

**Assessment of Effectiveness of
Geologic Isolation Systems**

74

**ARRRG AND FOOD—Computer
Programs for Calculating
Radiation Dose to Man
From Radionuclides in the
Environment**

B. A. Napier
R. L. Roswell
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D. L. Strenge

June 1980

Prepared for the
Office of Nuclear Waste Isolation
Under its Contract with the
U.S. Department of Energy

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute



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SUMMARY

The computer programs ARRRG and FOOD were written to facilitate the calculation of internal radiation doses to man from the radionuclides in the environment and external radiation doses from radionuclides in the environment. Characteristics of each code are:

- ARRRG--Radiation doses to man may be calculated for radionuclides released to bodies of water from which people might obtain fish, other aquatic foods, or drinking water, and in which they might fish, swim or boat.

The radiation doses from external exposure to contaminated water are calculated using the basic assumption that the contaminated medium is large enough to be considered an "infinite" volume relative to the range of the emitted radiations.

- FOOD--Radiation doses to man may be calculated from deposition on farm or garden soil and crops during either an atmospheric or water release of radionuclides. Deposition may be either directly from the air or from irrigation water. Fifteen crop or animal product pathways may be chosen.
- ARRRG and FOOD--Doses may be calculated for either a maximum-exposed individual or for a population group. Doses calculated are a one-year dose and a committed dose from one year of exposure. The exposure is usually considered as chronic; however, equations are included to calculate dose and dose commitment from acute (one-time) exposure.

The equations for calculating internal dose and dose commitment are derived from those given by the International Commission on Radiological Protection (ICRP) for body burdens and Maximum Permissible Concentration (MPC) of each radionuclide.

The radiation doses from external exposure to contaminated farm fields or shorelines are calculated assuming an "infinite" flat plane source of radionuclides. A factor of two is included for surface roughness. A modifying factor to compensate for finite extent is included in the shoreline calculations.

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INTRODUCTION

The computer programs ARRRG and FOOD were written as an enhancement of the dose calculation capabilities of the Environmental Analysis Section of the Ecological Sciences Department at Pacific Northwest Laboratory. This report contains details of these programs.

The two programs described in this report are the most recent FORTRAN versions of ARRRG and FOOD. The numerical models for both programs have been in existence for some time. Older versions of each code, written in BASIC, are no longer maintained by PNL. The fundamental equations documented for ARRRG (Soldat, et al. 1974) and for FOOD (Baker, et al. 1976, Brenchly, et al., 1977) have been retained essentially unchanged. However, the program documentation described in these references is no longer applicable. The new FORTRAN versions are believed to be easier to use, more efficient users of computer resources, and simpler to follow than the old BASIC codes. This report is a complete description of the new programs and the theory behind them.

The new programs permit rapid and consistent estimates of the radiation dose and dose commitment to man resulting from radioactive materials released to the environment. They are designed to calculate the dose and dose commitment following an accumulation of radionuclides in the environment from one year's ingestion of contaminated food products and from one year's external radiation exposure.

The program ARRRG addresses aquatic exposure pathways. ARRG can compute doses for five ingestion pathways, such as fish, other aquatic animals or plants, or drinking water, as well as three external pathways: swimming, boating, or shoreline exposure.

The program FOOD addresses terrestrial exposure pathways. FOOD can compute doses from fourteen food types and external exposure. Radionuclides may be deposited on the ground or crops from either atmospheric deposition or irrigation water. The type and amounts of crops grown around the point of release determine which pathways are activated.

Both computer programs can be used to calculate one-year doses and dose commitments from any one or combination of radionuclides for which sufficient biological data are available. As many as five of 23 possible organs and tissues, and mixtures of up to 100 radionuclides may be selected in any one case.

The computer output of both codes consists of radiation dose and dose commitment summaries to all chosen organs listed by exposure pathway and by radionuclide. In addition, options exist for complete listing of dose contributions by radionuclide for each pathway. The complete output includes radionuclide concentrations in all ingested plant and animal material.

MODELS AND METHODS

In the programs ARRRG and FOOD the radionuclide concentrations in aquatic and irrigated food products are based on the radionuclide concentrations in the contaminated water (Soldat, et al., 1974). The water concentration is based on the release rate of radioactive contamination and the characteristics of the receiving water body. Formulae for the three most common reconcentration situations for receiving water bodies are included in the computer programs.

If there is no water reconcentration, for example, if the cooling water is drawn from a river in which the outfall is downstream of the inlet, the reconcentration factor is set to unity. A second option is available for the case where the inlet is downstream of the outfall or so arranged, on a lake or ocean site, that recirculation occurs. The third option models cooling water drawn from a pond, lake, or reservoir which is connected to a larger body of water or is fed by a stream.

A simple model is used in ARRRG to predict the radionuclide concentration in the sediments of a river or lake downstream from a discharge point. The model is based on the assumption that there is a constant water concentration for each year of the release. The deposition rate to the sediment is assumed to be dependent only on the water concentration.

The concentrations of radionuclides in aquatic foods are directly related to the concentration in water. They are calculated in ARRRG using equilibrium ratios between the two concentrations, called bioaccumulation factors.

The model in FOOD for estimating the transfer of radionuclides (except for ^{3}H and ^{14}C) from air or irrigation water to plants through both leaves and soil to food products was derived by Soldat for a study of the potential doses to people from a nuclear power complex in the year 2000 (Soldat and Harr, 1971).

In FOOD, the source of contamination on farm land or garden plots may be from airborne or waterborne radionuclide releases. In the absence of specific data for sites where irrigation is used, sprinkler irrigation is normally assumed, rather than surface irrigation, because the aerial spray produced leads to foliar deposition resulting in higher radionuclide contamination in the plants.

Trickle irrigation systems can be simulated, if desired, by setting the foliar retention factor in the program to zero. For atmospheric contamination, a deposition velocity is assumed for the airborne radionuclides onto the plant foliage and ground.

Concentration of radionuclides in plants depends on the concentrations in the soil, air, and water. A plant accumulation factor is used in FOOD to relate these concentrations. Concentration of radionuclides in farm animal products, such as milk, meat, or eggs, depends on the animals' consumption of feed, forage, and water containing radionuclides.

Two radionuclides, ^3H and ^{14}C , are handled specially in FOOD. These two are assumed to be in equilibrium with their surroundings. Thus the concentration of tritium or carbon-14 in the hydrogen or carbon in environmental media (soil, plants, and animal products) is assumed to have the same specific activity as in the contaminating medium (air or water). The fractional content of hydrogen or carbon in a plant or animal product is then used to compute the concentration of tritium or carbon-14 in the food product under consideration.

External doses from radionuclides deposited in farm fields are calculated assuming an infinite flat plane source model. A factor of two is included for self-shielding by surface roughness. For a person standing next to a body of contaminated water, the dose from nuclides deposited in the sediments is calculated using the same model as that used for farm fields, modified to a shore-width factor. For persons swimming in contaminated water, the dose is calculated using the basic assumption that the body of contaminated water is large enough to be considered an "infinite medium" relative to the range of emitted radiations. Persons boating on the water are assumed to be exposed to a dose rate half that of swimmers.

Internal doses are calculated in both ARRG and FOOD as a function of radionuclide concentration in food products, as described above, ingestion rates, and a radionuclide-specific dose factor. The dose factors are calculated for both the one-year dose and the dose commitment. The dose commitment period may be any number of years desired. The factors are based on the model of ICRP Publication 2 (1959) for internally deposited radionuclides. The factors may be calculated assuming either an acute or chronic uptake during the year.

The details of the mathematical models, computer codes, data libraries, and input preparation are given in Appendices A through G. Sample problems are given in Appendices H and I.

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APPENDIX A

DESCRIPTION OF MATHEMATICAL MODELS

APPENDIX A

DESCRIPTION OF MATHEMATICAL MODELS

This appendix contains descriptions of the mathematical models used in the computer programs ARRRG and FOOD to calculate doses and dose commitments from external exposure to and ingestion of radionuclides in the environment.

A.1 BASIC DOSE EQUATION

The fundamental equation for calculation of radiation dose to man from radionuclides in the environment is:

$$D_{ijp} = C_{ip} U_p F_{ijp} \quad (A.1)$$

where:

D_{ijp} • the dose, or dose commitment, to organ j from radionuclide i via exposure pathway p, rem,

C_{ip} • the concentration of radionuclide i in the medium of pathway p, pCi/kg or pCi/l,

U_p • the usage, i.e. the exposure or intake rate of pathway p, kg/y, l/yr, or hr/yr, and

F_{ijp} • a dose or dose commitment factor, a value specific to a given organ j, pathway p, and nuclide i, that relates concentration and usage to dose.

The three terms on the right of Equation A.1 are discussed in the sections below. Equations tailored to each specific exposure pathway are derived from Equation A.1. The principle difference between pathways is the manner in which the radionuclide concentrations are calculated.

A.2 RADIONUCLIDE CONCENTRATIONS IN ENVIRONMENTAL MEDIA

Concentrations of radionuclides in air, water, soil, sediments and food products are calculated as intermediate steps in the computer programs ARRRG and FOOD. The concentrations in air and water are based on the annual releases from the nuclear facility under study. Radionuclide concentrations in soil and sediments are based on accumulation at the last year of facility operation, presumably the highest value.

Concentration in Aquatic Media

Concentrations of radionuclides in water, on shoreline sediments, and in aquatic food products are calculated from the annual average release rate from the nuclear facility, the effluent flow rate, the mixing and dilution in the receiving waters, and bioaccumulation factors for aquatic biota. Mixing and dilution is characterized by a mixing ratio and a reconcentration factor.

The mixing ratio, M_p , accounts for the dilution of the liquid effluent between the point of discharge and the point of exposure, and is best determined from site-specific hydrological studies. If the temperature increase which results at the point of exposure solely from mixing is known, then the mixing ratio is estimated from

$$M_p = \frac{T_p - T_A}{T_0 - T_A} \quad (A.2)$$

where:

- T_A • the ambient temperature of the receiving sink
- T_p • the temperature which would exist at the point of exposure for pathway p if no evaporation or radiation effects were present
- T_0 • the temperature of the effluent at the outlet.

The value for T_p can be estimated from a plot of isotherms due to mixing only in the receiving waters.

The reconcentration factor, N_i , accounts for the extent to which the effluent is recycled through the nuclear facility. Both computer programs

ARRRG and FOOD are designed to allow the user a choice of the following reconcentration models:

1. If the cooling water is drawn from a cooling pond, small lake or reservoir which is connected to a larger body of water or is fed by a stream, then:

$$N_1 = \left[1 - \frac{(F - L) e^{-\lambda_T t_c}}{F + V\lambda_T} \right]^{-1} \quad (A.3)$$

2. If the cooling water intake is downriver from the outfall or on a lake or ocean site and arranged such that recirculation occurs, then:

$$N_1 = \frac{1 - \left[ge^{-\lambda_T t_c} \right]^{n+1}}{1 - ge^{-\lambda_T t_c}} \quad (A.4)$$

3. If there is no reconcentration, for example, if the cooling water is drawn from a river in which the outfall is below the intake, then:

$$N_1 = 1.0 \quad (A.5)$$

where:

- g • recycle fraction (the mixing ratio at the point of intake), unitless,
- F • coolant flow, ft^3/sec ,
- L • makeup flow (water drawn into the intake to replace losses), ft^3/sec ,
- V • pond volume, ft^3 ,
- λ_T • pond turnover rate, sec^{-1} ,
- t_c • cycle time, hr,
- λ_1 • decay constant, hr^{-1} , and
- n • number of cycles during facility lifetime = $\frac{\text{plant life (hr)}}{t_c}$.

These three models were chosen for the programs because they apply to the most common reconcentration situations. Unusual cases could require that special reconcentration formulas be added to the programs.

Equation A.4 is the closed form of the series

$$N_i = 1 + G_i + G_i^2 + G_i^3 + \dots + G_i^n$$

where $G_i = g \exp(-\lambda_i t_c)$ for nuclide i.

Equation A.3, the most complex of the reconcentration models, is used for sites on a cooling pond, lake or reservoir where the water is exchanged by stream flow or connection with a larger body of water such as the ocean. It can also be used for a system of cooling canals where a fresh dilution stream (makeup) is injected into the inlet pipe along with the recycled water from the cooling pond. From elementary considerations of mass balance, assuming steady state conditions and instantaneous mixing in the cooling pond, Equation A.4 is of the form of Equation A.5 with $n \rightarrow \infty$ and with the recycle fraction a function of hydrological parameters and the radionuclide decay constant (see Figure A-1).

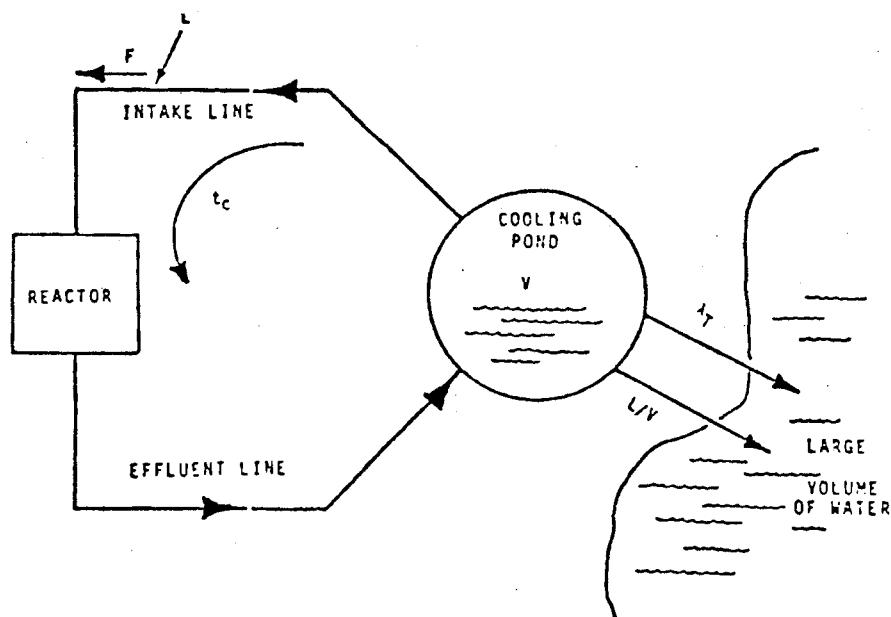


FIGURE A-1. Reconcentration in a Reactor Effluent due to Recycling Through a Cooling Pond

Thus:

$$N_i = \left[1 - \frac{(F - L) e^{-\lambda_i t_c}}{(F - L) + V(\lambda_T + \frac{L}{V})} \right]^{-1} \quad (A.6)$$

The volume, V , for Equation A.3 may be taken to be a series of canals, a pond, small bay, small lake, etc. However, the model loses credibility if V is very large since instantaneous mixing in V was assumed; therefore, Equation A.4 should be used for large V .

Once the mixing ratio, M_p , and the reconcentration factor, N_i , are determined, the water concentration, C_{iw} , of radionuclide i , is found as:

$$C_{iw} = 1119 Q_i N_i M_p / F_r \quad (A.7)$$

where:

1119 • a unit conversion factor from Ci/yr per ft³/sec to pCi/l,

Q_i • the release rate of radionuclide i , Ci/yr, and

F_r • the annual average river flow rate, ft³/sec.

Concentrations of radionuclides in aquatic foods are directly related to the concentrations in the water. Equilibrium ratios between the two concentrations, called bioaccumulation factors in this report, are taken from References 1 and 2 and are listed in the file BIOAC, presented in Appendix D. The concentration in aquatic foods, C_{ip} , is related to the water concentration as:

$$C_{ip} = C_{iw} B_{ip} \quad (A.8)$$

where:

B_{ip} • is the bioaccumulation factor for nuclide i and pathway p .

The concentrations of radionuclides in drinking water are also related to concentrations in the river water. Water consumed by humans is subject to a wide variety of types of treatment processing prior to consumption. Radionuclides are removed with varying degrees of efficiency depending on the specific treatment used. Radionuclide removal efficiencies assumed for use in the

computer program ARRRG are based on extensive experience with the alum-floc process used at Richland and Pasco, Washington. These two cities are located on the Columbia River downstream of the Hanford nuclear reservation. Water samples have been collected at treatment plants both before and after processing for a combined total of 12 years of operation.^(3,4) From these data, the fractions of contained radionuclides that pass through a water treatment plant have been estimated. These fractions are presented in the data file BIOAC, presented in Appendix E. They are used in similar fashion to B_{ip} .

The calculation of sediment load, transport, and concentrations of radionuclides associated with suspended and deposited materials is a complex problem. For the program ARRRG, a simplified scheme for obtaining an order of magnitude estimate of the concentration of radionuclides in sediments is used.^(3,5) The model assumes a constant water concentration during the duration of the release, i.e. for the facility lifetime. The deposition rate of radionuclides to the sediment is dependent only on the water concentration. Removal from the sediment is only by radioactive decay. This is described mathematically as:

$$\frac{dc_{is}}{dt} = KC_{iw} - c_{is}\lambda_i \quad (A.9)$$

where:

- c_{is} • the sediment surface concentration, pCi/m^2 ,
- K • a rate constant, $\text{liter}/\text{m}^2\text{-yr}$, and
- λ_i • the decay constant of nuclide i , yr^{-1} .

The buildup of an individual radionuclide is:

$$c_{is} = KC_{iw}(1 - e^{-\lambda_i t})/\lambda_i \quad (A.10)$$

where t is the duration time of the release, yr.

In the original evaluation of Equation A.10, λ_i was chosen to be the radiological decay constant, although the true value should include an unknown "environmental" removal constant. The value of K was derived from radionuclide

concentrations measured in water and sediment samples collected over a period of years in the Columbia River between Richland, Washington and the river mouth and in Tillamook Bay, Oregon, 75 km (47 miles) south of the river mouth.^(6,7) The value used is $25,300 \text{ l} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$.^(a) Radioactive daughter products are allowed to build up in both the water and sediment. Once the release of radio-nuclides to the river ceases removal from the sediments is assumed by radioactive decay only.

External irradiation doses to people standing near the sediments are calculated based on an infinite flat plane source model. To correct for the actual geometry of a river bank or other beach, shore width factors^(3,8) are used. Shore width factors, W, suggested for use with ARRRG, are given in Table A-1. These are multiplicative factors used to describe the effective surface contamination, C_{is} , as:

$$C_{is} = C_{iw} W \quad (\text{A.11})$$

TABLE A-1. Shore Width Factors

<u>Exposure Situation</u>	<u>Shore Width Factor (W)</u>
Discharge canal bank	0.1
River shoreline	0.2
Lake shore	0.3
Nominal ocean site	0.5
Tidal basin	1.0

(a) A value for a constant $K \text{ l} \cdot \text{m}^{-2} \text{d}^{-1}$, was originally derived as about 10^2 for an equation of the form

$$C_{is} = KC_{iw} T_{Ri} (1 - e^{-\lambda_i t})$$

where $T_{Ri} = \ln 2/\lambda_i$, days.

Conversion of T_{Ri} in days to λ_i in years⁻¹ leads to the value of $25,300 \text{ l} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ used for Equation A.10 in ARRRG. Three "significant" digits are carried to assure that the ARRRG code yields answers comparable to those obtained with the older expression. The answer is, however, still only an order of magnitude estimate of the sediment surface concentration.

Dose factors for persons swimming in contaminated water are calculated using the water concentration of radionuclides, and the assumption that the water is an infinite medium with respect to the range of the emitted radiations. The radiation dose rate to people boating on this water is assumed to be half that for swimmers.

Concentrations in Terrestrial Media

The models presented for estimating the transfer of radionuclides from irrigation water or air through leaves and soil to plants or farm products were derived by Soldat for a study of the potential doses to people from a nuclear power complex.⁽⁹⁾

The source of the radionuclide contamination of terrestrial foods is, either directly or indirectly, uptake through roots from contaminated ground and either deposition from the atmosphere or deposition from the contaminated water used for sprinkler irrigation. Local air concentrations are based on a factor which has units of concentration per unit release rate, (\bar{X}/Q'), and which must be calculated separately and input to the program FOOD. Water concentrations for irrigation are calculated in FOOD as described above for ARRRG. In the absence of site-specific data for cases where irrigation is used, sprinkler irrigation is assumed, rather than surface irrigation, because the aerial spray leads to foliar deposition of radionuclides. This results in a higher radionuclide concentration in the plants (and in the animals consuming them) than does trickle or surface irrigation. Surface irrigation systems can be simulated by setting the foliar retention factor in the program to zero.

Radionuclides are assumed to accumulate in the soil from continuous deposition from contaminated air or irrigation water. The program FOOD can consider either mode separately. The deposition rate from air is given by:

$$d_i = 3.15 \times 10^7 \bar{X}_i V_{di} \quad (A.12)$$

where:

- d_i • the deposition rate of radionuclide i , $\text{pCi}/\text{m}^2\text{-yr}$,
- 3.15×10^7 • a conversion factor of sec/yr ,
- \bar{x}_i • the annual average air concentration, pCi/m^3 , and
- v_{di} • the deposition velocity of nuclide i , m/sec .

For irrigation water, the deposition rate is:

$$d_i = C_{iw} I \quad (\text{A.13})$$

where:

- C_{iw} • the irrigation water concentration of radionuclide i , pCi/ℓ , and
- I • the annual average irrigation rate, $\ell/\text{m}^2\text{-yr}$.

The concentration of radionuclide i in soil at the end of the life of the releasing nuclear facility is:

$$C_{is} = d_i (1 - e^{-\lambda_i t}) / \lambda_i \quad (\text{A.14})$$

where:

- C_{is} • the soil concentration of radionuclide i , pCi/m^2 , and
- t • the life of the nuclear facility, yr.

The accumulation of radionuclides is assumed to be contained in the top 15 cm of soil.⁽⁹⁾ Removal from the upper soil layer is by radioactive decay only.

The concentration of radionuclides at the time of harvest in terrestrial vegetation from direct deposition is:

$$C_{id} = d_i r T_v \left(1 - e^{-\lambda_{Ei} t_e}\right) / \lambda_{Ei} \gamma_v \quad (\text{A.15})$$

and the concentration at harvest from root uptake is:

$$C_{ir} = C_{id} B_{iv} / P \quad (A.16)$$

where:

- C_{id} • the vegetation concentration from direct deposition, pCi/kg,
- C_{ir} • the vegetation concentration from root uptake, pCi/kg,
- r • the fraction of direct deposition retained on plant foliage, dimensionless, taken to be 0.25,
- T_v • the factor for translocation of externally deposited radionuclides to edible parts of plants, dimensionless. For simplicity it is taken to be independent of radionuclide and set to 1.0 for leafy vegetables and fresh forage, and to 0.1 for all other produce, including grain,
- λ_{Ei} • the effective environmental removal constant for plants, day⁻¹.
 $\lambda_{Ei} = \lambda_i + \lambda_w$, where λ_w is the weathering constant, taken to be 0.693/14 days,
- γ_v • the plant yield, kg (wet weight)/m²,
- B_{iv} • the concentration ratio for plant uptake of radionuclide i , pCi/kg (wet weight) per pCi/kg (dry soil),
- P • the soil "surface density," kg (dry soil)/m², taken to be 224 kg/m²,⁽⁹⁾ and
- t_e • time of crop exposure above ground during one growing season, yr.

Thus, the concentration in farm- or garden-grown crops, C_{iv} , is:

$$C_{iv} = [C_{id} + C_{is}] e^{-\lambda_i t_h} \quad (A.17)$$

where t_h is the holdup time between harvest and consumption. The first term in the bracketed expression represents the concentration in the plant derived from direct deposition during the growing season. The second term in the expression represents uptake by plant roots and reflects the total accumulated concentration, from releases during the nuclear facility lifetime corrected for radioactive decay, at the time of harvest.

The radionuclide concentration in an animal product such as meat, milk or eggs is dependent on the amount of contaminated feed or forage eaten by the animal and its intake of contaminated water. The following equation describes the calculation.⁽⁹⁾

$$C_{ia} = S_{ia}[C_{if}Q_F + C_{iaw}Q_{aw}] \quad (A.18)$$

where:

- C_{ia} • the concentration in animal product, pCi/l or pCi/kg,
- S_{ia} • the transfer coefficient of radionuclide i from daily intake of animal to edible portion of animal product, pCi/l (milk) per pCi/d or pCi/kg (animal product) per pCi/d,
- C_{if} • the concentration of nuclide i in feed or forage, pCi/kg, calculated from Equation A.17, above,
- Q_F • the consumption rate of contaminated feed or forage by animal, kg/d,
- C_{iaw} • the concentration of nuclide i in water consumed by animals, pCi/l, assumed to be equal to C_{iw} , and
- Q_{aw} • the consumption rate of contaminated water by animal, l/d.

The second set of terms in the brackets in Equation A.18 is omitted if the animal does not drink contaminated water. Default values of the animal consumption rates used in the program FOOD are listed in Table A-2.

TABLE A-2. Consumption Rates⁽⁹⁾ of Feed and Water by Farm Animals

	Feed or Forage ^(a) (kg/day)		Water (l/day)
	Q_F		Q_{aw}
Milk Cow	55	(fresh forage)	60
Beef Cattle	68	(dry feed)	50
Pig	4.2	(dry feed)	10
Poultry (chickens)	0.12	(dry feed)	0.3

(a) Equivalent fresh weight used to ensure proper calculation of radionuclide intake by animal.

Values for plant concentration ratios and animal product transfer coefficients are listed by chemical element in the FOOD input library FTRANSLIB, described in Appendix D and listed in Appendix E. Plant concentration factors are taken from UCRL-50163, pt. IV⁽¹⁰⁾ and supplemented with radionuclide data as explained in Reference 8. The literature yielded coefficients of transfer from feed to animal products for a limited number of radionuclides. For those radionuclides lacking data, comparisons were made with the behavior of chemically similar elements in man⁽¹¹⁾ and animals. In some instances, where other data are lacking, transfer coefficients are set to 9.9×10^{-4} . The most complete listing of transfer coefficients to be found is that for milk in Reference 9. The milk transfer coefficients given in this reference were intended to be maximum or "worst case" values. The authors imply by reference to ^{131}I , that average values would be about one-half of their listed values. As a result, the milk transfer values in FTRANSLIB for elements lacking specific radionuclide data are one-half of those found in Reference 9.

Some experimental data are available on the transfer of several radionuclides for chicken, eggs and meat.⁽¹²⁾ Some of these literature sources are referenced in HERMES.⁽⁹⁾ Unfortunately very little data are currently available on the transfer of radionuclides to beef and pork. Uncontrolled studies have been performed on the principal constituents of fallout, ^{90}Sr , ^{131}I and ^{137}Cs ,⁽⁹⁾ and the EPA National Environmental Research Center at Las Vegas has an ongoing study of radionuclides in cattle and milk.

The radionuclides tritium and carbon-14 behave differently in the environment than most radionuclides. A special specific activity model is therefore used. The concentration of tritium or ^{14}C in environmental media (soil, plants and animal products) is assumed to have the same specific activity (pCi of radionuclide per kg of stable element) as the contaminating medium (air or water). The fractional content of hydrogen or carbon in a plant or animal product is then used to calculate the concentration of tritium or ^{14}C in the food product under consideration. Hydrogen content in both the water and nonwater (dry) portion of the food product is used to calculate the tritium concentration. The model assumes that plants obtain all their carbon from airborne carbon dioxide and that animals obtain all their carbon through ingestion of plants.

Because plants acquire most of their carbon from the air, it is difficult to model the transfer of this radionuclide to vegetation when ^{14}C is present only in the water used for irrigation. Since we have not yet determined the transfer of carbon from water to the air or soil, we have conservatively assumed that plants obtain all their carbon from irrigation water. Such an assumption could lead to plant concentrations which are high by about an order of magnitude or more. To date no operating nuclear facilities have been identified which specify releases of ^{14}C in their liquid effluents. However, this pathway could exist from migration of ^{14}C into ground water from long-term storage of nuclear wastes.

The concentration of tritium in vegetation, $C_{3_{\text{HV}}}$, is calculated as:

$$C_{3_{\text{HV}}} = 9C_{3_{\text{HW}}} F_{\text{hv}} \quad (\text{A.19})$$

where:

- $C_{3_{\text{HW}}}$ • the concentration of tritium in the environmental water, pCi/l; for a water release $C_{3_{\text{HW}}}$ represents concentration in irrigation water; for an airborne release $C_{3_{\text{HW}}} = \text{air concentration in pCi}({}^3\text{H})/\text{m}^3 \div \text{absolute humidity in l/m}^3$.
- F_{hv} • the fraction of hydrogen in total vegetation (see Table A-2). The coefficient 9 converts tritium concentration in environmental water to concentration in hydrogen.

The concentration of tritium in the animal product, $C_{3_{\text{Ha}}}$, is:

$$C_{3_{\text{Ha}}} = \left[\frac{C_{3_{\text{HF}}} Q_F + C_{3_{\text{Haw}}} Q_{\text{aw}}}{F_{\text{hf}} Q_F + Q_{\text{aw}}/9} \right] F_{\text{ha}} \quad (\text{A.20})$$

where:

- C_{3HF} • the concentration of tritium in feed or forage, pCi/kg calculated by Equation A.19 above, where now $C_{3HF} = C_{3HV}$.
- F_{hF} • the fraction of hydrogen in animal feed, where now $F_{hF} = F_{hv}$ (grain),
- F_{ha} • the fraction of hydrogen in animal product (see Table A-2), and
- C_{3Haw} • the concentration of tritium in animal drinking water (set to 0 unless there is a release of water).

Similarly, the concentration of ^{14}C in vegetation, C_{14CV} , is:

$$C_{14CV} = C_{14CW} F_{cv} \quad (\text{A.21})$$

where:

- C_{14CW} • the concentration of ^{14}C in the environmental medium : carbon concentration in that medium, pCi $^{14}\text{C}/\text{kg}$ C. C_{14CW} represents pCi $^{14}\text{C}/\ell$: carbon concentration in irrigated water, kg/ℓ ; for water release and pCi $^{14}\text{C}/\text{m}^3$: carbon concentration in air, kg/m^3 , for air release, and
- F_{cv} • the fraction of carbon in total vegetation.

The concentration of ^{14}C in the animal product is:

$$C_{14Ca} = \left[\frac{C_{14CF} Q_F + C_{14Caw} Q_{aw}}{F_{cF} Q_F + F_{cw} Q_{aw}} \right] F_{ca} \quad (\text{A.22})$$

For an air release $C_{14Caw} = 0$, and since F_{cw} is very small compared to F_{cF} , Equation A.22 reduces to:

$$C_{14Ca} = C_{14CF} \left(\frac{F_{ca}}{F_{cF}} \right) \quad (\text{A.23})$$

Table A-3 lists the various parameters and fractions, needed for Equations A.19 through A.23, that are used in the computer program FOOD.

TABLE A-3. Fractions of Hydrogen and Carbon in Environmental Media, Vegetation, and Animal Products

Food or Fodder	Water f_w	Carbon (dry) f_c	Hydrogen (dry) f_h	Carbon ^(a) (wet) F_{cv}, F_{ca}	Hydrogen ^(b) (wet) F_{hv}, F_{na}
Fresh fruits, vegetables and grass	0.80	0.45	0.062	0.090	0.10
Grain and stored animal feed	0.12	0.45	0.062	0.40	0.068
Eggs	0.75	0.60	0.092	0.15	0.11
Milk	0.88	0.58	0.083	0.070	0.11
Beef	0.60	0.60	0.094	0.24	0.10
Pork	0.50	0.66	0.10	0.33	0.11
Poultry	0.70	0.67	0.087	0.20	0.10
Absolute humidity				0.008 ℓ/m^3	
Concentration of carbon in water				$2.0 \times 10^{-5} \text{ kg}/\ell$	(c)
Concentration of carbon in air.				$1.6 \times 10^{-4} \text{ kg}/m^3$	(d)
Fraction of soil which is carbon.				0.03	
Soil moisture				0.1 ℓ/kg	

(a) F_{cv} or $F_{ca} = f_c (1 - f_w)$

(b) F_{hv} or $F_{na} = F_w/9 + f_h(1 - f_w)$

(c) Assumes a typical bicarbonate concentration of 100 mg/ ℓ

(d) Assumes a typical atmospheric CO_2 concentration of 320 ppm_v.

A.3 USAGE PARAMETERS

Usage refers to duration of exposure to external sources of radiation and to intake rates of ingested food and water. The usage depends on the specific exposure pathway and situation. The type and amount of crops grown around the site of a nuclear facility determines which terrestrial pathways are considered. The presence of liquid effluents determines which, if any, of the aquatic pathways or irrigation pathways are activated. The hypothetical "maximum-exposed individual" has usage rates higher than an average individual, to realistically maximize potential dose. For population dose calculations, the usages of the average adult are assumed for the entire exposed population. Usage values are input to both the program ARRRG and the program FOOD.

A.4 DOSE AND DOSE COMMITMENT FACTORS

The form of the dose or dose commitment factor used depends on the exposure pathway considered. For external radiation exposure, the dose is received only during the first year of exposure. However, for ingestion pathways the radionuclides may accumulate in the body and one year of exposure may result in a dose received over many years. Thus, there are different equations for the two types of exposure. There are also special models for some organs and for some radionuclides.

A.4.1 External Exposure Dose Factors

For calculating external dose factors from water immersion, the penetrating power of the radiation emitted determines whether it contributes to skin dose only, or to both skin and total-body dose. Beta and gamma radiation which can penetrate 0.07 mm of tissue is considered to contribute to skin dose. Radiation that can penetrate 50 mm of tissue is considered to contribute to total-body dose (and dose to internal organs). The dose factors for immersion are derived assuming that the contaminated water is an infinite medium compared with the range of the emitted radiations.

Under this assumption, the energy emitted per gram of water equals the energy absorbed per gram of water. Corrections are applied for differences in energy absorption between tissue and water, physical geometry of the specific exposure situation, and the conversion from MeV per disintegration per gram to rem. The resulting dose factor, input to ARRRG from the file GRDFLIB, are presented in Appendix E. The units are mrem/hr per pCi/liter.

Material deposited from the air or from irrigation water onto the ground, or from water onto shoreline sediments, represents a large, uniform, thin sheet of contamination. The factors for converting surface contamination in pCi/m^2 to gamma dose at one meter above a uniformly contaminated plane are also presented in file GRDFLIB in Appendix E. The units are mrem/hr per pCi/m^2 of surface. Both FOOD and ARRRG use these factors.

The total dose and dose commitment from one year's exposure to external radiation are equal, since the absorption of radiation ceases with the end of exposure. The dose is calculated as:

$$D_{ijp} = \sum_{i=1}^{\text{No. of radionuclides}} C_{ip} U_p F_{ijp} \quad (\text{A.24})$$

The organ, j , is either skin or total-body. Doses for other internal organs are set equal to that for total-body.

A.4.2 Internal Exposure Dose Factors

Unlike the dose from external exposure, the dose from ingestion of radionuclides can be received by an individual for a period of many years after the initial intake. The intake may be either one-time (acute) or continuous (chronic). The computer codes ARRRG and FOOD both use the same models for calculating dose and dose commitment factors. These factors relate an intake of radionuclides to the dose received during the year of ingestion, a one-year dose, and to the integrated dose received over a period of many years due to that one-year's ingestion, a dose commitment. The dose and dose commitment factors are calculated in ARRRG and FOOD from more basic nuclear and metabolic data.

The dose model used is derived from the originally given by the International Commission on Radiological Protection⁽¹¹⁾ for body burden and maximum permissible concentration. For the ICRP model, effective decay energies for radionuclides are calculated based on the assumption that the entire quantity of a given radionuclide is located at the center of a spherical organ with an appropriate effective radius. Metabolic parameters for the standard man⁽¹³⁾ are used.

Separate equations are required for dose and dose commitment factors for both acute and chronic ingestion. The equation for dose to organ r from an acute intake of radionuclide i , $F_{ijp}^a(t_2)$, is:

$$F_{ijp}^a(t_2) = 1.87 \times 10^{-2} E_{ij} f_{wij} \frac{(1 - e^{-\lambda_{ei} t_2})}{\lambda_{ei} M_j} \quad (\text{A.25})$$

where:

$F_{ijp}^a(t_2)$ • the dose or dose commitment factor for radionuclide i , ingested through pathway p , to organ j , accumulated over a period of time t_2 (years), rem/pCi,

1.87×10^{-2} • a conversion factor for

$$\left(1.602 \times 10^{-8} \frac{\text{g-rad}}{\text{MeV}} \right) \left(\frac{0.037 \text{ dis}}{\text{sec-pCi}} \right) \left(\frac{3.15 \times 10^7 \text{ sec}}{\text{year}} \right),$$

E_{ij} • the effective decay energy of radionuclide, in organ j , MeV,

f_{wij} • the fraction of radionuclide i ingested reaching organ j ,

λ_{ei} • the effective removal constant, related to the biological half-time, T_{bi} , and the radiological half-life, T_{Ri} , as:

$$\lambda_{ei} = 0.693(T_{Ri} + T_{bi})/T_{Ri}T_{bi}, \text{ in years}^{-1},$$

M_j • the mass of organ j , grams. Organ masses used in ARRRG and FOOD are taken from ICRP-23.⁽¹³⁾ They are listed in Table A-4.

TABLE A-4. Metabolic Data for GI Tract Model

Organ	mass (grams)	Organ Reference Number
Total-body	70,000	1
Body water	63,000	2
Kidney	310	3
Liver	1,800	4
Spleen	180	5
Bone	7,000	6
Fat	13,500	7
Lung	1,000	8
Adrenals	14	9
Testes	35	10
Ovaries	11	11
Skin	2,600	12
Brain	1,400	13
Muscle	28,000	14
Prostate	16	15
Thyroid	20	16
Pancreas	100	17
Heart	330	18
GI-general ^(a)	0	19
GI-stomach ^(a)	250	20
GI-small intestine ^(a)	400	21
GI-upper large intestine ^(a)	250	22
GI-lower large intestine ^(a)	135	23

(a) Masses for GI are contents of compartment

Equation A.25 can be used to calculate both the one-year dose and the dose commitment, using appropriate values for t_2 , since following an acute intake the amount of radionuclide in the body is controlled only by biological elimination and radioactive decay. The equation for dose from a continuous exposure for one year is:

$$F_{ijp}^c(t_2) = 1.87 \times 10^{-2} \frac{f_{wij} E_{ij}}{M_j \lambda_{ei}^2 e^{t_1}} \left[t_1 \lambda_{ei} + e^{-\lambda_{ei} t_2} - e^{-\lambda_{ei} (t_2 - t_1)} \right] \quad (A.26)$$

where now:

$F_{ijp}^c(t_2)$ • the dose or dose commitment factor for radionuclide i , pathway p , and organ j , from chronic ingestion of 1 pCi over a period of t_1 , for a dose time of t_2 , rem.

t_1 • the intake (ingestion) time, taken to be one year, and

t_2 • the dose or dose commitment time, usually 1 and 50 or 70 years.

The computer programs ARRRG and Food account for special cases which deviate from Equations A.24 or A.25. For the radionuclides 3H and ^{14}C , the doses for the organs total-body and bone are calculated as above. Since these radionuclides distribute evenly throughout the rest of the body, the doses for all other organs are set equal to that for total-body. For isotopes of nitrogen and sodium, all organs including bone are set to total-body. The GI tract model also differs from Equations A.24 or A.25.

The GI tract is modeled as a four-compartment system with plug flow. The portions of the GI tract are assumed to be irradiated by radionuclides in the contents of each compartment. Since the residence time of the radionuclide in the GI is short, the dose in any one year is equal to the dose commitment for that year. The dose factor per picocurie ingested is calculated as:

$$F_{ijp} = 2.56 \times 10^{-5} \frac{\tau_{1j} f_{ij}^* E_{ij}}{M_j} e^{-\lambda_i \tau_{2j}} \quad (A.27)$$

where:

2.56×10^{-5} • a unit conversion factor equal to

$$\left(1.602 \times 10^{-8} \frac{\text{g-rad}}{\text{MeV}}\right) \left(\frac{0.037 \text{ dis}}{\text{sec-pCi}}\right) \left(\frac{86400 \text{ sec}}{\text{day}}\right) / 2$$

The factor of 2 in the denominator accounts for the distribution of the radionuclide in the contents of the GI. In other words, the dose is to the inner wall of the organ from radionuclides in the contents,

- τ_{1j} • the travel time of the contents of the compartment j through that compartment, days,
- τ_{2j} • the travel time to the entrance of the compartment j, days, and
- f_{ij}^* • the fraction of the total quantity of radionuclide i that is not absorbed or decayed prior to reaching the entrance of compartment j.

Values of the travel times to and through each of the four compartments of the GI tract are given in Table A-5.

TABLE A-5. Metabolic Data for GI Tract Model

Organ	Travel Time in Organ (hours)	Travel Time to Organ (hours)
Stomach	1	0
GI-Small Intestine	4	1
GI-Upper Large Intestine	8	5
GI-Lower Large Intestine	18	13

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APPENDIX B

ARRRG AND FOOD SUBROUTINE DESCRIPTIONS

APPENDIX B

ARRRG AND FOOD SUBROUTINE DESCRIPTIONS

The models described in Appendix A are incorporated into the computer codes ARRRG and FOOD, which are programmed for the UNIVAC 1100/44 in ASCII FORTRAN. A number of the subroutines are used in common for the two codes. Short descriptions of the functions of each subroutine in ARRRG and FOOD are given in this appendix. Programs using each subroutine are indicated.

MAIN (ARRRG)

The main program of ARRRG calls the other subroutines to perform the calculations requested by the user. The data library reading subroutines are called and all other input data is read by the main program. (Required input data is explained in detail in Appendix F.) The main program is designed for flexibility and ease of running related calculations. Many cases may be run using an input of control or inventory data. The main program also controls the calling of the environmental and dose calculating subroutines.

There are no common or equivalence statements. All input to subroutines is through the calling sequence.

MAIN (FOOD)

The main program of FOOD performs the same functions as the main program of ARRRG. The two codes are structurally similar, but FOOD uses some subroutines specifically tailored for the terrestrial food pathways, so the main programs differ slightly.

RLIBIN (ARRRG and FOOD)

Subroutine RLIBIN reads the master file of isotope names and half-lives from the radionuclide master data library.

OLIBS (ARRRG AND FOOD)

Subroutine OLIBS reads biological data from the organ data library. It also checks for library consistancy with the radionuclide master library read by RLIBIN.

BLIBIN (ARRRG)

Subroutine BLIBIN reads bioaccumulation factors from the library for aquatic organisms in salt and fresh water. It also reads a factor for cleanup of drinking water by water treatment plants.

FLIBIN (FOOD)

Subroutine FLIBIN reads the terrestrial food transfer coefficient library.

SLIBIN (ARRRG)

Subroutine SLIBIN reads dose factors from the library for external exposure from radionuclides in soil and in water. It also checks for consistency with the master radionuclide library read by RLIBIN.

GLIBIN (FOOD)

Subroutine GLIBIN for FOOD is similar to subroutine SLIBIN for ARRRG, except it reads only the factors for external exposure from radionuclides in soil.

ZEROR (ARRRG and FOOD)

Subroutine ZEROR is used to set the values of real number assays to real zero.

ZEROI (ARRRG and FOOD)

Subroutine ZEROI is used to set the values of integer number arrays to integer zero.

IDNUC (ARRRG and FOOD)

Subroutine IDNUC checks the nuclides from the input source term against the radionuclide master library read by RLIBIN. If a nuclide is unidentifiable, the programs abort. The subroutine also initializes the input inventory array.

OPCHCK (ARRRG)

Subroutine OPCHCK counts the number of organs and aquatic release exposure pathways chosen for the calculation. If no organs or no exposure pathways are initialized, the program aborts.

OFCHCK (FOOD)

Subroutine OFCHCK for FOOD is similar in structure and function to subroutine OPCHCK for ARRRG, except it counts organs and terrestrial exposure pathways for the calculation.

SETDAT (ARRRG)

Subroutine SETDAT selects data required for the calculation from that read by the library reading subroutines and creates condensed data arrays. This subroutine also adjusts units on the input data to make it compatible with the later calculations. If no data is available for a nuclide, a message is printed and the radionuclide is dropped, but the program is not aborted.

SETDAT (FOOD)

Subroutine SETDAT for FOOD is similar in structure and purpose to that for ARRRG. Since it handles different types of data, it is compiled separately, but referred to by the same name.

QAPAGE (ARRRG)

Subroutine QAPAGE performs no calculations. It prints back the options chosen and parameters used in the dose calculation. It allows the user to check his input and verify the problem run.

QAPAGE (FOOD)

Subroutine QAPAGE for FOOD is similar in structure and function to that for ARRRG, but prints different option lists.

DFCALC (ARRRG and FOOD)

Subroutine DFCALC uses the biological data from the organ data library to prepare dose and dose commitment factors for ingestion pathways for each radionuclide used in the calculation. The dose factors are organ specific. Dose factors may be calculated for either chronic or acute uptake. There is a separate model for organs of the GI tract. There are also special cases for ^3H , ^{14}C , ^{13}N , and ^{22}Na and ^{24}Na . For these radionuclides, all organ dose factors are set equal to that for total-body, except those for bone for ^3H and ^{14}C .

DOZE (ARRRG)

Subroutine DOZE calculates the environmental concentrations of radionuclides from the aquatic release inventory. A reconcentration factor may be calculated in one of three ways. Water and shoreline sediment concentrations are found from the reconcentration ratio, flow rate, and mixing rate of the receiving water body. Radionuclide concentrations in aquatic foods are derived from the water concentrations.

DOSE (FOOD)

Subroutine DOSE calculates the environmental concentrations of radionuclides in the terrestrial exposure pathways. If the initial inventory is for an atmospheric release, an air concentration is calculated and soil and plant concentrations are derived from it. If the initial inventory is for a liquid release, water concentrations are calculated as in Subroutine DOZE for ARRRG. Soil and plant concentrations derived from irrigation with the contaminated water are calculated. There are special specific activity models included for tritium and for carbon-14.

DOZCAL (ARRRG)

Subroutine DOZCAL in ARRRG calculates doses and dose commitments from ingestion of contaminated aquatic food products and exposure to contaminated shoreline and water. It also sets up arrays for the output routine.

DOZCAL (FOOD)

Subroutine DOZCAL in FOOD calculates doses and dose commitments from ingestion of contaminated farm crops and from exposure to contaminated soil.

DOSOUT (ARRRG)

Subroutine DOSOUT in ARRRG prints summary and complete output dose and dose commitment tables for all aquatic exposure pathways.

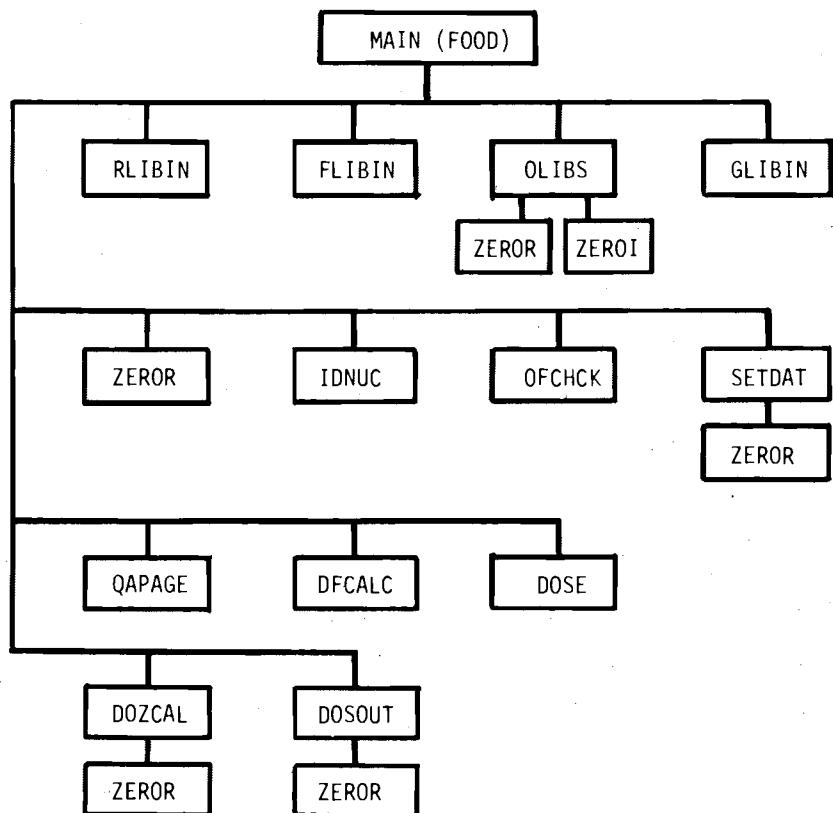
DOSOUT (FOOD)

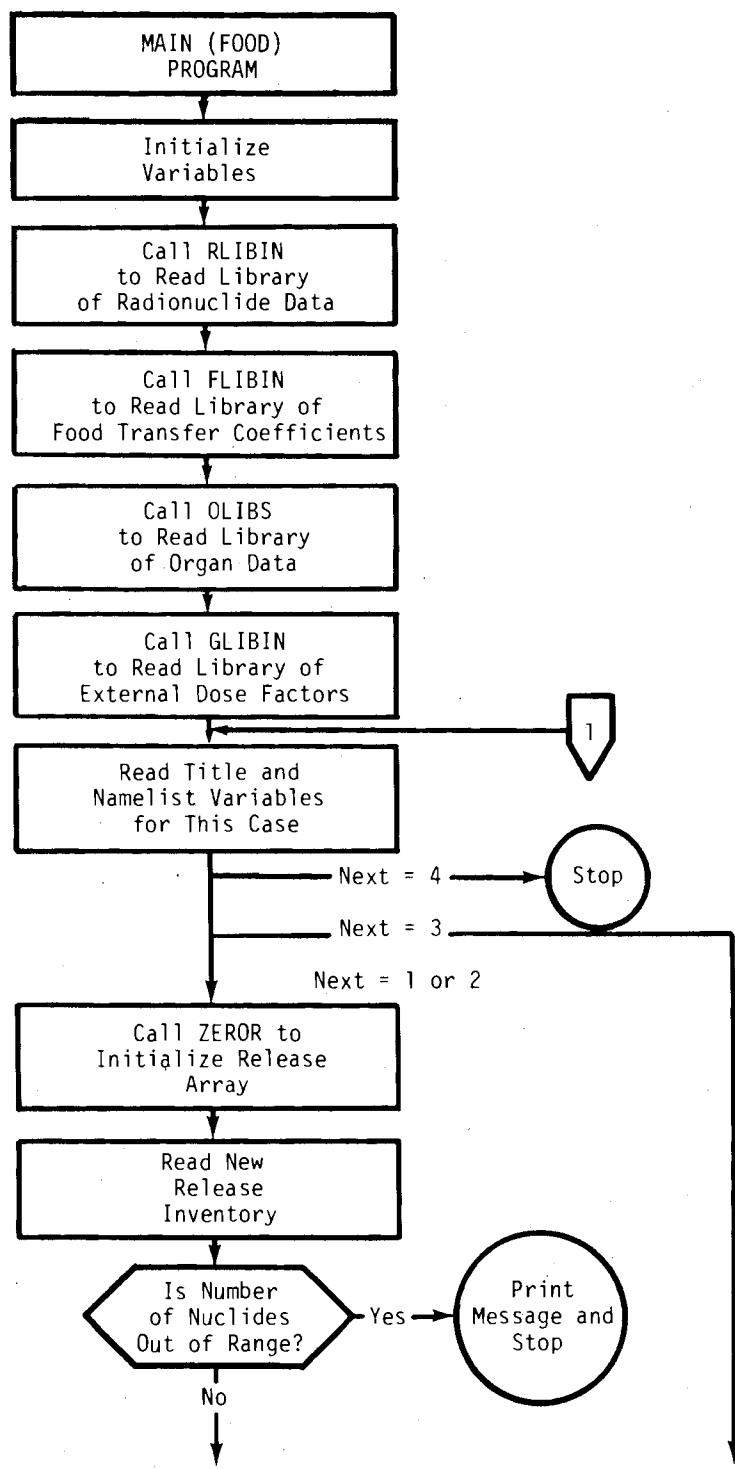
Subroutine DOSOUT in FOOD prints summary and complete output dose and dose commitment tables for all terrestrial exposure pathways.

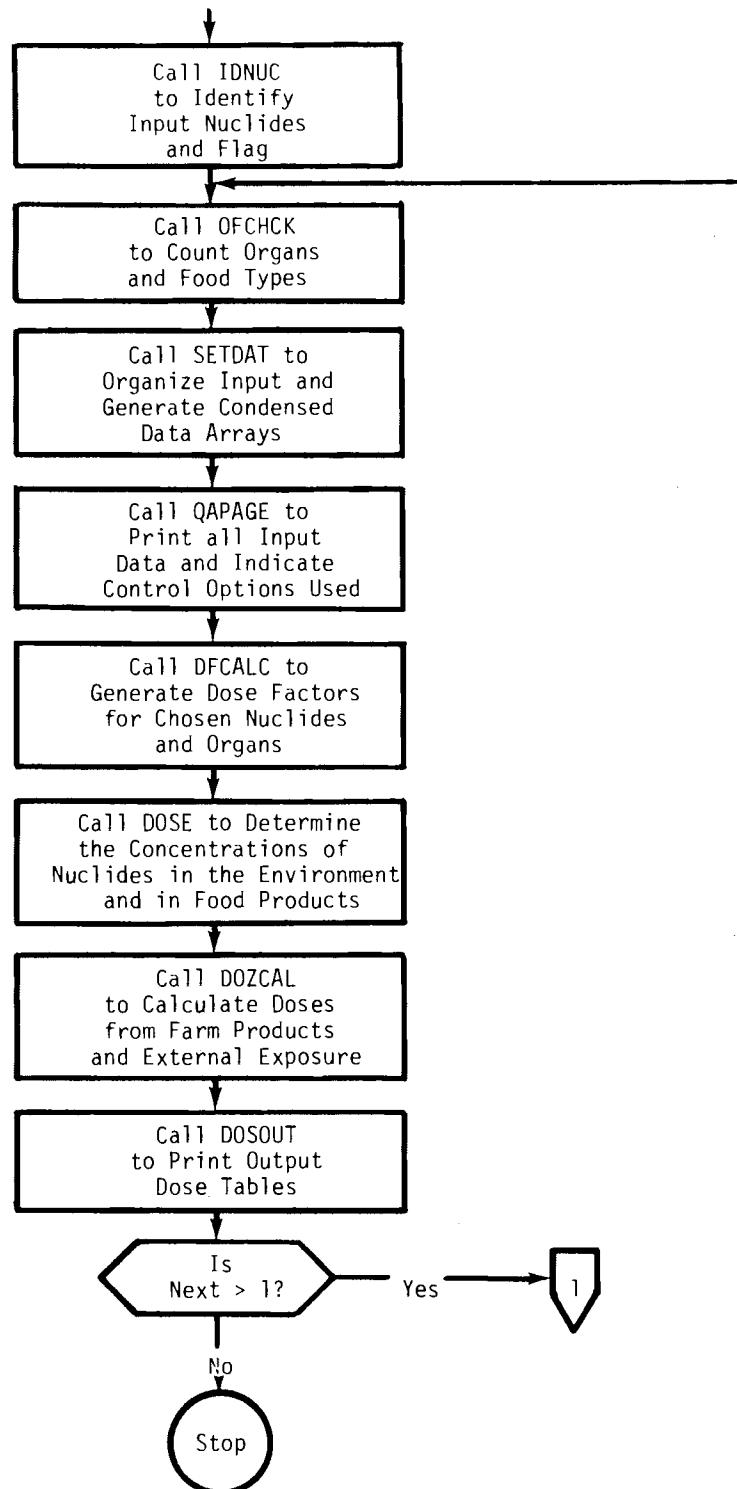
APPENDIX C

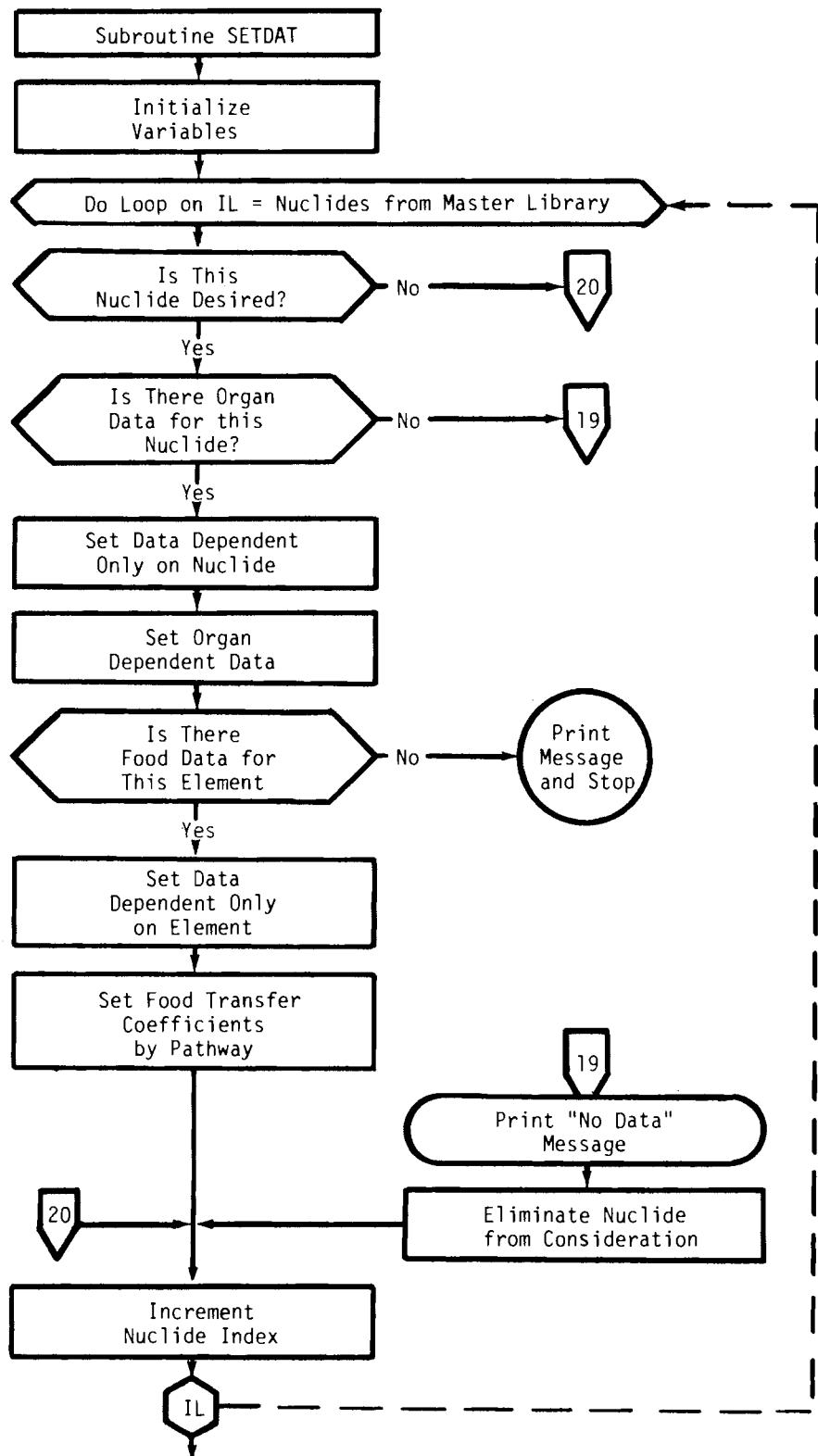
ARRRG AND FOOD FLOW DIAGRAMS

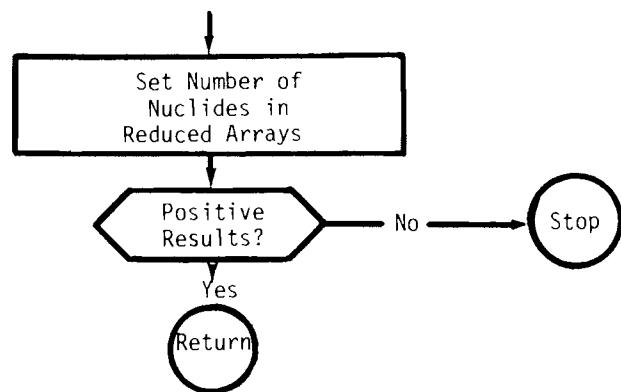
1. FOOD Subroutine Hierarchy
2. FOOD - MAIN
 - SETDAT
 - DFCALC
 - DOSE
 - DOZCAL
 - DOSOUT
3. ARRRG Subroutine Hieracrhy
4. ARRRG - DOZE
 - DOZCAL

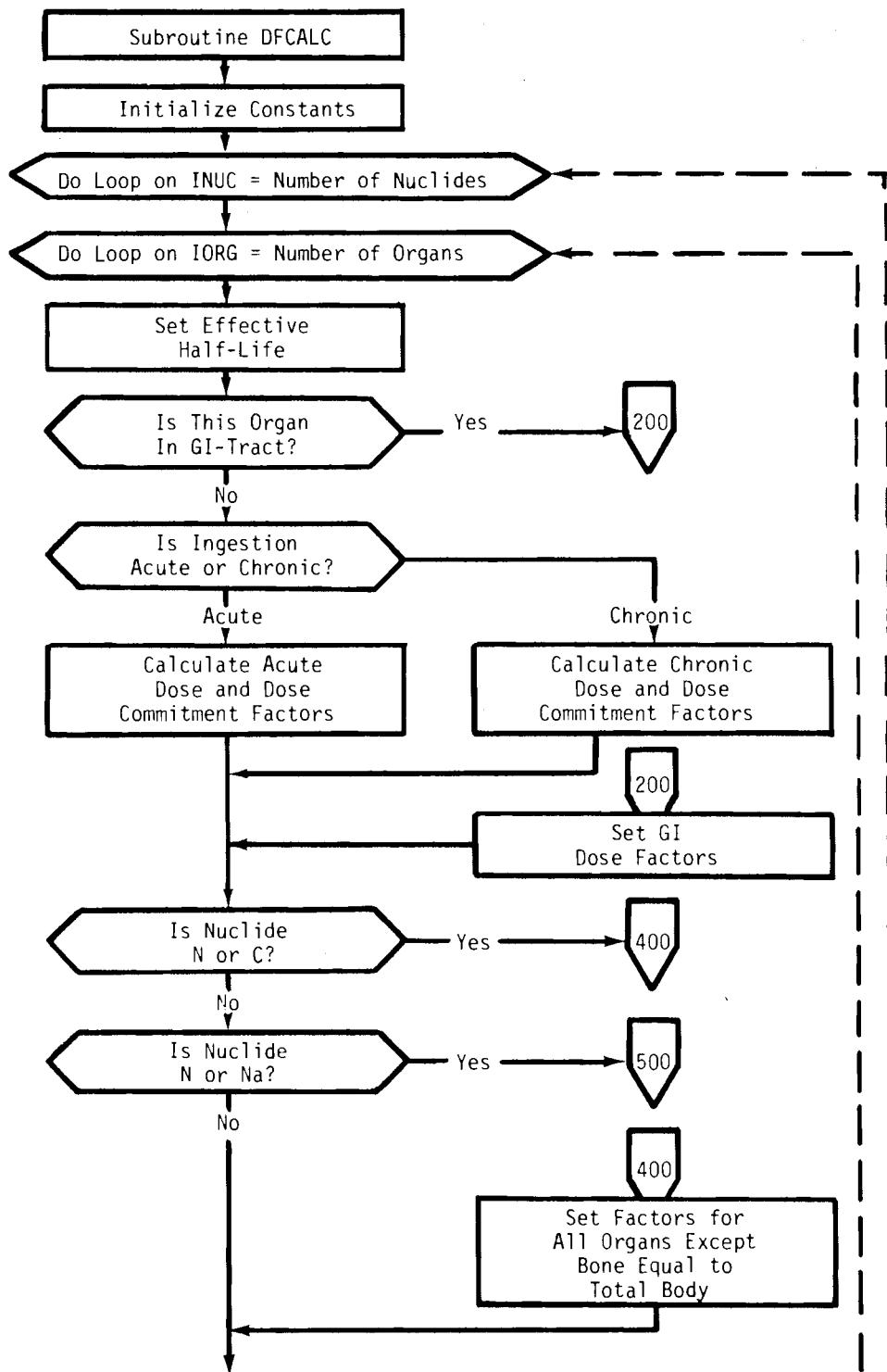


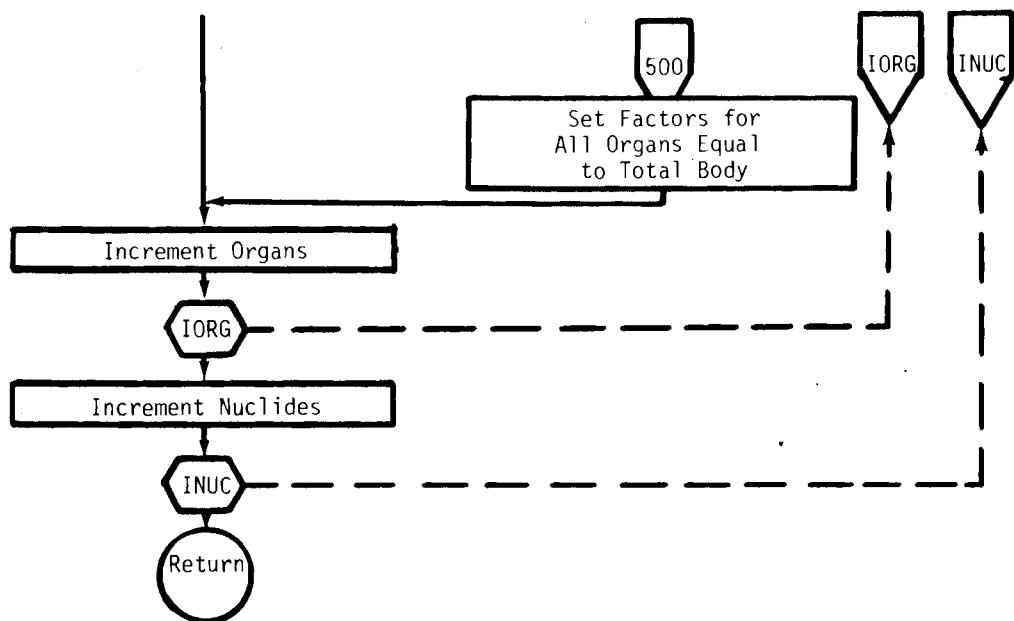


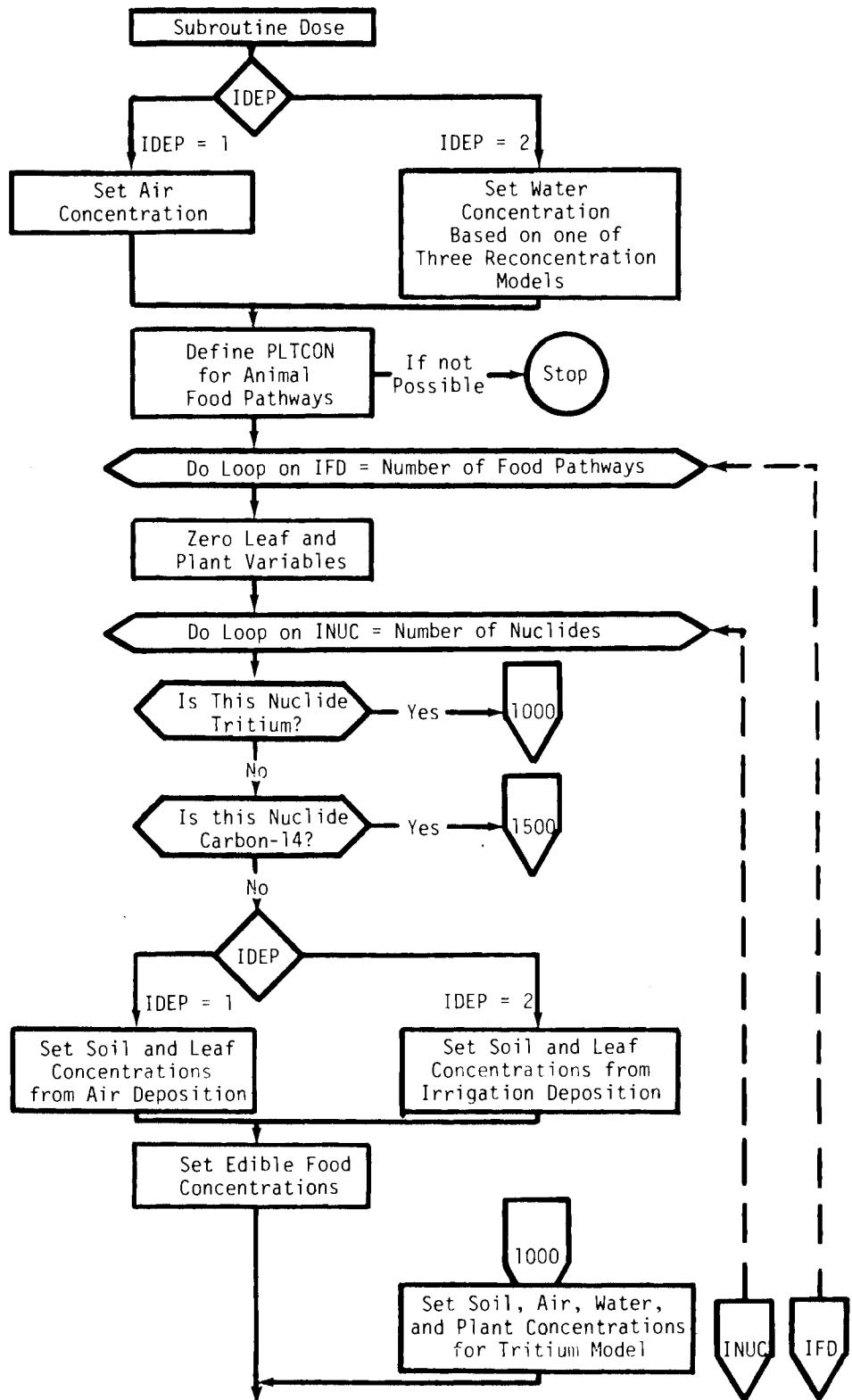


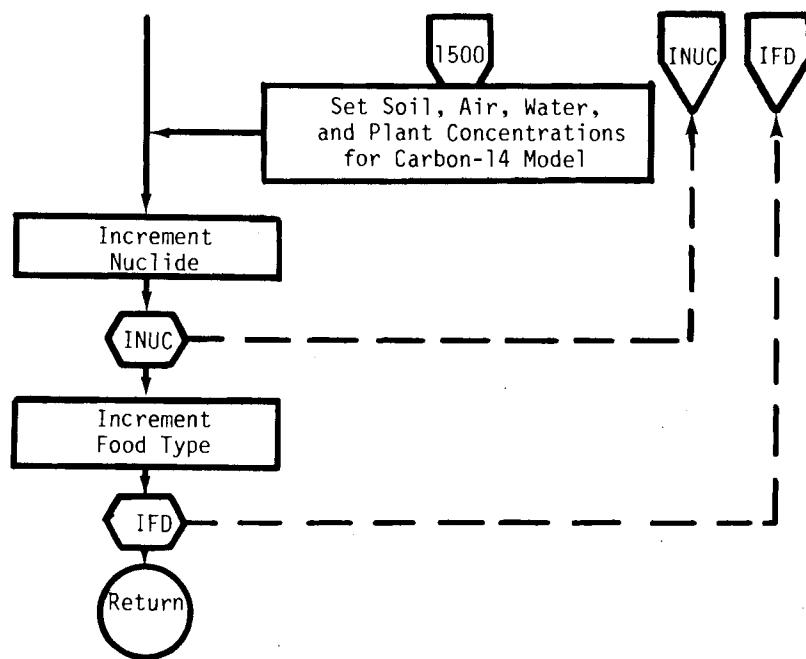


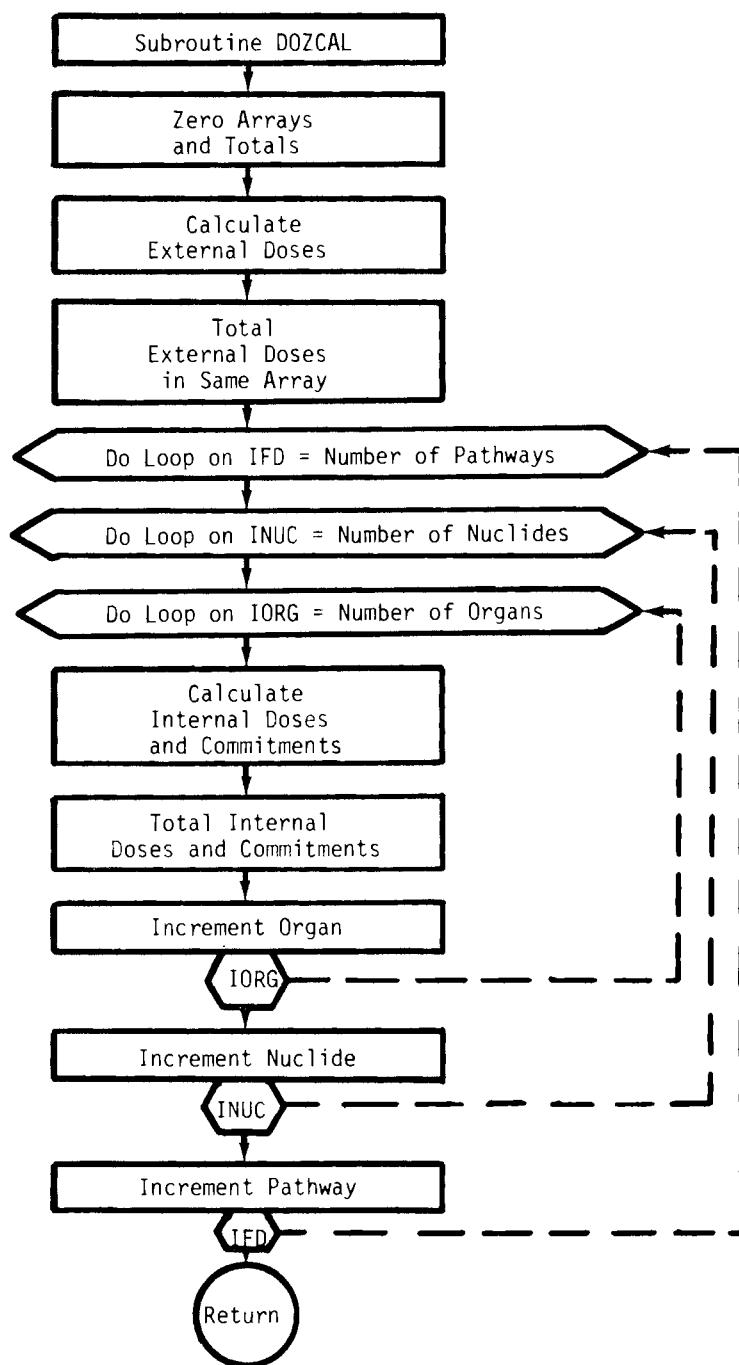


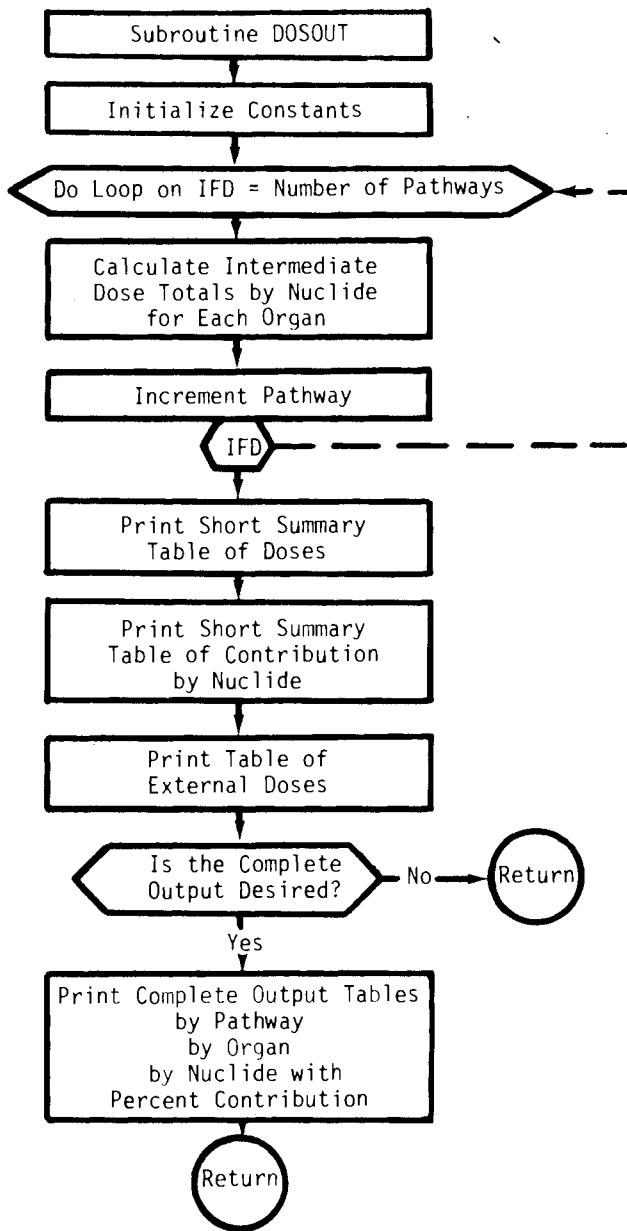


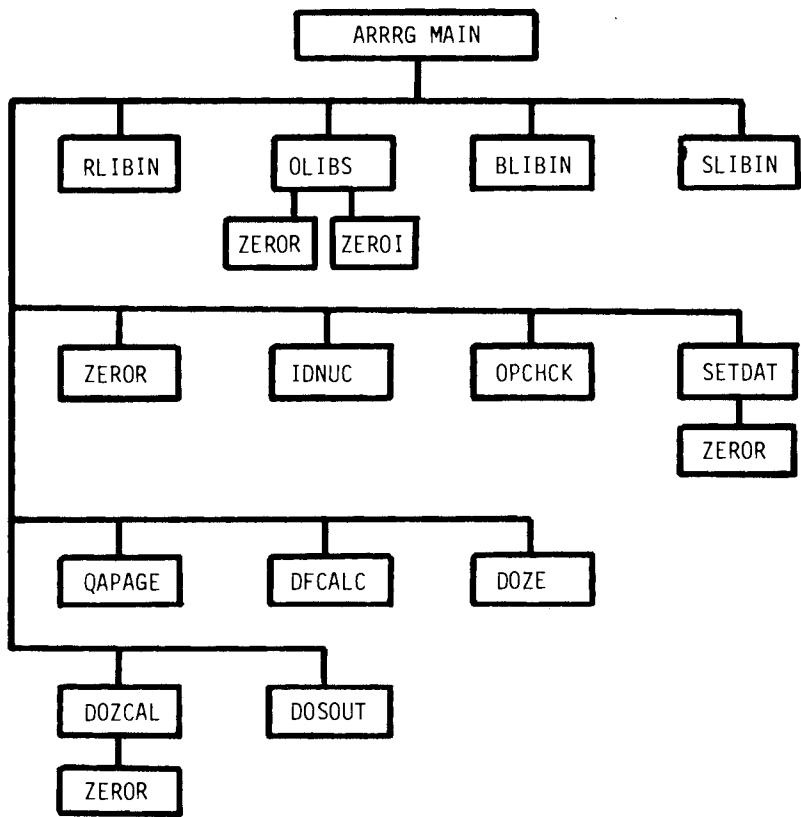


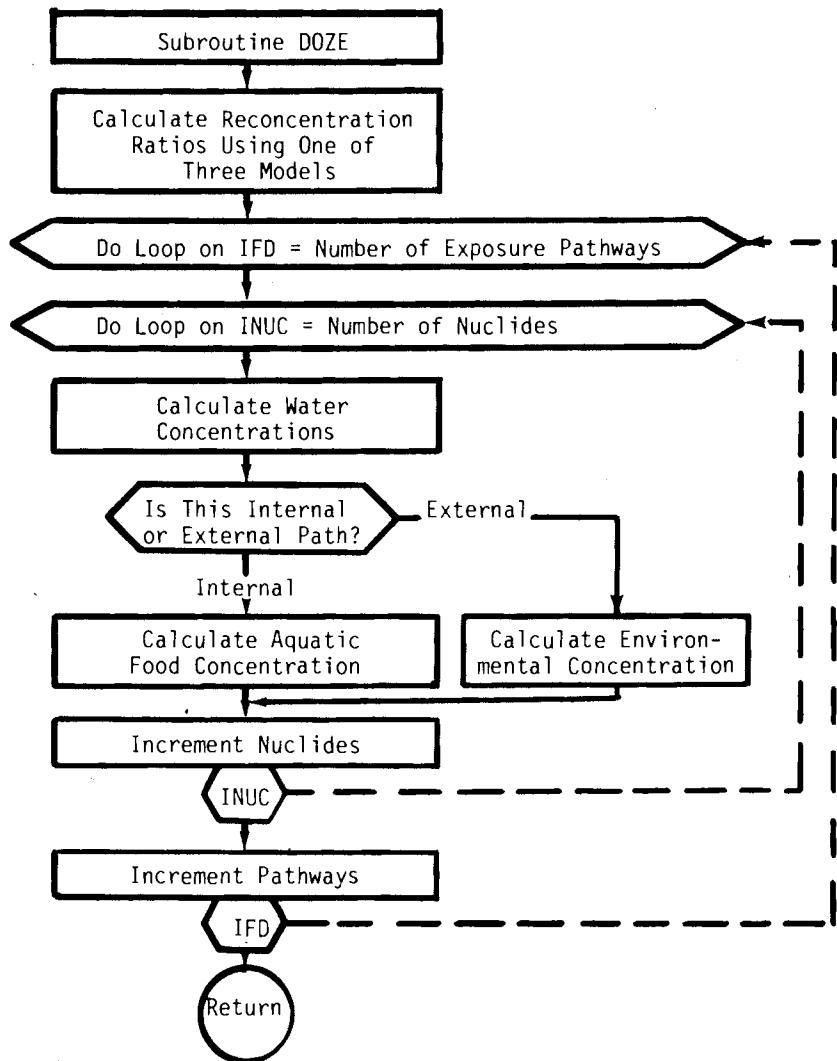


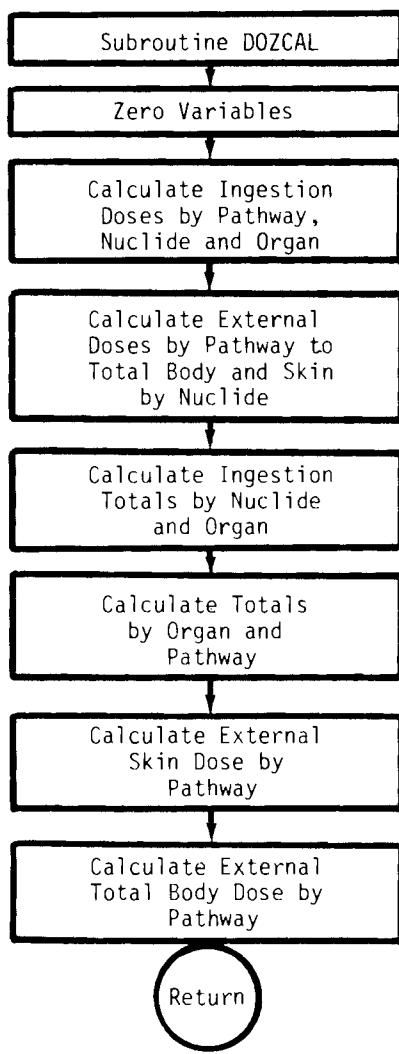












APPENDIX D

DATA LIBRARY DESCRIPTIONS

APPENDIX D

DATA LIBRARY DESCRIPTIONS

Three data libraries are used by both ARRRG and FOOD:

- 1) RMDLIB - a radionuclide decay data library,
- 2) ORGLIB - an organ data library, and
- 3) GRDFLIB - an external exposure dose factor library.

In addition, ARRRG requires:

- 4) BIOAC - a bioaccumulation factor library,
and FOOD uses
- 5) FTRANSLIB - a food transfer coefficient library.

The data in the libraries is set up such that additional data on changes to existing data may be made with little difficulty. Listings of the libraries are given in Appendix E.

RADIONUCLIDE MASTER DATA LIBRARY--RMDLIB

The RMDLIB contains all radiological decay data used by ARRRG and FOOD. The library is organized into roughly two sections. The first section contains radionuclides which are not members of decay chains, and also radionuclides singled out from chains with the "+D" (plus daughters) designation. Data entries in the first section are arranged by increasing atomic number. The second section of the library contains radionuclides organized into decay chains, ordered under the radionuclides highest in the chain. The RMDLIB contains about 280 entries.

ARRRG and FOOD use only the radionuclide identifier and half-life information from RMDLIB. Other data in the library is ignored. Data contained on each card image of RMDLIB is:

Column 1 Alphabetic element symbol
Column 2 Atomic weight, also metastable and/or "+D" designation
Column 3 Radiological half-life, days
Column 4 Relative position in decay chain
Column 5 Precursor in decay chain
Column 6 Branching ratio from primary precursor
Column 7 Alternate precursor in decay chain
Column 8 Branching ratio from alterante precursor

The RMDLIB FORTRAN format is (A.2, A6, E10.2, 2I2, F7.4, I2, F7.4).

ORGAN DATA LIBRARY--ORGLIB

The ORGLIB contains data used in ARRRG and FOOD for dose calculations to specific organs from ingested radionuclides. Data is arranged in blocks by nuclide. The blocks are ordered to be compatible with the RMDLIB chain order. Data in each block is arranged by organ index. The organs for which data are potentially available are:

<u>Organ Index</u>	<u>Organ Name</u>
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
19	GI
20	Stomach
21	Small intestine
22	Upper large intestine
23	Lower large intestine

For most entries, only data for organs number 1, 3, 4, 6, 20, 21, 22, and 23 are included. The data contained on each card in the ORGLIB library is as follows:

Column 1 Alphabetic element symbol
Column 2 Atomic weight, also metastable and/or "+D" designation
Column 3 Organ index (1 - 23)
Column 4 Biological half-life, days
Column 5 f_w --fraction of ingested nuclide reaching organ of interest
Column 6 F_2' --fraction from blood to organ of interest (not used by FOOD or ARRRG)
Columns 7,8,9 Effective energy absorbed per disintergration in adult organs (MeV). Columns 8 and 9 are only used for organ 8 (lungs).

The ORGLIB FORTRAN format is (A2, A6, I2, 6E8.2).

EXTERNAL RADIATION DOSE FACTOR LIBRARY--GRDFLIB

The external radiation dose factor file contains factors used in ARRRG and FOOD to calculate skin and total-body doses from exposure to radionuclides in the environment. FOOD uses only the factors for dose from exposure to contaminated ground. ARRRG uses both the factors for exposure to contaminated ground and for immersion in contaminated water. A third set for submersion in contaminated air is not used by either code. There are currently entries for 186 radionuclides, arranged in the order of RMDLIB.

The data contained on each card of the GRDFLIB library is as follows:

Column 1 Alphabetic element symbol
Column 2 Atomic weight, also metastable and/or "+D",
Columns 3-4 Soil contamination external dose factors for skin and total body, (mrem/yr per pCi/m²),
Columns 5-6 Swimming external dose factors for skin and total body, (mrem/yr per pCi/l), and
Columns 7-8 Air submersion dose factors for total body and skin (mrem/yr per pCi/m³).

The GRDFLIB FORTRAN format is (A2, A6, 6E9.2).

AQUATIC BIOACCUMULATION FACTOR LIBRARY--BIOAC

The bioaccumulation library contains the factors used by ARRRG relating the concentration of nuclides in aquatic biota to the concentration of the nuclides in the water. There are separate factors for fresh and salt water. Also included is a factor for the clean-up of drinking water in water treatment plants. The library contains entries for 63 elements.

The library is organized as:

Column 1 Alphabetic element symbol
Columns 2-5 Bioaccumulation factors for fish, crustacea, molluscs, and algae for salt water (pCi/kg per pCi/l)
Columns 6-9 Bioaccumulation factors as above for freshwater
Column 10 Drinking water cleanup factor.

The FORTRAN format is (A2, 9F9.1).

FOOD TRANSFER COEFFICIENT LIBRARY--FTRANSLIB

The FTRANSLIB contains factors used in FOOD relating concentrations of elements in soil to concentrations in farm products produced on that soil, and relating concentrations in animal feed to concentrations in animal products. The library has entries for 63 elements arranged by increasing atomic number compatible with the order of RMDLIB. The data contained on each card in the FTRANSLIB is as follows:

Column 1 Alphabetic element symbol
Column 2 Elemental deposition velocity, m/sec
Columns 3-8 Food transfer coefficients for plants (dimensionless; pCi per gram plant (wet)/pCi per gram soil), milk (day/liter), eggs, beef, pork, and poultry (day/kilogram).

APPENDIX E

LIBRARY AND CODE LISTINGS

RMDLIB
ORGLIB
FTRANSLIB
BIOAC
GRDFLIB
ARRRG
FOOD

Radionuclide Master Data Library (RMDLIB)

RADIONUCLIDE MASTER DATA LIBRARY, 15 MARCH 78, BA NAPIER

H 3	4.51E+3	1	0	0
BE10	5.84E+8	1	0	0
C 14	2.091E+6	1	0	0
N 13	6.92E-3	1	0	0
F 18	7.62E-2	1	0	0
NA22	9.50E+2	1	0	0
NA24	6.25E-1	1	0	0
P 32	1.43E+1	1	0	0
P 33	2.44E+1	1	0	0
AR39	9.83E+4	1	0	0
AR41	7.61E-2	1	0	0
CA41	5.11E+7	1	0	0
SC46	8.38E+1	1	0	0
CR51	2.77E+1	1	0	0
MN54	3.12E+2	1	0	0
MN56	1.07E-1	1	0	0
FE55	9.86E+2	1	0	0
FE59	4.45E+1	1	0	0
CO57	2.71E+2	1	0	0
CO58	7.08E+1	1	0	0
CO60	1.92E+3	1	0	0
N159	2.74E+7	1	0	0
N163	3.51E+4	1	0	0
N165	1.05E-1	1	0	0
CU64	5.29E-1	1	0	0
ZN65	2.44E+2	1	0	0
AS76	1.10E+0	1	0	0
SE79	2.37E+7	1	0	0
BR82	1.47E+0	1	0	0
BR83+D	9.96E-2	1	0	0
BR84	2.21E-2	1	0	0
KR90	3.74E-4	1	0	0
KR91	1.13E-4	1	0	0
RB86	1.87E+1	1	0	0
RB89+D	1.06E-2	1	0	0
SR89+D	5.06E+1	1	0	0
SR90+D	1.04E+4	1	0	0
SR91+D	3.96E-1	1	0	0
SR92+D	1.13E-1	1	0	0
Y 91M+D	3.45E-2	1	0	0
ZR93+D	5.59E+8	1	0	0
ZR95+D	6.40E+1	1	0	0
ZR97+D	7.04E-1	1	0	0
MO93	3.65E+4	1	0	0
MO99+D	2.75E+0	1	0	0
TC101	9.86E-3	1	0	0
RU103+D	3.94E+1	1	0	0
RU105+D	1.85E-1	1	0	0
RU106+D	3.68E+2	1	0	0
PD107	2.37E+9	1	0	0
AG110M+D	2.52E+2	1	0	0
AG111	7.45E+0	1	0	0
CD113M	4.97E+3	1	0	0
SN117M	1.40E+1	1	0	0
SN119M	2.50E+2	1	0	0
SN121M	2.78E+4	1	0	0
SN123	1.29E+2	1	0	0
SN125+D	9.64E+0	1	0	0
SN126+D	3.65E+7	1	0	0
SB124	6.02E+1	1	0	0
SB125+D	1.01E+3	1	0	0
TE123M	1.17E+2	1	0	0
TE127M+D	1.09E+2	1	0	0
TE129M+D	3.36E+1	1	0	0
TE131M+D	1.25E+0	1	0	0
TE131+D	1.74E-2	1	0	0
TE132+D	3.26E+0	1	0	0
TE133M+D	3.85E-2	1	0	0
I 130	5.15E-1	1	0	0
I 131+D	8.04E+0	1	0	0
I 135+D	2.75E-1	1	0	0
CS136	1.31E+1	1	0	0
CS137+D	1.10E+4	1	0	0
CS139+D	6.53E-3	1	0	0
BA140+D	1.28E+1	1	0	0

Radionuclide Master Data Library (RMDLIB)

CE143+D	1.38E+0	1	0	0
CE144+D	2.84E+2	1	0	0
PM148M+D	4.13E+1	1	0	0
PM149	2.21E+0	1	0	0
SM153	1.95E+0	1	0	0
EU152	4.97E+3	1	0	0
EU153	1.94E+0	1	0	0
EU154	3.14E+3	1	0	0
EU155	1.81E+3	1	0	0
EU156	1.52E+1	1	0	0
GD153	2.42E+2	1	0	0
TB160	7.23E+1	1	0	0
HO166M	4.38E+5	1	0	0
W 181	1.40E+2	1	0	0
W 185	7.51E+1	1	0	0
HG203	4.56E+1	1	0	0
PB210+D	8.14E+3	1	0	0
BI210+D	5.01E+0	1	0	0
RN222+D	3.82E+0	1	0	0
RA223+D	1.14E+1	1	0	0
RA224+D	3.66E+0	1	0	0
RA225+D	1.48E+1	1	0	0
RA226..D	5.84E+5	1	0	0
RA228+D	2.10E+3	1	0	0
AC227+D	7.95E+3	1	0	0
TH227+D	1.87E+1	1	0	0
TH228+D	6.99E+2	1	0	0
TH230+D	2.81E+7	1	0	0
TH232+D	5.13E12	1	0	0
PA231+D	1.19E+7	1	0	0
U 232+D	2.52E+4	1	0	0
U 233+D	5.79E+7	1	0	0
U 234	8.91E+7	1	0	0
U 235+D	2.59E11	1	0	0
U 236	8.55E+9	1	0	0
U 238+D	1.65E12	1	0	0
NP237+D	7.82E+8	1	0	0
PU236	1.04E+3	1	0	0
PU237	4.56E+1	1	0	0
PU241+D	5.26E+3	1	0	0
CM246	1.73E+5	1	0	0
CM247+D	5.70E+9	1	0	0
CM248	1.24E+8	1	0	0
CF252	9.64E+2	1	0	0
ZN69M	5.73E-1	1	0	0
ZN59	3.96E-2	2	1	1.0
BR83	9.96E-2	1	0	0
KR83M	7.62E-2	2	1	1.0
BR85	1.99E-3	1	0	0
KR85M	1.87E-1	2	1	1.0
KR85	3.92E+3	3	2	0.211
KR87	5.30E-2	1	0	0
RB87	1.72E13	2	1	1.0
KR88	1.18E-1	1	0	0
RB88	1.24E-2	2	1	1.0
KR89	2.20E-3	1	0	0
RB89	1.06E-2	2	1	1.0
SR89	5.06E+1	3	2	1.0
Y 89M	1.86E-4	4	3	0.0002
SR90	1.04E+4	1	0	0
Y 90	2.67E+0	2	1	1.0
SR91	3.96E-1	1	0	0
Y 91M	3.45E-2	2	1	0.58
Y 91	5.85E+1	3	2	1.0
SR92	1.13E-1	1	0	0
Y 92	1.48E-1	2	1	1.0
Y 93	4.21E-1	1	0	0
ZR93	5.59E+8	2	1	1.0
NB93M	4.97E+3	3	2	0.25
ZR95	6.40E+1	1	0	0
NB95M	3.61E+0	2	1	0.007
NB95~	3.52E+1	3	2	1.0
ZR97	7.04E-1	1	0	0
NB97M	6.94E-4	2	1	0.946
NB97	5.01E-2	3	2	1.0
M099	2.75E+0	1	0	0

Radionuclide Master Data Library (RMDLIB)

TC99M	2.51E-1	2	1	0.868	0
TC99	7.78E+7	3	2	1.0	1 0.132
RU103	3.94E+1	1	0		0
RH103M	3.90E-2	2	1	.0025	0
PD103	1.70E+1	3	2	1.0	1 0.9975
RU105	1.85E-1	1	0		0
RH105M	5.21E-4	2	1	0.28	0
RH105	1.47E+0	3	2	1.0	1 0.72
RU106	3.68E+2	1	0		0
RH106	3.46E-4	2	1	1.0	0
PD109M	5.43E-5	1	0		0
PD109	5.61E-1	2	1	1.0	0
AG109M	4.58E-4	3	2	1.0	0
AG110M	2.52E+2	1	0		0
AG110	2.85E-4	2	1	0.0113	0
IN114M	5.00E+1	1	0		0
IN114	8.33E-4	2	1	1.0	0
CD115M	4.46E+0	1	0		0
CD115	2.23E+0	2	0		0
IN115M	1.88E-1	3	2	1.0	0
IN115	2.19E17	4	3	0.963	1 1.0
SN125	9.64E+0	1	0		0
SB125	1.01E+3	2	1	1.0	0
TE125M	5.80E+1	3	2	0.23	0
SN126	3.65E+7	1	0		0
SB126M	1.32E-2	2	1	1.0	0
SB126	3.75E-1	3	2	0.14	0
SB127	3.85E+0	1	0		0
TE127M	1.09E+2	2	1	0.139	0
TE127	3.90E-1	3	2	0.976	1 0.861
TE129M	3.35E+1	1	0		0
TE129	4.83E-2	2	1	1.0	0
I 129	5.73E+9	3	2	1.0	0
TE131M	1.25E+0	1	0		0
TE131	1.74E-2	2	1	0.222	0
I 131	8.04E+0	3	2	1.0	1 0.778
XE131M	1.19E+1	4	3	0.0109	0
TE132	3.26E+0	1	0		0
I 132	9.58E-2	2	1	1.0	0
TE133M	3.85E-2	1	0		0
TE133	8.64E-3	2	1	0.13	0
I 133	8.67E-1	3	2	1.0	1 0.87
XE133M	2.19E+0	4	3	0.029	0
XE133	5.24E+0	5	4	1.0	3 0.971
TE134	2.90E-2	1	0		0
I 134	3.65E-2	2	1	1.0	0
CS134M	1.21E-1	1	0		0
CS134	7.53E+2	2	1	1.0	0
I 135	2.75E-1	1	0		0
XE135M	1.09E-2	2	1	0.166	0
XE135	3.78E-1	3	2	1.0	1 0.834
CS135	8.40E+8	4	3	1.0	0
XE137	2.66E-3	1	0		0
CS137	1.10E+4	2	1	1.0	0
BA137M	1.77E-3	3	2	0.946	0
XE138	9.84E-3	1	0		0
CS138	2.24E-2	2	1	1.0	0
XE139	4.98E-4	1	0		0
CS139	6.53E-3	2	1	1.0	0
BA139	5.74E-2	3	2	1.0	0
XE140	1.85E-4	1	0		0
CS140	7.64E-4	2	1	1.0	0
BA140	1.28E+1	3	2	1.0	0
LA140	1.68E+0	4	3	1.0	0
BA141	1.27E-2	1	0		0
LA141	1.64E-1	2	1	1.0	0
CE141	3.25E+1	3	2	1.0	0
BA142	7.43E-3	1	0		0
LA142	6.44E-2	2	1	1.0	0
CE143	1.38E+0	1	0		0
PR143	1.36E+1	2	1	1.0	0
CE144	2.84E+2	1	0		0
PR144	1.20E-2	2	1	1.0	0
ND144	8.77E17	3	2	1.0	0
ND147	1.11E+1	1	0		0
PM147	9.58E+2	2	1	1.0	0

Radionuclide Master Data Library (RMDLIB)

PM148M	4.13E+1	1	0	0
PM148	5.37E+0	2	1	1.0
PM151	1.18E+0	1	0	0
SM151	3.29E+4	2	1	1.0
W 187	9.95E-1	1	0	0
RE187	1.83E13	2	1	1.0
TH230	2.81E+7	1	0	0
RA226	5.84E+5	2	1	1.0
RN222	3.82E+0	3	2	1.0
PB210	8.14E+3	4	3	1.0
BI210	5.01E+0	5	4	1.0
PO210	1.38E+2	6	5	1.0
U 232	2.62E+4	1	0	0
TH232	4.16E13	2	0	0
RA228	2.10E+3	3	2	1.0
AC228	2.55E-1	4	3	1.0
TH228	6.99E+2	5	4	1.0
RA224	3.66E+0	6	5	1.0
PB212	4.43E-1	7	6	1.0
BI212	4.20E-2	8	7	1.0
U 235	2.59E11	1	0	0
TH231	1.06E+0	2	1	1.0
PA231	1.19E+7	3	2	1.0
AC227	7.95E+3	4	3	1.0
TH227	1.87E+1	5	4	0.9862
FR223	1.51E-2	6	4	0.0138
RA223	1.14E+1	7	5	1.0
U 237	6.75E+0	1	0	0
NP237	7.82E+8	2	1	1.0
PA233	2.70E+1	3	2	1.0
U 233	5.79E+7	4	3	1.0
TH229	2.68E+6	5	4	1.0
RA225	1.48E+1	6	5	1.0
AC225	1.00E+1	7	6	1.0
U 238	1.65E12	1	0	0.0
TH234	2.41E+1	2	1	1.0
PA234M	8.13E-4	3	2	1.0
PA234	2.81E-1	4	3	0.0013
AM242M	5.55E+4	1	0	0
AM242	6.68E-1	2	1	1.0
CM242	1.63E+2	3	2	0.827
PU242	1.41E+8	4	2	0.173
NP238	2.18E+0	5	0	0
PU238	3.21E+4	6	5	1.0
CM244	6.61E+3	1	0	0
PU244	3.02E10	2	0	0
U 240	5.88E-1	3	2	0.999
PU240	2.39E+6	4	3	1.0
CM247	5.70E+9	1	0	0
CM243	1.04E+4	2	0	0
PU243	2.05E-1	3	1	1.0
AM243	2.70E+6	4	3	1.0
NP239	2.36E+0	5	4	1.0
PU239	8.91E+6	6	5	1.0
CM245	3.10E+6	1	0	0
PU241	5.26E+3	2	1	1.0
AM241	1.58E+5	3	2	1.0
	0			

ORGAN DATA LIBRARY (ORGLIB)

H 3	1	1.0+1	1.0	1.0	.0058
H 3	8				.0058
BE10	1	1.8+2	2.00-3	1.0	.209
BE10	3	1.2+2	6.00 -5	0.03	.209
BE10	4	2.7+2	2.00-4	0.1	.209
BE10	5	4.5+2	6.40-4	0.32	1.045
BE10	8				.209
BE10	20				.209
BE10	21				.209
BE10	22				.209
BE10	23				.209
C 14	1	10.	1.0	1.0	.054
C 14	5	40.	0.025	0.025	.27
C 14	7	12.	0.5	0.5	.054
C 14	20				.054
C 14	21				.054
C 14	22				.054
C 14	23				.054
N 13	1	90.	1.0		1.143
F 18	1	8.08+2	1.0	1.0	0.86
F 18	6	1.45+3	0.53	0.53	1.462
F 18	8				0.54
F 18	20				0.54
F 18	21				0.89
F 18	22				0.39
F 18	23				0.39
NA22	1	1.10+1	1.0	1.0	1.513
NA22	8				0.8
NA22	20				1.513
NA22	21				1.513
NA22	22				1.513
NA22	23				1.513
NA24	1	1.10+1	1.0	1.0	2.725
NA24	8				1.5
NA24	20				1.5
NA24	21				2.7
NA24	22				1.0
NA24	23				1.0
P 32	1	257.	.75	1.0	.696
P 32	4	18.	.05	0.07	.695
P 32	6	1.15+3	.375	0.50	3.459
P 32	8				.690
P 32	13	257.	.53-2	.007	.690
P 32	20				.695
P 32	21				.696
P 32	22				.695
P 32	23				.695
P 33	1	257.	.75	1.0	.0853
P 33	4	18.	.05	0.07	.0853
P 33	6	1.15+3	.38	0.20	0.426
P 33	8				.0853
P 33	13	257.	.53-2	.007	.0853
P 33	20				.0853
P 33	21				.0853
P 33	22				.0853
P 33	23				.0853
CA41	1	1.64+4	.60	1.0	.0036
CA41	6	1.8+4	.54	0.9	.0036
CA41	8				.0036
CA41	20				.0036
CA41	21				.0036
CA41	22				.0036
CA41	23				.0036
SC46	1	30.0	.10-3	1.0	1.333
SC46	3	75.0	.20-5	.02	.512
SC46	4	36.0	.15-4	.15	.654
SC46	5	33.0	.20-4	.20	1.101
SC46	8				.640
SC46	20				.640
SC46	21				1.3
SC46	22				.409
SC46	23				.409
CR51	1	615.	.005	1.0	.019
CR51	3	615.	.15-4	.27-2	.007
CR51	8	615.	.20-3	.04	.014

ORGAN DATA LIBRARY (ORGLIB)

CR51	15	616.	.45-5	.90-3	.084-1
CR51	15	616.	0.45-5	.90-3	3.6-3
CR51	20				.014
CR51	21				.025
CR51	22				.0053
CR51	23				.0053
MN54	1	17.	.10	1.0	.512
MN54	4	25.	.02	.24	.227
MN54	8				.230
MN54	17	5.70	.003	.03	.130
MN54	20				.230
MN54	21				.510
MN54	22				.122
MN54	23				.122
MN56	1	17.	.10	1.0	1.810
MN56	4	25.	.02	.24	1.235
MN56	8				1.30
MN56	17	5.70	.003	.03	1.10
MN56	20				1.3
MN56	21				1.9
MN56	22				1.03
MN56	23				1.03
FE55	1	800.	.10	1.0	9.5 -3
FE55	4	554.	.013	.13	9.5 -3
FE55	5	600.	.002	.02	6.5 -3
FE55	6	1680.	.010	.10	4.2 -2
FE55	8	3200.	.002	.02	9.5 -3
FE55	20				.0055
FE55	21				.0065
FE55	22				.0065
FE55	23				9.5 -3
FE59	1	800.	.10	1.0	.835
FE59	4	554.	.013	.13	.439
FE59	5	500.	.002	.02	.340
FE59	6	1680.	.01	.10	.946
FE59	8	3200.	.002	.02	.420
FE59	20				.420
FE59	21				.810
FE59	22				.298
FE59	23				.298
C057	1	9.50	.300	1.0	.10
C057	4	9.50	.007	.04	.063
C057	5	9.50	.420 -3	.14-2	.045
C057	8				.053
C057	17	9.50	.600 -3	.002	.040
C057	20				.053
C057	21				.090
C057	22				.0495
C057	23				4.95-2
C058	1	9.50	.300	1.0	.628
C058	4	9.50	.007	.040	.292
C058	5	9.50	.420-3	.140-2	.220
C058	8				.290
C058	17	9.50	.600-3	.002	.170
C058	20				.290
C058	21				.610
C058	22				.169
C058	23				.169
C060	1	9.50	.300	1.0	1.575
C060	4	9.50	.007	.040	.745
C060	5	9.50	.420-3	.140-2	.560
C060	8				.720
C060	17	9.50	.600-3	.200-2	.440
C060	20				.720
C060	21				1.50
C060	22				.449
C060	23				.449
NI59	1	567.	.300	1.0	7.7-3
NI59	4	500.	.020	.070	7.7-3
NI59	6	800.	.150	.500	7.7-3
NI59	8				.770-2
NI59	20				.077-1
NI59	21				.077-1
NI59	22				.077-1
NI59	23				7.7-3
NI63	1	567.	.300	1.0	.021

ORGAN DATA LIBRARY (ORGLIB)

N163	4	500.	.020	.070	.021
N163	6	800.	.150	.500	.105
N163	8				.021
N163	20				.021
N163	21				.021
N163	22				.021
N163	23				.021
N165	1	667.	.300	1.0	.940
N165	4	500.	.020	.070	.752
N165	6	800.	.150	.500	3.176
N165	8				1.20
N165	20				1.2
N165	21				1.4
N165	22				.686
N165	23				.686
CU64	1	80.	.280	1.0	.251
CU64	3	16.	.010	.050	.166
CU64	4	150.	.020	.080	.181
CU64	5	2.	.020	.070	.170
CU64	8				.190
CU64	13	800.	.003	.010	.210
CU64	18	80.	.003	.010	.170
CU64	20				.19
CU64	21				.25
CU64	22				.156
CU64	23				.156
ZN65	1	933.	.100	1.0	.341
ZN65	3	149.	.004	.04	.113
ZN65	4	91.	.035	.350	.153
ZN65	6	1300.	.015	.150	.149
ZN65	8				.150
ZN65	10	270.	.900-4	.900-3	.056
ZN65	11	107.	.400-4	.400-3	.056
ZN65	14	1950.	.030	.300	.320
ZN65	15	14.	.005	.060	.056
ZN65	17	25.	.003	.030	.084
ZN65	20				.15
ZN65	21				.32
ZN65	22				.084
ZN65	23				.084
AS76	1	280.	.030	1.0	1.3
AS76	3	550.	.300-3	.010	1.1
AS76	4	550.	.900-3	.030	1.1
AS76	8				1.10
AS76	20				1.1
AS76	21				1.3
AS76	22				1.1
AS76	23				1.1
SE79	1	11.	.9	1.	.042
SE79	3	11.	.04	.04	.042
SE79	4	24.	.05	.07	.042
SE79	8				.042 .042 .042
SE79	20				.042
SE79	21				.042
SE79	22				.042
SE79	23				.042
BR82	1	8.0	1.0	1.0	1.715
BR82	8				.850
BR82	20		5.0-2		.85
BR82	21		5.0-2		1.8
BR82	22		5.0-2		.532
BR82	23		5.0-2		.522
RB86	1	45.	1.0	1.0	.706
RB86	4	63.	.05	.05	.674
RB86	5	45.	.004	.004	.660
RB86	8				.660
RB86	14	80.	.450	.450	.700
RB86	17	60.	.003	.003	.650
RB86	20				.66
RB86	21				.70
RB86	22				.663
RB86	23				.663
SR90+D	1	4000.	.3	1.0	1.137
SR90+D	6	4000.	.0225	.300	5.650
SR90+D	8				1.305
SR90+D	20				.777

ORGAN DATA LIBRARY (ORGLIB)

SR90+D	21			.777
SR90+D	22			.777
SP90+D	23	.7		.777
SR91+D	1 4000.	.300	1.0	1.834
SR91+D	5 4000.	.210	.700	6.47
SR91+D	8			1.15
SR91+D	20			.68
SR91+D	21			.98
SR91+D	22			.777
SR91+D	23			0.777
SR92+D	1 4000.	.300	1.0	2.601
SR92+D	6 4000.	.210	.700	8.602
SR92+D	8			1.75
SR92+D	20			.45
SR92+D	21			.96
SR92+D	22			1.867
SR92+D	23			1.857
ZR93+D	1 450.	.100-3	1.0	.023
ZR93+D	3 900.	.200-5	.020	.020
ZR93+D	4 320.	.700-5	.070	.024
ZR93+D	5 900.	.600-6	.006	.025
ZR93+D	61000.	.360-4	.360	.110
ZR93+D	8			.019
ZR93+D	20			.019
ZR93+D	21			.019
ZR93+D	22			.019
ZR93+D	23			.019
ZR95+D	1 450.	.100-3	1.0	1.09
ZR95+D	3 900.	.200-5	.020	.510
ZR95+D	4 320.	.700-5	.070	.589
ZR95+D	5 900.	.600-6	.006	.460
ZR95+D	61000.	.360-4	.360	1.30
ZR95+D	8			.327
ZR95+D	20			.32
ZR95+D	21			.57
ZR95+D	22			.238
ZR95+D	23			.238
ZR97+D	1 450.	.100-3	1.0	2.11
ZR97+D	3 900.	.200-5	.020	1.485
ZR97+D	4 320.	.700-5	.070	1.594
ZR97+D	5 900.	.600-6	.006	1.50
ZR97+D	61000.	.360-4	.360	6.3
ZR97+D	8			1.55
ZR97+D	20			.94
ZR97+D	21			1.2
ZR97+D	22			1.406
ZR97+D	23			1.406
MO93	1 5.	.8	1.	.048
MO93	3 3.	.06	.08	.048
MO93	445.	.08	.1	.048
MO93	8			.048
MO93	20			.048
MO93	21			.048
MO93	22			.048
MO93	23			4.77 -2
MO99+D	1 5.0	.800	1.0	.547
MO99+D	3 3.0	.060	.080	.46
MO99+D	445.0	.080	.100	.478
MO99+D	8			.470
MO99+D	20			.44
MO99+D	21			.48
MO99+D	22			.43
MO99+D	23			.447
TC101	1 1.0	.500	1.0	.697
TC101	3 20.0	.005	.01	.543
TC101	4 30.0	.15 -2	.003	.570
TC101	6 25.0	.001	.002	.570
TC101	20			.524
TC101	21			.524
TC101	22			.524
TC101	23			.524
RU103+D	1 7.30	.030	1.0	.408
RU103+D	3 2.50	.005	.200	.203
RU103+D	5 16.0	.240-2	.080	.639
RU103+D	8			.263
RU103+D	20			.21

ORGAN DATA LIBRARY (ORGLIB)

RU103+D	21			.38
RU103+D	22			.176
RU103+D	23			.176
RU105+D	1 7.30	.030	1.0	1.063
RU105+D	3 2.50	.006	.200	.780
RU105+D	616.0	.240-2	.080	3.325
RU105+D	8			.795 .90 .91
RU105+D	20			.72
RU105+D	21			.98
RU105+D	22			.574
RU105+D	23			.574
RU106+D	1 7.30	.030	1.0	1.534
RU106+D	3 2.50	.006	.200	1.447
RU106+D	616.0	.240-2	.080	7.078
RU106+D	8			1.40
RU106+D	20	.030	1.0	1.40
RU106+D	21	.030	1.0	1.40
RU106+D	22	.030	1.0	1.40
RU106+D	23		.97	1.436
PD107	1 5.0	.2	1.0	.0089
PD107	3 30.0	.02	.08	.0089
PD107	4 19.0	.02	.09	.0089
PD107	8			.0089 .0089 .0089
PD107	20			.0089
PD107	21			.0089
PD107	22			.0089
PD107	23			.0089
AG110M+D	1 5.0	.010	1.0	1.697
AG110M+D	3 10.0	.200-3	.020	.614
AG110M+D	4 15.0	.300-3	.030	.803
AG110M+D	6 30.0	.500-3	.050	1.129
AG110M+D	8			.840
AG110M+D	20			.84
AG110M+D	21			1.7
AG110M+D	22			.51
AG110M+D	23			.477
AG111	1 5.0	.010	1.0	.383
AG111	3 10.0	.200-3	.020	.372
AG111	4 15.0	.300-3	.030	.374
AG111	6 30.0	.500-3	.050	1.84
AG111	8			.380
AG111	20			.38
AG111	21			.40
AG111	22			.37
AG111	23			.370
CD113M	1 200.	.0025	1.0	.200
CD113M	3 300.	2.5 -4	0.1	.200
CD113M	4 200.	1.9 -3	0.75	.200
CD113M	8			.184 .184 .184
CD113M	20			.184
CD113M	21			.184
CD113M	22			.200
CD113M	23			.200
SN123	1 .35 +2	.05	1.0	.522
SN123	4 .70 +2	5.00-4	.01	.522
SN123	6 .10 +3	.02	.3	2.611
SN123	8			.522
SN123	15 .35+2	.8-4	.16-2	.522
SN123	16 .70+2	.5-5	.10-3	.522
SN123	20			.522
SN123	21			.522
SN123	22			.522
SN123	23			.522
SN125+D	1 35.0	.050	1.0	.946
SN125+D	4 70.0	.500-3	.010	.911
SN125+D	6100.	.020	.300	4.482
SN125+D	8			.930 .94 1.0
SN125+D	15 35.	.800-4	.160-2	.940
SN125+D	16 70.	.500-5	.100-3	.880
SN125+D	20			.892
SN125+D	21			.892
SN125+D	22			.892
SN125+D	23			.892
SN125+D	1 35.	.05	1.0	1.3
SN125+D	4 70.	.0005	.01	1.1
SN125+D	6100.	.02	.3	4.0

ORGAN DATA LIBRARY (ORGLIB)

SN126+D 8			1.1	1.1	1.1
SN126+D 15	35.	.800-4	.160-2	.38	
SN126+D 16	70.	5.0 -6	.0001	.38	
SN126+D 20				1.1	
SN126+D 21				1.3	
SN126+D 22				.2	
SN126+D 23				.2	
SB124 1	38.0	.030	1.0	1.507	
SB124 4	38.0	.600-4	.002	.871	
SB124 5	100.0	.003	.100	2.356	
SB124 8	100.0	.900-3	.030	.920	
SB124 16	4.0	.900-6	.300-4	.544	
SB124 20				.92	
SB124 21				1.6	
SB124 22				.544	
SB124 23				.644	
SB125+D 1	38.0	.03	1.0	.367	
SB125+D 4	36.0	.600-4	.002	.221	
SB125+D 6	100.	.003	.1	.623	
SB125+D 8	100.	.0009	.03	.229	.23
SB125+D 16	4.0	.900-5	.300-4	.137	.26
SB125+D 20				.21	
SB125+D 21				.34	
SB125+D 22				.16	
SB125+D 23		.93		.159	
TE127M+D 1	15.	.250	1.0	.237	
TE127M+D 3	30.	.020	.070	.237	
TE127M+D 4	30.	.010	.050	.237	
TE127M+D 5	30.	.250-2	.010	.320	
TE127M+D 6	30.	.023	.090	1.185	
TE127M+D 8				.256	.32
TE127M+D10	30.	.750-3	.003	.310	
TE127M+D16	9.	.250-3	.001	.225	
TE127M+D20				.083	
TE127M+D21				.089	
TE127M+D22				.237	
TE127M+D23				.237	
TE129M+D 1	15.	.250	1.0	.665	
TE129M+D 3	30.	.020	.070	.616	
TE129M+D 4	30.	.010	.050	.625	
TE129M+D 5	30.	.250-2	.010	.780	
TE129M+D 6	30.	.023	.090	2.985	
TE129M+D 8				.795	.83
TE129M+D10	30.	.750-3	.003	.690	
TE129M+D16	9.	.250-3	.001	.603	
TE129M+D20				.10	
TE129M+D21				.11	
TE129M+D22				.610	
TE129M+D23				.610	
TE131M+D 1	15.	.250	1.0	2.316	
TE131M+D 3	30.	.020	.070	1.449	
TE131M+D 4	30.	.010	.050	1.621	
TE131M+D 5	30.	.250-2	.010	.800	
TE131M+D 6	30.	.023	.090	5.953	
TE131M+D 8				.763	.99
TE131M+D10	30.	.750-3	.003	1.317	1.0
TE131M+D16	9.	.250-3	.001	1.317	
TE131M+D20				.73	
TE131M+D21				2.32	
TE131M+D22				1.181	
TE131M+D23				1.181	
TE131+D 1	15.	.25	1.0	1.358	
TE131+D 3	30.	.02	.07	1.009	
TE131+D 4	30.	.01	.05	1.091	
TE131+D 5	30.	.0025	.01	1.009	
TE131+D 6	30.	.023	.09	4.666	
TE131+D 8				1.13	
TE131+D 10	30.	.75-3	.003	1.01	
TE131+D 16	9.	.25-3	.001	1.010	
TE131+D 20				6.7 +4	
TE131+D 21				6.7 +4	
TE131+D 22				6.7 +4	
TE131+D 23				6.7 +4	
TE132+D 1	15.	.250	1.0	2.169	
TE132+D 3	30.	.020	.070	1.090	
TE132+D 4	30.	.010	.050	1.282	

ORGAN DATA LIBRARY (ORGLIB)

TE132+D	5	30.	.250-2	.010	1.090		
TE132+D	6	30.	.023	.090	3.544		
TE132+D	8				1.22	1.28	1.28
TE132+D	10	30.	.750-3	.003	.814		
TE132+D	16	9.	.250-3	.001	.814		
TE132+D	20				1.28		
TE132+D	21				2.17		
TE132+D	22				.901		
TE132+D	23				.901		
I 131+D	1	100.	1.0	1.0	.434		
I 131+D	3	7.	.040	.04	.277		
I 131+D	4	7.	.120	.12	.305		
I 131+D	5	7.	.005	.005	0.27		
I 131+D	6	14.	.070	.07	1.102		
I 131+D	8				.305		
I 131+D	10	7.	.005	.005	.236		
I 131+D	16	100.	.300	.300	.236		
I 131+D	20		5.0-2		.30		
I 131+D	21		5.0-2		.44		
I 131+D	22		5.0-2		.257		
I 131+D	23		5.0-2		.257		
I 135+D	1	100.	1.0	1.0	1.483		
I 135+D	8				.990	1.1	1.1
I 135+D	16	100.	.150	.170	.503		
I 135+D	20		5.0-2		.70		
I 135+D	21		5.0-2		.12		
I 135+D	22		5.0-2		.802		
I 135+D	23		5.0-2		.802		
CS136	1	115.	1.0	1.0	1.497		
CS136	3	42.	.010	.010	.583		
CS136	4	90.	.070	.070	.742		
CS136	5	98.	.005	.005	.290		
CS136	6	140.	.040	.040	1.295		
CS136	8	140.	.003	.003	.350		
CS136	14	140.	.400	.400	.650		
CS136	20				.35		
CS136	21				.65		
CS136	22				.469		
CS136	23				.459		
BA140+D	1	65.0	.050	1.0	2.364		
BA140+D	3	8.50	.500-5	.100-3	1.379		
BA140+D	4	975.	.300-4	.600-3	1.548		
BA140+D	5	13.0	.250-5	.500-4	1.20		
BA140+D	6	65.0	.035	.700	5.139		
BA140+D	8				.751	1.4	1.4
BA140+D	14	2000.	.150-3	.003	2.30		
BA140+D	20				.34		
BA140+D	21				.40		
BA140+D	22				.354		
BA140+D	23				.354		
CE143+D	1	563.	.100-3	1.0	.933		
CE143+D	3	563.	.200-5	.020	.795		
CE143+D	4	293.	.250-4	.250	.818		
CE143+D	61	1500.	.300-4	.300	3.791		
CE143+D	8				.562	.79	.85
CE143+D	20				.818		
CE143+D	21				.933		
CE143+D	22				.468		
CE143+D	23				.458		
CE144+D	1	563.	.100-3	1.0	1.313		
CE144+D	3	563.	.200-5	.020	1.295		
CE144+D	4	293.	.250-4	.250	1.298		
CE144+D	61	1500.	.300-4	.300	6.443		
CE144+D	8				1.30	1.30	1.30
CE144+D	20				1.3		
CE144+D	21				1.3		
CE144+D	22				1.3		
CE144+D	23				1.292		
PM148M+D	1	655.	.10-3	1.0	1.481		
PM148M+D	3	655.	.20-5	.02	.629		
PM148M+D	4	656.	.60-5	.06	.784		
PM148M+D	6	1500.	.35-4	.35	2.067		
PM148M+D	8				.784		
PM148M+D20					.784		
PM148M+D21					1.481		
PM148M+D22					.531		

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PM148M+D23				.531
PM149	1 656.	.100-3	1.0	.377
PM149	3 656.	.200-5	.020	.374
PM149	4 656.	.600-5	.060	.374
PM149	61500.	.350-4	.350	1.863
PM149	8			.440
PM149	20			.44
PM149	21			.54
PM149	22			.373
PM149	23			.373
EU152	1 635.	.100-3	1.0	.66
EU152	31480.	.300-5	.030	.33
EU152	4 127.	.250-4	.250	.33
EU152	61500.	.360-4	.360	.45
EU152	8			.330
EU152	20			.71
EU152	21			.88
EU152	22			.20
EU152	23			.20
EU154	1 635.	.100-3	1.0	.965
EU154	31480.	.300-5	.030	0.487
EU154	4 127.	.250-4	.25	.570
EU154	61500.	.360-4	.360	1.595
EU154	8			.570
EU154	20			.57
EU154	21			.965
EU154	22			.428
EU154	23			.428
EU155	1 635.	.100-3	1.0	.160
EU155	31480.	.300-5	.030	.095
EU155	4 127.	.250-4	.250	.095
EU155	61500.	.360-4	.360	.280
EU155	8			.095
EU155	20			.095
EU155	21			.16
EU155	22			.075
EU155	23			.075
EU155	1 635.	.10-3	1.0	1.09
EU156	3 1480.	.30-5	.03	.637
EU156	4 127.	.25-4	.25	.715
EU156	6 1500.	.36-4	.36	2.399
EU156	8			.715
EU156	20			.715
EU156	21			1.09
EU156	22			.581
EU156	23			.581
GD153	1 550.	.100-3	1.0	.170
GD153	4 450.	.120-4	.120	.099
GD153	61000.	.450-4	.450	.230
GD153	8			.099
GD153	20			.099
GD153	21			.17
GD153	22			.072
GD153	23			.072
TB160	1 670.	.100-3	1.0	.850
TB160	3 700.	.300-5	.030	.400
TB160	61000.	.500-4	.600	1.1
TB160	8			.480
TB160	20			.48
TB160	21			.85
TB160	22			.34
TB160	23			.34
HO166M	1 750.	1.0	-4 1.0	.810
HO166M	3 800.	2.0	-5 .02	.320
HO166M	4 875.	6.0	-6 .06	.370
HO166M	61000.	5.4	-5 .54	.400
HO166M	8			.37
HO166M	20			.37
HO166M	21			.81
HO166M	22			.20
HO166M	23			.20
W 181	1 1.0	.100	1.0	3.300-3
W 181	4 4.0	.005	.060	3.200-3
W 181	5 9.0	.007	.070	.016
W 181	8			3.200-3
W 181	20			3.200-3

ORGAN DATA LIBRARY (ORGLIB)

W 181	21			3.300-3	
W 181	22			3.200-3	
W 181	23			3.200-3	
W 185	1	1.0	.100	1.0	.135
W 185	4	4.0	.006	.060	.135
W 185	6	9.0	.007	.070	.682
W 185	8				.140
W 185	20				.14
W 185	21				.14
W 185	22				.135
W 185	23				.136
HG203	1	10.	0.63	1.0	0.25
HG203	3	14.5	0.22	0.35	0.15
HG203	4	13.5	0.09	0.15	0.17
HG203	5	10.	0.01	0.02	0.15
HG203	8				0.17
HG203	20				0.17
HG203	21				0.25
HG203	22				0.14
HG203	23				0.14
PB210+D	11460.		.080	1.0	5.20
PB210+D	3 531.		.010	.140	10.0
PB210+D	4 1950.		.0064	.080	10.
PB210+D	5 3650.		.020	.280	29.
PB210+D	8				.157 14. 43.
PB210+D	20				.027
PB210+D	21				.045
PB210+D	22				.460
PB210+D	23				.460
B1210+D	1 5.0		.010	1.0	10.
B1210+D	3 5.0		.003	.300	19.
B1210+D	4 15.0		.150-2	.150	13.
B1210+D	5 10.0		.100-3	.010	17.
B1210+D	5 13.3		.300-3	.030	40.
B1210+D	8				.795 15. 43.
B1210+D	20				.40
B1210+D	21				.40
B1210+D	22				.40
B1210+D	23				.40
RA224+D	18100.		.300	1.0	2.80 +2
RA224+D	6 154. +2		.150	.500	2.80 +2
RA224+D	8				.249+3 .28 +3 .28+3
RA224+D	20				4.2
RA224+D	21				4.2
RA224+D	22				4.2
RA224+D	23				4.2
RA225+D	18100.		.30	1.0	2.80 +2
RA225+D	3 10.		6.0 -4	.002	2.50 +2
RA225+D	4 10.		.12 -3	.040-2	2.50 +2
RA225+D	6 164. +2		.15	.50	2.80 +2
RA225+D	8				2.50 +2 2.50 +2 2.50+2
RA225+D	20				3.5
RA225+D	21				3.5
RA225+D	22				3.5
RA225+D	23				3.5
RA226+D	18100.		.300	1.0	.110+3
RA226+D	6 164. +2		.030	.100	.110+3
RA226+D	8				.110+3
RA226+D	20				3.70
RA226+D	21				3.70
RA226+D	22				3.70
RA226+D	23				3.7
RA228+D	18100.		.300	1.0	2.3 +2
RA228+D	6 154. +2		.030	.100	1.9 +2
RA228+D	8				.716 .22 +2 .14+3
RA228+D	20				.63
RA228+D	21				.63
RA228+D	22				.63
RA228+D	23				.63
AC227+D	1 240. +2		.100-3	1.0	2.0 +2
AC227+D	3 240. +2		.100-5	.010	6.2 +1
AC227+D	4 240. +1		.500-4	.500	6.2 +1
AC227+D	6 355. +2		.300-4	.300	1.0 +3
AC227+D	8				.489 +1 2.10+2 3.2 +2
AC227+D	20				.640
AC227+D	21				.640

ORGAN DATA LIBRARY (ORGLIB)

AC227+D	22		.640	
AC227+D	23		.640	
TH227+D	1	570. +2	.100-3 1.0	.200+3
TH227+D	3	220. +2	.500-5 .050	.61 +2
TH227+D	4	570. +2	.500-5 .050	.61 +2
TH227+D	6	365. +2	.700-4 .700	.990+3
TH227+D	8			.827+2 .28 +3 .33+3
TH227+D	20		.64	
TH227+D	21		.69	
TH227+D	22		4.30	
TH227+D	23		4.3	
TH228+D	1	570. +2	.100-3 1.0	.230+3
TH228+D	3	220. +2	.500-5 .050	.56 +2
TH228+D	4	570. +2	.500-5 .050	.56 +2
TH228+D	6	365. +2	.700-4 .700	.970+3
TH228+D	8			.110+3 .31 +3 .33+3
TH228+D	20		4.4	
TH228+D	21		4.4	
TH228+D	22		4.4	
TH228+D	23		4.4	
TH230+D	1	570. +2	.100-3 1.0	.480+2
TH230+D	3	220. +2	.500-5 .050	.480+2
TH230+D	4	570. +2	.500-5 .050	.480+2
TH230+D	6	365. +2	.700-4 .700	.242+3
TH230+D	8			.480+2 .480+2 .48+2
TH230+D	20		.47	
TH230+D	21		.47	
TH230+D	22		.47	
TH230+D	23		.47	
TH232+D	1	570. +2	.100-3 1.0	.62 +2
TH232+D	3	220. +2	.500-5 .050	.41 +2
TH232+D	4	570. +2	.500-5 .050	.41 +2
TH232+D	6	365. +2	.700-4 .700	.270+3
TH232+D	8			.410+2 .410+2 .55+2
TH232+D	20		.40	
TH232+D	21		.41	
TH232+D	22		.40	
TH232+D	23	1.0	.40	
PA231+D	1	410. +2	.100-3 1.0	1.40 +2
PA231+D	3	510. +2	.400-5 .040	79.0
PA231+D	4	580. +2	.500-5 .050	9.3 +1
PA231+D	6	365. +2	.450-4 .450	7.50 +2
PA231+D	8			.510+2 .52 +2 .70+2
PA231+D	20		.60	
PA231+D	21		.70	
PA231+D	22		.56	
PA231+D	23		.56	
U 232+D	1	100.	.010 1.0	2.80 +2
U 232+D	3	15.0	.110-2 .110	1.10 +2
U 232+D	6	300.	.110-2 .110	1.200 +3
U 232+D	8			.552+2 .760+2 .19+3
U 232+D	20		.54	
U 232+D	21		.54	
U 232+D	22		.53	
U 232+D	23	5:U 233+D	1 100. .010 1.0	50.
U 233+D	3	15.	.110-2 .110	50.
U 233+D	6	300.	.110-2 .110	2.50 +2
U 233+D	8			.500+2
U 233+D	20			.49
U 233+D	21			.49
U 233+D	22			.49
U 233+D	23			.49
U 234	1	100.	.010 1.0	49.
U 234	3	15.	.110-2 .110	49.
U 234	6	300.	.110-2 .110	2.40 +2
U 234	8			.490+2
U 234	20		1.000	.48
U 234	21		1.000	.49
U 234	22		1.000	.48
U 234	23		1.000	.48
U 235+D	1	100.	.010 1.0	46.
U 235+D	3	15.	.110-2 .110	46.
U 235+D	6	300.	.110-2 .110	2.30 +2
U 235+D	8			.46 +2 .45 +2 .46+2
U 235+D	20		1.0	.56
U 235+D	21		1.0	.77

ORGAN DATA LIBRARY (ORGLIB)

U 235+D 22		1.0	.61
U 235+D 23		1.0	.61
U 235 1 100.	.010	1.0	47.
U 235 3 15.	.110-2	.110	47.7
U 235 6 300.	.110-2	.110	2.30 +2
U 236 8			47.
U 235 20			.45
U 235 21			.45
U 236 22			.45
U 235 23			.45
U 238+D 1 100.	.01	1.0	43.0
U 238+D 3 15.	1.1 -3	0.11	43.0
U 238+D 5 300.	1.1 -3	0.11	220.0
U 238+D 8			43.0
U 238+D 20		1.0	0.43
U 238+D 21		1.0	0.43
U 238+D 22		1.0	0.43
U 238+D 23		1.0	0.43
NP237+D 1 390. +2	.100-3	1.0	49.
NP237+D 3 540. +2	.300-5	.030	49.
NP237+D 4 1.46+4	4.50-5	.450	49.
NP237+D 6 355. +2	.450-4	.450	2.50 +2
NP237+D 8			.490+2 .490+2 .49+2
NP237+D 20			.50
NP237+D 21			.52
NP237+D 22			.62
NP237+D 23			.62
PU235 1 550. +2	.30 -4	1.0	61.
PU236 3 320. +2	.60 -6	.02	60.
PU236 4 146. +2	1.35-5	.45	60.
PU236 5 355. +2	1.35-5	.45	3.12 +2
PU236 8			.60 .60 .61
PU236 20	.3-4	1.0	.0
PU236 21	.3-4	1.0	.0
PU236 22	.3-4	1.0	.0
PU236 23	.3-4	1.0	.0
PU237 1 650. +2	.300-4	1.0	.038
PU237 3 320. +2	.600-6	.020	.024
PU237 4 146. +2	1.35-5	.450	.027
PU237 6 355. +2	1.35-5	.450	.058
PU237 8			.027
PU237 20			.027
PU237 21			.038
PU237 22			.022
PU237 23			.022
PU241+D 1 650. +2	.300-4	1.0	2.262
PU241+D 3 320. +2	.600-5	.020	2.372
PU241+D 4 146. +2	1.35-5	.450	.999
PU241+D 6 355. +2	1.35-5	.450	14.
PU241+D 8			.133-1 .030 .18
PU241+D 20	.3-4	1.0	.0
PU241+D 21	.3-4	1.0	.0
PU241+D 22	.3-4	1.0	.0
PU241+D 23	.3-4	1.0	.0
CM246 1 240. +2	.100-3	1.0	56.0
CM246 3 240. +2	.200-5	.020	56.0
CM246 4 150. +2	.450-4	.450	56.0
CM246 6 355. +2	.450-4	.300	2.78 +2
CM246 8			56.0
CM246 20			.54
CM246 21			.54
CM246 22			.54
CM246 23			.4
CM247+D 1 240. +2	.100-3	1.0	55.0
CM247+D 3 240. +2	2.0 -6	.020	55.0
CM247+D 4 150. +2	.45 -4	.450	55.0
CM247+D 6 365. +2	.45 -4	.450	2.70 +2
CM247+D 8			55.0 55.0 55.0
CM247+D 20			.71
CM247+D 21			.71
CM247+D 22			.71
CM247+D 23			.71
CM248 1 240. +2	.100-3	1.0	4.53 +2
CM248 3 240. +2	2.0 -6	.020	4.53 +2
CM248 4 146. +2	4.5 -5	.45	4.53 +2
CM248 6 355. +2	.45 -4	.45	22.44 +2

ORGAN DATA LIBRARY (ORGLIB)

CM248	8			4.53 +2
CM248	20			11.45
CM248	21			11.45
CM248	22			11.45
CM248	23			11.45
CF252	1	650. +2	.300-4 1.0	.210+3
CF252	6	365. +2	.135-4 .45	.110+4
CF252	8			.210+3
ZN69M	1	933.	.100 1.0	.610
ZN69M	3	149.	.004 .040	.435
ZN69M	4	91.	.035 .350	.466
ZN69M	6	1300.	.015 .150	1.852
ZN69M	8			.487 .50 .50
ZN69M	10	270.	.900-4 .900-3	.430
ZN69M	11	107.	.400-4 .400-3	.430
ZN69M	14	1950.	.030 .300	.640
ZN69M	15	14.	.006 .060	.430
ZN69M	17	25.	.003 .030	.450
ZN69M	20			.13
ZN69M	21			.27
ZN69M	22			.412
ZN69M	23			.412
ZN69	1	933.	.100 1.0	.328
ZN69	3	149.	.004 .040	.328
ZN69	4	91.	.035 .350	.328
ZN69	6	1300.	.015 .150	1.638
ZN69	8			.370
ZN69	10	270.	.900-4 .900-3	.370
ZN69	11	107.	.400-4 .400-3	.370
ZN69	14	1950.	.030 .300	.370
ZN69	15	14.	.006 .060	.370
ZN69	17	25.	.003 .030	.370
ZN69	20			.328
ZN69	21			.328
ZN69	22			.328
ZN69	23			.328
RB87	1	45.	1.0 1.0	.090
RB87	4	63.	.050 .050	.090
RB87	5	45.	.004 .004	.090
RB87	8			.090
RB87	14	80.	.450 .450	.090
RB87	17	60.	.003 .003	.090
RB87	20			.090
RB87	21			.090
RB87	22			.090
RB87	23			.090
SR89	1	.130+5	.300 1.0	.555
SR89	6	.180+5	.210 .700	2.75
SR89	8			.550
SR89	20	.3	1.0 0.0	0.555
SR89	21	.3	1.0 0.0	.555
SR89	22	.3	1.0 0.0	.555
SR89	23	.3	1.0 0.0	.555
SR90	1	4000.	.3 1.0	1.137
SR90	6	4000.	.0225 .300	5.650
SR90	8			1.305
SR90	20			.777
SR90	21			.777
SR90	22			.777
SR90	23		.7	.777
Y 90	1	.140+5	.100-3 1.0	.917
Y 90	6	.180+5	.750-4 .750	4.955
Y 90	8			.890
Y 90	20			.89
Y 90	21			.89
Y 90	22			.917
Y 90	23		1.0	.917
SR91	1	.130+5	.300 1.0	1.834
SR91	6	.180+5	.210 .700	6.47
SR91	8			1.15 1.4 1.7
SR91	20			.68
SR91	21			.98
SR91	22			.777
SR91	23			0.777
Y 91M	1	.140+5	.100-3 1.0	.967
Y 91M	6	.180+5	.750-4 .750	3.325

ORGAN DATA LIBRARY (ORGLIB)

Y 91M	8			.160	.42	.68
Y 91M	20			.59		
Y 91M	21			.59		
Y 91M	22			.107		
Y 91M	23			.107		
Y 91	1	.140+5	.100-3	1.0	.612	
Y 91	6	.180+5	.750-4	.750	3.049	
Y 91	8			.59		
Y 91	20			.59		
Y 91	21			.59		
Y 91	22			.61		
Y 91	23			.61		
SR92	1	.130+5	.300	1.0	2.601	
SR92	6	.180+5	.210	.700	8.602	
SR92	8			1.75	1.9	1.9
SR92	20			.45		
SR92	21			.96		
SR92	22			1.867		
SR92	23			1.867		
Y 92	1	.140+5	.100-3	1.0	1.589	
Y 92	6	.180+5	.750-4	.750	7.257	
Y 92	8			1.50		
Y 92	20			1.5		
Y 92	21			1.6		
Y 92	22			1.475		
Y 92	23			1.475		
Y 93	1	.140+5	.100-3	1.0	1.648	
Y 93	6	.180+5	.750-4	.750	7.957	
Y 93	8			1.50	1.50	1.50
Y 93	20			1.5		
Y 93	21			1.7		
Y 93	22			1.602		
Y 93	23			1.602		
ZR93	1	450.	.100-3	1.0	.023	
ZR93	3	900.	.200-5	.020	.020	
ZR93	4	320.	.700-5	.070	.024	
ZR93	5	900.	.600-6	.005	.025	
ZR93	6	1000.	.360-4	.360	.110	
ZR93	8			.019	.020	.024
ZR93	20			.019		
ZR93	21			.019		
ZR93	22			.019		
ZR93	23			.019		
NB93M	1	760.	.100-3	1.0	.030	
NB93M	3	760.	.200-5	.020	.030	
NB93M	4	845.	.900-5	.090	.030	
NB93M	5	95.	.800-6	.008	.038	
NB93M	6	1000.	.380-4	.380	.078	
NB93M	8			.038		
NB93M	20			.038		
NB93M	21			.038		
NB93M	22			.030		
NB93M	23			.030		
ZR95	1	450.	.100-3	1.0	1.09	
ZR95	3	900.	.200-5	.020	.510	
ZR95	4	320.	.700-5	.070	.589	
ZR95	5	900.	.600-6	.005	.460	
ZR95	6	1000.	.360-4	.360	1.30	
ZR95	8			.327	.47	.56
ZR95	20			.32		
ZR95	21			.57		
ZR95	22			.238		
ZR95	23			.238		
NB95	1	760.	.100-3	1.0	.525	
NB95	3	760.	.200-5	.020	.207	
NB95	4	840.	.900-5	.090	.252	
NB95	5	95.	.800-6	.008	.200	
NB95	6	1000.	.380-4	.380	.457	
NB95	8			.260		
NB95	20			.26		
NB95	21			.51		
NB95	22			.166		
NB95	23			.166		
ZR97	1	450.	.100-3	1.0	2.11	
ZR97	3	900.	.200-5	.020	1.485	
ZR97	4	320.	.700-5	.070	1.594	

ORGAN DATA LIBRARY (ORGLIB)

ZR97	5	900.	.600-5	.005	1.50		
ZR97	61000.		.360-4	.360	6.30		
ZR97	8				1.55	1.6	1.6
ZR97	20				.94		
ZR97	21				1.2		
ZR97	22				1.406		
ZR97	23				1.406		
NB97	1	760.	.100-3	1.0	.897		
NB97	3	760.	.200-5	.020	.611		
NB97	4	840.	.900-5	.090	.661		
NB97	5	95.	.800-6	.008	.600		
NB97	6	1000.	.380-4	.380	2.546		
NB97	8				.640		
NB97	20				.65		
NB97	21				.87		
NB97	22				.576		
NB97	23				.576		
M099	1	5.0	.800	1.0	.547		
M099	3	3.0	.050	.080	.46		
M099	4	45.	.080	.1	.478		
M099	8				.470	.47	.47
M099	20				.44		
M099	21				.48		
M099	22				.447		
M099	23				.447		
TC99M	1	1.0	.500	1.0	.084		
TC99M	3	20.0	.005	.01	.035		
TC99M	4	30.0	.15 -2	.003	.043		
TC99M	6	25.0	.001	.002	.094		
TC99M	20				.029		
TC99M	21				.029		
TC99M	22				.029		
TC99M	23		.50		.029		
TC99	1	1.0	.500	1.0	.005		
TC99	3	20.	.005	.010	.095		
TC99	4	30.	.150 -2	.003	.095		
TC99	6	25.	.001	.002	.475		
TC99	8	5.0	.450 -3	.90 -3	.094		
TC99	12	10.	.005	.010	.470		
TC99	20				.095		
TC99	21				.095		
TC99	22				.095		
TC99	23		.50		.095		
RU103	1	7.30	.030	1.0	.408		
RU103	3	2.50	.006	.200	.203		
RU103	5	16.0	.240 -2	.080	.639		
RU103	8				.263	.26	.26
RU103	20				.21		
RU103	21				.38		
RU103	22				.176		
RU103	23				.176		
RH103M	1	10.4	.200	1.0	.055		
RH103M	3	28.0	.005	.030	.054		
RH103M	4	18.2	.008	.040	.055		
RH103M	5	20.8	.002	.010	.054		
RH103M	6	16.6	.010	.050	.190		
RH103M	8				.055		
RH103M	20				.055		
RH103M	21				.055		
RH103M	22				.053		
RH103M	23				.053		
PD103	1	5.0	.2	1.0	.064		
PD103	3	30.0	.020	.080	.061		
PD103	4	19.0	.020	.090	.063		
PD103	5	15.0	.002	.010	.061		
PD103	8				.062	.064	.064
PD103	20				.022		
PD103	21				.023		
PD103	22				.019		
PD103	23				.019		
RU105	1	7.30	.030	1.0	1.063		
RU105	3	2.50	.006	.200	.780		
RU105	5	16.	.240 -2	.080	3.325		
RU105	8				.795	.90	.91
RU105	20				.72		
RU105	21				.98		

ORGAN DATA LIBRARY (ORGLIB)

RU105	22			.574		
RU105	23			.574		
RH105	1	10.4	.200	1.0	.213	
RH105	3	28.0	.005	.030	.181	
RH105	4	18.2	.008	.040	.186	
RH105	5	20.8	.002	.010	.190	
RH105	6	16.6	.010	.050	.847	
RH105	8			.019		
RH105	20			.190		
RH105	21			.20		
RH105	22			.177		
RH105	23			.177		
RU106	1	7.30	.030	1.0	1.534	
RU106	3	2.50	.006	.200	1.447	
RU106	5	15.0	.240-2	.080	7.078	
RU106	8			1.40		
RU106	20	.030	1.0	0.0	1.40	
RU106	21	.030	1.0	0.0	1.40	
RU106	22	.030	1.0	0.0	1.436	
RU106	23		.97		1.436	
PD109	1	5.0	.200	1.0	.375	
PD109	3	30.0	.020	.080	.373	
PD109	4	19.0	.020	.090	.374	
PD109	5	15.0	.002	.010	.420	
PD109	8			.42		
PD109	20			.42		
PD109	21			.42		
PD109	22			.373		
PD109	23			.373		
AG110M	1	5.0	.010	1.0	1.697	
AG110M	3	10.0	.200-3	.020	.614	
AG110M	4	15.0	.300-3	.030	.803	
AG110M	6	30.0	.500-3	.050	1.129	
AG110M	8			.840		
AG110M	20			.84		
AG110M	21			1.7		
AG110M	22			.477		
AG110M	23			.477		
IN114M	1	48.0	.002	1.0	.970	
IN114M	3	60.0	.800-4	.040	.930	
IN114M	4	58.0	.280-3	.140	.940	
IN114M	5	48.0	.400-4	.020	.930	
IN114M	6	57.0	.340-3	.170	4.50	
IN114M	8			.940		
IN114M	12	67.0	.350-3	.180	.900	
IN114M	16	8.40	.800-6	.400-3	.920	
IN114M	20			.94		
IN114M	21			.97		
IN114M	22			.93		
IN114M	23			.93		
CD115M	1	200.	.250-2	1.0	.610	
CD115M	3	300.	.250-3	.10	.610	
CD115M	4	200.	.190-2	.750	.610	
CD115M	8			.610	.610	
CD115M	20			.20		
CD115M	21			.26		
CD115M	22			.61		
CD115M	23			.51		
CD115	1	200.	.250-2	1.0	.710	
CD115	3	300.	.250-3	.1	.560	
CD115	4	200.	.190-2	.750	.580	
CD115	8			.650-18	.38-16	.39-15
CD115	20			.38		
CD115	21			.45		
CD115	22			.36		
CD115	23			.35		
IN115M	01	48.0	.002	1.0	.260	
IN115M	3	50.0	.800-4	.040	.190	
IN115M	4	58.0	.280-3	.140	.200	
IN115M	05	48.0	.400-4	.020	.190	
IN115M	6	57.0	.340-3	.170	.740	
IN115M	8			.77-18	.39-16	.39-15
IN115M	12	67.0	.350-3	.180	.140	
IN115M	16	8.40	.800-5	.400-3	.160	
IN115M	20			.20		
IN115M	21			.26		

ORGAN DATA LIBRARY (ORGLIB)

IN115M	22			.18	
IN115M	23			.18	
IN115	1	48.0	.002	1.0	.170
IN115	3	60.0	.800-4	.040	.170
IN115	4	58.0	.280-3	.140	.170
IN115	5	48.0	.400-4	.020	.170
IN115	6	57.0	.340-3	.170	.850
IN115	8			.170	
IN115	12	67.0	.360-3	.180	.170
IN115	16	8.40	.800-5	.400-3	.170
IN115	20			.17	
IN115	21			.17	
IN115	22			.17	
IN115	23			.17	
SN125	1	35.0	.050	1.0	.946
SN125	4	70.0	.500-3	.010	.911
SN125	6100.		.02	.300	4.482
SN125	8			.930	.94 1.0
SN125	15	35.0	.800-4	.150-2	.940
SN125	16	70.0	.500-5	.100-3	.880
SN125	20			.892	
SN125	21			.892	
SN125	22			.892	
SN125	23			.892	
SB125	1	380.	.03	1.0	.367
SB125	4	380.	.600-4	.002	.221
SB125	61000.		.003	.1	.623
SB125	8			.211	.23 .26
SB125	16	4.0	.900-5	.300-4	.137
SB125	20			.21	
SB125	21			.34	
SB125	22			.16	
SB125	23		.93		.159
TE125M	1	15.0	.250	1.0	.114
TE125M	3	30.0	.020	.070	.112
TE125M	4	30.0	.010	.050	.113
TE125M	5	30.0	.250-2	.010	.140
TE125M	6	30.	.023	.090	.558
TE125M	8				.140
TE125M	10	30.	.750-3	.003	.110
TE125M	16	9.	.250-3	.001	.112
TE125M	20			.14	
TE125M	21			.15	
TE125M	22			.112	
TE125M	23			.112	
SN126	1	35.	.05	1.0	1.3
SN126	4	70.	.0005	.0100	1.1
SN126	6100.		.02	.3	4.
SN126	8			1.1	1.1 1.1
SN126	15	35.	.800-4	.16-2	.38
SN126	16	70.	5.0 -6	.0001	.38
SN126	20			1.1	
SN126	21			1.3	
SN126	22			0.2	
SN126	23			0.2	
SB126	1	38.	.03	1.0	1.4
SB126	4	38.	5.0 -5	.002	.96
SB126	6100.		.003	.1	3.3
SB126	8			.95	.95 .95
SB126	16	4.0	9. -7	3.0 -5	.70
SB126	20			.95	
SB126	21			1.4	
SB126	22			.78	
SB126	23			.78	
SB127	1	38.	.03	1.0	.905
SB127	4	38.	6.0 -5	.002	.627
SB127	6100.		.003	.1	2.226
SB127	8			.627	
SB127	16	4.	9. -7	3.0 -5	.479
SB127	20			.627	
SB127	21			1.4	
SB127	22			.524	
SB127	23			.524	
TE127M	1	15.0	.250	1.0	.237
TE127M	3	30.0	.020	.070	.237
TE127M	4	30.0	.010	.050	.237

ORGAN DATA LIBRARY (ORGLIB)

TE127M	5	30.0	.250-2	.010	.320
TE127M	6	30.0	.023	.090	1.185
TE127M	8				.256 .32 .32
TE127M	10	30.0	.750-3	.003	.310
TE127M	16	9.	.250-3	.001	.225
TE127M	20				.083
TE127M	21				.089
TE127M	22				.237
TE127M	23				.237
TE127	1	15.	.250	1.0	.236
TE127	3	30.	.020	.070	.235
TE127	4	30.	.010	.050	.235
TE127	5	30.	.250-2	.010	.240
TE127	6	30.	.023	.090	1.175
TE127	8				.240
TE127	10	30.	.750-3	.003	.240
TE127	16	9.0	.250-3	.001	.235
TE127	20				.24
TE127	21				.24
TE127	22				.24
TE127	23				.235
TE129M	1	15.	.250	1.0	.665
TE129M	3	30.0	.020	.070	.615
TE129M	4	30.	.010	.050	.625
TE129M	5	30.	.250-2	.010	.780
TE129M	6	30.	.023	.090	2.985
TE129M	8				.795 .83 .83
TE129M	10	30.	.750-3	.003	.590
TE129M	16	9.0	.250-3	.001	.503
TE129M	20				.10
TE129M	21				.11
TE129M	22				.610
TE129M	23				.610
TE129	1	15.0	.250	1.0	.598
TE129	3	30.	.020	.070	.552
TE129	4	30.	.010	.050	.561
TE129	5	30.	.250-2	.010	.680
TE129	6	30.	.023	.090	2.665
TE129	8				.730 .73 .73
TE129	10	30.	.750-3	.003	.600
TE129	16	9.0	.250-3	.001	.539
TE129	20				.73
TE129	21				.98
TE129	22				.546
TE129	23				.546
I 129	1	100.	1.0	1.0	8.72 -2
I 129	3	7.0	.040	.040	8.76 -2
I 129	4	7.0	.120	.120	7.59 -2
I 129	5	7.0	.005	.005	.077
I 129	6	14.0	.070	.070	.316
I 129	8				.082
I 129	10	7.0	.005	.005	.068
I 129	16	100.	.300	.300	6.52 -2
I 129	20				.082
I 129	21				.089
I 129	22				.0694
I 129	23		.05		.0694
TE131M	1	15.	.250	1.0	1.50
TE131M	3	30.	.020	.070	.810
TE131M	4	30.	.010	.050	.970
TE131M	5	30.	.250-2	.010	.800
TE131M	6	30.	.023	.090	2.60
TE131M	8				.763 .99 1.0
TE131M	10	30.	.750-3	.003	.69
TE131M	16	9.	.250-3	.001	.690
TE131M	20				.73
TE131M	21				1.2
TE131M	22				.55
TE131M	23				.55
TE131	1	15.	.25	1.0	1.358
TE131	3	30.	.02	.07	1.009
TE131	4	30.	.01	.05	1.091
TE131	6	30.	.023	.09	4.665
TE131	8				1.13
TE131	10	30.	.75-3	.003	1.01
TE131	16	9.	.25-3	.001	1.010

ORGAN DATA LIBRARY (ORGLIB)

TE131	20			1.13
TE131	21			1.36
TE131	22			.805
TE131	23			.805
I 131	1 100.	1.0	1.0	.434
I 131	3 7.	.04	.04	.277
I 131	4 7.	.12	.12	.305
I 131	5 7.	.005	.005	0.27
I 131	6 14.	.07	.07	1.102
I 131	8			.300
I 131	10 7.	.005	.005	.23
I 131	16 100.	.300	.300	.236
I 131	20	5.0-2		.30
I 131	21	5.0-2		.44
I 131	22	5.0-2		.257
I 131	23	5.0-2		.257
TE132	1 15.	.250	1.0	2.169
TE132	3 30.	.020	.070	1.09
TE132	4 30.	.010	.050	1.282
TE132	5 30.	.250-2	.010	.960
TE132	6 30.	.023	.090	3.544
TE132	8			1.04 1.1 1.1
TE132	10 30.	.750-3	.003	.730
TE132	16 9.0	.250-3	.001	.814
TE132	20			.13
TE132	21			.21
TE132	22			.901
TE132	23			.901
I 132	1 100.	1.0	1.0	1.921
I 132	3 7.0	.040	.040	.934
I 132	4 7.0	.120	.120	1.107
I 132	5 7.0	.005	.005	.850
I 132	6 14.0	.070	.070	2.899
I 132	8			.100
I 132	10 7.0	.005	.005	.640
I 132	16 100.	.080	.090	.677
I 132	20	5.0-2		1.0
I 132	21	5.0-2		1.7
I 132	22	5.0-2		.810
I 132	23	5.0-2		.810
I 133	1 100.	1.0	1.0	.830
I 133	8			.666 .78 .80
I 133	16 100.	.225	.240	.498
I 133	20	5.0-2		.54
I 133	21	5.0-2		.84
I 133	22	5.0-2		.534
I 133	23	5.0-2		.534
I 134	1 100.	1.0	1.0	2.66
I 134	8			1.10
I 134	16 100.	.040	.040	.923
I 134	20	5.0-2		1.1
I 134	21	5.0-2		1.5
I 134	22	5.0-2		1.107
I 134	23	5.0-2		1.107
CS134M	1 115.	1.0	1.0	.180
CS134M	3 42.	.010	.010	.082
CS134M	4 90.	.070	.070	.122
CS134M	5 98.	.005	.005	.130
CS134M	6 140.	.040	.040	.417
CS134M	8			.927-1 .12 .30
CS134M	14 140.	.400	.400	.260
CS134M	20			.092
CS134M	21			.011
CS134M	22			.0548
CS134M	23			.0548
CS134	1 115.0	1.0	1.0	1.152
CS134	3 42.0	.010	.010	.489
CS134	4 90.0	.070	.070	.606
CS134	5 98.0	.005	.005	.460
CS134	6 140.	.040	.040	1.247
CS134	8 140.	.003	.003	.570
CS134	14 140.	.400	.400	1.1
CS134	20			.57
CS134	21			1.1
CS134	22			.405
CS134	23			.405

ORGAN DATA LIBRARY (ORGLIB)

I 135	1 100.	1.0	1.0	1.483		
I 135	8			.99	1.1	1.1
I 135	16 100.	.150	.170	.503		
I 135	20	5.0-2		.70		
I 135	21	5.0-2		.12		
I 135	22	5.0-2		.802		
I 135	23	5.0-2		.802		
CS135	1 115.	1.0	1.0	6.58 -2		
CS135	3 42.	.010	.010	6.58 -2		
CS135	4 90.	.070	.070	6.58 -2		
CS135	5 98.	.005	.005	.066		
CS135	6 140.	.040	.040	.329		
CS135	8 140.	.003	.003	.066		
CS135	14 140.	.400	.400	.066		
CS135	20			.066		
CS135	21			.066		
CS135	22			.066		
CS135	23			.066		
CS137	1 115.	1.0	1.0	.594		
CS137	3 42.	.010	.010	.359		
CS137	4 90.	.070	.070	.400		
CS137	5 98.	.005	.005	.370		
CS137	6 140.	.040	.040	1.365		
CS137	8 140.	.003	.003	.410		
CS137	14 140.	.400	.400	.590		
CS137	20			.41		
CS137	21			.59		
CS137	22			.329		
CS137	23	.05		.329		
CS139	1 115.	1.0	1.0	2.289		
CS138	3 42.	.01	.01	1.454		
CS138	4 90.	.07	.07	1.596		
CS138	5 98.	.005	.005	1.45		
CS138	6 140.	.04	.04	5.842		
CS138	8			1.6		
CS138	14 140.	.40	.40	2.29		
CS138	20			1.6		
CS138	21			2.29		
CS138	22			1.352		
CS138	23			1.352		
CS139	1 115.	1.	1.	2.711		
CS139	3 42.	.01	.01	2.557		
CS139	4 90.	.07	.07	2.584		
CS139	5 98.	.005	.005	2.56		
CS139	6 140.	.04	.04	12.5		
CS139	8			2.58		
CS139	14 140.	.4	.4	2.71		
CS139	20			2.58		
CS139	21			2.71		
CS139	22			2.535		
CS139	23			2.535		
BA140	1 65.0	.050	1.0	2.364		
BA140	3 8.50	.500-5	.100-3	1.379		
BA140	4 975.	.300-4	.500-3	1.548		
BA140	5 13.0	.250-5	.500-4	1.20		
BA140	6 65.0	.035	.700	5.139		
BA140	8			.751	1.4	1.4
BA140	142000.	.150-3	.003	2.30		
BA140	20			.34		
BA140	21			.40		
BA140	22			.354		
BA140	23			.354		
LA140	1 500.	.0001	1.0	1.889		
LA140	4 400.	.150-4	.150	1.160		
LA140	6 1000.	.400-4	.400	3.536		
LA140	8			1.10		
LA140	20			1.1		
LA140	21			1.9		
LA140	22			.903		
LA140	23			.903		
BA141	1 65.	.05	1.0	2.365		
BA141	3 8.5	.500-5	.10-3	2.115		
BA141	4 975.	.300-4	.50-3	2.147		
BA141	5 13.	.250-5	.50-4	2.116		
BA141	6 65.	.035	.7	10.04		
SA141	8			2.147		

ORGAN DATA LIBRARY (ORGLIB)

BA141	142000.	.150-3	.003	2.365
BA141	20			2.147
BA141	21			2.365
BA141	22			1.129
BA141	23			1.129
LA141	1 500.	.0001	1.0	.951
LA141	4 400.	.150-4	.15	.942
LA141	61000.	.400-4	.40	4.680
LA141	8			.942
LA141	20			.942
LA141	21			.951
LA141	22			.938
LA141	23			.938
CE141	1 563.	.100-3	1.000	.221
CE141	3 563.	.200-5	.020	.194
CE141	4 293.	.250-4	.250	.199
CE141	61500.	.300-4	.300	.928
CE141	8			.180
CE141	20			.18
CE141	21			.221
CE141	22			.191
CE141	23			.191
BA142	1 65.	.05	1.0	3.409
BA142	3 8.5	.500-5	.100-3	2.022
BA142	4 975.	.300-4	.600-3	2.257
BA142	5 13.	.250-5	.500-4	2.022
BA142	6 55.	.035	.7	7.755
BA142	8			2.257
BA142	14 2000.	.150-3	.003	3.409
BA142	20			2.257
BA142	21			3.409
BA142	22			1.855
BA142	23			1.855
LA142	1 500.	.0001	1.0	2.133
LA142	4 400.	.15-4	.15	1.39
LA142	6 1000.	.40-4	.40	4.718
LA142	8			1.39
LA142	20			1.39
LA142	21			2.133
LA142	22			1.135
LA142	23			1.135
CE143	1 563.	.100-3	1.0	.933
CE143	3 563.	.200-5	.020	.795
CE143	4 293.	.250-4	.250	.818
CE143	61500.	.300-4	.300	3.791
CE143	8			.562 .79 .85
CE143	20			.818
CE143	21			.933
CE143	22			.458
CE143	23			.458
PR143	1 75.0	.100-3	1.0	.324
PR143	3 750.	.200-5	.020	.324
PR143	4 375.	.200-4	.200	.324
PR143	61500.	.400-4	.400	1.618
PR143	8			.320
PR143	20			.32
PR143	21			.32
PR143	22			.32
PR143	23			.324
CE144	1 563.	.100-3	1.0	1.313
CE144	3 563.	.200-5	.020	1.295
CE144	4 293.	.250-4	.250	1.298
CE144	61500.	.300-4	.300	6.443
CE144	8			1.30 1.30 1.30
CE144	20			1.3
CE144	21			1.3
CE144	22			1.3
CE144	23			1.292
PR144	1 75.	.10-3	1.	1.205
PR144	3 750.	.20-5	.02	1.193
PR144	4 375.	.20-4	.20	1.195
PR144	61500.	.40-4	.40	5.944
PR144	8			1.195
PR144	20			1.195
PR144	21			1.205
PR144	22			1.191

ORGAN DATA LIBRARY (ORGLIB)

PR144	23				1.191
ND144	1	656.	.100-3	1.0	20.0
ND144	3	656.	.500-5	.050	20.0
ND144	4	131.	.500-4	.500	20.0
ND144	61500.		.350-4	.350	100.
ND144	8				20.
ND144	20				.19
ND144	21				.19
ND144	22				.19
ND144	23				.19
ND147	1	656.	.100-3	1.0	.381
ND147	3	656.	.500-5	.050	.319
ND147	4	131.	.500-4	.500	.330
ND147	61500.		.350-4	.350	1.550
ND147	8				.290
ND147	20				.29
ND147	21				.37
ND147	22				.282
ND147	23				.282
PM147	1	656.	.100-3	1.0	6.980-2
PM147	3	656.	.200-5	.020	6.980-2
PM147	4	656.	.500-5	.060	6.980-2
PM147	61500.		.350-4	.350	.349
PM147	8				.059
PM147	20				6.980-2
PM147	21				6.980-2
PM147	22				6.980-2
PM147	23				6.980-2
PM148M	1	656.	.10-3	1.0	1.481
PM148M	3	656.	.20-5	.02	.629
PM148M	4	656.	.60-5	.06	.784
PM148M	61500.		.35-4	.35	2.057
PM148M	8				.784
PM148M	20				.784
PM148M	21				1.481
PM148M	22				.531
PM148M	23				.531
PM148	1	656.	.10-3	1.0	1.065
PM148	3	656.	.20-5	.02	.857
PM148	4	656.	.60-5	.06	.857
PM148	61500.		.35-4	.35	3.627
PM148	8				.857
PM148	20				.857
PM148	21				1.065
PM148	22				.783
PM148	23				.783
PM151	1	656.	.1-3	1.	.474
PM151	3	656.	.2-5	.02	.359
PM151	4	656.	.6-5	.06	.379
PM151	61500.		.35-4	.35	1.594
PM151	8				.379
PM151	20				.379
PM151	21				.474
PM151	22				.345
PM151	23				.345
SM151	1	656.	.100-3	1.0	.042
SM151	3	656.	.200-5	.020	.042
SM151	4	187.	.350-4	.350	.042
SM151	61500.		.350-4	.350	.130
SM151	8				.042
SM151	20				.042
SM151	21				.042
SM151	22				.041
SM151	23				.041
W 187	1	1.0	.100	1.0	.572
W 187	4	4.0	.005	.060	.414
W 187	6	9.0	.007	.070	1.558
W 187	8				.440
W 187	20				.44
W 187	21				.68
W 187	22				.356
W 187	23				.356
RE187	1	7.0	.500	1.0	.012
RE187	4	14.0	.005	.010	.012
RE187	6	3.50	.005	.010	.052
RE187	8				.012

ORGAN DATA LIBRARY (ORGLIB)

RE187	12	25.0	.130	.250	.012
RE187	16	3.0	.350-2	.007	.012
RE187	20				.012
RE187	21				.012
RE187	22				.012
RE187	23				.012
TH230	1	570. +2	.100-3	1.0	.480+2
TH230	3	220. +2	.500-5	.050	.480+2
TH230	4	570. +2	.500-5	.050	.480+2
TH230	5	365. +2	.700-4	.700	.242+3
TH230	8				.480+2 .480+2 .48+2
TH230	20				.47
TH230	21				.47
TH230	22				.47
TH230	23				.47
RA226	18100.	.300	1.0		.110+3
RA226	6 164. +2	.030	.100		.110+3
RA226	8				.110+3
RA226	20				3.70
RA226	21				3.70
RA226	22				3.70
RA226	23				3.7
PB210	11450.	.080	1.0		5.20
PB210	3 531.	.010	.140		10.0
PB210	4 1950.	.0054	.080		10.
PB210	6 3550.	.020	.280		29.
PB210	8				.157 14. 43.
PB210	20				.027
PB210	21				.045
PB210	22				.460
PB210	23				.460
BI210	1 5.0	.010	1.0		10.0
BI210	3 6.0	.003	.300		19.
BI210	4 15.0	.150-2	.150		13.
BI210	5 10.0	.100-3	.010		17.
BI210	6 13.3	.300-3	.030		40.
BI210	8				.795 15. 43.
BI210	20				.40
BI210	21				.40
BI210	22				.40
BI210	23				.40
PO210	1 30.	.060	1.0		55.0
PO210	3 70.	.004	.070		55.0
PO210	4 41.	.010	.170		55.0
PO210	5 60.	.002	.040		55.0
PO210	6 24.	.006	.100		275.
PO210	8				55.0
PO210	20				.53
PO210	21				.53
PO210	22				.53
PO210	23				.53
U 232	1 100.	.010	1.0		2.80 +2
U 232	3 15.0	.110-2	.110		1.10 +2
U 232	5 300.	.110-2	.110		1.20 +3
U 232	8				.552+2 .760+2 .19+3
U 232	20				.54
U 232	21				.54
U 232	22				.53
U 232	23				.53
TH232	1 570. +2	.100-3	1.0		.62 +2
TH232	3 220. +2	.500-5	.050		.41 +2
TH232	4 570. +2	.500-5	.050		.41 +2
TH232	6 365. +2	.700-4	.700		.270+3
TH232	8				.410+2 .410+2 .55+2
TH232	20				.40
TH232	21				.41
TH232	22				.40
TH232	23	1.0			.40
RA228	18100.	.300	1.0		2.3 +2
RA228	6 164. +2	.030	.100		1.9 +2
RA228	8				.716 .22 +2 .14+3
RA228	20				.63
RA228	21				.63
RA228	22				.63
RA228	23				.63
AC228	1 240. +2	.100-3	1.0		.230+3

ORGAN DATA LIBRARY (ORGLIB)

AC228	3	240.	+2	.100-5	.010	.550+2
AC228	4	240.	+1	.500-4	.500	.560+2
AC228	6	365.	+2	.300-4	.300	.970+3
AC228	8				.897	2.2 +1 1.4 +2
AC228	20				.74	
AC228	21				1.1	
AC228	22				.62	
AC228	23				.62	
TH228	1	570.	+2	.100-3	1.0	.230+3
TH228	3	220.	+2	.500-5	.050	.56 +2
TH228	4	570.	+2	.500-5	.050	.56 +2
TH228	6	365.	+2	.700-4	.700	.970+3
TH228	8				.110+3	.31 +3 .33+3
TH228	20				4.4	
TH228	21				4.4	
TH228	22				4.4	
TH228	23				4.4	
RA224	18100.			.300	1.0	2.80 +2
RA224	6	164.	+2	.150	.500	2.80 +2
RA224	8				.249+3	.28 +3 .28+3
RA224	20				4.2	
RA224	21				4.2	
RA224	22				4.2	
RA224	23				4.2	
PB212	11460.			.080	1.0	82.0
PB212	3	531.		.010	.140	81.0
PB212	4	1950.		.640-2	.080	83.0
PB212	6	3650.		.020	.280	410.0
PB212	8				79.9	83.0 83.0
PB212	20				.24	
PB212	21				.29	
PB212	22				.22	
PB212	23				.22	
B1212	1	5.0		.010	1.0	83.0
B1212	3	6.0		.003	.300	82.0
B1212	4	15.0		.150-2	.150	83.0
B1212	5	10.0		.100-3	.010	82.0
B1212	6	13.3		.300-3	.030	.411+3
B1212	8				83.0	
B1212	20				1.8	
B1212	21				2.2	
B1212	22				1.7	
B1212	23				1.7	
U 235	1	100.		.010	1.0	45.
U 235	3	15.		.110-2	.110	45.
U 235	6	300.		.110-2	.110	2.30 +2
U 235	8				.451+2	.46 +2 .45+2
U 235	20				.56	
U 235	21				.77	
U 235	22				.61	
U 235	23				.61	
TH231	1	570.	+2	.100-3	1.0	.180
TH231	3	220.	+2	.500-5	.050	.140
TH231	4	570.	+2	.500-5	.050	.160
TH231	6	365.	+2	.700-4	.700	.560
TH231	8				.110	.110 .110
TH231	20				.11	
TH231	21				.14	
TH231	22				.093	
TH231	23				.093	
PA231	1	410.	+2	.100-3	1.0	1.40 +2
PA231	3	510.	+2	.400-5	.040	79.0
PA231	4	580.	+2	.500-5	.050	6.3 +1
PA231	6	365.	+2	.450-4	.450	7.50 +2
PA231	8				.510+2	.52 +2 .70+2
PA231	20				.60	
PA231	21				.70	
PA231	22				.55	
PA231	23				.56	
AC227	1	240.	+2	.100-3	1.0	2.0 +2
AC227	3	240.	+2	.100-5	.010	6.2 +1
AC227	4	240.	+1	.500-4	.500	6.2 +1
AC227	6	365.	+2	.300-4	.300	1.0 +3
AC227	8				4.89	2.10 +2 3.2 +2
AC227	20				.640	
AC227	21				.640	

ORGAN DATA LIBRARY (ORGLIB)

AC227	22		.640	
AC227	23		.640	
TH227	1	570. +2	.100-3 1.0	.200+3
TH227	3	220. +2	.500-5 .050	.61 +2
TH227	4	570. +2	.500-5 .050	.61 +2
TH227	6	355. +2	.700-4 .700	.990+3
TH227	8		.827+2 .28 +3 .33+3	
TH227	20		.64	
TH227	21		.69	
TH227	22		4.30	
TH227	23		4.3	
RA223	1	18100.	.300 1.0	2.75 +2
RA223	3	10.	6.0 -4 .002	2.75 +2
RA223	4	10.	1.2 -4 4.0 -4	2.75 +2
RA223	5	164. +2	.150 .500	2.75 +2
RA223	8		28.0 +1	
RA223	20		3.7	
RA223	21		3.8	
RA223	22		3.7	
RA223	23		3.7	
NP237	1	390. +2	.100-3 1.0	49.
NP237	3	640. +2	.300-5 .030	49.
NP237	4	145. +3	4.50-5 .450	49.
NP237	6	355. +2	.450-4 .450	2.50 +2
NP237	8		.490+2 .490+2 .49+2	
NP237	20		.50	
NP237	21		.52	
NP237	22		.62	
NP237	23		.62	
PA233	1	410. +2	.100-3 1.0	.32
PA233	3	510. +2	.400-5 .040	.15
PA233	4	580. +2	.500-5 .050	.18
PA233	5	355. +2	.450-4 .450	.41
PA233	8		.18	
PA233	20		.18	
PA233	21		.32	
PA233	22		.13	
PA233	23		.13	
U 233	1	100.	.010 1.0	50.
U 233	3	15.0	.110-2 .110	50.
U 233	6	300.	.110-2 .110	2.50 +2
U 233	8		.500+2	
U 233	20		.49	
U 233	21		.49	
U 233	22		.49	
U 233	23		.49	
TH229	1	570. +2	.100-3 1.0	.330+3
TH229	3	220. +2	.500-5 .050	.49 +2
TH229	4	570. +2	.500-5 .050	.49 +2
TH229	6	730. +2	.700-4 .700	.940+3
TH229	8		.270+3 .270+3 .27+3	
TH229	20		4.0	
TH229	21		4.0	
TH229	22		4.0	
TH229	23		4.0	
RA225	18100.	.30	1.0	2.80 +2
RA225	3	10.	6.0 -4 .002	2.50 +2
RA225	4	10.	.12 -3 .040-2	2.50 +2
RA225	6	164. +2	.15 .50	2.80 +2
RA225	8		2.50 +2 2.50 +2 2.50+2	
RA225	20		3.5	
RA225	21		3.5	
RA225	22		3.5	
RA225	23		3.5	
AC225	1	240. +2	.001-1 1.0	2.80 +2
AC225	3	240. +2	1.0 -6 .01	2.80 +2
AC225	4	240. +1	5.0 -5 .50	2.80 +2
AC225	5	730. +2	3.0 -5 .30	1.39 +3
AC225	8		2.70 +2 2.70 +2 2.70+2	
AC225	20		3.3	
AC225	21		3.3	
AC225	22		3.3	
AC225	23		3.3	
U 238	1	100.	.01 1.0	43.0
U 238	3	15.	1.1 -3 0.11	43.0
U 238	6	300.	1.1 -3 0.11	220.0

ORGAN DATA LIBRARY (ORGLIB)

U 238	8		43.0
U 238	20	1.0	0.43
U 238	21	1.0	0.43
U 238	22	1.0	0.43
U 238	23	1.0	0.43
TH234	1 570.	+2 .100-3 1.0	.91
TH234	3 570.	+2 .500-5 .050	.90
TH234	4 570.	+2 .500-5 .050	.90
TH234	6 365.	+2 7.00-5 .700	4.5
TH234	8		.900
TH234	20	1.0	.90
TH234	21	1.0	.91
TH234	22	1.0	.90
TH234	23	1.0	.90
AM242M	1 200.	+2 .100-3 1.0	61.
AM242M	3 270.	+2 .300-5 .030	60.5
AM242M	4 146.	+2 4.50-5 .450	57.
AM242M	6 365.	+2 4.50-5 .450	3.02 +2
AM242M	8		.340 .13 +2 .40+2
AM242M	20		.019
AM242M	21		.037
AM242M	22		.73
AM242M	23		.730
AM242	1 200.	+2 .100-3 1.0	67.0
AM242	3 270.	+2 .300-5 .030	66.0
AM242	4 146.	+2 4.50-5 .450	63.0
AM242	6 365.	+2 4.50-5 .450	3.40 +2
AM242	8		.540 .13 +2 .40+2
AM242	20		.22
AM242	21		.22
AM242	22		.20
AM242	23		.20
CM242	1 240.	+2 .100-3 1.0	80.0
CM242	3 240.	+2 .200-5 .020	78.0
CM242	4 150.	+2 4.50-4 .450	78.0
CM242	6 365.	+2 .450-4 .450	4.0 +2
CM242	8		63.0 63.0 64.0
CM242	20		.62
CM242	21		.62
CM242	22		.62
CM242	23		.62
PU242	1 650.	+2 .300-4 1.0	51.
PU242	3 320.	+2 .600-5 .020	51.
PU242	4 146.	+2 1.35-5 .450	51.
PU242	6 365.	+2 1.35-5 .450	2.50 +2
PU242	8		51.0
PU242	20	.3-4 1.0 .0	.510
PU242	21	.3-4 1.0 .0	.510
PU242	22	.3-4 1.0 .0	.510
PU242	23	.3-4 1.0 .0	.510
PU238	1 650.	+2 .300-4 1.0	57.
PU238	3 320.	+2 .600-5 .020	57.
PU238	4 146.	+2 1.35-5 .450	57.
PU238	6 365.	+2 1.35-5 .450	2.80 +2
PU238	8		57.0
PU238	20	.3-4 1.0 0.0	.55
PU238	21	.3-4 1.0 0.0	.55
PU238	22	.3-4 1.0 0.0	.57
PU238	23	.3-4 1.0 0.0	.57
CM244	1 240.	+2 .100-3 1.0	58.
CM244	3 240.	+2 .200-5 .020	58.
CM244	4 150.	+2 4.50-4 .400	58.
CM244	6 365.	+2 .450-4 .450	2.90 +2
CM244	8		60.0 60. 60.
CM244	10 1.0+8		0.5 -3 5.0 +1
CM244	11 1.0+8		0.1 -3 5.0 +1
CM244	20		.59
CM244	21		.59
CM244	22		.59
CM244	23		.59
PU244	1 650.	+2 .300-4 1.0	58.4
PU244	3 320.	+2 .60 -5 .020	58.4
PU244	4 14.6+3	1.35-5 .45	58.4
PU244	5 365.	+2 1.35-5 .45	2.92 +2
PU244	8		58.4 58.4 58.4
PU244	20		.76

ORGAN DATA LIBRARY (ORGLIB)

PU244	21		.76	
PU244	22		.75	
PU244	23		.76	
PU240	1	650. +2 .300-4 1.0	53.0	
PU240	3	320. +2 .600-6 .020	53.0	
PU240	4	146. +2 1.35-5 .450	53.0	
PU240	6	365. +2 1.35-5 .450	2.70 +2	
PU240	8		53.0	
PU240	20	.3-4 1.0	.0	.53
PU240	21	.3-4 1.0	.0	.53
PU240	22	.3-4 1.0	.0	.53
PU240	23	.3-4 1.0	.0	.53
CM247	1	240. +2 .100-3 1.0	55.	
CM247	3	240. +2 2.0 -6 .020	55.	
CM247	4	150. +2 .45 -4 .450	55.	
CM247	6	365. +2 .45 -4 .450	2.70 +2	
CM247	8		55.0	55.0
CM247	20		.71	
CM247	21		.71	
CM247	22		.71	
CM247	23		.71	
CM243	1	240. +2 .100-3 1.0	60.0	
CM243	3	240. +2 .200-5 .020	60.0	
CM243	4	150. +2 .450-4 .450	60.0	
CM243	6	365. +2 .450-4 .450	2.99 +2	
CM243	8		60.	60.
CM243	20		.64	
CM243	21		.71	
CM243	22		.61	
CM243	23		.51	
PU243	1	650. +2 .300-4 1.0	.37	
PU243	3	320. +2 .600-6 .020	.37	
PU243	4	1.5+4 1.35-5 .45	.25	
PU243	5	365. +2 1.35-5 .45	2.	
PU243	8		.19	
PU243	20		.18	
PU243	21		.19	
PU243	22		.18	
PU243	23		.18	
AM243	1	200. +2 .100-3 1.0	54.0	
AM243	3	270. +2 .300-5 .030	54.0	
AM243	4	146. +2 .450-4 .450	54.0	
AM243	6	365. +2 .450-4 .450	2.70 +2	
AM243	8		54.0	54.0
AM243	20		.54	
AM243	21		.56	
AM243	22		.68	
AM243	23		.58	
NP239	1	390. +2 .100-3 1.0	.260	
NP239	3	640. +2 .300-5 .030	.210	
NP239	4	1.45 +5 4.50-5 .450	.230	
NP239	6	365. +2 .450-4 .450	1.070	
NP239	8		.160	.15
NP239	20		.16	
NP239	21		.22	
NP239	22		.22	
NP239	23		.22	
PU239	1	650. +2 .300-4 1.0	53.0	
PU239	3	320. +2 .600-6 .020	53.0	
PU239	4	146. +2 1.35-5 .450	53.0	
PU239	6	365. +2 1.35-5 .450	2.70 +2	
PU239	8		53.0	
PU239	20	.3-4 1.0	0.0	.520
PU239	21	.3-4 1.0	0.0	.520
PU239	22	.3-4 1.0	0.0	.520
PU239	23	.3-4 1.0	0.0	.520
CM245	1	240. +2 .100-3 1.0	56.0	
CM245	3	240. +2 .200-5 .020	56.0	
CM245	4	150. +2 .450-4 .450	56.0	
CM245	6	365. +2 .450-4 .450	2.80 +2	
CM245	8		55.0	55.0
CM245	20		.57	
CM245	21		.61	
CM245	22		.55	
CM245	23		.55	
PU241	1	550. +2 .300-4 1.0	2.252	

ORGAN DATA LIBRARY (ORGLIB)

PU241	3	320.	+2	.600-6	.020	2.372		
PU241	4	146.	+2	1.35-5	.450	.999		
PU241	6	365.	+2	1.35-5	.450	14.		
PU241	8				.133-1	.030	.18	
PU241	20		.3-4	1.0	.0	.011		
PU241	21		.3-4	1.0	.0	.012		
PU241	22		.3-4	1.0	.0	.011		
PU241	23		.3-4	1.0	.0	.011		
AM241	1	200.	+2	.100-3	1.0	57.		
AM241	3	270.	+2	.300-5	.030	57.		
AM241	4	146.	+2	.450-4	.450	57.		
AM241	6	365.	+2	.450-4	.450	2.80 +2		
AM241	8				57.0			
AM241	20			1.0		.56		
AM241	21			1.0		.59		
AM241	22			1.0		.58		
AM241	23			1.0		.58		

FOOD TRANSFER COEFFICIENTS (FTRANSLIB)

*** FOOD TRANSFER COEFFICIENT LIBRARY 2/27/78 BA NAPIER ***							
ELT	DEP.	VEL.	PLANT	EGG	MILK	BEEF	PORK
		M/SEC	--	DAY/KG	DAY/L	DAY/KG	POULTRY
H	0.0	0.0		0.0	0.0	0.0	0.0
BE	1.0-03	4.7-04	2.0-02	2.0-06	8.0-04	1.0-02	4.0-01
C	0.0	0.0		0.0	0.0	0.0	0.0
N	1.0-03	7.5+00	9.9-04	1.1-02	9.9-04	9.9-04	9.9-04
F	1.0-02	2.0-02	9.9-04	7.0-03	2.0-02	9.0-02	9.9-04
NA	1.0-03	5.0-02	2.0-01	4.0-02	5.0-02	1.0-01	1.0-02
P	1.0-03	5.0+01	1.0+01	1.2-02	5.0-02	5.4-01	1.9-01
AR	0.0	0.0		0.0	0.0	0.0	0.0
CA	1.0-03	4.0-02	1.0+00	8.0-03	3.3-03	3.3-03	3.3-03
SC	1.0-03	1.1-03	9.9-04	2.5-05	5.0-03	1.0-02	4.0-03
CR	1.0-03	2.5-04	9.9-04	1.1-03	9.9-04	9.9-04	9.9-04
MN	1.0-03	3.0-02	1.0-01	1.0-04	5.0-03	2.0-02	1.1-01
FE	1.0-03	4.0-04	1.0-01	6.0-04	2.0-02	5.0-03	1.0-03
CO	1.0-03	9.4-03	1.0-01	5.0-04	1.0-03	5.0-03	1.0-03
NI	1.0-03	1.9-02	1.0-01	3.4-03	1.0-03	5.0-03	1.0-03
CU	1.0-03	1.3-01	2.0-01	7.0-03	1.0-02	1.5-02	2.0-03
ZN	1.0-03	4.0-01	4.0-03	5.0-03	5.0-02	1.4-01	2.0-03
AS	1.0-03	1.0-02	9.9-04	3.0-03	1.47-3	2.38-2	8.33-1
SE	1.0-03	1.3+00	2.1+00	2.3-02	1.0+00	4.5-01	3.7-01
BR	1.0-02	7.6-01	1.6+00	2.5-02	2.0-02	9.0-02	4.0-03
KR	0.0	0.0		0.0	0.0	0.0	0.0
RB	1.0-03	1.3-01	3.0+00	1.0-02	1.5-01	2.0-01	2.0+00
SR	1.0-03	2.0-01	4.0-01	1.5-03	3.0-04	7.3-03	9.0-04
Y	1.0-03	2.5-03	5.0-04	5.0-05	5.0-03	5.0-03	5.0-04
ZR	1.0-03	1.7-04	1.2-03	2.5-05	5.0-04	1.0-03	1.0-04
NP	1.0-03	9.4-03	1.2-03	1.2-03	5.0-04	1.0-03	1.0-04
MO	1.0-03	1.3-01	4.0-01	4.0-03	1.0-02	2.0-02	2.0-03
TC	1.0-03	2.5-01	9.9-04	1.2-02	9.9-04	9.9-04	9.9-04
RU	1.0-03	1.0-02	4.0-03	5.0-07	1.0-03	5.0-03	3.0-04
RH	1.0-03	1.3+01	4.0-03	5.0-03	1.0-03	5.0-03	3.0-04
PD	1.0-03	5.0+00	4.0-03	5.0-03	1.0-03	5.0-03	3.0-04
AG	1.0-03	1.5-01	9.9-04	2.5-02	9.9-04	9.9-04	9.9-04
CD	1.0-03	3.0-01	9.9-04	5.2-05	1.6-02	1.6-02	1.6-02
SN	1.0-03	2.5-03	9.9-04	1.3-03	9.9-04	9.9-04	9.9-04
SB	1.0-03	1.1-02	7.0-02	7.5-04	3.0-03	7.0-03	6.0-03
TE	1.0-03	1.3+00	4.0-01	5.0-04	5.0-02	1.0-02	1.0-02
I	1.0-02	2.0-02	1.6+00	1.0-02	2.0-02	9.0-02	4.0-03
XE	0.0	0.0		0.0	0.0	0.0	0.0
CS	1.0-03	2.0-03	5.0-01	5.0-03	3.0-02	2.6-01	4.5+00
BA	1.0-03	5.0-03	4.0-01	4.0-04	5.0-04	1.0-02	5.0-04
LA	1.0-03	2.5-03	2.0-03	2.5-05	5.0-03	5.0-03	4.0-03
CE	1.0-03	5.0-04	3.0-03	1.0-05	1.0-03	5.0-03	6.0-04
PR	1.0-03	2.5-03	4.0-03	2.5-05	5.0-03	5.0-03	1.0-03
ND	1.0-03	2.4-03	2.0-04	2.5-06	5.0-03	5.0-03	4.0-03
PM	1.0-03	2.5-03	7.0-03	2.5-05	5.0-03	5.0-03	1.0-04
SM	1.0-03	2.5-03	7.0-03	2.5-05	5.0-03	5.0-03	4.0-03
EU	1.0-03	2.5-03	7.0-03	2.5-05	5.0-03	5.0-03	4.0-03
TB	1.0-03	2.5-03	7.0-03	2.5-05	5.0-03	5.0-03	4.0-03
HO	1.0-03	2.5-03	7.0-03	2.5-05	5.0-03	5.0-03	4.0-03
W	1.0-03	1.8-02	9.9-04	2.5-04	9.9-04	9.9-04	9.9-04
HG	1.0-03	3.8-01	9.9-04	1.9-02	1.0-01	3.1+00	1.1-02
P3	1.0-03	6.8-02	9.9-04	1.0-05	9.9-04	9.9-04	9.9-04
SI	1.0-03	1.5-01	9.9-04	2.5-04	9.9-04	9.9-04	9.9-04
PO	1.0-03	9.0-03	9.9-04	1.2-04	9.9-04	9.9-04	9.9-04
RN	0.0	0.0		0.0	0.0	0.0	0.0
RA	1.0-03	1.4-03	2.0-05	2.0-04	9.9-04	9.9-04	9.9-04
AC	1.0-03	2.5-03	2.0-03	2.5-05	5.0-03	1.0-02	4.0-03
TH	1.0-03	4.2-03	2.0-03	2.5-05	5.0-03	1.0-02	4.0-03
PA	1.0-03	2.5-03	2.0-03	2.5-05	5.0-03	1.0-02	4.0-03
U	1.0-03	2.5-03	3.4-01	6.0-04	5.0-03	5.0-04	1.2-03
NP	1.0-03	2.5-03	2.0-03	2.5-06	5.0-03	1.0-02	4.0-03
PU	1.0-03	2.5-04	2.0-03	2.5-08	5.0-03	1.0-02	4.0-03
AM	1.0-03	2.5-04	2.0-03	2.5-05	5.0-03	1.0-02	4.0-03
CM	1.0-03	2.5-03	2.0-03	2.5-06	5.0-03	1.0-02	4.0-03
CF	1.0-03	2.5-03	2.0-03	7.5-07	5.0-03	1.0-02	4.0-03

AQUATIC BIOACCUMULATION FACTOR LIBRARY (BIOAC)

	BIOACCUMULATION FACTOR LIBRARY FOR FOOD, PABL M, MAXI BA NAPIER								
	FISH	CRUS.	MOLL.	ALGAE	FISH	CRUS.	MOLL.	ALGAE	FACTORS
H	1.0	1.0	1.0	1.0	.9	.9	.9	.9	1.0
SE	1000.0	10000.0	10000.0	10000.0	2.0	10.0	10.0	20.0	.2
C	1.0	1.0	1.0	1.0	4600.0	9100.0	9100.0	4600.0	1.0
N	.0	.0	.0	.0	.0	.0	.0	.0	1.0
F	4.0	4.0	4.0	1.0	10.0	100.0	100.0	2.0	.8
NA	1.0	1.0	1.0	1.0	100.0	200.0	200.0	500.0	.9
P	10000.0	10000.0	10000.0	100000.0	100000.0	20000.0	20000.0	500000.0	.4
AR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.0
CA	10.0	10.0	10.0	1.0	40.0	330.0	330.0	130.0	.2
SC	100.0	300.0	300.0	1000.0	2.0	1000.0	1000.0	10000.0	.3
CR	100.0	1000.0	1000.0	1000.0	20.0	2000.0	2000.0	4000.0	.9
MN	3000.0	10000.0	50000.0	100000.0	400.0	90000.0	90000.0	100000.0	.5
FE	1000.0	4000.0	20000.0	50000.0	100.0	3200.0	3200.0	1000.0	.2
CO	100.0	1000.0	300.0	100.0	50.0	200.0	200.0	200.0	.2
NI	500.0	1000.0	1000.0	1000.0	100.0	100.0	100.0	50.0	.2
CU	1000.0	5000.0	5000.0	1000.0	50.0	400.0	400.0	2000.0	.5
ZN	5000.0	5000.0	50000.0	1000.0	2000.0	10000.0	10000.0	20000.0	.4
AS	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	.7
SE	10.0	10.0	10.0	100.0	170.0	170.0	170.0	1000.0	.8
BR	3.0	10.0	10.0	100.0	420.0	330.0	330.0	50.0	.8
KP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.0
RB	30.0	50.0	10.0	10.0	2000.0	1000.0	1000.0	1000.0	.9
SR	1.0	1.0	1.0	20.0	20.0	100.0	100.0	500.0	.2
Y	30.0	100.0	100.0	300.0	25.0	1000.0	1000.0	5000.0	.2
ZR	30.0	100.0	100.0	1000.0	3.3	5.7	5.7	1000.0	.7
NB	100.0	200.0	200.0	100.0	30000.0	100.0	100.0	800.0	.7
MO	10.0	100.0	100.0	100.0	10.0	10.0	10.0	1000.0	.9
TC	10.0	100.0	100.0	1000.0	15.0	5.0	5.0	40.0	.7
RU	3.0	100.0	100.0	1000.0	10.0	300.0	300.0	2000.0	.5
RH	10.0	100.0	100.0	100.0	10.0	300.0	300.0	200.0	.5
PD	10.0	100.0	100.0	100.0	10.0	300.0	300.0	200.0	.5
AG	1000.0	5000.0	5000.0	1000.0	2.3	770.0	770.0	200.0	.7
CD	100.0	3000.0	10000.0	10000.0	200.0	2000.0	2000.0	1000.0	.6
SN	3.0	3.0	3.0	10.0	3000.0	1000.0	1000.0	100.0	.7
SB	1000.0	1000.0	1000.0	10000.0	1.0	18.0	10.0	1500.0	.8
TE	10.0	10.0	100.0	1000.0	400.0	75.0	75.0	100.0	.8
I	20.0	100.0	100.0	10000.0	15.0	5.0	5.0	40.0	.8
XE	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.0
CS	30.0	50.0	10.0	10.0	2000.0	100.0	100.0	500.0	.9
BA	3.0	3.0	3.0	100.0	4.0	200.0	200.0	500.0	.4
LA	30.0	100.0	100.0	300.0	25.0	1000.0	1000.0	5000.0	.2
CE	30.0	100.0	100.0	300.0	1.0	1000.0	1000.0	4000.0	.2
PR	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
ND	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
PM	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
SM	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
EU	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
TB	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
HO	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
W	10.0	10.0	10.0	100.0	1200.0	10.0	10.0	1200.0	.9
HG	1200.0	310.0	10000.0	34000.0	20000.0	20000.0	20000.0	34000.0	.5
PB	300.0	1000.0	1000.0	5000.0	100.0	100.0	100.0	200.0	.9
SI	15.0	1000.0	1000.0	10000.0	15.0	10.0	10.0	1500.0	.9
PO	300.0	5000.0	5000.0	2000.0	500.0	20000.0	20000.0	2000.0	.8
RN	1.0	1.0	1.0	1.0	57.0	1.0	1.0	1.0	.0
RA	50.0	100.0	100.0	100.0	50.0	250.0	250.0	2500.0	.7
AC	25.0	1000.0	1000.0	5000.0	25.0	1000.0	1000.0	5000.0	.7
TH	10000.0	2000.0	2000.0	3000.0	30.0	500.0	500.0	1500.0	.7
PA	10.0	10.0	10.0	6.0	11.0	110.0	110.0	1100.0	.7
U	10.0	10.0	10.0	67.0	2.0	60.0	60.0	.5	.7
NP	10.0	10.0	10.0	5.0	10.0	400.0	400.0	300.0	.7
PU	3.0	200.0	200.0	1000.0	3.5	100.0	100.0	350.0	.7
AM	25.0	1000.0	1000.0	5000.0	25.0	1000.0	1000.0	5000.0	.7
CM	25.0	1000.0	1000.0	5000.0	25.0	1000.0	1000.0	5000.0	.7
CF	25.0	1000.0	1000.0	5000.0	25.0	1000.0	1000.0	5000.0	.7

EXTERNAL RADIATION DOSE LIBRARY (GRDFLIB)

****	GRDFLIB FOR FOOD, 15 MARCH 1978, BA NAPIER ****						
H 3	.0E+00	.0E+00	.0E+00	.0E+00	.0E+00	.0E+00	.0E+00
BE10	.0E+00	.0E+00	2.9E-07	.0E+00	2.0E+00	3.0E+00	
C 14	.0E+00	.0E+00	3.8E-09	.0E+00	1.4E-11	3.5E-09	
N 13	8.8E-09	7.6E-09	2.6E-05	1.9E-06	8.5E-07	1.4E-06	
F 18	8.0E-09	6.8E-09	2.3E-05	1.8E-06	8.2E-07	1.1E-06	
NA22	1.8E-08	1.5E-08	4.8E-05	4.0E-06	1.8E-06	2.3E-06	
NA24	2.9E-08	2.5E-08	9.3E-06	7.8E-06	3.5E-06	4.5E-06	
P 32	.0E+00	.0E+00	6.8E-07	6.4E-09	3.0E-09	6.2E-07	
P 33	.0E+00	.0E+00	2.2E-08	9.9E-11	4.3E-11	2.0E-08	
AR39	.0E+00	.0E+00	1.3E-07	6.2E-10	3.3E-10	1.2E-07	
AR41	.0E+00	.0E+00	3.2E-06	2.4E-06	1.1E-06	1.6E-06	
CA41	4.0E-09	3.4E-09	8.5E-07	7.3E-07	2.0E+00	3.0E+00	
SC46	1.5E-08	1.3E-08	4.3E-06	3.7E-06	1.7E-06	2.0E-06	
CR51	2.6E-10	2.2E-10	6.4E-08	5.2E-08	2.4E-08	2.9E-08	
MN54	6.8E-09	5.8E-09	1.8E-06	1.5E-06	7.0E-07	8.1E-07	
MN56	1.3E-08	1.1E-08	4.5E-06	3.2E-06	1.5E-06	2.4E-06	
FE55	.0E+00	.0E+00	3.6E-10	6.4E-11	3.5E-11	1.6E-09	
FE59	9.4E-09	8.0E-09	2.6E-06	2.2E-05	1.0E-06	1.2E-06	
CO57	1.0E-09	9.1E-10	2.7E-07	2.2E-07	1.0E-07	1.2E-07	
CO58	8.2E-09	7.0E-09	2.3E-06	1.8E-06	8.2E-07	1.1E-06	
CO60	2.0E-08	1.7E-08	5.4E-06	4.6E-06	2.0E-06	2.5E-06	
NI59	.0E+00	.0E+00	3.4E-09	2.3E-09	2.0E+00	3.0E+00	
NI63	.0E+00	.0E+00	.0E+00	.0E+00	.0E+00	.0E+00	
NI65	4.3E-09	3.7E-09	1.9E-06	1.0E-05	4.8E-07	1.1E-05	
CU64	1.7E-09	1.5E-09	5.2E-07	3.7E-07	1.7E-07	2.8E-07	
ZN65	4.6E-09	4.0E-09	1.2E-05	1.1E-06	4.9E-07	5.6E-07	
SE79	.0E+00	.0E+00	3.2E-09	3.4E-11	2.8E-06	3.3E-05	
BR82	2.2E-08	1.9E-08	5.3E-06	5.3E-05	2.4E-05	2.9E-05	
BR83+D	9.3E-11	6.4E-11	3.1E-07	1.7E-08	7.5E-09	2.7E-07	
BR84	1.4E-08	1.2E-08	5.3E-06	3.5E-05	1.5E-06	3.0E-06	
RB86	7.2E-10	6.3E-10	8.5E-07	1.7E-07	8.0E-08	6.8E-07	
RB89+D	1.8E-08	1.5E-08	5.8E-06	4.5E-06	2.1E-06	2.8E-06	
SR89+D	6.5E-13	5.6E-13	5.4E-07	4.6E-09	2.1E-09	4.9E-07	
SR90+D	.0E+00	.0E+00	1.5E-07	5.4E-10	2.4E-10	1.3E-07	
SR91+D	8.3E-09	7.1E-09	2.9E-06	1.9E-06	8.9E-07	1.5E-06	
SR92+D	1.0E-08	9.0E-09	3.1E-06	2.5E-06	1.1E-06	1.3E-06	
Y 91M+D	4.4E-09	3.8E-09	1.2E-06	1.0E-06	4.6E-07	5.6E-07	
ZR93+D	.0E+00	.0E+00	.0E+00	.0E+00	1.3E-05	1.6E-05	
ZR95+D	5.8E-09	5.0E-09	1.8E-06	1.5E-06	5.8E-07	8.4E-07	
ZR97+D	5.4E-09	5.5E-09	2.4E-06	1.5E-06	5.9E-07	1.4E-06	
MO93	9.3E-10	2.3E-11	2.9E-08	1.2E-09	2.0E+00	3.0E+00	
MO99+D	2.2E-09	1.9E-09	9.1E-07	4.7E-07	2.2E-07	5.8E-07	
TC101	3.0E-09	2.7E-09	1.2E-06	6.8E-07	3.5E-07	7.5E-07	
RU103+D	4.2E-09	3.6E-09	1.1E-06	8.9E-07	4.1E-07	4.9E-07	
RU105+D	5.1E-09	4.5E-09	1.8E-06	1.2E-06	5.4E-07	1.0E-06	
RU106+D	1.8E-09	1.5E-09	1.9E-06	3.8E-07	1.7E-07	1.5E-06	
PD107	.0E+00	.0E+00	.0E+00	.0E+00	5.9E-07	6.9E-06	
AG110M+D	2.1E-08	1.8E-08	5.3E-06	4.9E-06	2.2E-06	2.4E-06	
AG111	2.1E-10	1.8E-10	3.8E-07	4.8E-08	2.2E-08	3.2E-07	
CD113M1	2.6E-12	2.3E-12	1.4E-07	5.9E-10	1.2E-05	1.4E-04	
SN123	6.5E-08	.0E+00	5.0E-07	.0E+00	2.0E+00	3.0E+00	
SN125+D	6.6E-10	5.7E-10	1.1E-06	1.6E-07	7.3E-08	9.1E-07	
SN126+D	1.0E-08	9.0E-09	6.0E-08	1.8E-08	1.3E-05	8.5E-04	
SB124	1.5E-09	1.3E-08	4.5E-06	3.6E-06	1.6E-05	2.2E-05	
SB125+D	3.5E-09	3.1E-09	9.5E-07	7.8E-07	3.6E-07	4.5E-07	
TE127M+D	1.3E-12	1.1E-12	1.8E-09	2.5E-10	1.2E-10	1.6E-09	
TE129M+D	9.0E-10	7.7E-10	7.4E-07	2.1E-07	9.4E-08	5.7E-07	
TE131M+D	9.9E-09	8.4E-09	2.7E-06	2.2E-06	1.0E-05	1.3E-05	
TE131+D	2.5E-06	2.2E-09	1.5E-06	7.4E-07	3.4E-07	1.1E-06	
TE132+D	2.0E-09	1.7E-09	4.8E-07	4.0E-07	1.8E-07	2.3E-07	
TE133M+D	1.7E-08	1.5E-08	5.0E-06	3.9E-06	1.8E-06	2.4E-06	
I 130	1.7E-08	1.4E-08	4.8E-06	3.9E-06	1.9E-06	2.3E-06	
I 131+D	3.4E-09	2.8E-09	9.3E-07	7.8E-07	3.1E-07	4.9E-07	
I 135+D	1.4E-08	1.2E-08	4.0E-06	3.3E-06	1.5E-06	2.0E-06	
CS136	1.7E-08	1.5E-08	4.8E-06	4.1E-06	1.9E-06	2.2E-06	
CS137+D	4.9E-09	4.2E-09	1.4E-06	1.0E-06	4.7E-07	7.0E-07	
CS139+D	7.2E-09	6.3E-09	3.2E-06	1.7E-06	8.0E-07	2.1E-06	
BA140+D	2.4E-09	2.1E-08	7.6E-07	4.9E-07	2.2E-07	4.4E-07	
CE143+D	2.5E-09	2.2E-09	1.0E-06	5.7E-07	2.6E-07	6.3E-07	
CE144+D	3.7E-10	3.2E-10	1.4E-06	8.5E-08	4.0E-08	1.2E-06	
PM149M+D	8.2E-08	1.4E-08	4.5E-06	3.7E-06	2.0E+00	3.0E+00	
PM149	2.9E-11	2.5E-11	3.5E-07	1.5E-08	5.9E-09	3.1E-07	
SM153	3.0E-10	2.7E-10	2.5E-07	5.5E-08	3.0E-08	2.0E-07	
EU152	8.5E-09	7.4E-09	2.1E-06	1.8E-06	1.3E-05	2.5E-04	
EU154	9.0E-09	7.8E-09	2.7E-06	2.1E-06	4.6E-05	5.6E-04	

EXTERNAL RADIATION DOSE LIBRARY (GRDFLIB)

EU155	4.3E-10	3.8E-10	1.1E-07	9.0E-08	5.0E-05	5.6E-05
EU156	8.7E-09	7.6E-09	2.8E-06	2.1E-06	9.8E-07	1.5E-06
TB160	1.0E-08	8.6E-09	2.8E-06	2.4E-06	2.0E+00	3.0E+00
HO166M	1.0E-08	8.9E-09	2.8E-05	2.4E-05	2.0E+00	3.0E+00
W 181	2.8E-12	2.1E-12	6.8E-10	5.3E-10	2.5E-10	3.2E-10
W 185	.0E+00	.0E+00	7.9E-08	3.2E-10	1.4E-10	7.2E-08
PR210+D	1.7E-11	1.3E-11	3.6E-07	3.0E-09	2.7E-09	3.4E-07
BI210+D	.0E+00	.0E+00	3.5E-07	2.7E-09	1.3E-09	3.3E-07
RN222+D	1.5E-08	1.3E-08	5.0E-06	3.2E-06	1.5E-06	2.9E-06
RA223+D	1.8E-09	1.5E-09	1.3E-05	4.0E-07	2.0E+00	3.0E+00
RA224+D	1.0E-08	8.9E-09	3.5E-06	2.6E-06	2.0E+00	3.0E+00
RA225+D	1.2E-10	8.4E-11	6.3E-08	1.9E-08	2.0E+00	3.0E+00
RA226+D	1.5E-08	1.3E-08	5.0E-06	3.3E-06	1.5E-05	2.9E-06
RA228+D	1.4E-08	1.2E-08	4.8E-06	3.4E-05	2.0E+00	3.0E+00
AC227+D	2.4E-09	2.0E-09	5.3E-07	4.4E-07	2.0E+00	3.0E+00
TH227+D	5.3E-10	5.1E-10	1.6E-07	1.3E-07	2.0E+00	3.0E+00
TH228+D	1.0E-08	8.9E-09	3.5E-05	2.6E-06	2.0E+00	3.0E+00
TH230+D	1.0E-10	7.8E-12	4.4E-09	1.2E-09	5.5E-10	1.9E-09
TH232+D	4.0E-09	3.0E-09	4.8E-06	3.4E-06	2.0E+00	3.0E+00
PA231+D	2.7E-09	2.2E-09	7.0E-07	5.0E-07	2.0E+00	3.0E+00
U 232+D	2.7E-11	2.6E-12	1.1E-09	4.6E-10	2.0E-10	4.8E-10
U 233+D	7.5E-11	5.7E-12	2.9E-09	1.0E-09	4.7E-10	1.3E-09
U 234	5.1E-10	7.3E-12	1.2E-08	1.2E-09	5.2E-10	5.3E-09
U 235+D	2.1E-09	1.3E-09	3.8E-07	3.0E-07	1.4E-07	1.9E-07
U 236	1.3E-10	2.1E-13	3.1E-09	3.0E-12	1.2E-12	1.3E-09
U 238+D	6.3E-10	3.5E-10	9.3E-07	7.4E-08	3.4E-08	8.1E-07
NP237+D	1.6E-09	1.4E-09	4.5E-07	3.5E-07	1.4E-07	2.1E-07
PU241+D	6.8E-12	4.6E-12	9.5E-11	6.1E-11	2.8E-11	4.2E-11
CM246	1.5E-11	1.0E-12	3.3E-09	1.1E-10	3.6E-05	4.0E-02
CM247+D	2.6E-09	2.2E-09	7.5E-07	4.7E-07	2.0E+00	3.0E+00
CM248	5.2E-09	6.8E-09	4.7E-07	3.1E-07	2.0E+00	3.0E+00
CF252	7.2E-08	6.6E-08	1.7E-05	1.4E-05	.0E+00	.0E+00
ZN59M	3.4E-09	2.9E-09	1.2E-05	7.5E-07	3.4E-07	6.8E-07
ZN59	.0E+00	.0E+00	2.8E-07	1.6E-09	7.1E-10	2.5E-07
KR83M	4.2E-10	1.3E-11	9.4E-09	2.4E-11	.0E+00	7.6E-10
BR85	.0E+00	.0E+00	1.1E-06	1.4E-08	6.7E-09	9.7E-07
KR85M	.0E+00	.0E+00	5.1E-07	2.8E-07	1.3E-07	3.2E-07
KR85	.0E+00	.0E+00	1.8E-07	4.7E-09	2.2E-09	1.5E-07
KR87	.0E+00	.0E+00	4.5E-06	2.7E-05	1.3E-06	2.7E-05
RB87	.0E+00	.0E+00	2.5E-08	1.2E-10	2.0E+00	3.0E+00
KR88	.0E+00	.0E+00	7.7E-06	4.5E-06	2.1E-05	4.7E-05
RB88	4.0E-09	3.5E-09	3.6E-06	1.2E-06	5.6E-07	2.7E-06
KP89	.0E+00	.0E+00	6.8E-06	4.8E-06	3.8E-06	2.2E-06
SR90	.0E+00	.0E+00	1.5E-07	5.4E-10	2.4E-10	1.3E-07
Y 90	2.5E-12	2.2E-12	9.6E-07	1.3E-08	6.1E-09	8.6E-07
Y 91	2.7E-11	2.4E-11	5.7E-07	6.7E-09	3.1E-09	5.2E-07
Y 92	1.9E-09	1.6E-09	2.0E-06	4.6E-07	2.1E-07	1.6E-06
Y 93	7.8E-10	5.7E-10	1.4E-06	1.9E-07	8.7E-08	1.2E-06
NB93M	1.0E-10	8.2E-13	3.0E-09	2.2E-11	9.2E-12	1.2E-09
NB95	6.0E-09	5.1E-09	1.6E-05	1.4E-06	5.4E-07	7.5E-07
NB97	5.4E-09	4.6E-09	1.9E-06	1.2E-06	5.6E-07	1.1E-06
TC99M	1.1E-09	9.6E-10	2.7E-07	2.4E-07	1.1E-07	1.3E-07
TC99	.0E+00	.0E+00	2.6E-10	1.3E-10	5.8E-11	2.4E-08
RH105	7.7E-10	6.6E-10	3.0E-07	1.7E-07	7.8E-08	1.8E-07
RU106	1.8E-09	1.5E-09	1.9E-06	3.8E-07	1.7E-07	1.5E-05
PD109	4.0E-11	3.5E-11	3.4E-07	9.3E-09	4.3E-09	3.0E-07
CD115M	.0E+00	.0E+00	.0E+00	.0E+00	2.0E+00	3.0E+00
TE125M	4.8E-11	3.5E-11	1.5E-08	3.7E-09	1.7E-09	1.1E-08
SN125	1.0E-08	9.0E-09	5.0E-09	1.8E-08	1.3E-05	8.6E-04
SB126	1.0E-08	8.9E-09	3.3E-06	2.4E-06	5.0E-05	8.0E-05
SB127	6.6E-09	5.7E-09	1.8E-06	1.5E-06	6.7E-07	9.0E-07
TE127	1.1E-11	1.0E-11	1.7E-07	2.8E-09	1.2E-09	1.6E-07
TE129	8.4E-10	7.1E-10	7.0E-07	1.9E-07	8.7E-08	5.3E-07
I 129	7.5E-10	4.5E-10	3.3E-08	1.7E-08	1.8E-08	3.9E-08
XE131M	.0E+00	.0E+00	5.6E-08	6.2E-09	2.8E-09	4.8E-08
I 132	2.0E-08	1.7E-08	5.5E-06	4.4E-06	2.0E-06	2.7E-06
I 133	4.5E-09	3.7E-09	1.5E-06	9.6E-07	4.4E-07	8.8E-07
XE133M	.0E+00	.0E+00	1.0E-07	6.0E-08	2.7E-08	6.0E-08
XE137	.0E+00	.0E+00	1.1E-07	5.7E-08	2.5E-08	6.9E-08
TE134	1.2E-09	1.0E-09	3.5E-07	2.5E-07	1.2E-07	1.9E-07
I 134	1.9E-08	1.6E-08	5.5E-06	4.2E-06	2.0E-06	2.9E-06
CS134M	7.3E-10	6.2E-10	1.9E-07	1.6E-07	7.3E-08	9.1E-08
CS134	1.4E-08	1.2E-08	3.5E-05	2.9E-06	1.3E-06	1.7E-06
XE135M	.0E+00	.0E+00	1.0E-06	7.6E-07	3.5E-07	5.0E-07
XE135	.0E+00	.0E+00	7.9E-07	4.5E-07	2.1E-07	4.9E-07
CS135	.0E+00	.0E+00	1.1E-08	6.6E-11	2.8E-11	8.8E-09

EXTERNAL RADIATION DOSE LIBRARY (GRDFLIB)

XE137	.0E+00	.0E+00	2.1E-05	2.7E-07	1.2E-07	1.8E-06
CS137	4.9E-09	4.2E-09	1.4E-06	1.0E-06	4.7E-07	7.0E-07
XE138	.0E+00	.0E+00	3.4E-06	2.6E-05	3.0E-05	4.8E-06
CS138	2.4E-08	2.1E-08	5.7E-06	4.0E-06	1.8E-05	3.1E-06
BA139	2.7E-09	2.4E-09	1.0E-06	7.7E-08	3.7E-08	8.9E-07
LA140	1.7E-08	1.5E-08	5.3E-06	4.1E-06	1.9E-05	2.7E-05
BA141	4.9E-09	4.3E-09	2.4E-06	1.1E-06	5.2E-07	1.6E-06
LA141	2.8E-10	2.5E-10	1.0E-06	5.1E-08	2.3E-09	9.2E-07
CE141	6.2E-10	5.5E-10	2.4E-07	1.3E-07	5.9E-08	1.5E-07
BA142	9.0E-09	7.9E-09	3.0E-06	2.2E-06	1.0E-06	1.6E-06
LA142	1.8E-08	1.5E-08	5.9E-06	4.5E-06	2.0E-06	3.1E-06
PR143	.0E+00	.0E+00	2.8E-07	1.5E-09	7.5E-10	2.5E-07
CE144	3.7E-10	3.2E-10	1.4E-06	8.6E-08	4.0E-08	1.2E-06
PR144	2.3E-10	2.0E-10	1.3E-06	5.6E-08	2.6E-08	1.2E-06
ND147	1.2E-09	1.0E-09	5.0E-07	2.8E-07	1.3E-07	3.1E-07
PM147	.0E+00	.0E+00	1.3E-08	7.5E-11	3.3E-11	1.2E-08
PM148	5.3E-09	4.5E-09	2.0E-06	1.1E-06	5.2E-07	1.2E-06
PM151	2.3E-09	2.2E-09	8.4E-07	5.0E-07	2.3E-07	5.0E-07
SM151	2.1E-10	4.8E-11	1.9E-09	2.6E-10	2.7E-06	3.3E-05
W 187	3.6E-09	3.1E-09	1.2E-06	8.3E-07	3.8E-07	6.3E-07
TH230	1.0E-10	7.8E-12	4.4E-09	1.2E-09	5.5E-10	1.9E-09
RA225	1.5E-08	1.3E-08	5.0E-06	3.3E-06	1.5E-06	2.9E-06
RN222	1.5E-08	1.3E-08	5.0E-05	3.2E-05	1.5E-06	2.9E-06
PB210	1.7E-11	1.3E-11	3.6E-07	3.0E-09	2.7E-09	3.4E-07
B1210	.0E+00	.0E+00	3.5E-07	2.7E-09	1.3E-09	3.3E-07
PO210	5.2E-14	5.4E-14	1.7E-11	1.5E-11	8.0E-12	9.5E-12
U 232	2.7E-11	2.5E-12	1.1E-09	4.6E-10	2.0E-10	4.8E-10
TH232	4.0E-09	3.0E-09	4.8E-06	3.4E-06	2.0E+00	3.0E+00
RA228	1.4E-08	1.2E-08	4.8E-06	3.4E-06	2.0E+00	3.0E+00
TH228	1.0E-08	8.9E-09	3.5E-06	2.6E-05	2.0E+00	3.0E+00
U 235	2.1E-09	1.3E-09	3.8E-07	3.0E-07	1.4E-07	1.9E-07
PA231	2.7E-09	2.2E-09	7.0E-07	5.0E-07	2.0E+00	3.0E+00
AC227	2.4E-09	2.0E-09	6.3E-07	4.4E-07	2.0E+00	3.0E+00
U 237	2.3E-09	1.3E-09	3.4E-07	2.6E-07	1.2E-07	1.5E-07
NP237	1.6E-09	1.4E-09	4.5E-07	3.6E-07	1.4E-07	2.1E-07
PA233	1.5E-09	1.3E-09	4.0E-07	3.3E-07	8.5E-06	3.0E-05
U 233	7.5E-11	5.7E-12	2.9E-09	1.0E-09	4.7E-10	1.3E-09
TH229	2.7E-09	2.2E-09	1.3E-06	5.8E-07	2.0E+00	3.0E+00
AC225	1.8E-09	1.6E-09	1.1E-06	4.0E-07	2.0E+00	3.0E+00
U 238	6.3E-10	3.5E-10	9.3E-07	7.4E-08	3.4E-08	8.1E-07
TH234	1.3E-10	1.1E-10	8.7E-07	2.3E-09	5.8E-05	1.6E-04
AM242M	1.8E-10	2.6E-11	1.6E-07	5.1E-09	4.8E-05	1.8E-02
CM242	2.3E-11	5.5E-12	4.7E-09	3.4E-10	1.6E-10	2.1E-09
PU242	1.6E-11	1.1E-12	3.6E-09	1.1E-10	5.1E-11	1.6E-09
NP239	3.2E-09	2.8E-09	1.1E-05	7.7E-07	3.5E-07	5.7E-07
PU238	1.8E-11	1.3E-12	4.0E-09	1.5E-10	6.8E-11	1.7E-09
CM244	1.8E-11	2.9E-12	3.0E-09	2.6E-10	1.2E-10	1.7E-09
PU244	9.6E-10	8.9E-10	1.5E-07	1.3E-07	2.0E+00	3.0E+00
PU240	1.8E-11	1.3E-12	4.0E-09	1.4E-10	6.5E-11	1.7E-09
CM243	1.4E-09	1.2E-09	2.9E-07	2.5E-07	1.2E-07	1.3E-07
AM243	1.5E-09	1.3E-09	4.5E-07	3.1E-07	1.4E-07	2.5E-07
NP239	1.1E-09	9.5E-10	3.7E-07	2.4E-07	1.1E-07	2.1E-07
PU239	7.7E-12	7.9E-13	1.7E-09	1.2E-10	5.6E-11	7.6E-10
CM245	1.2E-09	9.5E-10	1.3E-07	9.5E-08	3.6E-05	4.3E-02
AM241	2.5E-10	1.8E-10	6.1E-08	3.9E-08	1.8E-08	2.7E-08

ARRRG LISTING

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C THIS CODE CALCULATES RADIATION DOSES FROM LIQUID RELEASES
C ANNUAL DOSE AND DOSE COMMITMENT TO INDIVIDUALS OR POPULATIONS
C FOR EIGHT EXPOSURE PATHWAYS
C
C VERSION 1.0 18 APRIL 1978 BAN RLR
C
C      DIMENSION TITLE1(200),TITLR(20),TITLO(20),TITLB(40),TITLS(20)
C      DIMENSION ELT(300),AW(300),TR(300)
C      DIMENSION FWL(2000),TB(2000),E(2000),IO(2000),IBEG(300),IEND(300)
C      DIMENSION BIOAC1(9,100),BELT(100),ELTO(100),AWO(100)
C      DIMENSION ELTI(100),AWI(100),Q(100),QC(300)
C      DIMENSION REL(100),KORG(5),KPTHWY(8),TRAD(100),TBIO(100,5),
C      .ENC(100,5),FW(100,5),BIOACF(5,100)
C      DIMENSION T2(2),DFAC(100,5),DCFAC(100,5)
C      DIMENSION RECON(100),RM(8),FDCON(8,100),HLDUP(8),EXTCON(8,100)
C      ,WAT(100,8)
C      DIMENSION DINT(8,100,5),DCINT(8,100,5),USAG(8),TTIDOS(100,5),
C      .TTIDC(100,5),DEXT(8,100,5),SLDFAC(100,2),
C      .SWDFAC(100,2),ETTDOS(100,5),TOTDOS(100,5),TOTDC(100,5),DINTN(8,5),
C      .DCINTN(8,5),DEXTN(8,5),DOSE(5),DOSCM(5),DPSKIN(8),DPBODY(R)
C      DIMENSION SHORDF(300,2),SWIMDF(300,2)
C
C      CHARACTER DD#8,AW#6,AWO#6,AWI#6
C
C      NAMELIST INPUT LIST
C
C      NAMELIST/INPUT/NEXT,KPTHWY,IAC,T2,KORG,IREC,CFLO,FLO,VOL,TOR,CTIM,
C      .RCYF,PLIFE,RM,HLDUP,SW,USAG,POP,ISALT,IPOP,IPCNT
C      ,IHNF RD
C
C      NMAX=100
C      POP=1.0
C      ISTRT=0
C
C      READ INPUT CARD DATA
C
C      1 READ(5,100,END=99) TITLE1
C         READ(5,INPUT,ERR=97)
C         IF(NEXT.GE.4)GO TO 95
C         IF(NEXT.EQ.3)GO TO 2
C
C      C ASSIGNS REQUIRED DATA FILES
C         IF(ISTRT.EQ.1)GO TO 3
C         ISTRT=1
C
C         CALL ASGA(1,IHNF RD)
C
C
C      READ DATA LIBRARY FOR MASTER NUCLIDE INDEX AND RADIOLOGICAL HALF-LIFE
C
C         CALL RLIBIN(ELT,AW,TR,NUC,TITLR)
C
C      READ ORGAN DATA LIBRARY
C
C         CALL OLIBS(NUC,ELT,AW,IO,TB,FWL,E,IBEG,IEND,TITLO)
C
C      READ BIOACCUMULATION DATA LIBRARY
C
C         CALL BLIBIN(BELT,NBELT,BIOAC1,TITLB)
C
C      READ SHORLINE AND SWIMMING DOSE FACTORS
C
C         CALL SLIBIN(NUC,ELT,AW,SHORDF,SWIMDF,TITLS)
C
C      3 CONTINUE
C
C      START OF CALCULATION
C
C      READ NEW RELEASE INVENTORY
C
C         READ(5,200,END=99) NIN,FINV
C         CALL ZEROR(100,Q)
C         CALL ZEROR(300,QQ)
C
C      IF NUMBER OF NUCLIDES IS OUT OF RANGE, PRINT ERROR MESSAGE AND STOP
C
```

ARRRG LISTING

```

        IF(NIN.GT.NMAX.OR.NIN.LT.1) GO TO 98
        READ(5,300,END=99)(ELTI(I),AWI(I),Q(I),I=1,NIN)

C IDENTIFY INPUT RADIONUCLIDES
C     CALL IDNUC(NUC,ELT,AW,ELTI,AWI,Q,QO,NIN)

C COUNT ORGANS AND PATHWAYS
C     2 CALL OPCHCK(KORG,NORG,KPTHWY,NPT)

C SET DATA ARRAYS FOR DOSE CALCULATION ACCORDING TO NUCLIDES,ORGANS,
C AND EXPOSURE PATHWAYS SPECIFIED ON INPUT
C     CALL SETDAT(NUC,AW,ELT,TR,TB,E,FWL,OO,REL,FINV,KORG,KPTHWY,NORG,
C .NPT,NBELT,BELT,BIOAC1,BIOACF,NUNC,AWO,ELTO,TRAD,TRIO,IO,EN,IBEG,
C .IEND,FW,SHORDF,SWIMDF,SLDFAC,SWDFAC,ISALT)

C WRITE QUALITY ASSURANCE PAGE
C     CALL QAPAGE(TITLE1,TITLR,TITLB,TITLS,KPTHWY,IAC,NPT,
C .NORG,KORG,IREC,CFLO,FLO,VOL,TOR,CTIM,RCYF,PLIFE,T2,RM,HLDUP,SW,
C .USAG,POP,NUNC,AWO,ELTO,REL,FINV,DD,ISALT,IPOP)

C CALCULATE DOSE FACTOR FOR CURRENT INVENTORY AND OPGANS
C     CALL DFCALC(TRAD,TBIO,FW,EN,NUNC,NORG,IAC,T2,DFAC,DCFAC,KORG,
C .ELTO)

C CALCULATE FOOD CONCENTRATION FACTORS
C     CALL DOZE(NUNC,REL,IREC,CFLO,FLO,VOL,TOR,TRAD,CTIM,RCYF,
C .PLIFE,NPT,KPTHWY,RM,BIOACF,HLDUP,SW,EXTCON,FDCON,WAT,RECON)

C CALCULATE DOSE FROM FOOD CONCENTRATION, EXTERNAL AND INTERNAL DF,S
C     CALL DOZCAL(KPTHWY,DFAC,DINT,FDCON,USAG,POP,DCINT,DCFAC,
C .TTIDOS,TTIDC,DEXT,EXTCON,SLDFAC,SWDFAC,ETTDOS,NORG,NUNC,TOTDOS,
C .TOTDC,KORG,NPT,DINTN,DCINTN,DEXTN,DOSE,DOSCM,DPSKIN,TTSKIN,
C .DPBODY,TTBODY)

C WRITE OUTPUT REPORTS
C     CALL DOSOUT(TITLE1,DD,ELTO,AWO,NORG,KORG,NPT,NUNC,KPTHWY,
C .DINT,DCINT,DEXT,TRAD,REL,WAT,CFLO,SW,DINTN,DCINTN,DEXTN,HLDUP,
C .USAG,RM,FDCON,BIOACF,TOTDOS,TOTDC,ETTDOS,EXTCON,DOSE,DOSCM,
C .DPSKIN,TTSKIN,RECON,ISALT,IPOP,DPBODY,TTBODY,T2,IPCNT)

C     IF(NEXT.GE.2)GO TO 1

C NORMAL EXIT 95,STOP
C     95 PRINT 400
C         CALL ASGA(2,0)
C         STOP

C INVENTORY ERROR IN SPECIFICATION OF NUMBER OF NUCLIDES,
C     98 PRINT 500,NMIN,NMAX
C         CALL ASGA(2,0)
C         STOP .

C END OF INPUT CARD FILE, STOP
C     99 PRINT 600
C         CALL ASGA(2,0)
C         STOP

C NAMELIST INPUT ERROR, STOP
C     97 PRINT 700
C         CALL ASGA(2,0)
C         STOP

C FORMAT STATEMENTS
C

```

ARRRG LISTING

```
100 FORMAT(20A4)
200 FORMAT(I3,E10.2)
300 FORMAT(A2,A6,4X,E8.2)
400 FORMAT(1H1,' END OF INPUT FOR THIS RUN')
500 FORMAT(1H1,'ERROR IN NUMBER OF NUCLIDES INPUT, NONUC =',I5,' MAXI
.MUM ALLOWED IS',I4)
600 FORMAT(1H1,' END OF FILE ON INPUT, STOP')
700 FORMAT(1H1,' ERROR ON INPUT NAMELIST, STOP')
END
```

ARRRG LISTING

```
SUBROUTINE RLIBIN(ELT,AW,TR,NUC,TITLR)
DIMENSION ELT(300),AW(300),TR(300),TITLR(20)
CHARACTER AW*6
READ(10,200,END=99) TITLR
200 FORMAT(20A4)
C
C READ AND COUNT NUCLIDE ID AND HALF-LIFE DATA FROM UNIT 10
C
NUC=0
1 NUC=NUC+1
READ(10,100,END=99) ELT(NUC),AW(NUC),TR(NUC),IEND
IF(IEND.GT.0) GO TO 1
2 NUC=NUC-1
IF(NUC.GT.300) GO TO 98
IF(NUC.LT.1) GO TO 98
RETURN
C
C PRINT ERROR MESSAGES AND STOP
C
98 PRINT 300, NUC
300 FORMAT(1H1,'IMPROPER NUMBER OF NUCLIDES IN MASTER LIBRARY, NUC=',I8)
CALL ASGA(2,0)
STOP
99 PRINT 400
100 FORMAT(A2,A6,E10.2,I2)
400 FORMAT(1H1,'END OF FILE ON MASTER LIBRARY UNIT 10')
CALL ASGA(2,0)
STOP
END
```

ARRRG LISTING

```

      SUBROUTINE OLIBS(NUC,ELT,AW,IO,TB,FWL,E,IREG,IEND,TITLO)
C THIS MODULE READS DATA FROM THE ORGAN DATA LIBRARY
C
C      DIMENSION ELT(300),AW(300),FWL(2000),IBEG(300),IEND(300)
C      DIMENSION TB(2000),E(2000),IO(2000)
C      DIMENSION TITLO(20),EI(3)
C      CHARACTER AW*6,A*6
C
C      SET DATA ARRAYS TO ZERO
C
C      CALL ZEROI(2000,IO)
C      CALL ZEROI(NUC,IEND)
C      CALL ZEROI(NUC,IBEG)
C      CALL ZEROR(2000,FWL)
C      CALL ZEROR(2000,TB)
C      CALL ZEROR(2000,E)
C
C      INITIALIZE CONTROL INTEGERS
C
C      NC=1
C      IP=0
C      NOLD=0
C      IER=0
C
C      READ ORGAN LIBRARY TITLE CARD
C
C      READ(11,100,END=99) TITLO
C      100 FORMAT(20A4)
C
C      READ FIRST DATA CARD
C
C      READ(11,200,END=99) EL,A,IOR,TBI,FWI,F2PI,(EI(I),I=1,3)
C      200 FORMAT(A2,A6,12,6E8.2)
C      1 IF(EL.NE.ELT(NC).OR.A.NE.AW(NC)) GO TO 6
C      IF(IOR.EQ.1) GO TO 2
C      IF(NOLD.NE.NC) GO TO 7
C      GO TO 3
C      2 IF(NC.GT.1) IEND(NOLD)=IP
C      NOLD=NC
C      IBEG(NC)=IP+1
C      3 IP=IP+1
C
C      SET DATA FOR CURRENT NUCLIDE AND ORGAN
C
C      FWL(IP)=FWI
C      TB(IP)=TBI
C      IO(IP)=IOR
C      E(IP)=EI(1)
C      IF(EI(3).GT.0.) E(IP)=EI(3)
C
C      READ NEXT DATA CARD
C
C      READ(11,200,END=99) EL,A,IOR,TBI,FWI,F2PI,(EI(I),I=1,3)
C      GO TO 1
C
C      INCREMENT NUCLIDE INDEX NC
C
C      6 NC=NC+1
C      IF(NC.GT.NUC) GO TO 98
C      GO TO 1
C
C      ERROR IN ORGAN LIBRARY DATA ORDER
C
C      7 PRINT 300,NC,NOLD,EL,A,ELT(NOLD),AW(NOLD)
C      300 FORMAT(1H1,'ERROR IN ORGAN DATA LIBRARY INPUT, NC, NOLD =',215
C      .' NUCLIDE INPUT IS ',A2,A6/' NUCLIDE NOLD IS ',A2,A6)
C      CALL ASGA(2,0)
C      STOP
C
C      UNIDENTIFIED NUCLIDE OR OTHER PROBLEM
C
C      98 WRITE(6,401)EL,A,NC
C      401 FORMAT(' UNABLE TO IDENTIFY NUCLIDE ',A2,A6,' NUCLIDES CHECKED
C      & =',15,' --STOP')
C      CALL ASGA(2,0)

```

ARRRG LISTING

```
STOP
C END OF FILE ON ORGAN DATA LIBRARY
C
99 IF(NOLD.GT.0) IEND(NOLD)=IP
IF(NC.GT.1) RETURN
PRINT 400,NUC,NC,NOLD,IP
400 FORMAT(1H1,'END OF FILE ON ORGAN DATA LIBRARY'/
.' NUCLIDES IN MASTER LIBRARY =',I4/' CURRENT NUCLIDE INDEX =',I4/
.' PREVIOUS NUCLIDE INDEX =',I4/' DATA ARRAY INDEX =',I5)
CALL ASGA(2,0)
STOP
END
```

ARRRG LISTING

```
SUBROUTINE BLIBIN(BELT,NBELT,BIOAC1,TITLB)
C THIS SUBROUTINE READS THE BIOACCUMULATION DATA LIBRARY
C DIMENSION BIOAC1(9,100),TITLB(40),BELT(100)
C NB=1
C READ TITLE INFORMATION
C READ(14,100,END=99)TITLB
100 FORMAT(20A4)
C READ DATA RECORDS
C 1 READ(14,200,END=2)BELT(NB),(BIOAC1(I,NB),I=1,9)
  NB=NB+1
  GO TO 1
C ON END-OF-FILE, RETURN
C 2 NBELT=NB-1
  RETURN
C IF END-OF-FILE ON TITLE CARD READ, PRINT ERROR MESSAGE AND STOP
C 99 PRINT 300
300 FORMAT(1H1,' END-OF-FILE ON TITLE CARD READ, BIOACCUMULATION LIBRA
    RY, STOP')
200 FORMAT(A2,8F9.1,F6.1)
CALL ASGA(2,0)
STOP
END
```

ARRRG LISTING

```
SUBROUTINE SLIBIN(NUC,ELT,AW,SHORDF,SWIMDF,TITLS)
C THIS SUBROUTINE READS DATA FROM THE EXTERNAL DOSE FACTOR LIBRARY
C
C      DIMENSION ELT(300),AW(300),SHORDF(300,2),SWIMDF(300,2),TITLS(20)
C      CHARACTER AW*6,W*6
C
C INITIALIZE ARRAYS AND CONTROL INTEGERS
C
C      NC=1
C      IP=0
C      DO 10 I=1,2
C      DO 10 J=1,300
C      SHORDF(J,I)=0.0
C 10 SWIMDF(J,I)=0.0
C
C READ TITLE CARD
C
C      READ(16,100,END=99) TITLS
C
C READ DATA FROM FILE
C
C      2 READ(16,200,END=98)EL,WSHORS,SHORTB,SWMS,SWMTB
C      1 IF(EL.NE.ELT(NC).OR.W.NE.AW(NC)) GO TO 6
C          IP=IP+1
C          IF(IP.GT.300) GO TO 97
C
C SET DATA FOR CURRENT NUCLIDE
C
C      SHORDF(NC,1)=SHORS
C      SHORDF(NC,2)=SHORTB
C      SWIMDF(NC,1)=SWMS
C      SWIMDF(NC,2)=SWMTB
C
C READ NEXT DATA CARD
C
C      GO TO 2
C
C INCREMENT NUCLIDE INDEX
C
C      6 NC=NC+1
C          IF(NC.GT.NUC)GOTO 97
C          GO TO 1
C
C ERROR IN LIBRARY ORDER OR SIZE, PRINT MESSAGE AND STOP
C
C      97 PRINT 300,IP,NC
C          CALL ASGA(2,0)
C          STOP
C
C END-OF-FILE ON DATA READ
C
C      98 IF(IP.GT.1) RETURN
C
C IF EMPTY,PRINT MESSAGE AND STOP
C
C      PRINT 400
C      CALL ASGA(2,0)
C      STOP
C
C END-OF-FILE ON TITLE READ, STOP
C
C      99 PRINT 500
C      CALL ASGA(2,0)
C      STOP
C
C FORMAT STATEMENTS
C
C      100 FORMAT(20A4)
C      200 FORMAT(A2,A6,4E9.2)
C      300 FORMAT(1H1,' PROBLEM IN EXTERNAL DF LIB READ',/,
C           ' , NUCLIDES FOUND =''IS,/, ' NUCLIDES CHECKED FROM MASTER LIBRARY ='
C           ',15,' STOP')
C      400 FORMAT(1H1,' EXTERNAL DOSE FACTOR LIBRARY EMPTY, STOP')
C      500 FORMAT(1H1,' EXTERNAL DOSE FACTOR LIBRARY TITLE READ ERROR,STOP')
C      END
```

ARRRG LISTING

```
SUBROUTINE IDNUC(NUC,ELT,AW,ELTI,AWI,Q,OQ,NIN)
C THIS MODULE IDENTIFIES NUCLIDES IN INPUT INVENTORY
C      DIMENSION ELT(300),AW(300),ELTI(100),AWI(100),O(100),Q(300)
C      CHARACTER AW*6,AWI*6
C INITIALIZE COUNT INDEX ON UNIDENTIFIED NUCLIDES
C
50 CONTINUE
      ISTOP=0
C LOOP ON NUCLIDES INPUT. TEST AGAINST MASTER LIST.
C
      DO 3 IN=1,NIN
      DO 1 IL=1,NUC
      ILN=IL
      IF(ELT(IL).NE.ELTI(IN)) GO TO 1
      IF(AW(IL).EQ.AWI(IN)) GO TO 2
1   CONTINUE
C NO MATCH IN LIBRARY FOR INPUT NUCLIDE. PRINT NAME OF UNKNOWN NUCLIDE
C
      ISTOP=ISTOP+1
      PRINT 100, ELTI(IN),AWI(IN)
      GO TO 3
C SET MASTER INVENTORY ARRAY OQ.
C
      2 OQ(ILN)=Q(IN)
      3 CONTINUE
      IF(ISTOP.LT.1) RETURN
C PRINT TOTAL NUMBER OF UNKNOWN NUCLIDES AND STOP.
C
      PRINT 200, ISTOP
100 FORMAT(1H0,'UNIDENTIFIED NUCLIDE ',A2,A5)
200 FORMAT(1H0,'THERE WERE UNIDENTIFIED NUCLIDES, ISTOP =',I4)
      CALL ASGA(2,0)
      STOP
      END
```

ARRRG LISTING

```
SUBROUTINE OPCHCK(KORG,NORG,KPTHWY,NPT)
C THIS SUBROUTINE COUNTS ORGANS AND EXPOSURE PATHWAYS SPECIFIED
C
C      DIMENSION KORG(5),KPTHWY(8)
C      ISTOP=0
50  CONTINUE
C
C COUNT ORGANS INDICATED FOR DOSE CALCULATIONS
C
C      NORG=0
C      DO 10 I=1,5
C          IF(KORG(I).GT.0)NORG=NORG+1
10  CONTINUE
C
C COUNT EXPOSURE PATHWAYS REQUESTED FOR DOSE CALCULATIONS
C
C      NPT=0
C      DO 11 J=1,8
C          IF(KPTHWY(J).GT.0)NPT=NPT+1
11  CONTINUE
C
C PRINT ERROR MESSAGES IF NO ORGANS OR NO PATHWAYS SPECIFIED
C
C      IF(NORG.GT.0)GO TO 12
C      ISTOP=1
12  IF(NPT.GT.0)GO TO 13
C      ISTOP=ISTOP+2
13  IF(ISTOP.EQ.1)PRINT 100,NORG
C      IF(ISTOP.EQ.2)PRINT 200,NPT
C      IF(ISTOP.EQ.3)PRINT 300,NORG,NPT
C      IF(ISTOP.EQ.0)RETURN
C      CALL ASGA(2,0)
C      STOP
C
C FORMAT STATEMENTS
C
100 FORMAT(1H1,' NO ORGANS SPECIFIED, NORG=',15)
200 FORMAT(1H1,' NO PATHWAYS SPECIFIED, NPT =',15)
300 FORMAT(1H1,' NO ORGANS OR PATHWAYS SPECIFIED--NORG,KORG =',215)
END
```

ARRRG LISTING

```
SUBROUTINE ZEROR(N,A)
C THIS MODULE SETS N VALUES OF ARRAY A TO REAL ZERO.
DIMENSION A(1)
DO I J=1,N
A(J)=0.
1 CONTINUE
RETURN
END
```

ARRRG LISTING

```
SUBROUTINE ZEROI(N,K)
C THIS MODULE SETS N VALUES OF ARRAY K TO INTEGER ZERO.
      DIMENSION K(1)
      DO 1 J=1,N
      K(J)=0
1 CONTINUE
      RETURN
      END
```

ARRRG LISTING

```

SUBROUTINE SETDAT(NUC,AW,ELT,TR,TB,E,FWL,OO,REL,FINV,KORG,KPTHWY,
.NORG,NPT,NBELT,BELT,BIOAC1,BIOACF,NUC,AWO,ELTO,TRAD,TBIO,IO,EN,
.IBEG,IEND,FW,SHORDF,SWIMDF,SLDFAC,SWDFAC,ISALT)
C THIS SUBROUTINE PREPARES CONDENSED DATA ARRAYS FOR DOSE CALCULATIONS.
C THE RELEASE INVENTORY IS MODIFIED BY THE FACTOR FINV.
C
C DIMENSION AW(300),ELT(300),TR(300),TB(2000),E(2000),FWL(2000)
C DIMENSION AWO(100),ELTO(100),TRAD(100),TBIO(100,5)
C DIMENSION OO(300),REL(100),KORG(5),KPTHWY(8),IO(2000)
C DIMENSION BELT(100),BIOAC1(9,100),BIOACF(5,100),SWIMDF(300,2)
C DIMENSION EN(100,5),IBEG(300),IEND(300),SHORDF(300,2)
C DIMENSION SLDFAC(100,2),SWDFAC(100,2),FW(100,5)
C
C CHARACTER AW*6,AWO*6
C
C INITIALIZE ARRAYS AND CONTROL INTEGERS
C
1 CONTINUE
    CALL ZEROR(100,TRAD)
    CALL ZEROR(500,TBIO)
    CALL ZEROR(100,AWO)
    CALL ZEROR(100,ELTO)
    CALL ZEROR(100,REL)
    CALL ZEROR(500,BIOACF)
    INUC=0
    IF(FINV.LE.0)FINV=1.0
C
C LOOP ON MASTER NUCLIDE LIST
C
    DO 20 IL=1,NUC
        IF(OO(IL).LE.0.0)GO TO 20
        IF(IBEG(IL).EQ.0)GO TO 19
C
C IGNORE NUCLIDE IL IF NO SOURCE INVENTORY OR NO ORGAN DATA
C OTHERWISE INCLUDE NUCLIDE IL IN DATA ARRAY POSITION INUC
C
        INUC=INUC+1
C
C SET NUCLIDE-DEPENDENT DATA FOR CURRENT NUCLIDE
C
        ELTO(INUC)=ELT(IL)
        AWO(INUC)=AW(IL)
        TRAD(INUC)=TR(IL)
        REL(INUC)=OO(IL)*FINV
C
C MULTIPLY BY .001 TO CHANGE UNITS TO REM FROM MREM
C
        SLDFAC(INUC,1)=SHORDF(IL,1)*0.001
        SLDFAC(INUC,2)=SHORDF(IL,2)*0.001
        SWDFAC(INUC,1)=SWIMDF(IL,1)*0.001
        SWDFAC(INUC,2)=SWIMDF(IL,2)*0.001
C
C FIRST FIND ELEMENT
C
        DO 7 IE=1,NBELT
            IEK=IE
            IF(ELTO(INUC).EQ.BELT(IE))GO TO 8
7 CONTINUE
        PRINT 200,ELT(IL),AW(IL)
        INUC=INUC-1
        GO TO 20
8 DO 11 IP=1,NPT
        JPT=KPTHWY(IP)
        IF(JPT.GE.5)GO TO 9
        KPT=JPT
        IF(ISALT.EQ.0)KPT=KPT+4
        BIOACF(IP,INUC)=BIOAC1(KPT,IEK)
        GO TO 10
9 IF(JPT.NE.5)GO TO 10
        BIOACF(IP,INUC)=BIOAC1(9,IEK)
10 CONTINUE
11 CONTINUE
C
C SET ORGAN-DEPENDENT DATA FOR SELECTED ORGANS FOR CURRENT NUCLIDE
C
    IL=IBEG(IL)

```

ARRRG LISTING

```
I2=IEND(IL)
DO 5 IOG=1,NORG
DO 3 II=1,I2
IK=II
IF(KORG(1OG).EQ.IO(II))GO TO 4
3 CONTINUE
GO TO 5
4 FW(INUC,1OG)=FWL(IK)
EN(INUC,1OG)=E(IK)
TBIO(INUC,1OG)=TB(IK)
5 CONTINUE
GO TO 20
C
C PRINT MESSAGE FOR ELIMINATING NUCLIDE BECAUSE NO ORGAN DATA
C
19 PRINT 100,ELT(IL),AW(IL)
20 NONUC=INUC
IF(NONUC.LE.0)GO TO 98
RETURN
C
C FORMAT STATEMENTS
C
100 FORMAT(1H1,' NO DATA IN ORGAN LIBRARY FOR NUCLIDE ',A2,A5,'. THIS
.NUCLIDE DROPPED')
200 FORMAT(1H1,' NO DATA FOR ELEMENT ',A2,A6,'IN BIOACCUMULATION FACTO
.R LIBRARY, THIS NUCLIDE DROPPED.')
300 FORMAT(1H1,' NONE OF THE INPUT NUCLIDES HAVE DATA IN THE LIBRARIES
., NUC =',15,'. STOP.')
C
C
98 PRINT 300,NONUC
CALL ASGA(2,0)
99 STOP
END
```

ARRRG LISTING

```

SUBROUTINE QAPAGE(TITLE1,TITLR,TITLO,TITLB,TITLS,KPTHWY,IAC,NPT,
.NORG,KORG,IREC,CFLO,FLO,VOL,TOR,CTIM,RCYF,PLIFE,T2,RM,HLDUP,SW,
.USAG,POP,NUUC,AWO,ELTO,REL,FINV,DD,ISALT,IPOP)
C
C THIS SURROUTINE CREATES AN ORGANIZED LISTING OF ALL PERTINENT INPUT
C PROBLEM PARAMETERS
C
C      DIMENSION TITLE1(20),TITLR(20),TITLO(20),TITLB(40),TITLS(20)
C      DIMENSION KPTHWY(8),KORG(5),T2(2),RM(8),HLDUP(8),USAG(8),UNITS(8)
C      DIMENSION AWO(100),ELTO(100),REL(100),ONAME(23),PNAME(8)
C
C      CHARACTER AWO*6,ONAME*10,PNAME*10,TYPE*7,TT*8,DD*8,UNITS*7
C      CHARACTER WATR*5,TPOP*10
C
C      DATA (PNAME(I),I=1,8)/'FISH','CRUSTACEA','MOLLUSCS','PLANTS',
C      .'DRINK. H2O','SHORELINE','SWIMMING','BOATING'
C
C      DATA (ONAME(I),I=1,23)/'TOTAL BODY','BODY WATER','KIDNEYS',
C      .'LIVER','SPLEEN','BONE','FAT','LUNGS','ADRENALS','TESTES',
C      .'OVARIES','SKIN','BRAIN','MUSCLE','PROSTATE','THYROID','PANCREAS',
C      .'HEART','GI','STOMACH','SMALL INT','UPPER LARG','LOWER LARG'
C
C      CALL ADATE(DD,TT)
C
C
C      WRITE(6,1)DD,TITLE1
1 FORMAT(1H1,56X,' **** Q.A. PAGE ****',33X,'RUN ON ',A8,/,50X,
.' ARRRG, VERSION 1.0, 1 AUGUST 78',/18X,' CASE TITLE: ',20A4)
CALL IDLINE
C
C      WATR='FRESH'
IF(ISALT.NE.0)WATR=' SALT'
TPOP=' MAX. IND.'
IF(IPOP.NE.0)TPOP='POPULATION'
TYPE=' ACUTE'
IF(IAC.EQ.0)TYPE='CHRONIC'
WRITE(6,2)TPOP,TYPE,WATR
2 FORMAT(27X,' TYPE OF DOSE CALCULATED: ',A10,1X,A7,' INGESTION AND
EXTERNAL EXPOSURE',/,40X,' FOR LIQUID RELEASES OF RADIONUCLIDES IN
.',A5,' WATER',/)
C
C      WRITE(6,3)TITLR,TITLO,(TITLE(I),I=1,20),TITLS
3 FORMAT(5X,' **** DATA LIBRARIES USED ',/,8X,' RADIONUCLIDE LIBRARY:
.',20A4,/,10X,' ORGAN DATA LIBRARY: ',20A4,/,5X,' BIOACCUMULATION
LIBRARY: ',20A4,/,7X,' EXTERNAL D.F. LIBRARY: ',20A4,/)
C
C      DATA (UNITS(I),I=1,8)/'(KG/YR)','(KG/YR)','(KG/YR)','(KG/YR)',
C      .'(L/YR)','(HR/YR)','(HR/YR)','(HR/YR)'/
C
C      WRITE(5,4)
4 FORMAT(5X,' **** PATHWAY DATA USED ',/,20X,'PATHWAY',T40,'MIXING RAT
.I0',T50,'HOLDUP (DAYS)',T85,'USAGE UNITS',/,20X,80(''))
DO 100 IP=1,NPT
JP=KPTHWY(IP)
100 WRITE(6,5)PNAME(JP),RM(IP),HLDUP(IP),USAG(IP),UNITS(JP)
5 FORMAT(20X,A10,3(10X,1PE10.2E2),2X,A7)
C
C      WRITE(6,6)(ONAME(KORG(I)),I=1,NORG)
6 FORMAT(/,5X,' **** ORGANS CONSIDERED ',/,5(10X,A10))
C
C      WRITE(6,7)(ELTO(I),AWO(I),REL(I),I=1,NUUC)
7 FORMAT(/,5X,' **** NUCLIDES CONSIDERED: ',/,10X,5('NUCLIDE RELEASE
.',7X),/,9X,5('ELT. WT. (C1/YR)',6X),//(10X,5(A2,1X,A6,1X,1PE8.2
.E2,6X)))
C
C      WRITE(6,8)FINV,IREC,PLIFE,CFLO,POP,FLO,T2(1),VOL,T2(2),TOR,SW,CTIM
.,RCYF
8 FORMAT(/5X,' **** SITE SPECIFIC DATA USED ',T70,'**** RECONCENTRATION
. DATA USED ',/,13X,'INVENTORY MODIFICATION FACTOR: ',E10.2E2,T97,'M
.ODEL USED: ',I2,/,T22,'FACILITY LIFE (YEARS): ',E10.2E2,T90,'COOLA
.NT FLOW RATE: ',E10.2E2,/,T33,'POPULATION: ',E10.2E2,T78,'COOLANT
.MAKEUP FLOW (FT3/SEC): ',E10.2E2,/,T26,'DOSE TIME (YEARS): ',E10.2
.E2,T90,'POND VOLUME (FT3): ',E10.2E2,/,T15,'DOSE COMMITMENT TIME (
.YEARS): ',E10.2E2,T94,'TURNOVER RATE: ',E10.2E2,/,T89,'SHORE WIDTH
.FACTOR: ',E10.2E2,/,T92,'CYCLE TIME (HR): ',E10.2E2,/
.,T91,'RECYCLE FRACTION: ',E10.2E2)

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      WRITE(6,9)
9 FORMAT( 15X,' INPUT PREPARED BY:',15X,'DATE:',/,34X,'XXXXXXXXXX
     .XXX',5X,'XXXXXXXXXX',//,15X,' INPUT CHECKED BY:',15X,'DATE:',/,
     .34X,'XXXXXXXXXXXX',5X,'XXXXXXXXXX')
C
      RETURN
      END
```

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```

C THIS SUBROUTINE CALCULATES DOSE FACTORS FOR INGESTION AND           DFC00100
C EXPOSURE TO CONTAMINATED GROUND.                                         DFC00200
C SUBROUTINE DFCALC(TRAD,TRIO,FW,EN,NONUC,NORG,IAC,T2,                 DFC00300
C &DFAC,DCFAC,KORG,ELTO)
C REAL#4 MASS(23)
C DIMENSION DFAC(100,5),DCFAC(100,5),EN(100,5),T2(2)                  DFC00500
C DIMENSION TEFF(100,5),TRAD(100),TRIO(100,5),FW(100,5)
C DIMENSION KORG(5),TRTM(4),TP(4),ELTO(100)
C GI TRAVEL TIMES, FRACTIONAL DAYS
C DATA (TRTM(I),I=1,4)/.0417,.1557,.3333,.7500/
C TRAVEL TIMES TO GI ORGANS, FRACTIONAL DAYS
C DATA (TP(I),I=1,4)/0.0,.0417,.2083,.5417/
C DATA T1/1.0/
C ICRP-23 ORGAN MASSES OR GI ORGAN CONTENTS MASS
C DATA (MASS(I),I=1,23)/70000.,600.,310.,1800.,180.,7000.,13500.,
C &1000.,14.,35.,11.,2600.,1400.,28000.,16.,20.,100.,330.,0.,250.,
C .400.,250.,135./
C DO 100 INUC=1,NONUC
C DO 100 IORG=1,NORG
C JORG=KORG(IORG)
C TEFF(INUC,IORG)=TRAD(INUC)*TBIO(INUC,IORG)/(TRAD(INUC)+      DFC01100
C &TBIO(INUC,IORG))
C IF(KORG(IORG).GE.20)GO TO 200
C IF (IAC .EQ.0) GO TO 300
C DFAC(INUC,IORG)=0.074*EN(INUC,IORG)*TEFF(INUC,IORG)*          DFC01200
C &FW(INUC,IORG)*(1.0-EXP(-0.693/TEFF(INUC,IORG)*T2(1)*355.25))/   DFC01300
C &MASS(JORG)*0.001
C DCFAC(INUC,IORG)=0.074*EN(INUC,IORG)*TEFF(INUC,IORG)*          DFC01400
C &FW(INUC,IORG)*(1.0-EXP(-0.693/TEFF(INUC,IORG)*T2(2)*355.25))/   DFC01500
C &MASS(JORG)*0.001
C GO TO 99
C 300 DFAC(INUC,IORG)=2.92E-4*FW(INUC,IORG)*EN(INUC,IORG)*          DFC02400
C &(TEFF(INUC,IORG)**2)*(0.693/TEFF(INUC,IORG)*T1*355.25+
C &EXP(-0.693/TEFF(INUC,IORG)*T2(1)*355.25)-EXP(-0.693/TEFF(INUC,
C &IORG)*T2(1)-T1)*355.25)/MASS(JORG)*0.001
C DCFAC(INUC,IORG)=2.92E-4*FW(INUC,IORG)*EN(INUC,IORG)*
C &(TEFF(INUC,IORG)**2)*(0.693/TEFF(INUC,IORG)*T1*355.25+
C &EXP(-0.693/TEFF(INUC,IORG)*T2(2)*355.25)-EXP(-0.693/TEFF(INUC,
C &IORG)*T2(2)-T1)*355.25)/MASS(JORG)*0.001
C GO TO 99
C 200 IOR=JORG-19
C DFAC(INUC,IORG)=0.0256*TRTM(IOR)*EN(INUC,IORG)*FW(INUC,IORG)*
C &EXP(-0.693/TRAD(INUC)*TP(IOR))/MASS(JORG)*0.001
C DCFAC(INUC,IORG)=0.0256*TRTM(IOR)*EN(INUC,IORG)*FW(INUC,IORG)*
C &EXP(-0.693/TRAD(INUC)*TP(IOR))/MASS(JORG)*0.001
C 99 CONTINUE
C H='H '
C C='C '
C N='N '
C NA='NA'
C IF(ELTO(INUC).EQ.H.OR.ELTO(INUC).EQ.C)GO TO 400
C IF(ELTO(INUC).EQ.N.OR.ELTO(INUC).EQ.NA)GO TO 500
C GO TO 100
C
C SPECIAL CASE FOR H-3,C-14
C
C 400 IF(JORG.EQ.6)GO TO 100
C DO 401 I=1,NORG
C IF(KORG(I).NE.1)GO TO 401
C DFAC(INUC,IORG)=DFAC(INUC,I)
C DCFAC(INUC,IORG)=DCFAC(INUC,I)
C GO TO 100
C 401 CONTINUE
C
C SPECIAL CASE FOR N-13,NA-22,NA-24
C
C 500 DO 501 I=1,NORG
C IF(KORG(I).NE.1)GO TO 501
C DFAC(INUC,IORG)=DFAC(INUC,I)
C DCFAC(INUC,IORG)=DCFAC(INUC,I)
C 501 CONTINUE
C 100 CONTINUE
C RETURN
C END

```

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C THIS SUBROUTINE CALCULATES THE CONCENTRATIONS IN THE
C FOOD AND EXTERNAL
    SUBROUTINE DOZE(NONUC,REL,IREC,CFLO,FLO,VOL,TOR,TRAD,CTIM,RCYF,
    &PLIFE,NPT,KPTHWY,RM,BIOACF,HLDUP,SW,EXTCON,FDCON,WAT,RECON)
    DIMENSION REL(100),RECON(100),TRAD(100),KPTHWY(8),RM(8)
    DIMENSION FDCON(8,100),BIOACF(5,100),HLDUP(8),EXTCON(8,100)
    DIMENSION WAT(100,8)
C CALCULATE RECONCENTRATION FORMULA
1 CONTINUE
    DO 50 INUC=1,NONUC
        IF (REL(INUC) .EQ. 0) GO TO 50
        IF (IREC .EQ. 3) GO TO 100
        IF (IREC .EQ. 2) GO TO 150
        RECON(INUC)=1./(1.-(CFLO-FLO)/(CFLO+VOL*TOR)*EXP(-0.693/
        &TRAD(INUC)*CTIM*0.0417))
        GO TO 50
150   RECON(INUC)=(1.-(RCYF*EXP(-0.693/TRAD(INUC)*CTIM*0.0417))*
        &((PLIFE*8765./CTIM+1.))/(1.-RCYF*EXP(-0.693/TRAD(INUC)*
        &CTIM*0.0417)))
        GO TO 50
100   RECON(INUC)=1.0
50    CONTINUE
C CALCULATE WATER CONCENTRATION      PCI/L
    DO 200 IFD=1,NPT
        IF (KPTHWY(IFD) .EQ. 0.) GO TO 200
    DC 250 INUC=1,NONUC
        WAT(INUC,IFD)=REL(INUC)*RECON(INUC)*RM(IFD)*1119.11/CFLO
        IF (KPTHWY(IFD) .EQ. 6) GO TO 260
        IF (KPTHWY(IFD) .EQ. 7) GO TO 270
        IF (KPTHWY(IFD) .EQ. 8) GO TO 280
C CALCULATE FOOD CONCENTRATION      PCI/KG
        FDCON(IFD,INUC)=BIOACF(IFD,INUC)*WAT(INUC,IFD)*EXP(-0.693/
        &TRAD(INUC)*HLDUP(IFD))
        GO TO 250
C CALCULATE EXTERNAL CONCENTRATION
250   WATC(INUC,IFD)=WAT(INUC,IFD)*SW*100.
        EXTCON(IFD,INUC)=WAT(INUC,IFD)*EXP(-0.693/TRAD(INUC)*HLDUP(IFD))
        &*((1.-EXP(-0.693/TRAD(INUC)*PLIFE*355.25))/TRAD(INUC))
        GO TO 250
270   EXTCON(IFD,INUC)=WAT(INUC,IFD)*EXP(-0.693/TRAD(INUC)*HLDUP(IFD))
        GO TO 250
280   EXTCON(IFD,INUC)=WAT(INUC,IFD)*EXP(-0.693/TRAD(INUC)*HLDUP(IFD)
        .)/2.
250   CONTINUE
200   CONTINUE
    RETURN
END
```

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SUBROUTINE DOZCAL(KPTHWY,DFAC,DINT,FDCON,USAG,POP,DCINT,DCFAC,
&TTIDOS,TTIDC,DEXT,EXTCON,SLDFAC,SWDFAC,ETTDOS,NORG,NUC,
&TOTDOS,TOTDC,KORG,NPT,DINTN,DCINTN,DEXTN,DOSE,DOSCM,DPSKIN,
&TTSKIN,DPRODY,TTBODY)
C DOSE CALCULATIONS
      DIMENSION KPTHWY(8),DFAC(100,5),DINT(8,100,5),FDCON(8,100)
      DIMENSION USAG(8),DCINT(8,100,5),DCFAC(100,5),TTIDOS(100,5)
      DIMENSION TTIDC(100,5),DEXT(8,100,5),EXTCON(8,100),
&SLDFAC(100,2),KORG(5)
      DIMENSION SWDFAC(100,2),ETTDOS(100,5),TOTDOS(100,5),TOTDC(100,5)
      DIMENSION DINTN(8,5),DCINTN(8,5),DEXTN(8,5),DINTNP(5),DCINTNP(5)
      DIMENSION DEXTNP(5),DOSE(5),DOSCM(5),DPSKIN(8),DPBODY(8)
C ZERO TOTAL VARIABLES
      CALL ZEROR(500,TTIDOS)
      CALL ZEROR(500,TTIDC)
      CALL ZEROR(500,ETTDOS)
      CALL ZEROR(500,TOTDC)
      CALL ZEROR(500,TOTDOS)
      CALL ZEROP(40,DINTN)
      CALL ZEROR(40,DCINTN)
      CALL ZEROR(40,DEXTN)
      CALL ZEROR(5,DINTNP)
      CALL ZEROR(5,DCINTNP)
      CALL ZEROR(5,DEXTNP)
      CALL ZEROR(5,DOSE)
      CALL ZEROR(5,DOSCM)
      CALL ZEROR(8,DPSKIN)
C INTERNAL DOSE
      DO 100 IFD=1,NPT
      IF (KPTHWY(IFD) .EQ. 0 .OR. KPTHWY(IFD) .GE. 6) GO TO 100
      DO 110 INUC=1,NUC
      DO 120 IORG=1,NORG
      IF(KORG(IORG) .EQ. 12) GO TO 120
      DINT(IFD,INUC,IORG)=FDCON(IFD,INUC)*USAG(IFD)*DFAC(INUC,IORG)*POP
      DCINT(IFD,INUC,IORG)=FDCON(IFD,INUC)*USAG(IFD)*DCFAC(INUC,IORG)*PO
      P
      TTIDOS(INUC,IORG)=TTIDOS(INUC,IORG) + DINT(IFD,INUC,IORG)
      TTIDC(INUC,IORG)=TTIDC(INUC,IORG) + DCINT(IFD,INUC,IORG)
120  CONTINUE
110  CONTINUE
100  CONTINUE
C EXTERNAL DOSE--TOTAL BODY AND SKIN
      DO 200 IFD=1,NPT
      IF (KPTHWY(IFD) .EQ. 0 .OR. KPTHWY(IFD) .LT. 6) GO TO 200
      DO 210 IORG=1,2
      DO 210 INUC=1,NUC
      IF (KPTHWY(IFD) .GT. 6) GO TO 250
      DEXT(IFD,INUC,IORG)=EXTCON(IFD,INUC)*USAG(IFD)*SLDFAC(INUC,IORG)
      *POP
      GO TO 250
250  DEXT(IFD,INUC,IORG)=EXTCON(IFD,INUC)*USAG(IFD)*SWDFAC(INUC,IORG)
      *POP
260  ETTDOS(INUC,IORG)=ETTDOS(INUC,IORG) + DEXT(IFD,INUC,IORG)
210  CONTINUE
200  CONTINUE
C TOTAL DOSE, INTERNAL ONLY
      DO 300 INUC=1,NUC
      DO 310 IORG=1,NORG
      IF (KORG(IORG) .EQ. 12) GO TO 310
      TOTDOS(INUC,IORG)=TTIDOS(INUC,IORG) +
      &TOTDOS(INUC,IORG)
      TOTDC(INUC,IORG)=TTIDC(INUC,IORG)+TOTDC(INUC,IORG)
310  CONTINUE
300  CONTINUE
C DOSE TO ORGAN BY PATHWAY
C DOSE COMMITMENT TO ORGAN BY PATHWAY
      DO 400 IORG=1,NORG
      IF (KORG(IORG) .EQ.12) GO TO 400
      DO 410 IFD=1,NPT
      IF(KPTHWY(IFD) .EQ. 0) GO TO 410
      DO 420 INUC=1,NUC
      IF (KPTHWY(IFD) .GE. 6) GO TO 430
      DINTN(IFD,IORG)=DINTN(IFD,IORG) + DINT(IFD,INUC,IORG)
      DCINTN(IFD,IORG)=DCINTN(IFD,IORG) + DCINT(IFD,INUC,IORG)
      GO TO 420
430  CONTINUE

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430 CONTINUE

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        DEXTN(IFD,IORG)=DEXTN(IFD,IORG)+ DEXT(IFD,INUC,2)
420    CONTINUE
        IF (KPTHWY(IFD) .GE. 6) GO TO 440
        DINTNP(IORG)=DINTNP(IORG) + DINTN(IFD,IORG)
        DCNTNP(IORG)=DCNTNP(IORG) + DCINTN(IFD,IORG)
        GO TO 410
440    CONTINUE
        DEXTNP(IORG)=DEXTNP(IORG) + DEXTN(IFD,IORG)
410    CONTINUE
        DOSE(IORG)=DINTNP(IORG)
        DOSCM(IORG)=DCNTNP(IORG)
400    CONTINUE
C DOSE TO SKIN BY PATHWAY
        DO 450 IFD=1,NPT
        IF (KPTHWY(IFD) .LT. 6) GO TO 450
        DO 450 INUC=1,NUC
460    DPSKIN(IFD)=DPSKIN(IFD) + DEXT(IFD,INUC,1)
        TTSKIN=TTSKIN + DPSKIN(IFD)
450    CONTINUE
C EXTERNAL DOSE TO TOTAL BODY BY PATHWAY
C
        DO 550 IFD=1,NPT
        IF(KPTHWY(IFD) .LT. 5) GO TO 550
        DO 550 INUC=1,NUC
560    DPBODY(IFD)=DPBODY(IFD)+DEXT(IFD,INUC,2)
        TTBODY=TTBODY+DPBODY(IFD)
550    CONTINUE
        RETURN
        END
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SUBROUTINE DOSOUT(TITLE1,DD,ELTO,AWO,NORG,KORG,NPT,NONUC,KPTHWY,
&DINT,DCINT,DEXT,TRAD,REL,WAT,CFL0,SW,DINTN,DCINTN,DEXTN,HLDUP,
&USAG,RM,FDCON,BIOACF,TOTDOS,TOTDC,ETTDOS,EXTCON,DOSE,DOSCM,
2DPSKIN,TTSKIN,RECON,ISALT,IPOP,DPBODY,TTBODY,T2,IPCNT)
DIMENSION ELTO(100),AWO(100),ONAME(23),PNAME(R),KORG(5)
DIMENSION KPTHWY(R),DINT(R,100,5),DCINT(R,100,5),DEXT(R,100,5)
DIMENSION DINTN(8,5),DCINTN(8,5),DEXTN(8,5),DOSE(5),DOSCM(5)
DIMENSION TRAD(100),REL(100),WAT(100,8),DPSKIN(8),TOTDOS(100,5)
DIMENSION TOTDC(100,5),ETTDOS(100,5),EXTCON(8,100)
DIMENSION HLDUP(8),T2(2),USAG(8),FDCON(8,100),RM(R)
DIMENSION BIOACF(5,100),DPBODY(8),TITLE1(20),RECON(100)
DIMENSION AM(2),D1(5),D2(5)
CHARACTER AM*7
CHARACTER DD*8
CHARACTER AWO*6
CHARACTER ONAME*10
CHARACTER PNAME*10
DATA AM(1),AM(2)/* REM 1, 'MAN-REM'
DATA (PNAME(I),I=1,8)/*'FISH', 'CRUSTACEA', 'MOLLUSCS', 'PLANTS',
&'DRINK. H2O', 'SHORELINE', 'SWIMMING', 'BOATING'
DATA (ONAME(I),I=1,23)/*'TOTAL BODY', 'BODY WATER', 'KIDNEYS',
&'LIVER', 'SPLEEN', 'BONE', 'FAT', 'LUNGS', 'ADRENALS', 'TESTES',
&'OVARIES', 'SKIN', 'BRAIN', 'MUSCLE', 'PROSTATE', 'THYROID', 'PANCREAS'
&,'HEART', 'GI', 'STOMACH', 'SMALL INT', 'UPPER LARG', 'LOWER LARG'/
C
C SUMMARY TABLE--DOSE TO ORGAN BY PATHWAY
C
C
      M=1
      IF(IPOP.NE.0)M=2
1 CONTINUE
      PRINT 20, TITLE1,DD
20 FORMAT(1H1,4X,20A4,10X,A8)
      PRINT 21
21 FORMAT(1H0,'ARRRG',10X,'VERSION 1.0',10X,'1 AUGUST 78')
      PRINT 22, AM(M),T2(1)
22 FORMAT(1H0,'DOSE TO ORGAN BY PATHWAY (',A7,')',
.' FOR A PERIOD OF ',1PE8.2E2,' YEARS')
      PRINT 31
31 FORMAT(22X,'EXTERNAL',40X,'INTERNAL',/,
. 40(''),5X,70(''))
      PRINT 23,(ONAME(KORG(IORG)),IORG=1,NORG)
23 FORMAT(1H0,'PATHWAY',9X,!SKIN',8X,'TOTAL BODY',8X,5(A10,5X),/)
DO 210 IFD=1,NPT
IF (KPTHWY(IFD) .GE. 6) GO TO 220
PRINT 24, PNAME(KPTHWY(IFD)),(DINTN(IFD,IORG),IORG=1,NORG)
24 FORMAT (1X,A10,36X,5(1PE8.1E2,7X))
GO TO 210
220 PRINT 26, PNAME(KPTHWY(IFD)),DPSKIN(IFD),DPBODY(IFD),
.(DEXTN(IFD,IORG),IORG=1,NORG)
25 FORMAT (1X,A10,4X,1PE8.1E2,8X,1PE8.1E2,8X,5(1PE8.1E2,7X))
210 CONTINUE
DO 100 I=1,NORG
D1(I)=DCSE(I)+TTBODY
100 D2(I)=DOSCM(I)+TTBODY
PRINT 25, TTSKIN,TTBODY,(D1(IORG),IORG=1,NORG)
25 FORMAT(1H0,'TOTAL',9X,1PE8.1E2,8X,1PE8.1E2,8X,5(1PE8.1E2,7X))
C
C SUMMARY TABLE--DOSE COMMITMENT TO ORGAN BY PATHWAY
C
      PRINT 20,TITLE1,DD
      PRINT 21
      PRINT 30, AM(M),T2(2)
30 FORMAT (1H0,'DOSE COMMITMENT TO ORGAN BY PATHWAY (',A7,')',
.' FOR A COMMITMENT TIME OF ',1PE8.2E2,' YEARS')
      PRINT 31
      PRINT 23,(ONAME(KORG(IORG)),IORG=1,NORG)
DO 310 IFD=1,NPT
IF (KPTHWY(IFD) .GE. 6) GO TO 320
PRINT 24, PNAME(KPTHWY(IFD)),(DCINTN(IFD,IORG),IORG=1,NORG)
GO TO 310
320 PRINT 26,PNAME(KPTHWY(IFD)),DPSKIN(IFD),DPBODY(IFD),
.(DEXTN(IFD,IORG),IORG=1,NORG)
310 CONTINUE
PRINT 25,TTSKIN,TTBODY,(D2(IORG),IORG=1,NORG)
C

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C SUMMARY TABLE--DOSE AND DOSE COMMITMENT TO ORGAN BY NUCLIDE
C
      PRINT 20, TITLE1,DD
      PRINT 21
      PRINT 40
 40   FORMAT(1H0, 'DOSE AND DOSE COMMITMENT TO ORGAN BY NUCLIDE,
. EXTERNAL DOSES SEPERATE')
      DO 400 IORG=1,NORG
      PRINT 41,ONAME(KORG(IORG)),CFLO
 41   FORMAT(//,1X,A10,10X,'COOLANT FLOW = ',1PE8.1E2,'CURIC FEET/SEC')
      PRINT 42
 42   FORMAT(//, 'NUCLIDE',8X,'HALF-LIFE',3X,'RELEASE',6X,'DOSE',
$6X,1%,4X,'DOSE COMM',4X,1%)
      PRINT 43, AM(M),AM(M)
 43   FORMAT(17X,'DAYS',5X,' CI/YR',5X,A7,10X,A7,/,1X,70('::'))
      DO 410 INUC=1,NNUC
      IDPER=TOTDOS(INUC,IORG)/DOSE(IORG)*100.
      IDCPER=TOTDC(INUC,IORG)/DOSCM(IORG)*100.
      PRINT 44,ELTO(INUC),AWO(INUC),TRAD(INUC),REL(INUC),TOTDOS(INUC,
&IORG),IDPER,TOTDC(INUC,IORG),IDCPER
 44   FORMAT(1X,A4,A6,5X,1PE8.1E2,3X,1PE8.1E2,4X,1PE8.1E2,3X,13,3X,
.1PE8.1E2,
&4X,13)
 410  CONTINUE
      PRINT 45, DOSE(IORG),DOSCM(IORG)
 45   FORMAT(740,7(' -'),T57,7(' -'),/,2X,'TOTAL',22X,2(9X,1PER.1))
 400  CONTINUE
      PRINT 46,CFLO
 46   FORMAT(//,1X,'EXTERNAL DOSE',16X,'COOLANT FLOW = ',1PE8.1E2,'CUB
.CU FEET/SEC.')
      PRINT 47
 47   FORMAT(//, 'NUCLIDE',8X,'HALF-LIFE',3X,'RELEASE',4X,
.'SKIN DOSE',3X,1%,4X,'T.B. DOSE',4X,1%)
      PRINT 43, AM(M),AM(M)
      DO 420 INUC=1,NNUC
      ISDPER=ETTDOS(INUC,1)/TTSKIN*100.
      IBDPER=ETTDOS(INUC,2)/TTBODY*100
      PRINT 44,ELTO(INUC),AWO(INUC),TRAD(INUC),REL(INUC),ETTDOS(INUC,1)
&,ISDPER,ETTDOS(INUC,2),IBDPER
 420  CONTINUE
      PRINT 45,TTSKIN,TTBODY
C
C COMPLETE TABLE--DOSE AND DOSE COMMITMENT TO ORGAN
C
C     BY PATHWAY AND NUCLIDE
C
C INTERNAL PATHWAY
C
      PRINT 20,TITLE1,DD
      PRINT 21
      PRINT 50
 50   FORMAT(1H0,'DOSE AND DOSE COMMITMENT')
      DO 500 IFD=1,NPT
      IF (KPTHWY(IFD) .EQ. 0 .OR. KPTHWY(IFD) .GE. 5) GO TO 500
      IF(IFD.NE.1)PRINT 2
 2   FORMAT(1H1)
      PRINT 51, PNAME(KPTHWY(IFD))
 51   FORMAT(/,5X,A10,/,5X,10(':='))
      PRINT 52,HLDUP(IFD),USAG(IFD),RM(IFD)
 52   FORMAT(//, 'HOLDUP = ',1PE8.1E2,10X,'CONSUMPTION = ',1PE8.1E2,
$10X,'MIXING RATIO = ',1PE8.1E2)
      DO 510 IORG=1,NORG
      IF (KORG(IORG) .EQ. 12) GO TO 510
      PRINT 51,ONAME(KORG(IORG))
      IF (KPTHWY(IFD) .EQ. 5) GO TO 520
      PRINT 53
 53   FORMAT(//, 'NUCLIDE',7X,'HALF-LIFE',3X,'RELEASE',4X,'WATER',
&' CONC',3X,'RECON',3X,'B10ACF',5X,'CONC',6X,'DOSE',6X,1%,4X,
' DOSE COMM',3X,1%)
      PRINT 54, AM(M),AM(M)
 54   FORMAT(16X,'DAYS',7X,' CI/YR',5X,'PCI/L ',6X,'FAC',14X,
&'PCI/KG',4X,A7,9X,A7,/,1X,110('::'))
      GO TO 530
 520  PRINT 55
 55   FORMAT(//, 'NUCLIDE',7X,'HALF-LIFE',3X,'RELEASE',4X,'WATER ',
&' CONC',2X,'RECON',3X,'H2O CU',5X,'CONC',5X,'DOSE',5X,1%,

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      E4X,'DOSE COM',4X,'%')
      PRINT 55, AM(M),AM(M)
 56   FORMAT(16X,'DAYS',7X,' CI/YR',8X,'PCI/L ',4X,'FAC',
      &4X,'FACTOR',4X,'PCI/KG',4X,A7,9X,A7,/,1X,110(':''))
 530  DO 540 INUC=1,NONUC
      IDPER=DINT(IFD,INUC,IORG)/DINTN(IFD,IORG)*100.
      IDCPER=DCINT(IFD,INUC,IORG)/DCINTN(IFD,IORG)*100.
      IF(IDPER.GE.IPCNT)GO TO 59
      IF(IDCER.LT.IPCNT)GO TO 540
 59   PRINT 57,ELTO(INUC),AWO(INUC),TRAD(INUC),REL(INUC),WAT(INUC,IFD),
      &RECON(INUC),BIOACF(IFD,INUC),FDCON(IFD,INUC),DINT(IFD,INUC,IORG),
      &IDPER,DCINT(IFD,INUC,IORG),IDCER
 57   FORMAT(1X,A4,A6,3(4X,1PE8.1E2),3(1X,1PE8.1E2),
      &3X,2(1PE8.1E2,2X,13,4X))
 540  CONTINUE
      PRINT 58,DINTN(IFD,IORG),DCINTN(IFD,IORG)
 58   FORMAT(778,7(''),10X,7(''),/,2X,'TOTAL',69X,2(1PE8.1,9X))
 510  CONTINUE
 500  CONTINUE
  C
  C EXTERNAL PATHWAY
  C
      DO 550 IFD=1,NPT
      IF(KPTHWY(IFD).EQ.0.OR.KPTHWY(IFD).LT.6) GO TO 550
      PRINT 2
      PRINT 51,PNAME(KPTHWY(IFD))
      PRINT 60,HLDUP(IFD),USAG(IFD),RM(8),SW
 60   FORMAT(/,' HOLDUP = ',F5.1,10X,'USAGE(HR/YP) = ',1PE8.1,10X,
      &'MIXING RATIO = ',0PF6.3,10X,'SHORE WIDTH FACT. = ',F5.3)
      PRINT 61, AM(M)
 61   FORMAT(/,' NUCLIDE',7X,'HALF-LIFE',8X,'RELEASE',7X,'WATER '
      &,'CONC',7X,'RECON',3X,'SHORELINE CONC',3X,'DOSE AND DOSE ',
      &'COMMITMENTC ',A7,' ')
      PRINT 62
 62   FORMAT(16X,'DAYS',12X,' CI/YR',10X,'PCI/L ',10X,'FAC',
      &9X,'PCI/M**2',8X,'SKIN',7X,'%',4X,'T BODY',6X,'%',/,1X,123(':''))
      DO 570 INUC=1,NONUC
      ISPER=DEXT(IFD,INUC,1)/DPSKIN(IFD)*100.
      IBPER=DEXT(IFD,INUC,2)/DEXTN(IFD,1)*100.
      IF(ISPER.GE.IPCNT)GO TO 65
      IF(IBPER.LT.IPCNT)GO TO 570
 65   PRINT 63,ELTO(INUC),AWO(INUC),TRAD(INUC),REL(INUC),WAT(INUC,IFD),
      &RECON(INUC),EXTCON(IFD,INUC),DEXT(IFD,INUC,1),ISPER,DEXT(IFD,
      &INUC,2),IBPER
 63   FORMAT(1X,A2,A6,6(6X,1PE8.1E2,1X),15,1PE11.1,2X,15)
 570  CONTINUE
      PRINT 64,DPSKIN(IFD),DEXTN(IFD,2)
 64   FORMAT(791,7(''),10X,7(''),/,2X,'TOTAL',74X,2(8X,1PE8.1E2))
 550  CONTINUE
      RETURN
      END

```

FOOD LISTING

```

C THIS CODE CALCULATES RADIATION DOSES FROM AIRBORNE RELEASES FOR
C INGESTION OF CONTAMINATED FOODSTUFFS AND FOR EXPOSURE TO
C CONTAMINATED GROUND
C
C      DIMENSION TITLR(20),TITLF(60),TITLO(20),TITLG(20)
C      REAL*4 LFCON(15,100)
C      DIMENSION AIRCON(15,100),PLTCOM(15,100),WATCON(15,100)
C      DIMENSION KFDTYP(15),XQ(15),GRWP(15),YELD(15),RIRR(15),HLDUP(15)
C      DIMENSION CON(15),T2(2),KORG(5)
C      DIMENSION REL(100),TRAD(100),DPVL(100),FDTC(15,100),TBIO(100,5)
C      DIMENSION FW(100,5),EN(100,5)
C      DIMENSION ELT(300),AW(300),TR(300),DVEL(70),FTRC(6,70),FELT(70)
C      DIMENSION IO(2000),IBEG(300),IEND(300)
C      DIMENSION TB(2000),E(2000),FWL(2000),AWO(100),ELTO(100)
C      DIMENSION TITLE1(20),ELTI(100),AWI(100),Q(100),QO(300)
C      DIMENSION DFGRD(100,5),DFAC(100,5),DCFAC(100,5),SLCON(15,100),
C      .EDBCON(15,100),DOSRD(100,5),DINT(15,100,5),DCINT(15,100,5),
C      .TOTDOS(100,5),TOTDC(100,5)
C      DIMENSION GRDF(300,2),TRNS(15)
C      CHARACTER AW*6,AWO*6,TT*8,DD*8
C      CHARACTER AWI*6
C
C      NAMELIST INPUT LIST
C
C      NAMELIST/INPUT/NEXT,KFDTYP,XQ,GRWP,YELD,RIRR,HLDUP,CON,IDEF,CFL0,
C      .RM,FLO,VOL,TOR,CTIM,PLIFE,EXTIM,KORG,T2,1AC,IREC,POP,IPOP,
C      .IOUT,TRNS,IPCNT
C      NMAX=100
C      POP=1.0
C      ISTRT=0
C
C      READ INPUT CARD DATA
C
C      1 READ(5,100,END=99) TITLE1
C         READ(5,INPUT,ERR=97)
C         IF(NEXT.GE.4.) GO TO 95
C         IF(NEXT.EQ.3) GO TO 2
C         IF(ISTRT.EQ.1)GO TO 3
C         ISTRT=1
C
C      ASSIGNS REQUIRED DATA FILES
C
C      CALL ASGF(1)
C
C      READ DATA LIBRARY FOR MASTER NUCLIDE INDEX AND RADIOLOGICAL HALF LIFE
C
C      CALL RLIBIN(ELT,AW,TR,NUC,TITLR)
C
C      READ FOOD TRANSFER COEFFICIENT DATA LIBRARY
C
C      CALL FLIBIN(NFELT,FELT,DVEL,FTRC,TITLF)
C
C      READ ORGAN DATA LIBRARY
C
C      CALL OLIBS(NUC,ELT,AW,IO,TB,FWL,E,IBEG,IEND,TITLO)
C
C      READ GROUND DOSE FACTOR LIBRARY
C
C      CALL GLIBIN(NUC,ELT,AW,GRDF,TITLG)
C
C      START OF CALCULATION FOR NEXT CASE
C
C      3 CONTINUE
C      READ NEW RELEASE INVENTORY
C
C      CALL ZEROR(100,Q)
C      CALL ZEROR(300,QO)
C      READ(5,200,END=99) NIN,FINV
C
C      IF NUMBER OF NUCLIDES IS OUT OF RANGE PRINT ERROR MESSAGE AND STOP
C
C      IF(NIN.GT.NMAX.OR.NIN.LT.1) GO TO 98
C      READ(5,300,END=99) (ELTI(I),AWI(I),Q(I),I=1,NIN)

```

FOOD LISTING

```
C IDENTIFY INPUT RADIONUCLIDES
C   CALL IDNUC(NUC,ELT,AW,ELTI,AWI,Q,QO,NIN)
C COUNT ORGANS AND FOOD TYPES
C   2 CALL OFCHCK(KORG,NORG,KFDTYP,NFT)
C SET DATA ARRAYS FOR DOSE CALUCATION ACCORDING TO NUCLIDES, ORGANS
C AND FOOD PATHS SPECIFIED ON INPUT.
C   CALL SETDAT(NUC,AW,ELT,TR,TB,E,FWL,QO,REL,FINV,KORG,KFDTYP,
C .NORG,NFT,NFELT,FELT,DVEL,FTRC,DPVL,FDTC,NUC,AWO,ELTO,TRAD,TBIO,
C .IO,EN,IBEG,IEND,DFGRD,GRDF,FW)
C WRITE QUALITY ASSURANCE PAGE
C   CALL QAPAGE(TITLE1,TITLR,TITLF,TITLO,TITLG,KFDTYP,XQ,GRWP,
C .RIRR,HLDUP,CON,IDEPIAC,PLIFE,EXTIM,KORG,T2,IREC,POP,TRNS,NFT,
C .YIELD,NORG,NUC,ELTO,AWO,REL,FINV,DD,IPOP,
C .CFLO,RM,FLO,VOL,TOR,CTIM)
C CALCULATE DOSE FACTOR FOR CURRENT INVENTORY AND ORGANS.
C   CALL DFCALC(TRAD,TBIO,FW,EN,NUC,NORG,IAC,T2,DFAC,DCFAC,KORG,
C .ELTO)
C CALCULATE FOOD CONCENTRATION FACTORS
C   CALL DOSE(IDEPI,NFT,NUC,IREC,CFLO,FLO,VOL,TOR,CTIM,PLIFE,RM,
C .SLCON,EDBCON,KFDTYP,ELTO,REL,XQ,TRAD,YIELD,GRWP,DPVL,TRNS,
C .RIRR,FDTC,HLDUP,PLTCON,WATCON,AIRCON,LFCON)
C CALCULATE DOSE FROM FOOD CONCENTRATION AND DOSE FACTORS
C   CALL DOZCAL(NUC,NORG,KORG,NFT,CON,POP,EXTIM,SLCON,EDBCON,
C .DOSGRD,DINT,DCINT,TOTDOS,TOTDC,DFAC,DCFAC,DFGRD,KFDTYP)
C WRITE OUTPUT REPORTS
C   CALL DOSOUT(NFT,NORG,NUC,ELTO,TRAD,REL,IOUT,CON,XQ,RIRR,HLDUP,
C .TRNS,PLIFE,TITLE1,DINT,DCINT,TOTDOS,TOTDC,DOSGRD,KORG,DD,AWO,
C .WATCON,AIRCON,PLTCON,KFDTYP,LFCON,IPOP,T2,IPCNT)
C   IF(NEXT.GE.2)GO TO 1
C NORMAL EXIT 95
C   95 PRINT 400
C     CALL ASGF(2)
C     STOP
C INVENTORY INPUT ERROR IN SPECIFICATION OF NUMBER OF NUCLIDES.
C   98 PRINT 500, NIN,NMAX
C     CALL ASGF(2)
C     STOP
C END OF INPUT CARD FILE
C   99 PRINT 600
C     CALL ASGF(2)
C     STOP
C   97 PRINT 1009
C 1009 FORMAT(' ERROR ON NAMELIST INPUT')
C     CALL ASGF(2)
C     STOP
C FORMAT STATEMENTS
C   100 FORMAT(20A4)
C   200 FORMAT(I3,E10.2)
C   300 FORMAT(A2,A5,4X,E8.2)
```

FOOD LISTING

```
400 FORMAT(1H1,'END OF INPUT FOR THIS RUN')
500 FORMAT(1H1,'ERROR IN NUMBER OF NUCLIDES INPUT, NONUC =',I5,', MAXI
    .MUM ALLOWED IS',I4)
600 FORMAT(1H1,'END OF FILE ON INPUT, STOP')
END
```

FOOD LISTING

```
SUBROUTINE RLIBIN(ELT,AW,TR,NUC,TITLR)
DIMENSION ELT(300),AW(300),TR(300),TITLR(20)
CHARACTER AW*6
READ(10,200,END=99) TITLR
200 FORMAT(20A4)
C
C READ AND COUNT NUCLIDE ID AND HALF-LIFE DATA FROM UNIT 10
C
NUC=0
1 NUC=NUC+1
READ(10,100,END=99) ELT(NUC),AW(NUC),TR(NUC),IEND
IF(IEND.GT.0) GO TO 1
2 NUC=NUC-1
IF(NUC.GT.300) GO TO 98
IF(NUC.LT.1) GO TO 98
RETURN
C
C PRINT ERROR MESSAGES AND STOP
C
98 PRINT 300, NUC
300 FORMAT(1H1,'IMPROPER NUMBER OF NUCLIDES IN MASTER LIBRARY, NUC=',18)
CALL ASGF(2)
STOP
99 PRINT 400
100 FORMAT(A2,A6,E10.2,I2)
400 FORMAT(1H1,'END OF FILE ON MASTER LIBRARY UNIT 10')
CALL ASGF(2)
STOP
END
```

FOOD LISTING

```
SUBROUTINE FLIBIN(NFELT,FELT,DVEL,FTRC,TITLF)
C THIS MODULE READS A FOOD TRANSFER FACTOR LIBRARY
C
C      DIMENSION FELT(70),DVEL(70),FTRC(6,70),TITLF(60)
C
C SET ELEMENT COUNT INDEX NE
C
C      NE=1
C
C READ TITLE INFORMATION
C
C      READ(12,100,END=99) TITLF
100 FORMAT(20A4)
C
C READ NEXT DATA CARD
C
C      1 READ(12,300,END=2) FELT(NE),DVEL(NE),(FTRC(I,NE),I=1,6)
        NE=NE+1
        GO TO 1
C
C ON END OF FILE ON DATA CARD READ, RETURN
C
C      2 NFELT=NE-1
        RETURN
C
C ON END OF FILE ON TITLE CARD READ PRINT ERROR MESSAGE AND STOP
C
C      99 PRINT 400
400 FORMAT(1H1,'END OF FILE AT TITLE CARD ON FOOD DATA LIBRARY')
300 FORMAT(A2,7E9.2)
        CALL ASGF(2)
        STOP
        END
```

FOOD LISTING

```

      SUBROUTINE OLIBS(NUC,ELT,AW,IO,TB,FWL,E,IBEG,IEND,TITLO)
C THIS MODULE READS DATA FROM THE ORGAN DATA LIBRARY
C
C      DIMENSION ELT(300),AW(300),FWL(2000),IBEG(300),IEND(300)
C      DIMENSION TB(2000),E(2000),IO(2000)
C      DIMENSION TITLO(20),EI(3)
C      CHARACTER AW#6,A#6
C      AL2=ALOG(2.)
C
C      SET DATA ARRAYS TO ZERO
C
C      CALL ZEROI(2000,IO)
C      CALL ZEROI(NUC,IEND)
C      CALL ZEROI(NUC,IREG)
C      CALL ZEROR(2000,FWL)
C      CALL ZEROR(2000,TB)
C      CALL ZEROR(2000,E)
C
C      INITIALIZE CONTROL INTEGERS
C
C      NC=1
C      IP=0
C      NOLD=0
C      IER=0
C
C      READ ORGAN LIBRARY TITLE CARD
C
C      READ(11,100,END=99) TITLO
C      100 FORMAT(20A4)
C
C      READ FIRST DATA CARD
C
C      READ(11,200,END=99) EL,A,IOR,TBI,FWI,F2PI,(EI(I),I=1,3)
C      200 FORMAT(A2,A6,12,6E8.2)
C      1 IF(EL.NE.ELT(NC).OR.A.NE.AW(NC)) GO TO 5
C      1F(IOR.EQ.1) GO TO 2
C      1F(NOLD.NE.NC) GO TO 7
C      GO TO 3
C      2 IF(NC.GT.1) IEND(NOLD)=IP
C      NOLD=NC
C      IBEG(NC)=IP+1
C      3 IP=IP+1
C
C      SET DATA FOR CURRENT NUCLIDE AND ORGAN
C
C      FWL(IP)=FWI
C      TB(IP)=TBI
C      IO(IP)=IOR
C      E(IP)=EI(1)
C      IF(EI(3).GT.0.) E(IP)=EI(3)
C
C      READ NEXT DATA CARD
C
C      READ(11,200,END=99) EL,A,IOR,TBI,FWI,F2PI,(EI(I),I=1,3)
C      GO TO 1
C
C      INCREMENT NUCLIDE INDEX NC
C
C      6 NC=NC+1
C      1F(NC.GT.NUC) GO TO 98
C      GO TO 1
C
C      ERROR IN ORGAN LIBRARY DATA ORDER
C
C      7 PRINT 300,NC,NOLD,EL,A,ELT(NOLD),AW(NOLD)
C      300 FORMAT(1H1,'ERROR IN ORGAN DATA LIBRARY INPUT, NC, NOLD =',215/
C      .' NUCLIDE INPUT IS ',A2,A6/' NUCLIDE NOLD IS ',A2,A6)
C      CALL ASGF(2)
C      STOP
C
C      UNIDENTIFIED NUCLIDE OR OTHER PROBLEM
C
C      98 WRITE(6,401)EL,A,NC
C      401 FORMAT(' UNABLE TO IDENTIFY NUCLIDE ',A2,A6,' NUCLIDES CHECKED
C      & =',15,' --STOP')

```

FOOD LISTING

```
CALL ASGF(2)
STOP
C
C END OF FILE ON ORGAN DATA LIBRARY
C
99 IF(NOLD.GT.0) IEND(NOLD)=IP
IF(NC.GT.1) RETURN
PRINT 400,NUC,NC,NOLD,IP
400 FORMAT(1H1,'END OF FILE ON ORGAN DATA LIBRARY/
',NUCLIDES IN MASTER LIBRARY =',I4/' CURRENT NUCLIDE INDEX =',I4/
', PREVIOUS NUCLIDE INDEX =',I4/' DATA ARRAY INDEX =',I5)
CALL ASGF(2)
STOP
END
```

FOOD LISTING

```
SUBROUTINE GLIBIN(NUC,ELT,AW,GRDF,TITLG)
C THIS SUBROUTINE READS DATA FROM THE EXTERNAL DOSE FACTOR LIBRARY
C
C      DIMENSION ELT(300),AW(300),GRDF(300,2),TITLG(20)
C      CHARACTER AW#6
C      CHARACTER W#6
C
C INITIALIZE ARRAY AND CONTROL INTEGERS
C
C      NC=1
C      IP=0
C      DO 10 I=1,2
C          DO 10 J=1,300
C              GRDF(J,I)=0.0
C 10      CONTINUE
C
C READ TITLE CARD
C
C      READ(13,100,END=99)TITLG
C 100     FORMAT(20A4)
C
C READ DATA FROM FILE
C
C      READ(13,200,END=98)EL,W,GRDFI,GRDFJ
C 200     FORMAT(A2,A6,2X,E7.2,2X,E7.2)
C 1      IF(EL.NE.ELT(NC).OR.W.NE.AW(NC)) GO TO 6
C          IP=IP+1
C          IF(IP.GT.300) GO TO 97
C
C SET DATA FOR CURRENT NUCLIDE
C
C      GRDF(NC,1)=GRDFI
C      GRDF(NC,2)=GRDFJ
C
C READ NEXT DATA CARD
C
C      GO TO 2
C
C INCREMENT NUCLIDE INDEX
C
C 6      NC=NC+1
C      IF(NC.GT.NUC) GO TO 97
C      GO TO 1
C
C ERROR IN DATA LIBRARY ORDER OR SIZE
C
C 97      PRINT 301,IP,NC
C 301     FORMAT(' PROBLEM IN GROUND DOSE FACTOR LIBRARY READ',/,
C      & ' NUCLIDES FOUND = ',I5,/, ' NUCLIDES CHECKED FROM MASTER LIBRARY',
C      & ' = ',I5,' STOP')
C          CALL ASGF(2)
C          STOP
C
C END OF FILE ON DATA READ
C
C 98      IF(IP.GT.1)RETURN
C          PRINT 302
C 302     FORMAT(' GROUND DOSE FACTOR LIBRARY EMPTY--STOP')
C          CALL ASGF(2)
C          STOP
C
C END OF FILE ON TITLE READ--STOP
C
C 99      PRINT 303
C 303     FORMAT(' GROUND DOSE FACTOR TITLE READ ERROR--STOP')
C          CALL ASGF(2)
C          STOP
C          END
```

FOOD LISTING

```
SUBROUTINE OFCHCK(KORG,NORG,KFDTYP,NFT)
C THIS MODULE COUNTS ORGANS AND FOOD TYPES SPECIFIED
C DIMENSION KORG(5),KFDTYP(15)
C COUNT ORGANS INDICATED FOR DOSE CALCULATIONS
C
NORG=0
DO 10 I=1,5
IF(KORG(I).GT.0) NORG=NORG+1
10 CONTINUE
C COUNT FOOD TYPES REQUESTED FOR DOSE CALCULATION
C
NFT=0
DO 11 I=1,15
IF(KFDTYP(I).GT.0) NFT=NFT+1
11 CONTINUE
C PRINT ERROR MESSAGES IF NO ORGANS OR FOOD TYPES SPECIFIED
C
IF(NORG.GT.0) GO TO 12
PRINT 100, NORG
CALL ASGF(2)
STOP
12 IF(NFT.GT.0) RETURN
PRINT 200, NFT
CALL ASGF(2)
STOP
C FORMAT STATEMENTS
C
100 FORMAT(1H1,'NO ORGANS SPECIFIED, NORG = ',I4)
200 FORMAT(1H1,'NO FOOD TYPES SPECIFIED, NFT = ',I4)
END
```

FOOD LISTING

```
SUBROUTINE ZEROR(N,A)
C THIS MODULE SETS N VALUES OF ARRAY A TO REAL ZERO.
DIMENSION A(1)
DO 1 J=1,N
A(J)=0.
1 CONTINUE
RETURN
END
```

FOOD LISTING

```
SUBROUTINE ZEROI(N,K)
C   THIS MODULE SETS N VALUES OF ARRAY K TO INTEGER ZERO.
      DIMENSION K(1)
      DO 1 J=1,N
         K(J)=0
1    CONTINUE
      RETURN
      END
```

FOOD LISTING

```
SUBROUTINE IDNUC(NUC,ELT,AW,ELTI,AWI,Q,OO,NIN)
C THIS MODULE IDENTIFIES NUCLIDES IN INPUT INVENTORY
C DIMENSION ELT(300),AW(300),ELTI(100),AWI(100),Q(100),OO(300)
C CHARACTER AW*6,AWI*6
C INITIALIZE COUNT INDEX ON UNIDENTIFIED NUCLIDES
C      ISTOP=0
C LOOP ON NUCLIDES INPUT. TEST AGAINST MASTEP LIST.
C      DO 3 IN=1,NIN
C      DO 1 IL=1,NUC
C      ILN=IL
C      IF(ELT(IL).NE.ELTI(IN)) GO TO 1
C      IF(AW(IL).EQ.AWI(IN)) GO TO 2
C      1 CONTINUE
C      NO MATCH IN LIBRARY FOR INPUT NUCLIDE. PRINT NAME OF UNKNOWN NUCLIDE
C      ISTOP=ISTOP+1
C      PRINT 100, ELTI(IN),AWI(IN)
C      GO TO 3
C      SET MASTER INVENTORY ARRAY QO.
C      2 OO(ILN)=Q(IN)
C      3 CONTINUE
C      IF(ISTOP.LT.1) RETURN
C      PRINT TOTAL NUMBER OF UNKNOWN NUCLIDES AND STOP.
C      PRINT 200, ISTOP
100 FORMAT(1H0,'UNIDENTIFIED NUCLIDE ',A2,A6)
200 FORMAT(1H0,'THERE WERE UNIDENTIFIED NUCLIDES, ISTOP =',I4)
CALL ASGF(2)
STOP
END
```

FOOD LISTING

```

SUBROUTINE SETDAT(NUC,AW,ELT,TR,TB,E,FWL,OO,REL,FINV,KORG,KFDTYP,
.NORG,NFELT,FELT,DVEL,FTRC,DPVL,FDTC,NONUC,AWO,ELTO,TRAD,TBIO,
.IO,EN,IBEG,IEND,DFGRD,GRDF,FW)
C THIS MODULE PREPARES CONDENSED DATA ARRAYS FOR DOSE CALCULATIONS.
C THE INVENTORY IS MODIFIED BY THE FACTOR FINV.
C
      DIMENSION AW(300),ELT(300),TR(300),TB(2000),E(2000),FWL(2000)
      DIMENSION AWO(1000),ELTO(100),TRAD(100),TBIO(100,5),LFT(15)
      DIMENSION OO(300),REL(100),KORG(5),KFDTYP(15),IO(2000)
      DIMENSION FELT(70),DVEL(70),FTRC(5,70),DPVL(100),FDTC(15,100)
      DIMENSION EN(100,5),IBEG(300),IEND(300),DFGRD(100,5),
     .GRDF(300,2)
      DIMENSION FW(100,5)
      CHARACTER AW*6
      CHARACTER AWO*6
      DATA LFT/1,1,1,1,1,1,1,1,1,2,3,4,5,6,0/
C
C INITIALIZE VALID NUCLIDE COUNT, INUC, AND OTHER DATA ARRAYS
C
      INUC=0
      CALL ZEROR(100,TRAD)
      CALL ZEROR(500,TBIO)
      CALL ZEROR(1500,FDTC)
      IF(FINV.LE.0.) FINV=1.0
C
C LOOP ON MASTER NUCLIDE LIST.
C
      DO 20 IL=1,NUC
      IF(OO(IL).LE.0.) GO TO 20
C
C IGNORE NUCLIDE IL IF INVENTORY IS ZERO OR IF THERE IS NO ORGAN DATA
C
      IF(IBEG(IL).LE.0.) GO TO 19
C
C INCLUDE NUCLIDE IL IN DATA ARRAY POSITION INUC
C
      INUC=INUC+1
C
C SET DATA THAT DEPENDS ONLY ON NUCLIDE
C
      AWO(INUC)=AW(IL)
      ELTO(INUC)=ELT(IL)
      TRAD(INUC)=TR(IL)
      REL(INUC)=OO(IL)*FINV
      DFGRD(INUC,1)=GRDF(IL,1)
      DFGPD(INUC,2)=GRDF(IL,2)
C
C SET DATA FOR SELECTED ORGANS FOR CURRENT NUCLIDE
C
      I1=IREG(IL)
      I2=IEND(IL)
      DO 5 IOG=1,NORG
      DO 3 II=I1,I2
      IK=II
      IF(KORG(IOG).EQ.IO(II)) GO TO 4
      3 CONTINUE
      GO TO 5
      4 FW(INUC,IOG)=FWL(IK)
      ENC(INUC,IOG)=E(IK)
      TBIO(INUC,IOG)=TB(IK)
      5 CONTINUE
C
C SET DATA FOR SELECTED FOOD TYPES FOR CURRENT NUCLIDE BY ELEMENT.
C FIRST FIND ELEMENT.
      DO 7 IE=1,NFELT
      IEK=IE
      IF(FELT(IL).EQ.FELT(IE)) GO TO 8
      7 CONTINUE
      PRINT 200, ELT(IL),AW(IL)
      GO TO 99
      8 DPVL(INUC)=DVEL(IEK)
C
C SET FOOD TRANSFER COEFFICIENT
C
      DO 9 IFD=1,NFT
      IF(KFDTYP(IFD).EQ.15) GO TO 9

```

FOOD LISTING

```
KFD=LFT(KFDTYP(IFD))
FDT(C(IFD,INUC)=FTRC(KFD,IEK)
9 CONTINUE
GO TO 20
C
C NO DATA IN ORGAN LIBRARY, ELIMINATE THIS NUCLIDE.
C
19 PRINT 100, ELT(IL),AW(IL)
20 NONUC=INUC
IF(NONUC.LE.0) GO TO 98
RETURN
C
C FORMAT STATEMENTS
C
100 FORMAT(1H0,'NO DATA IN ORGAN LIBRARY FOR NUCLIDE ',A2,A6,' THIS NU
.CLIDE DROPPED')
200 FORMAT(1H0,'NO DATA FOR ELEMENT IN FOOD DATA LIBRARY, STOP. ',A2,
.A6)
300 FORMAT(1H0,'NONE OF INPUT NUCLIDES HAVE DATA IN LIBRARIES, NUC = '
.,13)
C
C NO DATA FOR ANY NUCLIDES IN INPUT INVENTORY.
C
98 PRINT 300, NONUC
99 CALL ASGF(2)
STOP
END
```

FOOD LISTING

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SUBROUTINE CAPAGE(TITLE1,TITLR,TITLEF,TITLO,TITLG,KFDTYP,X0,GRWP,
&RIRR,HLDUP,CON,IDEP,IAC,PLIFE,EXTIM,KORG,T2,IREC,POP,TRNS,NFT,YELD
.,NORG,NONUC,ELTO,AWO,REL,FINV,DD,IPOP,
.CFLQ,RM,FLO,VOL,TOP,CTIM)
DIMENSION TITLE1(20),TITLR(20),TITLEF(20),TITLO(20),TITLG(20)
DIMENSION KFDTYP(15),X0(15),GRWP(15),RIRR(15),HLDUP(15),CON(15)
DIMENSION KORG(5),T2(2),TRNS(15),YELD(15),ELTO(100),AWO(100),
&REL(100),PNAME(15),ONAME(23)
C
CHARACTER AW0$6,TT$8,DD$4,PNAME#10,ONAME#10,TYPE#7,PATH#5
CHARACTER TPOP#10
C
DATA(PNAME(I),I=1,15)/'LEAFY VEG.', 'O.A.G.VEG.', 'POTATOES',
&'OT.RT.VEG.', 'BERRIES', 'MELONS', 'ORCH.FRUIT', 'WHEAT',
&'OT.GRAIN', 'EGGS', 'MILK', 'BEEF', 'PORK', 'POULTRY', 'EXTERNAL'/
DATA (ONAME(I),I=1,23)/'TOTAL BODY', 'BODY WATER', 'KIDNEYS',
&'LIVER', 'SPLEEN', 'BONE', 'FAT', 'LUNGS', 'ADRENALS', 'TESTES',
&'OVARIES', 'SKIN', 'BRAIN', 'MUSCLE', 'PROSTATE', 'THYROID', 'PANCREAS'
&,'HEART', 'GI', 'STOMACH', 'SMALL INTI', 'UPPER LARG', 'LOWER LARG'/
C
CALL ADATE(DD,TT)
C
WRITE(6,1)DD,TITLE1
1 FORMAT(1H1,5X,' *** Q.A. PAGE ****',3X,'RUN ON ',A8,/,5X,
&' FOOD, VERSION 1.0, 1 AUGUST 78',/18X,' CASE TITLE: ',20A4)
CALL IDLINE
C
TPOP=' MAX. IND.'
IF(1POP.NE.0)TPOP='POPULATION'
TYPE=' ACUTE'
IF(IAC.EQ.0)TYPE='CHRONIC'
PATH='WATER'
IF(IDEF.EQ.1)PATH=' AIR'
WRITE(6,2)TYPE,PATH,TPOP
2 FORMAT(3X,' TYPE OF DOSE CALCULATED: ',A7,' INGESTION AND EXTERNA
.L EXPOSURE',/,4X,' FOR :',A5,' PATHWAY, ',A10,/)
C
WRITE(6,3)TITLE,(TITLE(I),I=1,20),TITLO,TITLG
3 FORMAT(5X,' **** DATA LIBRARIES USED:',/,8X,' RADIONUCLIDE LIBRARY:
& ',20A4,/,1 FOOD TRANSFER FACTOR LIBRARY: ',20A4,/,10X,' ORGAN DAT
& A LIBRARY: ',20A4,/,2X,' GROUND DOSE FACTOR LIBRARY: ',20A4,/)
C
WRITE(6,4)
4 FORMAT(5X,' **** FOOD DATA USED:',/,8X,' FOOD TYPE',9X,'X/Q',5X,
&'GROWING PERIOD YIELD IRR. RATE HOLDUP CON
&SUMPTION TRANSLLOCATION',/,22X,' (SEC/M**3) (DAYS) (
&KG/M**3) (L/M**2/MONTH) (DAYS) (KG/YR)',/)
DO 10 I=1,NFT
10 WRITE(6,5)PNAME(KFDTYP(I)),X0(I),GRWP(I),YELD(I),RIRR(I),
&HLDUP(I),CON(I),TRNS(I)
5 FORMAT(PX,A10.7(5X,1PE10.2E2))
WRITE(6,5)(ONAME(KORG(I)),I=1,NORG)
6 FORMAT(/,5X,' **** ORGANS CONSIDERED:',/,10X,5(10X,A10),/)
C
WRITE(6,7)(ELTO(I),AWO(I),REL(I),I=1,NONUC)
7 FORMAT(/,5X,' **** NUCLIDES CONSIDERED:',/,10X,5('NUCLIDE RELEASE
.',7X),/,9X,5('ELT. WT. (C1/YR)',6X),//,(10X,5(A2,1X,A5,1X,1PE8.2
.E2,6X)))
C
WRITE(6,8)FINV,IREC,PLIFE,CFLQ,POP,FLO,T2(1),VOL,T2(2),TOP,
.&EXTIM,CTIM
8 FORMAT(/5X,'***** SITE SPECIFIC DATA USED',T70,'*****RECONCENTRATION
.DATA USED',/,13X,'INVENTORY MODIFICATION FACTOR: ',1PE10.2E2,T97,
.'MODEL USED: ',13,/,T22,'FACILITY LIFE (YEARS): ',1PE10.2E2,T90,
.'COOLANT FLOW RATE: ',1PE10.2E2,/,T33,'POPULATION: ',1PE10.2E2,T78
.,,'COOLANT MAKEUP FLOW (FT3/SEC): ',1PE10.2E2,/,T26,
.'DOSE TIME (YEARS): ',
.1PE10.2E2,T90,'POND VOLUME (FT3): ',1PE10.2E2,/,T15,
.'DOSE COMMITMENT TIME (YEARS): ',1PE10.2E2,T94,'TURNOVER RATE: ',
.1PE10.2E2,/,T16,'EXTERNAL EXPOSURE TIME (HR): ',1PE10.2E2,T92,
.'CYCLE TIME (HR): ',1PE10.2E2)
C
WRITE(6,9)
9 FORMAT(/,20X,' INPUT PREPARED BY:',15X,'DATE:',/,38X,15(':"'),5X,
.&10(':"'),/,21X,' INPUT CHECKED BY:',15X,'DATE:',/,38X,15(':"'),5X,
.&10(':"'))
RETURN
END

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FOOD LISTING

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C THIS SUBROUTINE CALCULATES DOSE FACTORS FOR INGESTION AND          DFC00100
C EXPOSURE TO CONTAMINATED GROUND.                                     DFC00200
C   SUBROUTINE DFCALC(TRAD,TB10,FW,EN,NUC,NORG,IAC,T2,              DFC00300
&DFAC,DCFAC,KORG,ELTO)
REAL#4 MASS(23)
DIMENSION DFAC(100,5),DCFAC(100,5),EN(100,5),T2(2)
DIMENSION TEFF(100,5),TRAD(100),TB10(100,5),FW(100,5)           DFC00500
DIMENSION KORG(5),TRTM(4),TP(4),ELTO(100)

C GI TRAVEL TIMES, FRACTIONAL DAYS
DATA (TRTM(I),I=1,4)/.0417,.1667,.3333,.7500/
C TRAVEL TIMES TO GI ORGANS, FRACTIONAL DAYS
DATA (TP(I),I=1,4)/0.0,.0417,.2083,.5417/
DATA T1/1.0/

C ICRP-23 ORGAN MASSES OR GI ORGAN CONTENTS MASS
DATA (MASS(I),I=1,23)/70000.,600.,310.,180.,100.,7000.,13500.,
&1000.,14.,35.,11.,2600.,1400.,28000.,16.,20.,100.,330.,0.,250.,
.400.,250.,135./
DO 100 INUC=1,NUC
DO 100 IORG=1,NORG
JORG=KORG(IORG)
TEFF(INUC,IORG)=TRAD(INUC)*TB10(INUC,IORG)/(TRAD(INUC)+      DFC01100
&TB10(INUC,IORG))
IF (KORG(IORG) .GE. 20)GO TO 200
IF (IAC .EQ.0) GO TO 300
DFAC(INUC,IORG)=0.074*EN(INUC,IORG)*TEFF(INUC,IORG)*      DFC01200
&FW(INUC,IORG)*(1.0-EXP(-0.693/TEFF(INUC,IORG)*T2(1)*365.25))/      DFC01300
&MASS(JORG)*0.001
DCFAC(INUC,IORG)=0.074*EN(INUC,IORG)*TEFF(INUC,IORG)*      DFC01400
&FW(INUC,IORG)*(1.0-EXP(-0.693/TEFF(INUC,IORG)*T2(2)*365.25))/      DFC01500
&MASS(JORG)*0.001
GO TO 99
300 DFAC(INUC,IORG)=2.92E-4*FW(INUC,IORG)*EN(INUC,IORG)*      DFC02400
&(TEFF(INUC,IORG)**2)*(0.693/TEFF(INUC,IORG)*T1*365.25+
&EXP(-0.693/TEFF(INUC,IORG)*T2(1)*365.25)-EXP(-0.693/TEFF(INUC,
&IORG)*(T2(1)-T1)*365.25))/MASS(JORG)*0.001
DCFAC(INUC,IORG)=2.92E-4*FW(INUC,IORG)*EN(INUC,IORG)*
&(TEFF(INUC,IORG)**2)*(0.693/TEFF(INUC,IORG)*T1*365.25+
&EXP(-0.693/TEFF(INUC,IORG)*T2(2)*365.25)-EXP(-0.693/TEFF(INUC,
&IORG)*(T2(2)-T1)*365.25))/MASS(JORG)*0.001
GO TO 99
DFC03300
200 IOR=JORG-19
DFAC(INUC,IORG)=0.0255*TRTM(IOR)*EN(INUC,IORG)*FW(INUC,IORG)*
&EXP(-0.693/TRAD(INUC)*TP(IOR))/MASS(JORG)*0.001
DCFAC(INUC,IORG)=0.0256*TRTM(IOR)*EN(INUC,IORG)*FW(INUC,IORG)*
&EXP(-0.693/TRAD(INUC)*TP(IOR))/MASS(JORG)*0.001
99 CONTINUE
H='H'
C='C'
N='N'
NA='NA'
IF(ELTO(INUC).EQ.H.OR.ELTO(INUC).EQ.C)GO TO 400
IF(ELTO(INUC).EQ.N.OR.ELTO(INUC).EQ.NA)GO TO 500
GO TO 100
C
C SPECIAL CASE FOR H-3,C-14
C
400 IF(JORG.EQ.6)GO TO 100
DO 401 I=1,NORG
IF(KORG(I).NE.1)GO TO 401
DFAC(INUC,IORG)=DFAC(INUC,1)
DCFAC(INUC,IORG)=DCFAC(INUC,1)
GO TO 100
401 CONTINUE
C
C SPECIAL CASE FOR N-13,NA-22,NA-24
C
500 DO 501 I=1,NORG
IF(KORG(I).NE.1)GO TO 501
DFAC(INUC,IORG)=DFAC(INUC,1)
DCFAC(INUC,IORG)=DCFAC(INUC,1)
501 CONTINUE
100 CONTINUE
RETURN
END
DFC03800
DFC03900

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FOOD LISTING

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C ROUTINE FOR AIR AND WATER CONCENTRATION
      SUBROUTINE DOSE(IDEF,NFT,NUC,IREC,CFLO,FLO,VOL,TOP,CTIM,
      &PLIFE,RM,SLCON,EDBCON,KFDTYP,ELTO,REL,XQ,TRAD,YELD,GRWP,DPVL,
      &TRNS,RIRR,FDTc,HLDUP,PLTCON,WATCON,AIRCON,LFCON)
      REAL*4 LFCON(15,100)
      DIMENSION AIRCON(15,100),RECON(100),WATCON(100)
      DIMENSION SLCON(15,100),EDBCON(15,100),PLTCON(15,100)
      DIMENSION ELTO(100),KFDTYP(15), REL(100),XQ(15),TRAD(100),
      &DPVL(100),TRNS(15),RIRR(15),FDTc(15,100),HLDUP(15)
      DIMENSION YELD(15),GRWP(15)
      DATA TENV,DEPR,SLDN/14.,.25,224./,CHKNGC,CHKNWC/.12,.3/
      DATA COWGC,COWWC/55.,60./,BFFC,BFWC/68.,50./,PIGGC,PIGWC/4.2,10./
      DO 101 I=1,NUC
      WATCON(I)=0.0
      DO 101 J=1,NFT
      101 AIRCON(J,I)=0.0
      IF (IDEF .EQ. 1) GO TO 50
      IF (IDEF .EQ.2) GO TO 60
C CALCULATE AIR CONCENTRATION PCI/M**3
      50  DO 100 IFD=1,NFT
      IF (KFDTYP(IFD) .EQ. 0) GO TO 100
      DO 110 INUC=1,NUC
      AIRCON(IFD,INUC)=REL(INUC)*XQ(IFD)*1.E12*3.169E-8
      110 CONTINUE
      100 CONTINUE
      IF (IDEF .EQ. 1) GO TO 150
C CALCULATE WATER CONCENTRATION PCI/LITER
      60  DO 200 INUC=1,NUC
      IF (IREC .EQ. 2) GO TO 51
      IF (IREC .EQ. 3) GO TO 52
      RECON(INUC)=1./(1.-(CFLO-FLO)/(CFLO+VOL*TOR)
      &EXP(-0.693/TRAD(INUC)*CTIM*0.0417))
      GO TO 200
      51  RECON(INUC)=(1.-(VOL*EXP(-0.693/TRAD(INUC)*CTIM*0.0417)))
      &*(PLIFE*0.755/CTIM+1.)/(1.-VOL*EXP(-0.693/TRAD(INUC)*
      &CTIM*0.0417))
      GO TO 200
      52  RECON(INUC)=1.
      200  WATCON(INUC)=1119.11*RECON(INUC)*REL(INUC)*RM/CFLO
C
C FIND AN INDEX TO GIVE CORRECT FDTc TO USE IN PLTCON
C FOR NON-PLANT PATHWAYS: IPL
C
      150 CONTINUE
      DO 10 I=1,NFT
      IF(KFDTYP(I).GT.9)GO TO 10
      IPL=I
      GO TO 11
      10 CONTINUE
C
C IF THERE ARE NO PLANT PATHWAYS, PRINT MESSAGE AND STOP
C
      PRINT 12
      12 FORMAT(1H1,' THIS CODE WILL NOT RUN WITHOUT AT LEAST',
      .' ONE PLANT PATHWAY--STOP')
      STOP
      11 CONTINUE
      DO 300 IFD=1,NFT
      DO 301 INUC=1,NUC
      PLTCON(IFD,INUC)=0.0
      LFCON(IFD,INUC)=0.0
      SLCON(IFD,INUC)=0.0
      301 EDBCOn(IFD,INUC)=0.0
      ENVDC=0.0
      TAIR=0.0
      CAIR=0.0
      GRCON=0.0
      DO 399 INUC=1,NUC
      H = 'H '
      IF (ELTO(INUC) .NE. H) GO TO 310
      GO TO 1000
      310  C = 'C '
      IF (ELTO(INUC) .NE. C ) GO TO 330
      GO TO 150
      330  ENVDC=0.693/TENV + 0.693/TRAD(INUC)
      IF (IDEF .EQ. 2) GO TO 340
      LFCON(IFD,INUC)=DEPFR*TRNS(IFD)*AIRCON(IFD,INUC)*DPVL(INUC)*

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FOOD LISTING

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&(1.-EXP(-ENVDC#GRWP(IFD)))/(YELD(IFD)#ENVDC):86400.
    SLCON(IFD,INUC)=AIRCON(IFD,INUC)#DPVL(INUC):(1.-EXP(-0.693/
&TRAD(INUC)#PLIFE#355))/(0.693/TRAD(INUC))/SLDN#86400.
    IF (IDEP .EQ. 1) GO TO 320
340    LFCON(IFD,INUC)=LFCON(IFD,INUC)+DEPFR#TRNS(IFD)#WATCON(INUC)
&#RIRR(IFD)/2.635E6:(1.-EXP(-ENVDC#GRWP(IFD)))/(YELD(IFD)
&#ENVDC):86400
    SLCON(IFD,INUC)=SLCON(IFD,INUC)+WATCON(INUC)#RIRR(IFD)/2.635E6#
&(1.-EXP(-0.693/TRAD(INUC)#PLIFE#355.25))/(0.693/TRAD(INUC))/
&SLDN#86400
320    IF (KFDTYP(IFD) .EQ. 15) GO TO 400
    PLTCON(IFD,INUC)=LFCON(IFD,INUC)+SLCON(IFD,INUC)#FDTCC(IPL,INUC)
    IF(KFDTYP(IFD) .GT. 9)GO TO 350
    EDBCON(IFD,INUC)=PLTCON(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP
&(IFD))
    GO TO 400
350    IF(KFDTYP(IFD) .EQ. 11) GO TO 370
    IF(KFDTYP(IFD) .EQ. 12) GO TO 375
    IF(KFDTYP(IFD) .EQ. 13) GO TO 380
    IF(KFDTYP(IFD) .EQ. 14) GO TO 385
    EDRCON(IFD,INUC)=(CHKNGC#PLTCON(IFD,INUC)+CHKNWC#WATCON(INUC))
&#FDTCC(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP(IFD))
    GO TO 400
370    EDBCON(IFD,INUC)=(COWGC#PLTCON(IFD,INUC)+COWWC#WATCON(INUC))#
&FDTCC(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP(IFD))
    GO TO 400
375    EDBCON(IFD,INUC)=(BFFC#PLTCON(IFD,INUC)+BFWC#WATCON(INUC))#
&FDTCC(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP(IFD))
    GO TO 400
380    EDBC CN(IFD,INUC)=(PIGGC#PLTCON(IFD,INUC)+PIGWG#WATCON(INUC))#
&FDTCC(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP(IFD))
    GO TO 400
385    EDBCON(IFD,INUC)=(CHKNGC#PLTCON(IFD,INUC)+CHKNWC#WATCON(INUC))
&#FDTCC(IFD,INUC):EXP(-0.693/TRAD(INUC)#HLDUP(IFD))
    GO TO 400
C TRITIUM PLANT CONCENTRATION
1000    CONTINUE
        DATA H1,H2,H3,H4,H5,H6,H7,H8/9.,.008,.0625,.083,.094,
&.10,.087,.092/,W1,W2,W3,W4,W5,W6,W7,W8/.80,.12,.80,.88,.60,
&.50,.70,.75/
        IF (IDEP .EQ. 2) GO TO 450
C CALCULATE TRITIUM AIR CONCENTRATION PCI/KG OF H
        TAIR=AIRCON(IFD,INUC):H1/H2
C CALCULATE PLANT CONCENTRATION - LEAF ROUTE PCI/KG
        LFCON(IFD,INUC)=TAIP:(W1/H1+(1.-W1):H3)
C CALCULATE SOIL CONCENTRATION PCI/KG
        SLCON(IFD,INUC)=AIRCON(IFD,INUC):Z1/H2
        IF (KFDTYP(IFD) .EQ. 15) GO TO 400
        PLTCON(IFD,INUC)=LFCON(IFD,INUC)+SLCON(IFD,INUC)#FDTCC(IPL,INUC)
        IF (IDEP .EQ. 1) GO TO 500
C CALCULATE TRITIUM WATER CONCENTRATION PCI/KG OF H
450    TWATE=WATCON(INUC):H1
        LFCON(IFD,INUC)=TWAT:(W1/H1+(1.-W1):H3)
        SLCON(IFD,INUC)=SLCON(IFD,INUC)+WATCON(INUC):Z1
        PLTCON(IFD,INUC)=PLTCON(IFD,INUC)+LFCON(IFD,INUC)+#
&SLCON(IFD,INUC):FDTCC(IPL,INUC)
        IF (KFDTYP(IFD) .EQ. 15) GO TO 400
500    IF (KFDTYP(IFD) .LT. 8) GO TO 550
        IF (KFDTYP(IFD) .GT. 9) GO TO 600
        LFCON(IFD,INUC)=LFCON(IFD,INUC):(W2/H1+(1.-W2):H3)/
&(W1/H1+(1.-W1):H3)
        PLTCON(IFD,INUC)=LFCON(IFD,INUC)
550    EDBCON(IFD,INUC)=PLTCON(IFD,INUC):EXP(-0.693/TRAD(INUC))#
&HLDUP(IFD))
        GO TO 400
C CALCULATE ANIMAL PRODUCTS CONCENTRATION
C CALCULATE TRITIUM GRAIN CONCENTRATION PCI/KG
500    GRCON=(W2/H1+(1.-W2):H3)/(W1/H1+(1.-W1):H3)
        IF(KFDTYP(IFD) .EQ. 11)GO TO 610
        IF (KFDTYP(IFD) .EQ. 12) GO TO 620
        IF(KFDTYP(IFD) .EQ. 13) GO TO 630
        IF(KFDTYP(IFD) .EQ. 14) GO TO 640
        LFCON(IFD,INUC)=LFCON(IFD,INUC):GPCON
        PLTCON(IFD,INUC)=LFCON(IFD,INUC)
        EDBCON(IFD,INUC)=(CHKNGC#PLTCON(IFD,INUC)+CHKNWC#WATCON(INUC))/
&(CHKNGC:(W2/H1+(1.-W2):H3)+CHKNWC/H1):(W8/H1+(1.-W8):H8)
        GO TO 400

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FOOD LISTING

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610  LFCON(IFD,INUC)=LFCON(IFD,INUC)*(W3/H1+(1.-W3)*
&H3)/(W1/H1+(1.-W1)*H3)
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDBCON(IFD,INUC)=(COWGC*PLTCON(IFD,INUC)+COWWC*WATCON(INUC))/(
&(COWGC*(W3/H1+(1.-W3)*H3)+COWWC/H1)*(W4/H1+(1.-W4)*H4)
      GO TO 400
620  LFCON(IFD,INUC)=LFCON(IFD,INUC)*GRCON
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDBCON(IFD,INUC)=(BFFC*PLTCON(IFD,INUC)+BFWC*WATCON(INUC))/(
&(BFFC*(W2/H1+(1.-W2)*H3)+BFWC/H1)*(W5/H1+(1.-W5)*H5)
      GO TO 400
630  LFCON(IFD,INUC)=LFCON(IFD,INUC)*GRCON
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDRCON(IFD,INUC)=(PIGGC*PLTCON(IFD,INUC)+PIGWC*WATCON(INUC))/(
&(PIGGC*(W2/H1+(1.-W2)*H3)+PIGWC/H1)*(W6/H1+(1.-W6)*H6)
      GO TO 400
640  LFCON(IFD,INUC)=LFCON(IFD,INUC)*GRCON
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDRCON(IFD,INUC)=(CHKNGC*PLTCON(IFD,INUC)+CHKNWC*WATCON(INUC))/(
&(CHKNGC*(W2/H1+(1.-W2)*H3)+CHKNWC/H1)*(W7/H1+(1.-W7)*H7)
      GO TO 400
C CARBON-14 PLANT CONCENTRATION
1500 CONTINUE
      DATA C0,C1,C2,C3,C4,C5,C6,C7,C8,C9/2.1E-5,1.5E-4,.11,
&.40,.11,.059,.24,.33,.20,.15/,Z1,Z2/.10,.03/
      IF (IDEP.EQ. 2) GO TO 700
C CALCULATE C-14 AIR CONCENTRATION - PCI/KG OF C
      CAIR=AIRCON(IFD,INUC)/C1
C CALCULATE C-14 PLANT CONCENTRATION - LEAF ROUTE
      LFCON(IFD,INUC)=CAIR*C2
      SLCON(IFD,INUC)=CAIR*Z2
      IF (KFDTYP(IFD) .EO. 15) GO TO 400
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)+SLCON(IFD,INUC)*FDTCC(IPL,INUC)
      IF (IDEP.EQ. 1) GO TO 750
C CALCULATE C-14 WATER CONCENTRATION - PCI/KG OF C
      CWAT=WATCON(INUC)/C0
      LFCON(IFD,INUC)=CWAT*C2
      SLCON(IFD,INUC)=SLCON(IFD,INUC)+CWAT*Z2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)+SLCON(IFD,INUC)*FDTCC(IPL,INUC)
      &+PLTCON(IFD,INUC)
      IF (KFDTYP(IFD) .EO. 15) GO TO 400
550  IF (KFDTYP(IFD) .LT. 8) GO TO 750
      IF (KFDTYP(IFD) .GT. 9) GO TO 800
      LFCON(IFD,INUC)=LFCON(IFD,INUC)*C3/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDRCON(IFD,INUC)=PLTCON(IFD,INUC)
      GO TO 400
800  IF (KFDTYP(IFD) .EO. 11) GO TO 810
      IF (KFDTYP(IFD) .EO. 12) GO TO 820
      IF (KFDTYP(IFD) .EO. 13) GO TO 830
      IF (KFDTYP(IFD) .EO. 14) GO TO 840
      LFCON(IFD,INUC)=LFCON(IFD,INUC)*C3/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDRCON(IFD,INUC)=PLTCON(IFD,INUC)/C3*C9
      GO TO 400
810  LFCON(IFD,INUC)=LFCON(IFD,INUC)*C4/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDRCON(IFD,INUC)=PLTCON(IFD,INUC)/C4*C5
      GO TO 400
820  LFCON(IFD,INUC)=LFCON(IFD,INUC)*C3/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDBCON(IFD,INUC)=PLTCON(IFD,INUC)/C3*C6
      GO TO 400
830  LFCON(IFD,INUC)=LFCON(IFD,INUC)*C3/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDBCON(IFD,INUC)=PLTCON(IFD,INUC)*C3*C7
      GO TO 400
840  LFCON(IFD,INUC)=LFCON(IFD,INUC)*C3/C2
      PLTCON(IFD,INUC)=LFCON(IFD,INUC)
      EDBCON(IFD,INUC)=PLTCON(IFD,INUC)/C3*C8
400  CONTINUE
399  CONTINUE
      IF (KFDTYP(IFD) .EO. 15) GO TO 900
300  CONTINUE
900  RETURN
      END

```

FOOD LISTING

```

C THIS SUBROUTINE CALCULATES THE RADIATION DOSE FROM
C FROM INGESTION OF CONTAMINATED FARM PRODUCTS AND
C EXPOSURE TO CONTAMINATED GROUND
    SUBROUTINE DOZCAL (NONUC,NORG,KORG,NFT,CON,POP,EXTIM,SLCON,EDBCON
& ,DOSGRD,DINT,DCINT,TOTDOS,TOTDC,DFAC,DCFAC,DFGRD,KFDTYP)
        DIMENSION DOSGRD(100,5),DFAC(100,5),DFGRD(100,5),DINT(15,100,5)
        DIMENSION SLCON(15,100),EDBCON(15,100),KFDTYP(15),CON(15)
        DIMENSION KORG(5)
        DIMENSION DCINT(15,100,5),DCFAC(100,5),TOTDOS(100,5),TOTDC(100,5)
C DOSE FROM EXPOSURE TO CONTAMINATED GROUND
    DATA SLDN/224./
    CALL ZEROR(500,TOTDC)
    CALL ZERORC(500,TOTDOS)
    CALL ZEROR(7500,DINT)
    CALL ZERORC(7500,DCINT)
    DO 60 I=1,NFT
    IF(KFDTYP(I) .NE. 15)GO TO 60
    DO 100 INUC=1,NONUC
        DOSGRD(INUC,1)=DFGRD(INUC,1)*SLCON(I,INUC)*SLDN*EXTIM*POP*.001
100     DOSGRD(INUC,2)=DFGRD(INUC,2)*SLCON(I,INUC)*SLDN*EXTIM*POP*.001
    60 CONTINUE
C USE UNUSED ARRAY SPACE FOR EXTERNAL TOTALS
    DOSGRD(1,3)=0.0
    DOSGRD(1,4)=0.0
    DO 150 INUC=1,NONUC
        DOSGRD(1,3)=DOSGRD(1,3)+DOSGRD(INUC,1)
        DOSGRD(1,4)=DOSGRD(1,4)+DOSGRD(INUC,2)
150 CONTINUE
C INTERNAL DOSE DUE TO INGESTION OF CONTAMINATED FARM PRODUCTS
    DO 200 IFD=1,NFT
    IF (KFDTYP(IFD) .EQ. 0.) GO TO 200
    IF (KFDTYP(IFD) .EQ. 15.) GO TO 200
    DO 300 INUC=1,NONUC
    DO 300 IORG=1,NORG
    IF (DFAC(INUC,IORG) .EQ. 0.) GO TO 300
    DINT(IFD,INUC,IORG)=DFAC(INUC,IORG)*EDBCON(IFD,INUC)*CON(IFD)*
& POP
    DCINT(IFD,INUC,IORG)=DCFAC(INUC,IORG)*EDBCON(IFD,INUC)*CON(IFD)*
& POP
    TOTDOS(INUC,IORG)=TOTDOS(INUC,IORG)+DINT(IFD,INUC,IORG)
    TOTDC(INUC,IORG)=TOTDC(INUC,IORG)+DCINT(IFD,INUC,IORG)
300     CONTINUE
200     CONTINUE
    RETURN
END

```

FOOD LISTING

```

SUBROUTINE DOSOUT(NFT,NORG,NONUC,ELTO,TRAD,REL,IOUT,
&CON,XQ,RIRR,HLDUP,TRNS,PLIFE,TITLE1,DINT,DCINT,TOTDOS,
&TOTDC,DOSGRD,KORG,DD,AWO,WATCON,AIRCON,PLTCON,KFDTYP,LFCON,
&IPOP,T2,IPCNT)
REAL#4 LFCON(15,100)
DIMENSION KORG(5),WATCON(100),AIRCON(15,100),PLTCON(15,100)
DIMENSION KFDTYP(15),TDDOSE(5),T2(2)
DIMENSION DINT(15,100,5),DCINT(15,100,5),DOSE(4,5),DOSCOM(4,5),
&TTDOSE(5),ONA(5),FNAME(4),ELTO(100),TRAD(100),REL(100),CON(15),
&TOTDOS(100,5),TOTDC(100,5),DOSGRD(100,5),PNAME(15),XQ(15),
&RIRR(15),HLDUP(15),TRNS(15),ONAME(23),TITLE1(20),AWO(100)
DIMENSION AM(2)
CHARACTER AM#7
CHARACTER DD#8
CHARACTER AWO#6
CHARACTER ONAME#10
CHARACTER FNAME#7
CHARACTER PNAME#10
CHARACTER ONA#10
DATA (FNAME(I),I=1,4)/*PRODUCE','EGGS ','MILK ','MEAT  */
DATA (PNAME(I),I=1,15)/*LEAFY VEG.', 'O.A.G. VEG', 'POTATOES ',
&'OT.RT.VEG.', 'BERRIES ', 'MELONS ', 'ORCH.FRUIT', 'WHEAT  ',
&'OT.GRAIN', 'EGGS', 'MILK', 'BEEF', 'PORK', 'POULTRY', 'EXTERNAL'
DATA (ONAME(I),I=1,23)/*TOTAL BODY', 'BODY WATER', 'KIDNEYS',
&'LIVER', 'SPLEEN', 'BONE', 'FAT', 'LUNGS', 'ADRENALS', 'TESTES',
&'OVARIES', 'SKIN', 'BRAIN', 'MUSCLE', 'PROSTATE', 'THYROID', 'PANCREAS',
&'HEART', 'GI', 'STOMACH', 'SMALL INT', 'UPPER LARG', 'LOWER LARG*/
DATA AM(1),AM(2)/* REM , 'MAN-REM'/
M=1
IF(IPOP.NE.0)M=2
CALL ZEROR(20,DOSE)
CALL ZEROR(20,DOSCOM)
C
C CALCULATE INTERMEDIATE DOSE TOTALS FOR SUMMARY PAGE
DO 100 IFD=1,NFT
IF (KFDTYP(IFD) .EO. 0) GO TO 100
IF (KFDTYP(IFD) .LT. 10) GO TO 110
IF (KFDTYP(IFD) .EO. 10) GO TO 120
IF (KFDTYP(IFD) .EQ. 11) GO TO 130
IF (KFDTYP(IFD) .LT. 15) GO TO 140
GO TO 100
110 DO 101 IORG=1,NORG
DO 101 INUC=1,NONUC
DOSE(1,IORG)=DOSE(1,IORG)+DINT(IFD,INUC,IORG)
101 DOSCOM(1,IORG)=DOSCOM(1,IORG)+DCINT(IFD,INUC,IORG)
GO TO 100
120 DO 102 IORG=1,NORG
DO 102 INUC=1,NONUC
DOSE(2,IORG)=DOSE(2,IORG)+DINT(IFD,INUC,IORG)
DOSCOM(2,IORG)=DOSCOM(2,IORG)+DCINT(IFD,INUC,IORG)
102 CONTINUE
GO TO 100
130 DO 103 IORG=1,NORG
DO 103 INUC=1,NONUC
DOSE(3,IORG)=DOSE(3,IORG)+DINT(IFD,INUC,IORG)
DOSCOM(3,IORG)=DOSCOM(3,IORG)+DCINT(IFD,INUC,IORG)
103 CONTINUE
GO TO 100
140 DO 104 IORG=1,NORG
DO 104 INUC=1,NONUC
DOSE(4,IORG)=DOSE(4,IORG)+DINT(IFD,INUC,IORG)
DOSCOM(4,IORG)=DOSCOM(4,IORG)+DCINT(IFD,INUC,IORG)
104 CONTINUE
100 CONTINUE
DO 151 I=1,NORG
TTDOSE(I)=0.0
151 TTDOSE(I)=0.0
DO 150 IORG=1,NORG
DO 150 ID=1,4
TDDOSE(IORG)=TDDOSE(IORG)+DOSCOM(ID,IORG)
150 TTDOSE(IORG)=TTDOSE(IORG)+DOSE(ID,IORG)
C
C SHORT SUMMARY
C
PRINT 649
649 FORMAT(1H1)

```

FOOD LISTING

```

      PRINT 13, TITLE1,DD
13   FORMAT(4X,20A4,10X,A8)
      PRINT 14
14   FORMAT(1H0,'FOOD',10X,'VERSION 1.0', 10X,'1 AUGUST 78')
      WRITE(6,650) AM(M),T2(1)
650  FORMAT(///,' *** DOSE SUMMARY, ',A7,' FOR ',1PE8.1E2,' YEARS
& ***')
      DO 160 IORG=1,NORG
160  ONA(IORG)=ONAME(KORG(IORG))
      PRINT 10,(ONA(IORG),IORG=1,NORG)
10   FORMAT(1H0,14X, 5(A10,5X),/)
      DO 170 J=1,4
      PRINT 11, FNAME(J),(DOSE(J,IORG),IORG=1,NORG)
11   FORMAT(1H ,A7,5X,5(1PE10.2E2,5X))
170  CONTINUE
      PRINT 12,(TDOSE(IORG),IORG=1,NORG)
12   FORMAT(/, ' INT. TOTAL',2X,5(1PE10.2E2,5X))
      PRINT 16,DOSGRD(1,3),DOSGRD(1,4)
16   FORMAT(/, ' EXTERNAL DOSE TOTALS',10X,'SKIN',5X,
. 'TOTAL BODY',/,28X,1PE9.2E2,4X,1PE9.2E2)
      PRINT 15, TITLE1,DD
15   FORMAT(////,4X,20A4,10X,A8)
      PRINT 14
      WRITE(6,651) AM(M),T2(2)
651  FORMAT(///,' *** DOSE COMMITMENT SUMMARY, ',A7,
& ' FOR A COMMITMENT TIME OF ',1PE8.1E2,' YEARS ***')
      PRINT 10, (ONA(IORG),IORG=1,NORG)
      DO 180 J=1,4
      PRINT 11,FNAME(J),(DOSCOM(J,IORG),IORG=1,NORG)
180  CONTINUE
      PRINT 12, (TDOSE(IORG),IORG=1,NORG)
      PRINT 16,DOSGRD(1,3),DOSGRD(1,4)
C
C SUMMARY BY NUCLIDE
C
      PRINT 20
20   FORMAT(1H1,'SUMMARY OF NUCLIDE CONTRIBUTORS')
      PRINT 13,TITLE1,DD
      PRINT 14
      PRINT 21
21   FORMAT(1H0,' ALL FOOD PRODUCTS')
      DO 200 IORG=1,NORG
      TDORG=0.0
      TDCORG=0.0
      DO 210 INUC=1,NUC
      TDORG=TDORG+TOTDOS(INUC,IORG)
210  TDCORG=TDCORG + TOTDC(INUC,IORG)
      ONA(IORG)=ONAME(KORG(IORG))
      PRINT 22, ONA(IORG)
22   FORMAT(///,1X,A10)
      PRINT 23
23   FORMAT(1H , 'NUCLIDE',6X,'HALF-LIFE',4X,'RELEASE',7X,'DOSE',
&8X,'%',5X,'DOSE COMM',5X,'%')
      PRINT 24, AM(M),AM(M)
24   FORMAT(1H ,15X,'DAYS',9X,'CI/YR',5X,A7,14X,A7,/)
      DO 250 INUC=1,NUC
      IDPER=TOTDOS(INUC,IORG)/TDORG*100
      IDCPER=TOTDC(INUC,IORG)/TDCORG*100
      IF (IDPER .GE. IPCNT) GO TO 260
      IF (IDCPER .LT. IPCNT) GO TO 250
250  PRINT 25, ELTO(INUC),AWO(INUC),TRAD(INUC),REL(INUC),
&TOTDOS(INUC,IORG),IDPER,TOTDC(INUC,IORG),IDCPER
25   FORMAT(1X,A4,A6,3X,1PE8.2E2,5X,1PE8.2E2,2(5X,1PE7.1E2,5X,13))
250  CONTINUE
      PRINT 26,TDORG,TDCORG
26   FORMAT(1H , 'TOTAL',34X,1PE7.1E2,13X,1PE7.1E2)
200  CONTINUE
C
C CHART FOR EXTERNAL DOSE
C
      PRINT 27
27   FORMAT(///,' EXTERNAL DOSE',/)
      PRINT 28
28   FORMAT(1H , 'NUCLIDE',6X,'HALF-LIFE',4X,'RELEASE',6X,
&3X,'DOSE-SKIN',3X,'%',3X,'DOSE-TOT BODY',1X,'%',/)
      TDGRD1=0.0

```

FOOD LISTING

```

        TDGRD2=0.0
        DO 225 INUC=1,NONUC
        TDGRD1=TDGRD1 + DOSGRD(INUC,1)
225      TDGRD2=TDGRD2 + DOSGRD(INUC,2)
        DO 230 INUC=1,NONUC
        IDPER1=DOSGRD(INUC,1)/TDGRD1*100.
        IDPER2=DOSGRD(INUC,2)/TDGRD2*100.
        IF(IDPER1 .GE. IPCNT) GO TO 235
        IF(IDPER2 .LT. IPCNT) GO TO 230
235      PRINT 29,ELTDC(INUC),AWO(INUC),TRAD(INUC),REL(INUC),
&DOSGRD(INUC,1),IDPER1,DOSGRD(INUC,2),IDPER2
29      FORMAT(1H ,A4,A6,3(5X,1PE8.2E2),3X,13,5X,1PE8.2E2,3X,13)
230      CONTINUE
        PRINT 30, TDGRD1,TDGRD2
30      FORMAT(1H , 'TOTAL',36X,1PE8.2E2,11X,1PE8.2E2)
C
C COMPLETE INFORMATION LISTING -- OPTIONAL
C
        IF (IOUT .EQ. 0) GO TO 399
        DO 300 IFD=1,NFT
        PRINT 649
        IF(IFD.EQ.1)PRINT 13,TITLE1
        IF(IFD.EQ.1)PRINT 14
        IF(KFDTYP(IFD) .EQ. 0 .OR. KFDTYP(IFD) .EQ. 15) GO TO 300
        PRINT 36,PNAME(KFDTYP(IFD)),CON(IFD),XQ(IFD),RIRR(IFD),
&HLDUP(IFD),TRNS(IFD),PLIFE
36      FORMAT(1X,A10,/,1X,10('='),' CONSUMPTION = ',1PE8.2E2,T50,
&' X/Q = ',1PE8.2E2,
.T80,' IRRIGATION RATE = ',1PE8.2E2,/,T12,' HOLDUP = ',
.1PE8.2E2,T50,
.' TRANSLOCATION = ',1PE8.2E2,T80,' PLANT LIFE (YRS) = ',
.1PE8.2E2)
        DO 325 IORG=1,NORG
        TDNUC=0.0
        TDCNUC=0.0
        DO 350 INUC=1,NONUC
        TDNUC=TDNUC + DINT(IFD,INUC,IORG)
360      TDCNUC=TDCNUC + DCINT(IFD,INUC,IORG)
        ONA(IORG)=ONAME(KDRG(IORG))
        IFLAG=0
        IF(TDCNUC.LE.0)GO TO 325
        PRINT 37,ONA(IORG)
        PRINT 31
        PRINT 32, AM(M),AM(M)
        IFLAG = 1
500      CONTINUE
37      FORMAT(1X,A10,/)
31      FORMAT(1H , 'NUCLIDE',6X,'HALF-LIFE',4X,'RELEASE',4X,
&'CONCENTRATION',10X,' FRACTION ',6X,'PLANT',7X,'DOSE',8X,'%',',
&10X,'DOSE COMM',5X,'%')
32      FORMAT(1H ,15X,'DAYS',8X,'C1/YR',5X,'WATER',5X,'AIR',7X,
&'LEAF',4X,'ROOT',7X,'CONC',6X,A7,18X,A7,/,1X,130(''))
        DO 350 INUC=1,NONUC
        FL=LFCON(IFD,INUC)/PLTCON(IFD,INUC)
        FR=(1.-FL)
        KDPER=DINT(IFD,INUC,IORG)/TDNUC*100
        KDCPER=DCINT(IFD,INUC,IORG)/TDCNUC*100
        IF(KDPER .GE. IPCNT) GO TO 370
        IF(KDCPER .LT. IPCNT) GO TO 350
370      CONTINUE
        PRINT 34,ELTDC(INUC),AWO(INUC),TRAD(INUC),REL(INUC),WATCON
&(INUC),AIRCON(IFD,INUC),FL,FR,PLTCON(IFD,INUC),DINT(IFD,INUC,
&IORG),KDPER,DCINT(IFD,INUC,IORG),KDCPER
34      FORMAT(1X,A4,A6,5X,2(1PE8.2E2,2X),2(1PE7.1E2,3X),2(1PE7.1E2,2X),
&2X,2(1PE7.1E2,5X),13,10X,1PE7.1E2,5X,13)
350      CONTINUE
        IF(IFLAG.EQ.1)PRINT 35,TDNUC,TDCNUC
35      FORMAT(88X,7(''),T114,7(''),/,1X,'TOTAL',82X,1PE7.1E2,18X,
.1PE7.1E2)
325      CONTINUE
300      CONTINUE
399      RETURN
        END

```

APPENDIX F

INPUT PREPARATION AND DIAGNOSTICS FOR ARRRG

APPENDIX F

INPUT PREPARATION AND DISGNOSTICS FOR ARRRG

The input data required by ARRRG for the calcualtions falls into four categories: program control, reconcentration, site, and release parameters. The program control, reconcentration, and site parameters are input through the namelist. The radionuclide release parameters are formatted input. The rest of the data required by ARRRG for the calculations is contained in four data libraries that are accessed by the code (see Appendix E), thus eliminating much effort in preparing the input.

This appendix describes in detail the variables input to ARRRG, their use, and the manner in which they are entered. The code has some self-generated diagnostics if an error is made on input. These are discussed after the input parameters. An ARRRG sample problem and input deck are presented in Appendix H.

ARRRG DATA CARD DESCRIPTIONS

Card 1--Title Card

An entire card in Format 20A4. Words entered here are reprinted as a title on the output pages. Each following case requires either a title or a 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 \$END. 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:

ARRRG NAMELIST VARIABLES

A. Program Control Parameters.

1. NEXT: This variable controls the isotopic data input after the NAMELIST read. There are 4 options corresponding to NEXT = 1, 2, 3, 4.
 NEXT = 1: Read isotopic data, do computations, and end.
 NEXT = 2: Read isotopic data, do computations, and prepare to do another case.
 NEXT = 3: Use previously input isotopic data, do computations, and prepare to do another case (NEXT = 3 cannot be used on a first case).
 NEXT = 4: Stop.
2. IAC: Key for type of dose calculated.
 IAC = 0 (default) Chronic
 IAC = 1 Acute (accidental)
3. KORG(5): Numeric definition of organs considered, up to 5 allowed.

<u>Number</u>	<u>Organ</u>
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
19	GE
20	Stomach
21	Small Intestine
22	Upper Large Intestine
23	Lower Large Intestine

4. T2(2): Dose and Dose Commitment Times (years)
5. PLIFE: Facility lifetime (years)
6. IPCNT: The percent cutoff for reporting results. The output subroutine will print all contributors above the IPCNT cutoff. Defaults to zero. This option is useful in reducing output of long runs.

B. Reconcentration Parameters

7. IREC: Key for reconcentration model used.

IREC = 1, cooling water is drawn from a cooling pond, small lake or reservoir which is connected to a larger body of water or is fed by a stream. Requires NAMELIST variables CFL0, FLO, CTIM, VOL and TOR (described below) be included.

IREC = 2, the cooling water inlet is downriver from the outfall, or on a lake or ocean site arranged such that recirculation occurs. Requires that NAMELIST variables CTIM and RCYF be included.

IREC = 3, no reconcentration, RECON = 1.

8. CFL0: Coolant flow in ft^3/sec .
9. FLO: Makeup flow, ft^3/sec (water drawn into the intake to replace losses).

- 10: CTIM: Cycle time, hours.
11. TOR: Pond turnover rate, inverse seconds.
12. VOL: Pond volume, ft³.
13. RCYF: The recycle fraction (the mixing ratio at the point of intake).

C. Site Parameters

14. IPOP: Key for population considered
IPOP = 0 (default) Maximum Individual (POP = 1.0)
IPOP = 1 Population
15. POP: Population size; defaults to 1.0 for use with default IPOP = 0,
Maximum Individual
16. ISALT: Key for bioaccumulation factors
ISALT = 0 fresh water factors
ISALT = 1 salt water factors. Note that if ISALT = 1, the drinking
water pathway should logically not be used.
17. KPTHWY(8): Key for definition of exposure pathways for which to do
computation.

Number	Pathway
1	Fish
2	Crustacea
3	Molluscs
4	Water plants
5	Drinking water
6	Shoreline external exposure
7	Swimming external exposure
8	Boating external exposure

18. RM(8): Mixing ratio at each of the corresponding dose pathways
(dimensionless)
19. HLDUP(8): Holdup (days) for each of the corresponding pathways.
20. USAG(8): Usage for each of the exposure pathways; kg/yr for edibles,
l/yr for drinking water, and hr/yr for external exposure.
21. SW: Shore Width Factor for external exposure pathways.

D. RELEASE PARAMETERS (Cards N + I to M)

The release cards are used to characterize the source term. The first card supplies the number of nuclides to be read and a modification factor,

if desired. The remaining cards give the nuclide name and release rate in Ci/yr.

Card N + 1 supplies NIN and FINV; FORMAT 13, E10.2 FINV defaults to 1.0 if left blank.

The following cards hold [ELTI(I), AWI(I), and Q(I), I = 1,NIN] FORMAT A2, A6, 4X, E8.2.

The formats of ELTI and AWI must precisely match those of RMDLIB, otherwise a match cannot be made.

A sample input deck listing is provided in Appendix H.

ARRRG SELF-GENERATED DIAGNOSTICS

If an error or anomaly is detected, the program ARRRG will write an informative message. These come from several places in the code. These are listed below, with some hints as to what might be wrong. The list is ordered by originating routine.

MAIN

1. END OF INPUT FOR THIS RUN. Normal termination.
2. END OF FILE INPUT, STOP. The code was expecting another case, but ran out of data cards.
3. ERROR IN NUMBER OF NUCLIDES INPUT, NONUC = XXX, MAXIMUM ALLOWED IS XXX. There were either zero or too many inventory cards.
4. ERROR ON INPUT NAMELIST, STOP. Something in the namelist may be misspelled.

RLIBIN

5. IMPROPER NUMBER OF NUCLIDES IN MASTER LIBRARY, NUC = XXXX.
6. END OF FILE ON MASTER LIBRARY UNIT 10.

These two indicate a problem with the radionuclide master data library.

OLIBS

7. ERROR IN ORGAN DATA LIBRARY INPUT, NC, NOLD = XXX, NUCLIDE INPUT IS XXXXX, NUCLIDE NOLD IS XXX. There is an error in the order of the organ data library compared with the radionuclide master data library.

8. UNABLE TO IDENTIFY NUCLIDE XXXXX, NUCLIDES CHECKED = XXX--STOP. There is a nuclide in the organ library that is not in the master library.
9. END OF FILE ON ORGAN DATA LIBRARY.
NUCLIDES IN MASTER LIBRARY = XXX.
CURRENT NUCLIDE INDEX = XXX.
PREVIOUS NUCLIDE INDEX = XXX.
DATA ARRAY INDEX = XXX.

The organ data file ended before any data could be obtained.

SLIBIN

10. EXTERNAL DOSE FACTOR LIBRARY TITLE READ ERROR, STOP.
11. EXTERNAL DOSE FACTOR LIBRARY EMPTY, STOP.
12. PROBLEM IN EXTERNAL DF LIBRARY READ
NUCLIDES FOUND = XXX.
NUCLIDES CHECKED FROM MASTER LIBRARY = XXX, STOP.

These three messages indicate a problem with the external dose factor file.

BLIBIN

13. END OF FILE ON TITLE CARD READ,
BIOACCUMULATION LIBRARY, STOP.

IDNUC

14. UNIDENTIFIED NUCLIDE XXXXX.
15. THERE WERE UNIDENTIFIED NUCLIDES,
ISTOP = XXX. There is an error in the input source term.

OPCHCK

16. NO ORGANS SPECIFIED, NORG = XXX.
KORG was probably omitted from Namelist.
17. NO PATHWAYS SPECIFIED, NPT = XXX.
KPTHWY was probably omitted from Namelist.
18. NO ORGANS OR PATHWAYS SPECIFIED, NORG, KORG = XXX, XXX.
Both KORG and KPTHWY were omitted.

SETDAT

19. NO DATA IN ORGAN LIBRARY FOR NUCLIDE XXXX. THIS NUCLIDE DROPPED.
20. NO DATA FOR ELEMENT XXXXX IN BIOACCUMULATION FACTOR LIBRARY, THIS NUCLIDE DROPPED.
21. NONE OF THE INPUT NUCLIDES HAVE DATA IN LIBRARIES, NUC = XXX. Program terminated.

APPENDIX G

INPUT PREPARATION AND DIAGNOSTICS FOR FOOD

APPENDIX G

INPUT PREPARATION AND DIAGNOSTICS FOR FOOD

The input data required by FOOD for the calculations falls into four categories: program control, reconcentration, site, and release parameters. The program control, reconcentration, and site parameters are input through the Namelist. The radionuclide release parameters are formatted input. The rest of the data required by FOOD for the calculations is contained in four data libraries that are accessed by the code (see Appendix E), thus eliminating much effort in preparing the input.

This appendix describes in detail the variables input to FOOD, their use and the manner in which they are entered. The code has some self-generated diagnostics if an error is made on input. These are discussed after the input parameters. A FOOD sample problem and input deck are presented in Appendix I.

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An entire card in Format 20A4. Words entered here are reprinted as a title on the output pages. Each following case requires either a title or a 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) and one or more cards using the Namelist format (Cards 2 to N). The Namelist format is described in Appendix F. The Namelist input variables are shown in the following list:

FOOD NAMELIST VARIABLES

A. Program Control Variables:

1. NEXT: This variable instructs the program what to do after the namelist data has been read. It controls isotopic data input. There are 4 options corresponding to NEXT = 1, 2, 3, 4.
NEXT = 1. Read isotopic data, do computations and end.
NEXT = 2. Read isotopic data, do computations and prepare to read another case.
NEXT = 3. Use previously input isotopic data, do computations, and prepare another case. (NEXT = 3 cannot be used on a first case.)
NEXT = 4. Stop.
2. IDEP: Key for the type of radionuclide deposition mechanism.
IDEP = 1. Atmospheric deposition pathway.
IDEP = 2. Water deposition (irrigation) pathway
3. IAC: Key for type of dose calculated
IAC = 0 (default) Chronic ingestion
IAC = 1 Acute (accidental) ingestion
4. IOU: Key for output
IOU = 0 (default), summary output
IOU = 1 summary output plus complete listing
5. IPCNT: The percent cutoff for reporting results. The output subroutine will print all contributors above the IPCNT cutoff. Defaults to zero. This option is useful in reducing output of long runs with IOU = 1.
6. T2(2): The dose and dose commitment times, yrs.
7. KORG(5): Choice of organs, by number:

<u>Number</u>	<u>Organ</u>
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
19	GI
20	Stomach
21	Small intestine
22	Upper large intestine
23	Lower large intestine

B. Reconcentration Variables

8. IREC: Reconcentration model used. All of this category may be omitted if IDEP = 1.

IREC = 1, cooling water is drawn from a cooling pond, small lake or reservoir which is connected to a larger body of water or is fed by a stream. Requires namelist variables CFL0, FLO, CTIM, VOL, and TOR be included (described below).

IREC = 2, the cooling water inlet is downriver from the outfall or on a lake or ocean site arranged such that recirculation occurs. Requires namelist variables CTIM and VOL be included.

IREC = 3, no reconcentration, RECON = 1.

9. CFL0: coolant flow in ft³/sec.

10. FLO: makeup flow, ft³/sec (water drawn into the intake to replace losses).

11. CTIM: Cycle time in hours.

12. TOR: Pond turnover rate in inverse seconds.

13. VOL: for IREC = 1, VOL is the pond volume in ft³

for IREC = 2, VOL is the recycle fraction (the [unitless] mixing ratio at the point of intake).

14. RM: The mixing ratio, used in calculating the water concentration of released radionuclides.

C. Site Parameters

15. PLIFE: The facility lifetime in years.

16. IPOP: Key for population considered

IPOP = 0 (default) Maximum Individual

(POP) = 1.0

IPOP = 1 Population

17. POP: Population size, defaults to 1.0 for use with default IPOP, maximum individual.

18. KFDTYP(15): Numeric definition of the food types for which to do the computations.

Number	Food Type
1	Leafy vegetables
2	Other above-ground vegetables
3	Potatoes
4	Other root vegetables
5	Berries
6	Melons
7	Orchard fruit
8	Wheat
9	Other grain
10	Eggs
11	Milk
12	Beef
13	Pork
14	Poultry
15	External doses

19. XQ(15): The air concentration per unit release (x/Q in sec/m³) of radionuclides at the growing site of the corresponding food type.

20. GRWP(15): The growing period in days of the corresponding food type. For animal products this is the growing period of the feed that the animal eats.

21. YELD(15): The yield in kg/m² of the corresponding food type.

22. RIRR(15): The irrigation rate in E/m^2 month of the corresponding food type.
23. HLDUP(15): The holdup period in days of the corresponding food type.
24. CON(15): The consumption rate in kg/yr or E/yr of the corresponding food type.
25. TRNS(15): The translocation factor of the corresponding food type.
26. EXTIM: The external exposure time hours. (The time an individual spends being exposed to nuclides on contaminated farm ground).

CARDS N + 1 TO M--RELEASE PARAMETERS

The release cards are used to characterize the nuclide source term. The first card supplies the number of nuclides to be read, and a modification factor. The following cards give the nuclide name and release factor in Ci/year.

Card N + 1 contains NIN and NINV, FORMAT I3, E10.2. FINV defaults to 1.0 if left blank. The following cards contain (ELTI(I), AWI(I) and Q(I), I = 1, NIN) FORMAT A2, A6, 4X, E8.2.

The formats of ELTI and AWI must precisely match those of RMDLIB, otherwise a match cannot be made.

A sample input deck listing is provided in Appendix I.

FOOD SELF-GENERATED DIAGNOSTICS

If an error or anomaly is detected, FOOD will write an informative message. These come from several places in the code. These are listed below, with some hints as to what might be wrong. The list is ordered by originating routine.

MAIN

1. END OF INPUT FOR THIS RUN. Normal termination.
2. END OF FILE ON INPUT, STOP. The code was expecting another case, but ran out of data cards.

3. ERROR IN NUMBER OF NUCLIDES INPUT, NONUC = XXX, MAXIMUM ALLOWED IS XXX.
There were either zero or too many inventory cards.
4. ERROR ON NAMELIST INPUT. Something may be misspelled.

RLIBIN

5. IMPROPER NUMBER OF NUCLIDES IN MASTER LIBRARY, NUC = XXXX.
6. END OF FILE ON MASTER LIBRARY UNIT 10.

These two indicate a problem with the radionuclide master data library.

FLIBIN

7. END OF FILE AT TITLE CARD ON FOOD DATA LIBRARY. There is no data in the Food Transfer Coefficient File.

OLIBS

8. ERROR IN ORGAN DATA LIBRARY INPUT, NC, NOLD = XXX, NUCLIDE INPUT IS XXXXX. NUCLIDE NOLD IS XXX. There is an error in the order of the organ data library compared with the radionuclide master data library.
9. UNABLE TO IDENTIFY NUCLIDE XXXXX, NUCLIDES CHECKED = XXX -- STOP. There is a nuclide in the organ library that is not in the master library.
10. END OF FILE ON ORGAN DATA LIBRARY.
NUCLIDES IN MASTER LIBRARY = XXX.
CURRENT NUCLIDE INDEX = XXX.
PREVIOUS NUCLIDE INDEX = XXX.
DATA ARRAY INDEX = XXX.

The organ data file ended before any data could be obtained.

GLIBIN

11. GROUND DOSE FACTOR TITLE READ ERROR--STOP
12. GROUND DOSE FACTOR LIBRARY EMPTY--STOP.
13. PROBLEM IN GROUND DOSE FACTOR LIBRARY READ
NUCLIDES FOUND = XXX
NUCLIDES CHECKED FROM LIBRARY = XXX, STOP.

These three messages indicate a problem with the external dose factor file.

IDNUC

14. UNIDENTIFIED NUCLIDE XXXXX.
15. THERE WERE UNIDENTIFIED NUCLIDES, ISTOP = XXX.

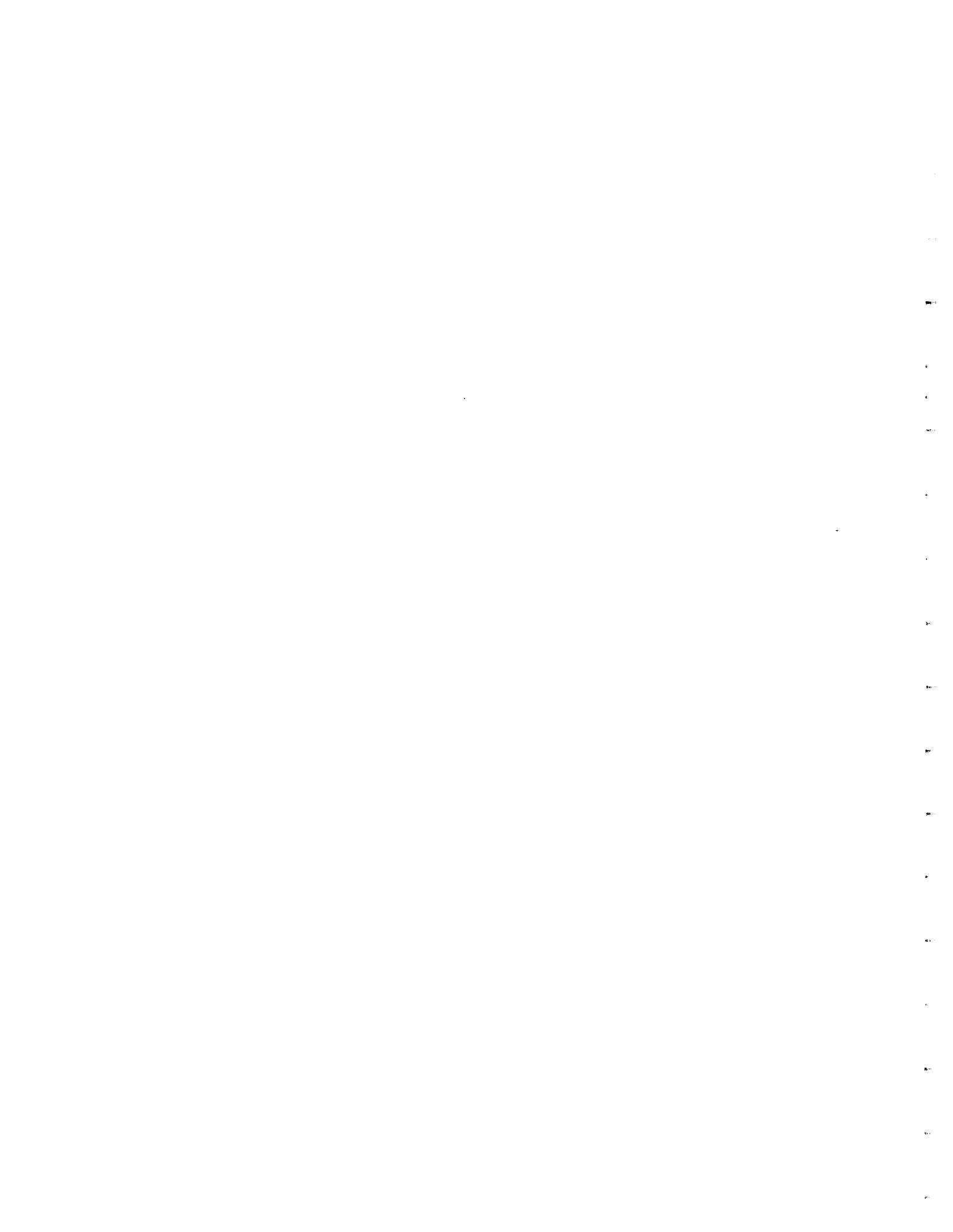
There is an error in the input source term.

OFCHCK

16. NO FOOD TYPES SPECIFIED, NPT = XXX.
KFDTYP was probably omitted from NAMELIST.
17. NO ORGANS SPECIFIED, NORG = XXX.
KORG was probably omitted from NAMELIST.

SETDAT

18. NO DATA IN ORGAN LIBRARY FOR NUCLIDE XXXXX. THIS NUCLIDE DROPPED.
19. NO DATA FOR ELEMENT IN FOOD DATA LIBRARY, STOP. XXX.
Program terminated.
20. NONE OF THE INPUT NUCLIDES HAVE DATA IN LIBRARIES, NUC = XXX.
Program terminated.



APPENDIX H

ARRRG SAMPLE PROBLEM

To illustrate the use of the computer code ARRRG, two sample problems are presented here. The first illustrates the general use of the code and the second illustrates the flexibility of use.

The first problem includes the dose to five organs of an individual living by and obtaining food from a river, just downstream of a nuclear facility that has been releasing radionuclides to the water for 30 years. The second illustrates the effect this same nuclear plant would have on the population of a city farther downstream. Input for the first problem is:

Namelist Parameter	Value	Remarks
NEXT	2	Program control variable
KORG		Organ identifier:
	1	Total body
	6	Bone
	8	Lungs
	16	Thyroid
	23	GI-LLI
T2	1	Dose time, years
	50	Dose commitment time, years
PLIFE	30	Facility lifetime, years
IPCNT	1	One-percent cutoff.
IREC	3	No reconcentration
CFL0	1.0×10^4	River flow rate, cfs
IPOP	0 or default	Maximum Individual

ISALT	0 or default	Fresh water release
KPTHWY		Exposure pathways:
	1	Fish
	3	Crustacea
	5	Drinking water
	6	Shoreline exposure
	7	Swimming
RM		Mixing ratio:
	0.3	
	0.1	
	0.9	
	0.9	
	0.8	
HLDUP		Holdup time, days
	1.0	
	2.0	
	0.1	
	0.1	
	0.1	
USAG	40.	kg/yr of fish
	10.	kg/yr of crayfish
	730.	l/yr of water
	500.	hr/yr on the beach
	100.	hr/yr swimming
SW	0.2	River bank.

<u>Other Parameters</u>	<u>Value</u>	<u>Remarks</u>
NIN	5	
ELTI, AWI, Q	H 3 100.	Release terms, Ci/yr
	C 14 25.	
	I 129 1.	
	CS 137 2.	
	U 238 0.1	

The input for Problem Two, assuming it is run concurrently with Problem One, is quite simple. Any namelist variables not reinitialized are carried over from the first problem.

<u>Namelist Parameter</u>	<u>Value</u>	<u>Remarks</u>
NEXT	3	Program control
IPOP	1	Population case
POP	2.5E5	Regional Population
KPTHWY		Exposure pathways: Fish Drinking water Shoreline Swimming Boating
RM	5 * 1.0	Mixing ratios
USAG	0.05	kg/yr fish
	440	l/yr water
	17	hr/yr on the beach
	10	hr/yr swimming
	5	hr/yr boating

The sample input card stream and ARRRG output resulting are presented.

ARRRG SAMPLE PROBLEM

*** Q.A. PAGE ***

RUN ON 050780

ARRRG, VERSION 1.0, 1 AUGUST 78

CASE TITLE: ARRRG SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL DOWNSTREAM, 50 YR COMMITMENT
 EXECUTING HANFORD^HARRRG(1).ABS CREATED ON MARCH 13, 1980 AT 14:24:11
 TYPE OF DOSE CALCULATED: MAX. IND. CHRONIC INGESTION AND EXTERNAL EXPOSURE
 FOR LIQUID RELEASES OF RADIONUCLIDES IN FRESH WATER

*** DATA LIBRARIES USED

RADIONUCLIDE LIBRARY: RADIONUCLIDE MASTER DATA LIBRARY, 15 MARCH 78, BA NAPIER

ORGAN DATA LIBRARY: *** ORGAN DATA LIBRARY UPDATED BY BAN 8/10/79 ***

BIOACCUMULATION LIBRARY: BIOACCUMULATION FACTOR LIBRARY FOR FOOD, PARLM, MAXI BA NAPIER

EXTERNAL D.F. LIBRARY: *** GRDFLIB FOR FOOD, 15 MARCH 1979, BA NAPIER ***

*** PATHWAY DATA USED

PATHWAY	MIXING RATIO	HOLDUP (DAYS)	USAGE	UNITS
FISH	3.00E-01	1.00E+00	4.00E+01	(KG/YR)
MOLLUSCS	1.00E-01	2.00E+00	1.00E+01	(KG/YR)
DRINK. H2O	9.00E-01	1.00E-01	7.30E+02	(L/YR)
SHORELINE	9.00E-01	1.00E-01	5.00E+02	(HR/YR)
SWIMMING	8.00E-01	1.00E-01	1.00E+02	(HR/YR)

*** ORGANS CONSIDERED

TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
------------	------	-------	---------	------------

*** NUCLIDES CONSIDERED:

NUCLIDE ELT. WT. (CI/YR)	RELEASE ELT. WT. (CI/YR)								
H 3	1.00E+02	C 14	2.50E+01	I 129	1.00E+00	CS 137	2.00E+00	U 238	1.00E-01

*** SITE SPECIFIC DATA USED

INVENTORY MODIFICATION FACTOR: .10E+01
 FACILITY LIFE (YEARS): .30E+02
 POPULATION: .10E+01
 DOSE TIME (YEARS): .10E+01
 DOSE COMMITMENT TIME (YEARS): .50E+02

*** RECONCENTRATION DATA USED

MODEL USED:	3
COOLANT FLOW RATE:	.1E+05
COOLANT MAKEUP FLOW (FT ³ /SEC):	.00
POND VOLUME (FT ³):	.00
TURNOVER RATE:	.00
SHORE WIDTH FACTOR:	.20E+00
CYCLE TIME (HR):	.00
RECYCLE FRACTION:	.00

INPUT PREPARED BY: ██████████ DATE: ██████████

INPUT CHECKED BY: ██████████ DATE: ██████████

ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE TO ORGAN BY PATHWAY (REM) FOR A PERIOD OF 1.00E+00 YEARS

050780

PATHWAY	SKIN	TOTAL BODY	INTERNAL				
			TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
FISH			3.1E-04	6.0E-04	1.2E-04	1.8E-04	9.7E-05
MOLLUSCS			1.5E-05	5.2E-05	1.4E-05	1.7E-05	1.4E-05
DRINK. H2O			7.5E-06	1.2E-05	2.3E-06	2.7E-04	2.1E-06
SHORELINE	6.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05
SWIMMING	2.7E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08
TOTAL	6.0E-05	5.0E-05	3.9E-04	7.3E-04	1.9E-04	5.2E-04	1.6E-04

ARRRG SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE COMMITMENT TO ORGAN BY PATHWAY,(REM) FOR A COMMITMENT TIME OF 5.00E+01 YEARS

050780

PATHWAY	SKIN	TOTAL BODY	INTERNAL				
			TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
FISH			4.7E-04	8.7E-04	1.6E-04	2.3E-04	1.0E-04
MOLLUSCS			1.5E-05	7.5E-05	1.5E-05	1.9E-05	1.5E-05
DRINK. H2O			1.2E-05	2.0E-05	3.2E-06	4.3E-04	2.2E-06
SHORELINE	6.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05	5.0E-05
SWIMMING	2.7E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.8E-08
TOTAL	6.0E-05	5.0E-05	5.5E-04	1.0E-03	2.2E-04	7.3E-04	1.7E-04

ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL DOWNSTREAM, 50 YR COMMITMENT
 ARRGG VERSION 1.0 1 AUGUST 78
 DOSE AND DOSE COMMITMENT TO ORGAN BY NUCLIDE, EXTERNAL DOSES SEPERATE

050780

TOTAL BODY COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.5E+03	1.0E+02	4.4E-07	0	4.4E-07	0
C 14	2.1E+05	2.5E+01	1.0E-04	29	1.0E-04	20
I 129	5.7E+09	1.0E+00	4.7E-07	0	7.3E-07	0
CS 137	1.1E+04	2.0E+00	2.4E-04	70	3.0E-04	78
U 238	1.7E+12	1.0E-01	1.8E-07	0	2.8E-07	0
-----					-----	
TOTAL			3.4-004		5.0-004	

BONE COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.5E+03	1.0E+02	.0	0	.0	0
C 14	2.1E+05	2.5E+01	4.4E-04	64	5.2E-04	53
I 129	5.7E+09	1.0E+00	2.5E-07	0	2.6E-07	0
CS 137	1.1E+04	2.0E+00	2.4E-04	35	4.4E-04	45
U 238	1.7E+12	1.0E-01	1.5E-06	0	4.7E-06	0
-----					-----	
TOTAL			6.8-004		9.6-004	

H
96

LUNGS COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.5E+03	1.0E+02	4.4E-07	0	4.4E-07	0
C 14	2.1E+05	2.5E+01	1.0E-04	72	1.0E-04	59
I 129	5.7E+09	1.0E+00	.0	0	.0	0
CS 137	1.1E+04	2.0E+00	3.8E-05	27	5.9E-05	40
U 238	1.7E+12	1.0E-01	.0	0	.0	0
-----					-----	
TOTAL			1.4-004		1.7-004	

ARRRG SAMPLE PROBLEM

THYROID COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.5E+03	1.0E+02	4.4E-07	0	4.6E-07	0
C 14	2.1E+06	2.5E+01	1.0E-04	21	1.0E-04	15
I 129	5.7E+09	1.0E+00	3.7E-04	78	5.7E-04	84
CS 137	1.1E+04	2.0E+00	.0	0	.0	0
U 238	1.7E+12	1.0E-01	.0	0	.0	0
			-----		-----	
TOTAL			4.7-004		6.8-004	

LOWER LARG COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.5E+03	1.0E+02	4.4E-07	0	4.6E-07	0
C 14	2.1E+05	2.5E+01	1.0E-04	87	1.0E-04	88
I 129	5.7E+09	1.0E+00	3.9E-08	0	3.9E-08	0
CS 137	1.1E+04	2.0E+00	1.3E-05	11	1.3E-05	11
U 238	1.7E+12	1.0E-01	3.7E-07	0	3.7E-07	0
			-----		-----	
TOTAL			1.1-004		1.2-004	

EXTERNAL DOSE COOLANT FLOW = 1.0E+04 CUR IC FEET/SEC.

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	SKIN DOSE REM	%	T.B. DOSE REM	%
H 3	4.5E+03	1.0E+02	.0	0	.0	0
C 14	2.1E+06	2.5E+01	8.5E-10	0	.0	0
I 129	5.7E+09	1.0E+00	5.7E-06	9	3.4E-06	5
CS 137	1.1E+04	2.0E+00	5.4E-05	90	4.6E-05	93
U 238	1.7E+12	1.0E-01	8.3E-10	0	5.5E-11	0
			-----		-----	
TOTAL			6.0-005		5.0-005	

L+H

ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE AND DOSE COMMITMENT

050780

FISH

HOLDUP = 1.0E+00 CONSUMPTION = 4.0E+01 MIXING RATIO = 3.0E-01

TOTAL BODY

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	BIOACF	CONC PC1/KG	DOSE REM	% REM	DOSE COMM %	DOSE REM %
C 14	2.1E+06	2.5E+01	8.4E-01	1.0E+00	4.6E+03	3.9E+03	8.5E-05	25	8.8E-05	18
CS 137	1.1E+04	2.0E+00	6.7E-02	1.0E+00	2.0E+03	1.3E+02	2.3E-04	73	3.8E-04	81
TOTAL							3.1-004		4.7-004	

BONE

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	BIOACF	CONC PC1/KG	DOSE REM	% REM	DOSE COMM %	DOSE REM %
C 14	2.1E+06	2.5E+01	8.4E-01	1.0E+00	4.6E+03	3.9E+03	3.7E-04	51	4.4E-04	50
CS 137	1.1E+04	2.0E+00	6.7E-02	1.0E+00	2.0E+03	1.3E+02	2.3E-04	38	4.3E-04	49
TOTAL							5.0-004		8.7-004	

LUNGS

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	BIOACF	CONC PC1/KG	DOSE REM	% REM	DOSE COMM %	DOSE REM %
C 14	2.1E+06	2.5E+01	8.4E-01	1.0E+00	4.6E+03	3.9E+03	8.5E-05	69	8.8E-05	56
CS 137	1.1E+04	2.0E+00	6.7E-02	1.0E+00	2.0E+03	1.3E+02	3.7E-05	30	6.8E-05	43
TOTAL							1.2-004		1.5-004	

THYROID

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	BIOACF	CONC PC1/KG	DOSE REM	% REM	DOSE COMM %	DOSE REM %
C 14	2.1E+06	2.5E+01	8.4E-01	1.0E+00	4.6E+03	3.9E+03	8.5E-05	47	8.8E-05	37

ARRRG SAMPLE PROBLEM

I	129	5.7E+09	1.0E+00	3.4E-02	1.0E+00	1.5E+01	5.0E-01	9.3E-05	52	1.5E-04	62
<hr/>											
TOTAL											
<hr/>											

LOWER LARG
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE REM	\$	DOSE COMM REM	\$	
C 14	2.1E+06	2.5E+01	8.4E-01	1.0E+00	4.6E+03	3.9E+03	8.5E-05	87	8.8E-05	87	
CS 137	1.1E+04	2.0E+00	6.7E-02	1.0E+00	2.0E+03	1.3E+02	1.3E-05	12	1.3E-05	12	
<hr/>											
TOTAL											
<hr/>											

ARRRG SAMPLE PROBLEM

MOLLUSCS

=====

HOLDUP = 2.0E+00

CONSUMPTION = 1.0E+01

MIXING RATIO = 1.0E-01

TOTAL BODY

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE REM	%	DOSE COMM REM	%
C 14	2.1E+05	2.5E+01	2.8E-01	1.0E+00	9.1E+03	2.5E+03	1.4E-05	93	1.5E-05	89
CS 137	1.1E+04	2.0E+00	2.2E-02	1.0E+00	1.0E+02	2.2E+00	9.6E-07	5	1.6E-06	9
TOTAL							1.5-005		1.6-005	

BONE

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE REM	%	DOSE COMM REM	%
C 14	2.1E+06	2.5E+01	2.8E-01	1.0E+00	9.1E+03	2.5E+03	6.1E-05	98	7.3E-05	96
CS 137	1.1E+04	2.0E+00	2.2E-02	1.0E+00	1.0E+02	2.2E+00	9.7E-07	1	1.8E-06	2
TOTAL							6.2-005		7.5-005	

LUNGS

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE REM	%	DOSE COMM REM	%
C 14	2.1E+06	2.5E+01	2.8E-01	1.0E+00	9.1E+03	2.5E+03	1.4E-05	98	1.5E-05	98
CS 137	1.1E+04	2.0E+00	2.2E-02	1.0E+00	1.0E+02	2.2E+00	1.5E-07	1	2.8E-07	1
TOTAL							1.4-005		1.5-005	

THYROID

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE REM	%	DOSE COMM REM	%
C 14	2.1E+05	2.5E+01	2.8E-01	1.0E+00	9.1E+03	2.5E+03	1.4E-05	84	1.5E-05	78
I 129	5.7E+09	1.0E+00	1.1E-02	1.0E+00	5.0E+00	5.6E-02	2.6E-06	15	4.0E-06	21
TOTAL							1.7-005		1.9-005	

ARRRG SAMPLE PROBLEM

LOWER LARG
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	BIOAFC	CONC PC1/KG	DOSE REM	% REM	DOSE COMM	%
C 14	2.1E+05	2.5E+01	2.8E-01	1.0E+00	9.1E+03	2.5E+03	1.4E-05	99	1.5E-05	99
TOTAL							1.4-005	-----	1.5-005	-----

H
11

ARRRG SAMPLE PROBLEM

DRINK. H₂O
=====

HOLDUP = 1.0E-01

CONSUMPTION = 7.3E+02

MIXING RATIO = 9.0E-01

TOTAL BODY
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCU/L	RECON FAC	H ₂ O CU FACTOR	CONC PCU/KG	DOSE REM	%	DOSE COM REM	%
H 3	4.5E+03	1.0E+02	1.0E+01	1.0E+00	1.0E+00	1.0E+01	4.3E-07	5	4.5E-07	3
C 14	2.1E+06	2.5E+01	2.5E+00	1.0E+00	1.0E+00	2.5E+00	1.0E-06	13	1.0E-06	8
I 129	5.7E+09	1.0E+00	1.0E-01	1.0E+00	8.0E-01	8.1E-02	3.4E-07	4	5.4E-07	4
CS 137	1.1E+04	2.0E+00	2.0E-01	1.0E+00	9.0E-01	1.8E-01	5.7E-06	74	9.4E-06	80
U 238	1.7E+12	1.0E-01	1.0E-02	1.0E+00	7.0E-01	7.1E-03	1.5E-07	1	2.3E-07	1
TOTAL							7.5E-06		1.2E-05	

BONE
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCU/L	RECON FAC	H ₂ O CU FACTOR	CONC PCU/KG	DOSE REM	%	DOSE COM REM	%
C 14	2.1E+06	2.5E+01	2.5E+00	1.0E+00	1.0E+00	2.5E+00	4.4E-06	38	5.2E-06	25
I 129	5.7E+09	1.0E+00	1.0E-01	1.0E+00	8.0E-01	8.1E-02	1.8E-07	1	1.9E-07	0
CS 137	1.1E+04	2.0E+00	2.0E-01	1.0E+00	9.0E-01	1.8E-01	5.7E-06	49	1.1E-05	52
U 238	1.7E+12	1.0E-01	1.0E-02	1.0E+00	7.0E-01	7.1E-03	1.3E-06	11	3.9E-06	19
TOTAL							1.2E-05		2.0E-05	

H-12

LUNGS
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCU/L	RECON FAC	H ₂ O CU FACTOR	CONC PCU/KG	DOSE REM	%	DOSE COM REM	%
H 3	4.5E+03	1.0E+02	1.0E+01	1.0E+00	1.0E+00	1.0E+01	4.3E-07	18	4.5E-07	14
C 14	2.1E+06	2.5E+01	2.5E+00	1.0E+00	1.0E+00	2.5E+00	1.0E-05	43	1.0E-06	33
CS 137	1.1E+04	2.0E+00	2.0E-01	1.0E+00	9.0E-01	1.8E-01	9.0E-07	38	1.7E-06	52
TOTAL							2.3E-05		3.2E-05	

THYROID
=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCU/L	RECON FAC	H ₂ O CU FACTOR	CONC PCU/KG	DOSE REM	%	DOSE COM REM	%
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ARRRG SAMPLE PROBLEM

I	129	5.7E+09	1.0E+00	1.0E-01	1.0E+00	8.0E-01	8.1E-02	2.7E-04	99	4.3E-04	99	
<hr/>												
TOTAL											2.7-004	4.3-004
<hr/>												
LOWER LARG												
<hr/>												
NUCLIDE		HALF-LIFE	RELEASE	WATER CONC	RECON	H2O CU	CONC	DOSE	%	DOSE COM	%	
		DAYS	CI/YR	PCI/L	FAC	FACTOR	PCI/KG	REM	REM			
H	3	4.5E+03	1.0E+02	1.0E+01	1.0E+00	1.0E+00	1.0E+01	4.3E-07	20	4.5E-07	20	
C	14	2.1E+05	2.5E+01	2.5E+00	1.0E+00	1.0E+00	2.5E+00	1.0E-06	48	1.0E-05	48	
I	129	5.7E+09	1.0E+00	1.0E-01	1.0E+00	9.0E-01	8.1E-02	2.9E-08	1	2.9E-08	1	
CS	137	1.1E+04	2.0E+00	2.0E-01	1.0E+00	9.0E-01	1.8E-01	3.1E-07	14	3.1E-07	14	
U	238	1.7E+12	1.0E-01	1.0E-02	1.0E+00	7.0E-01	7.1E-03	3.1E-07	15	3.1E-07	14	
<hr/>											<hr/>	
TOTAL											2.1-006	2.2-006

ARRRG SAMPLE PROBLEM

SHORELINE
=====

HOLDUP = .1 USAGE(HR/YR) = 5.0E+002 MIXING RATIO = .000 SHORE WIDTH FACT. = .200

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	SHORELINE CONC PC1/M ² /S ²	DOSE AND DOSE COMMITMENT(REM)
					SKIN %	T BODY %
I 129 *	5.7E+09	1.0E+00	2.0E+00	1.0E+00	1.5E+04	5.7E-06 9 3.4E-006 5
CS137	1.1E+04	2.0E+00	4.0E+00	1.0E+00	2.2E+04	5.4E-05 90 4.6E-005 93
TOTAL						6.0E-05 5.0E-05

SWIMMING
=====

HOLDUP = .1 USAGE(HR/YR) = 1.0E+002 MIXING RATIO = .000 SHORE WIDTH FACT. = .200

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PC1/L	RECON FAC	SHORELINE CONC PC1/M ² /S ²	DOSE AND DOSE COMMITMENT(REM)
					SKIN %	T BODY %
C 14	2.1E+06	2.5E+01	2.2E+00	1.0E+00	2.2E+00	8.5E-10 3 .0 0
I 129	5.7E+09	1.0E+00	9.0E-02	1.0E+00	9.0E-02	3.0E-10 1 1.5E-010 0
CS137	1.1E+04	2.0E+00	1.8E-01	1.0E+00	1.8E-01	2.5E-08 92 1.8E-008 98
U 238	1.7E+12	1.0E-01	9.0E-03	1.0E+00	9.0E-03	8.3E-10 3 5.6E-011 0
TOTAL						2.7E-08 1.8E-08

H-14

ARRRG SAMPLE PROBLEM

*** Q.A. PAGE ***

RUN ON 050780

ARRRG, VERSION 1.0, 1 AUGUST 78
 CASE TITLE: ARRRG SAMPLE PROBLEM TWO-POPULATION DOWNSTREAM, 50 YR COMMITMENT
 EXECUTING HANFORD^HARRRG(1).ABS CREATED ON MARCH 13, 1980 AT 14:24:11
 TYPE OF DOSE CALCULATED: POPULATION CHRONIC INGESTION AND EXTERNAL EXPOSURE
 FOR LIQUID RELEASES OF RADIONUCLIDES IN FRESH WATER

*** DATA LIBRARIES USED

RADIONUCLIDE LIBRARY: RADIONUCLIDE MASTER DATA LIBRARY, 15 MARCH 78, BA NAPIER
 ORGAN DATA LIBRARY: *** ORGAN DATA LIBRARY UPDATED BY RAN 8/10/79 ***
 BIOACCUMULATION LIBRARY: BIOACCUMULATION FACTOR LIBRARY FOR FOOD,PABLM,MAXI BA NAPIER
 EXTERNAL D.F. LIBRARY: *** GRDFLIB FOR FOOD, 15 MARCH 1978, BA NAPIER ***

*** PATHWAY DATA USED

PATHWAY	MIXING RATIO	HOLDUP (DAYS)	USAGE	UNITS
FISH	1.00E+00	1.00E+00	5.00E-02	(KG/YR)
DRINK. H2O	1.00E+00	2.00E+00	4.40E+02	(L/YR)
SHORELINE	1.00E+00	1.00E-01	1.70E+01	(HR/YR)
SWIMMING	1.00E+00	1.00E-01	1.00E+01	(HR/YR)
BOATING	1.00E+00	1.00E-01	5.00E+00	(HR/YR)

*** ORGANS CONSIDERED

TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
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*** NUCLIDES CONSIDERED:

NUCLIDE ELT. WT.	RELEASE (CI/YR)								
H 3	1.00E+02	C 14	2.50E+01	I 129	1.00E+00	CS 137	2.00E+00	U 238	1.00E-01

*** SITE SPECIFIC DATA USED

INVENTORY MODIFICATION FACTOR: .10E+01
 FACILITY LIFE (YEARS): .30E+02
 POPULATION: .25E+05
 DOSE TIME (YEARS): .10E+01
 DOSE COMMITMENT TIME (YEARS): .50E+02

*** RECONCENTRATION DATA USED

MODEL USED: 3
 COOLANT FLOW RATE: .10E+05
 COOLANT MAKEUP FLOW (FT³/SEC): .0
 POND VOLUME (FT³): .0
 TURNOVER RATE: .0
 SHORE WIDTH FACTOR: .20E+00
 CYCLE TIME (HR): .0
 RECYCLE FRACTION: .0

INPUT PREPARED BY: DATE:
 ***** *****

INPUT CHECKED BY: DATE:
 ***** *****

H-15

ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM TWO-POPULATION DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE TO ORGAN BY PATHWAY (MAN-REM) FOR A PERIOD OF 1.00E+00 YEARS

050780

PATHWAY	SKIN	TOTAL BODY	INTERNAL				
			TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
FISH			3.3E-01	6.3E-01	1.3E-01	1.8E-01	1.0E-01
DRINK. H2O			1.3E+00	1.9E+00	3.9E-01	4.5E+01	3.5E-01
SHORELINE	5.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01
SWIMMING	8.5E-04	6.2E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04
BOATING	2.1E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04
TOTAL	5.7E-01	4.7E-01	2.1E+00	3.0E+00	9.9E-01	4.6E+01	9.2E-01

ARRRG SAMPLE PROBLEM TWO-POPULATION DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE COMMITMENT TO ORGAN BY PATHWAY,(MAN-REM) FOR A COMMITMENT TIME OF 5.00E+01 YEARS

050780

PATHWAY	SKIN	TOTAL BODY	INTERNAL				
			TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
FISH			4.9E-01	9.0E-01	1.6E-01	2.4E-01	1.0E-01
DRINK. H2O			2.0E+00	3.3E+00	5.3E-01	7.1E+01	3.6E-01
SHORELINE	5.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01	4.7E-01
SWIMMING	8.5E-04	6.2E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04
BOATING	2.1E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04	1.4E-04
TOTAL	5.7E-01	4.7E-01	2.9E+00	4.7E+00	1.2E+00	7.2E+01	9.4E-01

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ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM TWO-POPULATION DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE AND DOSE COMMITMENT TO ORGAN BY NUCLIDE, EXTERNAL DOSES SEPERATE

050780

TOTAL BODY COOLANT FLOW = 1.0E+04CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.5E+03	1.0E+02	7.2E-02	4	7.5E-02	3
C 14	2.1E+05	2.5E+01	2.6E-01	15	2.7E-01	10
I 129	5.7E+09	1.0E+00	5.8E-02	3	9.1E-02	3
CS 137	1.1E+04	2.0E+00	1.2E+00	74	2.0E+00	80
U 238	1.7E+12	1.0E-01	2.5E-02	1	3.9E-02	1
<hr/>						
TOTAL			1.6+000		2.5+000	

BONE COOLANT FLOW = 1.0E+04CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.5E+03	1.0E+02	.0	0	.0	0
C 14	2.1E+05	2.5E+01	1.1E+00	43	1.3E+00	31
I 129	5.7E+09	1.0E+00	3.0E-02	1	3.2E-02	0
CS 137	1.1E+04	2.0E+00	1.2E+00	46	2.2E+00	52
U 238	1.7E+12	1.0E-01	2.1E-01	8	5.6E-01	15
<hr/>						
TOTAL			2.6+000		4.2+000	

H-17

LUNGS COOLANT FLOW = 1.0E+04CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.5E+03	1.0E+02	7.2E-02	13	7.5E-02	10
C 14	2.1E+05	2.5E+01	2.6E-01	49	2.7E-01	38
I 129	5.7E+09	1.0E+00	.0	0	.0	0
CS 137	1.1E+04	2.0E+00	1.9E-01	35	3.5E-01	50
U 238	1.7E+12	1.0E-01	.0	0	.0	0
<hr/>						
TOTAL			5.2-001		6.9-001	

ARRRG SAMPLE PROBLEM

THYROID

COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE Ci/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.5E+03	1.0E+02	7.2E-02	0	7.5E-02	0
C 14	2.1E+05	2.5E+01	2.6E-01	0	2.7E-01	0
I 129	5.7E+09	1.0E+00	4.5E+01	99	7.1E+01	99
CS 137	1.1E+04	2.0E+00	.0	0	.0	0
U 238	1.7E+12	1.0E-01	.0	0	.0	0
TOTAL			4.6E+01		7.2E+01	

LOWER LARG

COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC

NUCLIDE	HALF-LIFE DAYS	RELEASE Ci/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.5E+03	1.0E+02	7.2E-02	16	7.5E-02	16
C 14	2.1E+05	2.5E+01	2.6E-01	56	2.7E-01	57
I 129	5.7E+09	1.0E+00	4.9E-03	1	4.9E-03	1
CS 137	1.1E+04	2.0E+00	6.5E-02	14	6.5E-02	13
U 238	1.7E+12	1.0E-01	5.3E-02	11	5.3E-02	11
TOTAL			4.5E+01		4.6E+01	

EXTERNAL DOSE

COOLANT FLOW = 1.0E+04 CUBIC FEET/SEC.

NUCLIDE	HALF-LIFE DAYS	RELEASE Ci/YR	SKIN DOSE MAN-REM	%	T.R. DOSE MAN-REM	%
H 3	4.5E+03	1.0E+02	.0	0	.0	0
C 14	2.1E+05	2.5E+01	3.3E-05	0	.0	0
I 129	5.7E+09	1.0E+00	5.4E-02	9	3.3E-02	6
CS 137	1.1E+04	2.0E+00	5.1E-01	90	4.4E-01	93
U 238	1.7E+12	1.0E-01	3.3E-05	0	2.6E-06	0
TOTAL			5.7E+01		4.7E+01	

ARRRG SAMPLE PROBLEM

ARRRG SAMPLE PROBLEM TWO-POPULATION DOWNSTREAM, 50 YR COMMITMENT
 ARRRG VERSION 1.0 1 AUGUST 78
 DOSE AND DOSE COMMITMENT

050780

FISH

=====

HOLDUP = 1.0E+00

CONSUMPTION = 5.0E-02

MIXING RATIO = 1.0E+00

TOTAL BODY

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	4.5E+03	1.3E+04	8.8E-02	26	9.2E-02	18
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	2.0E+03	4.5E+02	2.4E-01	73	4.0E-01	81
<hr/>								-----	-----	
TOTAL								3.3-001	4.9-001	

BONE

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	4.5E+03	1.3E+04	3.9E-01	51	4.6E-01	50
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	2.0E+03	4.5E+02	2.4E-01	38	4.5E-01	49
<hr/>								-----	-----	
TOTAL								6.3-001	9.0-001	

LUNGS

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	4.5E+03	1.3E+04	8.8E-02	69	9.2E-02	56
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	2.0E+03	4.5E+02	3.8E-02	30	7.0E-02	43
<hr/>								-----	-----	
TOTAL								1.3-001	1.6-001	

THYROID

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	BIOACF	CONC PCI/KG	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	4.5E+03	1.3E+04	8.8E-02	47	9.2E-02	37

H-16

ARRRG SAMPLE PROBLEM

I	120	5.7E+09	1.0E+00	1.1E-01	1.0E+00	1.5E+01	1.7E+00	9.7E-02	52	1.5E-01	62

TOTAL											

1.8-001											
2.4-001											

LOWER LARG

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE Ci/YR	WATER CONC PCI/L	RECON FAC	BIOACTF	CONC PCI/KG	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
C 14	2.1E+06	2.5E+01	2.8E+00	1.0E+00	4.6E+03	1.3E+04	8.8E-02	87	9.2E-02	87
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	2.0E+03	4.5E+02	1.3E-02	12	1.3E-02	12

TOTAL										

1.0-001										
1.0-001										

ARRRG SAMPLE PROBLEM

DRINK. H₂O

=====

HOLDUP = 2.0E+00

CONSUMPTION = 4.4E+02

MIXING RATIO = 1.0E+00

TOTAL BODY

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	H ₂ O CU FACTOR	CONC PCI/KG	DOSE MAN-REM	%	DOSE COM MAN-REM	%
H 3	4.5E+03	1.0E+02	1.1E+01	1.0E+00	1.0E+00	1.1E+01	7.2E-02	5	7.5E-02	3
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	1.0E+00	2.8E+00	1.7E-01	13	1.8E-01	8
I 129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	8.0E-01	9.0E-02	5.8E-02	4	9.1E-02	4
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	9.0E-01	2.0E-01	9.5E-01	74	1.6E+00	80
U 238	1.7E+12	1.0E-01	1.1E-02	1.0E+00	7.0E-01	7.8E-03	2.5E-02	1	3.9E-02	1
TOTAL							1.3+000		2.0+000	

BONE

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	H ₂ O CU FACTOR	CONC PCI/KG	DOSE MAN-REM	%	DOSE COM MAN-REM	%
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	1.0E+00	2.8E+00	7.4E-01	39	8.8E-01	25
I 129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	8.0E-01	9.0E-02	3.0E-02	1	3.2E-02	0
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	9.0E-01	2.0E-01	9.6E-01	49	1.8E+00	52
U 238	1.7E+12	1.0E-01	1.1E-02	1.0E+00	7.0E-01	7.8E-03	2.1E-01	11	5.6E-01	19
TOTAL							1.9+000		3.3+000	

LUNGS

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	H ₂ O CU FACTOR	CONC PCI/KG	DOSE MAN-REM	%	DOSE COM MAN-REM	%
H 3	4.5E+03	1.0E+02	1.1E+01	1.0E+00	1.0E+00	1.1E+01	7.2E-02	18	7.5E-02	14
C 14	2.1E+05	2.5E+01	2.8E+00	1.0E+00	1.0E+00	2.8E+00	1.7E-01	43	1.8E-01	33
CS 137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	9.0E-01	2.0E-01	1.5E-01	38	2.8E-01	52
TOTAL							3.9-001		5.3-001	

THYROID

=====

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	H ₂ O CU FACTOR	CONC PCI/KG	DOSE MAN-REM	%	DOSE COM MAN-REM	%
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ARRRG SAMPLE PROBLEM

I	129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	8.0E-01	9.0E-02	4.5E+01	99	7.1E+01	99	
<hr/>												
TOTAL											4.6+001	7.1+001
<hr/>												
LOWER LARG												
<hr/>												
NUCLIDE		HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	H2O CU FACTOR	CONC PCI/KG	DOSE MAN-REM	%	DOSE COM MAN-REM	%	
H	3	4.5E+03	1.0E+02	1.1E+01	1.0E+00	1.0E+00	1.1E+01	7.2E-02	20	7.5E-02	20	
C	14	2.1E+06	2.5E+01	2.8E+00	1.0E+00	1.0E+00	2.8E+00	1.7E-01	48	1.8E-01	48	
I	129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	8.0E-01	9.0E-02	4.9E-03	1	4.9E-03	1	
CS	137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	9.0E-01	2.0E-01	5.2E-02	14	5.2E-02	14	
U	238	1.7E+12	1.0E-01	1.1E-02	1.0E+00	7.0E-01	7.8E-03	5.3E-02	15	5.3E-02	14	
<hr/>											3.5-001	3.6-001
TOTAL												

ARRRG SAMPLE PROBLEM

SHORELINE

=====

HOLDUP	USAGE(HR/YR)	MIXING RATIO	SHORE WIDTH FACT.			
.1	1.7+001	.000	.200			
NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	SHORELINE CONC PCI/M ² /2	DOSE AND DOSE COMMITMENT(MAN-REM) SKIN % T BODY %
I 129	5.7E+09	1.0E+00	2.2E+00	1.0E+00	1.7E+04	5.4E-02 9 3.3-002 6
CS137	1.1E+04	2.0E+00	4.5E+00	1.0E+00	2.5E+04	5.1E-01 90 4.4-001 93
TOTAL						5.7E-01 4.7E-01

SWIMMING

=====

HOLDUP	USAGE(HR/YR)	MIXING RATIO	SHORE WIDTH FACT.			
.1	1.0-001	.000	.200			
NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	SHORELINE CONC PCI/M ² /2	DOSE AND DOSE COMMITMENT(MAN-REM) SKIN % T BODY %
C 14	2.1E+06	2.5E+01	2.8E+00	1.0E+00	2.8E+00	2.7E-05 3 .0 0
I 129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	1.1E-01	9.2E-06 1 4.8-006 0
CS137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	2.2E-01	7.8E-04 92 5.6-004 93
U 238	1.7E+12	1.0E-01	1.1E-02	1.0E+00	1.1E-02	2.6E-05 3 2.1-005 0
TOTAL						8.5E-04 5.7E-04

H-23

BOATING

=====

HOLDUP	USAGE(HR/YR)	MIXING RATIO	SHORE WIDTH FACT.			
.1	5.0+000	.000	.200			
NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	WATER CONC PCI/L	RECON FAC	SHORELINE CONC PCI/M ² /2	DOSE AND DOSE COMMITMENT(MAN-REM) SKIN % T BODY %
C 14	2.1E+06	2.5E+01	2.8E+00	1.0E+00	1.4E+00	6.6E-06 3 .0 0
I 129	5.7E+09	1.0E+00	1.1E-01	1.0E+00	5.6E-02	2.3E-05 1 1.2-005 0
CS137	1.1E+04	2.0E+00	2.2E-01	1.0E+00	1.1E-01	2.0E-04 92 1.4-004 93
U 238	1.7E+12	1.0E-01	1.1E-02	1.0E+00	5.6E-03	5.5E-06 3 5.2-007 0
TOTAL						2.1E-04 1.4E-04

END OF INPUT FOR THIS RUN

APPENDIX I

FOOD SAMPLE PROBLEM

APPENDIX I

FOOD SAMPLE PROBLEM

To illustrate the use of the computer code FOOD, two sample problems are presented here. The first illustrates the general use of the code, the second illustrates the flexibility of use.

The first problem includes the dose and dose commitment to five organs of an individual living down-wind of a nuclear facility that has been releasing radionuclides to the atmosphere for 30 years. The second illustrates the effect the same plant would have on a regional population if the radionuclide release were to a river instead of to the air.

Input to the first problem is:

Namelist Parameter	Value	Remarks
NEXT	2	Program control parameter
IDEP	1	Atmospheric release
IOUT	0	Summary output only
T2	1	Dose time, years
	50	Dose commitment time, years
PLIFE	30	Facility release time
KORG		Organs considered:
	1	Total body
	6	Bone
	8	Lungs
	16	Thyroid
	23	GI-LLI

KFDTYP		Food types:
	1	Leafy vegetables
	3	Potatoes
	7	Fruit
	8	Grain
	10	Eggs
	11	Milk
	12	Beef
	15	External
XQ	$8 * 1.4 \times 10^{-7}$	Air concentration per unit release at the maximum individual's residence (sec/m^3)
GRWP	5 * 90. 30. 90.	Growing period, days
YELD	1.5 4.0 2.0 1.0 0.84 1.3 0.84	Yields of crops, kg/m^2 .
HLDUP	1. 10. 10. $3 * 1.$ 15.	Holdup times, days between harvest and consumption
TRNS	1.0 $4 * 0.1$ 1.0 0.1	Translocation factors

CON	30.	Consumption rates, kg/yr
	180.	
	330.	
	80.	
	30.	
	250.	
	40.	
EXTIM	4383.	External exposure for 12 hours per day for one year.

Other Parameters	Value	Remarks
NIN	5	
ELTI, AWI, Q	H 3 100. C 14 25. I 129 1. CS 137 2. U 238 0.1	Release term, Ci/yr

The input for sample Problem Two, assuming it is run concurrently with Problem One, is quite simple. Any namelist variables not reinitialized are carried over from the first problem. The input is:

Namelist Parameter	Value	Remarks
NEXT	3	Program control
IDEP	2	Liquid release
IPOP	1	Population case
POP	2.5×10^5	Regional population
XQ	8 * 0.0	No atmospheric release
RIRR	8 * 150	Irrigation rate, $\text{L/m}^2/\text{mo.}$

CON	15.	The average person eats less than the "maximum" individual.
	110.	
	65.	
	70.	
	20.	
	200.	
	20.	
EXTIM	2920.	
IREC	3	Assume no reconcentration
CFLO	1.0×10^4	River flow rate, cfs
RM	1.0	Mixing ratio

The sample input card stream and resulting FOOD output are presented.

FOOD SAMPLE PROBLEM

**** Q.A. PAGE ****

RUN ON 050780

FOOD, VERSION 1.0, 1 AUGUST 78

CASE TITLE: FOOD SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL, AIR PATHWAYS, 50 YR COMMITMENT
EXECUTING HANFORD:FOOD(1).ARS CREATED ON MARCH 13, 1980 AT 14:46:36

TYPE OF DOSE CALCULATED: CHRONIC INGESTION AND EXTERNAL EXPOSURE
FOR : AIR PATHWAY, MAX. IND.

**** DATA LIBRARIES USED:

RADIOMUCLIDE LIBRARY: RADIOMUCLIDE MASTER DATA LIBRARY, 15 MARCH 78, BA NAPIER
FOOD TRANSFER FACTOR LIBRARY: *** FOOD TRANSFER COEFFICIENT LIBRARY 2/27/78 BA NAPIER ***
ORGAN DATA LIBRARY: *** ORGAN DATA LIBRARY UPDATED BY BAN 8/10/79 ***
GROUND DOSE FACTOR LIBRARY: *** GRDFLIR FOR FOOD, 15 MARCH 1978, BA NAPIER ***

**** FOOD DATA USED:

FOOD TYPE	X/Q (SEC/M**3)	GROWING PERIOD (DAYS)	YIELD (KG/M**3)	IRR. RATE (L/M**2/MONTH)	HOLDUP (DAYS)	CONSUMPTION (KG/YR)	TRANSLOCATION
LEAFY VEG.	1.40E-07	9.00E+01	1.50E+00	.00	1.00E+00	3.00E+01	1.00E+00
POTATOES	1.40E-07	9.00E+01	4.00E+00	.00	1.00E+01	1.80E+02	1.00E-01
ORCH.FRUIT	1.40E-07	9.00E+01	2.00E+00	.00	1.00E+01	3.30E+02	1.00E-01
OT.GRAIN	1.40E-07	9.00E+01	1.00E+00	.00	1.00E+00	8.00E+01	1.00E-01
EGGS	1.40E-07	9.00E+01	8.40E-01	.00	1.00E+00	3.00E+01	1.00E-01
MILK	1.40E-07	3.00E+01	1.30E+00	.00	1.00E+00	2.50E+02	1.00E+00
BEEF	1.40E-07	9.00E+01	8.40E-01	.00	1.50E+01	4.00E+01	1.00E-01
EXTERNAL	1.40E-07	.00	.00	.00	.00	.00	.00

**** ORGANS CONSIDERED:

TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
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**** NUCLIDES CONSIDERED:

NUCLIDE ELT. WT. (CI/YR)	RELEASE (CI/YR)								
H 3	1.00E+02	C 14	2.50E+01	I 129	1.00E+00	CS 137	2.00E+00	U 238	1.00E-01

***** SITE SPECIFIC DATA USED

INVENTORY MODIFICATION FACTOR: 1.00E+00
FACILITY LIFE (YEARS): 3.00E+01
POPULATION: 1.00E+00
DOSE TIME (YEARS): 1.00E+00
DOSE COMMITMENT TIME (YEARS): 5.00E+01
EXTERNAL EXPOSURE TIME (HR): 4.38E+03

***** RECONCENTRATION DATA USED

MODEL USED:	0
COOLANT FLOW RATE:	.00
COOLANT MAKEUP FLOW (FT3/SEC):	.00
POND VOLUME (FT3):	.00
TURNOVER RATE:	.00
CYCLE TIME (HR):	.00

INPUT PREPARED BY: XXXXXXXXXXXXXXX DATE: XXXXXXXXX

INPUT CHECKED BY: XXXXXXXXXXXXXXX DATE: XXXXXXXXX

FOOD SAMPLE PROBLEM

FOOD SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL, AIR PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78

050780

	*** DOSE SUMMARY, REM TOTAL BODY	FOR 1.0E+00 YEARS BONE	*** LUNGS	THYROID	LOWER LARG
PRODUCE	6.53E-05	1.74E-04	3.80E-05	1.51E-02	3.92E-05
EGGS	1.98E-06	7.65E-06	1.73E-06	1.62E-04	1.75E-06
MILK	2.62E-05	4.24E-05	8.01E-06	9.67E-03	8.38E-05
MEAT	7.41E-05	1.89E-05	3.98E-06	1.51E-03	3.98E-05
INT. TOTAL	1.01E-04	2.43E-04	5.17E-05	2.64E-02	5.33E-05
EXTERNAL DOSE TOTALS		SKIN 2.68E-04	TOTAL BODY 1.95E-04		

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FOOD SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL, AIR PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78

050780

	*** DOSE COMMITMENT SUMMARY, REM TOTAL BODY	FOR A COMMITMENT TIME OF 5.0E+01 YEARS *** BONE	LUNGS	THYROID	LOWER LARG
PRODUCE	8.42E-05	2.16E-04	4.07E-05	2.36E-02	4.07E-05
EGGS	2.20E-06	9.12E-06	1.81E-06	2.53E-04	1.82E-06
MILK	3.81E-05	5.46E-05	9.23E-06	1.52E-02	8.67E-06
MEAT	9.85E-06	2.36E-05	4.37E-06	2.38E-03	4.13E-06
INT. TOTAL	1.34E-04	3.03E-04	5.61E-05	4.14E-02	5.53E-05
EXTERNAL DOSE TOTALS		SKIN 2.68E-04	TOTAL BODY 1.95E-04		

FOOD SAMPLE PROBLEM

SUMMARY OF NUCLIDE CONTRIBUTORS

FOOD SAMPLE PROBLEM ONE-MAXIMUM INDIVIDUAL, AIR PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78
 ALL FOOD PRODUCTS

050780

TOTAL BODY

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.51E+03	1.00E+02	2.2E-06	2	2.3E-06	1
C 14	2.09E+06	2.50E+01	4.7E-05	46	4.9E-05	36
I 129	5.73E+09	1.00E+00	3.4E-05	33	5.3E-05	39
CS 137	1.10E+04	2.00E+00	1.8E-05	18	3.0E-05	22
U 238	1.65E+12	1.00E-01	3.1E-07	0	4.8E-07	0
TOTAL			1.0E-04		1.3E-04	

BONE

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.51E+03	1.00E+02	.0	0	.0	0
C 14	2.09E+06	2.50E+01	2.0E-04	84	2.4E-04	79
I 129	5.73E+09	1.00E+00	1.8E-05	7	1.9E-05	6
CS 137	1.10E+04	2.00E+00	1.8E-05	7	3.4E-05	11
U 238	1.65E+12	1.00E-01	2.7E-06	1	8.2E-06	2
TOTAL			2.4E-04		3.0E-04	

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LUNGS

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.51E+03	1.00E+02	2.2E-06	4	2.3E-06	4
C 14	2.09E+06	2.50E+01	4.7E-05	90	4.9E-05	85
I 129	5.73E+09	1.00E+00	.0	0	.0	0
CS 137	1.10E+04	2.00E+00	2.9E-06	5	5.3E-06	9
U 238	1.65E+12	1.00E-01	.0	0	.0	0
TOTAL			5.2E-05		5.6E-05	

THYROID

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%

FOOD SAMPLE PROBLEM

H 3	4.51E+03	1.00E+02	2.2E-06	0	2.3E-06	0
C 14	2.09E+06	2.50E+01	4.7E-05	0	4.9E-05	0
I 129	5.73E+09	1.00E+00	2.6E-02	99	4.1E-02	99
CS 137	1.10E+04	2.00E+00	.0	0	.0	0
U 238	1.65E+12	1.00E-01	.0	0	.0	0
TOTAL			2.6E-02		4.1E-02	

LOWER LARG NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE REM	%	DOSE COMM REM	%
H 3	4.51E+03	1.00E+02	2.2E-06	4	2.3E-06	4
C 14	2.09E+06	2.50E+01	4.7E-05	87	4.9E-05	87
I 129	5.73E+09	1.00E+00	2.8E-05	5	2.8E-05	5
CS 137	1.10E+04	2.00E+00	1.0E-06	1	1.0E-06	1
U 238	1.65E+12	1.00E-01	6.5E-07	1	6.5E-07	1
TOTAL			5.3E-05		5.5E-05	

I-8

EXTERNAL DOSE

NUCLIDE	HALF-LIFE	RELEASE	DOSE-SKIN	%	DOSE-TOT BODY %
H 3	4.51E+03	1.00E+02	.00	0	.00 0
C 14	2.09E+06	2.50E+01	.00	0	.00 0
I 129	5.73E+09	1.00E+00	1.38E-04	51	8.29E-05 42
CS 137	1.10E+04	2.00E+00	1.30E-04	48	1.12E-04 57
U 238	1.65E+12	1.00E-01	.00	0	.00 0
TOTAL			2.68E-04		1.95E-04

FOOD SAMPLE PROBLEM

FOOD SAMPLE PROBLEM TWO-POPULATION, WATER PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78

050780

	*** DOSE SUMMARY, MAN-REM FOR 1.0E+00 YEARS ***				
	TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
PRODUCE	8.94E+02	3.91E+03	8.92E+02	1.13E+03	8.92E+02
EGGS	5.48E+01	2.40E+02	5.47E+01	5.98E+01	5.47E+01
MILK	2.54E+02	1.11E+03	2.52E+02	5.45E+02	2.52E+02
MEAT	8.80E+01	3.84E+02	8.76E+01	1.17E+02	8.76E+01
INT. TOTAL	1.29E+03	5.64E+03	1.29E+03	1.85E+03	1.29E+03
EXTERNAL DOSE TOTALS		SKIN	TOTAL BODY		
		3.45E+01	2.87E+01		

FOOD SAMPLE PROBLEM TWO-POPULATION, WATER PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78

050780

	*** DOSE COMMITMENT SUMMARY, MAN-REM FOR A COMMITMENT TIME OF 5.0E+01 YEARS ***				
	TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
PRODUCE	9.32E+02	4.65E+03	9.29E+02	1.30E+03	9.29E+02
EGGS	5.70E+01	2.85E+02	5.70E+01	6.49E+01	5.70E+01
MILK	2.66E+02	1.31E+03	2.63E+02	7.22E+02	2.62E+02
MEAT	9.19E+01	4.57E+02	9.13E+01	1.38E+02	9.12E+01
INT. TOTAL	1.35E+03	6.70E+03	1.34E+03	2.22E+03	1.34E+03
EXTERNAL DOSE TOTALS		SKIN	TOTAL BODY		
		3.45E+01	2.87E+01		

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FOOD SAMPLE PROBLEM

SUMMARY OF NUCLIDE CONTRIBUTORS

FOOD SAMPLE PROBLEM TWO-POPULATION, WATER PATHWAYS, 50 YR COMMITMENT
 FOOD VERSION 1.0 1 AUGUST 78
 ALL FOOD PRODUCTS

050780

TOTAL BODY

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.51E+03	1.00E+02	7.4E-02	0	7.7E-02	0
C 14	2.09E+06	2.50E+01	1.3E+03	99	1.3E+03	99
I 129	5.73E+09	1.00E+00	7.2E-01	0	1.1E+00	0
CS 137	1.10E+04	2.00E+00	4.1E+00	0	5.9E+00	0
U 238	1.65E+12	1.00E-01	5.6E-02	0	8.9E-02	0
TOTAL			1.3E+03		1.3E+03	

BONE

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.51E+03	1.00E+02	.0	0	.0	0
C 14	2.09E+06	2.50E+01	5.6E+03	99	5.7E+03	99
I 129	5.73E+09	1.00E+00	3.8E-01	0	4.0E-01	0
CS 137	1.10E+04	2.00E+00	4.1E+00	0	7.7E+00	0
U 238	1.65E+12	1.00E-01	4.9E-01	0	1.5E+00	0
TOTAL			5.6E+03		6.7E+03	

LUNGS

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.51E+03	1.00E+02	7.4E-02	0	7.7E-02	0
C 14	2.09E+06	2.50E+01	1.3E+03	99	1.3E+03	99
I 129	5.73E+09	1.00E+00	.0	0	.0	0
CS 137	1.10E+04	2.00E+00	6.5E-01	0	1.2E+00	0
U 238	1.65E+12	1.00E-01	.0	0	.0	0
TOTAL			1.3E+03		1.3E+03	

THYROID

NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%

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FOOD SAMPLE PROBLEM

H 3	4.51E+03	1.00E+02	7.4E-02	0	7.7E-02	0
C 14	2.09E+05	2.50E+01	1.3E+03	99	1.3E+03	60
I 129	5.73E+09	1.00E+00	5.6E+02	30	8.8E+02	39
CS 137	1.10E+04	2.00E+00	.0	0	.0	0
U 238	1.65E+12	1.00E-01	.0	0	.0	0
TOTAL			1.8E+03		2.2E+03	

LOWER LARG NUCLIDE	HALF-LIFE DAYS	RELEASE CI/YR	DOSE MAN-REM	%	DOSE COMM MAN-REM	%
H 3	4.51E+03	1.00E+02	7.4E-02	0	7.7E-02	0
C 14	2.09E+05	2.50E+01	1.3E+03	99	1.3E+03	99
I 129	5.73E+09	1.00E+00	5.6E-02	0	6.0E-02	0
CS 137	1.10E+04	2.00E+00	2.2E-01	0	2.2E-01	0
U 238	1.65E+12	1.00E-01	1.2E-01	0	1.2E-01	0
TOTAL			1.3E+03		1.3E+03	

EXTERNAL DOSE

NUCLIDE	HALF-LIFE	RELEASE	DOSE-SKIN	%	DOSE-TOT BODY %
H 3	4.51E+03	1.00E+02	.00	0	.00 0
C 14	2.09E+05	2.50E+01	.00	0	.00 0
I 129	5.73E+09	1.00E+00	3.30E+00	9	1.98E+00 6
CS 137	1.10E+04	2.00E+00	3.12E+01	90	2.57E+01 93
U 238	1.65E+12	1.00E-01	.00	0	.00 0
TOTAL			3.45E+01		2.17E+01

END OF INPUT FOR THIS RUN

FOOD SAMPLE PROBLEM

*** Q.A. PAGE ***

RUN ON 050780

FOOD, VERSION 1.0, 1 AUGUST 78

CASE TITLE: FOOD SAMPLE PROBLEM TWO-POPULATION, WATER PATHWAYS, 50 YR COMMITMENT
EXECUTING HANFORD#FOOD(1).ABS CREATED ON MARCH 13, 1980 AT 14:46:36

TYPE OF DOSE CALCULATED: CHRONIC INGESTION AND EXTERNAL EXPOSURE
FOR :WATER PATHWAY, POPULATION

*** DATA LIBRARIES USED:

RADIOMUCLIDE LIBRARY: RADIONUCLIDE MASTER DATA LIBRARY, 15 MARCH 78, RA NAPIER
FOOD TRANSFER FACTOR LIBRARY: *** FOOD TRANSFER COEFFICIENT LIBRARY 2/27/78 RA NAPIER ***
ORGAN DATA LIBRARY: *** ORGAN DATA LIBRARY UPDATED BY RAN 8/10/79 ***
GROUND DOSE FACTOR LIBRARY: *** GRDFLIB FOR FOOD, 15 MARCH 1978, RA NAPIER ***

*** FOOD DATA USED:

FOOD TYPE	X/O (SEC/M**3)	GROWING PERIOD (DAYS)	YIELD (KG/M**3)	IRR. RATE (L/M**2/MONTH)	HOLDUP (DAYS)	CONSUMPTION (KG/YR)	TRANSLOCATION
LEAFY VEG.	.00	9.00E+01	1.50E+00	1.50E+02	1.00E+00	1.50E+01	1.00E+00
POTATOES	.00	9.00E+01	4.00E+00	1.50E+02	1.00E+01	1.10E+02	1.00E-01
ORCH. FRUIT	.00	9.00E+01	2.00E+00	1.50E+02	1.00E+01	6.50E+01	1.00E-01
OT. GRAIN	.00	9.00E+01	1.00E+00	1.50E+02	1.00E+00	7.00E+01	1.00E-01
EGGS	.00	9.00E+01	8.40E-01	1.50E+02	1.00E+00	2.00E+01	1.00E-01
MILK	.00	3.00E+01	1.30E+00	1.50E+02	1.00E+00	2.00E+02	1.00E+00
BEEF	.00	9.00E+01	8.40E-01	1.50E+02	1.50E+01	2.00E+01	1.00E-01
EXTERNAL	.00	.00	.00	1.50E+02	.00	.00	.00

I-12

*** ORGANS CONSIDERED:

TOTAL BODY	BONE	LUNGS	THYROID	LOWER LARG
------------	------	-------	---------	------------

*** NUCLIDES CONSIDERED:

| NUCLIDE
ELT. WT.
(CI/YR) |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| H 3 | 1.00E+02 | C 14 | 2.50E+01 | I 129 | 1.00E+00 |
| | | | | CS 137 | 2.00E+00 |
| | | | | U 238 | 1.00E-01 |

***OSITE SPECIFIC DATA USED

INVENTORY MODIFICATION FACTOR: 1.00E+00
FACILITY LIFE (YEARS): 3.00E+01
POPULATION: 2.50E+05
DOSE TIME (YEARS): 1.00E+00
DOSE COMMITMENT TIME (YEARS): 5.00E+01
EXTERNAL EXPOSURE TIME (HR): 2.00E+03

***RECONCENTRATION DATA USED

MODEL USED: 3
COOLANT FLOW RATE: 1.00E+04
COOLANT MAKEUP FLOW (FT3/SEC): .0
POND VOLUME (FT3): .0
TURNOVER RATE: .0
CYCLE TIME (HR): .0

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