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ORNL--5785

DE85 003717

Health and Safety Research Division

**TERRA: A Computer Code for Simulating the Transport
of Environmentally Released Radionuclides
through Agriculture**

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Date Published: November 1984

Research sponsored by the Office of Radiation Programs, U. S.
Environmental Protection Agency under Interagency Agreement
AD-89-F-2-A186 (formerly EPA-78-D-X8394).

Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.
for the
U. S. DEPARTMENT OF ENERGY
under contract No. DE-AC05-84OR21400

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ACKNOWLEDGEMENT

We wish to express our deepest gratitude to C. B. Nelson, Office of Radiation Programs, U.S. Environmental Protection Agency, for his ideas, support, discussion, and assistance in this work. We also wish to especially recognize R. W. Shor, Oak Ridge National Laboratory, for her guidance and her critique of our code. We thank our coworkers at Oak Ridge National Laboratory, C. L. Begovich, S. Y. Chi, B. D. Murphy, M. R. Patterson, S. J. Cotter, R. O. Chester, C. W. Miller, and F. O. Hoffman who have contributed ideas, suggestions, and encouragement in this work. Also, we especially wish to recognize G. G. Killough, N. S. Hardin, B. J. Waddell and B. R. Roth for their assistance in preparing this report.

HIGHLIGHTS

TERRA is a computer code which calculates concentrations of radionuclides and ingrowing daughters in surface and root-zone soil, produce and feed, beef, and milk from a given deposition rate at any location in the conterminous United States. The code is fully integrated with seven other computer codes which together comprise a Computerized Radiological Risk Investigation System, CRRIS. Output from either the long range (>100 km) atmospheric dispersion code RETADD-II or the short range (<80 km) atmospheric dispersion code ANEMOS, in the form of radionuclide air concentrations and ground deposition rates by downwind location, serves as input to TERRA. User-defined deposition rates and air concentrations may also be provided as input to TERRA through use of the PRIMUS computer code. The environmental concentrations of radionuclides predicted by TERRA serve as input to the ANDROS computer code which calculates population and individual intakes, exposures, doses, and risks. TERRA may be run individually or in concert with the other codes of CRRIS, depending on the needs of the user and the application required.

TERRA is based on modifications of the NRC Reg. Guide 1.109 models for food-chain transport to account for leaching of radionuclides from root-zone soil; resuspension of deposited material; input of location-specific information; variations in transport pathway calculations for various food, feed, and cattle types; and explicit calculation of ingrowth of daughter radionuclide chains of varying length and complexity. Input and output of calculated concentrations may be specified for a point location or on rectangular or circular grids of variable size. The code automatically accesses a computerized data base of default location-specific agricultural, climatological, land use, and demographic parameters on a $\frac{1}{2} \times \frac{1}{2}$ degree longitude-latitude basis for the conterminous United States, called SITE. These parameters are converted from the $\frac{1}{2} \times \frac{1}{2}$ degree cell basis to square grid or sector segment-averaged basis before terrestrial transport is calculated. A second data base of transport parameters for soil-water distribution, plant uptake, and transport to beef and milk is also automatically accessed by TERRA.

TERRA incorporates models, based on the NRC Reg. Guide 1.109 approach, to calculate uptake from soil and atmospheric deposition on four groups of produce for human consumption and four groups of livestock feeds. Transport is considered from feed to milk and from feed to beef for milk cows, feedlot cattle, and "other" beef cattle. During the environmental transport simulation, intermediate calculations of interception fraction for leafy vegetables, produce directly exposed to atmospherically depositing material, pasture, hay, and silage are made based on location-specific estimates of standing crop biomass. Pasture productivity is estimated by a model which considers the number and types of cattle and sheep, pasture area, and annual production of other forages (hay and silage) at a given location. Calculations are made of the fraction of grain imported from outside of the assessment area. TERRA output includes the above calculations and estimated radionuclide concentrations in plant produce, milk, and a beef composite by location.

TERRA is designed to run on an IBM 370/3033 digital computer. The minimum requirement for user input is the time period for long-term buildup of depositing material in soil. Default values of all other transport and agricultural parameters are automatically accessed by TERRA from the SITE and element-specific data bases or are included within the code itself. However, for user convenience any default parameter may be overridden via NAMELIST input.

1. INTRODUCTION

The funding for this research was provided by the U.S. Environmental Protection Agency (EPA), which upon assuming regulatory authority of nuclear effluents covered by the Clean Air Act amendments of 1977, launched an extensive review and revision of models that simulate transport of radionuclides through environmental pathways to man and calculate resulting health impacts. The results of the first phase of this work undertaken by the Health and Safety Research Division (HASRD) of the Oak Ridge National Laboratory (ORNL) are published in two reports: AIRDOS-EPA (Moore et al., 1979) and DARTAB (Begovich et al., 1981). While the AIRDOS-EPA and DARTAB computer codes have provided an interim methodology for performing nuclear assessments, work has continued at ORNL on an integrated set of computer codes and data bases which serves as a state-of-the-art radiological risk assessment methodology. This Computerized Radiological Risk Investigation System, or CRRIS (Baes and Miller, 1981; 1984), is based on a review and evaluation of the AIRDOS-EPA - DARTAB system. This report documents one code of the CRRIS — TERRA, a code for calculation of the Transport of Environmentally Released Radionuclides through Agriculture. This report documents only the models and approaches used in TERRA and serves as a user's manual. A second report (Baes et al., 1984) documents all of the default parameters, location-specific data, time constants, etc. in the TERRA code.

The relationship of TERRA to the other codes of the CRRIS is shown in Figure 1.1. PRIMUS (Hermann et al., 1984) is a preprocessing code which accesses a data base of decay data (Kocher, 1981) and determines the members of each decay chain which must be considered in transport, dose, and risk calculations by the other codes of the CRRIS. RETADD-II (Murphy, Ohr, and Begovich, 1984) is a long range (>100 km) trajectory atmospheric dispersion code which calculates radionuclide air concentrations and ground deposition rates on a rectangular grid of regional or continental scale. ANEMOS (Miller, Begovich, and Hermann, 1984) is a short range (≤ 80 km) Gaussian plume atmospheric dispersion code which calculates radionuclide air concentrations and ground deposition rates on a circular grid. Output from ANEMOS may be specific for successive downwind distances or averaged over the sector segments. Multiple runs of ANEMOS within a relatively small area may be summed on a "master" grid by the SUMIT code (Begovich et al., 1984a). MLSOIL and DFSOIL (Sjoreen et al., 1984) contain a multi-layer model of radionuclide transport through soil. MLSOIL may be used in place of TERRA or will merge its output with a previously produced TERRA file. DFSOIL computes the external dose factors used by MLSOIL. ANDROS (Begovich et al., 1984b) receives environmental concentrations from the other CRRIS codes and combines them with population estimates (from the SITE data base), food and air intake rates, and dose and risk factors to calculate population and average individual doses and risks from the source terms used.

As indicated by Fig. 1.1, various combinations of the CRRIS codes may be used to tailor the assessment to the user's needs. For example, if inhalation and air immersion exposures, doses, and risks only are to be calculated, then the user may elect to eliminate TERRA from the assessment pathway. On the other hand, if ground deposition rates or soil concentrations are known for a given location, then the user may complete the assessment using the PRIMUS-TERRA-ANDROS computer codes.

TERRA is designed as an integrated component of the CRRIS, but it may also be used alone to calculate concentrations of radionuclide chains in four vegetable and produce categories, four livestock feed categories, irrigated and non-irrigated root-zone soil, beef, and milk. Currently, transport pathways involving animal products other than beef and cow's milk, such as chicken, eggs, pork, lamb, goat's milk, etc., are not considered. However, TERRA's modular structure allows for additional pathways to be added if necessary, when and if the appropriate transport parameters are available. TERRA may also be used to calculate circular grid sector segment averaged or regional rectangular grid averaged environmental (SITE) parameters anywhere in the conterminous United States. Within TERRA the processes of leaching from root-zone soil, radiological decay and daughter buildup, weathering from plant surfaces, and resuspension are accounted for. However,

Figure 1.1. The codes which make up the CRRIS and possible pathways of information flow among them in performing nuclear risk assessments. Note that multiple runs of ANEMOS are summed on a master grid by SUMIT.

the net effect of these processes, rather than detailed simulation of them, has been the goal. Finally, TERRA simulates transport in a generalized agricultural system, where the parameters have been adjusted to reported regional averages based on a review of agricultural practices in the United States (Shor, Baes, and Sharp, 1982). In fact, actual practices at a given location may be quite different from the TERRA simulation. Therefore, TERRA is an alternative to a simple national-averaged generalized model, but it is not a substitute for an actual site-specific assessment.

2. CONCEPTUAL MODELS

The conceptual agricultural model used in TERRA is summarized in Figure 2.1. Briefly, TERRA considers root uptake pathways for four food crop and four feed crop categories, direct deposition onto edible plant surfaces for two food crop and three feed crop categories, transport to three cattle types producing beef, and transport to cow's milk. Also, included in TERRA are considerations for irrigated and non-irrigated soil and differences in root uptake for "vegetative" (leafy) and "reproductive" (fruit) plant parts. The following sections discuss the implementation of these models in the TERRA computer code. However, the reader is referred to the reports by Shor, Baes, and Sharp (1982) and Baes et al. (1984) for more detailed descriptions of these conceptual models and the transport parameters characterizing them.

2.1 Parent Decay and Daughter Buildup

Parent decay and daughter buildup in TERRA is incorporated into all transport calculations for all radionuclide chains. These calculations are performed via the subroutines DECAYC and DECAYI which combine the PRIMUS file of decay constants with other radionuclide input and removal processes. The transport calculations are accomplished by assuming that each of the terrestrial media (soil, plants, beef, etc.) may be represented by a "chain" of single compartments as indicated in Fig. 2.2. The single compartment "chain" is linked together via the radiological decay constants. Each nuclide ($i, j, k, \dots, n$) may have unique input and removal rates. However, the protocols of the DECAYC routine require that decay and all input and removal processes be additive. Thus, processes such as root uptake, atmospheric deposition, weathering removal, leaching from soil, and ingestion of contaminated feed by cattle must all be considered as linear rate constants in TERRA.

The concentration of radionuclides in a given chain is calculated by solving the following set of differential equations:

$$\begin{aligned}\frac{\Delta C_i}{\Delta t} &= I_i - C_i(\lambda_i + \lambda_{ri}) \quad , \\ \frac{\Delta C_j}{\Delta t} &= I_j + C_i(\lambda_i b_{ij}) - C_j(\lambda_j + \lambda_{rj}) \quad , \\ \frac{\Delta C_k}{\Delta t} &= I_k + C_i(\lambda_i b_{ik}) + C_j(\lambda_j b_{jk}) - C_k(\lambda_k + \lambda_{rk}) \quad \dots, \end{aligned} \quad (1)$$

where

- $C_i, C_j, C_k =$ the concentration of nuclides i, j , and k , respectively, in a given medium,
- $I_i, I_j, I_k =$ the input rate constants for nuclides i, j , and k , respectively,
- $\lambda_{ri}, \lambda_{rj}, \lambda_{rk} =$ the removal rate constants for nuclides i, j , and k , respectively,
- $\lambda_i, \lambda_j, \lambda_k =$ the radiological decay constants for nuclides i, j , and k , respectively,
- $b_{ij}, b_{ik}, b_{jk} =$ the branching ratios from nuclide i to j , nuclide i to k , and nuclide j to k , respectively,
- $t =$ the time over which transport occurs, and
- $i, j, k =$ the nuclides in a given decay chain, $i, j, k, \dots, n$.

Figure 2.1. Conceptual model of an agricultural food chain used in the TERRA computer code.

Figure 2.2. Conceptual model of a TERRA compartment, including input and removal rates and radiological decay.

Equation (1) is the general form for all transport calculations. Definition of the input and removal mechanisms for each compartment model in TERRA simply requires modification of the NRC Reg. Guide 1.109 models. The models for soil, plant interior and surface, beef, and milk are discussed in the following sections.

2.2 Buildup of Deposited Radionuclides in Soil

In TERRA the accumulation of radionuclides in soil is calculated for 1) both irrigated and non-irrigated agricultural soils to a depth of 15 cm in preparation for the calculation of root uptake of radionuclides by food and feed crops and 2) surface soil to a depth of 1 cm for the ground surface exposure calculations made in the ANDROS code. The input to soil is the ground-level deposition rate in Bq or Ci/m²/s, as output by ANEMOS or RETADD-II or specified by the user. The time over which Eq. (1) is integrated is specified by the user as either the "period of long-term buildup," t_b (equivalent to the time that the source term exists) or the "time of the assessment," t_a in years. If $t_b \geq t_a$, then Eq. (1) is integrated over t_a (converted to seconds). If $t_a > t_b$, then Eq. (1) is integrated over t_b with the deposition rates of the nuclides as input to TERRA and over $(t_a - t_b)$ with deposition rates of zero. That is, during the time between the termination of the source term and the time of the assessment only removal processes from soil are considered.

In addition to radiological decay, leaching of material to depths below the surface or root zone layers is considered as a removal process. This leaching removal rate constant is specified in TERRA for each of the three soil types being considered. For irrigated agricultural soil the leaching constant is given by

$$\lambda_l = \frac{P + I - E}{\theta d [1 + (\frac{\rho}{\theta} K_d)]} \quad (2)$$

where

- λ_l = the removal constant due to leaching (s⁻¹),
- P = annual average total precipitation (cm/yr),
- E = annual average evapotranspiration (cm/yr),
- I = annual average irrigation (cm/yr),
- d = soil depth from which leaching removal occurs (15 cm),
- ρ = soil bulk density (g/cm³),
- θ = soil volumetric water content (mL/cm³), and
- K_d = the soil-water distribution coefficient (mL/g).

For non-irrigated and surface exposure soils, the leaching constant is given by

$$\lambda_l = \frac{P - E}{\theta d [1 + (\frac{\rho}{\theta} K_d)]} \quad (3)$$

with $d = 15$ cm for non-irrigated soils and $d = 1$ cm for surface exposure soil.

In the TERRA code P , I , and E are read in from the SITE data base in units of millimeters per year and converted to centimeters in Eqs. (2) and (3). The integration time is specified by the user in years and is converted to seconds via

$$1.0 \text{ year} = 365.2422 \text{ days} \quad \text{and} \quad (4)$$

$$1.0 \text{ day} = 86,400 \text{ seconds} \quad (5)$$

Finally, K_d is read in from the element-specific data base, and the defaults for ρ and θ are 1.35 g/cm³ and 0.485 mL/cm³, respectively. Soil concentrations output by TERRA are activity (either Bq or Ci as input by the user) per kilogram of soil.

2.3 Root Uptake of Radionuclides from Contaminated Soil

In TERRA food and feed crop radionuclide concentrations are not "equilibrium" concentrations, but rather concentrations expected at harvest during the year t_a or t_h , as specified by the user. The NRC Reg. Guide 1.109 models (USNRC, 1977) currently in use in many assessment codes have been modified to conform to the constraints of the DECAYC routines as shown in Fig. 2.2 to account for parent nuclide decay and daughter nuclide ingrowth. Thus, root uptake of radionuclides in soil is considered as a constant process which may be represented by a single input rate constant to the plant. Using the traditional approach to calculating root uptake via a soil-plant bioaccumulation factor, the root uptake rate is derived according to

$$I_{\text{root}} = \frac{C_s B_{\text{plant}}}{t_h} \quad (6)$$

where

- I_{root} = The root uptake rate constant (Bq or Ci/kg/s),
- C_s = the root zone soil concentration (Bq or Ci/kg),
- B_{plant} = the soil-plant bioaccumulation factor (unitless), and
- t_h = the time to harvest (s).

As shown in Fig. 2.1, leafy vegetables and exposed and protected produce are assumed to be grown on irrigated soils, and all other food and feed crops are assumed to be grown on non-irrigated soils. The respective soil concentrations, calculated via Eqs. (1) and (2) are used to calculate I_{root} in Eq. (6). The parameter B_{plant} is either the vegetative plant part/soil (B_v) or reproductive plant part/soil (B_r) concentration factor (as described in Baes et al., 1984), depending on the food or feed crop being simulated. For food crops I_{root} is converted to a fresh weight equivalent value using dry/fresh weight conversion factors for each food category as discussed in Baes et al. (1984) before solving Eq. (1). Feed crop concentrations, however, are in dry weight.

The removal rate constant (λ_r) in Eq. (1) has been provided for in the calculation of plant interior concentrations in the TERRA code, although parameterization of λ_r is left to the user. As discussed in Sect. 3, the removal rate constant for plant interiors may be specified by nuclide by the user. However, because of a lack of empirical information on such values, the default element-specific values incorporated into TERRA are all equal to zero.

2.4 Direct Deposition of Radionuclides on Plant Surfaces

In addition to root uptake of radionuclides built up in soil, TERRA considers direct deposition of radionuclides on the edible surfaces of leafy vegetables, exposed produce, pasture, silage, and hay (Fig. 2.1). The input rate to plant surfaces is given by

$$I_{surface} = \frac{Dr^i}{Y_i} \quad (7)$$

where

- $I_{surface}$ = the input rate of a given nuclide on the surface of plant i (Bq or Ci/kg/s),
 D = the ground-level deposition rate of a given nuclide (Bq or Ci/m²/s),
 r^i = the interception fraction for plant i (unitless), and
 Y_i = the standing crop biomass or productivity of plant i (kg/m²).

The interception fraction modifies the ground-level deposition rate to account for the fraction of depositing material intercepted by the edible plant surface, and the productivity value converts an input per square meter to a per kilogram basis. Productivity estimates are read in for each crop category from the SITE data base. Productivities for food and feed crops are on a fresh weight and dry weight basis, respectively. Default crop category-specific interception fractions are incorporated in TERRA based on a theoretical analysis of field crop geometries (Baes et al., 1984).

The removal rate constants from the plant surface compartment are radiological decay and weathering removal. The weathering removal rate constants are on an element-specific basis. However, the default value for all elements, except iodine, is $5.73 \times 10^{-7} \text{ s}^{-1}$ (equal to a half time of 14 d) for all plant types; the value for iodine is $1.0 \times 10^{-6} \text{ s}^{-1}$ (half time = 8 d) based on Baes et al., 1984. This default value is expected to vary by location (environmental conditions), plant type, and nuclide (especially with chemical form). The user of TERRA is encouraged to override the default values when deemed appropriate.

TERRA adds the interior (root uptake) and surface plant concentrations together for leafy vegetables, exposed produce, pasture, hay, and silage before printing out food concentrations or calculating transport from feeds to beef and milk. However, the user may elect to see the interior and surface plant concentrations separately by selecting the intermediate output print option.

2.5 Milk Radionuclide Concentrations

The transport of radionuclides to milk requires definition of input and removal rates to the milk compartment as specified in Eq. (1). The input rate is given by

$$I_{milk} = \frac{(Q_{grain} C_{grain} + Q_{forage} C_{forage}) f_{im}}{m_p} \quad (8)$$

where

- I_{milk} = the input rate of a radionuclide into milk (Bq or Ci/kg/s),
 Q_{grain} = consumption rate of grain by a milk cow (kg/s),
 C_{grain} = activity concentration of grain (Bq or Ci/kg),
 Q_{forage} = consumption rate of forage by a milk cow (kg/s),
 C_{forage} = activity concentration of forage (Bq or Ci/kg),
 f_{im} = the fractional transfer of ingested activity to milk (unitless) and,
 m_p = the quantity of milk produced per day (kg).

Default values for Q_{grain} and Q_{forage} incorporated into TERRA are 2600 and 4010 kg/yr, respectively (Shor, Baes, and Sharp, 1982). These values are converted by the code to a per second basis before I_{milk} is calculated. The feed concentrations C_{grain} and C_{forage} are calculated via Eq. (1) according to the methods described in Sects. 2.3 and 2.4. The forage concentration is actually a weighted average of the concentrations calculated for hay, silage, and pasture (Fig. 2.1). The weighting factors are the production of these forages at the given location. Hay and silage production are read in from the SITE data base and pasture production is calculated according to the method of Shor, Baes, and Sharp (1982) from inventories of cattle and sheep supplied from SITE. The parameter m_p is assumed to be 13.4 kg based on an average for milk cows in the United States (Shor, Baes, and Sharp, 1982).

Because the TERRA models are an adaptation of the NRC Reg. Guide 1.109 models and because of the existing data bases of milk transport parameters the model parameter f_{im} is given by

$$f_{\text{im}} = 86,400 F_m m_p \lambda_m \quad (9)$$

where

86,400 = the number of seconds in a day (s/d),

F_m = the fraction of daily ingested activity which appears in milk (d/kg),

m_p = the quantity of milk produced per day (kg), and

λ_m = the metabolic turnover rate constant for activity in milk (s^{-1}).

In the TERRA code the parameters F_m and λ_m are read in from the element specific data base. Both of these parameters are taken from Ng et al., 1977. The metabolic removal rate constant is combined with decay [Eq. (1)] in the milk concentration calculation in addition to its use in the calculation of f_{im} in Eq. (9). Integration time of Eq. (1) is 3.08×10^7 s (1 year). This value represents milk concentrations after a years' continuous feeding of contaminated feed by milk cows.

2.6 Beef Radionuclide Concentrations

The transport of radionuclides to beef is calculated in a similar manner to the calculation for milk, except that calculations are made for three cattle types: feedlot cattle, other beef producing cattle, and milk cows. For each cattle type definition of input and removal rates to the beef compartment, as specified in Eq. (1), is given by

$$I_{\text{beef}} = \frac{(Q_{\text{grain}} C_{\text{grain}} + Q_{\text{forage}} C_{\text{forage}}) f_{\text{ib}}}{m_m} \quad (10)$$

where

I_{beef} = the input rate of a radionuclide into beef (Bq or Ci/kg/s),

f_{ib} = the fractional transfer of ingested activity to beef (unitless), and

m_m = the muscle mass of the cow (kg).

Default values for Q_{grain} incorporated into TERRA are 1820, 150, and 2600 kg/yr, respectively, for cattle on feed, "other" cattle, and milk cows (Shor, Baes, and Sharp, 1982). For these three beef-producing cattle types the respective Q_{forage} values are 970, 3030, and 4010 kg/yr. As in the milk calculations, these values are converted by the code to a per second basis before I_{beef} is calculated. The parameter m_m is assumed to be 250 kg based on an average over the United States for the entire cattle and calf inventory (Shor, Baes, and Sharp, 1982).

In a manner analogous to milk, for the beef calculations the parameter f_{ib} is given by

$$f_{ib} = 86,400 F_f m_m \lambda_b \quad (11)$$

where

F_f = the fraction of daily ingested activity which appears in beef (d/kg) and

λ_b = the metabolic turnover rate constant for activity in beef (s^{-1}).

The parameters F_f and λ_b are read in from the element specific data base. The parameter F_f is reviewed in Baes et al., 1984. The metabolic removal rate constant for beef, although element-specific, is defaulted to $5.73 \times 10^{-7} s^{-1}$ (equal to a half time of 14 d) for all elements because of a lack of information on this parameter. The user is encouraged to supply his own estimates of λ_b in running TERRA.

In a manner similar to milk concentration calculations, λ_b is combined with decay [Eq. (1)] in the milk concentration calculation in addition to its use in the calculation of f_{ib} in Eq. (11). The integration times for Eq. (1) for the three cattle types are $3.08 \times 10^7 s$ (1 year) for feedlot and "other" cattle and $1.89 \times 10^8 s$ (6 years) for milk cows. These times represent the time between birth and slaughter for these cattle types.

The beef concentrations output by TERRA are a weighted average of the beef concentrations calculated for the three cattle types. The weighting factors are the inventories of each type at the location for which the calculation is made. Milk cows inventory is read in directly from the SITE data base. The inventories of feedlot and "other" cattle are calculated in TERRA according to the methodology suggested by Shor, Baes, and Sharp (1982).

2.7 Resuspension of Surface Soil

In TERRA material initially deposited in the surface soil may be resuspended and redeposited on plant surfaces. The approach taken in TERRA is to assume that the specific activities of the radionuclide chain members in the surface soil are the same in the resuspended material. Using a mass loading approach (Baes et al., 1984), a deposition rate of resuspended material onto plant surfaces is given by

$$D_{\text{resus}} = \frac{C_{ss} P_{ss} V_d}{1 \times 10^9} \quad (12)$$

where

D_{resus} = the ground-level deposition rate of resuspended material (Bq or Ci/m²/s),

C_{ss} = the surface soil concentration (Bq or Ci/kg),

P_{ss} = resuspended particulate matter ($\mu\text{g}/\text{m}^3$),

V_d = the deposition velocity of resuspended particulate matter (m/s), and

1×10^9 = a conversion factor from micrograms to kilograms.

The value of P_{res} used as default in TERRA is $15.5 \mu\text{g}/\text{m}^3$ (Baes et al., 1984) and represents the coarse fraction (2.5 to $15 \mu\text{m}$) of suspended particulate matter generally attributed to windblown dusts. A value of 0.1 m/s is assumed for the deposition velocity of these resuspended dusts.

The deposition rate of resuspended material is calculated in TERRA if requested by the user. If such is the case, and if $t_a \leq t_b$, then D_{resus} is added to the numerator of Eq. (7) in the calculation of plant surface concentrations. If $t_a > t_b$, then D_{resus} replaces D in Eq. (7).

2.8 Tritium and Carbon-14 Calculations

The concentration of tritium and carbon-14 in food crops, beef, and milk are calculated via specific activity models. That is, it is assumed that their activity concentrations in water and in carbon in foods, respectively, at a given location are in equilibrium with their annual average specific activities in atmospheric water vapor and CO_2 in air, respectively, at the location same (Baes et al., 1984). Thus, for tritium

$$C_{\text{food}}^{H3} = \frac{1000 C_{\text{air}}^{H3} f_{\text{wa}} m_w}{H}, \quad (13)$$

where

- C_{food}^{H3} = the tritium concentration in food (Bq or Ci/kg),
- 1000 = a conversion factor from grams to kilograms (1000 g/kg),
- C_{air}^{H3} = the tritium concentration in air (Bq or Ci/ m^3),
- f_{wa} = the fraction of water in food derived from atmospheric sources (unitless),
- m_w = the mass fraction of water in food (unitless), and
- H = the absolute humidity at a given location (g/m^3).

The parameter C_{air}^{H3} is output by either ANEMOS or RETADD-II by location, and the absolute humidity, H , is taken from the SITE data base. Based on Baes et al. (1984), the default for f_{wa} used in TERRA is 1.0, and m_w is 0.934 for leafy vegetables, 0.874 for "exposed" produce, 0.778 for "protected" produce, 0.112 for grain, 0.615 for beef, and 0.870 for milk.

By analogy, the concentration of carbon-14 in food is given by

$$C_{\text{food}}^{C14} = \frac{1000 C_{\text{air}}^{C14} m_c}{0.18}, \quad (14)$$

where

- C_{food}^{C14} = the carbon-14 concentration in food (Bq or Ci/kg),
- C_{air}^{C14} = is the carbon-14 concentration in air (Bq or Ci/ m^3),
- m_c = is the mass fraction of carbon in food (unitless), and
- 0.18 = is the average concentration of CO_2 in the atmosphere (g/m^3).

The concentration of C-14 in air is output by ANEMOS and RETADD-II by location, and the mass fraction of carbon is 0.026 for leafy vegetables, 0.050 for "exposed" produce, 0.116 for "protected" produce, 0.293 for grain, 0.228 for beef, and 0.293 for milk (Baes et al., 1984).

3. TERRA USER'S GUIDE

The computer program TERRA is a package of eight FORTRAN IV routines, the Decay package of FORTRAN IV subroutines (Hermann et al., 1984), and one assembly language routine designed to be used with other computer codes in the CRRIS. TERRA has been written to be user-oriented and modular. The three subroutines SOILS, AGRON, and STOCK calculate radionuclide concentrations in each of the three types of compartments, soil, plant, and livestock. Additional compartments or mechanisms for radionuclide uptake into man's food chain could be added with minimal effort. The final concentrations to be passed to ANDROS are also passed in labeled COMMON (OUTPUT) which can be expanded as more compartments are included.

TERRA is the primary code in CRRIS for integration of large data sets. Also, TERRA provides the user with a variety of options for data storage and manipulation. Figure 3.1 details the integration of TERRA into CRRIS and how data is read in and how it is passed from TERRA to ANDROS. Several steps must precede execution of TERRA. ANEMOS or RETADD-II are run beforehand to determine deposition rates for each radionuclide over every calculational grid cell. These results from ANEMOS or RETADD-II have been stored as binary on data unit INB. In addition a data set of the same radionuclides used in ANEMOS or RETADD-II must be made from the PRIMUS program and stored as binary data on unit NPRIME. The logical unit numbers in Fig. 3.1 (NPRIME, INB, INS, INE, ISSAV, IBOUT, and IOUT) are set by the user. Unit INC is set at a statement in the main program. The remainder of logical unit numbers and control parameters are read on unit INC before TERRA proceeds through its calculations.

There are 12 major steps in execution of TERRA. These steps are listed below:

1. Read control parameters from unit INC.
2. Read nuclide list and nuclide-specific parameters from PRIMUS on logical unit NPRIME. The decay matrices are read from this data set.
3. Read case descriptors, list of radionuclides and number of calculational grid cells (NLOC) from unit INB. Then proceed through the following steps over the total nuclide list for each location.
4. Read location data, air concentrations, and deposition rates.
5. IF IOPT = 2 or IOPT = 3, the SITE parameters have not been averaged over the appropriate grid cells. If ISTORE = 2, read previously calculated grid-averaged SITE parameters from ISSAV. If INL > 0, read user-defined SITE parameters from unit INL.
6. If IOPT = 1 input is either from RETADD-II on a rectangular grid, and subroutine RECTAV is called to obtain rectangular grid-averaged SITE parameters or input is from ANEMOS on a circular grid and subroutine CIRCAV is called to obtain sector segment-averaged SITE parameters.
7. Call subroutine SOILS to calculate radionuclide concentrations in soil. Element-specific parameters are read on logical unit INE in the first pass through SOILS, and these parameters are matched with the nuclide list for the case. Call DECAYI from SOILS to compute radioactive decay and buildup. If IRESUS = 1 call subroutine RESUS from SOILS to incorporate resuspension into calculation of radionuclide concentrations.
8. Call subroutine AGRON from SOILS to calculate radionuclide concentrations in every plant compartment, except pasture grass.
9. Call subroutine STOCK from AGRON. Determine the radionuclide concentrations in pasture grass, and then in milk and all beef compartments.

Figure 3.1. Schematic representation of linkages within TERRA and between TERRA and the other codes of the CRRIS system.

10. In MAIN write the resultant concentrations on logical unit IBOUT (in binary) to be used with ANDROS.
11. If ISTORE = 1, save the calculated grid-averaged SITE parameters on logical unit ISSAV (binary write). The averaged SITE parameters remain the same for an identical grid, and any later run with the same grid can directly read the grid-averaged SITE parameters with ISTORE = 2.
12. Write output records on logical unit IOUT (usually the line printer output). Control parameter IWRITE determines the amount of written output given.

3.1 TERRA Routines

TERRA consists of the following ten routines:

AGRON	calculates concentrations in all plant compartments except pasture grass compartments;
CIRCAV	averages SITE parameters for each sector segment of a polar grid;
DECAYI	performs the radionuclide decay and daughter buildup calculations (see Hermann et al., 1984 for details of the DECAY package of subroutines);
FLTRNF	is an assembly language function that returns a random number between 0 and 1 (used with CIRCAV);
MAIN	is the driving routine for TERRA;
RECTAV	averages SITE parameters for each cell of a rectangular grid;
RESUS	recalculates air concentrations and ground-level deposition rates used in calculating plant surface radionuclide concentrations due to resuspension of surface soils;
SOILS	calculates concentrations in all soil compartments;
STOCK	calculates concentrations in all livestock-related compartments, including pasture grass; and
UNPACK	decodes the ZAS nuclide identification number.

A brief description of each subroutine follows:

3.1.1. MAIN

The MAIN routine is the "driver" of TERRA. Logical unit INC (Fig. 3.1) is defined at statement MAIN 0118. Other logical unit numbers for input/output and additional control parameters are read from unit INC. The logical unit numbers read on unit INC are INB, INL, INE, NPRIME, IOUT, IBOUT, and ISSAV (Fig. 3.1). Logical unit INL is not shown in Fig. 3.1, but is used in overriding default parameters in the MAIN program, concentration calculational subroutines, SOILS, AGRON, and STOCK, and in both of the SITE parameter averaging subroutines, CIRCAV and RECTAV. Control parameters NRECP, TA, TB, IOPT, IWRITE, ISTORE, and IRESUS are read in the same statement as the logical unit numbers listed above (MAIN 141-142).

The main calculational portion of the TERRA code is driven by the DO LOOP from MAIN 0343 to MAIN 0811. This loop is over the total number of grid cells or sectors (NLOC) given by ANEMOS or RETADD-II for which ground deposition rates have been defined for each

radionuclide. After reading the location identifiers for a grid cell, the MAIN program either reads directly from the SITE data base or obtains grid cell or sector averaged location-specific parameters by calling CIRCAV or RECTAV for either circular or rectangular grids, respectively. The user is given the option to override the default computational parameters in MAIN listed in Table 3.5 with a NAMELIST read if control parameter INL is greater than zero.

In addition, the calculation of the concentrations of two radionuclides, tritium and carbon-14 (if these radionuclides are present in the case considered), is done in MAIN. These concentrations do not depend upon the soil or food compartments of SOILS, AGRON, and STOCK, but only on air concentration and appropriate mass fractions of water and carbon in food. See APPENDIX C for the listing of MAIN. Read the comments to the right of the FORTRAN statements for a better understanding of MAIN and the other routines in TERRA. For example, all NAMELIST reads are noted at the side in the FORTRAN listing.

3.1.2. CIRCAV

CIRCAV is used to average SITE parameters over a circular grid. This routine receives the radial distances (XMIN and XMAX) and angles (YMIN and YMAX) in radians from SUMIT or ANEMOS. Although the angles are read, in fact, each angle is 22.5° . There are 16 sets of angles, starting at due north ($YMIN = 348.75^\circ$ and $YMAX = 11.25^\circ$, if 0° is due north). If IPTOGR = 1, then each radial distance read defines the location of each air concentration and deposition rate. If IPTOGR = 2, then the first pair of radial distances defines the minimum and maximum distances over which the air concentration and ground deposition rate have been averaged before being passed to TERRA. In other words, IPTOGR = 1 represents a single location (a 22.5° arc), and IPTOGR = 2 represents a 22.5° sector average. In order to define grid-averaged SITE parameters for an arc (IPTOGR = 1), some land area must be defined. This land area is defined by defining a sector 200 m in radial distance with the arc at the center of this sector. For calculational purposes this thin sector is assumed to represent the arc. With this sector defined, the same routine may be used to average the SITE parameters for either IPTOGR = 1 or 2.

The sector segment-averaged SITE parameters are derived in the following manner. First, five reference points are defined for the sector segment. They are (XMIN, YMIN), (XMIN, YMAX), (XMAX, YMIN), (XMAX, YMAX), and $[XMAX, (YMIN + YMAX) / 2]$. XMIN and XMAX are the radial distances, and YMIN and YMAX are the angles in radians read from ANEMOS or SUMIT. These points are checked to see if they are all located within the same SITE cell. If they are, then only that particular SITE cell is used to derive a set of sector-averaged parameters. If more than one SITE cell is associated with the five points, then 95 "random" points are generated through routine FLTRNF so that they fall within the sector. Each point is then associated with a SITE cell, and the frequency of each SITE cell becomes a weighting factor for that SITE cell. Before averaging is done the identified SITE cells are checked to determine if they contain land area. Only these "good" cells are used to determine sector-averaged parameters. If necessary, the weighting factors are recalculated based on the number of points associated with "good" SITE cells. The meteorological parameters and produce productivities are simply weighted averages of the SITE values. For all other parameters the "density" of the parameter is determined by dividing the parameter by the SITE cell area (AREAT), and the fraction of land area in each SITE cell is defined by the ratio of actual area (AREAT) to theoretical area (TAREA). These parameter densities are multiplied by this ratio and then the weighting factors to derive a weighted density over all SITE cells. The parameter value for the sector is the product of this weighted density and the ratio of sector segment theoretical area given by $[\pi(r_2^2 - r_1^2)\Delta\theta]$ to the SITE cell theoretical area (TAREA).

3.1.3. RECTAV

RECTAV is used to generate averaged SITE parameters over a rectangular grid from RETADD-II. Because both the assessment grid from RETADD-II and the SITE data base are rectangular, the fraction of each SITE cell overlapped by the calculational grid (weighting factors) can be determined more exactly (without the use of "random" points given XMIN, XMAX (longitude), YMIN, and YMAX (latitude) from the RETADD-II output. After these weighting factors are determined the same methods for obtaining the assessment grid-averaged SITE parameters as used in CIRCAV are used in RECTAV. An assumption inherent in the method for determining average SITE parameters both in CIRCAV and RECTAV is that the SITE parameters are uniformly distributed over the SITE cell.

If the rectangular window of interest defined by XMIN, XMAX, YMIN and YMAX lies completely outside the grid of the SITE data set, the subroutine RECTAV returns to MAIN with all the SITE parameters set to zero. If part of the window lies outside the SITE grid, the window is locally reduced in RECTAV to avoid using keys outside the range of the direct-access SITE data base.

Weighting of the SITE parameters involves the fractional portions of SITE data cells within the RETADD-II window. The variable TOTWT is the sum of all the fractional areas of SITE data cells within the RETADD-II window. IGOOD is the total number of SITE data cells which have shared an area with the RETADD-II window. Each of the SITE data items is weighted by the normalized weighting factor (fraction of land in the SITE cell/TOTWT) and added to a running total in order to obtain average SITE parameters for the RETADD-II window.

3.1.4. SOILS

After the grid-averaged SITE parameters have been determined via CIRCAV or RECTAV, the main program calls the subroutine SOILS to calculate the concentration of each radionuclide in surface and root zone soils. If the time that the assessment is performed (TA) is less than or equal to the period of long term buildup in soil (TB, equal to the time that the source term is operating), then buildup in soil is calculated for TA years. If $TA > TB$, then buildup (deposition) occurs over TB years, and only leaching removal and decay (no deposition) occur over $(TA - TB)$ years. If IRESUS = 1, subroutine RESUS is called by soils. After soil concentrations are calculated, AGRON is called by SOILS.

3.1.5. RESUS

The routine RESUS calculates the air concentration and ground deposition rate due to resuspension of contaminated surface soil. The methodology used is described in Baes et al. (1984). Resuspension is calculated if IRESUS = 1. If $TA \leq TB$, the deposition rate due to resuspension (DEPN) is added to the deposition rate input to TERRA (DEPR) before AGRON is called. If $TA > TB$, then only DEPN is used as the ground deposition rate when AGRON is called.

If there is no land area within the window of interest, resuspension is ignored and RESUS returns to subroutine SOILS before any unneeded calculations are made. Otherwise, the concentration of nuclide IN due to resuspension (CONRES[IN]) is calculated based upon the concentration of nuclide IN in the top DE centimeters of soil (CONES[IN]), deposition velocity of nuclide IN due to resuspension (VELD[IN]), and the mass loading factor, MLOAD.

3.1.6. AGRON and STOCK

The routines AGRON and STOCK calculate concentrations in plants and animal products, respectively. In AGRON calculations are made separately for surface and interior of all food and

feed plants, except pasture. Surface and interior concentrations are combined before passing concentrations from AGRON to STOCK and before printing the output. STOCK calculates surface and interior concentrations in pasture, rather than AGRON, because pasture production for a given assessment grid location is based on cattle and sheep inventories. From the feed concentrations determined in AGRON and STOCK, the beef and milk concentrations are calculated.

3.2. TERRA Compartments

The mathematical formulation in TERRA follows radionuclide transport through 20 predefined compartments used for the final calculation of radionuclide ingrowth into man's food (Fig. 2.1). The names and definitions of the variables in the TERRA program that represent the concentrations are given in Table 3.1. A compartment is defined as having both radionuclide input and output rates, and concentrations for the compartment are calculated over time by numerical integration. For example, CONLV is not a true compartment, but an output variable, only. CONSLV and CONILV are the true compartments.

3.3. Options in TERRA

The options available in TERRA are given in Table 3.2. Options IOPT, TA, and TB are the most important. Control parameter IOPT indicates the way in which the user intends to enter the receptor locations, deposition rates, and air concentrations. For IOPT = 1, TERRA reads the grid, deposition rates, and air concentrations from a file written by ANEMOS, RETADD-II, or SUMIT. The variable ICODE in this file tells TERRA whether ANEMOS (ICODE=0), RETADD-II (1), or SUMIT (2) wrote the file. When IOPT = 1 the SITE parameters are averaged for each location defined. The sample case illustrated in this document uses IOPT = 1 and an ANEMOS input file. When a RETADD-II file is read, the user must enter a window of interest on logical unit INB which contains some part of the RETADD-II grid. Thus, the user could make a TERRA run for a region of the country between longitudes XL to XR and latitudes YL and YU by using the data set read from INB that was created for a grid containing the conterminous United States. IOPT = 2 is used when the user is not interested in calculating results for every cell in the ANEMOS or RETADD-II grid. With IOPT = 2, TERRA reads from unit INB the deposition rates and air concentrations for the assessment cells that contains the points of interest, and directly reads the SITE parameters for the SITE cell containing the point of interest. Averaging of SITE parameters is bypassed with IOPT = 2 or 3. IOPT = 3 bypasses reading from unit INB altogether. The receptor locations, air concentrations, and deposition rates are all entered by the user on unit INC. The input variables TA and TB define the total assessment time and buildup time respectively. Setting ISTORE to 1 when IOPT is 1 causes TERRA to write the SITE parameters for each location onto unit ISSAV. This can save much execution time if more than one run of this assessment grid is planned.

3.4. Parameters in TERRA

There are three types of parameters in the TERRA code, SITE, element-specific, and miscellaneous. The user may override any default parameter in TERRA using a NAMELIST read. The following sections describe default parameters in the TERRA code.

3.4.1 SITE parameters

The SITE data set is invoked by a direct-access read statement where the key that points to the appropriate data cell is defined by the longitude and latitude of a particular location under study. The parameters in SITE are applicable not only for modeling radionuclide transport through the

Table 3.1. Compartments and output variables in the TERRA code

Compartment	Output variable	Description
CONBFC	CONEV	concentration of the nuclide in beef from cattle on grain feed
CONBOC		concentration of the nuclide in beef from "other" cattle
CONBMC		concentration of the nuclide in beef from milk cows
CONES		concentration of the nuclide in surface soil (for calculating surface exposures)
	CONF	total concentration of the nuclide in produce exposed to direct deposition of airborne particles
		concentration of the nuclide in a forage composite, weighted by the relative contribution of pasture, hay, and silage
CONGF	CONHF	concentration of the nuclide in grains used as livestock feeds
CONGH		concentration of the nuclide in grains used as human foods
		total concentration of the nuclide in hay feeds
CONIEV		concentration of the nuclide in the interior of "exposed" produce (from root uptake)
CONIHF	CONLV	concentration of the nuclide in the interior of hay feeds (from root uptake)
CONILV		concentration of the nuclide in the interior of leafy vegetables (from root uptake)
CONIPG		concentration of the nuclide in the interior of pasture grass (from root uptake)
CONIS		concentration of the nuclide in the root zone of irrigated soils
CONISF		concentration of the nuclide in interior of silage feeds (from root uptake)
		total concentration of the nuclide in leafy vegetables
CONMLK	CONRES	concentration of the nuclide in milk from cows
CONPV		concentration of the nuclide in "protected" produce (protected from direct deposition)
		concentration of the nuclide in air due to resuspension of surface soil
		concentration of the nuclide in the root zone of non-irrigated soils
CONS	CONSF	concentration of the nuclide on the surface of "exposed" produce (exposed to direct deposition)
CONSEV		total concentration of the nuclide in silage feeds
	CONSGF	concentration of the nuclide in stored grain feeds
CONSLV		concentration of the nuclide on the surface of leafy vegetables (from direct deposition)
CONSPG		concentration of the nuclide on the surface of pasture grass (from direct deposition)
CONSSF		concentration of the nuclide on the surface of silage feeds (from direct deposition)
CONSHF		concentration of the nuclide on the surface of hay feeds (from direct deposition)

food chain, but they are useful for almost any type of environmental modeling. A description of the 36 location-specific parameters and their variable names in each record for every SITE cell is given in Table 3.3.

3.4.2. Element-specific parameters

The following parameters are element-specific:

BR(IN)	soil-to-plant bioaccumulation factor in reproductive portions of plants for radionuclide IN,
BV(IN)	soil-to-plant bioaccumulation factor in vegetative portions of plants,
KD(IN)	distribution coefficient for an element between soil and water (mL/g),

Table 3.2. User-definable options or parameters in TERRA

Variables read	Option	Description
TA		Time (year) at which assessment is performed.
TB		Length of time (years) for long-term buildup of radionuclides in soil due to the operation of the source term.
INB		Logical unit number from which case description, grid options, grid layout, deposition rates and air concentrations are read (binary data).
IBOUT		Logical unit number on which calculated concentrations are written for later processing by ANDROS (binary write).
INL		Logical unit number from which all five NAMELIST data sets are read (if = 0, NAMELIST read is not used). See Tables 3.3, 3.5, 3.6, 3.7, and 3.8.
INE		Logical unit number from which element-specific parameters are read (e.g., KD, BR, etc.).
NPRIME		Logical unit number from which the PRIMUS data set is read.
IOUT		Logical unit number on which written output is given.
ISSAV		Logical unit number for storing or reading averaged SITE parameters.
IOPT		Specified integer control parameter for indicating type of computer run.
	- 1	Grid layout, deposition rates, and air concentrations come from RETADD-11 or ANEMOS.
	- 2	The user inputs a list of latitudes and longitudes which define locations for which radionuclide concentrations in foods are calculated. TERRA later reads deposition rates and air concentrations from unit INB. The calculation of radionuclide concentrations for a location is made for the total SITE cell which contains the location.
	- 3	IOPT = 3 is like IOPT = 2, except that the user reads deposition rates and air concentrations to override those from unit INB.
NRECP		The number of locations of interest (used with IOPT = 2 or 3).
XLONG(IS)		The longitude (in degrees) for location number IS (with IOPT = 1 or 2).
XLAT(IS)		The latitude (in degrees) for location number IS (with IOPT = 1 or 2).
XL		Western-most longitude of a window of interest (used with IOPT = 1 or 2).
XR		Eastern-most longitude of a window of interest (IOPT = 1 or 2).
YL		Southern-most latitude of a window of interest (IOPT = 1 or 2).
YU		Northern-most latitude of a window of interest (IOPT = 1 or 2). With the above four corners of a window, the user can narrow his region of interest.
IWRITE		Specified integer control parameter used to indicate the amount of written output on logical unit IOUT.
	- 0	SITE parameters and radionuclide concentrations are written for each location of interest.
	- 1	Total output on unit IOUT (this includes intermediate results useful for checking calculations, but not recommended for routine assessments because of the amount of output).
	- 2	Summary tables and radionuclide concentrations for each location are written, but SITE parameters and intermediate results are not written.
ISTORE		Specified integer control parameter that indicates status of averaged SITE parameters.
	- 0	Averaged SITE parameters are not stored.
	- 1	Averaged SITE parameters are stored for later use.
	- 2	The routine used for averaging SITE parameters is bypassed, and the averaged SITE parameters are read from unit ISSAV.
IRESUS		Specified integer control parameters for resuspension calculations.
	- 0	Resuspension is not calculated.
	- 1	Resuspension is calculated. If TA > TB, and IRESUS = 1, then resuspension occurs after time TB until TA, (the only direct deposition comes from resuspension after time TB).

Table 3.3. Variable names and descriptions of parameters in the SITE data base and NAMELIST SITE

Variable	Units	Description
CELLON	°W	longitude of the southeast corner of the SITE data cell
CELLAT	°N	latitude of the southeast corner of the SITE data cell
ET	mm/yr	evapotranspiration
IRRI	mm/yr	irrigation
PRECIP	mm/yr	precipitation
YEV	kg(fresh)/m ²	yield of exposed produce
AYHF	kg(dry)/yr/m ²	areal yield of hay feed
YLV	kg(fresh)/m ²	yield of leafy vegetables
YSF	kg(dry)/m ²	yield of (corn and sorghum) silage feed
AREAT	m ²	total area of pasture
NUMCC	head	cattle and calf inventory
NUMBC	head	number of beef cattle
SALFC	head/yr	number of cattle on feed sold
NUMMC	head	number of milk cows
NUMSHP	head	number of sheep
PGF	kg	production of grain for feed
PHF	kg	production of hay feed
PSF	kg	production of (corn and sorghum) silage feed
HUMID	g/m ³	average annual absolute humidity
AREAT	m ²	total area of cell
POP	number	population of cell based on 1980 Census
FRUNF	unitless	fraction of 1970 population classed as "rural, nonfarm"
FRUFM	unitless	fraction of 1970 population classed as "rural, farm"
FURBN	unitless	fraction of 1970 population classed as "urban"
PLV	kg	production of leafy vegetables
PEV	kg	production of "exposed" produce
PPV	kg	production of "protected" produce
PGH	kg	production of grain for human consumption
DOMLF	number	A five digit number of the form FLPPP is printed out. If F = 1, the cell is more than 50% federal land, i.e., land type is undefined. If F = 0, less than 50% of the cell is federal land. L = 1 means tall row crops. L = 2 means short row crops. L = 3 means hay or tall grass. L = 4 means urban area. L = 5 means small lakes. L = 6 means short grass. L = 7 means forest. Finally, PPP = the percentage of the dominant land type (may be 0 if the SITE cell is 100% federal land).
MMIXHT	m	morning mixing height
AMIXHT	m	afternoon mixing height
YPV	kg(fresh)/m ²	yield of "protected" produce
YGH	kg(fresh)/m ²	yield of grain food
YGF	kg(dry)/m ²	yield of grain feed
FFDAYS	number	number of frost-free days in a year
CFLAG	number	the caution flag: 1 means cell on Atlantic coast. 2 means cell on Mexican border. 3 means 1 and 2. 4 means cell has interior body of water. 5 means 1 and 4. 6 means 2 and 4. 8 means cell on pacific coast. 12 means 4 and 8. 16 means cell on Canadian border. 20 means 4 and 16. 21 means 1 and 4 and 16. 24 means 8 and 16. 32 means cell has desert or barren land. Finally, 36 means 4 and 32.

FM(IN) feed-to-milk bioaccumulation factor for nuclide IN,
FF(IN) feed-to-flesh bioaccumulation factor,
LAMB(IN) metabolic removal rate of radionuclide IN from beef (s^{-1}),
LAMB(IN) metabolic removal rate of radionuclide IN from milk (s^{-1}),
LAMR(IN) removal rate in plant interiors for radionuclide (s^{-1}), (currently default = 0.0 for all eleven),
LAMW(IN) removal rate constant from weathering for all atmospherically depositing nuclides (s^{-1}).

Table 3.4 lists the default values by element.

3.4.3. Miscellaneous parameters

Default parameters in the TERRA code are listed by subroutine MAIN, SOILS, AGRON, and STOCK in Tables 3.5, 3.6, 3.7, and 3.8, respectively.

Table 3.4. Default element-specific parameters incorporated into the TERRA computer code

Atomic number	Element	BV	BR	FM (d/kg)	FF (d/kg)	KD (mL/g)	LAMW (s ⁻¹)	LAMM (s ⁻¹)	LAMB (s ⁻¹)
3	Li	0.025	4.0×10^{-3}	0.020	0.010	300	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
4	Be	0.010	1.5×10^{-3}	9.0×10^{-7}	1.0×10^{-3}	650	5.73×10^{-7}	1.00×10^{-5}	5.73×10^{-7}
5	B	4.0	2.0	1.5×10^{-3}	8.0×10^{-6}	3.0	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
7	N	30	30	0.025	0.075	0.50	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
9	F	0.060	6.0×10^{-2}	1.0×10^{-3}	0.15	150	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
11	Na	0.075	0.055	0.035	0.055	100	5.73×10^{-7}	4.72×10^{-7}	5.73×10^{-7}
12	Mg	1.0	0.55	4.0×10^{-3}	5.0×10^{-3}	4.5	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
13	Al	4.0×10^{-3}	6.5×10^{-4}	2.0×10^{-4}	1.5×10^{-3}	1,500	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
14	Si	0.35	0.070	2.0×10^{-5}	4.0×10^{-5}	30	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
15	P	3.5	3.5	0.015	0.055	3.5	5.73×10^{-7}	4.07×10^{-6}	5.73×10^{-7}
16	S	1.5	1.5	0.015	0.10	7.5	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
17	Cl	70	70	0.015	0.080	0.25	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
19	K	1.0	0.55	7.0×10^{-3}	0.020	5.5	5.73×10^{-7}	1.51×10^{-6}	5.73×10^{-7}
20	Ca	3.5	0.35	0.010	7.0×10^{-4}	4.0	5.73×10^{-7}	7.94×10^{-6}	5.73×10^{-7}
21	Sc	6.0×10^{-3}	1.0×10^{-3}	5.0×10^{-6}	0.015	1,000	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
22	Ti	5.5×10^{-3}	3.0×10^{-3}	0.010	0.030	1,000	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
23	V	5.5×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.5×10^{-3}	1,000	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
24	Cr	7.5×10^{-3}	4.5×10^{-3}	1.5×10^{-3}	5.5×10^{-3}	850	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
25	Mn	0.25	0.050	3.5×10^{-4}	4.0×10^{-4}	65	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
26	Fe	4.0×10^{-3}	1.0×10^{-3}	2.5×10^{-4}	0.020	25	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
27	Co	0.020	7.0×10^{-3}	2.0×10^{-3}	0.020	45	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
28	Ni	0.060	0.060	1.0×10^{-3}	6.0×10^{-3}	150	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
29	Cu	0.40	0.25	1.5×10^{-3}	0.010	35	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
30	Zn	1.5	0.90	0.010	0.10	40	5.73×10^{-7}	2.96×10^{-6}	5.73×10^{-7}
31	Ga	4.0×10^{-3}	4.0×10^{-4}	5.0×10^{-5}	5.0×10^{-4}	1,500	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
32	Ge	0.40	0.080	0.070	0.70	25	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
33	As	0.040	6.0×10^{-3}	6.0×10^{-5}	2.0×10^{-3}	200	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
34	Se	0.025	0.025	4.0×10^{-3}	0.015	300	5.73×10^{-7}	3.63×10^{-6}	5.73×10^{-7}
35	Br	1.5	1.5	0.020	0.025	7.5	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
37	Rb	0.15	0.070	0.010	0.015	60	5.73×10^{-7}	1.49×10^{-5}	5.73×10^{-7}

Table 3.4. Default element-specific parameters incorporated into the TERRA computer code (continued)

Atomic number	Element	BV	BR	FM (d/kg)	FF (d/kg)	LD (mL/g)	LAMW (s ⁻¹)	LAMM (s ⁻¹)	LAMB (s ⁻¹)
38	Sr	2.5	0.25	1.5×10^{-3}	3.0×10^{-4}	35	5.73×10^{-7}	3.80×10^{-6}	5.73×10^{-7}
39	Y	0.015	6.0×10^{-3}	2.0×10^{-5}	3.0×10^{-4}	500	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
40	Zr	2.0×10^{-3}	5.0×10^{-4}	3.0×10^{-5}	5.5×10^{-3}	3,000	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
41	Nb	0.020	5.0×10^{-3}	0.020	0.25	350	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
42	Mo	0.25	0.060	1.5×10^{-3}	6.0×10^{-3}	20	5.73×10^{-7}	9.01×10^{-6}	5.73×10^{-7}
43	Tc	9.5	1.5	0.010	8.5×10^{-3}	1.5	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
44	Ru	0.075	0.020	6.0×10^{-7}	2.0×10^{-3}	350	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
45	Rh	0.15	0.040	0.010	2.0×10^{-3}	60	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
46	Pd	0.15	0.040	0.010	4.0×10^{-3}	60	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
47	Ag	0.40	0.10	0.020	3.0×10^{-3}	45	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
48	Cd	0.55	0.15	1.0×10^{-3}	5.5×10^{-4}	6.5	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
49	In	4.0×10^{-3}	4.0×10^{-4}	1.0×10^{-4}	8.0×10^{-3}	1,500	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
50	Sn	0.030	6.0×10^{-3}	1.0×10^{-3}	0.080	250	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
51	Sb	0.20	0.030	1.0×10^{-4}	1.0×10^{-3}	45	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
52	Te	0.025	4.0×10^{-3}	2.0×10^{-4}	0.015	300	5.73×10^{-7}	5.94×10^{-6}	5.73×10^{-7}
53	I	0.15	0.050	0.010	7.0×10^{-3}	60	1.00×10^{-6}	7.94×10^{-6}	5.73×10^{-7}
55	Cs	0.080	0.030	7.0×10^{-3}	0.070	1,000	5.73×10^{-7}	8.63×10^{-6}	5.73×10^{-7}
56	Ba	0.15	0.015	3.5×10^{-4}	1.5×10^{-4}	60	5.73×10^{-7}	5.08×10^{-6}	5.73×10^{-7}
57	La	0.010	4.0×10^{-3}	2.0×10^{-5}	3.0×10^{-4}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
58	Ce	0.010	4.0×10^{-3}	2.0×10^{-5}	7.5×10^{-4}	850	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
59	Pr	0.010	4.0×10^{-3}	2.0×10^{-5}	3.0×10^{-4}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
60	Nd	0.010	4.0×10^{-3}	2.0×10^{-5}	3.0×10^{-4}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
61	Pm	0.010	4.0×10^{-3}	2.0×10^{-5}	5.0×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
62	Sm	0.010	4.0×10^{-3}	2.0×10^{-5}	5.0×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
63	Eu	0.010	4.0×10^{-3}	2.0×10^{-5}	5.0×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
64	Gd	0.010	4.0×10^{-3}	2.0×10^{-5}	3.5×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
65	Tb	0.010	4.0×10^{-3}	2.0×10^{-5}	4.5×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
66	Dy	0.010	4.0×10^{-3}	2.0×10^{-5}	5.5×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}
67	Ho	0.010	4.0×10^{-3}	2.0×10^{-5}	4.5×10^{-3}	650	5.73×10^{-7}	1.16×10^{-5}	5.73×10^{-7}

Table 3.4. Default element-specific parameters incorporated into the TERRA computer code (continued)

Atomic number	Element	BV	BR	FM (d/kg)	FF (d/kg)	KD (mL/g)	LAMW (g ⁻¹)	LAMM (g ⁻¹)	LAMB (g ⁻¹)
68	Er	0.010	4.0×10 ⁻³	2.0×10 ⁻⁵	4.0×10 ⁻³	650	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
69	Tm	0.010	4.0×10 ⁻³	2.0×10 ⁻⁵	4.5×10 ⁻³	650	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
70	Yb	0.010	4.0×10 ⁻³	2.0×10 ⁻⁵	4.0×10 ⁻³	650	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
71	Lu	0.010	4.0×10 ⁻³	2.0×10 ⁻⁵	4.5×10 ⁻³	650	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
72	Hf	3.5×10 ⁻³	8.5×10 ⁻⁴	5.0×10 ⁻⁶	1.0×10 ⁻³	1,500	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
73	Ta	0.010	2.5×10 ⁻³	3.0×10 ⁻⁶	6.0×10 ⁻⁴	650	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
74	W	0.045	0.010	3.0×10 ⁻⁴	0.045	150	5.73×10 ⁻⁷	9.30×10 ⁻⁶	5.73×10 ⁻⁷
75	Re	1.5	0.35	1.5×10 ⁻³	8.0×10 ⁻³	7.5	5.73×10 ⁻⁷	1.20×10 ⁻⁵	5.73×10 ⁻⁷
76	Os	0.015	3.5×10 ⁻³	5.0×10 ⁻³	0.40	450	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
77	Ir	0.055	0.015	2.0×10 ⁻⁶	1.5×10 ⁻³	150	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
78	Pt	0.095	0.025	5.0×10 ⁻³	4.0×10 ⁻³	90	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
79	Au	0.40	0.10	5.5×10 ⁻⁶	8.0×10 ⁻³	25	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
80	Hg	0.90	0.20	4.5×10 ⁻⁴	0.25	10	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
81	Tl	4.0×10 ⁻³	4.0×10 ⁻⁴	2.0×10 ⁻³	0.040	1,500	5.73×10 ⁻⁷	3.66×10 ⁻⁶	5.73×10 ⁻⁷
82	Pb	0.045	9.0×10 ⁻³	2.5×10 ⁻⁴	3.0×10 ⁻⁴	900	5.73×10 ⁻⁷	2.41×10 ⁻⁶	5.73×10 ⁻⁷
83	Bi	0.035	5.0×10 ⁻³	5.0×10 ⁻⁴	4.0×10 ⁻⁴	200	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
84	Po	2.5×10 ⁻³	4.0×10 ⁻⁴	3.5×10 ⁻⁴	3.0×10 ⁻⁴	500	5.73×10 ⁻⁷	6.98×10 ⁻⁶	5.73×10 ⁻⁷
85	At	1.0	0.15	0.010	0.010	10	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
87	Fr	0.030	8.0×10 ⁻³	0.020	2.5×10 ⁻³	250	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
88	Ra	0.015	1.5×10 ⁻³	4.5×10 ⁻⁴	2.5×10 ⁻⁴	450	5.73×10 ⁻⁷	4.07×10 ⁻⁶	5.73×10 ⁻⁷
89	Ac	3.5×10 ⁻³	3.5×10 ⁻⁴	2.0×10 ⁻⁵	2.5×10 ⁻⁵	1,500	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
90	Th	8.5×10 ⁻⁴	8.5×10 ⁻⁵	5.0×10 ⁻⁶	6.0×10 ⁻⁶	150,000	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
91	Pa	2.5×10 ⁻³	2.5×10 ⁻⁴	5.0×10 ⁻⁶	1.0×10 ⁻⁵	2,500	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
92	U	8.5×10 ⁻³	4.0×10 ⁻³	6.0×10 ⁻⁴	2.0×10 ⁻⁴	450	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
93	Np	0.10	0.010	5.0×10 ⁻⁶	5.5×10 ⁻⁵	30	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
94	Pu	4.5×10 ⁻⁴	4.5×10 ⁻⁵	1.0×10 ⁻⁷	5.0×10 ⁻⁷	4,500	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
95	Am	5.5×10 ⁻³	2.5×10 ⁻⁴	4.0×10 ⁻⁷	3.5×10 ⁻⁶	700	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷
96	Cm	8.5×10 ⁻⁴	1.5×10 ⁻⁵	2.0×10 ⁻⁵	3.5×10 ⁻⁶	200	5.73×10 ⁻⁷	1.16×10 ⁻⁵	5.73×10 ⁻⁷

Table 3.5. Parameters in subroutine MAIN (NAMELIST NAME1)

Parameter	Default	Units	Description
FHA	1.0		the fraction of hydrogen derived from atmospheric hydrogen
MFWBEF	0.615		mass fraction of water in beef
MWFMLK	0.850		mass fraction of water in milk
MFWLV	0.934		mass fraction of water in leafy vegetables
MFWPV	0.778		mass fraction of water in "protected" produce
MFEV	0.874		mass fraction of water in "exposed" produce
MFWGH	0.112		mass fraction of water in grains for human consumption
KGCAIR	1.8×10^{-4}	kg/m ³	kilograms of carbon per cubic meter of air
MFCLV	0.026		mass fraction of carbon in leafy vegetables
MFCEV	0.050		mass fraction of carbon in "exposed" produce
MFCPV	0.116		mass fraction of carbon in "protected" produce
MFCGH	0.293		mass fraction of carbon in grains for human consumption
MFCMLK	0.069		mass fraction of carbon in milk
MFCBEF	0.228		mass fraction of carbon in beef
YRMILK	4884	kg	average yearly production of milk per milk cow
BEEFWT	452	kg	average weight of a beef at slaughter
DRWBEF	0.56		dressed weight-to-live weight fraction for beef cattle

Table 3.6. Parameters in subroutine SOILS (NAMELIST NAME2)

Parameter	Default	Units	Description
DE	1.0	cm	depth of soil on which surface exposure calculations are based
DR	15	cm	depth of root zone soil
RO	1.35	g/cm ³	soil bulk density
THETA	0.490	mL/cm ³	volumetric water content of the soil

Table 3.7. Parameters in subroutine AGRON (NAMELIST NAME3)

Parameter	Default	Units	Description
REV	$1.0 - \exp(-0.0324 \text{ YEV})$		interception fraction for "exposed" produce
RHF	$1.0 - \exp(-2.88 \text{ YHF})$		interception fraction for hay feed
RLV	$1.0 - \exp(-0.0846 \text{ YLV})$		interception fraction for leafy vegetables
RSF	$1.0 - \exp(-0.769 \text{ YSF})$		interception fraction for silage feeds
FDRYLV	0.067	kg dry/kg wet	fraction of dry matter in fresh leafy vegetables
FDRYEV	0.126	kg dry/kg wet	fraction of dry matter in fresh "exposed" produce
FDRYPV	0.222	kg dry/kg wet	fraction of dry matter in fresh "protected" produce
FDRYG	0.888	kg d-v/kg wet	fraction of dry matter in fresh grain
THLV	100	d	time between germination and harvest of leafy vegetables
THEV	100	d	time between germination and harvest of "exposed" produce
THPV	100	d	time between germination and harvest of "protected" produce
THG	150	d	time between germination and harvest of grain for human consumption
THSF	150	d	time between germination and harvest of (corn and sorghum) silage
THHF	60	d	time between germination and harvest of hay feed
TGRZ	30	d	time between successive grazings on the same area of pasture by a grazing herd of cattle

Table 3.8. Parameters in subroutine STOCK (NAMELIST NAME4)

Parameter	Default	Units	Description
FRQFC	970	kg/yr	forage or forage-equivalent requirement of cattle on feed
FRQMC	4010	kg/yr	forage or forage-equivalent requirement of milk cow
FRQOC	3030	kg/yr	forage or forage-equivalent requirement of "other" cattle
FRQSHF	600	kg/yr	forage or forage-equivalent requirement of sheep
GRQFC	1820	kg/yr	grain or grain-equivalent requirement of cattle on feed
GRQMC	2600	kg/yr	grain or grain-equivalent requirement of milk cows
GRQOC	1500	kg/yr	grain or grain-equivalent requirement of other cattle
AYPG	PPG/AREAP	kg/yr/m ²	areal yield of pasture grass
RPG	$1.0 - \exp(-2.88 \text{ YPG})$		interception fraction for pasture grass
TMLK	1	yr	time at which milk sample is taken
TSFC	1	yr	average lifetime for grain fed cattle
TSOC	1	yr	average lifetime for "other" cattle
TSGF	90	d	time of grain storage before feeding to cattle
TSMC	6	yr	average lifetime for milk cows
FSMC	0.167		fraction of milk cow inventory slaughtered
FSOC	0.153		fraction of "other cattle" inventory slaughtered
FSFC	1.0		fraction of "cattle on feed sold" slaughtered
MPC	13.4	kg/d	average milk production of a milk cow
MMC	250	kg	average muscle mass of a beef cow
LGQFC	891	kg	lifetime grain requirement for cattle on feed

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APPENDIX A. TERRA JCL

TERRA was developed on an IBM 3033 computer under MVS. Inherent to TERRA is the need for a large online disk for use with the direct access SITE data base and other recording media for data handling. The example output presented in this report (see APPENDIX B) required approximately 4.25 minutes to compile and execute. The example case required approximately 380K of core and used 13,000 I/O operations. Below is the JCL used to submit the sample problem from a DEC-10 computer to the IBM 3033 computer.

```

//DAS2 JOB (21714,130),'SAVE6200,160 BINS',TIME=20
/*ROUTE PRINT RMT45
/*ROUTE PUNCH RMT45
/*ROUTE XEQ STANDBY
/*JOBPARM COPIES=1,LINES=900,CARDS=90000
// EXEC SPDASCR
//SYSIN DD *
    T.DAS21714.TESTIW1
    T.DAS21714.CIRTEST1
/*
// EXEC FORTDCLG,PARM.FORT='XREF',REGION.FORT=540K,
// PARM.GO='DUMP=G,EU=-1',
// REGION.GO=540K
//FORT.SYSIN DD *
=TERRA.FOR
/*
//LKED.SYSIN DD *
=ALL:FLTRNF.HEX/H[6200,160]
/*
//GO.FT07F001 DD SYSOUT=B
//GO.FT01F001 DD DSN=T.CLB17603.TEST2,DISP=SHR,LABEL=(,,IN) -----Data from ANEMOS (INB)
//GO.FT02F001 DD UNIT=3330V,VOL=SER=VTATWO,DSN=BEFCEL.SITDAT,DISP=SHR
//GO.FT17F001 DD UNIT=SPDA,DSN=T.DAS21714.GRANTS1,DISP=SHR, -----Already averaged SITE parameters (ISSAV)
// DCB=(RECFM=VBS,LRECL=144,BLKSIZE=12964),SPACE=(TRK,(50,10),RLSE)
//GO.FT11F001 DD DSN=T.DAS21714.PSAMPLE,DISP=SHR,LABEL=(,,IN) -----Data from PRIMUS (NPRIME)
//GO.FT14F001 DD UNIT=SPDA,DSN=T.DAS21714.TESTIW1,DISP=(NEW,CATLG), -----Results to ANDROS (IBOUT)
// DCB=(RECFM=VBS,LRECL=372,BLKSIZE=13030),SPACE=(TRK,(50,10),RLSE)
//GO.FT13F001 DD DUMMY
//GO.FT10F001 DD *
    &NAM3      &END
//GO.FT12F001 DD * -----Element-specific data (INE)
=ELEM.REV
//GO.FT05F001 DD * -----Control parameters (INC)
=CONTRL.OP4
/*
// EXEC SPDASPA
//SYSIN DD *
    T.DAS21714.TESTIW1
    T.DAS21714.GRANTS1
/*
//
ENDINPUT

```


APPENDIX B. OUTPUT OF EXAMPLE TERRA RUNS

The output from an example problem using results from an ANEMOS run is presented below. The TERRA output can be divided into six sections. The first section (p. 33) lists specifics of the problem and options used in ANEMOS and TERRA. The location of the source term is at 37.9° N latitude and 87.6° W longitude. The radiological units (Ci) used to define the source term were selected by the user of ANEMOS and read in by TERRA. The number of locations, 144, for a sector-averaged ("average") run indicates that there are 10 distances specified from the source (there would be 160 locations for a "point" run). Options in the ANEMOS run were building wake and downwash effects, effective plume depletion, fast deposition lambda, overhead plume, and surface roughness calculations (Miller, Bezovich, and Hermann, 1984). The assessment grid is circular and the air concentrations and deposition rates output by ANEMOS are averages over the sector segments.

The second section (p. 34) lists the radionuclide chains for the problem and all element-specific data used in TERRA calculations. Each radionuclide chain is separated by a space, and the first member of the chain is the released nuclide. If more than one member of a chain is released, then the chain or remaining members of the chain will be repeated, again with the first member being the released nuclide. The element-specific data in columns 2-10 are the same values listed in Table 3.4. The radiological decay constants (s^{-1}) are taken from the PRIMUS output.

Section three (p. 35) lists the default parameters used in all calculations. If the user overrides the defaults in TERRA, then these NAMELIST input parameters will appear in section three.

The fourth section (pp. 36-37) gives the resulting concentrations in food and other environmental media calculated by TERRA. In the example output only the results for location #133 (p. 36, 40 to 80 km due east of the source point) and #141 (p. 37, 40 to 80 km due west of the source point) are shown, but in a typical TERRA output the results for all locations are printed out. As the number of grid locations and radionuclides increases, the length of this results section increases. In fact, usually the fourth section results make up the bulk of the TERRA output. In the example run the resuspension option was not used. Therefore, the air concentration due to resuspension of surface soils was not calculated. The deposition rates printed out are the ANEMOS input to TERRA. All other concentrations are calculated according to methods outlined in Section 2 of this report.

The fifth section (p. 38) is a location table showing the distance and direction of each location specified in the fourth section. Note that the locations are specified on a line between each distance. This configuration indicates that the location is between (results averaged over) these two distances. Had the sample problem been an individual run, then the locations would have been on the line of the distance which they correspond to. If the TERRA input had been a RETADD-II output, then the column and row identifiers would have been degrees of longitude and latitude, respectively.

The last section (p. 39) gives a summary of the grid-averaged SITE parameters, including minimum and maximum values of the parameter or parameter density per square meter (as appropriate), locations of these minima and maxima, weighted averages, and totals.

CASE: TEST CASE, USING EVANSVILLE, IND. MET.DATA
SOURCE LOCATION: LONGITUDE= 87.6000 LATITUDE= 37.9000
RADIOLOGICAL UNITS = CI
NO. OF LOCATIONS= 144

OPTIONS USED:

GRDOPT = 1 MEANS CIRCULAR GRID

ANEMCS RUN-OPTIONS-AVERAGE
CHAKE DNWASH CLANDA
FASCEP OVPCAL SRGUGH

IOPT = 1 MEANS DATA FROM UNIT INB

ISTORE = 1 MEANS AVERAGED SITE DATA IS SAVED ON LOGICAL UNIT = 17

IWRITE = 2 MEANS CONSTANTS, CONCENTRATIONS, AND TOTALS GIVEN

THE FOLLOWING ELEMENT OR NUCLIDE-SPECIFIC PARAMETERS WERE USED IN ALL CALCULATIONS:

IN	NUCLIDE	SOIL/WATER DIST. COEFF. K _D	SOIL/PLANT CONC. FACTORS B ₁ B ₂	FEED TRANSFER COEFF. MILK P _M BEEF FF	PLANT REMOVAL CONSTANT SURFACE INTERIOR LAMB LAMB	METABOLIC MILK LAMB	REMOVAL BEEF LAMB	DECAY CONST. LAMB
1	H-3	0.0	0.0 0.0	0.0 .0	0.0 0.0	0.0	0.0	1.79E-09
2	C-14	0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0	0.0	3.63E-12
3	Rb-222	0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0	0.0	2.10E-06
4	PC-218	1.00E 02	2.50E-03 4.00E-04	3.50E-04 9.50E-05	5.73E-07 0.0	6.98E-06	5.73E-07	3.79E-03
5	PE-214	6.00E 02	4.50E-02 1.00E-03	2.50E-04 3.00E-04	5.73E-07 0.0	2.41E-06	5.73E-07	4.31E-04
6	BT-214	2.00E 02	3.50E-02 5.00E-03	5.00E-04 4.00E-04	5.73E-07 0.0	1.16E-06	5.73E-07	5.61E-04
7	PC-214	3.00E 02	2.50E-03 4.00E-04	3.50E-04 9.50E-05	5.73E-07 0.0	6.98E-06	5.73E-07	4.23E-03
8	PE-210	6.00E 02	4.50E-02 9.00E-03	2.50E-04 3.00E-04	5.73E-07 0.0	2.41E-06	5.73E-07	9.87E-10
9	BT-210	2.00E 02	3.50E-02 5.00E-03	5.00E-04 4.00E-04	5.73E-07 0.0	1.16E-06	5.73E-07	1.60E-06
10	PC-210	3.00E 02	2.50E-03 4.00E-04	3.50E-04 9.50E-05	5.73E-07 0.0	6.98E-06	5.73E-07	5.60E-06

THE FOLLOWING TIME CONSTANTS OR DEFAULT PARAMETERS WERE USED IN ALL CALCULATIONS:

SOIL PARAMETERS:

DE	= DEPTH OF SOIL CORRESPONDING TO SURFACE EXP. (CM)	= 1.00
CR	= DEPTH OF ROOT ZONE (CM)	= 15.0
RC	= BULK DENSITY OF THE SOIL (G/CM**3)	= 1.35
THETA	= VOLUMETRIC WATER CONTENT OF THE SOIL (CM**3/CM**3)	= 0.490

TIME CONSTANTS:

TA	= TIME (YEARS) AT WHICH ASSESSMENT IS DONE	= 100.0
TE	= TIME (YEARS) OF LONGTERM BUILDUP IN SOIL	= 100.0
TLV	= TIME (DAYS) BETWEEN GERM. AND HARV. OF LEAFY VEG.	= 100.0
TEV	= TIME (DAYS) BETWEEN GERM. AND HARV. OF EXPOSED VEG.	= 100.0
TPV	= TIME (DAYS) BETWEEN GERM. AND HARV. OF PROTECTED VEG.	= 100.0
TPG	= TIME (DAYS) BETWEEN GERM. AND HARV. OF GRAINS	= 120.0
TPF	= TIME (DAYS) BETWEEN GERM. AND HARV. OF SLAGE FEEDS	= 150.0
TPF	= TIME (DAYS) BETWEEN SUCCESSIVE HARV. OF HAY FEEDS	= 60.0
IGFZ	= TIME (DAYS) BETWEEN SUCCESSIVE GRAZINGS OF PASTURE GRASS BY CATTLE	= 30.0
TDLK	= TIME (YEARS) AT WHICH MILK SAMPLE IS TAKEN	= 1.0
TSPC	= TIME (YEARS) BETWEEN GRAIN-FEEDING AND SLAUGHTER FOR GRAIN-FED CATTLE	= 1.0
TSCC	= TIME (YEARS) BETWEEN GRAIN-FEEDING AND SLAUGHTER FOR OTHER CATTLE	= 1.0
TSCC	= TIME (YEARS) BETWEEN GRAIN FEEDING AND SLAUGHTER FOR MILK COWS	= 6.0
TSGF	= TIME (DAYS) BETWEEN STORING GRAIN AND FEEDING TO CATTLE	= 90.0

FEED AND FORAGE REQUIREMENTS:

FRFC	= FORAGE OR FORAGE-EQUIVALENT REQUIREMENT OF CATTLE ON FEED (KG/Y)	= 570.0
FRFC	= OF MILK COWS (KG/Y)	= 4010.0
FRCC	= OF OTHER CATTLE (NOT MILK COWS OR CATTLE ON FEED) (KG/Y)	= 3030.0
FRCS	= OF SHEEP (KG/Y)	= 600.0
GRFC	= GRAIN OR GRAIN-EQUIVALENT REQUIREMENT OF CATTLE ON FEED (KG/Y)	= 1220.0
GRFC	= MILK COWS (KG/Y)	= 2600.0
GRCC	= OTHER CATTLE (KG/Y)	= 150.0
LGFC	= LIFETIME GRAIN REQUIREMENT OF CATTLE ON FEED (KG/Y)	= 691.0
LGFC	= LIFETIME FORAGE REQUIREMENT OF CATTLE ON FEED (KG/Y)	= 2108.0

CONVERSION FACTORS:

FRYEV	= FRACTION OF DRY MATTER IN FRESH EXPOSED VEGETABLES (KG DRY/KG WET)	= 1.2600E-01
FRYV	= FRACTION OF DRY MATTER IN FRESH GRAINS (KG DRY/KG WET)	= 2.8800E-01
FRYLV	= FRACTION OF DRY MATTER IN FRESH LEAFY VEGETABLES	= 6.7000E-02
FRYLV	= FRACTION OF DRY MATTER IN FRESH PROTECTED VEGETABLES	= 2.2200E-01
MFC	= MUSCLE MASS OF CATTLE (KG)	= 2.5000E-02
MFC	= MILK PRODUCTION OF A MILK COW (KG/Y)	= 1.3400E-01
FFA	= THE FRACTION OF HYDROGEN DERIVED FROM ATMOSPHERIC HYDROGEN	= 1.0000E-00
MFBEF	= MASS FRACTION OF WATER IN BEEF	= 6.1500E-01
MFBLK	= MASS FRACTION OF WATER IN MILK	= 6.5000E-01
MFBLV	= MASS FRACTION OF WATER IN LEAFY VEGETABLES	= 5.3400E-01
MFBLV	= MASS FRACTION OF WATER IN PROTECTED PRODUCE	= 7.7800E-01
MFBLV	= MASS FRACTION OF WATER IN EXPOSED PRODUCE	= 2.7400E-01
MFBLV	= MASS FRACTION OF WATER IN GRAINS FOR HUMAN CONSUMPTION	= 1.1200E-01
KGCAIR	= KG OF C/M**2 OF AIR	= 1.8000E-04
MFCLV	= MASS FRACTION OF CARBON IN LEAFY VEGETABLES	= 2.6000E-02
MFCLV	= MASS FRACTION OF CARBON IN EXPOSED PRODUCE	= 5.0000E-02
MFCLV	= MASS FRACTION OF CARBON IN PROTECTED PRODUCE	= 1.1600E-01
MFCLV	= MASS FRACTION OF CARBON IN GRAIN FOR HUMANS	= 2.9300E-01
MFCLV	= MASS FRACTION OF CARBON IN MILK	= 6.9000E-02
MFCLV	= MASS FRACTION OF CARBON IN BEEF	= 2.2800E-01

FOR LOCATION # 133 WHICH IS FROM 40000.0 M TO 80000.0 M IN DIRECTION E, THE FOLLOWING CONCENTRATIONS WERE CALCULATED:

IN	NUCLIDE	RESUSP. AIR CONC. (CI/M**3)	DEPOSITION RATE (CI/M**2/SEC)	SURFACE SOIL EXP. CONC. (CI/KG)	LEAFY VEGETABLES (CI/KG)	EXPOSED PRODUCE (CI/KG)	PROTECTED PRODUCE (CI/KG)	GRAINS (CI/KG)	BEEF (CI/KG)	MILK (CI/KG)
1	H-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	C-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	RN-222	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	PO-210	0.0	9.910E-12	2.616E-09	2.031E-10	6.737E-11	3.506E-20	9.349E-20	7.454E-16	4.956E-14
5	FB-214	0.0	7.632E-12	2.032E-08	1.576E-09	5.226E-10	5.387E-17	1.436E-16	1.610E-13	6.794E-13
6	E1-214	0.0	6.294E-12	3.116E-08	2.415E-09	8.010E-10	8.792E-17	2.345E-16	4.041E-13	6.828E-12
7	PO-214	0.0	6.294E-12	3.116E-08	2.415E-09	8.010E-10	8.792E-17	2.345E-16	4.041E-13	9.828E-12
8	FB-210	0.0	3.231E-17	3.255E-08	9.301E-12	3.122E-12	5.553E-13	2.272E-12	5.374E-13	6.718E-13
9	E1-210	0.0	2.549E-19	3.286E-08	7.050E-12	2.370E-12	5.379E-13	2.226E-12	5.245E-13	6.835E-13
10	PO-210	0.0	3.314E-23	3.194E-08	7.625E-13	2.576E-13	1.315E-13	7.226E-13	5.455E-14	4.773E-14

FOR LOCATION # 141 WHICH IS FROM 40000.0 M TO 80000.0 M IN DIRECTION W, THE FOLLOWING CONCENTRATIONS WERE CALCULATED:

IA	NUCLIDE	RESUSP. AIR CONC. (CI/M**3)	DEPOSITION RATE (CI/M**2/SEC)	SURFACE SOIL EXP. CONC. (CI/KG)	LEAFY VEGETABLES (CI/KG)	EXPOSED PRODUCE (CI/KG)	PROTECTED PRODUCE (CI/KG)	GRAINS (CI/KG)	BEEF (CI/KG)	MILK (CI/KG)
1	P-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	C-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	PN-222	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	PU-238	0.0	1.004E-11	2.651E-09	0.0	4.759E-11	3.552E-10	9.473E-20	7.182E-16	5.008E-14
5	PO-214	0.0	7.557E-12	2.018E-08	0.0	3.618E-10	5.350E-17	1.427E-16	1.821E-13	8.719E-13
6	PI-214	0.0	6.390E-12	3.119E-08	0.0	5.589E-10	8.758E-17	2.336E-16	3.838E-13	7.804E-12
7	PO-214	0.0	6.390E-12	3.119E-08	0.0	5.589E-10	8.758E-17	2.336E-16	3.838E-13	7.804E-12
8	PR-210	0.0	3.768E-17	3.661E-08	0.0	2.469E-12	6.080E-13	2.473E-12	8.561E-13	7.287E-13
9	PI-210	0.0	3.768E-17	3.662E-08	0.0	1.897E-12	5.887E-13	2.421E-12	8.430E-13	9.509E-13
10	PO-210	0.0	1.059E-22	3.555E-08	0.0	2.202E-13	1.440E-13	7.864E-13	8.657E-14	5.212E-14

TABLE OF GRID LOCATIONS FOR : TEST CASE, USING EVANSVILLE, IND. NET DATA

DIST. (ft)	DIRECTION															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
150.3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
312.5	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
625.0	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1250.0	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
2500.0	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
5000.0	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
10000.0	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
20000.0	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
40000.0	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
80000.0																

SITE PARAMETERS FOR THE TOTAL ASSESSMENT AREA

METEOROLOGICAL AND CLIMATOLOGICAL PARAMETERS:

PARAMETER	MINIMUM	LOC	MAXIMUM	LOC	WEIGHTED AVG.
AMXHM = AFTERNOON MIXING HEIGHT (M)	1.420532E 03	142	1.515344E 03	136	1.466781E 03
ET = EVAPOTRANSPIRATION (MM/Y)	7.572598E 02	142	7.988396E 02	138	7.784553E 02
FFCAYS = NUMBER OF FROST-FREE DAYS IN A YEAR	2.133721E 02	130	2.225539E 02	138	2.186157E 02
HUMID = AVERAGE ANNUAL ABSOLUTE HUMIDITY (G/M**3)	8.094398E 00	143	8.389797E 00	136	8.218820E 00
IRRI = IRRIGATION (MM/Y)	8.189997E 01	131	2.118100E 02	142	1.424868E 02
MIXHM = MORNING MIXING HEIGHT (M)	4.558440E 02	142	4.936099E 02	131	4.749109E 02
PRECIP = PRECIPITATION (MM/Y)	1.081400E 03	142	1.157800E 03	136	1.106098E 03

FECF AND FEED CROP PRODUCTIVITIES:

PARAMETER	MINIMUM	LOC	MAXIMUM	LOC	WEIGHTED AVG.
AYMF = APEAL YIELD OF MAY FEED (KG(DRY)/M**2)	1.023864E-07	13	7.133950E-03	134	2.020036E-03
YEV = YIELD OF EXPOSED PRODUCE (KG(FRESH)/M**2)	2.988452E-10	13	9.071832E-05	129	1.843484E-04
YLV = YIELD OF LEAFY VEG. (KG(FRESH)/M**2)	0.0	144	1.003480E-06	134	2.254290E-06
YPV = YIELD OF PROTECTED PRODUCE (KG(FRESH)/M**2)	2.767201E-04	13	4.285893E-04	131	9.910651E-04
YGH = YIELD OF GRAIN FOR HUMANS (KG(FRESH)/M**2)	1.066230E-07	13	4.801486E-03	131	1.387986E-02
YGF = YIELD OF GRAIN FOR LIVESTOCK (KG(DRY)/M**2)	1.785965E-07	13	2.566284E-02	134	8.655619E-03
YSF = YIELD OF SILAGE FEED (KG(DRY)/M**2)	2.515636E-08	13	1.834978E-03	134	5.121189E-04

LIVESTOCK INVENTORIES & POPULATION:

PARAMETER		TOTAL		MINIMUM	DENSITY (1/M**2)		LOC	WEIGHTED AVG.
					LOC	MAXIMUM		
POP	= HUMAN POPULATION (1980 CENSUS EST.)	6.770661E 05		1.143688E-05	141	9.257637E-05	96	3.434299E-05
MUMCC	= CATTLE AND CALF INVENTORY (HEAD)	3.968805E 05		1.337951E-05	128	2.725578E-05	80	2.018728E-05
NLMPC	= NUMBER OF MILK COWS (HEAD)	1.595923E 04		1.080980E-07	140	1.535713E-06	132	8.095039E-07
MUMBC	= NUMBER OF BEEF CATTLE (HEAD)	4.692523E 05		4.768098E-06	128	4.491388E-05	139	2.380200E-05
MUMOC	= NUMBER OF OTHER CATTLE (HEAD)	3.401677E 05		9.692724E-06	128	2.420878E-05	80	1.725441E-05
SALPC	= NUMBER OF CATTLE ON FEED SOLD	5.423920E 04		1.165598E-06	136	3.797129E-06	128	2.761194E-06

PRODUCTION OF FOOD AND FEED CROPS:

PARAMETER	TOTAL
PEV = PRODUCTION OF EXPOSED PRODUCE (KG)	3.241106E 06
PLV = PRODUCTION OF LEAFY VEGETABLES (KG)	4.444293E 04
PEV = PRODUCTION OF PROTECTED PRODUCE (KG)	1.953867E 07
PGH = PRODUCTION OF GRAIN FOR HUMANS (KG)	2.677206E 08
TOTBEF = PRODUCTION OF BEEF (KG)	2.767709E 07
TOTMLK = PRODUCTION OF MILK (KG)	7.794453E 07

MISCELLANEOUS:

PARAMETER	TOTAL
AREAT = LAND AREA (M**2)	1.971482E 10
AREAP = PASTURE LAND AREA (M**2)	3.018930E 09

APPENDIX C. LISTING OF THE TERRA CODE

An annotated listing of the TERRA code is presented below. Included are subroutines MAIN, AGPON, CIRCAV, RECTAV, RESUS, SOILS, STOCK, and UNPACK, a routine which converts ZAS numbers into radionuclide symbols.

[illegible]

```

C WRITE = FLAG THAT CONTROLS AMOUNT OF WRITTEN OUTPUT MAIN 96
C WRITE = 0 MEANS SITE PARAMETERS AND FINAL TABLE MAIN 97
C WRITE = 1 MEANS INTERMEDIATE RESULTS ALSO MAIN 98
C WRITE = 2 MEANS FINAL TABLE ONLY MAIN 99
C
C ISITP = FLAG INDICATING SOURCE OF RADIONUCLIDE CONCENTRATIONS MAIN 100
C -0 MEANS CONCENTRATIONS READ FROM UNIT INC (ANEMOS, ETALNA MAIN 101
C -1 MEANS CONCENTRATIONS FROM PRINTS ON UNIT HPRIME MAIN 102
C -2 MEANS CONCENTRATIONS IN CONC ARRAY WITH NO READ MAIN 103
C
C INHLT = FLAG INDICATING MODIFICATION OF RADIONUCLIDE CONC MAIN 104
C -0 MEANS NO MULTIPLICATION MAIN 105
C -1 MEANS MULTIPLY CONC(OR QIN) TO RATE SOURCE MAIN 106
C MULTIPLY BY FACTORS WELD OR EXTRA MAIN 107
C -2 MEANS CHANGE CONC TO RATE SOURCE BY USING MAIN 108
C CRATE WHICH IS SUPPLIED AS AN ARGUMENT MAIN 109
C
C KOUT = LOGICAL UNIT NUMBER FOR OUTPUT FROM DECATC (>0) MAIN 110
C ***** MAIN 111
C ***** MAIN 112
C ***** MAIN 113
C
C SET CERTAIN CONTROL PARAMETER, AND CONSTANTS MAIN 114
C SECCAT=8.64E-04 MAIN 115
C DAYSTR=365.2422 MAIN 116
C SECCSTR=SECCAT*DAYSTR MAIN 117
C INC=5 MAIN 118
C ICTYP=1 MAIN 119
C ISITP=2 MAIN 120
C INHLT=0 MAIN 121
C KOUT=0 MAIN 122
C UNIT=CI MAIN 123
C ***** MAIN 124
C ***** MAIN 125
C ***** MAIN 126
C
C INPUT CERTAIN CONTROL PARAMETERS MAIN 127
C NRECP = THE NUMBER OF RECEPTOR LOCATIONS MAIN 128
C KLONG = LONGITUDE OF THE RECEPTOR SITE MAIN 129
C YLAT = LATITUDE OF THE RECEPTOR SITE MAIN 130
C TA = TIME (YRS) AT WHICH ASSESSMENT IS DONE MAIN 131
C TB = TIME OF LONGTERM BUILDUP IN SOIL (YRS) MAIN 132
C
C IOPT = CONTROL OPTION FOR THE SOURCE OF DATA MAIN 133
C IOPT = 1 MEANS USER READS DEPOSITION RATES AND AIR MAIN 134
C AIR CONCENTRATIONS ON UNIT INC MAIN 135
C
C IOPT = 2 MEANS USER READS POINT(S) OF INTEREST FROM UNIT INC MAIN 136
C AND DEPOSITION RATES AND AIR CONCENTRATIONS FROM MAIN 137
C UNIT INC MAIN 138
C
C IOPT = 3 MEANS USER READS POINT(S) OF INTEREST AND DEPOSITION MAIN 139
C RATES AND AIR CONCENTRATIONS FROM UNIT INC MAIN 140
C
C READ (INC,130) INR,INS,INL,INB,NPRIME,IOPT,NRECP,TA,TB,IOPT,IBOUT, MAIN 141
C INWRITE,ISTORE,ISSAV,IRESU MAIN 142
C ***** MAIN 143
C IF (INL.GT.0) READ (INL,RANGE1) ***** MAIN 144
C ***** MAIN 145
C
C DEFINE TIME FOR LONGTERM BUILDUP AND FOR ASSESSMENT MAIN 146
C TIMES=TB*SECCSTR MAIN 147
C IF (TA.LE.TB) TIMES=TA*SECCSTR MAIN 148
C IF (TA.LE.TB) GO TO 1 MAIN 149
C TIMEA=(TA-TB)*SECCSTR MAIN 150
C ***** MAIN 151
C
C DATA INPUT ON LOGICAL UNIT INC MAIN 152
C RECORD 1 ***** MAIN 153
C TITLE,GRIDOPT,IPTOGR,KLAT,KLONG,KLOC WHERE MAIN 154
C TITLE = DESCRIPTION OF THE INPUT DATA SET (2044) MAIN 155
C GRIDOPT = FLAG FOR THE GRID OPTION MAIN 156
C -1 MEANS REGULAR CIRCULAR GRID MAIN 157
C -2 MEANS REGULAR RECTANGULAR GRID MAIN 158
C -3 MEANS POINTS BY DIRECTION AND DISTANCE MAIN 159
C -4 MEANS POINTS BY (X,Y) COORDINATES MAIN 160
C
C IPTOGR = FLAG THAT INDICATES POINT OR GRID OPTION FOR CPACK MAIN 161
C KLAT = LATITUDE IN DECIMAL DEGREES OF REFERENCE POINT MAIN 162
C KLONG = LONGITUDE IN DECIMAL DEGREES OF REFERENCE POINT MAIN 163
C KLOC = TOTAL NUMBER OF GRID POINTS MAIN 164
C
C RECORD 2 ***** MAIN 165
C ICODE,OPTS MAIN 166
C ICODE = FLAG THAT INDICATES PROGRAM RUN REPORT TERRA MAIN 167
C ICODE = 0 MEANS ANEMOS MAIN 168
C = 1 MEANS RETADD-II MAIN 169
C = 2 MEANS SUMIT MAIN 170
C
C OPTS = LIST OF OPTIONS SELECTED IN ANEMOS OR RETADD-II MAIN 171
C
C RECORD 3 ***** MAIN 172
C NRNUCS,(ZASRN(I),I=1,NRNUCS),NREXP,(ZASRN(I),I=1,NREXP), MAIN 173
C (CLCLS(I),I=1,NREXP), WHERE MAIN 174
C
C NRNUCS = NUMBER OF RELEASED RADIONUCLIDES MAIN 175
C ZASRN = ZAS NUMBER FOR EACH RELEASED RADIONUCLIDE MAIN 176
C NREXP = NUMBER OF EXPOSURE RADIONUCLIDES AT EACH GRID POINT MAIN 177
C ZASRN = ZAS NUMBER FOR EACH EXPOSURE RADIONUCLIDE AT EACH PT MAIN 178
C CLCLS = CLEARANCE CLASS FOR EACH EXPOSURE RADIONUCLIDE MAIN 179
C
C RECORD 4 -- KLOC OF THEM ***** MAIN 180
C XMIN,YMIN,XMAX,YMAX,THETA WHERE MAIN 181
C XMIN = WESTERN MOST LONGITUDINAL COORDINATE IN DEGREES MAIN 182
C OR FIRST ANGLE OF SECTOR, THETA MAIN 183
C
C XMAX = EASTMOST LONGITUDINAL COORDINATE IN DEGREES MAIN 184
C OR SECOND ANGLE OF SECTOR, THETA MAIN 185
C
C YMIN = SOUTHERN MOST LATITUDINAL COORDINATE IN DEGREES MAIN 186
C OR FIRST RADIUS OF SECTOR, R MAIN 187

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C      TMAX - NORTHERN MOST MOST LATITUDINAL COORDINATE IN DEGREES MAIN 188
C      OR SECOND RADIUS OF SECTOR, I MAIN 189
C      NIND - NUMBER OF CONCENTRATION FILES THAT FOLLOW MAIN 190
C      RECORD 5 -- NIND OF THEM ***** MAIN 191
C      IND,((CONC(I),I=1,NREXP),J=1,NRNOCS),EXTX MAIN 192
C      IND - INDICATOR FOR MEAT CONCENTRATION FOLLOWS MAIN 193
C      IND - 1 MEANS AIR CONCENTRATIONS (BQ OR CI/M**3) FROM MAIN 194
C      RETADO-II OR ANEMOS MAIN 195
C      IND - 2 MEANS EFFECTIVE AIR CONCENTRATION (BQ OR CI/M**2) MAIN 196
C      INCLUDING OVERHEAD CANOPY SHIELD FROM ANEMOS MAIN 197
C      IND - 3 MEANS GROUND SURFACE CONCENTRATIONS (BQ OR CI/M**3) MAIN 198
C      FROM TERRA MAIN 199
C      IND - 4 MEANS MEANS MEAT CONCENTRATIONS (BQ OR CI/EC) MAIN 200
C      FROM TERRA MAIN1550 MAIN 201
C      IND - 5 MEANS MILK CONCENTRATIONS (BQ OR CI/EC) FROM TERRA MAIN 202
C      IND - 6 MEANS LEAFY VEGETABLE CONCENTRATION (BQ OR CI/EC) MAIN 203
C      FROM TERRA MAIN 204
C      IND - 7 MEANS PROTECTED VEGETABLE CONCENTRATION (BQ OR CI/EC) MAIN 205
C      FROM TERRA MAIN 206
C      IND - 8 MEANS EXPOSED VEGETABLE CONCENTRATION (BQ OR CI/EC) MAIN 207
C      FROM TERRA MAIN 208
C      IND - 9 MEANS CHAIN CONCENTRATIONS (BQ OR CI/EC) FROM TERRA MAIN 209
C      IND -10 MEANS DEPOSITION RATES (BQ OR CI/(M**2*SEC)) MAIN 210
C      NPACK - THE NUMBER OF DATA POINTS MAIN 211
C      CPACK - THE DATA VALUES INDICATED BY IND MAIN 212
C      ***** MAIN 213
C      ***** MAIN 214
C      ***** MAIN 215
C      READ THE EXPOSURE NUCLIDE LIST FROM PRIMUS AND STORE PARAMETERS MAIN 216
C      REWIND NPRIME MAIN 217
C      READ (NPRIME) NUNCHA,KTYPE,NPACK MAIN 218
C      READ (NPRIME) (IC(N),N=1,NPACK),(JC(I),I=1,NPACK) MAIN 219
C      READ (NPRIME) MAIN 220
C      READ (NPRIME) NREL,NEXP,(N1(J),J=1,NREL),(N2(I),I=1,NEXP) MAIN 221
C      IF(KTYPE.GT.0)READ (NPRIME) NREL,NEXP,(N1(J),J=1,NREL), MAIN 222
C      (N2(I),I=1,NEXP) MAIN 223
C      NE=0 MAIN 224
C      DO 4 ICHAIN=1,NUNCHA MAIN 225
C      READ (NPRIME) L,LQ,NCEXP,NCREL,NKSHORT,JSBORT,((S(J,I),J=1,L),I=1,MAIN 226
C      IL),(JIN(K),K=1,NCREL),(DUM1,L1=1,L),LOUT,DUM1,(DUM2,L2=1,L),(DUM3,MAIN 227
C      2,DUM2,L3=1,LOUT),(DUM1,L4=1,L),NEX,((DUM1,N11=1,NEX),N1=1,L),KID,JIDMAIN 228
C      3,DLANK,DLANKJ,STW,STWJ MAIN 229
C      IF(KTYPE.GT.0) MAIN 230
C      -READ (NPRIME) L,LQ,NCEXP,NCREL,NKSHORT,JSBORT,((S(J,I),J=1,L),I=1,MAIN 231
C      IL),(JIN(K),K=1,NCREL),(DUM1,L1=1,L),LOUT,DUM1,(DUM2,L2=1,L),(DUM3,MAIN 232
C      2,DUM2,L3=1,LOUT),(DUM1,L4=1,L),NEX,((DUM1,N11=1,NEX),N1=1,L),KID,JIDMAIN 233
C      3,DLANK,DLANKJ,STW,STWJ MAIN 234
C      DO 3 IB=1,L MAIN 235
C      NE=NE+1 MAIN 236
C      IF (NKSHORT.SF.IN.AND.JSBORT.NE.IN) GO TO 2 MAIN 237
C      LAMIS IS USED HERE AS FOR TEMPORARY STORAGE MAIN 238
C      LAMIS(NE)=S(IN,IN) MAIN 239
C      NE=NE+1 MAIN 240
C      IF (IN.EQ.NKSHORT) LAMIS(NE)=DLANK MAIN 241
C      IF (IN.EQ.JSBORT) LAMIS(NE)=DLANKJ MAIN 242
C      GO TO 3 MAIN 243
C      LAMIS(NE)=S(IN,IN) MAIN 244
C      CONTINUE MAIN 245
C      CONTINUE MAIN 246
C      CREATE ZAS ARRAY TO HOLD ZAS NUMBERS FOR EXPANDED MAIN 247
C      NUCLIDE LIST (NPACK DOES NOT EQUAL NEXP) MAIN 248
C      IN HOLDS CHAIN COUNTER FOR OUTPUT MAIN 249
C      IK=0 MAIN 250
C      DO 6 IP=1,NPACK MAIN 251
C      IF (JC(IP).EQ.JCB) GO TO 5 MAIN 252
C      IK=IK+1 MAIN 253
C      IW(IK)=1 MAIN 254
C      JCB=JC(IP) MAIN 255
C      GO TO 6 MAIN 256
C      IW(IK)=IW(IK)+1 MAIN 257
C      CONTINUE MAIN 258
C      DO 7 IP=1,NPACK MAIN 259
C      DO 7 IW=1,NEXP MAIN 260
C      IF (IN.EQ.IC(IP)) ZAS(IP)=N2(IW) MAIN 261
C      IF (IN.EQ.IC(IP)) LAM1(IP)=LAMIS(IW) MAIN 262
C      CONTINUE MAIN 263
C      DO 8 IP=1,NPACK MAIN 264
C      STW(IP)=NUNPACK(ZAS(IP)) MAIN 265
C      LAM2(IP)=ZAS(IP)/10000 MAIN 266
C      ***** MAIN 267
C      IF (IWRITE.NE.1) GO TO 9 MAIN 268
C      WRITE (IOUT,131) NREL,NEXP MAIN 269
C      WRITE (IOUT,132) (N1(J),J=1,NREL) MAIN 270
C      WRITE (IOUT,132) (N2(I),I=1,NEXP) MAIN 271
C      9 IF(IOPT.NE.3)READ (INB) TITLE,GRDOPT,IPTOG,ALAT,ALONG,BLOC,TRLOC,MAIN 272
C      - DIFFX,DIFFY,UNIT,MLOC MAIN 273
C      BLONG=SMGL(ALONG) MAIN 274
C      BLAT=SMGL(ALAT) MAIN 275
C      IOLOC=MLOC MAIN 276
C      IF(IOPT.NE.1)IOLOC=MRECP MAIN 277
C      WRITE (IOUT) TITLE,GRDOPT,IPTOG,ALAT,ALONG,BLOC,TRLOC,DIFFX,DIFFYMAIN 278
C      IV,UNIT,IOLOC,TA,TB,INRESUS MAIN 279

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Read the PRIMUS radionuclide list
and decay matrix
from logical unit NPRIME.

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WRITE (IOUT,133) TITLE,XLONG,XLAT,URL: MLOC
IF(IOPT.NE.3)READ (INB) ICODE,OPTS
WRITE (IOUT,68)
IF (CHDOPT.NE.1) WRITE (IOUT,69)
IF (CHDOPT.NE.2) WRITE (IOUT,70)
IF (CHDOPT.NE.3) WRITE (IOUT,1069)
IF (CHDOPT.NE.4) WRITE (IOUT,1070)
IF (IPTOGR.NE.1) WRITE (IOUT,71)
IF (IPTOGR.NE.2) WRITE (IOUT,72)
ICNT=0
DO 13 IO=1,12
  IF (.NOT.OPTS(IC)) GO TO 13
  ICNT=ICNT+1
  IF (ICNT.GT.3) ICNT=1
  GO TO (10,11,12),ICNT
10 WRITE (IOUT,73) OUTIO(IO)
  GO TO 13
11 WRITE (IOUT,74) OUTIO(IO)
  GO TO 13
12 WRITE (IOUT,75) OUTIO(IO)
13 CONTINUE
WRITE (IOUT,60)
IF (IOPT.NE.1) WRITE (IOUT,78)
IF (IOPT.NE.2) WRITE (IOUT,76)
IF (IOPT.NE.3) WRITE (IOUT,77)
IF (IRESUS.NE.1) WRITE (IOUT,61) TB,TA
IF (ISTORE.NE.1) WRITE (IOUT,79) ISSAV
IF (ISTORE.NE.3) WRITE (IOUT,80) ISSAV
IF (IWRITE.NE.1) WRITE (IOUT,81)
IF (IWRITE.NE.2) WRITE (IOUT,82)
BRANC=MLOC
IF (CHDOPT.NE.2) BRANC=21
IF (CHDOPT.NE.1) BRANC=MLOC/16
WDIST=BRANC-1
ICODE=ICODE+20
WRITE (IOUT) ICODE,OPTS
WRITE (IOUT) TA,TB,IREADS
IF(IOPT.NE.3)READ (INB) NREUCS,(ZASRN(I),I=1,NREUCS),NREXP,
- (ZASRN(I),I=1,NREXP)
IF(ICODE.NE.0) WRITE (IOUT) NREUCS,(ZASRN(I),I=1,NREUCS),
- NPACK,(ZAS(I),I=1,NPACK)
IF(ICODE.NE.0) WRITE (IOUT) NREUCS,(ZASRN(I),I=1,NREUCS),
- NREXP,(ZASRN(I),I=1,NREXP)
IF (ICODE.NE.1.AND.IOPT.NE.1) GO TO 15
IF (IOPT.NE.1) GO TO 16
*****
C IOPT = 2 OR IOPT = 3
C READ USER-DEFINED POINT(S) OF INTEREST
DO 14 IS=1,NREXP
14 READ (INC,134) XLONG(IS),YLAT(IS)
  IF (IOPT.NE.2) WRITE (IOUT,137)
  IF (IOPT.NE.3) WRITE (IOUT,136)
  WRITE (IOUT,135) IOPT,NREXP,(XLONG(IS),YLAT(IS),IS=1,NREXP)
  WRITE (IOUT,60)
*****
C GO TO 16
*****
C IOPT = 1
C READ WINDOW OF INTEREST (RETA=2-11)
15 READ (INC,138) XL,XR,YL,YU
  WRITE (IOUT,139) XR,XL,YU,YL
*****
16 NIND=2
DO 48 K=1,MLOC
  ISKIP=0
  IF(IOPT.NE.3) GO TO 18
  READ (INB) XMIN,XMAX,YMIN,YMAX,NIND
  IF (IWRITE.NE.1) WRITE (IOUT,140) XMIN,XMAX,YMIN,YMAX
  IF (IOPT.NE.2.AND.XLONG(ISK).GT.XMAX.AND.XLONG(ISK).LE.XMIN.AND.YLMAIN
  JAT(ISK).GT.YMIN.AND.YLAT(ISK).LE.YMAX) GO TO 17
  IF ((IOPT.NE.1.AND.ICODE.NE.1).OR.IOPT.NE.2) GO TO 18
  IF (XMAX.LE.XL.AND.XMAX.GT.XR.AND.YMAX.GT.YL.AND.YMAX.LE.YU)
  - GO TO 18
  IF (XMAX.LE.XL.AND.XMAX.GT.XR.AND.YMIN.GT.YL.AND.YMIN.LE.YU)
  - GO TO 18
  IF (XMIN.LE.XL.AND.XMIN.GT.XR.AND.YMAX.GT.YL.AND.YMAX.LE.YU)
  - GO TO 18
  IF (XMIN.LE.XL.AND.XMIN.GT.XR.AND.YMIN.GT.YL.AND.YMIN.LE.YU)
  - GO TO 18
  ISKIP=1
  GO TO 18
  ISK=ISK+1
C SPT THE NUMBER OF VALUES OUTPUT TO ANDROS
18 NINDT=NIND+7
  IF (ISKIP.NE.0) WRITE (IOUT) XMIN,XMAX,YMIN,YMAX,NINDT
  IF (ISK.NE.3) GO TO 1018
  XMIN=XLONG(K)
  XMAX=XMIN
  YMIN=YLAT(K)
  YMAX=YMIN
  READ(INC,138)(CONAIR(IN),IN=1,NPACK)
  READ(INC,138)(PSIZZ(IN),IN=1,NPACK)

```

IOPT = 2 or 3;
Read user-defined point(s) of interest.

IOPT = 1;
Read window of interest for RETADD-II data.

Check if RETADD-II cell
lies within user-defined
window of interest.

ISKIP = 1; RETADD-II cell does not
share common area with the
window of interest.

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      READ(INC,1138)((CLCLS(I,N),I=1,4),N=1,NPACK)      MAIN 372
      READ(INC,138)(DEPR(I),I=1,NPACK)                  MAIN 373
1138  FORMAT(50a1)                                         MAIN 374
      IND=1                                                MAIN 375
      WRITE(IBOUT)IND,NPACK,(COMAIR(IN),IN=1,NPACK)      MAIN 376
      WRITE(IBOUT)(PSIZZ(I),I=1,NPACK),((CLCLS(I,N),I=1,4),N=1,NPACK) MAIN 377
      IND=10                                               MAIN 378
      WRITE(IBOUT)(DEPR(I),I=1,NPACK)                    MAIN 379
      GO 1, 27                                             MAIN 380
1018  DO 29 J=1,NIND                                     MAIN 381
      READ (IN) IND,NREXP,(CPACK(I),I=1,NREXP)          MAIN 382
      IF (IND.NE.1) GO TO 19                              MAIN 383
      READ (IN) (PSIZZ(N),N=1,NREXP),((CLEAR(I,N),I=1,4),N=1,NREXP) MAIN 384
19    IF (WRITE.EQ.1) WRITE (IBOUT,141) IND,NREXP,(CPACK(I),I=1,NREXP) MAIN 385
      IF (ISKIP.EQ.1) GO TO 29                            MAIN 386
      DO 20 I=1,NREXP                                    MAIN 387
      I' (IND.EQ.1) COMAI(1)=CPACK(I)                    MAIN 388
      I' (IND.EQ.10) DEPR(I)=CPACK(I)                   MAIN 389
20    CONTINUE                                           MAIN 390
      IF (ICODE.EQ.1) GO TO 21                            MAIN 391
      WRITE (IBOUT) IND,NPACK,(CPACK(I),I=1,NPACK)      MAIN 392
      IF (IND.EQ.1) WRITE (IBOUT) (PSIZZ(N),N=1,NPACK),((CLCLS(I,N),I=1,4),N=1,NPACK) MAIN 393
      I' (ICODE.NE.1) GO TO 29                            MAIN 394
      I' (ICODE.NE.1) GO TO 29                            MAIN 395
C      *****                                           MAIN 396
C      *****                                           MAIN 397
C      THIS SECTION CHECKS THE NUCLEIDE LIST FROM RETADD-II AGAINST      MAIN 398
C      THE CHAIN FROM PRIMUS AND INSERTS MISSING NUCLEIDES WHERE NECESSARY MAIN 399
21    IF (J.NE.WIND) GO TO 29                             MAIN 400
      DO 26 IN=1,NPACK                                    MAIN 401
      DO 25 INN=1,NREXP                                    MAIN 402
      IF (ZASIN(INN).NE.ZAS(IN)) GO TO 23                MAIN 403
      DEPR(IN)=DEPR(INN)                                  MAIN 404
      COMAIR(IN)=COMAIR(INN)                             MAIN 405
      PSIZZ(IN)=PSIZZ(INN)                               MAIN 406
      DO 22 I=1,4                                         MAIN 407
      CLCLS(I,IN)=CLEAR(I,INN)                           MAIN 408
      GO TO 25                                             MAIN 409
23    IF (IN.GT.1) PSIZZ(IN)=PSIZZ(IN-1)                 MAIN 410
      DO 24 I=1,4                                         MAIN 411
      CLCLS(I,IN)=CLEAR(I,IN)                            MAIN 412
24    CONTINUE                                           MAIN 413
25    CONTINUE                                           MAIN 414
26    CONTINUE                                           MAIN 415
      IF (IND.EQ.1) WRITE (IBOUT) IND,NPACK,(COMAIR(IN),IN=1,NPACK) MAIN 416
      IF (IND.EQ.1) WRITE (IBOUT) (PSIZZ(N),N=1,NPACK),((CLCLS(I,N),I=1,4),N=1,NPACK) MAIN 417
      IF (IND.EQ.10) WRITE (IBOUT) IND,NPACK,(DEPR(IN),IN=1,NPACK) MAIN 418
C      *****                                           MAIN 419
C      *****                                           MAIN 420
29    CONTINUE                                           MAIN 421
C      CHECK 2 TO SEE IF GAS                                MAIN 422
27    DO 28 IN=1,NPACK                                    MAIN 423
      DO 28 IC=1,8                                         MAIN 424
      IF (IAND(IN).EQ.ICAS(IC)) DEPR(IN)=0.0E+0         MAIN 425
      DEPR(IN)=DEPR(IN)                                  MAIN 426
28    COMAIR(IN)=COMAIR(IN)                              MAIN 427
C      *****                                           MAIN 428
      IF (ISKIP.EQ.1) GO TO 48                            MAIN 429
      LOC=LOC+1                                           MAIN 430
      IF (ICODE.NE.0) GO TO 30                            MAIN 431
      IR=IR+1                                             MAIN 432
      LOCNO=KEYBAS((LOC-1)/NRANG+1)*16*(IR-1)           MAIN 433
      IF (IR.EQ.NRANG) IR=0                               MAIN 434
      GO TO 31                                             MAIN 435
30    LOCNO=LOC                                           MAIN 436
31    IF (LOCNO.EQ.1.AND.IOPT.EQ.1.AND.ICODE.EQ.1) YS(LOCNO)=YMAX MAIN 437
      IF (LOCNO.EQ.1.AND.IOPT.EQ.1.AND.ICODE.EQ.0) YS(LOCNO)=YMIN MAIN 438
      IF (IOPT.EQ.1) GO TO 32                             MAIN 439
C      *****                                           MAIN 440
C      IOPT = 2 OR 3 MEANS DO NOT HAVE TO AVERAGE SITE PARAMETERS      MAIN 441
C      DETERMINE THE POINTS (KEY) FOR THE DIRECT ACCESS READ          MAIN 442
      IF (IOPT.NE.1) KEY=IFIX((XLOC(ISK-1)-66.5)/.5)     MAIN 443
      - +116*(IFIX((YLAT(ISK-1)-24.0)/.5)-2)           MAIN 444
      IF (IOPT.EQ.1) KEY=IFIX((XMIN-66.5)/.5)           MAIN 445
      - +116*(IFIX((YMIN-24.0)/.5)-1)                   MAIN 446
C      INPUT THE DATA FROM THE SITE DATA BASE                MAIN 447
C      CELLON = LONGITUDE OF THE SOUTHEAST CORNER OF THE SITE DATA CELL MAIN 448
C      CELLAT = LATITUDE OF THE SOUTHEAST CORNER OF THE SITE DATA CELL MAIN 449
C      CFLAG = THE CAUTION FLAG, = 1 MEANS CELL ON ATLANTIC COAST      MAIN 450
C      = 2 MEANS CELL ON MEXICAN BORDER                            MAIN 451
C      = 3 MEANS 1 AND 2                                           MAIN 452
C      = 4 MEANS CELL HAS INTERIOR BODY OF WATER                  MAIN 453
C      = 5 MEANS 1 AND 4                                           MAIN 454
C      = 6 MEANS 2 AND 4                                           MAIN 455
C      = 8 MEANS CELL ON PACIFIC COAST                            MAIN 456
C      = 12 MEANS 4 AND 8                                           MAIN 457
C      = 16 MEANS CELL ON CANADIAN BORDER                        MAIN 458
C      = 20 MEANS 4 AND 16                                          MAIN 459
C      = 21 MEANS 1 AND 4 AND 16                                    MAIN 460
C      = 24 MEANS 8 AND 16                                          MAIN 461
C      = 32 MEANS CELL HAS DESERT OR BARREN LAKES                MAIN 462
C      = 36 MEANS 4 AND 32                                          MAIN 463

```

This section ensures that PRIMUS list of
nuclides is the same as from RETADD-II.

If the radionuclide is a gas,
deposition rate is set to 0.

Determine direct access key for the
(IOPT = 2 or 3) location.
Determine direct access key for the
(IOPT = 1) location.

```

C      ET      = EVAPOTRANSPIRATION (MM/Y)                MAIN 464
C      IRR      = IRRIGATION (MM/Y)                      MAIN 465
C      PRE      = PRECIPITATION (MM/Y)                   MAIN 466
C      YEV      = YIELD OF EXPOSED VEGETABLES (Y/(FRESH)/M**2) MAIN 467
C      AYHF     = AREAL YIELD OF HAY FEED (KG(DRY)/YR/M**2) MAIN 468
C      YLV      = YIELD OF LEAFY VEGETABLES (KG(FRESH)/M**2) MAIN 469
C      YSF      = YIELD OF (CORN AND SORGHUM) SILAGE FEED (KG(DRY)/M**2) MAIN 470
C      AREAP    = TOTAL AREA OF PASTURE (M**2)            MAIN 471
C      NUMCC    = CATTLE AND CALF INVENTORY (HEAD)       MAIN 472
C      NUMBC    = NUMBER OF BRED CATTLE (HEAD)           MAIN 473
C      SALFC    = NUMBER OF CATTLE ON FEED SOLD (HEAD/YR) MAIN 474
C      NUMNC    = NUMBER OF MILK COWS (HEAD)             MAIN 475
C      NUMSRP   = NUMBER OF SHEEP (HEAD)                 MAIN 476
C      PGF      = PRODUCTION OF GRAIN FOR FEED (KG)       MAIN 477
C      PHF      = PRODUCTION OF HAY FEED (KG)             MAIN 478
C      PSF      = PRODUCTION OF (CORN AND SORGHUM) SILAGE FEED (KG) MAIN 479
C      HUMID    = AVERAGE ANNUAL ABSOLUTE HUMIDITY (G/M**3) MAIN 480
C      AREAT    = TOTAL AREA OF CELL (M**2)              MAIN 481
C      POP      = HUMAN POPULATION OF CELL (NUMBER)      MAIN 482
C      FRUMF    = FRACTION OF 1970 POPULATION CLASSED AS RURAL NON-FARM MAIN 483
C      FRUPM    = FRACTION OF 1970 POPULATION CLASSED AS RURAL FARM MAIN 484
C      FURBN    = FRACTION OF 1970 POPULATION CLASSED AS URBAN MAIN 485
C      PLV      = PRODUCTION OF LEAFY VEGETABLES (KG)    MAIN 486
C      PEV      = PRODUCTION OF EXPOSED VEGETABLES (KG)  MAIN 487
C      PPV      = PRODUCTION OF PROTECTED VEGETABLES (KG) MAIN 488
C      PGR      = PRODUCTION OF GRAINS FOR HUMAN CONSUMPTION (KG) MAIN 489
C      DOMLF    = DOMINANT LAND FEATURE OF THE FORM PLPPP, WHERE
C      F=1 IF THE CELL IS MORE THAN 50% FEDERAL LAND,
C      I.E. LAND TYPE IS UNDETERMINED                    MAIN 490
C      F=0 LESS THAN 50 PERCENT IN FEDERAL LAND          MAIN 491
C      L=1 MEANS TALL ROW CROPS IS DOMINANT LAND TYPE    MAIN 492
C      L=2 MEANS SHORT ROW CROPS                        MAIN 493
C      L=3 MEANS HAY OR TALL GRASS                      MAIN 494
C      L=4 MEANS URBAN                                  MAIN 495
C      L=5 MEANS SMALL LAKES                            MAIN 496
C      L=6 MEANS SHORT GRASS                            MAIN 497
C      L=7 MEANS FOREST                                 MAIN 498
C      PPP      = THE PERCENTAGE OF THE DOMINANT LAND TYPE MAIN 499
C      (MAY BE 0 IF CELL IS 100% FEDERAL)               MAIN 500
C      MMIXHT   = MORNING MIXING HEIGHT (M)              MAIN 501
C      AMIXHT   = AFTERNOON MIXING HEIGHT (M)            MAIN 502
C      YV      = YIELD OF PROTECTED VEGETABLES (KG(FRESH)/M**2) MAIN 503
C      YGR      = YIELD OF GRAIN FOR HUMAN FOOD (KG(FRESH)/M**2) MAIN 504
C      YGF      = YIELD OF GRAIN FOR LIVESTOCK FEED (KG(DRY)/M**2) MAIN 505
C      FFDAYS   = NUMBER OF FROST-FREE DAYS IN A YEAR    MAIN 506
C      IF (KEY.EQ.KEYS) GO TO 35                         MAIN 507
C      READ(15,'KEY')CELLNO,CELLAT,CFLAG,ET,IRR,PRECIP,YEV,AYHF,YLV,YSF, MAIN 508
C      AREAP,NUMCC,SALFC,NUMBC,NUMSRP,PGF,PHF,PSF,HUMID,AREAT,POP, MAIN 509
C      FRUMF,FRUPM,FURBN,PLV,PEV,PPV,PGR,DOMLF,MMIXHT, MAIN 510
C      AMIXHT,YPV,YGR,YGF,FFDAYS,NUMB MAIN 511
C      IF (INL.GT.0) READ (INL,SITE)                   MAIN 512
C      WRITE (IOUT,142) LOCNO,XLONG(ISK-1),YLAT(ISK-1),KEY,CELLNO,CFLAG MAIN 513
C      WRITE (IOUT,143) XMIN,XMAX,YMIN,YMAX             MAIN 514
C      KEYS=KEY                                         MAIN 515
C      IF (CFLAG.NE.0.0) WRITE (IOUT,145) KEY          MAIN 516
C      IF (IFIX(CFLAG+.1).EQ.0) WRITE (IOUT,146)       MAIN 517
C      IF (IFIX(CFLAG+.1).EQ.1) WRITE (IOUT,147)       MAIN 518
C      IF (IFIX(CFLAG+.1).EQ.2) WRITE (IOUT,148)       MAIN 519
C      IF (IFIX(CFLAG+.1).EQ.3) WRITE (IOUT,149)       MAIN 520
C      IF (IFIX(CFLAG+.1).EQ.4) WRITE (IOUT,150)       MAIN 521
C      IF (IFIX(CFLAG+.1).EQ.5) WRITE (IOUT,151)       MAIN 522
C      IF (IFIX(CFLAG+.1).EQ.6) WRITE (IOUT,152)       MAIN 523
C      IF (IFIX(CFLAG+.1).EQ.8) WRITE (IOUT,153)       MAIN 524
C      IF (IFIX(CFLAG+.1).EQ.12) WRITE (IOUT,154)      MAIN 525
C      IF (IFIX(CFLAG+.1).EQ.16) WRITE (IOUT,155)      MAIN 526
C      IF (IFIX(CFLAG+.1).EQ.20) WRITE (IOUT,156)      MAIN 527
C      IF (IFIX(CFLAG+.1).EQ.21) WRITE (IOUT,157)      MAIN 528
C      IF (IFIX(CFLAG+.1).EQ.24) WRITE (IOUT,158)      MAIN 529
C      IF (IFIX(CFLAG+.1).EQ.32) WRITE (IOUT,159)      MAIN 530
C      IF (IFIX(CFLAG+.1).EQ.36) WRITE (IOUT,159)      MAIN 531
C      *****MAIN *****                          MAIN 532
C      IF (ISTORE.EQ.2) GO TO 179                      MAIN 533
C      IF (GRDOPT.EQ.2.OR.GRDOPT.EQ.4) CALL RECTAV(RLONG,RLAT,XMIN,XMAX, MAIN 534
C      YMIN,YMAX,IPTOGR,GRDOPT)                      MAIN 535
C      IF (GRDOPT.EQ.1.OR.GRDOPT.EQ.3) CALL CIRCAY(RLONG,RLAT,XMIN,XMAX, MAIN 536
C      YMIN,YMAX,IPTOGR,GRDOPT,TO=SEC)                MAIN 537
C      IF (ISTORE.EQ.1.AND.IPTOGR.EQ.1) WRITE (17'LOCNO)XMIN,YMIN, MAIN 538
C      IDS,ET,IRR,PRECIP,YEV,AYHF,YLV,YSF,AREAP,NUMCC,SALFC,MAIN 539
C      NUMBC,NUMSRP,PGF,PHF,PSF,HUMID,AREAT,POP,MAIN 540
C      FRUMF,FRUPM,FURBN,PLV,PEV,PPV,PGR,DOMLF,MMIXHT,MAIN 541
C      AMIXHT,YPV,YGR,YGF,FFDAYS,NUMB MAIN 542
C      GO TO 33                                         MAIN 543
C      *****MAIN *****                          MAIN 544
C      READ ALREADY AVERAGED SITE PARAMETERS FROM UNIT 15BAV MAIN 545
C      179 READ(17'LOCNO)X,Y,IDS,ET,IRR,PRECIP,YEV,AYHF,YLV,YSF,AREAP,NUMCC,MAIN 546
C      SALFC,NUMBC,NUMSRP,PGF,PHF,PSF,HUMID,AREAT,POP, MAIN 547
C      1 FRUMF,FRUPM,FURBN,PLV,PEV,PPV,PGR,DOMLF,MMIXHT, MAIN 548
C      2 AMIXHT,YPV,YGR,YGF,FFDAYS,NUMB MAIN 549
C      3 *****MAIN *****                          MAIN 550
C      CALL SOILS (DEPR,CONAIR,ZAS,LOCNO,RPG,YPG,NUMDC,RLV,REV,RHF,RSF,TIMAIN MAIN 551
C      TIME,TIMES) MAIN 552
C      IF (IWRITE.EQ.2) GO TO 34                      MAIN 553

```

Can override SITE parameters with NAMELIST
READ if INL > 0.

Write caution flag information.

Call RECTAV to obtain SITE parameters for a
rectangular grid.
Call CIRCAY to obtain SITE parameters for a
circular grid.
Save the SITE parameters for later runs
if ISTORE = 1.

Read the previously saved SITE parameters
if ISTORE = 2.

Call SOILS to determine radionuclide
concentrations in different soils.

```

IF(IOPT.EQ.1.AND.ICODE.EQ.1) WRITE (IOUT,161) LOCHO,XMAX,XMIN, MAIN 556
- YMAX,YMIN MAIN 557
WRITE (IOUT,162) LOCHO MAIN 558
C PEF AND PSF ARE MODIFIED HERE TO EQUAL AS FROM SITE MAIN 559
C THEY WERE REDUCED BY 25 PERCENT IN SUBROUTINE STOCK MAIN 560
34 PEF=PEF/0.75 MAIN 561
PSF=PSF/0.75 MAIN 562
IF (IWRITE.EQ.2) GO TO 38 MAIN 563
WRITE (IOUT,163) XT,IRRI,PRECIP,XTV,ATVF,TLV,TSF MAIN 564
WRITE (IOUT,164) AREA,NUMCC,NUMIC,SALPC,NUMHC,NUMHSP,PGF,PHF,PSF MAIN 565
WRITE (IOUT,165) HUMID,AREAT,POP,FRUHF,FRUHF,FOREN,PLV,PEV MAIN 566
WRITE (IOUT,166) PFF,PCF,DOMLF,UMIXT,AMIXT,YPV,TCH,TCF,TFDATE MAIN 567
GO TO 36 MAIN 568
35 WRITE (IOUT,167) MAIN 569
36 WRITE (IOUT,168) LOCHO MAIN 570
WRITE (IOUT,169) MAIN 571
DO 37 IN=1,NPACK MAIN 572
WRITE (IOUT,160) IN,SYN(IN),LAMIS(IN),LAMS(IN),LAMES(IN) MAIN 573
37 CONTINUE MAIN 574
WRITE (IOUT,170) LOCHO,RLV,REV,REF,RSF,YPC,RPC,NUMOC MAIN 575
38 IF (LOCHO.GT.1) GO TO 40 MAIN 576
C WRITE TABLE 2 MAIN 577
WRITE (IOUT,175) MAIN 578
WRITE (IOUT,176) MAIN 579
DO 39 IN=1,NPACK MAIN 580
WRITE (IOUT,129, IN,SYN(IN),KD(IN),BV(IN),BR(IN),FR(IN),FF(IN), MAIN 581
1 LAMH(IN),LAMH(IN),LAMH(IN),LAMH(IN),LAMH(IN) MAIN 582
39 CONTINUE MAIN 583
C WRITE TABLE 3 MAIN 584
WRITE (IOUT,127) MAIN 585
WRITE (IOUT,128) OF DR,RO,THET: MAIN 586
WRITE (IOUT,171) MAIN 587
WRITE (IOUT,172) TA,TS,TLV,THEV,THEV,THC,THSF,THSF,TCRZ MAIN 588
WRITE (IOUT,85) THLK,TSFC,TSOC,TSNC,TSCF MAIN 589
WRITE (IOUT,83) PRQFC,PRQMC,PRQOC,PRQSHF MAIN 590
WRITE (IOUT,84) GRQFC,GRQMC,GRQOC,LRQFC,LRQSHF MAIN 591
WRITE (IOUT,86) FDRYEV,FDRYFC,FDRYLV,FDRYFP,NUMC,MPC MAIN 592
WRITE (IOUT,87) FMA,MFWBEF,MFWMLK,MFWLV,MFWPV,MFWEV,MFWCH MAIN 593
WRITE (IOUT,88) EGCAIR,MFCCLV,MFCEV,MFCPV,MFCCH,MFCMLK,MFCBEF MAIN 594
IF (IRRSUB.EQ.1) WRITE (IOUT,89) MLOAD,VELD(1) MAIN 595
40 IF (IOPT.GE.2) WRITE (IOUT,62) XLONG(ISK-1),VLAT(ISK-1) MAIN 596
IF (GRDOPT.EQ.2.OR.GRDOPT.EQ.4) WRITE (IOUT,173) LOCHO,XMIN,XMAX, MAIN 597
- YMIN,YMAX MAIN 598
IF ((GRDOPT.EQ.1.OR.GRDOPT.EQ.3).AND.IPTOCR.EQ.1) MAIN 599
- WRITE (IOUT,175) LOCHO,XMIN,DIR((LOC-1)/NRANG+1) MAIN 600
IF (GRDOPT.EQ.1.AND.IPTOCR.EQ.2) WRITE (IOUT,176) LOCHO,XMIN,XMAX, MAIN 601
DIR((LOC-1)/NRANG+1) MAIN 602
WRITE (IOUT,174) UNIT,UNIT,UNIT,UNIT,UNIT,UNIT,UNIT,UNIT,UNIT MAIN 603
IRK=1 MAIN 604
IRK=IV(IRE) MAIN 605
DO 43 IN=1,NPACK MAIN 606
IF (SYN(IN).NE.H3) GO TO 41 MAIN 607
C ***** MAIN 608
C THE NUCLEIDE IS TRITIUM AND THE CONCENTRATIONS ARE RECALCULATED MAIN 609
CONH2=0.0 MAIN 610
IF (AREAT.GT.1.0.AND.NUMID.NE.0.0) CONH2=CONAIR(IN)/HUMID MAIN 611
C FRA = THE FRACTION OF H DERIVED FROM ATMOSPHERIC H MAIN 612
C MFWBEF = MASS FRACTION OF WATER IN BEEF MAIN 613
C CONBEF(IN)=CONH2*MFWBEF*FRA MAIN 614
C MFWMLK = MASS FRACTION OF WATER IN MILK MAIN 615
C CONMLK(IN)=CONH2*MFWMLK*FRA MAIN 616
C MFWLV = MASS FRACTION OF WATER IN LEAFY VEGETABLES MAIN 617
C CONLV(IN)=CONH2*MFWLV*FRA MAIN 618
C MFWPV = MASS FRACTION OF WATER IN PROTECTED PRODUCE MAIN 619
C CONPV(IN)=CONH2*MFWPV*FRA MAIN 620
C MFWEV = MASS FRACTION OF WATER IN EXPOSED PRODUCE MAIN 621
C CONEV(IN)=CONH2*MFWEV*FRA MAIN 622
C MFWCH = MASS FRACTION OF WATER IN GRAINS FOR HUMAN CONSUMPTION MAIN 623
C CONCH(IN)=CONH2*MFWCH*FRA MAIN 624
C ***** MAIN 625
41 IF (SYN(IN).NE.C14) GO TO 42 MAIN 626
C ***** MAIN 627
C CONCENTRATIONS FOR C-14 ARE RECALCULATED HERE MAIN 628
EGCAIR = EG OF C/M**3 OF AIR MAIN 629
CONC14=CONAIR(IN)/EGCAIR MAIN 630
C MFCCLV = MASS FRACTION OF CARBON IN LEAFY VEGETABLES MAIN 631
C CONCLV(IN)=CONC14*MFCCLV MAIN 632
C MFCEV = MASS FRACTION OF CARBON IN EXPOSED PRODUCE MAIN 633
C CONEV(IN)=CONC14*MFCEV MAIN 634
C MFCPV = MASS FRACTION OF CARBON IN PROTECTED PRODUCE MAIN 635
C CONPV(IN)=CONC14*MFCPV MAIN 636
C MFCCH = MASS FRACTION OF CARBON IN GRAIN FOR HUMAN CONSUMPTION MAIN 637
C CONCH(IN)=CONC14*MFCCH MAIN 638
C MFCMLK = MASS FRACTION OF CARBON IN MILK MAIN 639
C CONMLK(IN)=CONC14*MFCMLK MAIN 640
C MFCBEF = MASS FRACTION OF CARBON IN BEEF MAIN 641
C CONBEF(IN)=CONC14*MFCBEF MAIN 642
C ***** MAIN 643
42 WRITE (IOUT,177) IN,SYN(IN),CONRES(IN),DEPR(IN),CONRES(IN), MAIN 644
- CONLV(IN),CONEV(IN),CONPV(IN),CONCH(IN),CONBEF(IN),CONMLK(IN) MAIN 645
IF (IN.NE.IRR) GO TO 43 MAIN 646
WRITE (IOUT,178) MAIN 647

```

Write Table 2.

Write Table 3.

Tritium concentrations are recalculated
based upon mass fraction of water
within the food type.

Carbon-14 concentrations are recalculated
based upon mass fraction of carbon
within the food type.

Save the results from TERN1 for ATRN02.

Total the SITE parameters for Table 6.

Determine the ranges of SITE parameters for Table 6.

```

MROCK=AMAX1(MROCK,MNINT)
IF (MNINT.EQ.MROCK) LROCK=LOCRO
AVGROCK=AVGROCK+MNINT*AREAT
AMROCK=AMINI(AMROCK,MNINT)
IF (AMINT.EQ.AMROCK) LAMROCK=LOCRO
AMROCK=AMAX1(AMROCK,AMINT)
IF (AMINT.EQ.AMROCK) LAMROCK=LOCRO
AVGAROCK=AVGAROCK+AMINT*AREAT
YFVRO=AMINI(YFVRO,YFV)
IF (YFV.EQ.YFVRO) LYFVRO=LOCRO
YFVRO=AMAX1(YFVRO,YFV)
IF (YFV.EQ.YFVRO) LYFVRO=LOCRO
YGFRO=AMINI(YGFRO,YGF)
IF (YGF.EQ.YGFRO) LYGFRO=LOCRO
YGFRO=AMAX1(YGFRO,YGF)
IF (YGF.EQ.YGFRO) LYGFRO=LOCRO
AVGCTGF=AVGCTGF+YGF*AREAT
YGRRO=AMINI(YGRRO,YGR)
IF (YGR.EQ.YGRRO) LYGRRO=LOCRO
YGRRO=AMAX1(YGRRO,YGR)
IF (YGR.EQ.YGRRO) LYGRRO=LOCRO
FFVRO=AMINI(FFVRO,FFV)
IF (FFV.EQ.FFVRO) LFFVRO=LOCRO
FFVRO=AMAX1(FFVRO,FFV)
IF (FFV.EQ.FFVRO) LFFVRO=LOCRO
AVGCTFF=AVGCTFF+FFV*AREAT
DPOPR=POP/AREAT
DPOPR=AMINI(DPOPR,DPOP)
IF (DPOP.EQ.DPOPR) LPDPR=LOCRO
DPOPR=AMAX1(DPOPR,DPOP)
IF (DPOP.EQ.DPOPR) LPDPR=LOCRO
DNUNCC=NUNCC/AREAT
DNUNCC=AMINI(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=AMAX1(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=NUNCC/AREAT
DNUNCC=AMINI(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=AMAX1(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=NUNCC/AREAT
DNUNCC=AMINI(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=AMAX1(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=NUNCC/AREAT
DNUNCC=AMINI(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DNUNCC=AMAX1(DNUNCC,DNUNCC)
IF (DNUNCC.EQ.DNUNCC) LUNCC=LOCRO
DSALFC=SALEFC/AREAT
DSALFC=AMINI(DSALFC,DSALFC)
IF (DSALFC.EQ.DSALFC) LSFCH=LOCRO
DSALFC=AMAX1(DSALFC,DSALFC)
IF (DSALFC.EQ.DSALFC) LSFCH=LOCRO
IF (GRDOPT.NE.2) GO TO 47
C SAVE GRID LOCATIONS FOR RECTANGULAR GRID
IF (LOCRO.GT.1) GO TO 45
XS(LOCRO)=XMIN
45 IF (MOD(LOCRO,16).EQ.0) GO TO 46
GO TO 48
46 KNTY=KNTY+1
YS(KNTY)=YMAX
GO TO 48
C SAVE GRID LOCATIONS FOR CIRCULAR GRID
47 IF (GRDOPT.NE.1) GO TO 48
IF (LOC.GT.NRANG) GO TO 48
IF (LOC.EQ.NRANG) YS(MDIST)=XMAX
KNTY=KNTY+1
YS(KNTY)=XMIN
48 CONTINUE
IF (GRDOPT.NE.2) GO TO 52
IF (GRDOPT.NE.1) GO TO 55
C TABLE 5 FOR CIRCULAR GRID
WRITE (IOUT,90) TITLE
WRITE (IOUT,91) DIR
DO 51 IR=1,NRANG
DO 49 IX=1,16
49 KEYS(IX)=KEYBAS(IX)+(IR-1)*16
IF (IPTOGR.EQ.1) GO TO 50
WRITE (IOUT,92) YS(IR)
WRITE (IOUT,94) (KEYS(IX),IX=1,16)
GO TO 51
50 WRITE (IOUT,93) YS(IR),(KEYS(IX),IX=1,16)
51 CONTINUE
IF (IPTOGR.NE.1) WRITE (IOUT,92) YS(MDIST)
GO TO 55
C WRITE LOCATION TABLE FOR RECTANGULAR GRID
52 WRITE (IOUT,63) TITLE
XS(22)=XMAX
YS(16)=YMIN

```

```

MAIN 740
MAIN 741
MAIN 742
MAIN 743
MAIN 744
MAIN 745
MAIN 746
MAIN 747
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MAIN 820
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MAIN 828
MAIN 829
MAIN 830
MAIN 831

```

Save and write rectangular grid locations.

Save and write circular grid locations.

```

WRITE (IOUT,64) IS MAIN 832
WRITE (IOUT,65) MAIN 833
DO 54 IR=1,16 MAIN 834
DO 53 IX=1,21 MAIN 835
53 KEYS(IX)=KEYBAS(IX)+(IR-1)*21 MAIN 836
WRITE (IOUT,66) TS(IX) MAIN 837
IF (IR.NE.16) GO TO 54 MAIN 838
WRITE (IOUT,67) KEYS MAIN 839
54 CONTINUE MAIN 840
C DETERMINE ADDITIONAL PARAMETERS AND WRITE TABLE 6 MAIN 841
55 IF (TAREAT.NE.0.0) GO TO 56 MAIN 842
DPOF=TPOF/TAREAT MAIN 843
THUMCC=THUMCC/TAREAT MAIN 844
THUMHC=THUMHC/TAREAT MAIN 845
THUMBC=THUMBC/TAREAT MAIN 846
THUMOC=THUMOC/TAREAT MAIN 847
DSALFC=TSALFC/TAREAT MAIN 848
AVGET=AVGET/TAREAT MAIN 849
AVGIR=AVGIR/TAREAT MAIN 850
AVGPR=AVGPR/TAREAT MAIN 851
AVCTLV=TOTPLV/TAREAT MAIN 852
AVCTEV=TOTPEV/TAREAT MAIN 853
AVGATH=AVGATH/TAREAT MAIN 854
AVCTSF=AVCTSF/TAREAT MAIN 855
AVCHUM=AVCHUM/TAREAT MAIN 856
AVCHCK=AVCHCK/TAREAT MAIN 857
AVGANK=AVGANK/TAREAT MAIN 858
AVCTPV=TOTFPV/TAREAT MAIN 859
AVCTCF=AVCTCF/TAREAT MAIN 860
AVCTCH=TOTPCB/TAREAT MAIN 861
AVCTFD=AVCTFD/TAREAT MAIN 862
56 IF (IPTOGR.NE.1) GO TO 57 MAIN 863
GO TO 58 MAIN 864
C ***** MAIN 865
C IPTOGR = 1 AND WE HAVE TO AVERAGE TO GET TOTALS MAIN 866
57 TAREAT=(TS(HRANG)-TS(1))*2*PI MAIN 867
RATIO=TAREAT/TOTSEC MAIN 868
TPOF=TPOF*RATIO MAIN 869
THUMCC=THUMCC*RATIO MAIN 870
THUMHC=THUMHC*RATIO MAIN 871
THUMBC=THUMBC*RATIO MAIN 872
THUMOC=THUMOC*RATIO MAIN 873
TSALFC=TSALFC*RATIO MAIN 874
TOTPLV=TOTPLV*RATIO MAIN 875
TOTPEV=TOTPEV*RATIO MAIN 876
TOTFPV=TOTFPV*RATIO MAIN 877
TOTPCB=TOTPCB*RATIO MAIN 878
TOTBEF=TOTBEF*RATIO MAIN 879
TOTMLK=TOTMLK*RATIO MAIN 880
TAREAT=TAREAT*RATIO MAIN 881
C ***** MAIN 882
58 WRITE (IOUT,95) MAIN 883
IF (IPTOGR.NE.1) WRITE (IOUT,96) MAIN 884
WRITE (IOUT,101) ANCHN,LANCHN,ANCHK,LANCHK,AVGANK MAIN 885
WRITE (IOUT,97) ETHN,ETHNIN,ETHAX,LETHAX,AVGET MAIN 886
WRITE (IOUT,103) YFDMN,LFFDMN,YFDMK,LFFDMK,AVCTFD MAIN 887
WRITE (IOUT,102) HJDMN,LHJDMN,HJDMK,LHJDMK,AVCHUM MAIN 888
WRITE (IOUT,98) LRMN,LRMNIN,LRMAX,LRMAX,AVGIR MAIN 889
WRITE (IOUT,100) MCKMN,LCKMN,MCKMK,LCKMK,AVCHCK MAIN 890
WRITE (IOUT,99) PRMN,LRPMN,PRMAX,LRPMAX,AVGPR MAIN 891
WRITE (IOUT,104) AYHNM,LAYHNM,AYHMK,LAYHMK,AVGATH MAIN 892
WRITE (IOUT,105) YEVNM,LYEVNM,YEVNK,LYEVNK,AVCTEV MAIN 893
WRITE (IOUT,106) YLVNM,LYLVNM,YLVNK,LYLVNK,AVCTLV MAIN 894
WRITE (IOUT,107) YFVNM,LYFVNM,YFVNK,LYFVNK,AVCTPV MAIN 895
WRITE (IOUT,108) YGDMN,LYGDMN,YGDMK,LYGDMK,AVCTCH MAIN 896
WRITE (IOUT,109) YCFNM,LYCFNM,YCFMK,LYCFMK,AVCTCF MAIN 897
WRITE (IOUT,110) YSFMN,LYSFMN,YSFMK,LYSFMK,AVCTSF MAIN 898
WRITE (IOUT,111) TPOF,DPOFNM,LPOFNM,DPOFMK,LPOFMK,DPOF MAIN 899
WRITE (IOUT,112) THUMCC,DHCCNM,LHCCNM,DHCCMK,LHCCMK,THUMCC MAIN 900
WRITE (IOUT,113) THUMHC,DHHCNM,LHHCNM,DHHCNK,LHHCNK,THUMHC MAIN 901
WRITE (IOUT,114) THUMBC,DHBCNM,LHBCNM,DHBCNK,LHBCNK,THUMBC MAIN 902
WRITE (IOUT,115) THUMOC,DHOCNM,LHOCNM,DHOCNK,LHOCNK,THUMOC MAIN 903
WRITE (IOUT,116) TSALFC,DSALFCNM,LSALFCNM,DSALFCNK,LSALFCNK,DSALFC MAIN 904
WRITE (IOUT,117) TOTPEV MAIN 905
WRITE (IOUT,118) TOTPLV MAIN 906
WRITE (IOUT,119) TOTFPV MAIN 907
WRITE (IOUT,120) TOTPCB MAIN 908
WRITE (IOUT,121) TOTBEF MAIN 909
WRITE (IOUT,122) TOTMLK MAIN 910
WRITE (IOUT,123) TAREAT MAIN 911
WRITE (IOUT,124) TAREAP MAIN 912
59 STOP MAIN 913
C MAIN 914
60 FORMAT (//) MAIN 915
61 FORMAT ('0',12X,'IRANGS = 1 MEANS RESUSPENSION FROM YEAR = ',F5.1, MAIN 916
1' TO YEAR = ',F5.1) MAIN 917
62 FORMAT ('0FOR LOCATION WITH LONGITUDE =',F9.4,' AND LATITUDE =',F8.1 MAIN 918
1.4,' THE FOLLOWING CONCENTRATIONS WERE CALCULATED: (//) MAIN 919
63 FORMAT (///,5X,'TABLE OF GRID LOCATIONS FOR : ',20A4///' LAT. 1' MAIN 920
1,51X,'LONGITUDE'/8X,'1') MAIN 921
64 FORMAT (8X,'1',2X,10F6.1,12F5.1/8X,'1') MAIN 922
65 FORMAT (' ',11(' '),10('---- '),12('---- '),/8X,'1') MAIN 923

```

IPTOGR = 1;
scale to get 817K totals.

```

66 FORMAT ('F5.2,2X,I') MAIN 924
67 FORMAT (1X,10(1X,13),11(2X,13)) MAIN 925
68 FORMAT (/// 'OPTIONS USED:') MAIN 926
69 FORMAT (' GRIDPT = 1 MEANS CIRCULAR GRID') MAIN 927
70 FORMAT (' GRIDPT = 2 MEANS RECTANGULAR GRID') MAIN 928
1069 FORMAT (' GRIDPT = 3 MEANS (R,THETA) POINTS') MAIN 929
1070 FORMAT (' GRIDPT = 4 MEANS (X,Y) POINTS') MAIN 930
71 FORMAT (1X,'AREAS RUN-OPTIONS-POINT') MAIN 931
72 FORMAT (1X,'AREAS RUN-OPTIONS-AVERAGE') MAIN 932
73 FORMAT (1X,A6) MAIN 933
74 FORMAT ('F7X,A5') MAIN 934
75 FORMAT ('F15X,A6') MAIN 935
76 FORMAT (1X,'IOPT = 2 MEANS DATA FROM UNIT INS AND CONCENTRATION') MAIN 936
INS COMPUTED FOR THE WHOLE CELL THAT CONTAINS USER-SELECTED LOCATION MAIN 937
2N(S)') MAIN 938
77 FORMAT (1X,'IOPT = 3 MEANS DATA FROM UNIT INS AND CONCENTRATIONS') MAIN 939
1 ARE FOR THE WHOLE CELL THAT CONTAINS USER-SELECTED LOCATION(S)') MAIN 940
78 FORMAT (1X,'IOPT = 1 MEANS DATA FROM UNIT INS') MAIN 941
79 FORMAT ('O ISTORE = 1 MEANS AVERAGED SITE DATA IS SAVED') MAIN 942
1 ON LOGICAL UNIT = .13) MAIN 943
80 FORMAT ('O ISTORE = 2 MEANS AVERAGED SITE DATA IS READ') MAIN 944
1 FROM LOGICAL UNIT = .13) MAIN 945
81 FORMAT ('O IWRITE = 1 MEANS TOTAL WRITTEN OUTPUT GIVEN') MAIN 946
1) MAIN 947
82 FORMAT ('O IWRITE = 2 MEANS CONSTANTS, CONCENTRATIONS,') MAIN 948
1 AND TOTALS GIVEN') MAIN 949
83 FORMAT (/// 'FEED AN: FORAGE REQUIREMENTS: ///', FQPC = FORAGE ORAIN MAIN 950
1 FORAGE-EQUIVALENT REQUIREMENT OF CATTLE ON FELD (KG/Y)',T106, = MAIN 951
2',F6.1,/, FQPC = .4X,'OF MILK COWS (KG/Y)',T106, = .F6.1,/, MAIN 952
3 FQPC = .4X,'OF OTHER CATTLE (NOT MILK COWS OR CATTLE ON FELD) MAIN 953
4 (KG/Y)' = .F6.1,/, FQPC = .4X,'OF SHEEP (KG/Y)',T106, = .F6.1,/, MAIN 954
5.1, MAIN 955
84 FORMAT (' GRQC = .4X,'GRAIN OR GRAIN-EQUIVALENT REQUIREMENT OF CATTLE MAIN 956
1 (KG/Y)',T106, = .F6.1,/, GRQC = .4X,'MILK COWS MAIN 957
2 (KG/Y)',T106, = .F6.1,/, GRQC = .4X,'OTHER CATTLE (KG/Y)',T106, = MAIN 958
3',F6.1,/, LQPC = .5X,'LIFETIME GRAIN REQUIREMENT OF CATTLE MAIN 959
4 (KG/Y)',T106, = .F6.1,/, LQPC = .5X,'LIFETIME GRAIN MAIN 960
5 REQUIREMENT OF CATTLE ON FELD (KG/Y)',T106, = .F6.1,/, MAIN 961
85 FORMAT (' TIME = TIME (YEARS) AT WHICH MILK SAMPLE IS TAKEN',T106, MAIN 962
1, = .F5.1,/, TSPC = TIME (YEARS) BETWEEN GRAIN-FEEDING AND SLAUGHTER MAIN 963
2 (YEARS) FOR GRAIN-FED CATTLE',T106, = .F5.1,/, TSCC = TIME (YEARS) MAIN 964
3 (YEARS) BETWEEN GRAIN-FEEDING AND SLAUGHTER FOR OTHER CATTLE',T106, = MAIN 965
4, = .F5.1,/, TSCC = TIME (YEARS) BETWEEN GRAIN FEEDING AND SLAUGHTER MAIN 966
5 FOR MILK COWS',T106, = .F5.1,/, TSCF = TIME (DAYS) BETWEEN MAIN 967
6 STORING GRAIN AND FEEDING TO CATTLE',T106, = .F5.1,/, MAIN 968
86 FORMAT (/// 'CONVERSION FACTORS: ///' FVRYC = FRACTION OF DRY MATTER MAIN 969
1 IN FRESH EXPOSED VEGETABLES (KG DRY/KG WET)',T106, = .F11.4,/, MAIN 970
2 FVRYC = FRACTION OF DRY MATTER IN FRESH GRAINS (KG DRY/KG WET) MAIN 971
3',T106, = .F11.4,/, FVRLV = FRACTION OF DRY MATTER IN FRESH LEAFY MAIN 972
4 VEGETABLES',T106, = .F11.4,/, FVRPV = FRACTION OF DRY MATTER IN MAIN 973
5 FRESH PROTECTED VEGETABLES',T106, = .F11.4,/, MNC = MUSCLE MAIN 974
6 MASS OF CATTLE (KG)',T106, = .F11.4,/, MPC = MILK PRODUCTION OF MAIN 975
7 A MILK COW (KG/Y)',T106, = .F11.4,/, MAIN 976
87 FORMAT (' FRA = THE FRACTION OF HYDROGEN DERIVED FROM ATMOSPHERE MAIN 977
1 IN HYDROGEN',T106, = .F11.4,/, FVWLE = MASS FRACTION OF WATER IN MAIN 978
2 IN BEEF',T106, = .F11.4,/, FVWLV = MASS FRACTION OF WATER IN LEAFY MAIN 979
3 VEGETABLES',T106, = .F11.4,/, FVWVP = MASS FRACTION OF WATER IN MAIN 980
4 PROTECTED PRODUCE',T106, = .F11.4,/, FVWV = MASS FRACTION OF WATER IN MAIN 981
5 EXPOSED PRODUCE',T106, = .F11.4,/, FVWCH = MASS FRACTION OF WATER IN MAIN 982
6 OF WATER IN GRAINS FOR HUMAN CONSUMPTION',T106, = .F11.4,/, MAIN 983
88 FORMAT (' KGCAR = KG OF C/M**3 OF AIR',T106, = .F11.4,/, KVCLEMAIN 984
1 = MASS FRACTION OF CARBON IN LEAFY VEGETABLES',T106, = .F11.4,/, MAIN 985
2 KVCLEV = MASS FRACTION OF CARBON IN EXPOSED PRODUCE',T106, = .F11.4,/, MAIN 986
3 KVCLEPV = MASS FRACTION OF CARBON IN PROTECTED PRODUCE',T106, = .F11.4,/, MAIN 987
4 KVCLE = MASS FRACTION OF CARBON IN GRAIN FOR HUMAN MAIN 988
5 CONSUMPTION',T106, = .F11.4,/, KVCMLK = MASS FRACTION OF CARBON IN MILK',T106, = MAIN 989
6',T106, = .F11.4,/, KVCMBE = MASS FRACTION OF CARBON IN BEEF',T106, = MAIN 990
7',T106, = .F11.4,/, MAIN 991
89 FORMAT (/// 'RESUSPENSION PARAMETERS: ///', KLOAD = MASS MAIN 992
1 LOADING FACTOR (MICROGRAM/M**3)',T106, = .F10.3,/, VELD = MAIN 993
2 DEPOSITION VELOCITY OF RESUSPENDED MATERIAL (CM/S)',T106, = .F10.3,/, MAIN 994
3.3) MAIN 995
90 FORMAT (/// '1',5X,'TABLE OF GRID LOCATIONS FOR :',F0A4,///' D1MAIN 997
1ST. = .4X,'DIRECTION/5X,(M)',3X,*) MAIN 998
91 FORMAT (1X,*,16(A4,3X) 11X,*/19(*),15(*),11X,*) MAIN 999
92 FORMAT ('F8.1,2X,*) MAIN 1000
93 FORMAT ('O',F8.1,4X,16(1A,3X)) MAIN 1001
94 FORMAT (1X,*,16(1A,3X)) MAIN 1002
95 FORMAT ('1',4X,'SITE PARAMETERS FOR THE TOTAL ASSESSMENT AREA'///MAIN 1003
1, 'METEOROLOGICAL AND CLIMATOLOGICAL PARAMETERS: ///' PARAMETER, T6MAIN 1004
27, 'MINIMUM',4X,'LOC',4X,'MAXIMUM',4X,'LOC',4X,'WEIGHTED AVG.',4X, MAIN 1005
39(''),T67,2(7(''),4X,1(''),4X),13('')//) MAIN 1006
96 FORMAT (' NOTE: TOTAL PARAMETERS HAVE BEEN APPROXIMATED FROM A',MAIN 1007
1 DISCRETE NUMBER OF VALUES (ARCS) SKEWERED OVER THE TOTAL AREA') MAIN 1008
97 FORMAT (' ET = EVAPOTRANSPIRATION (MM/Y)',T64,2(1P13.6,1X,13,MAIN 1009
11X),2X,1P13.6) MAIN 1010
98 FORMAT (' IRR1 = IRRIGATION (MM/Y)',T64,2(1P13.6,1X,13,1X),2X,MAIN 1011
1P13.6) MAIN 1012
99 FORMAT (' PRECIP = PRECIPITATION (MM/Y)',T64,2(1P13.6,1X,13,1X),2X,MAIN 1013
1,1P13.6) MAIN 1014
100 FORMAT (' MIXWT = MORNING MIXING WEIGHT (M)',T64,2(1P13.6,1X,13,MAIN 1015

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142 FORMAT ('0','POINT #',I3,' OF INTEREST ',' HAS LONGITUDE =',F6.2,MAIN1109
12X,' AND LATITUDE =',F5.2,/, ' THE AGRICULTURAL DATA COMES FROM SITE',MAIN1110
2X ' CELL #',I4,' WHICH HAS LONGITUDE AND LATITUDE AT THE SOUTHEAST',MAIN1111
30X,MAIN1112
143 FORMAT ('0','THE CORRESPONDING WINDOW FROM RETABO-11 WITH DEPOSIT',MAIN1113
10X ' RATES AND',/, ' AIR CONCENTRATIONS HAS XMIN=',F6.2,3X,' XMAX=',F6.2,MAIN1114
22,3X,' YMIN=',F6.2,3X,' YMAX=',F6.2,/) MAIN1115
144 FORMAT (' ',MAIN1116
145 FORMAT ('0',I5X,' CELL #',I4,' HAS THE FOLLOWING CAUTION FLAG:',/MAIN1117
1) MAIN1118
146 FORMAT (5X,'CAUTION - THE CELL IS ON THE ATLANTIC COAST') MAIN1119
147 FORMAT (5X,'CAUTION - THE CELL IS ON THE MEXICAN BORDER') MAIN1120
148 FORMAT (5X,'CAUTION - THE CELL IS ON THE ATLANTIC COAST AND ON THE',MAIN1121
1 MEXICAN BORDER') MAIN1122
149 FORMAT (5X,'CAUTION - THE CELL HAS A LARGE INTERIOR BODY OF WATER',MAIN1123
1) MAIN1124
150 FORMAT (5X,'CAUTION - THE CELL IS ON THE ATLANTIC COAST AND HAS A',MAIN1125
1LARGE INTERIOR BODY OF WATER') MAIN1126
151 FORMAT (5X,'CAUTION - THE CELL IS ON THE MEXICAN BORDER AND HAS A',MAIN1127
1LARGE INTERIOR BODY OF WATER') MAIN1128
152 FORMAT (5X,'CAUTION - THE CELL IS ON THE PACIFIC COAST') MAIN1129
153 FORMAT (5X,'CAUTION - THE CELL IS ON THE PACIFIC COAST AND HAS A',MAIN1130
1LARGE INTERIOR BODY OF WATER') MAIN1131
154 FORMAT (5X,'CAUTION - THE CELL IS ON THE CANADIAN BORDER') MAIN1132
155 FORMAT (5X,'CAUTION - THE CELL IS ON THE CANADIAN BORDER AND HAS A',MAIN1133
1LARGE INTERIOR BODY OF WATER') MAIN1134
156 FORMAT (5X,'CAUTION - THE CELL IS ON THE ATLANTIC COAST AND ON THE',MAIN1135
1 CANADIAN BORDER AND HAS A LARGE INTERIOR BODY OF WATER') MAIN1136
157 FORMAT (5X,'CAUTION - THE CELL IS ON THE PACIFIC COAST AND ON THE',MAIN1137
1 CANADIAN BORDER') MAIN1138
158 FORMAT (5X,'CAUTION - THE CELL HAS LARGE AMOUNTS OF DESERT OR BARREN',MAIN1139
1 LAND') MAIN1140
159 FORMAT (5X,'CAUTION - THE CELL HAS A LARGE INTERIOR BODY OF WATER',MAIN1141
1 AND HAS LARGE AMOUNTS OF DESERT OR BARREN LAND') MAIN1142
160 FORMAT (' ',5X,I2,3X,I4,5X,6(4X,1PG10.3)) MAIN1143
161 FORMAT ('0','LOCATION #',I3,' IS DEFINED BY:',/, '0',' XMAX = EAST',MAIN1144
10X ' MOST LONGITUDE =',F6.1,/, ' XMIN = WESTERMOST LONGITUDE =',F6.1,MAIN1145
21,/, ' YMAX = NORTHERMOST LATITUDE =',F6.1,/, ' YMIN = SOUTHERMOST',MAIN1146
31 LATITUDE =',F6.1) MAIN1147
162 FORMAT ('0','THE FOLLOWING SITE DATA IS USED FOR LOCATION #',I3,/,MAIN1148
1) MAIN1149
163 FORMAT ('0','ET = EVAPOTRANSPIRATION (MM/Y)',30X,' =',IPE13.6,MAIN1150
1/ ' TIRI = IRRIGATION (MM/Y)',30X,' =',E13.6,/, ' PRECIP = PRECIPITATION',151
21TATION (MM/Y)',35X,' =',E13.6,/, ' YEV = YIELD OF EXPOSED VEGETATION',152
30LES (KG(FRESH)/M**2)',11X,' =',E13.6,/, ' AYEV = AREAL YIELD OF',MAIN1153
40AY FEED (KG(DRY)/YR/M**2)',14X,' =',E13.6,/, ' YLV = YIELD OF',MAIN1154
50EAFY VEGETABLES (KG(FRESH)/M**2)',13X,' =',E13.6,/, ' YSF = YIELD',MAIN1155
60 OF (CORN AND SORGHUM) SILAGE FEED (KG(DRY)/M**2) =',E13.6) MAIN1156
164 FORMAT (' ',AREAP = TOTAL AREA OF PASTURE (M**2)',27X,' =',IPE13.6,MAIN1157
1.6,/, ' NUMC = CATTLE AND CALF INVENTORY',30X,' =',E13.6,/, ' NUMH',MAIN1158
2C = NUMBER OF BEEF CATTLE',34X,' =',E13.6,/, ' SALFC = NUMBER OF',MAIN1159
3CATTLE ON FEED SOLD (HEAD/YR)',16X,' =',E13.6,/, ' NUMHC = NUMBER',MAIN1160
40F MILK COWS (HEAD)',29X,' =',E13.6,/, ' NUMSH = NUMBER OF SHEEP',MAIN1161
5HEAD',33X,' =',E13.6,/, ' PCF = PRODUCTION OF GRAIN FOR FEED (KG',MAIN1162
60)',22X,' =',E13.6,/, ' PFV = PRODUCTION OF HAY FEED (KG)',28X,' MAIN1163
7 =',E13.6,/, ' PSF = PRODUCTION OF (CORN AND SORGHUM) SILAGE',MAIN1164
80 (KG)',6X,' =',E13.6) MAIN1165
165 FORMAT (' ',HUMID = AVERAGE ANNUAL ABSOLUTE HUMIDITY (C/M**3)',14X,MAIN1166
1 =',E13.6,/, ' AREAT = TOTAL AREA OF THE CELL (M**2)',26X,' =',E13.6,MAIN1167
23.6,/, ' POP = HUMAN POPULATION OF THE CELL (NUMBER)',18X,' =',E13.6,MAIN1168
313.6,/, ' FRUV = FRACTION OF 1970 POPULATION CLASSIFIED AS RURAL',MAIN1169
4 = FARM =',E13.6,/, ' FRUVM = FRACTION OF 1970 POPULATION CLASSIFIED',MAIN1170
5AS RURAL FARM',6X,' =',E13.6,/, ' FURAN = FRACTION OF 1970 POPULATION',MAIN1171
610N CLASSIFIED AS URBAN',11X,' =',E13.6,/, ' PLV = PRODUCTION OF',MAIN1172
7AFY VEGETABLES (KG)',20X,' =',E13.6,/, ' PFV = PRODUCTION OF',MAIN1173
80SED VEGETABLES (KG)',18X,' =',E13.6) MAIN1174
166 FORMAT (' ',PPV = PRODUCTION OF PROTECTED VEGETABLES (KG)',16X,' =',MAIN1175
1 =',IPE13.6,/, ' PCH = PRODUCTION OF GRAINS FOR HUMAN CONSUMPTION',MAIN1176
2 (KG)',5X,' =',E13.6,/, ' DOMLF = DOMINANT LAND FEATURE',34X,' =',MAIN1177
30PF13.0,/, ' MHXHT = MORNING MIXING HEIGHT (M)',30X,' =',IPE13.6,MAIN1178
4 = AMXHT = AFTERNOON MIXING HEIGHT (M)',28X,' =',E13.6,/, ' YPV =',MAIN1179
5 = YIELD OF PROTECTED VEGETABLES (KG(FRESH)/M**2)',9X,' =',E13.6,MAIN1180
6 = YCH = YIELD OF GRAINS FOR HUMANS (KG(FRESH)/M**2)',12X,' =',MAIN1181
7E13.6,/, ' YCF = YIELD OF GRAIN FOR LIVESTOCK FEED (KG(DRY)/M**2)',MAIN1182
8)',7X,' =',E13.6,/, ' PFDAYS = NUMBER OF FROST-FREE DAYS IN A YEAR',MAIN1183
9,14X,' =',E13.6/) MAIN1184
167 FORMAT ('0','THIS SITE DATA CELL HAS THE SAME CHARACTERISTICS AS',MAIN1185
1 THE PREVIOUS ONE') MAIN1186
168 FORMAT ('0','FOR LOCATION #',I3,' THE FOLLOWING LEACHING CONSTANT',MAIN1187
15 HAVE BEEN CALCULATED:',/) MAIN1188
169 FORMAT ('0',5X,' IN',3X,' NUCLIDE',14X,' LAMIS(IN)',5X,' LANS(IN)',6X,MAIN1189
1 LAMES(IN),/) MAIN1190
170 FORMAT ('0','FOR LOCATION #',I3,' THE ADDITIONAL SITE-SPECIFIC PA',MAIN1191
1RAMETERS HAVE BEEN CALCULATED:',/, '0',' ELV = INTERCEPTION FRACT',MAIN1192
21ON FOR LEAFY VEG.',4X,' =',E13.6,/, ' REV = INTERCEPTION FRACT',MAIN1193
3ACTION FOR EXPOSED VEG. =',G10.3,/, ' RNF = INTERCEPTION FRACT',MAIN1194
41ON FOR HAY FEEDS =',E13.6,/, ' RSF = INTERCEPTION FRACT',MAIN1195
5ON FOR SILAGE FEEDS =',G10.3,/, ' YPG = EST. YIELD OF PAST.',MAIN1196
6ASS(KG(DRY)/M**2) =',G10.3,/, ' RFG = INTERCEPTION FRACT',MAIN1197
7 PASTURE GRASS =',G10.3,/, ' NUMDC = NUMBER OF OTHER CATTLE',MAIN1198
8 =',G10.3) MAIN1199

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[illegible]

C	CONISF	- CONCENTRATION OF NUCLIDE I IN THE INTERIOR OF (CORN	ACRO	61
C		AND SORGHUM) SILAGE FEEDS (FROM ROOT UPTAKE) AT LOCATION	ACRO	62
C		(X,Y) (UNIT/EC)	ACRO	63
C	CONSLV	- CONCENTRATION OF NUCLIDE I IN LEAFY VEGETABLES (SURFACE	ACRO	64
C		AND INTERIOR CONCENTRATIONS COMBINED) AT LOCATION (X,Y)	ACRO	65
C		(UNIT/EC)	ACRO	66
C	CONSPV	- CONCENTRATION OF NUCLIDE I IN VEGETABLES PROTECTED	ACRO	67
C		FROM ATMOSPHERICALLY-DEPOSITING NUCLIDES (FROM ROOT	ACRO	68
C		UPTAKE) AT LOCATION (X,Y) (UNIT/EC)	ACRO	69
C	CONSPV	- CONCENTRATION OF NUCLIDE I ON THE SURFACE OF EXPOSED	ACRO	70
C		VEGETABLES (FROM DIRECT DEPOSITION, AT LOCATION (X,Y)	ACRO	71
C		(UNIT/EC)	ACRO	72
C	CONSV	- CONCENTRATION OF NUCLIDE I IN (CORN AND SORGHUM)	ACRO	73
C		SILAGE FEEDS (SURFACE AND INTERIOR CONCENTRATIONS	ACRO	74
C		COMBINED) AT LOCATION (X,Y) (UNIT/EC)	ACRO	75
C	CONSHF	- CONCENTRATION OF NUCLIDE I ON THE SURFACE OF HAY	ACRO	76
C		FEEDS (FROM DIRECT DEPOSITION) AT LOCATION (X,Y)	ACRO	77
C		(UNIT/EC)	ACRO	78
C	CONSLV	- CONCENTRATION OF NUCLIDE I ON THE SURFACE OF LEAFY	ACRO	79
C		VEGETABLES FROM DIRECT DEPOSITION (UNIT/EC)	ACRO	80
C	CONSHF	- CONCENTRATION OF NUCLIDE I ON THE SURFACE OF (CORN	ACRO	81
C		AND SORGHUM) SILAGE FEEDS FROM DIRECT DEPOSITION	ACRO	82
C		(UNIT/EC)	ACRO	83
C	FORTV	- FRACTION OF DRY MATTER IN FRESH EXPOSED VEGETABLES	ACRO	84
C		(KG DRY/EC WET)	ACRO	85
C	FORTC	- FRACTION OF DRY MATTER IN FRESH GRAINS (KG DRY/EC WET)	ACRO	86
C	FORTLV	- FRACTION OF DRY MATTER IN FRESH LEAFY VEGETABLES	ACRO	87
C		(KG DRY/EC WET)	ACRO	88
C	FORTPV	- FRACTION OF DRY MATTER IN FRESH PROTECTED VEGETABLES	ACRO	89
C		(KG DRY/EC WET)	ACRO	90
C	INTV	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN EXPOSED	ACRO	91
C		VEGETABLES (UNIT/EC*Y)	ACRO	92
C	INTC	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN GRAINS	ACRO	93
C		(UNIT/EC*Y)	ACRO	94
C	INTV	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN HAY FEEDS	ACRO	95
C		AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	96
C	INTLV	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN LEAFY	ACRO	97
C		VEGETABLES AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	98
C	INTPC	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN PASTURE	ACRO	99
C		GRASS AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	100
C	INTPV	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN PROTECTED	ACRO	101
C		VEGETABLES AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	102
C	INTSV	- INTERIOR ACCUMULATION RATE OF NUCLIDE I IN (CORN AND	ACRO	103
C		SORGHUM) SILAGE FEEDS AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	104
C	LAMB	- WEATHERING REMOVAL CONSTANT FOR ALL ATMOSPHERICALLY-	ACRO	105
C		DEPOSITING NUCLIDES (S-1)	ACRO	106
C	NGRZ	- NUMBER OF SUCCESSIVE GRAZINGS OF PASTURE BY CATTLE PER YEAR	ACRO	107
C	HRF	- NUMBER OF HARVESTS OF HAY FEED PER YEAR	ACRO	108
C	REV	- INTERCEPTION FRACTION FOR EXPOSED VEGETABLES	ACRO	109
C	RFV	- INTERCEPTION FRACTION FOR HAY FEEDS	ACRO	110
C	RLV	- INTERCEPTION FRACTION FOR LEAFY VEGETABLES	ACRO	111
C	RSV	- INTERCEPTION FRACTION FOR (CORN AND SORGHUM) SILAGE	ACRO	112
C		FEEDS	ACRO	113
C	SURV	- SURFACE ACCUMULATION RATE OF NUCLIDE I ON EXPOSED	ACRO	114
C		VEGETABLES AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	115
C	SURFV	- SURFACE ACCUMULATION RATE OF NUCLIDE I ON HAY FEEDS	ACRO	116
C		AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	117
C	SURLV	- SURFACE ACCUMULATION RATE OF NUCLIDE I ON LEAFY	ACRO	118
C		VEGETABLES AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	119
C	SURSV	- SURFACE ACCUMULATION RATE OF NUCLIDE I ON (CORN AND	ACRO	120
C		SORGHUM) SILAGE FEEDS AT LOCATION (X,Y) (UNIT/EC*Y)	ACRO	121
C	TGRZ	- TIME BETWEEN SUCCESSIVE GRAZINGS OF THE SAME AREA	ACRO	122
C		OF PASTURE BY A GRAZING HERD (D)	ACRO	123
C	TRV	- TIME BETWEEN GERMINATION AND HARVEST OF EXPOSED	ACRO	124
C		VEGETABLES (D)	ACRO	125
C	TRC	- TIME BETWEEN GERMINATION AND HARVEST OF GRAINS (D)	ACRO	126
C	TRFV	- TIME BETWEEN SUCCESSIVE HARVESTS OF HAY FEEDS (D)	ACRO	127
C	TRLV	- TIME BETWEEN GERMINATION AND HARVEST OF LEAFY	ACRO	128
C		VEGETABLES (D)	ACRO	129
C	TRPV	- TIME BETWEEN GERMINATION AND HARVEST OF	ACRO	130
C		PROTECTED VEGETABLES (D)	ACRO	131
C	TRSV	- TIME BETWEEN GERMINATION AND HARVEST OF (CORN AND	ACRO	132
C		SORGHUM) SILAGE FEEDS (D)	ACRO	133
C	UPTKRI	- CONCENTRATION OF NUCLIDE I IN DRY REPRODUCTIVE PLANT	ACRO	134
C		PARTS AT MATURITY FROM ROOT UPTAKE OF NUCLIDE I IN	ACRO	135
C		IRRIGATED SOIL AT LOCATION (X,Y) IF RADIOLOGICAL DECAY	ACRO	136
C		IS NOT CONSIDERED (UNIT/EC)	ACRO	137
C	UPTKRS	- CONCENTRATION OF NUCLIDE I IN DRY REPRODUCTIVE PLANT	ACRO	138
C		PARTS AT MATURITY FROM ROOT UPTAKE OF NUCLIDE I IN NON-	ACRO	139
C		IRRIGATED SOIL AT LOCATION (X,Y) IF RADIOLOGICAL DECAY	ACRO	140
C		IS NOT CONSIDERED (UNIT/EC)	ACRO	141
C	UPTKVI	- CONCENTRATION OF NUCLIDE I IN DRY VEGETATIVE PLANT	ACRO	142
C		PARTS AT MATURITY FROM ROOT UPTAKE OF NUCLIDE I IN	ACRO	143
C		IRRIGATED SOIL AT LOCATION (X,Y) IF RADIOLOGICAL	ACRO	144
C		DECAY IS NOT CONSIDERED (UNIT/EC)	ACRO	145
C	UPTKVS	- CONCENTRATION OF NUCLIDE I IN DRY VEGETATIVE PLANT PARTS	ACRO	146
C		AT MATURITY FROM ROOT UPTAKE OF NUCLIDE I IN NON-	ACRO	147
C		IRRIGATED SOIL AT LOCATION (X,Y) IF RADIOLOGICAL DECAY	ACRO	148
C		IS NOT CONSIDERED (UNIT/EC)	ACRO	149
C	YEV	- YIELD OF EXPOSED VEGETABLES IN FRESH WEIGHT AT	ACRO	150
C		LOCATION (X,Y) (KG/M2)	ACRO	151
C	YHF	- YIELD OF HAY FEEDS IN DRY WEIGHT AT LOCATION (X,Y)	ACRO	152
C		(KG/M2)	ACRO	153

C	YLV	= YIELD OF LEAFY VEGETABLES IN FRESH WEIGHT AT LOCATION (X,Y) (KG/M2)	ACRO 154	
C	YCV	= YIELD OF (CORES AND BUNCHES) SILAGE FEEDS IN DRY WEIGHT AT LOCATION (X,Y) (KG/M2)	ACRO 155	
C	YCV	= YIELD OF (CORES AND BUNCHES) SILAGE FEEDS IN DRY WEIGHT AT LOCATION (X,Y) (KG/M2)	ACRO 156	
C	IF (.NOT.FIRST) GO TO 1		ACRO 157	
	FIRSTV=4.7E-2		ACRO 158	Initialize selected agricultural constants.
	FIRSTYV=1.25E-1		ACRO 159	
	FIRSTPV=2.22E-1		ACRO 160	
	FIRSTC=8.88E-1		ACRO 161	
	TLV=1.0E+2		ACRO 162	
	TVV=1.0E+2		ACRO 163	
	TPV=1.0E+2		ACRO 164	
	TVC=1.1E+2		ACRO 165	
	TVV=1.5E+2		ACRO 166	
	TPV=6.0E+1		ACRO 167	
	TCV=3.0E+1		ACRO 168	
	IF (INL.GT.0) READ (INL,NAME3)		ACRO 169	Can override ACRO parameters with NAMELIST READ (NAME3).
	FIRST=.FALSE.		ACRO 170	
C	*****		ACRO 171	
C	CALCULATE YIELD OF HAY FEEDS		ACRO 172	
1	HMF=0		ACRO 173	Calculate yield of hay feeds.
	YHF=0.0		ACRO 174	
	IF (ATVF.EQ.0.0) GO TO 3		ACRO 175	
	HMF=1/((ATVF/TVV)+.5)		ACRO 176	
	IF (HMF.EQ.0) HMF=1		ACRO 177	
2	YHF=ATVF/TVV		ACRO 178	
	IF (YHF.EQ.0.0.OR.YHF.GT.0.10) GO TO 3		ACRO 179	
	HMF=HMF-1		ACRO 180	
	IF (HMF.EQ.0) -3 TO 3		ACRO 181	
	GO TO 2		ACRO 182	
C	*****		ACRO 183	
C	DETERMINE INTERCEPTION FRACTIONS		ACRO 184	
3	IF (REV.EQ.-1.0) REV=1.0E-5-EXP(-2.88V-0*TVV)		ACRO 185	Calculate interception fractions for plant surfaces.
	IF (REV.EQ.-1.0) REV=1.0E-5-EXP(-2.6E-2*TVV)		ACRO 186	
	IF (REV.EQ.-1.0) REV=1.0E-5-EXP(-8.44E-2*TVV)		ACRO 187	
	IF (REV.EQ.-1.0) REV=1.0E-5-EXP(-7.69E-1*TVV)		ACRO 188	
C	*****		ACRO 189	
	IF (IWRITE.EQ.0.OR.IWRITE.EQ.2) GO TO 4		ACRO 190	
C	*****		ACRO 191	
C	IWRITE = 1 AND COMPLETE WRITTEN OUTPUT IS GIVEN		ACRO 192	
	WRITE (IOUT,18)		ACRO 193	
	WRITE (IOUT,29) HMF		ACRO 194	
	WRITE (IOUT,30)		ACRO 195	
C	*****		ACRO 196	
4	RATIO1=0.0		ACRO 197	
	IF (TLV.NE.0.0) RATIO1=REV/YLV		ACRO 198	
	RATIO2=0.0		ACRO 199	
	IF (TVV.NE.0.0) RATIO2=REV/TVV		ACRO 200	
	RATIO3=0.0		ACRO 201	
	IF (TVV.NE.0.0) RATIO3=REV/TVV		ACRO 202	
	RATIO4=0.0		ACRO 203	
	IF (TVV.NE.0.0) RATIO4=REV/TVV		ACRO 204	
	DO 7 IN=1,NPACK		ACRO 205	
	UPTRV(IN)=CONV(IN)*BV(IN)		ACRO 206	
C	IFLAG = 1 MEANS CONIS = 0		ACRO 207	
	IF (IFLAG.EQ.1) GO TO 5		ACRO 208	
	UPTRV(IN)=CONV(IN)*BV(IN)		ACRO 209	
	GO TO 6		ACRO 210	
5	UPTRV(IN)=UPTRV(IN)		ACRO 211	
6	UPTRV(IN)=CONV(IN)*BV(IN)		ACRO 212	Determine input rates into plant compartments.
	UPTRV(IN)=CONV(IN)*BV(IN)		ACRO 213	
	INTLV(IN)=UPTRV(IN)*FMYLV/((TVV*SECDAY)		ACRO 214	
	CONILV(IN)=INTLV(IN)*TLV		ACRO 215	
	IF (TLV.NE.0.0) CONILV(IN)=CONILV(IN)/TLV		ACRO 216	
7	CONTINUE		ACRO 217	
C	*****		ACRO 218	
C	CALCULATE CONCENTRATIONS IN THE INTERIOR OF PLANTS		ACRO 219	
	TIME=TIME*SECDAY		ACRO 220	Calculate concentrations for the interior of plants.
	IDIA=1		ACRO 221	
	CALL DECAY (NPACK,IND,CONILV,LAMB,CRATE,VELD,IC,JC,CYAK)		ACRO 222	
	DO 8 IN=1,NPACK		ACRO 223	
	INTSV(IN)=UPTRV(IN)/((TRV*SECDAY)		ACRO 224	
	CONISV(IN)=INTSV(IN)*TVV		ACRO 225	
	IF (TVV.NE.0.0) CONISV(IN)=CONISV(IN)/TVV		ACRO 226	
8	CONTINUE		ACRO 227	
	TIME=TIME*SECDAY		ACRO 228	
	CALL DECAY (NPACK,IND,CONISV,LAMB,CRATE,VELD,IC,JC,CYAK)		ACRO 229	
	DO 9 IN=1,NPACK		ACRO 230	
	INTSV(IN)=UPTRV(IN)/((TRV*SECDAY)		ACRO 231	
	CONISV(IN)=INTSV(IN)*TVV		ACRO 232	
	IF (TVV.NE.0.0) CONISV(IN)=CONISV(IN)/TVV		ACRO 233	
9	CONTINUE		ACRO 234	
	TIME=TIME*SECDAY		ACRO 235	
	CALL DECAY (NPACK,IND,CONISV,LAMB,CRATE,VELD,IC,JC,CYAK)		ACRO 236	
	DO 10 IN=1,NPACK		ACRO 237	
	INTSV(IN)=UPTRV(IN)/((TRV*SECDAY)		ACRO 238	
	CONISV(IN)=INTSV(IN)*TVV		ACRO 239	
10	CONTINUE		ACRO 240	
	DO 11 IN=1,NPACK		ACRO 241	
	INTSV(IN)=UPTRV(IN)/((TRV*SECDAY)		ACRO 242	
	CONISV(IN)=INTSV(IN)*TVV		ACRO 243	
	IF (TVV.NE.0.0) CONISV(IN)=CONISV(IN)/TVV		ACRO 244	
			ACRO 245	

```

11 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,CONVEY,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 12 IN=1,NPAK
     INTTPV(IN)=INTPRL(IN)*TIME/TPV/(TIME*SECDAY)
     COMFPV(IN)=INTTPV(IN)*TPV
     IF (TPV.EQ.0.0) COMFPV(IN)=COMFPV(IN)/TPV
12 CONTINUE
C *****
C   CALCULATE CONCENTRATIONS IN PLANTS NOT EXPOSED TO SURFACE DEPOSITION
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,CONFPV,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 13 IN=1,NPAK
     INTTC(IN)=INTPLS(IN)*TIME/(TIME*SECDAY)
     COMCH(IN)=INTTC(IN)*TCH
     IF (TCH.EQ.0.0) COMCH(IN)=COMCH(IN)/TCH
13 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,COMCH,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 14 IN=1,NPAK
     COMCF(IN)=COMCH(IN)/VDRTC
14 CONTINUE
C *****
C   CALCULATE CONCENTRATIONS ON SURFACE OF PLANTS
   DO 15 IN=1,NPAK
     SURLV(IN)=DEPR(IN)*RATIO1
     COMSLV(IN)=SURLV(IN)
15 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,COMSLV,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 16 IN=1,NPAK
     SURLEV(IN)=DEPR(IN)*RATIO2
     COMSEV(IN)=SURLEV(IN)
16 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,COMSEV,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 17 IN=1,NPAK
     SURSF(IN)=DEPR(IN)*RATIO4
     COMSSF(IN)=SURSF(IN)
17 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,COMSSF,LAMB,CRATE,VELD,IC,JC,CPAK)
   DO 18 IN=1,NPAK
     SURSF(IN)=DEPR(IN)*RATIO3
     COMSNF(IN)=SURSF(IN)
18 CONTINUE
   TIME=TIME*SECDAY
   CALL DECAT1 (SPACK,IND,COMSNF,LAMB,CRATE,VELD,IC,JC,CPAK)
C *****
C *****
C   DETERMINE TOTAL CONCENTRATIONS
   DO 19 IN=1,NPAK
     COMTLV(IN)=COMSLV(IN)+COMSEV(IN)
     COMTLV(IN)=COMTLV(IN)+COMSLV(IN)
     COMSF(IN)=COMISF(IN)+COMSSF(IN)
     COMSF(IN)=COMSF(IN)+COMSNF(IN)
19 CONTINUE
C *****
C *****
   IF (IWRITE.EQ.1) GO TO 27
C *****
C   IWRITE = 1 AND COMPLETE WRITTEN OUTPUT GIVEN
   WRITE (IOUT,31) UNIT
   WRITE (IOUT,32)
   DO 20 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMTLV(IN),COMSLV(IN),COMSEV(IN)
20 CONTINUE
   WRITE (IOUT,33) UNIT
   WRITE (IOUT,32)
   DO 21 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMISF(IN),COMSEV(IN),COMSF(IN)
21 CONTINUE
   WRITE (IOUT,35) UNIT
   DO 22 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMFPV(IN)
22 CONTINUE
   WRITE (IOUT,36) UNIT
   DO 23 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMCH(IN)
23 CONTINUE
   WRITE (IOUT,37) UNIT
   WRITE (IOUT,32)
   DO 24 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMISF(IN),COMSSF(IN),COMSF(IN)
24 CONTINUE
   WRITE (IOUT,38) UNIT
   WRITE (IOUT,32)
   DO 25 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMINF(IN),COMSNF(IN),COMNF(IN)
25 CONTINUE
   WRITE (IOUT,39) UNIT
   DO 26 IN=1,NPAK
     WRITE (IOUT,34) IN,SYN(IN),COMCF(IN)
26 CONTINUE

```

Calculate concentrations in plants
not exposed to direct deposition.

Calculate concentrations on the surface of plants.

Sum to get total plant concentrations.

Initialize SITE parameters.

```

PCTTOT=0.0
PCTT=0.0
PLV=0.0
PLV=0.0
PPV=0.0
PPV=0.0
PCB=0.0
DOBLE=10000.
MOMENT=0.0
AMULET=0.0
YPT=0.0
YCB=0.0
YCT=0.0
FYDAYS=0.0
DO 2 IL=1.7
  FWT(IL)=0
  DE(IL)=0
  POPPY=0.0
  POPPB=0.0
  POPPB=0.0
  PRUPY=0.0
  PRUPB=0.0
  FURB=0.0
  IGOOD=0
  WGOOD=0
  KNIFED=0
  RATIO=0.0
  DO 3 IJ=1.100
    NUM(IJ)=0
    ICSAV(IJ)=0
  CONTINUE
3
C *****
  IF (ISAVE.NJ.1) WRITE (7,27) FREF,YREF
  IF (IPTOGR.NJ.2) GO TO 4
C *****
C TREAT ARC AS THIN SECTOR
  R1=R1-100.0
  IF (R1.LT.0.0) R1=0.0
  R2=R2+100.0
C *****
4 DELTNE=ABS(TH1-TH2)
  IF (DELTNE.GT.1.0) GO TO 5
  GO TO 6
5 DELTNE=.3926991E+0
  THN=DELTNE/2.0
  TH=0.0
  GO TO 7
6 TH=AMV1(TH1,TH2)
  THN=(TH1+TH2)/2.0
7 DELTAR=R2-R1
C *****
C DEFINE 5 POINTS THAT ENCOMPASS RING SEGMENT (CHECK POINTS)
  PT1X=YREF-R1*COS(TH1)*COS(YREF/RADIAN)/AMPD
  PT2X=YREF-R2*COS(TH1)*COS(YREF/RADIAN)/AMPD
  PT3X=YREF-R2*COS(THN)*COS(YREF/RADIAN)/AMPD
  PT4X=YREF-R2*COS(TH2)*COS(YREF/RADIAN)/AMPD
  PT5X=YREF-R1*COS(TH2)*COS(YREF/RADIAN)/AMPD
  PT1Y=YREF+R1*SIN(TH1)/AMPD
  PT2Y=YREF+R2*SIN(TH1)/AMPD
  PT3Y=YREF+R2*SIN(THN)/AMPD
  PT4Y=YREF+R2*SIN(TH2)/AMPD
  PT5Y=YREF+R1*SIN(TH2)/AMPD
C *****
C IF (ISAVE.LT.1) GO TO 8
  WRITE (7,27) PT1X,PT1Y
  WRITE (7,27) PT2X,PT2Y
  WRITE (7,27) PT3X,PT3Y
  WRITE (7,27) PT4X,PT4Y
  WRITE (7,27) PT5X,PT5Y
C *****
C DETERMINE IN WHICH SITE CELLS THE CHECK POINTS LIE
8 INDEX(1)=INDEX(PT1X)+116*(INDY(PT1Y)-1)
  INDEX(2)=INDEX(PT2X)+116*(INDY(PT2Y)-1)
  INDEX(3)=INDEX(PT3X)+116*(INDY(PT3Y)-1)
  INDEX(4)=INDEX(PT4X)+116*(INDY(PT4Y)-1)
  INDEX(5)=INDEX(PT5X)+116*(INDY(PT5Y)-1)
C *****
C *****
C *****
C DETERMINE IF ALL CHECK POINTS ARE IN THE SAME SITE CELL
  IMORE=0
  DO 9 IP=2,NPOINT
    IF (INDEX(1).NE.INDEX(IP)) IMORE=1
  CONTINUE
9 *****
C IF (IMORE.NE.1) GO TO 17
  NK=1
  INK=1
C *****
C MORE THAN 1 SITE CELL SHARES AREA WITH THE AREA OF INTEREST
C GENERATE RANDOM POINTS WITHIN AREA AND USE FOR WEIGHTING

```

CIRC 54
 CIRC 55
 CIRC 56
 CIRC 57
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 CIRC 141
 CIRC 142
 CIRC 143
 CIRC 144

IPTOGR = 1.

Set the 5 check points that define the sector segment.

If ISAVE does not equal 0, save the locations of 5 check points.

Calculate the index numbers for the 5 check points.

IMORE = 0 if the 5 check points lie within the same SITE grid cell.

```

DO 10 IP=IBEGIN,100                                CIRC 145
TRN=TRN+PLTRN(0)*DELTA                               CIRC 146
ARR=PI+PLTRN(0)*DELTA                               CIRC 147
PTX=TRN+ARR*COS(THR)/(AMPD+COS(THR)/RADIANS)         CIRC 148
PTY=TRN+ARR*SIN(THR)/(AMPD+COS(THR)/RADIANS)         CIRC 149
IF (ISAVE.EQ.1) WRITE (7,27) PTX,PTY                 CIRC 150
INDEX(IP)=INDEX(PTX)+116*(IFDY(PTY)-1)                CIRC 151
CONTINUE                                              CIRC 152
***.*****CIRC 153
C*****CIRC 154
C*****CIRC 155
C SORT SITE DATA KEYS AND DETERMINE LIST OF UNIQUE KEYS CIRC 156
DO 11 IL=1,100                                       CIRC 157
DO 11 IP=1,99                                       CIRC 158
IF (INDEX(IP).LT.INDEX(IP+1)) GO TO 11              CIRC 159
ITEM=INDEX(IP)                                       CIRC 160
INDEX(IP)=INDEX(IP+1)                               CIRC 161
INDEX(IP+1)=ITEM                                     CIRC 162
CONTINUE                                             CIRC 163
11 INDS=INDEX(1)                                     CIRC 164
DO 13 IP=1,100                                       CIRC 165
IF (INDS.NE.INDEX(IP)) GO TO 12                     CIRC 166
NUM(NK)=NUM(NK)+1                                    CIRC 167
GO TO 13                                             CIRC 168
12 NK=NK+1                                           CIRC 169
NUM(NK)=NUM(NK)+1                                    CIRC 170
INDS=INDEX(IP)                                       CIRC 171
CONTINUE                                             CIRC 172
C*****CIRC 173
C THERE ARE NK UNIQUE SITE CELLS IN THE AREA IN QUESTION CIRC 174
IF (INWRITE.NE.2) WRITE (10UT,28) NK                CIRC 175
IF (INWRITE.NE.2) WRITE (10UT,29) INDEX(1),NUM(1)   CIRC 176
IF (NK.EQ.1) GO TO 18                               CIRC 177
IF (INWRITE.EQ.2) GO TO 15                           CIRC 178
DO 14 IC=2,NK                                       CIRC 179
INK=INK+NUM(IC-1)                                   CIRC 180
WRITE (10UT,29) INDEX(INK),NUM(IC)                  CIRC 181
14 INK=0                                             CIRC 182
C*****CIRC 183
C DETERMINE WHICH SITE CELLS HAVE LAND AREA ASSOCIATED WITH THEM CIRC 184
INK=1                                                CIRC 185
DO 16 NCELL=1,NK                                    CIRC 186
IF (NCELL.NE.1) INK=INK+NUM(NCELL-1)               CIRC 187
IND=INDEX(INK)                                       CIRC 188
IF (IND.GT.5800.OR.IND.LE.0) GO TO 16               CIRC 189
READ(INS'IND)LONG,LAT,DATA                          CIRC 190
IF (DATA(18).LT.1.0) GO TO 16                       CIRC 191
IGOOD=IGOOD+1                                       CIRC 192
INDS(IGOOD)=IND                                     CIRC 193
NUMS(IGOOD)=NUM(NCELL)                              CIRC 194
IF (DATA(1).GT.0.99) ICSAV(IGOOD)=IFIX(DATA(1)+.1) CIRC 195
NGOOD=NGOOD+NUMS(IGOOD)                            CIRC 196
CONTINUE                                             CIRC 197
IF (IGOOD.EQ.0) RETURN                              CIRC 198
C*****CIRC 199
C GO TO 18                                           CIRC 200
C*****CIRC 201
C THE AREA OF INTEREST IS WITHIN 1 SITE CELL        CIRC 202
17 NGOOD=1                                           CIRC 203
IGOOD=1                                              CIRC 204
INDS(1)=INDEX(1)                                    CIRC 205
NUMS(1)=1                                           CIRC 206
IND=INDS(1)                                         CIRC 207
IF (IND.GT.5800.OR.IND.LE.0) RETURN                 CIRC 208
READ(INS'IND)LONG,LAT,DATA                          CIRC 209
IF (DATA(1).GT.0.99) ICSAV(IGOOD)=IFIX(DATA(1)+.1) CIRC 210
IF (DATA(18).LT.1.0) WRITE (10UT,30) INK           CIRC 211
IF (DATA(18).LT.1.0) RETURN                         CIRC 212
C*****CIRC 213
C IF (INWRITE.NE.2) WRITE (10UT,31) IGOOD          CIRC 214
C*****CIRC 215
C PROCEED THROUGH THE LIST OF GOOD CELLS TO DETERMINE AVERAGE CIRC 216
C SITE PARAMETERS                                   CIRC 217
DO 22 NCELL=1,IGOOD                                 CIRC 218
WEIGHT=FLOAT(NUMS(NCELL))/FLOAT(NGOOD)             CIRC 219
IND=INDS(NCELL)                                     CIRC 220
IF (INWRITE.NE.2) WRITE (10UT,32) IND,WEIGHT,ICSAV(NCELL) CIRC 221
READ(INS'IND)LONG,LAT,DATA                          CIRC 222
DO 19 IC=1,33                                       CIRC 223
IF (IC.EQ.18.OR.IC.EQ.27) GO TO 19                 CIRC 224
IF (IC.GE.20.AND.IC.LE.22) GO TO 19                CIRC 225
DATA(IC)=DATA(IC)*WEIGHT                           CIRC 226
CONTINUE                                             CIRC 227
IF (LONG.EQ.0.AND.LAT.EQ.0) GO TO 25               CIRC 228
C*****CIRC 229
C LATN=LAT+.5                                       CIRC 230
TAREA IS THE AREA OF RECTANGULAR GRID OF SPHERICAL SURFACE. CIRC 231
SINE=SIN(LATN/RADIANS)-SIN(LAT/RADIANS)           CIRC 232
TAREA=R*R*.5*SINE                                   CIRC 233
BASEL=LAT                                           CIRC 234
XCOMP=111.321*COS(BASEL/RADIANS)-9.8549E-2+7.78E-3*BASEL-5.894E-5 CIRC 235
1 BASEL**2                                           CIRC 236
YCOMP=XCOMP/COS(BASEL/RADIANS)-8.5697E-1+7.927E-3*BASEL+5.888E-5 CIRC 237

```

Generate 95 more "random" locations within the sector segment for weighting the SITE parameters.

Determine the list of unique SITE cells that share area with the sector segment.

Determine the number of SITE cells which have land and share area with the sector segment (IGOOD number of cells).

There is only 1 SITE cell that shares area with the sector segment.

```

ISEL**2
DISTX=.5*YCOMP
DISTY=.5*XCOMP
TAREAR=DISTX*DISTY*1.0E+6
C  RATIO=RATIO+DATA(18)/TAREAR*WEIGHT
TOTAL WEIGHTED VALUES
ST-ST*DATA(2)
IRRI=IRRI+DATA(3)
PRECIP=PRECIP+DATA(4)
TEV=TEV+DATA(5)
ATNF=ATNF+DATA(6)
VLV=VLV+DATA(7)
YSP=YSP+DATA(8)
YFV=YFV+DATA(9)
YGH=YGH+DATA(10)
YCF=YCF+DATA(11)
MMINT=MMINT+DATA(12)
AMINT=AMINT+DATA(13)
FFDAYS=FFDAYS+DATA(14)
BUMID=BUMID+DATA(15)
AREAT=AREAT+DATA(16)
C  TOTAL WEIGHTED DENSITIES
AREAP=AREAP+DATA(17)/DATA(16)
NUMCC=NUMCC+DATA(18)/DATA(16)
NUMBC=NUMBC+DATA(19)/DATA(16)
SALFC=SALFC+DATA(20)/DATA(16)
NUMHC=NUMHC+DATA(21)/DATA(16)
NUMSH=NUMSH+DATA(22)/DATA(16)
PGF=PGF+DATA(23)/DATA(16)
PHF=PHF+DATA(24)/DATA(16)
PSF=PSF+DATA(25)/DATA(16)
POP=POP+DATA(26)/DATA(16)
POPH=POPH+DATA(27)/DATA(16)
POPF=POPF+DATA(28)/DATA(16)
POPHB=POPHB+DATA(29)/DATA(16)
PLV=PLV+DATA(30)/DATA(16)
PEV=PEV+DATA(31)/DATA(16)
PPV=PPV+DATA(32)/DATA(16)
PCH=PCH+DATA(33)/DATA(16)
IF (DATA(27).GT.9999) GO TO 20
GO TO 21
C  CELL IS MORE THAN 50 PERCENT FEDERAL LAND
20  KNTFED=KNTFED+1
IF (AMOD(DATA(27),10000.).EQ.0.) GO TO 21
DATA(27)=1.0E+4-DATA(27)
21  IL=1+IL+(DATA(27))/1000
PCT=DATA(27)-FLOAT(IL)*1000.0
DL(IL)=DL(IL)+PCT
KNT(IL)=KNT(IL)+1
22  CONTINUE
C  *****
C  ASEC IS THE AREA OF A CIRCULAR GRID SEGMENT.
ASEG=(R2*R2-R1*R1)*3.141593*DELTH/6.283906
TOTSEG=TOTSEG+ASEG
C  COMPUTE PERCENTAGES OF POPULATION GROUPS
C  AND OBTAIN THE AVERAGE DENSITY OF EACH VALUE.
C  CALCULATE PERCENTAGE OF POPULATION AND COMPUTE THE DENSITY.
IF (AREAT.EQ.0) GO TO 26
C  AREA ADJUSTED TO ACTUAL LAND AREA.
IF (RATIO.GT..0) RATIO=1./
FAC=ASEG/RATIO
TOTSEG=TOTSEG+FAC
IF (WRITE.WE.2) WRITE (1007,33) RATIO
AREAP=AREAP*FAC
NUMCC=NUMCC*FAC
NUMBC=NUMBC*FAC
SALFC=SALFC*FAC
NUMHC=NUMHC*FAC
NUMSH=NUMSH*FAC
PGF=PGF*FAC
PHF=PHF*FAC
PSF=PSF*FAC
POP=POP*FAC
PLV=PLV*FAC
PEV=PEV*FAC
PPV=PPV*FAC
PCH=PCH*FAC
POPH=POPH*FAC
POPF=POPF*FAC
POPHB=POPHB*FAC
IF (POP.WE.0.0) FRUW=POPH/POP
IF (POP.WE.0.0) FRUF=POPF/POP
IF (POP.WE.0.0) FRUB=POPHB/POP
VLV=VLV/AREAT
YFV=YFV/AREAT
YFV=YFV/AREAT
YGH=YGH/AREAT
YCF=YCF/AREAT
ATNF=ATNF/AREAT
IF (KNTFED.GE.WK/2) GO TO 24
DO 2  IL=1,7
CIRC 238
CIRC 239
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```

RATIO is the approx. fraction of land area
in the SITE cell.
Total measured quantities.

Densities of measured quantities are totalled.

ASEG is the approx. area of the sector segment.

FAC is the calculated land area in
the sector segment.

Multiply densities by the land area to obtain
average SITE parameters.

Determine productivities.

```

PCTTOT=AMAX1(PCTTOT,DL(IL))          CIRC 330
23 IF (DL(IL).EQ.PCTTOT) ISVIL=IL      CIRC 331
    IF (KMT(ISVIL).NE.0) PCTT=PCTTOT/(FLOAT(KMT(ISVIL))*10.0) CIRC 332
    DOMLF=FLOAT(ISVIL)*1000.-PCTT      CIRC 333
    AREAT NOW EQUALS AREA OF THE SEGMENT THAT IS LAND CIRC 334
24 AREAT=FAC                          CIRC 335
C *****CIRC 336
    IF (INL.GT.0) READ (INL,SITE)      CIRC 337
    *****CIRC 338
    RETURN                             CIRC 339
25 WRITE (IOUT,34) IND                 CIRC 340
    CALL ERRGR                         CIRC 341
    RETURN                             CIRC 342
26 WRITE (IOUT,35)                    CIRC 343
    CALL ERRGR                         CIRC 344
    RETURN                             CIRC 345
C                                     CIRC 346
27 FORMAT (F8.3,2X,F8.3)              CIRC 347
28 FORMAT ('0','THERE ARE ',I3,' UNIQUE CELLS WHICH SHARE COMMON AREA' CIRC 348
    I UTH THE AREA IN QUESTION',/,2X,'INDEX',2X,'FRQ',/,) CIRC 349
29 FORMAT (2X,I5,2X,I3)               CIRC 350
30 ' ANAT ('0','SITE CELL',I5,' HAS NO LAND AREA ASSOCIATED WITH IT') CIRC 351
31 FORMAT ('0','THE FOLLOWING ',I3,' SITE CELLS ARE USED TO GENERATE CIRC 352
    ISPATIALLY-AVERAGED PARAMETERS:',/,,' INDEX WEIGHT CFLAG') CIRC 353
32 FORMAT (' ',I5,2X,F6.4,5X,I3)      CIRC 354
33 FORMAT ('0','FRACTION OF THE SECTOR THAT IS LAND =',IPE13.7) CIRC 355
34 FORMAT (' SITE-DATA INDEX NOT IN THE FILE. KEY=',I5) CIRC 356
35 FORMAT (' SITE DATA OBTAINED NOT VALID') CIRC 357
    END                                CIRC 358

SUBROUTINE RECTAV (XREF,YREF,XMIN,XMAX,YMIN,YMAX,IPTOGR,GRDOPT) RECT 1
C THIS SUBROUTINE CALCULATES AVERAGE SITE PARAMETERS FOR THE RECT 2
C AREA OF INTEREST (RECTANGULAR GRID) RECT 3
    REAL IRR1,NUMCC,NUMNC,NUMNC,NUMNHP,NMIXHT,LONG,LAT,LATN RECT 4
    INTEGER GRDOPT,TPOINT RECT 5
    COMMON /CONTRL/ INB,IROUT,INS,INL,INC,INE,IOUT,UNIT,INWRITE RECT 6
    COMMON /SITE/ ET,IRR1,PRECIP,YEV,AYHF,YLV,YSF,AREAP,NUMCC,SALPC,RECT 7
    NUMNC,NUMNHP,PGF,PHF,PSF,HUMID,AREAT,POP,FRUWF,FRUFW,FURBN,PLV,PEV,RECT 8
    2,PPV,PCR,DOMLF,NMIXHT,AMIXHT,YPV,YCH,YCF,FFDAYS,NUMNC RECT 9
    DIMENSION DTA(3*), INDC(4), WT(5800), WTS(5800) RECT 10
    DIMENSION KMT(7), DL(7), INDEX(5800), INDS(5800), ICHAV(5800) RECT 11
    NAMELIST / SITE/ET,IRR1,PRECIP,YEV,AYHF,YLV,YSF,AREAP,NUMCC,SALPC,RECT 12
    INUMNC,NUMNHP,PGF,PHF,PSF,HUMID,AREAT,POP,FRUWF,FRUFW,FURBN,PLV,PEV,RECT 13
    2,PPV,PCR,DOMLF,NMIXHT,AMIXHT,YPV,YCH,YCF,FFDAYS,NUMNC RECT 14
    DEF..E FILE 2(5800,36,U,IAV) RECT 15
    DATA RADIAN/57.2958/ RECT 16
    INDX(XV)=IFIX((XV-56.5)/.5) RECT 17
    INDX(YV)=IFIX((YV-24.)/.5) RECT 18
    *****RECT 19
C INITIALIZATION OF SITE PARAMETERS RECT 20
    ET=0.0 RECT 21
    IRR1=0.0 RECT 22
    PRECIP=0.0 RECT 23
    YEV=0.0 RECT 24
    AYHF=0.0 RECT 25
    YLV=0.0 RECT 26
    YSF=0.0 RECT 27
    AREAP=0.0 RECT 28
    NUMCC=0.0 RECT 29
    NUMNC=0.0 RECT 30
    NUMNHP=0.0 RECT 31
    SALPC=0.0 RECT 32
    NUMNHP=0.0 RECT 33
    PGF=0.0 RECT 34
    PHF=0.0 RECT 35
    PSF=0.0 RECT 36
    HUMID=0.0 RECT 37
    AREAT=0.0 RECT 38
    POP=0.0 RECT 39
    PCTTOT=0.0 RECT 40
    PCTT=0.0 RECT 41
    PLV=0.0 RECT 42
    PEV=0.0 RECT 43
    PPV=0.0 RECT 44
    PCR=0.0 RECT 45
    L MLF=10000. RECT 46
    NMIXHT=0.0 RECT 47
    AMIXHT=0.0 RECT 48
    YPV=0.0 RECT 49
    YCH=0.0 RECT 50
    YCF=0.0 RECT 51
    FFDAYS=0.0 RECT 52
    DO 1 IL=1,7 RECT 53
        KMT(IL)=0.0 RECT 54
        DL(IL)=0.0 RECT 55
        POPNHP=0.0 RECT 56
        POPNHP=0.0 RECT 57
        POPNHP=0.0 RECT 58
        FRUWF=0.0 RECT 59
        FRUFW=0.0 RECT 60
        FURBN=0.0 RECT 61
        ICHAV=0.0 RECT 62
        INDFED=0.0 RECT 63

```

Determine dominant land feature.

Can override SITE parameters.

Initialize SITE parameters.

```

RATIO=0.0                                RECT 64
DO 2 IX=1,5800                            RECT 65
ICSAV(IX)=0                              RECT 66
2 CONTINUE                                RECT 67
C ***** RECT 68
C IF WINDOW OF INTEREST DOES NOT SHARE COMMON AREA WITH SITE DATA. RECT 69
C RETURN WITH THE SITE PARAMETERS SET TO ZERO RECT 70
IF(XMIN.LE.67.0)RETURN                    RECT 71
IF(XMAX.GT.124.5)RETURN                   RECT 72
IF(YMIN.GT.49.5)RETURN                   RECT 73
IF(YMAX.LT.24.5)RETURN                   RECT 74
C DEFINE CHECK POINTS                     RECT 75
PTIX=XMIN                                RECT 76
IF(PTIX.GT.124.5)PTIX=124.5              RECT 77
PTIX=PTIX                                RECT 78
PTIX=XMAX                                RECT 79
IF(PTIX.LT.67.0)PTIX=67.0                RECT 80
PTIX=PTIX                                RECT 81
PTIY=YMIN                                RECT 82
IF(PTIY.LT.24.5)PTIY=24.5                RECT 83
PTIY=PTIY                                RECT 84
PTIY=YMAX                                RECT 85
IF(PTIY.GT.49.5)PTIY=49.5                RECT 86
PTIY=PTIY                                RECT 87
C ***** RECT 88
C ***** RECT 89
C ***** RECT 90
C DETERMINE IN WHICH SITE CELLS THE CHECK POINTS LIE RECT 91
INDC(1)=INDEX(PTIX)+116*(INDY(PTIY)-1)   RECT 92
IF(INDC(1).GT.5800)INDC(1)=5800          RECT 93
IF(INDC(1).LE.0)INDC(1)=1                 RECT 94
INDC(2)=INDEX(PTIX)+116*(INDY(PTIY)-1)   RECT 95
IF(INDC(2).GT.5800)INDC(2)=5800          RECT 96
IF(INDC(2).LE.0)INDC(2)=1                 RECT 97
INDC(3)=INDEX(PTIX)+116*(INDY(PTIY)-1)   RECT 98
INDC(4)=INDEX(PTIX)+116*(INDY(PTIY)-1)   RECT 99
IF(INDC(4).GT.5800)INDC(4)=5800          RECT 100
IF(INDC(4).LE.0)INDC(4)=1                 RECT 101
C DETERMINE WEIGHTS FOR BOUNDARY CELLS RECT 102
DXL=PTIX-FLOAT(1+IX(PTIX))               RECT 103
IF (DXL.GE.0.5) DXL=DXL-0.5               RECT 104
WL=DXL/0.5                               RECT 105
DYU=PTIY-FLOAT(1+IY(PTIY))               RECT 106
IF (DYU.GE.0.5) DYU=DYU-0.5               RECT 107
WU=DYU/0.5                               RECT 108
DXR=1.0-(PTIX-FLOAT(1+IX(PTIX)))          RECT 109
IF (DXR.GT.0.5) DXR=DXR-0.5               RECT 110
WR=DXR/0.5                               RECT 111
DYB=1.0-(PTIY-FLOAT(1+IY(PTIY)))          RECT 112
IF (DYB.EQ.1.0.OR.DYB.EQ.0.5) GO TO 4    RECT 113
IF (DYB.GT.0.5) DYB=DYB-0.5               RECT 114
4 WB=DYB/0.5                             RECT 115
IF (WB.GT.1.0) WB=1.0                     RECT 116
C ***** RECT 117
C ***** RECT 118
C ***** RECT 119
C PROGRESS THROUGH POSSIBLE RANGE OF SITE CELLS RECT 120
NFX=INDC(1)-INDC(4)+1                     RECT 121
NFT=(INDC(2)-INDC(1))/116+1               RECT 122
IP=0                                       RECT 123
DO 13 IY=1,NFY                            RECT 124
DO 13 IX=1,NFX                            RECT 125
INDXX=INDC(4)+(IX-1)*(IY-1)*116          RECT 126
IF(INDXX.LE.0.OR.INDXX.GT.5800)GO TO 13   RECT 127
C TRY NEXT 3 STATEMENTS ADDED FOR RETADD WINDOWS THAT LIE COMPLETELY RECT 128
C WITHIN A SITE CELL IN ONE OR BOTH DIRECTIONS RECT 129
IF(NFX*NFY.EQ.1)GO TO 26                  RECT 130
IF(NFX.EQ.1)GO TO 27                      RECT 131
IF(NFY.EQ.1)GO TO 28                      RECT 132
IF (IX.EQ.1.AND.IY.EQ.1) GO TO 5          RECT 133
IF (IX.EQ.1.AND.IY.EQ.NFY) GO TO 6        RECT 134
IF (IX.EQ.NFX.AND.IY.EQ.1) GO TO 7        RECT 135
IF (IX.EQ.NFX.AND.IY.EQ.NFY) GO TO 8      RECT 136
IF (IX.EQ.1) GO TO 9                      RECT 137
IF (IX.EQ.NFX) GO TO 10                   RECT 138
IF (IY.EQ.1) GO TO 11                     RECT 139
IF (IY.EQ.NFY) GO TO 12                   RECT 140
IP=IP+1                                   RECT 141
INDEX(IP)=INDXX                           RECT 142
WT(IP)=1.0                                RECT 143
GO TO 13                                  RECT 144
C ***** RECT 145
C THE CELL OF INTEREST LIES COMPLETELY WITHIN ONE SITE CELL RECT 146
26 IP=IP+1                                RECT 147
INDEX(IP)=INDXX                           RECT 148
WT(IP)=(XMIN-XMAX)*(YMAX-YMIN)/.25        RECT 149
IF(WT(IP).EQ.0.) WT(IP)=1.               RECT 150
WRITE(6,772)INDEX(IP),WT(IP)              RECT 151
772 FORMAT('0','INDEX,WT=',15,2X,F10.5)  RECT 152
GO TO 13                                  RECT 153
C BAND IN THE Y-DIRECTION (ONLY 1 CELL DEEP IN THE X-DIR.) RECT 154
27 JP=IP+1                                RECT 155

```

If the total RETADD-II cell does not lie within the SITE data grid, return with the SITE parameters as 0.

Set the 4 check points that define the RETADD-II cell. If only part of the RETADD-II cell lies within the SITE data grid, reduce the cell to lie completely within the SITE data grid.

Calculate the index numbers for the 4 check points.

Determine weights for the RETADD-II cells that do not totally encompass a SITE data cell.

Determine the number of SITE data cells in the X-direction (NFX) and the number in the Y-direction (NFY) that share area with the RETADD-II cell.


```

      WT(IP)=(XMIN-XMAX)/.5                      RECT 156
      IF (IT.EQ.1) WT(IP)=WT(IP)*WB              RECT 157
      IF (IT.EQ.NPT) WT(IP)=WT(IP)*WU            RECT 158
      INDEX(IP)=INDEX                             RECT 159
      GO TO 13                                     RECT 160
C      BAND IS THE X-DIRECTION (ONLY 1 CELL DEEP IN THE Y-DIR.) RECT 161
28 IP=IP+1                                         RECT 162
      WT(IP)=(YMAX-YMIN)/.5                      RECT 163
      IF (IX.EQ.1) WT(IP)=WT(IP)*WB              RECT 164
      IF (IX.EQ.NPX) WT(IP)=WT(IP)*WL            RECT 165
      INDEX(IP)=INDEX                             RECT 166
      GO TO 13                                     RECT 167
C      THIS IS A CORNER CELL                       RECT 168
5 IP=IP+1                                         RECT 169
      INDEX(IP)=INDEX                             RECT 170
      WT(IP)=WB*WB                                RECT 171
      IF (DXR.EQ.0.0) WT(IP)=WB                  RECT 172
      IF (DYB.EQ.0.0) WT(IP)=WB                  RECT 173
      GO TO 13                                     RECT 174
6 IP=IP+1                                         RECT 175
      INDEX(IP)=INDEX                             RECT 176
      WT(IP)=WB*WU                                RECT 177
      IF (DXR.EQ.0.0) WT(IP)=WU                  RECT 178
      IF (DYU.EQ.0.0) WT(IP)=WB                  RECT 179
      GO TO 13                                     RECT 180
7 IP=IP+1                                         RECT 181
      INDEX(IP)=INDEX                             RECT 182
      WT(IP)=WB*WB                                RECT 183
      IF (DXL.EQ.0.0) WT(IP)=WB                  RECT 184
      IF (DYB.EQ.0.0) WT(IP)=WB                  RECT 185
      IF (DYB.EQ.0.0) WT(IP)=WB                  RECT 186
      GO TO 13                                     RECT 187
8 IP=IP+1                                         RECT 188
      INDEX(IP)=INDEX                             RECT 189
      WT(IP)=WB*WU                                RECT 190
      IF (DXL.EQ.0.0) WT(IP)=WU                  RECT 191
      IF (DYU.EQ.0.0) WT(IP)=WB                  RECT 192
      GO TO 13                                     RECT 193
C      ***** RECT 194
9 IP=IP+1                                         RECT 195
      INDEX(IP)=INDEX                             RECT 196
      WT(IP)=WB                                    RECT 197
      GO TO 13                                     RECT 198
10 IP=IP+1                                        RECT 199
      INDEX(IP)=INDEX                             RECT 200
      WT(IP)=WB                                    RECT 201
      GO TO 13                                     RECT 202
11 IP=IP+1                                        RECT 203
      INDEX(IP)=INDEX                             RECT 204
      WT(IP)=WB                                    RECT 205
      GO TO 13                                     RECT 206
12 IP=IP+1                                        RECT 207
      INDEX(IP)=INDEX                             RECT 208
      WT(IP)=WB                                    RECT 209
      GO TO 13                                     RECT 210
13 IP=IP+1                                        RECT 211
      INDEX(IP)=INDEX                             RECT 212
      WT(IP)=WB                                    RECT 213
      GO TO 13                                     RECT 214
14 IP=IP+1                                        RECT 215
      INDEX(IP)=INDEX                             RECT 216
      WT(IP)=WB                                    RECT 217
      GO TO 13                                     RECT 218
C      ***** RECT 219
C      ***** RECT 220
C      DETERMINE WHICH SITE CELLS HAVE LAND AREA ASSOCIATED WITH THEM RECT 221
C      INDS(I) HOLDS THE INDEX FOR SITE CELL I      RECT 222
C      IGOOD IS A COUNTER FOR THE NUMBER OF UNIQUE SITE CELLS THAT RECT 223
C      HAVE LAND AREA ASSOCIATED WITH THEM          RECT 224
C      TOTWT = SUM OF THE NORMALIZED WEIGHTS         RECT 225
C      TOTWT=0.0                                     RECT 226
C      DO 14 NCELL=1, IPOINT                          RECT 227
C      IND=INDEX(NCELL)                               RECT 228
C      READ(IND,IND) LONG, LAT, DATA                 RECT 229
C      IF (DATA(18).LT.1.0) GO TO 14                  RECT 230
C      IGOOD=IGOOD+1                                  RECT 231
C      INDS(IGOOD)=IND                                RECT 232
C      TOTWT=TOTWT+WT(NCELL)                          RECT 233
C      TB(IGOOD)=WT(NCELL)                            RECT 234
C      IF (DATA(1).GT.0.99) ICEAV(IGOOD)=IPX(DATA(1)+.1) RECT 235
C      CONTINUE                                       RECT 236
14 IF (IGOOD.EQ.0) RETURN                            RECT 237
C      GO TO 16                                       RECT 238
C      ***** RECT 239
C      ***** RECT 240
C      ***** RECT 241
C      ALL CHECK POINTS LIE WITHIN THE SAME SITE CELL RECT 242
15 IGOOD=1                                           RECT 243
      INDS(I)=INDC(I)                                RECT 244
      IND=INDS(I)                                    RECT 245
      IF (IND.GT.5800.OR.IND.LE.0) RETURN            RECT 246
      READ(IND,IND) LONG, LAT, DATA                 RECT 247

```

IGOOD is the number of SITE cells that have land
and shore area with the rectangular cell.

```

IF (DATA(1).GT.0.99) ICSAV(IGOOD)=FIX(DATA(1)+.1)      RECT 248
IF (DATA(1).LT.1.0) WRITE (IOUT,72) IHD              RECT 249
IF (DATA(1).LT.1.0) RETURN                            RECT 250
***** RECT 251
16 IF (IWRITE.NE.2) WRITE (IOUT,23) IGOOD             RECT 252
***** RECT 253
C CALCULATE (WEIGHTED) AVERAGE SITE PARAMETERS USING IGOOD NUMBER RECT 254
C OF SITE CELLS                                       RECT 255
DO 20 NCELL=1,IGOOD                                   RECT 256
WEIGHT=0.0                                            RECT 257
IF (TOTWT.NE.0.0) WEIGHT=WTS(NCELL)/TOTWT          RECT 258
IHD=IHD+(NCELL)                                       RECT 259
IF (IWRITE.NE.2) WRITE (IOUT,24) IHD,WTS(NCELL),ICSAV(NCELL) RECT 260
READ(INS'IND)LONG,LAT,DATA                          RECT 261
DO 17 IC=2,34                                         RECT 262
IF (IC.LE.8) GO TO 17                                RECT 263
IF (IC.EQ.17) GO TO 17                               RECT 264
IF (IC.GE.20.AND.IC.LE.22) GO TO 17                 RECT 265
IF (IC.GE.28.AND.IC.LE.33) GO TO 17                 RECT 266
DATA(IC)=DATA(IC)*WTS/NCELL                          RECT 267
17 CONTINUE                                           RECT 268
LATN=LAT+.5                                          RECT 269
BASEL=LAT                                             RECT 270
XCOMP=111.321*COS(BASEL/RADIAN)-9.8549E-2+7.789E-3*BASEL-5.894E-5*RECT 271
IASEL=2                                               RECT 272
YCOMP=XCOMP/COS(BASEL/RADIAN)-8.3697E-1+7.927E-3*BASEL+5.888E-5*BASEL RECT 273
IASEL=2                                               RECT 274
DISTT=.5*YCOMP                                       RECT 275
DISTY=.5*XCOMP                                       RECT 276
TAREAR=DISTT*DISTT*1.0E+6                           RECT 277
RATIO=RATIO+DATA(18)/TAREAR*WTS(NCELL)              RECT 278
***** RECT 279
C WEIGHT NET CONDITIONS                               RECT 280
WT=WT+DATA(2)*WEIGHT                                 RECT 281
TERR=IHD+DATA(3)*WEIGHT                              RECT 282
PRECIP=PRECIP+DATA(4)*WEIGHT                         RECT 283
YEV=YEV+DATA(5)*WEIGHT                              RECT 284
ATNF=ATNF+DATA(6)*WEIGHT                            RECT 285
YLV=YLW+DATA(7)*WEIGHT                              RECT 286
YSF=YSF+DATA(8)*WEIGHT                              RECT 287
YFV=YFV+DATA(9)*WEIGHT                              RECT 288
YGV=YGV+DATA(10)*WEIGHT                             RECT 289
YCF=YCF+DATA(11)*WEIGHT                             RECT 290
MNIKT=MNIKT+DATA(12)*WEIGHT                         RECT 291
ANIKT=ANIKT+DATA(13)*WEIGHT                         RECT 292
FFDAYS=FFDAYS+DATA(14)*WEIGHT                       RECT 293
HUMID=HUMID+DATA(15)*WEIGHT                         RECT 294
***** RECT 295
C TOTAL WEIGHTED VALUES                             RECT 296
AREAT=AREAT+DATA(16)*WEIGHT                          RECT 297
AREAP=AREAP+DATA(17)*WEIGHT                          RECT 298
NUMCC=NUMCC+DATA(18)*WEIGHT                          RECT 299
NUMOC=NUMOC+DATA(19)*WEIGHT                          RECT 300
SALPC=SALPC+DATA(20)*WEIGHT                          RECT 301
NUMWC=NUMWC+DATA(21)*WEIGHT                          RECT 302
NUMSHP=NUMSHP+DATA(22)*WEIGHT                       RECT 303
PCF=PCF+DATA(23)*WEIGHT                             RECT 304
PSF=PSF+DATA(24)*WEIGHT                             RECT 305
PLV=PLV+DATA(25)*WEIGHT                             RECT 306
PFV=PFV+DATA(26)*WEIGHT                             RECT 307
PPV=PPV+DATA(27)*WEIGHT                             RECT 308
PCN=PCN+DATA(28)*WEIGHT                             RECT 309
POP=POP+DATA(29)*WEIGHT                             RECT 310
PPOP=POP+DATA(30)*WEIGHT                            RECT 311
PCPOP=PCPOP+DATA(31)*WEIGHT                         RECT 312
POPOP=POPOP+DATA(32)*WEIGHT                         RECT 313
POPOP=POPOP+DATA(33)*WEIGHT                         RECT 314
***** RECT 315
C DETERMINE LAND FEATURE                             RECT 316
IF (DATA(27).GT.9999) GO TO 18                      RECT 317
GO TO 19                                              RECT 318
C CELL IS MORE THAN 50 PERCENT FEDERAL LAND         RECT 319
KNTFD=KNTFD+1                                         RECT 320
IF (AMGD(DATA(27),10000.).EQ.0.) GO TO 19           RECT 321
DATA(27)=1.0E+4+DATA(27)                            RECT 322
19 IL=FIX(DATA(27))/1000                             RECT 323
PCT=DATA(27)-FLOAT(IL)*1000.0                       RECT 324
DL(IL)=DL(IL)+PCT                                    RECT 325
KNT(IL)=KNT(IL)+1                                    RECT 326
20 CONTINUE                                           RECT 327
***** RECT 328
C DETERMINE PRODUCTIVITIES                           RECT 329
YEV=PEV/AREAT                                         RECT 330
ATNF=PNF/AREAT                                         RECT 331
YLV=PLV/AREAT                                         RECT 332
YSF=PSF/AREAT                                         RECT 333
YFV=PPV/AREAT                                         RECT 334
YGV=PCN/AREAT                                         RECT 335
YCF=PCF/AREAT                                         RECT 336
***** RECT 337
1, (RATIO.GT.1.0) RATIO=1.0                          RECT 338
IF (IWRITE.NE.2) WRITE (IOUT,25) RATIO              RECT 339

```

Weight certain parameter.

Total certain parameters.

Determine productivities.

```

      IF (POP.NR.0.0) PRTNF-POPNT/POP          RECT 340
      IF (POP.NR.0.0) PRTFM-POPFM/POP          RECT 341
      IF (POP.NR.0.0) PRTFM-POPFM/POP          RECT 342
      DETERMINE DOMINANT LAND FEATURE          RECT 343
      DO 21 IL=1,7                             RECT 344
      PCTTOT=AMAX/(PCTTOT,IL(1))              RECT 345
      IF (IL(1).EQ.PCTTOT) ISVIL=IL           RECT 346
      IF (INT(ISVIL).NE.0) PCTT=PCTTOT/(FLOAT(INT(ISVIL))*10.0) RECT 347
      DOWLF=FLOAT(ISVIL)*1000.+PCTT           RECT 348
      ***** RECT 349
      IF (INL.GT.0) READ (INL,SITE)            RECT 350
      ***** RECT 351
      RETURN                                   RECT 352
C                                             RECT 353
22  FORMAT ('0','SITE CELL',15,' HAS NO LAND AREA ASSOCIATED WITH IT') RECT 354
23  FORMAT ('//',' INTERMEDIATE OUTPUT FROM SUBROUTINE RECTAV:','0',' THERECT 355
1  FOLLOWING ',13,' SITE CELLS ARE USED TO GENERATE SPATIALLY-AVERAGERECT 356
2  ED PARAMETERS:','//',' INDEX FRACT.   CFLAG',10X,'WHERE FRACT. IS RECT 357
3  THE FRACTION OF THE CELL IN THE AREA OF INTEREST') RECT 358
24  FORMAT (' ',15,2X,F6.4,5X,13)            RECT 359
25  FORMAT ('0',' FRACTION OF THE AREA OF INTEREST THAT IS LAND =',1P) RECT 360
13.6)                                         RECT 361
END                                           RECT 362
SUBROUTINE RESUS (DEPN)                     RESU 1
REAL*8 SYN                                  RESU 2
LOGICAL FIRST                               RESU 3
REAL ITRI,MUMCC,MUMBC,MUMHC,MUMHP,MWIXHT,MLOAD,ED,LAMES,LAMIS RESU 4
COMMON /CONTRL/ INB,ISOUT,INB,INL,INC,INR,IOUT,UNIT,IMWRITE RESU 5
COMMON /ELTYPE/ ED(40),EV(40),ER(40),FR(40),FY(40) RESU 6
COMMON /LEACH/ LAMIS(40),LAMS(40),LAMES(40) RESU 7
COMMON /NAME/ PSIZE(40),CLCLS(4,40),SYN(40),LAMO(40) RESU 8
COMMON /OUTPUT/ CONES(40),CONLV(40),CONEV(40),CONPV(40),CONGR(40) RESU 9
ICOMBEY(40),COMBLE(40),COMRES(40)          RESU 10
COMMON /RESUSP/ TIMEA,IREBUS,PE           RESU 11
COMMON /SITE/ ET,ITRI,PRECIP,YEV,ATHP,YLV,YSP,AREAP,MUMCC,SALPC,RESU 12
IUMHC,MUMHP,PCF,PHF,PSF,MUMD,AREAT,POP,PRUP,PROFM,FORBM,FLV,PEV,RESU 13
ZPPV,PGH,DOWLF,MWIXHT,AWIXHT,YFV,YCH,YCF,FFDAYS,MUMBC RESU 14
COMMON /TABLE3/ DE,DR,RO,THETA,TA,TB,YELV,THEV,THPV,THC,THSF,THEV,RESU 15
ITCZ2,FDATLV,FDRYEV,FMYFV,FMYTG,FMYGC,FMYQC,FMYOC,FMYSHF,CQCF,CQRESU 16
ZMC,CQOC,LQCF,LQFC,FSOC,FSMC,FSFC,MPC,MNC,MLOAD,VELD(40),TMLK,TSRESU 17
3FC,TSOC,TSCT,TSNC                       RESU 18
COMMON /TIMECH/ TIME,ICTYP,ISTYP,IMULT,IDIAG,NPRIME,MCONC,KOUT,MRESU 19
IL,WEXP,KTRUNC,NPACK                      RESU 20
DIMENSION DEPN(1)                        RESU 21
NAMELIST / NAMES/VELD,MLOAD              RESU 22
DATA FIRST/.TRUE./                       RESU 23
IF (.NOT.FIRST) GO TO 2                   RESU 24
MLOAD=15.5                               RESU 25
DO 1 IN=1,NPACK                          RESU 26
VELD(IN)=0.1                             RESU 27
IF (INL.GT.0) READ (INL,NAMES)            RESU 28
FIRST=.FALSE.                            RESU 29
C  CONRES = AIR CONCENTRATION OF THE NUCLIDE DUE TO RESUSPENSION RESU 30
C  REVISED DEPOSITION RATE IS CONRES*VELD RESU 31
2  IF (AREAT.GT.1.0) GO TO 4              RESU 32
C  ***** RESU 33
C  THERE IS NO LAND AREA AND CONRES IS SET TO ZERO RESU 34
DO 3 IN=1,NPACK                          RESU 35
CONRES(IN)=0.0E+0                        RESU 36
DEPN(IN)=0.0E+0                          RESU 37
CONTINUE                                  RESU 38
RETURN                                   RESU 39
C  ***** RESU 40
4  IF (IMWRITE.EQ.1) WRITE (IOUT,6) UNIT,UNIT RESU 41
DO 5 IN=1,NPACK                          RESU 42
CONRES(IN)=CONRES(IN)*PE*MLOAD*1.0E-9    RESU 43
DEPN(IN)=CONRES(IN)*VELD(IN)*0.1         RESU 44
IF (IMWRITE.NE.1) GO TO 5                RESU 45
WRITE (IOUT,7) IN,SYN(IN),CONRES(IN),VELD(IN),DEPN(IN) RESU 46
CONTINUE                                  RESU 47
RETURN                                   RESU 48
C                                             RESU 49
6  FORMAT ('0','OUTPUT FROM SUBROUTINE RESUS:','0',5X,'IN',1X,'NUCLIDRESU 50
1  ID',3X,'AIR CONC. FROM RESUSPENSION',1X,'DEPOSITION VELOCITY',3X,'RESU 51
2  DEPOSITION RATE DUE TO RESUSPENSION',' ',T30,'(' ,A2,'/M**3)',T57,'RESU 52
3  (M/SEC)',T83,'(' ,A2,'/M**2/SEC)',/) RESU 53
7  FORMAT (6X,12,3X,A8,9X,1PE13.6,12X,E13.6,16X,E13.6) RESU 54
END                                         RESU 55
SUBROUTINE SOILS (DEPN,CONAIR,ZASER,LOCNO,RPC,YPC,MUMDC,RLV,REV,RHSOIL 1
IF,RSP,TITLE,TIMES)                      SOIL 2
LOGICAL FIRST                             SOIL 3
REAL*8 SYN                                SOIL 4
REAL ITRI,MUMCC,MUMBC,MUMHC,MUMHP,MWIXHT,LAMIS,LAMS,ED,EDT,LAMES,SOIL 5
ILAMI,MUMDC,MUMBC,LAMC,LAMB,LAMH,LAMW,LAMOT,LAMST,LAMST,LAMST,SOIL 6
INTEGER ZASER,ATWO                        SOIL 7
COMMON /CONTRL/ INB,ISOUT,INB,INL,INC,INR,IOUT,UNIT,IMWRITE SOIL 8
COMMON /LEACH/ LAMIS(40),LAMS(40),LAMES(40) SOIL 9
COMMON /NAME/ PSIZE(40),CLCLS(4,40),SYN(40),LAMO(40) SOIL 10
COMMON /OUTPUT/ CONES(40),CONLV(40),CONEV(40),CONPV(40),CONGR(40),SOIL 11
ICOMBEY(40),COMBLE(40),COMRES(40)        SOIL 12
COMMON /RESUSP/ TIMEA,IREBUS,PE          SOIL 13
COMMON /SITE/ ET,ITRI,PRECIP,YEV,ATHP,YLV,YSP,AREAP,MUMCC,SALPC,RESOIL 14

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Determine dominant land feature.

Can override resuspension constants with a NAMELIST READ.

If there is no land area, air concentration due to resuspension set to 0.

Air concentration and deposition rate due to resuspension are calculated.


```

C          SOIL 109
C          *****SOIL 110
C      DETERMINE NUCLIDE CONCENTRATIONS IN SOILS          SOIL 111
C      DO 9 IN=1,NPACK          SOIL 112
C      COMS AND COMIS ARE INPUT RATES BEFORE THEY GO TO DECATI          SOIL 113
C      COMS(IN)=DEPR(IN)/PR          SOIL 114
C      COMIS(IN)=DEPR(IN)/PR          SOIL 115
C      COMES(IN)=DEPR(IN)/PR          SOIL 116
C      LAMIS = LEACHING CONSTANT (1/SEC) FOR THE NUCLIDE IN THE ROOT ZONE          SOIL 117
C      IRRIGATED SOIL          SOIL 118
C      LAMS = LEACHING CONSTANT (1/SEC) FOR THE NUCLIDE IN THE ROOT ZONE          SOIL 119
C      NON-IRRIGATED SOIL          SOIL 120
C      LAMES = LEACHING CONSTANT (1/SEC) FOR THE NUCLIDE IN THE SOIL          SOIL 121
C      ON WHICH SURFACE EXPOSURES ARE BASED          SOIL 122
C      LAMIS(IN)=3.168876E-9*VWIS/(DE*(1.0E-6-RO/THETA*KB(IN)))          SOIL 123
C      LAMES(IN)=3.168876E-9*VWS/(DE*(1.0E-6-RO/THETA*KB(IN)))          SOIL 124
C      IF (IFLAG1.NE.1) GO TO 8          SOIL 125
C      LAMS(IN)=3.168876E-9*VWS/(DE*(1.0E-6-RO/THETA*KB(IN)))          SOIL 126
C      GO TO 9          SOIL 127
8      LAM(IN)=LAMIS(IN)          SOIL 128
9      CONTINUE          SOIL 129
C      CALL DECATI (NPACK,IND,COMS,LAMIS,CRATE,VELD,IC,JC,CPAK)          SOIL 130
C      CALL DECATI (NPACK,IND,COMS,LAMS,CRATE,VELD,IC,JC,CPAK)          SOIL 131
C      CALL DECATI (NPACK,IND,COMES,LAMES,CRATE,VELD,IC,JC,CPAK)          SOIL 132
C      *****SOIL 133
C      IF (IMRITE.NE.1) GO TO 10          SOIL 134
C      IMRITE = 1 AND COMPLETE WRITTEN OUTPUT IS GIVEN          SOIL 135
C      WRITE (IOUT,18) TB          SOIL 136
C      WRITE (IOUT,19) UNIT,UNIT,UNIT          SOIL 137
C      *****SOIL 138
C      *****SOIL 139
10     DO 11 IN=1,NPACK          SOIL 140
C      CHANGE COMES TO AIR CONCENTRATION          SOIL 141
C      COMES(IN)=COMES(IN)*PR          SOIL 142
C      IF (IMRITE.NE.1) GO TO 11          SOIL 143
C      WRITE (IOUT,20) IN,STN(IN),COMS(IN),COMIS(IN),COMES(IN)          SOIL 144
11     CONTINUE          SOIL 145
C      *****SOIL 146
C      *****SOIL 147
C      *****SOIL 148
C      IF (IREZUS.NE.1) GO TO 13          SOIL 149
C      CALL RESUC (NPR)          SOIL 150
C      DO 12 IN=1,NPACK          SOIL 151
12     DEPR(IN)=DEPR(IN)+DEPR(IN)          SOIL 152
C      GO TO 15          SOIL 153
13     IF (TA.LE.TB) GO TO 15          SOIL 154
C      DO 14 IN=1,NPACK          SOIL 155
14     DEPR(IN)=0.0          SOIL 156
C      CALL AGROW TO CALCULATE CONCENTRATIONS IN PLANT COMPARTMENTS          SOIL 157
C      USING SOIL CONCENTRATIONS JUST CALCULATED          SOIL 158
15     CALL AGROW (DEPR,COMS,COMS,IFLAG1,PPG,TPG,MUMCC,RLV,REV,RSF,RSF)          SOIL 159
C      *****SOIL 160
C      RETURN          SOIL 161
C      *****SOIL 162
16     FORMAT (A4)          SOIL 163
17     FORMAT (I2,I1,A2,5E8.1,E9.2,E8.1,2E9.2)          SOIL 164
18     FORMAT (/,," OUTPUT FROM SUBROUTINE SOILS.  TB = ",F6.1," YEARS:")          SOIL 165
19     FORMAT ('0','5X','IN',2X,'NUCLIDE',3X,'CONC. IN NON-IRRIGATED SOIL',          SOIL 166
15X,'CONC. IN IRRIGATED SOIL',7X,'EXP. CONC. ON SURFACE',/31X,'(','ASOIL 167
22,'/KG)',22X,'(','A2,'/KG)',21X,'(','A2,'/M**2)',/)          SOIL 168
20     FORMAT (' ',5X,12,'A8,E14.7,15X,E14.7,15X,E14.7)          SOIL 169
C      END          SOIL 170
C      SUBROUTINE STOCK (CONSLV,CONSEV,CONSEF,CONSEF,CONIFC,REV,RSF,RSF,RSF,RSF)          1
17     REV,RSF,RSF,CONIFC,CONIFC,CONIFC,CONIFC,CONIFC,CONIFC,CONIFC          STOC 2
C      REAL*8 STN          STOC 3
C      LOGICAL FIRST          STOC 4
C      REAL IERR,MUMCC,MUMFC,MUMOC,MUMSF,MUMXT,INMC,INFC,INOC,MUPC          STOC 5
18     INC,BC,ED,LAMV,LQFC,INOC,LQFC,LAMB,LAMB,MNC,MPC,LAMB          STOC 6
C      COMMON /CONTR/ INB,IOUT,INS,INL,INC,INF,IOUT,UNIT,IWRITE          STOC 7
C      COMMON /PLANT/ PSIZE(40),CLCL(4,40),STN(40),IAND(40)          STOC 8
C      COMMON /OTHERC/ ELABEF          STOC 9
C      COMMON /OUTPUT/ COMS(40),CONLV(40),CONEV(40),CONPV(40),CONCH(40)          STOC 10
19     ICONREV(40),CONMEX(40),CONRES(40)          STOC 11
C      COMMON /SITED/ ST,IERR,PRECIP,TPV,AYPV,TLV,YSP,AREAP,MUMCC,SALFC          STOC 12
20     IUMMC,MUMSF,PCF,PRF,PSF,UGMID,AREAT,POF,PRUPF,PRUPH,FUBBH,PLV,PEV          STOC 13
C      ZPPV,PCB,DOMEF,MUMXT,AMIXT,TPV,YCH,YCF,FFDAYS,MUMCC          STOC 14
C      COMMON /TABLE2/ ED(40),BV(40),BR(40),PK(40),FF(40),LAMI(40),LAMN(40)          STOC 15
10     LAMB(40),LAMV(40),LAMW(40)          STOC 16
C      COMMON /TABLE3/ DE,DR,RO,THETA,TA,TB,TBLV,TRIV,TRPV,TSG,TSP,TRSP          STOC 17
21     ITCR2,FDRLV,FDREV,FDYTPV,FATG,FRQFC,FRQMC,FRQOC,FRQHP,CRQFC,CRQMC          STOC 18
C      FMC,CRQOC,LQFC,LQFC,FSOC,FSMC,FSFC,MPC,MNC,MLOAD,VELD(40),TBLK,TB          STOC 19
22     JPC,TSGC,TSCF,TSMC          STOC 20
C      COMMON /TCOBS/ SPFCDAY,DAYSFR,SECSFR          STOC 21
C      COMMON /TIMECH/ TIME,ICTYP,ISTYP,IMULT,IDIAG,NPRIME,NCONC,IOUT,NRES          STOC 22
11     NREF,STRUNC,NPACK          STOC 23
C      DIMENSION CONSPG(40), CONSLV(40), CONSEV(40), CONSEF(40), SURPG(40)          STOC 24
23     CONIFC(40), CONIFC(40), INMC(40), INFC(40), INOC(40), INOC(40)          STOC 25
24     CONSC(40), CONOC(40), CONIFC(40), CPAC(40), IC(40), JC(40), CRSTOC          STOC 26
25     MTR(40), CONMC(40), CONCF(40), PRTR(40), PRTH(40)          STOC 27
C      DIMENSION DEPR(1), C(MPC(1)), CONIF(1), CONIF(1), CONIF(1)          STOC 28
26     NAMELIST / NAME4/PRQFC,FRQMC,FRQOC,FRQHP,CRQFC,CRQMC,CRQOC,YPG          STOC 29
27     IPC,TBLK,TSPC,TSOC,TSCF,TSNC,FSOC,FSMC,FSFC,PRTR,LAMB,MNC,MPC,LAMB          STOC 30
28     ZPRTM          STOC 31

```

Determine nuclide concentrations in soils.

Call RESUC if IREZUS = 1.

Call AGROW with the radionuclide concentrations in soils.

```

DATA FIRST/.TRUE./
DATA FRTS/40*-1.0/,FRTH/40*-1.0/
C ATFC = AREAL YIELD OF PASTURE GRASS (KG/M**2)
C CONREF = CONCENTRATION OF NUCLIDE I IN A COMPOSITE OF BEEF FROM
C ALL CATTLE (/KG)
C CONBFC = CONCENTRATION OF NUCLIDE I IN BEEF FROM OTHER CATTLE
C (NOT MILK COWS OR CATTLE ON FEED) (/KG)
C CONBMC = CONCENTRATION OF NUCLIDE I IN BEEF FROM MILK COWS (/KG)
C CONST = CONCENTRATION OF NUCLIDE I IN A FORAGE COMPOSITE
C (WEIGHT% %: THE RELATIVE CONTRIBUTIONS OF PASTURE, HAY,
C AND SILAGE) (/KG)
C CONMLE = CONCENTRATION OF NUCLIDE I IN MILK FROM COWS GRAYING
C (/KG)
C JONSGF = CONCENTRATION OF NUCLIDE I IN GRAIN FEED STORED (/KG)
C FCTIME = FRACTION OF GRAIN FEED IMPORTED
C FRQFC = FORAGE OR FORAGE-EQUIVALENT REQUIREMENT OF CATTLE ON FEED
C (KG/Y)
C FRQMC = FORAGE OR FORAGE-EQUIVALENT REQUIREMENT OF MILK COWS
C (KG/Y)
C FRQOC = FORAGE OR FORAGE-EQUIVALENT REQUIREMENT OF OTHER CATTLE
C (NOT MILK COWS OR CATTLE ON FEED) (KG/Y)
C FRQSHF = FORAGE OR FORAGE-EQUIVALENT REQUIREMENT OF SHEEP (KG/Y)
C GRQFC = GRAIN OR GRAIN-EQUIVALENT REQUIREMENT OF CATTLE ON FEED
C (KG/Y)
C GRQMC = GRAIN OR GRAIN-EQUIVALENT REQUIREMENT OF MILK COWS (KG/Y)
C GRQOC = GRAIN OR GRAIN-EQUIVALENT REQUIREMENT OF OTHER CATTLE
C (KG/Y)
C INBFC = INPUT RATE OF NUCLIDE I TO BEEF FOR CATTLE ON FEED (/S)
C INBMC = INPUT RATE OF NUCLIDE I TO MILK COWS (/S)
C INBOC = INPUT RATE OF NUCLIDE I TO BEEF FOR OTHER CATTLE (/S)
C INBMC = INPUT RATE OF NUCLIDE I TO MILK FOR MILK COWS (/S)
C MNC = MUSCLE MASS OF CATTLE (KG)
C MPC = MILK PRODUCTION (KG/Y)
C MUNC = NUMBER OF OTHER CATTLE
C RATIO5 = RATIO OF GRAIN PRODUCED TO GRAIN EATEN BY CATTLE
C RFC = INTERCEPTION FRACTION FOR PASTURE GRASS
C SLABF = TOTAL NUMBER OF BEEF SLAUGHTERED
C SURFC = ACCUMULATION RATE OF NUCLIDE I ON THE SURFACE OF PASTURE
C GRASS ((KGX))
C IF (.NOT.FIRST) GO TO 4
C FRQFC=9.7E+2
C FRQMC=4.01E+3
C FRQOC=3.03E+3
C FRQSHF=6.0E+2
C GRQFC=1.82E+3
C GRQMC=2.6E+3
C GRQOC=1.5E+2
C TPLK=1.0
C TSFC=1.0
C TSOC=1.0
C TSGF=90.0
C TSNC=6.0
C PSOC=0.153
C PSNC=0.167
C PSFC=1.0
C MPC=13.4
C MNC=250.0
C LQFC=891.0
C LQMC=2108.0
C *****
C CALCULATE FEED TO FLESH OR MILK CONVERSION FACTORS
C IF (FRTS(1).NE.-1.0) GO TO 2
C DO 1 IN=1,NPACK
C FRTS(IN)=FF(IN)*LAMB(IN)*MNC*SECDAY
C IF (FRTH(1).NE.-1.0) GO TO 4
C DO 3 IN=1,NPACK
C FRTH(IN)=FM(IN)*LAMB(IN)*MPC*SECDAY
C IF (INL.CT.0) READ (INL,NAME4)
C FIRST=.FALSE.
C *****
C RATIO5=0.0
C MUNC=SALFC/2.0
C MUNC=MUNC-MUNC-1.5*MUNC
C IF (MUNC.LT.0.0) MUNC=MUNC
C IF (MUNC.EQ.0.0.AND.MUNC.EQ.0.0.AND.MUNC.EQ.0.0) GO TO 5
C GO TO 7
C *****
C IF MUNC=0 AND MUNC=0 AND MUNC=0, WE SKIP CALCULATIONS
C DO 6 IN=1,NPACK
C CONREF(IN)=0.0
C CONMLE(IN)=0.0
C RETURN
C *****
C IF (ATFC.NE.-1.0) GO TO 9
C *****
C CALCULATE PASTURE PARAMETERS
C ATFC=0.0
C YPG=0.0E+0
C MGRZ=0
C MGRZ=IFIX(FFDAYS/TORZ+.5)
C IF (MGRZ.EQ.0) MGRZ=1
C PFC=FRQFC*MUNC+FRQMC*MUNC+FRQSHF*MUNSHF+RQFC*MUNC-7.5E-1*(PRF+
C 178F)

```

Initialize stock-related constants.

Can override stock-related constants with a NAMELIST READ.

If there are no livestock in the area, concentrations in beef compartments are set to zero and further calculations for livestock are skipped.

Determine pasture parameters.

```

C IF PPG LT 0 MEANS FORAGE PRODUCTION ADEQUATE FOR FEED. STOC 125
C PASTURE NOT UTILIZED STOC 126
C IF (PPG.LT.0.0) PPG=0.0 STOC 127
C IF (PPG.EQ.0.0) GO TO 9 STOC 128
C IF (ARRAP.EQ.0.0) ATPG=PPG/ARRAP STOC 129
8 YPG=ATPG/FLOAT(NGRZ) STOC 130
C IF (YPG.EQ.0.0.OR.YPG.GT.0.005) GO TO 9 STOC 131
NGRZ=NGRZ-1 STOC 132
C IF (NGRZ.EQ.0) GO TO 9 STOC 133
GO TO 8 STOC 134
9 IF (RPG.EE.-1.0) GO TO 10 STOC 135
RPG=1.0-EXP(-2.88E+C*TPG) STOC 136
RPGC=RPG STOC 137
YPGC=YPG STOC 138
***** STOC 139
C IF (IWRITE.EE.1) GO TO 11 STOC 140
***** STOC 141
C IWRITE = 1 AND COMPLETE WRITTEN OUTPUT IS GIVEN STOC 142
WRITE (IOUT,27) NGRZ STOC 143
***** STOC 144
C ***** STOC 145
C CALCULATE NUCLEIDE CONCENTRATIONS IN PASTURE GRASS STOC 146
11 DO 12 IN=1,NPACK STOC 147
SURPG(IN)=0.0 STOC 148
C IF (YPG.EE.0.0) SURPG(IN)=DEPR(IN)*RPG/YPG STOC 149
CONSPG(IN)=SURPG(IN) STOC 150
IDIAQ=1 STOC 151
TIME=TCRZ*SECDAY STOC 152
CALL DECATI (NPACK,IND,CONSPG,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 153
CALL DECATI (NPACK,IND,LAMB,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 154
DO 13 IN=1,NPACK STOC 155
CONIPG(IN)=CONIPG(IN)*TPG STOC 156
13 IF (YPG.EE.0.0) CONIPG(IN)=CONIPG(IN)/YPG STOC 157
DO 14 IN=1,NPACK STOC 158
CONPG(IN)=CONIPG(IN)+CONSPG(IN) STOC 159
***** STOC 160
C ***** STOC 161
C RATIOS = RATIO OF GRAIN PRODUCED TO GRAIN EATEN BY CATTLE STOC 162
RATIOS=PGF/(GRQMC*WUMMC+GRQFC*WUMFC+GRQOC*WUMOC) STOC 163
IF (RATIOS.GT.1.0) GO TO 15 STOC 164
GO TO 16 STOC 165
15 RATIOS=1.0 STOC 166
16 FCTIMP=1.0E+0-RATIOS STOC 167
C IF (IWRITE.EE.1) GO TO 17 STOC 168
WRITE (IOUT,28) FCTIMP STOC 169
***** STOC 170
C CALCULATE FORAGE COMPOSITE AND CONCENTRATION IN STORED FEED STOC 171
C THE FOLLOWING CORRECTION ACCOUNTS FOR LOSS DURING STORAGE AND HANDLING STOC 172
17 PHF=7.5E-1*PHF STOC 173
PSF=7.5E-1*PSF STOC 174
DO 18 IN=1,NPACK STOC 175
CONF(IN)=PHF/(PHF+PSF+PPG)*CONF(IN)+PSF/(PHF+PSF+PPG)*CONSF(IN)+PPG STOC 176
IPG/(PHF+PSF+PPG)*CONPG(IN) STOC 177
18 CONSGF(IN)=CONGF(IN) STOC 178
IDIAQ=0 STOC 179
ICTYP=0 STOC 180
TIME=TSOF*SECDAY STOC 181
CALL DECATI (NPACK,IND,CONSGF,SURPG,CRATE,VELD,IC,JC,CPAK) STOC 182
***** STOC 183
C ***** STOC 184
C CALCULATE CONCENTRATIONS IN BEEF AND MILK COMPARTMENTS STOC 185
DO 19 IN=1,NPACK STOC 186
INBMC(IN)=PRTH(IN)*(RATIOS*CONSGF(IN)*GRQMC+FRQMC*CONF(IN))/(SECSYSTOC 187
1E*WFC) STOC 188
INBMC(IN)=PRTH(IN)*(RATIOS*CONSGF(IN)*GRQMC+FRQMC*CONF(IN))/(SECSYSTOC 189
1E*WMC) STOC 190
INBFC(IN)=PRTH(IN)*(RATIOS*CONSGF(IN)*LQQFC+LPQFC*CONF(IN))/(SECSYSTOC 191
1E*WMC) STOC 192
INBOC(IN)=PRTH(IN)*(RATIOS*CONSGF(IN)*GRQOC+FRQOC*CONF(IN))/(SECSYSTOC 193
1E*WMC) STOC 194
CONMLK(IN)=INBMC(IN) STOC 195
CONBFC(IN)=INBFC(IN) STOC 196
CONBMC(IN)=INBMC(IN) STOC 197
19 CONBOC(IN)=INBOC(IN) STOC 198
IDIAQ=1 STOC 199
TIME=TSFC*SECDAY STOC 200
CALL DECATI (NPACK,IND,CONBFC,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 201
TIME=TSOC*SECDAY STOC 202
CALL DECATI (NPACK,IND,CONBOC,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 203
TIME=TMLE*SECDAY STOC 204
CALL DECATI (NPACK,IND,CONMLK,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 205
TIME=TSNC*SECDAY STOC 206
CALL DECATI (NPACK,IND,CONBMC,LAMB,CRATE,VELD,IC,JC,CPAK) STOC 207
SLABF=PSFC*SLAFC+FSOC*WUMOC+FSMC*WUMMC STOC 208
DO 20 IN=1,NPACK STOC 209
CONBFC(IN)=(PSFC*SLAFC+CONBFC(IN)+FSOC*WUMOC+CONBOC(IN)+FSMC*WUMMC) STOC 210
1*CONBMC(IN))/SLABF STOC 211
***** STOC 212
C ***** STOC 213
C IF (IWRITE.EE.1) GO TO 26 STOC 214
***** STOC 215
C IWRITE = 1 MEANS COMPLETE WRITTEN OUTPUT IS GIVEN STOC 216
WRITE (IOUT,29) STOC 216

```

Calculate concentrations in pasture grass.

Calculate concentrations in forage and stored feed.

Calculate concentrations in beef and milk compartments.

```

WRITE (IOUT,31) UNIT                                STOC 217
WRITE (IOUT,32)                                     STOC 218
DO 21 IN=1,NPACK                                    STOC 219
WRITE (IOUT,30) IN,SYN(IN),CONIFC(IN),CONSPC(IN),CONPG(IN) STOC 220
21 CONTINUE                                           STOC 221
WRITE (IOUT,33) UNIT                                STOC 222
DO 22 IN=1,NPACK                                    STOC 223
IF=PIF/(PIF+PSF+PPG)                                STOC 224
SF=PSF/(PIF+PSF+PPG)                                STOC 225
PF=PPG/(PIF+PSF+PPG)                                STOC 226
WRITE (IOUT,34) IN,SYN(IN),CONP(IN),IF,SF,PF         STOC 227
22 CONTINUE                                           STOC 228
WRITE (IOUT,35) UNIT                                STOC 229
DO 23 IN=1,NPACK                                    STOC 230
WRITE (IOUT,30) IN,SYN(IN),CONSG7(IN)                STOC 231
23 CONTINUE                                           STOC 232
WRITE (IOUT,36) UNIT,UNIT,UNIT                      STOC 233
DO 24 IN=1,NPACK                                    STOC 234
WRITE (IOUT,30) IN,SYN(IN),CONIFC(IN),CONPGC(IN),CONPGC(IN) STOC 235
24 CONTINUE                                           STOC 236
WRITE (IOUT,37) UNIT                                STOC 237
DO 25 IN=1,NPACK                                    STOC 238
WRITE (IOUT,30) IN,SYN(IN),CONPLX(IN)                STOC 239
25 CONTINUE                                           STOC 240
*****STOC 241
C *****STOC 242
C *****STOC 243
C *****STOC 244
C *****STOC 245
26 *****STOC 246
C *****STOC 247
C *****STOC 248
27 *****STOC 249
1 *****STOC 250
28 *****STOC 251
177.5) *****STOC 252
29 *****STOC 253
30 *****STOC 254
31 *****STOC 255
1) *****STOC 256
32 *****STOC 257
16X,TOTAL,/) *****STOC 258
33 *****STOC 259
1,A2,/KG),2X,"Y F",6X,"SIL F",5X,"PAST F",/) *****STOC 260
34 *****STOC 261
35 *****STOC 262
IN A SPECIFIED TIME (A2,/KG) /) *****STOC 263
36 *****STOC 264
1FRED",5X,"CONC. IN BEEF FROM OTHER CATTLE",5X,"CONC. IN BEEF FROM *****STOC 265
2MIL",X COWS",/7X,3(3X,(A2,/KG)),/) *****STOC 266
37 *****STOC 267
1GRAZING (A2,/KG),/) *****STOC 268
END *****STOC 269
FUNCTION UNPACK(ZAS) *****UNPA 1
C THE ROUTINE UNPACKS THE ZAS NUMBER TO FIND Z,A, AND WHERE *****UNPA 2
A=Z/1000 *****UNPA 3
ZAS = 10000*Z + 10*A + S *****UNPA 4
C WHERE S = 0 IF THE NUCLIDE IS IN THE NORMAL STATE *****UNPA 5
C S = 1 WHEN IN THE EXCITATION STATE *****UNPA 6
DOUBLE PRECISION NAME,NAMEIN,NAME,UNPACK *****UNPA 7
INTEGER A,ZAS,Z,EXCITE *****UNPA 8
INTEGER*2 NUCNAM(103),ELEMENT *****UNPA 9
LOGICAL*1 LNAME(4,103),HYPERN,M,LBLANK,LONAME(8),DIGIT(10) *****UNPA 10
EQUIVALENCE (LNAME(1),NUCNAM(1)),(LONAME(1),NAME), *****UNPA 11
- (ELEMENT,NAME) *****UNPA 12
DATA HYPERN/'-','M','M','L',LBLANK/' ',DIGIT/'0','1', *****UNPA 13
- '2','3','4','5','6','7','8','9'/ *****UNPA 14
DATA LBLANK/8 *****UNPA 15
DATA NUCNAM/2HR-, 2HNE, 2HLI, 2HNE, 2HB-, 2HC-, 2HN-, *****UNPA 16
- 2HO-, 2HF-, 2HNE, 2HNA, 2HMG, 2HAL, 2HSI, 2HP-, *****UNPA 17
- 2HS-, 2HCL, 2HAR, 2HK-, 2HCA, 2HSC, 2HTI, 2HV-, 2HCR, *****UNPA 18
- 2HMH, 2HFE, 2HCO, 2HNI, 2HCU, 2HZN, 2HGA, 2HGE, 2HAS, *****UNPA 19
- 2HSE, 2HBR, 2HBR, 2HBR, 2HBR, 2HY-, 2HZE, 2HNE, 2HMO, *****UNPA 20
- 2HIC, 2HRO, 2HBR, 2HPO, 2HAC, 2HCD, 2HIN, 2HSM, 2HSE, *****UNPA 21
- 2HTE, 2HFI-, 2HKE, 2HCS, 2HBA, 2HLA, 2HCE, 2HPR, 2HND, *****UNPA 22
- 2HFM, 2HSM, 2HEU, 2HGO, 2HTS, 2HUY, 2HMO, 2HBR, 2HPT, *****UNPA 23
- 2HVB, 2HLU, 2HNF, 2HTA, 2HW-, 2HRE, 2HOS, 2HIB, 2HPT, *****UNPA 24
- 2HAD, 2HRC, 2HTL, 2HPS, 2HBI, 2HPO, 2HAT, 2HBR, 2HPR, *****UNPA 25
- 2HRA, 2HAC, 2HTH, 2HFA, 2HU-, 2HNP, 2HPU, 2HAM, 2HCH, *****UNPA 26
- 2HBE, 2HCF, 2HES, 2HFM, 2HMD, 2HNO, 2HLW/ *****UNPA 27
NAME=BLANK *****UNPA 28
Z-ZAS/10000 *****UNPA 29
ITEMP=ZAS-Z*10000 *****UNPA 30
A=ITEMP/10 *****UNPA 31
EXCITE=ITEMP-A*10 *****UNPA 32
IF(Z,GRAND.Z.LE.103) GO TO 10 *****UNPA 33
WRITE(6,10100) Z,ZAS *****UNPA 34
10100 FORMAT('Z NUMBER NOT IN LIST = ',15,' ZAS = ',110) *****UNPA 35
RETURN *****UNPA 36
10 ELEMENT=NUCNAM(Z) *****UNPA 37
I=0 *****UNPA 38
J=0 *****UNPA 39

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      IP=3
      IF(LOWAME(1).EQ.HYPHEN) GO TO 20
      LOWAME(IP)=HYPER
      IP=IP+1
20  IF(A.LT.100) GO TO 30
      I=A/100
      LOWAME(IP)=DIGIT(I+1)
      IP=IP+1
30  IF(A.LT.10) GO TO 40
      J=A-100*I
      J=J/10
      LOWAME(IP)=DIGIT(J+1)
      IP=IP+1
40  K=A-100*I - 10*J
      LOWAME(IP)=DIGIT(K+1)
      IP=IP+1
      IF(EXCITE.EQ.0) LOWAME(IP)=M
      IP=IP+1
      IF(EXCITE.GT.1) LOWAME(IP)=DIGIT(EXCITE+1)
      UNPACK=NAME
      RETURN
C
C THIS ENTRY PERFORMS THE REVERSE TRANSFORMATION.
C FROM THE ALPHANUMERIC NUCLIDE NAME TO THE ZAS NUMBER.
C
      ENTRY ID(NAMEIN)
      NAME=NAMEIN
      DO 100 I=1,103
        IF(ELEMENT.EQ.NUCNAM(I)) GO TO 110
        CONTINUE
100  WRITE(6,10200)ELEMENT
10200 FORMAT(' ELEMENT NAME: ',A1,' NOT FOUND')
      ID=0
      RETURN
110  IS=0
      IA=0
      IZ=1
      IP=4
      IF(LOWAME(2).EQ.HYPHEN) IP=3
120  DO 140 I=1,10
        IF(LOWAME(IP).EQ.DIGIT(I)) GO TO 150
        CONTINUE
140  IA=IA*10+I-1
      IP=IP+1
      IF(LOWAME(IP).EQ.LBLANK) GO TO 210
      IF(LOWAME(IP).EQ.M) GO TO 180
      GO TO 120
180  IS=1
      IP=IP+1
      IF(LOWAME(IP).EQ.LBLANK) GO TO 210
      DO 190 I=1,10
        IF(LOWAME(IP).EQ.DIGIT(I)) GO TO 200
        CONTINUE
190  IS=1+I
200  ID=IZ*10000+IA*10+IS
      RETURN
210  END
      SUBROUTINE BACK (K1, L, CONC)
C
C * CALLED FROM DECAVC *
C
C PUTS CHAIN RESULTS, QIN, BACK INTO CONC, AFTER ADDING
C SHORT-LIVED NUCS.
C
      COMMON /DECAR/ S(37,37), QIN(37,37), REM(37)
      COMMON /DECON/ NCELP, NCREL, NS, NS1, JS, JS1,
      * JSHORT, KSHORT, QTOT
C
      DIMENSION CONC(K1, 1)
C
      IF (NCELP .EQ. L) GO TO 30
      IF (KSHORT .GT. L) GO TO 30
      IF (KSHORT .EQ. 0) CALL ERROR
      DO 22 J = 1, NCREL
        START MOVE FROM L TO L + 1.
        I = L + 2
        DO 20 I1 = KSHORT, L
          MOVES L - KSHORT + 1 NUMBER OF PLACES.
          I = I - 1
20  QIN(I,J) = QIN(I-1, J)
22  CONTINUE
      IF (JSHORT .EQ. 0) GO TO 30
      IF (JSHORT .GT. L + 1) GO TO 30
      DO 28 J = 1, NCREL
        I = L + 3
        START MOVE AT L + 1 TO L + 2.
        DO 26 I1 = JSHORT, L
          MOVES I - JSHORT + 1 NO. OF PLACES.
          I = I - 1
26  QIN(I,J) = QIN(I-1, J)
28  CONTINUE
30  CONTINUE

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C
C PUT BACK INTO CONC...
C
C J = 0
C I = 0
C DO 40 J1 = JS1, JS
C J = J + 1
C DO 38 N1 = NS1, NS
C I = I + 1
C 38 CONC(N1, J1) = QIN(I, J)
C 40 I = 0
C RETURN
C END
C SUBROUTINE CONVT (NPRIME)
C
C * CALLED FROM DECATC *
C
C PURPOSE IS TO SKIP PRINTS TRUNCATED SOURCE RECORD, OR CONVERT CONC
C FROM IT TO FULL SIZE CONC, IF A RETARD CODE CASE...
C
C READ (NPRIME)
C RETURN
C END
C SUBROUTINE DECAT (L, JIML, C, H, D, E, F, A)
C
C * CALLED FROM DECATC *
C
C PREPARES ARRAYS AND CALLS THE DECAY SUBRS. & APPLIES EITHER
C DECAY OR INTEGRAL MODEL.
C
C DOUBLE PRECISION C(L,L), B(L,L), D(L,L), E(L,L), F(L,L),
C * A(L,L), FACT
C *, OQQ(37)
C REAL*8 DC1, DC2
C
C COMMON /TIMECH/ TIME, ICTYP, ISTYP, INULT, IDIAG, NPRIME, NCONC,
C * KOUT, NREL, NEXP, NTRUNC, NPACK
C COMMON /DECAR/ S(37,37), QIN(37,37), REM(37)
C COMMON /DECONS/ NCEXP, NCREL, NS NS1, JS, JS1,
C * JSHORT, KSHORT, QTOT
C
C INTEGER JIML(1)
C LOGICAL PASS2
C
C NIOR4 = 1
C PASS2 = .FALSE.
C 2 IF (PASS2) NIOR4 = 4
C DO 6 I = 1, L
C DO 6 J = 1, L
C C(J,I) = 0.0D0
C 6 N(J,I) = 0.0D0
C DO 10 I = 1, L
C DO 10 J = 1, L
C C(J,I) = S(J,I)
C IF (IDIAG .EQ. 1 .AND. J .EQ. I) C(I,J) = C(I,J) - REM(I)
C 10 C(J,I) = C(J,I) * TIME
C CALL DECP (L, F, NP, KOUT, C, H, NFORM)
C SUBR. DECP COMPUTES WELL-BEHAVED R-MATRIX FROM C / 2**NP, AFTER
C DETERMINING NP SUCH THAT THE NORM, NFORM < 0.25
C
C 14 NTR = L - 2 * NP + 5
C ASSURES AT LEAST 5 TERMS IN EXPANSION....
C IF (NTR .LT. 5) NTR = 5
C AND AT LEAST 5 TERMS IN EXP EXPANSION
C
C CALL DECEX (L, NTR, D, E, H, A)
C
C SUBR. DECEX COMPUTES D-MATRIX = EXP(H-MATRIX)...
C
C CALL DECD (L, NP, D, E, F, H, A)
C
C SUBR. DECD COMPUTES D(C) FROM D(H) AND H, IN RECURSION RELATIONSHIP.
C
C IF (ICTYP .NE. 0) GO TO 50
C NEXT APPLY MODEL FOR REGULAR DECAY AND INGROWTH.
C DO 22 I = 1, L
C DO 22 J = 1, L
C A(J,I) = 1.0D50
C IF (D(J,I) .EQ. 0.0D0) GO TO 22
C A(J,I) = DABS(1.0D-74 / D(J,I))
C 22 F(J,I) = 0.0D0
C DO 30 I = 1, L
C DO 30 J = 1, L
C DC1 = 0.0D0
C DC2 = 0.0D0
C DO 30 K = J, I
C IF (DABS(C(K,I)) .LT. A(J,K)) GO TO 30
C IF (C(K,I) .EQ. 0.0D0) GO TO 30
C IF (J .EQ. I) GO TO 28
C IF (K .EQ. I) DC2 = C(K,I) * D(J,K)
C IF (K .NE. I) DC1 = C(K,I) * D(J,K) + DC1

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      IF (K.NE.1) GO TO 28
      IF (DC2.NE.0.000) GO TO 28
      IF (DC1.NE.0.000) GO TO 28
      IF (1.000 + DC2 / DC1 .GT. 1.00-11) GO TO 28
C
C   THERE ARE 2 PRODUCTS OF E * C NEARLY EQUAL. LOSS OF TOO MUCH
C   PRECISION IS AVOIDED BY USING 1/4 * TIME AND LOOP 4 TIMES THRU DO 44
C
      IF (.NOT. PASS2) GO TO 80
      IF (DABS(1.000 + DC1 / DC2) .GT. 3.00-16) GO TO 28
      F(J,I) = 3.00-16 * DC1
      GO TO 30
28 CONTINUE
      F(J,I) = F(J,I) * C(K,I) * D(J,K)
30 CONTINUE
      DO 44 KJ = 1, NCRJL
      DO 40 NPAS4 = 1, NIPAS4
      DO 31 J = 1, L
31 QQQ(J) = QIN(J,KJ)
      J1 = JIML(KJ)
      DO 32 I = 1, L
      E(I,1) = 0.000
      A(I,1) = 1.0050
      IF (QIN(I,KJ) .GT. 1.0) A(I,1) = 1.00-74
      IF (QIN(I,KJ) .GT. 1.0) GO TO 32
      IF (QIN(I,KJ) .EQ. 0.0) GO TO 32
      A(I,1) = ABS(1.0E-74 / QIN(I,KJ))
32 E(I,1) = 0.000
      DO 34 I = J1, L
      DO 34 J = J1, I
      IF (DABS(F(J,I)) .LT. A(J,I)) GO TO 34
      IF (QIN(J,KJ) .EQ. 0.0) GO TO 34
      IF (J.NE. J) GO TO 33
      IF (F(J,I) .GT. 0.000) CALL ERROR
      IF (1.000 + F(J,I) .GT. 1.00-11) GO TO 33
      E(I,2) = 1.000
      GO TO 34
33 CONTINUE
      E(I,1) = E(I,1) + F(J,I) * QQQ(J)
34 CONTINUE
      DO 38 J = 1, L
      IF (E(J,2) .GT. 0.000) GO TO 37
      IF (J .GE. J1) GO TO 36
      IF (QIN(J,KJ) .EQ. 0.0) GO TO 38
      CALL ERROR
C
C   NOTE, E(J,1) = DIFF. IN QIN, ADD QIN...
C
36 QQQ(J) = E(J,1) + QQQ(J)
      GO TO 38
37 EXPO = DABS( C(J,J) )
      EXPO = 0.0
      IF (EXPO .LT. 172.0) EXPO = EXP(-EXPO)
      EXPO = 0.0
      IF (EXPO .GT. 0.0) X = ALOG10(EXPO)
      IF (QIN(J,KJ) .GT. 0.0) X = X + ALOG10(QIN(J,KJ))
      IF (X .LT. -74.0) EXPO = 0.0
      QQQ(J) = E(J,1) + EXPO * QQQ(J)
C
C   NEED TO AVOID A DIFF. IN 1.0 AND F THAT IS LESS THAN 10**(-11)
C   THEN, REPLACE FF WITH SIMPLY THE SMALL ELEMENT. = DEFP(C(J,J))
C
C   THIS AVOIDS >100% ERRORS IN REMAINING FRACTIONS WHICH < 10**(-15).
C
38 CONTINUE
      DO 39 J = 1, L
39 QIN(J,KJ) = QQQ(J)
40 CONTINUE
44 CONTINUE
      IF (PASS2) TIME = TSAVF
      GO TO 100
50 CONTINUE
C
C   NEXT, APPLY MODEL FOR INTEGRATED OR ACCUMULATED QUANTITY FROM INPUT
C   RATE. IT IS TIME * D * (EACH QIN VECTOR FOR J1 NUC).
C
      DO 70 KJ = 1, NCRJL
      J1 = JIML(KJ)
      DO 60 I = 1, L
      A(I,1) = 1.0050
      IF (QIN(I,KJ) .EQ. 0.0) GO TO 60
      A(I,1) = ABS(1.0E-74 / QIN(I,KJ))
60 E(I,1) = 0.000
      DO 64 I = J1, L
      DO 64 J = J1, I
      IF (DABS(D(J,I)) .LT. A(J,I)) GO TO 64
      F(I,1) = E(I,1) + D(I,1) * QIN(I,KJ)
64 CONTINUE
      DO 68 J = 1, L
      IF (J .GE. J1) GO TO 68
      IF (QIN(J,KJ) .EQ. 0.0) GO TO 68
      CALL ERROR
66 QIN(J,KJ) = E(J,1) * TIME
68 CONTINUE

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70 CONTINUE
GO TO 100
80 PASS2 = .TRUE.
TSAVE = TIME
TIME = TIME / 4.0
GO TO 2
100 RETURN
END
SUBROUTINE DECATC (K1, IND, CONC, REMLAN, CRATE, VELD,
* IC, JC, CPAR)
C
C PERFORMS EITHER DECAY OR INTEGRAL MODEL OF NUCLIDE DECAY & INGROWTH.
C
C <<<ANSWERS>>> RETURNED IN CONC(I,J), I=1,NEXP, J=1,NREL-----
C
C MODEL CONTROLLED FROM FLAGS BELOW...
C
C ICTYP=0 REGULAR DECAY & INGROWTH MODEL, CURIES INPUT.
C ICTYP=1 INTEGRAL OF DECAY MODEL, CURIES/SEC USUALLY INPUT.
C
C ISTYP=0 READ SOURCE FROM NCONC, NOT MADE BY PRIMUS.
C ISTYP=1 READ SOURCE FROM NPRIME, MADE BY PRIMUS CODE.
C ISTYP=2 SOURCE SUPPLIED IN CONC - ARRAY, WITH NO READS.
C
C IMULT=0 NO MULTIPLICATION OF CONC.
C IMULT=1 MAX. CONC = CONC * VELD (OR EXTR), FOR SOURCE RATE.
C IMULT=2 MAKE CONC = CONC * CRATE, SUPPLIED AS ARGUMENT.
C
C IDIAG=0 MATRIX DIAGONAL UNCHANGED.
C IDIAG=1 ADD TO DECAY CONSTANTS OTHER REMOVAL CONS., FROM REMLAN.
C
C IKEEP=0 STARTING CONC NOT SAVED.
C IKEEP=1 STARTING CONC ARE SAVED IN CONAR(NEXP,NREL).
C
C KTRUNC=0 CPAR INCLUDES FULL-SIZE OF DECAY CHAINS.
C KTRUNC=1 CPAR INCLUDES ONLY PART OF DECAY CHAIN.
C
C ....OTHER DEFINITIONS....
C
C NPRIME = UNIT NO. OF PRIMUS DATA SET.
C
C NCONC = UNIT NO. OF ANEMOS OR OTHER CODE DATA SET.
C
C THESE ARGUMENTS SENT, IF OPTIONS REQUIRE THEM.
C
C CPAR SHOULD ALWAYS BE SENT, IF ISTYP .NE. 2. FOR STORING PACKED INPUT.
C READ FROM NPRIME OR NCONC. THE INPUT IS RETURNED IN CPAR.
C
C CONC SHOULD ALWAYS BE SENT, FOR STORING UNPACKED ANSWERS.
C
C K1 SHOULD ALWAYS BE SENT AS NEXP (OR, NREXP), NO. OF EXP. NUCL.
C
C REMLAN(NEXP) > 0, ADDITIONAL REMOVAL RATE CONSTANTS.
C
C CRATE(NEXP) = , FACTORS TIMES CONC TO GET INPUT SOURCE RATES.
C
C ARGUMENTS RETURNED, PER OPTION.
C
C IND = CONC-TYPE INDICATOR. = 1 FOR AIR CONC.. = 5 FOR MILK CONC..ETC.
C
C VELD(NEXP) = DEPOSITION RATES READ FROM DATA SET (EITHER DATA SET).
C
C
C DIMENSION CONC(K1,1), REMLAN(1), CRATE(1), VELD(1), JIML(37)
C DIMENSION CPAR( 1), IC( 1), JC( 1)
C
C DOUBLE PRECISION C(1370), H(1370), D(1370), E(1370), F(1370).
C * A(1370)
C
C COMMON /TIMECM/ TIME, ICTYP, ISTYP, IMULT, IDIAG, NPTIME, NCONC,
C * KOU, NREL, NEXP, KTRUNC, NPACK
C COMMON /DECAR/ S(37,37), QIN(37,37), REM(37)
C COMMON /DECONS/ NCEXP, NCREL, NS, NS1, JS, JS1,
C * JSHORT, KSHORT, QTOT
C
C 2 IF(ISTYP .LT. 0 .OR. ISTYP .GT. 2) CALL EPROR
C 3 IF(ICTYP .LT. 0 .OR. ICTYP .GT. 1) CALL EPROR
C 4 IF(IMULT .LT. 0 .OR. IMULT .GT. 2) CALL EPROR
C 5 IF(IDIAG .LT. 0 .OR. IDIAG .GT. 1) CALL EPROR
C 7 IF(KTRUNC.LT. 0 .OR. KTRUNC.GT. 1) CALL EPROR
C IF (KOUT .EQ. 40)
C *WRITE(KOUT,12) ICTYP, ISTYP, IMULT, IDIAG,KTRUNC, IKEEP, TIME
C 12 FORMAT(1X,6H:ICTYP=,11,7H ISTYP=,11,7H IMULT=,11,7H IDIAG=,11,
C *8H KTRUNC=,11, 7H IKEEP=,11,6H TIME=,1PE14.7)
C IF (ISTYP .EQ. 2) GO TO 10
C DO 8 J = 1, NREL
C DO 8 I = 1, NEXP
C 8 CONC(I,J) = 0.0
10 CONTINUE

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DECC 84

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      REVISED NPRINT
      READ (NPRINT) NUNCHA, NTRUNC, NPACK
      READ (NPRINT) (IC(N), N = 1, NPACK),
      * (JC(I), I = 1, NPACK)
      IGO = ISTYP + 1
      GO TO (20, 30, 40), IGO
C
C      READ SOURCE FROM NCONC, SINCE ISTYP=0.
C
20 IF (IMULT.EQ. 1) READ(NCONC) IN, (CPAK(I), I = 1, NPACK)
   * (VELD(K), K = 1, NEXP)
   IF (IMULT.NE. 1) READ(NCONC) IN, (CPAK(I), I = 1, NPACK)
   IF (NTRUNC.EQ. 1) CALL CONVRT (NPRINT, CONC, VELD, IC, JC, NPACK)
C   IF (KOUT.EQ. 40) WRITE(KOUT,24)
24 FORMAT (IX, 24HREAD SOURCE FROM NCONC )
   GO TO 50
C
C      READ SOURCE FROM NPRINT, SINCE ISTYP=1.
C
30 N2 = NREL + NEXP + 2
   IF (IMULT.EQ. 1) READ (NPRINT) (CPAK(I), I = 1, NPACK),
   * (VELD(K), K = 1, NEXP)
   IF (IMULT.NE. 1) READ (NPRINT) (CPAK(I), I = 1, NPACK)
   IF (NTRUNC.EQ. 1) READ (NPRINT)
C   IF (KOUT.EQ. 40) WRITE(KOUT,34)
34 FORMAT (IX, 24HREAD SOURCE FROM NPRINT )
   GO TO 50
C
C      SOURCE SUPPLIED IN CONC, SINCE ISTYP=2.
C
40 READ (NPRINT)
   IF (NTRUNC.EQ. 1) READ (NPRINT)
C   IF (KOUT.EQ. 40) WRITE(KOUT,44)
44 FORMAT (IX, 28HSOURCE SUPPLIED IN CONC )
   GO TO 52
50 IF (K.NE. 1) GO TO 52
   DO 51 I = 1, NPACK
51 CONC( IC(N), JC(N) ) = CPAK(N)
52 JGO = IMULT + 1
   GO TO (80, 54, 64), JGO
C
C      MULTIPLY CONC = VELD
C
54 DO 56 J = 1, NREL
   DO 56 I = 1, NEXP
56 CONC(I,J) = CONC(I,J) * VELD(I)
C   IF (KOUT.EQ. 40) WRITE(KOUT,58)
58 FORMAT (IX, 28HCONC MULTIPLIED BY VELD )
   GO TO 80
C
C      MULTIPLY CONC = CRATE
C
64 DO 66 J = 1, NREL
   DO 66 I = 1, NEXP
66 CONC(I,J) = CONC(I,J) * CRATE(I)
C   IF (KOUT.EQ. 40) WRITE(KOUT,68)
68 FORMAT (IX, 28HCONC MULTIPLIED BY CRATE )
80 NS = 0
   JS = 0
   READ (NPRINT)
C
C      NS, JS, SET FOR CHAIN POINTERS IN EXTRAC & BACK...
C
1. (KOUT.EQ. 40 .AND. ICTYP.EQ. 0) WRITE(KOUT,82)
   IF (KOUT.EQ. 40 .AND. ICTYP.EQ. 1) WRITE(KOUT,84)
   IF (KOUT.EQ. 40 .AND. IDIAG.EQ. 1) WRITE(KOUT,86)
C 82 FORMAT (IX, 38HTIME-DEPENDENT DECAY MODEL )
 84 FORMAT (IX, 38HTIME-INTEGRAL OF SOURCE-DECAY MODEL )
 86 FORMAT (IX, 43HREMOVAL CONSTANTS ADDED TO DECAY CONST. MTS )
   DO 100 NC = 1, NUNCHA
C
C      PROCESS NEXT CHAIN RECORD...
C
      READ (NPRINT) L, ISQ, NCKXP, NCREL, KSHORT, JSHORT,
      * ((S(J,I), J=1,L), I=1,L), (JINL(K), K = 1, NCREL)
      IF (NTRUNC.EQ. 1) READ (NPRINT)
      IF (NEXP.EQ. 1) GO TO 90
      CALL EXTRAC (K1, L, CONC, NRELAN)
C
C      EXTRACTS SOURCE FROM CONC FOR NC CHAIN.
C
      IF (QTOT.EQ. 0.0) GO TO 100
      CALL DECAIT (L, JINL, C, N, D, F, F, A)
C
C      PERFORMS TYPE OF DECAY WANTED FROM ICTYP & IDIAG...
C
      CALL BACK (K1, L, CONC)
C
C      STORES RESULTS PROPERLY IN CONC.
C
      GO TO 100

```

```

DECC 85
DECC 86
DECC 87
DECC 88
DECC 89
DECC 90
DECC 91
DECC 92
DECC 93
DECC 94
DECC 95
DECC 96
DECC 97
DECC 98
DECC 99
DECC 100
DECC 101
DECC 102
DECC 103
DECC 104
DECC 105
DECC 106
DECC 107
DECC 108
DECC 109
DECC 110
DECC 111
DECC 112
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DECC 158
DECC 159
DECC 160
DECC 161
DECC 162
DECC 163
DECC 164
DECC 165
DECC 166
DECC 167
DECC 168
DECC 169
DECC 170
DECC 171
DECC 172
DECC 173
DECC 174
DECC 175
DECC 176

```

```

90 NS = NS + 1
JS = JS + 1
IF (IDLAG.EQ. 0) C(1) = S(1,1) * TIME
IF (IDLAG.GT. 0)
  *C(1) = (S(1,1) - REMLAN(NS)) * TIME
  EXPOW = C(1)
  IF (ICTYP.EQ. 1) GO TO 96
  IF (EXPOW.LT. -178.0) CONC(NS,JS) = 0.0
  IF (EXPOW.LT. -178.0) GO TO 100
  EXX = EXP(-EXPOW)
  IF (CONC(NS,JS).GT. 1.0) GO TO 94
  IF (CONC(NS,JS).LE. 0.0) GO TO 100
  IF (EXX.LT. 1.0E-74 / CONC(NS,JS)) CONC(NS,JS) = 0.0
94 CONC(NS,JS) = CONC(NS,JS) * EXX
GO TO 100
DECC 177
DECC 178
DECC 179
DECC 180
DECC 181
DECC 182
DECC 183
DECC 184
DECC 185
DECC 186
DECC 187
DECC 188
DECC 189
DECC 190
DECC 191
C
C BELOW IS THE INTEGRAL OF A RATE IN CONC...
DECC 192
C
DECC 193
C
DECC 194
C
DECC 195
C
DECC 196
C
DECC 197
C
DECC 198
C
DECC 199
C
DECC 200
C
DECC 201
C
DECC 202
C
DECC 203
96 CH = CONC(NS,JS) * TIME / (DABS(C(1)))
CONC(NS,JS) = CH
IF (EXPOW.LT. -178.0) GO TO 100
EXDIF = -EXPOW
IF (EXDIF.GT. 1.0E-4) EXDIF = 1.0 - EXP(EXPOW)
CONC(NS,JS) = CH * EXDIF
DECC 204
DECC 205
DECC 206
DECC 207
DECC 208
DECC 209
100 CONTINUE
DECC 210
REWIND NPRIME
DECC 211
RETURN
DECC 212
END
SUBROUTINE DECAVI(KEXP,IND,X,REMLAN,CRATE,VELD,IC,JC,CPAK)
DECI 1
C
DECI 2
C CALLED IN PLACE OF DECAVC, ALWAYS, WHEN X IS A PACKED ARRAY -
DECI 3
C AS INPUT FROM PRESENT AREMOS DATA SET. THIS SUBROUTINE
DECI 4
C PROVIDES AN INTERFACE TO DECAVC BY UNPACKING X TO C, CALLS
DECI 5
C DECAVC, AND REPACKS C TO X. ** NOTE ** THIS SUBROUTINE MAY NOT
DECI 6
C BE CALLED UNLESS ISTYP=2, WHERE SOURCE IS NOT READ BY DECAVC BUT
DECI 7
C SENT IN X. DWN 7/22/82.
DECI 8
C
DECI 9
C
DECI 10
COMMON/TIMECH/ TIME,ICTYP,ISTYP,INULY,IDIAG,NPRIME,NOCONC,
DECI 11
- KOUT,NREL,NEXP,ETRUNC,NPACK
DECI 12
DIMENSION C(5000),X(1),REMLAN(1),CRATE(1),VELD(1),
DECI 13
- IC(1),JC(1),CPAK(1)
DECI 14
DATA JCALL/O,C/5*0.0/
DECI 15
IF(ISTYP.EQ.2) GO TO 8
DECI 16
WRITE(KOUT,4) ISTYP
DECI 17
4 FORMAT('1 ISTYP =',12,' MAY NOT CALL DECAVI UNLESS =2')
DECI 18
CALL ERROR
DECI 19
C
DECI 20
8 IF(JCALL.GT.0) GO TO 16
DECI 21
8 JCALL=1
DECI 22
REWIND NPRIME
DECI 23
READ(NPRIME)N1,N2,K
DECI 24
READ(NPRIME)(IC(N),N=1,NPACK),(JC(1),I=1,NPACK)
DECI 25
16 CALL UNPAKX(NREL,NEXP,NPACK,X,C,IC,JC)
DECI 26
CALL DECAVC(KEXP,NEXP,C,REMLAN,CRATE,VELD,IC,JC,CPAK)
DECI 27
CALL PACKX(NREL,NEXP,NPACK,X,C,IC,JC)
DECI 28
RETURN
DECI 29
END
DECI 30
C
UNFX 1
SUBROUTINE UNPAKX(NREL,NEXP,NPACK,X,C,IC,JC)
UNFX 2
C
UNFX 3
C CALLED FROM DECAVI. UNPACKS X TO C(NEXP,NREL) FOR CONC IN
UNFX 4
C DECAVC -- DWN
UNFX 5
C
UNFX 6
DIMENSION X(1),C(NEXP,NREL),IC(1),JC(1)
UNFX 7
DO 2 J=1,NREL
UNFX 8
DO 2 I=1,NEXP
UNFX 9
2 C(I,J)=X(1)
UNFX 10
C
UNFX 11
ZERO X, SINCE ONLY PARTLY FILLED
UNFX 12
DO 4 N=1,NPACK
UNFX 13
4 C(IC(N),JC(N))=X(N)
UNFX 14
RETURN
UNFX 15
END
UNFX 16
C
PACK 1
SUBROUTINE PACKX(NREL,NEXP,NPACK,X,C,IC,JC)
PACK 2
C
PACK 3
C CALLED FROM DECAVI. PACKS C INTO X FOR RETURN FROM DECAVC - DWN
PACK 4
C
PACK 5
DIMENSION X(1),C(NEXP,NREL),IC(1),JC(1)
PACK 6
DO 2 N=1,NPACK
PACK 7
2 X(N)=C(IC(N),JC(N))
PACK 8
RETURN
PACK 9
END
PACK 10

```

```

      SUBROUTINE DECD (L, NP, B, E, F, H, A)
C
C ..FINDS D(C), GIVEN H OF L*L SIZE AND NP= P NUMBER OF HALVES..
C
C ..NOTE LEFT-HAND INDEX OF MATRICES DENOTES THE COLUMN OF MATRIX...
C
C
      REAL*8 D(L,L), E(L,L), F(L,L), H(L,L), ONE, POW2, A(L,L)
      * , DC1, DC2
C
      IF (NP .EQ. 0) RETURN
      ONE = 1.0D0
      NUM = NP
      POW2 = 0.5D0
      DO 20 N=1,NUM
      DO 1 K=1,L
      DO 1 J=1, K
      A(J,K) = 1.0D50
      IF (D(J,K) .EQ. 0.0D00) GO TO 1
      A(J,K) = DABS(1.0D-74 / D(J,K) )
1 CONTINUE
      DO 2 I=1,L
      DO 2 J=1, I
      F(J,I) = 0.0D0
2 E(J,I) = 0.0D0
      DO 4 I=1,L
      DO 4 J=1, I
      DC1 = 0.0D0
      DC2 = 0.0D0
      DO 4 K = J, I
      IF (DABS(H(K,I)).LT. A(J,K) ) GO TO 4
      IF (J .EQ. I) GO TO 3
      IF (K .EQ. I) DC2 = H(K,I) * D(J,K)
      IF (K .EQ. I) DC1 = H(K,I) * D(J,K) + DC1
      IF (K .EQ. I) GO TO 3
      IF (DC2 .EQ. 0.0D0) GO TO 3
      IF (DC1 .EQ. 0.0D0) GO TO 3
      IF (1.0D0 + DC2 / DC1 .GT. 3.0D-16) GO TO 3
      F(J,I) = 3.0D-16 * DC1
      GO TO 4
3 CONTINUE
      F(J,I) = F(J,I) + H(K,I) * D(J,K)
4 CONTINUE
C
      DO 6 I=1,L
      DO 6 J=1, I
      F(J,I) = F(J,I) * POW2
      DO 8 I=1,L
      F(I,I) = F(I,I) + ONE
C
      DO 10 I=1,L
      DO 10 J=1, I
      DO 10 K = J, I
      IF (DABS(F(J,K)).LT. A(K,I) ) GO TO 10
      E(J,I) = E(J,I) + D(K,I) * F(J,K)
10 CONTINUE
      DO 12 I=1,L
      DO 12 J=1, I
      D(J,I) = E(J,I)
20 POW2 = 2.0D0 * POW2
      RETURN
      END
      SUBROUTINE DECEX(L, NTR, D, F, Y, A)
C
C -----WRITTEN FOR ANEWS CODE BY O. W. HERMANN, 8/1/80.
C
C
C ** CALLED FROM SUBR. DECAY **
C
C ..THIS SUBR. CALCS. D(N) = H**(-1) * (EXP(H) - 1)
C USING SUM(K) = (H**K / (FACTORIAL(K+1))), K=0,NTR.
C OR, D(N) = 1 + H/2 + H**2/(2*3) + ....H**K / (2*3*...K+1) ...
C OR, D(N) = 1 + (H/2)*(1+(H/3)*(1+(H/4)*....*(1+(H/NTR))))
C ..GIVEN H OF L*L SIZE AND NTR, NO. OF TERMS WEEDED.
C
C ..NOTE LEFT-HAND INDEX OF MATRICES DENOTES THE COLUMN OF MATRIX...
C
C
      REAL*8 D(L,L), F(L,L), * L,L), FAC, ONE, A(L,L)
C
      ONE = 1.0D0
      IF (NTR .LT. 2) NTR = 2
      FAC = NTR
      DO 1 I=1,L
      DO 1 K=1, I
      A(K,I) = 1.0D50
      IF (H(K,I) .EQ. 0.0D00) GO TO 1
      A(K,I) = DABS(1.0D-74 / H(K,I) )
1 CONTINUE
      DO 4 I=1,L
      DO 4 J=1, I
      F(J,I) = 0.0D0
      D(J,I) = H(J,I) / FAC
      DO 14 N=2,NTR

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```

      DECD 1
      DECD 2
      DECD 3
      DECD 4
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      DECD 6
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      DECD 62
      DECEX 1
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      DECEX 6
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      DECEX 14
      DECEX 15
      DECEX 16
      DECEX 17
      DECEX 18
      DECEX 19
      DECEX 20
      DECEX 21
      DECEX 22
      DECEX 23
      DECEX 24
      DECEX 25
      DECEX 26
      DECEX 27
      DECEX 28
      DECEX 29
      DECEX 30

```

```

C  WRITE(6,22) B
C  WRITE(6,22) B
C 22 FORMAT (5E20.7)
C 22 FORMAT ( 4E20.7)
      DO 6 I=1,L
      S(I,I) = D(I,I) + ONE
      IF (X.NQ.NTH) GO TO 1A
      FAC = FAC - ONE
      DO 8 I=1,L
      DO 8 J=1,I
      DO 8 K = J, I
      IF (DABS(S(J,K)) .LT. A(K,I) ) GO TO 8
      F(J,I) = F(J,I) + S(K,I) * D(J,K)
      8 CONTINUE
      DO 10 I=1,L
      DO 10 J=1, I
      D(J,I) = F(J,I) / FAC
      10 F(J,I) = 0.000
      1A CONTINUE
      RETURN
      END
      SUBROUTINE DECP (L, F, NP, KOUT, C, H, HNOBN)
C  -----WRITTEN FOR AFRONS CODE BY O. F. KERNAN, 8/1/80.
C
C      ** CALLED FROM SUBR. DECAT **
C
C  .. FINDS P IN REDUCTION EQ FOR H = 2**(-P) * C
C
C      REAL*8 C(L,L), H(L,L), SUM, HI, HJ, HIN, HJN, FACT
C
C  ..NOTE LEFT-HAND INDEX OF MATRICES DENOTES THE COLUMN OF MATRIX...
C
C      SUM = 0.000
C      DO 4 I=1,L
C      DO 4 J=1,I
C      IF (C(J,I) .EQ. 0.0) GO TO 4
C      SUM = SUM + C(J,I) * C(J,I)
C  ..FOR CALC OF THE EUCLIDEAN NORM OF S (THEN SQRT, BELOW) 4/28/80
C  4 CONTINUE
C
C      S = SUM
C      IF (S .LE. 0.0) GO TO 9
C      S = SQRT (S)
C      P = ALOG(S) / 0.693147 + 2.0
C  6 CONTINUE
C      NP = P + 1.
C      IF (P .LT. 0.0) NP = 0
C      FACT = 1.000
C      IF (NP .GT. 0) FACT = (2.000) ** NP
C      DO 8 I=1,L
C      DO 8 J=1,I
C      F(J,I) = C(J,I) / FACT
C  9 HIN = 0.000
C      HJN = 0.000
C      HNOBN = 0.0
C      DO 12 I=1,L
C      HI = 0.000
C      HJ = 0.000
C      DO 10 J=1,I
C      IF (H(J,I) .NE. 0.0) HNOBN = HNOBN + H(J,I) * H(J,I)
C  ..FOR CALC OF THE EUCLIDEAN NORM OF H (THEN SQRT, BELOW) 4/28/80
C      HI = HI + DABS(H(J,I) )
C  10 HJ = HJ + DABS(H(I,J) )
C      HIN = DMAX1 (HIN, HI)
C  12 HJN = DMAX1 (HJN, HJ)
C      HNORM = DMIN1 (HIN, HJN)
C      HNOBN = SQRT (HNOBN)
C      IF (KOUT .EQ. 40)
C      * WRITE (KOUT,20) NP, HNOBN, HNORM
C  20 FORMAT (5H NP = , I4, 19H, EUCLIDEAN-NORM = , E16.4,
C      * 17H, MIN-MAX-NORM = , E16.4)
C      HNORM = AMAX1 (HNORM, HNOBN)
C  .. FORM SATISFIES EITHER DEFINITION BY LEE OR LAPIDUS AND LOUS.
C      IF ( S .GE. 0.0 .AND. HNORM .LT. 0.25) RETURN
C      RN = HNORM / 0.25
C      P = NP + ALOG(RN) / 0.693147
C      GO TO 6
C      END
      SUBROUTINE EXTRAC (K1, L, CONC, REMLAN)
C
C  * CALLED FROM DECAT *
C
C  EXTRACTS CHAIN SOURCE QIN FROM CONC AND DELETES SHORT-LIVED NUCL.
C  DOES THE SAME FOR REM...
C
C      COMMON /DECAT/ S(37,37), QIN(37,37), REM(37)
C      COMMON /DECONV/ NCEXP, NCHL, NS, NS1, JS, JS1,
C      * JSHORT, FSHORT, QTOT
C
C      DIMENSION CONC(K1,1), REMLAN(1)

```

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DECP 31
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DECP 33
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EXTR 4
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EXTR 7
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EXTR 9
EXTR 10
EXTR 11
EXTR 12

```



```

C
  NS1 = NS + 1
  JS1 = JS + 1
  NS = NS + NCKXP
  JS = JS + NCKEL
  KREDUS = 0
  JREDUS = 0
  IF (KSHORT .GT. 0) KREDUS = KSHORT + 1
  IF (JSHORT .GT. 0) JREDUS = JSHORT + 2
C
C NOW, EXTRACT THE PROPER QIN FROM CONC, AS NEEDED.
C
  QTOT = 0.0
  J = 0
  I = 0
  DO 40 J1 = JS1, JS
    J = J + 1
    DO 38 N1 = NS1, NS
      I = I + 1
      IF (J .EQ. 1) REM(I) = REPLAN(N1)
      QTOT = QTOT + CONC(N1, J1)
      38 QIN(I, J) = CONC(N1, J1)
    40 I = 0
C
C NOW, DELETE KREDUS AND JREDUS BUFS FROM QIN.
C
C DO 2ND, JRED: S, FIRST.
C
  IF (NCKXP .EQ. 1) GO TO 56
  IF (JREDUS .EQ. 0) GO TO 50
  NS2 = NCKXP - 1
  IF (JREDUS .GT. NS2) GO TO 50
  DO 46 J = 1, NCKEL
    DO 46 I = JREDUS, NS2
      IF (J .EQ. 1) REM(I) = REM(I+1)
      46 QIN(I, J) = QIN(I+1, J)
  50 IF (KREDUS .EQ. 0) CALL ERROR
  IF (KREDUS .GT. 1) CALL ERROR
  DO 52 J = 1, NCKEL
    DO 52 I = KREDUS, 1
      IF (J .EQ. 1) REM(I) = REM(I+1)
      52 QIN(I, J) = QIN(I+1, J)
C
  56 RETURN
  END
SUBROUTINE PACKIT(NPACK, NEXP, CPAK, CONC, IC, JC, N1, N2) PAKI 1
  DIMENSION CPAK(400), IC(400), JC(400), CONC(NEXP, 1), N1(1), N2(1) PAKI 2
  DO 4 N=1, NPACK PAKI 3
    4 CPAK(N) = CONC ( IC(N), JC(N) ) PAKI 4
    WRITE(6,300) ( :C(N), JC(N), CPAK(N), N1( JC(N) ), N2( IC(N) ), PAKI 5
    * N=1, NPACK) PAKI 6
  300 FORMAT ( 1X, 215, E20.7, 219) PAKI 7
  RETURN PAKI 8
  END PAKI 9

```

ORNL-5785

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