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BNWL-B-389
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DACRIN - A COMPUTER PROGRAM FOR CALCULATING ORGAN DOSE FROM ACUTE OR CHRONIC RADIONUCLIDE INHALATION

MASTER

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Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

DECEMBER 1974

Prepared for the U.S. Atomic Energy Commission under Contract AT(45-1):1830

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BNWL-B-389

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Under Contract AT(45-1)-1830

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy $7.60; Microfiche ~~$0.95~~ 2.25

BNWL-B-389

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by

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December 1974

OCCUPATIONAL AND ENVIRONMENTAL SAFETY DEPARTMENT

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PACIFIC NORTHWEST LABORATORIES
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INTRODUCTION

The lung model, proposed by the ICRP Task Group on Lung Dynamics,[1,2] permits a more realistic calculation of radiation dose to the human respiratory tract from the inhalation of radioactive aerosols than does the initial ICRP lung model.[3] As is the case with most models the more closely the model approaches reality the more complex the mathematics describing the model become. The present case is no exception. This quantum increase in complexity has removed the calculation of the dose to an organ following inhalation of a radionuclide from the convenient realm of the slide rule and simple "desk top" calculator. This is particularly true when calculating the radiation dose to internal organs other than the lung. The computer program presented here has been designed to quickly and easily compute the effective dose to the respiratory tract and other organs and tissues of interest following either acute or chronic inhalation of a radioactive aerosol. A detailed description of the mathematical models used in the code is presented in Appendix A.

SUMMARY

The computer program, DACRIN, permits rapid and consistent estimates of the effective radiation dose to the human respiratory tract and other organs resulting from the inhalation of radioactive aerosols. The program is an outgrowth of the development of a mathematical model for the organ dose following the basic precepts of the ICRP Task Group on Lung Dynamics and a simple exponential model for retention by an organ of interest. As an adjunct to the organ dose model, mathematical models describing atmospheric dispersion have been included for the purpose of evaluating doses resulting from either accidental or chronic atmospheric releases of radionuclides.

The program will calculate the effective radiation dose to any of 18 organs and tissues from inhalation of any one or combination of radionuclides considered by the ICRP. A maximum of 10 organs may be selected for any one case (run). In addition, up to five multiple intake intervals and 10 time intervals measured from the last intake, may be selected for each case. Organ doses from inhalation can be calculated by specifying either the quantity of a radionuclide inhaled or the quantity released to the atmosphere. In the latter case, the duration of release, the release height, wind speed, atmospheric dispersion parameters and downwind distance at which the dose is to be calculated must also be specified. As many as 10 distances may be specified for each case.

Input to the code, in its simplest form, consists of a few program control variables, the duration of inhalation exposure, ventilation rate, the time interval within which the dose is delivered, the organs of interest, the quantity of the radionuclide inhaled, its solubility class and its particle size. Input to the code in its most complex form, results from invoking an atmospheric dispersion model. It is then necessary to input a number of additional parameters, the exact number being determined by the particular atmospheric dispersion model selected for analysis. Data libraries accessed by the code provide most of the basic data required to complete the calculations.

Output of the code consists of the effective radiation dose to the selected organs at selected time intervals, for each radionuclide inhaled as indicated by the input.

Models and Methods

The model of the respiratory tract adopted by the Task Group on Lung Dynamics forms the general basis for the mathematical models developed to calculate the dose from the inhalation of radionuclides.[1] In this model, the respiratory tract is divided into three regions, the nasopharyngeal (NP), the tracheobronchial (TB), and the plumonary (P). The schematic representation of the respiratory tract used in the development of the mathematical model for the deposition and clearance of inhaled radionuclides is shown in Figure 1. Deposition is assumed to vary with the aerodynamic properties of the aerosol distribution and is described by the three parameters D_3, D_4, and D_5. These parameters represent the fraction of the inhaled material, Q_I, initially deposited in the NP, TB, and P regions, respectively. Each of the three regions of deposition are further subdivided into two or more subcompartments. Each subcompartment represents the fraction of material initially in a compartment that is subject to a particular clearance process. This fraction is represented by f_k, where k indicates the clearance pathway. The quantity of material in the TB region, for example, cleared by process (c) is then represented by the product $f_c D_4 Q_I$. Values of the (f_k) and the clearance half times T_k for each clearance process for the three solubility classes of aerosols used in the code are those suggested by the ICRP,[2] see Appendix A, Table A-5. Values of the deposition fractions D_3, D_4, and D_5 as function of activity median aerodynamic diameter in the form of a graph have been published.[1] Routines to generate these values directly from the AMAD have been included in the code and yield essentially the same values as those presented by the Task Group for the range of particle size distributions considered by that group.

The respiratory tract model was incorporated by Voillequè into a simple metabolic model for acute inhalation exposures.[4] The model was programmed into a computer code called AERIN. In this model, transport of a radionuclide from the respiratory tract lymphatic system and GI tract

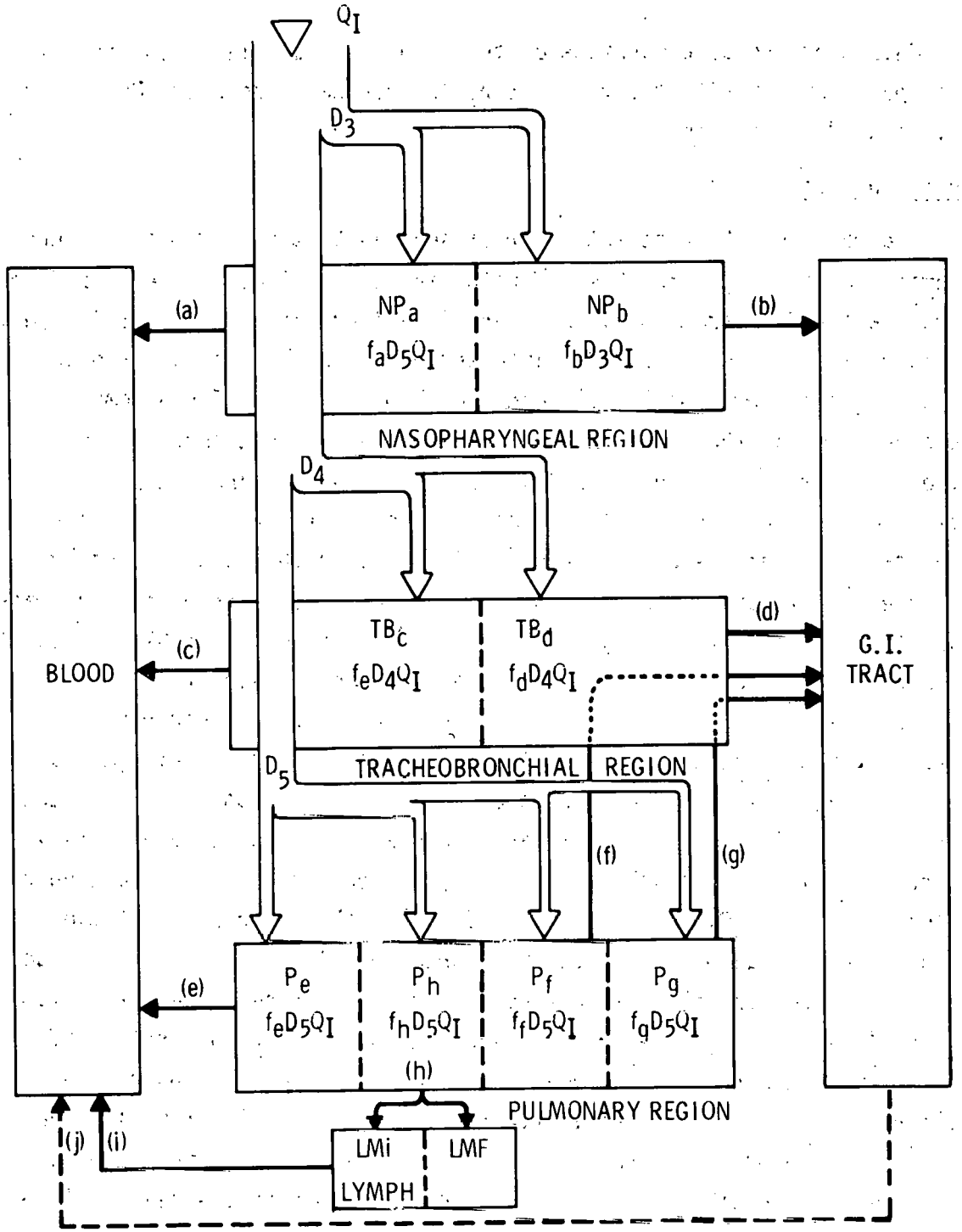

FIGURE 1. Schematic Diagram of the Task Group Lung Model

to other organs and tissues where significant accumulations of the inhaled radionuclides occur, is assumed to take place via the blood. This translocation from the respiratory tract and lymphatic system to the blood has been described in some detail by the Task Group. Of the material clearing from the respiratory tract through the GI tract, a constant fraction, f_1 is assumed to be taken up by the blood. That moving to the n^{th} organ or tissue is assumed to be a constant fraction, f_{2n} of the amount entering the blood stream at any time t. Once in the n^{th} organ, the activity is assumed to clear the organ (and the body) at a constant rate, λ_n. Voilleque's program, AERIN[4], calculates the quantity of a radionuclide present in and the dose received by organs of interest as a function of time following acute exposures.

The present code extends previous codes based on the Task Group Lung Model to include calculating organ doses resulting from chronic inhalation exposure. A schematic presentation of the DACRIN metabolic model is shown in Figure 2. A model for the dose to the GI tract from radionuclides moving through it is not included in the present version of the code, although some provisions have been made in the code for the eventual addition of a GI tract dose model.

The contribution to the pulmonary lung dose from daughter nuclides formed there is computed indirectly by utilizing weighted values of the effective energy emitted by the daughter nuclides in the chain. Weighted values were calculated for each of the decay chains tabulated by the ICRP[3,5] for residence half times of 1 day, 50 days and 500 days. These values were included in the organ data library.

Normalized air concentrations at desired distances as calculated by any atmospheric dispersion model can be used as input to DACRIN. The bivariate normal distribution model, however, was incorported in the code because of its wide use and acceptance. As part of the input to the bivariate model, the standard deviation of the cloud concentration in the crosswind lateral and vertical directions is needed. Of the several methods in common use for estimating these standard deviations, three have been selected and programmed, i.e., Sutton's parameters, the Hanford equations, and values

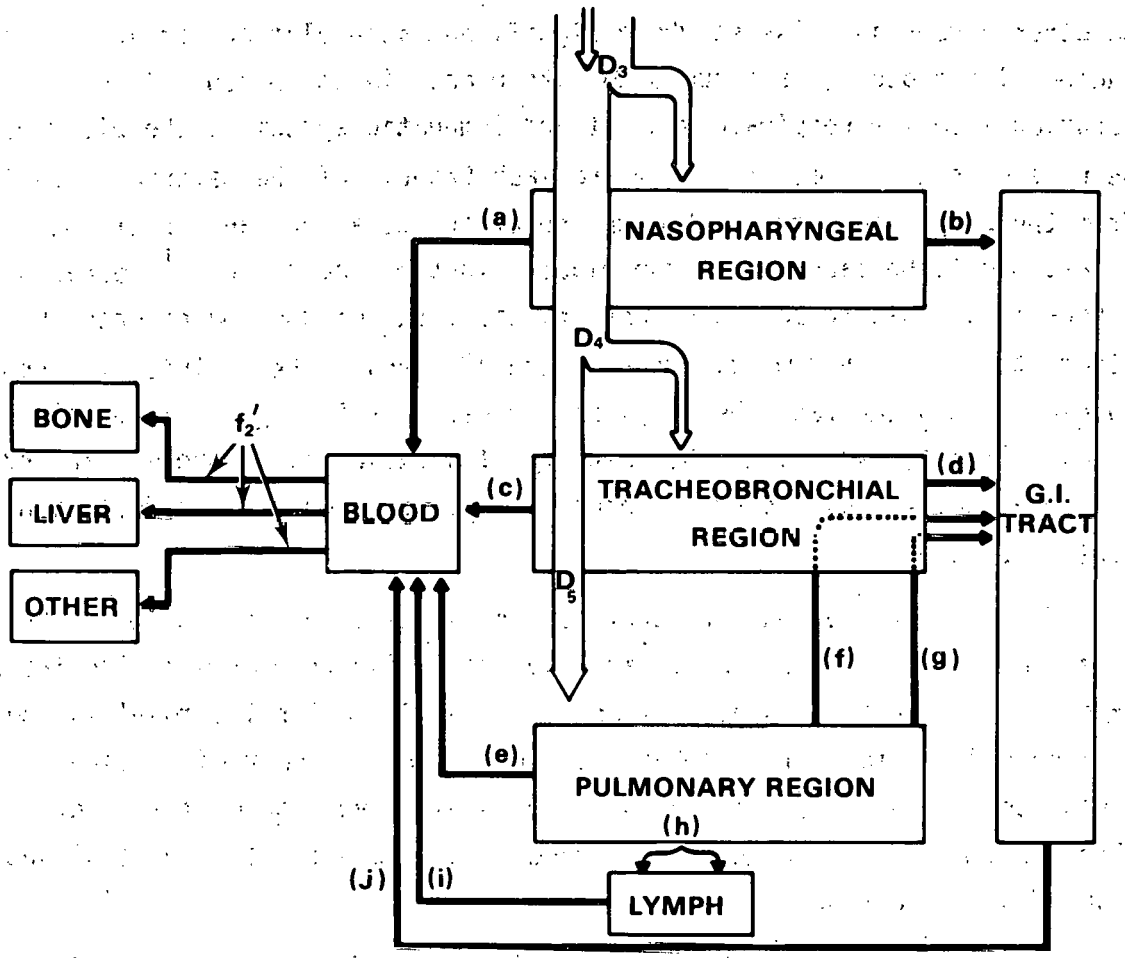

FIGURE 2. Schematic Diagram of DACRIN Metabolic Model

selected from Pasquill's curves. To provide further flexibility, arbitrarily selected values of standard deviations can be input.

The details of the mathematical models, computer code, data libraries and input preparation are given in Appendices A through F. Sample problem input and output is contained in Appendix G.

REFERENCES

1. "Task Group on Lung Dynamics for Committee II of the International Commission on Radiological Protection", Health Physics 12, 173 (1966)

2. "The Metabolism of Compounds of Plutonium and Other Actinides", ICRP Publication 19, Pergamon Press, Oxford (1972)

3. The International Commission on Radiological Protection, Radiation Protection, "Report of Committee II on Permissible Dose for Internal Radiation", ICRP Publication 2, Pergamon Press, Oxford (1959).

4. Voilleque, Paul G., "AERIN, A Code for the Acute Aerosol Inhalation Exposure Calculations", Health Physics, 19, 427 (1970).

5. The International Commission on Radiological Protection, Radiation Protection, "Recommendations of the International Commission on Radiological Protection", ICRP Publication 6, Pergamon Press, Oxford (1962).

APPENDIX A

Description of Mathematical Models

Reissued October 1975

DESCRIPTION OF MATHEMATICAL MODELS

This appendix describes mathematical models used to calculate inhalation exposures and internal doses from the atmospheric release of radionuclides.

Atmospheric Dispersion Models

The atmospheric dispersion of radionuclides is frequently described mathematically by a bivariate normal distribution model. The standard deviations of the cloud concentration in the crosswind lateral and vertical directions can be estimated from any of the several methods in common use; i.e., Sutton's parameters, Hanford equations, or Pasquill's curves. Using this model, the air concentration at ground level is given by:

$$\chi = \frac{Q'}{\pi \sigma_y \sigma_z \bar{u}_h} \exp\left(-y^2/2\,\sigma_y^2 - h^2/2\,\sigma_z^2\right) \qquad (1)$$

where:

- χ • ground level air concentration at the coordinates x and y, Ci/m^3
- x • downwind distance measured from point of release, meters
- y • crosswind distance measured horizontally from centerline of cloud, meters
- Q' • apparent rate of release at receptor, Ci/sec (a)
- σ_y • crosswind lateral standard deviation of cloud concentration, m
- σ_z • crosswind vertical standard deviation of cloud concentration, m
- $\bar{u}_h$ • average wind speed at the height of release in direction of travel, m/sec
- h • height of release, m

(a) apparent rate of release at receptor is the rate of release at the source corrected for radioactive decay during time of transport to receptor

Accidental Release

The time-integrated air concentration is convenient to use when calculating doses resulting from accidental releases of short duration. Also, use of the cloud centerline air concentration results in a maximum estimate of this quantity thereby maximizing the resultant dose. The centerline time-integrated air concentration is given by:

$$E_o = \frac{Q}{\pi \sigma_y \sigma_z \bar{u}_h} \exp\left(-h^2/2\sigma_z^2\right) \qquad (2)$$

where:

- E_o • time-integrated air concentration at ground level beneath the centerline of the cloud, $Ci \cdot sec/m^3$
- Q • total release from source, curies.

The crosswind standard deviations, σ_y and σ_z, for stable atmospheric conditions are calculated by the Hanford model[1,2] as follows:

$$\sigma_y^2 = A\left[T - \alpha(1 - e^{-T/\alpha})\right] \qquad (3a)$$

$$\sigma_z^2 = a(1 - e^{-K^2T^2}) + bT \qquad (3b)$$

where: T • transport time from point of release to point of interest, sec

and: $A = c + d(\sigma_\theta \bar{u})$

$$\alpha = A/2\ (\sigma_\theta \bar{u})^2$$

a, b, c, d, k and $(\sigma_\theta \bar{u})$ are parameters describing the atmospheric condition. Table A-1 summarizes suggested parameter values for use in DACRIN.

TABLE A-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
d	230	230
k	2.5×10^{-4}	8.8×10^{-4}

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

ASSUMED DURATION OF RELEASE, MIN.	AVERAGE WIND SPEED, m/sec			
	1	2.5	5	10
10	0.024	0.10	0.20	0.30
60	0.04	0.15	0.25	0.35
120	0.08	0.25	0.35	0.45
240	0.10	0.40	0.50	0.60
480	0.18	0.60	0.70	0.90

Crosswind standard deviations calculated for unstable and neutral conditions with Sutton's parameters are:

$$\sigma_y^2 = 0.5C_y^2 \, x^{(2 - n)} \qquad (4a)$$

$$\sigma_z^2 = 0.5C_z^2 \, x^{(2 - n)} \qquad (4b)$$

where:

- n • atmospheric stability index
- C_y • virtual diffusion parameter in the horizontal crosswind direction
- C_z • virtual diffusion parameter in the vertical crosswind direction.

Representative values of the parameters n, C_y and C_z are tabulated in Table A-2.[1]

Numerical values of σ_y and σ_z in use at Hanford representative of Pasquill's curves and incorporated in the code are listed in Tables A-3 and A-4.

Inhalation Dose Model

The mathematical model for calculating the dose to an organ of interest via inhalation using the ICRP Task Group Lung Model, TGLM[3,4] is considerably more complex than that utilized by the lung model initially proposed by the ICRP. In the TGLM, the respiratory tract is divided into three regions, the nasopharyngeal (NP), the tracheobronchial (TB), and the pulmonary (P). The schematic representation of the respiratory tract used in the development of the mathematical model for the deposition and clearance of inhaled radionuclides is shown in Figure 1 of the text. Deposition is assumed to vary with the aerodynamic properties of the aerosol distribution and is described by the three parameters D_3, D_4, and D_5. These parameters represent the fraction of the inhaled material, Q_I initially deposited in the NP, TB and P regions, respectively. Each of the three regions of deposition are further subdivided into two or more subcompartments, each representing the fraction

TABLE A-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 A-3. Values of σ_y for Pasquill Stability Categories

DISTANCE METERS	σ_y for Pasquill Type					
	A	B	C	D	E	F
100	21	16	12	8.0	6.0	3.9
150	34	24	18	12	9.0	6.0
250	54	40	28	20	14	9.8
350	75	55	40	26	20	14
500	100	76	55	37	28	18
700	140	110	76	51	37	26
1,000	200	150	110	72	52	36
1,500	290	220	160	100	75	52
2,500	450	340	240	160	120	81
3,500	610	460	330	220	160	110
5,000	830	630	450	310	220	150
7,000	1,100	840	610	420	300	210
10,000	1,600	1,200	850	570	410	280
15,000	2,200	1,700	1,200	810	570	400
25,000	3,400	2,600	1,800	1,200	880	610
35,000	4,500	3,500	2,500	1,700	1,200	820
50,000	6,200	4,700	3,400	2,300	1,600	1,100
70,000	8,200	6,400	4,700	3,000	2,100	1,500
100,000	11,000	8,500	6,300	4,100	2,800	2,000

TABLE A-4. Values of σ_z for Pasquill Stability Categories

DISTANCE METERS	σ_z for Pasquill Type					
	A	B	C	D	E	F
100	15	10	7.8	4.7	3.0	1.4
150	22	15	11	6.8	4.3	2.2
250	43	26	18	10	7.1	4.0
350	70	37	24	14	9.4	5.3
500	140	57	34	19	13	7.6
700	270	86	46	25	17	10
1,000	670	140	64	33	22	14
1,500	2,000	240	90	43	29	18
2,500	2,000	580	140	62	41	25
3,500	2,000	1,200	190	76	50	30
5,000	2,000	2,000	260	95	61	35
7,000	2,000	2,000	340	120	72	41
10,000	2,000	2,000	440	140	84	47
15,000	2,000	2,000	600	170	99	55
25,000	2,000	2,000	880	220	120	64
35,000	2,000	2,000	1,100	260	130	72
50,000	2,000	2,000	1,400	320	140	79
70,000	2,000	2,000	1,800	370	160	36
100,000	2,000	2,000	2,000	450	170	94

of material initially in a compartment that is subject to a certain clearance process. This fraction is represented by f_j, where J indicates the clearance pathway. The quantity of material in the TB region, for example, cleared by process (c) is then represented by the product $f_c D_4 Q_I$. Values of the (f_j) and the clearance half times T_j for each clearance process for the three translocation classes of aerosols used in the computer code are shown in Table A-5.[4] Values of the deposition fractions D_3, D_4, and D_5 as function of activity median aerodynamic diameter in the form of a graph have been published.[3]

The respiratory tract model has been incorporated into the simple metabolic model.[5] Transport of the radionuclides from the respiratory tract, lymphatic systems, and GI tract to other organs and tissues where significant accumulations of the inhaled radionuclide occur, is assumed to take place via the blood. This translocation from the respiratory tract and lymphatic system to the blood has been described in considerable detail.[3] Of the material clearing from the respiratory tract through the GI tract, a constant fraction is assumed to be taken up by the blood. Uptake by the n^{th} organ or tissue is assumed to be a constant fraction of the amount entering the blood stream at any time. Once in the n^{th} organ, the activity is assumed to clear the organ and the body at a constant rate.

Notation for the equations found in this section is as follows:

$D_{1n}(T_1)$ is the dose equivalent in rem received by the nth organ or tissue by time T_1 during continuous inhalation of a radioactive aerosol.

$D_{2n}(T_2)$ is the dose equivalent in rem received by the nth organ or tissue by time T_2 following the termination of continuous inhalation of a radioactive aerosol.

$Q_{1n}(T_1)$ is the quantity of radioactive material in μCi present in the nth organ or tissue as a function of time during continuous inhalation of a radioactive aerosol.

TABLE A-5. Values of the Clearance Parameters for the Task Group Lung Model

COMPARTMENT		TRANSLOCATION CLASS					
		D		W		Y	
	j(a)	T_j(b)	f_j(c)	T_j	f_j	T_j	f_j
NP	a	0.01	0.5	0.01	0.1	0.01	0.01
	b	0.01	0.5	0.40	0.9	0.4	0.99
TB	c	0.01	0.95	0.01	0.5	0.01	0.01
	d	0.2	0.05	0.2	0.5	0.2	0.99
P	e	0.5	0.8	50	0.15	500	0.05
	f	n.a.	n.a.	1	0.4	1	0.4
	g	n.a	n.a.	50	0.4	500	0.4
	h	0.5	0.2	50	0.05	500	0.15
L	i	0.5	1	50	1	1000	0.9

(a) Metabolic pathways from lung.

(b) Removal half time in days from compartment via pathway j.

(c) Fraction removed from compartment via pathway j.

$Q_{2n}(T_2)$ • is the quantity of radioactive material in μCi present in the nth organ or tissue following the termination of continuous inhalation of a radioactive aerosol.

E_n • is the effective absorbed energy per disintegration in $\frac{\text{MeV}\cdot\text{rem}}{\text{dis}\cdot\text{rad}}$ for the nth organ or tissue.

M_n • is the mass in grams of the nth organ or tissue over which the dose is to be averaged.

λ_j^b • is the biological removal rate constant for the j^{th} sub-compartment of the respiratory tract, sec^{-1}.

λ • is the radiological decay constant of the nuclide of interest, sec^{-1}.

- λ_j • is the total removal rate constant for the kth subcompartment of the respiratory tract, sec^{-1}. Note: $\lambda_j = \lambda_j^b + \lambda$.
- λ_n^b • is the biological removal rate constant for the nth organ or tissue, sec^{-1}.
- λ_n • is the total effective removal rate constant for the nth organ or tissue, sec^{-1}. Note: $\lambda_n = \lambda_n^b + \lambda$.
- f_2' • is the fraction of material in the blood that reaches the organ or tissue of interest.
- f_1 • is the fraction of material in the G.I. tract that reaches the blood.
- P_o • is the rate at which the radioactive aerosol is inhaled in μCi/sec.
- f_j • is the fraction of the material in a deposition region, NP, etc., that clears by the jth pathway.
- D_k • is the fraction of the inhaled material deposited in the kth compartment of the respiratory tract.

  k = 3 for the nasopharynx (NP) compartment.

  k = 4 for the tracheobronchial (TB) compartment.

  k = 5 for the pulmonary (P) and lymph (LM) compartments

- T_1 • is the total uptake time, sec.
- T_2 • is the time interval following termination of uptake, sec.

Developing the equations to describe the lung clearance model was divided into two parts. The first part is concerned with describing the organ burdens and the organ doses in the time interval during which the inhalation of radionuclides is taking place. The second part, requiring a different set of equations, describes the organ burdens and the organ doses for the contiguous time interval following the cessation of radionuclide intake.

During uptake, the equations for computing the quantity of radionuclide in the eight subcompartments (j) of the three compartments (k) of the respiratory tract have the form:

$$Q_{j,k}(t) = f_j D_k Q_I \frac{1 - e^{-\lambda_j t}}{\lambda_j} \quad (5)$$

The equations for the removable quantity in the pulmonary lymph nodes are complicated by the fact that both equal and unequal rates for transfer paths into and out of the system are involved. This is due to the dependence of transfer rate upon the solubility class of the radionuclide. Thus, two equations are needed to compute the quantity in the lymph compartment.

For the case $\lambda_h \neq \lambda_i$, i.e., Class Y solubility in the current version of the model:

$$Q_{LMi}(t) = \frac{\lambda_h^b f_i f_h P_o D_5}{\lambda_h} \left[\frac{(1-e^{-\lambda_i t})}{\lambda_i} - \frac{(e^{-\lambda_i t} - e^{-\lambda_h t})}{\lambda_h - \lambda_i}\right] \quad (6)$$

and for the case $\lambda_h = \lambda_i$, i.e., Class D and W in the current version of the model:

$$Q_{LMi}(t) = \frac{\lambda_h^b f_i f_h P_o D_5}{\lambda_h} \left[\frac{(1-e^{-\lambda_i t})}{\lambda_i} - te^{-\lambda_i t}\right] \quad (7)$$

With the preceding equations, the equations describing the quantity of radionuclide in the n^{th} organ as a function of time during uptake can be derived by:

$$Q_{1n}(t) = P_o \left\{ \sum_{j=a}^{g} f_2' C_j \left[\frac{(1-e^{-\lambda_n t})}{\lambda_n} - \frac{(e^{-\lambda_n t} - e^{-\lambda_j t})}{(\lambda_j - \lambda_n)}\right] + L \right\} \quad (8)$$

where:

L is the contribution to the organ burden from material passing through the lymphatic system,

and:

$$C_a = \lambda_a^b f_a D_3/\lambda_a$$

$$C_b = \lambda_b^b f_b D_3 f_1/\lambda_b$$

$$C_c = \lambda_c^b f_c D_4/\lambda_c$$

$$C_d = \lambda_d^b f_d D_4 f_1/\lambda_d$$

$$C_e = \lambda_e^b f_e D_5/\lambda_e$$

$$C_f = \lambda_f^b f_f D_5 f_1/\lambda_f$$

$$C_g = \lambda_g^b f_g D_5 f_1/\lambda_g$$

The lymph pathway contributions to the n^{th} organ burden for the two situations are calculated as follows:

$$L = f_2' C_h \left\{ \frac{1}{\lambda_i} \left[\frac{(1-e^{-\lambda_n t})}{\lambda_n} - \frac{(e^{-\lambda_n t} - e^{-\lambda_i t})}{(\lambda_i - \lambda_n)} \right] - \frac{1}{(\lambda_h - \lambda_i)} \left[\frac{(e^{-\lambda_n t} - e^{-\lambda_i t})}{(\lambda_i - \lambda_n)} - \frac{(e^{-\lambda_n t} - e^{-\lambda_h t})}{(\lambda_h - \lambda_n)} \right] \right\} \quad \text{for } \lambda_h \neq \lambda_i \tag{9a}$$

$$L = f_2' C_h \left\{ \frac{1}{\lambda_i} \left[\frac{(1-e^{-\lambda_n t})}{\lambda_i} - \frac{(e^{-\lambda_n t} - e^{-\lambda_i t})}{(\lambda_i - \lambda_n)} \right] - \frac{e^{-\lambda_n t} - \left[(\lambda_i - \lambda_n)\, t + 1 \right] e^{-\lambda_i t}}{(\lambda_i - \lambda_n)^2} \right\}$$

for $\lambda_h = \lambda_i$ (9b)

where: $C_h = \dfrac{\lambda_i^b \lambda_h^b f_i f_h D_5}{\lambda_h}$

The calculation of the dose equivalents to organs burdened by the radionuclide are based on the following:

$$D_{1n}(t) = \frac{5.92 \times 10^{-4} E_n}{M_n} \int_0^t Q_{1n}(\tau) d\tau \tag{10}$$

where the constant is a combination of the conversion factors:

$$3.7 \times 10^{4} \left(\frac{\text{dis/sec}}{\mu\text{Ci}}\right) \; 1.6\text{x}10^{-6} \left(\frac{\text{ergs}}{\text{MeV}}\right) \; 10^{-2} \left(\frac{\text{rads}}{\text{erg/g}}\right) = 5.92 \times 10^{-4}$$

The dose to the pulmonary lung at the end of inhalation intake of a radionuclide is determined by:

$$D_{1p}(T_1) = \frac{5.92\text{x}10^{-4} E_p}{M_p} P_o D_5 \sum_{j=e}^{h} \frac{f_j}{\lambda_j} \; (T_1 - A_j) \qquad (11)$$

where: M_p is the mass of the lung in grams

and: $A_j = \dfrac{1 - e^{-\lambda_j T_1}}{\lambda_j}$

For the n^{th} organ or tissue, the dose is computed by:

$$D_{1n}(T_1) = 5.92 \times 10^{-4} \frac{E_n P_o f_2'}{M_n} \left\{ \sum_{j=a}^{g} C_j \left[\frac{T_1 - A_n}{\lambda_n} - \left(\frac{A_n - A_j}{\lambda_j - \lambda_n} \right) \right] \right.$$

$$+ \frac{C_h}{\lambda_i} \left[\frac{T_1 - A_n}{\lambda_n} - \frac{A_n - A_i}{(\lambda_i - \lambda_n)} \right] - \frac{C_h}{(\lambda_h - \lambda_i)} \left[\frac{A_n - A_i}{(\lambda_i - \lambda_n)} \right.$$

$$\left. \left. - \frac{A_n - A_h}{\lambda_h - \lambda_n} \right] \right\} \text{ for } \lambda_h \neq \lambda_i \qquad (12)$$

or:

$$D_{1n}(T_1) = 5.92 \times 10^{-4} \frac{E_n P_o f'_2}{M_n} \left(\sum_{j=a}^{g} C_j \left(\frac{T_1 - A_n}{\lambda_n} - \frac{A_n - A_j}{\lambda_j - \lambda_n} \right) + \frac{C_n}{\lambda_i} \left(\frac{T_1 - A_n}{\lambda_n} - \frac{A_n - A_i}{\lambda_i - \lambda_n} \right) + \frac{C_h}{(\lambda_i - \lambda_n)^2} \left\{ A_i - A_n + \frac{(\lambda_i - \lambda_n)}{\lambda_i^2} \left[1 - (\lambda_i T_1 + 1) e^{-\lambda_i T_1} \right] \right\} \right) \quad \text{for } \lambda_h = \lambda_i \tag{13}$$

where:

$$A_n = \frac{1 - e^{-\lambda_n T_1}}{\lambda_n}$$

$$A_i = \frac{1 - e^{-\lambda_i T_1}}{\lambda_i}$$

$$A_h = \frac{1 - e^{-\lambda_h T_1}}{\lambda_h}$$

and C_j and C_h are as previously defined.

Now for the time following cessation of radionuclide inhalation, the equations used to calculate the respiratory tract burden become:

$$Q_{2j}(T_2) = Q_{1j}(T_1) e^{-\lambda_j T_2} \tag{14}$$

where: $Q_{2j}(T_2)$ is the respiratory tract subcompartment burden at a time T_2 following the termination of inhalation uptake.

$Q_{1j}(T_1)$ is the respiratory tract subcompartment burden at the end of inhalation uptake for a time T_1.

The burden in the n^{th} organ at time T_2 can be described by:

$$Q_{2n}(T_2) = Q_{1n}(T_1)e^{-\lambda_n T_2} + f_2' \lambda_i^b Q_{1LMi}(T_1) \frac{(e^{-\lambda_i T_2} - e^{-\lambda_n T_2})}{(\lambda_n - \lambda_i)}$$

$$+ f_2' \left\{ \sum_{j=a}^{g} \frac{C_j'}{(\lambda_j - \lambda_n)} (e^{-\lambda_n T_2} - e^{-\lambda_j T_2}) \right.$$

$$\left. + \frac{C_h'}{(\lambda_h - \lambda_i)} \left[\frac{(e^{-\lambda_n T_2} - e^{-\lambda_i T_2})}{(\lambda_i - \lambda_n)} - \frac{(e^{-\lambda_n T_2} - e^{-\lambda_h T_2})}{(\lambda_h - \lambda_n)} \right] \right\} \text{ for } \lambda_h \neq \lambda_i \qquad (15)$$

or by:

$$Q_{2n}(T_2) = Q_{1n}(T_1)e^{-\lambda_n T_2} + f_2' \lambda_i^b Q_{1LMi}(T_1) \frac{(e^{-\lambda_i T_2} - e^{-\lambda_n T_2})}{(\lambda_n - \lambda_i)}$$

$$+ f_2' \left(\sum_{j=a}^{g} \frac{C_j'}{(\lambda_j - \lambda_n)} (e^{-\lambda_n T_2} - e^{-\lambda_j T_2}) \right.$$

$$\left. + \frac{C_h'}{(\lambda_i - \lambda_n)} \left\{ e^{-\lambda_n T_2} - \left[(\lambda_i - \lambda_n) T_2 - 1 \right] e^{-\lambda_i T_2} \right\} \right) \text{ for } \lambda_h = \lambda_i \qquad (16)$$

where:

$$C_a' = \lambda_a^b Q_{1a}(T_1)$$

$$C_b' = \lambda_b^b Q_{1b}(T_1) f_1$$

$$C_c' = \lambda_c^b Q_{1c}(T_1)$$

$$C_d' = \lambda_d^b Q_{1d}(T_1) f_1$$

$$C_e' = \lambda_e^b Q_{1e}(T_1)$$

$$C_f' = \lambda_f^b Q_{1f}(T_1) f_1$$

$$C_g' = \lambda_g^b Q_{1g}(T_1) f_1$$

$$C_h' = f_i \lambda_h^b \lambda_i^b Q_{1h}(T_1)$$

The pulmonary lung dose from inhalation of a radionuclide for a time T_1 followed by no additional radioactive intake for a time T_2 is determined by:

$$D_p = D_{1p}(T_1) + 5.92 \times 10^{-4} \frac{E_p P_o D_5}{M_p} \sum_{j=e}^{h} f_j A_j B_j \qquad (17)$$

where: $B_j = \frac{1-e^{-\lambda_j T_2}}{\lambda_j}$

and $D_{1p}(T_1)$ and A_j are the same as previously defined by Equation (11).

The effective dose to the n^{th} organ as a result of inhalation uptake for a time T_1 followed by no additional radioactive intake for a time T_2 is determined by:

$$D_n = D_{1n}(T_1) + 5.92 \times 10^{-4} \frac{E_n}{M_n} \left\{ Q_{1n}(T_1) B_n + f_2' \left[\frac{\lambda_i^b Q_{1LMi}(T_1)}{(\lambda_n - \lambda_i)} (B_i - B_n) + G \left[\frac{(B_n - B_i)}{(\lambda_i - \lambda_n)} - Z \right] + \sum_{j=a}^{g} \frac{C_j'}{(\lambda_j - \lambda_n)} (B_n - B_j) \right] \right\} \qquad (18)$$

where: $B_n = \frac{1 - e^{-\lambda_n T_2}}{\lambda_n}$

$$B_h = \frac{1 - e^{-\lambda_h T_2}}{\lambda_h}$$

$$B_i = \frac{1 - e^{-\lambda_i T_2}}{\lambda_i}$$

$$B_j = \frac{1 - e^{-\lambda_j T_2}}{\lambda_j}$$

also, for $\lambda_h \neq \lambda_i$:

$D_{1n}(T_1)$ is determined by Equation (12)

$Q_{1n}(T_1)$ is determined by Equations (8,9a)

$$G = \frac{C'_h}{(\lambda_h - \lambda_i)}$$

$$Z = \frac{B_n - B_h}{(\lambda_h - \lambda_n)}$$

and for $\lambda_h = \lambda_i$

$D_{1n}(T_1)$ is determined by Equation (13)

$Q_{1n}(T_1)$ is determined by Equations (8,9b)

$$G = \frac{C'_h}{(\lambda_i - \lambda_n)}$$

$$Z = \lambda_i^{-2} \left[1 - (\lambda_i T_2 + 1)\, e^{-\lambda_i T_2}\right]$$

Provision is made in the code to calculate the dose equivalent to the pulmonary lung as a result of primary deposition, i.e., that occurring directly on the lung surfaces during inhalation and also for secondary deposition, i.e., that occurring as a result of solubilization and redeposition in the lung tissue itself, in this respect the pulmonary lung is treated as any other organ.

Weighted values of the effective energy of daughter radionuclides, ε_i were calculated using the ICRP equations[6] for three biological clearance half times of 1 day, 50 days and 500 days. The effective energy of the i^{th} daughter is determined by:

$$\varepsilon_i = \sum_i F_i[E(RBE)n]i$$

where:

$$F_i = \frac{\prod_{j=1}^{i} T_j/T_j^r}{1-e^{-\lambda_o t}} \sum_{n=1}^{i} \frac{T_n^i \left(1-e^{-\lambda_n t}\right)}{\prod_{\substack{p=o \\ p\neq n}}^{i} \left(T_n - T_p\right)}$$

and:

- F_i • the ratio of the number of disintegrations of daughter atoms to the number of disintegrations of parent atoms in the lung over a time t.
- λ_o • the effective decay constant of the parent, the subscript, zero, refers to the parent.
- λ_i • the effective decay constant of the i^{th} daughter in the lung.
- T_i • the effective half life of the i^{th} daughter in the lung.
- T_i^r • the radioactive half life of the i^{th} daughter.
- t • the time of interest over which the dose is to be calculated.
- E • the total energy absorbed in the organ per disintegration of the radionuclide.
- RBE • the relative biological effectiveness of the radiation.
- n • the relative damage factor for radionuclides deposited in the bone.

REFERENCES FOR APPENDIX A

1. D. H. Slade, Ed, Meteorology and Atomic Energy, U.S. Atomic Energy Commission Division of Technical Information, TID-24190, 1968.

2. J. J. Fuquay, C. L. Simpson and W. T. Hinds, Estimates of Ground Level Air Exposures Resulting from Protracted Emissions from 70-Meter Stacks at Hanford, HW-80204, 1964.

3. Task Group of Committee 2, ICRP, Task Group on Lung Dynamics for Committee II of the ICRP, Health Physics, Vol. 12, p. 173, 1966.

4. Task Group of Committee 2, ICRP, The Metabolism of Compounds of Plutonium and Other Actinides, ICRP Publication 19, Pergamon Press, Oxford, 1972.

5. Paul G. Volilleque AERIN, A Code for the Acute Aerosol Inhalation Exposure Calculations, Health Physics, Vol. 19, p. 427, 1970.

6. Report of Committee II on Permissible Dose for Internal Radiation, ICRP Publication 2, Pergamon Press, 1959.

APPENDIX B

COMPUTER CODE

APPENDIX B

COMPUTER CODE

The models described in Appendix A have been incorporated into a computer code programmed for the CDC CYBER 74 Computer.

MAIN

MAIN is the main program and calls the other routines as needed to perform the calculations requested by the user. The data library reading subroutines are called by the main program and all other input data is read in this program. Input data that is required is explained in detail in Appendix F. If the calculation of E/Q values is called for, this program calls any required subroutines to assist. Maximum flexibility is provided in the generation of E/Q values. The code allows the use of Hanford Model equations, Sutton Model equations, data taken from Pasquill curves for σ_z and σ_y, the input of σ_y and σ_z of the users choice or the input of E/Q values directly. If the activity median aerodynamic diameter is input for the aerosol, the routine to generate the deposition fractions is called. If fission products input has been specified, the routine to perform a chain decay for the time during which the nuclides are in transit from the release point to the receptor is called. The ORDOSE subroutine is then called to calculate the doses to the organs chosen.

ORDOSE

Subroutine ORDOSE controls the routines that generate the necessary values for the organ dose calculation. All printing of the individual nuclide contributions to the organ dose values as well as the totals is accomplished in this routine. All values returned by called subroutines, ORDOT1, ORDOT2, QLUNT1, QLMIT1, and QNT1, are normalized to a unit uptake rate. These values are then multiplied by the actual uptake rate to arrive at the actual dose to the organ. Output page format is determined in this routine by the number of organs chosen at execution time (up to a maximum

of 10). Where no data exists for a nuclide-organ combination, a blank shows on the output page for that combination rather than a zero.

DEP

Subroutine DEP is used to calculate the compartment deposition fractions D_3, D_4 and D_5 when the activity median aerodynamic diameter is input instead of the fractions. The error function is integrated numerically over appropriate limits to produce the necessary fractions.

SIMPS

Function SIMPS performs the numerical integration of the error function using Simpsons rule.

ERFXP

Function ERFXP is the error function: e^{-x^2} that is integrated by SIMPS.

PASSIG

Subroutine PASSIG interpolates on a table of stored Pasquill data values of σ_y and σ_z at fixed distances and produces the values of Pasquill σ_y and σ_z for the distances of interest. The σ_y and σ_z data is in the form of data statements for each Pasquill atmospheric stability class A through F at 20 distances from release point out to 10^7 meters.

UNIT

Subroutine Unit converts input time in seconds to more convenient units depending on the magnitude of the value input. The appropriate units, i.e., minutes, hours, days, etc., are also returned for use in the printed output.

CHAINT

Subroutine CHAINT performs a chain decay on all fission product decay chains from which nuclides for consideration have been chosen. The time over which the decay is performed is the source to receptor transit time.

ORDOT1

Function ORDOT1 calculates the dose to an organ for the time T_1 during which inhalation of activity occurs at a unit rate.

ORDOT2

Function ORDOT2 calculates the dose to an organ during a time T_2 following inhalation of activity at a unit rate. The equations used, take into account any continuing movement of material from the respiratory compartments and the lymph to the organ following the termination of the inhalation of radioactive material.

QLUNT1

Function QLUNT1 calculates the activity in each lung subcompartment following continuous inhalation at a unit rate for a time T_1.

QLMIT1

Function QLMIT1 calculates the quantity of a nuclide present in the pulmonary lumph, that is removable, following continuous uptake at a unit rate for a time T_1.

QNT1

Function QNT1 calculates the quantity of a nuclide present in an organ following continuous uptake at a unit rate for a time T_1.

The results from the preceding three routines are used in the calculation of the dose following ceasation of inhalation uptake.

LIBB

Subroutine LIBB reads the biological data from the library and converts some of the values into units more readily used by the other routines in the program.

LIBK

Subroutine LIBK reads the nuclide radiological data library, converts some of the values to other units and generates the fractional decay yield array for use in the fission product chain calculations.

APPENDIX C

CODE FLOW DIAGRAM

APPENDIX C

CODE FLOW DIAGRAM

A general outline of the code operation is included here. The relationship between the main program and subroutines used by the code is shown in Figure C-1. The code flow diagram shown in Figure C-2 through C-12 covers the logic in the main program and subroutine ORDOSE in some detail. Code flow diagrams for the auxilliary routines are not shown, however, their function is included in the blocks at the appropriate places within the flow diagrams.

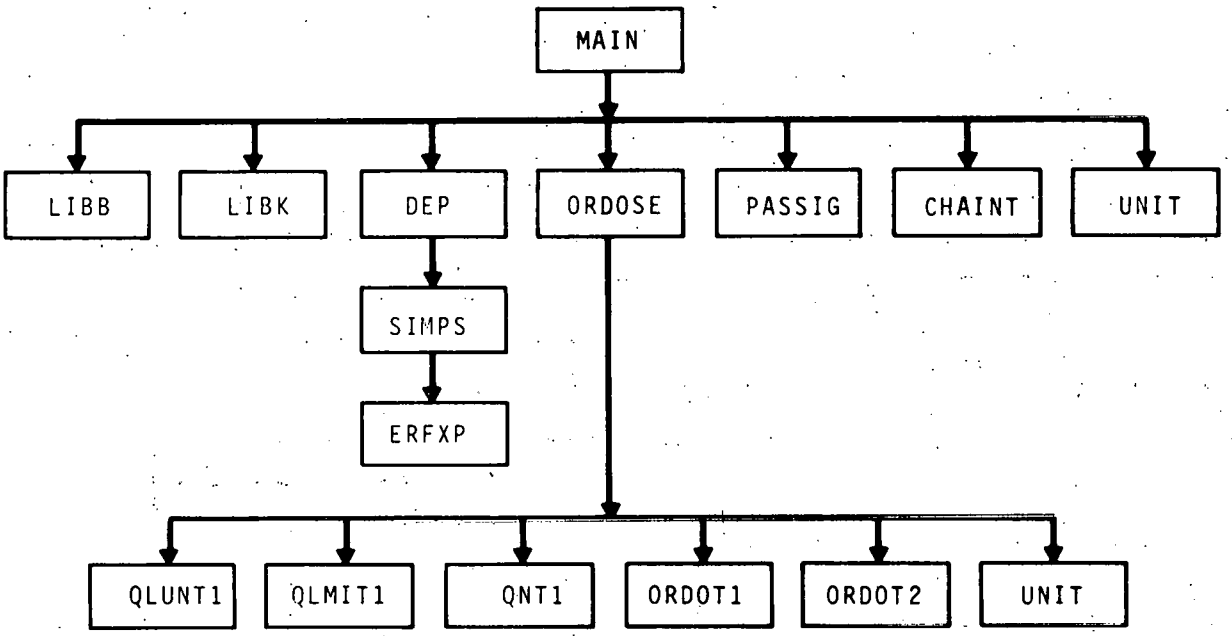

FIGURE C.12. Code Flow Diagram

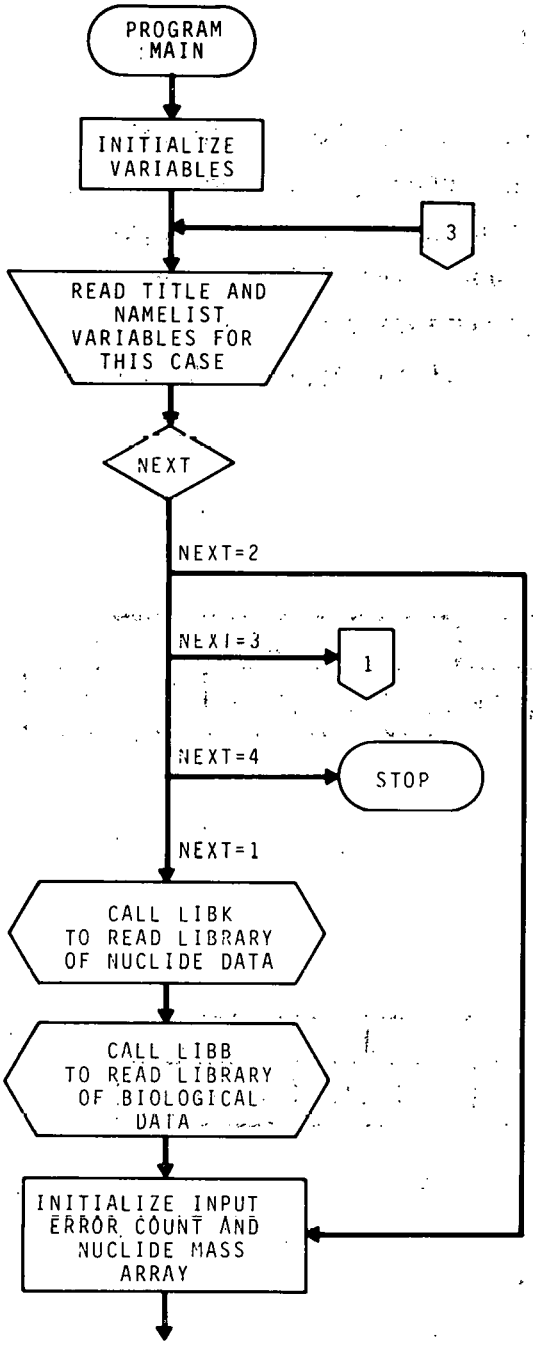

FIGURE C.2. Code Flow Diagram

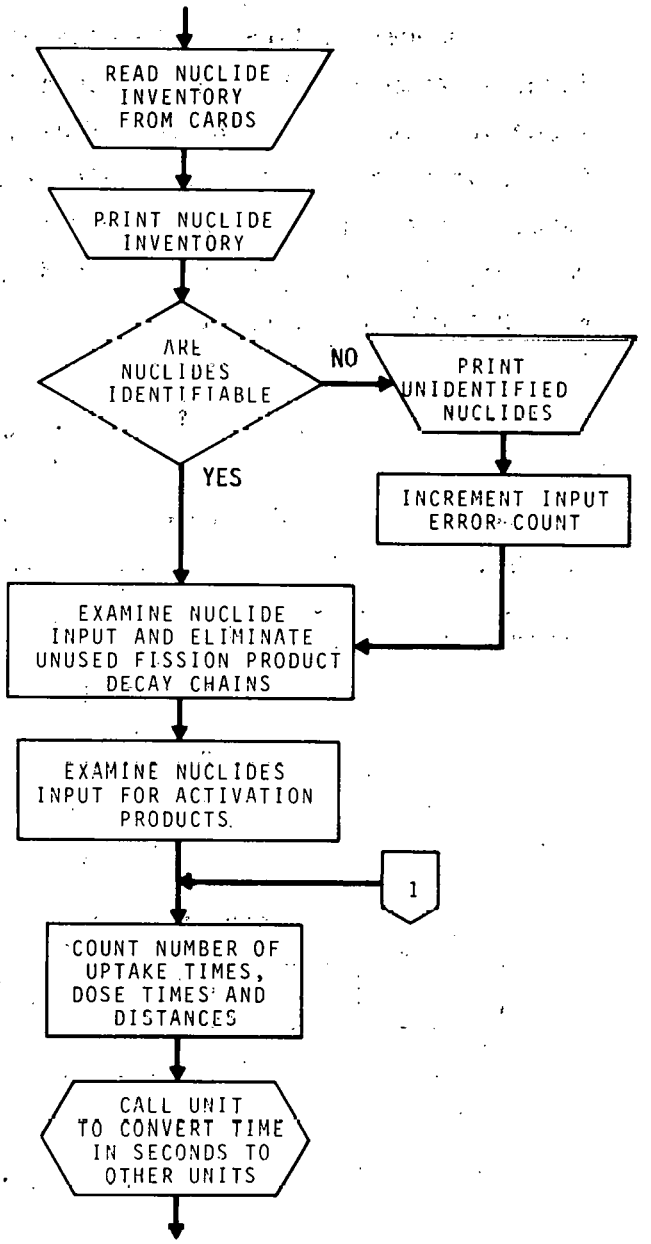

FIGURE C.3. Code Flow Diagram

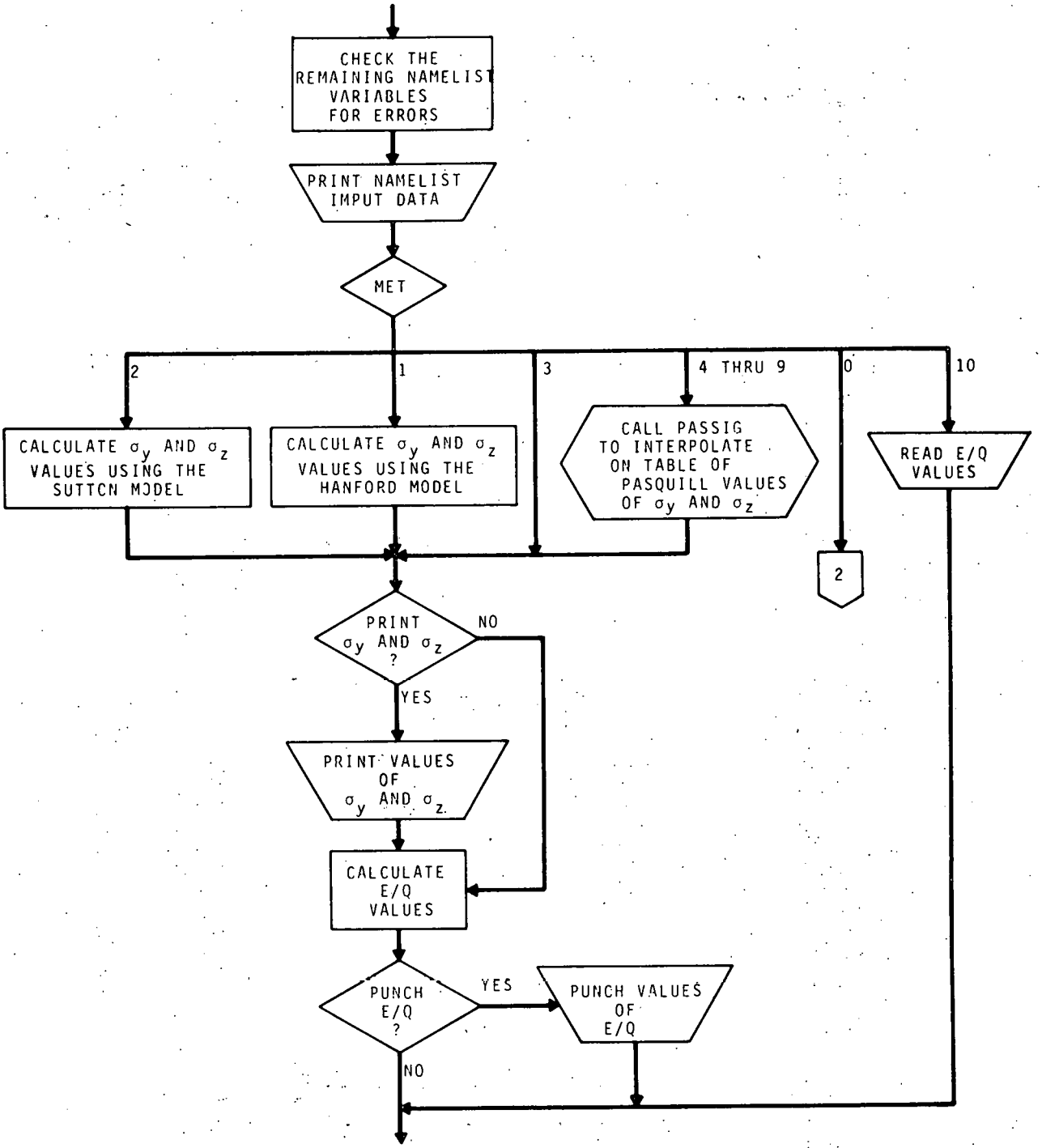

FIGURE C.4. Code Flow Diagram

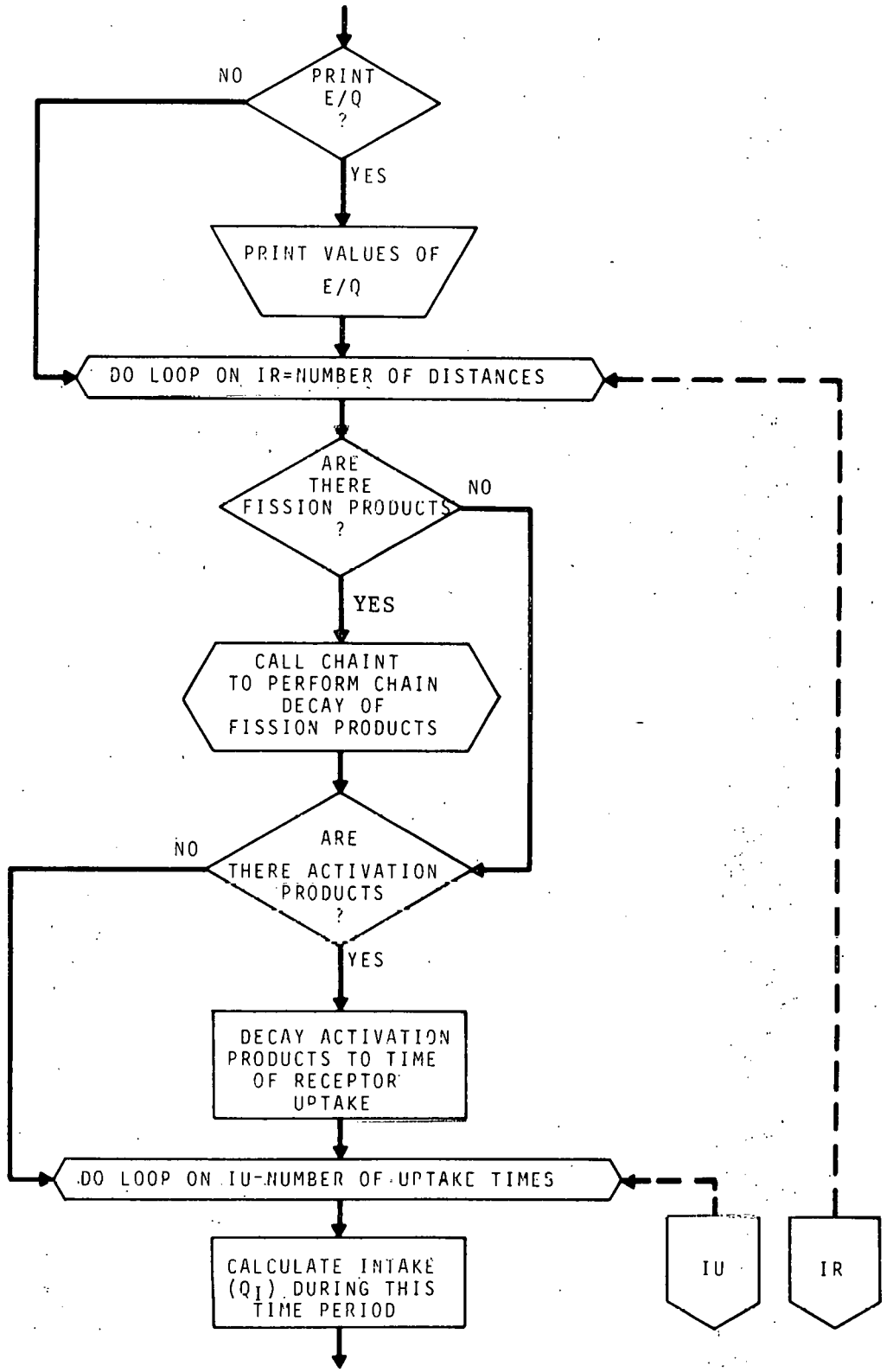

FIGURE C.5. Code Flow Diagram

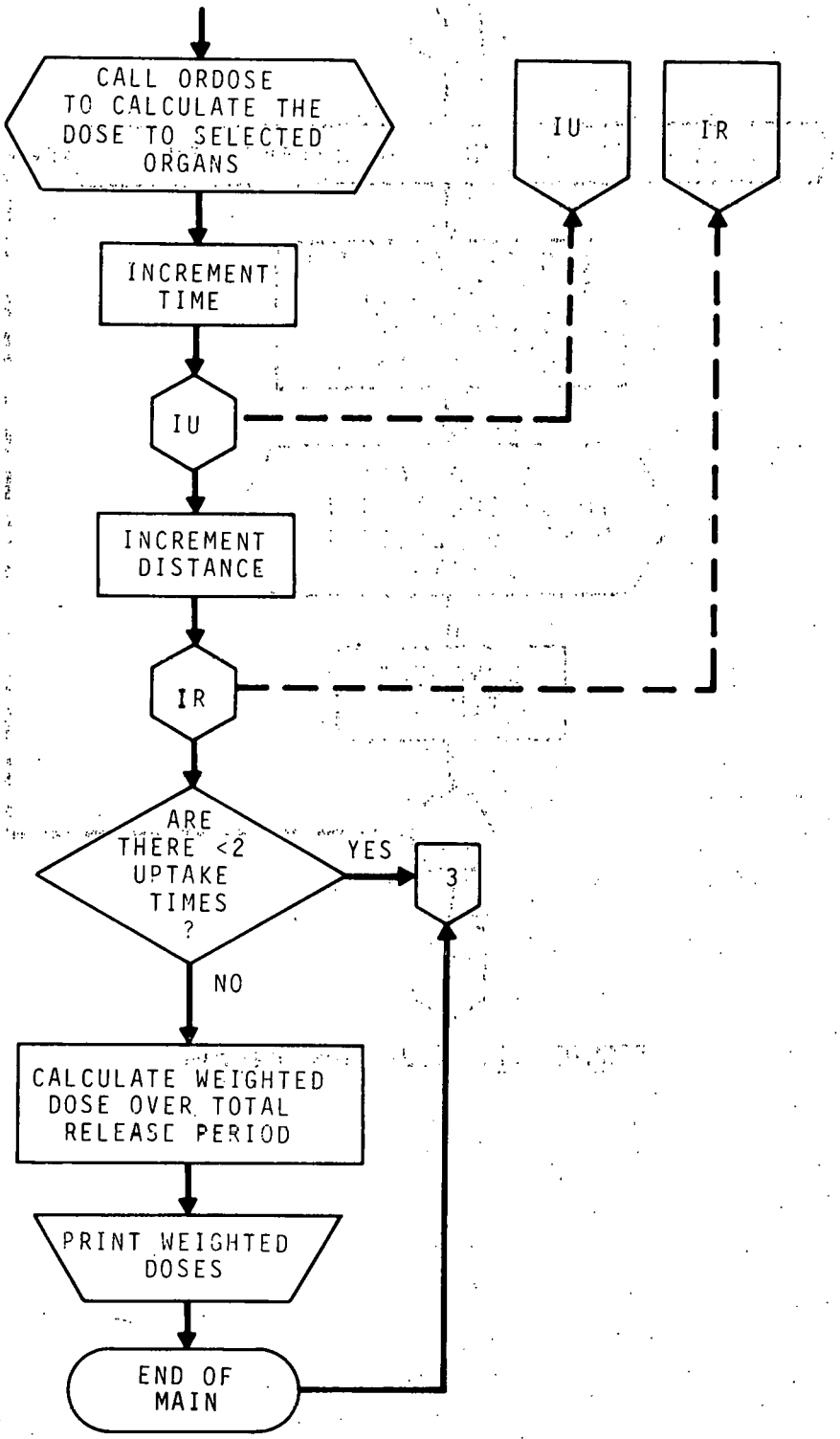

FIGURE C.6. Code Flow Diagram

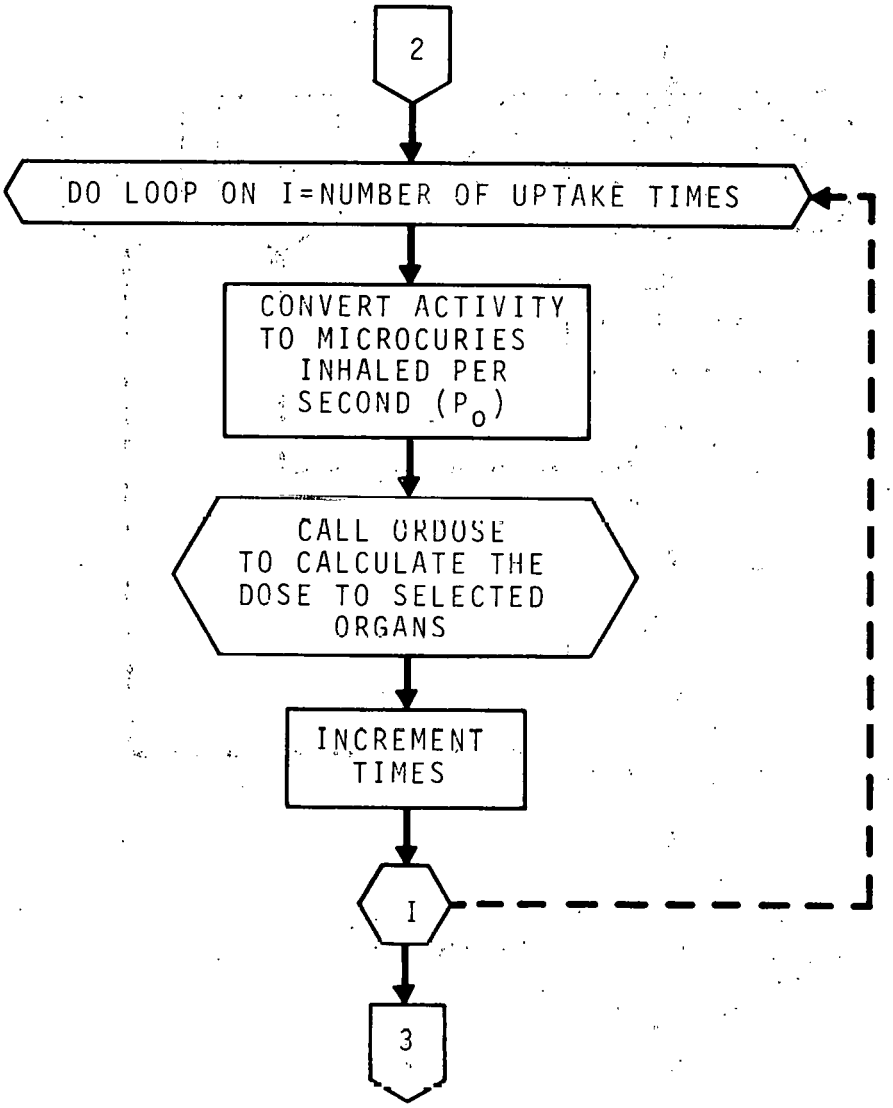

FIGURE C.7. Code Flow Diagram

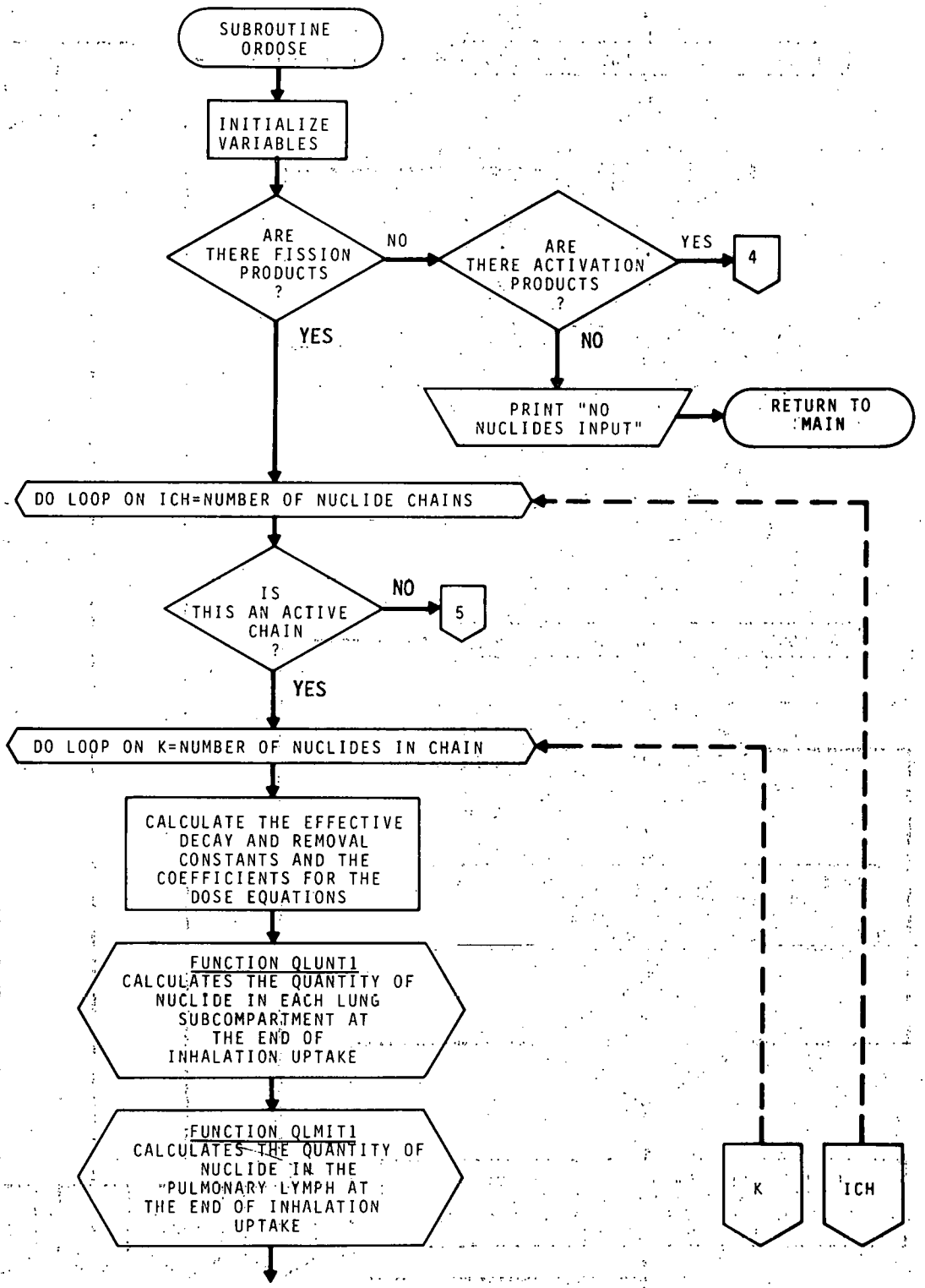

FIGURE C.8. Code Flow Diagram

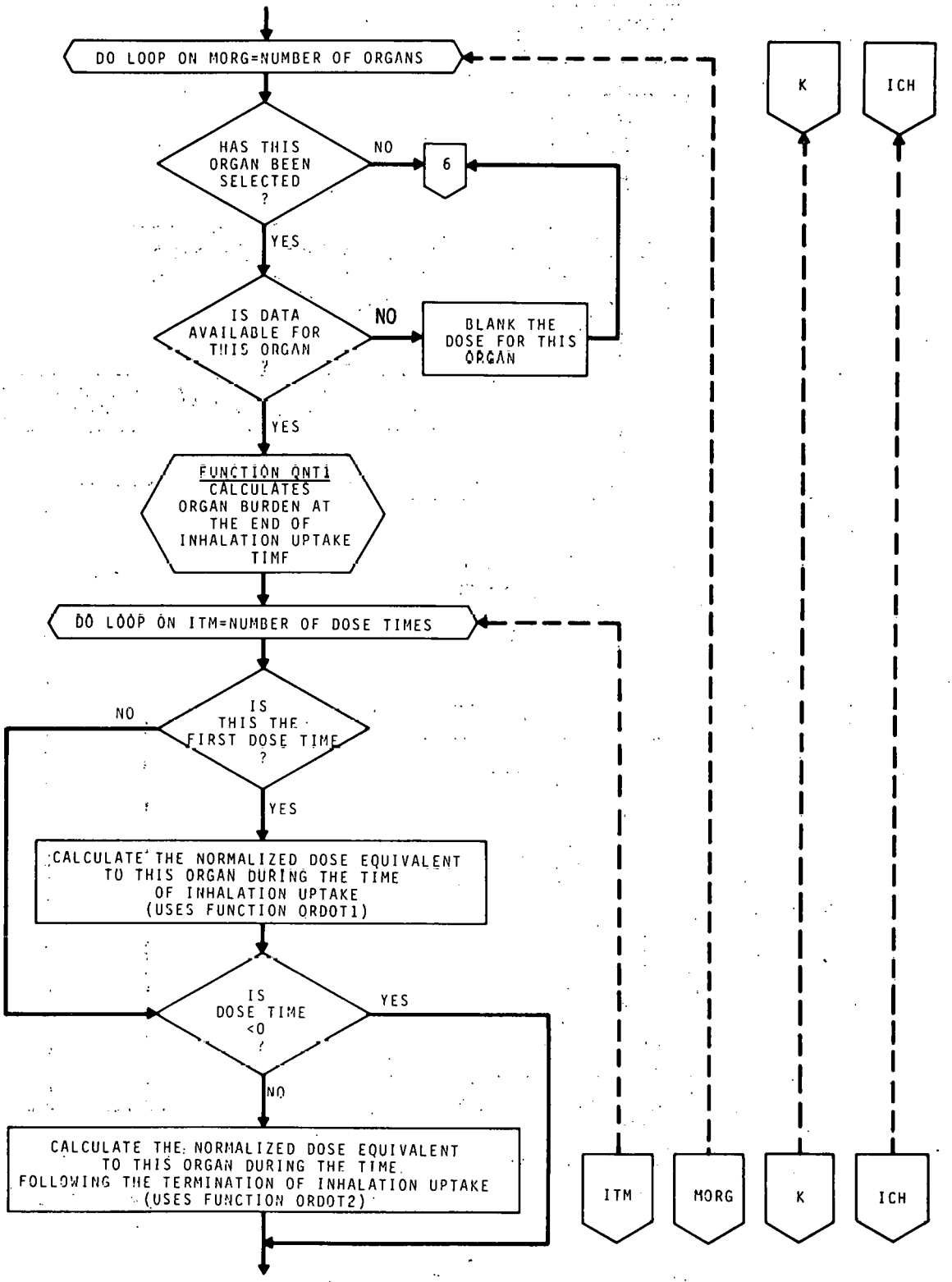

FIGURE C.9. Code Flow Diagram

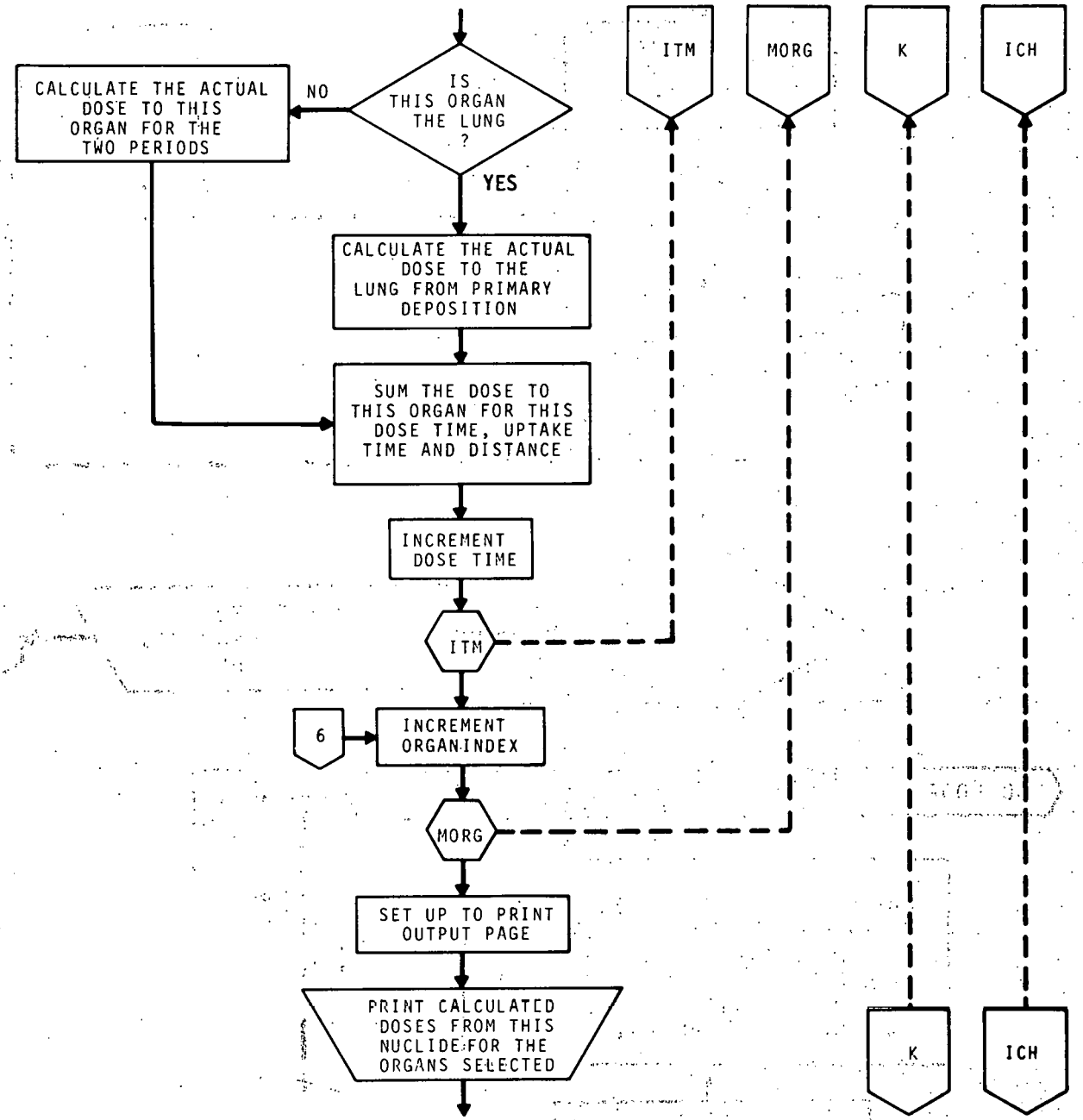

FIGURE C.10. Code Flow Diagram

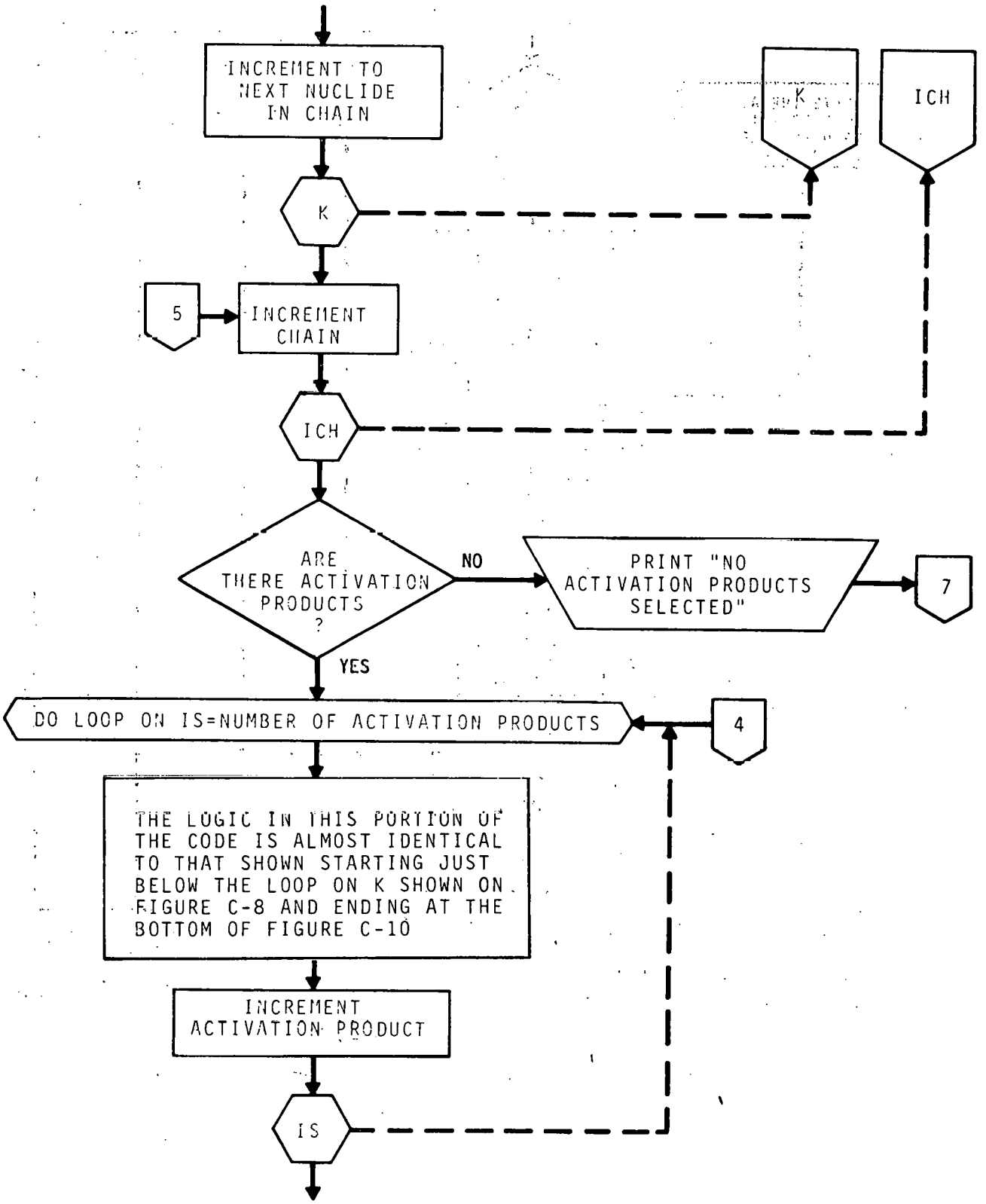

FIGURE C.11. Code Flow Diagram

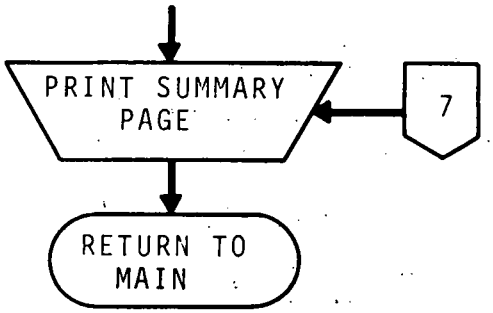

FIGURE C.12. Code Flow Diagram

APPENDIX D

DATA LIBRARIES

APPENDIX D

DATA LIBRARIES

Two data libraries are used by the code.

1. Isotope Data Library
2. Organ Data Library

The data in the libraries is set up such that additional data or changes to existing data may be made with little difficulty.

ISOTOPE DATA LIBRARY

The data in this library is used by CHAINT in performing the chain decay of fission products specified in the input data. Half-life data for activation product nuclides is included in the second half of this library. The library has been taken from that originally set up for a reactor fission product inventory code called RIBD,[1] hence not all of the data is required by the DACRIN code. The RIBD code could be added at a later date to generate a fission product inventory for input to this code.

The first card image of the isotope library contains the number of fission products in the library in I3 format in the first three columns. There is one card image for each fission product arranged in ascending atomic number order within an ascending atomic mass sequence. Currently the library contains data on 450 fission products.

The card image after the last fission product card image contains the number of activation products in I3 format in the first three columns. There is one card image for each activation product nuclide and there are currently 144 activation product nuclides in the library.

COLUMN	FORMAT	VARIABLE
1-3	I3	Atomic Mass Number
4-5	I2	Atomic Number
6-14	E9.3	Physical half-life, days
15-23	E9.3	*Fission yield from species one (^{235}U), %
24-32	E9.3	*Fission yield from species two (^{239}Pu), %
33-41	E9.3	*Absorption cross section, barns
42-46	E5.3	*Fraction of (n,α) captures that go to isomeric state
47-51	E5.3	If in isomeric state, fraction of decays by beta emission; if in ground state, fraction that decays to an isomer
52-56	E5.3	*Average beta energy released per disintegration, MeV
57-61	E5.3	*Average gamma energy released per disintegration, MeV
69-71	A3	Isotope name (left adjusted)
72	I1	*Isotope type: 1-Isomeric state 2-Ground state

*Not used by code.

ORGAN DATA LIBRARY

This library contains most of the data required by ORDOSE to calculate the effective dose to an organ. Data in the library is based on recommendations of the ICRP.[2,3,4]

The first card image contains the total number of data card images in the library in I4 format in the first four columns. The present limit is 1200 card images. There is one card image for each radionuclide-organ combination, (where data exists), arranged in ascending organ number within an ascending atomic mass sequence within an ascending atomic number order. There are currently 1136 entries in this library.

COLUMN	FORMAT	VARIABLE
1-3	I3	Atomic Number
4-6	I3	Atomic Mass Number
7	I1	Isotope type: blank - ground state 1 - Isomeric state
8-9	A2	Element name
10-11	I2	Organ code number
12-19	E8.3	Physical half-life, days
21-27	E8.3	Biological half-life in the organ or tissue, days
28-35	E8.3	*Fraction of that material taken into the body by ingestion that is retained in the organ, f_w in the initial ICRP lung model.
36-43	E8.3	**Fraction of that taken into the body by inhalation that arrives in the organ, f_a in the initial ICRP lung model.
44-51	E8.3	The fraction of the nuclide in the blood reaching the organ, f_2
52-59	E8.3	Effective absorbed energy per disintegration of the radionuclide and daughters in the organ, E, MeV (in the case of the lung this is for a 1 day half residence time)
60-65	E6.2	Weighted value of the effective absorbed energy per disintegration of the radionuclide and its daughters in the lung for a 50 day half residence time
66-71	E6.2	Same as previous field except for a 500 day half residence time in the lung.

* Used for extracting f_1, the fraction ingested reaching the blood.
** Not used by code.

REFERENCES FOR APPENDIX D

1. Mathematical Basis of Computer Code RIBD, R. O. Gumprecht, DUN-4136, Douglas United Nuclear, Inc., Richland, WA, June 1968.

2. Recommendations of the International Commission on Radiological Protection, ICRP Publication 2, Permagon Press, 1959.

3. Recommendations of the International Commission on Radiological Protection, ICRP Publication 6, Permagon Press, 1962.

4. The Metabolism of Compounds of Plutonium and Other Actinides, A Report prepared by a Task Group of Committee 2 of the International Commission on Radiological Protection, ICRP Publication 19, Pergamon Press, May 1972.

```
450                                                                    RIBLIB      2
 72301.938E 001.600E-051.200E-040.        0.    0.    .12  1.235     ZN 2 RIBLIB      3
 72315.875E-010.        0.        0.                  .43  2.869     GA 2 RIBLIB      4
 7232          0.        0.        1.                                GE 2 RIBLIB      5
 73301.390E-039.800E-050.                             2.25           ZN 2 RIBLIB      6
 73312.000E-012.000E-06                               .42  .409      GA 2 RIBLIB      7
 73320.        0.        0.        14.                               GE 2 RIBLIB      8
 74315.555E-033.500E-040.                             1.01 3.149     GA 2 RIBLIB      9
 7432          0.        0.        .5        .4                      GE 2 RIBLIB     10
 75311.389E-034.000E-04                               1.43 .58       GA 2 RIBLIB     11
 75325.671E-044.000E-04                                    .139      GE*1 RIBLIB     12
 75325.694E-02                                        .42  .038      GE 2 RIBLIB     13
 7533          0.        0.        4.5                               AS 2 RIBLIB     14
 76313.704E-04 .001                                   2.74 1.        GA 2 RIBLIB     15
 7632          .001                .2        .5                      GE 2 RIBLIB     16
 76331.104E 000.        0.                             1.09 0.404     AS 2 RIBLIB     17
 7634          0.        0.        85.       .259                    SE 2 RIBLIB     18
 77326.250E-045.400E-030.                        0.640.77  0.096     GE*1 RIBLIB     19
 77324.583E-013.700E-030.                             .64  1.134     GE 2 RIBLIB     20
 77331.625E 000.        0.                             .22  0.022     AS 2 RIBLIB     21
 77342.083E-04                                             .16       SE*1 RIBLIB     22
 7734          0.        0.        42.                               SE 2 RIBLIB     23
 78328.750E-021.800E-020.                             .32  0.300     GE 2 RIBLIB     24
 78336.319E-032.000E-030.                             1.47 0.888     AS 2 RIBLIB     25
 7834          0.        0.        .41       .875                    SE 2 RIBLIB     26
 79336.250E-034.000E-020.                        1.   .90            AS 2 RIBLIB     27
 79342.708E-030.        0.                                 0.096     SE*1 RIBLIB     28
 79342.555E 070.        0.                             .04            SE 2 RIBLIB     29
 79350.        0.        0.        1.140E 010.2540.                  BR 2 RIBLIB     30
 80331.736E-04 .08                                    2.73 .5        AS 2 RIBLIB     31
 8034                    .6        .2                                SE 2 RIBLIB     32
 80351.875E-010.        0.                                 0.085     BR*1 RIBLIB     33
 80351.250E-020.        0.                             .72  .116      BR 2 RIBLIB     34
 8036          0.        0.        15.                               KR 2 RIBLIB     35
 81333.819E-041.250E-010.                             1.66           AS 2 RIBLIB     36
 81343.958E-028.400E-030.                                   0.103     SE*1 RIBLIB     37
 81341.250E-020.        0.                             .53            SE 2 RIBLIB     38
 8135          0.        0.         3.                               BR 2 RIBLIB     39
 8136          0.        0.                                          KR 2 RIBLIB     40
 8234          3.800E-050.       5.400E-020.9200.                    SE 2 RIBLIB     41
 82351.471E 00                                        .14  2.648     BR 2 RIBLIB     42
 8236          0.        0.        45.       1.                      KR 2 RIBLIB     43
 83347.986E-043.030E-011.200E-01                 1.0001.55 0.200     SE*1 RIBLIB     44
 83341.736E-021.800E-018.600E-02                      .69  1.000     SE 2 RIBLIB     45
 83351.000E-010.        8.400E-020.       0.    1.000.34  0.010     BR 2 RIBLIB     46
 83367.750E-020.        0.        0.      0.    0.          0.041     KR*1 RIBLIB     47
 8336          0.        0.        180.                              KR 2 RIBLIB     48
 84342.083E-036.100E-023.000E-02                      .49            SE 2 RIBLIB     49
 84354.167E-031.900E-021.000E-02                 1.   .71  3.396     BR*1 RIBLIB     50
 84352.222E-029.200E-014.300E-01                      1.23 1.863     BR 2 RIBLIB     51
 8436          0.        0.        .14       .714                    KR 2 RIBLIB     52
 85334.977E-065.500E-011.260E-01                      1.28 5.0       AS 2 RIBLIB     53
 85344.514E-045.500E-011.260E-01                      2.24           SE 2 RIBLIB     54
 85352.083E-034.000E-011.600E-01                 1.   1.04           BR 2 RIBLIB     55
 85361.833E-010.        0.                        0.810.29  .179      KR*1 RIBLIB     56
 85363.927E 030.        1.270E-0115.                       .25  0.004 KR 2 RIBLIB     57
 8537          0.        0.        1.000E 000.1                      RB 2 RIBLIB     58
 86341.952E-041.010E 003.800E-01                      1.76           SE 2 RIBLIB     59
 86356.250E-041.010E 003.800E-01                      3.23 .9        BR 2 RIBLIB     60
 8636                    .06                                         KR 2 RIBLIB     61
 86377.222E-040.        0.                                 0.56      RB*1 RIBLIB     62
 86371.870E 012.800E-052.300E-05                      .66  0.097     RB 2 RIBLIB     63
 8638          0.        0.        .006      1.                      SR 2 RIBLIB     64
 87341.852E-042.700E 009.200E-01                      3.73           SE 2 RIBLIB     65
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87356.366E-040.       0.                          1.87 3.780      BR 2 RIBLIB      66
87365.278E-020.       0.       600.               1.34 1.089      KR 2 RIBLIB      67
8737          0.      0.       .12                                RB 2 RIBLIB      68
87381.167E-010.       0.                               0.388      SR*1 RIBLIB      69
8738          0.      0.                                          SR 2 RIBLIB      70
88351.852E-042.900E 001.100E 00                   3.22 .035       BR 2 RIBLIB      71
88361.167E-018.000E-013.200E-01                   .38  1.922      KR 2 RIBLIB      72
88371.252E-020.       0.       1.                 1.99 .748       RB 2 RIBLIB      73
8838                           .005                               SR 2 RIBLIB      74
89355.208E-052.000E-017.000E-02                   3.   .075       BR 2 RIBLIB      75
89362.222E-034.400E 001.640E 00                   1.39 2.265      KR 2 RIBLIB      76
89371.042E-022.000E-010.       .55                .60  2.455      RB 2 RIBLIB      77
89385.04 E 010.       0.       .4           .0002.58  .0002      SR 2 RIBLIB      78
89391.852E-04                                          .915       Y* 1 RIBLIB      79
8939          0.      0.       1.301    .00080.                   Y  2 RIBLIB      80
90351.852E-052.600E 009.800E-01                   3.   .075       BR 2 RIBLIB      81
90363.819E-042.600E 009.800E-01                   1.37 2.23       KR 2 RIBLIB      82
90372.014E-037.000E-012.900E-01                   2.05 4.15       RB 2 RIBLIB      83
90381.022E 040.       0.       1.                 .20             SR 2 RIBLIB      84
90391.333E-01                                          .68        Y* 1 RIBLIB      85
90392.675E 000.       0.                          .94  .0003      Y  2 RIBLIB      86
9040          0.      0.       .1                                 ZR 2 RIBLIB      87
91361.157E-043.700E 001.260E 00              .5   1.56 2.         KR 2 RIBLIB      88
91379.722E-032.000E-017.000E-02              1.   1.27 2.8        RB*1 RIBLIB      89
91378.338E-042.000E 001.100E 00                   2.04 0.4        RB 2 RIBLIB      90
91384.042E-010.       0.                     .590 .63  0.742      SR 2 RIBLIB      91
91393.472E-020.       0.                               0.551      Y* 1 RIBLIB      92
91395.900E 010.       0.       1.4                .61  0.004      Y  2 RIBLIB      93
9140          0.      0.       1.                                 ZR 2 RIBLIB      94
92363.471E-052.700E 001.530E 00                   2.73            KR 2 RIBLIB      95
92375.787E-052.800E 001.540E 00                   2.97            RB 2 RIBLIB      96
92381.125E-016.000E-017.000E-02                   2.26 1.274      SR 2 RIBLIB      97
92391.471E-010.       0.                          1.44 0.266      Y  2 RIBLIB      98
9240          0.      0.       .2                                 ZR 2 RIBLIB      99
93362.315E-051.300E 007.700E-01                   3.82            KR 2 RIBLIB     100
93376.944E-053.100E 001.820E 00                   2.83            RB 2 RIBLIB     101
93385.764E-032.000E 001.320E 00                   1.40 1.0        SR 2 RIBLIB     102
93394.208E-011.000E-016.000E-02                   1.18 0.102      Y  2 RIBLIB     103
93403.468E 080.       0.       4.            .25  .015            ZR 2 RIBLIB     104
93411.351E 030.       0.                               0.029      NB*1 RIBLIB     105
9341          0.      0.       1.1      .909                      NB 2 RIBLIB     106
94361.620E-056.000E-016.000E-01                   2.70            KR 2 RIBLIB     107
94373.472E-052.300E 001.500E 00                   4.57            RB 2 RIBLIB     108
94388.333E-042.900E 001.640E 00                   1.46            SR 2 RIBLIB     109
94391.389E-027.000E-017.400E-01                   2.23 1.         Y  2 RIBLIB     110
9440          0.      0.       .08                                ZR 2 RIBLIB     111
94414.583E-030.       0.                     .001 .00050.042      NB*1 RIBLIB     112
94417.300E 060.       0.       15.                .16  1.570      NB 2 RIBLIB     113
9442          0.      0.                                          MO 2 RIBLIB     114
95361.157E-053.200E 002.900E 00                   4.57            KR 2 RIBLIB     115
95372.314E-053.200E 002.900E 00                   3.58            RB 2 RIBLIB     116
95385.556E-04                                     2.72            SR 2 RIBLIB     117
95397.292E-03                                     2.09            Y  2 RIBLIB     118
95406.500E 010.       0.                     .02  .12  0.720      ZR 2 RIBLIB     119
95413.750E 000.       0.                               0.235      NB*1 RIBLIB     120
95413.500E 010.       0.       7.                 .043 0.760      NB 2 RIBLIB     121
9542          0.      0.       14.                                MO 2 RIBLIB     122
96391.597E-033.200E 002.585E 00                   1.55 1.7        Y  2 RIBLIB     123
9640          3.200E 002.585E 00.05                               ZR 2 RIBLIB     124
96419.583E-015.700E-043.600E-03                   .22  2.456      NB 2 RIBLIB     125
9642          0.      0.       1.                                 MO 2 RIBLIB     126
97361.157E-052.400E 002.210E 00                   4.20            KR 2 RIBLIB     127
97372.315E-052.400E 002.210E 00                   4.39            RB 2 RIBLIB     128
97383.472E-05                                     3.57            SR 2 RIBLIB     129
97394.630E-05                                     2.31            Y  2 RIBLIB     130
97407.083E-011.400E 001.230E 00              .9   .70  0.221      ZR 2 RIBLIB     131
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 97416.944E-040.       0.                                          0.75      NB*1 RIBLIB    132
 97415.000E-020.       0.                                    .47   .673      NB 2 RIBLIB    133
 9742         0.       0.        2.                                          MO 2 RIBLIB    134
 98406.944E-04 .2      1.000E-01                             1.99            ZR 2 RIBLIB    135
 98413.576E-02 .064    1.000E-01                       1.    1.31 2.         NB*1 RIBLIB    136
 98411.806E-02 3.      2.845E 00                             1.26 1.2        NB 2 RIBLIB    137
 9842         2.516    2.845E 00.15                                          MO 2 RIBLIB    138
 99401.852E-053.050E 003.050E 00                             1.55            ZR 2 RIBLIB    139
 99411.736E-033.050E 003.050E 00                             1.36 .26        NB 2 RIBLIB    140
 99422.750E 00                                         .92   .41  0.124      MO 2 RIBLIB    141
 99432.500E-010.       0.                                         .1423      TC*1 RIBLIB    142
 99437.665E 070.       0.        22.                         .084            TC 2 RIBLIB    143
 9944         0.       0.                                                    RU 2 RIBLIB    144
100412.083E-036.300E 007.100E 00                             3.39 1.05       NB 2 RIBLIB    145
10042         0.       0.        .2                                          MO 2 RIBLIB    146
100431.968E-040.       0.                                    1.44 .114       TC 2 RIBLIB    147
10044         0.       0.                                                    RU 2 RIBLIB    148
101416.944E-042.500E 002.950E 00                             1.03            NB 2 RIBLIB    149
101421.014E-022.500E 002.950E 00                             .42  1.649      MO 2 RIBLIB    150
101439.722E-030.       0.                                    .47  0.362      TC 2 RIBLIB    151
10144         0.       0.                                                    RU 2 RIBLIB    152
102427.981E-034.200E 005.990E 00                             .44  1.3        MO 2 RIBLIB    153
102435.787E-050.       0.                                    1.79            TC 2 RIBLIB    154
10244         0.       0.        1.4                                         RU 2 RIBLIB    155
103435.787E-041.550E 002.835E 00                             1.03            TC 2 RIBLIB    156
103444.000E+011.450E 002.835E 00                       .995 .063 0.488       RU 2 RIBLIB    157
103453.958E-020.       0.                                         0.040      RH*1 RIBLIB    158
10345         0.       0.        155.      .071                              RH 2 RIBLIB    159
104421.111E-031.800E 005.930E 00                             1.08 1.         MO 2 RIBLIB    160
104431.250E-020.       0.                                    .98  3.1        TC 2 RIBLIB    161
10444         0.       0.        .7                                          RU 2 RIBLIB    162
104453.056E-030.       0.        800.                  .0013.0002.131        RH*1 RIBLIB    163
104454.861E-040.       0.        40.                         .98  0.013      RH 2 RIBLIB    164
10446         0.       0.                                                    PD 2 RIBLIB    165
105424.630E-046.000E-012.600E 00                             2.54            MO 2 RIBLIB    166
105435.556E-033.000E-011.300E 00                             2.09            TC 2 RIBLIB    167
105441.846E-010.       0.        .2                    .2690.42  .7680       RU 2 RIBLIB    168
105453.472E-040.       0.                                         0.129      RH*1 RIBLIB    169
105451.500E 000.       0.        2.100E+04.715 0.      .17  0.032            RH 2 RIBLIB    170
10546         0.       0.                                                    PD 2 RIBLIB    171
106443.650E 023.800E-014.570E 00.1                           .01             RU 2 RIBLIB    172
106459.167E-02                                         1.    .35  2.627      RH*1 RIBLIB    173
106453.472E-040.       0.                                    1.40 .222       RH 2 RIBLIB    174
10646         0.       0.                                                    PD 2 RIBLIB    175
107431.042E-031.600E-013.600E 00                             2.71            TC 2 RIBLIB    176
107442.917E-034.000E-020.                                    1.67 .144       RU 2 RIBLIB    177
107451.507E-020.       0.                                    .42  0.328      RH 2 RIBLIB    178
107462.555E 090.       0.                                    .014            PD 2 RIBLIB    179
10747         0.       0.        35.       0.0100.                           AG 2 RIBLIB    180
108443.125E-038.000E-022.100E 00                             .54  0.059      RU 2 RIBLIB    181
108451.968E-040.       0.                                    1.74 0.553      RH 2 RIBLIB    182
10846         0.       0.        12.2      .016                              PD 2 RIBLIB    183
108471.825E 030.       0.                              .9         1.605      AG*1 RIBLIB    184
108471.667E-030.       0.                                    .62  .017       AG 2 RIBLIB    185
10848         0.       0.        10.                                         CD 2 RIBLIB    186
109453.472E-042.800E-021.400E 00                       1.    1.16 .31        RH 2 RIBLIB    187
109463.333E-030.       0.                                         0.18       PD*1 RIBLIB    188
109465.625E-010.       0.                              1.    .36  .0002      PD 2 RIBLIB    189
109474.630E-040.       0.                                         0.088      AG*1 RIBLIB    190
10947         0.       0.        92.       .0326                             AG 2 RIBLIB    191
11046         2.000E-020.        .24       .167                              PD 2 RIBLIB    192
110472.600E 020.       0.        80.                   0.98 .069 2.722       AG*1 RIBLIB    193
110472.778E-040.       0.                                    1.17 0.033      AG 2 RIBLIB    194
11048         2.000E-070.        3.1       .0322                             CD 2 RIBLIB    195
111462.292E-011.000E-031.000E-02                       0.32 .048 .676        PD*1 RIBLIB    196
111461.528E-021.800E-022.200E-01                       1.    .85  .3         PD 2 RIBLIB    197
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111478.565E-04                                          .065        AG*1 RIBLIB    198
111477.500E 00                                     .36  0.025       AG 2 RIBLIB    199
111483.403E-020.        0.                              0.397       CO*1 RIBLIB    200
11148          C.       C.                                          CO 2 RIBLIB    201
112468.750E-011.100E-021.200E-01                   .08  0.018       PD 2 RIBLIB    202
112471.333E-010.        0.                         1.44 0.695       AG 2 RIBLIB    203
11248          C.       0.        .03      1.                       CO 2 RIBLIB    204
113461.042E-031.100E-021.000E-02                1.   1.40           PD 2 RIBLIB    205
113478.333E-040.        0.                      .1   .08  0.200     AG*1 RIBLIB    206
113472.208E-010.        C.                           .79  0.030     AG 2 RIBLIB    207
113485.110E 030.        0.                      0.999.18  .0003     CO*1 RIBLIB    208
11348          C.       0.        2.000E 04                         CO 2 RIBLIB    209
11349                             12.      .67                      IN 2 RIBLIB    210
114461.667E-031.000E-021.000E-02                     .52            PD 2 RIBLIB    211
114475.787E-050.        C.                           2.02 C.5       AG 2 RIBLIB    212
11448          C.       0.        1.24     0.1130.                  CO 2 RIBLIB    213
114495.000E 01                                            .192      IN*1 RIBLIB    214
114498.333E-04                                       .779 .002      IN 2 RIBLIB    215
115465.208E-04 .01      .0038                   .28  1.91           PD 2 RIBLIB    216
115472.315E-04                                  1.   1.49           AG*1 RIBLIB    217
115471.458E-02 .0005    3.000E-04               .09  1.21 .2        AG 2 RIBLIB    218
115484.300E 010.        0.                      1.   .61  C.036     CO*1 RIBLIB    219
115482.300E 000.        0.                      1.   .32  0.192     CO 2 RIBLIB    220
115491.833E-010.        0.                      .055 .015 0.317     IN*1 RIBLIB    221
11549          0.       0.        203.     .78       .15            IN 2 RIBLIB    222
11550          0.       C.                                          SN 2 RIBLIB    223
116463.472E-041.000E-020.                            .93            PD 2 RIBLIB    224
116471.736E-030.        0.                           2.21 1.217     AG 2 RIBLIB    225
11648          0.       0.        1.4                               CO 2 RIBLIB    226
116493.750E-020.        0.                      1.   .29  2.495     IN*1 RIBLIB    227
116491.620E-040.        0.                           1.39           IN 2 RIBLIB    228
11650          3.000E-030.        .006     1.                       SN 2 RIBLIB    229
117477.639E-041.100E-021.100E-02                .5   1.63           AG 2 RIBLIB    230
117481.208E-010.        0.                      1.   .35  1.6       CO*1 RIBLIB    231
117483.472E-020.        0.                      1.   .70  0.49      CO 2 RIBLIB    232
117497.917E-020.        0.                      0.8  .52  .132      IN*1 RIBLIB    233
117493.125E-020.        0.                           .24  .73       IN 2 RIBLIB    234
117501.400E 010.        0.                                0.32      SN*1 RIBLIB    235
11750          0.       0.                                          SN 2 RIBLIB    236
118483.472E-021.000E-021.000E-03                     .27  .2        CO 2 RIBLIB    237
118495.903E-050.        0.                           1.85 0.244     IN 2 RIBLIB    238
11850          0.       0.        .01      1.                       SN 2 RIBLIB    239
119481.875E-03 .01      4.000E-03               .99  1.56           CO*1 RIBLIB    240
119486.597E-03                                  1.   1.44 .1        CO 2 RIBLIB    241
119491.250E-02                                  .96  1.04 0.066     IN*1 RIBLIB    242
119491.309E-03                                  .1   .61  .34       IN 2 RIBLIB    243
119502.500E+02                                            .089      SN*1 RIBLIB    244
11950          0.       0.                                          SN 2 RIBLIB    245
120495.787E-040.500E-020.500E-03                     .88  3.2       IN 2 RIBLIB    246
12050          0.500E-020.500E-03.141      .007                     SN 2 RIBLIB    247
121482.431E-032.500E-042.500E-03                     1.73 0.85      CO 2 RIBLIB    248
121492.153E-032.500E-042.500E-03                1.   1.58           IN*1 RIBLIB    249
121493.472E-04 .0005    .0053                        1.20 .94       IN 2 RIBLIB    250
121509.125E 030.500E-030.500E-02                1.   .15  .01       SN*1 RIBLIB    251
121501.125E 001.400E-023.000E-02                     .11            SN 2 RIBLIB    252
12151          0.       0.        6.06     .01                      SB 2 RIBLIB    253
122498.681E-050.650E-020.500E-03                     2.68 2.14      IN 2 RIBLIB    254
12250          0.650E-020.500E-03.201      .005                     SN 2 RIBLIB    255
122512.847E-030.        0.                                0.136     SB*1 RIBLIB    256
122512.750E 000.        0.                           .58  .405      SB 2 RIBLIB    257
12252          0.       0.        3.       .333                     TE 2 RIBLIB    258
123491.157E-040.600E-030.500E-03                     1.39 1.1       IN 2 RIBLIB    259
123501.250E+020.600E-030.500E-03                1.   .52  0.022     SN*1 RIBLIB    260
123502.778E-021.400E-020.                            .46  0.160     SN 2 RIBLIB    261
12351          0.       0.        3.345    .0135                    SB 2 RIBLIB    262
123521.040E+02                                            .249      TE*1 RIBLIB    263
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12352          0.          0.          402.                                   TE 2 RIBLIB      264
12450          2.000E-020.             .104        .962                       SN 2 RIBLIB      265
124511.458E-020.           0.                             .982 .97   0.427    SB*1 RIBLIB      266
124516.020E+010.           0.          2000.                   .38   1.899    SB 2 RIBLIB      267
12452          0.          0.          7.          .714                       TE 2 RIBLIB      268
125506.736E-031.100E-021.000E-03                          1.   .79   0.361    SN*1 RIBLIB      269
125509.400E 001.200E-027.100E-02                               .92   0.094    SN 2 RIBLIB      270
125519.855E 020.           0.          20.                .26  .096  .415     SB 2 RIBLIB      271
125525.800E 010.           0.                                        0.145    TE*1 RIBLIB      272
12552          0.          0.          1.5                                    TE 2 RIBLIB      273
126503.650E+071.000E-012.000E-01                          1.   .12   .09      SN 2 RIBLIB      274
126511.319E-020.           0.                             .01  .00780.117     SB*1 RIBLIB      275
126511.250E 010.           0.                                  .74   1.780    SB 2 RIBLIB      276
12652          0.          0.          1.          .1                         TE 2 RIBLIB      277
127508.750E-022.400E-013.900E-01                               1.34 1.        SN 2 RIBLIB      278
127513.900E 001.000E-021.000E-02                          .2   .38   0.505    SB 2 RIBLIB      279
127521.050E 020.           0.                             .015 .00410.088     TE*1 RIBLIB      280
127523.875E-010.           0.                                  .23   0.004    TE 2 RIBLIB      281
12753          0.          0.          6.4                                    I  2 RIBLIB      282
128504.306E-023.700E-014.000E-01                          .03  3.85 3.27      SN 2 RIBLIB      283
128514.000E-015.000E-020.                                 1.   .35   3.6      SB*1 RIBLIB      284
128516.944E-038.000E-021.000E-01                               1.20 1.7       SB 2 RIBLIB      285
12852          0.          0.          .157        .108                       TE 2 RIBLIB      286
128531.736E-023.000E-052.000E-04                               .77   0.093    I  2 RIBLIB      287
12854          0.          0.          5.                                     XE 2 RIBLIB      288
129511.792E-011.000E 001.000E 00                          .36  .542 .916      SB 2 RIBLIB      289
129523.300E 010.           0.                                        0.106    TE*1 RIBLIB      290
129524.653E-020.           0.                                  .45   .238     TE 2 RIBLIB      291
129535.840E 090.           0.          28.                     .050 .040      I  2 RIBLIB      292
12954          0.          0.          25.                                    XE 2 RIBLIB      293
130501.806E-032.000E 002.000E 00                               4.23           SN 2 RIBLIB      294
130512.293E-020.           0.                                  1.72 1.0       SB 2 RIBLIB      295
13052          0.          0.          .23         .13                        TE 2 RIBLIB      296
130535.208E-01 .0005       .0052       18.                     .27   2.123    I  2 RIBLIB      297
13054          0.          0.          5.                                     XE 2 RIBLIB      298
131511.597E-022.700E 003.100E 00                          .15  1.33           SB 2 RIBLIB      299
131521.200E 004.000E-021.300E-01                          .783 .16   1.468    TE*1 RIBLIB      300
131521.736E-021.600E-015.400E-01                               .74   0.376    TE 2 RIBLIB      301
131538.050E 00 .2          0.          .7                 .007 .18   0.399    I  2 RIBLIB      302
131541.200E 010.           1.000E-02                                 0.164    XE*1 RIBLIB      303
13154          0.          0.          85.                                    XE 2 RIBLIB      304
132511.458E-033.400E 005.100E 00                               2.68           SB 2 RIBLIB      305
132523.250E 001.000E 00 .18                                    .055 0.280     TE 2 RIBLIB      306
132539.583E-020.           0.                                  .49   2.249    I  2 RIBLIB      307
13254                                  5.2         .962                       XE 2 RIBLIB      308
133512.847E-033.800E 003.000E 00                          .72  1.72           SB 2 RIBLIB      309
133523.472E-021.100E 001.000E 00                          .87  .49   1.613    TE*1 RIBLIB      310
133521.389E-031.100E 001.000E 00                               .97   0.6      TE 2 RIBLIB      311
133538.750E-015.000E-012.000E-01                          .02  .46   .53      I  2 RIBLIB      312
133542.300E 000.           0.                                        0.233    XE*1 RIBLIB      313
133545.270E 000.           1.700E 00190.                       .10   .082     XE 2 RIBLIB      314
13355          0.          0.          30.6        .085                       CS 2 RIBLIB      315
134515.556E-043.000E 003.500E 00                               3.45 0.230     SB 2 RIBLIB      316
134522.917E-023.700E 004.000E 00                               .52   .1       TE 2 RIBLIB      317
134533.681E-029.000E-010.                                      .73   2.5      I  2 RIBLIB      318
13454          0.          0.          5.2         .962                       XE 2 RIBLIB      319
134551.208E-010.           0.                             .01  .00170.153     CS*1 RIBLIB      320
134557.665E 020.           0.          136.                    .16   1.588    CS 2 RIBLIB      321
13456                                  4.16        .038                       BA 2 RIBLIB      322
135512.778E-04 4.3         1.1                                 3.16           SB 2 RIBLIB      323
135526.944E-04                                                 2.68           TE 2 RIBLIB      324
135532.792E-01 1.9         5.700E 00                      .27  .32   1.642    I  2 RIBLIB      325
135541.111E-020.           0.                                        0.530    XE*1 RIBLIB      326
135543.833E-013.000E-01 .47            2.900E+06               .31   0.261    XE 2 RIBLIB      327
135557.300E+080.                       8.7                     .055           CS 2 RIBLIB      328
135561.208E 000.           0.                                        0.268    BA*1 RIBLIB      329
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13556          0.          0.          5.                                              BA 2 RIBLIB     330
136539.606E-043.100E 002.100E 00                                 1.68 3.237        I  2 RIBLIB     331
13654          3.76        4.520E 00.15                                            XE 2 RIBLIB     332
136551.300E 016.900E-031.100E-01                                 .11  2.466        CS 2 RIBLIB     333
13656          0.          0.          1.01        .01                             BA 2 RIBLIB     334
137532.778E-044.900E 005.100E 00                                 2.19 .71          I  2 RIBLIB     335
137542.708E-031.300E 001.530E 00                                 1.48 1.           XE 2 RIBLIB     336
137551.095E+040.           0.          .11                 .92   .20               CS 2 RIBLIB     337
137561.806E-030.           0.                                         0.662        BA*1 RIBLIB     338
13756          0.          0.          4.                                          BA 2 RIBLIB     339
138537.292E-053.400E 003.700E 00                                 3.10 1.5          I  2 RIBLIB     340
138549.722E-032.100E 002.210E 00                                 .96  0.420        XE 2 RIBLIB     341
138552.236E-023.000E-014.000E-01                                 1.10 2.153        CS 2 RIBLIB     342
13856          0.          0.          .4                                          BA 2 RIBLIB     343
139532.314E-051.800E 001.700E 00                                 2.40              I  2 RIBLIB     344
139544.745E-042.900E 002.800E 00                                 2.00 .4           XE 2 RIBLIB     345
139556.597E-031.200E 001.230E 00                                 1.74 0.232        CS 2 RIBLIB     346
139565.764E-021.000E-011.400E-014.                               .91  .053         BA 2 RIBLIB     347
13957          0.          0.          8.9                                         LA 2 RIBLIB     348
140541.852E-043.700E 003.300E 00                                 1.09              XE 2 RIBLIB     349
140557.639E-042.300E 002.100E 00                                 2.66 .59          CS 2 RIBLIB     350
140561.280E 013.000E-010.              20.                       .33  .222         BA 2 RIBLIB     351
140571.675E 000.           2.000E-01                             .48  2.468        LA 2 RIBLIB     352
14058          0.          0.          .6                                          CE 2 RIBLIB     353
141541.968E-051.800E 001.100E 00                                 2.36              XE 2 RIBLIB     354
141552.773E-042.900E 003.700E 00                                 1.72              CS 2 RIBLIB     355
141561.250E-021.200E 009.000E-01                                 1.14 .46          BA 2 RIBLIB     356
141571.625E-011.000E-010.                                        .96  .0272        LA 2 RIBLIB     357
141583.250E 010.           0.          30.                       .15  0.101        CE 2 RIBLIB     358
14159          0.          0.          12.                                         PR 2 RIBLIB     359
142541.736E-053.500E-013.100E-01                                 1.70              XE 2 RIBLIB     360
142552.662E-053.050E 002.870E 00                                 2.98              CS 2 RIBLIB     361
142567.639E-032.200E 001.830E 00                                 .78  .112         BA 2 RIBLIB     362
142575.833E-023.000E-010.                                        1.42 1.164        LA 2 RIBLIB     363
14258          0.          0.          1.                                          CE 2 RIBLIB     364
142598.000E-010.           0.          20.                       .83  .063         PR 2 RIBLIB     365
14260          0.          0.          17.                                         ND 2 RIBLIB     366
143541.157E-053.100E 002.650E 00                                 2.91              XE 2 RIBLIB     367
143552.314E-053.100E 002.650E 00                                 2.32              CS 2 RIBLIB     368
143561.389E-04                                                   1.47              BA 2 RIBLIB     369
143579.722E-03                                                   1.33 1.           LA 2 RIBLIB     370
143581.375E 000.           0.          6.                        .37  .377         CE 2 RIBLIB     371
143591.370E 010.           0.          39.                       .32               PR 2 RIBLIB     372
14360          0.          0.          330.                                        ND 2 RIBLIB     373
144541.157E-052.900E 001.600E 00                                 2.19              XE 2 RIBLIB     374
144552.315E-052.900E 001.600E 00                                 3.50              CS 2 RIBLIB     375
144563.472E-05                                                   1.00              BA 2 RIBLIB     376
144574.630E-05                                                   2.23              LA 2 RIBLIB     377
144582.850E 023.900E-015.900E-011.                               .080 0.030        CE 2 RIBLIB     378
144591.201E-020.           1.400E-01                             1.22 .031         PR 2 RIBLIB     379
14460          0.          0.          5.                                          ND 2 RIBLIB     380
145582.083E-034.200E 003.130E 00                                 .77               CE 2 RIBLIB     381
145592.458E-010.           0.                                    .68  .056         PR 2 RIBLIB     382
14560          0.          0.          50.                                         ND 2 RIBLIB     383
146589.722E-033.200E 002.600E 00                                 .22  0.320        CE 2 RIBLIB     384
146591.667E-021.000E-010.                                        1.27 1.107        PR 2 RIBLIB     385
14660          0.          0.          2.                                          ND 2 RIBLIB     386
147588.333E-040.650E 000.550E 00                                 1.55              CE 2 RIBLIB     387
147598.333E-030.650E 000.550E 00                                 1.12 1.           PR 2 RIBLIB     388
147601.110E+011.300E 001.100E 00                                 .23  0.196        ND 2 RIBLIB     389
147619.855E 020.           0.          230.        .522          .059              PM 2 RIBLIB     390
14762          0.          0.          90.                                         SM 2 RIBLIB     391
148584.861E-041.710E 001.730E 00                                 .95               CE 2 RIBLIB     392
148591.354E-030.           0.                                    2.17 0.300        PR 2 RIBLIB     393
14860          0.          0.          4.                                          ND 2 RIBLIB     394
148615.400E 000.           0.          2000.               1.    .39  1.343        PM*1 RIBLIB     395
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148614.100E 010.          0.          3.000E+04              .41   1.227          PM 2 RIBLIB     396
14862         0.          0.                                                      SM 2 RIBLIB     397
149607.500E-021.300E 001.320E 00                             .55   .5             ND 2 RIBLIB     398
149612.208E 000.          0.                                 .36   .035           PM 2 RIBLIB     399
14962         0.          0.          4.150E 04                                   SM 2 RIBLIB     400
15060         7.400E-011.010E 001.5                                               ND 2 RIBLIB     401
15062         0.          0.          100.                                        SM 2 RIBLIB     402
151608.333E-034.800E-018.000E-01                             .63   0.717          ND 2 RIBLIB     403
151611.183E 002.000E-020.                                    .38   .715           PM 2 RIBLIB     404
151623.285E 040.          0.          1.500E 04              .019  .0004          SM 2 RIBLIB     405
15163         0.          0.          8.700E 03.322                               EU 2 RIBLIB     406
152614.167E-031.500E-013.100E-01                             .86   2.8            PM 2 RIBLIB     407
15262         1.500E-013.100E-01210.                                              SM 2 RIBLIB     408
152633.875E-010.          0.                        1.       .60   .238           EU*1 RIBLIB     409
152634.745E 030.          0.          5000.                  .19   1.209          EU 2 RIBLIB     410
15264         0.          0.          180.                                        GD 2 RIBLIB     411
153613.819E-03 .075       .185                               .62   .3             PM 2 RIBLIB     412
153621.958E 00 .075       .185                               .22   .108           SM 2 RIBLIB     413
15363         0.          0.          320.                                        EU 2 RIBLIB     414
154611.736E-03 .045       .145                               1.                   PM 2 RIBLIB     415
15462          .045       .145        5.                                          SM 2 RIBLIB     416
154635.840E 030.          0.          1400.                  .20   1.351          EU 2 RIBLIB     417
15464         0.          0.                                                      GD 2 RIBLIB     418
155621.528E-023.100E-022.300E-01                             .60   0.115          SM 2 RIBLIB     419
155636.570E 020.          0.          1.300E 04              .046  0.072          EU 2 RIBLIB     420
15564         0.          0.          5.800E 04                                   GD 2 RIBLIB     421
156623.917E-011.300E-021.100E-01                             .30                  SM 2 RIBLIB     422
156631.500E 010.          0.                                 .70   1.2            EU 2 RIBLIB     423
15664         0.          0.                                                      GD 2 RIBLIB     424
157636.417E-017.400E-037.400E-02                             .42   0.525          EU 2 RIBLIB     425
15764         0.          0.          2.400E 05                                   GD 2 RIBLIB     426
158633.194E-022.000E-034.000E-02                             1.04  0.600          EU 2 RIBLIB     427
15864         0.          0.          3.4                                         GD 2 RIBLIB     428
159631.319E-02.00055      .0105                              .86   .2             EU 2 RIBLIB     429
159647.500E-01.00055      .0105                              .29   0.075          GD 2 RIBLIB     430
15965         0.          0.          46.                                         TB 2 RIBLIB     431
160631.736E-02.00135      .00081                             1.5                  EU 2 RIBLIB     432
16064          .00135     .00081      .8                                          GD 2 RIBLIB     433
160657.300E 010.          0.          525.                   .20   1.193          TB 2 RIBLIB     434
16066         0.          0.                                                      DY 2 RIBLIB     435
161642.569E-03 .008       3.900E-03                          .59   0.428          GD 2 RIBLIB     436
161656.900E 000.          0.                                 .15   0.037          TB 2 RIBLIB     437
16166         0.          0.          580.                                        DY 2 RIBLIB     438
162643.650E+02            1.800E-03                          .34   1.             GD 2 RIBLIB     439
162659.333E-02                                               1.68                 TB 2 RIBLIB     440
16266                                 140.                                        DY 2 RIBLIB     441
163652.917E-01            4.000E-04                          1.22  .2             TB 2 RIBLIB     442
16366                     4.000E-04120.                                           DY 2 RIBLIB     443
16466         0.          3.000E-042800.        .714                              DY 2 RIBLIB     444
165668.727E-040.          1.200E-04                     .03  .00840.120           DY*1 RIBLIB     445
165669.583E-020.          0.          4700.                  .44   .0269          DY 2 RIBLIB     446
16567         0.          0.          65.                                         HO 2 RIBLIB     447
166663.333E 000.          6.800E-05                          .12   0.088          DY 2 RIBLIB     448
166671.133E 000.          0.                                 .67   .0558          HO 2 RIBLIB     449
16668         0.          0.          12.       .01                               ER 2 RIBLIB     450
167682.892E-050.          0.                                       0.208          ER*1 RIBLIB     451
16768                                 700.                                        ER 2 RIBLIB     452
145                                                                                    RIBLIB     453
  3 1  4500.                                                                      H  2 RIBLIB     454
  7 4  53.6                                                                       BE 2 RIBLIB     455
 14 6   2.0 E6                                                                    C  2 RIBLIB     456
 18 9 0.078                                                                       F  2 RIBLIB     457
 2211  950.                                                                       NA 2 RIBLIB     458
 2411  0.63                                                                       NA 2 RIBLIB     459
 3114  0.11                                                                       SI 2 RIBLIB     460
 3215  14.3                                                                       P  2 RIBLIB     461
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3516	87.1		S	2	RIBLIB 462
3617	1.2	E8	CL	2	RIBLIB 463
3817	0.026		CL	2	RIBLIB 464
4118	0.0763		AR	2	RIBLIB 465
4219	.52		K	2	RIBLIB 466
4520	164.		CA	2	RIBLIB 467
4720	4.3		CA	2	RIBLIB 468
4621	85.		SC	2	RIBLIB 469
4721	3.43		SC	2	RIBLIB 470
4821	1.83		SC	2	RIBLIB 471
4823	16.1		V	2	RIBLIB 472
5124	27.8		CR	2	RIBLIB 473
5225	5.55		MN	2	RIBLIB 474
5425	300.		MN	2	RIBLIB 475
5625	.11		MN	2	RIBLIB 476
5526	1100.		FE	2	RIBLIB 477
5926	45.1		FE	2	RIBLIB 478
5727	270.		CO	2	RIBLIB 479
5827	0.38		CO*1		RIBLIB 480
5827	72.		CO	2	RIBLIB 481
6027	1.9	E3	CO	2	RIBLIB 482
5928	2.9	E7	NI	2	RIBLIB 483
6328	2.9	E4	NI	2	RIBLIB 484
6528	.11		NI	2	RIBLIB 485
6429	.53		CU	2	RIBLIB 486
6530	245.		ZN	2	RIBLIB 487
6930	.58		ZN*1		RIBLIB 488
6930	.036		ZN	2	RIBLIB 489
7132	12.		GE	2	RIBLIB 490
7333	76.		AS	2	RIBLIB 491
7433	17.5		AS	2	RIBLIB 492
7534	127.		SE	2	RIBLIB 493
8538	.049		SR*1		RIBLIB 494
8538	65.		SR	2	RIBLIB 495
9643	.036		TC*1		RIBLIB 496
9643	4.3		TC	2	RIBLIB 497
9743	.25		TC*1		RIBLIB 498
9743	3.7	E6	TC	2	RIBLIB 499
9744	2.8		RU	2	RIBLIB 500
10346	17.		PD	2	RIBLIB 501
10547	40.		AG	2	RIBLIB 502
10948	475.		CD	2	RIBLIB 503
11349	.073		IN*1		RIBLIB 504
11350	112.		SN	2	RIBLIB 505
12653	13.3		I	2	RIBLIB 506
13155	10.		CS	2	RIBLIB 507
13156	11.6		BA	2	RIBLIB 508
15364	236.		GD	2	RIBLIB 509
16968	9.4		ER	2	RIBLIB 510
17168	0.31		ER	2	RIBLIB 511
17069	127.		TM	2	RIBLIB 512
17169	694.		TM	2	RIBLIB 513
17570	4.1		YB	2	RIBLIB 514
17771	6.8		LU	2	RIBLIB 515
18172	46.		HF	2	RIBLIB 516
18273	112.		TA	2	RIBLIB 517
18174	140.		W	2	RIBLIB 518
18574	74.		W	2	RIBLIB 519
18774	1.		W	2	RIBLIB 520
18375	73.		RE	2	RIBLIB 521
18675	3.79		RE	2	RIBLIB 522
18775	1.8E13		RE	2	RIBLIB 523
18875	.71		RE	2	RIBLIB 524
18576	95.		OS	2	RIBLIB 525
19176	.58		OS*1		RIBLIB 526
19176	16.		OS	2	RIBLIB 527

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19376   1.3                                  OS 2 RIBLIB    529
19077  12.                                   IR 2 RIBLIB    529
19277   74.5                                 IR 2 RIBLIB    530
19477    .79                                 IR 2 RIBLIB    531
19178   3.                                   PT 2 RIBLIB    532
19378   3.4                                  PT*1 RIBLIB    533
19378   1.8 E5                               PT 2 RIBLIB    534
19778    .058                                PT*1 RIBLIB    535
19778    .75                                 PT 2 RIBLIB    536
19679    5.6                                 AU 2 RIBLIB    537
19879    2.7                                 AU 2 RIBLIB    538
19979   3.15                                 AU 2 RIBLIB    539
19780    1.                                  HG*1 RIBLIB    540
19780    2.7                                 HG 2 RIBLIB    541
20380   45.8                                 HG 2 RIBLIB    542
20081    1.13                                TL 2 RIBLIB    543
20181    3.                                  TL 2 RIBLIB    544
20281   12.                                  TL 2 RIBLIB    545
20481   1.1 E3                               TL 2 RIBLIB    546
20382   2.17                                 PB 2 RIBLIB    547
21082   7.1 E3                               PB 2 RIBLIB    548
21282    .44                                 PB 2 RIBLIB    549
20683   6.4                                  BI 2 RIBLIB    550
20783   2.9 E3                               BI 2 RIBLIB    551
21083   5.0                                  BI 2 RIBLIB    552
21283    .042                                BI 2 RIBLIB    553
21084 138.4                                  PO 2 RIBLIB    554
21185    .3                                  AT 2 RIBLIB    555
22388  11.7                                  RA 2 RIBLIB    556
22488   3.64                                 RA 2 RIBLIB    557
22688   5.9 E5                               RA 2 RIBLIB    558
22888   2.4 E3                               RA 2 RIBLIB    559
22789   8.0 E3                               AC 2 RIBLIB    560
22889    .26                                 AC 2 RIBLIB    561
22790  18.4                                  TH 2 RIBLIB    562
22890 700.                                   TH 2 RIBLIB    563
23090   2.9 E7                               TH 2 RIBLIB    564
23190   1.07                                 TH 2 RIBLIB    565
23290   5.1E12                               TH 2 RIBLIB    566
23490  24.1                                  TH 2 RIBLIB    567
23091  17.7                                  PA 2 RIBLIB    568
23191   1.3 E7                               PA 2 RIBLIB    569
23391  27.4                                  PA 2 RIBLIB    570
23092  20.8                                  U  2 RIBLIB    571
23292   2.7 E4                               U  2 RIBLIB    572
23392   5.9 E7                               U  2 RIBLIB    573
23492   9.1 E7                               U  2 RIBLIB    574
23592   2.6E11                               U  2 RIBLIB    575
23692   8.7 E9                               U  2 RIBLIB    576
23892   1.7E12                               U  2 RIBLIB    577
23793   8.3 E8                               NP 2 RIBLIB    578
23993   2.33                                 NP 2 RIBLIB    579
23894   3.3 E4                               PU 2 RIBLIB    580
23994   8.9 E6                               PU 2 RIBLIB    581
24094   2.4 E6                               PU 2 RIBLIB    582
24194   4.8 E3                               PU 2 RIBLIB    583
24294   1.4 E8                               PU 2 RIBLIB    584
24195   1.7 E5                               AM 2 RIBLIB    585
24295   5.6 E4                               AM*1 RIBLIB    586
24295   0.677                                AM 2 RIBLIB    587
24395   2.9 E6                               AM 2 RIBLIB    588
24296 162.5                                  CM 2 RIBLIB    589
24396   1.3 E4                               CM 2 RIBLIB    590
24496   6.7 E3                               CM 2 RIBLIB    591
24596   7.3 E6                               CM 2 RIBLIB    592
24696   2.4 E6                               CM 2 RIBLIB    593
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24997  290.
24998  1.31 E5
25098   3.7 E3
25298  803.
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BK 2 RIBLIB     594
CF 2 RIBLIB     595
CF 2 RIBLIB     596
CF 2 RIBLIB     597
     RIBLIB     598
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1136  ORGAN DATA LIBRARY VERSION 1A   SEPTEMBER 4,1974
  1   3   H 1 .450+04 .120+02 .100+01 .100+01 .100+01 .100-01
  1   3   H 2 .450+04 .120+02 .100+01 .100+01 .100+01 .100-01
  1   3   H 8                                           .100-01
  4   7  BE 1 .536+02 .180+03 .200-02 .250-00 .100+01 .350-01
  4   7  BE 3 .536+02 .120+03 .800-04 .750-02 .300-01 .120-01
  4   7  BE 4 .536+02 .270+03 .200-03 .250-01 .100+00 .160-01
  4   7  BE 5 .536+02 .540+03 .400-05 .500-03 .200-02 .120-01
  4   7  BE 6 .536+02 .450+03 .640-03 .800-01 .320-00 .850-01
  4   7  BE 8                                           .160-01
  6  14   C 1 .200+07 .100+02 .100+01 .750-00 .100+01 .540-01
  6  14   C 6 .200+07 .400+02 .250-01 .200-01 .250-01 .270-00
  6  14   C 7 .200+07 .120+02 .900-00 .380-00 .500-00 .540-01
  9  18   F 1 .780-01 .858+03 .100+01 .750-00 .100+01 .890-00
  9  18   F 6 .780-01 .145+04 .534-00 .400-00 .530-00 .140+01
  9  18   F 8                                           .540+00
 11  22  NA 1 .950+03 .110+02 .100+01 .750-00 .100+01 .160+01
 11  22  NA 8                                           .300+00
 11  24  NA 1 .531-00 .110+02 .100+01 .750-00 .100+01 .270+01
 11  24  NA 6                                           .150+01
 14  31  SI 1 .110+00 .600+02 .650-00 .680-00 .100+01 .590-00
 14  31  SI 8 .110+00 .600+02 .900-01 .700-01 .100+00 .590-00
 14  31  SI 9 .110+00 .600+02 .650-03 .700-03 .100-02 .590-00
 14  31  SI10 .110+00 .600+02 .430-03 .340-03 .500-03 .590-00
 14  31  SI11 .110+00 .600+02 .500-04 .400-04 .600-03 .590-00
 14  31  SI12 .110+00 .600+02 .300-01 .300-01 .400-01 .590-00
 15  32   P 1 .143+02 .257+03 .750-00 .630-00 .100+01 .690-00
 15  32   P 4 .143+02 .120+02 .500-01 .400-01 .700-01 .690-00
 15  32   P 6 .143+02 .115+04 .375-00 .320-00 .200-00 .350+01
 15  32   P 8                                           .690+00
 15  32  P13 .143+02 .257+03 .530-02 .440-02 .700-02 .690-00
 16  35   S 1 .871+02 .900+02 .100+01 .750-00 .100+01 .560-01
 16  35   S 6 .871+02 .600+03 .300-01 .200-01 .300-01 .280-00
 16  35   S 8                                           .960-01
 16  35  S10 .871+02 .623+03 .130-02 .980-03 .130-02 .560-01
 16  35  S12 .871+02 .153+04 .100-01 .750-02 .100-01 .560-01
 17  36  CL 1 .120+09 .290+02 .100+01 .750-00 .100+01 .260-00
 17  36  CL 8                                           .260+00
 17  36  CL 1 .260-01 .290+02 .100+01 .750-00 .100+01 .230+01
 17  36  CL 8                                           .160+01
 19  42   K 1 .520-00 .580+02 .100+01 .750-00 .100+01 .160+01
 19  42   K 4 .520-00 .580+02 .200-01 .150-01 .200-01 .150+01
 19  42   K 5 .520-00 .580+02 .400-02 .300-02 .400-02 .150+01
 19  42   K 8                                           .150+01
 19  42  K13 .520-00 .580+02 .400-01 .300-01 .400-01 .150+01
 19  42  K14 .520-00 .580+02 .650-00 .490-00 .650-00 .160+01
 20  45  CA 1 .164+03 .164+05 .600-00 .550-00 .100+01 .360-01
 20  45  CA 6 .164+03 .180+05 .540-00 .500-00 .900-00 .430-00
 20  45  CA 8                                           .860-01
 20  47  CA 1 .490+01 .164+05 .600-00 .550-00 .100+01 .140+01
 20  47  CA 6 .490+01 .180+05 .540-00 .500-00 .900-00 .260+01
 20  47  CA 8                                           .657-00.81-00.82-00
 21  46  SC 1 .850+02 .300+02 .100-03 .250-00 .100+01 .130+01
 21  46  SC 3 .850+02 .750+02 .200-05 .500-02 .200-01 .500-00
 21  46  SC 4 .850+02 .300+02 .150-04 .400-01 .150-00 .640-00
 21  46  SC 6 .850+02 .330+02 .200-04 .500-01 .200-00 .900-00
 21  46  SC 8                                           .640+00
 21  47  SC 1 .343+01 .300+02 .100-03 .250-00 .100+01 .260-00
 21  47  SC 3 .343+01 .750+02 .200-05 .500-02 .200-01 .200-00
 21  47  SC 4 .343+01 .300+02 .150-04 .400-01 .150-00 .210-00
 21  47  SC 6 .343+01 .330+02 .200-04 .500-01 .200-00 .890-00
 21  47  SC 8                                           .210+00
 21  48  SC 1 .183+01 .300+02 .100-03 .250-00 .100+01 .220+01
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21 46 SC 4 .183+01 .360+02 .150-04 .400-01 .150-00 .110+01
21 46 SC 6 .183+01 .330+02 .200-04 .900-01 .200-00 .160+01
21 46 SC 8                                                .110+01
23 48  V 1 .161+02 .420+02 .200-01 .260-00 .100+01 .190+01
23 48  V 3 .161+02 .740+02 .600-03 .100-01 .400-01 .700-00
23 48  V 4 .161+02 .700+02 .120-02 .200-01 .600-01 .900-00
23 48  V 5 .161+02 .900+02 .200-03 .260-02 .100-01 .700-00
23 48  V 6 .161+02 .130+03 .200-02 .400-01 .140-00 .120+01
23 48  V 8                                                .900+00
24 51 CR 1 .278+02 .616+03 .500-02 .250-00 .100+01 .250-01
24 51 CR 3 .278+02 .616+03 .130-04 .660-03 .270-02 .120-01
24 51 CR 8 .278+02 .616+03 .200-03 .100-01 .400-01 .140-01
24 51 CR15 .278+02 .616+03 .450-05 .230-03 .900-03 .340-02
24 51 CR16 .278+02 .616+03 .450-05 .230-03 .900-03 .840-02
25 52 MN 1 .555+01 .170+02 .100+00 .300-00 .100+01 .210+01
25 52 MN 4 .555+01 .250+02 .200-01 .700-01 .240-00 .960-00
25 52 MN 8                                                .960+00
25 52 MN17 .555+01 .570+01 .300-02 .900-02 .300+01 .560-00
25 54 MN 1 .300+03 .170+02 .100+00 .300-00 .100+01 .510-00
25 54 MN 4 .300+03 .250+02 .200-01 .700-01 .240-00 .230-00
25 54 MN 8                                                .230+00
25 54 MN17 .300+03 .570+01 .300-02 .900-02 .300-01 .130-00
25 56 MN 1 .110+00 .170+02 .100+00 .300-00 .100+01 .190+01
25 56 MN 4 .110+00 .250+02 .200-01 .700-01 .240-00 .130+01
25 56 MN 8                                                .130+01
25 56 MN17 .110+00 .570+01 .300-02 .900-02 .300-01 .110+01
26 55 FE 1 .110+04 .800+03 .100+00 .300-00 .100+01 .650-02
26 55 FE 4 .110+04 .594+03 .130-01 .400-01 .130-00 .650-02
26 55 FE 5 .110+04 .600+03 .200-02 .600-02 .200-01 .650-02
26 55 FE 6 .110+04 .160+04 .100-01 .300-01 .100+00 .650-02
26 55 FE 8 .110+04 .320+04 .200-02 .600-02 .200-01 .650-02
26 59 FE 1 .451+02 .800+03 .100+00 .300-00 .100+01 .810-00
26 59 FE 4 .451+02 .594+03 .130-01 .400-01 .130-00 .420-00
26 59 FE 5 .451+02 .600+03 .200-02 .600-02 .200-01 .340-00
26 59 FE 8 .451+02 .320+04 .200-02 .600-02 .200-01 .420-00
27 57 CO 1 .270+03 .950+01 .300-00 .400-00 .100+01 .900-01
27 57 CO 4 .270+03 .950+01 .700-02 .200-01 .400-01 .530-01
27 57 CO 5 .270+03 .950+01 .420-03 .560-03 .140-02 .450-01
27 57 CO 8                                                .530-01
27 57 CO17 .270+03 .950+01 .600-03 .800-03 .200-02 .400-01
27 58 CO 1 .720+02 .950+01 .300-00 .400-00 .100+01 .610-00
27 58 CO 4 .720+02 .950+01 .700-02 .200-01 .400-01 .290-00
27 58 CO 5 .720+02 .950+01 .420-03 .560-03 .140-02 .220-00
27 58 CO 8                                                .290+00
27 58 CO17 .720+02 .950+01 .600-03 .800-03 .200-02 .170-00
27 581CO 1 .380-00 .950+01 .300-00 .400-00 .100+01 .990-01
27 581CO 4 .380-00 .950+01 .700-02 .200-01 .400-01 .590-01
27 581CO 5 .380-00 .950+01 .420-03 .560-03 .140-02 .480-01
27 581CO 8                                                .230-01.14-00.26-00
27 581CO17 .380-00 .950+01 .600-03 .800-03 .200-02 .390-01
27 60 CO 1 .190+04 .950+01 .300-00 .400-00 .100+01 .150+01
27 60 CO 4 .190+04 .950+01 .700-02 .200-01 .400-01 .720-00
27 60 CO 5 .190+04 .950+01 .420-03 .560-03 .140-02 .560-00
27 60 CO 8                                                .720+00
27 60 CO17 .190+04 .950+01 .600-03 .800-03 .200-02 .440-00
28 59 NI 1 .290+08 .667+03 .300-00 .400-00 .100+01 .770-02
28 59 NI 4 .290+08 .500+03 .200-01 .300-01 .700-01 .770-02
28 59 NI 6 .290+08 .800+03 .150-00 .200-00 .500-00 .770-02
28 59 NI 8                                                .770-02
28 63 NI 1 .290+05 .667+03 .300-00 .400-00 .100+01 .210-01
28 63 NI 4 .290+05 .500+03 .200-01 .300-01 .700-01 .210-01
28 63 NI 6 .290+05 .800+03 .150-00 .200-00 .500-00 .110+00
28 63 NI 8                                                .210-01
28 65 NI 1 .110+00 .667+03 .300-00 .400-00 .100+01 .140+01
28 65 NI 4 .110+00 .500+03 .200-01 .300-01 .700-01 .120+01
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28 65 NI 6                                                          .120+01
29 64 CU 1 .530-00 .300+02 .280-00 .390-00 .100+01 .250-00
29 64 CU 3 .530-00 .100+02 .100-01 .200-01 .500-01 .170-00
29 64 CU 4 .530-00 .150+03 .200-01 .300-01 .800-01 .190-00
29 64 CU 5 .530-00 .200+01 .200-01 .300-01 .700-01 .170-00
29 64 CU 6                                                          .190+00
29 64 CU13 .530-00 .800+03 .300-02 .400-02 .100-01 .210-00
29 64 CU18 .530-00 .300+02 .300-02 .400-02 .100-01 .170-00
30 65 ZN 1 .245+03 .933+03 .100+00 .300-00 .100+01 .320-00
30 65 ZN 3 .245+03 .149+03 .400-02 .120-01 .400-01 .110+00
30 65 ZN 4 .245+03 .910+02 .350-01 .110+00 .350-00 .150-00
30 65 ZN 6 .245+03 .130+04 .150-01 .450-01 .150-00 .940-01
30 65 ZN 8                                                          .150+00
30 65 ZN10 .245+03 .270+03 .900-04 .270-03 .900-03 .560-01
30 65 ZN11 .245+03 .107+03 .400-04 .120-03 .400-03 .560-01
30 65 ZN14 .245+03 .196+04 .300-01 .900-01 .300-00 .320-00
30 65 ZN15 .245+03 .140+02 .600-02 .200-01 .600-01 .560-01
30 65 ZN17 .245+03 .250+02 .300-02 .900-02 .300-01 .640-01
30 69 ZN 1 .360-01 .933+03 .100+00 .300-00 .100+01 .370-00
30 69 ZN 3 .360-01 .149+03 .400-02 .120-01 .400-01 .370-00
30 69 ZN 4 .360-01 .910+02 .350-01 .110+00 .350-00 .370-00
30 69 ZN 6 .360-01 .130+04 .150-01 .450-01 .150-00 .190+01
30 69 ZN 8                                                          .370+00
30 69 ZN10 .360-01 .270+03 .900-04 .270-03 .900-03 .370-00
30 69 ZN11 .360-01 .107+03 .400-04 .120-03 .400-03 .370-00
30 69 ZN14 .360-01 .196+04 .300-01 .900-01 .300-00 .370-00
30 69 ZN15 .360-01 .140+02 .600-02 .200-01 .600-01 .370-00
30 69 ZN17 .360-01 .250+02 .300-02 .900-02 .300-01 .370-00
30 691ZN 1 .580-00 .933+03 .100+00 .300-00 .100+01 .640-00
30 691ZN 3 .580-00 .149+03 .400-02 .120-01 .400-01 .470-00
30 691ZN 4 .580-00 .910+02 .350-01 .110+00 .350-00 .500-00
30 691ZN 6 .580-00 .130+04 .150-01 .450-01 .150-00 .210+01
30 691ZN 8                                                          .467-00.50-00.50-00
30 691ZN10 .580-00 .270+03 .900-04 .270-03 .900-03 .430-00
30 691ZN11 .580-00 .107+03 .400-04 .120-03 .400-03 .430-00
30 691ZN14 .580-00 .196+04 .300-01 .900-01 .300-00 .640-00
30 691ZN15 .580-00 .140+02 .600-02 .200-01 .600-01 .430-00
30 691ZN17 .580-00 .250+02 .300-02 .900-02 .300-01 .450-00
31 72 GA 1 .590-00 .600+01 .100-02 .250-04 .100+01 .180+01
31 72 GA 3 .590-00 .900+01 .200-04 .500-02 .200-01 .890-00
31 72 GA 4 .590-00 .480+01 .250-03 .630-01 .250-00 .110+01
31 72 GA 5 .590-00 .600+01 .100-04 .250-02 .100-01 .890-00
31 72 GA 6 .590-00 .120+02 .300-03 .750-01 .300-00 .260+01
31 72 GA 8                                                          .110+01
32 71 GE 1 .120+02 .100+01 .100-01 .260-00 .100+01 .100-01
32 71 GE 3 .120+02 .120+02 .300-03 .800-02 .300-01 .100-01
32 71 GE 4 .120+02 .750+01 .200-03 .500-02 .200-01 .100-01
32 71 GE 8                                                          .100-01
33 73 AS 1 .760+02 .260+03 .300-01 .270-00 .100+01 .610-01
33 73 AS 3 .760+02 .550+03 .300-03 .270-02 .100-01 .360-01
33 73 AS 4 .760+02 .550+03 .900-03 .800-02 .300-01 .410-01
33 73 AS 8                                                          .410-01
33 74 AS 1 .175+02 .200+03 .300-01 .270-00 .100+01 .560-00
33 74 AS 3 .175+02 .550+03 .300-03 .270-02 .100-01 .340-00
33 74 AS 4 .175+02 .550+03 .900-03 .800-02 .300-01 .300-00
33 74 AS 8                                                          .380+00
33 76 AS 1 .111+01 .290+03 .300-01 .270-00 .100+01 .130+01
33 76 AS 3 .111+01 .550+03 .300-03 .270-02 .100-01 .110+01
33 76 AS 4 .111+01 .550+03 .900-03 .800-02 .300-01 .110+01
33 76 AS 8                                                          .110+01
33 77 AS 1 .162+01 .260+03 .300-01 .270-00 .100+01 .240-00
33 77 AS 3 .162+01 .550+03 .300-03 .270-02 .100-01 .240-00
33 77 AS 4 .162+01 .550+03 .900-03 .800-02 .300-01 .240-00
33 77 AS 8                                                          .240+00
34 73 SE 1 .127+03 .110+02 .900-00 .700-00 .100+01 .200-00
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34 79 ZR 4 .127+03 .240+02 .600-01 .500-01 .700-01 .940-01
34 79 ZR 5 .127+03 .180+02 .450-02 .350-02 .500-02 .720-01
34 79 ZR 8                                                .940+01
35 82 FR 1 .150+01 .800+01 .100+01 .750-00 .100+01 .180+01
35 82 FR 8                                                .850+00
37 86 FB 1 .186+02 .450+02 .100+01 .750-00 .100+01 .700-00
37 86 FB 4 .186+02 .630+02 .500-01 .400-01 .500-01 .660-00
37 86 FB 5 .186+02 .450+02 .400-02 .300-02 .400-02 .660-00
37 86 FB 6                                                .660+00
37 86 FB14 .186+02 .800+02 .450-00 .340-00 .450-00 .700-00
37 86 FB17 .186+02 .600+02 .300-02 .230-02 .300-02 .650-00
37 87 FB 1 .180+14 .450+02 .100+01 .750-00 .100+01 .900-01
37 87 FB 4 .180+14 .630+02 .500-01 .400-01 .500-01 .900-01
37 87 FB 5 .180+14 .450+02 .400-02 .300-02 .400-02 .900-01
37 87 FB 6                                                .900-01
37 87 FB14 .180+14 .800+02 .450-00 .340-00 .450-00 .900-01
37 87 FB17 .180+14 .600+02 .300-02 .230-02 .300-02 .900-01
38 85 SR 1 .650+02 .130+05 .300-00 .400-00 .100+01 .330-00
38 85 SR 6 .650+02 .180+05 .900-01 .120+00 .175-00 .910-01
38 85 SR 6                                                .160+00
38 851SR 1 .490-01 .130+05 .300-00 .400-00 .100+01 .470-00
38 851SR 6 .490-01 .180+05 .900-01 .120+00 .175-00 .130-00
38 851SR 8                                                .150+00.17+00.23+00
38 89 SR 1 .505+02 .130+05 .300-00 .400-00 .100+01 .550-00
38 89 SR 6 .505+02 .180+05 .900-01 .120+00 .175-00 .280+01
38 89 SR 8                                                .550+00
38 89 SR20 .505+02 .300-00 .100+01 .625-00 .000    .550-00
38 89 SR21 .505+02 .300-00 .100+01 .625-00 .000    .550-00
38 89 SR22 .505+02 .300-00 .100+01 .625-00 .000    .550-00
38 89 SR23 .505+02 .300-00 .100+01 .625-00 .000    .550-00
38 90 SR 1 .100+05 .130+05 .300-00 .400-00 .100+01 .110+01
38 90 SR 6 .100+05 .180+05 .900-01 .120+00 .750-01 .550+01
38 90 SR 8                                                .452-00.11+01.11+01
38 91 SR 1 .400-00 .130+05 .300-00 .400-00 .100+01 .240+01
38 91 SR 6 .400-00 .180+05 .900-01 .120+00 .175-00 .740+01
38 91 SR 8                                                .115+01.14+01.17+01
38 92 SR 1 .110+00 .130+05 .300-00 .400-00 .100+01 .260+01
38 92 SR 6 .110+00 .180+05 .900-01 .120+00 .175-00 .800+01
38 92 SR 8                                                .175+01.19+01.19+01
39 90  Y 1 .268+01 .140+05 .100-03 .250-00 .100+01 .990-00
39 90  Y 6 .268+01 .180+05 .750-04 .190-00 .750-00 .440+01
39 90  Y 8                                                .890+00
39 91  Y 1 .580+02 .140+05 .100-03 .250-00 .100+01 .590-00
39 91  Y 6 .580+02 .180+05 .750-04 .190-00 .750-00 .290+01
39 91  Y 8                                                .590+00
39 911 Y 1 .350-01 .140+05 .100-03 .250-00 .100+01 .930-00
39 911 Y 6 .350-01 .180+05 .750-04 .190-00 .750-00 .300+01
39 911 Y 8                                                .160-00.42-00.68-00
39 92  Y 1 .150-00 .140+05 .100-03 .250-00 .100+01 .160+01
39 92  Y 6 .150-00 .180+05 .750-04 .190-00 .750-00 .590+01
39 92  Y 8                                                .150+01
39 93  Y 1 .420-00 .140+05 .100-03 .250-00 .100+01 .170+01
39 93  Y 6 .420-00 .180+05 .750-04 .190-00 .750-00 .650+01
39 93  Y 8                                                .150+01.15+01.15+01
40 93 ZR 1 .480+09 .450+03 .100-03 .250-00 .100+01 .240-01
40 93 ZR 3 .480+09 .900+03 .200-05 .500-02 .200-01 .240-01
40 93 ZR 4 .480+09 .320+03 .700-05 .200-01 .700-01 .250-01
40 93 ZR 5 .480+09 .900+03 .600-06 .150-02 .600-02 .250-01
40 93 ZR 6 .480+09 .100+04 .360-04 .900-01 .360-00 .110+00
40 93 ZR 8                                                .190-01.20-01.24-01
40 95 ZR 1 .633+02 .450+03 .100-03 .250-00 .100+01 .110+01
40 95 ZR 3 .633+02 .900+03 .200-05 .500-02 .200-01 .460-00
40 95 ZR 4 .633+02 .320+03 .700-05 .200-01 .700-01 .570-00
40 95 ZR 5 .633+02 .900+03 .600-06 .150-02 .600-02 .460-00
40 95 ZR 6 .633+02 .100+04 .360-04 .900-01 .360-00 .110+01
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40 97 ZR 1 .710-00 .450+03 .100-03 .250-00 .100+01 .210+01
40 97 ZR 3 .710-00 .900+03 .200-05 .500-02 .200-01 .150+01
40 97 ZR 4 .710-00 .320+03 .700-05 .200-01 .700-01 .160+01
40 97 ZR 5 .710-00 .900+03 .600-06 .150-02 .600-02 .150+01
40 97 ZR 6 .710-00 .100+04 .360-04 .900-01 .360-00 .620+01
40 97 ZR 8                                          .155+01.16+01.16+01
41 931NB 1 .370+04 .760+03 .100-03 .250-00 .100+01 .380-01
41 931NB 3 .370+04 .760+03 .200-05 .500-02 .200-01 .380-01
41 931NB 4 .370+04 .345+03 .900-05 .200-01 .900-01 .380-01
41 931NB 5 .370+04 .950+02 .800-06 .200-02 .800-02 .380-01
41 931NB 6 .370+04 .100+04 .380-04 .100+00 .380-00 .120+00
41 931NB 8                                          .380-01
41 95 NB 1 .350+02 .760+03 .100-03 .250-00 .100+01 .510-00
41 95 NB 3 .350+02 .760+03 .200-05 .500-02 .200-01 .200-00
41 95 NB 4 .350+02 .840+03 .900-05 .200-01 .900-01 .260-00
41 95 NB 5 .350+02 .950+02 .800-06 .200-02 .800-02 .200-00
41 95 NB 6 .350+02 .100+04 .380-04 .100+00 .380-00 .370-00
41 95 NB 8                                          .260+00
41 97 NB 1 .510-01 .760+03 .100-03 .250-00 .100+01 .870-00
41 97 NB 3 .510-01 .760+03 .200-05 .500-02 .200-01 .600-00
41 97 NB 4 .510-01 .840+03 .900-05 .200-01 .900-01 .640-00
41 97 NB 5 .510-01 .950+02 .800-06 .200-02 .800-02 .600-00
41 97 NB 6 .510-01 .100+04 .380-04 .100+00 .380-00 .240+01
41 97 NB 8                                          .640+00
42 99 MO 1 .279+01 .500+01 .600-00 .650-00 .100+01 .510-00
42 99 MO 3 .279+01 .300+01 .600-01 .500-01 .800-01 .480-00
42 99 MO 4 .279+01 .450+02 .600-01 .650-01 .100+00 .480-00
42 99 MO 8                                          .470-00.47-00.47-00
43 96 TC 1 .430+01 .100+01 .500-00 .500-00 .100+01 .140+01
43 96 TC 3 .430+01 .200+02 .500-02 .500-02 .100-01 .470-00
43 96 TC 4 .430+01 .300+02 .150-02 .150-02 .300-02 .640-00
43 96 TC 6 .430+01 .250+02 .100-02 .100-02 .200-02 .350-00
43 96 TC 8 .430+01 .500+01 .450-03 .450-03 .900-03 .640-00
43 96 TC12 .430+01 .100+02 .500-02 .500-02 .100-01 .830-02
43 961TC 1 .360-01 .100+01 .500-00 .500-00 .100+01 .300-00
43 961TC 3 .360-01 .200+02 .500-02 .500-02 .100-01 .420-00
43 961TC 4 .360-01 .300+02 .150-02 .150-02 .300-02 .600-00
43 961TC 6 .360-01 .250+02 .100-02 .100-02 .200-02 .390-00
43 961TC 8                                          .155-00.62-00.67-00
43 961TC12 .360-01 .100+02 .500-02 .500-02 .100-01 .210-01
43 97 TC 1 .370+07 .100+01 .500-00 .500-00 .100+01 .200-01
43 97 TC 3 .370+07 .200+02 .500-02 .500-02 .100-01 .200-01
43 97 TC 4 .370+07 .300+02 .150-02 .150-02 .300-02 .200-01
43 97 TC 6 .370+07 .250+02 .100-02 .100-02 .200-02 .190-01
43 97 TC 8 .370+07 .500+01 .450-03 .450-02 .900-03 .200-01
43 97 TC12 .370+07 .100+02 .500-02 .500-02 .100-01 .110-02
43 971TC 1 .920+02 .100+01 .500-00 .500-00 .100+01 .900-01
43 971TC 3 .920+02 .200+02 .500-02 .500-02 .100-01 .900-01
43 971TC 4 .920+02 .300+02 .150-02 .150-02 .300-02 .900-01
43 971TC 6 .920+02 .250+02 .100-02 .100-02 .200-02 .370-00
43 971TC 8                                          .900-01.90-01.90-01
43 971TC12 .920+02 .100+02 .500-02 .500-02 .100-01 .710-01
43 99 TC 1 .730+08 .100+01 .500-00 .500-00 .100+01 .940-01
43 99 TC 3 .730+08 .200+02 .500-02 .500-02 .100-01 .940-01
43 99 TC 4 .730+08 .300+02 .150-02 .150-02 .300-02 .940-01
43 99 TC 6 .730+08 .250+02 .100-02 .100-02 .200-02 .940-01
43 99 TC 8 .730+08 .500+01 .450-03 .450-03 .900-03 .940-01
43 99 TC12 .730+08 .100+02 .500-02 .500-02 .100-01 .470-00
44 97 FU 1 .280+01 .730+01 .300-01 .270-00 .100+01 .150-00
44 97 FU 3 .280+01 .250+01 .600-02 .500-01 .200-00 .770-01
44 97 FU 6 .280+01 .160+02 .240-02 .200-01 .800-01 .130-00
44 97 FU 8                                          .790-01.11+00.15-00
44103 FU 1 .410+02 .730+01 .300-01 .270-00 .100+01 .440-00
44103 FU 3 .410+02 .250+01 .600-02 .500-01 .200-00 .220-00
44103 FU 6 .410+02 .160+02 .240-02 .200-01 .800-01 .620-00
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44105 FU 1 .190-00 .730+01 .300-01 .270-00 .100+01 .120+01
44105 FU 3 .190-00 .250+01 .600-02 .500-01 .200-00 .840-00
44105 FU 6 .190-00 .160+02 .240-02 .200-01 .800-01 .350+01
44105 FU 8                                          .795-00.90-00.91-00
44106 FU 1 .365+03 .730+01 .300-01 .270-00 .100+01 .140+01
44106 FU 3 .365+03 .250+01 .600-02 .500-01 .200-00 .130+01
44106 FU 6 .365+03 .160+02 .240-02 .200-01 .800-01 .650+01
44106 FU 8                                          .140+01
44106 FU20 .365+03 .300-01 .100+01 .625-00 .000     .140+01
44106 FU21 .365+03 .300-01 .100+01 .625-00 .000     .140+01
44106 FU22 .365+03 .300-01 .100+01 .625-00 .000     .130+01
44106 FU23 .365+03 .300-01 .100+01 .625-00 .000     .130+01
45103 FH 1 .380-01 .104+02 .200-00 .350-00 .100+01 .550-01
45103 FH 3 .380-01 .280+02 .600-02 .100-01 .300-01 .540-01
45103 FH 4 .380-01 .182+02 .800-02 .140-01 .400-01 .550-01
45103 FH 5 .380-01 .208+02 .200-02 .350-02 .100-01 .540-01
45103 FH 6 .380-01 .166+02 .100-01 .200-01 .500-01 .190-00
45103 FH 8                                          .550-01
45105 FH 1 .152+01 .104+02 .200-00 .350-00 .100+01 .200-00
45105 FH 3 .152+01 .280+02 .600-02 .100-01 .300-01 .190-00
45105 FH 4 .152+01 .182+02 .800-02 .140-01 .400-01 .190-00
45105 FH 5 .152+01 .208+02 .200-02 .350-02 .100-01 .190-00
45105 FH 6 .152+01 .166+02 .100-01 .200-01 .500-01 .950-00
45105 FH 8                                          .190-01
46103 FD 1 .170+02 .500+01 .200-00 .350-00 .100+01 .640-01
46103 FD 3 .170+02 .300+02 .200-01 .300-01 .800-01 .610-01
46103 FD 4 .170+02 .190+02 .200-01 .300-01 .900-01 .630-01
46103 FD 5 .170+02 .150+02 .200-02 .350-02 .100-01 .610-01
46103 FD 8                                          .625-01.64-01.64-01
46109 FD 1 .570-00 .500+01 .200-00 .350-00 .100+01 .420-00
46109 FD 3 .570-00 .300+02 .200-01 .300-01 .800-01 .420-00
46109 FD 4 .570-00 .190+02 .200-01 .300-01 .900-01 .420-00
46109 FD 5 .570-00 .150+02 .200-02 .350-02 .100-01 .420-00
46109 FD 8                                          .420+00
47105 AG 1 .400+02 .500+01 .100-01 .260-00 .100+01 .630-00
47105 AG 3 .400+02 .100+02 .200-03 .500-02 .200-01 .220-00
47105 AG 4 .400+02 .150+02 .300-03 .770-02 .300-01 .290-00
47105 AG 6 .400+02 .300+02 .500-03 .130-01 .500-01 .160-00
47105 AG 8                                          .290+00
47110AG 1 .270+03 .500+01 .100-01 .260-00 .100+01 .170+01
47110AG 3 .270+03 .100+02 .200-03 .500-02 .200-01 .650-00
47110AG 4 .270+03 .150+02 .300-03 .770-02 .300-01 .840-00
47110AG 6 .270+03 .300+02 .500-03 .130-01 .500-01 .110+01
47110AG 8                                           .840+00
47111 AG 1 .750+01 .500+01 .100-01 .260-00 .100+01 .400-00
47111 AG 3 .750+01 .100+02 .200-03 .500-02 .200-01 .370-00
47111 AG 4 .750+01 .150+02 .300-03 .770-02 .300-01 .380-00
47111 AG 6 .750+01 .300+02 .500-03 .130-01 .500-01 .180+01
47111 AG 8                                          .380+00
48109 CD 1 .475+03 .200+03 .250-02 .250-00 .100+01 .110+00
48109 CD 3 .475+03 .300+03 .250-03 .250-01 .100+00 .980-01
48109 CD 4 .475+03 .200+03 .190-02 .190-00 .750-00 .100+00
48109 CD 8                                          .100+00
48115 CD 1 .220+01 .200+03 .250-02 .250-00 .100+01 .710-00
48115 CD 3 .220+01 .300+03 .250-03 .250-01 .100+00 .560-00
48115 CD 4 .220+01 .200+03 .190-02 .190-00 .750-00 .580-00
48115 CD 8                                          .650-18.38-16.39-15
48115IFD 1 .430+02 .200+03 .250-02 .250-00 .100+01 .610-00
48115ICD 3 .430+02 .300+03 .250-03 .250-01 .100+00 .610-00
48115ICD 4 .430+02 .200+03 .190-02 .190-00 .750-00 .610-00
48115ICD 6                                          .610-00.61-00.61-00
491131IN 1 .730-01 .480+02 .200-02 .250-00 .100+01 .290-00
491131IN 3 .730-01 .600+02 .800-04 .100-01 .400-01 .190-00
491131IN 4 .730-01 .560+02 .280-03 .400-01 .140-00 .210-00
491131IN 5 .730-01 .480+02 .400-04 .500-02 .200-01 .190-00
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491131IN 6                                                    .210+00
491131IN12 .730-01 .670+02 .360-03 .500-01 .180-00 .130-00
491131IN16 .730-01 .840+01 .800-06 .100-03 .400-03 .160-00
4911-1IN 1 .490+02 .480+02 .200-02 .250-00 .100+01 .970-00
491141IN 3 .490+02 .600+02 .800-04 .100-01 .400-01 .930-00
491141IN 4 .490+02 .580+02 .280-03 .400-01 .140-00 .940-00
491141IN 5 .490+02 .480+02 .400-04 .500-02 .200-01 .930-00
491141IN 6 .490+02 .570+02 .340-03 .400-01 .170-00 .450+01
491141IN 8                                                    .940+00
491141IN12 .490+02 .670+02 .360-03 .500-01 .180-00 .900-00
491141IN16 .490+02 .840+01 .800-06 .100-03 .400-03 .920-00
49115 IN 1 .220+18 .480+02 .200-02 .250-00 .100+01 .170-00
49115 IN 3 .220+18 .600+02 .800-04 .100-01 .400-01 .170-00
49115 IN 4 .220+18 .580+02 .280-03 .400-01 .140-00 .170-00
49115 IN 5 .220+18 .480+02 .400-04 .500-02 .200-01 .170-00
49115 IN 6 .220+18 .570+02 .340-03 .400-01 .170-00 .850-00
49115 IN 8                                                    .170+00
49115 IN12 .220+18 .670+02 .360-03 .500-01 .180-00 .170-00
49115 IN16 .220+18 .840+01 .800-06 .100-03 .400-03 .170-00
491151IN 1 .190-00 .480+02 .200-02 .250-00 .100+01 .260-00
491151IN 3 .190-00 .600+02 .800-04 .100-01 .400-01 .190-00
491151IN 4 .190-00 .580+02 .280-03 .400-01 .140-00 .200-00
491151IN 5 .190-00 .480+02 .400-04 .500-02 .200-01 .190-00
491151IN 6 .190-00 .570+02 .340-03 .400-01 .170-00 .740-00
491151IN 8                                                    .773-18.39-16.39-15
491151IN12 .190-00 .670+02 .360-03 .500-01 .180-00 .140-00
491151IN16 .190-00 .840+01 .800-06 .100-03 .400-03 .160-00
50113 SN 1 .112+03 .350+02 .500-01 .280-00 .100+01 .320-00
50113 SN 4 .112+03 .700+02 .500-03 .280-02 .100-01 .230-00
50113 SN 6 .112+03 .100+03 .200-01 .800-01 .300-01 .700-00
50113 SN 8                                                    .220-00.23-00.23-00
50113 SN15 .112+03 .350+02 .800-04 .440-03 .160-02 .160-00
50113 SN16 .112+03 .700+02 .500-05 .280-04 .100-03 .160-00
50125 SN 1 .950+01 .350+02 .500-01 .280-00 .100+01 .940-00
50125 SN 4 .950+01 .700+02 .500-03 .280-02 .100-01 .940-00
50125 SN 6 .950+01 .100+03 .200-01 .800-02 .300-00 .480+01
50125 SN 8                                                    .930-00.94-00.10+01
50125 SN15 .950+01 .350+02 .800-04 .440-03 .160-02 .940-00
50125 SN16 .950+01 .700+02 .500-05 .280-04 .100-03 .930-00
51122 SB 1 .280+01 .380+02 .300-01 .270-00 .100+01 .820-00
51122 SB 4 .280+01 .380+02 .600-04 .500-03 .200-02 .670-00
51122 SB 6 .280+01 .100+03 .300-02 .300-01 .100-01 .270+01
51122 SB 8 .280+01 .100+03 .900-03 .800-02 .300-01 .670-00
51122 SB16 .280+01 .400+01 .900-06 .800-05 .300-04 .590-00
51124 SB 1 .600+02 .380+02 .300-01 .270-00 .100+01 .160+01
51124 SB 4 .600+02 .380+02 .600-04 .500-03 .200-02 .920-00
51124 SB 6 .600+02 .100+03 .300-02 .300-01 .100+00 .230+01
51124 SB 8 .600+02 .100+03 .900-03 .800-02 .300-01 .920-00
51124 SB16 .600+02 .400+01 .900-06 .800-05 .300-04 .570-00
51125 SB 1 .877+03 .380+02 .300-01 .270-00 .100+01 .340-00
51125 SB 4 .877+03 .380+02 .600+06 .500-03 .200-02 .230-00
51125 SB 6 .877+03 .100+03 .300-02 .300-01 .100+00 .690-00
51125 SB 8                                                    .211-00.23-00.26-00
51125 SB16 .877+03 .400+01 .900-06 .800-05 .300-04 .150-00
521251TE 1 .580+02 .150+02 .250-00 .360-00 .100+01 .150-00
521251TE 3 .580+02 .300+02 .200-01 .300-01 .700-01 .140-00
521251TE 4 .580+02 .300+02 .100-01 .200-01 .500-01 .140-00
521251TE 5 .580+02 .300+02 .250-02 .380-02 .100-01 .140-00
521251TE 6 .580+02 .300+02 .230-01 .340-01 .900-01 .510-00
521251TE 8                                                    .140+00
521251TE10 .580+02 .300+02 .750-03 .110-02 .300-02 .110+00
521251TE16 .580+02 .900+01 .250-03 .380-03 .300-00 .110+00
52127 TE 1 .390-00 .150+02 .250-00 .380-00 .100+01 .240-00
52127 TE 3 .390-00 .300+02 .200-01 .300-01 .700-01 .240-00
52127 TE 4 .390-00 .300+02 .100-01 .200-01 .500-01 .240-00
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52127 TE 6 .390-00 .300+02 .230-01 .340-01 .900-01 .120+01
52127 TE 8                                          .240+00
52127 TE10 .390-00 .300+02 .750-03 .110-02 .300-02 .240-00
52127 TE16 .390-00 .900+01 .250-03 .380-03 .300-00 .240-00
521271TE 1 .105+03 .150+02 .250-00 .380-00 .100+01 .320-00
521271TE 3 .105+03 .300+02 .200-01 .300-01 .700-01 .320-00
521271TE 4 .105+03 .300+02 .100-01 .200-01 .500-01 .320-00
521271TE 5 .105+03 .300+02 .250-02 .380-02 .100-01 .320-00
521271TE 6 .105+03 .300+02 .230-01 .340-01 .900-01 .150+01
521271TE 8                                          .256-00.32-00.32-00
521271TE10 .105+03 .300+02 .750-03 .110-02 .300-02 .310-00
521271TE16 .105+03 .900+01 .250-03 .380-03 .300-00 .300-00
52129 TE 1 .510-01 .150+02 .250-00 .380-00 .100+01 .980-00
52129 TE 3 .510-01 .300+02 .200-01 .300-01 .700-01 .680-00
52129 TE 4 .510-01 .300+02 .100-01 .200-01 .500-01 .730-00
52129 TE 5 .510-01 .300+02 .250-02 .380-02 .100-01 .680-00
52129 TE 6 .510-01 .300+02 .230-01 .340-01 .900-01 .280+01
52129 TE 8                                          .730-00.73-00.73-00
52129 TE10 .510-01 .300+02 .750-03 .110-02 .300-02 .600-00
52129 TE16 .510-01 .900+01 .250-03 .380-03 .300-00 .600-00
521291TE 1 .330+02 .150+02 .250-00 .380-00 .100+01 .110+01
521291TE 3 .330+02 .300+02 .200-01 .300-01 .700-01 .780-00
521291TE 4 .330+02 .300+02 .100-01 .200-01 .500-01 .830-00
521291TE 5 .330+02 .300+02 .250-02 .380-02 .100-01 .780-00
521291TE 6 .330+02 .300+02 .230-01 .340-01 .900-01 .320+01
521291TE 8                                          .795-00.83-00.83-00
521291TE10 .330+02 .300+02 .750-03 .110-02 .300-02 .690-00
521291TE16 .330+02 .900+01 .250-03 .380-03 .300-00 .680-00
521311TE 1 .125+01 .150+02 .250-00 .380-00 .100+01 .160+01
521311TE 3 .125+01 .300+02 .200-01 .300-01 .700-01 .810-00
521311TE 4 .125+01 .300+02 .100-01 .200-01 .500-01 .870-00
521311TE 5 .125+01 .300+02 .250-02 .380-02 .100-01 .800-00
521311TE 6 .125+01 .300+02 .230-01 .340-01 .900-01 .260+01
521311TE 8                                          .763-00.99-00.10+01
521311TE16 .125+01 .900+01 .250-03 .380-03 .300-00 .690-00
52132 TE 1 .320+01 .150+02 .250-00 .380-00 .100+01 .190+01
52132 TE 3 .320+01 .300+02 .200-01 .300-01 .700-01 .960-00
52132 TE 4 .320+01 .300+02 .100-01 .200-01 .500-01 .110+01
52132 TE 5 .320+01 .300+02 .250-02 .380-02 .100-01 .960-00
52132 TE 6 .320+01 .300+02 .230-01 .340-01 .900-01 .310+01
52132 TE 8                                          .104+01.11+01.11+01
52132 TE10 .320+01 .300+02 .750-03 .110-02 .300-02 .730-00
52132 TE16 .320+01 .900+01 .250-03 .380-03 .300-00 .160-00
53126  I 1 .133+02 .138+03 .100+01 .750-00 .100+01 .230-00
53126  I 8                                          .180+01
53126  I16 .133+02 .138+03 .300-00 .230-00 .300-00 .160-00
53129  I 1 .630+10 .138+03 .100+01 .750-00 .100+01 .890-01
53129  I 3 .630+10 .700+01 .400-01 .300-01 .400-01 .210-09
53129  I 4 .630+10 .700+01 .120+00 .900-01 .120+00 .460-09
53129  I 5 .630+10 .700+01 .500-02 .380-02 .500-02 .170-09
53129  I 6 .630+10 .140+02 .700-01 .530-01 .700-01 .960-10
53129  I 8                                          .820-01
53129  I10 .630+10 .700+01 .500-02 .380-02 .500-02 .150-09
53129  I16 .630+10 .138+03 .300-00 .230-00 .300-00 .600-01
53131  I 1 .805+01 .138+03 .100+01 .750-00 .100+01 .440-00
53131  I 8                                          .300+00
53131  I16 .805+01 .138+03 .300-00 .230-00 .300-00 .230-00
53132  I 1 .970-01 .138+03 .100+01 .750-00 .100+01 .170+01
53132  I 3 .970-01 .700+01 .400-01 .300-01 .400-01 .850-00
53132  I 4 .970-01 .700+01 .120+00 .900-01 .120+00 .990-00
53132  I 5 .970-01 .700+01 .500-02 .380-02 .500-02 .850-00
53132  I 6 .970-01 .140+02 .700-01 .530-01 .700-01 .270+01
53132  I 8                                          .100+00
53132  I10 .970-01 .700+01 .500-02 .380-02 .500-02 .640-00
53132  I16 .970-01 .138+03 .300-00 .230-00 .300-00 .650-00
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53133  I16 .370-00 .133+03 .300-00 .230-00 .300-00 .540-00
53134  I 1 .360-01 .139+03 .100+01 .750-00 .100+01 .150+01
53134  I 8                                         .110+01
53134  I16 .360-01 .138+03 .300-00 .230-00 .300-00 .820-00
53135  I 1 .280-00 .133+03 .100+01 .750-00 .100+01 .130+01
53135  I 8                                         .990-00.11+01.11+01
53135  I16 .280-00 .138+03 .300-00 .230-00 .300-00 .520-00
55131 CS 1 .100+02 .700+02 .100+01 .750-00 .100+01 .290-01
55131 CS 3 .100+02 .420+02 .100-01 .750-02 .100-01 .210-01
55131 CS 4 .100+02 .900+02 .700-01 .500-01 .700-01 .240-01
55131 CS 5 .100+02 .980+02 .500-02 .380-02 .500-02 .210-01
55131 CS 6 .100+02 .140+03 .400-01 .300-01 .400-01 .170-01
55131 CS 8 .100+02 .140+03 .300-02 .230-02 .300-02 .240-01
55131 CS14 .100+02 .140+03 .400-00 .300-00 .400-00 .290-01
55134 CS 1 .840+03 .700+02 .100+01 .750-00 .100+01 .110+01
55134 CS 3 .840+03 .420+02 .100-01 .750-02 .100-01 .460-00
55134 CS 4 .840+03 .900+02 .700-01 .500-01 .700-01 .570-00
55134 CS 5 .840+03 .980+02 .500-02 .380-02 .500-02 .460-00
55134 CS 6 .840+03 .140+03 .400-01 .300-01 .400-01 .990-00
55134 CS 8 .840+03 .140+03 .300-02 .230-02 .300-02 .570-00
55134 CS14 .840+03 .140+03 .400-00 .300-00 .400-00 .110+01
55134CS 1 .130-00 .700+02 .100+01 .750-00 .100+01 .190-00
55134CS 3 .130-00 .420+02 .100-01 .750-02 .100-01 .110+00
55134CS 4 .130-00 .900+02 .700-01 .500-01 .700-01 .150-00
55134CS 5 .130-00 .980+02 .500-02 .380-02 .500-02 .130-00
55134CS 6 .130-00 .140+03 .400-01 .300-01 .400-01 .490-00
55134CS 8                                         .927-01.12+00.30-00
55134CS14 .130-00 .140+03 .400-00 .300-00 .400-00 .260-00
55135 CS 1 .110+10 .700+02 .100+01 .750-00 .100+01 .660-01
55135 CS 3 .110+10 .420+02 .100-01 .750-02 .100-01 .660-01
55135 CS 4 .110+10 .900+02 .700-01 .500-01 .700-01 .660-01
55135 CS 5 .110+10 .980+02 .500-02 .380-02 .500-02 .660-01
55135 CS 6 .110+10 .140+03 .400-01 .300-01 .400-01 .330-00
55135 CS 8 .110+10 .140+03 .300-02 .230-02 .300-02 .660-01
55135 CS14 .110+10 .140+03 .400-00 .300-00 .400-00 .660-01
55136 CS 1 .130+02 .700+02 .100+01 .750-00 .100+01 .650-00
55136 CS 3 .130+02 .420+02 .100-01 .750-02 .100-01 .290-00
55136 CS 4 .130+02 .900+02 .700-01 .500-01 .700-01 .350-00
55136 CS 5 .130+02 .980+02 .500-02 .380-02 .500-02 .290-00
55136 CS 6 .130+02 .140+03 .400-01 .300-01 .400-01 .720-00
55136 CS 8 .130+02 .140+03 .300-02 .230-02 .300-02 .350-00
55136 CS14 .130+02 .140+03 .400-00 .300-00 .400-00 .650-00
55137 CS 1 .110+05 .700+02 .100+01 .750-00 .100+01 .590-00
55137 CS 3 .110+05 .420+02 .100-01 .750-02 .100-01 .370-00
55137 CS 4 .110+05 .900+02 .700-01 .500-01 .700-01 .410-00
55137 CS 5 .110+05 .980+02 .500-02 .380-02 .500-02 .370-00
55137 CS 6 .110+05 .140+03 .400-01 .300-01 .400-01 .140+01
55137 CS 8 .110+05 .140+03 .300-02 .230-02 .300-02 .410-00
55137 CS14 .110+05 .140+03 .400-00 .300-00 .400-00 .590-00
56131 BA 1 .116+02 .650+02 .500-01 .280-00 .100+01 .380-00
56131 BA 3 .116+02 .850+01 .500-05 .280-04 .100-03 .140-00
56131 BA 4 .116+02 .975+03 .300-04 .170-03 .600-03 .190-00
56131 BA 5 .116+02 .130+02 .250-05 .140-04 .500-04 .140-00
56131 BA 6 .116+02 .650+02 .350-01 .190-00 .700-00 .110+00
56131 BA 8                                         .172-00.19-00.19-00
56131 BA14 .116+02 .200+04 .150-03 .830-03 .300-02 .380-00
56140 BA 1 .128+02 .650+02 .500-01 .280-00 .100+01 .230+01
56140 BA 3 .128+02 .850+01 .500-05 .280-04 .100-03 .120+01
56140 BA 4 .128+02 .975+03 .300-04 .170-03 .600-03 .140+01
56140 BA 5 .128+02 .130+02 .250-05 .140-04 .500-04 .120+01
56140 BA 6 .128+02 .650+02 .350-00 .190-00 .700-00 .420+01
56140 BA 8                                         .751-00.14+01.14+01
56140 BA14 .128+02 .200+04 .150-03 .830-03 .300-02 .230+01
57140 LA 1 .168+01 .500+03 .100-03 .250-00 .100+01 .190+01
57140 LA 4 .168+01 .400+03 .150-04 .400-01 .150-00 .110+01
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57140 LA 8                                                          .110+01
58141 CE 1 .320+02 .563+03 .100-03 .250-00 .100+01 .210-00
58141 CE 3 .320+02 .563+03 .200-05 .500-02 .200-01 .180-00
58141 CE 4 .320+02 .293+03 .250-04 .600-01 .250-00 .180-00
58141 CE 6 .320+02 .150+04 .300-04 .750-01 .300-00 .810-00
58141 CE 8                                                          .160+00
58143 CE 1 .133+01 .563+03 .100-03 .250-00 .100+01 .970-00
58143 CE 3 .133+01 .563+03 .200-05 .500-02 .200-01 .820-00
58143 CE 4 .133+01 .293+03 .250-04 .600-01 .250-00 .850-00
58143 CE 6 .133+01 .150+04 .300-04 .750-01 .300-00 .380+01
58143 CE 8                                                          .562-00.79-00.85-00
58144 CE 1 .290+03 .563+03 .100-03 .250-00 .100+01 .130+01
58144 CE 3 .290+03 .563+03 .200-05 .500-02 .200-01 .130+01
58144 CE 4 .290+03 .293+03 .250-04 .600-01 .250-00 .130+01
58144 CE 6 .290+03 .150+04 .300-04 .750-01 .300-00 .630+01
58144 CE 8                                                          .130+01.13+01.13+01
59142 PR 1 .800-00 .750+03 .100-03 .250-00 .100+01 .850-00
59142 PR 3 .800-00 .750+03 .200-05 .500-02 .200-01 .810-00
59142 PR 4 .800-00 .375+03 .200-04 .500-01 .200-00 .810-00
59142 PR 6 .800-00 .150+04 .400-04 .100+00 .400-00 .390+01
59142 PR 8                                                          .810+00
59143 PR 1 .137+02 .750+02 .100-03 .250-00 .100+01 .320-00
59143 PR 3 .137+02 .750+03 .200-05 .500-02 .200-01 .320-00
59143 PR 4 .137+02 .375+03 .200-04 .500-01 .200-00 .320-00
59143 PR 6 .137+02 .150+04 .400-04 .100+00 .400-00 .160+01
59143 PR 8                                                          .320+00
60144 ND 1 .730+08 .656+03 .100-03 .250-00 .100+01 .200+02
60144 ND 3 .730+08 .656+03 .500-05 .100-01 .500-01 .200+02
60144 ND 4 .730+08 .131+03 .500-04 .130-00 .500-00 .200+02
60144 ND 6 .730+08 .150+04 .350-04 .900-01 .350-00 .100+03
60144 ND 8                                                          .200+02
60147 ND 1 .113+02 .656+03 .100-03 .250-00 .100+01 .400-00
60147 ND 3 .113+02 .656+03 .500-05 .100-01 .500-01 .310-00
60147 ND 4 .113+02 .131+03 .500-04 .130-00 .500-00 .320-00
60147 ND 6 .113+02 .150+04 .350-04 .900-01 .350-00 .140+01
60147 ND 8                                                          .290-00.29-00.31-00
60149 ND 1 .830-01 .656+03 .100-03 .250-00 .100+01 .110+01
60149 ND 3 .830-01 .656+03 .500-05 .100-01 .500-01 .970-00
60149 ND 4 .830-01 .131+03 .500-04 .130-00 .500-00 .990-00
60149 ND 6 .830-01 .150+04 .350-04 .900-01 .350-00 .470+01
60149 ND 8                                                          .688-00.97-00.99-00
61147 PM 1 .920+03 .656+03 .100-03 .250-00 .100+01 .690-01
61147 PM 3 .920+03 .656+03 .200-05 .500-02 .200-01 .690-01
61147 PM 4 .920+03 .656+03 .600-05 .200-01 .600-01 .690-01
61147 PM 6 .920+03 .150+04 .350-04 .900-01 .350-00 .350-00
61147 PM 8                                                          .690-01.69-01.69-01
61149 PM 1 .220+01 .656+03 .100-03 .250-00 .100+01 .540-00
61149 PM 3 .220+01 .656+03 .200-05 .500-02 .200-01 .420-00
61149 PM 4 .220+01 .656+03 .600-05 .200-01 .600-01 .440-00
61149 PM 6 .220+01 .150+04 .350-04 .900-01 .350-00 .190+01
61149 PM 8                                                          .440+00
62147 SM 1 .480+14 .656+03 .100-03 .250-00 .100+01 .230+02
62147 SM 3 .480+14 .656+03 .200-05 .500-02 .200-01 .230+02
62147 SM 4 .480+14 .187+03 .350-04 .900-01 .350-00 .230+02
62147 SM 6 .480+14 .150+04 .350-04 .900-01 .350-00 .115+03
62147 SM 8                                                          .230+02
62151 SM 1 .370+05 .656+03 .100-03 .250-00 .100+01 .420-01
62151 SM 3 .370+05 .656+03 .200-05 .500-02 .200-01 .420-01
62151 SM 4 .370+05 .187+03 .350-04 .900-01 .350-00 .420-01
62151 SM 6 .370+05 .150+04 .350-04 .900-01 .350-00 .130-00
62151 SM 8                                                          .420-01
62153 SM 1 .196+01 .656+03 .100-03 .250-00 .100+01 .300-00
62153 SM 3 .196+01 .656+03 .200-05 .500-02 .200-01 .250-00
62153 SM 4 .196+01 .187+03 .350-04 .900-01 .350-00 .260-00
62153 SM 6 .196+01 .150+04 .350-04 .900-01 .350-00 .110+01
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63152 EU 1 .470+04 .635+03 .100-03 .250-00 .100+01 .660-00
63152 EU 3 .470+04 .148+04 .300-05 .750-02 .300-01 .250-00
63152 EU 4 .470+04 .127+03 .250-04 .600-01 .250-00 .330-00
63152 EU 6 .470+04 .150+04 .360-04 .900-01 .360-00 .450-00
63152 EU 8                                          .330+00
63154 EU 1 .580+04 .635+03 .100-03 .250-00 .100+01 .130+01
63154 EU 3 .580+04 .148+04 .300-05 .750-02 .300-01 .760-00
63154 EU 4 .580+04 .127+03 .250-04 .600-01 .250-00 .860-00
63154 EU 6 .580+04 .150+04 .360-04 .900-01 .360-00 .270+01
63154 EU 8                                          .960+00
63155 EU 1 .621+03 .635+03 .100-03 .250-00 .100+01 .160-00
63155 EU 3 .621+03 .148+04 .300-05 .750-02 .300-01 .830-01
63155 EU 4 .621+03 .127+03 .250-04 .600-01 .250-00 .950-01
63155 EU 6 .621+03 .150+04 .360-04 .900-01 .360-00 .280-00
63155 EU 8                                          .950-01
64153 GD 1 .236+03 .550+03 .100-03 .250-00 .100+01 .170-00
64153 GD 4 .236+03 .460+03 .120-04 .300-01 .120+00 .990-01
64153 GD 6 .236+03 .100+04 .450-04 .110+00 .450-00 .230-00
64153 GD 8                                          .990-01
64159 GD 1 .750-00 .550+03 .100-03 .250-00 .100+01 .360-00
64159 GD 4 .750-00 .460+03 .120-04 .300-01 .120+00 .330-00
64159 GD 6 .750-00 .100+04 .450-04 .110+00 .450-00 .750-00
64159 GD 8                                          .330+00
65160 TB 1 .730+02 .670+03 .100-03 .250-00 .100+01 .850-00
65160 TB 3 .730+02 .700+03 .300-05 .750-02 .300-01 .400-00
65160 TB 6 .730+02 .100+04 .600-04 .150-00 .600-00 .110+01
65160 TB 8                                          .480+00
66165 LY 1 .970-01 .700+03 .100-03 .250-00 .100+01 .510-00
66165 LY 4 .970-01 .500+03 .600-05 .200-01 .600-01 .390-00
66165 LY 6 .970-01 .100+04 .600-04 .150-00 .600-00 .150+01
66165 LY 8                                          .390+00
66166 LY 1 .340+01 .700+03 .100-03 .250-00 .100+01 .790-00
66166 LY 4 .340+01 .500+03 .600-05 .200-01 .600-01 .780-00
66166 LY 6 .340+01 .100+03 .600-04 .150-00 .600-00 .390+01
66166 LY 8                                          .423-00.77-00.78-00
67166 MO 1 .110+01 .750+03 .100-03 .250-00 .100+01 .700-00
67166 MO 3 .110+01 .800+03 .200-05 .500-02 .200-01 .690-00
67166 MO 4 .110+01 .875+03 .600-05 .200-01 .600-01 .690-00
67166 MO 6 .110+01 .100+04 .640-04 .160-00 .640-00 .340+01
67166 MO 8                                          .690+00
68169 ER 1 .940+01 .650+03 .100-03 .250-00 .100+01 .370-00
68169 ER 3 .940+01 .650+03 .200-05 .500-02 .200-01 .190-00
68169 ER 4 .940+01 .433+03 .300-05 .750-02 .600-01 .220-00
68169 ER 6 .940+01 .100+04 .600-04 .150-00 .640-00 .580-00
68169 ER 8                                          .220+00
68171 ER 1 .310-00 .650+03 .100-03 .250-01 .100+01 .650-00
68171 ER 3 .310-00 .650+03 .200-05 .500-02 .200-01 .460-00
68171 ER 6 .310-00 .100+04 .600-04 .150-00 .600-00 .200+01
68171 ER 8                                          .490-00.49-00.50-00
69170 TM 1 .127+03 .675+03 .100-03 .250-00 .100+01 .340-00
69170 TM 3 .127+03 .335+03 .200-05 .500-02 .200-01 .340-00
69170 TM 6 .127+03 .100+04 .650-04 .160-00 .650-00 .170+01
69170 TM 8                                          .340+00
69171 TM 1 .694+03 .675+03 .100-03 .250-00 .100+01 .300-01
69171 TM 3 .694+03 .335+03 .200-05 .500-02 .200-01 .300-01
69171 TM 6 .694+03 .100+04 .650-04 .160-00 .650-00 .150-00
69171 TM 8                                          .300-01
70173 YB 1 .410+01 .685+03 .100-03 .250-00 .100+01 .160-00
70173 YB 3 .410+01 .685+03 .300-05 .130-01 .500-01 .150-00
70173 YB 6 .410+01 .100+04 .580-04 .150-00 .580-00 .710-00
70173 YB 8                                          .150+00
71177 LU 1 .670+01 .730+03 .100-03 .250-00 .100+01 .170-00
71177 LU 3 .670+01 .750+03 .100-05 .250-02 .100-01 .160-00
71177 LU 6 .670+01 .100+04 .680-04 .170-00 .680-01 .760-00
71177 LU 8                                          .160+00
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72181 HF 3 .460+02 .563+03 .200-05 .500-02 .200-01 .250-00
72181 HF 4 .460+02 .625+03 .450-04 .110+00 .450-05 .290-00
72181 HF 5 .460+02 .350+03 .130-04 .300-01 .130-00 .250-00
72181 HF 6 .460+02 .600+03 .150-04 .400-01 .150-00 .740-00
72181 HF 8                                          .290+00
73182 TA 1 .112+03 .240+03 .100-03 .250-00 .100+01 .110+01
73182 TA 3 .112+03 .496+03 .300-05 .750-02 .300-01 .450-00
73182 TA 4 .112+03 .480+03 .300-04 .800-01 .300-00 .560-00
73182 TA 5 .112+03 .240+03 .100-05 .250-02 .100-01 .430-00
73182 TA 6 .112+03 .300+03 .200-04 .500-01 .200-00 .100+01
73182 TA 8                                          .560+00
74181  W 1 .140+03 .100+01 .100+00 .300-00 .100+01 .200-00
74181  W 4 .140+03 .400+01 .600-02 .200-01 .600-01 .870-01
74181  W 6 .140+03 .900+01 .700-02 .200-01 .700-01 .470-01
74181  W 8                                          .970-01
74185  W 1 .740+02 .100+01 .100+00 .300-00 .100+01 .140+00
74185  W 4 .740+02 .400+01 .600-02 .200-01 .600-01 .140-00
74185  W 6 .740+02 .900+01 .700-02 .200-01 .700-01 .660-00
74185  W 8                                          .140+00
74187  W 1 .100+01 .100+01 .100+00 .300-00 .100+01 .680-00
74187  W 4 .100+01 .400+01 .600-02 .200-01 .600-01 .440-00
74187  W 6 .100+01 .900+01 .700-02 .200-01 .700-01 .140+01
74187  W 8                                          .440-00.44-00.44-00
75183 RE 1 .730+02 .700+01 .500-00 .500-00 .100+01 .240-00
75183 RE 4 .730+02 .140+02 .500-02 .500-02 .100-01 .100+00
75183 RE 6 .730+02 .350+01 .500-02 .500-02 .100-01 .550-01
75183 RE 8                                          .100+00
75183 RE12 .730+02 .250+02 .130-00 .130-00 .250-00 .120-02
75183 RE16 .730+02 .300+01 .350-02 .350-02 .700-02 .340-01
75186 RE 1 .379+01 .700+01 .500-00 .500-00 .100+01 .380-00
75186 RE 4 .379+01 .140+02 .500-02 .500-02 .100-01 .370-00
75186 RE 6 .379+01 .350+01 .500-02 .500-02 .100-01 .180+01
75186 RE 8                                          .370+00
75186 RE12 .379+01 .250+02 .130-00 .130-00 .250-00 .360-00
75186 RE16 .379+01 .300+01 .350-02 .350-02 .700-02 .370-00
75187 RE 1 .180+14 .700+01 .500-00 .500-00 .100+01 .120-01
75187 RE 4 .180+14 .140+02 .500-02 .500-02 .100-01 .120-01
75187 RE 6 .180+14 .350+01 .500-02 .500-02 .100-01 .620-01
75187 RE 8                                          .120-01
75187 RE12 .180+14 .250+02 .130-00 .130-00 .250-00 .120-01
75187 RE16 .180+14 .300+01 .350-02 .350-02 .700-02 .120-01
75188 RE 1 .710-00 .700+01 .500-00 .500-00 .100+01 .940-00
75188 RE 4 .710-00 .140+02 .500-02 .500-02 .100-01 .850-00
75188 RE 6 .710-00 .350+01 .500-02 .500-02 .100-01 .390+01
75188 RE 8                                          .850+00
75188 RE12 .710-00 .250+02 .130-00 .130-00 .250-00 .780-00
75188 RE16 .710-00 .300+01 .350-02 .350-02 .700-02 .800-00
76185 OS 1 .950+02 .200+01 .100+00 .300-00 .100+01 .510-00
76185 OS 3 .950+02 .500+01 .500-02 .200-01 .500-01 .250-00
76185 OS 4 .950+02 .550+01 .400-02 .100-01 .400-01 .290-00
76185 OS 8                                          .290+00
76191 OS 1 .160+02 .200+01 .100+00 .300-00 .100+01 .160-00
76191 OS 3 .160+02 .500+01 .500-02 .200-01 .500-01 .110+00
76191 OS 4 .160+02 .550+01 .400-02 .100-01 .400-01 .120+00
76191 OS 8                                          .120+00
76191105 1 .580-00 .200+01 .100+00 .300-00 .100+01 .600-01
76191105 3 .580-00 .500+01 .500-02 .200-01 .500-01 .390-01
76191105 4 .580-00 .550+01 .400-02 .100-01 .400-01 .490-01
76191105 8                                          .251-01.11+00.13-00
76193 OS 1 .131+01 .200+01 .100+00 .300-00 .100+01 .380-00
76193 OS 3 .131+01 .500+01 .500-02 .200-01 .500-01 .380-00
76193 OS 4 .131+01 .550+01 .400-02 .100-01 .400-01 .380-00
76193 OS 8                                          .380+00
77190 IR 1 .120+02 .200+02 .100+00 .300-00 .100+01 .370-00
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77190 IR 5 .120+02 .500+02 .200-02 .600-02 .200-01 .120+00
77190 IR 8                                                .160+00
77192 IR 1 .745+02 .200+02 .100+00 .300-00 .100+01 .110+01
77192 IR 3 .745+02 .500+02 .450-02 .140-01 .450-01 .500-00
77192 IR 4 .745+02 .270+02 .230-01 .700-01 .230-00 .600+00
77192 IR 5 .745+02 .500+02 .200-02 .600-02 .200-01 .500+00
77192 IR 8                                                .600+00
77194 IR 1 .790-00 .200+02 .100+00 .300-00 .100+01 .810-00
77194 IR 3 .790-00 .500+02 .450-02 .140-00 .450-01 .810-00
77194 IR 4 .790-00 .270+02 .230-01 .700-01 .230-00 .810-00
77194 IR 5 .790-00 .500+02 .200-02 .600-02 .200-01 .810-00
77194 IR 8                                                .810+00
78191 PT 1 .300+01 .240+02 .100+00 .300-00 .100+01 .700-00
78191 PT 3 .300+01 .600+02 .100-01 .300-01 .100+00 .220-00
78191 PT 4 .300+01 .200+02 .800-03 .240-02 .800-02 .310-00
78191 PT 5 .300+01 .600+02 .800-03 .240-02 .800-02 .220-00
78191 PT 8                                                .310+00
78193 PT 1 .180+06 .240+02 .100+00 .300-00 .100+01 .430-01
78193 PT 3 .180+06 .600+02 .100-01 .300-01 .100+00 .140-01
78193 PT 4 .180+06 .200+02 .800-03 .240-02 .800-02 .190-01
78193 PT 5 .180+06 .600+02 .800-03 .240-02 .800-02 .140-01
78193 PT 8                                                .190-01
781931PT 1 .350+01 .240+02 .100+00 .300-00 .100+01 .750-01
781931PT 3 .350+01 .600+02 .100-01 .300-01 .100+00 .230-01
781931PT 4 .350+01 .200+02 .800-03 .240-02 .800-02 .320-01
781931PT 5 .350+01 .600+02 .800-03 .240-02 .800-02 .230-01
781931PT 8                                                .320-01.32-01.32-01
78197 PT 1 .750-00 .240+02 .100+00 .300-00 .100+01 .260-00
78197 PT 3 .750-00 .600+02 .100-01 .300-01 .100+00 .230-00
78197 PT 4 .750-00 .200+02 .800-03 .240-02 .800-02 .240-00
78197 PT 5 .750-00 .600+02 .800-03 .240-02 .800-02 .230-00
78197 PT 8                                                .240+00
781971PT 1 .560-01 .240+02 .100+00 .300-00 .100+01 .550-00
781971PT 3 .560-01 .600+02 .100-01 .300-01 .100+00 .500-00
781971PT 4 .560-01 .200+02 .800-03 .240-02 .800-02 .510-00
781971PT 5 .560-01 .600+02 .800-00 .240-02 .800-02 .500-00
781971PT 8                                                .417-00.52-00.52-00
79196 AU 1 .560+01 .120+03 .100+00 .300-00 .100+01 .460-00
79196 AU 3 .560+01 .280+03 .300-02 .900-02 .300-01 .150-00
79196 AU 4 .560+01 .300+03 .400-02 .100-01 .400-01 .210-00
79196 AU 5 .560+01 .240+03 .500-03 .150-02 .500-02 .150-00
79196 AU 8                                                .210+00
79198 AU 1 .270+01 .120+03 .100+00 .300-00 .100+01 .580-00
79198 AU 3 .270+01 .280+03 .300-02 .900-02 .300-01 .410-00
79198 AU 4 .270+01 .300+03 .400-02 .100-01 .400-01 .440-00
79198 AU 5 .270+01 .240+03 .500-03 .150-02 .500-02 .410-00
79198 AU 8                                                .440+00
79199 AU 1 .315+01 .120+03 .100+00 .300-00 .100+01 .180-00
79199 AU 3 .315+01 .280+03 .300-02 .900-02 .300-01 .120+00
79199 AU 4 .315+01 .300+03 .400-02 .100-01 .400-01 .130-00
79199 AU 5 .315+01 .240+03 .500-03 .150-02 .500-02 .120+00
79199 AU 8                                                .130+00
80197 HG 1 .270+01 .100+02 .750-00 .630-00 .100+01 .970-01
80197 HG 3 .270+01 .145+02 .260-00 .220-00 .350-00 .430-01
80197 HG 4 .270+01 .135+02 .110+00 .900-01 .150-00 .520-01
80197 HG 5 .270+01 .100+02 .200-01 .100-01 .200-01 .430-01
80197 HG 8                                                .520-01
801971HG 1 .100+01 .100+02 .750-00 .630-00 .100+01 .300-00
801971HG 3 .100+01 .145+02 .260-00 .220-00 .350-00 .180-00
801971HG 4 .100+01 .135+02 .110+00 .900-01 .150-00 .190-00
801971HG 5 .100+01 .100+02 .200-01 .100-01 .200-01 .170-00
801971HG 8                                                .165-00.20-00.21-00
80203 HG 1 .458+02 .100+02 .750-00 .630-00 .100+01 .250-00
80203 HG 3 .458+02 .145+02 .260-00 .220-00 .350-00 .150-00
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80203 MG  8                                                    .170+00
81203 TL  1 .113+01 .500+01 .450-00 .480-00 .100+01 .400-00
81203 TL  3 .113+01 .700+01 .230-01 .240-01 .500-01 .130-00
81203 TL  4 .113+01 .500+01 .200-01 .200-01 .400-01 .180-00
81203 TL  6 .113+01 .700+01 .250-01 .260-01 .550-01 .950-01
81203 TL  8 .113+01 .600+01 .270-02 .290-02 .600-02 .180-00
81203 TL14 .113+01 .550+01 .240-00 .260-00 .540-00 .400-00
81201 TL  1 .300+01 .500+01 .450-00 .480-00 .100+01 .170-00
81201 TL  3 .300+01 .700+01 .230-01 .240-01 .500-01 .110+00
81201 TL  4 .300+01 .500+01 .200-01 .200-01 .400-01 .120+00
81201 TL  6 .300+01 .700+01 .250-01 .260-01 .550-01 .440-00
81201 TL  8 .300+01 .600+01 .270-02 .290-02 .600-02 .120+00
81201 TL14 .300+01 .550+01 .240-00 .260-00 .540-00 .170-00
81202 TL  1 .120+02 .500+01 .450-00 .480-00 .100+01 .380-00
81202 TL  3 .120+02 .700+01 .230-01 .240-01 .500-01 .240-00
81202 TL  4 .120+02 .500+01 .200-01 .200-01 .400-01 .270-00
81202 TL  6 .120+02 .700+01 .250-01 .260-01 .550-01 .940-00
81202 TL  8 .120+02 .600+01 .270-02 .290-02 .600-02 .270-00
81202 TL14 .120+02 .550+01 .240-00 .260-00 .540-00 .380-00
81204 TL  1 .110+04 .500+01 .450-00 .480-00 .100+01 .250-00
81204 TL  3 .110+04 .700+01 .230-01 .240-01 .500-01 .250-00
81204 TL  4 .110+04 .500+01 .200-01 .200-01 .400-01 .250-00
81204 TL  6 .110+04 .700+01 .250-01 .260-01 .550-01 .130+01
81204 TL  8 .110+04 .600+01 .270-02 .290-02 .600-02 .250-00
81204 TL14 .110+04 .550+01 .240-00 .260-00 .540-00 .250-00
82203 PB  1 .217+01 .146+04 .800-01 .290-00 .100+01 .220-00
82203 PB  3 .217+01 .531+03 .100-01 .400-01 .140-00 .690-01
82203 PB  4 .217+01 .195+04 .640-02 .230-01 .800-01 .940-01
82203 PB  6 .217+01 .365+04 .200-01 .800-01 .280-00 .510-01
82203 PB  8                                                    .940-01
82210 PB  1 .710+04 .146+04 .800-01 .290-00 .100+01 .520+01
82210 PB  3 .710+04 .531+03 .100-01 .400-01 .140-00 .100+02
82210 PB  4 .710+04 .195+04 .640-02 .230-01 .800-01 .100+02
82210 PB  6 .710+04 .365+04 .200-01 .800-01 .280-00 .290+02
82210 PB  8                                                    .157-00.14+02.43+02
82212 PB  1 .440-00 .146+04 .800-01 .290-00 .100+01 .320+02
82212 PB  3 .440-00 .531+03 .100-01 .400-01 .140-00 .810+02
82212 PB  4 .440-00 .195+04 .640-02 .230-01 .800-01 .830+02
82212 PB  6 .440-00 .365+04 .200-01 .804-01 .280-00 .100+02
82212 PB  8                                                    .790+02.83+02.83+02
83206 BI  1 .640+01 .500+01 .100-01 .260-00 .100+01 .150+01
83206 BI  3 .640+01 .600+01 .300-02 .800-01 .300-00 .580-00
83206 BI  4 .640+01 .150+02 .150-02 .400-01 .150-00 .800-00
83206 BI  5 .640+01 .100+02 .100-03 .260-02 .100-01 .580-00
83206 BI  6 .640+01 .133+02 .300-03 .770-02 .300-01 .430-00
83206 BI  8                                                    .900+00
83207 BI  1 .290+04 .500+01 .100-01 .260-00 .100+01 .100+01
83207 BI  3 .290+04 .600+01 .300-02 .800-01 .300-00 .330-00
83207 BI  4 .290+04 .150+02 .150-02 .400-01 .150-00 .450-00
83207 BI  5 .290+04 .100+02 .100-03 .260-02 .100-01 .330-00
83207 BI  6 .290+04 .133+02 .300-03 .770-02 .300-01 .240-00
83207 BI  8                                                    .450+00
83210 BI  1 .500+01 .500+01 .100-01 .260-00 .100+01 .100+02
83210 BI  3 .500+01 .600+01 .300-02 .800-01 .300-00 .190+02
83210 BI  4 .500+01 .150+02 .150-02 .400-01 .150-00 .130+02
83210 BI  5 .500+01 .100+02 .100-03 .260-02 .100-01 .170+02
83210 BI  6 .500+01 .133+02 .300-03 .770-02 .300-01 .400+02
83210 BI  8                                                    .795-00.15+02.43+02
83212 BI  1 .420-01 .500+01 .100-01 .260-00 .100+01 .830+02
83212 BI  3 .420-01 .600+01 .300-02 .800-01 .300-00 .820+02
83212 BI  4 .420-01 .150+02 .150-02 .400-01 .150-00 .930+02
83212 BI  5 .420-01 .100+02 .100-03 .260-02 .100-01 .825+02
83212 BI  6 .420-01 .133+02 .300-03 .770-02 .300-01 .411+03
83212 BI  8                                                    .830+02
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83210 BI 4 .500+01 .150+02 .150-02 .400-01 .150-00 .130+02
83210 BI 5 .500+01 .100+02 .100-03 .260-02 .100-01 .170+02
83210 BI 6 .500+01 .133+02 .300-03 .770-02 .300-01 .400+02
83210 BI 8                                          .795-00.15+02.43+02
83212 BI 1 .420-01 .500+01 .100-01 .260-00 .100+01 .830+02
83212 BI 3 .420-01 .600+01 .300-02 .800-01 .300-00 .820+02
83212 BI 4 .420-01 .150+02 .150-02 .400-01 .150-00 .830+02
83212 BI 5 .420-01 .100+02 .100-03 .260-02 .100-01 .820+02
83212 BI 6 .420-01 .133+02 .300-03 .770-02 .300-01 .411+03
83212 BI 8                                          .830+02
84210 PO 1 .138+03 .300+02 .600-01 .280-00 .100+01 .550+02
84210 PO 3 .138+03 .700+02 .400-02 .200-01 .700-01 .550+02
84210 PO 4 .138+03 .410+02 .100-01 .500-01 .170-00 .550+02
84210 PO 5 .138+03 .600+02 .200-02 .160-01 .400-01 .550+02
84210 PO 6 .138+03 .240+02 .600-02 .300-01 .100+00 .280+03
84210 PO 8                                          .550+02
85211 AT 1 .300-00 .270+02 .100+01 .750-00 .100+01 .610+02
85211 AT 5 .300-00 .270+02 .300-01 .200-01 .300-01 .610+02
85211 AT 8                                          .700+02.70+02.70+02
85211 AT11 .300-00 .135+02 .200-02 .150-02 .200-02 .610+02
85211 AT16 .300-00 .360+02 .300-01 .230-01 .300-01 .610+02
88223 RA 1 .117+02 .810+04 .300-00 .400-00 .100+01 .280+03
88223 RA 6 .117+02 .164+05 .150-00 .200-00 .500-00 .280+03
88223 RA 8                                          .280+03
88224 RA 1 .364+01 .810+04 .300-00 .400-00 .100+01 .280+03
88224 RA 6 .364+01 .164+05 .150-00 .200-00 .500-00 .280+03
88224 RA 8                                          .249+03.28+03.28+03
88226 RA 1 .590+06 .810+04 .300-00 .400-00 .100+01 .110+03
88226 RA 6 .590+06 .164+05 .400-01 .300-01 .100+00 .110+03
88226 RA 8                                          .110+03
88228 RA 1 .240+04 .810+04 .300-00 .400-00 .100+01 .230+03
88228 RA 5 .240+04 .164+05 .400-01 .300-01 .100+00 .190+03
88228 RA 8                                          .716-00.22+02.14+03
89227 AC 1 .800+04 .240+05 .100-03 .250-00 .100+01 .200+03
89227 AC 3 .800+04 .240+05 .100-05 .300-02 .100-01 .620+02
89227 AC 4 .800+04 .240+04 .500-04 .130-00 .500-00 .620+02
89227 AC 6 .800+04 .365+05 .300-04 .800-01 .300-00 .101+04
89227 AC 8                                          .485+01.21+03.32+03
89228 AC 1 .260-00 .240+05 .100-03 .250-00 .100+01 .230+03
89228 AC 3 .260-00 .240+05 .100-05 .300-02 .100-01 .550+02
89228 AC 4 .260-00 .240+04 .500-04 .250-00 .500-00 .560+02
89228 AC 6 .260-00 .365+05 .300-04 .800-01 .300-00 .970+03
89228 AC 8                                          .897-00.22+02.14+03
90227 TH 1 .184+02 .570+05 .100-03 .250-00 .100+01 .200+03
90227 TH 3 .184+02 .220+05 .500-05 .100-01 .500-01 .610+02
90227 TH 4 .184+02 .570+05 .500-05 .100-01 .500-01 .610+02
90227 TH 6 .184+02 .365+05 .700-04 .180-00 .700-00 .990+03
90227 TH 8                                          .827+02.28+03.33+03
90228 TH 1 .700+03 .570+05 .100-03 .250-00 .100+01 .230+03
90228 TH 3 .700+03 .220+05 .500-05 .100-01 .500-01 .560+02
90228 TH 4 .700+03 .570+05 .500-05 .100-01 .500-01 .560+02
90228 TH 6 .700+03 .365+05 .700-04 .180-00 .700-00 .970+03
90228 TH 8                                          .110+03.31+03.33+03
90230 TH 1 .290+00 .570+05 .100-03 .250-00 .100+01 .480+02
90230 TH 3 .290+00 .220+05 .500-05 .100-01 .500-01 .480+02
90230 TH 4 .290+00 .570+05 .500-05 .100-01 .500-01 .480+02
90230 TH 6 .290+00 .365+05 .700-04 .180-00 .700-00 .240+03
90230 TH 8                                          .480+02.48+02.48+02
90231 TH 1 .107+01 .570+05 .100-03 .250-00 .100+01 .180-00
90231 TH 3 .107+01 .220+05 .500-05 .100-01 .500-01 .140-00
90231 TH 4 .107+01 .570+05 .500-05 .100-01 .500-01 .160-00
90231 TH 6 .107+01 .365+05 .700-04 .180-00 .700-00 .560-00
90231 TH 8                                          .110+00.11+00.11+00
90232 TH 1 .510+13 .570+05 .100-03 .250-00 .100+01 .620+02
90232 TH 3 .510+13 .220+05 .500-05 .100-01 .500-01 .410+02
90232 TH 4 .510+13 .570+05 .500-05 .100-01 .500-01 .410+02
90232 TH 6 .510+13 .365+05 .700-04 .130-00 .700-00 .270+03
90232 TH 8                                          .410+02.41+02.65+02
90234 TH 1 .241+02 .570+05 .100-03 .250-00 .100+01 .910-00
90234 TH 3 .241+02 .570+05 .500-05 .100-01 .500-01 .900-00
90234 TH 4 .241+02 .570+05 .500-05 .100-01 .500-01 .900-00
90234 TH 6 .241+02 .365+05 .500-05 .100-01 .700-00 .450+01
90234 TH 8                                          .900+00
91230 PA 1 .177+02 .410+05 .100-03 .250-00 .100+01 .670-01
91230 PA 3 .177+02 .510+05 .400-05 .100-01 .400-01 .310-01
91230 PA 6 .177+02 .365+05 .450-04 .110+00 .450-00 .110+00
91230 PA 8                                          .320+01.50+02.68+02
91231 PA 1 .130+00 .410+05 .100-03 .250-00 .100+01 .140+03
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91231 PA 3 .130+08 .510+05 .400-05 .100-01 .400-01 .790+02
91231 PA 4 .130+08 .580+05 .500-05 .130-01 .500-01 .630+02
91231 PA 6 .130+08 .365+05 .450-04 .110+00 .450-00 .750+03
91231 PA 8                                          .510+02.52+02.70+02
91233 PA 1 .274+02 .410+05 .100-03 .250-00 .100+01 .320-00
91233 PA 3 .274+02 .510+05 .400-05 .100-01 .400-01 .150-00
91233 PA 4 .274+02 .580+05 .500-05 .130-01 .500-01 .180-00
91233 PA 6 .274+02 .365+05 .450-04 .110+00 .450-00 .410-00
91233 PA 8                                          .180+00
92230  U 1 .208+02 .100+03 .100-03 .250-00 .100+01 .350+03
92230  U 3 .208+02 .150+02 .110-04 .280-01 .110+00 .350+03
92230  U 6 .208+02 .300+03 .110-04 .280-01 .110+00 .180+04
92230  U 8                                          .348+03.35+03.35+03
92232  U 1 .270+05 .100+03 .100-03 .250-00 .100+01 .280+03
92232  U 3 .270+05 .150+02 .110-04 .280-01 .110+00 .110+03
92232  U 6 .270+05 .300+03 .110-04 .280-01 .110+00 .120+04
92232  U 8                                          .552+02.76+02.19+03
92233  U 1 .590+08 .100+03 .100-03 .250-00 .100+01 .500+02
92233  U 3 .590+08 .150+02 .110-04 .280-01 .110+00 .500+02
92233  U 6 .590+08 .300+03 .110-04 .280-01 .110+00 .250+03
92233  U 8                                          .500+02
92234  U 1 .910+08 .100+03 .100-03 .250-00 .100+01 .490+02
92234  U 3 .910+08 .150+02 .110-04 .280-01 .110+00 .490+02
92234  U 6 .910+08 .300+03 .110-04 .280-01 .110+00 .240+03
92234  U 8                                          .490+02
92235  U 1 .260+12 .100+03 .100-03 .250-00 .100+01 .460+02
92235  U 3 .260+12 .150+02 .110-04 .280-01 .110+00 .460+02
92235  U 6 .260+12 .300+03 .110-04 .280-01 .110+00 .230+03
92235  U 8                                          .461+02.46+02.46+02
92236  U 1 .870+10 .100+03 .100-03 .250-00 .100+01 .470+02
92236  U 3 .870+10 .150+02 .110-04 .280-01 .110+00 .477+02
92236  U 6 .870+10 .300+03 .110-04 .280-01 .110+00 .230+03
92236  U 8                                          .470+02
92238  U 1 .160+13 .100+03 .100-03 .250-00 .100+01 .430+02
92238  U 3 .160+13 .150+02 .110-04 .280-01 .110+00 .430+02
92238  U 6 .160+13 .300+03 .110-04 .280-01 .110+00 .220+03
92238  U 8                                          .430+02
93237 NP 1 .800+09 .390+05 .100-03 .250-00 .100+01 .490+02
93237 NP 3 .800+09 .640+05 .300-05 .750-02 .300-01 .490+02
93237 NP 4 .800+09 .540+05 .500-05 .130-01 .500-01 .490+02
93237 NP 6 .800+09 .365+05 .540-04 .110+00 .450-00 .250+03
93237 NP 8                                          .490+02.49+02.49+02
93239 NP 1 .233+01 .390+05 .100-03 .250-00 .100+01 .290-00
93239 NP 3 .233+01 .640+05 .300-05 .750-02 .300-01 .210-00
93239 NP 4 .233+01 .540+05 .500-05 .130-01 .500-01 .220-00
93239 NP 6 .233+01 .365+05 .540-04 .110+00 .450-00 .980-00
93239 NP 8                                          .160-00.16-00.16-00
94238 PU 1 .330+05 .650+05 .300-04 .250-00 .100+01 .570+02
94238 PU 3 .330+05 .320+05 .600-06 .500-02 .200-01 .570+02
94238 PU 4 .330+05 .300+05 .450-05 .380-01 .450-00 .570+02
94238 PU 6 .330+05 .365+05 .240-04 .200-00 .450-00 .280+03
94238 PU 8 .330+05 .120+03 .300-04 .125-00 .000    .570+02
94238 PU20 .330+05 .300-04 .100+01 .625-00 .000    .550-00
94238 PU21 .330+05 .300-04 .100+01 .625-00 .000    .550-00
94238 PU22 .330+05 .300-04 .100+01 .625-00 .000    .550-00
94238 PU23 .330+05 .300-04 .100+01 .625-00 .000    .550-00
94239 PU 1 .890+07 .650+05 .300-04 .250-00 .100+01 .530+02
94239 PU 3 .890+07 .320+05 .600-06 .500-02 .200-01 .530+02
94239 PU 4 .890+07 .300+05 .450-05 .380-01 .450-00 .530+02
94239 PU 6 .890+07 .365+05 .240-04 .200-00 .450-00 .270+03
94239 PU 8 .890+07 .120+03 .300-04 .125-00 .000    .530+02
94239 PU20 .890+07 .300-04 .100+01 .625-00 .000    .520-00
94239 PU21 .890+07 .300-04 .100+01 .625-00 .000    .520-00
94239 PU22 .890+07 .300-04 .100+01 .625-00 .000    .520-00
94239 PU23 .890+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU 1 .240+07 .650+05 .300-04 .250-00 .100+01 .530+02
94240 PU 3 .240+07 .320+05 .600-06 .500-02 .200-01 .530+02
94240 PU 4 .240+07 .300+05 .450-05 .380-01 .450-00 .530+02
94240 PU 6 .240+07 .365+05 .240-04 .200-00 .450-00 .270+03
94240 PU 8 .240+07 .120+03 .300-04 .125-00 .000    .530+02
94240 PU20 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU21 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU22 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU23 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94241 PU 1 .480+04 .650+05 .300-04 .250-00 .100+01 .230+01
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94240 PU 3 .240+07 .320+05 .600-06 .500-02 .200-01 .530+02
94240 PU 4 .240+07 .300+05 .450-05 .380-01 .450-00 .530+02
94240 PU 6 .240+07 .365+05 .240-04 .200-00 .450-00 .270+03
94240 PU 8 .240+07 .120+03 .300-04 .125-00 .000    .530+02
94240 PU20 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU21 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU22 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94240 PU23 .240+07 .300-04 .100+01 .625-00 .000    .520-00
94241 PU 1 .480+04 .650+05 .300-04 .250-00 .100+01 .230+01
94241 PU 3 .480+04 .320+05 .600-06 .500-02 .200-01 .250+01
94241 PU 4 .480+04 .300+05 .450-05 .380-01 .450-00 .100+01
94241 PU 6 .480+04 .365+05 .240-04 .200-00 .450-00 .140+02
94241 PU 8                                         .133-01.30-01.18-00
94241 PU20 .480+04 .300-04 .100+01 .625-00 .000    .570-00
94241 PU21 .480+04 .300-04 .100+01 .625-00 .000    .600-00
94241 PU22 .480+04 .300-04 .100+01 .625-00 .000    .570-00
94241 PU23 .480+04 .300-04 .100+01 .625-00 .000    .570-00
94242 PU 1 .140+09 .650+05 .300-04 .250-00 .100+01 .510+02
94242 PU 3 .140+09 .320+05 .600-06 .500-02 .200-01 .510+02
94242 PU 4 .140+09 .300+05 .450-05 .380-01 .450-00 .510+02
94242 PU 6 .140+09 .365+05 .240-04 .200-00 .450-00 .250+03
94242 PU 8 .140+09 .120+03 .300-04 .125-00 .000    .510+02
94242 PU20 .140+09 .300-04 .100+01 .625-00 .000    .490-00
94242 PU21 .140+09 .300-04 .100+01 .625-00 .000    .490-00
94242 PU22 .140+09 .300-04 .100+01 .625-00 .000    .490-00
94242 PU23 .140+09 .300-04 .100+01 .625-00 .000    .490-00
95241 AM 1 .170+06 .200+05 .100-03 .250-00 .100+01 .570+02
95241 AM 3 .170+06 .270+05 .300-05 .750-02 .300-01 .570+02
95241 AM 4 .170+06 .348+04 .350-04 .880-01 .350-00 .570+02
95241 AM 6 .170+06 .365+05 .250-04 .630-01 .250-00 .280+03
95241 AM 8 .167+06 .120+03 .300-04 .125-00 .000    .570+02
95242 AM 1 .667+00 .200+05 .100-03 .250+00 .100+01 .670+02
95242 AM 3 .667+00 .270+05 .300-05 .750-02 .030+00 .660+02
95242 AM 4 .667+00 .348+04 .350-04 .088+00 .350+00 .630+02
95242 AM 6 .667+00 .365+05 .250-04 .063+00 .250+00 .340+03
95242 AM 8                                         .540+00.13+02.40+02
952421AM 1 .560+05 .200+05 .100-03 .250+00 .100+01 .610+02
952421AM 3 .560+05 .270+05 .300-05 .750-02 .030+00 .610+02
952421AM 4 .560+05 .348+04 .350-04 .088+00 .350+00 .570+02
952421AM 6 .560+05 .365+05 .250-04 .063+00 .250+00 .300+03
952421AM 8                                         .340+00.13+02.40+02
95243 AM 1 .290+07 .200+05 .100-03 .250-00 .100+01 .540+02
95243 AM 3 .290+07 .270+05 .300-05 .750-02 .300-01 .540+02
95243 AM 4 .290+07 .348+04 .350-04 .880-01 .350-00 .540+02
95243 AM 6 .290+07 .365+05 .250-04 .630-01 .250-00 .270+03
95243 AM 8                                         .540+02.54+02.54+02
96242 CM 1 .163+03 .240+05 .100-03 .250-01 .100+01 .800+02
96242 CM 3 .163+03 .240+05 .200-05 .500-02 .200-01 .780+02
96242 CM 4 .163+03 .300+04 .400-04 .100+00 .400-00 .780+02
96242 CM 6 .163+03 .365+05 .300-04 .750-01 .300-00 .400+03
96242 CM 8                                         .630+02.63+02.64+02
96243 CM 1 .130+05 .240+05 .100-03 .250-00 .100+01 .600+02
96243 CM 3 .130+05 .240+05 .200-05 .500-02 .200-01 .600+02
96243 CM 4 .130+05 .300+04 .400-04 .100+00 .400-00 .600+02
96243 CM 6 .130+05 .365+05 .300-04 .750-01 .300-00 .300+03
96243 CM 8                                         .600+02.60+02.60+02
96244 CM 1 .670+04 .240+05 .100-03 .250-00 .100+01 .600+02
96244 CM 3 .670+04 .240+05 .200-05 .500-02 .200-01 .600+02
96244 CM 4 .670+04 .300+04 .400-04 .100+00 .400-00 .600+02
96244 CM 6 .670+04 .365+05 .300-04 .750-01 .300-00 .300+03
96244 CM 8                                         .600+02.60+02.60+02
96245 CM 1 .730+07 .240+05 .100-03 .250-00 .100+01 .560+02
96245 CM 3 .730+07 .240+05 .200-05 .500-02 .200-01 .560+02
96245 CM 4 .730+07 .300+04 .400-04 .100+00 .400-00 .560+02
96245 CM 6 .730+07 .365+05 .300-04 .750-01 .300-00 .280+03
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96245 CM 8                                                    .550+02.55+02.55+02
96246 CM 1 .240+07 .240+05 .100-03 .250-00 .100+01 .560+02
96246 CM 3 .240+07 .240+05 .200-05 .500-02 .200-01 .560+02
96246 CM 6 .240+07 .365+05 .300-04 .750-01 .300-00 .280+03
96246 CM 8                                                    .560+02
97249 BK 1 .290+03 .650+05 .300-04 .250-00 .100+01 .380+01
97249 BK 6 .290+03 .365+05 .240-04 .200-00 .800-00 .200+02
97249 BK 8                                                    .264-01.44-01.20-00
98249 CF 1 .170+06 .650+05 .300-04 .250-00 .100+01 .600+02
98249 CF 6 .170+06 .365+05 .240-04 .200-00 .800-00 .300+03
98249 CF 8                                                    .600+02
98250 CF 1 .370+04 .650+05 .300-04 .250-00 .100+01 .620+02
98250 CF 6 .370+04 .365+05 .240-04 .200-00 .800-00 .310+03
98250 CF 8                                                    .620+02.62+02.62+02
98252 CF 1 .804+03 .650+05 .300-04 .250-00 .100+01 .210+03
98252 CF 6 .804+03 .365+05 .240-04 .200-00 .800-00 .110+04
98252 CF 8                                                    .210+03
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APPENDIX E

PROGRAM LISTING

APPENDIX E

PROGRAM LISTING

The order of the program listing shown here is:

MAIN
LIBB
LIBK
DEP
ERFXP
SIMPS
PASSIG
CHAINT
ORDOSE
ORDOT1
ORDOT2
QNT1
QLUNT1
QLMIT1
UNIT

PROGRAM LISTING

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      PROGRAM MAIN       74/74   OPT=0    TRACE                FTN 4.2+P380      12/16/74  14.40.20.

                      PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,PUNCH,          MAIN      2
                     .ORGLIB,RIBLIB,TAPE28=ORGLIB,TAPE29=RIBLIB,TAPE1)                   9/4/74    9
                      COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),    COMN      2
                     1CHAINS,DKFACT(450,3),REC(600),ML(600),ICL(600)                     COMN      3
                      COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)         COMN      4
                      COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)           COMN      5
                      COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                       COMN      6
                      COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                      COMN      7
                      COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN              COMN      8
                      COMMON IPAGE,ORGAN(2,10)                                            COMN      9
                      COMMON/NAM/ORGNAM(2,25)                                             COMN     10
                      REAL LAMBIO,LAMBDA,MASS                                             COMN     11
                      INTEGER CHAINS,SKIP                                                 COMN     12
                      LOGICAL FISPRD,ACTPRD                                               COMN     13
                      COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                    COMN     14
                      COMMON LIBT(7)                                                      9/9/74    3
                      DIMENSION          SMASS(600),DTLH(5),DTLN(5),ORGANS(10)            MAIN      5
                      DIMENSION QUANTY(600)                                               MAIN      6
                      DIMENSION STUB(5),SIGZ(10,5), SIGY(10,5),EGQ(10,5)                  MAIN      7
                      INTEGER REC,ORGANS                                                  MAIN      8
                      REAL KSQD                                                           MAIN      9
                      DIMENSION NAME(600),M(600)                                          MAIN     10
                      DIMENSION CTLH(10),CTLN(10),ISL(600)                                MAIN     11
                      DIMENSION ITA8(21)                                                  MAIN     12
                      DIMENSION ISPACE(10),LFMT(8),MFMT(5),NFMT(6),JFMT(9),IFIELD(10)     MAIN     13
                      DATA (LFMT(I),I=1,5) /"(1H0,","  ","X,19HD","ISTANC","E /,7X,"/     MAIN     14
                      DATA LFMT(7),LFMT(8) /"(A6,A5","))"/                                MAIN     15
                      DATA (MFMT(I),I=1,5) /"(1H ,","  ","X,9HD","OSE TI","ME)"/          MAIN     16
                      DATA (NFMT(I),I=1,6) /"(1H0,","  ","X,1H","F0.0,","7H MET","ERS//)  MAIN     17
                     1"/                                                                  MAIN     18
                      DATA (JFMT(I),I=1,6) /"(1H ,","  ","X,F7.1","1X,A5",",2X,1P","E11.2 MAIN     19
                     1,"/                                                                 MAIN     20
                      DATA JFMT(8),JFMT(9) /"(E11.2",","))"/                              MAIN     21
                      DATA IFIELD/"0","1","2","3","4","5","6","7","8","9"/                MAIN     22
                      DATA CH,DH/13.0,232./                                               MAIN     23
                      DATA ((ORGNAM(I,J),I=1,2),J=1,23) /"TOTAL ","BODY  ","BODY W",      MAIN     24
                     1"ATER  ","  KIDN","EYS   ","    LIV","ER    ","  SPLE","EN    ","    MAIN     25
                     2  BON","E     ","     FA","T     ","   LUN","GS    ","  ADRN",      MAIN     26
                     3"ALS  ","   TES","TES   ","  OVAR","IES   ","   SKI","N     ",      MAIN     27
                     4"    BRA","IN    ","  MUSC","LE    ","  PROST","ATE   ","  THYR",    MAIN     28
                     5"OID   ","  PANCR","EAS   ","   HEA","RT    ","  GI TI","SSUE  ",    MAIN     29
                     6"  STOM","ACH   ","SMALL ","INTEST","UP-LG-","INTEST","LO-LG-",     MAIN     30
                     7"INTEST"/                                                          MAIN     31
                      NAMELIST/INPUT/NEXT,MET,AH,BH,CH,DH,KSQD,CZ,CY,EN,UBAR,D3,D4,D5,    MAIN     32
                     1H,DIAM,UPTIME,BRATE,STUD,IPR,IPU,IOP,SIGZ,SIGY,R,DOSTIM,ORGANS     MAIN     33
                C     UNIT 29 IS FOR RIBD LIBRARY, USE LOGICAL FILE NAME AND PERMANENT    MAIN     34
                C     FILE NAME OF  -RIBLIB- ON ATTACH CARD.                              MAIN     35
                C                                                                         MAIN     36
                C     UNIT 28 IS FOR THE ORGAN DATA LIBRARY, USE LOGICAL AND PERMANENT    MAIN     37
                C     FILE NAME OF  -ORGLIB- ON ATTACH CARD.                              MAIN     38
                C                                                                         MAIN     39
                      CALL DATE(DOY)                                                      MAIN     40
                      IER=0                                                               MAIN     41
                      MET=-1                                                              MAIN     42
                      IPAGE=1                                                             MAIN     43
                  100 READ 1050, TITLE2                                                   MAIN     44
                      READ (5,INPUT)                                                      MAIN     45
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                      KASE=1                                                    MAIN      46
                      IF (NEXT.GT.3.AND.NEXT.LE.4) GO TO 110                    MAIN      47
      60              PRINT 900,NEXT                                            MAIN      48
                      STOP                                                      MAIN      49
                110   GO TO (120,130,270,810),NEXT                              MAIN      50
                C     READ NUCLIDE DATA LIBRARY                                 MAIN      51
                120   CONTINUE                                                  MAIN      52
      65              CALL LIBK                                                 MAIN      53
                      CALL LIB8                                                 MAIN      54
                130   DO 140 I=1,CHAINS                                         MAIN      55
                      SKIP(I)=0                                                 MAIN      56
                140   CONTINUE                                                  MAIN      57
      70              IER=0                                                     MAIN      58
                C     INITIALIZE NUCLIDE MASS ARRAY                             MAIN      59
                      DO 150 I=1,NTOT                                           MAIN      60
                      MASS(I,2)=0.                                              MAIN      61
                150   MASS(I,1)=3.0                                             MAIN      62
      75              N1=NFP                                                    MAIN      63
                      N2=NTOT                                                   MAIN      64
                C     READ NUCLIDE INVENTORY FROM CARDS                         MAIN      65
                      READ 850, NUMBER                                          MAIN      66
                      READ 880, (NAME(I),M(I),ISL(I),QUANTY(I),I=1,NUMBER)      MAIN      67
      80              LIM=282                                                   MAIN      68
                      PRINT 855,IPAGE,DOY                                       MAIN      69
                      PRINT 856,(LIBT(I),I=1,7)                                 9/9/74     4
                      PRINT 860                                                 MAIN      70
                      ISTART=1                                                  MAIN      71
      85        160   IPAGE=IPAGE+1                                             MAIN      72
                      ISTOP=MIN0(NUMBER,LIM)                                    MAIN      73
                      DO 170 I=ISTART,ISTOP,6                                   MAIN      74
                      JSTOP=MIN0(I+5,ISTOP)                                     MAIN      75
                170   PRINT 870, (NAME(J),M(J),ISL(J),QUANTY(J),J=I,JSTOP)      MAIN      76
      90              IF (ISTOP.EQ.NUMBER) GO TO 180                            MAIN      77
                      ISTART=ISTOP+1                                            MAIN      78
                      PRINT 820,IPAGE,DOY                                       MAIN      79
                      LIM=LIM +330                                              MAIN      80
                      GO TO 160                                                 MAIN      81
      95        C                                                               MAIN      82
                C     TRY TO IDENTIFY NUCLIDES READ FROM CARDS                  MAIN      83
                180   DO 210 I=1,NUMBER                                         MAIN      84
                      DO 190 J=1,NTOT                                           MAIN      85
                      IF (NAME(I).EQ.REC(J).AND.M(I).EQ.ML(J)) GO TO 208        MAIN      86
     100        190   CONTINUE                                                  MAIN      87
                C                                                               MAIN      88
                C     IF CAN NOT IDENTIFY NUCLIDE -STOP                         MAIN      89
                      PRINT 890, NAME(I),M(I)                                   MAIN      90
                      IER=IER+1                                                 MAIN      91
     105        C     CONVERT CURIES TO CURIE-SEC                               MAIN      92
                200   MASS(J,1)=QUANTY(I)/LAMBDA(J)                             MAIN      93
                      ICL(J)=ISL(I)                                             MAIN      94
                      IF (ISL(I).GE.1.AND.ISL(I).LE.3) GO TO 210                MAIN      95
                C     IF NO SOLUBILITY INDEX ON NUCLIDE PRINT OFFENDER          MAIN      96
     110              IF (ICL(I).GE.1.AND.ICL(I).LE.3) GO TO 210                MAIN      97
                      PRINT 1060, NAME(I),M(I),ICL(I)                           MAIN      98
                      IER=IER+1                                                 MAIN      99
                208   CONTINUE                                                  MAIN     100
                C     ELIMINATE UNUSED CHAINS                                   MAIN     101
```

```
      C     FISPRD = FALSE IF NO FISSION PRODUCTS PRESENT
      C     ACTPRD = FALSE IF NO ACTIVATION PRODUCTS PRESENT
            ACTPRD=.FALSE.
            FISPRD=.FALSE.
            ISOTOP=0
            DO 250 K=1,CHAINS
            LIM=NOFNUC(K)
            IF (SKIP(K).NE.0) GO TO 240
            DO 220 I=1,LIM
            L=ISOTOP+I
            IF (MASS(L,1).GT.1.E-30.AND.LAMBDA(L).GT.1.E-30) GO TO 230
      220   CONTINUE
            SKIP(K)=LIM
            GO TO 240
      230   CONTINUE
            FISPRD=.TRUE.
      240   ISOTOP=ISOTOP+LIM
      250   CONTINUE
            DO 260 L=N1,N2
            IF (MASS(L,1).LT.1.E-30.OR.LAMBDA(L).LT.1.E-30) GO TO 260
            ACTPRD=.TRUE.
      260   CONTINUE
      C     COUNT DOSE TIMES, DISTANCES, AND UPTAKE TIMES
      270   NUPT=0
            NR=0
            NDT=0
            IF(NEXT.LT.3) GO TO 275
            PRINT 820,IPAGE,DOY
            IPAGE=IPAGE + 1
      275   DO 320 I=1,10
            IF (R(I)) 290,290,280
      280   NR=I
      290   IF (DOSTIM(I)) 310,310,300
      300   NDT=I
      310   IF (NUPT.GE.5.OR.I.GT.5.OR.UPTIME(I).LE.0.) GO TO 320
            NUPT=NUPT+1
            UPTIME(NUPT)=UPTIME(I)
      320   CONTINUE
            CALL UNIT (DTLH,DTLN,NUPT,UPTIME)
            IO=0
            DO 330 I=1,20
      330   KORG(I)=0
            DO 340 I=1,10
            IND=ORGANS(I)
            IF (IND.LE.0) GO TO 340
            IO=IO+1
            KORG(IND)=1
      340   CONTINUE
            IF (IO.GT.0) GO TO 350
            PRINT 910, ORGANS
            IER=IER+1
      350   IF (UBAR.LT.1.E-30) IER=IER+1
            IF (BRATE(1).LE.0.) IER=IER+1
            IF(MET.LT.0.OR.MET.GT.10) IER=IER+1
            IF (LIM.LE.220) GO TO 355
            IPAGE=IPAGE + 1
            PRINT 820,IPAGE,DOY
```

```
      PROGRAM MAIN      74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.40.29.

                  355   PRINT 920,UBAR,BRATE,MET                                  MAIN      159
                        IH=H                                                      MAIN      160
                        PRINT 356,IH                                              MAIN      161
            175   356   FORMAT(1H ,"H=",I5," METERS")                             MAIN      162
                        IGO=MET                                                   MAIN      163
                        IF(MET.EQ.0) GO TO 815                                    MAIN      164
                        IF (MET.GT.3) IGO=3                                       MAIN      165
                        GO TO (350,330,390), IGO                                  MAIN      166
            180   360   IF (AH.LE.0.) IER=IER+1                                   MAIN      167
                        IF (BH.LE.0.) IER=IER+1                                   MAIN      168
                        IF (CH.LE.0.) IER=IER+1                                   MAIN      169
                        IF (DH.LE.0.) IER=IER+1                                   MAIN      170
                        IF (KSQD.LE.0.) IER=IER+1                                 MAIN      171
            185         IF (STUB(1).LE.0.) IER=IER+1                              MAIN      172
                        PRINT 930, AH,BH,CH,DH,KSQD,STUB(1)                       MAIN      173
                        IF (NUPT.EQ.1) GO TO 390                                  MAIN      174
                        DO 370 I=2,NUPT                                           MAIN      175
                        IF (STUB(I).LE.1.E-30) STUB(I)=STUB(I-1)                  MAIN      176
            190         IF (BRATE(I).LE.0.) BRATE(I)=BRATE(I-1)                   MAIN      177
                  370   CONTINUE                                                  MAIN      178
                        GO TO 390                                                 MAIN      179
                  380   IF (CZ.LE.0.) IER=IER+1                                   MAIN      180
                        IF (CY.LE.0.) IER=IER+1                                   MAIN      181
            195         IF (EN.LE.0.) IER=IER+1                                   MAIN      182
                        PRINT 940, CY,CZ,EN                                       MAIN      183
                  390   IF (DIAM.GT.0.) CALL DEP                                  MAIN      184
                        IF (D5.GT.0.) GO TO 400                                   MAIN      185
                        IF (D4.GT.0.) GO TO 400                                   MAIN      186
            200         IF (D3.GT.0.) GO TO 400                                   MAIN      187
                        IER=IER+1                                                 MAIN      188
                  400   PRINT 830,DIAM,D3,D4,D5                                   MAIN      189
                        IF (R(1).LE.0.) IER=IER+1                                 MAIN      190
                        IF (DOSTIM(1).LE.0.) IER=IER+1                            MAIN      191
            205         PRINT 950, NR,(R(I),I=1,NR)                               MAIN      192
                        PRINT 960, NUPT,(UPTIME(I),I=1,NUPT)                      MAIN      193
                        PRINT 970, NOT,(DOSTIM(I),I=1,NOT)                        MAIN      194
                        IF (IER.LT.1) GO TO 410                                   MAIN      195
                        PRINT 1020, IER                                           MAIN      196
            210         STOP                                                      MAIN      197
                  410   CONTINUE                                                  MAIN      198
                        OUB=1/UBAR                                                MAIN      199
                        IGO=MET                                                   MAIN      200
                        GO TO (420,430,540,480,480,480,480,480,480,590), MET      MAIN      201
            215   C     HANFORD MODEL                                             MAIN      202
                  420   CONTINUE                                                  MAIN      203
                        DO 440 IU=1,NUPT                                          MAIN      204
                        DO 430 IR=1,NR                                            MAIN      205
                        TT=R(IR)*OUB                                              MAIN      206
            220         TT2=TT*TT                                                 MAIN      207
                        EXPO=KSQD*TT2                                             MAIN      208
                        EXX=EXP(-EXPO)                                            MAIN      209
                        OME=1.-EXX                                                MAIN      210
                        SZ2=BH*TT+OME*AH                                          MAIN      211
            225         SIGZ(IR,IU)=SQRT(SZ2)                                     MAIN      212
                        BA=CH+DH*STUB(IU)                                         MAIN      213
                        APH=.5*BA/(STUB(IU)**2)                                   MAIN      214
                        SY2=BA*(TT-APH*(1.-EXP(-TT/APH)))                         MAIN      215
```

```
                      SIGY(IR,IU)=SQRT(SY2)                                  MAIN    215
  230           430   CONTINUE                                               MAIN    217
                440   CONTINUE                                               MAIN    218
                      GO TO 540                                              MAIN    219
                C     SUTTON MODEL                                           MAIN    220
                450   CONTINUE                                               MAIN    221
  235                 SQ2=1./SQRT(2.)                                        MAIN    222
                      DO 470 IR=1,NR                                         MAIN    223
                      SIGY(IR,1)=CY*SQ2*(R(IR)**(1.-.5*EN))                  MAIN    224
                      SIGZ(IR,1)=CZ*SQ2*(R(IR)**(1.-.5*EN))                  MAIN    225
                      DO 460 IU=2,NUPT                                       MAIN    226
  240                 SIGZ(IR,IU)=SIGZ(IR,1)                                 MAIN    227
                      SIGY(IR,IU)=SIGY(IR,1)                                 MAIN    228
                460   CONTINUE                                               MAIN    229
                470   CONTINUE                                               MAIN    230
                      GO TO 540                                              MAIN    231
  245           C     PASQUILL CURVES FOR SIGMA Z                            MAIN    232
                480   ITM3=MET-3                                             MAIN    233
                      DO 490 IR=1,NR                                         MAIN    234
                      X(IR)=100.*R(IR)                                       MAIN    235
                490   CONTINUE                                               MAIN    236
  250                 ERR=0.                                                 MAIN    237
                      CALL PASSIG (ITM3,NR,ERR)                              MAIN    238
                      IF (ERR) 510,510,500                                   MAIN    239
                500   WRITE (6,980) MET                                      MAIN    240
                510   CONTINUE                                               MAIN    241
  255                 DO 530 IR=1,NR                                         MAIN    242
                      DO 520 IU=1,NUPT                                       MAIN    243
                      SIGZ(IR,IU)=SZ(IR)/100.                                MAIN    244
                      SIGY(IR,IU)=SY(IR)/100.                                MAIN    245
                520   CONTINUE                                               MAIN    246
  260           530   CONTINUE                                               MAIN    247
                C     PRINT SIGMA Y AND SIGMA Z VALUES IF IPR GT 0           MAIN    248
                540   IF (IPR) 560,560,550                                   MAIN    249
                550   WRITE (6,990)                                          MAIN    250
                      WRITE (6,1000) R                                       MAIN    251
  265                 WRITE (6,1010) UBAR,((SIGZ(IR,IU),IR=1,10),IU=1,NUPT)  MAIN    252
                      WRITE (6,1070)                                         MAIN    253
                      WRITE (6,1000) R                                       MAIN    254
                      WRITE (6,1010) UBAR,((SIGY(IR,IU),IR=1,10),IU=1,NUPT)  MAIN    255
                560   CONTINUE                                               MAIN    256
  270           C     CALCULATE EOQ                                          MAIN    257
                      DO 580 IR=1,NR                                         MAIN    258
                      DO 570 IU=1,NUPT                                       MAIN    259
                      DENOM=SIGY(IR,IU)*SIGZ(IR,IU)*UBAR*3.1415927           MAIN    260
                      EXPO=(-.5*(H/SIGZ(IR,IU))**2)                          MAIN    261
  275                 EOQ(IR,IU)=EXP(EXPO)/DENOM                             MAIN    262
                570   CONTINUE                                               MAIN    263
                580   CONTINUE                                               MAIN    264
                      IF (IPU.GT.0) PUNCH 840, ((EOQ(I,J),I=1,10),J=1,NUPT)  MAIN    265
                      GO TO 600                                              MAIN    266
  280           590   READ (5,840) ((EOQ(I,J),I=1,10),J=1,NUPT)              MAIN    267
                600   CONTINUE                                               MAIN    268
                C     PRINT EOQ VALUES IF IQP.GT.0                           MAIN    269
                      IF (IQP.LE.0) GO TO 620                                MAIN    270
                      PRINT 820,IPAGE,JDY                                    MAIN    271
  285                 PRINT 1030,(R(I),I=1,NR)                               MAIN    272
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      PROGRAM MAIN      74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/7-  1--0.2--

                        IPAGE=IPAGE+1                                          MAIN      272
                        DO 610 IU=1,NUPT                                       MAIN      274
                        PRINT 1040, UPTIME(IU),(EOQ(IR,IU),IR=1,NR)            MAIN      275
                  610   CONTINUE                                               MAIN      276
              290       C     START DOSE CALCULATION                           MAIN      277
                        C     PERFORME DOSE CALCULATION                        MAIN      278
                        C     MAIN DO LOOP ON DISTANCES                        MAIN      279
                  620   DO 720 IR=1,NR                                         MAIN      280
                        KR=IR                                                  MAIN      281
              295       TT=P(IR)/UBAR                                          MAIN      282
                        IF (.NOT.FISPRD) GO TO 630                             MAIN      283
                        CALL CHAINT (2,TT,1)                                   MAIN      284
                  630   IF (.NOT.ACTPRD) GO TO 650                             MAIN      285
                        DO 640 ISO=N1,NTOT                                     MAIN      286
              300       IF (MASS(ISO,1).LT.1.E-30) GO TO 640                   MAIN      287
                        MASS(ISO,2)=MASS(ISO,1)*EXP(-LAMBDA(ISO)*TT)           MAIN      288
                  640   CONTINUE                                               MAIN      289
                  650   DO 660 ISO=1,NTOT                                      MAIN      290
                  660   SMASS(ISO)=MASS(ISO,2)                                 MAIN      291
              305       DO 710 IU=1,NUPT                                       MAIN      292
                        BOU=BRATE(IU)*EOQ(IR,IU)/UPTIME(IU)                    MAIN      293
                        IF (.NOT.FISPRD) GO TO 680                             MAIN      294
                        DO 670 ISO=1,NFP                                       MAIN      295
                  670   MASS(ISO,2)=SMASS(ISO)*BOU                             MAIN      296
              310 ____  680   IF (.NOT.ACTPRD) GO TO 700                       MAIN      297
                        DO 690 ISO=N1,NTOT                                     MAIN      298
                  690   MASS(ISO,2)=SMASS(ISO)*BOU                             MAIN      299
                  700   TLH=DTLH(IU)                                           MAIN      300
                        TLN=DTLN(IU)                                           MAIN      301
              315       KUPT=IU                                                MAIN      302
                        CALL ORDOSE                                            MAIN      303
                  C     END OF CASE                                            MAIN      304
                  710   CONTINUE                                               MAIN      305
                  720   CONTINUE                                               MAIN      306
              320       WRITE(1,725)                                           9/4/74    11
                  725   FORMAT(" START OF NEXT CASE")                          9/4/7-    12
                        DO 729 KO=1,IO                                         9/4/7-    13
                        DO 729 ID=1,NDT                                        9/4/74    14
                        KOG=ORGANS(KO)                                         9/4/74    15
              325       WRITE(1,728) TITLE2(1),ID,KOG,(SUMDOS(IR,ID,KO),IR=1,NR)  9/4/7-  16
                  728   FORMAT(A4,3X,I1,I2,1OE7.2)                             9/4/74    17
                  729   CONTINUE                                               9/4/74    18
                  C     RETURN TO START FOR NEXT CASE                          MAIN      307
                  C     CALCULATE WEIGHTED DOSE VALUES OVER TOTAL RELEASE PERIOD  MAIN    308
              330       IF (NUPT.LT.2) GO TO 100                               MAIN      309
                        LFMT(2)=ISPACE(IO)                                     MAIN      310
                        LFMT(7)=IFIELD(IO)                                     MAIN      311
                        MFMT(2)=ISPACE(IO)                                     MAIN      312
                        NFMT(2)=ISPACE(IO)                                     MAIN      313
              335       JFMT(7)=IFIELD(IO)                                     MAIN      314
                        JFMT(2)=ISPACE(IO)                                     MAIN      315
                        DO 760 IU=2,NUPT                                       MAIN      316
                        FAC=UPTIME(IU)/(UPTIME(IU)+UPTIME(IU-1))               MAIN      317
                        DO 750 ID=1,NDT                                        MAIN      318
              340       DO 740 KO=1,IO                                         MAIN      319
                        DO 730 IR=1,NR                                         MAIN      320
                        IRIU=IR + (IU-1)*10                                    MAIN      321
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```
                IRIUM=IR + (IU-2)*10                                             MAIN    322
                SUMDOS(IRIU,ID,KO)=SUMDOS(IRIU,ID,KO)*FAC+SUMDOS(IRIUM,ID,KO)*(1.- MAIN  323
               1FAC)                                                             MAIN    324
          730   CONTINUE                                                         MAIN    325
          740   CONTINUE                                                         MAIN    326
          750   CONTINUE                                                         MAIN    327
          760   CONTINUE                                                         MAIN    328
                CALL UNIT (CTLH,CTLN,NOT,DOSTIM)                                 MAIN    329
                ILINE=40                                                         MAIN    330
                DO 800 IU=1,NUPT                                                 MAIN    331
                DO 790 IR=1,NR                                                   MAIN    332
                IRIU=IR + (IU-1)*10                                              MAIN    333
                IF (ILINE+NOT+3.LE.41) GO TO 770                                 MAIN    334
                ILINE=0                                                          MAIN    335
                PRINT 1080,IPAGE,DOY,DTLH(IU),DTLN(IU)                           MAIN    336
                WRITE (6,1090) ((ORGAN(I,J),I=1,2),J=1,ID)                       MAIN    337
                IPAGE=IPAGE+1                                                    MAIN    338
          770   WRITE (6,1100) R(IR)                                             MAIN    339
                ILINE=ILINE+3                                                    MAIN    340
                DO 780 ID=1,NOT                                                  MAIN    341
                WRITE (6,1110) CTLH(ID),CTLN(ID),(SUMDOS(IRIU,ID,K),K=1,10)      MAIN    342
          780   CONTINUE                                                         MAIN    343
                ILINE=ILINE+NOT                                                  MAIN    344
          790   CONTINUE                                                         MAIN    345
          800   CONTINUE                                                         MAIN    346
                GO TO 100                                                        MAIN    347
          C     STOP ON END OF FILE                                              MAIN    348
          310   STOP                                                             MAIN    349
          C                                                                      MAIN    350
          C     ORGAN DOSE CALCULATION ONLY                                      MAIN    351
            815 IF(IER.GT.2) GO TO 819                                           MAIN    352
                PRINT 960,NUPT,(UPTIME(I),I=1,NUPT)                              MAIN    353
                PRINT 970,NOT,(DOSTIM(I),I=1,NOT)                                MAIN    354
                KUPT=1                                                           MAIN    355
                KR=1                                                             MAIN    356
                DO 817  I=1,NUPT                                                 MAIN    357
                DO 816 J=1,NTOT                                                  MAIN    358
          816   MASS(J,2)=MASS(J,1)*1.E+6/UPTIME(I)                              MAIN    359
                TLH=DTLH(I)                                                      MAIN    360
                TLN=DTLN(I)                                                      MAIN    361
                KUPT=I                                                           MAIN    362
                KR=1                                                             MAIN    363
                CALL ORDOSE                                                      MAIN    364
            817 CONTINUE                                                         MAIN    365
                GO TO 100                                                        MAIN    366
            819 IER=IER-1                                                        MAIN    367
                PRINT 1020,IER                                                   MAIN    368
                STOP                                                             MAIN    369
          C                                                                      MAIN    370
          820   FORMAT (1H1,"PAGE",I5,113X,A9/)                                  MAIN    371
          830   FORMAT (1H ,"DIAM =",F9.3," MICROMETERS"/1H ,"D3 =",F9.3/1H ,"D4 = MAIN  372
               1",F9.3/1H ,"D5 =",F9.3)                                          MAIN    373
          840   FORMAT (10E7.3)                                                  MAIN    374
          850   FORMAT (I3)                                                      MAIN    375
          855   FORMAT(1H1,"PAGE",I5,45X,"*****  INPUT DATA  *****",44X,A9///)   MAIN    376
          856   FORMAT(1H0,7A10)                                                 9/4/74   19
          860   FORMAT(1H0,53X,"NUCLIDE RELEASE IN CURIES"//)                    MAIN    377
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      870   FORMAT(1H ,2X,6(2X,A3,I3,I2,1PE11.4))                          MAIN      378
      880   FORMAT (4(A3,I3,I2,E12.0))                                     MAIN      379
      890   FORMAT ("0UNKNOWN ISOTOPE - "A3,I3)                            MAIN      380
      900   FORMAT (" INVALID VALUE FOR NEXT - "I6,)                       MAIN      381
      910   FORMAT (" NO ORGANS SPECIFIED - ORGANS",10I2)                  MAIN      382
  405 920   FORMAT(1H0///1H0,"UBAR =",F6.1/1H ,"dRATE =",5F9.0/1H ,"MET =",I3) MAIN  383
      930   FORMAT (" AH="F7.1/" BH="F8.5/" CH="F7.1/" DH="F7.1/" KSQD ="F9.6/ MAIN  384
     1" STUB(1)="F7.3)                                                    MAIN      385
      940   FORMAT (" CY ="F6.3,/" CZ ="F6.3/" EN ="F6.3)                  MAIN      386
      950   FORMAT (" "I3," DISTANCES, METERS"10F10.0)                     MAIN      387
  410 960   FORMAT (1H ,I3," UPTAKE TIMES, SECONDS ",1P5E10.3)             MAIN      388
      970   FORMAT (1H ,I3," DOSE TIMES, SECONDS ",1P10E10.3)              MAIN      389
      980   FORMAT (57H0LIMITS OF STORED SIGZ DATA EXCEEDED FOR METEOROLOGY TY MAIN  390
     1PE,I3)                                                              MAIN      391
      990   FORMAT (//60X,"SIGMA Z VALUES")                                MAIN      392
  415 1000  FORMAT (13H0AVERAGE WIND,3CX,34HDISTANCE FROM RELEASE POINT METERS MAIN  393
     1/13H SPEED, M/SEC,10F10.0/)                                         MAIN      394
     1010   FORMAT (1H ,F10.1,2X,10F10.0/(1H ,12X,10F10.0))                MAIN      395
     1020   FORMAT (" IER = "I3," ERRORS IN INPUT DATA - STOP")            MAIN      396
     1030   FORMAT (1H0,61X,"E/Q VALUES"/1H0,                  "UPTAK MAIN      397
  420 1 TIMES / DISTANCES"/1H ,2X,"(SECONDS)",3X,"(METERS)",10F10.0)      MAIN      398
     1040   FORMAT (1H0,1PE10.3,15X,10E10.3/(1H ,1PE10.3,15X,10E10.3))     MAIN      399
     1050   FORMAT(8A10)                                                   MAIN      400
     1060   FORMAT (" IMPROPER SOLUBILITY INDEX SPECIFIED FOR ",A3,I3,I2)  MAIN      401
     1070   FORMAT (//60X,"SIGMA Y VALUES")                                MAIN      402
  425 1080  FORMAT (1H1,"PAGE",I3,42X,"DOSE COMMITMENT FROM UPTAKE",44X,A9/ MAIN      403
     11H ,40X,"AVERAGED OVER A TOTAL RELEASE PERIOD OF ",F5.1,1X,A6/1H0, MAIN      404
     249X,"TASK GROUP ON LUNG DYNAMICS MODEL"/1H ,56X,"ORGAN DOSE IN REM MAIN      405
     3"//)                                                                MAIN      406
     1090   FORMAT ("0DISTANCE/"33X"ORGANS CONSIDERED ARE"/" DOSE TIME    "10( MAIN      407
  430 1A6,A5))                                                            MAIN      408
     1100   FORMAT ("0"F8.0," METERS"/)                                    MAIN      409
     1110   FORMAT (" "F5.1,1XA5,1P10E11.2)                                MAIN      410
            END                                                            MAIN      411
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      SUBROUTINE LIBB                                                   LIBB   2
C     LIBB READS AN ORGAN DATA LIBRARY.                                 LIBB   3
      COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),  COMN   2
     1CHAINS,DKFRCT(450,3),RED(600),ML(600),ICL(600)                    COMN   3
      COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)       COMN   4
      COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)         COMN   5
      COMMON DOSTIM(10),D3,D4,D5,UPT,MI(5),ISM(600)                     COMN   6
      COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                    COMN   7
      COMMON SUMDOS(50,10,10),TITLE2(8),NOT,KORG(20),TLM,TLN            COMN   8
      COMMON IPAGE,ORGAN(2,10)                                          COMN   9
      COMMON/NAM/ORGNAM(2,25)                                           COMN  10
      REAL LAMBIO,LAMBDA,MASS                                           COMN  11
      INTEGER CHAINS,SKIP                                               COMN  12
      LOGICAL FISPRO,ACTPRO                                             COMN  13
      COMMON ACTPRO,FISPRO,KR,KUPT,DOY                                  COMN  14
      COMMON LIBT(7)                                                    9/9/74   1
      LOGICAL SKIPO                                                     LIBB   5
C READ BIOLOGICAL DATA LIBRARY                                          LIBB   6
    1 FORMAT(I4,7A10)                                                   9/4/74   1
    2 FORMAT(2I3,I1,A2,I2,6E8.3,2E6.2)                                  LIBB   8
    3 FORMAT(" LIBRARY DATA SEQUENCE ERROR "/" "2I3,I1,A2,I2,6E10.4)    LIBB   9
      SKIPO=.FALSE.                                                     LIBB  10
      DO 100 I=1,600                                                    LIBB  11
  100 IBEG(I)=0                                                         LIBB  12
      KRN=0                                                             LIBB  13
      KET=0                                                             LIBB  14
      KIST=0                                                            LIBB  15
      KMT=0                                                             LIBB  16
      IOT=0                                                             LIBB  17
      KJ=0                                                              LIBB  18
      READ(28,1) NCOS,(LIBT(K),K=1,7)                                   9/9/74   2
      DO 300 I=1,NCOS                                                   LIBB  20
      READ(28,2) KE,KIS,KM,ELT,IO,TR,TB,FW,FA,FP2,EFF1,EFF2,EFF3        LIBB  21
      IF(KE-KET) 150,110,160                                            LIBB  22
  110 IF(KIS-KIST) 150,120,160                                          LIBB  23
  120 IF(KM-KMT) 150,130,160                                            LIBB  24
  130 IF(IO-IOT) 150,150,210                                            LIBB  25
C  LIBRARY DATA SEQUENCE ERROR                                          LIBB  26
  150 PRINT 3,   KE,KIS,KM,ELT,IO,TR,TB,FW,FA,FP2,EFF1,EFF2,EFF3        LIBB  27
      STOP                                                              LIBB  28
  160 IOT=1                                                             LIBB  29
      KET=KE                                                            LIBB  30
      KIST=KIS                                                          LIBB  31
      KMT=KM                                                            LIBB  32
      IF(IO-1) 150,170,150                                              LIBB  33
  170 IF(KRN.GT.0) IEND(KJ)=KRN                                         LIBB  34
      SKIPO=.FALSE.                                                     LIBB  35
      DO 190 J=1,NTOT                                                   LIBB  36
      IF(KE.NE.MA(J).OR.KIS.NE.ML(J)) GO TO 190                         LIBB  37
      IF(KM) 175,175,180                                                LIBB  38
  175 IF(KM+2.EQ.ISM(J)) GO TO 200                                      LIBB  39
      GO TO 190                                                         LIBB  40
  180 IF(KM.EQ.ISM(J)) GO TO 200                                        LIBB  41
  190 CONTINUE                                                          LIBB  42
C  ISOTOPE NOT IN BIO LIBRARY                                           LIBB  43
      SKIPO=.TRUE.                                                      LIBB  44
      GO TO 300                                                         LIBB  45
```

```
C  NEW ISOTOPE
  200 KJ=J
      IBEG(KJ)=KRN+1
      F1(KJ)=FW
  210 IF(SKIPO) GO TO 300
      IOT=IO
      KRN=KRN+1
      IF(TB.LE.0.) GO TO 220
      LAMBIO(KRN)=.69314/(86400.*TB)
      GO TO 230
  220 LAMBIO(KRN)=0.
  230 FWAT(KRN)=FW
      FAIR(KRN)=FA
      F2P(KRN)=FP2
      IORG(KRN)= IO
      ENG(KRN,1)=EFF1
      ENG(KRN,2)=EFF2
      ENG(KRN,3)=EFF3
      IF(EFF2.LE.0.) ENG(KRN,2)=EFF1
      IF(EFF3.LE.0.) ENG(KRN,3)=EFF1
  300 CONTINUE
      IEND(KJ)=KRN
      RETURN
      END
```

```
SUBROUTINE LIBK      74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.34.45.

                      SUBROUTINE LIBK                                                    LIBK      2
                C     LIBK READS AN ISOTOPE DATA LIBRARY                                 LIBK      3
                      COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),   COMN      2
                     1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                     COMN      3
      5               COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)        COMN      4
                      COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)          COMN      5
                      COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                      COMN      6
                      COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                     COMN      7
                      COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN             COMN      8
     10               COMMON IPAGE,ORGAN(2,15)                                           COMN      9
                      COMMON/NAM/ORGNAM(2,25)                                            COMN     10
                      REAL LAMBIO,LAMBDA,MASS                                            COMN     11
                      INTEGER CHAINS,SKIP                                                COMN     12
                      LOGICAL FISPRD,ACTPRD                                              COMN     13
     15               COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                   COMN     14
                      DIMENSION FRACT(450)                                               LIBK      5
                      LOGICAL ERROR                                                      LIBK      6
                C                                                                        LIBK      7
                C  READ RIBD DATA LIBRARY                                                LIBK      8
     20               READ (29,1) NCD                                                    LIBK      9
                    1 FORMAT(I3)                                                         LIBK     10
                      READ(29,2)(ML(J),MA(J),LAMBDA(J),FRACT(J),REC(J),ISM(J),J=1,NCD)   LIBK     11
                    2 FORMAT(I3,I2,E9.3,32X,F5.3,17X,A3,I1)                              LIBK     12
                      READ(29,1) N2                                                      LIBK     13
     25               N1=NCD+1                                                           LIBK     14
                      NAC=N2                                                             LIBK     15
                      N2=N2+NCD                                                          LIBK     16
                      NFP=NCD                                                            LIBK     17
                      NTOT=N2                                                            LIBK     18
     30               READ(29,102)(ML(J),MA(J),LAMBDA(J),REC(J),ISM(J),J=N1,N2)          LIBK     19
                  102 FORMAT(I3,I2,E9.3,54X,A3,I1)                                       LIBK     20
                      DO 202 L=N1,N2                                                     LIBK     21
                      IF(LAMBDA(L).LT.1.E-30) GO TO 202                                  LIBK     22
                      LAMBDA(L)=.69314/86400./LAMBDA(L)                                  LIBK     23
     35           202 CONTINUE                                                           LIBK     24
                      ERROR=.FALSE.                                                      LIBK     25
                      MP=0                                                               LIBK     26
                      CHAINS=0                                                           LIBK     27
                      DO 3 I=1,96                                                        LIBK     28
     40             3 NOFNUC(I)=0                                                       LIBK     29
                C  CALCULATE LAMBDA IN SEC-1                                             LIBK     30
                      DO 10 J=1,NCD                                                      LIBK     31
                      IF(LAMBDA(J).LT.1.E-30) GO TO 40                                   LIBK     32
                      LAMBDA(J)=.69314/LAMBDA(J)/86400.                                  LIBK     33
     45            40 IF(MP-ML(J)) 4,5,6                                                 LIBK     34
                    4 MP=ML(J)                                                           LIBK     35
                C NEW MASS CHAIN                                                         LIBK     36
                      CHAINS=CHAINS+1                                                    LIBK     37
                C COUNT NUMBER OF NUCLIDES IN THIS CHAIN                                 LIBK     38
     50             5 NOFNUC(CHAINS)=NOFNUC(CHAINS)+1                                   LIBK     39
                      GO TO 8                                                            LIBK     40
                    6 ERROR=.TRUE.                                                       LIBK     41
                      PRINT 7,J                                                          LIBK     42
                    7 FORMAT("0LIBRARY ENTRY"I4," IS OUT OF PLACE")                      LIBK     43
     55             8 DO 9 L=1,3                                                        LIBK     44
                    9 DKFRCT(J,L)=0.0                                                    LIBK     45
                   10 CONTINUE                                                           LIBK     46
```

```
      IF(ERROR) STOP
C     ISM=1 MEANS ISOMERIC STATE,=2 MEANS GROUND STATE
      ISOTOP=0
      DO 15 K=1,CHAINS
      LIM=NOFNUC(K)
      J=0
C     DETERMINE FRACTIONAL DECAY YIELDS
      DO 14 I=1,LIM
      J=J+1
      ISOTOP=ISOTOP+1
      IF(J.EQ.1) GO TO 13
      IF(ISM(ISOTOP).EQ.2) GO TO 11
      DKFRCT(ISOTOP,1)=FRACT(ISOTOP-1)
      GO TO 13
   11 DKFRCT(ISOTOP,1)=1.-FRACT(ISOTOP-1)
      IF(J.EQ.2) GO TO 13
      IF(ISM(ISOTOP-1).EQ.1) GO TO 12
      IF(ISM(ISOTOP-2).EQ.2) GO TO 13
      DKFRCT(ISOTOP,2)=FRACT(ISOTOP-2)
      GO TO 13
   12 DKFRCT(ISOTOP,2)=1.-FRACT(ISOTOP-2)
      IF(J.EQ.3.OR.ISM(ISOTOP-3).EQ.2) GO TO 13
      DKFRCT(ISOTOP,3)=FRACT(ISOTOP-3)
   13 IF(LAMBDA(ISOTOP).LT.1.E-30) J=0
   14 CONTINUE
   15 CONTINUE
C
      RETURN
      END
```

```
      SUBROUTINE DEP        74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.29.27.

                            SUBROUTINE DEP                                                    DEP       2
                      C     DEP CALCULATES THE RESPIRATORY TRACT DEPOSITION FACTORS FROM THE   DEP       3
                      C     ACTIVITY MEDIAN ATMOSPHERIC DIAMETER OF AN AEROSOL DISTRIBUTION    DEP       4
                            COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),   COMN      2
                           1CHAINS,DKFACT(450,3),REC(600),ML(600),ICL(600)                     COMN      3
                            COMMON MA(600),LAMBIO(1200),FNAT(1200),FAIR(1200),F2P(1200)        COMN      4
                            COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)          COMN      5
                            COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                      COMN      6
                            COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                     COMN      7
                            COMMON SUMDOS(50,10,10),TITLE2(8),NOT,KORG(20),TLH,TLN             COMN      8
                            COMMON IPAGE,ORGAN(2,10)                                           COMN      9
                            COMMON/NAM/ORGNAM(2,25)                                            COMN     10
                            REAL LAMBIO,LAMBDA,MASS                                            COMN     11
                            INTEGER CHAINS,SKIP                                                COMN     12
                            LOGICAL FISPRD,ACTPRD                                              COMN     13
                            COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                   COMN     14
                            EXTERNAL ERFXP                                                     DEP       6
                            DELTA=.000001                                                      DEP       7
                            DP=.1                                                              DEP       8
                            SP=24.                                                             DEP       9
                            DPL=ALOG10(DP)                                                     DEP      10
                            SPL=ALOG10(SP)                                                     DEP      11
                            XL=ALOG10(DIAM)                                                    DEP      12
                            XP=(XL-DPL)/SPL                                                    DEP      13
                            FP=SIMPS(-5.0,XP,DELTA,ERFXP)                                      DEP      14
                            FAC=SQRT(2.*3.1415927)                                             DEP      15
                            D5=1.-FP/FAC                                                       DEP      16
                            DP=2.                                                              DEP      17
                            SP=3.45                                                            DEP      18
                            DPL=ALOG10(DP)                                                     DEP      19
                            SPL=ALOG10(SP)                                                     DEP      20
                            XP=(XL-DPL)/SPL                                                    DEP      21
                            FP=SIMPS(-5.0,XP,DELTA,ERFXP)                                      DEP      22
                            D3=FP/FAC                                                          DEP      23
                            D4=.08                                                             DEP      24
                            RETURN                                                             DEP      25
                            END                                                                DEP      26
```

```
      FUNCTION ERFXP      74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.29.23.

                      FUNCTION ERFXP(ARG)                                          ERFXP      2
                C     ERFXP IS THE ERROR FUNCTION                                  ERFXP      3
                      EX=-.5*(ARG**2)                                              ERFXP      4
                      ERFXP=EXP(EX)                                                ERFXP      5
              5       RETURN                                                       ERFXP      6
                      END                                                          ERFXP      7
```

```
      FUNCTION SIMPS     74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.29.19.

                        FUNCTION SIMPS(A,B,DELTA,FCOOOO)                                    SIMPS      2
                C       A AND B ARE MIN AND MAX OF THE DEFINITE INTEGRAL                    SIMPS      3
                C       DELTA IS THE PERMISSIBLE DIFFERENCE BETWEEN  TWO SUCCESSIVE SUMS.   SIMPS      4
                        N=1                                                                 SIMPS      5
      5                 H=(B-A)/2.                                                          SIMPS      6
                        FJAY=H*(FCOOOO(A)+FCOOOO(B))                                        SIMPS      7
                C       A MAXIMUM OF 2049 POINTS WILL BE USED WHEN L=11                     SIMPS      8
                        DO 35 L=1,11                                                        SIMPS      9
                   10   S=0.0                                                               SIMPS     10
      10                DO 20 K=1,N                                                         SIMPS     11
                   20   S=S+FCOOOO(A+(2.0*FLOAT(K)-1.0)*H)                                  SIMPS     12
                        FI=FJAY+4.0*H*S                                                     SIMPS     13
                        IF(L-3)26,26,23                                                     SIMPS     14
                   23   CONTINUE                                                            SIMPS     15
      15                IF(DELTA-ABS((FI-BAR)/FI))30,40,40                                  SIMPS     16
                   26   CONTINUE                                                            SIMPS     17
                   30   BAR=FI                                                              SIMPS     18
                        FJAY=(FI+FJAY)/4.0                                                  SIMPS     19
                        N=2*N                                                               SIMPS     20
      20                H=H/2.0                                                             SIMPS     21
                   35   CONTINUE                                                            SIMPS     22
                   40   SIMPS =FI/3.0                                                       SIMPS     23
                        RETURN                                                              SIMPS     24
                        END                                                                 SIMPS     25
```

```
      SUBROUTINE PASSIG(TYPE,NUM,ERR)                                  PASSIG     2
C  PASSIG INTERPOLATES STORED PASQUILL CURVES FOR SY AND SZ FOR TYPE TYP PASSIG   3
C  AND NUM X POSITIONS                                                 PASSIG     4
      COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),  COMN      2
     1CHAINS,DKFRCT(450,3),REC(500),ML(600),ICL(600)                   COMN       3
      COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2F(1200)      COMN       4
      COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)        COMN       5
      COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                    COMN       6
      COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                   COMN       7
      COMMON SUMLOS(50,10,10),TITLE2(8),NOT,KORG(20),TLH,TLN           COMN       8
      COMMON IPAGE,ORGAN(2,10)                                         COMN       9
      COMMON/NAM/ORGNAM(2,25)                                          COMN      10
      REAL LAMBIC,LAMBDA,MASS                                          COMN      11
      INTEGER CHAINS,SKIP                                              COMN      12
      LOGICAL FISPRD,ACTPRD                                            COMN      13
      COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                 COMN      14
      INTEGER TYPE                                                     PASSIG     6
      DIMENSION SIGY(6,20),SIGZ(6,20),DIST(20)                         PASSIG     7
C  DISTANCES TO WHICH SY AND SZ DATA CORRESPOND.                       PASSIG     8
      DATA DIST/0.0,1.E4,1.5E4,2.5E4,3.5E4,5.E4,7.E4,1.E5,1.5E5,2.5E5,  PASSIG     9
     13.5E5,5.E5,7.E5,1.E6,1.5E6,2.5E6,3.5E6,5.E6,7.E6,1.E7/           PASSIG    10
C  SIGMA Y DATA - 1 FOR TYPE A, 2 FOR TYPE B, ETC.                     PASSIG    11
      DATA (SIGY(1,I),I=1,20)/20.,2.75E3,3.8E3,6.1E3,8.3E3,1.15E4,1.54E4 PASSIG   12
     1,2.14E4,3.05E4,4.7E4,6.3E4,8.7E4,1.14E5,1.56E5,2.2E5,3.32E5,4.4E5, PASSIG   13
     25.95E5,8.E5,1.15E6/                                              PASSIG    14
      DATA (SIGY(2,I),I=1,20)/90.,1.95E3,2.75E3,4.4E3,6.E3,8.3E3,1.12E4, PASSIG   15
     11.56E4,2.25E4,3.6E4,4.9E4,6.6E4,8.8E4,1.18E5,1.68E5,2.6E5,3.45E5,4 PASSIG   16
     2.6E5,6.1E5,8.2E5/                                                PASSIG    17
      DATA (SIGY(3,I),I=1,20)/90.,1.26E3,1.8E3,2.9E3,4.E3,5.5E3,7.5E3,1. PASSIG   18
     104E4,1.51E4,2.44E4,3.3E4,4.5E4,6.1E4,8.4E4,1.19E5,1.87E5,2.5E5,3.3 PASSIG   19
     25E5,4.5E5,6.2E5/                                                 PASSIG    20
      DATA (SIGY(4,I),I=1,20)/90.,8.2E2,1.18E3,1.9E3,2.6E3,3.6E3,4.9E3,6 PASSIG   21
     1.9E3,1.E4,1.6E4,2.17E4,3.E4,4.05E4,5.5E4,7.9E4,1.21E5,1.62E5,2.2E5 PASSIG   22
     2,3.E5,4.1E5/                                                     PASSIG    23
      DATA (SIGY(5,I),I=1,20)/90.,6.1E2,8.8E2,1.4E3,1.9E3,2.6E3,3.6E3,5. PASSIG   24
     105E3,7.3E3,1.18E4,1.6E4,2.22E4,3.E4,4.2E4,5.9E4,9.2E4,1.21E5,1.68E PASSIG   25
     25,2.25E5,3.E5/                                                   PASSIG    26
      DATA (SIGY(6,I),I=1,20)/90.,4.2E2,5.8E2,9.4E2,1.19E3,1.77E3,2.4E3, PASSIG   27
     13.4E3,4.9E3,7.8E3,1.07E4,1.48E4,2.E4,2.72E4,3.95E4,6.2E4,8.3E4,1.1 PASSIG   28
     22E5,1.5E5,2.E5/                                                  PASSIG    29
C  SIGMA Z DATA - 1 FOR TYPE A, 2 FOR TYPE B, ETC.                     PASSIG    30
      DATA (SIGZ(1,I),I=1,20)/100.,1.4E3,2.2E3,3.8E3,6.E3,1.08E4,2.17E4, PASSIG   31
     14.6E4,1.08E5,3.15E5,6.0E5,9*-1.0/                                PASSIG    32
      DATA (SIGZ(2,I),I=1,20)/100.,1.08E3,1.56E3,2.55E3,3.5E3,5.1E3,7.4E PASSIG   33
     13,1.1E4,1.7E4,3.E4,4.3E4,6.4E4,9.2E4,1.35E5,2.1E5,3.75E5,6.4E5,-1. PASSIG   34
     2,-1.,-1./                                                        PASSIG    35
      DATA (SIGZ(3,I),I=1,20)/100.,7.3E2,1.06E3,1.7E3,2.3E3,3.2E3,4.4E3, PASSIG   36
     16.1E3,8.9E3,1.42E4,1.95E4,2.65E4,3.65E4,5.E4,7.4E4,1.15E5,1.6E5,2. PASSIG   37
     22E5,2.9E5,4.E5/                                                  PASSIG    38
      DATA (SIGZ(4,I),I=1,20)/100.,4.6E2,6.6E2,1.02E3,1.37E3,1.85E3,2.4E PASSIG   39
     13,3.15E3,4.2E3,5.8E3,7.1E3,8.8E3,1.1E4,1.37E4,1.72E4,2.3E4,2.75E4, PASSIG   40
     23.3E4,3.9E4,4.6E4/                                               PASSIG    41
      DATA (SIGZ(5,I),I=1,20)/100.,3.5E2,5.E2,7.6E2,9.9E2,1.3E3,1.65E3,2 PASSIG   42
     1.15E3,2.8E3,3.8E3,4.7E3,5.5E3,6.6E3,7.9E3,9.6E3,1.21E4,1.39E4,1.54 PASSIG   43
     2E4,1.7E4,1.85E4/                                                 PASSIG    44
      DATA (SIGZ(6,I),I=1,20)/100.,2.3E2,3.2E2,4.9E2,6.3E2,8.5E2,1.1E3,1 PASSIG   45
     1.4E3,1.8E3,2.4E3,2.86E3,3.4E3,4.E3,4.65E3,5.4E3,6.4E3,7.1E3,7.8E3, PASSIG   46
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```
                28.6E3,9.3E3/                                         PASSIG  47
                IDATA=1                                               PASSIG  48
      C                                                               PASSIG  49
      C  CALCULATE SY AND SZ FOR EACH X POSITION DESIRED              PASSIG  50
                DO 5  I=1,NUM                                         PASSIG  51
              1 IF(IDATA.GT.20) GO TO 7                               PASSIG  52
                IF(SIGY(TYPE,IDATA)) 7,7,101                          PASSIG  53
            101 IF(SIGZ(TYPE,IDATA)) 7,7,201                          PASSIG  54
            201 IF(X(I)-DIST(IDATA)) 4,3,2                            PASSIG  55
              2 IDATA=IDATA+1                                         PASSIG  56
                GO TO 1                                               PASSIG  57
              3 SY(I)=SIGY(TYPE,IDATA)                                PASSIG  58
                SZ(I)=SIGZ(TYPE,IDATA)                                PASSIG  59
                GO TO 5                                               PASSIG  60
              4 IF(IDATA.EQ.1) GO TO 3                                PASSIG  61
                SY1=SIGY(TYPE,IDATA-1)                                PASSIG  62
                SY2=SIGY(TYPE,IDATA)                                  PASSIG  63
                SZ1=SIGZ(TYPE,IDATA-1)                                PASSIG  64
                SZ2=SIGZ(TYPE,IDATA)                                  PASSIG  65
                D1=DIST(IDATA-1)                                      PASSIG  66
                D2=DIST(IDATA)                                        PASSIG  67
                SY(I)=SY1+(X(I)-D1)*(SY2-SY1)/(D2-D1)                 PASSIG  68
                SZ(I)=SZ1+(X(I)-D1)*(SZ2-SZ1)/(D2-D1)                 PASSIG  69
              5 CONTINUE                                              PASSIG  70
                RETURN                                                PASSIG  71
              7 ERR=1.                                                PASSIG  72
                RETURN                                                PASSIG  73
                END                                                   PASSIG  74
```

```
      SUBROUTINE CHAINT     74/74   OPT=0   TRACE                FTN 4.2+P390      12/16/74  14.32.55.

                        SUBROUTINE CHAINT(LOC,THETA,POSIT)                                  CHAINT     2
                  C  SUBROUTINE CHAIN2 DECAYS NUCLIDES IN MASS ARRAY LOC FOR A TIME THETA    CHAINT     3
                  C  STORES RESULTS IN MASS ARRAY POSIT                                     CHAINT     4
                  C                                                                         CHAINT     5
              5         DIMENSION EXPO(8)                                                   CHAINT     6
                        COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),    COMN       2
                       1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                      COMN       3
                        COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)         COMN       4
                        COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)           COMN       5
             10         COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISN(600)                       COMN       6
                        COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                      COMN       7
                        COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN              COMN       8
                        COMMON IPAGE,ORGAN(2,10)                                            COMN       9
                        COMMON/NAM/ORGNAM(2,25)                                             COMN      10
             15         REAL LAMBIO,LAMBDA,MASS                                             COMN      11
                        INTEGER CHAINS,SKIP                                                 COMN      12
                        LOGICAL FISPRD,ACTPRD                                               COMN      13
                        COMMON ACTPRD,FISPRD,KR,KUPT,DDY                                    COMN      14
                        INTEGER POSIT                                                       CHAINT     8
             20         ISOTOP=0                                                            CHAINT     9
                  C  DO LOOP ON NUMBER OF CHAINS                                            CHAINT    10
                        DO 11 K=1,CHAINS                                                    CHAINT    11
                        LIM=NOFNUC(K)                                                       CHAINT    12
                        IF(SKIP(K).NE.0) GO TO 10                                           CHAINT    13
             25         J=0                                                                 CHAINT    14
                  C  DO LOOP ON ISOTOPES IN THE CHAIN                                       CHAINT    15
                        DO 9 I=1,LIM                                                        CHAINT    16
                        ISOTOP=ISOTOP+1                                                     CHAINT    17
                        J=J+1                                                               CHAINT    18
             30         IF(LAMBDA(ISOTOP).LT.1.E-30) GO TO 8                                CHAINT    19
                        EXPO(J)=EXP(-LAMBDA(ISOTOP)*THETA)                                  CHAINT    20
                  C  TRANSFER ON CHAIN MEMBER J                                             CHAINT    21
                        GO TO (1,2,3,4,5,6,7),J                                             CHAINT    22
                  C  FIRST CHAIN MEMBER                                                     CHAINT    23
             35       1 A1=MASS(ISOTOP,POSIT)                                               CHAINT    24
                        MASS(ISOTOP,LOC)=A1*EXPO(1)                                         CHAINT    25
                        GO TO 9                                                             CHAINT    26
                  C  SECOND CHAIN MEMBER                                                    CHAINT    27
                       2 A2=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)*A1/(LAMBDA(ISOTOP)-LAMBDA(ISO CHAINT    28
             40       1TOP-1))                                                             CHAINT    29
                        A3=MASS(ISOTOP,POSIT)-A2                                            CHAINT    30
                        MASS(ISOTOP,LOC)=A3*EXPO(2)+A2*EXPO(1)                              CHAINT    31
                        GO TO 9                                                             CHAINT    32
                  C  THIRD CHAIN MEMBER                                                     CHAINT    33
             45       3 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                              CHAINT    34
                        A4=(ABLE*A2+DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)*A1)/(LAMBDA(ISOTOP)- CHAINT    35
                       1LAMBDA(ISOTOP-2))                                                   CHAINT    36
                        A5=ABLE*A3/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))                        CHAINT    37
                        A6=MASS(ISOTOP,POSIT)-A4-A5                                         CHAINT    38
             50         MASS(ISOTOP,LOC)=A6*EXPO(3)+A5*EXPO(2)+A4*EXPO(1)                   CHAINT    39
                        GO TO 9                                                             CHAINT    40
                  C  FOURTH CHAIN MEMBER                                                    CHAINT    41
                       4 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)                             CHAINT    42
                        BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)                             CHAINT    43
             55         A7=(ABLE*A4+BAKER*A2+DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)*A1)/(LAMBDA CHAINT    44
                       1(ISOTOP)-LAMBDA(ISOTOP-3))                                          CHAINT    45
                        A8=(ABLE*A5+BAKER*A3)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))             CHAINT    46
```

```
      A9=ABLE*A6/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))
      A10=MASS(ISOTOP,POSIT)-A9-A8-A7
      MASS(ISOTOP,LOC)=A10*EXPO(4)+A9*EXPO(3)+A8*EXPO(2)+A7*EXPO(1)
      GO TO 9
C FIFTH CHAIN MEMBER
    5 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)
      BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)
      CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)
      A11=(ABLE*A7+BAKER*A4+CHARLY*A2)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4)
     1)
      A12=(ABLE*A8 +BAKER*A5+CHARLY*A3)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-3)
     1)
      A13=(ABLE*A9+ BAKER*A6)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))
      A14=ABLE*A10/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))
      A15=MASS(ISOTOP,POSIT)-A14-A13-A12-A11
      MASS(ISOTOP,LOC)=A15*EXPO(5)+A14*EXPO(4)+A13*EXPO(3)+A12*EXPO(2)+
     1A11*EXPO(1)
      GO TO 9
C SIXTH CHAIN MEMBER
    6 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)
      BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)
      CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)
      A16=(ABLE*A11+BAKER*A7+CHARLY*A4)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-5)
     1)
      A17=(ABLE*A12+BAKER*A8+CHARLY*A5)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4)
     1)
      A18=(ABLE*A13+BAKER*A9+CHARLY*A6)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-3)
     1)
      A19=(ABLE*A14+BAKER*A10)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))
      A20=ABLE*A15/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))
      A21=MASS(ISOTOP,POSIT)-A20-A19-A18-A17-A16
      MASS(ISOTOP,LOC)=A21*EXPO(6)+A20*EXPO(5)+A19*EXPO(4)+A18*EXPO(3)
     1+A17*EXPO(2)+A16*EXPO(1)
      GO TO 9
C SEVENTH CHAIN MEMBER
    7 ABLE=DKFRCT(ISOTOP,1)*LAMBDA(ISOTOP-1)
      BAKER=DKFRCT(ISOTOP,2)*LAMBDA(ISOTOP-2)
      CHARLY=DKFRCT(ISOTOP,3)*LAMBDA(ISOTOP-3)
      A22=(ABLE*A16+BAKER*A11+CHARLY*A7)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-6
     1))
      A23=(ABLE*A17+BAKER*A12+CHARLY*A8)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-5
     1))
      A24=(ABLE*A18+BAKER*A13+CHARLY*A9)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-4
     1))
      A25=(ABLE*A19+BAKER*A14+CHARLY*A10)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-
     13))
      A26=(ABLE*A20+BAKER*A15)/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-2))
      A27=ABLE*A21/(LAMBDA(ISOTOP)-LAMBDA(ISOTOP-1))
      A28=MASS(ISOTOP,POSIT)-A27-A26-A25-A24-A23-A22
      MASS(ISOTOP,LOC)=A28*EXPO(7)+A27*EXPO(6)+A26*EXPO(5)+A25*EXPO(4)+
     1A24*EXPO(3)+A23*EXPO(2)+A22*EXPO(1)
      GO TO 9
    8 J=0
    9 CONTINUE
      GO TO 11
   10 ISOTOP=ISOTOP+LIM
   11 CONTINUE
```

```
115     C  RETURN TO INDOSE                                   CHAINT   104
              RETURN                                          CHAINT   105
              END                                             CHAINT   106
```

```
      SUBROUTINE ORDOSE     74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.38.52.

                            SUBROUTINE ORDOSE                                                  ORDOSE     2
                      C                                                                        ORDOSE     3
                      C     THIS ROUTINE CALCULATES THE DOSES TO SELECTED ORGANS DUE TO        ORDOSE     4
                      C     INHALATION OF SELECTED RADIONUCLIDES.                              ORDOSE     5
                  5   C                                                                        ORDOSE     6
                            COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),   COMN      2
                           1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                     COMN      3
                            COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)        COMN      4
                            COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)          COMN      5
                 10         COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                      COMN      6
                            COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                     COMN      7
                            COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN             COMN      8
                            COMMON IPAGE,ORGAN(2,10)                                           COMN      9
                            COMMON/NAM/ORGNAM(2,25)                                            COMN     10
                 15         REAL LAMBIO,LAMBDA,MASS                                            COMN     11
                            INTEGER CHAINS,SKIP                                                COMN     12
                            LOGICAL FISPRD,ACTPRD                                              COMN     13
                            COMMON ACTPRD,FISPRD,AR,KUPT,DUT                                   COMN     14
                            COMMON/COMO/ALAMO,ALB(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),          COMO      2
                 20        1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLHT1,VQLUT1(8),OMASS(25)        COMO      3
                            DIMENSION      DOSE(10,10),ALLB(9,3),F(9,3),IBLNK(10,10),IFMT(17), ORDOSE     9
                           1KFMT(21),ISPACE(10),TLH2(10)                                       ORDOSE    10
                            DIMENSION ISOL(3)                                                  ORDOSE    11
                            DATA ISOL/" (D)  "," (H)  "," (Y)  "/                              ORDOSE    12
                 25         DATA (IFMT(I),I=1,6)/"(1H ","," ","X,1X","A3,I3,","1PE9.2",",2X"/  ORDOSE    13
                            DATA (KFMT(I),I=1,21)/"(1H ","," ","X,","4HRADI","2HO-",",2X,",    ORDOSE    14
                           1"4HDOSE",",1X,","4HTIME","/1H ","," ","X,","4HNUCL","3HIDE",",3X,", ORDOSE    15
                           2"4H(DAY","2HS),",","4X","10(A6,","A5)","/1H )"/                    ORDOSE    16
                            DATA ISPACE/"46","41","36","31","26","21","16","11","6","1"/       ORDOSE    17
                 30         DATA (((ALLB(I,J),I=1,9),J=1,3)/3*8.023E-4,4.012E-5,1.605E-5,2*0., ORDOSE    18
                           12*1.605E-5,8.023E-4,2.006E-5,8.023E-4,4.012E-5,1.605E-7,8.023E-6,  ORDOSE    19
                           23*1.605E-7,8.023E-4,2.006E-5,8.023E-4,4.012E-5,1.605E-8,8.023E-6,  ORDOSE    20
                           32*1.605E-8,8.023E-9/                                               ORDOSE    21
                            DATA (((F(I,J),I=1,9),J=1,3)/2*.5,.95,.05,.8,2*0.,.2,1.,.1,.9,2*.5, ORDOSE    22
                 35        1.1,,2*.4,.95,1.,.01,.99,.01,.99,.05,2*.4,.15,.9/                  ORDOSE    23
                            DATA (OMASS(I),I=1,25)/7.E4,4.3E4,300.,1700.,150.,7000.,1.E4,      ORDOSE    24
                           11000.,20.,40.,8.,6100.,1500.,3.E4,20.,20.,70.,300.,2000.,250.,     ORDOSE    25
                           21100.,135.,150.,0.,0./                                             ORDOSE    26
                      C     INITIALIZE VARIABLES                                               ORDOSE    27
                 40         DUMMY=0                                                            ORDOSE    28
                            ISO=0                                                              ORDOSE    29
                            ILINE=60                                                           ORDOSE    30
                            KRKUPT=KR + (KUPT-1)*10                                            ORDOSE    31
                      C     SET T1 EQUAL TO THE CURRENT UPTAKE TIME                            ORDOSE    32
                 45         T1=UPTIME(KUPT)                                                    ORDOSE    33
                            DO 90 I=1,NOT                                                      ORDOSE    34
                            TLH2(I)=(DOSTIM(I) + UPTIME(KUPT))/86400.                          ORDOSE    35
                         90 CONTINUE                                                           ORDOSE    36
                            DO 100 I=1,10                                                      ORDOSE    37
                 50         DO 100 J=1,10                                                      ORDOSE    38
                            DOSE(I,J)=0.                                                       ORDOSE    39
                            SUMDOS(KRKUPT,I,J)=0.0                                             ORDOSE    40
                        100 CONTINUE                                                           ORDOSE    41
                      C     SET UP ORGAN NAMES FOR PRINT OUT                                   ORDOSE    42
                 55         LORG=0                                                             ORDOSE    43
                            DO 106 I=1,20                                                      ORDOSE    44
                            IF(KORG(I).EQ.0) GO TO 106                                         ORDOSE    45
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                      LORG=LORG+1                                                ORDOSE    46
                      DO 105 J=1,2                                               ORDOSE    47
      60          105 ORGAN(J,LORG)= ORGNAM(J,I)                                 ORDOSE    48
                  106 CONTINUE                                                   ORDOSE    49
                      IFMT(LORG+7)=")"                                           ORDOSE    50
                      NORG=LORG                                                  ORDOSE    51
                      IF(FISPRO) GO TO 200                                       ORDOSE    52
      65              IF(ACTPRO) GO TO 700                                       ORDOSE    53
                      WRITE(6,110) KUPT                                          ORDOSE    54
                  110 FORMAT(1H0,"NO FISSION PRODUTS OR ACTIVATION PRODUCTS SPECIFIED FO ORDOSE    55
                     1R CASE",I3)                                                ORDOSE    56
                      GO TO 3000                                                 ORDOSE    57
      70          C   LOOP ON NUCLIDE CHAINS                                     ORDOSE    58
                  200 DO 600 ICH=1,CHAINS                                        ORDOSE    59
                      LIM=NOFNUC(ICH)                                            ORDOSE    60
                  C   BYPASS UNUSED CHAINS                                       ORDOSE    61
                      IF(SKIP(ICH).EQ.3) GO TO 300                               ORDOSE    62
      75              ISO=ISO+LIM                                                ORDOSE    63
                      GO TO 600                                                  ORDOSE    64
                  300 DO 500 K=1,LIM                                             ORDOSE    65
                      ISO=ISO + 1                                                ORDOSE    66
                      IF(MASS(ISO,2).LE.0.) GO TO 500                            ORDOSE    67
      80          C                                                              ORDOSE    68
                  C   IF DAUGHTER NUCLIDE SOLUBILITY INDEX HAS NOT BEEN SPECIFIED USE ORDOSE    69
                  C   THE SOLUBILITY INDEX OF THE PARENT                        ORDOSE    70
                      DO 302 J=1,K                                               ORDOSE    71
                      IF(ICL(ISO).GT.0) GO TO 304                                ORDOSE    72
      85              ICL(ISO)=ICL(ISO-J)                                        ORDOSE    73
                  302 CONTINUE                                                   ORDOSE    74
                      PRINT 303,ISO                                              ORDOSE    75
                  303 FORMAT(1H0,"*** NO SOLUBILITY CLASS NUMBER FOR",I5," FOUND") ORDOSE    76
                  304 NSOL=ICL(ISO)                                              ORDOSE    77
      90              L1=IBEG(ISO)                                               ORDOSE    78
                      L2=IEND(ISO)                                               ORDOSE    79
                      LORG=0                                                     ORDOSE    80
                      DO 305 L=1,9                                               ORDOSE    81
                      ALL(L)=ALLB(L,NSOL) + LAMBDA(ISO)                          ORDOSE    82
      95              FT(L)=F(L,NSOL)                                            ORDOSE    83
                      ARG=ALL(L)*T1                                              ORDOSE    84
                      OMEJ1(L)=1. - EXP(-ARG)                                    ORDOSE    85
                      IF(ARG.GT.1000.) OMEJ1(L)=1.                               ORDOSE    86
                      ALB(L)=ALLB(L,NSOL)                                        ORDOSE    87
     100          305 CONTINUE                                                   ORDOSE    88
                      C(1)=ALB(1)*FT(1)*D3/ALL(1)                                ORDOSE    89
                      C(2)=ALB(2)*FT(2)*D3/ALL(2)*F1(ISO)                        ORDOSE    90
                      C(3)=ALB(3)*FT(3)*D4/ALL(3)                                ORDOSE    91
                      C(4)=ALB(4)*FT(4)*D4/ALL(4)*F1(ISO)                        ORDOSE    92
     105              C(5)=ALB(5)*FT(5)*D5/ALL(5)                                ORDOSE    93
                      C(6)=ALB(6)*FT(6)*D5/ALL(6)*F1(ISO)                        ORDOSE    94
                      C(7)=ALB(7)*FT(7)*D5/ALL(7)*F1(ISO)                        ORDOSE    95
                      C(8)=ALB(8)*ALB(9)*FT(8)*FT(9)*D3/ALL(8)                   ORDOSE    96
                      C(9)=C(8)/ALB(9)                                           ORDOSE    97
     110              VQLMT1=QLMIT1(DUMMY)                                       ORDOSE    98
                      DO 306 J=1,8                                               ORDOSE    99
                  306 VQLUT1(J)=QLUNT1(J)                                        ORDOSE   100
                  C   ORGAN LOOP                                                 ORDOSE   101
                      DO 400 MORG=1,20                                           ORDOSE   102
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      SUBROUTINE ORDOSE     74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.38.52.

  115           C     TEST FOR ORGAN INCLUSION                                      ORDOSE   103
                      IF(KORG(MORG).EQ.0) GO TO 400                                 ORDOSE   104
                C     TEST FOR ORGAN-NUCLIDE COMBINATION                            ORDOSE   105
                      LORG=LORG + 1                                                 ORDOSE   106
                      IF(L1.EQ.0.OR.L2.EQ.0) GO TO 312                              ORDOSE   107
  120                 DO  310 IO=L1,L2                                              ORDOSE   108
                      KRN=IO                                                        ORDOSE   109
                      IF(IORG(IO).EQ.MORG) GO TO 320                                ORDOSE   110
                310 CONTINUE                                                        ORDOSE   111
                C     NO ORGAN DATA AVAILABLE FOR THIS NUCLIDE - BLANK THE DOSE     ORDOSE   112
  125           312 DO 315 ITM=1,NDT                                                ORDOSE   113
                      IBLNK(ITM,LORG)=1                                             ORDOSE   114
                315 DOSE(ITM,LORG)=" "                                              ORDOSE   115
                      GO TO 400                                                     ORDOSE   116
                320 ALAMO=LAMBIO(IO) +LAMBDA(ISO)                                   ORDOSE   117
  130                 OMEN1=1. - EXP(-ALAMO*T1)                                     ORDOSE   118
                      VONT1=ONT1(KRN)                                               ORDOSE   119
                      D1=0.                                                         ORDOSE   120
                C     LOOP OVER DOSE TIMES                                          ORDOSE   121
                      DO 395 ITM=1,NDT                                              ORDOSE   122
  135                 D2=0.                                                         ORDOSE   123
                      T2=DOSTIM(ITM)                                                ORDOSE   124
                C     ZERO OUT DOSE TIME FOR PRINT OUT IF LESS THAN 1 SEC           ORDOSE   125
                      IF(T2.LT.1.) T2=0.                                            ORDOSE   126
                      IBLNK(ITM,LORG)=0                                             ORDOSE   127
  140                 IF(ITM.GT.1.AND.T2.LE.0.) GO TO 345                           ORDOSE   128
                      OMEN2=1. - EXP(-ALAMO*T2)                                     ORDOSE   129
                      DO 325 J=1,9                                                  ORDOSE   130
                      ARG=ALL(J)*T2                                                 ORDOSE   131
                      OMEJ2(J)=1. - EXP(-ARG)                                       ORDOSE   132
  145                 IF(ARG.GT.1000.) OMEJ2(J)=1.                                  ORDOSE   133
                325 CONTINUE                                                        ORDOSE   134
                330 IF(ITM.GT.1) GO TO 340                                          ORDOSE   135
                      D1=ORDOT1(KRN,MORG)                                           ORDOSE   136
                340 IF(T2.LE.0.) GO TO 345                                          ORDOSE   137
  150                 D2=ORDOT2(KRN,MORG,ISO)                                       ORDOSE   138
                345 IF(MORG.EQ.8) GO TO 360                                         ORDOSE   139
                      DOSE(ITM,LORG)=MASS(ISO,2) * LAMBDA(ISO) * (D1 + D2)          ORDOSE   140
                      GO TO 385                                                     ORDOSE   141
                C     ADD LUNG DOSE DUE TO PRIMARY DEPOSITION                       ORDOSE   142
  155           360 SUM2=0.                                                         ORDOSE   143
                      IF(ITM.GT.1) GO TO 370                                        ORDOSE   144
                      SUM1=0.                                                       ORDOSE   145
                      DO  365 J=5,8                                                 ORDOSE   146
                365 SUM1=SUM1 + 5.92E-4*ENG(KRN,NSOL)/OMASS(MORG)*FT(J)*D5/ALL(J)   ORDOSE   147
  160                 1*(T1 - OMEJ1(J)/ALL(J))                                      ORDOSE   148
                370 IF(T2.LE.0.) GO TO 380                                          ORDOSE   149
                      DO 375 J=5,8                                                  ORDOSE   150
                375 SUM2=SUM2 + 5.92E-4*ENG(KRN,NSOL)/OMASS(MORG)*FT(J)*D5/ALL(J)**2 ORDOSE   151
                    1*OMEJ1(J)*OMEJ2(J)                                             ORDOSE   152
  165           380 DOSE(ITM,LORG)=MASS(ISO,2)*LAMBDA(ISO)*(SUM1+SUM2+D1+D2)        ORDOSE   153
                385 SUMDOS(KRKUPT,ITM,LORG)=SUMDOS(KRKUPT,ITM,LORG) + DOSE(ITM,LORG) ORDOSE   154
                C     END OF TIME LOOP                                              ORDOSE   155
                395 CONTINUE                                                        ORDOSE   156
                C     END OF ORGAN LOOP                                             ORDOSE   157
  170           400 CONTINUE                                                        ORDOSE   158
                C     SET UP TO WRITE DATA FOR ONE NUCLIDE                          ORDOSE   159
```

```
      IF (ILINE + NOT + 1.LE.60) GO TO 420
C     WRITE NEW PAGE HEADER
      WRITE(6,410) IPAGE,DOY,TLH,TLN
  410 FORMAT(1H1,"PAGE",I5,31X,"DOSE TO SELECTED ORGANS OF INTEREST VIA
     1INHALATION",32X,A9/1H ,49X,"TASK GROUP ON LUNG DYNAMICS MODEL"/
     21H ,46X,"DURATION OF INHALATION",1PE9.2,1X,A6/1H ,56X,"ORGAN DOSE
     3IN REM"//)
      KFMT(2)=ISFACE(NORG)
      KFMT(11)=KFMT(2)
      WRITE(6,KFMT) ((ORGAN(M,N),M=1,2),N=1,NORG)
      IFMT(2)=KFMT(2)
      IPAGE=IPAGE+1
      ILINE=10
  420 DO 450  ITM=1,NDT
      DO  430 I=1,NORG
      IFMT(I+6)=",E11.3"
  430 IF(IBLNK(ITM,I).EQ.1) IFMT(I+6)=",5X,A6"
      IF(ITM.GT.1) GO TO 440
      IFMT(1)="(1H0,"
      IFMT(4)="A3,I3,"
      WRITE(6,IFMT) REC(ISO),ML(ISO),TLH2(1),(DOSE(1,I),I=1,NORG)
      GO TO 450
  440 IFMT(1)="(1H ,"
      IFMT(4)="A6,"
      MARK=ISOL(NSOL)
      IF(ITM.GT.2) MARK=" "
      WRITE(6,IFMT) MARK,TLH2(ITM),(DOSE(ITM,I),I=1,NORG)
  450 CONTINUE
      ILINE=ILINE+NDT+1
C     END OF FP CHAIN LOOP
  500 CONTINUE
C     END OF FP LOOP
  600 CONTINUE
      IF(ACTPRO) GO TO 700
      GO TO 2000
C     DO LOOP OVER ACTIVATION PRODUCTS
  700 ISTART=NFP+1
      DO 1000 IS=ISTART,NTOT
      IF(MASS(IS,2).LE.0.)   GO TO 1000
      L1=IBEG(IS)
      L2=IEND(IS)
      NSOL=ICL(IS)
      LORG=0
      DO 705 L=1,9
      ALL(L)=ALLB(L,NSOL) + LAMBDA(IS)
      FT(L)=F(L,NSOL)
      ARG=ALL(L)*T1
      OMEJ1(L)=1. - EXP(-ARG)
      IF(ARG.GT.1000.) OMEJ1(L)=1.
      ALB(L)=ALLB(L,NSOL)
  705 CONTINUE
      C(1)=ALB(1)*FT(1)*D3/ALL(1)
      C(2)=ALB(2)*FT(2)*D3/ALL(2)*F1(IS)
      C(3)=ALB(3)*FT(3)*D4/ALL(3)
      C(4)=ALB(4)*FT(4)*D4/ALL(4)*F1(IS)
      C(5)=ALB(5)*FT(5)*D5/ALL(5)
      C(6)=ALB(6)*FT(6)*D5/ALL(6)*F1(IS)
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      SUBROUTINE ORDOSE     74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.38.52.

                  C(7)=ALB(7)*FT(7)*D5/ALL(7)*F1(IS)                                ORDOSE    217
  230             C(8)=ALB(8)*ALB(9)*FT(8)*FT(9)*D5/ALL(8)                          ORDOSE    218
                  C(9)=C(8)/ALB(9)                                                  ORDOSE    219
                  VOLMT1=QLMIT1(DUMMY)                                              ORDOSE    220
                  DO 706 J=1,8                                                      ORDOSE    221
              706 VOLUT1(J)=QLUNT1(J)                                               ORDOSE    222
  235         C   ORGAN LOOP                                                        ORDOSE    223
                  DO 900 MORG=1,20                                                  ORDOSE    224
              C   TEST FOR ORGAN INCLUSION                                         ORDOSE    225
                  IF(KORG(MORG).EQ.0) GO TO 900                                     ORDOSE    226
              C   TEST FOR ORGAN-NUCLIDE COMBINATION DATA                         ORDOSE    227
  240             LORG=LORG + 1                                                     ORDOSE    228
                  DO 910 IO=L1,L2                                                   ORDOSE    229
                  KRN=IO                                                            ORDOSE    230
                  IF(IORG(IO).EQ.MORG) GO TO 820                                    ORDOSE    231
              810 CONTINUE                                                          ORDOSE    232
  245         C   NO ORGAN DATA FOR THIS NUCLIDE - BLANK DOSE ARRAY                 ORDOSE    233
                  DO 815  ITM=1,NDT                                                 ORDOSE    234
                  IBLNK(ITM,LORG)=1                                                 ORDOSE    235
              815 DOSE(ITM,LORG)=" "                                                ORDOSE    236
                  GO TO 900                                                         ORDOSE    237
  250         820 ALAMO= LAMBIO(IO) + LAMBDA(IS)                                    ORDOSE    238
                  OMEN1=1. - EXP(-ALAMO*T1)                                         ORDOSE    239
                  VQNT1=QNT1(KRN)                                                   ORDOSE    240
                  D1=0.                                                             ORDOSE    241
              C   THE FOLLOWING TWO CARDS WERE ADDED TO ALLOW CHANGING THE MASS OF  9/4/74     3
  255         C   THE LUNG TO 570 GRAMS IF A ALPHA EMITTER DOSE IS BEING COMPUTED.  9/4/74     4
                  OMCF=1.                                                           9/4/74     5
                  IF(MORG.EQ.8.AND.ENG(KRN,NSOL).GT.10.) OMCF=1.754                 9/4/74     6
              C   LOOP OVER DOSE TIMES                                             ORDOSE    242
                  DO 895  ITM=1,NDT                                                 ORDOSE    243
  260             D2=0.                                                             ORDOSE    244
                  T2=DOSTIM(ITM)                                                    ORDOSE    245
              C   ZERO OUT DOSE TIME FOR PRINT OUT IF LESS THAN 1 SEC               ORDOSE    246
                  IF(T2.LT.1.) T2=0.                                                ORDOSE    247
                  IBLNK(ITM,LORG)=0                                                 ORDOSE    248
  265             IF(ITM.GT.1.AND.T2.LE.0.) GO TO 845                               ORDOSE    249
                  OMEN2=1. - EXP(-ALAMO*T2)                                         ORDOSE    250
                  DO 825 J=1,9                                                      ORDOSE    251
                  ARG=ALL(J)*T2                                                     ORDOSE    252
                  OMEJ2(J)=1. - EXP(-ARG)                                           ORDOSE    253
  270             IF(ARG.GT.1000.) OMEJ2(J)=1.                                      ORDOSE    254
              825 CONTINUE                                                          ORDOSE    255
              830 IF(ITM.GT.1) GO TO 840                                            ORDOSE    256
                  D1= ORDOT1(KRN,MORG)                                              ORDOSE    257
              840 IF(T2.LE.0) GO TO 845                                             ORDOSE    258
  275             D2= ORDOT2(KRN,MORG,IS)                                           ORDOSE    259
              845 IF(MORG.EQ.8) GO TO 860                                           ORDOSE    260
                  DOSE(ITM,LORG)= MASS(IS,2)*LAMBDA(IS) * (D1 + D2)                 ORDOSE    261
                  GO TO 885                                                         ORDOSE    262
              C   ADD LUNG DOSE FOR THAT DEPOSITED DIRECTLY                        ORDOSE    263
  280         860 SUM2=0.                                                           ORDOSE    264
                  IF(ITM.GT.1) GO TO 870                                            ORDOSE    265
                  SUM1=0.                                                           ORDOSE    266
                  DO 865 J=5,8                                                      ORDOSE    267
              865 SUM1=SUM1 + 3.92E-4*ENG(KRN,NSOL)/CMASS(MORG)*FT(J)*D5/ALL(J)     ORDOSE    268
  285           1*(T1 - OMEJ1(J)/ALL(J)) * OMCF                                   9/4/74     7
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```
      870 IF(T2.LE.0.) GO TO 880                                       ORDOSE   270
          DO 875 J=5,8                                                 ORDOSE   271
      875 SUM2=SUM2 + 5.92E-4*ENG(KRN,NSOL)/OMASS(NORG)*FT(J)*D5/ALL(J)**2 ORDOSE   272
         1*OMEJ1(J)*OMEJ2(J) * OMCF                                    9/4/74     8
      880 DOSE(ITM,LORG)=MASS(IS,2)*LAMBDA(IS)*(SUM1+SUM2+D1+D2)       ORDOSE   274
      885 SUMDOS(KRKUPT,ITM,LORG)=SUMDOS(KRKUPT,ITM,LORG) + DOSE(ITM,LORG) ORDOSE   275
C     END OF TIME LOOP                                                 ORDOSE   276
      895 CONTINUE                                                     ORDOSE   277
C     END OF ORGAN LOOP                                                ORDOSE   278
      900 CONTINUE                                                     ORDOSE   279
C         SET UP TO WRITE DATA FOR ONE NUCLIDE                         ORDOSE   280
          IF (ILINE + NOT + 1.LE.60) GO TO 920                         ORDOSE   281
C         WRITE NEW PAGE HEADER                                        ORDOSE   282
          WRITE(6,410) IPAGE,DOY,TLH,TLN                               ORDOSE   283
          KFMT(2)=ISFACE(NORG)                                         ORDOSE   284
          KFMT(11)=KFMT(2)                                             ORDOSE   285
          WRITE(6,KFMT) ((ORGAN(M,N),M=1,2),N=1,NORG)                  ORDOSE   286
          IFMT(2)=KFMT(2)                                              ORDOSE   287
          IFMT(NORG+7)=")"                                             ORDOSE   288
          IPAGE=IPAGE+1                                                ORDOSE   289
          ILINE=10                                                     ORDOSE   290
      920 DO 950 ITM=1,NOT                                             ORDOSE   291
          DO 930  I=1,NORG                                             ORDOSE   292
          IFMT(I+6)=",E11.3"                                           ORDOSE   293
      930 IF(IBLNK(ITM,I).EQ.1) IFMT(I+6)=",5X,A6"                     ORDOSE   294
          IF(ITM.GT.1) GO TO 940                                       ORDOSE   295
          IFMT(1)="(1H0,"                                              ORDOSE   296
          IFMT(4)="A3,I3,"                                             ORDOSE   297
          WRITE(6,IFMT) REC(IS),ML(IS),TLH2(1),(DOSE(1,I),I=1,NORG)    ORDOSE   298
          GO TO 950                                                    ORDOSE   299
      940 IFMT(1)="(1H ,"                                              ORDOSE   300
          IFMT(4)="A6,"                                                ORDOSE   301
          MARK=ISOL(NSOL)                                              ORDOSE   302
          IF(ITM.GT.2.OR.NSOL.EQ.0) MARK=" "                           ORDOSE   303
          WRITE(6,IFMT) MARK,TLH2(ITM),(DOSE(ITM,I),I=1,NORG)          ORDOSE   304
      950 CONTINUE                                                     ORDOSE   305
          ILINE=ILINE+NOT+1                                            ORDOSE   306
C     END OF ACTIVATION PRODUCT LOOP                                   ORDOSE   307
     1000 CONTINUE                                                     ORDOSE   308
C     SUMMARY PAGE OUTPUT                                              ORDOSE   309
     2000 WRITE(6,2001) IPAGE,KUPT,KR,TITLE2,DOY                       ORDOSE   310
 2001     FORMAT(1H1,"PAGE",I5,1X,"(",I2,",",I2,")",8X,8A10,17X,A9)    5/30/74    1
          WRITE(6,2010) TLH,TLN                                        ORDOSE   312
     2010 FORMAT(1H0,40X,"DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION ORDOSE   313
         1"/1H ,48X,"TASK GROUP ON LUNG DYNAMICS MODEL"/1H ,46X,       ORDOSE   314
         2"DURATION OF INHALATION",1PE9.2,1X,A6/1H ,57X,"ORGAN DOSE IN REM"/ ORDOSE   315
         1/)                                                           ORDOSE   316
          WRITE(6,KFMT)((ORGAN(I,J),I=1,2),J=1,NORG)                   ORDOSE   317
          IFMT(1)="(1H0,"                                              ORDOSE   318
          IFMT(4)=",A6,"                                               ORDOSE   319
          HALL="ALL   "                                                ORDOSE   320
          DO 2015 I=1,NORG                                             ORDOSE   321
     2015 IFMT(I+6)=",E11.2"                                           ORDOSE   322
          IPAGE=IPAGE+1                                                ORDOSE   323
          DO 2020 I=1,NOT                                              ORDOSE   324
          WRITE(6,IFMT) HALL,TLH2(I),(SUMDOS(KRKUPT,I,J),J=1,NORG)     ORDOSE   325
     2020 CONTINUE                                                     ORDOSE   326
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 3000 RETURN                                                  ORDOSE   327
      END                                                     ORDOSE   328
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      FUNCTION ORDOT1     74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.38.43.

                            FUNCTION ORDOT1(KRN,MORG)                                    ORDOT1     2
                      C     ORDOT1 CALCULATES THE NORMALIZED DOSE TO AN ORGAN DURING THE TIME  ORDOT1     3
                      C     OF UPTAKE T1.                                                ORDOT1     4
                      C                                                                  ORDOT1     5
                      C     "C" ARE THE COEF. FOR THE RESPIRATORY TRACT CLEARANCE        ORDOT1     6
                      C     "ALAMO" IS THE EFFECTIVE REMOVAL CONSTANT FOR THE ORGAN      ORDOT1     7
                      C     "ALL" ARE THE EFFECTIVE REMOVAL  CONSTANTS FOR THE LUNG COMPARTMENT ORDOT1     8
                      C     "OMEN1" IS (1 - EXP(-ALAMO * T1))                            ORDOT1     9
                      C     "T1" IS THE UPTAKE TIME                                      ORDOT1    10
                      C     "NSOL" IS THE SOLUBILITY INDEX                               ORDOT1    11
                      C     "F2P" IS THE BLOOD TO ORGAN FRACTION                         ORDOT1    12
                      C     "FT" ARE THE RESPIRATORY TRACT CLEARANCE PATHWAY FRACTIONS    ORDOT1    13
                      C     "ALB" ARE THE BIOLOGICAL REMOVAL CONSTANTS FOR THE LUNG      ORDOT1    14
                      C     "ENG" IS THE EFFECTIVE ENERGY FOR THE NUCLIDE IN THE ORGAN   ORDOT1    15
                      C     "OMASS" IS THE ORGAN MASS                                    ORDOT1    16
                      C     "D3,D4,D5" ARE THE FRACTION INHALED DEPOSITION FACTORS       ORDOT1    17
                      C     "OMEJ1" IS (1 -EXP(ALL*T1)                                  ORDOT1    18
                            COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),  COMN      2
                           1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)               COMN      3
                            COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)  COMN      4
                            COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)    COMN      5
                            COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                COMN      6
                            COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM               COMN      7
                            COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN       COMN      8
                            COMMON IPAGE,ORGAN(2,10)                                     COMN      9
                            COMMON/NAM/ORGNAM(2,25)                                      COMN     10
                            REAL LAMBIO,LAMBDA,MASS                                      COMN     11
                            INTEGER CHAINS,SKIP                                          COMN     12
                            LOGICAL FISPRD,ACTPRD                                        COMN     13
                            COMMON ACTPRD,FISPRD,KR,KUPT,DOY                             COMN     14
                            COMMON/COMO/ALAMO,ALB(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),    COMO      2
                           1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLNT1,VQLUT1(8),OMASS(25)  COMO      3
                            FIRST=0.                                                     ORDOT1    21
                            W=T1/ALAMO                                                   ORDOT1    22
                            Y=OMEN1/ALAMO                                                ORDOT1    23
                            Z=Y/ALAMO                                                    ORDOT1    24
                            DO 30 I=1,7                                                  ORDOT1    25
                            IF(NSOL.EQ.1.AND.(I.EQ.6.OR.I.EQ.7)) GO TO 30                ORDOT1    26
                            FIRST=FIRST +C(I)*(W-Z-(Y -OMEJ1(I)/ALL(I))/(ALL(I)-ALAMO))  ORDOT1    27
                         30 CONTINUE                                                     ORDOT1    28
                            SECOND=C(9)*(W-Z-Y/(ALL(9)-ALAMO)+OMEJ1(9)/ALL(9)/(ALL(9)-   ORDOT1    29
                           1ALAMO))/ALL(9)                                               ORDOT1    30
                            IF(NSOL.LE.2) GO TO 40                                       ORDOT1    31
                      C     ALL(8).NE.ALL(9)                                             ORDOT1    32
                            THIRD=-C(8)/(ALL(8)-ALL(9))*((Y-OMEJ1(9)/ALL(9))/(ALL(9)-ALAMO)  ORDOT1    33
                           1-(Y-OMEJ1(8)/ALL(8))/(ALL(8)-ALAMO))                         ORDOT1    34
                            GO TO 100                                                    ORDOT1    35
                      C     ALL(8).EQ.ALL(9)                                             ORDOT1    36
                         40 THIRD=C(8)/(ALL(9)-ALAMO)**2 * (OMEJ1(9)/ALL(9)-Y+(ALL(9)-ALAMO)  ORDOT1    37
                           1/ALL(9)**2 *(1. -EXP(-ALL(9)*T1)*(ALL(9)*T1 +1.)))           ORDOT1    38
                        100 ORDOT1=5.92E-4*ENG(KRN,NSOL)*F2P(KRN)/OMASS(MORG)*(FIRST+SECOND  ORDOT1    39
                           1 + THIRD)                                                    ORDOT1    40
                            END                                                          ORDOT1    41
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      FUNCTION ORDOT2     74/74   OPT=0   TRACE                FTN 4.2+P382     12/10/74  14.38.47.

                            FUNCTION ORDOT2(KRN,MORG,ISO)                                      ORDOT2      2
                      C     ORDOT2 CALCULATES THE NORMALIZED DOSE TO AN ORGAN DURING THE TIME  ORDOT2      3
                      C     FOLLOWING TERMINATION OF UPTAKE T2                                 ORDOT2      4
                      C                                                                        ORDOT2      5
                      C    "C" ARE THE COEF. FOR RESPIRATORY TRACT CLEARANCE                   ORDOT2      6
                      C     "ALAMO" IS THE EFFECTIVE REMOVAL CONSTANT FOR THE ORGAN            ORDOT2      7
                      C     "ALL" ARE THE EFFECTIVE REMOVAL CONSTANTS FOR THE LUNG COMPARTMENTS ORDOT2      8
                      C     "OMEN1" AND "OMEN2" ARE (1 -EXP(-ALAMO*T1)) AND (1 -EXP(-ALAMO*T2)) ORDOT2     9
                      C     "OMEJ1" AND"OMEJ2" ARE (1 -EXP(-ALL*T1)) AND (1 -EXP(-ALL*T2)      ORDOT2     10
                      C     "T1" IS THE UPTAKE TIME                                            ORDOT2     11
                      C     "T2" IS THE DOSE TIME FOLLOWING UPTAKE                             ORDOT2     12
                      C     "NSOL" IS THE SOLUBILITY INDEX                                     ORDOT2     13
                      C     "F2P" IS THE BLOOD TO ORGAN INDEX                                  ORDOT2     14
                      C    "FT" ARE THE RESPIRATORY TRACT CLEARANCE PATHWAY FRACTIONS          ORDOT2     15
                      C     "ALO" ARE THE BIOLOGICAL REMOVAL CONSTANTS FOR THE LUNG            ORDOT2     16
                      C                                                                        ORDOT2     17
                            COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),   COMN       2
                           1CHAINS,DKFRCT(450,3),REC(600),ML(600),IUL(600)                     COMN       3
                            COMMON MA(600),LAMBIO(1200),FMAT(1200),FAIR(1200),F2P(1200)        COMN       4
                            COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)          COMN       5
                            COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                      COMN       6
                            COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                     COMN       7
                            COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN             COMN       8
                            COMMON IPAGE,ORGAN(2,10)                                           COMN       9
                            COMMON/NAM/ORGNAM(2,25)                                            COMN      10
                            REAL LAMBIC,LAMBDA,MASS                                            COMN      11
                            INTEGER CHAINS,SKIP                                                COMN      12
                            LOGICAL FISPRD,ACTPRD                                              COMN      13
                            COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                   COMN      14
                            COMMON/COMO/ALAMO,ALB(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),          COMO       2
                           1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLNT1,VQLUT1(8),OMASS(25)        COMO       3
                            FIRST=OMEN2/ALAMO * VQNT1                                          ORDOT2     20
                            SECOND=0.                                                          ORDOT2     21
                            DO 30 I=1,7                                                        ORDOT2     22
                            FGIB=1.                                                            ORDOT2     23
                            IF(MOD(I,2).EQ.0.OR.I.EQ.7) FGIB=F1(ISO)                           ORDOT2     24
                            IF(NSOL.EQ.1.AND.(I.EQ.6.OR.I.EQ.7)) GO TO 30                      ORDOT2     25
                            SECOND=SECOND + ALB(I) /(ALL(I)-ALAMO)*(OMEN2/ALAMO-OMEJ2(I)/      ORDOT2     26
                           1ALL(I))*VQLUT1(I)*FGIB                                             ORDOT2     27
                         30 CONTINUE                                                           ORDOT2     28
                            IF(NSOL.LE.2) GO TO 40                                             ORDOT2     29
                            THIRD=ALB(8) * ALB(9) * FT(9)*VQLUT1(8)/(ALL(8)-ALL(9)) *          ORDOT2     30
                           1((OMEN2 /ALAMO-OMEJ2(9)/ALL(9))/(ALL(9)-ALAMO)                     ORDOT2     31
                           2-(OMEN2 /ALAMO - OMEJ2(9)/ALL(8))/(ALL(8)-ALAMO))                  ORDOT2     32
                            GO TO 100                                                          ORDOT2     33
                         40 THIRD=ALB(8) *ALB(9) *FT(9)*VQLUT1(8)/(ALL(9)-ALAMO)*((OMEN2/ALAMO ORDOT2     34
                           1-OMEJ2(9)/ALL(9))/(ALL(9)-ALAMO) -(1.-EXP(-ALL(9)*T2)*(ALL(9)*T2   ORDOT2     35
                           2 +1.))/ALL(9)**2)                                                  ORDOT2     36
                        100 FOURTH=ALB(9) * VQLNT1/(ALAMO-ALL(9))*(OMEJ2(9)/ALL(9)             ORDOT2     37
                           1 - OMEN2/ALAMO)                                                    ORDOT2     38
                            ORDOT2=5.92E-4 * ENG(KRN,NSOL)/OMASS(MORG)*(FIRST + F2P(KRN)       ORDOT2     39
                           1 * (SECOND + THIRD + FOURTH))                                      ORDOT2     40
                            RETURN                                                             ORDOT2     41
                            END                                                                ORDOT2     42
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      FUNCTION QNT1      74/74   OPT=0   TRACE                FTN 4.2+P380      12/16/74  14.38.35.

                      FUNCTION QNT1(KRN)                                                  QNT1       2
                C     THIS FUNCTION CALCULATES THE QUANTITY OF A NUCLIDE PRESENT IN AN OR QNT1       3
                C     FOLLOWING CONTINUOUS UPTAKE AT A UNIT RATE FOR A TIME T1 USING      QNT1       4
                C     THE NEW ICRP LUNG MODEL.                                            QNT1       5
              5 C                                                                         QNT1       6
                C     "T1" IS THE UPTAKE TIME                                             QNT1       7
                C     "C" ARE THE COEF. FOR THE RESPIRATORY TRACT CLEARANCE               QNT1       8
                C     "ALAMO"IS THE EFFECTIVE REMOVAL CONSTANT FOR THE ORGAN              QNT1       9
                C     "ALL"ARE THE EFFECTIVE REMOVAL CONSTANTS FOR THE LUNG COMPARTMENTS  QNT1      10
             10 C     "OMEN" IS (1 - EXP(-ALAMO*T1))                                      QNT1      11
                C     "OMEJ" ARE (1- EXP(-ALL(J)*T1))                                     QNT1      12
                C     "NSOL"IS THE SOLUBILITY INDEX                                       QNT1      13
                C     "F2P"IS THE BLOOD TO ORGAN FRACTION                                 QNT1      14
                C                                                                         QNT1      15
             15       COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),    COMN       2
                     1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                      COMN       3
                      COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)         COMN       4
                      COMMON IORG(1200),ENG(1200,3),F1(600),IDEG(600),IEND(600)           COMN       5
                      COMMON DOSTIM(10),D3,D4,D5,UPTIME(3),ISM(600)                       COMN       6
             20       COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                      COMN       7
                      COMMON SUMDOS(50,10,10),TITLE2(8),NOT,KORG(20),TLH,TLN              COMN       8
                      COMMON IPAGE,ORGAN(2,10)                                            COMN       9
                      COMMON/NAM/ORGNAM(2,25)                                             COMN      10
                      REAL LAMBIC,LAMBDA,MASS                                             COMN      11
             25       INTEGER CHAINS,SKIP                                                 COMN      12
                      LOGICAL FISPRD,ACTPRD                                               COMN      13
                      COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                    COMN      14
                      COMMON/COMO/ALAMO,ALB(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),           COMO       2
                     1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLMT1,VQLUT1(8),OMASS(25)         COMO       3
             30       SUM=0.                                                              QNT1      18
                      DO  50  I=1,7                                                       QNT1      19
                      IF(NSOL.EQ.1.AND.(I.EQ.6.OR.I.EQ.7)) GO TO 50                       QNT1      20
                      SUM=SUM + C(I) * (OMEN1/ALAMO - (OMEJ1(I) - OMEN1)/(ALL(I)-ALAMO))  QNT1      21
                   50 CONTINUE                                                            QNT1      22
             35 C                                                                         QNT1      23
                      SUM=SUM +C(8)/ALL(9)*(OMEN1/ALAMO-(OMEJ1(9)-OMEN1)/(ALL(9)-ALAMO))  QNT1      24
                      IF (NSOL.LE.2) GO TO 70                                             QNT1      25
                C     THIS CASE IS FOR WHEN ALL(8) NOT EQUAL TO ALL(9)                    QNT1      26
                      SUM=SUM - C(8)/(ALL(8)-ALL(9))*((OMEJ1(9)-OMEN1)/(ALL(9)-ALAMO)     QNT1      27
             40      1 -(OMEJ1(8) - OMEN1)/(ALL(8)-ALAMO))                               QNT1      28
                      GO TO 100                                                           QNT1      29
                C     THIS CASE IS FOR ALL(8)=ALL(9)                                      QNT1      30
                   70 SUM=SUM-C(8)/(ALL(9)-ALAMO)**2 * (EXP(-ALAMO*T1)                    QNT1      31
                     1-EXP(-ALL(9)*T1) * ((ALL(9)-ALAMO) *T1 + 1.))                       QNT1      32
             45     100 QNT1=SUM * F2P(KRN)                                              QNT1      33
                      RETURN                                                              QNT1      34
                      END                                                                 QNT1      35
```

```
      FUNCTION QLUNT1(I)                                                QLUNT1     2
C                                                                       QLUNT1     3
C     THIS FUNCTION CALCULATES THE QUANTITY OF A NUCLIDE PRESENT IN     QLUNT1     4
C     EACH OF THE LUNG SUB COMPARTMENTS FOLLOWING CONTINUOUS INHALATION QLUNT1     5
C     AT A UNIT RATE FOR A TIME T1 USING THE NEW ICRP LUNG MODEL.       QLUNT1     6
C                                                                       QLUNT1     7
C  "FT" ARE THE RESPIRATORY TRACT CLEARANCE PATHWAY FRACTIONS           QLUNT1     8
C  "D3,D4,D5" ARE THE LUNG DEPOSITION FACTORS                           QLUNT1     9
C  "OMEJ1" IS  (1 - EXP(-ALL*T1))                                       QLUNT1    10
C  "ALL" ARE THE EFFECTIVE REMOVAL CONSTANTS FOR THE LUNG COMPARTMENTS  QLUNT1    11
C                                                                       QLUNT1    12
      COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),  COMN       2
     1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                    COMN       3
      COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)       COMN       4
      COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)         COMN       5
      COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                     COMN       6
      COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                    COMN       7
      COMMON SUMDOS(30,10,10),TITLE2(8),NOT,KORG(20),TLH,ILN            COMN       8
      COMMON IPAGE,ORGAN(2,10)                                          COMN       9
      COMMON/NAM/ORGNAM(2,25)                                           COMN      10
      REAL LAMBIO,LAMBDA,MASS                                           COMN      11
      INTEGER CHAINS,SKIP                                               COMN      12
      LOGICAL FISPRO,ACTPRO                                             COMN      13
      COMMON ACTPRO,FISPRO,KR,KUPT,DOY                                  COMN      14
      COMMON/COMO/ALAMO,ALE(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),         COMO       2
     1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLMT1,VQLUT1(8),OMASS(25)       COMO       3
      GO TO (10,10,20,20,30,30,30,30), I                                QLUNT1    15
   10 QLUNT1= FT(I) * D3 * OMEJ1(I)/ALL(I)                              QLUNT1    16
      GO TO 100                                                         QLUNT1    17
   20 QLUNT1= FT(I) * D4 * OMEJ1(I)/ALL(I)                              QLUNT1    18
      GO TO 100                                                         QLUNT1    19
   30 QLUNT1= FT(I) * D5 * OMEJ1(I)/ALL(I)                              QLUNT1    20
  100 RETURN                                                            QLUNT1    21
      END                                                               QLUNT1    22
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      FUNCTION QLMIT1     74/74   OPT=0   TRACE                FTN 4.2+P390      12/16/74  14.38.38.

                            FUNCTION QLMIT1(DUMMY)                                          QLMIT1     2
                      C                                                                     QLMIT1     3
                      C   THIS FUNCTION CALCULATES THE QUANTITY OF NUCLIDE PRESENT IN THE   QLMIT1     4
                      C    LYMPH,THAT IS REMOVABLE, FOLLOWING CONTINUOUS UPTAKE AT A UNIT   QLMIT1     5
                    5 C    RATE FOR A TIME T1 USING THE NEW LUNG MODEL.                     QLMIT1     6
                      C                                                                     QLMIT1     7
                      C   "ALL" ARE THE REMOVAL CONSTANTS FOR THE RESPIRATORY TRACT        QLMIT1     8
                      C   "OMEJ1" ARE  (1 - EXP(-ALL(J)*T1))                               QLMIT1     9
                      C   "C" ARE THE COEF. FOR THE RESPIRATORY TRACT CLEARANCE           QLMIT1    10
                   10 C   "T1" IS THE UPTAKE TIME                                         QLMIT1    11
                      C   "NSOL" IS THE SOLUBILITY INDEX                                  QLMIT1    12
                            COMMON NFP,NAC,NTOT,NOFNUC(96),SKIP(96),MASS(600,2),LAMBDA(600),  COMN    2
                           1CHAINS,DKFRCT(450,3),REC(600),ML(600),ICL(600)                  COMN     3
                            COMMON MA(600),LAMBIO(1200),FWAT(1200),FAIR(1200),F2P(1200)     COMN     4
                   15       COMMON IORG(1200),ENG(1200,3),F1(600),IBEG(600),IEND(600)       COMN     5
                            COMMON DOSTIM(10),D3,D4,D5,UPTIME(5),ISM(600)                   COMN     6
                            COMMON BRATE(5),R(10),X(10),SY(10),SZ(10),DIAM                  COMN     7
                            COMMON SUMDOS(50,10,10),TITLE2(8),NDT,KORG(20),TLH,TLN          COMN     8
                            COMMON IPAGE,ORGAN(2,10)                                        COMN     9
                   20       COMMON/NAM/ORGNAM(2,25)                                         COMN    10
                            REAL LAMBIO,LAMBDA,MASS                                         COMN    11
                            INTEGER CHAINS,SKIP                                             COMN    12
                            LOGICAL FISPRD,ACTPRD                                           COMN    13
                            COMMON ACTPRD,FISPRD,KR,KUPT,DOY                                COMN    14
                   25       COMMON/COMO/ALAMO,ALB(9),ALL(9),C(9),FT(9),NSOL,OMEJ1(9),       COMO     2
                           1OMEJ2(9),OMEN1,OMEN2,T1,T2,VQNT1,VQLMT1,VQLUT1(8),OMASS(25)     COMO     3
                            DUM=DUMMY                                                       QLMIT1    15
                            FIRST= OMEJ1(9)/ALL(9)                                          QLMIT1    16
                            IF(NSOL.LE.2) GO TO 50                                          QLMIT1    17
                   30     C   ALL8.NE.ALL9                                                 QLMIT1    18
                              QLMIT1= C(9)*(FIRST -(OMEJ1(8) - OMEJ1(9))/(ALL(8)-ALL(9)))   QLMIT1    19
                              GO TO 100                                                     QLMIT1    20
                          C   ALL8.EQ.ALL9                                                 QLMIT1    21
                             50 QLMIT1= C(9)* (FIRST - T1 * EXP(-ALL(9)*T1))              QLMIT1    22
                   35        100 RETURN                                                    QLMIT1    23
                              END                                                           QLMIT1    24
```

```
SUBROUTINE UNIT      74/74   OPT=0   TRACE                FTN 4.2+P380     12/16/74  1-.29.17.

                      SUBROUTINE UNIT(DTLH,DTLN,NUPT,UPTIME)                          UNIT        2
                C     UNIT CONVERTS TIME IN SECONDS TO MORE CONVENIENT UNITS          UNIT        3
                      DIMENSION DTLH(5),DTLN(5),UPTIME(5)                             UNIT        4
                      DO 100 I=1,NUPT                                                 UNIT        5
 5                    IF(UPTIME(I).GT.60.) GO TO 10                                   UNIT        6
                      DTLH(I)=UPTIME(I)                                               UNIT        7
                      DTLN(I)="SEC"                                                   UNIT        8
                      GO TO 100                                                       UNIT        9
                   10 IF(UPTIME(I).GT.3600.) GO TO 20                                 UNIT       10
10                    DTLH(I)=UPTIME(I)/60.                                           UNIT       11
                      DTLN(I)="MIN"                                                   UNIT       12
                      GO TO 100                                                       UNIT       13
                   20 IF(UPTIME(I).GT.86400.) GO TO 30                                UNIT       14
                      DTLH(I)=UPTIME(I)/3600.                                         UNIT       15
15                    DTLN(I)="HOURS"                                                 UNIT       16
                      GO TO 100                                                       UNIT       17
                   30 IF(UPTIME(I).GT.3.1536E7) GO TO 40                              UNIT       18
                      DTLH(I)=UPTIME(I)/86400.                                        UNIT       19
                      DTLN(I)="DAYS"                                                  UNIT       20
20                    GO TO 100                                                       UNIT       21
                   40 DTLH(I)=UPTIME(I)/3.1536E7                                      UNIT       22
                      DTLN(I)="YEARS"                                                 UNIT       23
                  100 CONTINUE                                                        UNIT       24
                      RETURN                                                          UNIT       25
25                    END                                                             UNIT       26
```

APPENDIX F

INPUT PREPARATION

APPENDIX F

INPUT PREPARATION

The input data required for the calculations falls into three general categories: (1) Program control variables, (2) Parameters associated with atmospheric diffusion and dispersion and (3) Parameters associated with the organ dose calculation. The majority of the data required by the code is contained in two data libraries that are accessed by the code (see Appendix D) thus eliminating much time consuming preparation of input.

Program control variables consist of parameters to control the reading of the data libraries, the optional printing of some input and intermediate data and the type of atmospheric dispersion calculation to be performed, if any. The atmospheric dispersion calculation can be by-passed by setting MET = 0; in this case, the values entered for the radionuclide activity become the total quantity inhaled rather than the quantity released to the atmosphere.

The remainder of this appendix describes in detail, the input variables, their use and the manner in which they are input to the program.

DATA CARD DESCRIPTIONS

CARD 1 - Title card

COLUMN	FORMAT	VARIABLE	USE
1-72	12A6	TITLE 2	words entered here are reprinted as a title on the summary page. Each case requires a title card or blank card.

CARDS 2 to N - Namelist Data Cards (one or more namelist cards).

The minimum data for each case consists of one title card (card 1) one or more cards using the Namelist format (cards 2 to N). The first Namelist card (card 2) must be blank in Column 1, $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 item must be followed by a $. The data items must have one of the three following forms:

1. Variable name = constant, where the variable name may be either subscripted or not.

2. Array name = set of constants (separated by commas). The number of constants must not exceed 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.

3. 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. Again, the number of elements in the array between the given element in the array and the last element in the array.

The namelist variables retain their values throughout the execution of the program and need not be respecified unless a change is wished. The namelist input variables are shown in the following list:

TABLE OF NAMELIST VARIABLES

I. PROGRAM CONTROL VARIABLES

VARIABLE	ARRAY SIZE	USE	VALUE UNITS	VALUES
NEXT	(1)	Next Case Options	None	1 to 4
IPR	(1)	Controls printing of v_z values (no or yes)	None	0 or 1
IPU	(1)	Controls punching of E/Q values on cards (no or yes)	None	0 or 1
IQP	(1)	Controls printing of E/Q values (no or yes)	None	0 or 1

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
MET	(1)	Selects atmospheric dispersion model to be used	None	0 to 10

II. ATMOSPHERIC DISPERSION VARIABLES

A. GENERAL

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
H	(1)	Release height	meters	any
R(K)	(10)	Radial distance to receptor	meters	any
UBAR	(1)	Wind speed	m/sec	any

B. SIMPSON-FUQUAY (MET=1)

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
STUB(J)	(5)	Meterological parameters, $(\sigma_\theta \bar{u})$	radian-m/sec	any
AH	(1)	Meteorological parameter, a	m^2	any
BH	(1)	Meteorological parameter, b	m^2/sec	any
CH	(1)	Meteorological parameter, c	m^2/sec	any
DH	(1)	Meteorological parameter, d	sec	any
KSQD	(1)	Meteorological parameter, k^2	sec^{-2}	any

C. SUTTON (MET=2)

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
CY	(1)	Sutton's lateral diffusion coefficient, Cy	None	any

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
CZ	(1)	Sutton's vertical diffusion coefficient, C_z	None	any
EN	(1)	Sutton's power coefficient, n	None	any

D. ANY OTHER MODEL DESCRIBED BY σ_z AND σ_y (MET=3)

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
SIGY (K,I)	(10,5)	Standard deviation of lateral plume growth, σ_y at the Kth distance for the Ith inhalation uptake time.	meters	any
SIGZ (K,I)	10,5)	Standard deviation of vertical plume growth, σ_z at the Kth distance for the Ith inhalation uptake time.	meters	any

E. PASQUILL (MET=4 through 9)

No special atmospheric dispersion variables required.

III. ORGAN DOSE VARIABLES

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
D3	(1)	Fraction of aerosol inhaled deposited in nasal passages	None	any
D4	(1)	Fraction of aerosol inhaled deposited in trachea and bronchia	None	any
D5	(1)	Fraction of aerosol inhaled deposited in pulmonary region	None	any

VARIABLE	ARRAY SIZE	DESCRIPTION	VALUE UNITS	VALUES
DIAM	(1)	Mass median aerodynamic diameter of inhaled material	μm	any
BRATE(I)	(5)	Ventilation rate of receptor during the Ith inhalation uptake time	cm^3/sec	any
UPTIME(I)	(5)	The length of time during which inhalation uptake takes place	sec	any
DOSTIM(J)	(10)	The length of time following the termination of inhalation uptake for which the dose is to be calculated	sec	any
ORGANS(L)	(10)	Selects the organ's for which the dose is to be calculated (see the organ list for numerical code)	None	1 to 18 (integer)

NEXT

Next is a variable controlling the dose calculations that instructs the program what to do after the namelist data has been read. It controls library reading and quantitative isotopic input data. There are 4 options corresponding to NEXT - 1,2,3,4.

NEXT = 1 Reads in libraries, zeros out isotopic quantities and reads in a set of isotope quantities.

NEXT = 2 Zeros out existing isotopes and reads in a new set of isotope quantities.

NEXT = 3 Isotopic quantities are kept, other variables may be changed.

NEXT = 4 End of job. No further calculations are done. Provides for normal exit.

Any of the namelist variables may be changed when NEXT = 1, 2 or 3. NEXT must be specified as 1 in the first case so the libraries will be read.

MET

MET is a variable used to select the atmospheric dispersion model to calculated the E/Q values. There are 11 options available corresponding to MET = 0,1,2,3,....10.

MET = 0 By-passes atmospheric dispersion portion of the code. Only program control and organ dose namelist variables are required.

MET = 1 Simpson-Fuquay Model for stable atmospheric conditions. The unique namelist variables required for this case are shown under II.B.

MET = 2 Sutton's Model for neutral and unstable atmospheric conditions. The unique namelist variables required for this case are shown under II.C.

Met = 3 Any other situation where the values of σ_y and σ_z are known. The unique namelist variables required for this case are shown under II.D.

MET = 4 to 9 Pasquill's Model for atmospheric conditions "A" through "F". MET = 4 corresponds to condition "A", etc. No unique namelist variables are required for this case. The values for σ_y and σ_z are interpolated from built-in data.

MET = 10 Input of E/Q values directly. No unique namelist variables are required for this case.

CARD N+1 - Number of Radionuclides Card

COLUMN	FORMAT	VARIABLE	USE
1-3	I3	NUMBER	Controls the number of radionuclides (maximum of 600) to be read from subsequent input cards.

CARDS N+2 to M - Radionuclide Data Cards

COLUMN	FORMAT	VARIABLE	USE
1-3	A3	NAME	The name of an element selected from the Isotope Data Labrary
4-6	I3	M	The mass number of the selected radionuclide
7-8	I2	ISL	The solubility class of the nuclide (1=D, 2=W, 3=Y)
9-20	E12.0	QUANTITY	The total quantity of this radionuclide released to the atmosphere or if MET=0 the total inhaled.

The format shown may be repeated 4 times on each card starting in columns 21, 41, and 61 for additional nuclides.

CARDS M+1 to K - E/Q Value Input Cards (used only with MET=10)

COLUMN	FORMAT	VARIABLE	USE
1-70	10E7.3	EOQ	E/Q values for up to ten downwind distances

One of these cards is required for each uptake time specified only if MET=10 is used.

ORGAN LIST

NUMERICAL CODE	ORGAN
1	TOTAL BODY
2	BODY WATER
3	KIDNEYS
4	LIVER
5	SPLEEN
6	BONE
7	FAT
8	LUNGS
9	ADRENALS
10	TESTES
11	OVARIES
12	SKIN
13	BRAIN
14	MUSCLE
15	PROSTATE
16	THYROID
17	PANCREAS
18	HEART

APPENDIX G

SAMPLE PROBLEMS

APPENDIX G

SAMPLE PROBLEMS

To illustrate the use of the computer code, two sample problems are presented here. One using the direct inhalation option and one using the Simpson-Fuquay stable atmospheric diffusion model option, to simulate the inhalation of radionuclides released to the atmosphere.

The first problem includes calculation of the effective dose to ten different organs or tissues from the chronic inhalation of a mixture of fission products for five dose times following the termination of uptake.

The second problem will make use of the atmospheric diffusion model built into the program to calculate the dose to four organs at two dose times following passage of the cloud produced by the short term release to the atmosphere of a mixture of transuranic nuclides.

Input for the first problem is:

Name List Parameter	Value	Remarks
NEXT	1	Program control variables.
MET	0	See Appendix F.
D3	0.30	Respiratory tract disposition
D4	0.08	factors for one micrometer
D5	0.25	particles.
UPTIME	3.156×10^{7}	Time of uptakes in seconds (one year)
DOSTIM	1	Dose times in seconds (zero
	3.156×10^{7}	time not allowed by data
	6.312×10^{7}	checking portion of program).
	1.578×10^{8}	
	3.156×10^{8}	

Name List Parameter	Value	Remarks
ORGANS		Organs Considered:
	1	Whole Body
	3	Kidneys
	4	Liver
	5	Spleen
	6	Bone
	8	Lung
	10	Testes
	14	Muscle
	16	Thyroid
	18	Heart

Other Parameters	Value			Remarks
NUMBER	9			Number of radionuclides to be read from succeeding cards.
M, NAME ISL, QUANTY	^{90}Sr	2	$1x10^{-6}$	Radionuclide identifiers, solubility index and quantity in curies inhaled.
	^{90}Y	2	$1x10^{-6}$	
	^{95}Zr	3	$2x10^{-6}$	
	^{95}Nb	3	$1x10^{-6}$	
	^{106}Ru	3	$5x10^{-6}$	
	^{131}I	1	$1x10^{-5}$	
	^{137}Cs	1	$1x10^{-6}$	
	^{144}Ce	3	$2x10^{-6}$	
	^{144}Pr	3	$2x10^{-6}$	

If both problems are submitted in the same deck, input for the second problem is as follows:

Name List Parameter	Value	Remarks
NEXT	2	Program control variables.
MET	1	General atmospheric dispersion variables.
H	70	Height in meters.

Name List Parameter	Value	Remarks
R	100,200,300,500,1000,2000, 3000,5000,10000,20000	Downwind distances in meters.
UBAR	1.	Windspeed in meters/sec.
		Simpson-Fuquay Model Variables.
STUB	0.04	$(\sigma_\theta \bar{u})$ radian-meters/sec
AH	97	a, m^2
BH	0.33	b, m^2/sec
CH	13	c, m^2/sec
DH	230	d, sec
KSQD	0.00025	k^2, sec^{-2}
D3 D4 D5	Same as preceding case--no need to respecify	Respiratory tract deposition factors.
BRATE	350	Ventilation rate of receptor in cm^3/sec
UPTIME	3600	Uptake time in seconds (one hour)
DOSTIM	3.156×10^7	Dosetimes in seconds (one year and 50 years)
ORGANS		Organs Considered:
	3	Kidneys
	4	Liver
	6	Bone
	8	Lung

Other Parameters	Value			Remarks
NUMBER		3		Number of radionuclides to be read from succeeding cards.
M, NAME ISL, QUANTY	^{238}Pu	3	$5x10^{-4}$	Radionuclide identifiers, solubility index and quantity in curies released to the atmosphere.
	^{239}Pu	3	$4x10^{-2}$	
	^{240}Pu	3	$1x10^{-2}$	

Shown in Table G.1 is a listing of the input data card stream prepared from the preceding information.

Output reports generated by the code for the two sample problems are shown following the input listing.

SAMPLE INPUT

```
        SAMPLE PROBLEM NUMBER ONE   CHRONIC INHALATION
 $INPUT NEXT=1,MET=0,D3=.3,D4=.08,D5=.25,UPTIME=3.156E+7,4*0.,
 DOSTIM=1.,3.156E+7,6.312E+7,1.578E+8,3.156E+8,5*0.,ORGANS=1,3,4,5,
 6,8,10,14,16,18$END
  9
SR  90 2        1.E-6Y    90 2        1.E-6ZR  95 3        2.E-6NB  95 3        1.E-6
RU 106 3        5.E-6I   131 1        1.E-5CS 137 1        1.E-6CE 144 3        2.E-6
PR 144 3        2.E-6
        SAMPLE PROBLEM NUMBER TWO     ACUTE INHALATION
 $INPUT NEXT=2,MET=1,H=70.0,R=100.,200.,300.,500.,1000.,2000.,3000.,
 5000.,10000.,20000.,UBAR=1.,STUB=.04,4*0.,AH=97.,BH=.330,CH=13.,DH=230.,
 KSOD=2.5E-4,BRATE=350.,4*0.,UPTIME=3600.,4*0.,IPR=1,IQP=1,
 ORGANS=3,4,6,8,6*0,DOSTIM=3.156E+7,1.578E+9,8*0.$
  3
PU 238 3        5.E-4PU 239 3        4.E-2PU 240 3        1.E-2
   END OF RUN
 $INPUT NEXT=4$
```

SAMPLE OUTPUT

```
PAGE   1                                  ***** INPUT DATA *****                                     11/05/74

 ORGAN DATA LIBRARY VERSION 1B   SEPTEMBER 24,1974
                                                    NUCLIDE RELEASE IN CURIES

     SR  90 2 1,0000E-06  Y   90 2 1,0000E-06  ZR  95 3 2,0000E-06  NB  95 3 1,0000E-06  RU 106 3 5,0000E-06  I  131 1 1,0000E-05
     CS 137 1 1,0000E-06  CE 144 3 2,0000E-06  PR 144 3 2,0000E-06

UBAR =    0,0
BRATE =        0,        0,        0,        0,        0,
MET =  0
H=     0 METERS
  1 UPTAKE TIMES, SECONDS  3,156E+07
  5 DOSE TIMES, SECONDS  1,000E+00 3,156E+07 6,312E+07 1,578E+08 3,156E+08
```

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION

TASK GROUP ON LUNG DYNAMICS MODEL

DURATION OF INHALATION 1.00E+00 YEARS

ORGAN DOSE IN REM

RADIONUCLIDE	DOSE TIME (DAYS)	TOTAL BODY	KIDNEYS	LIVER	SPLEEN	BONE	LUNGS	TESTES	MUSCLE	THYROID	HEART
SR 90	3.65E+02	3.769E-02				1.416E-01	1.318E-01				
(W)	7.31E+02	1.141E-01				4.295E-01	1.612E-01				
	1.10E+03	1.876E-01				7.081E-01	1.614E-01				
	2.19E+03	3.898E-01				1.483E+00	1.614E-01				
	4.02E+03	6.734E-01				2.593E+00	1.614E-01				
Y 90	3.65E+02	2.048E-04				7.592E-03	1.233E-02				
(W)	7.31E+02	2.070E-04				7.677E-03	1.241E-02				
	1.10E+03	2.070E-04				7.677E-03	1.241E-02				
	2.19E+03	2.070E-04				7.677E-03	1.241E-02				
	4.02E+03	2.070E-04				7.677E-03	1.241E-02				
ZR 95	3.65E+02	5.132E-04	1.049E-03	7.393E-04	6.292E-04	1.944E-03	5.612E-01				
(Y)	7.31E+02	7.211E-04	1.499E-03	1.026E-03	8.997E-04	2.784E-03	7.193E-01				
	1.10E+03	7.274E-04	1.515E-03	1.033E-03	9.090E-04	2.814E-03	7.212E-01				
	2.19E+03	7.275E-04	1.515E-03	1.034E-03	9.093E-04	2.815E-03	7.212E-01				
	4.02E+03	7.275E-04	1.515E-03	1.034E-03	9.093E-04	2.815E-03	7.212E-01				
NB 95	3.65E+02	7.174E-05	1.513E-04	1.360E-04	8.325E-05	1.996E-04	8.384E-02				
(Y)	7.31E+02	8.523E-05	1.560E-04	1.617E-04	9.540E-05	2.375E-04	9.600E-02				
	1.10E+03	8.525E-05	1.560E-04	1.617E-04	9.541E-05	2.375E-04	9.600E-02				
	2.19E+03	8.525E-05	1.560E-04	1.617E-04	9.541E-05	2.375E-04	9.600E-02				
	4.02E+03	8.525E-05	1.560E-04	1.617E-04	9.541E-05	2.375E-04	9.600E-02				
RU 106	3.65E+02	1.085E-03	1.665E-02			8.312E-03	6.879E+00				
(Y)	7.31E+02	1.329E-03	2.002E-02			1.053E-02	1.353E+01				
	1.10E+03	1.428E-03	2.148E-02			1.134E-02	1.553E+01				
	2.19E+03	1.496E-03	2.249E-02			1.190E-02	1.637E+01				
	4.02E+03	1.501E-03	2.256E-02			1.194E-02	1.640E+01				
I 131	3.65E+02	2.093E-02					2.600E-02			1.149E+01	
(D)	7.31E+02	2.159E-02					2.605E-02			1.185E+01	
	1.10E+03	2.159E-02					2.605E-02			1.185E+01	
	2.19E+03	2.159E-02					2.605E-02			1.185E+01	
	4.02E+03	2.159E-02					2.605E-02			1.185E+01	
CS 137	3.65E+02	1.994E-02	2.001E-02	4.674E-02	3.585E-02	2.780E-02	8.047E-03		2.733E-02		
(D)	7.31E+02	2.706E-02	2.398E-02	6.869E-02	5.423E-02	4.763E-02	1.110E-02		4.683E-02		
	1.10E+03	2.725E-02	2.399E-02	6.998E-02	5.558E-02	5.080E-02	1.159E-02		4.996E-02		
	2.19E+03	2.725E-02	2.399E-02	7.006E-02	5.569E-02	5.141E-02	1.168E-02		5.055E-02		
	4.02E+03	2.725E-02	2.399E-02	7.006E-02	5.569E-02	5.141E-02	1.168E-02		5.055E-02		
CE 144	3.65E+02	1.383E-03	6.266E-03	1.251E-02		2.096E-02	2.426E+00				
(Y)	7.31E+02	3.542E-03	1.653E-02	3.055E-02		5.883E-02	4.585E+00				
	1.10E+03	4.788E-03	2.236E-02	3.940E-02		8.310E-02	5.070E+00				
	2.19E+03	5.706E-03	2.663E-02	4.501E-02		1.042E-01	5.240E+00				
	4.02E+03	5.761E-03	2.688E-02	4.528E-02		1.060E-01	5.303E+00				

PAGE 3 DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION 11/05/74

TASK GROUP ON LUNG DYNAMICS MODEL

DURATION OF INHALATION 1.00E+00 YEARS

ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	TOTAL BODY	KIDNEYS	LIVER	SPLEEN	BONE	LUNGS	TESTES	MUSCLE	THYROID	HEART
PR-144	3.65E+02										
(Y)	7.31E+02										
	1.10E+03										
	2.19E+03										
	4.02E+03										

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 1.00E+00 YEARS
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	TOTAL BODY	KIDNEYS	LIVER	SPLEEN	BONE	LUNGS	TESTES	MUSCLE	THYROID	HEART
ALL	3.65E+02	8.18E-02	4.41E-02	6.01E-02	3.66E-02	2.08E-01	1.01E+01	0.	2.73E-02	1.15E+01	0.
ALL	7.31E+02	1.69E-01	6.22E-02	1.00E-01	5.52E-02	5.57E-01	1.91E+01	0.	4.68E-02	1.19E+01	0.
ALL	1.10E+03	2.44E-01	6.95E-02	1.11E-01	5.66E-02	8.64E-01	2.16E+01	0.	5.00E-02	1.19E+01	0.
ALL	2.19E+03	4.47E-01	7.08E-02	1.16E-01	5.67E-02	1.66E+00	2.26E+01	0.	5.06E-02	1.19E+01	0.
ALL	4.02E+03	7.31E-01	7.51E-02	1.17E-01	5.67E-02	2.77E+00	2.27E+01	0.	5.06E-02	1.19E+01	0.

ORGAN DATA LIBRARY VERSION 1B SEPTEMBER 24,1974

NUCLIDE RELEASE IN CURIES

PU 238 3 5.0000E-04 PU 239 3 4.0000E-02 PU 240 3 1.0000E-02

UBAR = 1.0
BRATE = 350. 0. 0. 0. 0.
MET = 1
H= 70 METERS
AM= 97.0
BM= .33000
CM= 13.0
DM= 230.0
KSOD = .000250
STUB(1)= .040
DIAM = 0.000 MICROMETERS
D3 = .300
D4 = .080
D5 = .250
10 DISTANCES, METERS 100. 200. 300. 500. 1000. 2000. 3000. 5000. 10000. 20000.
1 UPTAKE TIMES, SECONDS 3.600E+03
2 DOSE TIMES, SECONDS 1.156E+07 1.578E+09

SIGMA Z VALUES

AVERAGE WIND SPEED, M/SEC	DISTANCE FROM RELEASE POINT METERS 100.	200.	300.	500.	1000.	2000.	3000.	5000.	10000.	20000.
1.0	11.	13.	14.	16.	21.	28.	33.	42.	58.	82.

SIGMA Y VALUES

AVERAGE WIND SPEED, M/SEC	DISTANCE FROM RELEASE POINT METERS 100.	200.	300.	500.	1000.	2000.	3000.	5000.	10000.	20000.
1.0	4.	8.	12.	20.	39.	76.	112.	179.	323.	546.

X/Q VALUES

UPTAK TIMES / DISTANCES (SECONDS) \ (METERS)	100.	200.	300.	500.	1000.	2000.	3000.	5000.	10000.	20000.
3.600E+03	1.380E-11	9.286E-10	7.112E-09	8.604E-08	1.271E-06	5.957E-06	9.055E-06	1.049E-05	8.216E-06	4.937E-06

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION

TASK GROUP ON LUNG DYNAMICS MODEL

DURATION OF INHALATION 6.00E+01 MIN

ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	1.209E-12	4.781E-12	5.729E-12	5.307E-10
(Y)	1.83E+04	2.704E-10	8.942E-10	1.307E-09	1.517E-09
PU 239	3.65E+02	9.033E-11	3.572E-10	4.439E-10	5.962E-08
(Y)	1.83E+04	2.439E-08	7.954E-08	1.222E-07	9.948E-08
PU 240	3.65E+02	2.258E-11	6.930E-11	1.110E-10	9.904E-09
(Y)	1.83E+04	6.375E-09	1.935E-08	3.048E-08	2.487E-08

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	1.14E-10	4.51E-10	5.61E-10	5.01E-08
ALL	1.83E+04	3.07E-08	1.00E-07	1.54E-07	1.26E-07

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	8.137E-11	3.218E-10	3.856E-10	3.572E-08
(Y)	1.83E+04	1.820E-08	6.018E-08	8.795E-08	8.867E-08
PU 239	3.65E+02	6.079E-09	2.404E-08	2.988E-08	2.666E-06
(Y)	1.83E+04	1.639E-06	5.353E-06	8.222E-06	6.695E-06
PU 240	3.65E+02	1.520E-09	6.011E-09	7.469E-09	6.666E-07
(Y)	1.83E+04	4.089E-07	1.334E-06	2.051E-06	1.674E-06

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	7.68E-09	3.04E-08	3.77E-08	3.37E-06
ALL	1.83E+04	2.07E-06	6.75E-06	1.04E-05	8.46E-06

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	6.231E-10	2.464E-09	2.953E-09	2.736E-07
(Y)	1.83E+04	1.304E-07	4.609E-07	6.735E-07	6.791E-07
PU-239	3.65E+02	4.656E-08	1.841E-07	2.288E-07	2.042E-05
(Y)	1.83E+04	1.255E-05	4.100E-05	6.297E-05	5.127E-05
PU 240	3.65E+02	1.164E-08	4.603E-08	5.720E-08	5.105E-06
(Y)	1.83E+04	3.132E-06	1.023E-05	1.571E-05	1.282E-05

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	5.88E-08	2.33E-07	2.89E-07	2.58E-05
ALL	1.83E+04	1.58E-05	5.17E-05	7.90E-05	6.48E-05

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIONUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	7.574E-09	2.995E-08	3.589E-08	3.325E-06
(Y)	1.83E+04	1.694E-06	5.602E-06	8.186E-06	8.254E-06
PU 239	3.65E+02	5.659E-07	2.238E-06	2.781E-06	2.482E-04
(Y)	1.83E+04	1.525E-04	4.983E-04	7.654E-04	6.232E-04
PU 240	3.65E+02	1.415E-07	5.595E-07	6.952E-07	6.205E-05
(Y)	1.83E+04	3.806E-05	1.243E-04	1.910E-04	1.558E-04

SAMPLE PROBLEM NUMBER TWO. ACUTE INHALATION.

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 0.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	7.15E-07	2.83E-06	3.51E-06	3.14E-04
ALL	1.83E+04	1.92E-04	6.28E-04	9.64E-04	7.87E-04

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	1.113E-07	4.403E-07	5.276E-07	4.888E-05
(Y)	1.83E+04	2.491E-05	8.235E-05	1.203E-04	1.213E-04
PU 239	3.65E+02	8.319E-06	3.290E-05	4.088E-05	3.649E-03
(Y)	1.83E+04	2.243E-03	7.325E-03	1.125E-02	9.161E-03
PU 240	3.65E+02	2.080E-06	8.224E-06	1.022E-05	9.121E-04
(Y)	1.83E+04	5.595E-04	1.828E-03	2.807E-03	2.290E-03

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN.
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	1.05E-05	4.16E-05	5.16E-05	4.61E-03
ALL	1.83E+04	2.83E-03	9.24E-03	1.42E-02	1.16E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION

TASK GROUP ON LUNG DYNAMICS MODEL

DURATION OF INHALATION 6.00E+01 MIN

ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	5.219E-07	2.064E-06	2.473E-06	2.291E-04
(Y)	1.83E+04	1.168E-04	3.860E-04	5.641E-04	5.688E-04
PU 239	3.65E+02	3.900E-05	1.542E-04	1.916E-04	1.710E-02
(Y)	1.83E+04	1.051E-02	3.434E-02	5.274E-02	4.295E-02
PU 240	3.65E+02	9.749E-06	3.856E-05	4.791E-05	4.276E-03
(Y)	1.83E+04	2.623E-03	8.569E-03	1.316E-02	1.074E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	4.93E-05	1.95E-04	2.42E-04	2.16E-02
ALL	1.83E+04	1.33E-02	4.33E-02	6.65E-02	5.43E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	7.934E-07	3.138E-06	3.760E-06	3.483E-04
(Y)	1.83E+04	1.775E-04	5.868E-04	8.576E-04	8.646E-04
PU 239	3.65E+02	5.928E-05	2.344E-04	2.913E-04	2.600E-02
(Y)	1.83E+04	1.598E-02	5.220E-02	8.018E-02	6.529E-02
PU 240	3.65E+02	1.482E-05	5.861E-05	7.283E-05	6.500E-03
(Y)	1.83E+04	3.987E-03	1.303E-02	2.000E-02	1.632E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN.
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	7.49E-05	2.96E-04	3.68E-04	3.28E-02
ALL	1.83E+04	2.01E-02	6.58E-02	1.01E-01	8.25E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	9.191E-07	3.635E-06	4.355E-06	4.035E-04
(Y)	1.83E+04	2.056E-04	6.798E-04	9.934E-04	1.002E-03
PU 239	3.65E+02	6.867E-05	2.716E-04	3.375E-04	3.012E-02
(Y)	1.83E+04	1.851E-02	6.047E-02	9.288E-02	7.563E-02
PU 240	3.65E+02	1.717E-05	6.789E-05	8.437E-05	7.530E-03
(Y)	1.83E+04	4.619E-03	1.509E-02	2.317E-02	1.890E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	8.68E-05	3.43E-04	4.26E-04	3.81E-02
ALL	1.83E+04	2.33E-02	7.62E-02	1.17E-01	9.55E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	7.199E-07	2.847E-06	3.412E-06	3.161E-04
(Y)	1.83E+04	1.610E-04	5.329E-04	7.781E-04	7.845E-04
PU 239	3.65E+02	5.379E-05	2.127E-04	2.643E-04	2.359E-02
(Y)	1.83E+04	1.450E-02	4.737E-02	7.275E-02	5.924E-02
PU 240	3.65E+02	1.345E-05	5.318E-05	6.608E-05	5.898E-03
(Y)	1.83E+04	3.618E-03	1.182E-02	1.815E-02	1.481E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6.00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3.65E+02	6.80E-05	2.69E-04	3.34E-04	2.98E-02
ALL	1.83E+04	1.83E-02	5.97E-02	9.17E-02	7.48E-02

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION

TASK GROUP ON LUNG DYNAMICS MODEL

DURATION OF INHALATION 6.00E+01 MIN

ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
PU 238	3.65E+02	4.326E-07	1.711E-06	2.050E-06	1.899E-04
(Y)	1.83E+04	9.677E-05	3.200E-04	4.676E-04	4.714E-04
PU 239	3.65E+02	3.232E-05	1.278E-04	1.588E-04	1.418E-02
(Y)	1.83E+04	8.713E-03	2.846E-02	4.372E-02	3.560E-02
PU 240	3.65E+02	8.080E-06	3.196E-05	3.971E-05	3.544E-03
(Y)	1.83E+04	2.174E-03	7.102E-03	1.091E-02	8.898E-03

DOSE TO SELECTED ORGANS OF INTEREST VIA INHALATION
TASK GROUP ON LUNG DYNAMICS MODEL
DURATION OF INHALATION 6,00E+01 MIN
ORGAN DOSE IN REM

RADIO-NUCLIDE	DOSE TIME (DAYS)	KIDNEYS	LIVER	BONE	LUNGS
ALL	3,65E+02	4,08E-05	1,61E-04	2,01E-04	1,79E-02
ALL	1,83E+04	1,10E-02	3,59E-02	5,51E-02	4,50E-02

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