL LIBARY,BLIB,GLIB,DLIB,FDRF,BETA,DRFP, CHIOQ,GAMA            SUBD      7
      INTEGER REC,CHAINS,SKIP,GROUPS                                      SUBD      8
      REAL    LAMBDA,MASS                                                 SUBD      9
      COMMON/MAINC/HFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),          NEWLIB    1
     ,LAMBDA(500),CHAINS,DKFRCT(350,3),BURST(500,12),REC(500),D(10),      NEWLIB    2
     ,BETEN(500,4),GROUPS,ML(500),DRF(120,1,6),NMET,HH,NREL,ICL(500)      NEWLIB    3
      COMMON/REPTCOM/GDOSE(30,1,6),BDOSE(40,1,6),SDOSE(10,1,6),TDOSE(100 REPTCOM    2
     1,1,6),NBD,NGD,NBG,NGG,NBS,NGS,NBE,NGE,NBDI,CHIQ(10,1,6),EDOSE(10,1 REPTCOM    3
     2,6),IRPT,TITLE(14),RTN(10),RTH(10),GNDOS(10,1,6),TDEP,BDEP         REPTCOM    4
      COMMON/METCOM/SY(10,1,6),SZ(10,1,6),UBAR,H,NIN,DRFB(10,1,6),NR,NM, METCOM    2
     1R(10),MET(1,6),NDRF(6)                                              METCOM    3
      COMMON/LOGIC/LIBARY,BLIB,GLIB,DLIB,FDRF,BETA,DRFP,CHIOQ,GAMA        LOGIC     2
      DATA  TDEP/0.,1.,5./                                                SUBD      14
      DATA BDEP/0.,7.,20.,100./                                           SUBD      15
      DATA  (TOTMU(I),I=1,12)/.35,.23,.19,.16,.13,.10,.081,.068,.056,.04 SUBD      16
     18,.042,.038/                                                        SUBD      17
      NAMELIST/INPUT/NEXT,NREL,D,RT,UBAR,H,LIB,LBLIB,LGLIB,LDLIB,LFDRF,   SUBD      18
     1LBETA,LDRFP,LCHIOQ,LGAMA,NR,KINT,NMET,    ITZ,NDPTH,TDEP,NBD,NGD,   SUBD      19
     2NBS,NGS,IRPT,NBG,NGG,BDEP,NBDI,NBE, NGE,INX,NDRF                    SUBD      20
  100 FORMAT(13A6,A2)                                                     SUBD      21
  200 FORMAT(1H1,13A6,A2)                                                 SUBD      22
  500 FORMAT("1END OF INPUT FILE AT TITLE CARD READ")                     SUBD      23
  600 FORMAT("1END OF INPUT FILE AT NAMELIST READ")                       SUBD      24
  700 FORMAT(8E10.3)                                                      SUBD      25
  800 FORMAT("0NO CALCULATION SPECIFIED, LGAMA, LBETA, LCHIOQ ="3I5)      SUBD      26
  900 FORMAT("0ERROR IN NAMELIST INPUT, CHECK CONTROL INTEGERS")          SUBD      27
 1000 FORMAT("0NEXT OUT OF RANGE"I10)                                     SUBD      28
 1200 FORMAT(6A10)                                                        SUBD      29
 1300 FORMAT("0EXECUTION TIME FOR THIS CASE WAS "F6.3," SECONDS")         SUBD      30
 1500 FORMAT(1X,12E10.3)                                                  SUBD      31
 1600 FORMAT(10E7.2)                                                      SUBD      32
C  THESE 3 STATEMENTS SUPPRESS DIAGNOSTIC :15 FOR SMALL ARGUMENTS IN     SUPPRE    2
C  FUNCTION EXP(ARG) WHERE ARG IS LESS THAN=700                          SUPPRE    3
      IARY(1)=0                                                           SUPPRE    4
      IARY(2)=0                                                           SUPPRE    5
      CALL SYSTEMC(115,IARY)                                              SUPPRE    6
    1 LIBARY=.FALSE.                                                      SUBD      33
      CALL SECOND(TIME1)                                                  SUBD      34
      BLIB=.FALSE.                                                        SUBD      35
      GLIB=.FALSE.                                                        SUBD      36
      DLIB=.FALSE.                                                        SUBD      37
      FDRF=.FALSE.                                                        SUBD      38
      BETA=.FALSE.                                                        SUBD      39
      DRFP=.FALSE.                                                        SUBD      40
      CHIOQ=.FALSE.                                                       SUBD      41
      GAMA=.FALSE.                                                        SUBD      42
      IER=0                                                               SUBD      43
```

```
                      READ(5,100) TITLE                                  SUBD      44
     55               IF(EOF(5))  2,3                                    SUBD      45
                    2 PRINT 500                                          SUBD      46
                      GO TO 99                                           SUBD      47
                    3 PRINT 200, TITLE                                   SUBD      48
                C  SET D = R                                             SUBD      49
     60         C  READ NAMELIST INPUT                                   SUBD      50
                      READ(5,INPUT)                                      SUBD      51
                      IF(EOF(5))  4,5                                    SUBD      52
                    4 PRINT 600                                          SUBD      53
                      GO TO 99                                           SUBD      54
     65         C  EDIT INPUT                                            SUBD      55
                    5 IF(LIB.GT.0) LIBARY=.TRUE.                         SUBD      56
                      LIB=0                                              SUBD      57
                      IF(LBLIB.GT.0) BLIB=.TRUE.                         SUBD      58
                      LBLIB=0                                            SUBD      59
     70               IF(LGLIB.GT.0) GLIB=.TRUE.                         SUBD      60
                      LGLIB=0                                            SUBD      61
                      IF(LDLIB.GT.0) DLIB=.TRUE.                         SUBD      62
                      IF(LFDRF.GT.0) FDRF=.TRUE.                         SUBD      63
                      IF(LBETA.GT.0) BETA=.TRUE.                         SUBD      64
     75               IF(LDRFP.GT.0) DRFP=.TRUE.                         SUBD      65
                      IF(LCHIOQ.GT.0) CHIOQ=.TRUE.                       SUBD      66
                      IF(LGAMA.GT.0) GAMA=.TRUE.                         SUBD      67
                      GF=0.                                              SUBD      68
                      BF=0.                                              SUBD      69
     80               IF(GAMA) GF=1.                                     SUBD      70
                      IF(BETA) BF=1.                                     SUBD      71
                      NIN=NREL                                           SUBD      72
                      DO  9 IR=1,NR                                      SUBD      73
                      R(IR)=D(IR)                                        SUBD      74
     85               9 CONTINUE                                         SUBD      75
                      NMET=1                                             SUBD      76
                      NM=NMET                                            SUBD      77
                      IF(NEXT.LT.1.OR.NEXT.GT.6) GO TO 98                SUBD      78
                      GO TO (10,11,11,20,21,8),NEXT                      SUBD      79
     90         C  START OF CALCULATION OR NEW SOURCE INVENTORIES         SUBD      80
                   10 IF(LIBARY) CALL LIBK                               SUBD      81
                      IF(GLIB) CALL GLIBE                                SUBD      82
                   11 READ(5,1200) ( MET(1,I),I=1,NREL)                  SUBD      84
                      IF(FDRF) GO TO 12                                  SUBD      85
     95               IF(DLIB) CALL DLIBE                                SUBD      86
                      DO 112 IR=1,NR                                     SUBD      87
                  112 R(IR)=D(IR)                                        SUBD      88
                      IF(NEXT.EQ.3) GO TO 18                             SUBD      89
                  212 CALL SOURCE                                        SUBD      90
    100               GO TO 18                                           SUBD      91
                   12 IF(GAMA) GO TO 312                                 SUBD      92
                      IF(NEXT.EQ.3) GO TO 18                             SUBD      93
                      GO TO 212                                          SUBD      94
                  312 CONTINUE                                           SUBD      95
    105           C  READ  DRF FROM CARDS                                SUBD      96
                      DO 15 IN=1,NREL                                    SUBD      97
```

```
                      DO 14 IM=1,NMET                                    SUBD      98
                      DO 15 IR=1,NR                                      SUBD      99
                      I1=(IR-1)*GROUPS+1                                 SUBD     100
  110                 I2=I1+GROUPS-1                                     SUBD     101
                      READ(5,700) (DRF(I,IM,IN),I=I1,I2)                 SUBD     102
                      IF(.NOT.DRFP) GO TO 13                             SUBD     103
                      PRINT 1500, (DRF(I,IM,IN),I=I1,I2)                 SUBD     104
                   13 CONTINUE                                           SUBD     105
  115              14 CONTINUE                                           SUBD     106
                   15 CONTINUE                                           SUBD     107
                      IF(NEXT.EQ.3) GO TO 18                             SUBD     108
                      GO TO 212                                          SUBD     109
                   18 IF(ENX.GT.0) GO TO 26                              SUBD     110
  120                 CALL METIN                                         SUBD     111
                      IF(BETA) CALL BETADRF                              SUBD     112
                      GO TO 25                                           SUBD     113
                C  READ EOQ VALUES FROM CARDS                            SUBD     114
                   26 DO 27 IN=1,NREL                                    SUBD     115
  125                 READ 1600, (CHIQ(I,1,IN),I=1,NR)                   SUBD     116
                      DO 27 IR=1,NR                                      SUBD     117
                      DRFB(IR,1,IN)=CHIQ(IR,1,IN)*.229                   SUBD     118
                   27 CONTINUE                                           SUBD     119
                      GO TO 25                                           SUBD     120
  130              21 CALL SOURCE                                        SUBD     121
                   20 CONTINUE                                           SUBD     122
                C  CALCULATE UNITS FOR RELEASE TIME                      SUBD     123
                   25 CALL UNITS(RTN,RTH,NREL,RT,1)                      SUBD     124
                C  EDIT INPUT                                            SUBD     125
  135                 IF(NREL.LE.0) IER=IER+1                            SUBD     126
                      IF(NREL.GT.6) IER=IER+1                            SUBD     127
                      IF(NR.LT.0.OR.NR.GT.10) IER=IER+1                  SUBD     128
                      IF(IER.GT.0) GO TO 97                              SUBD     129
                C  DO LOOP ON TISSUE DEPTHS                              SUBD     130
  140                 DO 39 IDEPTH=1,NGD                                 SUBD     131
                      DO 39 IE=1,GROUPS                                  SUBD     132
                      TDTM=TDEP(IDEPTH)*TDTMU(IE)                        SUBD     133
                   39 DEPTH(IE,IDEPTH)=EXP(-TDTM)*(1.+TDTM)              SUBD     134
                C  DO LOOP ON RELEASE PERIODS                            SUBD     135
  145                 TTB=0.                                             SUBD     136
                      TTG=0.                                             SUBD     137
                      DO 70 IN=1,NREL                                    SUBD     138
                      DO 31 I=1,NTOT                                     SUBD     139
                   31 MASS(I,7)=0.                                       SUBD     140
  150                 DO 32 I=1,CHAINS                                   SUBD     141
                   32 SKIP(I)=0                                          SUBD     142
                C  ELIMINATE UNUSED CHAINS                               SUBD     143
                      ISOTOP=0                                           SUBD     144
                      DO 35 K=1,CHAINS                                   SUBD     145
  155                 LIM=NOFNUC(K)                                      SUBD     146
                      IF(SKIP(K).NE.0) GO TO 34                          SUBD     147
                      DO 33 I=1,LIM                                      SUBD     148
                      L=ISOTOP+I                                         SUBD     149
                      IF(MASS(L,IN).GT.1.E-30.AND.LAMBDA(L).GT.1.E-30) GO TO 34  SUBD  150
```

```
      33 CONTINUE                                                       SUBD      151
         SKIP(K)=LIM                                                    SUBD      152
      34 ISOTOP=ISOTOP+LIM                                              SUBD      153
      35 CONTINUE                                                       SUBD      154
C     INITIALIZE ARRAYS                                                 SUBD      155
      NNN=1                                                             SUBD      156
      DO 38 IM=1,NNN                                                    SUBD      157
      DO 36 IR=1,30                                                     SUBD      158
      TDOSE(IR,IM,IN)=0.                                                SUBD      159
      TDOSE(IR+70,IM,IN)=0.                                             SUBD      160
      36 GDOSE(IR,IM,IN)=0.                                             SUBD      161
      DO 37 IR=1,40                                                     SUBD      162
      TDOSE(IR+30,IM,IN)=0.                                             SUBD      163
      37 BDOSE(IR,IM,IN)=0.                                             SUBD      164
      38 CONTINUE                                                       SUBD      165
      IF(.NOT.GAMA) GO TO 53                                            SUBD      166
C     CALCULATE GAMMA DOSE FOR CURRENT PERIOD AT EACH DISTANCE          SUBD      167
      40 DO 51 IR=1,NR                                                  SUBD      168
      IF(ITZ.EQ.0) TTG=TTG+RT(IN)                                       SUBD      169
      TT=R(IR)/UBAR+TTG                                                 SUBD      170
      CALL CHAINT(7,TT,IN,0)                                            SUBD      171
      N1=NFP+1                                                          SUBD      172
      DO 41 I=N1,NTOT                                                   SUBD      173
      IF(MASS(I,IN).GT.1.E-30) MASS(I,7)=MASS(I,IN)*EXP(-LAMBDA(I)*TT)  SUBD      174
      41 CONTINUE                                                       SUBD      175
C     CALCULATE TIME INTEGRAL OF CLOUD CONCENTRATION = GAMMA            SUBD      176
      IF(ITZ.EQ.2) GO TO 142                                            SUBD      177
      TT=RT(IN)                                                         SUBD      178
      CALL CHAINT(7,TT,7,1)                                             SUBD      179
      DO 42 I=N1,NTOT                                                   SUBD      180
      IF(MASS(I,IN).LT.1.E-30) GO TO 42                                 SUBD      181
      MASS(I,7)=MASS(I,7)*(1.-EXP(-LAMBDA(I)*TT))/(LAMBDA(I)*TT)        SUBD      182
      42 CONTINUE                                                       SUBD      183
      142 CONTINUE                                                      SUBD      184
C     CALCULATE GAMMA DOSE                                              SUBD      185
      ISOTOP=0                                                          SUBD      186
      DO 48 K=1,CHAINS                                                  SUBD      187
      LIM=NOFNUC(K)                                                     SUBD      188
      IF(SKIP(K).NE.0) GO TO 47                                         SUBD      189
      DO 45 I=1,LIM                                                     SUBD      190
      L=ISOTOP+I                                                        SUBD      191
      IF(MASS(L,7).LT.1.E-30.OR.LAMBDA(L).LT.1.E-30) GO TO 45           SUBD      192
      DO 44 IM=1,NMET                                                   SUBD      193
      DO 43 IE=1,GROUPS                                                 SUBD      194
      II=(IR-1)*12+IE                                                   SUBD      195
      DO 43 IDEPTH=1,NGD                                                SUBD      196
      ID=(IDEPTH-1)*10+IR                                               SUBD      197
      43 GDOSE(ID,IM,IN)=GDOSE(ID,IM,IN)+MASS(L,7)*BURST(L,IE)*DRF(II,IM,IN  SUBD      198
     1* DEPTH(IE,IDEPTH)                                                SUBD      199
      44 CONTINUE                                                       SUBD      200
      45 CONTINUE                                                       SUBD      201
      47 ISOTOP=ISOTOP+LIM                                              SUBD      202
      48 CONTINUE                                                       SUBD      203
```

```
                      DO 50 L=N1,NTOT                                                  SUBD      204
                      IF(MASS(L,7).LT.1.E-30) GO TO 50                                 SUBD      205
  215                 DO 49 IM=1,NMET                                                  SUBD      206
                      DO 49 IE=1,GROUPS                                                SUBD      207
                      II=(IR-1)*12+IE                                                  SUBD      208
                      DO 49 IDEPTH=1,NGD                                               SUBD      209
                      ID=(IDEPTH-1)*10+IR                                              SUBD      210
  220                49 GDOSE(ID,IM,IN)=GDOSE(ID,IM,IN)+MASS(L,7)*BURST(L,IE)*DRF(II,IM,IN SUBD      211
                     1)*DEPTH(IE,IDEPTH)                                               SUBD      212
                     50 CONTINUE                                                       SUBD      213
                     51 CONTINUE                                                       SUBD      214
                     52 CONTINUE                                                       SUBD      215
  225                53 IF(.NOT.BETA) GO TO 62                                         SUBD      216
                   C  CALCULATE BETA DOSE                                              SUBD      217
                   C  DO  LOOP  ON  DISTANCE FOR BETA DOSE                             SUBD      218
                      DO 61 IR=1,NR                                                    SUBD      219
                      IF(ITZ.EQ.0) TTB=TTB+RT(IN)                                      SUBD      220
  230                 TT=R(IR)/UBAR+TTB                                                SUBD      221
                      CALL CHAINT(7,TT,IN,0)                                           SUBD      222
                      N1=NFP+1                                                         SUBD      223
                      DO 54 I=N1,NTOT                                                  SUBD      224
                      IF(MASS(I,IN).GT.1.E-30) MASS(I,7)=MASS(I,IN)*EXP(-LAMBDA(I)*TT) SUBD      225
  235                54 CONTINUE                                                       SUBD      226
                   C CALCULATE TIME INTEGRAL OF CLOUD CONCENTRATION = BETA             SUBD      227
                      IF(ITZ.EQ.2) GO TO 155                                           SUBD      228
                      TT=RT(IN)                                                        SUBD      229
                      CALL CHAINT(7,TT,7,1)                                            SUBD      230
  240                 DO 55 I=N1,NTOT                                                  SUBD      231
                      IF(MASS(I,7).LT.1.E-30) GO TO 55                                 SUBD      232
                      MASS(I,7)=MASS(I,7)*(1.-EXP(-LAMBDA(I)*TT))/(LAMBDA(I)*TT)       SUBD      233
                     55 CONTINUE                                                       SUBD      234
                    155 CONTINUE                                                       SUBD      235
  245               C  CALCULATE BETA DOSE                                           SUBD      236
                      ISOTOP=0                                                         SUBD      237
                      DO 59 K=1,CHAINS                                                 SUBD      238
                      LIM=NOFNUC(K)                                                    SUBD      239
                      IF(SKIP(K).NE.0) GO TO 58                                        SUBD      240
  250                 DO 57 I=1,LIM                                                    SUBD      241
                      L=ISOTOP+I                                                       SUBD      242
                      IF(MASS(L,7).LT.1.E-30.OR.LAMBDA(L).LT.1.E-30) GO TO 57          SUBD      243
                      DO 56 IM=1,NMET                                                  SUBD      244
                      DO 56 NDEPTH=1,NBD                                               SUBD      245
  255                 ID=(NDEPTH-1)*10+IR                                              SUBD      246
                      IDEPTH=NBDI(NDEPTH)                                              SUBD      247
                      BDOSE(ID,IM,IN)=BDOSE(ID,IM,IN)+MASS(L,7)*BETEN(L,IDEPTH)*DRFB(IR, SUBD      248
                     .IM,IN)*LAMBDA(L)                                                 SUBD      249
                     56 CONTINUE                                                       SUBD      250
  260                57 CONTINUE                                                       SUBD      251
                     58 ISOTOP=ISOTOP+LIM                                              SUBD      252
                     59 CONTINUE                                                       SUBD      253
                      DO 60 L=N1,NTOT                                                  SUBD      254
                      IF(MASS(L,7).LT.1.E-30) GO TO 60                                 SUBD      255
  265                 DO 160 IM=1,NMET                                                 SUBD      256
```

```
                      DO 160 NDEPTH=1,NBD                                          SUBD      257
                      ID=(NDEPTH-1)*10+IR                                          SUBD      258
                      IDEPTH=NBDI(NDEPTH)                                          SUBD      259
                      BDOSE(ID,IM,IN)=BDOSE(ID,IM,IN)+MASS(L,7)*BETEN(L,IDEPTH)*DRFB(IR,  SUBD      260
     270             .IM,IN)*LAMBDA(L)                                             SUBD      261
                  160 CONTINUE                                                     SUBD      262
                   60 CONTINUE                                                     SUBD      263
                   61 CONTINUE                                                     SUBD      264
                C  END OF DOSE CALCULATIONS - ADD GAMMA NG TO BETA NB FOR SKIN DOSE.  SUBD      265
     275            62 IF(NBS.LE.0.AND.NGS.LE.0) GO TO 66                         SUBD      266
                C  CALCULATE SKIN DOSE                                           SUBD      267
                      DO 65 IR=1,NR                                              SUBD      268
                      IDG=(NGS-1)*10+IR                                          SUBD      269
                      IDB=(NBS-1)*10+IR                                          SUBD      270
     280              DO 64 IM=1,NMET                                            SUBD      271
                      SDOSE(IR,IM,IN)=GDOSE(IDG,IM,IN)*GF+BDOSE(IDB,IM,IN)*BF    SUBD      272
                   64 CONTINUE                                                   SUBD      273
                   65 CONTINUE                                                   SUBD      274
                   66 IF(NBG.LE.0.AND.NGG.LE.0) GO TO 170                        SUBD      275
     285           C  CALCULATE GENETIC DOSE                                     SUBD      276
                      DO 69 IR=1,NR                                              SUBD      277
                      IDG=(NGG-1)*10+IR                                          SUBD      278
                      IDB=(NBG-1)*10+IR                                          SUBD      279
                      DO 68 IM=1,NMET                                            SUBD      280
     290              GNDOS(IR,IM,IN)=GDOSE(IDG,IM,IN)*GF+BDOSE(IDB,IM,IN)*BF    SUBD      281
                   68 CONTINUE                                                   SUBD      282
                   69 CONTINUE                                                   SUBD      283
B-36               170 IF(NGE.LE.0.AND.NBE.LE.0) GO TO 70                       SUBD      284
                C  CALCULATE EYE DOSE                                            SUBD      285
     295              DO 269 IR=1,NR                                             SUBD      286
                      IDG=(NGE-1)*10+IR                                          SUBD      287
                      IDB=(NBE-1)*10+IR                                          SUBD      288
                      DO 169 IM=1,NMET                                           SUBD      289
                      EDOSE(IR,IM,IN)=GDOSE(IDG,IM,IN)*GF+BDOSE(IDB,IM,IN)*BF    SUBD      290
     300              169 CONTINUE                                               SUBD      291
                      269 CONTINUE                                               SUBD      292
                   70 CONTINUE                                                   SUBD      293
                   71 IF(GAMA) GO TO 72                                          SUBD      294
                      IF(BETA) GO TO 72                                          SUBD      295
     305              IF(CHIOQ) GO TO 79                                         SUBD      296
                      GO TO 96                                                   SUBD      297
                C  SUM DOSE OVER ALL RELEASE PERIODS                             SUBD      298
                   72 DO 78 IR=1,NR                                              SUBD      299
                      DO 77 IM=1,NMET                                            SUBD      300
     310              IF(NREL.LT.2) GO TO 77                                     SUBD      301
                      TDOSE(IR,IM,1)=GDOSE(IR,IM,1)                              SUBD      302
                      TDOSE(IR+10,IM,1)=GDOSE(IR+10,IM,1)                        SUBD      303
                      TDOSE(IR+20,IM,1)=GDOSE(IR+20,IM,1)                        SUBD      304
                      TDOSE(IR+30,IM,1)=BDOSE(IR,IM,1)                           SUBD      305
     315              TDOSE(IR+40,IM,1)=BDOSE(IR+10,IM,1)                        SUBD      306
                      TDOSE(IR+50,IM,1)=BDOSE(IR+20,IM,1)                        SUBD      307
                      TDOSE(IR+60,IM,1)=BDOSE(IR+30,IM,1)                        SUBD      308
                      TDOSE(IR+70,IM,1)=SDOSE(IR,IM,1)                           SUBD      309
```

```
                  TDOSE(IR+80,IM,1)=GNDOS(IR,IM,1)                                  SUBD      310
320               TDOSE(IR+90,IM,1)=EDOSE(IR,IM,1)                                  SUBD      311
                  DO 76 IN=2,NREL                                                   SUBD      312
                  DO 74 JJ=1,NGD                                                    SUBD      313
                  ID=(JJ-1)*10+IR                                                   SUBD      314
               74 TDOSE(ID,IM,IN)=TDOSE(ID,IM,IN-1)+GDOSE(ID,IM,IN)                 SUBD      315
325               DO 75 JJ=1,NBD                                                    SUBD      316
                  ID=(JJ-1)*10+IR                                                   SUBD      317
                  IDT=ID+30                                                         SUBD      318
               75 TDOSE(IDT,IM,IN)=TDOSE(IDT,IM,IN-1)+BDOSE(ID,IM,IN)               SUBD      319
                  TDOSE(IR+70,IM,IN)=TDOSE(IR+70,IM,IN-1)+SDOSE(IR,IM,IN)           SUBD      320
330               TDOSE(IR+80,IM,IN)=TDOSE(IR+80,IM,IN-1)+GNDOS(IR,IM,IN)           SUBD      321
                  TDOSE(IR+90,IM,IN)=TDOSE(IR+90,IM,IN-1)+EDOSE(IR,IM,IN)           SUBD      322
               76 CONTINUE                                                          SUBD      323
               77 CONTINUE                                                          SUBD      324
               78 CONTINUE                                                          SUBD      325
335            79 IF(.NOT.CHIOQ) GO TO 83                                           SUBD      326
                  IF(NOPTH.GT.0) GO TO 83                                           SUBD      327
            C  CALCULATE NORMALIZED AIR CONCENTRATION                               SUBD      328
                  IF(.NOT.BETA) CALL BETADRF                                        SUBD      329
                  DO 82 IN=1,NREL                                                   SUBD      330
340               DO 81 IM=1,NMET                                                   SUBD      331
                  DO 80 IR=1,NR                                                     SUBD      332
                  CHIQ(IR,IM,IN)=DRFB(IR,IM,IN)/.229                                SUBD      333
               80 CONTINUE                                                          SUBD      334
               81 CONTINUE                                                          SUBD      335
345            82 CONTINUE                                                          SUBD      336
            C  PRINT RESULTS                                                        SUBD      337
               83 CALL REPT(IRFT)                                                   SUBD      338
                  CALL SECOND(TIME2)                                                SUBD      339
                  SEC=TIME2-TIME1                                                   SUBD      340
350               PRINT 1300, SEC                                                   SUBD      341
                  GO TO 1                                                           SUBD      342
            C  PRINT ERROR MESSAGES                                                 SUBD      343
            C                                                                       SUBD      344
            C  NO DOSE CALCULATION SPECIFIED                                        SUBD      345
355            96 PRINT 800, LGAMA,LBETA,LCHIOQ                                     SUBD      346
                  GO TO 99                                                          SUBD      347
            C  INPUT ERROR - NAMELIST                                               SUBD      348
               97 PRINT 900                                                         SUBD      349
                  GO TO 99                                                          SUBD      350
360         C  NEXT OUT OF RANGE                                                    SUBD      351
               98 PRINT 1000, NEXT                                                  SUBD      352
               99 STOP                                                              SUBD      353
                  END                                                               SUBD      354
```

```
      SUBROUTINE BETADRF                                                    SUBD     805
      COMMON/METCOM/SY(10,1,6),SZ(10,1,6),UBAR,H,NIN,DRFB(10,1,6),NR,NM,    METCOM     2
     1R(10),MET(1,6),NDRF(6)                                                METCOM     3
      COMMON/LOGIC/LIBARY,B_IB,GLIB,CLIB,FDRF,BETA,DRFP,CHIOQ,GAMA          LOGIC      2
      LOGICAL DRFP                                                          SUBD     808
      DO 3 IN=1,NIN                                                         SUBD     809
      DO 2 IR=1,NR                                                          SUBD     810
      DO 1 IM=1,NM                                                          SUBD     811
      SZ2=SZ(IR,IM,IN)**2                                                   SUBD     812
      DENOM=UBAR*SZ(IR,IM,IN)*SY(IR,IM,IN)*3.14159                          SUBD     813
      DRFB(IR,IM,IN)=EXP(-(H*H)/(2.*SZ2))/DENOM*.229                        SUBD     814
    1 CONTINUE                                                              SUBD     815
    2 CONTINUE                                                              SUBD     816
      IF(.NOT.DRFP) GO TO 3                                                 SUBD     817
      PRINT 100, (DRFB(I,1,IN),I=1,NR)                                      SUBD     818
  100 FORMAT(" DRFB"1P10E11.3)                                              SUBD     819
    3 CONTINUE                                                              SUBD     820
      RETURN                                                                SUBD     821
      END                                                                   SUBD     822
```

```
      SUBROUTINE CHAINT(LOC,THETA,POSIT,INT)                                SUBD      901
C  SUBROUTINE CHAINT DECAYS FISSION PRODUCTS IN MASS ARRAY POSIT FOR A T     SUBD      902
C THETA AND STORES RESULTS IN MASS ARRAY LOC.                               SUBD      903
C                                                                           SUBD      904
      DIMENSION EXPO(8)                                                     SUBD      905
      COMMON/MAINC/NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),            NEWLIB     1
     ,LAMBDA(500),CHAINS,DKFRCT(350,3),BURST(500,12),REC(500),D(10),        NEWLIB     2
     ,BETEN(500,4),GROUPS,ML(500),DRF(120,1,6),NMET,HH,NREL,ICL(500)        NEWLIB     3
      REAL LAMBDA,MASS                                                      SUBD      907
      INTEGER CHAINS,SKIP,POSIT                                             SUBD      908
      ISOTOP=0                                                              SUBD      909
C  DO LOOP ON NUMBER OF CHAINS                                              SUBD      910
      DO 11 K=1,CHAINS                                                      SUBD      911
      LIM=NOFNUC(K)                                                         SUBD      912
      IF(SKIP(K).NE.0) GO TO 10                                             SUBD      913
      J=0                                                                   SUBD      914
C  DO LOOP ON ISOTOPES IN THE CHAIN                                         SUBD      915
      DO 9 I=1,LIM                                                          SUBD      916
      ISOTOP=ISOTOP+1                                                       SUBD      917
      J=J+1                                                                 SUBD      918
      IF(LAMBDA(ISOTOP).LT.1.E-30) GO TO 6                                  SUBD      919
      EXPO(J)=EXP(-THETA*LAMBDA(ISOTOP))                                    SUBD      920
      IF(INT.GT.0) EXPO(J)=(1.-EXPO(J))/(THETA*LAMBDA(ISOTOP))              SUBD      921
C  TRANSFER ON CHAIN MEMBER J                                               SUBD      922
      GO TO (1,2,3,4,5,6,7),J                                               SUBD      923
C  FIRST CHAIN MEMBER                                                       SUBD      924
    1 A1=MASS(ISOTOP,POSIT)                                                 SUBD      925
      MASS(ISOTOP,LOC)=A1*EXPO(1)                                           SUBD      926
      GO TO 9                                                               SUBD      927
C  SECOND CHAIN MEMBER                                                      SUBD      928
    2 A2=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)*A1/(LAMBDA(ISOTOP)-LAMBDA(ISO    SUBD      929
     1TOP-1))                                                               SUBD      930
      A3=MASS(ISOTOP,POSIT)-A2                                              SUBD      931
      MASS(ISOTOP,LOC)=A3*EXPO(2)+A2*EXPO(1)                                SUBD      932
      GO TO 9                                                               SUBD      933
C  THIRD CHAIN MEMBER                                                       SUBD      934
    3 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                                SUBD      935
      A4=(ABLE*A2+DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)*A1)/(LAMBDA(ISOTOP)-    SUBD      936
     1LAMBDA(ISOTOP-2))                                                     SUBD      937
      A5=ABLE*A3/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                          SUBD      938
      A6=MASS(ISOTOP,POSIT)-A4-A5                                           SUBD      939
      MASS(ISOTOP,LOC)=A6*EXPO(3)+A5*EXPO(2)+A4*EXPO(1)                     SUBD      940
      GO TO 9                                                               SUBD      941
C  FOURTH CHAIN MEMBER                                                      SUBD      942
    4 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                                SUBD      943
      BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)                               SUBD      944
      A7=(ABLE*A4+BAKER*A2+DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)*A1)/(LAMBDA    SUBD      945
     1(ISOTOP)-LAMBDA(ISOTOP-3))                                            SUBD      946
      A8=(ABLE*A5+BAKER*A3)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))               SUBD      947
      A9=ABLE*A6/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                          SUBD      948
      A10=MASS(ISOTOP,POSIT)-A9-A8-A7                                       SUBD      949
      MASS(ISOTOP,LOC)=A10*EXPO(4)+A9*EXPO(3)+A8*EXPO(2)+A7*EXPO(1)         SUBD      950
      GO TO 9                                                               SUBD      951
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                C  FIFTH CHAIN MEMBER                                                SUBD      952
     55           5 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                           SUBD      953
                    BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)                          SUBD      954
                    CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)                         SUBD      955
                    A11=(ABLE*A7+BAKER*A4-CHARLY*A2)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4)  SUBD      956
                   1)                                                                SUBD      957
     60             A12=(ABLE*A8 +BAKER*A5+CHARLY*A3)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-3) SUBD      958
                   1)                                                                SUBD      959
                    A13=(ABLE*A9+ BAKER*A6)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))        SUBD      960
                    A14=ABLE*A10/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                   SUBD      961
                    A15=MASS(ISOTOP,POSIT)-A14-A13-A12-A11                           SUBD      962
     65             MASS(ISOTOP,LOC)=A15*EXPO(5)+A14*EXPO(4)+A13*EXPO(3)+A12*EXPO(2)+  SUBD      963
                   1A11*EXPO(1)                                                      SUBD      964
                    GO TO 9                                                          SUBD      965
                C  SIXTH CHAIN MEMBER                                                SUBD      966
                 6 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                            SUBD      967
     70             BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)                          SUBD      968
                    CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)                         SUBD      969
                    A16=(ABLE*A11+BAKER*A7+CHARLY*A4)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-5) SUBD      970
                   1)                                                                SUBD      971
                    A17=(ABLE*A12+BAKER*A8+CHARLY*A5)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4) SUBD      972
     75             1)                                                                SUBD      973
                    A18=(ABLE*A13+BAKER*A9+CHARLY*A6)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-3) SUBD      974
                   1)                                                                SUBD      975
                    A19=(ABLE*A14+BAKER*A10)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))       SUBD      976
                    A20=ABLE*A15/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                   SUBD      977
     80             A21=MASS(ISOTOP,POSIT)-A20-A19-A18-A17-A16                       SUBD      978
                    MASS(ISOTOP,LOC)=A21*EXPO(6)+A20*EXPO(5)+A19*EXPO(4)+A18*EXPO(3) SUBD      979
                   1+A17*EXPO(2)+A16*EXPO(1)                                         SUBD      980
                    GO TO 9                                                          SUBD      981
                C  SEVENTH CHAIN MEMBER                                              SUBD      982
     85             7 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                         SUBD      983
                    BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)                          SUBD      984
                    CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)                         SUBD      985
                    A22=(ABLE*A16+BAKER*A11+CHARLY*A7)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-6 SUBD      986
                   1))                                                               SUBD      987
     90             A23=(ABLE*A17+BAKER*A12+CHARLY*A8)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-5 SUBD      988
                   1))                                                               SUBD      989
                    A24=(ABLE*A18+BAKER*A13+CHARLY*A9)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4 SUBD      990
                   1))                                                               SUBD      991
                    A25=(ABLE*A19+BAKER*A14+CHARLY*A10)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP- SUBD      992
     95            13))                                                              SUBD      993
                    A26=(ABLE*A20+BAKER*A15)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))       SUBD      994
                    A27=ABLE*A21/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                   SUBD      995
                    A28=MASS(ISOTOP,POSIT)-A27-A26-A25-A24-A23-A22                   SUBD      996
                    MASS(ISOTOP,LOC)=A28*EXPO(7)+A27*EXPO(6)+A26*EXPO(5)+A25*EXPO(4)+  SUBD      997
    100            1A24*EXPO(3)+A23*EXPO(2)-A22*EXPO(1)                              SUBD      998
                    GO TO 9                                                          SUBD      999
                 8 J=0                                                               SUBD     1000
                 9 CONTINUE                                                          SUBD     1001
                    GO TO 11                                                         SUBD     1002
    105            10 ISOTOP=ISOTOP+LIM                                              SUBD     1003
                   11 CONTINUE                                                       SUBD     1004
                    RETURN                                                           SUBD     1006
                    END                                                              SUBD     1007
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      1           SUBROUTINE DLIBE                                                  SUBD      355
                  DIMENSION RD(10),DDD(12,10)                                       SUBD      356
                  COMMON/MAINC/NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),        NEWLIB     1
                 ,LAMBDA(500),CHAINS,DKFRCT(350,3),BURST(500,12),REC(500),D(10),    NEWLIB     2
      5          ,BETEN(500,4),GROUPS,ML(500),DRF(120,1,6),NMET,HH,NREL,ICL(500)    NEWLIB     3
                  COMMON/METCOM/SY(10,1,6),SZ(10,1,6),UBAR,H,NIN,DRFB(10,1,6),NR,NM, METCOM    2
                 1R(10),MET(1,6),NDRF(6)                                            METCOM     3
                  COMMON/LOGIC/LIBARY,BLIB,GLIB,DLIB,FORF,BETA,DRFP,CHIOQ,GAMA      LOGIC      2
                  LOGICAL GAMA,DRFP                                                 SUBD      360
     10           IF(GAMA) GO TO 22                                                 SUBD      361
                21 PRINT 900                                                        SUBD      362
                  GO TO 14                                                          SUBD      363
                22 CONTINUE                                                         SUBD      364
                  READ(25,100) NSETS                                                SUBD      365
     15           IF(EOF(25)) 99,122                                                SUBD      366
               122 CONTINUE                                                         SUBD      367
                  DO 2 I=1,NREL                                                     SUBD      368
                  IF(NDRF(I).GT.NSETS) GO TO 98                                     SUBD      369
                  IF(NDRF(I).LE.0) GO TO 98                                         SUBD      370
     20           2 CONTINUE                                                        SUBD      371
                  DO 8 IS=1,NSETS                                                   SUBD      372
                  READ(25,200) HD,MD,MRD,IEN                                        SUBD      373
                  IF(EOF(25)) 99,102                                                SUBD      374
                102 CONTINUE                                                        SUBD      375
     25           READ(25,300)  (RD(I),I=1,MRD)                                     SUBD      376
                  IF(EOF(25)) 99,103                                                SUBD      377
                103 CONTINUE                                                        SUBD      378
B-41              DO 3 IN=1,NREL                                                    SUBD      379
                  IF(NDRF(IN).GE.IS) GO TO 4                                        SUBD      380
     30           3 CONTINUE                                                        SUBD      381
                  GO TO 9                                                           SUBD      382
                4 DO 5 IR=1,MRD                                                     SUBD      383
                  READ(25,300) (DDD(I,IR),I=1,IEN)                                  SUBD      384
                  IF(EOF(25)) 99,5                                                  SUBD      385
     35           5 CONTINUE                                                        SUBD      386
                  DO 7 IN=1,NREL                                                    SUBD      387
                  IF(NDRF(IN).NE.IS) GO TO 7                                        SUBD      388
                  DO 6 IR=1,MRD                                                     SUBD      389
                  DO 6 I=1,IEN                                                      SUBD      390
     40           II=(IR-1)*IEN+1                                                   SUBD      391
                  DRF(II,1,IN)=DDD(I,IR)                                            SUBD      392
                6 CONTINUE                                                          SUBD      393
                7 CONTINUE                                                          SUBD      394
                8 CONTINUE                                                          SUBD      395
     45           9 NR=MRD                                                          SUBD      396
                  IN=NREL                                                           SUBD      397
                  DO 10 IR=1,NR                                                     SUBD      398
               10 D(IR)=RD(IR)                                                      SUBD      399
                  REWIND 25                                                         SUBD      400
     50           IF(.NOT.DRFP) GO TO 14                                            SUBD      401
               C  PRINT DOSE RATE FACTORS                                           SUBD      402
                  PRINT 500                                                         SUBD      403
                  DO 13 IM=1,NMET                                                   SUBD      404
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      DO 12 IN=1,NREL                                                   SUBD      405
55    PRINT 600, MET(IM,IN),IN                                          SUBD      406
      DO 11 IR=1,NR                                                     SUBD      407
      I1=(IR-1)*IEN+1                                                   SUBD      408
      I2=I1+IEN-1                                                       SUBD      409
      PRINT 800, (DRF(I,IM,IN),I=I1,I2)                                 SUBD      410
60  11 CONTINUE                                                         SUBD      411
    12 CONTINUE                                                         SUBD      412
    13 CONTINUE                                                         SUBD      413
    14 RETURN                                                           SUBD      414
    98 PRINT 400, NSETS,NDRF                                            SUBD      415
65  99 PRINT 700                                                        SUBD      416
      STOP                                                              SUBD      417
   100 FORMAT(I5)                                                       SUBD      418
   200 FORMAT(F10.2,5I5)                                                SUBD      419
   300 FORMAT(8F10.2)                                                   SUBD      420
70 400 FORMAT(" DRF LIBRARY INPUT ERROR, NSETS ="I3," NDRF ="6I3)       SUBD      421
   500 FORMAT(1H1,"DOSE RATE FACTORS")                                  SUBD      422
   600 FORMAT("OSTABILITY  "A1D,"  RELEASE PERIOD "I3)                  SUBD      423
   700 FORMAT(" END OF FILE ON UNIT 25, DRFLIB")                        SUBD      424
   800 FORMAT(1X,1P16E8.2)                                              SUBD      425
75 900 FORMAT("ONO GAMMA DOSE CALCULATION REQUESTED, GAMMA=DRFLIB NOT REA SUBD      426
     1D IN")                                                            SUBD      427
      END                                                               SUBD      428
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      SUBROUTINE GLIBE                                                  SUBD      599
C     THIS SUBROUTINE READS A PHOTON PROBABILITY LIBRARY - GAMLIB - AND SUBD      600
C     CALCULATES BURST(ISO,IEN) FOR EACH ISOTOPE AND ENERGY GROUP.      SUBD      601
C     A RADIONUCLIDE DATA LIBRARY MUST BE READ FIRST.                   SUBD      602
      DIMENSION FRACT(100),ENERGY(100),MEV(16),ENG(16)                  SUBD      603
      DIMENSION KEV(16)                                                 SUBD      604
      COMMON/MAINC/NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),        NEWLIB      1
     ,LAMBDA(500),CHAINS,DKFRCT(350,3),BURST(500,12),REC(500),D(10),    NEWLIB      2
     ,BETEN(500,4),GROUPS,ML(500),DKF(120,1,6),NMET,HH,NREL,ICL(500)    NEWLIB      3
      REAL LAMBDA                                                       SUBD      606
      INTEGER GROUPS                                                    SUBD      607
      REAL MEV,KEV                                                      SUBD      608
      READ(28,1) GROUPS                                                 SUBD      609
    1 FORMAT(I3)                                                        SUBD      610
      KEV(GROUPS)=5.0                                                   SUBD      611
      LIM=GROUPS-1                                                      SUBD      612
C KEV IS UPPER MEV LIMIT OF GROUP FOR LOWER 15 GROUPS                   SUBD      613
      READ (28,16) (KEV(I),I=1,LIM)                                     SUBD      614
   16 FORMAT(16F5.0)                                                    SUBD      615
      READ(28,216) (MEV(I),I=1,GROUPS)                                  SUBD      616
  216 FORMAT(8E10.0)                                                    SUBD      617
      IF(GROUPS.GT.1) GO TO 316                                         SUBD      618
      ENG(1)= .7                                                        SUBD      619
      GO TO 616                                                         SUBD      620
  316 IF(GROUPS.GT.2) GO TO 416                                         SUBD      621
      ENG(1)=.6667*KEV(1)                                               SUBD      622
      ENG(2)=1.2*KEV(1)                                                 SUBD      623
      GO TO 616                                                         SUBD      624
  416 ENG(1)= .6667*KEV(1)                                              SUBD      625
      ENG(GROUPS)=1.2*KEV(GROUPS-1)                                     SUBD      626
      L=GROUPS-1                                                        SUBD      627
      DO 516 I=2,L                                                      SUBD      628
  516 ENG(I)=(KEV(I)+KEV(I-1))/2.0                                      SUBD      629
  616 CONTINUE                                                          SUBD      630
      DO 716 I=1,GROUPS                                                 SUBD      631
  716 MEV(I)=MEV(I)/ENG(I)                                              SUBD      632
      READ(28,100) NCD,ISOS                                             SUBD      633
  100 FORMAT(2I3)                                                       SUBD      634
      DO 23 ISOTOP=1,NTOT                                               SUBD      635
      DO 116 L=1,12                                                     SUBD      636
  116 BURST(ISOTOP,L)=0.0                                               SUBD      637
  816 READ(28,17) N,NO,(FRACT(J),ENERGY(J),J=1,6),NCMMT                 SUBD      638
   17 FORMAT(3X,I2,3X,I2,12F5.0,I2)                                     SUBD      639
      NUM=NO                                                            SUBD      640
      NPTN=0                                                            SUBD      641
      IF(NCMMT.LE.0) GO TO 217                                          SUBD      642
      DO 117 JJJ=1,NCMMT                                                SUBD      643
  117 READ(28,200) NCMT                                                 SUBD      644
  200 FORMAT(A1)                                                        SUBD      645
      GO TO 816                                                         SUBD      646
  217 ICL(ISOTOP)=4                                                     SUBD      647
      IF(N.EQ.18.OR.N.EQ.36.OR.N.EQ.54) ICL(ISOTOP)=1                   SUBD      648
      IF(N.EQ.54.OR.N.EQ.52.OR.N.EQ.55) ICL(ISOTOP)=3                   SUBD      649
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      IF(N.EQ.17.OR.N.EQ.35.OR.N.EQ.53.OR.N.EQ.91) ICL(ISOTOP)=2          SUBD  650
   55 IF(NO.EQ.0) GO TO 23                                                SUBD  651
      IF(NO.LT.7) GO TO 20                                                SUBD  652
      NO=NO-6                                                             SUBD  653
  317 NPTN=NPTN+7                                                         SUBD  654
      NPTS=NPTN+6                                                         SUBD  655
   60 IF(NPTS.GT.NUM) NPTS=NUM                                            SUBD  656
      READ(28,19) (FRACT(J),ENERGY(J),J=NPTN,NPTS)                        SUBD  657
      IF(NO.LT.8) GO TO 20                                                SUBD  658
      NO=NO-7                                                             SUBD  659
      GO TO 317                                                           SUBD  660
   65 19 FORMAT(14E5.0)                                                   SUBD  661
    C CALCULATE BRUST FOR CURRENT ISOTOPE                                 SUBD  662
      20 DO 22 K=1,NUM                                                    SUBD  663
         DO 21 L=1,LIM                                                    SUBD  664
         I=L                                                              SUBD  665
   70    IF(ENERGY(K).LE.KEV(L)) GO TO 22                                 SUBD  666
      21 CONTINUE                                                         SUBD  667
         I=GROUPS                                                         SUBD  668
      22 BURST(ISOTOP,I)=BURST(ISOTOP,I)+FRACT(K)*LAMBDA(ISOTOP)*ENERGY(K) SUBD  669
      23 CONTINUE                                                         SUBD  670
   75    REWIND 28                                                        SUBD  671
         RETURN                                                           SUBD  672
         END                                                              SUBD  673
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                                                                                SUBD      482
      SUBROUTINE LIBK                                                           SUBD      483
C  SUBROUTINE LIBK READS A RADIONUCLIDE DATA LIBRARY, RNDLIB, AND               SUBD      484
C  CALCULATES DKFRCT(FRACTIONAL YIELD FROM PARENTS).                            SUBD      485
      DIMENSION FRACT(350),ISO(500),NA(500)                                     NEWLIB      4
      COMMON/MAINC/NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),                NEWLIB      1
     .LAMBDA(500),CHAINS,DKFRCT(350,3),BURST(500,12),REC(500),D(10),            NEWLIB      2
     .BETEN(500,4),GROUPS,ML(500),DRF(120,1,6),NMET,HH,NREL,ICL(500)            NEWLIB      3
      INTEGER CHAINS                                                            SUBD      488
      LOGICAL ERROR                                                             SUBD      489
      REAL LAMBDA                                                               SUBD      490
C                                                                               SUBD      491
C                                                                               SUBD      492
      READ (29,1) NCD                                                           SUBD      493
    1 FORMAT(I5)                                                                NEWLIB      5
      READ(29,2)   (ML(J),NA(J),REC(J),ISO(J),LAMBDA(J),    FRACT(J),          5/22/75     1
     .(BETEN(J,I),I=1,4),J=1,NCD)                                               5/22/75C    1
    2 FORMAT(I3,I2,A3,I1,E9.1,F7.4,4E10.2)                                      NEWLIB      8
  102 FORMAT(I3,I2,A3,I1,E9.1,7X,4E10.2)                                        5/22/75B    1
      READ(29,1) N2                                                             SUBD      497
      N1=NCD+1                                                                  SUBD      498
      NAC=N2                                                                    SUBD      499
      N2=N2+NCD                                                                 SUBD      500
      NFP=NCD                                                                   SUBD      501
      NTOT=N2                                                                   SUBD      502
      READ(29,102) (ML(J),NA(J),REC(J),ISO(J),LAMBDA(J),                        5/22/75     3
     .  (BETEN(J,I),I=1,4),J=N1,N2)                                             5/22/75     4
      DO 202 L=N1,N2                                                            SUBD      505
      IF(LAMBDA(L).LE.1.E-30) GO TO 202                                         SUBD      506
      LAMBDA(L)=.69314/86400./LAMBDA(L)                                         SUBD      507
  202 CONTINUE                                                                  SUBD      508
      REWIND 29                                                                 SUBD      509
      ERROR=.FALSE.                                                             SUBD      510
      MP=0                                                                      SUBD      511
      CHAINS=0                                                                  SUBD      512
      DO 3 I=1,96                                                               SUBD      513
    3 NOFNUC(I)=0                                                               SUBD      514
C  CALCULATE LAMBDA IN SEC-1                                                    SUBD      515
      DO 10 J=1,NCD                                                             SUBD      516
      IF(LAMBDA(J).LE.1.E-30) GO TO 104                                         SUBD      517
      LAMBDA(J)=.69314/LAMBDA(J)/86400.                                         SUBD      518
  104 CONTINUE                                                                  SUBD      519
      IF(MP-ML(J)) 4,204,6                                                      NEWLIB      9
  204 IF(NA(J)-NA(J-1).LT.2)  GO TO 5                                           NEWLIB     10
    4 MP=ML(J)                                                                  SUBD      521
C NEW MASS CHAIN                                                                SUBD      522
      CHAINS=CHAINS+1                                                           SUBD      523
C COUNT NUMBER OF NUCLIDES IN THIS CHAIN                                        SUBD      524
    5 NOFNUC(CHAINS)=NOFNUC(CHAINS)+1                                           SUBD      525
      GO TO 8                                                                   SUBD      526
    6 ERROR=.TRUE.                                                              SUBD      527
      PRINT 7,J                                                                 SUBD      528
    7 FORMAT("0LIBRARY ENTRY"I4," IS OUT OF PLACE")                             SUBD      529
```

```
      8 DO 9 L=1,3                                                    SUBD  530
55    9 DKFRCT(J,L)=0.0                                               SUBD  531
     10 CONTINUE                                                      SUBD  532
        IF(ERROR) STOP                                                SUBD  533
C ISO=1 MEANS ISOMERIC STATE, =2 MEANS GROUND STATE                   SUBD  534
        ISOTOP=0                                                      SUBD  535
60      DO 15 K=1,CHAINS                                              SUBD  536
        LIM=NOFNUC(K)                                                 SUBD  537
        J=0                                                           SUBD  538
C  DETERMINE FRACTIONAL DECAY YIELDS                                  SUBD  539
        DO 14 I=1,LIM                                                 SUBD  540
65      J=J+4                                                         SUBD  541
        ISOTOP=ISOTOP+1                                               SUBD  542
        IF(J.EQ.1) GO TO 13                                           SUBD  543
        IF(ISO(ISOTOP).EQ.2) GO TO 11                                 SUBD  544
        DKFRCT(ISOTOP,1)=FRACT(ISOTOP-1)                              SUBD  545
70      GO TO 13                                                      SUBD  546
     11 DKFRCT(ISOTOP,1)=1.-FRACT(ISOTOP-1)                           SUBD  547
        IF(J.EQ.2) GO TO 13                                           SUBD  548
        IF(ISO(ISOTOP-1).EQ.1) GO TO 12                               SUBD  549
        IF(ISO(ISOTOP-2).EQ.2) GO TO 13                               SUBD  550
75      DKFRCT(ISOTOP,2)=FRACT(ISOTOP-2)                              SUBD  551
        GO TO 13                                                      SUBD  552
     12 DKFRCT(ISOTOP,2)=1.-FRACT(ISOTOP-2)                           SUBD  553
        IF(J.EQ.3.OR.ISO(ISOTOP-3).EQ.2) GO TO 13                     SUBD  554
        DKFRCT(ISOTOP,3)=FRACT(ISOTOP-3)                              SUBD  555
80   13 IF(LAMBDA(ISOTOP).LT.1.E-30) J=0                              SUBD  556
     14 CONTINUE                                                      SUBD  557
     15 CONTINUE                                                      SUBD  558
        RETURN                                                        SUBD  559
        END                                                           SUBD  560
```

```
      1              SUBROUTINE METIN                                                  SUBD      823
                     DIMENSION DUMBY(7)                                                SUBD      824
                     REAL IER                                                          SUBD      825
                     REAL KSQ                                                          SUBD      826
      5              COMMON/METCOM/SY(10,1,6),SZ(10,1,6),UBAR,H,NIN,DRFB(10,1,6),NR,NM, METCOM    2
                    1R(10),MET(1,6),NDRF(6)                                            METCOM    3
                C READ METEOROLOGICAL PARAMETERS AND DETERMINE SIGMA Y AND Z FOR N CLASS SUBD      828
                     DO 17 IN=1,NIN                                                    SUBD      829
                     DO 17 IM=1,NM                                                     SUBD      830
     10              READ 100, ITYPE,IFR,DUMBY                                         SUBD      831
                     IGO=ITYPE                                                         SUBD      832
                     IF(IGO.GT.4) IGO=4                                                SUBD      833
                     GO TO (4,1,7,9),IGO                                               SUBD      834
                C   PANFORD MODEL                                                     SUBD      835
     15             1 AH=DUMBY(1)                                                     SUBD      836
                      BH=DUMBY(2)                                                      SUBD      837
                      CH=DUMBY(3)                                                      SUBD      838
                      DH=DUMBY(4)                                                      SUBD      839
                      KSQ=DUMBY(5)                                                     SUBD      840
     20               STUB=DUMBY(6)                                                    SUBD      841
                      IF(IPR.GT.0) PRINT 300, IN,AH,BH,CH,DH,KSQ,STUB                  SUBD      842
                      DO 2 IR=1,NR                                                     SUBD      843
                      TT=R(IR)/UBAR                                                    SUBD      844
                      TT2=TT*TT                                                        SUBD      845
     25               EXPO=-KSQ*TT2                                                    SUBD      846
                      EXX=EXP(EXPO)                                                    SUBD      847
                      OME=1.-EXX                                                       SUBD      848
                      SZ2=BH*TT+OME*AH                                                 SUBD      849
                      SZ(IR,IM,IN)=SQRT(SZ2)                                           SUBD      850
     30               BIGA=CH+DH*STUB                                                  SUBD      851
                      AP=BIGA*.5/(STUB**2)                                             SUBD      852
                      EXPO=-TT/AP                                                      SUBD      853
                      OME=1.-EXP(EXPO)                                                 SUBD      854
                      SY2=BIGA*(TT-AP*OME)                                             SUBD      855
     35               SY(IR,IM,IN)=SQRT(SY2)                                           SUBD      856
                    2 CONTINUE                                                         SUBD      857
                      GO TO 15                                                         SUBD      858
                C   SUTTON MODEL                                                     SUBD      859
                    4 CY=DUMBY(1)                                                      SUBD      860
     40               CZ=DUMBY(2)                                                      SUBD      861
                      EN=DUMBY(3)                                                      SUBD      862
                      IF(IPR.GT.0) PRINT 400,IN,CY,CZ,EN                               SUBD      863
                      SQ2=1./SQRT(2.)                                                  SUBD      864
                      DO 6 IR=1,NR                                                     SUBD      865
     45               SUT=SQ2*(R(IR)**(1.-.5*EN))                                      SUBD      866
                      SY(IR,IM,IN)=SUT*CY                                              SUBD      867
                      SZ(IR,IM,IN)=SUT*CZ                                              SUBD      868
                    6 CONTINUE                                                         SUBD      869
                      GO TO 15                                                         SUBD      870
     50           C  INPUT SIGMA Y AND Z.                                             SUBD      871
                    7 READ(5,200) (SY(IR,IM,IN),IR=1,NR)                               SUBD      872
                      READ(5,200) (SZ(IR,IM,IN),IR=1,NR)                               SUBD      873
                      GO TO 15                                                         SUBD      874
```

```
      C  PASQUILL CURVES FOR SIGMA Y AND Z.                                  SUBD      875
   55      9 ITM3=ITYPE-3                                                    SUBD      876
           CALL PASSIG(SY(1,IM,IN),SZ(1,IM,IN),R,ITM3,NR,IER)                SUBD      877
           DO 10 IR=1,NR                                                     SUBD      878
           SY(IR,IM,IN)=SY(IR,IM,IN)*.01                                     SUBD      879
           SZ(IR,IM,IN)=SZ(IR,IM,IN)*.01                                     SUBD      880
   60     10 CONTINUE                                                       SUBD      881
           IF(IER) 15,15,11                                                  SUBD      882
          11 PRINT 500, IN,ITM3                                              SUBD      883
          15 IF(IPR) 17,17,16                                                SUBD      884
          16 PRINT 600, IN,(R(I),I=1,10),(SY(I,IM,IN),I=1,10),(SZ(I,IM,IN),I=1, SUBD      885
   65     $10)                                                              SUBD      886
          17 CONTINUE                                                        SUBD      887
           RETURN                                                            SUBD      888
         100 FORMAT(2I5,7F10.2)                                              SUBD      889
         200 FORMAT(8E10.2)                                                  SUBD      890
   70    300 FORMAT("0DATA FOR STABILITY "I2/"0HANFORD MODEL, A ="E10.3,"  B =" SUBD      891
          1E10.3,"  C ="E10.3,"  D ="E10.3,"  KSQ ="E10.3,"  SIGTUB ="E10.3) SUBD      892
         400 FORMAT("0DATA FOR STABILITY "I2/"0SUTTON EQUATIONS, CY ="F6.3,"  SUBD      893
          1CZ ="F6.3,"  EN ="F6.3)                                           SUBD      894
         500 FORMAT("0LIMITS OF STORED PASQUILL DATA EXCEEDED FOR TIME PERIOD" SUBD      895
   75    1I3," AND MET TYPE"I3)                                            SUBD      896
         600 FORMAT("0SIGMA Y AND Z FOR STABILITY"I3/43X,"DISTANCE FROM RELEASE SUBD      897
          1POINT METERS"/13X,10F10.0/" SIGMA Y  "10F10.1/" SIGMA Z  "       SUBD      898
          2:0F10.1)                                                         SUBD      899
           END                                                              SUBD      900
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      SUBROUTINE PASSIG(SY,SZ,X,TYPE3,INEXT,ERR)                        SUBD    722
      DIMENSION X(10),SY(10),SZ(10)                                     SUBD    723
      DIMENSION DIST(20),SIGY(6,20),SIGZ(6,20)                          SUBD    724
      INTEGER TYPE3                                                     SUBD    725
      DATA (SIGY(1,I),I=1,20)/100.,2.1E3,3.2E3,5.4E3,7.5E3,1.05E4,1.42E4 SUBD   726
     1,2.E4,2.9E4,4.5E4,6.1E4,8.3E4,1.12E5,1.55E5,2.2E5,3.4E5,4.5E5,    SUBD    727
     26.2E5,8.2E5,1.1E6/                                                SUBD    728
      DATA (SIGY(2,I),I=1,20)/100.,1.6E3,2.4E3,4.E3,5.5E3,7.6E3,1.06E4, SUBD   729
     1,4.8E4,2.15E4,3.4E4,4.6E4,6.3E4,8.4E4,1.2E5,1.68E5,2.6E5,3.5E5,  SUBD    730
     24.7E5,6.4E5,8.5E5/                                                SUBD    731
      DATA (SIGY(3,I),I=1,20)/100.,1.2E3,1.75E3,2.85E3,4.E3,5.5E3,7.6E3, SUBD   732
     1,.06E4,1.55E4,2.4E4,3.3E4,4.5E4,6.1E4,8.5E4,1.2E5,1.85E5,2.5E5,  SUBD    733
     23.4E5,4.7E5,6.3E5/                                                SUBD    734
      DATA (SIGY(4,I),I=1,20)/100.,800.,1.2E3,1.95E3,2.65E3,3.7E3,5.1E3, SUBD   735
     17.2E3,1.04E4,1.6E4,2.25E4,3.1E4,4.2E4,5.7E4,7.1E4,1.25E5,1.7E5,  SUBD    736
     22.3E5,3.E5,4.1E5/                                                 SUBD    737
      DATA (SIGY(5,I),I=1,20)/100.,600.,900.,1450.,2.E3,2.8E3,3.7E3,    SUBD    738
     15.2E3,7.5E3,1.20E4,1.65E4,2.2E4,3.E4,4.1E4,5.7E4,8.8E4,1.18E5,   SUBD    739
     21.6E5,2.1E5,2.8E5/                                                SUBD    740
      DATA (SIGY(6,I),I=1,20)/100.,390.,600.,980.,1350.,1850.,2550.,    SUBD    741
     13600.,5200.,8100.,1.1E4,1.53E4,2.1E4,2.8E4,4.E4,6.1E4,8.2E4,1.12E5 SUBD   742
     2,1.48E5,2.E5/                                                     SUBD    743
      DATA (SIGZ(1,I),I=1,20)/100.,1500.,2250.,4300.,7.E3,1.35E4,2.7E4, SUBD    744
     1e.7E4,2.E5,11*2.E5/                                               SUBD    745
      DATA (SIGZ(2,I),I=1,20)/100.,1.E3,1500.,2550.,3700.,5700.,8600.,  SUBD    746
     11.35E4,2.4E4,5.8E4,1.2E5,2.E5,8*2.E5/                             SUBD    747
      DATA (SIGZ(3,I),I=1,20)/100.,780.,1100.,1750.,2400.,3400.,4600.,  SUBD    748
     16000.,9000.,1.4E4,1.9E4,2.6E4,3.4E4,4.4E4,6.E4,8.8E4,1.12E5,1.44E5 SUBD   749
     2,1.78E5,2.E5/                                                     SUBD    750
      DATA (SIGZ(4,I),I=1,20)/100.,470.,680.,1050.,1400.,1900.,2500.,   SUBD    751
     13300.,4300.,6200.,7600.,9500.,1.15E4,1.4E4,1.7E4,2.2E4,2.65E4,   SUBD    752
     23.2E4,3.7E4,4.5E4/                                                SUBD    753
      DATA (SIGZ(5,I),I=1,20)/100.,300.,430.,710.,940.,1300.,1700.,2200. SUBD   754
     1,2900.,4100.,5000.,6100.,7200.,8400.,9900.,1.17E4,1.3E4,1.4E4,    SUBD    755
     21.55E4,1.7E4/                                                     SUBD    756
      DATA (SIGZ(6,I),I=1,20)/100.,140.,220.,400.,530.,760.,1000.,1350., SUBD   757
     11770.,2500.,3000.,3500.,4100.,4700.,5500.,6400.,7200.,7900.,8600., SUBD   758
     29400./                                                            SUBD    759
      DATA (DIST(I),I=1,20)/0.,1.E4,1.5E4,2.5E4,3.5E4,5.E4,7.E4,1.E5,   SUBD    760
     11.5E5,2.5E5,3.5E5,5.E5,7.E5,1.E6,1.5E6,2.5E6,3.5E6,5.E6,7.E6,1.E7/ SUBD   761
C  CALCULATE SY AND SZ FOR EACH X POSITION DESIRED                      SUBD    762
      IDATA=1                                                           SUBD    763
      ERR=0.                                                            SUBD    764
      DO 19 I=1,INEXT                                                   SUBD    765
      X(I)=X(I)*100.                                                    SUBD    766
    1 IF(IDATA.GT.20) GO TO 8                                           SUBD    767
    2 IF(SIGZ(TYPE3,IDATA)) 8,8,3                                       SUBD    768
    3 IF(X(I)-DIST(IDATA)) 6,5,4                                        SUBD    769
    4 IDATA=IDATA+1                                                     SUBD    770
      GO TO 1                                                           SUBD    771
    5 SZ(I)=SIGZ(TYPE3,IDATA)                                           SUBD    772
      GO TO 9                                                           SUBD    773
    6 IF(IDATA.EQ.1) GO TO 5                                            SUBD    774
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```
                SZ1=SIGZ(TYPE3,IDATA-1)                                  SUBD      775
     55         SZ2=SIGZ(TYPE3,IDATA)                                    SUBD      776
                D1=DIST(IDATA-1)                                         SUBD      777
                D2=DIST(IDATA)                                           SUBD      778
                SZ(I)=SZ1+(X(I)-D1)*(SZ2-SZ1)/(D2-D1)                    SUBD      779
                GO TO 9                                                  SUBD      780
     60       8 ERR=1.0                                                  SUBD      781
                IF(IDATA.GT.20) IDATA=21                                 SUBD      782
                SZ(I)=SIGZ(TYPE3,IDATA-1)                                SUBD      783
              9 CONTINUE                                                 SUBD      784
             11 IF(IDATA.GT.20) GO TO 18                                 SUBD      785
     65         IF(SIGY(TYPE3,IDATA)) 18,18,13                           SUBD      786
             13 IF(X(I)-DIST(IDATA)) 16,15,14                            SUBD      787
             14 IDATA=IDATA+1                                            SUBD      788
                GO TO 11                                                 SUBD      789
             15 SY(I)=SIGY(TYPE3,IDATA)                                  SUBD      790
     70         GO TO 19                                                 SUBD      791
             16 IF(IDATA.EQ.1) GO TO 15                                  SUBD      792
                SY1=SIGY(TYPE3,IDATA-1)                                  SUBD      793
                SY2=SIGY(TYPE3,IDATA)                                    SUBD      794
                D1=DIST(IDATA-1)                                         SUBD      795
     75         D2=DIST(IDATA)                                           SUBD      796
                SY(I)=SY1+(X(I)-D1)*(SY2-SY1)/(D2-D1)                    SUBD      797
                GO TO 19                                                 SUBD      798
             18 ERR=1.0                                                  SUBD      799
                IF(IDATA.GT.20) IDATA=21                                 SUBD      800
     80         SY(I)=SIGY(TYPE3,IDATA-1)                                SUBD      801
             19 X(I)=X(I)*.01                                            SUBD      802
                RETURN                                                   SUBD      803
                END                                                      SUBD      804
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      SUBROUTINE REPT                                                    SUBD    1008
C  SUBROUTINE REPT GENERATES REPORTS                                     SUBD    1009
      DIMENSION TDEP(3),BDEP(4)                                          SUBD    1010
      DIMENSION NBDI(4)                                                  SUBD    1011
      DIMENSION GNAME(3),BNAME(4)                                        SUBD    1012
      COMMON/METCOM/SY(10,1,6),SZ(10,1,6),UBAR,H,NIN,DRFB(10,1,6),NR,NM, METCOM    2
     1R(10),MET(1,6),NDRF(6)                                             METCOM    3
      COMMON/REPTCOM/GDOSE(30,1,6),BDOSE(40,1,6),SDOSE(10,1,6),TDOSE(100 REPTCOM    2
     1,1,6),NBD,NGD,NBG,NGG,NBS,NGS,NBE,NGE,NBDI,CHIQ(10,1,6),EDOSE(10,1 REPTCOM    3
     2,6),IRPT,TITLE(14),RTN(10),RTH(10),GNDOS(10,1,6),TDEP,BDEP        REPTCOM    4
      COMMON/LOGIC/LIBARY,BLIB,GLIB,DLIB,FDRF,BETA,DRFP,CHIQQ,GAMA       LOGIC     2
      LOGICAL BETA, GAMA,CHIQQ                                           SUBD    1016
      DATA BDEP/0.,7.,20.,100./                                          SUBD    1017
      DATA ENAME,SNAME/"EYE       ","SKIN      "/                        SUBD    1018
      DATA BNAME/"BETA 0 MG ","BETA 7 MG ","BETA 20 MG","BETA 100MG"/    SUBD    1019
      DATA GNAME/"GAMMA 0 CM","GAMMA 1 CM","GAMMA 5 CM"/                 SUBD    1020
C                                                                        SUBD    1021
C  IRPT DETERMINES TYPE OF REPORTS TO BE PRINTED.                        SUBD    1022
C                                                                        SUBD    1023
C  IRPT = 1  FOR DETAILED REPORTS.                                       SUBD    1024
C                                                                        SUBD    1025
C  IRPT = 2  FOR SUMMARY REPORTS (CUMULATIVE DOSES ONLY).                SUBD    1026
C                                                                        SUBD    1027
C  IRPT = 3  FOR BRIEF REPORT (DOSE AT END OF LAST RELEASE PERIOD).      SUBD    1028
C                                                                        SUBD    1029
C  IRPT = 1  IS DEFAULT VALUE.                                           SUBD    1030
C                                                                        SUBD    1031
      CALL DATE(DDD)                                                     SUBD    1032
      IF(IRPT.LE.0.OR.IRPT.GT.3) IRPT=1                                  SUBD    1033
      GO TO (10,10,10),IRPT                                              SUBD    1034
C  DETAILED REPORT OF DOSES.                                             SUBD    1035
C                                                                        SUBD    1036
C  DO LOOP ON STABILITY SETS                                             SUBD    1037
   10 IF(.NOT.GAMA.AND..NOT.BETA) GO TO 20                               SUBD    1038
      DO 19 IM=1,NM                                                      SUBD    1039
C  DO LOOP ON RELEASE PERIODS.                                           SUBD    1040
      DO 18 IN=1,NIN                                                     SUBD    1041
      PRINT 100, TITLE,DDD                                               SUBD    1042
      PRINT 200, RTN(IN),RTH(IN),MET(IM,IN),H,(R(I),I=1,NR)              SUBD    1043
      IF(.NOT.GAMA) GO TO 13                                             SUBD    1044
      DO 12  IG=1,NGD                                                    SUBD    1045
      IB=(IG-1)*10+1                                                     SUBD    1046
      IE=IB+NR-1                                                         SUBD    1047
      PRINT 300, TDEP(IG),(GDOSE(II,IM,IN),II=IB,IE)                     SUBD    1048
      IF(IRPT.EQ.1) GO TO 112                                            SUBD    1049
      PUNCH 1700, TITLE(1),GNAME(IG)                                     SUBD    1050
      PUNCH 1600, (GDOSE(II,IM,IN),II=IB,IE)                             SUBD    1051
  112 CONTINUE                                                           SUBD    1052
      IF(IN.EQ.1) GO TO 12                                               SUBD    1053
      PRINT 400, (TDOSE(II,IM,IN),II=IB,IE)                              SUBD    1054
   12 CONTINUE                                                           SUBD    1055
   13 IF(.NOT.BETA) GO TO 15                                             SUBD    1056
C  PRINT BETA DOSE                                                       SUBD    1057
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      DO 14 IB=1,NBD                                                    SUBD    1058
      I1=(IB-1)*10+1                                                    SUBD    1059
      I2=I1+NR-1                                                        SUBD    1060
      ID=NBDI(IB)                                                       SUBD    1061
      PRINT 500, BDEP(IB),(BDOSE(II,IM,IN),II=I1,I2)                    SUBD    1062
      IF(IRPT.EQ.1) GO TO 114                                           SUBD    1063
      PUNCH 1700, TITLE(1),BNAME(ID)                                    SUBD    1064
      PUNCH 1600, (BDOSE(II,IM,IN),II=I1,I2)                            SUBD    1065
  114 CONTINUE                                                          SUBD    1066
      IF(IN.EQ.1) GO TO 14                                              SUBD    1067
      I1=I1+30                                                          SUBD    1068
      I2=I2+30                                                          SUBD    1069
      PRINT 400, (TDOSE(II,IM,IN),II=I1,I2)                             SUBD    1070
   14 CONTINUE                                                          SUBD    1071
C  PRINT SKIN DOSE                                                      SUBD    1072
   15 IF(NBS.LT.1.AND.NGS.LT.1) GO TO 16                                SUBD    1073
      PRINT 600,(SDOSE(I,IM,IN),I=1,NR)                                 SUBD    1074
      IF(IRPT.EQ.1) GO TO 116                                           SUBD    1075
      PUNCH 1700, TITLE(1),SNAME                                        SUBD    1076
      PUNCH 1600, (SDOSE(I,IM,IN),I=1,NR)                               SUBD    1077
  116 CONTINUE                                                          SUBD    1078
      IF(IN.EQ.1) GO TO 16                                              SUBD    1079
      I1=71                                                             SUBD    1080
      I2=70+NR                                                          SUBD    1081
      PRINT 400,(TDOSE(I,IM,IN),I=I1,I2)                                SUBD    1082
C  PRINT EYE DOSE                                                       SUBD    1083
   16 IF(NBE.LT.1.AND.NGE.LT.1) GO TO 17                                SUBD    1084
      PRINT 700,(EDOSE(I,IM,IN),I=1,NR)                                 SUBD    1085
      IF(IRPT.EQ.1) GO TO 117                                           SUBD    1086
      PUNCH 1700, TITLE(1),ENAME                                        SUBD    1087
      PUNCH 1600, (EDOSE(I,IM,IN),I=1,NR)                               SUBD    1088
  117 CONTINUE                                                          SUBD    1089
      IF(IN.EQ.1) GO TO 17                                              SUBD    1090
      I1=91                                                             SUBD    1091
      I2=90+NR                                                          SUBD    1092
      PRINT 400,(TDOSE(I,IM,IN),I=I1,I2)                                SUBD    1093
C  PRINT GENETIC DOSE                                                   SUBD    1094
   17 IF(NBG.LT.1.AND.NGG.LT.1) GO TO 118                               SUBD    1095
      PRINT 800,(GNDOS(I,IM,IN),I=1,NR)                                 SUBD    1096
      IF(IN.EQ.1) GO TO 118                                             SUBD    1097
      I1=81                                                             SUBD    1098
      I2=80+NR                                                          SUBD    1099
      PRINT 400,(TDOSE(I,IM,IN),I=I1,I2)                                SUBD    1100
  118 IF(.NOT.BETA.AND..NOT.GAMA) GO TO 18                              SUBD    1101
      PRINT 1500                                                        SUBD    1102
      IF(NBS.LT.1.AND.NGS.LT.1) GO TO 218                               SUBD    1103
      PRINT 1200, TDEP(NGS),EDEP(NBS)                                   SUBD    1104
  218 IF(NBE.LT.1.AND.NGE.LT.1) GO TO 318                               SUBD    1105
      PRINT 1300, TDEP(NGE),BDEP(NBE)                                   SUBD    1106
  318 IF(NBG.LT.1.AND.NGG.LT.1) GO TO 18                                SUBD    1107
      PRINT 1400, TDEP(NGG),BDEP(NBG)                                   SUBD    1108
   18 CONTINUE                                                          SUBD    1109
   19 CONTINUE                                                          SUBD    1110
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      C  PRINT CHI/Q VALUES                                                  SUBD    1111
         20 IF(.NOT.CHIQQ) GO TO 30                                          SUBD    1112
            PRINT 100,TIT_E,DDD                                              SUBD    1113
110         PRINT 900, H,(R(I),I=1,NR)                                       SUBD    1114
            DO 22 IM=1,NM                                                    SUBD    1115
            DO 21 IN=1,NIN                                                   SUBD    1116
            PRINT 1000, RTN(IN),RTH(IN),  MET(IM,IN), (CHIQ(I,IM,IN),I=1,NR) SUBD    1117
         21 CONTINUE                                                         SUBD    1118
115         PRINT 1100                                                       SUBD    1119
         22 CONTINUE                                                         SUBD    1120
      C  HEADING FORMAT FOR DETAILED DOSE REPORT                             SUBD    1121
        100 FORMAT("1"13A6,A2,20X,"DATE  "A10)                               SUBD    1122
        200 FORMAT("0"30X,"DOSE FOR "F4.1,A5," RELEASE PERIOD, STABILITY "A10/ SUBD    1123
120       1  "  DOSE TYPE"    50X ,"DISTANCE, METERS"10X,"RELEASE HEIGHT"F5.0 SUBD    1124
          2," METERS"/21X,10F11.0)                                           SUBD    1125
      C  GAMMA DOSE FORMAT                                                   SUBD    1126
        300 FORMAT("0GAMMA   "F3.0," CM"6X,1P10E11.3)                        SUBD    1127
      C  CUMULATIVE DOSE FORMAT                                              SUBD    1128
125   400 FORMAT(" TOTAL DOSE THIS TYPE"1P10E11.3)                           SUBD    1129
      C  BETA DOSE FORMAT                                                    SUBD    1130
        500 FORMAT("0BETA   "F4.0," MG/CM2  "1P10E11.3)                      SUBD    1131
      C  SKIN DOSE FORMAT                                                    SUBD    1132
        600 FORMAT("0SKIN"16X,1P10E11.3)                                     SUBD    1133
130   C  EYE  DOSE FORMAT                                                    SUBD    1134
        700 FORMAT("0EYE"17X,1P10E11.3)                                      SUBD    1135
      C  GENETIC DOSE FORMAT                                                 SUBD    1136
        800 FORMAT("0GENETIC"13X,1P10E11.3)                                  SUBD    1137
      C  CHI/Q TITLE FORMAT                                                  SUBD    1138
135     900 FORMAT(40X,"NORMALIZED AIR CONCENTRATION",                       SUBD    1139
     .         /"0PERIOD    STABILITY "40X,"DISTANCE, METERS"10X"RELEASE HE SUBD    1140
          1IGHT "F5.0,"METERS"/21X,10F11.0)                                  SUBD    1141
       1000 FORMAT(1X,F4.1,A5,1X,A10,1P10E11.3)                              SUBD    1142
       1100 FORMAT(/)                                                        SUBD    1143
140    1200 FORMAT(" SKIN DOSE IS"   F5.1," CM GAMMA DOSE +"F5.0," MG/CM2 BETA SUBD    1144
          1 DOSE.")                                                          SUBD    1145
       1300 FORMAT(" EYE DOSE IS "   F5.1," CM GAMMA DOSE +"F5.0," MG/CM2 BETA SUBD    1146
          1 DOSE.")                                                          SUBD    1147
       1400 FORMAT(" GENETIC DOSE IS"F5.1," CM GAMMA DOSE +"F5.0," MG/CM2 BETA SUBD    1148
145       1 DOSE.")                                                          SUBD    1149
       1500 FORMAT(//)                                                       SUBD    1150
       1600 FORMAT(10E8.3)                                                   SUBD    1151
       1700 FORMAT(A5,A10,"1")                                               SUBD    1152
         30 RETURN                                                           SUBD    1153
150      END                                                                 SUBD    1154
```

```
      SUBROUTINE SOURCE                                                  SUBD      674
C  SUBROUTINE SOURCE CONTROLS LIBRARY READING AND RELEASE RATE SPECIFICA SUBD      675
C                                                                        SUBD      676
      DIMENSION TITL(14)                                                 SUBD      677
      DIMENSION QUANTY(600)                                              SUBD      678
      DIMENSION NAME(600),M(600)                                         SUBD      679
      COMMON/MAINC/NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(500,7),         NEWLIB     1
     ,LAMBDA(500),CHAINS,DKFACT(350,3),BURST(500,12),REC(500),D(10),     NEWLIB     2
     ,BETEN(500,4),GROUPS,ML(500),DKF(120,1,6),NMET,HH,NREL,ICL(500)     NEWLIB     3
      REAL LAMBDA,MASS                                                   SUBD      681
      INTEGER REC                                                        SUBD      682
      INTEGER CHAINS,SKIP                                                SUBD      683
C                                                                        SUBD      684
    1 FORMAT(I3)                                                         SUBD      685
      PRINT 300                                                          SUBD      686
  300 FORMAT("1")                                                        SUBD      687
    4 DO 17 IN=1,NREL                                                    SUBD      688
      READ 100, TITL                                                     SUBD      689
      PRINT 200, TITL                                                    SUBD      690
  100 FORMAT(13A6,A2)                                                    SUBD      691
  200 FORMAT("0"13A6,A2)                                                 SUBD      692
      DO 104 I=1,NTOT                                                    SUBD      693
  104 MASS(I,IN)=0.                                                      SUBD      694
C                                                                        SUBD      695
C  READ NUCLIDE INVENTORY FROM CARDS                                     SUBD      696
   10 READ 1,NUMBER                                                      SUBD      697
      READ 11, (NAME(I),M(I),QUANTY(I),I=1,NUMBER)                       SUBD      698
   11 FORMAT(4(A3,I3,E14.0))                                             SUBD      699
      PRINT 6, IN                                                        SUBD      700
    6 FORMAT(" NUCLIDE INVENTORY IN CURIES FOR RELEASE TIME "I2)         SUBD      701
      PRINT 7, (NAME(I),M(I),QUANTY(I),I=1,NUMBER)                       SUBD      702
    7 FORMAT(4(2XA3,I3,1PE10.2) )                                        SUBD      703
C                                                                        SUBD      704
C  TRY TO IDENTIFY NUCLIDES READ FROM CARDS                              SUBD      705
      DO 16 I=1,NUMBER                                                   SUBD      706
      DO 13 J=1,NTOT                                                     SUBD      707
      IF(NAME(I).EQ.REC(J).AND.M(I).EQ.ML(J)) GO TO 15                   SUBD      708
   13 CONTINUE                                                           SUBD      709
C                                                                        SUBD      710
C  IF CAN NOT IDENTIFY NUCLIDE -STOP                                     SUBD      711
      PRINT 14, NAME(I),M(I)                                             SUBD      712
   14 FORMAT("0UNKNOWN ISOTOPE - "A3,I3)                                 SUBD      713
      STOP                                                               SUBD      714
C  CONVERT CURIES TO CURIE-SEC                                           SUBD      715
   15 IF(LAMBDA(J).LE.1.E-30) GO TO 16                                   SUBD      716
      MASS(J,IN)=QUANTY(I)/LAMBDA(J)                                     SUBD      717
   16 CONTINUE                                                           SUBD      718
   17 CONTINUE                                                           SUBD      719
      RETURN                                                             SUBD      720
      END                                                                SUBD      721
```

```
      SUBROUTINE UNITS(TLN,TLH,NDT,X,IUNIT)                              SUBD      429
      DIMENSION TLN(10),TLH(10),DL(10),X(10)                             SUBD      430
      DIMENSION DT(10)                                                   SUBD      431
      DATA ADNE/" SEC,"/                                                 SUBD      432
      DATA ATWO/" MIN,"/                                                 SUBD      433
      DATA ATHREE/5HHOURS/                                               SUBD      434
      DATA AFOUR/" DAYS"/                                                SUBD      435
      DATA AFIVE/" YRS,"/                                                SUBD      436
C     IUNIT INDICATES UNITS OF NUMBERS TO BE TESTED                      SUBD      437
      DO 1018 L=1,NDT                                                    SUBD      438
      GO TO (1,2,3,4,5),IUNIT                                            SUBD      439
C     INPUT UNITS ARE SECONDS                                            SUBD      440
    1 DL(L)=X(L)                                                         SUBD      441
      GO TO 6                                                            SUBD      442
C     INPUT UNITS ARE MINUTES                                            SUBD      443
    2 DL(L)=X(L)*60.                                                     SUBD      444
      GO TO 6                                                            SUBD      445
C     INPUT UNITS ARE HOURS                                              SUBD      446
    3 DL(L)=X(L)*3600.                                                   SUBD      447
      GO TO 6                                                            SUBD      448
C     INPUT UNITS ARE DAYS                                               SUBD      449
    4 DL(L)=X(L)*86400.                                                  SUBD      450
      GO TO 6                                                            SUBD      451
C     INPUT UNITS ARE YEARS                                              SUBD      452
    5 DL(L)=X(L)*3.15576E7                                               SUBD      453
    6 CONTINUE                                                           SUBD      454
      DT(L)=DL(L)                                                        SUBD      455
C     DETERMINE UNITS FOR TITLES                                         SUBD      456
      TRY=DT(L)/100.                                                     SUBD      457
      IF(TRY-1.) 1010,1010,1011                                          SUBD      458
1010  TLN(L)=DT(L)                                                       SUBD      459
      TLH(L)=ADNE                                                        SUBD      460
      GO TO 1018                                                         SUBD      461
1011  TRY=DT(L)/3600.                                                    SUBD      462
      IF(TRY-1.) 1012,1012,1013                                          SUBD      463
1012  TLN(L)=60.*TRY                                                     SUBD      464
      TLH(L)=ATWO                                                        SUBD      465
      GO TO 1018                                                         SUBD      466
1013  TRY=TRY/24.                                                        SUBD      467
      IF(TRY-1.) 1014,1015,1015                                          SUBD      468
1014  TLN(L)=24.*TRY                                                     SUBD      469
      TLH(L)=ATHREE                                                      SUBD      470
      GO TO 1018                                                         SUBD      471
1015  TRY=TRY/365.                                                       SUBD      472
      IF(TRY-1.) 1016,1017,1017                                          SUBD      473
1016  TLN(L)=365.*TRY                                                    SUBD      474
      TLH(L)=AFOUR                                                       SUBD      475
      GO TO 1018                                                         SUBD      476
1017  TLN(L)=TRY                                                         SUBD      477
      TLH(L)=AFIVE                                                       SUBD      478
1018  CONTINUE                                                           SUBD      479
      RETURN                                                             SUBD      480
      END                                                                SUBD      481
```

FIGURE B-6. Library BISLIB Listing

```
BISLIB - BETA ENDPOINT ENERGY LIBRARY

532500    ISOSHIELD BETA END POINT LIBRARY          E.O.   12/10/69     19
C
   THE SYMBOLS IN COLUMNS 73-5 INDICATE THE SOURSE OF THE DATA ON A
              PARTICULAR ISOTOPE.
   SYMBOLS                        REFERENCES
   H1       1ST TABLE IN   THE TABLE OF ISOTOPES   BY LEDERER, HOLLANDER,
              AND PERLMAN
   H2       2ND TABLE IN   THE TABLE OF ISOTOPES
   H3       BOTH TABLES IN   THE TABLE OF ISOTOPES
   NDS      NUCLEAR DATA SHEETS -- (1959-1965)
   PR       PHYSICAL REVIEW
   JPS      JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN
   INC      JOURNAL OF INORGANIC NUCLEAR CHEMISTRY
   CJP      CANADIAN JOURNAL OF PHYSICS
   ZP       ZEITSCHRIFT FUR PHYSIK
   O        OTHER REFERENCES
                        IN COLUMN 76
   1   INDICATES THAT THIS IS A FIRST FORBIDDEN TRANSITION AND IS USED
         FOR A SPECIAL VERSION OF ISOSHIELD  BY J.R.HOUSTON

 7230ZN2 2 .90  .28  .10  .23                                          H2  001K
 7231GA2 9 .08 3.16  .04 2.54  .04 2.27  .05 1.93  .08 1.48  .30  .96  H2  002K
 .22  .67  .15  .66                                                        002
 7232GE2 0                                                             H2  003S
 7330ZN2 0                                                             NDS 004U
 7331GA2 3 .01 1.48  .93 1.19  .06  .45                                H2  005K
 7332GE2 0                                                             H2  006S
 7431GA2 6 .03 4.3   .69 2.65  .10 2.27  .03 2.05  .04 1.84  .11 1.10  NDS 007K
 7432GE2 0                                                             H2  008S
 7531GA2 1 1.0 3.5                                                     CR  009U
 7532GE1 0                                                             H2  010K
 7532GE2 5 .87 1.20 .014 1.00  .11  .94 .003  .73 .004  .57            H2  011K
 7533AS2 0                                                             H2  012S
 7631GA2 1 1.0 6.0                                                     FSJ 013U
 7632GE2 0                                                             H2  014S
 7633AS2 9 .53 2.97  .35 2.41 .069 1.75 .021 1.18 .002  .87 .003  .86  H2  015K
 .01  .54 .012  .32                                                        015
 7634SE2 0                                                             H2  016S
 7732GE1 2 .55 2.91  .21 2.70                                          H2  017K
 7732GE2 9 .15 2.28  .24 2.12  .22 1.56  .05 1.29  .13 1.19  .08  .75  H2  018K
 .02  .67  .03  .40                                                        018
 7733AS2 4.066  .68 .023  .44 .003  .43 .008  .16                      H2  019K
 7734SE1 0                                                             H2  020K
 7734SE2 0                                                             H2  021S
 7832GE2 2 .94  .71  .06  .70                                          H2  022K
 7833AS2 7 .47 4.27  .19 3.65 .097 2.96 .062 1.86  .14 1.00 .021 1.49  NDS 023K
 .022 1.42                                                                 023
 7834SE2 0                                                             H2  024S
 7933AS2 5.945 2.10 .015 1.75  .02 1.67 .005 1.38 .015 1.21            H2  025K
 7934SE1 0                                                             H2  026K
 7934SE2 1 1.0 .154                                                    H2  027K
 7935BR2 0                                                             H2  028S
 8033AS2 8.265 6.00  .32 5.33  .01 4.92 .017 4.23  .04 4.14  .04 3.68  H2  029K
 .005 3.50 .003 2.97                                                       029
```

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```
8034SE2 0                                                                  H2   030S
8035BR1 0                                                                  H2   031K
8035BR2 4 .85 2.01  .06 1.39 .003  .75 .0016 .69                           H2   032K
8036KR2 0                                                                  H2   033S
8133AS2 1 1.0 3.3                                                          H2   034K
8134SE1 0                                                                  H2   035K
8134SE2 3 .99 1.58 .006 1.02 .004  .75                                     H2   036K
8135BR2 0                                                                  H2   037S
8136KR2 0                                                                  H2   038K
8234SE2 0                                                                  NDS 039S
8235BR2 1 1.0  .44                                                         H2   040K
8236KR2 0                                                                  H2   041S
8334SE1 2 .90 3.4   .10 1.5                                                NDS 042K
8334SE2 1 1.0 1.5                                                          NDS 043K
8335BR2 2.986  .93 .014  .40                                               H2   044K
8336KR1 0                                                                  H2   045K
8336KR2 0                                                                  H2   046S
8434SE2 1 1.0  .49                                                         O    047
8435BR1 3 .08 3.2   .72 1.9   .20  .8                                      NDS 048K
8435BR2 9 .32 4.70  .14 3.82  .15 2.80  .01 1.79  .14 1.35  .02 1.00      H2   049K
.19  .79  .03  .52                                                              049
8436KR2 0                                                                  H2   050S
8533AS2 1 1.0 2.5                                                          O    051
8534SE2 1 1.0 5.0                                                          O    052
8535BR2 1 1.0  2.5                                                         H2   053K
8536KR1 1 .77  .83                                                         H2   054K
8536KR2 2.9959 .67 .0041 .16                                               H2 1055K
8537RB2 0                                                                  H2   056S
8634SE2 1 1.0 4.0                                                          O    057
8635BR2 1 1.0 8.0                                                          O    058
8636KR2 0                                                                  H2   059S
8637RB1 0                                                                  H2   060K
8637RB2 2.912 1.78 .088  .70                                               H2 1061K
8638SR2 0                                                                  H2   062S
8734SE2 1 1.0 9.0                                                          O    063
8735BR2 2 .30 8.0   .70 2.6                                                NDS 064K
8736KR2 3 .70 3.8   .05 3.3   .25 1.3                                      H2   065K
8737RB2 1 1.0 .274                                                         H2   066K
8738SR1 0                                                                  H2   067K
8738SR2 0                                                                  H2   068S
8835BR2 1 1.0 3.2                                                          O    069
8836KR2 3 .20 2.8   .12  .9   .68  .52                                     H2   070K
8837RB2 8 .76 5.2   .04 3.36  .14 2.47 .017 1.96 .003 1.68 .00081.52      H2 1071K
.025  .68 .017  .35                                                             1071
8838SR2 0                                                                  H2   072S
8935BR2 1 1.0 3.0                                                          O    073
8936KR2 2 .65 3.9   .35 2.0                                                NDS 074K
8937RB2 7 .07 3.92  .05 2.87  .53 1.61  .02 1.33  .03 1.17  .28  .68      H2   075K
.02  .42                                                                        075
8938SR2 2 1.0 1.463.0001 .553                                              H2 1076K
8939Y 1 0                                                                  H2   077K
8939Y 2 0                                                                  H2   078S
9035BR2 1 1.0 3.0                                                          O    079
9036KR2 9 .07 2.93  .47 2.78  .10 2.54  .13 2.28  .07 2.15  .04 2.08      H2   080K
```

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BESLIB - BETA ENDPOINT ENERGY LIBRARY

```
.05 1.85  .03 1.37  .04  .95                                                          080
9037RB212 .05 5.60  .10 5.77  .06 4.91  .05 4.65  .05 4.37  .06 3.53        H2   081K
.07 3.26  .23 2.45  .17 2.25  .05 2.08  .02 1.52  .03 1.37                          081
9038SR2 1 1.0  .546                                                         H2  1082K
9039Y 1 1.004  .64                                                          H2   083K
9039Y 2 2 1.0 2.27 .0002 .52                                                H2  1084K
9040ZR2 0                                                                   H2   085S
9135KR2 1 1.0 3.6                                                           NDS  086K
9137RB1 1 1.0 3.0                                                           NDS  087K
9137RB2 1 1.0 4.5                                                           NDS  088K
9138SR2 5 .27 2.57  .04 2.03  .29 1.37  .33 1.09  .07  .51                  H2  1089K
9139Y 1 0                                                                   H2   090K
9139Y 2 2.997 1.35 .003  .34                                                H2  1091K
9140ZR2 0                                                                   H2   092S
9235KR2 1 1.0 2.7                                                           0    093
9237RB2 1 1.0 3.0                                                           0    094
9238SR2 2 .10 1.5  .90  .53                                                 H3   095K
9239Y 2 7 .86 3.63 .031 2.70 .023 2.25 .015 2.14 .008 1.80 .005 1.58        H2  1096K
.06 1.30                                                                        1096
9240ZR2 0                                                                   H2   097S
9335KR2 1 1.0 3.8                                                           0    098
9337RB2 1 1.0 2.8                                                           0    099
9338SR2 3 .65 2.9   .25 2.6   .10 2.2                                       H2   100K
9339Y 2 6 .90 2.89  .04 2.62  .53 1.95 .009 1.47 .018  .71 .002  .45        H2   101K
9340ZR2 2 .05  .09  .95  .06                                                H2   102K
9341NB1 0                                                                   H2   103K
9341NB2 0                                                                   H2   104S
9436KR2 1 1.0 2.7                                                           0    105
9437RB2 1 1.0 4.6                                                           0    106
9438SR2 1 1.0 2.1                                                           H2   107K
9439Y 2 1 1.0 3.0                                                           NDS  108K
9440ZR2 0                                                                   H2   109S
9441NB1 2.002 1.23 .0001 .53                                                H2   110K
9441NB2 1 1.0  .49                                                          H2   111K
9442MO2 0                                                                   H2   112S
9536KR2 1 1.0 4.6                                                           0    113
9537RB2 1 1.0 3.6                                                           0    114
9538SR2 1 1.0 2.7                                                           0    115
9539Y 2 1 1.0 2.1                                                           0    116
9540ZR2 3 .02 .886  .49 .397  .49 .355                                      H2   117K
9541NB1 0                                                                   H2   118K
9541NB2 2.0007.925  1.0 .160                                                H2   119K
9542MO2 0                                                                   H2   120S
9639Y 2 1 1.0 3.5                                                           INC  121U
9640ZR2 0                                                                   H2   122S
9641NB2 3 .27  .72  .68  .71  .05  .50                                      H2   123K
9642MO2 0                                                                   H2   124S
9736KR2 1 1.0 4.2                                                           0    125
9737RB2 1 1.0 4.4                                                           0    126
9738SR2 1 1.0 3.6                                                           0    127
9739Y 2 1 1.0 2.3                                                           0    128
9740ZR2 2 .93 1.92  .07  .57                                                H2   129K
9741NB1 0                                                                   H2   130K
9741NB2 2 .98 1.27  .02  .91                                                H2   131K
```

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```
 9742402 0                                                                                                  H2  132S
 9840782 1 1.0 2.0                                                                                          O   133
 9841N81 1 1.0 3.5                                                                                          CJP 134U
 9841N82 1 1.0 2.6                                                                                          CJP 135U
 9842402 0                                                                                                  H2  136S
 9940782 1 1.0 3.6                                                                                          NDS 137
 9941N82 1 1.0 3.2                                                                                          NDS 138K
 9942402 4 .82 1.23  .01  .86  .17  .45 .003  .26                                                            H2  139K
 9943TC1 0                                                                                                  H2  140K
 9943TC2 1 1.0  .292                                                                                        H2  141K
 9944BU2 0                                                                                                  H2  142S
10041N82 3 .10 4.2   .45 3.5   .45 3.1                                                                      H2  143K
10042402 0                                                                                                  H2  144S
10043TC2 1 1.0 3.4                                                                                          H2  145K
10044BU2 0                                                                                                  H2  146S
10141N82 1 1.2 1.33                                                                                         O   147
10142402 6 .10 2.23  .25 1.61  .11 1.23  .13  .84  .38  .74  .03  .66                                       H2  148K
10143TC2 2 .90 1.32  .08 1.07                                                                               NDS 149K
10144BU2 0                                                                                                  H2  150S
10242402 1 1.0 1.2                                                                                          NDS 151U
10243TC2 1 1.0 4.1                                                                                          NDS 152K
10244BU2 0                                                                                                  H2  153S
10343TC2 1 1.0 2.3                                                                                          NDS 154U
10344BU2 6 .03  .79 .005  .45 .005  .33  .89  .20  .07  .09                                                 H2  155K
10345BH1 0                                                                                                  H2  156K
10345BH2 0                                                                                                  H2  157S
10442402 2 .50 4.8   .50 2.2                                                                                INC 158U
10443TC2 1 1.0 2.4                                                                                          NDS 159K
10444BU2 0                                                                                                  H2  160S
10445BH1 2.0015 .52 .0003 .34                                                                               H2  161K
10445BH2 3 .93 2.47 .019 1.91 .0013 .67                                                                     H2  162K
10446BD2 0                                                                                                  H2  163S
10542402 2 .50 4.9   .50 2.2                                                                                INC 164U
10543TC2 1 1.0 3.4                                                                                          ZP  165U
10544BU2 6 .10 1.87  .48 1.145.306 1.08  .08 .915 .048 .525 .001 .136                                       NDS 166K
10545BH1 0                                                                                                  H2  167K
10545BH2 4 .75 .565  .85 .259  .20 .246 .0004 .122                                                          H2  168K
10546BD2 0                                                                                                  H2  169S
10644BU2 1 1.0 .0394                                                                                        H2  170K
10645BH1 4 .11 1.62  .11 1.18  .38  .95  .40  .79                                                           H2  171K
10645BH2 9 .79 3.54  .08 3.03  .11 2.41  .01 1.98 .004 1.54 .001 1.27                                       H2  172K
.001 1.10 .001  .91 .001  .66                                                                                   172
10646BD2 0                                                                                                  H2  173S
10743TC2 1 1.0 2.7                                                                                          O   174
10744BU2 6 .74 3.2   .01 3.0   .06 2.63  .04 2.37  .11 2.15  .04 1.91                                       H2  175K
10745BH2 5 .12 1.51  .71 1.20  .08 1.12  .02  .34  .07  .84                                                 H2  176K
10746BD2 1 1.0 .035                                                                                         H2  177K
10747AG2 0                                                                                                  H2  178S
10844BU2 2 .72 1.3   .28 1.14                                                                               H2  179K
10845BH2 4 .51 4.5   .17 4.1   .05 3.6   .22 3.5                                                            H2  180K
10846BD2 0                                                                                                  H2  181S
10847AG1 0                                                                                                  H2  182K
10847AG2 3 .95 1.54 .019 1.01 .0002 .16                                                                     H2  183K
10944BU2 0                                                                                                  H2  184S
```

BISLIB - BETA ENDPOINT ENERGY LIBRARY

```
10945RH2 1 1.0 2.8                                                          NDS 185
10946PD1 0                                                                  H2  186K
10946PD2 3.99971.03 .0001 .40 .0002 .26                                     H2  187K
10947AG1 0                                                                  H2  188K
10947AG2 0                                                                  H2  189S
11046PD2 0                                                                  H2  190S
11047AG1 3.006 1.45  .31  .51  .67  .07                                     H2  191K
11047AG2 3.956 2.87 .045 2.21 .0005 1.4                                     H2  192K
11048CD2 0                                                                  H2  193S
11146PD1 1 .32  .61                                                         NDS 194U
11146PD2 1 1.0 2.13                                                         NDS 195K
11147AG1 0                                                                  H2  196K
11147AG2 3 .93 1.05  .01  .80  .06  .71                                     H2  197K
11148CD1 0                                                                  H2  198K
11148CD2 0                                                                  H2  199S
11246PD2 1 1.0  .30                                                         H2  200K
11247AG213 .56 4.04  .18 3.42 .028 2.73 .009 2.63 .016 2.57 .006 2.20       NDS 201K
 .053 2.01 .044 1.78  .02 1.61 .018 1.50 .036 1.34 .026 1.22 .008  .92          201
11248CD2 0                                                                  H2  202S
11346PD2 1 1.0 3.3                                                          NDS 203K
11347AG1 1 .10 2.0                                                          NDS 204U
11347AG2 1 1.0 2.0                                                          NDS 205K
11348CD1 1.994  .57                                                         H2  206K
11349CD2 0                                                                  H2  207S
11349IN2 0                                                                  H2  208S
11446PD2 1 1.0 1.4                                                          NDS 209K
11447AG2 1 1.0 4.6                                                          NDS 210K
11448CD2 0                                                                  H2  211S
11449IN1 0                                                                  H2  212K
11449IN2 2 .98 1.986 .002 .687                                              H2  213K
11546PD2 1 1.0 4.4                                                          PR  214U
11547AG1 1 .28 3.2                                                          PR  215K
11547AG2 3 .09 2.93  .73 2.87  .18 2.73                                     PR  216K
11548CD1 5 .97 1.63 .016  .70 .0007 .50 .009  .34 .004  .21                 H2  217K
11548CD2 4 .62 1.12 .014  .85  .10  .62  .27  .59                           H2  218K
11549IN1 1 .05  .43                                                         H2  219K
11549IN2 1 1.1  .49                                                         H2  220K
11550SN2 0                                                                  H2  221S
11646PD2 1 1.0  .93                                                         O   222
11647AG2 2 .80 5.0   .20 4.3                                                PR  223K
11648CD2 0                                                                  H2  224S
11649IN1 4 .48 1.01 .395  .87  .11  .59 .015  .34                           H2  225K
11649IN2 4 .99 3.33  .01 2.04 .001 1.61 .001 1.11                           H2  226K
11650SN2 0                                                                  H2  227S
11747AG2 1 1.0 3.8                                                          NDS 228
11748CD112 .03 1.90  .04 1.59  .01 1.42  .08 1.40  .04  .97  .03  .71       H2  229K
  .34  .65  .08  .55  .26  .34  .03  .33  .01  .26  .05  .24                    229
11748CD210 .12 2.21  .07 1.93  .09 1.85  .16 1.77 .004 1.64  .01 1.47       H2  230K
  .02  .82  .07  .81  .38  .63  .03  .59                                       230
11749IN1 2 .37 1.78  .16 1.63                                               H2  231K
11749IN2 1 1.0  .74                                                         H2  232K
11750SN1 0                                                                  H2  233K
11750SN2 0                                                                  H2  234S
11849PD2 1 1.0  .8                                                          H2  235K
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11849IN2 2 .85 4.2 .15 3.0	H2	236K
11950SN2 0	H2	237S
11948CD1 1 1.0 1.2	PR	238U
11948CD2 1 1.0 3.5	PR	239U
11949IN1 3 .40 2.8 .50 2.78 .05 1.38	H2	240K
11949IN2 1 1.0 1.66	H2	241K
11950SN1 0	H2	242K
11950SN2 0	H2	243S
12049IN2 7 .27 3.12 .06 2.65 .41 2.24 .05 2.13 .03 1.91 .01 1.73	H2	244K
.02 1.50		244
12050SN2 0		245S
12149CD2 1 1.0 1.7	O	246
12149IN1 1 1.0 3.7	NDS	247K
12149IN2 1 1.0 2.9	NDS	248K
12150SN1 1 1.0 .416	H2	249K
12150SN2 1 1.0 .393	H2	250K
12151SD2 0	H2	251S
12249IN2 1 1.0 4.8	PR	252U
12250SN2 0	H2	253S
12251SD1 0	H2	254K
12251SD2 3 .30 1.972 .63 1.403 .04 .722	H2	1255K
12252TE2 0	H2	256S
12349IN2 1 1.0 3.3	NDS	257K
12350SN1 1 1.0 1.24	H2	1258K
12350SN2 1 1.0 1.42	H2	259K
12351SD2 0	H2	260S
12352TE1 0	H2	261K
12352TE2 0	H2	262S
12450SN2 0	H2	263S
12451SD1 1 .20 1.174	H2	264K
12451SD2 8 .22 2.313 .03 1.669 .05 1.59 .015 1.015 .05 .954 .50 .621	H2	265K
.11 .225 .02 .05		265
12452TE2 0	H2	266S
12550SN1 6 .99 2.04 .00151.73 .005 1.46 .0017 .90 .01 .65 .003 .43	H2	1267K
12550SN2 6 .95 2.34 .009 1.27 .0025 .93 .019 .46 .019 .35 .002 .11	H2	268K
12551SD2 7 .13 .62 .06 .44 .43 .30 .01 .24 .28 .13 .07 .12	H2	269K
.02 .03		269
12552TE1 0	H2	270K
12552TE2 0	H2	271S
12650SN2 1 1.0 .23	INC	272U
12651SD1 1 .01 1.9	NDS	273K
12651SD2 1 1.0 1.9	NDS	274K
12652TE2 0	H2	275S
12750SN2 1 1.0 3.2	NDS	276U
12751SD2 3 .30 1.57 .20 1.11 .50 .85	H2	277K
12752TE1 1.004 .73	H2	278K
12752TE2 2.497 .69 .0032 .27	H2	279K
12753T 2 0	H2	280S
12850SN2 1 1.0 1.3	NDS	2810
12851SD1 1 1.0 1.0	NDS	282K
12851SD2 1 1.0 2.9	NDS	283K
12852TE2 0	H2	284S
12[illegible] 2 1 .79 2.1[illegible] .11 1.70 .01[illegible] 1.1[illegible]	H2	285K
12852VE2 0	H2	286S

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12951SB2 1 1.0 1.87                                                                                                  NDS 287U
12952TE1 2 .30 1.59  .06  .89                                                                                        H2  288K
12952TE2 5 .81 1.45  .01 1.20  .16 1.0   .01  .40 .002  .22                                                         H2  289K
12953I 2 1 1.0  .15                                                                                                  H2  290K
12954XE2 0                                                                                                           H2  291S
13050SN2 1 1.0 2.0                                                                                                   NDS 292U
13051SB2 1.1.0 1.7                                                                                                   0   293
13052TE2 0                                                                                                           H2  294S
13053I 2 3.004 1.78  .52 1.04  .48  .62                                                                              H2  295K
13054XE2 0                                                                                                           H2  296S
13151SB2 2 .85 3.2   .15 3.0                                                                                         NDS 297U
13152TE111 .05 2.46  .16  .83  .07  .63  .13  .56  .03  .53  .12  .50                                                H2  298K
 .11  .48  .10  .45 .005  .33  .04  .22 .003  .13                                                                        298
13152TE2 9 .62 2.13 .014 1.79  .20 1.68 .087 1.40 .024 1.18  .01 1.13                                                H2  299K
.015  .86 .016  .84 .014  .79                                                                                            299
13153I 2 5.006 .806 .904 .606 .005 .467 .069 .333 .016 .247                                                          H2  300K
13154XE1 0                                                                                                           H2  301K
13154XE2 0                                                                                                           H2  302S
13251SB2 1 1.0 2.7                                                                                                   0   303
13252TE2 1 1.0  .22                                                                                                  H2  304K
13253I 2 8 .19 2.12  .06 1.76  .09 1.60  .20 1.16  .18  .98  .05  .90                                                H2  305K
 .08  .80  .16  .72                                                                                                      305
13254XE2 0                                                                                                           H2  306S
13351SB2 1 1.0 2.7                                                                                                   0   307
13352TE1 2 .17 2.4   .70 1.3                                                                                         NDS 308K
13352TE2 1 1.0 2.4                                                                                                   NDS 309K
13353I 2 2 .91 1.3   .09  .65                                                                                        NDS 310K
13354XE1 0                                                                                                           H2  311K
13354XE2 2.993 .347 .007 .268                                                                                        H2  312K
13355CS2 0                                                                                                           H2  313S
13451SB2 1 1.0 3.5                                                                                                   0   314
13452TE2 1 1.0 1.4                                                                                                   INC 315U
13453I 2 8 .25 2.41  .12 2.21 .095 1.81 .075 1.68  .15 1.49  .23 1.25                                                NDS 316K
 .01 1.05 .065  .50                                                                                                      316
13454XE2 0                                                                                                           H2  317S
13455CS1 1 .01  .35                                                                                                  H3  318K
13455CS2 3 .71  .66 .025  .42  .27  .1                                                                               H2  319K
13456BA2 0                                                                                                           H2  320S
13551SB2 1 1.0 3.2                                                                                                   0   321
13552TE2 1 1.0 2.7                                                                                                   0   322
13553I 2 3 .25 1.4   .40 1.0   .35  .50                                                                              H2  323K
13554XE1 0                                                                                                           H2  324K
13554XE2 2 .97  .91  .03  .55                                                                                        H2  325K
13555CS2 1 1.0  .21                                                                                                  H2  326K
13556BA1 0                                                                                                           H2  327K
13556BA2 0                                                                                                           H2  328S
13653I 2 6 .06 7.00  .15 5.60  .24 4.37  .44 4.23  .05 4.16  .06 2.73                                                NDS 329K
13654XE2 0                                                                                                           H2  330S
13655CS2 3 .07  .67  .02  .48  .91  .33                                                                              H2  331K
13656BA2 0                                                                                                           H2  332S
13753I 2 1 1.0 2.2                                                                                                   0   333
13754XE2 2 .33 4.0   .07 3.6                                                                                         H2  334K
13755CS2 2.069 1.176 .845  .514                                                                                      H2  335K
13756BA1 0                                                                                                           H2  336K
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13756BA2 0                                                                                                  H2  337S
13853I  2 1 1.0 3.1                                                                                         0   338
13854XE2 1 1.0 2.4                                                                                          NDS 339K
13855CS2 7 .21 3.40  .12 2.94  .16 2.62  .05 2.53  .36 2.39  .10 2.20                                       H2  340K
.005 1.49                                                                                                       340
13856BA2 0                                                                                                  H2  341S
13953I  2 1 1.0 2.4                                                                                         0   342
13954XE2 1 1.0 4.6                                                                                          INC 343U
13955CS2 3 .80 4.0   .04 3.4   .16 2.7                                                                       NDS 344K
13956BA2 3 .72 2.34  .27 2.17  .01  .91                                                                     H2  345K
13957LA2 0                                                                                                  H2  346S
14054XE2 1 1.0 1.1                                                                                          0   347
14055CS2 1 1.0 6.0                                                                                          NDS 348K
14056BA2 5 .19 1.02  .33 1.01  .03  .89  .11  .58  .34  .47                                                 H2  349K
14057LA2 8 .27 2.17 .0004 1.87  .18 1.69  .04 1.42  .35 1.36  .15 1.25                                      H2  350K
.0008 .87 .0004 .64                                                                                             350
14058CE2 0                                                                                                  H2  351S
14154XE2 1 1.0 2.4                                                                                          0   352
14155CS2 1 1.0 6.0                                                                                          0   353
14156BA2 1 1.0 2.8                                                                                          NDS 354K
14157LA2 2 .98 2.43  .02 1.06                                                                               H2  355K
14158CE2 2 .30 .581  .70 .436                                                                               H2  356K
14159PR2 0                                                                                                  H2  357S
14254XE2 1 1.0 1.7                                                                                          0   358
14255CS2 1 1.0 3.0                                                                                          0   359
14256BA2 1 1.0 2.3                                                                                          NDS 360U
14257LA211 .13 4.51 .024 3.86 .017 2.97  .01 2.49  .06 2.32  .24 2.10                                       H2  361K
 .19 1.96  .11 1.80  .05 1.20  .06 1.06  .12  .86                                                                361
14258CE2 0                                                                                                  H2  362S
14259PR2 2.963 2.16 .037  .59                                                                               H2 1363K
14260ND2 0                                                                                                  H2  364S
14354XE2 1 1.0 3.0                                                                                          0   365
14355CS2 1 1.0 2.3                                                                                          0   366
14356BA2 1 1.0 3.5                                                                                          0   367
14357LA2 1 1.0 3.3                                                                                          NDS 368K
14358CE2 5 .38 1.38  .42 1.09  .16  .72  .03  .50  .01  .28                                                 H2  369K
14359PR2 1 1.0  .933                                                                                        H2  370K
14360ND2 0                                                                                                  H2  371S
14454XE2 1 1.0 2.2                                                                                          0   372
14455CS2 1 1.0 3.5                                                                                          0   373
14456BA2 1 1.0 1.0                                                                                          0   374
14457LA2 1 1.0 1.2                                                                                          0   375
14458CE2 5 .76  .32 .003  .26 .045  .24 .002  .22  .19  .19                                                 H2  376K
14459PR2 3.977 2.99 .013 2.30  .01  .81                                                                     H2  377K
14460ND2 0                                                                                                  H2  378S
14558CE2 1 1.0 2.0                                                                                          NDS 379K
14559PR2 1 1.0 1.8                                                                                          NDS 380K
14560ND2 0                                                                                                  H2  381S
14658CE2 1 1.0  .7                                                                                          NDS 382K
14659PR2 6 .21 3.75  .03 2.83  .05 2.48  .52 2.23  .12 1.98  .07 1.48                                       H2  383K
14660ND2 0                                                                                                  H2  384S
14758CE2 1 1.0 1.6                                                                                          0   385
14759PR2 1 1.0 2.1                                                                                          H3  386U
14760ND2 5 .77  .41  .01  .41  .17  .37  .04  .22  .06  .18                                                 H2  387K
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```
147619M2 1 1.0 .225                                                          H2  388K
147629M2 0                                                                   H2  389S
148580E2 1 1.0 1.1                                                           0   390
148599P2 1 1.0 4.2                                                           H3  391U
148609N2 0                                                                   H2  392S
148619M1 4 .01 1.02  .24  .71  .19  .52  .50  .42                            H2  393K
148619M2 3 .50 2.48  .10 1.93  .40 1.02                                      H2  394K
148629M2 0                                                                   H2  395S
149609N2 9 .11 1.56  .03 1.48  .23 1.46  .04 1.43  .19 1.40 .003 1.29        H2  396K
 .19 1.13  .18 1.02 .013  .90                                                    396
149619M2 5 .97 1.07  .03  .79 .0015 .5  .0008 .23 .0018 .19                  H2  397K
149629M2 0                                                                   H2  398S
150609N2 0                                                                   H2  399S
150629M2 0                                                                   H2  400S
151609N2 1 1.0 2.0                                                           H3  401U
151619M2 9 .10 1.19  .06 1.13  .11 1.05  .03  .98  .43  .84  .10  .73        H2  402K
 .05  .50  .11  .35                                                              402
151629M2 2.983 .076 .017 .055                                                H2  403K
151639EU2 0                                                                  H2  404S
152619M2 1 1.0 2.2                                                           NDS 405U
152629M2 0                                                                   H2  406S
152639M1 4 .73 1.87 .022 1.53 .016 1.26 .015  .56                            H2  407K
152639EU2 4 .09 1.48 .016 1.07  .15  .70 .017  .20                           H2  408K
152649G02 0                                                                  H2  409S
153619M2 1 1.0 1.65                                                          NDS 410K
153629M2 8 .20 .801 .004 .718  .01 .704  .48 .698  .32 .628 .0007.167        H2  411K
.0007.165 .0015.107                                                              411
153639EU2 0                                                                  H2  412S
154619M2 1 1.0 2.5                                                           NDS 413U
154629M2 0                                                                   H2  414S
154639EU2 8 .07 1.96  .43 1.61  .03 1.16  .02  .98  .17  .85  .37  .58       H2  415K
 .02  .36  .29  .26                                                              415
154649G02 0                                                                  H2  416S
155629M2 7.924 1.55  .06 1.41 .006 1.34 .006  .89 .001  .78 .001  .56        H2  417K
.002  .38                                                                        417
155639EU2 4 .16 .248  .10 .188  .40 .162  .34 .143                           H2  418K
155649G02 0                                                                  H2  419S
156629M2 2 .45  .72  .55  .43                                                H2  420K
156639EU2 9 .31 2.45  .06 1.28 .013 1.21 .023 1.09  .33  .49  .06  .43       H2  421K
.022  .27  .09  .26  .08  .25                                                    421
156649G02 0                                                                  H2  422S
157639EU2 6 .03 1.34  .30 1.28  .20  .91  .35  .86  .10  .65  .02  .55       H2  423K
157649G02 0                                                                  H2  424S
158639EU2 1 1.0 2.65                                                         NDS 425U
158649G02 0                                                                  H2  426S
159639EU2 6 .25 2.57  .21 2.35  .21 1.90  .11 1.75  .11 1.50  .10 1.00       H2  427K
159649G02 6 .63  .95  .24  .89 .004  .60  .13  .59 .0003  .37 .0006  .3      H2  428K
159659TB2 0                                                                  H2  429S
160639EU2 1 1.0 3.6                                                          H2  430K
160649G02 0                                                                  H2  431S
160659TB2 9.004 1.72 .002 1.53  .29  .85  .07  .76  .44  .55  .04  .52       H2  432K
 .10  .45 .004  .43  .05  .41                                                    432
160669M2 0                                                                   H2  433S
161649G02 3 .90 1.58  .07 1.52  .03 1.42                                     H2  434K
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16165TB2 6 .10  .59  .64  .51  .26  .45 .0011 .21 .0002 .17 .0007 .04   H2  435K
16166DY2 0                                                              H2  436S
16264GD2 1 1.0  .34                                                     O   437
16265TB2 1 1.0 1.7                                                      O   438
16266DY2 0                                                              H2  439S
16365TB2 4 .30 1.66  .15 1.45  .40 1.32  .15 1.17                       H2  440K
16366DY2 0                                                              H2  441S
16466DY2 0                                                              H2  442S
16566DY1 4.004 1.05 .021  .90 .0003 .39 .0001 .29                       H2  443K
16566DY2 5 .83 1.30  .15 1.21                                           H2  444K
16567HO2 0                                                              H2  445S
16666DY2 4 .05 .482  .94  .40 .0002 .11  .01  .06                       H2  446K
16667HO2 6 .52 1.847 .47 1.77 .00021.16 .009  .39 .003  .19 .0004 .03   H2  447K
16668ER2 0                                                              H2  448S
16768ER1 0                                                              H2  449K
16768ER2 0                                                              H2  450S
   3 1H 2 1 1.0 .0186
  14 6C 2 1 1.0 .156                                                    H2  451K
  16 7N 2 4 .26 10.42 .68 4.29 .049 3.31 .011 1.55                      H2  452K
2411NA2 2.999 1.40 .001  .30                                            H2  453K
2511NA2 3 .65 3.83  .29 2.85  .06 2.22                                  H2  454K
2712MG2 2 .69 1.77  .31 1.60                                            H2  455K
2813AL2 1 1.0 2.86                                                      H2  456K
2913AL2 2 .94 2.40  .06 1.25                                            H2  457K
3114SI2 2.999 1.48 .001  .21                                            H2  458K
3215P 2 1 1.0 1.71                                                      H2  459K
3516S 2   1.0 .167                                                      H2  460K
4520CA2 1 1.0 .252                                                      H2  461K
4621SC2 1 1.0 .357                                                      H2  462K
4721SC2 2 .27  .60  .73  .44                                            H2  463K
5124CR2 0                                                               H2  464K
5425MN2 0                                                               H2  465K
5524CR2 1 1.0 2.59                                                      H2  466K
5526FE2 0                                                               H2  467K
5624CR2 1 1.0 1.5                                                       H2  468K
5625MN2 4 .53 2.86  .30 1.05  .16  .75 .013  .33                        H2  469K
5827CO2 0                                                               H2  470K
5926FE2 4.003 1.57  .53  .48  .45  .28 .011  .13                        H2  471K
6027CO2 2.00121.49 .939  .32                                            H2  472K
6429CU2 1 .38  .573                                                     H2  473K
6530ZN2 0                                                               H2  474K
69307N2 1 1.0  .901                                                     H2  475K
14661PM2 2 .32  .78  .03  .15                                           H2  476K
17169TM2 2 .99 .098  .02 .032                                           H2  477K
18774W 2 6 .15 1.31 .003  .80 .083  .69  .70  .63  .05  .54 .014  .44   H2  478K
19879AU2 2 .99 .962 .011 .287                                           H2  479K
20380HG2 1 1.0 .213                                                     H2  480K
20580HG2 2 .99 1.65  .01 1.4                                            NDS 481K
20982PB2 1 1.0  .64                                                     H2  482K
21083BI2 1 1.0 1.16                                                     H2  483K
21084PO2 0                                                              H2  484K
22688RA2 0                                                              H2  485K
22788AC2 1 1.0 1.31                                                     PR  486U
22789AC2 3 .54 .044  .35 .035  .10 .020                                 H2  487K
```

BISLI3 - BETA ENDPOINT ENERGY LIBRARY

22888RA2 1 1.0 .055	H2	488K
23390TH2 1 .87 1.245	H2	489U
23391PA2 5 .05 .271 .27 .259 .20 .231 .13 .173 .26 .155	H2	490K
23792U 2 4 .43 .250 .53 .238 .03 .185 .01 .146	H2	491K
2389-PU2 0	H2	492K
23994PU2 0	H2	493K
24094PU2 0	H2	494K
24194PU2 1 1.0 .021	H2	495K
24195AM2 0	H2	496K
24294PU2 0	H2	497K
24295AM1 0	H2	498K
24295AM2 2 .34 .66 .50 .62	H2	499K
24496CM2 0	H2	500K

FIGURE B-7. Library RNDBET Listing

```
 331      COMBINED DATA LIBRARY - THERMS, BAVELIBS     05/23/75
7230ZN 2 1.94E+00 0.0000   .080997   .023312   .004160  0.000000
7231GA 2 5.88E-01-0.0000   .501576   .427320   .352472   .171456
7330ZN 2 1.39E-03-0.0000  0.000000  0.000000  0.000000  0.000000
7331GA 2 2.00E-01-0.0000   .425735   .345605   .264501   .073555
7431GA 2 5.56E-03-0.0000  1.019124   .947673   .859029   .539997
7531GA 2 1.39E-03-0.0000  1.522975  1.452349  1.360119   .991549
7532GE+1 5.67E-04-0.0000  0.000000  0.000000  0.000000  0.000000
7532GE 2 5.69E-02-0.0000   .431198   .350926   .268495   .073255
7631GA 2 3.70E-04-0.0000  2.742974  2.673441  2.580294  2.177339
7633AS 2 1.10E+00-0.0000  1.081276  1.011114   .923163   .597337
7732GE+1 6.83E-04   .6400  1.919581  1.850990  1.797130  1.532970
7732GE 2 4.71E-01-0.0000   .591482   .525544   .450583   .222648
7733AS 2 1.63E+00-0.0000   .225866   .152220   .091739   .005937
7734SE+1 2.08E-04-0.0000  0.000000  0.000000  0.000000  0.000000
7832GE 2 6.11E-02-0.0000   .240030   .167151   .103698   .007922
7833AS 2 6.32E-03-0.0000  1.471350  1.400633  1.309768   .859356
7933AS 2 6.25E-03 1.0000   .839137   .769117   .682306   .376734
7934SE+1 2.71E-03-0.0000  0.000000  0.000000  0.000000  0.000000
7934SE 2 2.55E+07-0.0000   .042267   .002622   .000029  0.000000
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8035BR 2 1.25E-02-0.0000   .719995   .655714   .577013   .306593
8133AS 2 3.82E-04-0.0000  1.664393  1.593996  1.501562  1.126822
8134SE+1 3.96E-02-0.0000  0.000000  0.000000  0.000000  0.000000
8134SE 2 1.25E-02-0.0000   .609787   .541210   .459173   .197149
8136KR 2 7.67E+07-0.0000  0.000000  0.000000  0.000000  0.000000
8235BR 2 1.07E+00+0.0000   .136103   .067475   .028882   .000154
8334SE+1 7.99E-04 1.0000  1.380023  1.309858  1.219196  .865649
8334SE 2 1.74E-02-0.0000   .576631   .508413   .427278   .175150
8335BR 2 1.00E-01 1.0000   .324809   .248452   .175201   .029826
8336KR+1 7.75E-02-0.0000  0.000000  0.000000  0.000000  0.000000
8434SE 2 2.08E-03-0.0000   .154681   .083417   .036953   .000453
8435BR+1 4.17E-03 1.0000   .710126   .639819   .557624   .294722
8435BR 2 2.22E-02-0.0000  1.223839  1.151763  1.066402   .776934
8533AS 2 4.93E-06-0.0000  1.041279   .971019   .881835   .549977
8534SE 2 4.51E-04+0.0000  2.240181  2.176333  2.083316  1.690174
8535BR 2 2.08E-03 1.0000  1.038182   .968130   .879212   .548312
8536KR+1 1.85E-01   .8100   .219983   .162567   .109323   .013819
8536KR 2 3.93E+03-0.0000   .290847   .202378   .121370   .007453
8634SE 2 1.85E-04+0.0000  1.759358  1.689099  1.596558  1.218819
8635BR 2 6.25E-04-0.0000  3.715102  3.646799  3.555004  3.145272
8637RB+1 6.94E-04-0.0000  0.000000  0.000000  0.000000  0.000000
8637RB 2 1.87E+01-0.0000   .845182   .758353   .655120   .319477
8734SE 2 1.85E-04-0.0000  3.716276  3.649915  3.558042  3.179710
8735BR 2 6.57E-04-0.0000  1.874387  1.804810  1.714725  1.358834
8736KR 2 5.28E-02-0.0000  1.353196  1.280334  1.189922   .856152
8737RB 2 1.60E+13-0.0000   .078453   .022509   .003604  0.000000
8738SR+1 1.17E-01-0.0000  0.000000  0.000000  0.000000  0.000000
8835BR 2 1.85E-04-0.0000  1.371820  1.301502  1.210279   .851832
8836KR 2 1.17E-01-0.0000   .385556   .317060   .256862   .138721
8837RB 2 1.25E-02-0.0000  2.371352  2.287944  2.180246  1.742317
8935BR 2 5.21E-05-0.0000  1.275995  1.205704  1.114987   .763143
8936KR 2 2.22E-03-0.0000  1.390337  1.320500  1.230519   .881432
8937RB 2 1.04E-02-0.0000   .548900   .529080   .452709   .233613
8938SR 2 5.06E+01   .0002   .700044   .596459   .484405   .180433
8939Y+ 1 1.85E-04-0.0000  0.000000  0.000000  0.000000  0.000000
9035BR 2 1.85E-05-0.0000  1.275995  1.205704  1.114987   .763143
9036KR 2 3.82E-04-0.0000  1.023910   .953561   .865109   .541443
9037RB 2 2.01E-03-0.0000  1.446528  1.375473  1.286410   .945616
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0038AR	2	1.05E+00-0.0000	.279333	.183090	.108460	.004641	
0039V+	1	1.33E-01-0.0000	.000838	.000555	.000323	.000010	
0039V-	2	2.8AE+00-0.0030	1.153994	1.064705	.961371	.570411	
0136VA	2	1.16E-08 .5000	1.562453	1.492248	1.400382	1.031834	
0137BA01		9.72E-03 1.0000	1.272504	1.202406	1.111937	.761056	
0137B4	2	8.34E-04-0.0000	2.044327	1.974525	1.881907	1.695015	
0138SR	2	4.04E-01 .5000	.780081	.683952	.570526	.287621	
0139V+	1	3.47E-02-0.0000	0.000000	0.000000	0.000000	0.000000	
0139V-	2	5.90E-01-0.0000	.773177	.647446	.548697	.254349	
0236AB	2	3.47E-05-0.0000	1.131326	1.061246	.971631	.631979	
0237BH	2	5.79E-05-0.0000	1.272504	1.202406	1.111937	.761056	
0238SA	2	1.13E-01-0.0000	.207959	.141189	.088265	.018092	
0239V-	2	1.47E-01-0.0000	1.746768	1.661859	1.552612	1.120078	
0336AR	2	2.32E-05-0.0000	1.654472	1.588325	1.498220	1.122818	
0337B9	2	5.94E-05-0.0000	1.177175	1.107187	1.017302	.673971	
0338SA	2	5.76E-03-0.0000	1.154404	1.084534	.995078	.654942	
0339V-	2	4.21E-01-0.0000	1.171193	1.101300	1.012298	.674858	
0340ZH	2	3.47E-05 .2500	.010260	0.000000	0.000000	0.000000	
0341BA01		1.35E-03-0.0000	0.000000	0.000000	0.000000	0.000000	
0436AA	2	1.16E-05-0.0000	1.131326	1.061240	.971631	.631979	
0437B4	2	3.47E-05-0.0000	2.044327	1.974525	1.881907	1.695015	
0438SA	2	6.33E-04-0.0000	.488093	.778453	.690610	.384596	
0439V-	2	1.39E-02-0.0000	2.234106	2.164854	2.072110	1.881086	
0441BA01		6.38E-05 .0010	.000916	.000751	.000581	.000169	
0441BA	2	7.30E-06-0.0000	.151424	.081768	.030222	.000446	
0536AA	2	1.16E-05-0.0000	2.040018	1.974738	1.884016	1.695691	
0537BH	2	2.31E-05-0.0000	1.540505	1.490343	1.398434	1.210138	
0538SA	2	5.58E-04-0.0000	1.127993	1.058119	.968768	.630117	
0539V-	2	7.04E-03-0.0000	.844631	.775512	.689417	.368931	
0540ZR	2	8.50E-01 .0200	.117520	.093042	.019201	.000513	
0541BA01		3.79E-06-0.0000	0.000000	0.000000	0.000000	0.000000	
0541BA	2	3.50E-01-0.0000	.043530	.003324	.000167	.000020	
0639V-	2	1.40E-03-0.0000	1.506402	1.436452	1.347105	.992061	
0641BA	2	9.58E-01-0.0000	.241528	.140448	.089285	.007584	
0736AA	2	1.16E-05-0.0000	1.852227	1.782195	1.689698	1.308564	
0737B9	2	2.32E-05-0.0000	1.947123	1.877283	1.784722	1.400764	
0738SA	2	3.47E-05-0.0000	1.558524	1.488491	1.396861	1.028830	
0739V-	2	8.94E-05-0.0000	.937871	.468461	.281110	.088054	
0740ZR	2	7.08E-01 .9000	.719533	.650958	.569809	.293150	
0741BA01		6.94E-08-0.0000	0.000000	0.000000	0.000000	0.000000	
0741BA	2	5.00E-02-0.0000	.464166	.384483	.300868	.092203	
0840ZR	2	6.94E-04-0.0000	.796885	.728070	.642855	.345002	
0841BA01		1.41E-02-0.0000	1.504346	1.434582	1.343681	.970419	
0841BA	2	3.58E-02 1.0000	1.075693	1.006119	.917583	.588973	
0842ZR	2	1.85E-05-0.0000	1.554462	1.484012	1.393220	1.026149	
0941BA	2	1.74E-03-0.0000	1.360440	1.290895	1.200416	.848850	
0942ZR	2	2.79E-00 .9200	.348484	.317111	.241679	.069326	
0943TC01		2.50E-01-0.0000	0.000000	0.000000	0.000000	0.000000	
0943TC	2	7.67E-07-0.0000	.083352	.026206	.005313	0.000000	
1008BA	2	2.08E-03-0.0000	1.451927	1.382194	1.291399	.931136	
1009TC	2	1.97E-04-0.0000	1.452255	1.382609	1.292032	.931965	
1010BA	2	6.08E-04-0.0000	.364900	.287410	.211103	.045110	
1011ZR	2	1.01E-02-0.0000	.430347	.359006	.286180	.110213	
1012TC	2	9.72E-03-0.0000	.468548	.398422	.307984	.098597	
1013ZR	2	7.08E-03-0.0000	.435900	.357029	.275308	.077659	
1014TC	2	5.79E-05-0.0000	1.788714	1.719262	1.627584	1.251379	
1015TC	2	5.79E-04-0.0000	1.025120	.955950	.864151	.541443	
1016ZR	2	4.00E-01 .9950	.054450	.012451	.003555	.000218	
1017BA01		5.96E-02-0.0000	0.000000	0.000000	0.000000	0.000000	
1018ZR	2	1.11E-03-0.0000	1.508281	1.438118	1.348478	1.000969	

10443TC 2	1.25E-02	0.0000	.978248	.909184	.821881	.500369
10445RH*1	3.06E-03	.0013	.000271	.000155	.000074	.000001
10445RH 2	4.8AE-04	0.0000	1.001959	.933050	.845772	.522585
10542MO 2	4.63E-04	0.0000	1.508241	1.439114	1.349874	1.000069
10543TC 2	5.56E-03	0.0000	1.452255	1.382689	1.292032	.931065
10544RU 2	1.85E-01	.2690	.420300	.343417	.264970	.079734
10545RH*1	3.47E-04	0.0000	0.000000	0.000000	0.000000	0.000000
10545RH 2	1.50E+00	0.0000	.150205	.087161	.044762	.001253
10644RU 2	3.65E+02	0.0000	.010504	0.000000	0.000000	0.000000
10645RH*1	9.17E-02	1.0000	.344492	.271195	.199536	.048620
10645RH 2	3.47E-04	0.0000	1.417812	1.348648	1.258842	.904368
10743TC 2	3.36E-04	0.0000	1.119288	1.049954	.961292	.625254
10744RU 2	2.92E-03	0.0000	1.243229	1.173975	1.084867	.741525
10745RH 2	1.51E-02	0.0000	.433764	.357341	.277668	.082364
10746PD 2	2.56F+09	0.0000	.009379	0.000000	0.000000	0.000000
10844RU 2	3.13E-03	0.0000	.457834	.378742	.295964	.090132
10845RH 2	1.97E-04	0.0000	1.717703	1.651911	1.565141	1.208767
10847AG*1	3.65E+04	.9000	0.000000	0.000000	0.000000	0.000000
10847AG 2	1.67E-03	0.0000	.605087	.539445	.460602	.205462
10945RH 2	3.47E-04	1.0000	1.162823	1.093648	1.004899	.665753
10946PD*1	3.33E-03	0.0000	0.000000	0.000000	0.000000	0.000000
10946PD 2	5.63E-01	1.0000	.360037	.284077	.208505	.044554
10947AG*1	4.63E-04	0.0000	0.000000	0.000000	0.000000	0.000000
11046AG*1	2.60E+02	.9800	.063919	.031242	.016151	.001143
11047AG 2	2.78E-04	0.0000	1.178381	1.109383	1.020777	.681120
11146PD*1	2.29E-01	.3200	.061871	.040219	.022682	.000759
11146PD 2	1.53E-02	1.0000	.848181	.779848	.694594	.390411
11147AG*1	8.57E-04	0.0000	0.000000	0.000000	0.000000	0.000000
11147AG 2	7.50F+00	0.0000	.368340	.282683	.207594	.045101
11148CD*1	3.40E-02	0.0000	0.000000	0.000000	0.000000	0.000000
11246PD 2	8.75E-01	0.0000	.085253	.027855	.006002	.000101
11247AG 2	1.33E-01	0.0000	1.430996	1.361200	1.271958	.927161
11346PD 2	1.04E-03	1.0000	1.398120	1.329876	1.239834	.892121
11347AG*1	8.33E-04	.1000	.078685	.071890	.063476	.034966
11347AG 2	2.21E-01	0.0000	.786854	.718904	.634762	.340359
11348CD*1	5.11E+03	.9990	.177378	.111299	.059712	.001770
11446PD 2	1.67E-05	0.0000	.518566	.453348	.352326	.124158
11447AG 2	5.79E-05	0.0000	2.019695	1.950735	1.859232	1.477002
11449IN*1	5.00E+01	0.0000	0.000000	0.000000	0.000000	0.000000
11449IN 2	8.33E-04	0.0000	.762290	.695851	.613702	.327450
11546PD 2	5.21E-04	.2800	1.925918	1.856799	1.765286	1.385509
11547AG*1	2.32E-04	1.0000	.377544	.358192	.333086	.234436
11547AG 2	1.46E-02	.0900	1.182673	1.113700	1.025072	.685089
11548CD*1	4.30E+01	1.0000	.604231	.537566	.458261	.203340
11548CD 2	2.30E+00	1.0000	.319029	.245614	.170314	.038700
11549IN*1	1.83E-01	.0550	.013817	.010211	.006867	.000870
11549IN 2	2.20E+17	0.0000	.148353	.080004	.035441	.000434
11646PD 2	3.47E-04	0.0000	.318875	.244434	.172639	.029435
11647AG 2	1.70E-03	0.0000	2.145373	2.076511	1.984935	1.599548
11649IN*1	3.75E-02	1.0000	.304819	.231761	.162715	.028508
11649IN 2	1.62E-04	0.0000	1.400702	1.331649	1.241866	.886920
11747AG 2	7.64E-04	.5000	1.634846	1.565698	1.474905	1.106818
11748CD*1	1.33E-01	1.0000	.229356	.163372	.113117	.031377
11748CD 2	1.04E-01	1.0000	.472520	.403498	.332720	.151700
11749IN*1	7.92E-02	.8000	.351701	.316203	.273066	.129591
11749IN 2	3.13E-02	0.0000	.241077	.170775	.108448	.009609
11750SN*1	1.40F+01	0.0000	0.000000	0.000000	0.000000	0.000000
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11849IN 2	5.90E-05	0.0000	1.735786	1.666918	1.576272	1.205986
11948CD*1	1.88E-03	.9900	.429889	.352106	.271511	.076621

11948CD 2	6.60E-03	1.0000	1.489007	1.419956	1.329784	.969433
11949IN*1	1.25E-02	.9600	1.071257	1.006056	.922615	.605665
11949IN 2	1.39E-03	.1000	.430014	.563273	.482659	.218965
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12148CD 2	2.43E-03	0.0000	.649280	.582264	.501042	.232856
12149IN*1	2.15E-03	1.0000	1.582099	1.513154	1.422782	1.058067
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12251SB*1	2.85E-03	0.0000	0.000000	0.000000	0.000000	0.000000
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12352TE*1	1.17E+02	0.0000	0.000000	0.000000	0.000000	0.000000
12451SB*1	1.46E-02	.9820	.083164	.067780	.051925	.014135
12451SB 2	6.02E+01	0.0000	.378038	.313729	.255189	.121154
12550SN*1	6.74E-03	1.0000	.009418	.007305	.005392	.001632
12550SN 2	9.62E+00	0.0000	.900758	.832724	.748938	.447542
12551SB 2	9.86E+02	.1350	.082111	.032683	.013545	.000428
12552TE*1	5.80E+01	0.0000	0.000000	0.000000	0.000000	0.000000
12650SN 2	3.65E+07	1.0000	.062808	.013051	.001317	0.000000
12651SB*1	1.32E-02	.0100	.007352	.006680	.005654	.003013
12651SB 2	1.25E+01	0.0000	.735209	.668035	.585386	.301303
12750SN 2	8.75E-02	0.0000	1.341767	1.272990	1.183765	.833170
12751SB 2	3.90E+00	.2000	.397383	.326171	.252988	.078529
12752TE*1	1.05E+02	.0150	.001883	.001326	.000836	.000171
12752TE 2	3.68E-01	0.0000	.219670	.151094	.092213	.000254
12850SN 2	4.31E-02	.0300	.470626	.392110	.309230	.098565
12851SB*1	4.00E-01	1.0000	.343358	.268764	.195181	.039210
12851SB 2	6.94E-03	0.0000	1.198406	1.129848	1.041618	.701665
12853I 2	1.74E-02	0.0000	.754528	.691422	.613233	.338560
12951SB 2	1.88E-01	.3600	.721627	.654531	.572148	.290508
12952TE*1	3.40E+01	0.0000	.196342	.172168	.144244	.059674
12952TE 2	4.65E-02	0.0000	.492345	.414469	.331941	.116704
12953I 2	5.64E+09	0.0000	.039358	.002171	.000019	0.000000
13050SN 2	1.81E-03	0.0000	.782233	.714683	.631035	.338658
13051SB 2	2.71E-02	0.0000	.645165	.578574	.497867	.231380
13053I 2	5.21E-01	0.0000	.281702	.210544	.145277	.026204
13151SB 2	1.72E-02	.1500	1.325392	1.256739	1.167744	.818729
13152TE*1	1.20E+00	.7830	.184594	.130741	.089203	.029208
13152TE 2	1.81E-02	0.0000	.727162	.658365	.575869	.301788
13153I 2	8.05E+00	.0070	.180029	.114467	.063493	.002564
13154XE*1	1.20E+01	0.0000	0.000000	0.000000	0.000000	0.000000
13251SB 2	1.46E-03	0.0000	1.104526	1.036106	.948614	.617008
13252TE 2	3.25E+00	0.0000	.059525	.011245	.000958	0.000000
13253I 2	9.58E-02	0.0000	.458290	.387303	.313116	.125815
13351SB 2	2.85E-03	.7200	1.104526	1.036106	.948614	.617008
13352TE*1	3.47E+02	.8700	.491569	.425312	.352961	.152394
13352TE 2	1.39E-03	0.0000	.962847	.894870	.808942	.492091
13353I 2	8.75E-01	.0200	.443634	.366622	.286661	.089152
13354XE*1	2.30E+00	0.0000	0.000000	0.000000	0.000000	0.000000
13354XE 2	5.27E+00	0.0000	.098191	.038506	.010957	.000107
13451SB 2	1.74E-05	0.0000	1.481834	1.413115	1.323377	.964763
13452TE 2	2.92E-02	0.0000	.511574	.432438	.347575	.122484
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13455CS*1	1.21E-01	.0100	.001670	.001027	.000536	.000013
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1355189	2	2.20E-05	0.0000	1.339489	1.270828	1.181755	.831155
13552TE	2	5.30E-04	0.0000	1.102515	1.034219	.946887	.615864
13553I	2	2.79E-01	.2700	.316818	.245347	.179010	.046160
1355HXE	1	1.11E-02	0.0000	0.000000	0.000000	0.000000	0.000000
1355HXE	2	3.83E-01	0.0000	.300787	.227931	.159015	.025496
13555CS	2	7.30E+08	0.0000	.056152	.009528	.000669	0.000000
1355681	1	1.21E+00	0.0000	0.000000	0.000000	0.000000	0.000000
13563I	2	9.61E-04	0.0000	1.975297	1.907004	1.816656	1.441119
1365SCS	2	1.30E+01	0.0000	.101933	.042750	.014815	.000580
13753I	2	2.78E-04	0.0000	.868805	.801267	.716691	.412494
1375HXE	2	2.92E-03	0.0000	1.584901	1.516508	1.426826	1.064476
1375SCS	2	1.10E+04	.9200	.203307	.120133	.059112	.000988
1375681	1	1.81E-03	0.0000	0.000000	0.000000	0.000000	0.000000
13853I	2	7.29E-05	0.0000	1.288211	1.219797	1.131264	.785580
1385HXE	2	1.18E-02	0.0000	.959088	.891376	.805784	.490568
1385SCS	2	2.24E-02	0.0000	1.096756	1.028565	.941628	.614832
13953I	2	2.32E-05	0.0000	.960982	.893136	.807374	.491537
1395HXE	2	4.75E-04	0.0000	1.998764	1.930518	1.839964	1.461595
1395SCS	2	6.60E-03	0.0000	1.599655	1.531458	1.442090	1.081242
1395681	2	5.70E-02	0.0000	.900325	.833002	.748534	.442412
1405HXE	2	1.65E-04	0.0000	.381853	.306431	.230001	.055344
1405SCS	2	7.60E-04	0.0000	2.667901	2.600271	2.509674	2.117748
1405691	2	1.28E+01	0.0000	.254607	.184412	.124530	.022260
1405TLA	2	1.65E+00	0.0000	.600988	.529127	.447687	.204745
1415HXE	2	2.32E-05	0.0000	.959088	.891376	.805784	.490568
1415SCS	2	2.78E-04	0.0000	2.667901	2.600271	2.509674	2.117748
1415681	2	1.25E-02	0.0000	1.140729	1.072868	.985806	.653104
1415TLA	2	1.63E-01	0.0000	.959952	.887473	.802455	.490568
1415BCE	2	3.25E+01	0.0000	.141089	.077113	.035319	.000689
1425HXE	2	1.74E-05	0.0000	.640917	.574764	.494588	.229356
1425SCS	2	2.66E-05	0.0000	1.235577	1.168458	1.080543	.739569
1425681	2	7.64E-03	0.0000	.909226	.841936	.757258	.488411
1425TLA	2	5.83E-02	0.0000	.868337	.799292	.717147	.442717
1425991	2	8.00E-01	0.0000	.009271	.005925	.003263	.000115
1435HXE	2	1.15E-05	0.0000	1.235867	1.170622	1.082545	.740139
1435SCS	2	2.32E-05	0.0000	.911112	.843683	.758829	.449342
1435681	2	1.39E-04	0.0000	1.469676	1.401521	1.312520	.956948
1435TLA	2	9.72E-03	0.0000	1.372703	1.304718	1.216313	.866370
1435BCE	2	1.38E+00	0.0000	.357092	.312901	.258548	.067763
1435991	2	1.37E+01	0.0000	.309503	.237479	.167944	.028455
1445HXE	2	1.16E-05	0.0000	.867038	.799637	.715233	.411654
1445SCS	2	2.32E-05	0.0000	1.472306	1.404029	1.314868	.958560
1445681	2	3.47E-05	0.0000	.338934	.265300	.192666	.038705
1445TLA	2	4.63E-05	0.0000	.420617	.344511	.265655	.074769
1445BCE	2	2.85E+02	0.0000	.080184	.025997	.006056	.000101
1445991	2	1.20E-02	0.0000	1.208584	1.140985	1.054053	.718743
1446ND	2	7.30E+07	0.0000	0.000000	0.000000	0.000000	0.000000
1455BCE	2	2.08E-03	0.0000	.769026	.702616	.620380	.332740
1455991	2	2.46E-01	0.0000	.677769	.612057	.531781	.261000
1465BCE	2	9.72E-03	0.0000	.220255	.152526	.093903	.006830
1465991	2	1.67E-02	0.0000	.997185	.929418	.844571	.535574
1475BCE	2	7.64E-04	0.0000	.590990	.525817	.447524	.195255
1475991	2	8.33E-03	0.0000	.812417	.745933	.663122	.369288
1476ND	2	1.11E+01	0.0000	.224666	.155784	.100346	.011541
1476191	2	9.49E+02	0.0000	.059553	.011815	.001099	0.000000
1476254	2	4.80E+13	0.0000	0.000000	0.000000	0.000000	0.000000
1485BCE	2	4.86E-04	0.0000	.378024	.303359	.227695	.055284
1485991	2	1.39E-03	0.0000	1.792560	1.724783	1.635266	1.266910
1486191	1	4.10E+01	0.0000	.144377	.084860	.043599	.002368
1486191	2	5.40E+00	1.0000	.701060	.631885	.552442	.304393

14960ND	2	7.21E-02-0.0000	.456962	.383137	.304785	.102873
14961PM	2	2.21F+00-0.0000	.359759	.286040	.212209	.048456
15160ND	2	8.33E-03-0.0000	.765483	.699380	.617522	.331407
15161PM	2	1.17E+00-0.0000	.272020	.203146	.140907	.025540
15162SM	2	3.29E+04-0.0000	.019123	0.000000	0.000000	0.000000
15261PM	2	4.17E-03-0.0000	.853895	.787516	.704392	.405414
15263EU+1		3.88E-01 1.0000	.534434	.483195	.420978	.211539
15263EU	2	4.53E+03-0.0000	.047095	.048162	.050606	.014343
15361PM	2	3.82E-03-0.0000	.608675	.543767	.465438	.209835
15362SM	2	1.96E+00-0.0000	.219710	.151888	.093515	.007194
15461PM	2	1.74E-03-0.0000	.990779	.923926	.839068	.523315
15465EU	2	5.54E+03-0.0000	.217835	.156197	.109840	.032010
15562SM	2	1.53E-02-0.0000	.555213	.490984	.413861	.172452
15565EU	2	6.57E+02-0.0000	.044475	.004970	.000379	0.000000
15662SM	2	3.92E-01-0.0000	.166895	.103839	.057056	.008638
15663EU	2	1.52E+01-0.0000	.409419	.345107	.291547	.165095
15761EU	2	6.53E-01-0.0000	.327099	.266504	.187140	.042945
15863EU	2	3.19E-02-0.0000	1.055065	.948537	.903156	.581737
15963EU	2	1.32E-02-0.0000	.761860	.696131	.616270	.344037
15964GD	2	7.50E-01-0.0000	.283431	.219037	.152567	.025138
16065EU	2	1.74E-02-0.0000	1.496671	1.429417	1.341423	.987979
16065TB	2	7.20E+01-0.0000	.165690	.130651	.078796	.008032
16164GD	2	2.57E-03-0.0000	.569749	.505250	.428233	.183000
16165TB	2	6.90E+00-0.0000	.145718	.083667	.040075	.000674
16265GD	2	3.65E+02-0.0000	.093389	.035824	.009861	.000005
16265TB	2	8.33E-02-0.0000	.624149	.559727	.481649	.223843
16365TB	2	2.71E-01-0.0000	.503917	.431644	.352316	.132809
16566DY+1		8.73E-04 .0300	.007537	.005754	.004050	.000689
16566DY	2	9.79E-02-0.0000	.437113	.363405	.285794	.089804
16666DY	2	5.42E+00-0.0000	.112052	.051496	.018432	.000062
16667-0	2	1.13E+00-0.0000	.663478	.598993	.520678	.256889
16766ER+1		2.89E-05-0.0000	0.000000	0.000000	0.000000	0.000000
161		COMBINED DATA LIBRARY - THERMS, BAVELIES				
3 1H	2	4.50E+03-0.0000	.006341	0.000000	0.000000	0.000000
7 4HE	2	5.36E+01-0.0000	0.000000	0.000000	0.000000	0.000000
10 4HE	2	9.18E+06-0.0000	.203523	.125835	.066106	.001705
14 0C	2	2.00E+06-0.0000	.050277	.003297	.000040	0.000000
18 9F	2	7.80E-02-0.0000	0.000000	0.000000	0.000000	0.000000
2211NA	2	9.50E+02-0.0000	0.000000	0.000000	0.000000	0.000000
2411NA	2	5.30E-01-0.0000	.559404	.472818	.380013	.135912
3114SI	2	1.10E-01-0.0000	.591346	.504884	.411192	.155150
3215P	2	1.43E+01-0.0000	.695987	.624610	.538029	.251503
3516S	2	6.71E+01-0.0000	0.000000	0.000000	0.000000	0.000000
3617CL	2	1.20E+06-0.0000	0.000000	0.000000	0.000000	0.000000
3817CL	2	2.60E-03-0.0000	0.000000	0.000000	0.000000	0.000000
4118AR	2	7.63E-02-0.0000	0.000000	0.000000	0.000000	0.000000
4219K	2	5.20E-01-0.0000	0.000000	0.000000	0.000000	0.000000
4120CA	2	2.97E+07-0.0000	0.000000	0.000000	0.000000	0.000000
4520CA	2	1.64E+02-0.0000	.076374	.018926	.002592	0.000000
4720CA	2	4.90E+03-0.0000	0.000000	0.000000	0.000000	0.000000
4621SC	2	6.50E+01-0.0000	.112653	.045679	.013637	.000012
4721SC	2	3.43E+00-0.0000	.159728	.087416	.040337	.000875
4821SC	2	1.83E+00-0.0000	0.000000	0.000000	0.000000	0.000000
4823V	2	1.61E+01-0.0000	0.000000	0.000000	0.000000	0.000000
5124CR	2	2.78E+01-0.0000	0.000000	0.000000	0.000000	0.000000
5225MN	2	5.55E+00-0.0000	0.000000	0.000000	0.000000	0.000000
5425MN	2	3.00E+02-0.0000	0.000000	0.000000	0.000000	0.000000
5625MN	2	1.10E-01-0.0000	.808885	.733987	.650311	.393722
5526FE	2	1.10E+03-0.0000	0.000000	0.000000	0.000000	0.000000
5926FE	2	4.51E+01-0.0000	.122128	.056439	.022383	.000799

5727CO	2	2.70E+02-0.0000	0.000000	0.000000	0.000000	0.000000
5827CO+1		3.80E-01-0.0000	0.000000	0.000000	0.000000	0.000000
5827CO	2	7.20E+01-0.0000	0.000000	0.000000	0.000000	0.000000
6027CO	2	1.90E+03-0.0000	.097617	.035113	.008985	.000187
5928NI	2	2.90E+07-0.0000	0.000000	0.000000	0.000000	0.000000
6528NI	2	2.90E+04-0.0000	0.000000	0.000000	0.000000	0.000000
6528NI	2	1.10E-01-0.0000	0.000000	0.000000	0.000000	0.000000
6429CU	2	5.30E-01-0.0000	.071668	.045098	.024293	.000140
6530ZN	2	2.45E+02-0.0000	0.000000	0.000000	0.000000	0.000000
6930ZN+1		5.60E-01-0.0000	0.000000	0.000000	0.000000	0.000000
6930ZN	2	5.60E-02-0.0000	.319854	.242817	.169249	.026009
7132GE	2	1.20E+01-0.0000	0.000000	0.000000	0.000000	0.000000
7333AS	2	7.60E+01-0.0000	0.000000	0.000000	0.000000	0.000000
7433AS	2	1.75E+01-0.0000	0.000000	0.000000	0.000000	0.000000
7534SE	2	1.27E+02-0.0000	0.000000	0.000000	0.000000	0.000000
8538SR+1		4.90E-02-0.0000	0.000000	0.000000	0.000000	0.000000
8538SR	2	8.50E+01-0.0000	0.000000	0.000000	0.000000	0.000000
9342MO	2	1.10E+06-0.0000	0.000000	0.000000	0.000000	0.000000
9043TC+1		3.60E-02-0.0000	0.000000	0.000000	0.000000	0.000000
9043TC	2	4.30E+00-0.0000	0.000000	0.000000	0.000000	0.000000
9743TC+1		2.50E-01-0.0000	0.000000	0.000000	0.000000	0.000000
9743TC	2	3.70E+06-0.0000	0.000000	0.000000	0.000000	0.000000
9744RU	2	2.80E+00-0.0000	0.000000	0.000000	0.000000	0.000000
10346PD	2	1.70E+01-0.0000	0.000000	0.000000	0.000000	0.000000
10547AG	2	4.00E+01-0.0000	0.000000	0.000000	0.000000	0.000000
10948CD	2	4.75E+02-0.0000	0.000000	0.000000	0.000000	0.000000
11349IN+1		7.30E-02-0.0000	0.000000	0.000000	0.000000	0.000000
11350SN	2	1.12E+02-0.0000	0.000000	0.000000	0.000000	0.000000
12553I	2	6.00E+01-0.0000	.009243	0.000000	0.000000	0.000000
12653I	2	1.33E+01-0.0000	0.000000	0.000000	0.000000	0.000000
13155CS	2	1.00E+01-0.0000	0.000000	0.000000	0.000000	0.000000
13156BA	2	1.16E+01-0.0000	0.000000	0.000000	0.000000	0.000000
15364GD	2	2.36E+02-0.0000	0.000000	0.000000	0.000000	0.000000
16667HO+1		4.38E+05-0.0000	.016262	0.000000	0.000000	0.000000
16968ER	2	9.40E+00-0.0000	0.000000	0.000000	0.000000	0.000000
17168ER	2	3.10E-01-0.0000	0.000000	0.000000	0.000000	0.000000
17069TM	2	1.27E+02-0.0000	0.000000	0.000000	0.000000	0.000000
17169TM	2	6.94E+02-0.0000	.024001	0.000000	0.000000	0.000000
17570YB	2	4.10E+00-0.0000	0.000000	0.000000	0.000000	0.000000
17771LU	2	6.80E+00-0.0000	0.000000	0.000000	0.000000	0.000000
18172HF	2	9.60E+01-0.0000	0.000000	0.000000	0.000000	0.000000
18273TA	2	1.12E+02-0.0000	0.000000	0.000000	0.000000	0.000000
18174W	2	1.40E+02-0.0000	0.000000	0.000000	0.000000	0.000000
18574W	2	7.40E+01-0.0000	0.000000	0.000000	0.000000	0.000000
18774W	2	1.00E+00-0.0000	.223065	.158771	.103431	.011103
18375RE	2	7.30E+01-0.0000	0.000000	0.000000	0.000000	0.000000
18675RE	2	3.79E+00-0.0000	0.000000	0.000000	0.000000	0.000000
18775RE	2	1.80E+13-0.0000	0.000000	0.000000	0.000000	0.000000
18875RE	2	7.10E-01-0.0000	0.000000	0.000000	0.000000	0.000000
18576OS	2	9.50E+01-0.0000	0.000000	0.000000	0.000000	0.000000
19176OS+1		5.90E-01-0.0000	0.000000	0.000000	0.000000	0.000000
19176OS	2	1.60E+01-0.0000	0.000000	0.000000	0.000000	0.000000
19376OS	2	1.30E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19077IR	2	1.20E+01-0.0000	0.000000	0.000000	0.000000	0.000000
19277IR	2	7.45E+01-0.0000	0.000000	0.000000	0.000000	0.000000
19477IR	2	7.90E-01-0.0000	0.000000	0.000000	0.000000	0.000000
19178PT	2	3.05E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19378PT+1		5.40E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19378PT	2	1.80E+05-0.0000	0.000000	0.000000	0.000000	0.000000
19778PT+1		5.80E-02-0.0000	0.000000	0.000000	0.000000	0.000000

19778PT	2	7.50E-01-0.0000	0.000000	0.000000	0.000000	0.000000
19679AU	2	5.60E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19879AU	2	2.70E+00-0.0000	.298595	.230805	.165065	.030440
19979AU	2	3.15E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19780MG+1		1.00E+00-0.0000	0.000000	0.000000	0.000000	0.000000
19780MG	2	2.70E+00-0.0000	0.000000	0.000000	0.000000	0.000000
20380MG	2	4.58E+01-0.0000	.052620	.009234	.000689	0.000000
20081TL	2	1.13E+00-0.0000	0.000000	0.000000	0.000000	0.000000
20181TL	2	3.00E+00-0.0000	0.000000	0.000000	0.000000	0.000000
20281TL	2	1.20E+01-0.0000	0.000000	0.000000	0.000000	0.000000
20481TL	2	1.10E+03-0.0000	0.000000	0.000000	0.000000	0.000000
20382PB	2	2.17E+00-0.0000	0.000000	0.000000	0.000000	0.000000
21082PB	2	7.10E+03-0.0000	0.000000	0.000000	0.000000	0.000000
21282PB	2	4.40E-01-0.0000	0.000000	0.000000	0.000000	0.000000
20683BI	2	6.40E+00-0.0000	0.000000	0.000000	0.000000	0.000000
20783BI	2	2.90E+03-0.0000	0.000000	0.000000	0.000000	0.000000
21083BI	2	5.00E+00-0.0000	.371178	.301679	.230271	.061430
21283BI	2	4.20E-02-0.0000	0.000000	0.000000	0.000000	0.000000
21044PO	2	1.34E+02-0.0000	0.000000	0.000000	0.000000	0.000000
21185AT	2	3.00E-01-0.0000	0.000000	0.000000	0.000000	0.000000
22389RA	2	1.17E+01-0.0000	0.000000	0.000000	0.000000	0.000000
22489RA	2	3.60E+00-0.0000	0.000000	0.000000	0.000000	0.000000
22589RA	2	1.48E+01-0.0000	.093865	.039706	.012626	.000018
22688RA	2	5.90E+05-0.0000	0.000000	0.000000	0.000000	0.000000
22589RA	2	2.40E+03-0.0000	.012924	0.000000	0.000000	0.000000
22589AC	2	1.00E+01-0.0000	0.000000	0.000000	0.000000	0.000000
22789AC	2	8.00E+03-0.0000	.009135	0.000000	0.000000	0.000000
22889AC	2	2.60E-01-0.0000	0.000000	0.000000	0.000000	0.000000
22790TH	2	1.84E+01-0.0000	0.000000	0.000000	0.000000	0.000000
22590TH	2	7.06E+02-0.0000	0.000000	0.000000	0.000000	0.000000
22990TH	2	2.86E+04-0.0000	0.000000	0.000000	0.000000	0.000000
23090TH	2	2.90E+07-0.0000	0.000000	0.000000	0.000000	0.000000
23190TH	2	1.07E+00-0.0000	0.000000	0.000000	0.000000	0.000000
23290TH	2	5.10E+12-0.0000	0.000000	0.000000	0.000000	0.000000
23490TH	2	2.41E+01-0.0000	0.000000	0.000000	0.000000	0.000000
23091PA	2	1.77E+01-0.0000	0.000000	0.000000	0.000000	0.000000
23191PA	2	1.30E+07-0.0000	0.000000	0.000000	0.000000	0.000000
23391PA	2	2.74E+01-0.0000	.052956	.013190	.003537	.000077
23092U	2	2.05E+01-0.0000	0.000000	0.000000	0.000000	0.000000
23292U	2	2.70E+04-0.0000	0.000000	0.000000	0.000000	0.000000
23592U	2	5.90E+07-0.0000	0.000000	0.000000	0.000000	0.000000
23492U	2	9.10E+07-0.0000	0.000000	0.000000	0.000000	0.000000
23592U	2	2.60E+11-0.0000	0.000000	0.000000	0.000000	0.000000
23692U	2	8.70E+09-0.0000	0.000000	0.000000	0.000000	0.000000
23792U	2	6.75E+00-0.0000	.055956	.012597	.001489	0.000000
23892U	2	1.70E+12-0.0000	0.000000	0.000000	0.000000	0.000000
24092U	2	5.84E-01-0.0000	.088728	.038308	.010984	.000010
23793NP	2	8.00E+08-0.0000	0.000000	0.000000	0.000000	0.000000
23993NP	2	2.53E+00-0.0000	0.000000	0.000000	0.000000	0.000000
23794PU	2	4.56E+01-0.0000	0.000000	0.000000	0.000000	0.000000
23694PU	2	3.30E+04-0.0000	0.000000	0.000000	0.000000	0.000000
23994PU	2	8.90E+06-0.0000	0.000000	0.000000	0.000000	0.000000
24094PU	2	2.40E+06-0.0000	0.000000	0.000000	0.000000	0.000000
24194PU	2	4.80E+03-0.0000	.005360	0.000000	0.000000	0.000000
24294PU	2	1.40E+08-0.0000	0.000000	0.000000	0.000000	0.000000
24194PU	2	2.08E-01-0.0000	.143070	.098165	.046328	.001264
24494PU	2	2.92E+10-0.0000	0.000000	0.000000	0.000000	0.000000
24195AM	2	1.70E+05-0.0000	0.000000	0.000000	0.000000	0.000000
24295AM+1		5.60E+04-0.0000	0.000000	0.000000	0.000000	0.000000
24295AM	2	6.77E-01-0.0000	.142090	.094289	.054745	.002753

24395AM	2	2.90E+06-0.0000	0.000000	0.000000	0.000000	0.000100
24495AM	2	4.21E-01-0.0000	.994642	.041746	.014050	.000027
24296CM	2	1.63E+02-0.0000	0.000000	0.000000	0.000000	0.000100
24396CM	2	1.30E+04-0.0000	0.000000	0.000000	0.000000	0.000100
24496CM	2	6.70E+03-0.0000	0.000000	0.000000	0.000000	0.000100
24596CM	2	7.30E+06-0.0000	0.000000	0.000000	0.000000	0.000100
24696CM	2	2.40E+06-0.0000	0.000000	0.000000	0.000000	0.000100
24796CM	2	5.84E+09-0.0000	0.000000	0.000000	0.000000	0.000100
24896CM	2	1.72E+03-0.0000	0.000000	0.000000	0.000000	0.000100
24997BK	2	2.90E+02-0.0000	0.000000	0.000000	0.000000	0.000000
25097BK	2	1.34E-01-0.0000	.237034	.179005	.125809	.029482
24996CF	2	1.31E+05-0.0000	0.000000	0.000000	0.000000	0.000100
25096CF	2	3.70E+03-0.0000	0.000000	0.000000	0.000000	0.000000
25296CF	2	8.03E+02-0.0000	0.000000	0.000000	0.000000	0.000100

```
12
.03  .05  .07  .10  .20  .40  .70  1.0  1.5  2.0  2.5
 6.08      1.61      0.95      1.30      2.46      5.68      10.7      16.0
 22.0      28.4      34.1      41.5
698454    PHOTON PRODUCTION LIBRARY
                                                                    25
 THE SYMBOLS IN COLUMNS 73-5 INDICATE THE SOURCE OF THE DATA ON A
          PARTICULAR ISOTOPE.
 SYMBOLS                    REFERENCES
 M1      1ST TABLE IN   THE TABLE OF ISOTOPES   BY LEDERER, HOLLANDER,
           AND PERLMAN
 M2      2ND TABLE IN   THE TABLE OF ISOTOPES
 MB      BOTH TABLES IN   THE TABLE OF ISOTOPES
 ND      NUCLEAR DATA SHEETS -- SECTION B   (1966-1968)
 N1      ND AND M1
 N2      ND AND M2
 NB      ND AND MB
 O       OTHER REFERENCES
 MO      M1 AND O
 OM      M2 AND O
 OB      MB AND O
 NO      ND AND O
 N20     N2 AND O
                IN COLUMN 75
 *   INDICATES  (1) INCLUSION OF X-RAY(S) FROM INTERNAL CONVERSION PROCESS
       AND  (2) THAT SOME OF THE INFO ON X-RAY(S) COMES PP. 570-1 OF
       THE TABLE OF ISOTOPES
 $   INDICATES THE SAME THING AS * AND , ADDITIONALLY, THAT SOME OF THE
       INFO ALSO COMES FROM PP. E74-5 OF THE HANDBOOK OF CHEMISTRY AND
       PHYSICS (1964-5)

7230ZN2 6 .41  .009 .07  .016 .018 .049 .009 .1   .9   .145 .08  .198  N1* 001K
7231GA241.0003 .115 .072 .601 .008 .62  .27  .55  .004 .69  .003 .73   ND  002K
.03  .786 .043 .81  .95  .8347 .1   .895 .002 .95  .016 .972 .03  1.05      002
.0071.219 .0141.252 .0131.263 .0171.278 .012 1.32 .0004 1.34 .0041.377     002
.0341.464 .003 1.48 .0091.573 .0361.602 .01  1.665 .0051.718 .0007 1.82     002
.07 1.859 .0112.114 .0007 2.15 .29  2.2  .003 2.24 .002 2.4  .07  2.491     002
.14 2.508 .0007 2.69 .0052.846 .0004 2.91 .0012.976 .0001 3.05 .0011 3.34   002
7330ZN2 0                                                                  004N
7331GA2 8 .005 .067 .87  .296 .13  .325 .001 .377 .001 .487 .001 .541  ND  005K
.07  .742 .017 .77                                                         005
7431GA222 .02  .38  .11  .493 .85  .596 .13  .609 .02  .72  .005 .869  N1  007K
.04  .98  .05 1.103 .08 1.205 .05 1.338 .075 1.46  .02  1.58  .03  1.74      007
.06  1.93 .02  2.18 .49  2.35 .03  2.55 .03  2.73 .03  2.97 .016 3.17      007
.017 3.33 .02  3.14                                                        007
7531GA2 2 .01  .36  .03  .58                                               H1  009K
7532GE1 2 .24  .01  .34  .139                                              MB* 010K
7532GE2 7.0004 .011.0027 .066 .014.1986 .11 .2646.0027 .419.0027.4689  NO* 011K
.0016.6177                                                                 011
7631GA2 3 .5   .5   .5   .563 .5   1.12                                    013U
7633AS218 .04  .559 .41 .5593 .002 .572 .063.6574 .003 .666 .003 .773  ND  015K
.0015 .869 .02 1.283 .0451.316 .0151.229 .0041.433.00151.453 .0731.788     015
.00091.883 .0062.037 .0032.112.0005 2.43.00052.655                         015
7732GE1 3 .08  .081 .12  .159 .21  .215                                    N1* 017K
7732GE251 .01  .123 .013 .159 .32  .21  .28  .215 .5   .263 .005 .36   ND  018K
.145 .368 .251 .417 .004 .435 .175 .563 .006 .565 .107 .632 .002 .64       018
.01  .705 .015 .71  .077 .718 .06  .755 .01  .765 .031 .805 .012 .825     018
.006 .89  .01  .92  .04  .925 .002 .94  .005 .985 .0031.025 .002 1.07      018
.0631.085 .0291.195 .0061.245.0056 1.28 .0071.295 .0091.335 .031 1.37      018
.012 1.46 .0021.475 .0081.515 .012 1.56 .003 1.6  .004 1.7  .00751.715     018
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FIGURE B-8. Library GISLIB Listing

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.0018 1.83,.0011 1.89 .004 1.98 .0062,.003 .0042,.085 .0042,.109,.00172,.135      018
.0009 2.3 .0006 2.34 .0052,347                                                     018
 7733AS2 7,.0023,.0871,.0018,.1616,.0163 .239,.0037,.2498,.0001,.2711,.0006,.2819  ND  019K
,.0061,.5209                                                                       019
 7734SE1 2 .22  .011 .5   .161                                                     HB* 020K
 7832GE2 2 .94  .277 .06  .294                                                     H2  022K
 7833AS2 9 .56 .6141 .21  .695 .06  .83  .02  1.1  .06  1.21 .10  1.51  ND  023K
 .03  1.49 .02  1.7  .02  1.94                                                     023
 7933AS2 5 .02  .36  .02  .43  .005 .54  .005 .73  .01  .89                       ND  025K
 7934SE1 2 .36  .011 .091 .096                                                     ND* 026K
 7934SE2 0                                                                         HB  027K
 8033AS2 9 .42  .666 .007 .785 .007 .812 .036 1.22 .04  1.64 .017 1.77  ND  029K
 .005 1.84 .003 2.3  .004 2.35                                                     029
 8035RR1 3 .494 .012 .36  .037,.0033 .049                                          HB* 031K
 8035RR2 5 .072 .616,.0023 .639 .011 .666 .002 .704,.00081,.257                    ND  032K
 8133AS2 0                                                                         HB  034K
 8134SE1 2 .4   .011 .08  .103                                                     HB* 035K
 8134SE2 6,.0056 .205 .003 .27  .02  .276 .013 .29  .01  .335 .003 .561  ND  036K
 .01  .565,.0033 .65  .01  .836                                                    036
 8136KR2 0                                                                         HB  038K
 8235RR219 .004,.0922 .023,.2214 .012 .274 .73 .5543 .43 .6191 .27 .6984  ND  040K
 .83 .7768 .24 .8274 .004 .951 .017 1.01 .29 1.044 .0041,.084 .28 1.317        040
 .17 1.475 .0081,.651,.00121,.782,.00051,.874,.00051,.959,.00022,.056          040
 8334SE1 9 .15  .356 .13  .676 .14  .989 .22 1.031 .04 1.063 .0061,.116  ND  042K
 .02 1.654 .1  2.054 .0022,.147                                                042
 8334SE227 .34  .226 .73  .356 .035 .457 .45  .512 .03  .554 .04  .572  ND  043K
 .22  .72  .15  .801 .14  .837 .09  .868 .09  .886 .06 1.065 .02 1.082        043
 .04 1.102 .09 1.299 .04 1.319 .06 1.344 .03 1.355 .0071,.421 .03 1.558       043
 .04 1.784 .013 1.83 .03 1.855 .09 1.897 .12 2.291 .04 2.338 .01 2.421        043
 8335RR2 1 .014 .521                                                           ND  044K
 8336KR1 3 .09 .0093 .6   .013,.0001 .032                                      N1* 045K
 8434SE2 1 1.0 .4077                                                           0   047K
 8435RR1 4 .68  .44  .75  .88  .75  1.46 .16  1.89                             H1  048K
 8435RR222 .005 .27  .008 .35  .022 .43  .014 .47  .021 .52  .024 .61  HB  049K
 .026 .74  .09  .81  .51  .88  .1   1.01 .04  1.21 .026 1.47 .01  1.57        049
 .015 1.74 .18  1.9  .016 2.05 .011 2.17 .08  2.47 .02  2.82 .031 3.03        049
 .025 3.29 .13  3.93                                                           049
 8533AS2 0                                                                     051N
 8534SE2 0                                                                     052N
 8535RR2 0                                                                     HB  053K
 8536KR1 3 .07  .013 .74  .15  .13  .305                                       HB* 054K
 8536KR2 1,.0041 .514                                                          H1  055K
 8834SE2 0                                                                     057N
 8835RR2 6 .35  1.22 .55  1.56 .06  1.75 .2   2.3  .2   2.75 .15  3.6        058U
 8837RR1 2 .01  .013 .984 .556                                                 OH* 060K
 8837RR2 1 .088 1.08                                                           HB  061K
 8734SE2 0                                                                     063N
 8735RR2 5 .6   1.44 .1   1.85 .1   2.48 .09  2.98 .65  3.0                   064U
 8736KR2 4 .84  .405 .16  .85  .042 2.05 .35  2.57                            HB  065K
 8737RR2 0                                                                     HB  066K
 8738SR1 2 .12  .014 .8   .388                                                 HB* 067K
 8835RR2 1 .5   .76                                                            069U
 8836KR2 9 .008 .013 .064 .028 .064 .166 .35  .191 .05  .36  .23  .85  HB* 070K
 .14  1.55 .21  2.19 .35  2.4                                                  070
 8837RR211 .13  .898 .014 1.39 .21  1.84 .011 2.11 .023 2.68,.0008 2.76  HB  071K
.0032 3.01,.0032 3.24,.0032 3.52,.0008 3.68,.0032 4.87                         071
 8935RR2 0                                                                     073N
 8936KR2299 .005,.0856 .004,.0936 .01 .1508 .25 .2206 .009,.2642 .02 .3453  0  074K
 .065,.3563 .02 .3688 .015 .396 .015,.4114 .005,.4345 .012,.4393 .012 .455     074
.0075,.4687 .11 .4978 .005 .527 .08 .5772 .21 .5864 .005 .613 .015 .627        074
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 .02  .695 .007 .708 .04 .7376 .003 .744 .005 .76  .006 .777 .005 .802      074
 .02  .823 .007 .86  .06 .8675 .073.9035 .004 .971 .005 .987 .01  1.01      074
 .0091.077 .0541.105 .0251.117 .01 1.173 .0031.273 .0051.298 .0161.324      074
 .028 1.37 .0951.472 .008 1.5  .11 1.533 .01 1.636 .0071.665 .01  1.67      074
 .0471.692 .03  1.74 .0281.775 .0111.843 .0121.902 .0041.998 .0262.011      074
 .017 2.02 .01  2.12 .02 2.281 .004 2.36 .0142.618 .0082.644 .0072.753      074
 .0052.762 .014 2.79 .0282.866 .0032.946.00163.125 .0093.143.00363.219      074
.0025 3.32 .0123.363.00251.384 .002 3.48 .003 3.51.01543.534.00853.568      074
.00083.629.00073.653 .008 3.72 .0023.734.00083.823.00083.834.00083.843      074
.00143.894.00143.904 .0033.924.00153.962 .0035.976 .0013.993.00074.005      074
.00154.044.00174.075 .0014.111.00394.142.00034.185.00054.343.00294.369      074
.00074.485.00054.651                                                        074
 8937R82 8 .15  .66  .75  1.05 .55  1.26 .04  1.55 .13  2.2  .13  2.59  H2  075K
 .03  2.75 .02  3.5                                                        075
 8938S82 0                                                              HB  076K
 8939V 1 2.0067 .015 .99  .91                                           HB* 077K
 9035S82 0                                                                  079N
 9036K82 6 .04  .013 .15  .11  .65  .12  .09  .23  .07  .236 .042 .42   HB* 080K
 .12  .495 .48  .536 .07  .64  .041 .96  .48  1.12 .04  1.34 .05  1.4        080
 .168 1.59 .041 1.63 .114 1.79 .009 2.03 .009 2.29 .009 2.4  .04  2.48       080
 .02  2.58 .03  2.7  .03  2.94 .02  3.08 .01  3.17 .01  3.6                 080
 9037R82I8 .04  .53  .51  .83  .1   .86  .05  1.03 .07  1.11 .05  1.4   HB  081K
 .03  1.7  .021 2.2  .03  2.51 .06  3.07 .156 3.34 .05  3.54 .11  4.13       081
 .1   4.37 .053 4.37 .05  4.6  .02  5.08 .04  5.23                         081
 9038S82 0                                                              HB  082K
 9039V 1 3 .08  .015 .97  .202 .91  .482                                HB* 083K
 9039V 2 2.01-2.16-1.04-31.734                                          H2* 084K
 9136K82 0                                                              HB  085K
 9137R81 0                                                                  087N
 9137R82 0                                                                  088N
 9138S82 5 .15  .645 .27  .748 .03  .93  .3  1.025 .05 1.413            H1  089K
 9139V 1 2 .034 .015 .95  .55                                           HB* 090K
 9139V 2 1 .005 1.21                                                    HB  091K
 9236K82 0                                                                  093N
 9237R82 0                                                                  094N
 9238S82 3 .03  .23  .04  .44  .9   1.37                                 H1  095K
 9239V 210 .025 .448 .004 .49  .026 .56  .011 .84 .0083 .9   .36  .934  H2  096K
.0026 1.12 .045 1.4  .004 1.83.0005 2.06                                    096
 9336K82 0                                                                  098N
 9337R82 0                                                                  099N
 9338S82 3 .65  1.1  .25  1.4  .1   1.8                                    100U
 9339V 213.0009 .015 .06  .267.0003 .49  .007 .67  .023 .94  .002 1.15  HB* 101K
.0915 1.2  .007 1.42.0007 1.62 .018 1.9 .0007 2.14 .003 2.18.0005 2.43      101
 9340Z82 0                                                              HB  102K
 9341V81 1 .01  .017                                                    OH* 103U
 9436K82 0                                                                  105N
 9437R82 0                                                                  106N
 9438S82 1 1.0  1.42                                                    HB  107K
 9439V 210 .06  .56  .43  .92  .05  1.13 .024 1.65 .016 1.9  .024 2.13  HB  108K
 .015 2.57 .007 2.84 .013 3.06 .011 3.53                                    108
 9441V81 3 .417 .017.0007 .407 .002 .871                                H2* 110K
 9441V82 2 1.0  .702 1.0  .871                                          HB  111K
 9536K82 0                                                                  113N
 9537R82 0                                                                  114N
 9538S82 0                                                                  115N
 9539V 240 .001.0732 .008 .432 .003 .632 .1   .953 .0021.001 .0051.047  0   116K
 .0041.173 .0031.274 .0261.323 .0041.356 .0041.419 .0011.445 .0071.619      116
.00151.654 .0011.785 .0011.798 .0081.906 .0021.814 .0031.893 .0021.905      116
 .0051.926 .014 1.94 .0412.175 .0032.252 .0062.295 .0052.372 .0032.496      116
 .0222.631.00012.729.00012.761.00012.846.00012.996.00053.129 .0043.249      116
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.002 3.45 .0223.576.00013.684.00013.887.00013.922.00014.068                    116
9540ZR2 2 .49  .724 .49  .756                                                  H1  117K
9541NB1 2 .41  .017 .254 .235                                                  OH* 118U
9541NB2 1 .99  .765                                                            O   119K
9639Y 2 3 1.0  .7   .4   1.0  .33  1.5                                         121U
9641NB216 .044 .215 .029 .241 .329 .349 .035 .372 .262 .459 .037 .48   H2  123K
.579 .569 .055 .72  .975 .778 .145 .811 .209 .851 .008 .94 .0065 1.03       123
.515 1.09 .196 1.2  .025 1.5                                                   123
9736KR2 0                                                                      125N
9737RR2 0                                                                      126N
9738SR2 0                                                                      127N
9739Y 2 0                                                                      128N
9740ZR226.0007.1117.0005 .182.0021.2192.0001.2543.0027.2724.0009 .296  0   129K
.0009 .331 .021.3555.0027 .401 .057.5078 .009 .513 .015.6024.0022.6903       129
.011.7036 .89 .7432.0075.8048.002A.8299.0037.8548.0029.9711.00051.021        129
.0271.109 .0111.148 .0111.276 .0151.363 .015 1.75.00451.852                    129
9741NB1 2 .01  .017 .98  .747                                                  HB* 130K
9741NB2 2 .98  .665 .02  1.02                                                  H2  131K
9800ZR2 0                                                                      133N
9801NB1 0                                                                      134N
9841NB212 .09  .33  .75  .72  1.0  .787 .3   1.16 .1   1.44 .04  1.52       135U
.1   1.68 .04  1.88 .08  1.93 .05  2.24 .05  2.44 .05  2.7                    135
9940ZR2 0                                                                      137N
9941NB2 2 .1   .1   .1   .26                                                   138U
9942MB210 .023 .018 .01 .0406 .024 .141 .088 .181 .013 .372 .002 .41   H2* 139K
.001 .62  .124 .74  .044 .78  .002 .94                                         139
9943TC1 2 .075 .018 .9   .14                                                   HB* 140K
9943TC2 0                                                                      HB  141K
10041NB2 4 .1   .14  .55  .36  .4   .45  1.0  .53                             143U
10043TC2 2 .5   .54  .5   .6                                                    145U
10141NB2 0                                                                     147N
10142MB219 .073 .018 .25  .191 .02  .193 .07  .3   .02  .4   .15  .51   H2* 148K
.21  .59  .12  .7   .01  .84  .15  .89  .02  .95  .25  1.02 .01  1.14       148
.11  1.18 .03  1.28 .09  1.38 .01  1.46 .11  1.56 .16  2.08                   148
10143TC2 6 .03  .13  .91  .307 .18  .36  .08  .545 .02  .72  .004 .85   HB  149K
10242MB2 0                                                                     151U
10243TC2 7 .88  .475 .34  .63  .09  1.05 .24  1.11 .04  1.31 .11  1.6    O   152U
.16  2.19                                                                      152
10343TC2 4 .51  .019 .34  .135 .20  .21  .01  .35                        H2* 154U
10344RU2 7.0047 .02 .0036 .053.0027 .297.0035 .445 .88  .498.0077 .557  HO* 155K
.0647 .61                                                                      155
10345RH1 2 .12  .02  .004 .04                                                  HB* 156K
10442MB2 0                                                                     158N
10443TC2 5 .78  .36  .42  .53  .22  .88  .19  1.63 .02  3.1                 O   159U
10445RH114 .76  .02  .47 .0514 .025.0776 .026.0971.0002 .262.0016.5555 HB* 161K
.0007 .75 .0001 .767.0006 .78  .0003 .938.0001 1.26.0001 1.34.0006 1.53       161
.0001 1.81                                                                     161
10445RH2 2 .02  .56 .0013 1.24                                                 HB  162K
10542MB2 0                                                                     164N
10543TC216 .02 .0553 .03 .0752 .08 .0823 .3  .1079 .02 .1135 .03  .127  O   165U
.1  .1382 .4  .1432 .4  .1591 .08  .226 .13 .2522 .07 .2728 .26 .3211       165
.08  .335 .16  .35  .16  .462                                                  165
10544RU223 .02  .148 .02  .15  .02  .188 .02  .21  .07  .263 .09  .315  H2  166K
.02  .317 .04  .393 .03  .41  .18  .47  .03  .49  .02  .57  .05  .65       166
.11  .68  .48  .726 .01  .87  .03  .89  .02  .92  .01  .96  .003 1.35      166
.001 1.38 .001 1.58 .001 1.73                                                  166
10545RH1 2 .59  .02  .08  .129                                             H2* 167U
10545RH2 6.0034 .021.0003.0388.0017.2805 .054.3063 .191.3193.0004.4427  O   168K
10642RU2 0                                                                 HB  170K
10645RH113 .18  .22  .18  .406 .35  .451 .88  .512 .29  .616 .41  .735       171K
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 .35  .82  .25  1.05 .12  1.13 .17  1.22 .18  1.56 .04  1.86 .015 2.28      171
10645PM222 .098,5116,0034,6166,0075,6225,0001,7176,0021,8734,0073 1.05  0   172K
.00011,062,00011,114 .0021,129,0001 1.13,00031,193,00011,496,00081,562      172
.00011,765,00011,796,00011,925,00011,986,00022,111,00012,367,00012,407      172
.00012,571,0001 2,65                                                        172
10743TC2 0                                                                  174N
10744PD2 6 .14  .195 .06  .37  .07  .86  .04  .93  .04  1.03 .04  1.29  M2  175K
10745PM2 8 .005 .115 .03  .265 .73  .307 .02  .365 .11  .39  .01  .47   M2  176K
 .018 .57  .028 .67                                                         176
10746PD2 0                                                                  MR  177K
10748PD2 1 .28  .165                                                        MB  179K
10749PM2 5 .43  .434 .1   .51  .22  .62  .85  1.52 .03  2.0               MA  180K
10847AG1 9 .074 .022 .074,0795,0007,4057 .895,4337 .94 ,6135,0016 .633  0 * 182K
 .913,7226,0005,8365 .009 1.02                                              182
10847AG2 6,0045 .434,0056 .511,0018 .615 .017 .633,0002 .842,0001 1.01  MB  183K
10945PM2 0                                                                  185N
10946PD1 2 .241 .022 .58  .188                                              MB* 186K
10946PD2 4,0001 .129,0001 .31  .0001 .41  .0001 .64                         M1  187K
10947AG1 2 .38  .022 .05  .088                                              MB* 188K
11047AG117 .005 .023,0001 .116 .027 .447 .033 .62  .96  .658 . 62 .677  OB* 191K
 .077 .667 .261 .706 .081 .744 .235 .764 .108 .818 .752 .885 .337 .937      191
 .214 1.38 .051 1.48 .124 1.51 .018 1.57                                    191
11047AG2 3 .045 .658,0003 .818,0002 1.48                                    M2  192K
11146PD176 .07 .0705,0025,1017,0006,1191,0005 .167 .007,1694 .305,1722  0   194K
.0003 .178,0002 .263,0013 .272 .007,2698,0013,3075,0002,3169 .004,3581      194
 .007,3767 .05 .3913 .034 .415,0005 .418,0024,4392,0125,4546,0005 .476      194
.0055,4859,0005 .504 .001,5102,0125,5256,0026,5525,0017,5563 .035,5751      194
.0008 .617,0025,6232,0335,6327 .001,6456,0018 .654,0105,6683 .02 .6941      194
.0005 .697,0065,7036,0004 .716,0018,7189,0023,7246 .001,7463,0008,7527      194
.0105 .762 .005,7976,0005,8065,0009,8168 .001 .829,0013,8631 .002 .882      194
.0005,9166 .001 .945 .002,9756,0025 .997 .0011,001 .0011,023,00071,029      194
.00071,046 .0021,063,00041,076,00251,088,01351,099,01051,116 .001 1.14      194
 .0031,163 .003 1.2 .00051,224,01151,283,00051,309,00041,381,00091,418      194
.00091,651,0135,691,00271,722,00471,775,00381,905,00081,939 .0071,971      194
.00032,004,00042,086                                                        194
11146PD265,0008,0705,0001 .166,0005,1694,0001,2021,0002,2305,0 01,2788  0   195K
.0006,2968,0001 .308,0002,3169,0001,3526,0047,3767,0003,3913,0 07,4049      195
.0009 .415,0005,4387,0007,4707,0002,4785,0003,4859,0001,4942,0024,5089      195
.0002,5165,0001,5192,0002 .541,0037,5471,0002,5529,0001 .572,0 05,5801      195
.0001 .603,0001,6114,0033,6232,0002 .624,0005 .642,0658,6506,0 01,6577      195
.0004,6857,0013 .71 .0001 .743,0001 .746,0004,7756,0001 .794,0 03,8039      195
.0003,8085,0001,8195,0001 .833,0024,8358,0001,9205,0001,9373,0 01 .95       195
.0003,9551,00051,002,00011,015,00011,022,00011,027,0001 1.06,0 0011,067    195
.00011,098,0015 1.12,0001 1.27,00011,311,00721,368,00651,459,0 021,542     195
.00011,549,00031,574,00021,644                                              195
11147AG1 2 .34  .022 .014 .07                                               OM* 196U
11147AG2 3 .002 .095 .01  .247 .06  .342                                    MB  197K
11149CD1 3 .78  .023 .3   .15  .94  .247                                    MB* 198K
11246PD2 1 .2   .019                                                        M1  200K
11247AG297,0021,1199,0002,2255,0003,2783,0002,3107,0003,3513,0 03,3588  MO  201K
.0005,3811,0007,3868,0002 .505,0002,5289,0005,5353,0003,5577,0 34,6061     201
 .41 .6168,0002,6475,0001 .66 .0004,6629,0003 .664,0004,6866,0 45,6915     201
.0279,6942,0006 .714,0017,7181,0006,7516,0006,7619,0002,7848,0 57,7974     201
.0004 .803,0011,8149,0001,8366,0001,8428,0103,8511,0026 .861 .01 .918      201
 .001,9068,0003,9573 .0011,006,00081,063,00031,071,00381,103,0 171,125     201
.00041,144,00031,199,00311,253 .0011,281,01071,312,00021,322,0 06 1.33     201
.00491,356,05081,387,00041,397,00031,411,00041,445,00111,451,0 491,468     201
.00021,484,00021,501,00141,504,00451,538,00061,599,02791,613,0 041,653     201
.00051,653,00041,701,00051,715,00031,756,00821,798,00271,888,0 051,908     201
.00021,919,00111,945,00051,953,00031,992,00142,051,00532,057,0 032,068     201
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.02052.106.00072.148.00042.156.00392.212.00942.507.00082.552.00032.577          201
.00242.686.00052.723.00092.752.00022.765.00012.776.00012.804.00392.829          201
.00012.839.00022.853.00012.863.00022.884.00012.921.0002 2.96.00013.375          201
11346PD2 0                                                                  HB  203K
11347AG1 5 .25  .14  .25  .3   .25  .39  .05  .56  .05  .7                       204U
11347AG2 7 .1   .12  1.0  .3   .05  .58  .17  .67  .04  .88  .05  .98          205U
 .04  1.18                                                                     205
11348CD1 2 .74  .023 .001 .265                                              HB* 206K
11446PD2 0                                                                  HB  209K
11447AG2 1 1.0  .57                                                             210U
11449IN1 4 .61  .024 .17  .192 .035 .558 .035 .724                          HB* 212K
11449IN2 1.0017 .3                                                          H1  213K
11546PD2 0                                                                      214N
11547AG1 0                                                                      215N
11547AG222 .01  .11  .12  .14  .02  .17  .49  .22  .07  .24  .13  .28       H2  216K
 .11  .36  .07  .42  .01  .45  .1   .47  .01  .62  .04  .64  .02  1.04          216
 .02  1.08 .11  1.48 .1   1.66 .02  1.76 .1   1.86 .07  1.9  .02  2.03          216
 .15  2.12 .01  2.5                                                           216
11548CD1 6.0003 .162.0038 .485.0038 .935.0003 1.13.0087 1.29.0002 1.42      H2  217K
11548CD2 6.0006 .035 .005 .23  .0005 .26  .02  .262 .1   .49  .255 .53      H2  218K
11549IN1 2 .33  .024 .5   .335                                              HB* 219K
11549IN2 0                                                                  HB  220S
11646PD2 0                                                                      222N
11647AG2 2 1.0  .52  .21  .7                                                    223U

                                                                            1
     THE NEXT ISOTOPE HAS A HALF-LIFE OF 54 MINUTES.
11649IN112 .032 .138 .007 .385 .368 .417 .007 .434 .166 .819.0006 .93       H2  225K
 .522 1.1  .821 1.29 .11  1.51 .051 1.75 .195 2.11.0004 2.23                    225

                                                                            1
      THE NEXT ISOTOPE HAS A HALF-LIFE OF 14 SECONDS.
11649IN2 6 .001 .434.0006 .93  .012 1.29.0004 2.23                          H2  226K
11747AG2 0                                                                      228N
11748CD137 .035 .089 .001 .161 .028 .222 .166 .273 .006 .293 .04  .345      H2  229K
 .054 .366 .064 .434 .009 .462 .05  .565 .016 .631 .03  .702 .05  .715          229
 .03  .748 .028 .862 .105 .88  .017 .931 .04  .947 .036 1.03 .025 1.05         229
 .0931.065 .041 1.12 .006 1.17 .072 1.23 .026 1.25 .018 1.26 .071 1.34         229
 .01  1.38 .071 1.41 .104 1.43 .06  1.56 .024 1.64 .078 1.72 .139 2.0          229
 .018 2.1  .03  2.32 .004 2.39                                                  229
11748CD222 .076 .089 .002 .161 .006 .222 .28  .273 .001 .293 .172 .345      H2  230K
 .139 .434 .016 .462 .013 .565 .039 .832 .024 .88  .016 .947 .011 .964          230
 .002 1.01 .044 1.05 .027 1.14 .004 1.27 .19  1.3  .004 1.38 .021 1.4           230
 .16  1.58 .026 1.71                                                            230
11749IN1 3 .15  .024 .14  .158 .31  .314                                    HB* 231K
11749IN2 3 .11  .025 .87  .158 1.0  .565                                    HB* 232K
11750SN1 2 .95  .025 .87  .158                                              HB* 233K
11848CD2 0                                                                  HB  235K
11849IN2 1 .15  1.23                                                        HB  236K
11948CD1 0                                                                      238N
11948CD2 1 .21  .8                                                              239U
11949IN1 5 .066 .024 .036 .025 .007 .3   .024 .898 .026 .922                H2* 240U
11949IN2 3 .136 .024 .05  .73  .95  .82                                     H2* 241K
11950SN1 3 .2   .024 .35  .025.0001 .065                                    0H* 242U
12049IN214 .12  .09  .09  .198 .12  .71  .34  .86  .12  .94  .61  1.02      H1  244K
 1.0  1.17 .14  1.28 .06  1.47 .37  1.87 .06  2.01 .03  2.22 .01  2.4           244
 .02  2.63                                                                      244
12148CD2 0                                                                      246N
12149IN1 0                                                                      247N
12149IN2 1 1.0  .94                                                             248U
12150SN1 2 .903 .024 .097.0372                                              0   249K
12150SN2 0                                                                  HB  250K
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 12249IN2 3 .4   .99  .4   1.14 .72  1.16                                    252U
 12251S91 3 .83  .026 .5   .061 .17  .075                                   HB* 254K
 12251882 4 .66  .554 .034 .686 .007 1.14 .007 1.26                         H1  255K
 12349IN2 1 1.0  1.1                                                        257U

      THE NEXT ISOTOPE HAS A HALF-LIFE OF 40 MINUTES.                                1
 12350SN1 4 1.0  .10 .0004 .381.0002 .542.0001 .552                         0   258K
 12350SN2 1 .02  1.08                                                       259U
 12352TE1 3 .44  .027 .002.0855 .84  .159                                   0B* 261K
 12451S91 3 .2   .595 .2   .603 .2   .644                                   H1  264K
 12451S8239.0008.3358.0015 .4  .0021.4439.0019.5253 .979.6027.0011.8324  0   265K
 .0726.6459.0103.7094 .023.7138 .11 .7228.0018.7357 .007.7907.0007.8166      265
 .0144.9682 .0191.065.01541.326.00971.355.02721.368.08471.376.01171.437      265
 .00231.385.00681.389 .0041.526 .52 1.691.0011 1.72.00061.919.0007 2.04      265
 .00432.091.00052.099.00062.104.00482.162.00042.294                          265
 12550SN111 .013 .026 .97  .325 .006 .58  .003 .64 .0004 .83 .0014 1.07  HR* 267K
  .008 1.39.0013 1.47 .002 1.61.0007 1.72.0006 1.94                          267
 12550SN2 9 .003 .342 .004 .468 .015 .811 .014 .904 .04 1.068.0014 1.17  H1  268K
 .0014 1.41 .006 1.97.0005 2.23                                             266
 12551S8213 .001.1094 .003.1727 .06 .1763 .003.2042 .003 .208 .004.3211  0B  269K
 .012 .3206 .31  .428 .1  .4634 .19 .6007 .05 .6068 .11 .6361 .019.6714     269
 12552TE1 3 1.08 .027 .07  .035 .003 .11                                    HB* 270K
 12650SN2 3 .35  .06  .35  .067 .35  .092                                   272U
 12651S41 2 .1   .41  .15  .67                                             273U
 12651S82 3 1.0  .41  1.0  .69  1.0  .66                                    274U
 12750SN2 6 .5   .27  .5   .49  .5   .99  .2   1.45 .1   2.32 .1   2.74    276U
 12751S234 .03  .027 .013 .061.0013.1543.0762.2524 .006.2804 .018.2908  0 * 277K
 .0026.2933.0023 .31 .0086.3018.0343.4121.0063 .441 .039.4451.0015 .451      277
 .2313 .473 .007.5028.0264.5433 .003.5802 .04 .6035 .014.6378.0013.6523      277
 .0066.6675 .005.6823 .33 .6857.0327.6985.0168.7222.0012.7459.0017.7637      277
 .1356.7637.0036 .813 .002.8208.0046.9244.0033 .142.0033 1.29.00071.378      277
 12752TE1 3 .35  .027.0019 .059.0008 .089                                   HB* 278K
 12752TE2 6.0014 .028.0001 .058.0002 .203.0001 .215.0005 .36  .013 .418   OH  279K
 12750SN2 4 .07  .044 .19  .072 .61  .5   .22  .57                         H1  281K
 12851SH1 4 .7   .314 .8   .53  1.5  .64  2.0  .75                         2820
 12851S82 3 .83  .32  2.0  .75  .04  1.07                                   H1  283K
 12853I 2 4 .14  .041 .014 .528 .002 .743 .003 .969                         H1  285K
 12951S42 4 .4   .11  .3   .62  .15  1.04 .2   .534                        287U
 12952TE113 .04 .0278.0014.1055.0011.5567.0302 .672.0301 .696.0032.7018  0   288K
 .0081.7295.0003.7411.0009.8172.0003.8449.0021.823.0002 1.05.00011.402       288
 12952TE225 .116.0278.0024.1055.0021 .209.0145.2507.0064.2784.00 7.2812  0   289K
 .0001.3426.0004.3428 .08 .4596.0152.4874 .001.5314.0001.5515.0001.5597      289
  .001.6244.0005.7411.0001.7649.0022.8022.0001.8299.0005.8334.0002.9824      289
 .00631.084.00251.112.00011.233.00011.261.00011.264                          289
 129531 2 2 .7   .029 .09  .04                                              H1* 290K
 13050SN2 0.                                                                292N
 13051S82 4 .3   .19  .3   .33  .3   .82  .3   .94                         2930
 130531 2 6 .014 .03  .35  .419 .99  .538 1.0  .669 .87  .743 .12  1.15  HB* 295K
 13151S42 2 .37  .54  .48  .95                                             H1  297K
 13152TE115 .071 .327 .02  .081 .05  .102.0007 .182 .057 .15  .07  .2    HB* 298K
  .074 .241 .036 .278 .123 .336.0003 .343.0033 .453 .002 .493.0004 .548      298
 .0001 .603.0023 .650 .556 .775.0585 .786.0755 .797 .015 .831 .3   .854      298
  .021 .869 .035 .915.0065 .997 .006 1.05 .0151.055 .13  1.13 .012 1.15      298
  .11  1.21.0165 1.58 .03  1.63 .026 1.86 .0331.905 .005 2.13 .004 2.24      298
 .006 2.33                                                                  298
 13152TE221 .58  .5  .007 .279 .009 .343 .007 .384 .16  .453 .05  .493  HR  299K
  .002 .544 .043 .603 .013 .654 .003 .695 .002 .727 .001 .842 .002 .896      299
  .008 .933 .02  .948 .004 .952 .036 .997 .012 1.01 .005 1.1  .06  1.15     299
  .01  1.3                                                                  299
 131531 2 9 .07  .03  .026 .08  .002 .177 .034 .264 .002 .326 .62  .364  HR* 300K
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 .003 .503 .066 .637 .016 .723                                                  300
13154XE1 2 .49  .03  .02  .164                                                  HB* 301K
13251S82 0                                                                      303N
13252TE2 3 .77  .029 .17  .053 .9   .23                                        HB* 304K
13253I 227 .029 .147 .01  .24  .015 .263 .002 .285 .006 .36  .027 .508  HB  305K
 .2   .523 .081 .521 .1   .63  1.44 .67  .07  .728 .89  .773 .22  .955        305
 .06  1.14 .007 1.22 .07  1.28 .005 1.3  .019 1.36 .14  1.4  .01  1.44       305
 .002 1.72 .013 1.91 .013 1.99 .003 2.08 .002 2.16.0005 2.55.0002 2.68       305
13351S82 0                                                                      307N
13352TE163.0029.0741.0029.0815.0108 .088.0216.0949.0056.1643.0432.1689  0   308K
.0054.1771.0036.1782.0014.1845.0043.1932.0022.1982.0151.2134.0018.2209         308
.0014 .224.0025.2443.0022.2515.0036.2576.0504.2614 .054.3341.0054.3445         308
.0047.3472.0022.3556 .004.3628.0022.3768.0061 .397 .013 .429.0158.4449         308
.0122.4621.0083.4719.0065.4786.0018.5196.0072.5349 .013 .574.0058 .622         308
.1224.6474.0155.7028.0061.7317.0119.7339.0141.7798.0054.7957.0079.8005         308
.1054.8639.0173.8828.0018.8977 .36 .9126.0684.9147.0054.9344.0335.9782         308
.0097.9804.0047.9829.0065 1.03.01121.062.01041.349 .0091.459 .0341.516         308
.00341.532.00791.587.02411.683 .0041.704.00471.886.01942.005 .0052.028         308
.00612.049                                                                     308
13352TE214 .48  .312 .31  .4076.0011.4747 .083.7197 .072.7868 .046.8444  0   309K
 .054.8907 .0451.001 .0341.021 .0141.252 .11 1.333 .0081.406 .0321.718         309
 .0131.682                                                                     309
13353I 2 1 .9   .53                                                      H1  310K
13354XE1 2 .49  .03  .14  .233                                                  HB* 311K
13354XE2 4 .5   .031.0024.0796 .37  .081.0008 .161                            HB* 312K
13451S82 0                                                                      314N
13452TE214 .31  .029 .22 .0795.0004.1014 .16 .1811 .085.2015 .23 .2108  0 *  315K
 .6  .2781 .14 .0348 .089.4607 .043.4644 .19 .5656 .051.7125 .14  .742         315
 .27 .7667                                                                     315
13453I 225 .052.1356 .005.1864 .019.2343 .083.4053 .05 .4327 .071.5013  OH  316U
 .104.5943 .092.6209 .176.6769 .037.7062 .94 .8475 .085 .856 .614.8842         316
 .015 .911 .016 .921 .028 .948 .043 .974 .017 1.04 .1371.073 .0961.136         316
 .0201.457 .0361.621 .0231.773 .0531.813 .0252.412                             316
13455CS1 3 .005 .01  .32  .031 .14  .128                                    HB* 318K
13455CS210.0162.4756 .086.5631 .133.5693 .975.6048 .87  .796 .079 .802  0   319K
.01041.634.02011.168.03471.365.0003 1.58                                       319
13551S82 0                                                                      321N
13552TE2 0                                                                      322N
13553I 2 8 .07  .42  .11  .86  .09  1.04 .37  1.14 .34  1.28 .12  1.46  H1  323K
 .19  1.72 .11  1.8                                                            323
13554XE1 2 .14  .03  .8   .527                                                  HB* 324K
13554XE2 4 .04  .031 .91  .25  .001 .36  .03  .61                            HB* 325K
13555CS2 0                                                                  HB  326K
13556AE1 2 .54  .032 .16  .268                                              HB* 327K
13553I 210 .12  .2   .18  .27  .19  .39  .02  .45  .02  .53  .03  .71   HB  329K
 .06  1.0  .35  1.32 .04  1.55 .02  1.72 .05  1.91 .07  2.2  .12  2.4          329
 .1   2.63 .08  2.8  .05  3.2                                                  329
13655CS210 .136 .032 .11  .067 .06  .085 .073 .153 .164 .176 .13  .273  HB* 331K
 .53  .34  .837 .818 .715 1.05 .2   1.25                                      331
13753I 2 0                                                                      333N
13754XE217.0017 .394 .3   .456.0009 .595.0065 .849.0007 .934.0022 .982  0   334K
.00081.969 .0021.117.00081.185.00251.275.00171.576.00161.615.00081.668         334
.00481.784.00111.918 .0012.396.00262.852                                       334
13755CS2 0                                                                  HB  335K
13756AE1 2 .04  .052 .89  .662                                              HB* 336K
13353I 2 0                                                                      338N
13554CS2 6 .22  .16  .06  .24  .28  .42  .05  .51  .44  .78  .37  2.02         339U
13655CS212 .018 .139 .008 .193 .015 .229 .029 .411 .23  .463 .091 .55   H2  340K
 .039 .87  .254 1.01 .733 1.43 .175 2.21 .092 2.63 .005 3.38                   340
13954I 2 0                                                                      342N
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13954xE218 .035 .031.0064 .121 .249.1749 .71  .219 .02 .2255 .099.2899  0 * 343K
 .234.2967.0063 .339.0049 .353 .078.3942.1014 .456 .014 .491 .021 .514      343
 .006 .549 .044 .613 .009 .723 .012 .732 .032 .788                          343
13955CS2 2 .04  .62  .16  1.28                                              344U
13956BA2 8.2492.0166.00031.091.00011.216.00011.219.00061.255.00021.311  0   345K
.00011.371 .0048.421                                                        345
14054xE2 4 .04 .0473 .15 .0794 .02 .0877 .08  .103 .13 .1116 .15 .1175  0   347U
 .01 .1636 .05 .1667 .01  .182 .04 .1976 .1  .2121 .01 .2584 .03 .2774      347
 .07 .2812 .02 .2937 .01 .3312 .03 .3739 .06 .3901 .03 .3965 .03 .4294      347
 .13 .4386 .03 .4451 .07 .4617 .01 .5033 .04 .5148 .04 .5189 .0> .5478      347
 .2  .5572 .1  .6041 .28  .622 .03 .6274 .05 .6389 .22 .6534 .13 .7739      347
 .7  .8154 .08 .8795 .02 .8913 .11 .9869 .06 1.137 .04 1.207 .2  1.31       347
 .24 1.315 .36 1.413 .03 1.426                                              347
14055CS221 .03  .528 .5  .602 .01  .672 .01  .736 .08  .908 .01  1.01  0   348U
 .03  1.13 .03  1.2  .02  1.23 .01  1.25 .01  1.59 .03  1.5  .02  1.64      348
 .01  1.83 .04  1.85 .01  1.95 .02  2.1  .01  2.24 .02  2.33 .02  2.43      348
 .03  2.52                                                                  348
14056BA2 8 .06 .014 .11  .03  .01 .112 .02  .133 .06  .163 .0>  .305  HB  349K
 .05  .438 .34  .538                                                       349
14057LA227 .018 .035.00011.064.0006.0689.0026.1094.0058.1311.0012.1735  0 * 350K
.0043 .242.0053.2666.0002.3069 .204.3288.0005.3978.0297.4325 .412 .487      350
.0004.6162 .042.7514 .23 .8158.0559.8678.0261.9196.0691.9252.0043.9509      350
 .955 .997.0086 .348.0336.522.0012 .548.0007 2.9 .00033.118.0001 3.32       350
14150xE2 0                                                                  352N
14155CS2 0                                                                  353N
14156BA2 3 .6  .3  .1  .5  .05 1.42                                         354U
14157LA2 1 .02 1.37                                                     HI  355K
14158CS2 2 .17 .046 .48 .105                                            HB* 356K
14254xE219 .001 .092 .005 .118 .005 .124 .012 .156 .013 .164 .026 .192  0   358U
 .069 .204 .005 .213 .005 .218 .023 .395 .037 .416 .083 .539 .1  .572      358
 .06 .418 .06 .645 .066 .657 .005 .737 .007 .966 .11 1.325                  358
14255CS2 0                                                                  359N
14256BA214 .56 .88  .16 .135 .42  .227 .8  .255 .1  .365 .2  .425  ND  360U
 .14  .625 .07  .69  .32  .89  .12  .97  .08 1.08 .28 1.2  .02 1.36        360
 .02 1.68                                                                   360
14257LA225 .48  .545 .024 .86  .089 .898 .045 1.01 .037 1.06 .028 1.16  ND  361K
 .027 1.25 .024 1.37 .025 1.54 .021 1.55 .151 1.74 .084 1.91 .015 2.02      361
 .008 2.06 .021 2.14 .048 2.19 .151 2.41 .008 2.55 .029 2.67 .022 2.8       361
 .053 2.99 .012 3.14 .019 3.31 .012 3.45 .023 3.65                          361
14258PA2 1 .0371.572                                                    ND  363K
14354xE2 0                                                                  365N
14355CS2 0                                                                  366N
14356BA2 0                                                                  367N
14357LA214 .02  .2  .03  .44  .2  .625 .09  .8  .02  .915 .05  1.07  ND  368U
 .11  1.17 .06  1.58 .04  1.7  .07  1.98 .01  2.22 .03  2.46 .05  2.56       368
 .03  2.45                                                                  368
14358CE225 .671 .036 .129.0574 .001 .14  .024.2317 .495.2933 .037.3507 ND* 369K
.0003 .372.0003 .39 .0019 .434 .001 .448 .022.4905.0007 .499.0003 .557      369
.0033 .587 .065 .664 .065 .722.0005 .809 .012 .881.0004 .937.00091.003      369
.00031.031.00021.046.00051.061.00521.103.00021.324                          369
14359PA2 0                                                              HB  370K
14454xE2 0                                                                  372N
14455CS2 0                                                                  373N
14456BA2 0                                                                  374N
14457LA2 0                                                                  375N
14458CE2 8 .002.0336 .119 .036 .004.0409 .01 .0534 .001 .059 .013.0801  NI* 376K
.0034 .01  .108.1335                                                        376
14459PA2 4.0147.6694.00011.389.0029 1.49.00732.186                      ND  377K
14460NP2 0                                                              HB  378S
14558CE2 9 .433 .035 .14  .063 .093 .285 .053 .345 .093 .435 .04  .5      ND  379K
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 .613 .725 .04  .86  .13 1.145                                                  379
14559PR2 7.006A .037 .002 .072.0051 .674.0043 .749.0018 .979.00171.054  ND* 380K
.00151.155                                                                     380
14558CE211 .178 .035 .01  .052 .008 .087 .072.0995 .106.1335 .047.1415  NO  382K
 .067 .21  .217 .218 .034 .251 .106 .264 .556 .317                             382
14559PR242 .024 .037 .838.4536 .005 .535.0084 .561 .018 .59  .058 .602  ND* 383K
 .01  .711.0076 .726 .136.7362 .009 .77  .133 .79  .049 .924 .03 1.017        383
 .0271.081 .0001.144 .0131.233 .02 1.284 .0491.333 .1  1.378 .0481.452       383
 .025 1.47.01841.498 .32 1.526 .017 1.66 .0141.685 .02 1.745.0154 1.81        383
.0222 1.9 .01841.985 .0032.058.00772.121.00682.226 .02  2.25 .0182.351       383
.00512.462.00852.512.00922.675.00622.774.01262.828.00173.187.00343.275       383
.00173.365                                                                     383
14755CE2 0                                                                     385N
14759PR212 .6  .037 .17  .078 .09  .127 .47  .315 .09  .46  .39  .565  N1* 386K
 .1  .41  .24  .645 .02  1.18 .11  1.26 .02  1.37 .03  1.51                    386
14760N 215 .48A .04  .27 .0911.0046.1205.0018.1967.0093.2758 .(22.3194  ND* 387K
 .009.3982 .01  .41  .012.4398 .001.4892 .135 .531.0004.5896 .003.5948        387
.0003.6794 .009.6859                                                           387
14761PR2 0                                                                     HB  388K
14762SR2 0                                                                     ND  389K
14858CE2 0                                                                     390N
14859PR2 2 .65  .005 .003 .049                                                 N2O 391U
14861PR116 .107 .04  .013.0757 .04 .0984 .013.1896 .114 .288 .038.3115  NO  393K
 .18 .4141 .066.4326 .071.5013 .91 .5502 .08 .5995 .06 .6113 .68 .6299        393
 .32 .7257 .2  .0152 .2  1.014                                                 393
14862PR2 3 .28 .5502 .15  .912 .22 1.465                                       ND  394K
14960ND210 .012 .06  .022 .076 .019 .098 .18  .114 .04  .156 .022 .188  HB  396K
 .005 .198 .27  .21 .0014 .227 .04  .24  .26  .269 .05  .327 .011 .349        396
.0018 .332 .09  .424 .014 .444 .1  .541 .012 .557 .09  .654                  396
14961PR2 4 .026.2857.0004 .55  .001 .56 .0018 .85                              H2  397K
15160ND210 .05  .08A .4  .118 .06  .138 .1  .174 .11  .256 .05  .425  H1  401K
 .35  .737 .03  .797 .02 1.122 .09  1.18                                       401
15161PR243 .12  .005 .34  .04  .034.0653 .01 .0697 .003.0762 .029 .1   H2$ 402K
 .04  .105 .005 .139 .002 .143 .002 .156 .025 .163 .1  .168 .012.1765        402
 .041 .177 .019 .209 .004 .227 .013 .232 .037 .24  .003 .258 .07  .275        402
 .006 .291 .013 .324 .21  .38  .016 .345 .013 .379 .015 .44  .034 .445        402
 .003 .452 .002 .566 .002 .575 .013 .638 .002 .655 .011 .671 .003 .704        402
 .036 .718 .005 .736 .012 .753 .008 .772 .002 .785 .003 .848 .01  .883        402
 .004 .951 .001 .955                                                           402
15162SR2 2 .013 .006.0006 .022                                                 OH  403K
15261PR2 2 .5   .122 .5   .245                                                  405U
15263EU116 .02  .004 .05  .043 .08 .1218 .001 .217 .025.3442 .003.5632  HB$ 407K
.0001.6153.0005 .7   .13 .8416 .12 .9633 .0049.9703 .0121.315 .0111.389       407
.0001 1.51.0001 1.56.0001 1.68                                                 407
15263EU220 .015 .006 .03  .043 .37  .122 .08  .245 .003 .296 .27  .344  HB$ 408K
 .006 .367 .022 .411 .036 .404 .144 .779 .04  .869 .143 .965 .01  1.01        408
 .117 1.09 .133 1.11 .012 1.21 .004 1.25 .017 1.3  .221 1.41 .005 1.46        408
15561PR2 2 .5   .12  .5   .18                                                  410U
15362SR225 .13  .006 .002 .02  .61  .042 .054 .07  .008.0754 .002.0834  HB$ 411K
 .002.0895 .008.0974 .28  .103.0001 .152.0004 .165 .003 .173.0003 .412       411
.0001 .464.0002 .509.0001 .521.0007 .531.0003 .533.0002 .539.0001 .555       411
.0002 .579.0001 .597.0003 .598.0001 .609.0001 .636                           411
15461PR2 0                                                                     413N
15463EU216 .38  .123 .07  .248 .006 .448 .058 .593 .026 .693 .206 .724  HB  415K
 .043 .759 .007 .817 .113 .876 .009 .906 .113 1.0  .185 1.01 .012 1.25        415
 .37  1.28 .007 1.5  .0174 1.6                                                 415
14562SR233.0045.0200 .171 .042 .004.0618.0001.0645.0118.0785.0001.0901  O * 417K
 .725.1043.0006.1384.0234.1414.0005.1675.0005.1691.0001.1957.0005.2031        417
.0007.2287.0395.2457.0001.3073.0001.4262.0007.4608.0001.5102.0015.5225       417
.0002.5718.0001.6038.0001.6312.0001.6486.0006 .664.0001 .665.0101.6772       417
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.0001,7684,0001,9329,0001,9979,00011.003,00021,223,00071,301                    417
15563EU2 A .03  .006 .07 .0226 .03 .0381 .18  .043 .012,0453 .016 .06   HB$ 418K
 .32 .0495 .2  .1053                                                           418
15562SY211 .07 .0226 .03 .0381 .023 .065 .24 .0876 .018 .103 .15 .1658  0    420K
 .21  .204 .005 .219 .021 .244 .024,2685 .028 .291                             420
15563EU226 .08  .069 .003 .199 .017 .6   .07  .646 .06  .723 .09  .812  HB   421K
 .003 .866 .016 .867 .048 .961 .025 1.05 .07 1.065 .04  1.08 .07 1.153        421
 .07 1.154 .02  1.17 .046 1.23 .075 1.24 .04 1.315 .017 1.88 .031 1.94        421
 .37  1.97 .049 2.03 .03  2.1  .022 2.18 .05  2.19 .0072,205                  421
15763EU212 .05  .518 .05 .0545 .27  .064 .05  .321 .03  .362 .11  .373  HB   423K
 .27  .913 .05  .477 .025 .57  .06  .623 .025 .688 .02  .727                  423
15763EU220 .2   .043 .11  .06  .03  .182 .02  .527 .06  .606 .03  .74   0    425K
 .2   .899 .01  .925 .55  .946 .01  .964 .12  .978 .05 1.006 .07 1.108        425
 .16 1.188 .04 1.264 .07 1.35 .06 1.43 .04 1.94 .03 2.16 .01  2.75            425
15763EU2 9 .42  .07  .18  .09  .14  .15  .05  .22  .21  .67  .1   .73   H1   427K
 .11  .9   .11  1.1  .05  1.5                                                  427
15764SU214 .03  .058,0004,0795,0003,1375,0002 .211,0025 .225,0014 .29   HB   429K
 .001 .306,0034 .348 .09  .363,0001 .536,0002 .558,000A .579,0002 .617        428
.0001 .674                                                                    428
14063EU2 0                                                             HB   430K
16065TU232 .26  .006 .18  .046 .12  .087,0005 .094 .06  .197 .04  .216  HB$  432K
 .0008 .231 .269 .259 .003 .31  .003 .337 .015 .392 .006 .682 .026 .765       432
 .533 .879 .094 .953 .235 .966 .01  1.0  .023 1.12 .132 1.18 .03  1.2         432
 .075 1.27 .023 1.31                                                          432
16164SU221A .29  .007 1.11 .045 .045 .057 .002 .078 .11  .102 .006 .106  HB$  434K
 .092 .134 .052 .185 .011 .181 .009 .259 .01  .273 .08  .284 .25  .315       434
 .66  .361 .023 .483 .014 .531                                               434
16165TU216 .73  .006 .21  .026 .01  .044 .34  .046 .19  .049 .05  .057  HB$  435K
 .1   .075 .02  .088 .001 .106 .001 .132,0001 .24  .001 .29 .0002 .34        435
.0001 .41 .0002 .47 .0004 .54                                                435
1A26AU02 2 .38  .41  .35  .428                                          0    437K
16265TU212 .122 .045 .073 .081 .162 .185 .78  .26  .01  .622 .024 .697  0    438K
 .45  .807 .12  .882 .59  .888 .0061,067 .0011,194,00091,275                  438
16365TU233 .167 .046 .015,0735 .005 .167 .006 .177 .06  .251 .005 .26   0 *  440K
 .007 .284 .005 .307 .098 .316 .04  .338 .381 .351 .005 .376 .287 .39        440
 .022 .402 .047 .415 .108 .422 .022 .428 .012 .435 .010 .46  .016 .462       440
 .022 .475 .233 .498 .035 .507 .093 .533 .016 .544 .021 .559 .072 .584       440
 .035 .608 .009 .63  .008 .636 .005 .668 .009 .832 .009 .842                 440
16566DY1 8 .78  .006 .095 .046 .03  .108 .003 .152 .006 .362 .018 .514  HB$  443K
 .0003 .96 .0001 .76                                                         443
16566DY215 .015 .007 .098 .048 .04  .095 .006 .3   .011 .362,0003 .479  HB$  444K
 .0012 .514,0008 .575,0008 .621 .007 .633,0001 .695 .007 .716,0007 .995      444
 .0002 1.06 .001 1.08                                                        444
16566DY2 9 .31  .007 .061 .028 .45  .048 .086 .054 .12 .0825,0002 .29   HB$  446K
 .0005 .343,0045 .372 .005 .426                                              446
16667HU211 .24  .007 .09  .049 .054 .081,0003 .673,0002 .706,0001 .787  H2$  447K
 .009 1.38 .002 1.58 .001 1.66,0003 1.75,0001 1.83                           447
16768EU1 3 .32  .007 .2   .049 .43  .208                                   HB$  449K
  3 1H 2 0
  7 4HE2 1.103 .477
 10 4BE2 0
 14 6C 2 0                                                               HB   451K
 18 9F 2 1 1.94 .511
 2211NA2 2 1.80 .511 1.0 1.275
 2411NA2 3 .9991,369 .9932,754,0009 3.85                                 H2   453K
 3114SI2 1.0007 1.27                                                     HB   458K
 3215P 2 0                                                               HB   459K
 3516S 2 0                                                               HB   460K
 3617CL2 0
 3617CL2 2 .38  1.6  .47  2.17
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4118A02 1 1.0  1.29
4219K 2 2 .002 .31  .18 1.524
4120CA2 0
4520CA2 0
4720CA2 3 .05  .49  .05  .815 .74  1.31
4021SC2 2 1.0  .889 1.0  1.12                                          HB  462K
4721SC2 1 .73  .16                                                     HB  463K
4221SC2 4 .06  .175 1.0  .983 1.0 1.040 1.0 1.314
4923V 2 5 1.0  .511 .10  .945 1.0  .983 .97 1.312 .03 2.241
5124C02 1 .09  .32                                                     HB  464K
5225M02 4 .67  .511 .82  .744 .84  .935 1.0 1.434
5425M02 1 1.0  .835                                                    HB  465K
5025M02 7 .99  .847 .293 1.81 .155 2.11 .011 2.52 .007 2.66 .005 2.95  H2  469K
.002 3.37                                                              469
5526E02 0                                                              HB  467K
5926E02 5 .008.1425 .027.1902.0045.3348 .56 1.099 .44 1.292            ND  471K
5727C02 4 .09  .014 .87  .122 .11  .136.0014 .692
5927C01 0
5827C02 4 .30  .511 .99  .81  .014 .865 .006 1.67
6027C02 3.0001 .83 .99681.173 1.0 1.333                                ND  472K
5928M12 0
6326M12 0
6526M12 3 .045 .368 .16 1.115 .25 1.481
6429C12 2 .38  .511 .0061.348                                          N1  473K
6530Z02 2 .034 .511 .5061.115                                          N1  474K
6930Z01 1 .95  .439
6930Z02 0
7136E02 0
7333A02 1 .09  .054
7433A02 3 .59  .511 .61  .596 .14  .635
7530S02 7 1.0  .066 .033 .097 .17  .121 .57  .136 .6   .265 .2   .28
.12  .401
8538S01 2 .14  .15  .85  .231
8538S02 1 1.0  .514
9342W02 1 .85  .03
9643T01 0
9643T02 5 .05  .32 1.0  .778 .84  .81  1.0  .851 .16  1.12
9743T01 0
9743T02 0
9760P02 2 .01  .215 .08  .324
10346P02 3.0001 .297.0006 .362.0001.498
10567A02 6 .10  .004 .32  .28  .42  .344.1   .443 .12  .65  .0  1.088
10968C02 1 .05  .088
11389T01 1 .64  .393
11350S02 1 .018 .255
12553I 2 5 .066 .036 .738 .028 .378 .027 .199 .031 .041 .032
12653I 2 2 .34  .366 .33  .667
13155C02 0
13156A02 8 .28  .124 .19  .216 .05  .25  .13  .373 .48  .496 .03  .60
.0131.048 .008 .924
15364G02 2 .024 .07  .55  .099
16667-0129 .12  .08  .9   .184 .04  .216 .01  .26  .3   .28  .06  .301
.02  .366 .12  .412 .03  .453 .02  .466 .12  .532 .07  .573 .008 .596
.02  .61  .06  .67  .01  .69  .58  .711 .14  .752 .04  .778 .60  .8
.11  .83  .008 .874 .033 .949 .0031.121 .0021.147 .01 1.242 .0031.282
.0071.402 .0061.428
16964F02 1 .003 .008
17163E02 4 .25  .112 .09  .124 .28  .296 .63  .308
17263T02 1 .033 .084
17169T02 0
```

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17570VB2 3 .019 .114 .037 .283 .06  .396
17771LU2 2 .028 .113 .061 .208
18172WF2 3 .48  .153 .13  .346 .81  .482
18273T42 8 .42  .068 .14  .1   .07  .152 .09  .222 .34 1.122 .16 1.189
 .27 1.222 .13 1.231
18174W 2 3 .01  .006 .001 .136 .001 .152
18574W 2 0
18774W 222 .25  .008.0002.0362 .01  .059 .125 .072.0005.1066.0009.1137  ND  478K
 .099.1342.0012.2062 .001.2392.0013.2463 .001 .45  .242.4796.0068.5116      478
 .057.5515.0014 .589 .069.6183 .011.6255 .289.6857 .003.7453 .042.7729      478
.0034.6548 .002.8796                                                       478
18375RE2 0
18675RE2 3 .09  .137.0003 .632.0004 .768
18775RE2 0
18875RE2 5 .10  .155 .006 .478 .009 .633 .003 .829 .004 .932
18576QS2 2 .40  .646 .14  .875
19176QS1 1 1.0  .074
19176QS2 1 .25  .129
19376QS2 6 .03  .139 .021 .28  .014 .322 .02  .38  .039 .46  .021 .558
19077IF2 6 .51  .187 .39  .37  .39  .40  .39  .518 .72  .56  .47  .604
19277IR2 7 .29  .296 .30  .308 .81  .317 .49  .468 .04  .589 .09  .604
 .06  .612
19477IR2 6 .10  .328 .01  .64  .004 .939 .006 1.16 .006 1.48 .002 1.7
19178PT2 9 .01  .096 .02  .129 .01  .175 .01  .269 .05  .36  .03  .41
 .01  .457 .09  .539 .01  .624
19378PT1 0
19378PT2 0
19778PT1 2 .026 .279 .013 .346
19778PT2 2 .20  .077 .06  .191
19678AU2 4 .25  .333 .94  .356 .06  .426 .0021.091
19878AU2 4 .027 .071 .95  .412 .01  .676 .0021.088                          HB  479K
19978AU2 2 .37  .158 .08  .204
19780HG1 2 .42  .134 .07  .279
19780HG2 3 .18  .077 .02  .191.0015 .268
20380HG2 2 .12  .077 .77  .279                                              HB  480K
20081TL2 7 .88  .368 .10  .579 .08  .829 .35  1.21 .04 1.364 .015 1.41
 .04 1.517
20181TL2 2 .02  .135 .08  .167
20281TL2 3 .95  .439 .001 .522.0007 .961
20481TL2 0
20382PH2 3 .81  .279 .05  .401 .009 .68
21082P52 1 .04  .047
21282P52 2 .47  .236 .032 .30
20683BI213.21   .184 .26  .343 .1   .398 .13  .497 .46  .516 .34  .538
 .99  .603 .72  .88  .19  .895 .08 1.099 .03 1.596 .36  1.72
20783BI2 3 .98  .57  .77 1.063 .09 1.771
21083BI2 0                                                                  H2  483K
21283BI2 6 .02  .04  .005 .268 .008 .46  .07  .727 .011 .785 .015 1.62
21084P02 0                                                                  HB  484K
21185AT2 0
22386RA2 3 .10  .149 .1   .27  .06  .33
22486RA2 4 .037 .241 8.-5 .29  4.-5 .41  9.-5 .55
22586RA2 1 .33  .04
22686RA2 4 .01  .012.0075 .084.0355 .186.0001 .26                           ND  485K
22986RA2 2.0001.0057 .2  .3103                                                  488U
22586QC2 0
22786QC2 6 .05  .013.0003.0995.0001.1215.0001 .147.0002 .16 .000  .172  ND  487K
22986QC2 3 .15  .34  .25  .908 .2   .96
22790TM2 3 .08  .05  .15  .237 .08  .31
22890TM2 4 .016 .050 .002 .132 .001 .167 .003 .214
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22990TH2 2 .03  .137 .1   .2
23090TH2 2 .006 .068.0007 .142
23190TH2 2 .02  .026 .10  .084
23290TH2 0
23390TH2 2 .035 .063 .04  .093
23091PA2 4 .18  .45  .08  .51  .24  .91  .50  .954
23191PA2 2 .06  .027 .06  .29
23391PA214 .35  .013.0002 .04  .008 .075 .31  .086 .017 .087 .007 .104  H2S 490K
.0044 .145.0029 .272 .063 .3   .34  .312 .039.3405.0056 .375 .011 .399      490
 .015 .015                                                                 490
23092U 2 3.0054 .072.0003 .156.0018 .231
23292U 2 2.0021 .058.0009 .129
23392U 2 0
23492U 2 1 .002 .053
23592U 2 3 .11  .143 .54  .185 .05  .204
23692U 2 0
23792U 2 7 .02  .026  .36 .06  .02  .165 .23  .208.0076 .267 .014 .331
.0017 .37
23892U 2 0
24092U 2 1 1.   .044
23793NP2 3 .14  .03  .14  .086 .01  .145
23993NP2 4 .23  .106 .04  .209 .12  .228 .14  .278
23794PU2 0
23894PU2 3 .22  .014.0004.0453.0001 .1                                    OHS 492K
23994PU2 4 .22  .014.0001 .039.0002 .052.0001 .129                        OHS 493K
24094PU2 3 .19  .014.0003.0453.0001.1036                                  OHS 494U
24194PU2 0                                                                H2  495K
24294PU2 2 .24  .014.0004.0447                                            H2S 497U
24394PU2 2 .21  .084 .007 .381
24494PU2 0
24195AM2 5 .54  .014 .025.0264.0001.0332.0007.0434 .359.0595.0002.0987  O $ 496K
.0002.1027.0001 .125                                                      496
24295AM110 .96  .014.0023.0668.0001.0679.0001.0733.0004.0867.0003.1069  OHS 498K
.0001.1218.0001.1316.0001.1534.0003.1634                                  498
24295AM2 3 .4   .014.0006.0422.0001.0445                                  OHS 499U
24395AM2 2 .04  .044.0004 .087.0003 .11 .0003 .163
24495AM2 6 .05  .099 .19  .154 .66  .746 .25  .90
24296CM2 5.0004 .044 4.-5 .1022.5-5 .1583.2-6 .58  3.-5 .89
24396CM2 3 .04  .209 .12  .228 .14  .278
24496CM2 2 .18  .014.0009.0329                                            OBS 500K
24596CM2 2 .05  .13  .14  .173
24696CM2 0
24796CM2 0
24896CM2 0
24997BK2 0
25097BK2 3 .39 1.032 .47  .99  .52  .042
24998CF2 2 .16  .333 .72  .388
25098CF2 0
25298CF2 0

  0.4       2.2       2.75      2.35      1.56      1.0       1.0       0.9
   .85       .8        .75       .65
  .0006     .143      .754     1.287     1.287     .831      .402      .211
  .0837     .0373     .0204    .0103
  .512      .0677     .0320    .0259     .0277     .0319     .0330     .0320
  .0296     .0272     .0255    .0233
  .691      .229      .179     .159      .134      .106      .084      .0693
  .057      .048      .042     .0358
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25
    0.00     1   10   12          PASQUILL F, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
2.64E-03 4.97E-04 2.47E-04 1.93E-04 1.94E-04 2.13E-04 2.17E-04 2.09E-04
1.95E-04 1.80E-04 1.67E-04 1.53E-04
1.11E-03 2.57E-04 1.33E-04 1.04E-04 1.01E-04 1.07E-04 1.09E-04 1.04E-04
9.74E-05 8.98E-05 8.31E-05 7.64E-05
3.27E-04 1.09E-04 6.10E-05 4.82E-05 4.52E-05 4.56E-05 4.57E-05 4.34E-05
4.05E-05 3.74E-05 3.46E-05 3.19E-05
1.21E-04 5.46E-05 3.31E-05 2.69E-05 2.49E-05 2.42E-05 2.38E-05 2.25E-05
2.09E-05 1.94E-05 1.80E-05 1.65E-05
4.65E-05 2.69E-05 1.79E-05 1.51E-05 1.41E-05 1.33E-05 1.29E-05 1.21E-05
1.13E-05 1.05E-05 9.72E-06 8.96E-06
1.32E-05 9.63E-06 7.06E-06 6.32E-06 6.10E-06 5.73E-06 5.46E-06 5.09E-06
4.76E-06 4.46E-06 4.14E-06 3.87E-06
5.50E-06 4.43E-06 3.43E-06 3.16E-06 3.12E-06 2.96E-06 2.82E-06 2.62E-06
2.47E-06 2.33E-06 2.20E-06 2.05E-06
2.43E-06 2.09E-06 1.68E-06 1.57E-06 1.58E-06 1.51E-06 1.44E-06 1.35E-06
1.27E-06 1.21E-06 1.15E-06 1.08E-06
8.32E-07 7.54E-07 6.27E-07 6.01E-07 6.16E-07 5.96E-07 5.68E-07 5.32E-01
5.04E-07 4.84E-07 4.62E-07 4.37E-07
3.91E-07 3.65E-07 3.09E-07 2.99E-07 3.10E-07 3.02E-07 2.89E-07 2.71E-07
2.57E-07 2.48E-07 2.38E-07 2.25E-07
    0.00     1   10   12          PASQUILL E, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.38E-03 3.03E-04 1.54E-04 1.20E-04 1.18E-04 1.26E-04 1.29E-04 1.24E-04
1.15E-04 1.06E-04 9.83E-05 9.05E-05
5.74E-04 1.62E-04 8.68E-05 6.80E-05 6.48E-05 6.68E-05 6.74E-05 6.43E-05
6.00E-05 5.54E-05 5.12E-05 4.71E-05
1.58E-04 6.65E-05 3.94E-05 3.18E-05 2.94E-05 2.88E-05 2.85E-05 2.69E-05
2.51E-05 2.32E-05 2.15E-05 1.96E-05
5.76E-05 3.25E-05 2.12E-05 1.77E-05 1.65E-05 1.56E-05 1.51E-05 1.42E-05
1.32E-05 1.23E-05 1.14E-05 1.05E-05
2.07E-05 1.46E-05 1.05E-05 9.21E-06 8.77E-06 8.19E-06 7.82E-06 7.29E-06
6.80E-06 6.35E-06 5.93E-06 5.48E-06
5.45E-06 4.64E-06 3.69E-06 3.44E-06 3.42E-06 3.24E-06 3.07E-06 2.86E-06
2.68E-06 2.54E-06 2.39E-06 2.23E-06
2.14E-06 1.95E-06 1.63E-06 1.56E-06 1.60E-06 1.54E-06 1.46E-06 1.36E-06
1.29E-06 1.23E-06 1.17E-06 1.10E-06
9.50E-07 8.94E-07 7.64E-07 7.45E-07 7.77E-07 7.59E-07 7.25E-07 6.79E-01
6.46E-07 6.22E-07 5.97E-07 5.65E-07
3.32E-07 3.22E-07 2.80E-07 2.77E-07 2.93E-07 2.90E-07 2.79E-07 2.63E-07
2.51E-07 2.44E-07 2.35E-07 2.24E-07
1.56E-07 1.54E-07 1.35E-07 1.35E-07 1.34E-07 1.44E-07 1.39E-07 1.31E-07
1.26E-07 1.23E-07 1.19E-07 1.14E-07
    0.00     1   10   12          PASQUILL D, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
8.67E-04 2.17E-04 1.13E-04 8.80E-05 8.47E-05 8.92E-05 9.05E-05 8.67E-05
8.09E-05 7.46E-05 6.90E-05 6.34E-05
3.45E-04 1.15E-04 6.37E-05 5.02E-05 4.70E-05 4.75E-05 4.76E-05 4.53E-05
4.22E-05 3.90E-05 3.60E-05 3.32E-05
9.31E-05 4.54E-05 2.84E-05 2.33E-05 2.25E-05 2.06E-05 2.02E-05 1.90E-05
1.77E-05 1.64E-05 1.52E-05 1.40E-05
2.94E-05 1.98E-05 1.38E-05 1.19E-05 1.12E-05 1.05E-05 1.00E-05 9.37E-06
8.74E-06 8.14E-06 7.56E-06 6.99E-06
1.05E-05 8.43E-06 6.46E-06 5.87E-06 5.73E-06 5.36E-06 5.08E-06 4.72E-06
4.41E-06 4.15E-06 3.89E-06 3.61E-06
```

FIGURE B-9. Library BIVLIB Listing

```
2.50E-06  2.32E-06  1.95E-06  1.87E-06  1.92E-06  1.85E-06  1.76E-06  1.64E-06
1.55E-06  1.48E-06  1.41E-06  1.32E-06
9.31E-07  9.02E-07  7.84E-07  7.74E-07  8.17E-07  8.06E-07  7.71E-07  7.24E-01
6.90E-07  6.68E-07  6.43E-07  6.10E-07
3.86E-07  3.87E-07  3.41E-07  3.41E-07  3.66E-07  3.68E-07  3.55E-07  3.36E-07
3.22E-07  3.15E-07  3.06E-07  2.93E-07
9.84E-08  1.03E-07  9.23E-08  9.30E-08  1.01E-07  1.03E-07  1.01E-07  9.59E-08
9.29E-08  9.20E-08  9.05E-08  8.74E-08
3.87E-08  4.10E-08  3.75E-08  3.80E-08  4.13E-08  4.23E-08  4.15E-08  3.97E-08
3.87E-08  3.85E-08  3.80E-08  3.72E-08
    0.00     1   10   12          PASQUILL C, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
4.62E-04  1.40E-04  7.58E-05  5.93E-05  5.58E-05  5.72E-05  5.76E-05  5.50E-05
5.13E-05  4.73E-05  4.37E-05  4.02E-05
1.75E-04  7.25E-05  4.26E-05  3.41E-05  3.15E-05  3.09E-05  3.06E-05  2.90E-05
2.79E-05  2.49E-05  2.31E-05  2.12E-05
3.72E-05  2.42E-05  1.65E-05  1.41E-05  1.32E-05  1.23E-05  1.19E-05  1.11E-05
1.03E-05  9.60E-06  8.93E-06  8.23E-06
1.08E-05  8.89E-06  6.87E-06  6.27E-06  6.12E-06  5.71E-06  5.39E-06  5.01E-06
4.68E-06  4.39E-06  4.12E-06  3.82E-06
3.27E-06  3.05E-06  2.57E-06  2.47E-06  2.54E-06  2.44E-06  2.31E-06  2.15E-06
2.02E-06  1.93E-06  1.83E-06  1.72E-06
6.20E-07  6.41E-07  5.69E-07  5.69E-07  6.12E-07  6.14E-07  5.96E-07  5.64E-07
5.42E-07  5.30E-07  5.14E-07  4.93E-07
1.91E-07  2.02E-07  1.84E-07  1.87E-07  2.03E-07  2.07E-07  2.02E-07  1.94E-07
1.88E-07  1.86E-07  1.83E-07  1.79E-07
6.33E-08  6.58E-08  6.09E-08  6.26E-08  6.91E-08  7.12E-08  6.97E-08  6.69E-08
6.52E-08  6.53E-08  6.47E-08  6.35E-08
1.70E-08  1.51E-08  1.38E-08  1.42E-08  1.58E-08  1.65E-08  1.64E-08  1.58E-08
1.55E-08  1.56E-08  1.55E-08  1.53E-08
7.77E-09  6.00E-09  5.41E-09  5.54E-09  6.14E-09  6.43E-09  6.38E-09  6.18E-09
6.07E-09  6.12E-09  6.11E-09  6.05E-09
    0.00     1   10   12          PASQUILL B, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
3.09E-04  1.06E-04  5.90E-05  4.64E-05  4.32E-05  4.35E-05  4.36E-05  4.15E-05
3.87E-05  3.57E-05  3.30E-05  3.03E-05
9.81E-05  4.88E-05  3.02E-05  2.46E-05  2.27E-05  2.17E-05  2.13E-05  2.01E-05
1.87E-05  1.73E-05  1.60E-05  1.47E-05
1.67E-05  1.30E-05  9.64E-06  8.60E-06  8.23E-06  7.64E-06  7.25E-06  6.74E-06
6.29E-06  5.88E-06  5.50E-06  5.08E-06
3.71E-06  3.47E-06  2.91E-06  2.80E-06  2.87E-06  2.75E-06  2.59E-06  2.41E-06
2.27E-06  2.16E-06  2.05E-06  1.91E-06
6.30E-07  6.60E-07  5.94E-07  5.96E-07  6.40E-07  6.43E-07  6.21E-07  5.88E-07
5.65E-07  5.53E-07  5.37E-07  5.14E-07
7.77E-08  6.02E-08  5.43E-08  5.55E-08  6.15E-08  6.42E-08  6.34E-08  6.12E-08
5.99E-08  6.00E-08  5.96E-08  5.86E-08
4.08E-08  3.15E-08  2.84E-08  2.90E-08  3.22E-08  3.37E-08  3.34E-08  3.23E-08
3.17E-08  3.18E-08  3.17E-08  3.13E-08
2.23E-08  1.77E-08  1.59E-08  1.63E-08  1.81E-08  1.89E-08  1.87E-08  1.81E-08
1.78E-08  1.79E-08  1.79E-08  1.77E-08
1.04E-08  8.05E-09  7.25E-09  7.42E-09  8.23E-09  8.61E-09  8.54E-09  8.27E-09
8.13E-09  8.19E-09  8.18E-09  8.10E-09
5.76E-09  4.45E-09  4.01E-09  4.10E-09  4.55E-09  4.76E-09  4.73E-09  4.58E-09
4.50E-09  4.54E-09  4.53E-09  4.49E-09
    0.00     1   10   12          PASQUILL A, UBAR = 1 M/SEC
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.83E-04  7.40E-05  4.31E-05  3.42E-05  3.15E-05  3.10E-05  3.08E-05  2.92E-05
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2.72E-05  2.51E-05  2.33E-05  2.14E-05
4.90E-05  3.01E-05  1.99E-05  1.67E-05  1.54E-05  1.44E-05  1.40E-05  1.31E-05
1.22E-05  1.13E-05  1.05E-05  9.63E-06
5.21E-06  4.78E-06  3.93E-06  3.72E-06  3.75E-06  3.54E-06  3.33E-06  3.08E-06
2.89E-06  2.74E-06  2.58E-06  2.40E-06
5.27E-07  5.41E-07  4.91E-07  4.97E-07  5.39E-07  5.44E-07  5.26E-07  4.97E-07
4.77E-07  4.67E-07  4.53E-07  4.34E-07
1.32E-07  1.02E-07  9.10E-08  9.26E-08  1.02E-07  1.05E-07  1.03E-07  9.90E-08
9.62E-08  9.56E-08  9.41E-08  9.17E-08
5.90E-08  4.55E-08  4.10E-08  4.19E-08  4.54E-08  4.84E-08  4.79E-08  4.63E-08
4.53E-08  4.55E-08  4.52E-08  4.46E-08
3.16E-08  2.44E-08  2.19E-08  2.25E-08  2.49E-08  2.61E-08  2.59E-08  2.50E-08
2.46E-08  2.47E-08  2.47E-08  2.44E-08
1.75E-08  1.35E-08  1.22E-08  1.24E-08  1.38E-08  1.44E-08  1.43E-08  1.39E-08
1.36E-08  1.37E-08  1.37E-08  1.36E-08
7.89E-09  6.10E-09  5.49E-09  5.62E-09  6.24E-09  6.53E-09  6.48E-09  6.28E-09
6.16E-09  6.21E-09  6.20E-09  6.14E-09
4.45E-09  3.44E-09  3.10E-09  3.17E-09  3.52E-09  3.68E-09  3.66E-09  3.54E-09
3.48E-09  3.51E-09  3.50E-09  3.47E-09
    0.00      1   10   12          SUTTON UNSTABLE, UBAR = 1 M/SE
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
2.28E-04  8.70E-05  4.95E-05  3.92E-05  3.62E-05  3.59E-05  3.59E-05  3.41E-05
3.17E-05  2.93E-05  2.71E-05  2.49E-05
7.81E-05  4.20E-05  2.65E-05  2.19E-05  2.32E-05  1.92E-05  1.87E-05  1.76E-05
1.64E-05  1.51E-05  1.40E-05  1.29E-05
1.65E-05  1.29E-05  9.61E-06  8.59E-06  8.33E-06  7.64E-06  7.24E-06  6.73E-06
6.28E-06  5.87E-06  5.49E-06  5.07E-06
4.84E-06  4.43E-06  3.66E-06  3.48E-06  3.53E-06  3.35E-06  3.16E-06  2.93E-06
2.75E-06  2.61E-06  2.47E-06  2.30E-06
1.37E-06  1.38E-06  1.21E-06  1.19E-06  1.26E-06  1.25E-06  1.20E-06  1.12E-06
1.07E-06  1.03E-06  9.92E-07  9.40E-07
2.56E-07  2.70E-07  2.48E-07  2.52E-07  2.74E-07  2.79E-07  2.72E-07  2.59E-07
2.51E-07  2.49E-07  2.45E-07  2.37E-07
7.66E-08  7.62E-08  7.04E-08  7.24E-08  8.04E-08  8.35E-08  8.20E-08  7.86E-08
7.67E-08  7.67E-08  7.60E-08  7.47E-08
2.77E-08  2.22E-08  2.02E-08  2.07E-08  2.29E-08  2.40E-08  2.38E-08  2.30E-08
2.24E-08  2.27E-08  2.27E-08  2.24E-08
9.13E-09  6.66E-09  6.37E-09  6.24E-09  6.64E-09  6.96E-09  6.92E-09  6.77E-09
6.65E-09  6.67E-09  6.63E-09  6.58E-09
4.32E-09  2.70E-09  1.87E-09  1.60E-09  1.67E-09  1.71E-09  1.73E-09  1.67E-09
1.62E-09  1.60E-09  1.57E-09  1.53E-09
    0.00      1   10   12          SUTTON NEUTRAL,  UBAR = 1 M/SE
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
6.70E-04  1.82E-04  9.61E-05  7.49E-05  7.14E-05  7.43E-05  7.52E-05  7.19E-05
6.71E-05  6.19E-05  5.72E-05  5.26E-05
2.77E-04  9.93E-05  5.61E-05  4.44E-05  4.14E-05  4.14E-05  4.13E-05  3.92E-05
3.65E-05  3.38E-05  3.12E-05  2.87E-05
7.08E-05  3.90E-05  2.50E-05  2.07E-05  1.92E-05  1.82E-05  1.77E-05  1.66E-05
1.55E-05  1.44E-05  1.33E-05  1.23E-05
2.27E-05  1.66E-05  1.20E-05  1.05E-05  9.96E-06  9.24E-06  8.81E-06  8.20E-06
7.65E-06  7.14E-06  6.69E-06  6.15E-06
6.90E-06  6.09E-06  4.90E-06  4.59E-06  4.56E-06  4.29E-06  4.05E-06  3.75E-06
3.52E-06  3.32E-06  3.12E-06  2.90E-06
1.39E-06  1.39E-06  1.21E-06  1.20E-06  1.27E-06  1.25E-06  1.20E-06  1.13E-06
1.07E-06  1.03E-06  9.94E-07  9.41E-07
4.05E-07  4.25E-07  3.83E-07  3.86E-07  4.17E-07  4.22E-07  4.11E-07  3.91E-07
3.77E-07  3.72E-07  3.63E-07  3.50E-07
1.19E-07  1.24E-07  1.15E-07  1.18E-07  1.33E-07  1.33E-07  1.30E-07  1.25E-07
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 1.21E-07  1.21E-07  1.20E-07  1.17E-07
 2.89E-08  2.49E-08  2.28E-08  2.34E-08  2.59E-08  2.71E-08  2.69E-08  2.60E-08
 2.55E-08  2.56E-08  2.55E-08  2.52E-08
 1.22E-08  8.18E-09  6.99E-09  7.07E-09  7.84E-09  8.24E-09  8.18E-09  7.92E-09
 7.77E-09  7.82E-09  7.80E-09  7.73E-09
    0.00     1   10   12          HANFORD VS, SIGT = .024, UBAR
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
 1.50E-03  3.23E-04  1.64E-04  1.28E-04  1.26E-04  1.35E-04  1.38E-04  1.32E-04
 1.23E-04  1.14E-04  1.05E-04  9.68E-05
 1.02E-03  2.45E-04  1.27E-04  9.90E-05  9.58E-05  1.01E-04  1.03E-04  9.86E-05
 9.21E-05  8.49E-05  7.85E-05  7.22E-05
 5.05E-04  1.49E-04  8.06E-05  6.32E-05  5.99E-05  6.16E-05  6.20E-05  5.92E-05
 5.52E-05  5.10E-05  4.72E-05  4.34E-05
 2.60E-04  9.20E-05  5.23E-05  4.15E-05  3.88E-05  3.88E-05  3.88E-05  3.68E-05
 3.43E-05  3.17E-05  2.94E-05  2.70E-05
 1.22E-04  5.15E-05  3.11E-05  2.53E-05  2.36E-05  2.30E-05  2.27E-05  2.14E-05
 2.00E-05  1.85E-05  1.71E-05  1.58E-05
 4.14E-05  2.10E-05  1.37E-05  1.16E-05  1.10E-05  1.05E-05  1.02E-05  9.59E-06
 8.95E-06  8.33E-06  7.76E-06  7.16E-06
 1.74E-05  1.00E-05  6.87E-06  5.97E-06  5.73E-06  5.48E-06  5.29E-06  4.95E-06
 4.63E-06  4.34E-06  4.08E-06  3.76E-06
 7.34E-06  4.77E-06  3.41E-06  3.02E-06  2.93E-06  2.80E-06  2.69E-06  2.52E-06
 2.37E-06  2.23E-06  2.10E-06  1.95E-06
 2.47E-06  1.86E-06  1.41E-06  1.28E-06  1.26E-06  1.21E-06  1.15E-06  1.08E-06
 1.02E-06  9.65E-07  9.13E-07  8.54E-07
 1.14E-06  9.57E-07  7.54E-07  7.01E-07  7.02E-07  6.73E-07  6.42E-07  6.01E-07
 5.67E-07  5.41E-07  5.14E-07  4.83E-07
    0.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
 9.56E-04  2.26E-04  1.17E-04  9.17E-05  8.88E-05  9.41E-05  9.55E-05  9.15E-05
 8.54E-05  7.88E-05  7.28E-05  6.70E-05
 6.02E-04  1.65E-04  8.84E-05  6.93E-05  6.61E-05  6.85E-05  6.91E-05  6.60E-05
 6.16E-05  5.68E-05  5.25E-05  4.83E-05
 2.71E-04  9.78E-05  5.54E-05  4.39E-05  4.10E-05  4.09E-05  4.09E-05  3.88E-05
 3.62E-05  3.35E-05  3.10E-05  2.85E-05
 1.26E-04  5.83E-05  3.53E-05  2.84E-05  2.64E-05  2.56E-05  2.52E-05  2.38E-05
 2.22E-05  2.05E-05  1.90E-05  1.75E-05
 5.22E-05  3.10E-05  2.04E-05  1.72E-05  1.60E-05  1.50E-05  1.46E-05  1.36E-05
 1.27E-05  1.18E-05  1.10E-05  1.01E-05
 1.50E-05  1.13E-05  8.36E-06  7.46E-06  7.18E-06  6.71E-06  6.38E-06  5.93E-06
 5.54E-06  5.19E-06  4.85E-06  4.49E-06
 5.76E-06  4.86E-06  3.84E-06  3.56E-06  3.54E-06  3.35E-06  3.18E-06  2.96E-06
 2.77E-06  2.62E-06  2.47E-06  2.30E-06
 2.26E-06  2.05E-06  1.71E-06  1.63E-06  1.67E-06  1.60E-06  1.52E-06  1.42E-06
 1.34E-06  1.28E-06  1.22E-06  1.15E-06
 7.21E-07  6.92E-07  5.99E-07  5.90E-07  6.21E-07  6.12E-07  5.85E-07  5.50E-07
 5.24E-07  5.07E-07  4.88E-07  4.64E-07
 3.26E-07  3.24E-07  2.86E-07  2.85E-07  3.05E-07  3.06E-07  2.95E-07  2.79E-07
 2.67E-07  2.61E-07  2.53E-07  2.43E-07
    0.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
 7.11E-04  1.25E-04  6.17E-05  4.85E-05  4.92E-05  5.45E-05  5.57E-05  5.37E-05
 5.02E-05  4.67E-05  4.28E-05  3.94E-05
 3.85E-04  7.64E-05  3.86E-05  3.03E-05  3.01E-05  3.27E-05  3.33E-05  3.20E-05
 2.99E-05  2.76E-05  2.55E-05  2.35E-05
 1.91E-04  4.53E-05  2.36E-05  1.85E-05  1.79E-05  1.90E-05  1.92E-05  1.84E-05
 1.72E-05  1.59E-05  1.47E-05  1.35E-05
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1.20E-04  3.31E-05  1.77E-05  1.39E-05  1.32E-05  1.37E-05  1.39E-05  1.32E-05
1.28E-05  1.14E-05  1.05E-05  9.70E-06
6.75E-05  2.26E-05  1.24E-05  9.93E-06  9.31E-06  9.40E-06  9.42E-06  8.96E-06
8.36E-06  7.71E-06  7.14E-06  6.57E-06
2.51E-05  1.17E-05  7.07E-06  5.73E-06  5.29E-06  5.11E-06  5.04E-06  4.76E-06
4.43E-06  4.10E-06  3.80E-06  3.50E-06
1.00E-05  5.19E-06  4.08E-06  3.43E-06  3.19E-06  3.00E-06  2.91E-06  2.73E-06
2.54E-06  2.36E-06  2.19E-06  2.02E-06
4.09E-06  2.93E-06  2.11E-06  1.86E-06  1.77E-06  1.65E-06  1.58E-06  1.47E-06
1.37E-06  1.28E-06  1.19E-06  1.10E-06
1.15E-06  9.72E-07  7.68E-07  7.13E-07  7.09E-07  6.70E-07  6.35E-07  5.91E-07
5.55E-07  5.25E-07  4.95E-07  4.61E-07
4.52E-07  4.11E-07  3.41E-07  3.26E-07  3.33E-07  3.21E-07  3.05E-07  2.85E-07
2.69E-07  2.57E-07  2.44E-07  2.30E-07
    0.00      1   10   12          HANFORD MS, SIGT = .024, UHAP
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
4.02E-04  7.03E-05  3.45E-05  2.71E-05  2.75E-05  3.06E-05  3.13E-05  3.01E-05
2.82E-05  2.60E-05  2.40E-05  2.21E-05
3.56E-04  6.28E-05  3.09E-05  2.43E-05  2.47E-05  2.73E-05  2.79E-05  2.69E-05
2.51E-05  2.32E-05  2.14E-05  1.97E-05
1.59E-04  3.31E-05  1.64E-05  1.31E-05  1.30E-05  1.40E-05  1.43E-05  1.37E-05
1.28E-05  1.18E-05  1.09E-05  1.01E-05
9.56E-05  2.26E-05  1.18E-05  9.22E-06  8.95E-06  9.48E-06  9.61E-06  9.21E-06
8.60E-06  7.93E-06  7.33E-06  6.75E-06
6.02E-05  1.65E-05  8.85E-06  6.94E-06  6.62E-06  6.86E-06  6.93E-06  6.62E-06
6.14E-06  5.70E-06  5.27E-06  4.85E-06
2.71E-05  9.78E-06  5.54E-06  4.39E-06  4.10E-06  4.09E-06  4.09E-06  3.88E-06
3.62E-06  3.35E-06  3.10E-06  2.85E-06
1.24E-05  5.81E-06  3.51E-06  2.86E-06  2.64E-06  2.56E-06  2.52E-06  2.38E-06
2.22E-06  2.05E-06  1.90E-06  1.75E-06
5.22E-06  3.09E-06  2.04E-06  1.72E-06  1.50E-06  1.50E-06  1.46E-06  1.36E-06
1.27E-06  1.18E-06  1.10E-06  1.01E-06
1.50E-06  1.13E-06  8.36E-07  7.40E-07  7.18E-07  6.71E-07  6.58E-07  5.93E-07
5.54E-07  5.19E-07  4.85E-07  4.49E-07
5.76E-07  4.86E-07  3.80E-07  3.56E-07  3.54E-07  3.35E-07  3.18E-07  2.98E-07
2.77E-07  2.62E-07  2.47E-07  2.30E-07
    0.00      1   10   12          HANFORD MS, SIGT = .04 , UBAP
  100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
50000.00 100000.00
7.49E-04  1.93E-04  1.01E-04  7.91E-05  7.58E-05  7.94E-05  8.04E-05  7.70E-05
7.18E-05  6.62E-05  6.12E-05  5.63E-05
4.40E-04  1.35E-04  7.38E-05  5.80E-05  5.47E-05  5.58E-05  5.61E-05  5.15E-05
4.99E-05  4.60E-05  4.26E-05  3.92E-05
1.81E-04  7.45E-05  4.37E-05  3.50E-05  3.24E-05  3.18E-05  3.16E-05  2.99E-05
2.79E-05  2.58E-05  2.36E-05  2.19E-05
7.99E-05  4.17E-05  2.64E-05  2.18E-05  2.01E-05  1.92E-05  1.88E-05  1.76E-05
1.64E-05  1.52E-05  1.41E-05  1.30E-05
3.26E-05  2.09E-05  1.44E-05  1.23E-05  1.16E-05  1.09E-05  1.05E-05  9.77E-06
9.11E-06  8.48E-06  7.90E-06  7.28E-06
9.61E-06  7.43E-06  5.61E-06  5.07E-06  4.95E-06  4.66E-06  4.43E-06  4.12E-06
3.86E-06  3.63E-06  3.41E-06  3.16E-06
3.88E-06  3.30E-06  2.63E-06  2.46E-06  2.46E-06  2.34E-06  2.22E-06  2.07E-06
1.95E-06  1.85E-06  1.75E-06  1.64E-06
1.65E-06  1.50E-06  1.25E-06  1.20E-06  1.23E-06  1.18E-06  1.13E-06  1.05E-06
9.96E-07  9.50E-07  9.10E-07  8.57E-07
5.90E-07  5.67E-07  4.91E-07  4.84E-07  5.09E-07  5.02E-07  4.81E-07  4.52E-07
4.31E-07  4.18E-07  4.02E-07  3.83E-07
2.83E-07  2.81E-07  2.48E-07  2.47E-07  2.65E-07  2.65E-07  2.56E-07  2.42E-07
2.32E-07  2.27E-07  2.20E-07  2.11E-07
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      0.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
    100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
  50000.00 100000.00
  6.25E-04  1.14E-04  5.60E-05  4.40E-05  4.44E-05  4.90E-05  5.01E-05  4.82E-05
  4.50E-05  4.15E-05  3.84E-05  3.53E-05
  3.26E-04  6.82E-05  3.46E-05  2.70E-05  2.67E-05  2.88E-05  2.94E-05  2.82E-05
  2.63E-05  2.43E-05  2.24E-05  2.07E-05
  1.50E-04  3.86E-05  2.04E-05  1.59E-05  1.53E-05  1.60E-05  1.62E-05  1.55E-05
  1.45E-05  1.34E-05  1.24E-05  1.14E-05
  6.79E-05  2.70E-05  1.48E-05  1.16E-05  1.10E-05  1.12E-05  1.13E-05  1.07E-05
  1.00E-05  9.24E-06  8.55E-06  7.86E-06
  4.58E-05  1.75E-05  1.01E-05  8.01E-06  7.45E-06  7.38E-06  7.36E-06  6.98E-06
  6.50E-06  6.01E-06  5.56E-06  5.12E-06
  1.60E-05  8.34E-06  5.28E-06  4.35E-06  4.03E-06  3.84E-06  3.75E-06  3.53E-06
  3.29E-06  3.05E-06  2.83E-06  2.60E-06
  6.53E-06  4.18E-06  2.87E-06  2.47E-06  2.32E-06  2.18E-06  2.09E-06  1.95E-06
  1.82E-06  1.70E-06  1.58E-06  1.46E-06
  2.59E-06  1.92E-06  1.42E-06  1.27E-06  1.23E-06  1.16E-06  1.10E-06  1.02E-06
  9.55E-07  8.98E-07  8.41E-07  7.79E-07
  7.76E-07  6.60E-07  5.26E-07  4.91E-07  4.92E-07  4.68E-07  4.45E-07  4.15E-07
  3.90E-07  3.70E-07  3.50E-07  3.28E-07
  3.29E-07  3.00E-07  2.50E-07  2.39E-07  2.45E-07  2.37E-07  2.25E-07  2.11E-07
  1.99E-07  1.91E-07  1.82E-07  1.71E-07
      0.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
    100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
  50000.00 100000.00
  5.48E-04  9.04E-05  4.40E-05  3.47E-05  3.56E-05  3.98E-05  4.08E-05  3.94E-05
  3.68E-05  3.39E-05  3.14E-05  2.89E-05
  3.13E-04  5.68E-05  2.81E-05  2.21E-05  2.23E-05  2.45E-05  2.51E-05  2.42E-05
  2.26E-05  2.08E-05  1.92E-05  1.77E-05
  1.33E-04  2.92E-05  1.49E-05  1.17E-05  1.14E-05  1.23E-05  1.25E-05  1.20E-05
  1.12E-05  1.03E-05  9.53E-06  8.77E-06
  7.48E-05  1.93E-05  1.02E-05  7.97E-06  7.65E-06  8.01E-06  8.11E-06  7.75E-06
  7.24E-06  6.68E-06  6.18E-06  5.68E-06
  4.40E-05  1.35E-05  7.39E-06  5.81E-06  5.48E-06  5.60E-06  5.63E-06  5.37E-06
  5.01E-06  4.62E-06  4.27E-06  3.93E-06
  1.81E-05  7.45E-06  4.37E-06  3.50E-06  3.24E-06  3.18E-06  3.16E-06  2.99E-06
  2.79E-06  2.57E-06  2.38E-06  2.19E-06
  7.98E-06  4.17E-06  2.64E-06  2.18E-06  2.01E-06  1.92E-06  1.88E-06  1.76E-06
  1.64E-06  1.52E-06  1.41E-06  1.30E-06
  3.26E-06  2.09E-06  1.44E-06  1.23E-06  1.16E-06  1.09E-06  1.05E-06  9.77E-07
  9.11E-07  8.48E-07  7.90E-07  7.28E-07
  9.61E-07  7.42E-07  5.60E-07  5.07E-07  4.95E-07  4.66E-07  4.43E-07  4.12E-07
  3.86E-07  3.63E-07  3.41E-07  3.16E-07
  3.88E-07  3.30E-07  2.63E-07  2.46E-07  2.46E-07  2.34E-07  2.22E-07  2.07E-07
  1.95E-07  1.85E-07  1.75E-07  1.64E-07
      0.00     1   10   12          HANFORD MS, SIGT = .18 , UBAR
    100.00    200.00    500.00   1000.00   2000.00   5000.00  10000.00  20000.00
  50000.00 100000.00
  3.24E-04  5.90E-05  2.91E-05  2.28E-05  2.30E-05  2.54E-05  2.60E-05  2.50E-05
  2.34E-05  2.16E-05  1.99E-05  1.83E-05
  1.64E-04  3.47E-05  1.76E-05  1.37E-05  1.35E-05  1.46E-05  1.49E-05  1.43E-05
  1.33E-05  1.23E-05  1.14E-05  1.05E-05
  5.75E-05  1.64E-05  8.79E-06  6.89E-06  6.54E-06  6.76E-06  6.82E-06  6.52E-06
  6.06E-06  5.61E-06  5.19E-06  4.77E-06
  2.67E-05  9.64E-06  5.47E-06  4.30E-06  4.04E-06  4.04E-06  4.03E-06  3.83E-06
  3.57E-06  3.30E-06  3.05E-06  2.81E-06
  1.31E-05  5.75E-06  3.46E-06  2.81E-06  2.60E-06  2.53E-06  2.50E-06  2.36E-06
  2.20E-06  2.03E-06  1.88E-06  1.73E-06
  4.75E-06  2.56E-06  1.68E-06  1.42E-06  1.33E-06  1.27E-06  1.23E-06  1.15E-06
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1.07E-06  9.98E-07  9.28E-07  8.55E-07
2.13E-06  1.31E-06  9.04E-07  7.86E-07  7.51E-07  7.11E-07  6.84E-07  6.39E-07
5.97E-07  5.58E-07  5.21E-07  4.52E-07
9.67E-07  6.64E-07  4.82E-07  4.29E-07  4.16E-07  3.95E-07  3.78E-07  3.53E-07
3.31E-07  3.11E-07  2.92E-07  2.72E-07
3.61E-07  2.80E-07  2.18E-07  2.00E-07  1.98E-07  1.89E-07  1.80E-07  1.68E-07
1.58E-07  1.50E-07  1.42E-07  1.33E-07
1.78E-07  1.52E-07  1.22E-07  1.14E-07  1.15E-07  1.10E-07  1.05E-07  9.83E-08
9.28E-08  8.85E-08  8.41E-08  7.90E-08
   10.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
6.79E-04  1.74E-04  9.20E-05  7.20E-05  6.91E-05  7.22E-05  7.31E-05  6.99E-05
6.52E-05  6.02E-05  5.56E-05  5.12E-05
4.67E-04  1.37E-04  7.46E-05  5.87E-05  5.56E-05  5.70E-05  5.74E-05  5.47E-05
5.10E-05  4.71E-05  4.35E-05  4.00E-05
2.31E-04  8.77E-05  5.03E-05  4.01E-05  3.73E-05  3.70E-05  3.68E-05  3.49E-05
3.26E-05  3.01E-05  2.77E-05  2.56E-05
1.14E-04  5.46E-05  3.34E-05  2.72E-05  2.51E-05  2.41E-05  2.37E-05  2.24E-05
2.09E-05  1.93E-05  1.79E-05  1.65E-05
4.91E-05  2.96E-05  1.98E-05  1.67E-05  1.55E-05  1.46E-05  1.41E-05  1.32E-05
1.21E-05  1.14E-05  1.06E-05  9.77E-06
1.46E-05  1.11E-05  8.22E-06  7.46E-06  7.09E-06  6.62E-06  6.29E-06  5.85E-06
5.47E-06  5.12E-06  4.79E-06  4.43E-06
5.66E-06  4.80E-06  3.80E-06  3.53E-06  3.52E-06  3.33E-06  3.15E-06  2.93E-06
2.76E-06  2.51E-06  2.40E-06  2.29E-06
2.24E-06  2.04E-06  1.70E-06  1.62E-06  1.66E-06  1.60E-06  1.52E-06  1.42E-06
1.34E-06  1.28E-06  1.22E-06  1.15E-06
7.15E-07  6.30E-07  5.97E-07  5.88E-07  6.19E-07  6.10E-07  5.84E-07  5.49E-07
5.24E-07  5.07E-07  4.88E-07  4.64E-07
3.25E-07  3.23E-07  2.65E-07  2.84E-07  3.05E-07  3.05E-07  2.95E-07  2.79E-07
2.67E-07  2.61E-07  2.54E-07  2.43E-07
   10.00     1    0   12          HANFORD MS, SIGT = .04 , UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
5.38E-04  1.51E-04  8.10E-05  6.34E-05  6.02E-05  6.22E-05  6.27E-05  5.99E-05
5.59E-05  5.16E-05  4.77E-05  4.38E-05
3.44E-04  1.14E-04  6.33E-05  4.99E-05  4.68E-05  4.73E-05  4.74E-05  4.51E-05
4.20E-05  3.88E-05  3.59E-05  3.30E-05
1.55E-04  6.74E-05  4.01E-05  3.23E-05  2.98E-05  2.91E-05  2.88E-05  2.72E-05
2.53E-05  2.34E-05  2.17E-05  2.00E-05
7.22E-05  3.92E-05  2.51E-05  2.08E-05  1.92E-05  1.82E-05  1.78E-05  1.67E-05
1.56E-05  1.44E-05  1.34E-05  1.23E-05
3.07E-05  2.01E-05  1.39E-05  1.20E-05  1.13E-05  1.06E-05  1.02E-05  9.48E-06
8.84E-06  8.24E-06  7.67E-06  7.08E-06
9.32E-06  7.24E-06  5.52E-06  5.00E-06  4.89E-06  4.66E-06  4.37E-06  4.07E-06
3.81E-06  3.58E-06  3.37E-06  3.13E-06
3.81E-06  3.26E-06  2.60E-06  2.43E-06  2.44E-06  2.32E-06  2.21E-06  2.06E-06
1.94E-06  1.84E-06  1.74E-06  1.63E-06
1.63E-06  1.49E-06  1.24E-06  1.19E-06  1.22E-06  1.18E-06  1.12E-06  1.05E-06
9.93E-07  9.52E-07  9.08E-07  8.56E-07
5.86E-07  5.65E-07  4.90E-07  4.82E-07  5.08E-07  5.01E-07  4.80E-07  4.52E-07
4.31E-07  4.17E-07  4.02E-07  3.83E-07
2.82E-07  2.81E-07  2.47E-07  2.47E-07  2.64E-07  2.65E-07  2.56E-07  2.42E-07
2.32E-07  2.27E-07  2.20E-07  2.11E-07
   10.00     1   10   12          HANFORD MS, SIGT = .06 , UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
4.31E-04  1.32E-04  7.17E-05  5.62E-05  5.29E-05  5.40E-05  5.44E-05  5.19E-05
4.84E-05  4.46E-05  4.13E-05  3.80E-05
```

```
2.59E-04  9.54E-05  5.42E-05  4.29E-05  3.99E-05  3.98E-05  3.97E-05  3.77E-05
3.51E-05  3.24E-05  3.00E-05  2.76E-05
1.09E-04  5.28E-05  3.24E-05  2.64E-05  2.44E-05  2.34E-05  2.30E-05  2.17E-05
2.02E-05  1.87E-05  1.74E-05  1.60E-05
4.99E-05  2.92E-05  1.93E-05  1.62E-05  1.51E-05  1.43E-05  1.38E-05  1.29E-05
1.21E-05  1.12E-05  1.04E-05  9.59E-06
2.10E-05  1.45E-05  1.03E-05  8.01E-06  8.59E-06  8.05E-06  7.70E-06  7.18E-06
6.71E-06  6.26E-06  5.85E-06  5.40E-06
6.79E-06  5.35E-06  4.09E-06  3.73E-06  3.67E-06  3.47E-06  3.31E-06  3.08E-06
2.89E-06  2.73E-06  2.57E-06  2.39E-06
2.94E-06  2.53E-06  2.02E-06  1.90E-06  1.91E-06  1.82E-06  1.73E-06  1.62E-06
1.52E-06  1.45E-06  1.38E-06  1.29E-06
1.35E-06  1.23E-06  1.03E-06  9.87E-07  1.01E-06  9.79E-07  9.33E-07  8.73E-07
8.27E-07  7.93E-07  7.58E-07  7.15E-07
5.15E-07  4.96E-07  4.50E-07  4.24E-07  4.46E-07  4.41E-07  4.22E-07  3.97E-07
3.79E-07  3.67E-07  3.54E-07  3.37E-07
2.52E-07  2.51E-07  2.22E-07  2.21E-07  2.37E-07  2.37E-07  2.29E-07  2.17E-07
2.08E-07  2.03E-07  1.98E-07  1.90E-07
   60.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.20E-06  9.15E-06  8.21E-06  7.65E-06  7.20E-06  6.27E-06  5.77E-06  5.28E-06
4.91E-06  4.59E-06  4.29E-06  5.95E-06
1.54E-06  9.71E-06  8.78E-06  8.25E-06  7.85E-06  6.89E-06  6.34E-06  5.80E-06
5.40E-06  5.05E-06  4.72E-06  4.36E-06
2.61E-06  1.02E-05  9.03E-06  8.45E-06  8.08E-06  7.17E-06  6.63E-06  6.09E-06
5.68E-06  5.33E-06  4.99E-06  4.61E-06
4.56E-06  1.04E-05  8.94E-06  8.32E-06  7.98E-06  7.14E-06  6.63E-06  6.10E-06
5.69E-06  5.34E-06  5.00E-06  4.63E-06
6.63E-06  9.36E-06  7.89E-06  7.37E-06  7.15E-06  6.49E-06  6.05E-06  5.58E-06
5.21E-06  4.89E-06  4.59E-06  4.25E-06
5.76E-06  5.86E-06  4.92E-06  4.67E-06  4.66E-06  4.36E-06  4.08E-06  3.78E-06
3.50E-06  3.35E-06  3.16E-06  2.94E-06
3.47E-06  3.29E-06  2.77E-06  2.66E-06  2.72E-06  2.60E-06  2.45E-06  2.28E-06
2.15E-06  2.05E-06  1.95E-06  1.82E-06
1.74E-06  1.65E-06  1.41E-06  1.37E-06  1.42E-06  1.38E-06  1.31E-06  1.23E-06
1.17E-06  1.12E-06  1.07E-06  1.01E-06
6.49E-07  6.27E-07  5.47E-07  5.41E-07  5.73E-07  5.68E-07  5.45E-07  5.14E-07
4.91E-07  4.78E-07  4.62E-07  4.41E-07
3.11E-07  3.07E-07  2.72E-07  2.72E-07  2.92E-07  2.93E-07  2.84E-07  2.69E-07
2.59E-07  2.54E-07  2.47E-07  2.38E-07
   60.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.34E-07  1.68E-06  1.56E-06  1.47E-06  1.39E-06  1.20E-06  1.10E-06  1.01E-06
9.38E-07  8.77E-07  8.19E-07  7.55E-07
1.57E-07  1.76E-06  1.66E-06  1.58E-06  1.51E-06  1.32E-06  1.21E-06  1.10E-06
1.03E-06  9.62E-07  9.00E-07  8.30E-07
2.43E-07  1.88E-06  1.73E-06  1.64E-06  1.57E-06  1.39E-06  1.28E-06  1.17E-06
1.09E-06  1.02E-06  9.59E-07  8.87E-07
3.09E-07  1.95E-06  1.76E-06  1.66E-06  1.59E-06  1.41E-06  1.30E-06  1.19E-06
1.11E-06  1.04E-06  9.77E-07  9.03E-07
4.44E-07  2.02E-06  1.80E-06  1.69E-06  1.61E-06  1.43E-06  1.32E-06  1.21E-06
1.13E-06  1.06E-06  9.93E-07  9.19E-07
9.12E-07  2.08E-06  1.79E-06  1.67E-06  1.60E-06  1.43E-06  1.33E-06  1.22E-06
1.11E-06  1.07E-06  1.00E-06  9.25E-07
1.33E-06  1.87E-06  1.58E-06  1.47E-06  1.43E-06  1.30E-06  1.21E-06  1.12E-06
1.04E-06  9.79E-07  9.19E-07  8.50E-07
1.27E-06  1.36E-06  1.12E-06  1.08E-06  1.07E-06  9.92E-07  9.28E-07  8.58E-07
8.03E-07  7.58E-07  7.13E-07  6.62E-07
```

```
6.94E-07  6.58E-07  5.54E-07  5.32E-07  5.43E-07  5.19E-07  4.91E-07  4.57E-07
4.30E-07  4.10E-07  3.89E-07  3.65E-07
3.48E-07  3.29E-07  2.81E-07  2.73E-07  2.84E-07  2.76E-07  2.63E-07  2.46E-07
2.33E-07  2.24E-07  2.14E-07  2.03E-07
   60.00     1   10   12          HANFORD MS, SIGT = .024, UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
8.35E-07  8.30E-07  7.74E-07  7.30E-07  6.91E-07  5.99E-07  5.49E-07  5.02E-07
4.67E-07  4.36E-07  4.08E-07  3.76E-07
8.70E-07  8.60E-07  8.16E-07  7.80E-07  7.48E-07  6.53E-07  5.97E-07  5.46E-07
5.08E-07  4.75E-07  4.45E-07  4.10E-07
8.58E-07  8.94E-07  8.39E-07  8.00E-07  7.70E-07  6.78E-07  6.21E-07  5.70E-07
5.32E-07  4.99E-07  4.68E-07  4.33E-07
1.22E-07  9.42E-07  8.65E-07  8.19E-07  7.86E-07  6.94E-07  6.39E-07  5.86E-07
5.46E-07  5.13E-07  4.80E-07  4.44E-07
1.54E-07  9.73E-07  8.92E-07  8.31E-07  7.96E-07  7.04E-07  6.49E-07  5.95E-07
5.55E-07  5.21E-07  4.88E-07  4.52E-07
2.61E-07  1.02E-06  9.03E-07  8.45E-07  8.08E-07  7.17E-07  6.64E-07  6.10E-07
5.69E-07  5.33E-07  5.00E-07  4.62E-07
4.56E-07  1.04E-06  8.94E-07  8.32E-07  7.96E-07  7.14E-07  6.63E-07  6.10E-07
5.69E-07  5.34E-07  5.00E-07  4.63E-07
6.63E-07  9.36E-07  7.89E-07  7.37E-07  7.15E-07  6.49E-07  6.05E-07  5.58E-07
5.21E-07  4.89E-07  4.59E-07  4.25E-07
5.76E-07  5.86E-07  4.92E-07  4.67E-07  4.66E-07  4.34E-07  4.08E-07  3.78E-07
3.54E-07  3.35E-07  3.16E-07  2.94E-07
3.47E-07  3.29E-07  2.77E-07  2.66E-07  2.72E-07  2.60E-07  2.45E-07  2.28E-07
2.15E-07  2.05E-07  1.95E-07  1.82E-07
   60.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.19E-06  9.11E-06  8.18E-06  7.63E-06  7.18E-06  6.25E-06  5.75E-06  5.27E-06
4.90E-06  4.58E-06  4.27E-06  3.94E-06
1.44E-06  9.56E-06  8.67E-06  8.16E-06  7.78E-06  6.83E-06  6.27E-06  5.75E-06
5.35E-06  5.00E-06  4.68E-06  4.31E-06
2.06E-06  9.83E-06  8.50E-06  8.02E-06  7.70E-06  6.84E-06  6.31E-06  5.79E-06
5.40E-06  5.07E-06  4.75E-06  4.39E-06
3.04E-06  8.49E-06  7.63E-06  7.24E-06  7.03E-06  6.30E-06  5.82E-06  5.35E-06
4.99E-06  4.69E-06  4.41E-06  4.08E-06
4.17E-06  6.67E-06  5.92E-06  5.68E-06  5.53E-06  5.14E-06  4.77E-06  4.40E-06
4.11E-06  3.88E-06  3.65E-06  3.39E-06
3.69E-06  3.88E-06  3.34E-06  3.22E-06  3.27E-06  3.10E-06  2.91E-06  2.70E-06
2.54E-06  2.41E-06  2.29E-06  2.14E-06
2.34E-06  2.24E-06  1.90E-06  1.84E-06  1.89E-06  1.82E-06  1.73E-06  1.61E-06
1.53E-06  1.46E-06  1.39E-06  1.31E-06
1.27E-06  1.20E-06  1.03E-06  1.00E-06  1.04E-06  1.02E-06  9.71E-07  9.11E-07
8.65E-07  8.34E-07  8.00E-07  7.58E-07
5.32E-07  5.14E-07  4.89E-07  4.44E-07  4.70E-07  4.67E-07  4.46E-07  4.23E-07
4.04E-07  3.93E-07  3.81E-07  3.64E-07
2.70E-07  2.67E-07  2.36E-07  2.36E-07  2.53E-07  2.55E-07  2.46E-07  2.34E-07
2.25E-07  2.20E-07  2.15E-07  2.07E-07
   60.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
1.34E-07  1.68E-06  1.56E-06  1.47E-06  1.39E-06  1.20E-06  1.10E-06  1.01E-06
9.38E-07  8.77E-07  8.17E-07  7.55E-07
1.57E-07  1.76E-06  1.64E-06  1.58E-06  1.51E-06  1.32E-06  1.21E-06  1.10E-06
1.03E-06  9.62E-07  9.00E-07  8.30E-07
2.40E-07  1.88E-06  1.73E-06  1.64E-06  1.57E-06  1.38E-06  1.27E-06  1.17E-06
1.09E-06  1.02E-06  9.57E-07  8.85E-07
2.93E-07  1.92E-06  1.74E-06  1.65E-06  1.58E-06  1.40E-06  1.29E-06  1.18E-06
```

```
1.10E-06  1.03E-06  9.68E-07  8.95E-07
3.72E-07  1.91E-06  1.72E-06  1.63E-06  1.56E-06  1.38E-06  1.29E-06  1.17E-06
1.09E-06  1.03E-06  9.61E-07  8.89E-07
6.09E-07  1.70E-06  1.53E-06  1.45E-06  1.41E-06  1.20E-06  1.16E-06  1.07E-06
9.90E-07  9.39E-07  8.81E-07  8.16E-07
5.30E-07  1.33E-06  1.18E-06  1.14E-06  1.13E-06  1.03E-06  9.55E-07  8.79E-07
8.23E-07  7.78E-07  7.30E-07  6.78E-07
8.06E-07  9.05E-07  7.84E-07  7.56E-07  7.65E-07  7.18E-07  6.72E-07  6.23E-07
5.85E-07  5.55E-07  5.25E-07  4.89E-07
4.67E-07  4.47E-07  3.80E-07  3.68E-07  3.79E-07  3.65E-07  3.46E-07  3.23E-07
3.05E-07  2.92E-07  2.78E-07  2.62E-07
2.53E-07  2.40E-07  2.06E-07  2.01E-07  2.09E-07  2.04E-07  1.94E-07  1.82E-07
1.73E-07  1.67E-07  1.60E-07  1.52E-07
   40.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
  100.00   200.00   500.00  1000.00  2000.00  5000.00 10000.00 20000.00
50000.00 100000.00
8.35E-08  8.30E-07  7.74E-07  7.30E-07  6.91E-07  5.99E-07  5.49E-07  5.02E-07
4.67E-07  4.36E-07  4.08E-07  3.76E-07
8.89E-08  8.49E-07  8.16E-07  7.80E-07  7.48E-07  6.53E-07  5.97E-07  5.45E-07
5.08E-07  4.75E-07  4.45E-07  4.10E-07
8.54E-08  8.04E-07  8.39E-07  8.00E-07  7.69E-07  6.78E-07  6.22E-07  5.70E-07
5.31E-07  4.99E-07  4.68E-07  4.33E-07
1.20E-07  9.59E-07  8.63E-07  8.18E-07  7.84E-07  6.92E-07  6.37E-07  5.84E-07
5.45E-07  5.11E-07  4.79E-07  4.44E-07
1.48E-07  9.58E-07  8.72E-07  8.24E-07  7.89E-07  6.98E-07  6.43E-07  5.90E-07
5.50E-07  5.16E-07  4.84E-07  4.48E-07
2.06E-07  9.45E-07  8.59E-07  8.02E-07  7.71E-07  6.84E-07  6.31E-07  5.80E-07
5.41E-07  5.08E-07  4.76E-07  4.40E-07
3.04E-07  8.89E-07  7.63E-07  7.24E-07  7.03E-07  6.30E-07  5.82E-07  5.35E-07
4.99E-07  4.69E-07  4.41E-07  4.08E-07
4.17E-07  6.57E-07  5.92E-07  5.68E-07  5.63E-07  5.14E-07  4.77E-07  4.40E-07
4.11E-07  3.83E-07  3.65E-07  3.39E-07
3.68E-07  3.83E-07  3.34E-07  5.22E-07  3.27E-07  3.10E-07  2.91E-07  2.70E-07
2.54E-07  2.41E-07  2.29E-07  2.14E-07
2.34E-07  2.22E-07  1.90E-07  1.84E-07  1.89E-07  1.82E-07  1.73E-07  1.61E-07
1.51E-07  1.45E-07  1.39E-07  1.31E-07
   80.00     1   10   12          HANFORD MS, SIGT = .04 , UBAR
```

APPENDIX C

INPUT PREPARATION

APPENDIX C

INPUT PREPARATION

The preparation of input cards for SUBDOSA is described in this appendix. The input to Part II, BIVAR, is discussed first followed by input to PART III, SUBDOSA. No input cards are necessary for Part I, BELI, since data are supplied as data libraries generally stored on disk. The features and operation of BELI are described in Appendix A.

PART II - BIVAR

Program BIVAR calculates dose rate factors as a function of energy (described in text). The current version uses the energy groupings of photon probability library GISLIB (Appendix A).

Input to BIVAR is by card sets. Each set will command dose rate factor calculations for all combinations of up to six atmospheric stability categories, eight wind speeds, and ten downwind distances. The program varies distance, keeping wind speed and atmospheric stability constant. Wind speed is varied within each stability category. The dose rate factors calculated are automatically punched onto cards for use by SUBDOSA or for preparation of a dose rate factor library.

Six types of cards are used as input to BIVAR as described in Table C-1.

PART III - SUBDOSA

The program SUBDOSA uses NAMELIST for input of control variables and some data. The first card for each case is a title card followed by the NAMELIST cards. Additional cards depend on values submitted for control variables. A diagram of input logic is given in Figure C-1. The figure should be used with the description of card types and variables given in Table C-2 when preparing input to SUBDOSA. Dimensioned variables are indicated by their dimension in parentheses following the variable name.

TABLE C-1. BIVAR Input Cards

Card	Format	Variable	Use
1	I5	NUBAR	Wind speeds to consider. Maximum is 8.
	I5	MET	Atmospheric stabilities to consider. Maximum is 6.
	I5	NR	Distances to consider. Maximum is 10.
	E10.3	H	Release height in meters.
	E10.3	YPF	Ratio of lateral off-centerline distance to downwind distance. This value of YPF is used for each downwind distance.
2	8E10.3	R	Downwind distance from release point, meters. The number of R values must correspond to NR.
3	8E10.3	UBAM	Average wind speeds in meters/sec. The number of UBAM values submitted should correspond to NUBAR.
4	4(3A6)	MNAME	Titles for atmospheric stabilities. Three 6 character words are read per stability. The number of titles should correspond to MET.
5	I10	ITY	Integer to indicate method of determining σ_y and σ_z.

ITY	Stability Type
1	Hanford Model
2	Sutton Model
3	Not Used
4	Pasquill A
5	Pasquill B
6	Pasquill C
7	Pasquill D
8	Pasquill E
9	Pasquill F

	7E10.3	DUMMY	Values read depend on value of ITY. For ITY = 1 (Hanford Model) input is: DUMMY (1) = a DUMMY (2) = b DUMMY (3) = c DUMMY (4) = d DUMMY (5) = k^2 (Also for ITY = 1, a card 6 is read.) For ITY = 2 (Sutton Model): DUMMY (1) = C_y DUMMY (2) = C_z DUMMY (3) = n For ITY $\geq$ 3, DUMMY is not used.
6	8E10.3	SM	Values of $\sigma_\theta \bar{u}$ are submitted for each wind speed. A card 6 is needed for each card 5 with ITY = 1.

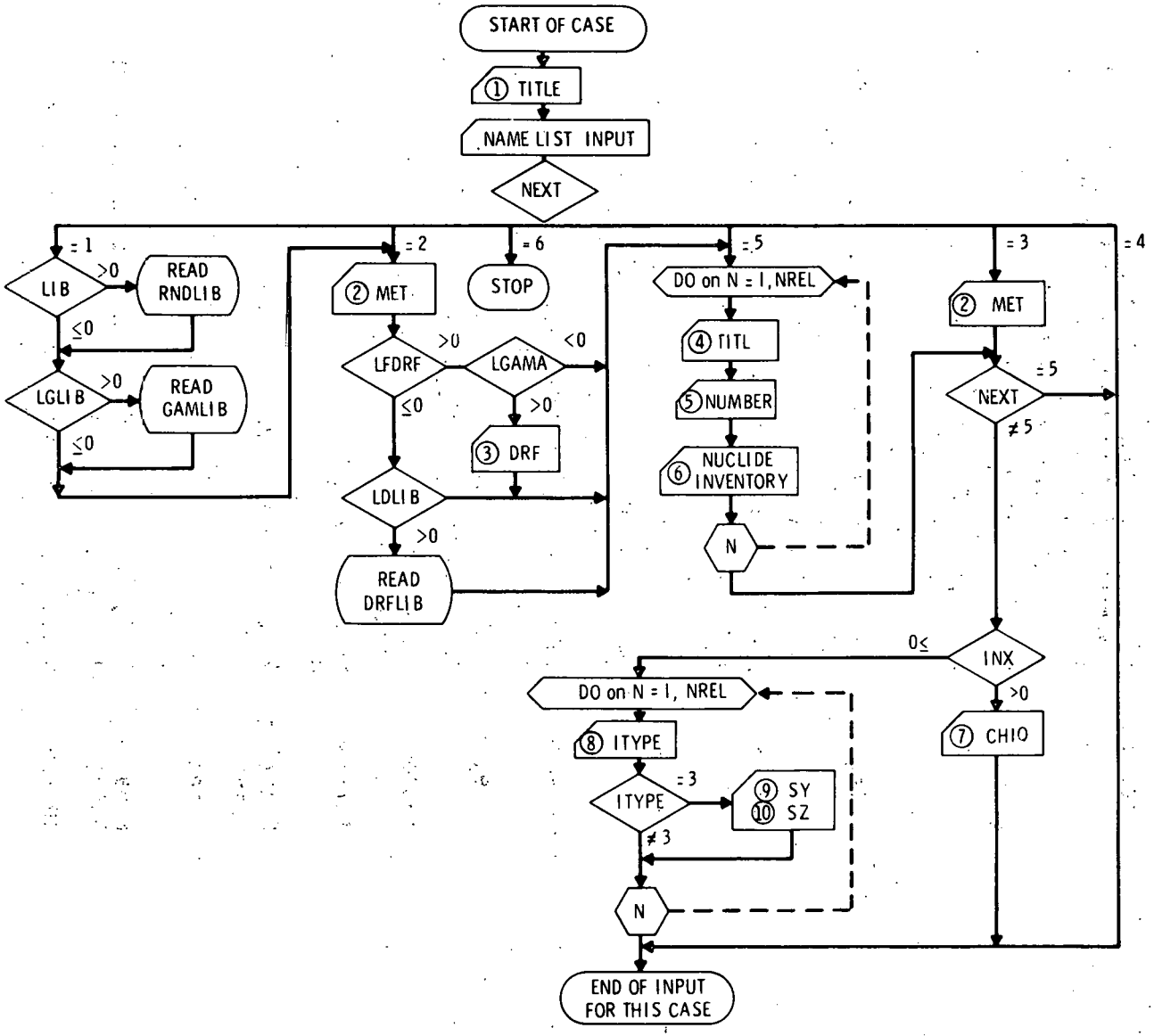

FIGURE C-1. Input Logic for Program SUBDOSA

TABLE C-2. SUBDOSA Input Cards

Card Type	Column	Format	Variable/Use
1	1-80	8A10	TITLE, title for current case to be printed in report heading.
NAMELIST		Integer	NEXT, input control integer. 1 · first case, initialize variables. 2 · input all but data libraries RNDLIB and GAMLIB (DRFLIB may be read). 3 · read new meteorological conditions only (DRF and/or XIQ). 4 · change NAMELIST variables only. 5 · read new nuclide inventories only. 6 · stop, end of run.
NAMELIST		Integer	LIB, control integer >0, read radionuclide data library (NEXT = 1); ≤0, do not read the library.
NAMELIST		Integer	LGLIB, control integer >0, read gamma energy library (NEXT = 1); ≤0, do not read the library.
NAMELIST		Integer	LDLIB, control integer >0, read dose rate factors from data library (NEXT = 1, 2, or 3); ≤0, do not read the library.
NAMELIST		Integer	LBETA, control integer >0, do beta dose calculation; ≤0, no beta dose calculation.
NAMELIST		Integer	LGAMA, control integer >0, do gamma dose calculation; ≤0, no gamma dose calculation.
NAMELIST		Integer	LCHIOQ, control integer, >0, calculate and print X/Q; ≤0, do not print X/Q.
NAMELIST		Integer	NREL, number of release periods, maximum is 6.
NAMELIST		Floating Point	RT(6) release times in seconds.
NAMELIST		Integer	NR, number of distances to consider, maximum is 10.
NAMELIST		Floating Point	D(10), downwind distances (meters) at which dose is to be calculated.
NAMELIST		Integer	NMET, number of weather stabilities to be considered for each input period. NMET is not currently in use and is set to 1.

TABLE C-2. (Continued)

Card Type	Column	Format	Variable/Use
NAMELIST		Floating Point	UBAR, wind speed in meters/sec.
NAMELIST		Floating Point	H, height of release point above ground level, meters.
NAMELIST		Integer	ITZ, control integer to indicate when nuclide decay is to be considered. ITZ = 0, for inventories specified at start of accident with decay considered to start of each release period and during travel to exposure point. ITZ = 1, for inventories specified at start of each period with decay during release and travel. ITZ = 2, for inventories specified as time integral of release during each release period with decay considered during travel only.
NAMELIST		Integer	NBD, number of tissue depths to consider for beta dose calculation. The standard beta energy library has data for tissue depths of 0, 7, 20, and 100 mg/cm^2. If other tissue depths are to be considered, a new library must be supplied with data corresponding to the tissue depths desired (Appendix A). Maximum for NBD is 4.
NAMELIST		Integer	NGD, number of tissue depths to be considered for the gamma dose calculation, maximum is 3. The program uses default values of 0, 1, and 5 cm tissue depths. Other values may be used by input of variable TDEP below.
NAMELIST		Floating Point	BDEP (4), beta dose tissue depth specification to be used with NBDI below. BDEP is used only for reports. Units of BDEP are mg/cm^2.
NAMELIST		Floating Point	TDEP (3), tissue depths for gamma dose calculation, cm. Values stored in data statements are 0, 1, and 5 cm.
NAMELIST		Integer	NBDI (4), index to indicate the relation between the beta energy library data sets (tissue depths) and the beta dose sets. For example, to indicate a 7 mg/cm^2 depth as the first beta dose set NBDI(1) = 2 since 7 mg/cm^2 is the second beta energy library data set. The number of values submitted must be at least equal to NBD.

TABLE C-2. (Continued)

Card Type	Column	Format	Variable/Use
NAMELIST		Integer	NBE, index to indicate the beta tissue depth that contributes to eye dose.
NAMELIST		Integer	NGE, index to indicate the gamma tissue depth that contributes to eye dose.
NAMELIST		Integer	NBG, index to indicate the beta tissue depth that contributes to genetic dose.
NAMELIST		Integer	NGG, index to indicate the gamma tissue depth that contributes to genetic dose.
NAMELIST		Integer	NBS, index to indicate the beta tissue depth that contributes to skin dose.
NAMELIST		Integer	NGS, index to indicate the gamma tissue depth that contributes to skin dose.
NAMELIST		Integer	LFDRF, control integer >0 to indicate DRF values are to be read from cards (overrides LDLIB). ≤0, do not read DRF from cards.
NAMELIST		Integer	LDRFP, control integer for printing DRF values. >0, print DRF values; ≤0, do not print DRF values.
NAMELIST		Integer	NDRF(6), index integers to be used when DRF values are to be read from a data library. One value is submitted for each release period (NREL total). The value submitted corresponds to the DRF set (in the DRF library) to be used for the release period.
NAMELIST		Integer	INX, control integer to indicate X/Q values are to be read from cards. INX > 0, read X/Q from cards. INX ≤ 0, do not read X/Q.
NAMELIST		Integer	IRPT, output control integer. IRPT = 1 for standard output reports. IRPT = 2 for standard reports plus punched card output of dose values.
NAMELIST		Integer	KINT, NDEPTH not used at this time.
2	1-10 11-20 . . . 51-60	6A10	MET(6), atmospheric stability titles for each release period.

TABLE C-2. (Continued)

Card Type	Column	Format	Variable/Use
3	1-10 11-20 • • • 71-80	8E10.3	DRF(120,1,6) values submitted in sets for each release period. Data within each release period set are for distances corresponding to values supplied for D. Two cards are needed for each distance containing DRF values for each of the 12 energy groups.
4	1-80	8A10	TITL, nuclide inventory title card for current release period.
5	1-3	I3	NUMBER, number of nuclides to be read for current inventory set.
6	1-3	A3	NAME (500), name of first nuclide, i.e., KR* (* indicates isomeric state).
	4-6	I3	M(500), atomic weight of first nuclide.
	7-20	E14.0	QUANTITY(500) curies of first nuclide.
	21-23	A3	NAME for second nuclide.
	24-26	I3	M, atomic weight for second nuclide.
	27-40	E14.0	QUANTY, curies of second nuclide.
	• • •	• • •	Four nuclides are entered per card with 20 columns for each as indicated above.
7	1-7	10E7.2	CHIQ(10,1,6) values of XIQ, one card submitted for each release period. Each card contains XIQ values corresponding to distances D.
8			This card contains data used to calculate XIQ values.
	1-5	I5	ITYPE, integer to indicate method of determining σ_y and σ_z.

ITY	Stability Type
1	Sutton Equations
2	Hanford Equations
3	Input σ_y and σ_z
4	Pasquill A
5	Pasquill B
6	Pasquill C
7	Pasquill D
8	Pasquill E
9	Pasquill F

TABLE C-2. (Continued)

Card Type	Column	Format	Variable/Use
8	6-11	I5	IPR, control integer for printing values of σ_y and σ_z. IPR > 0 for printing values; IPR $\leq$ 0, do not print values.
	11-20	7F10.2	DUMMY(7). Values read depend on the value of ITYPE. For ITYPE = 1, Sutton equations, input is: DUMMY (1) = C_y DUMMY (2) = C_z DUMMY (3) = n For ITYPE = 2, Hanford equations, input is: DUMMY (1) = a DUMMY (2) = b DUMMY (3) = c DUMMY (4) = d DUMMY (5) = k^2 DUMMY (6) = $\sigma_\theta \bar{u}$ DUMMY is not used for ITYPE $\geq$ 3.
9	1-10 11-20 . . . 71-80 1-10 11-20	8E10.2	SY(10,1,6) values of σ_y to be read when ITYPE = 3 on card 8. Values are submitted corresponding to values of distance D.
10	1-10 11-20 . . . 71-80 1-10 11-20	8E10.2	SZ(10,1,6) values of σ_z to be read when ITYPE = 3 on card 8. Values are submitted corresponding to values of distance, D.

Input under the NAMELIST routine consists of one or more cards with variables listed by their names as indicated above. The first NAMELIST card must be blank in column 1 with $INPUT in columns 2-7, followed by at least one blank, followed by data items. The data items are separated by a comma, and the last data items must have one of the following forms:

- Variable name = constant, where the variable name may be either subscripted or not.
- Array name = set of constants (separated by commas). The number of constants must be equal to the number of elements in the array and they must be in the same order as the array is in storage, i.e., the first subscript changes most rapidly.
- Subscripted variable = set of constants (separated by commas). This form results in the set of constants being placed in consecutive array elements, starting with the element designated by the subscripted variable. The number of constants supplied must be equal to or less than the number of array elements between the given element and the last element in the array.

The NAMELIST variables retain their values throughout execution of the program and need not be respecified, with the following exceptions. Control integers LIB and LGLIB are set to zero prior to the start of each case. Also, when DRF values are to be read from a data library, the distance values of the library replace values submitted for D. It is important to remember that XIQ values submitted by card input will not correspond to distance values used by the program (unless values submitted as D are the same as those in the DRF library).

APPENDIX D

SAMPLE PROBLEMS

APPENDIX D

SAMPLE PROBLEMS

Two sample problems are presented to illustrate preparation of input cards for BIVAR and SUBDOSA. No input cards are needed for program BELI.

The first sample problem is for calculation of dose rate factors using program BIVAR. Dose rate factors are calculated for Pasquill Type F and Hanford moderately stable meteorological conditions, a wind speed of 1 m/sec, a ground level release and downwind distances of from 100 to 10^5 m. Input cards for this problem are shown in Figure D-1. A listing of the output cards produced by BIVAR is given in Figure D-2.

NOTES:

- The first output card gives (in order) the release height, number of stabilities (MET), number of wind speeds (NUBAR), number of distances (NR) and the number of photon energy groups (GROUPS).
- The remainder of the output cards give dose rate factors, two cards per downwind distance.

A listing of the printed output is given in Figure D-3.

NOTES:

- Included in the output listing are values used for σ_y (SY), σ_z (SZ), and χ/Q for each X-grid integration position.
- The dose rate factors are the last 12 numbers of the line beginning with D=.

The second sample problem illustrates use of SUBDOSA to calculate gamma/beta skin and eye dose for two release types. The first release is 1 curie of ^{85}Kr released at ground level under Pasquill Type F stability conditions, wind speed of 1 m/sec, and for a puff release (RT(1) = 1 sec). The doses are calculated for the standard 10 downwind distances from 100 to 10^5 m. The second calculation is for release of various quantities of four noble

gas nuclides in three release periods. Both calculations are to be performed in the same run. Input cards are listed in Figure D-4.

NOTES:

- The first card is the title card for release of 1 curie ^{85}Kr.
- The next three cards are the NAMELIST cards for this calculation.
- The parameters LIB and LGLIB are set positive to cause the main data libraries to be read from appropriate files.
- LDLIB = 1 and LFDRF = 0 (not specified) indicating gamma dose rate factors are to be read from input file DRFLIB (in this example Library BIVLIB is assigned to file DRFLIB through an "ATTACH" CYBER control card).
- LBETA, LGAMA, and LCHIOQ are set positive to cause calculation of beta and gamma doses and normalized air concentration.
- NREL = 1 and R(1) = 1 indicate one release period of 1 sec duration (puff release) is desired.
- NR = 10 indicates that 10 downwind distances are to be considered. Values of D need not be supplied when dose rate factors are read from DRFLIB since distance values are supplied with the dose rate factors. In fact, distance values submitted in NAMELIST would be overridden by the DRFLIB value.
- ITZ = 2 indicates that nuclide decay during transit only will be considered.
- The parameters NBD = 2 and BDEP(1) = 7., 100. indicate that two beta tissue depth dose calculations are desired (at 7 and 100 mg/cm^2).
- NGD = 2 and TDEP(1) = 0., 5. indicate that two gamma tissue depth dose calculations are desired (at 0 and 5 cm tissue depth).
- NBDI(1) = 2,4 indicates that the effective beta energy data are to be taken from the second and fourth position of the effective beta energy library (RNDBET, Appendix A).

- The parameters NBE = 2 and NGE = 1 indicate that the eye dose is to be the sum of the second beta tissue depth dose (100 mg/cm^2) and the first gamma tissue depth dose (0 cm).
- Similarly NBS = 1 and NGS = 1 indicate that the skin dose is to be the sum of the first beta tissue depth dose (7 mg/cm^2) and the first gamma tissue depth dose (0 cm).
- LDRFP = 1 causes printing of gamma and beta dose rate factors.
- NDRF(1) = 1 indicates that the first set of dose rate factors on file DRFLIB are to be used for the gamma dose calculation.
- The next card is a title card for atmospheric stabilities (card Type 2).
- The next three cards specify 1 curie of ^{85}Kr for release in period 1 (card Types 4-6).
- The last card for this calculation (card Type 8) indicates that Pasquill Type F stability will be used for the beta dose and normalized air concentration calculations and that the values of σ_y and σ_z are to be printed.

The second calculation follows with a title card and one NAMELIST card. The NAMELIST card includes values only for the parameters that are to be changed from the first calculation. (LIB and LGLIB are set to zero before each case to avoid unnecessary rereading of data libraries.)

NOTES:

- NEXT = 2 to allow change of all variables but no library reads.
- Parameters NREL = 3 and RT(1) = 1800., 27000., 57600. specify three release periods are to be considered of duration 30 min, 7.5 hr, and 16 hr. This corresponds to release over 1 day in three periods 0 - 1/2 hr, 1/2 - 8 hr, and 8 - 24 hr.
- ITZ = 1 indicates that decay will be calculated from time zero to the start of each release period and during transit.

- NDRF(1) = 1, 1,3 indicates Pasquill Type F dose rate factors will be used for the first two release periods and Pasquill Type D for the third period.
- The next card (Type 2) gives the stability titles for each release period.
- Next follow three sets of inventory cards (Types 4-6), one set for each period. The curies of each nuclide represent the time integral of release rate with decay accounted for during release only (because ITZ = 1).
- The last three cards indicate the stability type to be used for the beta dose and normalized air concentration calculations and also cause printing of σ_y and σ_z values used.

Output for the second sample problem is shown in Figure D-5. The output is self-explanatory; the execution time is printed for each case. The first case took considerably longer than the second case because the three main data libraries were read during the first case.

FIGURE D-1. First Sample Problem Input

```
  1    2   10   0.          0.
100.      200.      500.      1000.      2000.      5000.      10000.     20000.
50000.    100000.
1.0
PASQUILL TYPE F    HANFORD MOD. STABL
         0
         1  97.       .33       13.       230.      .00025
 .024
```

FIGURE D-2. First Sample Problem Card Output

```
    0.00     2    1   10   12
2.63E+03  4.95E+04  2.46E+04  1.93E+04  1.94E+04  2.12E+04  2.18E+04  2.09E+04
1.95E+04  1.79E+04  1.67E+04  1.53E+04
1.10E+03  2.56E+04  1.32E+04  1.04E+04  1.01E+04  1.07E+04  1.09E+04  1.04E+04
9.73E+05  8.95E+05  8.33E+05  7.42E+05
3.31E+04  1.09E+04  6.11E+05  4.84E+05  4.54E+05  4.55E+05  4.62E+05  4.37E+05
4.07E+05  3.75E+05  3.49E+05  3.20E+05
1.21E+04  5.43E+05  3.30E+05  2.69E+05  2.49E+05  2.41E+05  2.39E+05  2.25E+05
2.09E+05  1.93E+05  1.80E+05  1.65E+05
4.62E+05  2.68E+05  1.74E+05  1.51E+05  1.41E+05  1.33E+05  1.29E+05  1.21E+05
1.12E+05  1.04E+05  9.73E+06  8.92E+06
1.31E+05  9.58E+06  7.05E+06  6.31E+06  6.10E+06  5.71E+06  5.68E+06  5.09E+06
4.75E+06  4.44E+06  4.19E+06  3.86E+06
5.43E+06  4.41E+06  3.82E+06  3.15E+06  3.12E+06  2.95E+06  2.83E+06  2.62E+06
2.40E+06  2.32E+06  2.20E+06  2.04E+06
2.40E+06  2.04E+06  1.67E+06  1.57E+06  1.54E+06  1.51E+06  1.45E+06  1.35E+06
1.27E+06  1.20E+06  1.15E+06  1.07E+06
8.22E+07  7.51E+07  6.25E+07  5.99E+07  6.15E+07  5.94E+07  5.70E+07  5.32E+07
5.03E+07  4.81E+07  4.43E+07  4.35E+07
3.88E+07  3.64E+07  3.04E+07  2.99E+07  3.10E+07  3.01E+07  2.90E+07  2.71E+07
2.57E+07  2.47E+07  2.38E+07  2.24E+07
9.51E+04  2.25E+04  1.17E+04  9.13E+05  8.87E+05  9.37E+05  9.58E+05  9.14E+05
8.52E+05  7.63E+05  7.29E+05  6.67E+05
5.98E+04  1.64E+04  8.91E+05  6.91E+05  6.60E+05  6.82E+05  6.93E+05  6.60E+05
6.14E+05  5.65E+05  5.26E+05  4.81E+05
2.70E+04  9.73E+05  5.52E+05  4.38E+05  4.09E+05  4.08E+05  4.10E+05  3.88E+05
3.61E+05  3.33E+05  3.10E+05  2.84E+05
1.25E+04  5.50E+05  3.52E+05  2.86E+05  2.63E+05  2.55E+05  2.53E+05  2.38E+05
2.21E+05  2.04E+05  1.90E+05  1.74E+05
5.16E+05  3.06E+05  2.04E+05  1.71E+05  1.59E+05  1.50E+05  1.46E+05  1.36E+05
1.27E+05  1.17E+05  1.10E+05  1.01E+05
1.48E+05  1.12E+05  8.33E+06  7.45E+06  7.18E+06  6.68E+06  6.40E+06  5.93E+06
5.53E+06  5.14E+06  4.86E+06  4.47E+06
5.69E+06  4.83E+06  3.83E+06  3.58E+06  3.54E+06  3.34E+06  3.19E+06  2.95E+06
2.77E+06  2.61E+06  2.48E+06  2.30E+06
2.23E+06  2.04E+06  1.70E+06  1.63E+06  1.67E+06  1.60E+06  1.53E+06  1.42E+06
1.34E+06  1.28E+06  1.22E+06  1.14E+06
7.09E+07  6.86E+07  5.97E+07  5.86E+07  6.20E+07  6.09E+07  5.87E+07  5.49E+07
5.23E+07  5.04E+07  4.89E+07  4.62E+07
3.23E+07  3.20E+07  2.94E+07  2.83E+07  3.35E+07  3.04E+07  2.95E+07  2.78E+07
2.66E+07  2.59E+07  2.53E+07  2.42E+07
```

FIGURE D-3. First Sample Problem Output

```
 1 WIND SPEEDS      1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
10 DISTANCES        100.      200.      500.      1000.     2000.     5000.     10000.    20000.    50000.    100000.
 2 STABILITIES PASQUILL TYPE F    HANFORD MOD. STABL
RELEASE HEIGHT =    0.0 METERS
```

DOSE RATE FACTORS FOR PASQUILL TYPE F DATE 07/07/75

WIND SPEED = 1.0 METERS/SEC

Sy =	100.29	120.96	141.64	162.31	182.98	203.65	224.33	245.00	259.50	274.00
	288.50	303.00	317.50	332.00	346.50	352.71	358.93	365.14	371.36	377.57
	383.79	390.00	399.00	408.00	417.00	426.00	435.00	444.00	453.00	474.00
	495.00	516.00	537.00	558.00	579.00	600.00	654.29	708.57	762.86	817.14
	871.43	925.71	980.00	1165.00	1350.00	1516.67	1683.33	1850.00	2025.00	2200.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Sz =	100.04	102.89	105.74	108.59	111.45	114.30	117.15	120.00	122.00	124.00
	126.00	128.00	130.00	132.00	134.00	134.86	135.71	136.57	137.43	138.29
	139.14	140.00	143.43	146.86	150.29	153.71	157.14	160.57	164.00	172.00
	180.00	188.00	196.00	204.00	212.00	220.00	245.71	271.43	297.14	322.86
	348.57	374.29	400.00	465.00	530.00	606.67	683.33	760.00	820.00	880.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1.586E-01 1.279E-01 1.063E-01 9.030E-02 7.805E-02 6.837E-02 6.056E-02 5.413E-02 5.027E-02 4.684E-02
4.379E-02 4.104E-02 3.856E-02 3.632E-02 3.428E-02 3.346E-02 3.267E-02 3.192E-02 3.119E-02 3.048E-02
2.980E-02 2.915E-02 2.791E-02 2.680E-02 2.580E-02 2.431E-02 2.324E-02 2.232E-02 2.142E-02 1.952E-02
1.780E-02 1.641E-02 1.512E-02 1.398E-02 1.297E-02 1.206E-02 9.900E-03 8.275E-03 7.021E-03 6.033E-03
5.240E-03 4.593E-03 4.060E-03 2.938E-03 2.224E-03 1.730E-03 1.384E-03 1.132E-03 9.585E-04 8.221E-04

D= 100. YP= 0. 2.63E-03 4.95E-04 2.46E-04 1.93E-04 1.94E-04 2.12E-04 2.18E-04 2.09E-04 1.95E-04 1.79E-04 1.67E-04 1.53E-04

Sy =	100.29	120.96	141.64	162.31	182.98	203.65	224.33	245.00	286.43	327.86
	369.29	420.00	440.00	540.00	600.00	619.00	638.00	657.00	676.00	695.00
	714.00	733.00	741.14	749.29	757.43	765.57	773.71	781.86	790.00	798.14
	806.29	814.43	822.57	830.71	838.86	847.00	864.00	885.00	904.00	923.00
	942.00	961.00	980.00	1032.86	1085.71	1138.57	1191.43	1244.29	1297.14	1350.00
	1516.67	1683.33	1850.00	2025.00	2200.00	2375.00	2550.00			
Sz =	100.04	102.89	105.74	108.59	111.45	114.30	117.15	120.00	125.71	131.43
	137.14	151.43	174.29	197.14	220.00	229.00	238.00	247.00	256.00	265.00
	274.00	283.00	286.86	290.71	294.57	298.43	302.29	306.14	310.00	313.86
	317.71	321.57	325.43	329.29	333.14	337.00	346.00	355.00	364.00	373.00
	382.00	391.00	400.00	418.57	437.14	455.71	474.29	492.86	511.43	530.00
	606.67	683.33	760.00	820.00	880.00	940.00	1000.00			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1.586E-01 1.279E-01 1.063E-01 9.030E-02 7.805E-02 6.837E-02 6.056E-02 5.413E-02 4.820E-02 5.694E-02
3.143E-02 2.502E-02 1.992E-02 1.695E-02 1.206E-02 1.123E-02 1.044E-02 9.807E-03 9.197E-03 8.642E-03
8.135E-03 7.672E-03 7.446E-03 7.306E-03 7.133E-03 6.966E-03 6.805E-03 6.649E-03 6.499E-03 6.353E-03
6.213E-03 6.077E-03 5.946E-03 5.818E-03 5.695E-03 5.576E-03 5.512E-03 5.066E-03 4.837E-03 4.623E-03
4.423E-03 4.236E-03 4.060E-03 3.681E-03 3.353E-03 3.067E-03 2.817E-03 2.595E-03 2.399E-03 2.224E-03
1.730E-03 1.384E-03 1.132E-03 9.585E-04 8.221E-04 7.129E-04 6.241E-04

D= 200. YP= 0. 1.10E-03 2.56E-04 1.32E-04 1.04E-04 1.01E-04 1.07E-04 1.09E-04 1.04E-04 9.75E-05 8.95E-05 8.33E-05 7.82E-05

Sy =	100.29	245.25	390.30	600.22	790.16	980.11	1165.05	1350.00	1397.62	1445.24
	1492.86	1540.48	1588.10	1635.71	1683.33	1700.10	1716.67	1733.33	1750.00	1766.67
	1783.33	1800.00	1807.14	1814.29	1821.43	1828.57	1835.71	1842.86	1850.00	1857.50
	1865.00	1872.50	1880.00	1887.50	1895.00	1902.50	1920.00	1937.50	1955.00	1972.50
	1990.00	2007.50	2025.00	2075.00	2125.00	2175.00	2225.00	2275.00	2325.00	2375.00
	2550.00	2725.00	2900.00	3075.00	3250.00	3425.00	3600.00			
Sz =	100.04	120.03	140.11	220.10	310.08	400.14	465.02	530.00	551.90	573.81
	595.71	617.62	639.52	661.43	683.33	691.00	698.67	706.33	714.00	721.67
	729.33	737.00	740.29	743.57	746.86	750.14	753.43	756.71	760.00	762.57
	765.14	767.71	770.29	772.86	775.43	778.00	784.00	790.00	796.00	802.00
	808.00	814.00	820.00	837.14	854.29	871.43	888.57	905.71	922.86	940.00
	1000.00	1058.33	1116.67	1175.00	1233.33	1291.67	1350.00			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1.586E-01 5.406E-02 2.910E-02 1.205E-02 6.496E-03 4.059E-03 2.938E-03 2.224E-03 2.063E-03 1.919E-03
1.790E-03 1.673E-03 1.567E-03 1.471E-03 1.384E-03 1.355E-03 1.327E-03 1.300E-03 1.274E-03 1.248E-03
1.224E-03 1.200E-03 1.190E-03 1.180E-03 1.170E-03 1.160E-03 1.151E-03 1.141E-03 1.132E-03 1.124E-03
1.115E-03 1.107E-03 1.099E-03 1.091E-03 1.083E-03 1.075E-03 1.157E-03 1.040E-03 1.023E-03 1.006E-03
9.899E-04 9.740E-04 9.585E-04 9.162E-04 8.767E-04 8.397E-04 8.050E-04 7.724E-04 7.418E-04 7.129E-04
6.241E-04 5.519E-04 4.915E-04 4.405E-04 3.971E-04 3.598E-04 3.275E-04

D= 500. YP= 0. 3.31E-04 1.09E-04 6.11E-05 4.84E-05 4.54E-05 4.58E-05 4.62E-05 4.37E-05 4.07E-05 3.75E-05 3.49E-05 3.20E-05
SY = 1650.35 2025.30 2200.25 2375.20 2550.15 2725.10 2900.05 3075.00 3125.00 3175.00
3225.00 3275.00 3325.00 3375.00 3425.00 3442.50 3460.00 3477.50 3495.00 3512.50
3530.00 3547.50 3565.00 3582.50 3570.00 3577.50 3585.00 3592.50 3600.00 3606.86
3613.71 3620.57 3627.43 3634.29 3641.14 3648.00 3664.00 3680.00 3696.00 3712.00
3728.00 3744.00 3760.00 3805.71 3851.43 3897.14 3942.86 3988.57 4034.29 4080.00
4240.00 4400.00 4560.00 4720.00 4880.00 5040.00 5200.00
SZ = 760.12 820.10 840.09 940.07 1000.05 1058.37 1116.68 1175.00 1191.67 1208.33
1225.00 1241.67 1258.33 1275.00 1291.67 1297.50 1303.33 1309.17 1315.00 1320.83
1326.67 1332.50 1335.00 1337.50 1340.00 1342.50 1345.00 1347.50 1350.00 1351.80
1353.60 1355.40 1357.20 1359.00 1360.80 1362.60 1366.80 1371.00 1375.20 1379.40
1383.60 1387.80 1392.00 1404.00 1416.00 1428.00 1440.00 1452.00 1464.00 1476.00
1518.00 1560.00 1602.00 1644.00 1686.00 1728.00 1770.00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1.132E-03 9.582E-04 8.219E-04 7.128E-04 6.241E-04 5.518E-04 4.915E-04 4.405E-04 4.274E-04 4.148E-04
4.029E-04 3.916E-04 3.804E-04 3.699E-04 3.598E-04 3.563E-04 3.529E-04 3.494E-04 3.463E-04 3.430E-04
3.396E-04 3.367E-04 3.354E-04 3.340E-04 3.327E-04 3.314E-04 3.301E-04 3.288E-04 3.275E-04 3.264E-04
3.254E-04 3.243E-04 3.233E-04 3.222E-04 3.212E-04 3.202E-04 3.178E-04 3.155E-04 3.131E-04 3.108E-04
3.086E-04 3.063E-04 3.041E-04 2.979E-04 2.918E-04 2.860E-04 2.803E-04 2.748E-04 2.695E-04 2.643E-04
2.473E-04 2.319E-04 2.179E-04 2.051E-04 1.934E-04 1.827E-04 1.729E-04

D= 1000. YP= 0. 1.21E-04 5.43E-05 3.30E-05 2.69E-05 2.41E-05 2.39E-05 2.25E-05 2.09E-05 1.93E-05 1.80E-05 1.65E-05
SY = 5200.29 5345.25 5490.21 5635.17 5780.12 5925.08 6070.04 6215.00 6256.43 6297.86
6339.29 6380.71 6422.14 6463.57 6505.00 6519.50 6534.00 6548.50 6563.00 6577.50
6592.00 6606.50 6612.71 6618.93 6625.14 6631.36 6637.57 6643.79 6650.00 6656.21
6662.43 6668.64 6674.86 6681.07 6687.29 6693.50 6708.00 6722.50 6737.00 6751.50
6766.00 6780.50 6795.00 6836.43 6877.86 6919.29 6960.71 7002.14 7043.57 7085.00
7230.00 7375.00 7520.00 7665.00 7810.00 7955.00 8100.00
SZ = 1770.07 1806.56 1843.05 1879.54 1916.03 1952.52 1989.01 2025.50 2035.93 2046.36
2056.79 2067.21 2077.64 2088.07 2098.50 2102.15 2105.80 2109.45 2113.10 2116.75
2120.40 2124.05 2125.61 2127.18 2128.74 2130.31 2131.87 2133.44 2135.00 2136.56
2138.13 2139.69 2141.26 2142.82 2144.39 2145.95 2149.60 2153.25 2156.90 2160.55
2164.20 2167.85 2171.50 2181.93 2192.36 2202.79 2213.21 2223.64 2234.07 2244.50
2281.00 2317.50 2354.00 2390.50 2427.00 2463.50 2500.00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1.729E-04 1.648E-04 1.573E-04 1.503E-04 1.437E-04 1.376E-04 1.318E-04 1.264E-04 1.249E-04 1.235E-04
1.221E-04 1.207E-04 1.193E-04 1.179E-04 1.166E-04 1.161E-04 1.157E-04 1.152E-04 1.148E-04 1.143E-04
1.139E-04 1.134E-04 1.132E-04 1.130E-04 1.129E-04 1.127E-04 1.125E-04 1.123E-04 1.121E-04 1.119E-04
1.117E-04 1.115E-04 1.114E-04 1.112E-04 1.110E-04 1.104E-04 1.104E-04 1.099E-04 1.095E-04 1.091E-04
1.087E-04 1.083E-04 1.079E-04 1.067E-04 1.055E-04 1.044E-04 1.033E-04 1.022E-04 1.011E-04 1.001E-04
9.651E-05 9.312E-05 8.991E-05 8.686E-05 8.397E-05 8.121E-05 7.860E-05

D= 2000. YP= 0. 4.62E-05 2.68E-05 1.78E-05 1.51E-05 1.41E-05 1.33E-05 1.29E-05 1.21E-05 1.12E-05 1.04E-05 9.73E-06 8.92E-06
SY = 13866.95 14010.25 14153.54 14296.83 14440.12 14583.42 14726.71 14870.00 14910.95 14951.90
14992.86 15033.81 15074.76 15115.71 15156.67 15171.00 15185.33 15199.67 15214.00 15228.33
15242.67 15257.00 15263.14 15269.29 15275.43 15281.57 15287.71 15293.86 15300.00 15306.11
15312.21 15318.32 15324.43 15330.54 15336.64 15342.75 15357.00 15371.25 15385.50 15399.75
15414.00 15428.25 15442.50 15483.21 15523.93 15564.64 15605.36 15646.07 15686.79 15727.50
15870.00 16012.50 16155.00 16297.50 16440.00 16582.50 16725.00
SZ = 3333.37 3350.03 3366.69 3383.35 3400.01 3416.68 3433.34 3450.00 3454.76 3459.52
3464.29 3469.05 3473.81 3474.57 3483.33 3485.00 3486.67 3488.33 3490.00 3491.67

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        3493,33   3495,00   3495,71   3496,43   3497,14   3497,86   3498,57   3499,29   3500,00   3500,64
        3501,29   3501,93   3502,57   3503,21   3503,86   3504,50   3506,00   3507,50   3509,00   3510,50
        3512,00   3513,50   3515,00   3519,29   3523,57   3527,86   3532,14   3536,43   3540,71   3545,00
        3560,00   3575,00   3590,00   3605,00   3620,00   3635,00   3650,00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
3,443E-05 3,391E-05 3,340E-05 3,290E-05 3,242E-05 3,194E-05 3,148E-05 3,102E-05 3,090E-05 3,077E-05
3,064E-05 3,052E-05 3,039E-05 3,027E-05 3,015E-05 3,010E-05 3,006E-05 3,002E-05 2,997E-05 2,993E-05
2,989E-05 2,985E-05 2,981E-05 2,981E-05 2,979E-05 2,977E-05 2,976E-05 2,974E-05 2,972E-05 2,970E-05
2,969E-05 2,967E-05 2,965E-05 2,963E-05 2,962E-05 2,960E-05 2,956E-05 2,952E-05 2,948E-05 2,944E-05
2,940E-05 2,936E-05 2,932E-05 2,921E-05 2,910E-05 2,898E-05 2,887E-05 2,876E-05 2,865E-05 2,855E-05
2,817E-05 2,780E-05 2,744E-05 2,709E-05 2,674E-05 2,640E-05 2,607E-05

D=    5000, YP=      0, 1,31E-05 9,58E-06 7,05E-06 6,31E-06 6,10E-06 5,71E-06 5,48E-06 5,09E-06 4,75E-06 4,44E-06 4,19E-06 3,86E-06
SY =   26833,57  26850,20  27066,43  27183,47  27300,10  27416,73  27533,37  27650,00  27683,33  27716,67
       27750,00  27783,33  27816,67  27850,00  27883,33  27895,00  27906,67  27918,33  27930,00  27941,67
       27953,33  27965,00  27970,00  27975,00  27980,00  27985,00  27990,00  27995,00  28000,00  28005,14
       28010,29  28015,43  28020,57  28025,71  28030,86  28036,00  28048,00  28060,00  28072,00  28084,00
       28096,00  28108,00  28120,00  28154,29  28188,57  28222,86  28257,14  28291,43  28325,71  28360,00
       28480,00  28600,00  28720,00  28840,00  28960,00  29080,00  29200,00
SZ =    4600,02   4610,02   4620,01   4630,01   4640,01   4650,01   4660,00   4670,00   4672,86   4675,71
       4678,57   4681,43   4684,29   4687,14   4690,00   4691,00   4692,00   4693,00   4694,00   4695,00
       4696,00   4697,00   4697,43   4697,86   4698,29   4698,71   4699,14   4699,57   4700,00   4700,34
       4700,69   4701,03   4701,37   4701,71   4702,06   4702,40   4703,20   4704,00   4704,80   4705,60
       4706,40   4707,20   4708,00   4710,29   4712,57   4714,86   4717,14   4719,43   4721,71   4724,00
       4732,00   4740,00   4748,00   4756,00   4764,00   4772,00   4780,00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1,289E-05 1,281E-05 1,273E-05 1,265E-05 1,256E-05 1,248E-05 1,240E-05 1,233E-05 1,230E-05 1,226E-05
1,226E-05 1,224E-05 1,221E-05 1,219E-05 1,217E-05 1,216E-05 1,215E-05 1,215E-05 1,214E-05 1,213E-05
1,212E-05 1,212E-05 1,211E-05 1,211E-05 1,211E-05 1,210E-05 1,210E-05 1,210E-05 1,209E-05 1,209E-05
1,209E-05 1,208E-05 1,208E-05 1,208E-05 1,208E-05 1,207E-05 1,206E-05 1,206E-05 1,205E-05 1,204E-05
1,204E-05 1,203E-05 1,202E-05 1,200E-05 1,198E-05 1,196E-05 1,194E-05 1,192E-05 1,190E-05 1,188E-05
1,181E-05 1,174E-05 1,167E-05 1,160E-05 1,154E-05 1,147E-05 1,140E-05

D=   10000, YP=      0, 5,43E-06 4,01E-06 3,42E-06 3,15E-06 3,12E-06 2,95E-06 2,83E-06 2,62E-06 2,46E-06 2,32E-06 2,20E-06 2,04E-06
SY =   49450,21  49555,18  49660,15  49765,12  49870,09  49975,06  50080,03  50185,00  50215,00  50245,00
       50275,00  50305,00  50335,00  50365,00  50395,00  50405,50  50416,00  50426,50  50437,00  50447,50
       50458,00  50468,50  50479,00  50489,50  50482,00  50486,50  50491,00  50495,50  50500,00  50504,50
       50509,00  50513,50  50518,00  50522,50  50527,00  50531,50  50536,00  50552,50  50569,00  50573,50
       50580,00  50594,50  50605,00  50635,00  50665,00  50695,00  50725,00  50755,00  50785,00  50815,00
       50920,00  51025,00  51130,00  51235,00  51340,00  51445,00  51550,00
SZ =    5905,01   5909,51   5914,01   5918,51   5923,00   5927,50   5932,00   5936,50   5937,79   5939,07
       5940,36   5941,64   5942,93   5944,21   5945,50   5945,95   5946,40   5946,85   5947,30   5947,75
       5948,20   5948,65   5948,84   5949,04   5949,23   5949,42   5949,61   5949,81   5950,00   5950,19
       5950,39   5950,58   5950,77   5950,96   5951,16   5951,35   5951,80   5952,25   5952,70   5953,15
       5953,60   5954,05   5954,50   5955,79   5957,07   5958,36   5959,64   5960,93   5962,21   5963,50
       5968,00   5972,50   5977,00   5981,50   5986,00   5990,50   5995,00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
5,450E-06 5,435E-06 5,419E-06 5,404E-06 5,388E-06 5,373E-06 5,357E-06 5,342E-06 5,338E-06 5,333E-06
5,329E-06 5,325E-06 5,320E-06 5,316E-06 5,312E-06 5,310E-06 5,309E-06 5,307E-06 5,306E-06 5,304E-06
5,303E-06 5,301E-06 5,301E-06 5,300E-06 5,299E-06 5,299E-06 5,298E-06 5,297E-06 5,297E-06 5,296E-06
5,295E-06 5,295E-06 5,294E-06 5,294E-06 5,293E-06 5,292E-06 5,291E-06 5,289E-06 5,288E-06 5,286E-06
5,285E-06 5,283E-06 5,282E-06 5,278E-06 5,273E-06 5,269E-06 5,265E-06 5,261E-06 5,256E-06 5,252E-06
5,237E-06 5,223E-06 5,208E-06 5,193E-06 5,179E-06 5,164E-06 5,150E-06

D=   20000, YP=      0, 2,40E-06 2,08E-06 1,67E-06 1,57E-06 1,56E-06 1,51E-06 1,45E-06 1,35E-06 1,27E-06 1,20E-06 1,15E-06 1,07E-06
SY =  111000,20 111100,17 111200,14 111300,11 111400,09 111500,06 111600,03 111700,00 111726,57 111753,14
      111765,71 111818,29 111842,86 111871,43 111900,00 111910,00 111920,00 111930,00 111940,00 111950,00
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      111960.00 111970.00 111974.29 111978.57 111982.86 111987.14 111991.43 111995.71 112000.00 112003.86
      112007.71 112011.57 112015.43 112019.29 112023.14 112027.00 112036.00 112045.00 112054.00 112063.00
      112072.00 112081.00 112090.00 112115.71 112141.43 112167.14 112192.86 112218.57 112244.29 112270.00
      112360.00 112450.00 112540.00 112630.00 112720.00 112810.00 112900.00
SZ =    7876.67   7879.00   7881.34   7883.67   7886.00   7888.33   7890.67   7893.00   7893.67   7894.33
        7895.00   7895.67   7896.33   7897.00   7897.67   7897.70   7898.13   7898.37   7898.60   7898.83
        7899.07   7899.30   7899.40   7899.50   7899.60   7899.70   7899.80   7899.90   7900.00   7900.08
        7900.15   7900.23   7900.30   7900.37   7900.45   7900.53   7900.70   7900.88   7901.05   7901.23
        7901.40   7901.58   7901.75   7902.25   7902.75   7903.25   7903.75   7904.25   7904.75   7905.25
        7907.00   7908.75   7910.50   7912.25   7914.00   7915.75   7917.50

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1.820E-06 1.818E-06 1.816E-06 1.814E-06 1.812E-06 1.810E-06 1.807E-06 1.805E-06 1.805E-06 1.804E-06
1.803E-06 1.803E-06 1.802E-06 1.802E-06 1.801E-06 1.801E-06 1.800E-06 1.800E-06 1.800E-06 1.800E-06
1.800E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06 1.799E-06
1.799E-06 1.799E-06 1.798E-06 1.798E-06 1.798E-06 1.798E-06 1.798E-06 1.798E-06 1.798E-06 1.797E-06
1.797E-06 1.797E-06 1.797E-06 1.796E-06 1.796E-06 1.795E-06 1.795E-06 1.794E-06 1.794E-06 1.793E-06
1.791E-06 1.790E-06 1.788E-06 1.786E-06 1.784E-06 1.782E-06 1.780E-06

D=   50000. VP=       0. 8.22E-07 7.51E-07 6.25E-07 5.99E-07 6.15E-07 5.94E-07 5.70E-07 5.32E-07 5.03E-07 4.81E-07 4.63E-07 4.35E-07
LIBRARY DISTANCE DATA TO SHORT FOR PASQUILL TYPE  6
Sv =  199133.51 199220.15 199306.79 199393.43 199480.07 199566.72 199653.36 199740.00 199764.76 199789.52
      199814.29 199839.05 199863.81 199888.57 199913.33 199922.10 199930.67 199939.33 199948.00 199956.67
      199965.33 199974.00 199977.71 199981.43 199985.14 199988.86 199992.57 199996.29 200000.00 200000.00
      200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00
      200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00
      200000.00 200000.00 200000.00 200000.00 200000.00 200000.00 200000.00
SZ =    9384.67   9388.00   9389.34   9390.67   9392.00   9393.33   9394.67   9396.00   9396.38   9396.76
        9397.14   9397.52   9397.90   9398.29   9398.67   9398.90   9399.03   9399.07   9399.20   9399.33
        9399.47   9399.60   9399.66   9399.71   9399.77   9399.83   9399.89   9399.94   9400.00   9400.00
        9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00
        9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00
        9400.00   9400.00   9400.00   9400.00   9400.00   9400.00   9400.00

E/Q VALUES AT EACH DOWNWIND POSITION ARE
8.515E-07 8.510E-07 8.505E-07 8.500E-07 8.495E-07 8.490E-07 8.485E-07 8.480E-07 8.479E-07 8.476E-07
8.470E-07 8.475E-07 8.473E-07 8.472E-07 8.471E-07 8.470E-07 8.470E-07 8.469E-07 8.469E-07 8.468E-07
8.468E-07 8.467E-07 8.467E-07 8.467E-07 8.467E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07
8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07
8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07
8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07 8.466E-07

D=  100000. VP=       0. 3.88E-07 3.64E-07 3.08E-07 2.99E-07 3.11E-07 3.01E-07 2.90E-07 2.71E-07 2.57E-07 2.47E-07 2.38E-07 2.24E-07
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DOSE RATE FACTORS FOR HANFORD MOD, STABL DATE 07/07/75

WIND SPEED = 1.0 METERS/SEC

SY =	110.00	110.00	110.00	51.55	68.65	85.75	102.85	119.94	137.02	143.91
	155.89	167.88	179.86	191.84	203.82	208.95	214.09	219.22	224.35	229.49
	234.62	239.75	244.88	250.02	255.15	260.28	265.41	270.54	275.67	287.64
	299.61	311.58	323.55	335.51	347.48	359.44	393.62	427.78	461.93	496.08
	530.21	564.34	598.45	717.77	836.96	956.04	1074.98	1193.81	1312.52	1431.10
	200000.00	200000.00	200000.00	200000.00	200000.00	200000.00	200000.00			
SZ =	110.00	190.90	310.00	420.28	523.43	619.00	706.27	784.73	834.36	879.56
	920.42	957.11	989.84	1018.90	1044.59	1054.64	1064.16	1073.18	1081.71	1089.80
	1097.45	1104.71	1111.58	1118.11	1124.31	1130.20	1135.82	1141.17	1146.27	1157.37
	1167.47	1176.78	1185.46	1193.64	1201.43	1208.53	1229.23	1248.58	1267.41	1285.90
	1304.11	1322.07	1339.78	1400.00	1457.74	1513.27	1566.84	1618.64	1668.83	1717.56
	9400.00	9400.00	9400.00	9400.00	9400.00	9400.00	9400.00			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1.315E-01 7.579E-02 4.667E-02 7.346E-02 4.429E-02 2.998E-02 2.191E-02 1.691E-02 1.446E-02 1.257E-02
1.109E-02 9.905E-03 8.940E-03 8.142E-03 7.475E-03 7.222E-03 6.986E-03 6.765E-03 6.558E-03 6.364E-03
6.181E-03 6.009E-03 5.847E-03 5.693E-03 5.548E-03 5.410E-03 5.280E-03 5.155E-03 5.037E-03 4.781E-03
4.550E-03 4.341E-03 4.150E-03 3.974E-03 3.812E-03 3.663E-03 3.219E-03 2.980E-03 2.718E-03 2.495E-03
2.302E-03 2.133E-03 1.985E-03 1.584E-03 1.304E-03 1.100E-03 9.449E-04 8.236E-04 7.266E-04 6.475E-04

D= 100. YP= 0. 9.51E-04 2.25E-04 1.17E-04 9.14E-05 8.87E-05 9.37E-05 9.58E-05 9.14E-05 8.52E-05 7.83E-05 7.29E-05 6.67E-05

SY =	110.00	110.00	110.00	51.55	68.65	85.75	102.85	119.94	154.18	188.42
	222.64	256.86	291.06	325.26	359.44	371.40	383.36	395.32	407.28	419.24
	431.20	443.15	448.27	453.40	458.52	463.64	468.76	473.89	479.01	484.13
	489.25	494.37	499.49	504.61	509.73	514.85	526.80	538.74	550.69	562.63
	574.57	586.51	598.45	632.55	666.65	700.73	734.80	768.87	802.92	836.96
	956.04	1074.98	1193.81	1312.52	1431.10	1549.56	1667.90			
SZ =	110.00	190.90	310.00	420.28	523.43	619.00	706.27	784.73	914.84	1010.96
	1078.92	1126.31	1160.34	1186.66	1208.93	1218.19	1223.27	1230.21	1237.05	1243.80
	1250.48	1257.11	1259.93	1262.74	1265.55	1268.35	1271.14	1273.92	1276.70	1279.47
	1282.23	1284.99	1287.74	1290.48	1293.22	1295.95	1302.30	1308.62	1314.91	1321.17
	1327.40	1333.60	1339.78	1357.26	1374.51	1391.56	1408.39	1425.03	1441.48	1457.74
	1513.27	1566.84	1618.64	1668.83	1717.56	1764.94	1811.08			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1.315E-01 7.579E-02 4.667E-02 7.346E-02 4.429E-02 2.998E-02 2.191E-02 1.691E-02 1.128E-02 8.355E-03
6.626E-03 5.501E-03 4.712E-03 4.124E-03 3.663E-03 3.524E-03 3.394E-03 3.273E-03 3.159E-03 3.052E-03
2.952E-03 2.857E-03 2.818E-03 2.783E-03 2.748E-03 2.706E-03 2.671E-03 2.634E-03 2.603E-03 2.569E-03
2.537E-03 2.505E-03 2.474E-03 2.444E-03 2.414E-03 2.385E-03 2.320E-03 2.257E-03 2.198E-03 2.141E-03
2.087E-03 2.035E-03 1.985E-03 1.854E-03 1.737E-03 1.632E-03 1.538E-03 1.453E-03 1.375E-03 1.304E-03
1.100E-03 9.449E-04 8.236E-04 7.266E-04 6.475E-04 5.819E-04 5.269E-04

D= 200. YP= 0. 5.98E-04 1.64E-04 8.81E-05 6.91E-05 6.60E-05 6.82E-05 6.93E-05 6.60E-05 6.14E-05 5.65E-05 5.26E-05 4.81E-05

SY =	110.00	120.14	239.92	359.58	479.11	598.52	717.80	836.96	871.00	905.02
	939.03	973.04	1007.03	1041.01	1074.98	1086.87	1098.76	1110.65	1122.53	1134.41
	1146.30	1158.18	1163.27	1168.36	1173.45	1178.54	1183.63	1188.72	1193.81	1198.90
	1203.99	1209.08	1214.17	1219.26	1224.35	1229.44	1241.31	1253.18	1265.05	1276.92
	1288.79	1300.65	1312.52	1346.41	1380.29	1414.17	1448.03	1481.88	1515.72	1549.56
	1667.90	1786.11	1904.21	2022.18	2140.03	2257.76	2375.37			
SZ =	110.00	785.62	1104.94	1209.01	1276.75	1339.81	1400.02	1457.74	1473.32	1489.73
	1505.47	1521.04	1536.46	1551.73	1566.84	1572.10	1577.34	1582.56	1587.77	1592.95
	1598.12	1603.28	1605.48	1607.68	1609.88	1612.07	1614.27	1616.46	1618.64	1620.82
	1623.00	1625.18	1627.36	1629.53	1631.69	1633.86	1638.90	1643.93	1648.94	1653.93
	1658.92	1663.88	1668.83	1682.90	1696.85	1710.68	1724.40	1738.02	1751.53	1764.94
	1811.08	1856.07	1900.00	1942.94	1984.94	2026.08	2066.40			

E/Q VALUES AT EACH DOWNWIND POSITION ARE

1,315E-01 1,686E-02 6,004E-03 3,661E-03 2,602E-03 1,985E-03 1,594E-03 1,304E-03 1,240E-03 1,180E-03
1,126E-03 1,075E-03 1,029E-03 9,853E-04 9,449E-04 9,315E-04 9,193E-04 9,055E-04 8,930E-04 8,807E-04
8,688E-04 8,571E-04 8,522E-04 8,473E-04 8,425E-04 8,377E-04 8,330E-04 8,283E-04 8,236E-04 8,190E-04
8,145E-04 8,100E-04 8,055E-04 8,011E-04 7,967E-04 7,923E-04 7,823E-04 7,725E-04 7,630E-04 7,536E-04
7,444E-04 7,354E-04 7,266E-04 7,024E-04 6,795E-04 6,579E-04 6,374E-04 6,179E-04 5,995E-04 5,819E-04
5,269E-04 4,801E-04 4,399E-04 4,051E-04 3,747E-04 3,479E-04 3,242E-04

D= 500, YP= 0, 2,70E-04 9,73E-05 5,52E-05 4,38E-05 4,09E-05 4,08E-05 4,10E-05 3,88E-05 3,61E-05 3,33E-05 3,10E-05 2,84E-05
Sy = 1194,05 1312,72 1431,27 1549,69 1668,00 1786,18 1904,24 2022,18 2055,87 2089,54
2123,20 2156,86 2190,50 2224,14 2257,76 2269,53 2281,30 2293,06 2304,82 2316,58
2328,34 2340,10 2345,14 2350,18 2355,22 2360,26 2365,30 2370,34 2375,37 2380,41
2385,45 2390,49 2395,52 2400,56 2405,60 2410,63 2422,39 2434,13 2445,88 2457,63
2469,38 2481,12 2492,86 2526,41 2559,95 2593,47 2626,99 2660,50 2694,00 2727,48
2844,61 2961,62 3078,51 3195,28 3311,93 3428,46 3544,88
Sz = 1618,74 1668,92 1717,63 1764,99 1811,12 1856,10 1900,01 1942,94 1955,03 1967,05
1979,00 1990,87 2002,68 2014,41 2026,08 2030,15 2034,21 2038,26 2042,30 2046,34
2050,37 2054,39 2056,11 2057,82 2059,54 2061,26 2062,97 2064,69 2066,40 2068,11
2069,82 2071,52 2073,23 2074,94 2076,64 2078,34 2082,31 2086,26 2090,22 2094,16
2098,09 2102,02 2105,94 2117,11 2128,21 2139,26 2150,25 2161,18 2172,06 2182,89
2220,36 2257,21 2293,47 2329,16 2364,32 2398,96 2433,11

E/Q VALUES AT EACH DOWNWIND POSITION ARE
8,234E-04 7,265E-04 6,474E-04 5,819E-04 5,268E-04 4,801E-04 4,399E-04 4,051E-04 3,960E-04 3,872E-04
3,788E-04 3,706E-04 3,628E-04 3,552E-04 3,479E-04 3,454E-04 3,430E-04 3,405E-04 3,381E-04 3,357E-04
3,334E-04 3,311E-04 3,301E-04 3,291E-04 3,281E-04 3,271E-04 3,262E-04 3,252E-04 3,242E-04 3,233E-04
3,223E-04 3,214E-04 3,205E-04 3,195E-04 3,186E-04 3,177E-04 3,165E-04 3,154E-04 3,143E-04 3,092E-04
3,072E-04 3,052E-04 3,032E-04 2,976E-04 2,921E-04 2,869E-04 2,818E-04 2,766E-04 2,720E-04 2,673E-04
2,520E-04 2,381E-04 2,254E-04 2,139E-04 2,033E-04 1,935E-04 1,845E-04

D= 1000, YP= 0, 1,25E-04 5,80E-05 3,52E-05 2,86E-05 2,66E-05 2,55E-05 2,53E-05 2,38E-05 2,21E-05 2,04E-05 1,90E-05 1,74E-05
Sy = 3545,11 3661,37 3777,51 3893,54 4009,44 4125,23 4240,90 4356,45 4389,46 4422,45
4455,43 4488,41 4521,37 4554,33 4587,27 4598,80 4610,33 4621,85 4633,36 4644,90
4656,43 4667,95 4672,88 4677,82 4682,76 4687,70 4692,63 4697,57 4702,50 4707,44
4712,38 4717,31 4722,25 4727,18 4732,12 4737,05 4748,57 4760,08 4771,59 4783,10
4794,61 4806,12 4817,62 4850,49 4883,35 4916,20 4949,04 4981,87 5014,69 5047,51
5182,27 5316,92 5391,46 5505,88 5620,18 5734,37 5848,44
Sz = 2433,17 2466,84 2500,05 2532,82 2565,18 2597,13 2628,70 2659,89 2668,75 2677,55
2686,34 2695,10 2703,83 2712,54 2721,21 2724,64 2727,27 2730,29 2733,31 2736,33
2739,34 2742,35 2743,64 2744,93 2746,22 2747,51 2748,79 2750,08 2751,36 2752,65
2753,93 2755,22 2756,50 2757,78 2759,06 2760,34 2763,33 2766,32 2769,30 2772,27
2775,25 2778,22 2781,19 2789,65 2798,09 2806,50 2814,88 2823,25 2831,58 2839,89
2868,80 2897,41 2925,75 2953,81 2981,61 3009,15 3036,45

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1,845E-04 1,762E-04 1,685E-04 1,614E-04 1,547E-04 1,486E-04 1,428E-04 1,373E-04 1,359E-04 1,344E-04
1,330E-04 1,316E-04 1,302E-04 1,288E-04 1,275E-04 1,270E-04 1,266E-04 1,261E-04 1,257E-04 1,252E-04
1,248E-04 1,243E-04 1,241E-04 1,239E-04 1,238E-04 1,236E-04 1,234E-04 1,232E-04 1,230E-04 1,228E-04
1,226E-04 1,225E-04 1,223E-04 1,221E-04 1,219E-04 1,217E-04 1,213E-04 1,209E-04 1,204E-04 1,200E-04
1,196E-04 1,192E-04 1,188E-04 1,176E-04 1,165E-04 1,154E-04 1,142E-04 1,132E-04 1,121E-04 1,110E-04
1,075E-04 1,041E-04 1,009E-04 9,786E-05 9,498E-05 9,223E-05 8,962E-05

D= 2000, YP= 0, 5,18E-05 3,08E-05 2,04E-05 1,71E-05 1,59E-05 1,50E-05 1,46E-05 1,36E-05 1,27E-05 1,17E-05 1,10E-05 1,01E-05
Sy = 10319,03 10428,49 10537,85 10647,10 10756,24 10865,27 10974,19 11083,01 11114,09 11145,16
11176,23 11207,28 11238,33 11269,36 11300,39 11311,85 11322,10 11332,96 11343,81 11354,67
11365,52 11376,37 11381,02 11385,67 11390,32 11394,97 11399,62 11404,27 11408,92 11413,57
11418,22 11422,86 11427,51 11432,16 11436,81 11441,46 11452,30 11463,14 11473,98 11484,83
11495,66 11506,50 11517,34 11548,30 11579,25 11610,19 11641,12 11672,04 11702,96 11733,87
11841,97 11946,97 12057,86 12165,64 12273,32 12380,90 12488,37
Sz = 3977,48 3998,16 4018,74 4039,21 4059,57 4079,84 4100,01 4120,07 4125,79 4131,50
4137,20 4142,89 4148,58 4154,26 4159,93 4161,51 4163,80 4165,87 4167,85 4169,83

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        4171.81   4173.79   4174.63   4175.48   4176.33   4177.17   4178.02   4178.87   4179.71   4180.56
        4181.40   4182.25   4183.10   4183.94   4184.79   4185.63   4187.60   4189.57   4191.54   4193.51
        4195.47   4197.44   4199.40   4205.01   4210.62   4216.21   4221.80   4227.38   4232.95   4238.51
        4257.93   4277.27   4296.51   4315.67   4334.74   4353.73   4372.64

 E/Q VALUES AT EACH DOWNWIND POSITION ARE
 3.878E-05 3.817E-05 3.758E-05 3.701E-05 3.645E-05 3.590E-05 3.537E-05 3.485E-05 3.471E-05 3.456E-05
 3.442E-05 3.428E-05 3.414E-05 3.400E-05 3.386E-05 3.381E-05 3.376E-05 3.371E-05 3.366E-05 3.361E-05
 3.357E-05 3.352E-05 3.350E-05 3.348E-05 3.346E-05 3.344E-05 3.342E-05 3.340E-05 3.338E-05 3.336E-05
 3.333E-05 3.331E-05 3.329E-05 3.327E-05 3.325E-05 3.323E-05 3.319E-05 3.314E-05 3.309E-05 3.305E-05
 3.300E-05 3.295E-05 3.291E-05 3.277E-05 3.264E-05 3.251E-05 3.238E-05 3.226E-05 3.213E-05 3.200E-05
 3.156E-05 3.114E-05 3.072E-05 3.031E-05 2.992E-05 2.953E-05 2.915E-05

 D=    5000. YP=       0. 1.48E-05 1.12E-05 8.33E-06 7.45E-06 7.10E-06 6.88E-06 6.40E-06 5.93E-06 5.53E-06 5.16E-06 4.86E-06 4.47E-06
 SY =  20750.43  20859.87  20958.21  21057.47  21156.63  21255.70  21354.68  21453.56  21481.81  21510.04
       21538.27  21566.49  21594.71  21622.91  21651.11  21660.98  21670.85  21680.72  21690.58  21700.44
       21710.31  21720.17  21724.40  21728.62  21732.85  21737.08  21741.30  21745.53  21749.75  21753.98
       21758.20  21762.43  21766.65  21770.88  21775.10  21779.33  21789.18  21799.04  21808.89  21818.74
       21828.60  21838.45  21848.30  21876.48  21904.57  21932.70  21960.81  21988.92  22017.02  22045.12
       22143.39  22241.58  22339.67  22437.67  22535.58  22633.40  22731.13
 SZ =   5685.10   5699.59   5714.04   5728.45   5742.83   5757.18   5771.49   5785.76   5789.63   5793.90
        5797.97   5802.03   5806.09   5810.15   5814.21   5815.63   5817.04   5818.46   5819.88   5821.30
        5822.71   5824.13   5824.74   5825.34   5825.95   5826.56   5827.17   5827.77   5828.38   5828.99
        5829.59   5830.20   5830.80   5831.41   5832.02   5832.62   5834.04   5835.45   5836.87   5838.28
        5839.69   5841.10   5842.52   5846.55   5850.58   5854.61   5858.63   5862.65   5866.67   5870.69
        5884.73   5898.73   5912.70   5926.63   5940.54   5954.41   5968.25

 E/Q VALUES AT EACH DOWNWIND POSITION ARE
 1.349E-05 1.339E-05 1.329E-05 1.319E-05 1.310E-05 1.301E-05 1.291E-05 1.282E-05 1.280E-05 1.277E-05
 1.274E-05 1.272E-05 1.269E-05 1.267E-05 1.264E-05 1.263E-05 1.263E-05 1.262E-05 1.261E-05 1.260E-05
 1.259E-05 1.258E-05 1.258E-05 1.257E-05 1.257E-05 1.257E-05 1.256E-05 1.256E-05 1.256E-05 1.255E-05
 1.255E-05 1.254E-05 1.254E-05 1.254E-05 1.253E-05 1.253E-05 1.252E-05 1.251E-05 1.250E-05 1.249E-05
 1.249E-05 1.248E-05 1.247E-05 1.244E-05 1.242E-05 1.239E-05 1.237E-05 1.235E-05 1.232E-05 1.230E-05
 1.221E-05 1.213E-05 1.205E-05 1.197E-05 1.189E-05 1.181E-05 1.173E-05

 D=   10000. YP=       0. 5.69E-06 4.83E-06 3.83E-06 3.56E-06 3.34E-06 3.19E-06 2.95E-06 2.77E-06 2.61E-06 2.48E-06 2.30E-06
 SY =  38977.94  39061.35  39144.69  39227.96  39311.16  39394.30  39477.37  39560.37  39584.08  39607.78
       39631.48  39655.17  39678.85  39702.53  39726.21  39734.09  39742.78  39751.06  39759.34  39767.63
       39775.91  39784.19  39787.74  39791.29  39794.83  39798.38  39801.93  39805.48  39809.03  39812.58
       39816.12  39819.67  39823.22  39826.77  39830.31  39833.86  39842.14  39850.41  39858.69  39866.96
       39875.23  39883.51  39891.78  39915.41  39939.03  39962.65  39986.27  40009.88  40033.48  40057.08
       40139.62  40222.10  40304.52  40386.86  40469.14  40551.35  40633.50
 SZ =   8082.10   8092.30   8102.48   8112.66   8122.82   8132.96   8143.10   8153.22   8156.11   8159.00
        8161.89   8164.78   8167.66   8170.55   8173.43   8174.40   8175.45   8176.46   8177.47   8178.48
        8179.49   8180.50   8180.93   8181.36   8181.79   8182.22   8182.66   8183.09   8183.52   8183.95
        8184.38   8184.82   8185.25   8185.68   8186.11   8186.54   8187.55   8188.56   8189.57   8190.57
        8191.58   8192.59   8193.60   8196.47   8199.35   8202.22   8205.09   8207.97   8210.84   8213.71
        8223.75   8233.77   8243.79   8253.79   8263.78   8273.75   8283.72

 E/Q VALUES AT EACH DOWNWIND POSITION ARE
 5.052E-06 5.035E-06 5.018E-06 5.001E-06 4.984E-06 4.968E-06 4.951E-06 4.934E-06 4.930E-06 4.925E-06
 4.920E-06 4.916E-06 4.911E-06 4.906E-06 4.902E-06 4.900E-06 4.898E-06 4.897E-06 4.895E-06 4.893E-06
 4.892E-06 4.890E-06 4.890E-06 4.889E-06 4.888E-06 4.887E-06 4.887E-06 4.886E-06 4.885E-06 4.885E-06
 4.884E-06 4.883E-06 4.883E-06 4.882E-06 4.881E-06 4.881E-06 4.879E-06 4.877E-06 4.876E-06 4.874E-06
 4.872E-06 4.871E-06 4.869E-06 4.865E-06 4.860E-06 4.856E-06 4.851E-06 4.846E-06 4.842E-06 4.837E-06
 4.821E-06 4.806E-06 4.790E-06 4.774E-06 4.759E-06 4.744E-06 4.728E-06

 D=   20000. YP=       0. 2.23E-06 2.04E-06 1.70E-06 1.63E-06 1.67E-06 1.60E-06 1.53E-06 1.42E-06 1.34E-06 1.28E-06 1.22E-06 1.14E-06
 SY =  79542.68  79598.17  79653.64  79709.08  79764.49  79819.87  79875.21  79930.53  79946.14  79962.14
       79977.94  79993.73  80009.53  80025.32  80041.11  80046.63  80052.16  80057.68  80063.21  80068.73
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        80074,26  80079,78  80082,15  80084,51  80086,88  80089,25  80091,62  80093,98  80096,35  80098,72
        80101,08  80103,45  80105,82  80108,18  80110,55  80112,92  80118,44  80123,96  80129,48  80135,00
        80140,52  80146,04  80151,56  80167,33  80183,10  80198,86  80214,63  80230,39  80246,14  80261,90
        80317,02  80372,11  80427,18  80482,21  80537,21  80592,19  80647,13
SZ =    12818,75  12825,18  12831,61  12838,04  12844,46  12850,88  12857,30  12863,71  12865,54  12867,37
        12869,20  12871,04  12872,87  12874,70  12876,53  12877,17  12877,81  12878,45  12879,09  12879,73
        12880,37  12881,01  12881,29  12881,56  12881,84  12882,11  12882,39  12882,66  12882,93  12883,21
        12883,48  12883,76  12884,03  12884,31  12884,58  12884,86  12885,50  12886,14  12886,78  12887,42
        12888,06  12888,70  12889,34  12891,17  12892,99  12894,82  12896,65  12898,48  12900,30  12902,13
        12904,52  12914,91  12921,30  12927,68  12934,06  12940,44  12946,81

E/Q VALUES AT EACH DOWNWIND POSITION ARE
1,561E-06 1,559E-06 1,557E-06 1,555E-06 1,553E-06 1,552E-06 1,550E-06 1,548E-06 1,547E-06 1,547E-06
1,546E-06 1,546E-06 1,545E-06 1,545E-06 1,544E-06 1,544E-06 1,544E-06 1,544E-06 1,543E-06 1,543E-06
1,543E-06 1,543E-06 1,543E-06 1,543E-06 1,543E-06 1,543E-06 1,543E-06 1,542E-06 1,542E-06 1,542E-06
1,542E-06 1,542E-06 1,542E-06 1,542E-06 1,542E-06 1,542E-06 1,542E-06 1,541E-06 1,541E-06 1,541E-06
1,541E-06 1,541E-06 1,541E-06 1,540E-06 1,540E-06 1,539E-06 1,538E-06 1,535E-06 1,537E-06 1,537E-06
1,535E-06 1,533E-06 1,531E-06 1,530E-06 1,528E-06 1,526E-06 1,524E-06

D=   50000, YP=       0, 7.09E-07 6.86E-07 5.97E-07 5.88E-07 6.20E-07 6.09E-07 5.87E-07 5.49E-07 5.23E-07 5.04E-07 4.89E-07 4.62E-07
SY =  124322.89 124360.03 124397.17 124434.30 124471.41 124508.52 124545.62 124582.70 124593.50 124603.89
      124614.49 124625.04 124635.67 124646.27 124656.86 124660.56 124664.27 124667.98 124671.68 124675.39
      124679.10 124682.80 124684.39 124685.98 124687.57 124689.16 124690.74 124692.33 124693.92 124695.51
      124697.10 124698.68 124700.27 124701.86 124703.45 124705.04 124708.74 124712.45 124716.15 124719.86
      124723.56 124727.27 124730.97 124741.56 124752.14 124762.72 124773.30 124783.88 124794.46 124805.04
      124842.06 124879.07 124916.07 124953.06 124990.05 125027.00 125063.95
SZ =   18147.19  18151.73  18156.27  18160.81  18165.36  18169.90  18174.43  18178.97  18180.27  18181.56
       18182.86  18184.16  18185.45  18186.75  18188.05  18188.50  18188.95  18189.41  18189.86  18190.31
       18190.77  18191.22  18191.41  18191.61  18191.80  18192.00  18192.19  18192.39  18192.58  18192.78
       18192.97  18193.16  18193.36  18193.55  18193.75  18193.94  18194.39  18194.85  18195.30  18195.75
       18196.21  18196.66  18197.12  18198.41  18199.71  18201.00  18202.30  18203.59  18204.89  18206.18
       18210.71  18215.24  18219.77  18224.30  18228.82  18233.35  18237.87

E/Q VALUES AT EACH DOWNWIND POSITION ARE
7,054E-07 7,051E-07 7,047E-07 7,043E-07 7,039E-07 7,035E-07 7,031E-07 7,027E-07 7,026E-07 7,025E-07
7,024E-07 7,023E-07 7,022E-07 7,021E-07 7,020E-07 7,019E-07 7,019E-07 7,019E-07 7,018E-07 7,018E-07
7,017E-07 7,017E-07 7,017E-07 7,017E-07 7,017E-07 7,016E-07 7,016E-07 7,016E-07 7,016E-07 7,016E-07
7,016E-07 7,015E-07 7,015E-07 7,015E-07 7,015E-07 7,015E-07 7,014E-07 7,014E-07 7,014E-07 7,013E-07
7,013E-07 7,012E-07 7,012E-07 7,011E-07 7,010E-07 7,009E-07 7,008E-07 7,007E-07 7,005E-07 7,004E-07
7,001E-07 6,997E-07 6,993E-07 6,989E-07 6,985E-07 6,982E-07 6,978E-07

D=  100000, YP=       0, 3.23E-07 3.20E-07 2.84E-07 2.84E-07 3.05E-07 3.04E-07 2.96E-07 2.78E-07 2.66E-07 2.59E-07 2.53E-07 2.42E-07
END OF CASE
```

FIGURE D-4. Second Sample Problem Input

```
SAMPLE PROBLEM 2 - RELEASE OF 1 CURIE OF KR 85
 $INPUT NEXT=1,LTIB=1,LHLIB=1,LGLIB=1,LDLIB=1,LBETA=1,LGAMA=1,LCHI00=1,
 NREL=1,RT(1)=1.,,NS=10,UMAR=1.,,M=0,,ITZ=2,NED=2,NGD=2,TDEP(1)=0.,,5.,
 BDEP(1)=7.,,100.,,NEDI(1)=2,4,NHE=2,NGE=1,NBS=1,NGS=1,LDRPP=1,NDRP(1)=18
PASQUILL F
ONE CURIE OF KR 85
  1
KR  85    1.0
    9     1
SAMPLE PROBLEM 2 - RELEASE IN 3 PERIODS
 $INPUT NEXT=2,NREL=3,RT(1)=1800.,,27000.,,57600.,, ITZ=1,NDRP(1)=1,1.33
PASQUILL FPASQUILL FPASQUILL D
INVENTORY FOR PERIOD 1
  4
KR* 85  1.8          KR  85          1.2XE 133          2.0XE 135          1.0
INVENTORY FOR PERIOD 2
  4
KR* 85           27.KR  85          18.XE 133          30.XE 135          15.
INVENTORY FOR PERIOD 3
  4
KR* 85          57.6KR  85          38.4XE 133          64.0XE 135          32.0
    9     1
    9     1
   .7     1
```

FIGURE D-5. Second Sample Problem Output

```
SAMPLE PROBLEM 2 - RELEASE OF 1 CURIE OF KR 85


DOSE RATE FACTORS
STABILITY  PASQUILL F  RELEASE PERIOD   1
2,64E-034,97E-042,47E-041,93E-041,94E-042,13E-042,17E-042,09E-041,95E-041,80E-041,67E-041,53E-04
1,11E-032,57E-041,33E-041,04E-041,01E-041,07E-041,09E-041,04E-049,74E-058,98E-058,31E-057,64E-05
3,27E-041,09E-046,10E-054,82E-054,52E-054,56E-054,57E-054,34E-054,05E-053,74E-053,46E-053,19E-05
1,21E-045,46E-053,31E-052,69E-052,49E-052,42E-052,38E-052,25E-052,09E-051,94E-051,80E-051,65E-05
4,65E-052,69E-051,70E-051,51E-051,41E-051,33E-051,29E-051,21E-051,13E-051,05E-059,72E-068,96E-06
1,32E-059,63E-067,08E-066,32E-066,10E-065,73E-065,46E-065,09E-064,74E-064,46E-064,14E-063,87E-06
5,50E-064,43E-063,43E-063,14E-063,12E-062,96E-062,82E-062,62E-062,47E-062,33E-062,20E-062,05E-06
2,43E-062,09E-061,84E-061,57E-061,54E-061,51E-061,44E-061,35E-061,27E-061,21E-061,15E-061,04E-06
8,32E-077,54E-076,27E-076,01E-076,16E-075,96E-075,68E-075,32E-075,04E-074,84E-074,62E-074,37E-07
3,91E-073,65E-073,09E-072,99E-073,10E-073,02E-072,89E-072,71E-072,57E-072,48E-072,38E-072,25E-07


ONE CURIE OF KR 85
NUCLIDE INVENTORY IN CURIES FOR RELEASE TIME   1
 KR  85  1,00E+00

SIGMA Y AND Z FOR STABILITY  1
                                        DISTANCE FROM RELEASE POINT METERS
                    100,     200,     500,     1000,     2000,     5000,     10000,     20000,     50000,     100000,
SIGMA Y              3,9      7,9     18,5      36,0      66,5     153,0      280,0      505,0     1120,0     2000,0
SIGMA Z              1,4      3,1      7,6      13,5      21,4      35,0       47,0       59,5       79,0       94,0
DRFB  1,335E-02 2,976E-03 5,184E-04 1,500E-04 5,134E-05 1,561E-05 5,539E-06 2,426E-06 8,23HE-07 3,877E-07
```

SAMPLE PROBLEM 2 - RELEASE OF 1 CURIE OF KR 85 DATE 08/12/75

DOSE FOR 1.0 SEC. RELEASE PERIOD, STABILITY PASQUILL F

DOSE TYPE		DISTANCE, METERS 100.	200.	500.	1000.	2000.	5000.	RELEASE HEIGHT 0. METERS 10000.	20000.	50000.	100000.
GAMMA	0. CM	4.573E-07	2.297E-07	9.031E-08	5.016E-08	2.719E-08	1.151E-08	5.943E-09	3.035E-09	1.197E-09	6.089E-10
GAMMA	5. CM	4.285E-07	2.153E-07	9.025E-08	4.700E-08	2.548E-08	1.078E-08	5.569E-09	2.844E-09	1.122E-09	5.706E-10
BETA	7. MG/CM2	2.702E-03	6.024E-04	1.049E-04	3.035E-05	1.039E-05	2.755E-06	1.121E-06	4.909E-07	1.667E-07	7.845E-08
BETA	100. MG/CM2	9.963E-05	2.221E-05	3.869E-06	1.119E-06	5.832E-07	1.016E-07	4.134E-08	1.810E-08	6.148E-09	2.893E-09
SKIN		2.702E-03	6.026E-04	1.050E-04	3.040E-05	1.042E-05	2.766E-06	1.127E-06	4.940E-07	1.679E-07	7.906E-08
EYE		1.001E-04	2.234E-05	3.985E-06	1.169E-06	4.103E-07	1.131E-07	4.726E-08	2.114E-08	7.345E-09	3.502E-09

SKIN DOSE IS 0.0 CM GAMMA DOSE + 7. MG/CM2 BETA DOSE.
EYE DOSE IS 0.0 CM GAMMA DOSE + 100. MG/CM2 BETA DOSE.

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SAMPLE PROBLEM 2 - RELEASE OF 1 CURIE OF KR 85 DATE 08/12/75

NORMALIZED AIR CONCENTRATION

PERIOD	STABILITY	DISTANCE, METERS 100.	200.	500.	1000.	2000.	5000.	RELEASE HEIGHT 0. METERS 10000.	20000.	50000.	100000.
1.0 SEC.	PASQUILL F	5.810E-02	1.300E-02	2.244E-03	6.550E-04	2.242E-04	5.944E-05	2.419E-05	1.054E-05	3.548E-06	1.693E-06

EXECUTION TIME FOR THIS CASE WAS 7.373 SECONDS

SAMPLE PROBLEM 2 - RELEASE IN 3 PERIODS

DOSE RATE FACTORS
STABILITY PASQUILL F RELEASE PERIOD 1
2.64E-034,9?E-042,47E-041,93E-041,94E-042,13E-042,17E-042,09E-041,95E-041,80E-041,67E-041,53E-04
1.11E-032,57E-041,33E-041,04E-041,01E-041,07E-041,09E-041,04E-019,74E-058,98E-059,31E-057,64E-05
3.27E-041,09E-046,10E-054,82E-054,52E-054,56E-054,57E-054,34E-054,05E-053,74E-053,46E-053,19E-05
1.21E-045,46E-051,31E-052,69E-052,49E-052,42E-052,38E-052,25E-052,09E-051,94E-051,80E-051,65E-05
4.65E-052,69E-051,70E-051,51E-051,41E-051,33E-051,29E-051,21E-051,13E-051,05E-059,72E-068,96E-06
1.32E-059,63E-067,08E-066,32E-066,10E-065,73E-065,46E-065,09E-064,70E-064,46E-064,15E-063,87E-06
5.50E-064,43E-063,43E-063,16E-063,12E-062,96E-062,82E-062,62E-062,47E-062,33E-062,20E-062,05E-06
2.43E-062,09E-061,68E-061,57E-061,58E-061,51E-061,44E-061,35E-061,27E-061,21E-061,15E-061,08E-06
8.32E-077,54E-076,27E-076,01E-076,16E-075,96E-075,68E-075,32E-075,04E-074,84E-074,62E-074,37E-07
3.91E-073,65E-073,09E-072,99E-073,10E-073,02E-072,89E-072,71E-072,57E-072,48E-072,38E-072,25E-07
STABILITY PASQUILL F RELEASE PERIOD 2
2.64E-034,97E-042,47E-041,93E-041,94E-042,13E-042,17E-042,09E-041,95E-041,80E-041,67E-041,53E-04
1.11E-032,57E-041,33E-041,04E-041,01E-041,07E-041,09E-041,04E-019,74E-058,98E-059,31E-057,64E-05
3.27E-041,09E-046,10E-054,82E-054,52E-054,56E-054,57E-054,34E-054,05E-053,74E-053,46E-053,19E-05
1.21E-045,46E-051,31E-052,69E-052,49E-052,42E-052,38E-052,25E-052,09E-051,94E-051,80E-051,65E-05
4.65E-052,69E-051,70E-051,51E-051,41E-051,33E-051,29E-051,21E-051,13E-051,05E-059,72E-068,96E-06
1.32E-059,63E-067,08E-066,32E-066,10E-065,73E-065,46E-065,09E-064,70E-064,46E-064,15E-063,87E-06
5.50E-064,43E-063,43E-063,16E-063,12E-062,96E-062,82E-062,62E-062,47E-062,33E-062,20E-062,05E-06
2.43E-062,09E-061,68E-061,57E-061,58E-061,51E-061,44E-061,35E-061,27E-061,21E-061,15E-061,08E-06
8.32E-077,54E-076,27E-076,01E-076,16E-075,96E-075,68E-075,32E-075,04E-074,84E-074,62E-074,37E-07
3.91E-073,65E-073,09E-072,99E-073,10E-073,02E-072,89E-072,71E-072,57E-072,48E-072,38E-072,25E-07
STABILITY PASQUILL D RELEASE PERIOD 3
6.67E-042,17E-041,13E-048,40E-058,47E-058,92E-059,05E-058,67E-058,09E-057,46E-056,90E-056,34E-05
3.45E-041,15E-046,37E-055,02E-054,70E-054,75E-054,76E-054,53E-054,22E-053,90E-053,60E-053,32E-05
9.01E-050,53E-052,84E-052,33E-052,15E-052,06E-052,02E-051,90E-051,77E-051,64E-051,52E-051,40E-05
2.90E-051,93E-051,38E-051,19E-051,12E-051,05E-051,00E-059,37E-068,74E-068,14E-067,58E-066,99E-06
1.05E-058,43E-066,46E-065,87E-065,73E-065,36E-065,08E-064,72E-064,41E-064,15E-063,89E-063,61E-06
2.50E-062,32E-061,95E-061,87E-061,92E-061,85E-061,76E-061,64E-061,55E-061,48E-061,41E-061,32E-06
9.31E-070,02E-077,84E-077,70E-078,17E-078,04E-077,71E-077,24E-016,99E-076,68E-076,43E-076,10E-07
3.86E-073,87E-073,41E-073,41E-073,56E-073,48E-073,55E-073,36E-073,22E-073,15E-073,06E-072,93E-07
9.84E-081,05E-079,23E-089,30E-081,01E-071,03E-071,01E-079,59E-089,29E-089,20E-089,03E-088,76E-08
3.87E-084,11E-083,75E-083,80E-084,13E-084,23E-084,15E-083,97E-083,87E-083,85E-083,80E-083,72E-08

INVENTORY FOR PERIOD 1
NUCLIDE INVENTORY IN CURIES FOR RELEASE TIME 1
KR= 85 1.80E+00 KR 85 1.20E+00 XE 133 2.00E+00 XE 135 1.00E+00

INVENTORY FOR PERIOD 2
NUCLIDE INVENTORY IN CURIES FOR RELEASE TIME 2
KR= 85 2.70E+01 KR 85 1.80E+01 XE 133 3.00E+01 XE 135 1.50E+01

INVENTORY FOR PERIOD 3
NUCLIDE INVENTORY IN CURIES FOR RELEASE TIME 3
KR= 85 5.76E+01 KR 85 3.84E+01 XE 133 6.40E+01 XE 135 3.20E+01

SIGMA Y AND Z FOR STABILITY 1

	DISTANCE FROM RELEASEPOINT METERS									
	100.	200.	500.	1000.	2000.	5000.	10000.	20000.	50000.	100000.
SIGMA Y	3.9	7.9	18.5	36.0	66.5	153.0	280.0	505.0	1120.0	2000.0
SIGMA Z	1.4	3.1	7.6	13.5	21.4	35.0	47.0	59.5	79.0	94.0

SIGMA Y AND Z FOR STABILITY 2

	DISTANCE FROM RELEASEPOINT METERS									
	100.	200.	500.	1000.	2000.	5000.	10000.	20000.	50000.	100000.
SIGMA Y	3.9	7.9	18.5	36.0	66.5	153.0	280.0	505.0	1120.0	2000.0
SIGMA Z	1.4	3.1	7.6	13.5	21.4	35.0	47.0	59.5	79.0	94.0

SIGMA Y AND Z FOR STABILITY 3

	DISTANCE FROM RELEASEPOINT METERS									
	100.	200.	500.	1000.	2000.	5000.	10000.	20000.	50000.	100000.
SIGMA Y	8.0	15.8	37.0	72.0	132.0	310.0	570.0	960.0	2300.0	4100.0
SIGMA Z	4.7	8.7	19.0	33.0	52.5	95.0	140.0	195.0	320.0	450.0
DRFB	1.335E-02	2.976E-03	5.184E-04	1.500E-04	5.134E-05	1.361E-05	5.539E-06	2.426E-06	8.238E-07	3.877E-07
DRFB	1.335E-02	2.976E-03	5.184E-04	1.500E-04	5.134E-05	1.361E-05	5.539E-06	2.426E-06	8.238E-07	3.877E-07
DRFB	1.939E-03	5.350E-04	1.037E-04	3.088E-05	1.052E-05	2.475E-06	9.134E-07	3.814E-07	9.904E-08	3.951E-08

SAMPLE PROBLEM 2 - RELEASE IN 3 PERIODS DATE 08/12/75

DOSE FOR 30.0 MIN. RELEASE PERIOD, STABILITY PASQUILL F

DOSE TYPE		DISTANCE, METERS RELEASE HEIGHT 0. METERS									
		100.	200.	500.	1000.	2000.	5000.	10000.	20000.	50000.	100000.
GAMMA	0. CM	1.354E-04	5.885E-05	2.950E-05	1.551E-05	8.264E-06	3.216E-06	1.436E-06	5.703E-07	1.254E-07	3.599E-08
GAMMA	5. CM	1.140E-04	5.850E-05	2.514E-05	1.325E-05	7.087E-06	2.767E-06	1.236E-06	4.886E-07	1.051E-07	2.894E-08
BETA	7. MG/CM2	1.099E-02	2.445E-03	4.232E-04	1.212E-04	4.065E-05	1.016E-05	3.775E-06	1.411E-06	3.493E-07	1.518E-07
BETA	100. MG/CM2	7.717E-04	1.716E-04	2.964E-05	8.461E-06	2.820E-06	6.909E-07	2.477E-07	8.588E-08	1.685E-08	4.787E-09
SKIN		1.112E-02	2.514E-03	4.527E-04	1.367E-04	4.892E-05	1.338E-05	5.211E-06	1.981E-06	4.747E-07	1.678E-07
EYE		9.071E-04	2.404E-04	5.914E-05	2.397E-05	1.108E-05	3.907E-06	1.684E-06	6.562E-07	1.422E-07	4.078E-08

SKIN DOSE IS 0.0 CM GAMMA DOSE + 7. MG/CM2 BETA DOSE.
EYE DOSE IS 0.0 CM GAMMA DOSE + 100. MG/CM2 BETA DOSE.

SAMPLE PROBLEM 2 - RELEASE IN 3 PERIODS

DATE 06/12/75

DOSE FOR 7.5HOURS RELEASE PERIOD, STABILITY PASQUILL F

DOSE TYPE	DISTANCE, METERS 100.	200.	500.	1000.	2000.	5000.	RELEASE HEIGHT 0, METERS 10000.	20000.	50000.	100000.
GAMMA 0, CM	1.524E-03	7.766E-04	3.333E-04	1.752E-04	9.331E-05	3.642E-05	1.645E-05	6.709E-06	1.591E-06	4.968E-07
TOTAL DOSE THIS TYPE	1.659E-03	8.454E-04	3.628E-04	1.907E-04	1.016E-04	3.963E-05	1.788E-05	7.279E-06	1.717E-06	5.328E-07
GAMMA 5, CM	1.284E-03	6.549E-04	2.818E-04	1.486E-04	7.938E-05	3.109E-05	1.404E-05	5.696E-06	1.319E-06	3.962E-07
TOTAL DOSE THIS TYPE	1.399E-03	7.134E-04	3.069E-04	1.618E-04	8.647E-05	3.386E-05	1.529E-05	6.184E-06	1.424E-06	4.252E-07
BETA 7, MG/CM2	1.327E-01	2.954E-02	5.120E-03	1.469E-03	4.945E-04	1.250E-04	4.727E-05	1.826E-05	4.856E-06	1.926E-06
TOTAL DOSE THIS TYPE	1.437E-01	3.199E-02	5.543E-03	1.590E-03	5.352E-04	1.352E-04	5.115E-05	1.976E-05	5.256E-06	2.058E-06
BETA 100, MG/CM2	8.601E-03	1.913E-03	3.304E-04	9.455E-05	3.160E-05	7.408E-06	2.891E-06	1.014E-06	2.154E-07	6.715E-08
TOTAL DOSE THIS TYPE	9.373E-03	2.085E-03	3.604E-04	1.030E-04	3.442E-05	8.099E-06	3.058E-06	1.100E-06	2.322E-07	7.193E-08
SKIN	1.343E-01	3.052E-02	5.453E-03	1.604E-03	5.878E-04	1.614E-04	6.372E-05	2.497E-05	6.448E-06	2.423E-06
TOTAL DOSE THIS TYPE	1.454E-01	3.283E-02	5.906E-03	1.781E-03	6.368E-04	1.748E-04	6.893E-05	2.695E-05	6.922E-06	2.591E-06
EYE	1.013E-02	2.690E-03	6.641E-04	2.698E-04	1.249E-04	4.423E-05	1.929E-05	7.723E-06	1.807E-06	5.639E-07
TOTAL DOSE THIS TYPE	1.103E-02	2.930E-03	7.232E-04	2.937E-04	1.360E-04	4.813E-05	2.097E-05	8.379E-06	1.949E-06	6.047E-07

SKIN DOSE IS 0.0 CM GAMMA DOSE + 7. MG/CM2 BETA DOSE.
EYE DOSE IS 0.0 CM GAMMA DOSE + 100. MG/CM2 BETA DOSE.

SAMPLE PROBLEM 2. • RELEASE IN 3 PERIODS DATE 08/12/75

DOSE FOR 16.0HOURS RELEASE PERIOD, STABILITY PASQUILL D

DOSE TYPE	DISTANCE, METERS					RELEASE HEIGHT 0, METERS				
	100.	200.	500.	1000.	2000.	5000.	10000.	20000.	50000.	100000.
GAMMA 0. CM	1.076E-03	5.795E-04	2.495E-04	1.228E-04	5.936E-05	1.828E-05	6.991E-06	2.595E-06	4.608E-07	1.229E-07
TOTAL DOSE THIS TYPE	2.736E-03	1.425E-03	6.123E-04	3.136E-04	1.609E-04	5.792E-05	2.487E-05	9.874E-06	2.177E-06	6.557E-07
GAMMA 5. CM	8.987E-04	4.847E-04	2.097E-04	1.038E-04	5.043E-05	1.560E-05	5.964E-06	2.200E-06	3.814E-07	9.814E-08
TOTAL DOSE THIS TYPE	2.298E-03	1.198E-03	5.166E-04	2.656E-04	1.369E-04	4.947E-05	2.124E-05	8.385E-06	1.806E-06	5.235E-07
BETA 7. MG/CM2	3.442E-02	9.486E-03	1.831E-03	5.381E-04	1.621E-04	4.125E-05	1.437E-05	5.441E-06	1.171E-06	4.093E-07
TOTAL DOSE THIS TYPE	1.781E-01	4.147E-02	7.374E-03	2.128E-03	7.173E-04	1.764E-04	6.542E-05	2.512E-05	6.377E-06	2.467E-06
BETA 100. MG/CM2	2.034E-03	5.602E-04	1.079E-04	3.157E-05	1.060E-05	2.344E-06	7.844E-07	2.745E-07	6.810E-08	1.578E-08
TOTAL DOSE THIS TYPE	1.141E-02	2.645E-03	4.683E-04	1.346E-04	4.502E-05	1.044E-05	3.874E-06	1.374E-06	2.803E-07	8.571E-08
SKIN	3.549E-02	1.007E-02	2.080E-03	6.609E-04	2.410E-04	5.954E-05	2.136E-05	8.036E-06	1.632E-06	5.522E-07
TOTAL DOSE THIS TYPE	1.809E-01	4.290E-02	7.986E-03	2.442E-03	8.782E-04	2.343E-04	9.029E-05	3.499E-05	8.554E-06	3.125E-06
EYE	3.110E-03	1.140E-03	3.574E-04	1.544E-04	6.996E-05	2.063E-05	7.775E-06	2.869E-06	5.092E-07	1.367E-07
TOTAL DOSE THIS TYPE	1.414E-02	4.070E-03	1.081E-03	4.481E-04	2.065E-04	6.876E-05	2.875E-05	1.125E-05	2.458E-06	7.414E-07

SKIN DOSE IS 0.0 CM GAMMA DOSE + 7. MG/CM2 BETA DOSE.
EYE DOSE IS 0.0 CM GAMMA DOSE + 100. MG/CM2 BETA DOSE.

SAMPLE PROBLEM 2 - RELEASE IN 3 PERIODS

DATE 08/12/75

NORMALIZED AIR CONCENTRATION

PERIOD	STABILITY	DISTANCE, METERS 100.	200.	500.	1000.	2000.	5000.	RELEASE HEIGHT 0. METERS 10000.	20000.	50000.	100000.
30.0 MIN.	PASQUILL F	5.830E-02	1.300E-02	2.204E-03	6.550E-04	2.242E-04	5.944E-05	2.419E-05	1.059E-05	3.598E-06	1.693E-06
7.5HOURS	PASQUILL F	5.830E-02	1.300E-02	2.204E-03	6.550E-04	2.242E-04	5.944E-05	2.419E-05	1.059E-05	3.598E-06	1.693E-06
16.0HOURS	PASQUILL D	8.466E-03	2.336E-03	4.528E-04	1.340E-04	4.593E-05	1.081E-05	3.989E-06	1.666E-06	4.525E-07	1.725E-07

EXECUTION TIME FOR THIS CASE WAS 2.884 SECONDS

APPENDIX E

CODE FLOW DIAGRAMS

APPENDIX E

CODE FLOW DIAGRAMS

This appendix gives general flow diagrams for program logic. Diagrams for BELI, BIVAR and SUBDOSA are given in Figures E-1, E-2, and E-3 respectively.

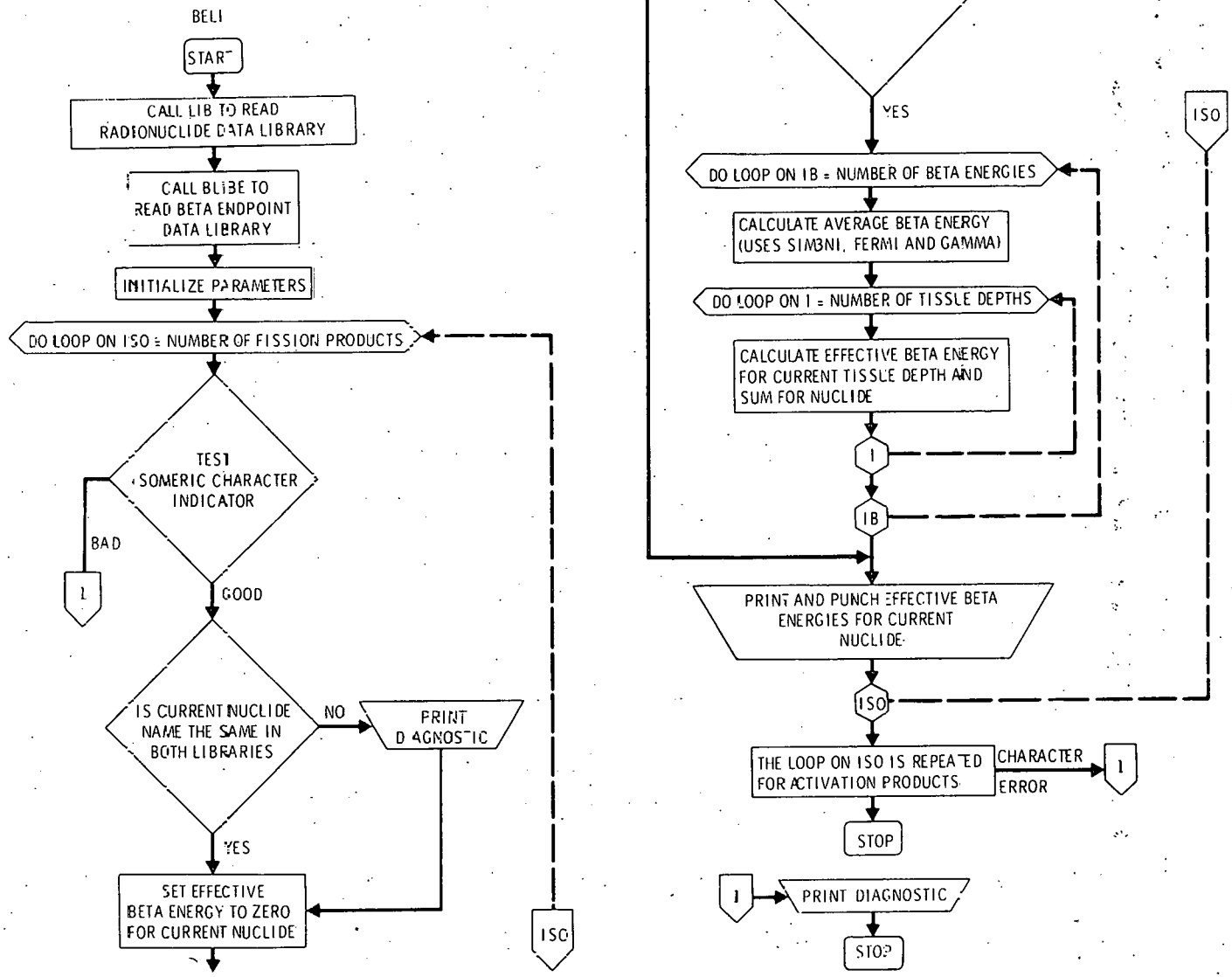

FIGURE E-1. Flow Diagram for BELI

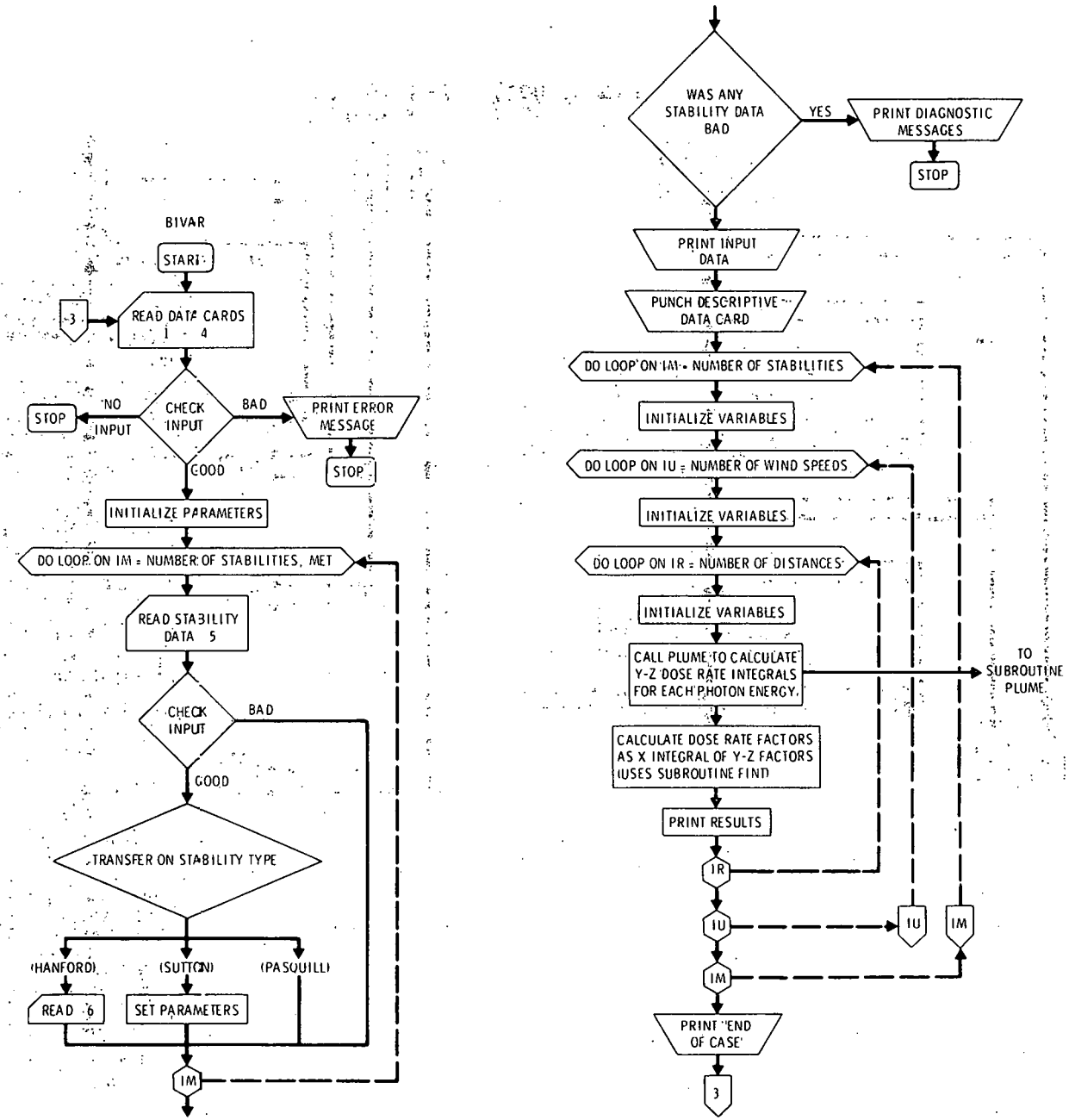

FIGURE E-2. Flow Diagram for BIVAR

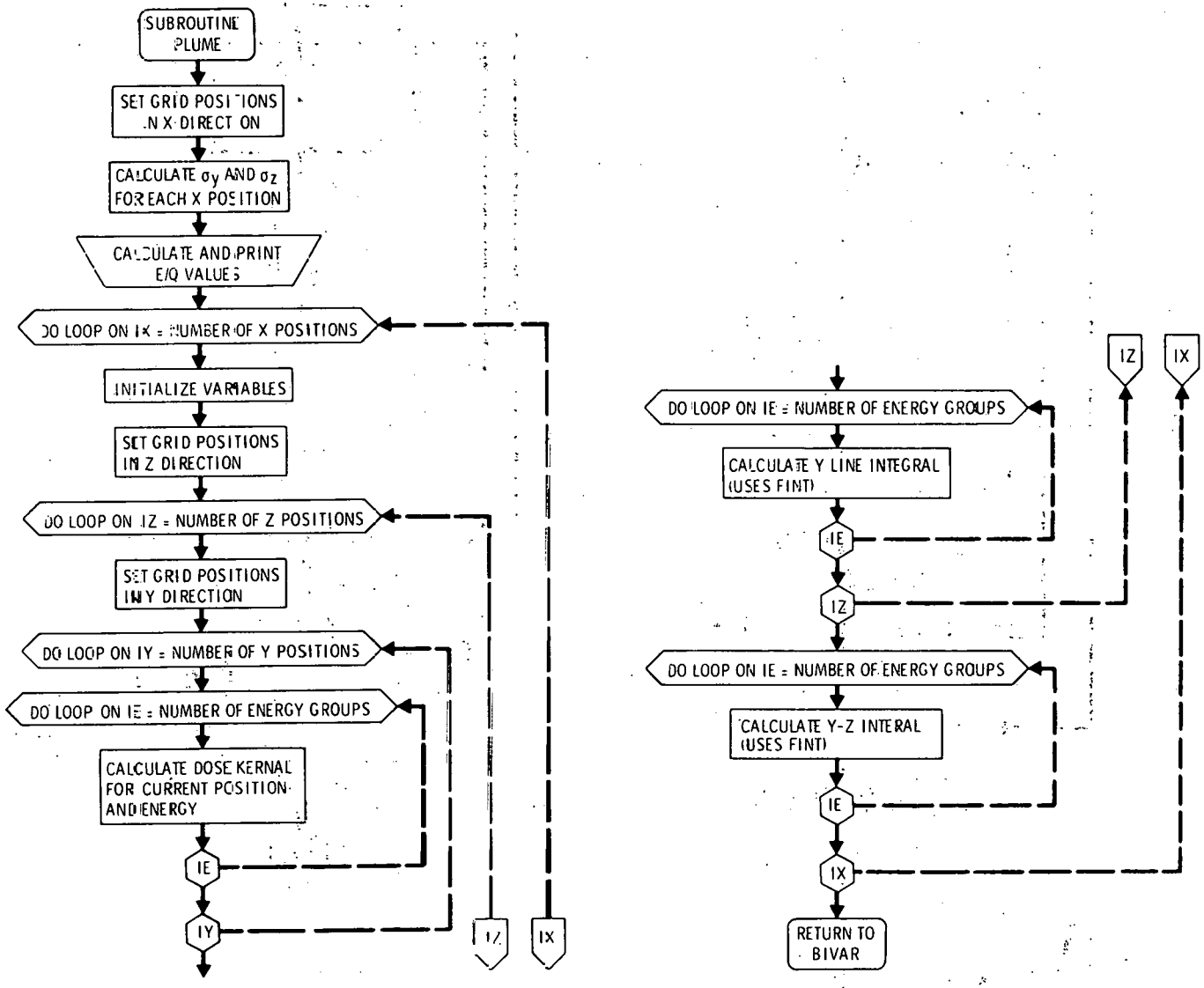

FIGURE E-2. (Continued)

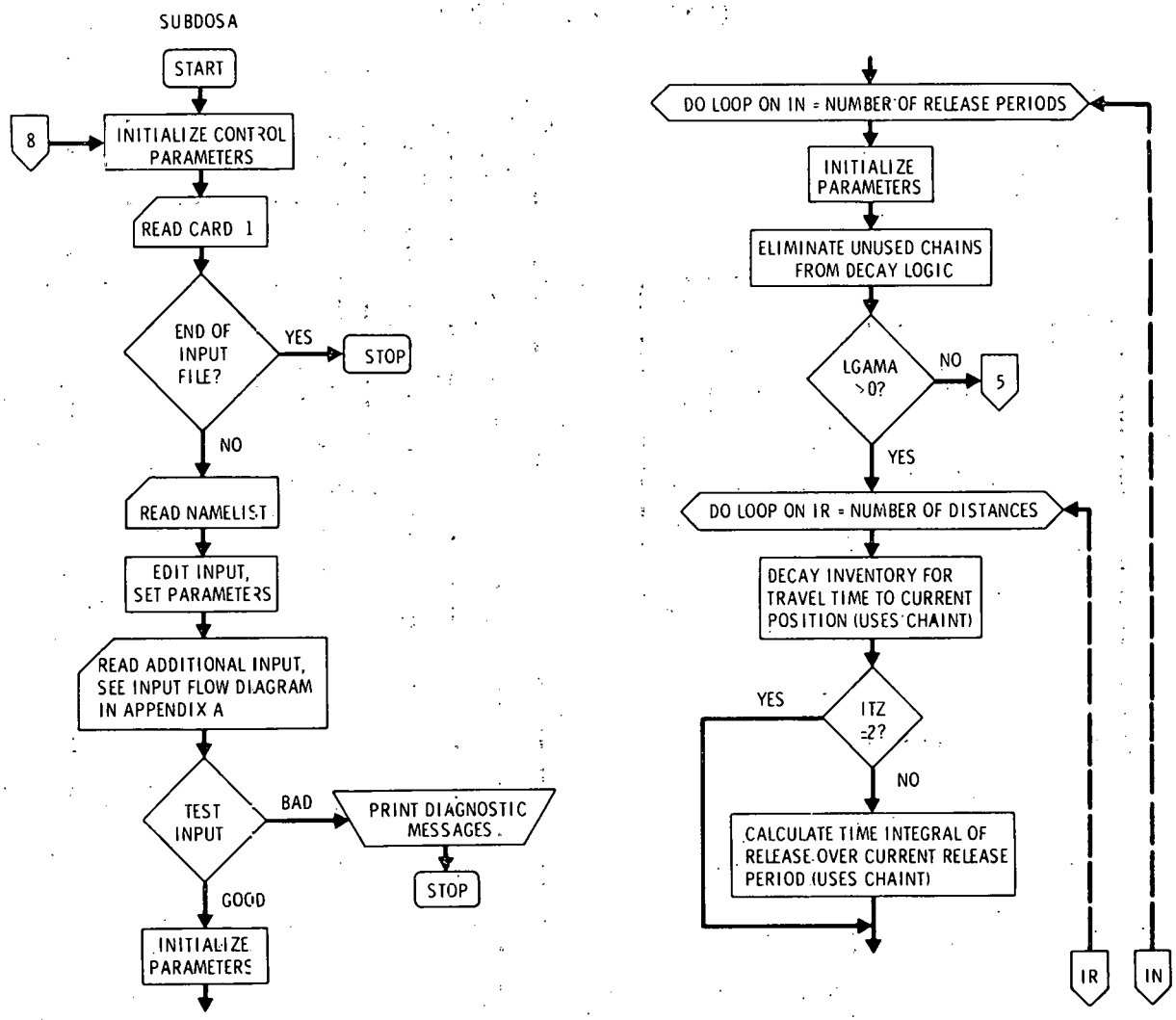

FIGURE E-3. Flow Diagram for SUBDOSA

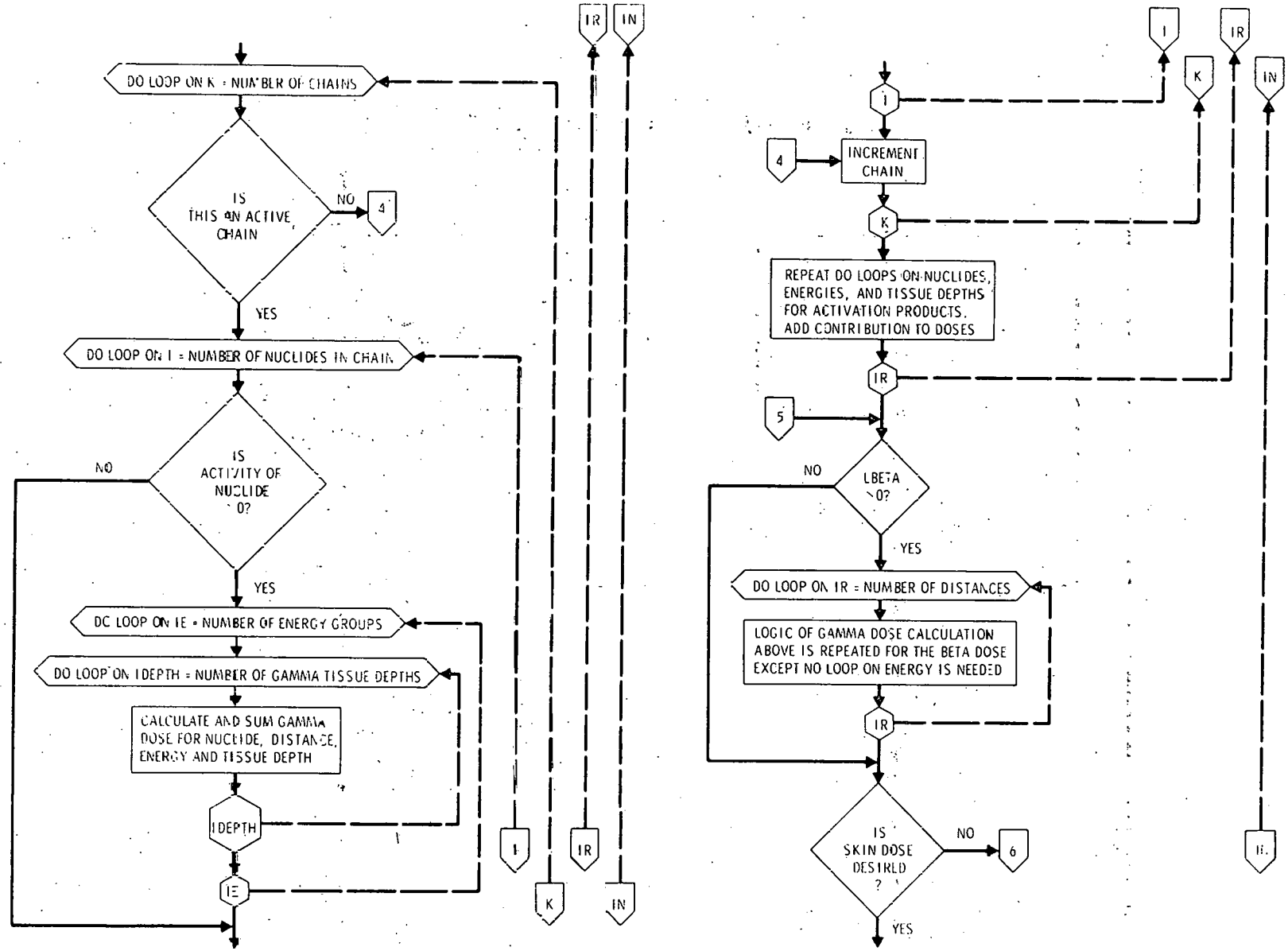

FIGURE E-3. (Continued)

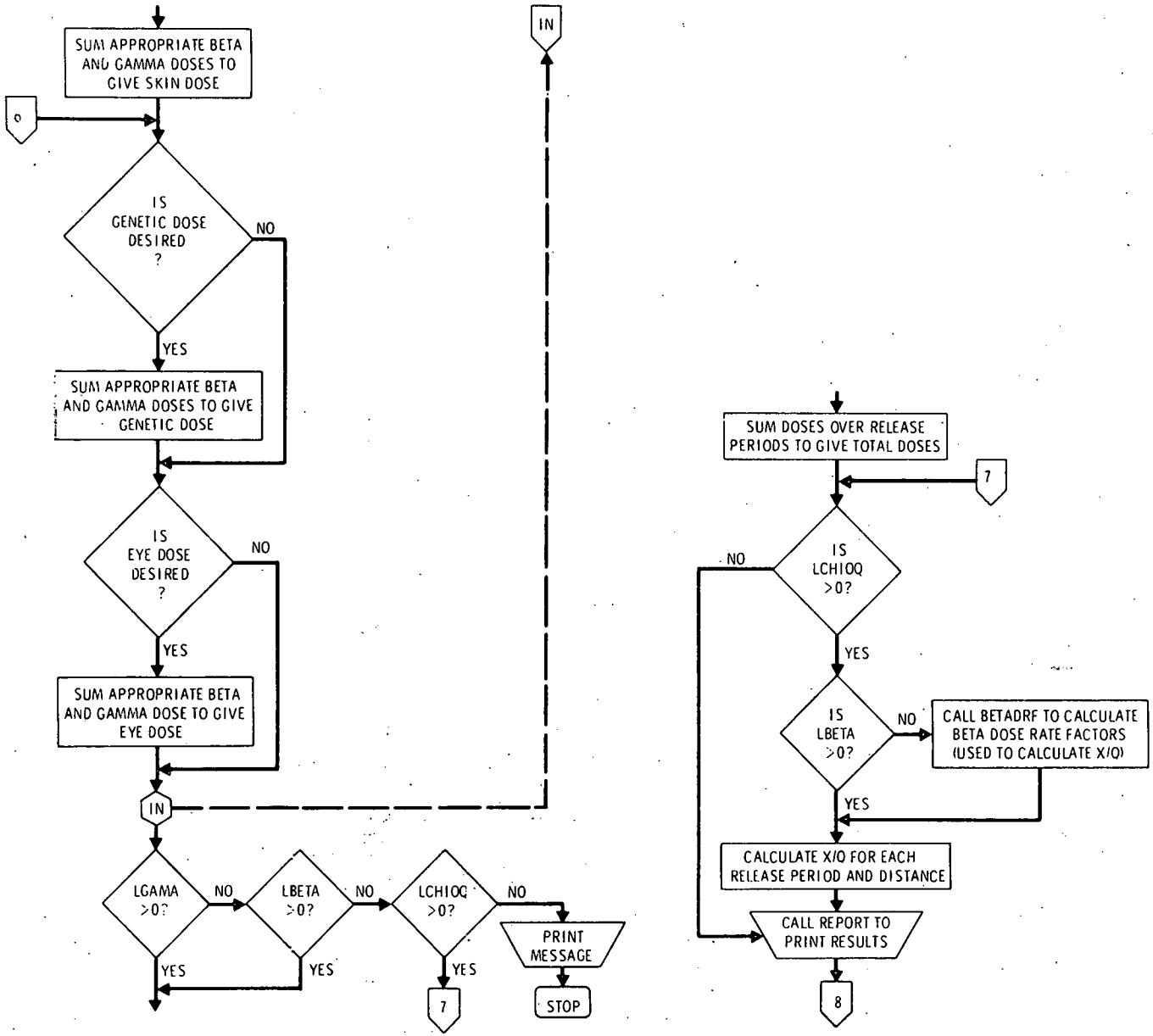

FIGURE E-3. (Continued)

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